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Third Series.

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LIST OF THE CONTRIBUTORS.

WITH REFERENCE TO THE SEVERAL ARTICLES CONTRIBUTED BY EACH.

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CORRIGENDA.

Page 352, line 20, *for* "Ballygriffy," *read* "Ballyportry."
,, 370, lines 12 and 15, *for* "planes," *read* "lines."
,, 374, *for* "Plate XVII.," *read* "Plate XVIII."

PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

PAPERS READ BEFORE THE ACADEMY.

I.

A REPORT UPON THE MOLLUSCA (EXCLUDING THE CEPHALOPODA AND NUDIBRANCHIATA) OBTAINED BY THE ROYAL IRISH ACADEMY CRUISES OF 1885, 1886, AND 1888. BY GEORGE W. CHASTER.

[Read JUNE 27, 1898.]

A PRELIMINARY and confessedly incomplete list of the Mollusca from the "Lord Bandon" expedition of 1885 was drawn up by Mr. W. Swanston, F.G.S., and published in the Proceedings of the R.I.A. in the following year. Further notes on mollusca of special interest, obtained by the later expeditions, have appeared subsequently. But no attempt has been made to draw up a full and annotated list of the Testacea of the district investigated by the Academy—a district surpassingly rich in its molluscan fauna. My object in preparing the present report is to attempt to supply this want, so far as is possible.

Some time ago there came into my hands certain of the dredgings which had been partially examined by Mr. Swanston, and put aside to be more carefully searched. These gatherings yielded a large number of species, many not included in the published list, and some of remarkable interest. On my communicating the results to Dr. Scharff, he, with the greatest courtesy, consented to allow me to examine the material that had been deposited in the Dublin Museum, only stipulating, as was necessary in the interests of the institution under his care, that any types required by the Museum should be sent. Mr. Joseph Wright, F.G.S., also, with the genial readiness which ever characterizes the true naturalist, has permitted me to search through the floatings from the finer portions of the dredgings, from which floatings he had obtained the Foraminifera already reported upon. To these gentlemen I must express my gratitude. My tribute of thanks is also due to Professor Haddon, Messrs. R. Welch, R. Ll. Praeger, B.A., and A. R. Nichols, B.A., for their hearty co-operation; and to Mr. E. A. Smith, F.Z.S., and the Marquis of Monterosato, for their kindness in determining certain critical forms.

The material, as it came to me, consisted of floatings, shelly *debris*, muddy sand, and fine gravel, from all of which the coarser part had already been separated. There were also a few boxes containing such of the larger shells as had been discarded. In the great majority of cases the larger forms, those measuring more than a quarter of an inch in length, are represented only by immature or fragmentary examples. Respecting these I can, therefore, give little or no information beyond the mere fact of their occurrence. Far different is the case of the more minute species. These are in many instances represented by a very great number of specimens, sometimes showing marked varietal modifications. Amongst them, too, there are several possessing special interest, being either rare or hitherto unknown.

I may here mention that, during the process of examination, certain species occurred in so large a number of the dredgings (not always in great numbers, be it understood) as to impart a characteristic "facies" to the molluscan fauna. I refer, of course, to such forms as are usually accounted more or less rare. Of these characteristic species the following may be mentioned:—*Pulsellum lofotense*, Sars; *Liostomia clavula*, Lov.; *Mangelia brachystoma*, Phil.; *Neolepton Clarkiæ*, Cl.; *Alvania abyssicola*, Forb.; *Cardium minimum*, Phil. Scarcely less remarkable is the comparative rarity of *Cyclostrema*, *Jeffreysia*, *Velutina*, *Turbonilla*. *Rissoa* (*Cingula*) *obtusa*, Cantr., usually one of the commonest of molluscs in British seas, only occurs in one or two gatherings with even a moderate degree of frequency. The group *Bela* is quite unrepresented.

In some cases an attempt has been made to indicate the bathymetrical range of a species. The figures given refer only to the coasts of Kerry and Cork. It seems far better thus to indicate the range of the various species within the limits of the district under consideration, rather than to give the vertical range of a widely distributed species, perhaps sub-littoral in Arctic regions and abyssal in the Mediterranean. In compiling these figures I have availed myself of the information given in published accounts such as the "Porcupine" expedition reports, for the first seven stations of the 1869 expedition lie within the limits of the area under consideration. As regards classification and arrangement, I have pretty closely followed the scheme adopted in the Rev. Canon Norman's "Museum Normannianum." The deplorably incorrect nomenclature of Jeffreys' "British Conchology" makes the matter of terminology a difficult one for a student who, like myself, has but little leisure time, and but limited opportunities for consulting the necessary literature. My endeavour will be to employ the names which, by the rule of priority, must of necessity be adopted. Unfortunately the number of changes is large, but there seems to be no alternative course.

As regards the value of sub-generic divisions, opinions may be allowed to differ. It seems greatly to facilitate the close study of some of the large groups, such as the *Odostomiæ* and *Rissoæ*, if the species be arranged in small groups with distinctive generic names, rather than to "lump" together a great assemblage of more or less heterogeneous forms.

I feel compelled to enter a strong protest against the useless and ridiculous practice of "emending" the names which have been given to species and genera—a practice greatly in vogue at the present time. Can anyone pretend that the change of *Kellia* into *Kellyia* aids in any way the study of the mollusc? Quite the contrary, it is a hindrance, increasing as it does the burden of synonymy, already weighing so heavily upon the student. Moreover, an author is not responsible for any want of classical erudition displayed in the names he quotes: to each name is (or should be) appended the name of its originator, to whom alone belongs any blame. Any attempt to tinker with original names seems to me to savour strongly of pedantry and impertinence; for the original author *may* have possessed scholastic knowledge equal to that of his critic. Are *Skeneia*, *Rissoia*, *Montaguia* really improvements upon *Skenea*, *Rissoa*, *Montacuta*? Let us take *Rissoia*: even if conchologists agree upon this, will the student of the sponges be willing to similarly change the name *Nardoa*, the only precisely analogous case I know? From Mr. MacAndrews' name there have been used in the mollusca *Macandreæ*, *Macandræi*, *Macandrewi*, *Macandrevia*. Can conchologists agree which of these is right, and will the student of the *Madreporaria* accept their decision for the correction of the name of the little Irish coral *Sphenotrochus Macandrewanus*? These so-called emendations add greatly to the cumbrous appearance of a name quoted fully. As an instance take

Montaguia, BD. & D. *emend.* (*Montacuta*, Turton) *ovata*, Jeff. *emend.* (*ovalis*, G. O. Sars.).

How much simpler and better is *Montacuta ovalis*, G. O. Sars?

It seems far better to leave all names in their original form, unless the author himself subsequently corrects them, as Jeffreys did *Omalogyra*.

The data of the various dredgings from which I have received material are given below. In some cases I was furnished with the number of the Station only, and the precise locality and depth cannot be given; this, however, is of but little consequence, for the different logs in a station were not widely separated, and did not vary greatly in depth.

"Lord Bandon" Cruise, 1885.

[Station I.—40 miles off S.W. Ireland; lat. 51° 15′ N.]

Log 3.—depth, 80 fathoms; sand and shells.

Station II.—Dursey Sound; depth, 20-25 fathoms; sand.

Log 6.—S. entrance to Dursey Sound; depth, 25 fathoms.

Station III.—Mouth of Kenmare River; depth, 38–47 fathoms (logs. 9, 10, 11, 12, 21).

Log 9.—Between Dursey Sound and Lamb's Head; depth, 41–38 fathoms; mud.

Log 11.—2 miles S.W. of Skarriff; depth, 44–38 fathoms; muddy sand.

Log 12.—1 mile S. of Skarriff; depth, 40 fathoms; muddy sand and dead shells.

Log 21.—Between Bull Rock and Great Skellig; depth, 48 fathoms; fine sand.

Station IV.—Ballinskellig Bay; depth, 5–27 fathoms (logs. 13, 14, 15).

Log 14.—S. end of the Bay, N.E. of Hog's Head; depth, 17–12 fathoms; stones.

Log 15.—N. end of the Bay; depth, 5 fathoms; fine sand, with Zostera.

Station V. (logs. 16, 17).

Log 16.—26 miles W.N.W. (compass) of Great Skellig; depth, 120 fathoms; sand.

Log 17.— 3½ miles S. of No. 16; depth, 110 fathoms; sand.

STATION VI. (logs. 18, 19, 20).

Log 18.—12 miles S.W. of Great Skellig; depth, 79 fathoms; sand.

Log 19.—2 miles N.W. of No. 18; depth, 79 fathoms; sand.

Log 20.—1 mile E.S.E. of No. 19; depth, 70 fathoms; muddy sand.

STATION VII. (logs. 22, 23).

Log 22.—7 miles S.S.W. of Dursey Head; depth, 40 fathoms; coarse sand.

Log 23.—2½ miles E. of No. 22; depth, 37–35 fathoms; coarse sand.

STATION VIII. (logs. 24, 25, 26).

Log 24.—W. entrance to Berehaven, close to Bere Island; depth, 25–8 fathoms; coarse sand and broken shells.

Log 25.—Berehaven, from Volage Rock to Hornet Rock; depth, about 5 fathoms; mud, sand, and stones.

Log 26.—Berehaven, S. of Beal Lough to George Rock; depth, 7 fathoms; fine, dense mud.

Log 28 (Station XI.).—Off Baltimore, 2½ miles S. of chapel on Sherkin Island; depth, 30 fathoms; mud.

Log 29 (Station XII.).—9 miles S. of Glandore; depth, 40 fathoms; broken shells.

Log 30 (Station XIII.).—About 10 miles S. of Galley Head light; depth, 54 fathoms; mud, sand, and dead shells.

Log 32 (Station IX.).—Bantry Harbour; depth, 4-6 fathoms; mud.

"LORD BANDON" CRUISE, 1886.

Log 31.—8½ miles S.W. of Ballycotton; depth, 39½ fathoms; sand and broken shells.

Log 33.—Lat. 51° 22½′ N., long. 7° 58′ W.; depth, 52½ fathoms; gravel and broken shells.

Log 34.—10 miles S. of No. 33; depth, 55½ fathoms; more sandy than last.

Log 35.—Glandore Harbour, W. channel; depth, 4 fathoms; seaweed, sand, and broken shells.

Log 39.—Lough Hyne; depth, 0–20 fathoms; fine, dense, foul mud.

Log 40.—Long-Island channel; depth, 3½–5 fathoms; fine sand and sea-weed.

Log 41.—Crookhaven (opposite Coastguard Station); depth, 3½ fathoms; dense, sticky mud.

Log 42.—9½ miles S.W. of Castletown Berehaven; depth, 37½ fathoms; sand.

Log 50.—Valentia Harbour; depth, 4–7 fathoms; sand and dead shells.

Log 53.—5–8 miles W. of Great Skellig; depth, 70–80 fathoms; fine muddy sand.

Log 55.—Mouth of Kenmare River; depth, 23–38 fathoms; foul ground.

Log 57.—35 miles W. ¾ S. of Dursey Head; depth, 100 fathoms; sand.

Log 58.—43½ miles W. ¾ S. of Dursey Head; depth, 110 fathoms; sand.

Log 59.—50 miles W. ½ S. of Dursey Head; depth, 214 fathoms; sand.

Log 60.—57 miles W. ½ S. of Dursey Head; depth, 265 fathoms; sand.

Log 62.—Berehaven; depth, 5–10 fathoms.

Log 63.—Berehaven; W. entrance; depth, 10–20 fathoms; mud, sand, dead shells.

Log 64.—Long Island Sound; depth, 5–6 fathoms; sand, mud, sea-weed.

"Flying Falcon" Cruise, 1888.

Log 67.—Lat. 51° 2′ N., long. 11° 27′ W.; depth, 345 fathoms; fine sand.

Log 69.—Lat. 51° 1′ N., long. 11° 50′ W.; depth, 750 fathoms; mud from stomach of *Holothuria.*

Log 70.—Berehaven Harbour; depth, 7 fathoms; mud.

Log 73.—Depth, 50 fathoms.

There were also a few packages of sand, etc., from the "Lord Bandon" cruises without log numbers. These are as follows:—

A.—Shallow water.

B.—Derrynane Harbour, between tides.

C.—Hone Island, Ballinskellig, between tides.

D.—Valentia Harbour, between tides.

E.—Between Horne Island and Ballinskellig.

For the sake of completing the records I have quoted from the published list of Mr. Swanston[1] and from a manuscript list placed at my disposal by Mr. Nichols. These quotations are enclosed in square brackets [ ], and those citing the numbers of the Stations are from the former; those log numbers from the latter source.

SPIRIALIS RETROVERSUS, Fleming, sp. (*Fusus*).

Logs 6, 9, 12, 17, 23, 25, 28, 30, 33, 42, 53, 54, 57, 65, 67, E.

The specimens met with are all of small size, though this is scarcely a matter of surprise; for shells so fragile as the adult *Spirialis* can scarcely be expected to stand the rough usage necessarily accompanying the process of washing and sifting. Great differences in the relative proportions were noticed, but it seemed better to avoid mentioning distinct varieties when all the examples were so small. As there still appears to be some doubt as to the identity of the genera *Limacina* and *Spirialis*, it appears advisable to retain the latter.

CAVOLINA TRISPINOSA, Lesueur, sp. (*Hyalæa*).

Logs 16, 67, 69 [69 tow-net dead.]

I only found fragmentary specimens.

CLIO PYRAMIDATA (Browne), Linn.

Logs 17, 65, 67 [68 living.] Fragments only occurred in the dredging.

[CLIONE BOREALIS, Pallas = *C. limacina*, Phipps.

Log 60, tow-nets.]

SCAPHANDER LIGNARIUS, Linné, sp. (*Bulla*).

Logs 9, 12, 18, 33, 42 [55, 59, 72]. Depth, 30–100 fathoms.

S. PUNCTO-STRIATUS, Mighels and Adams, sp. (*Bulla*).

Log 67.

A small, broken, dead specimen.

[ACERA BULLATA, Müller.

Log 62 (Berehaven; depth, 5–10 fathoms), living.]

ROXANIA UTRICULUS, Brocchi, sp. (*Bulla*).

Stations [III.], VIII. Logs [55, 56, 69].

DIAPHANA QUADRATA, Monterosato, s.p. (*Amphysphyra*).

Logs

A single specimen from each locality. The Marquis of Monterosato has identified the species amongst a number of minute indeterminable

[1] Proc. Royal Irish Academy, 2nd. Ser., vol. iv., July, 1886, pp. 623–632.

shells submitted to him. It has somewhat the form of *D. expansa*, Jeff., but differs in the following particulars:—The upper part of each whorl is very sharply angulated, the nucleus is inverted and concealed, instead of being prominent, and the lines of growth are far more flexuous. The species is new to the British fauna.

I have been unable to consult the original description, and to ascertain the locality whence the type specimens were obtained, and therefore quote the reference given me by the Marquis—"Journal de Conchyliologie," 1876, p. 280.

DIAPHANA MINUTA, Brown, sp. (*Utriculus*) = *Bulla hyalina*, Turton.
Logs 6, 9, 12, 25, 70; depth, 5–40 fathoms. The few specimens found are all small.

[TORNATINA OBTUSA, Montagu, sp. (*Bulla*).
Log 50.]

T. TRUNCATULA, Bruguière, sp. (*Bulla*).
Stations [III.], [VII.], VIII., VI. Logs 28, 33, 35, [39], 40, 62, 63, A, E, F.

T. MAMMILLATA, Philippi, sp. (*Bulla*).
Stations VI., [VIII., XI.] Logs 6, 12, 22, 33, 35.

CYLICHNINA NITIDULA, Lovén, sp. (*Cylichna*).
Logs 9, 11, 12, 17, 18, 20, 21, 28, 30, 33, 34, 41, 42, 53, 57, [63]; depth, 3½ to 54 fathoms. Very abundant.

VOLVULELLA ACUMINATA, Bruguière, sp. (*Bulla*).
[Station III.] Logs 30, 42; depth, 37½–54 fathoms. Three small dead specimens.

BULLINELLA CYLINDRACEA, Pennant, sp. (*Bulla*).
Logs 9, 11, 12, 21, 24, 28, 33, 42, 55; depth, 20–52½ fathoms.

ACTÆON TORNATILIS, Linné, sp. (*Voluta*).
Logs 9, 22, 28, 33, [35, 72, 73].

PHILINE APERTA, Linné sp. (*Bulla*).
Logs 41, [40, 62, living].

P. SCABRA, Müller, sp. (*Bulla*).
Stations [II.], VI. [VII.], VIII. Logs 9, 11, 12, 21, 28, 30, 31, 33, 42, 55; depth, 30–70 fathoms.

P. CATENA, Montagu, sp. (*Bulla*).
Station VIII. Logs 62, 63.

P. PUNCTATA, Clark, sp. (*Bullæa*).
Station VIII. Logs 55, 63.

P. PRUINOSA, Clark, sp. (*Bullæa*).

Logs 18, 28, 55; depth, 30–79 fathoms. Four very small specimens.

P. NITIDA, Jeffreys.

Logs 28, 42, 55, 63. A single specimen at each locality. This, like so many other species, progressively diminishes in size from northern to southern localities. The examples met with in these dredgings are of small dimensions, though not nearly so diminutive as a specimen in my collection from Malta.

TETHYS PUNCTATA, Cuvier, sp. (*Aplysia*).

Stations [II., VIII.] Logs 40, [41, 70, living].

[OSCANIUS MEMBRANACEUS, Montagu, sp. (*Lamellaria*).

Log 70 living, A. R. N.]

[PLEUROBRANCHUS PLUMULA, Montagu, sp. (*Bulla*).

Log 73 living.]

OTINA OTIS, Turton, sp. (*Helix*).

Station VIII., C.

[CARINARIA, sp.

Log 67 tow-net.]

CLATHURELLA LINEARIS, Montagu, sp. (*Murex*).

Station VIII. Logs 3, 6, 9, 11, 30, 31, 33, 34, 35, 50.

C. PURPUREA, Montagu, sp. (*Murex*).

Logs 25, 35.

C. RETICULATA, Renier, sp. (*Murex*).

[Station III.] Log 3. An immature specimen.

TERETIA ANCEPS, Eichwald, sp. (*Clathurella*), = *Pleurotoma teres*, Forbes.

Logs 12, 17, 18, 22, 28, 31, 33, 34, [56 (off Dursey Head; depth, 93 fathoms)]; depth, 30–110 fathoms.

BELLARDIELLA GRACILIS, Montagu, sp. (*Murex*).

[Station VIII.] Logs 28, 33, [73].

[HÆDROPLEURA SEPTANGULARIS, Montagu, sp. (*Murex*).

Stations III., VIII.]

TYPHLOMANGELIA NIVALIS, Lovén, sp. (*Pleurotoma*).

Logs [59], 67. A small, live specimen.

MANGELIA ATTENUATA, Montagu, sp. (*Murex*).

Logs [39], 55.

M. COSTATA, Donovan, sp. (*Murex*).
Station VIII. Logs 3, 6, 9, 11, 12, 21, 22, 28, 31, 33, 34, 35, 42, 50, 55, [62], 63, A.; depth, 0–80 fathoms.

M. STRIOLATA (Scacchi), Philippi, sp. (*Pleurotoma*).
Station VIII. Two specimens.

M. BRACHYSTOMA, Philippi, sp. (*Pleurotoma*).
Station VIII. Logs 3, 9, 11, 12, 21, 22, 28, 30, 33, 34, 42, 50, 55, 62, A.; depth, 0–80 fathoms. Frequent at depths of 30–50 fathoms.

[CHRYSODOMUS ANTIQUUS, Linné, sp. (*Murex*).
Station VIII.]

[*Var.* DESPECTA, Linné, var. (*Murex*).
Station III., A. R. Nichols.]

[TRITONOFUSUS GRACILIS, Da Costa, sp. (*Buccinum*).
Station XII. Logs 56, 67.]

[T. ISLANDICUS, Chemnitz, sp. (*Fusus*).
Log 67 living, H. K. Jordan.[1]]

[T. FUSIFORMIS, Broderip, sp. (*Buccinum*) = *Fusas fenestratus*, auct.
Log 73, H. K. Jordan and A. R. Nichols.]

T. PROPINQUUS, Alder, sp. (*Fusus*).
Stations [VI.], VIII.

[*Var.* INTERMEDIA, Jordan.
Log 44, H. K. Jordan and A. R. Nichols.]

[*Var.* NANA, Jordan.
Station IV., H. K. Jordan and A. R. Nichols.]

[*Var.* INCRASSATA, Jordan.
Log 42, H. K. Jordan and A. R. Nichols.]

[*Var.* JEFFREYSIANA, Fischer.
Station VII., H. K. Jordan and A. R. Nichols.]

[BUCCINOFUSUS BERNICIENSIS, King, sp. (*Fusus*).
Log 67, H. K. Jordan and A. R. Nichols].

[BUCCINOPSIS DALEI, J. Sowerby, sp. (*Buccinum*).
Log 67, H. K. Jordan and A. R. Nichols.]

BUCCINUM UNDATUM, Linné.
Stations [III.], VI., VIII. Log 34.

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[1] Proc. Roy. Irish Acad., 3rd Series, vol. ii., 1892, p. 394.

[B. HUMPHREYSIANUM, Bennett.
Log 53, H. K. Jordan and A. R. Nichols.]

NASSA INCRASSATA, Ström. sp. (*Buccinum*).
Station VII. Logs 3, 9, 11, 12, 24, 26, 28, 29, 30, 31, 34, 35, [41] 50, [52, Ballinskellig Bay; depth, 20–35½ fathoms], 55, 62,63, A, C, E; depth, 0 to 40 fathoms.

NASSA RETICULATA, Linné, sp., (*Buccinum*).
Stations [VI., VIII.] Logs 3, 35, 62.

COLUMBELLA HALIÆETI, Jeffreys.
Logs 58, 67, [69].

TROPHON CLATHRATUS, Linné, sp. (*Murex*), var. TRUNCATUS, Ström.
Stations VII., [IX.]. Logs 3, 9, 12, 24, 28, 33.
This species occurs only very sparingly. A live specimen of the *var. alba*, Jeffreys, at log 28.

TROPHON MURICATUS, Montagu, sp. (*Murex*).
Station VI.

[*Var.* BARVICENSIS, Johnston, var. (*Murex*).
Log 33.]
It is absolutely impossible to separate *Trophon barvicensis* specifically from *T. muricatus*. If a sufficient number of specimens are examined, a few typical examples of each may be picked out, leaving a residuum of shells, which present every intermediate gradation and which it is futile to attempt to allocate to either species.

PURPURA LAPILLUS, Linné, sp. (*Buccinum*).
Stations [VII.], VIII. Logs 35, [41], A.

[CASSIDARIA RUGOSA, Linné, sp. = *Morio tyrrhena*, auct. Logs 60, 67].[1]
Depth, 40–539 fathoms.

TRIVIA EUROPŒA, Montagu, sp. (Cypræa).
Stations [III.], VIII. Logs 3, 33, 35, 63, [70].

AMPHPERAS PATULA, Pennant, sp. (*Bulla*). Log 28.

CHENOPUS PES-PELICANI, Linné, sp. (*Strombus*).
Station VI. Logs 3, 9, 12, 22, 24, 28, 29, 30, 33, 34, [35], 40, 42, 50, [53], 55, 73; depth, 5 to 80 fathoms.

TRIPHORIS PERVERSA, Linné, sp. (*Trochus*).
Station [VII.], VIII. Logs 6, 9, 28, 30, 33, 34, 35, 40.

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[1] Proceedings Royal Irish Academy, 3rd Series, vol. i., 1888, p. 40.

Cerithiopsis tubercularis, Montagu, sp. (*Murex*).
Stations [II.], VIII. Logs 9, 11, 33, 34, 35, 62, C.

C. Barleei, Jeffreys.
Logs 11, 12, 25, 28, 33, E.; depth, 0 to 165 fathoms.

C. concatenata, Conti, sp. (*Cerithium*).
Logs 6, E.

Bittium reticulatum, Da Costa, sp. (*Strombiformis*).
[Station VII.] Logs 15, 18, 26, 28, 30, 35, 39, 40, 50, 62, 63, A, C, E.

Turritella communis, Risso = *terebra*, auct. (non Lin.).
Logs 3, 9, 11, 12, 17, 18, 21, 22, 24, 26, 28, 30, 31, 33, 34, 40, 42, 50, 53, 55, 63, [70, 72], A; depth, 0 to 110 fathoms.

Cæcum imperforatum, G. Adams, sp. (*Dentalium*), = *Dentalium trachea*, Montagu.
[Station VII.] Logs 25, [40].

C. incurvatum, G. Adams, sp. (*Serpula*), = *Dentalium glabrum*, Montagu.
Logs 6, 12, 15, 22, 25, 28, 31, 33, 35, 39, 40, 42, 50, 55, A, B, E; depth, 0 to 52½ fathoms.

Littorina littorea, Linné, sp. (*Turbo*).
Logs 35, [40], 63.

L. rudis, Maton, sp. (*Turbo*).
Station VIII. Logs 50, 62, 63, A, C, D, E, F.

L. neritoides, Linné, sp. (*Turbo*).
Log 62, C, E.

L. obtusata, Linné, sp. (*Turbo*).
[Station VIII.] Logs [50], 62, 63, A, B, D, F.

Lacuna pallidula, Da Costa, sp. (*Nerita*).
Station VIII. Logs 28, 35.

L. divaricata, Fabricius, sp. (*Trochus*).
Stations III., [IV.], VIII. Logs 20, 28, 35, 40, 42, 55, 62, 63, [52 (Ballinskellig Bay), 70]; depth, 4 to 70 fathoms.

Cithna tenella, Jeffreys, sp. (*Lacuna*).
Log 69. One broken specimen.

Skenea planorbis, Fabricius, sp. (*Turbo*).
Station VIII. Logs 6, 18, 28, 35, 40, A, E, F.

RETROTORTINA FUSCATA, Chaster.

Log 39. A single specimen. Though evidently specifically identical with my types from Tangier Bay, the shell from Lough Hyne is rather more flattened than they. It is not a mere reversed monstrosity of *Skenea planorbis*, as might at first be supposed. The nucleus of the shell is smaller; the direction of the lines of growth different, and the shell does not reach more than a third of the size of that species. Owing to its very diminutive size it will probably never be a commonly known shell.

HOMALOGYRA ATOMUS, Philippi, sp. (*Truncatella*).

Station VIII. Logs 39, 70, A. A good number of fine live specimens from Lough Hyne.

H. FISCHERIANA, Monterosato. Log 39. A single specimen. This species, so common in many parts of the Mediterranean, has apparently not been noticed on our coasts before. Though devoid of the characteristic radiating ribs of *H. rota*, it is in its other characters more closely allied to that species than to *H. atomus*.

H. ROTA, Forbes and Hanley, sp. (*Skenea*).

Station VIII. Logs 6, 28, 35.

JEFFREYSIA DIAPHANA, Alder, sp. (*Rissoa*?). F. A single specimen, Alder's change of his original name *glabra* to *diaphana* may perhaps be allowed to stand, although it was wholly unnecessary, for he had pointed out that his new species was not a true *Rissoa*. Consequently his original name was valid, even if Brown's *Rissoa glabra* proved to be a different species, as Alder thought it was when he suggested the alteration of the name.

RISSOA PARVA, Da Costa, sp. (*Turbo*).

Stations [VII.], VIII. Logs 3, 6, 15, 19, 28, 30, 35, 40, 50, 62, 63, 64, A, C, D, E, F.

Var. INTERRUPTA, J. Adams, var. (*Turbo*). Logs 3, 35, 40, 50, 55, 62, 63, 70, C, E, F.

R. INCONSPICUA, Alder.

Logs 6, 9, 11, 12, 17, 25, 28, 31, 33, 34, 35, 40, 42, 50, 55, 63, 70; depth, 4–110 fathoms.

Var. ALBELLA, Lovén.

[Station VIII.] Logs 35, 39, 40, 63, A. Young specimens of the var. *albella* greatly resemble in form *R. pulcherrima*, Jeffreys.

R. Guerini, Recluz. (= *R. costulata*, Alder).
[Station II.] Log 35.

Zippora membranacea, J. Adams, sp. (*Turbo*), var. labiasa, Montagu.
Logs [33], 35, 41, 63. Jeffreys very unfortunately applied Adams' name *membranacea* to the form which Montagu recognized as a well-marked variety and named *labiosa*. Equally unfortunate, too, was his use of Philippi's name *elata* for Adams' type; the true *elata* is wholly unlike any of our British varieties.

Persephona violacea, Desmarets, sp. (*Rissoa*).
Stations VI., [VIII.]. Logs 35, 50, 63. A very few dead specimens.

Alvania Testæ, Aradas and Maggiore, sp. (*Rissoa*): var. abyssicola, Forbes, var.
Station VII. Logs 9, 11, 17, 18, 21, 28, 30, 33, 42, 55, 59; depth, 30–808 fathoms. Little variation is exhibited by any of the numerous specimens, most of which are wholly white and uncoloured. There is, of course, a small form associated with those of ordinary size. This, however, seems of so constant occurrence amongst the Rissoidæ, that it cannot be considered as a true variation.

A. cimicoides, Forbes, sp. (*Rissoa*).
Logs 31, 33; depth, 39½–90 fathoms.

A. reticulata, Montagu, sp. (*Turbo*).
Stations [II., III., VI.], VIII., [XI.]. Logs 30, [33], 34, 50, A.

Var. calathus, Forbes and Hanley.
Log 33. I fully endorse the statement made by Jeffreys, in his "British Conchology," that *R. calathus* is probably only a variety of *R. reticulata*. It is hopeless to attempt to separate specimens if only a sufficient number are examined.

A. punctura, Montagu, sp. (*Turbo*).
Logs 6, 9, 11, 12, 15, 19, 22, 28, 31, 33, 35, 40, 42, 50, 53, 55, 62, 63, 70, C, E; depth, 0–79 fathoms. A few specimens exhibiting a varicose rib were noticed. Such specimens seem to be unworthy of recognition as distinct varieties, for they occur with approximately equal frequency at the most widely separated localities. It merely seems to indicate that amongst the *Rissoidæ* a further growth can, when conditions are favour-

able, take place after adult age is reached. The condition is met with in *Galeodina carinata*, Da Costa (= *Rissoa striatula*, Montagu); *Alvania cancellata*, Da Costa; *A. reticulata*, Montagu, and its var. *calathus*; *A. punctura*, Montagu; *A. abyssicola*, Forbes, *Rissoa parva*, Da Costa; and *R. inconspicua*, Alder. The variety *distorta*, Marshall of *Onoba striata*, Adams, belongs to the same category.

Var. DIVERSA, Jeffreys.
Log 28.

A. CANCELLATA, Da Costa, sp. (*Turbo*).
Station VIII. Logs 11, 30, 33, 34.

MANZONIA COSTATA, J. Adams, sp. (*Turbo*).
Station VIII. Logs 35, 40, [50], 62, E. The name *Flemingia*, proposed by Jeffreys in 1884 for the *Rissoa zetlandica* group, being pre-occupied by De Koninck in 1881, we must adopt the name *Manzonia*, Brusina, 1890.

M. ZETLANDICA, Montagu, sp. (*Turbo*).
Logs 9, 33.

CINGULA SEMISTRIATA, Montagu, sp. (*Turbo*).
Stations VI., VIII. Logs 28, 35, [40], 62, E.

C. OBTUSA, Cantraine, sp. (*Rissoa*) = *Rissoa soluta*, auct. non. Philippi.
Depth, 0–110 fathoms. The shell which the Marquis of Monterosato identifies as Philippi's *Rissoa soluta* agrees far more closely with the original description and figure than does our shell. It belongs to the *Setia* group, being quite smooth and glossy; instead of being spirally striated as is the species found in our seas.

CINGILLA TRIFASCIATA, J. Adams, sp. (*Turbo*) = *Rissoa cingillus*, auct.
Logs 33, 35, [39], A, B.

SETIA FULGIDA, J. Adams, sp. (*Helix*).
Logs 25, 64, E.

CERATIA PROXIMA, Alder, sp. (*Rissoa*).
Logs 12, 25, 28, 30, 40, 42; depth, 5–808 fathoms. The radula of this species is so remarkable as to render it worthy of generic distinction on that ground alone.

HYALA VITREA, Montagu, sp. (*Turbo*).
Stations VI., VII. Logs 3, 9, 11, 12, 21, 25, 26, 28, [33], 42, 55, 63, A; depth, 5–808 fathoms.

Onoba striata, J. Adams, sp. (*Turbo*).

Logs 6, 9, 11, 12, 17, 19, 22, 26, 28, 30, 31, 33, 34, 35 [39], 40, 50, 55, 62, 63, 64, A, C, D, E.

Var. saxatilis, Möller (= *arctica*, Lovén).

Logs 25, A, F.

Barleeia rubra, Montagu, sp. (*Turbo*).

Logs 40, E.

Paludestrina stagnalis, Baster, sp. (*Turbo*), = *Hydrobia ulvæ* (Pennant), auct.

Logs [35], 40, A.

Tornus subcarinatus, Montagu, sp. (*Helix*).

Station VIII. Logs 12, 30, 35. Loth as I am to alter the well-known name *Adeorbis* for this species, there seems to be no doubt as to to the propriety of so doing. The only species of S. V. Wood's genus *Adeorbis*, which is described and figured, is *A. striatus* (= *Valvata* ? *striata*, Phil.). This, the first species, becomes the type and the generic name, belongs to the species usually known as *Circulus striatus*, Ph. (= *Circulus Duminyi*, Jeff.).

The name *Tornus* of Turton, though published anonymously, antedates that of Wood, even though this were valid. But Wood's name being inadmissible, *Tornus* will stand on the strength of, and dated from, Jeffery's "British Conchology" (vol. iv., p. 231), if the original anonymous publication be unrecognized. The Marquis of Monterosato has for years used this emended nomenclature in his correspondence with me, and the name *Tornus* is used by Sacco in the present year (Bull. Mus. Turin).

The radula of this species is characteristically Rissoid, and very closely resembles in the form and arrangement of the teeth that of *Onoba striata*.

Tornus imperspicuus, Monterosato, sp. (*Adeorbis*).

Logs 9, 11; depth, about 40 fathoms. Four specimens. It is interesting to observe how the distribution of this species, so long unrecognised in our seas, is steadily extending. It is now known from the N.E., W., and S.W. of Ireland as well as from Scotch, Manx, and English waters.

Capulus hungaricus, Linné, sp. (*Patella*).

Stations [IV.], VIII. Logs 6, 11, 12, 22, 28, 31, 33, 63, [73].

[VELUTINA LÆVIGATA, Pennant, sp. (*Helix*).
Stations III., XI. Logs 70, 73.]

LAMELLARIA PERSPICUA, Linné, sp. (*Helix*).
Logs 40 E. A young specimen from each gathering.

[NATICA AFFINIS, Gmelin, sp. (*Nerita*).
Log 69. One young specimen.]

LUNATIA GLAUCINA, Linné, sp. (*Nerita*).
Stations [III., IV.], VI., VII., VIII., [XI]. Logs 3, 34, 35, [42, 62], 63, [72 (Glandore Harbour; depth, 53 fathoms), 73]; depth, 4 to 808 fathoms. Var. *lactea*, Jeffreys. Station VIII.

L. MONTAGUI, Forbes, sp. (*Natica*).
Stations III., VIII. Logs 28, [72]; depth, 30 to 808 fathoms.

L. SORDIDA, Philippi, sp. (*Natica*).
Logs 28, [42, 53, 55, 56 (off Dursey Head; depth, 93 fathoms), 59]; depth, 30 to 214 fathoms.

L. CATENA, Da Costa, sp. (*Cochlea*).
Station VIII. Log 33.

SCALARIA CLATHRATUS, Da Costa, sp. (*Stomibiformis*) = *S. communis*, Lamarck.
Station VIII. Logs 33, [50].

S. TREVELYANA (Leach M.S.), Winch.
Station VII. Logs 9, 11, 17, 18, 28, 30, 31, 33, 34, 42, 63, 67, [73]; depth, 10 or 20 to 808 fathoms.

S. CLATHRATULA, G. Adams, sp. (*Turbo*).
Station VIII. Logs 6, 21, 22, 28, 30, 33, [39], 42, 50, 64; depth, 5 or 6 to 52½ fathoms.

ACLIS SUPRANITIDA, S. V. Wood, sp. (*Alvania*).
Logs 9, 11, 17, 18, 22, 28, 33; depth, 30 to 110 fathoms.

A. ASCARIS, Turton, sp. (*Turbo*).
Logs 6, 9, 11, 12, 22, 28, 33, 42, 55; depth, 25 to 808 fathoms.

A. WALLERI, Jeffreys, *var.* EXIGUA, G. O. Sars.
Logs 18, 42; depth, 37½ to 79 fathoms. A single specimen from each locality. Judging from the records of this species, it appears to occur in comparatively shallow water, off the S.W. of Ireland.

PHERUSINA GULSONÆ, Clark, sp. (*Chemnitzia*).

Logs 6, 25. The name *Pherusa* being preoccupied, Canon Norman's generic name is adopted.

CIMA MINIMA, Jeffreys, sp. (*Odostomia*).

Log 25. A single specimen only represents this common form. Jeffreys was certainly mistaken in describing this species as possessing a tooth on the columella. I have minutely examined hundreds of specimens, and can, with confidence, assert that there is never any trace of such a tooth. I entirely agree with the Marquis of Monterosato in transferring this species from the *Pyramidellidæ* to the *Aclidæ*.

CIONISCUS UNICUS, Montagu, sp. (*Turbo*).

Logs 12, 28, 39.

EULIMA POLITA, Linné, sp. (*Turbo*).

Station VIII. Log 63.

E. INTERMEDIA, Cantraine.

Log 25.

E. INCURVA, Renier, sp. (*Helix*), = *E. distorta*, auct., non Deshayes.

Logs 6, 9, 11, 12, 15, 22, 25, 28, 33, 34, 35, 40, 42, 55, 63, 73; depth, 4 to 165 fathoms. It seems far better to follow MM. Bucquoy, Dantzenberg, and Dollfus in adopting Renier's very appropriate (and by far the earliest) name *incurva* for this species, than to attempt to settle whether *Eulima Philippii*, as Weinkauff called it, can stand, there being a prior *E. Philippii*, a fossil shell, so named by Rayneval and Ponzi. I must confess that I am quite unable to separate the *E. antiflexa* of Monterosato from this species.

[E. GRACILIS, Forbes and Hanley.

Log 63. Mr. Nichols, *fide* Mr. J. T. Marshall, as *E. distorta*, var. *gracilis*.] *E. gracilis* appears to me a good species.

[E. EPHAMILLA, Watson.

Log 63. Mr. Nichols, *fide* Mr. J. T. Marshall.]

LEIOSTRACA SUBULATA, Donovan, sp. (*Turbo*).

Stations [III.], VIII.; depth, 30 to 808 fathoms.

L. BILINEATA, Alder, sp. (*Eulima*).

Station VIII. Logs 6, 11, 12, 22, 28, 31, 33, 34, 42, 63, 73; depth, 4 or 7 to 80 fathoms. In Tryon's "Manual of Conchology" there is a suggestion that this species is probably only varietally separable from the last. In the entire group *Eulimidæ* no better separated species could be found.

ODOSTOMIA CONOÏDEA, Brocchi, sp. (*Turbo*).

Station VII. Logs 3, 9, 11, 12, 18, 21, 28, 31, 33, 42, 50, [55]; depth, 4 or 7 to 808 fathoms. This species, the type of the genus *Odostomia*, is well represented in the dredgings.

Var. AUSTRALIS, Jeffreys.

Log 33. A single specimen.

Although I am quite convinced of the propriety of subdividing the group of shells which Jeffreys included in the genus Odostomia, none the less do I agree in the main with his last remarks on the subject which appeared in the "Porcupine" Reports. Far too great value has been placed upon solitary characters, such as the presence or absence of sculpture or of columellar fold. I have specimens of *Pyrgulina indistincta*, Montagu, from Salona Bay, Greece, showing gradations from typically sculptured shells, to others quite smooth. In some species, *e.g.*, *Eulimella commutata*, Monts., the columellar fold is very variable as to its presence or absence. Obviously, then, characters such as these, which are not of specific value, cannot furnish bases for generic subdivisions when taken alone. But the peculiarities of the fold and sculpture, when taken in conjunction with other characters, as the form of the shell, the conformation of the apex, the sinuation of the outer lip, afford good ground on which to build.

O. CONSPICUA, Alder.

[Station VII.] Logs 30, 33. Young specimens only.

O. UMBILICARIS, Malm, sp. (*Turbonilla*).

Log 42. A single specimen. I strongly suspect that this species is little more than a local variety of the next.

O. ACUTA, Jeffreys.

Station VIII. Logs 9, 11, 28, 42.

O. PLICATA, Montagu, sp. (*Turbo*).

Logs 35, 62, E.

O. TURRITA, Hanley.

Logs 6, 28, 35, 63.

Var. NANA, Marshall.

Log 42.

O. UNIDENTATA, (Montagu), auct.

Logs 11, 17, 21, 22, 28, 33, 34, 55, 63, D; depth, 10 or 20 to 808 fathoms. Montagu's *Turbo unidentatus* apparently included the present and at least one other species, *Brachystomia eulimoides*, Hanley. In his remarks Montagu notes that the shell has usually a tinge of purple, or rose colour at the tip, and mentions that it was obtained alive on *Pecten maximus* from deep water. Being acquainted with the latter fact, he must have found *eulimoides*, the form which so usually is associated with the *Pecten*: the apex of the species under consideration has only a dull bluish colour, whilst *eulimoides* is always tinged with either orange or rose. It is worth noting that Turton, Fleming, Macgillivray, Martin, and Véramy all identified the species associated with *Pecten* as Montagu's *unidentata*.

BRACHYSTOMIA EULIMOIDES, Hanley, sp. (*Odostomia*).

Stations II., VIII. Logs 28, 31, 33, 63, A.

Var. RISSOIDES, Hanley, var. (*Odostomia*).

Logs 6, 25, 35, E, F.

Var. ALBELLA, Lovén, var. (*Turbonilla*).

Log 6. Some years ago I ventured to affirm that Clark was right in uniting these forms. Since then I have examined very many examples of the various forms and am still further confirmed in my opinion.

[B. SUBOBLONGA, Jeffreys, sp. (*Odostomia*).

Log 37, Mr. Nichols *fide* Mr. J. T. Marshall].

SPIRALINA, nov. gen. (non *Spiralina*, Gümbel, 1862, = *Spirolina*, Lam., 1804).

S. SPIRALIS, Montagu, sp. (*Turbo*).

Station VIII. Logs 6, 9, 11, 12, 17, 18, 22, 28, 33, 34, 35, 55, 63; depth, 4 to 110 fathoms. This species is a member of a group of closely allied forms widely distributed. Its affinities are all with the *Brachystomia* group, from which it differs in being sculptured with strong, straight, longitudinal costæ abruptly terminated (or in some forms abruptly reduced in size to thread-like striæ) at the periphery by the first of a series of spiral striæ which encircle the base.

JORDANIELLA, nov. gen.

J. NIVOSA, Montagu, sp. (*Turbo*).

Log 6, 25, F. This species is remarkably rare in the material examined. The *Turbo nivosus* of Montagu and the *Odostomia truncatula* of Jeffreys belong to a very distinct group for which I suggest the name *Jordaniella*. Mr. Jordan's name is appropriately associated with *O. truncatula*, he being the first to recognize its peculiarities.

ONDINA DIVISA, J. Adams, sp. (*Turbo*) = *Odostomia insculpta*, auct.

Logs 6, 9, 12, 18, 22, 28, 33, 34, 35, 42, 63; depth, 4 to 79 fathoms. The specific name *divisa* ought unquestionably to be adopted: Adams' description, brief as it is, applies perfectly to the present species and to it alone. Gray's generic name *Auriculina* (1847) was preoccupied by Gratel in 1838. Consequently De Folin's *Ondina*, 1870 stands.

O. DIAPHANA, Jeffreys, sp. (*Odostomia*).

Logs 6, 12, 22, 25, 33; depth, 5 to 52½ fathoms.

O. Warreni, Thompson, sp. (*Rissoa*).

Station VIII.

PYRGULINA INTERSTINCTA, Montagu, sp. (*Turbo*).

[Station VI.] Logs 6, 12, 28, 33, 34, 35, 63, A; depth, 4 to 55½ fathoms. Montagu's type, judging from his description and measurements, is evidently the small slender form which Jeffreys called the variety *suturalis*, supposing it to be the *Rissoa striata*, afterwards *R. suturalis*, of Philippi. The more robust form which Jeffreys took as his type may perhaps be recognized in Brown's *Jaminea obtusa*, in which case the form should be called var. *obtusa*, Brown. Both forms occur in the dredgings.

P. DECUSSATA, Montagu, sp. (*Turbo*).

Station VI. Logs 6, 25, 26, 33, 35; depth, 4 to 52½ fathoms.

P. INDISTINCTA, Montagu, sp. (*Turbo*).

Station VIII. Logs 3, 9, 11, 12, 28, [33], 39, 42, 63, 70, 73; depth, 7 to 80 fathoms. The majority of the specimens are broader than the type form, with more convex whorls and finer sculpture. They differ from the var. *brevior*, Jeffreys, in their large size. In the material from logs 12, 39, and 42, there occurred specimens of a remarkable form perhaps referable to the present species. The shells are small, the largest measuring only 2·2 mm. the longitudinal ribs are stronger than those of *indistincta*, the spiral striæ are three only in number on the body whorl, two on each of the upper whorls. The whorls are flattened. There is no trace of a columellar fold. Its apex is bluntly truncated like that of *indistincta* and not small and oblique like that of *clathrata* which latter species it closely resembles in sculpture. None of the numerous specimens of *indistincta* approach it. The two forms appear quite distinct. I have specimens of this puzzling form from the Mediterranean. It appears to be distinct from both *indistincta* and *clathrata*, but until a good series can be obtained, it may be considered a variety of the former and designated *var.* SIMULANS.

LIOSTOMIA CLAVULA, Lovén, sp. (*Turbonilla*).

Logs 9, 11, 12, 18, 21, 22, 28, 34, 42, 55, 63, 64, depth 5 or 6 to 79 fathoms. This species, usually accounted a rarity, occurred in surprising abundance, especially in the dredgings from the mouth of Kenmare River. The great majority of the specimens are of the form of Lovén's type which has not been recorded, so far as I am aware, from British waters. His description and the dimensions ($5\cdot\frac{2}{7}\cdot5$ mm.) agree entirely with my observations of these shells. There are, however, a few examples of a form so unlike the type that they would assuredly be considered specifically distinct did not intermediate gradations occur. This varietal form, which has the peculiarities of ordinary British specimens markedly exaggerated, deserve a special name, and I would suggest as a suitable appellation—*Var.* ROBUSTA, *var. nov.* Shell having the form of a truncated cone, instead of being almost cylindrical, of thicker texture than the type, with a larger umbilicus, and a sub-angulated periphery. Height 1·5 mm. Breadth ·75 mm.

NŒMIA DOLIOLIFORMIS, Jeffreys, sp. (*Odostomia*).

Log 28. Two or three broken specimens.

TURBONILLA LACTEA, Linné, sp. (*Turbo*).

Logs [33], 50, E. Remarkably rare. Linné's name may perhaps stand, although it is noteworthy that the Marquis of Monterosato rejects it.

T. PUSILLA, Phillippi, sp. (*Chemnitzia*), non *Odostomia pusilla*, Jeffreys.

Station VIII. Log 42. This, like the former species, is only represented by a fragmentary specimen or two.

Var. LACTOIDES (Monterosato MS.).

This form, characterised by its regularly conical outline and broad base, represents one extreme of a series, at the other end of which is *T. delicata*, Monterosato. Every intermediate gradation exists between the two. Like so many other common and widely ranging species *T. pusilla* varies greatly, and to attempt to separate the more marked varieties as distinct species is both unscientific and confusing.

EULIMELLA SCILLÆ, Scacchi, sp. (*Melania*).

Stations [VII.], VIII. Logs 21, 33; depth, 40 to at least 370 fathoms. *Eulimella* is, as Professor Verrill has pointed out, scarcely worthy of separation from *Turbonilla*. Both typically have the same microscopic spiral striæ and all other characters in common. *Turbonilla* differs only in its longitudinal ribs. These are absent on the lower whorls in some species, and are wanting on the upper half of the shell in a form I have from Delos. They consequently form a poor character on which to base a genus.

E. COMMUTATA, Monterosato, = *acicula*, Philippi, 1836, non Lamarck, 1815.

Logs 9, 11, 12, 16, 22, 26, 28, 33, 42, 50, 53, 55, 63, 70; depth 7–120 fathoms. The specimens found exhibit a good deal of variation in their characters.

Var. VENTRICOSA, Forbes v.

Logs 17, 18, 20, 33, 53; depth, 52½–110 fathoms. No intermediate specimens occurred connecting the variety and type. These appear to have become distinct in the district investigated. They are easily and completely connected in certain other British areas.

E. NITIDISSIMA, Montagu, sp. (*Turbo*).

Station VIII. Logs 6, 15, 25, 40, 62. Very rare in the dredgings examined.

PYRGOSTELIS INTERRUPTA, Totten, sp. (*Turbonilla*).

[Station III.] Logs 18, 30, 42. A few fragmentary examples.

P. SCALARIS, Philippi, sp. (*Melania*).

Log 6. A single broken specimen.

Var. RUFESCENS, Forbes, v.

Log 50.

PHASIANELLA PULLUS, Linné, sp. (*Turbo*).
Station VIII. Logs 6, 19, 28, 35, 40, 50, [52 (Ballinskellig Bay)], 62 C, E.

CYCLOSTREMA SERPULOIDES, Montagu, sp. (*Helix*).
Logs 6, 22, 25, 30, 42. Rare.

C. NITENS, Philippi, sp. (*Delphinula*).
Logs 6, 22, 25, 28, 30, 33, 35, 42, E.

CALLIOSTOMA ZIZYPHINUS, Linné, sp. (*Trochus*).
Logs 3, 24, 28, 30, 33, 35, [40, 53, 55], 62.

C. MILIARE, Brocchi, sp. (*Trochus*) =
[Station III.] Logs 24, 30, 50, [72].

C. MONTAGUI, W. Wood.
Stations III., VIII. Logs 30, 33, 34.

GIBBULA MAGUS, Linné, sp. (*Trochus*).
Station VIII. Logs 34, 35.

[GIBBULA UMBILICALIS, Da Costa, sp. (*Trochus*), = *umbilicata*, Montagu.
Station II. Log. 52.]

G. TUMIDA, Montagu, sp. (*Trochus*).
Logs 21, 28, 30, 33, 34, [35].

G. CINERARIA, Linné, sp. (*Trochus*).
Station VIII. Logs 6, 28, 35, 40, 50, 62, [70], A, C, D, E.

FISSURELLA GRÆCA, Linné, sp. (*Patella*).
Station VIII. Logs 30, 31, 33, 35 [73].

EMARGINULA FISSURA, Linné, sp. (*Patella*). Logs 3, 9, 12, 24, 29, 30, 31, 33, 35, [72 (south of Glandore Harbour; depth, 53 fathoms), 73]; depth, 4 to 808 fathoms.

[EMARGINULA CRASSA, J. Sowerby.
Stations III., VIII.]; depth, 25 to 90 fathoms.

PROPILIDIUM ANCYLOIDE, Forbes, sp. (*Patella* ?).
Station VIII. Logs 9, 11, 12, 55; depth, 40 to 90 fathoms.

PILIDIUM FULVUM, Forbes and Hanley.
Stations [II., VI., VII.], VIII. Logs 9, 11, 12, 21, 31, 33, 42, 55; depth, 37½ to 169 fathoms.

ACMÆA VIRGINEA, Muller, sp. (*Patella*).
Stations VI., VIII. Logs 15, 30, 33, 35, 40, 62, 64, C, E, F.

HELCION PELLUCIDUM, Linné, sp. (*Patella*.)
Station VIII. Logs 28, 35, 40, [62], A, C, E.

Var. LÆVIS, Pennant, v.
Log 62.

PATELLA VULGATA, Linné.
Station VIII. Logs 35, C.

[TRACHYDERMON CINEREUS, Linné, sp. (Chiton), = *marginatus*, Pennant.
Log 62.]

LEPIDOPLEURUS ONYX, Spengler, sp. (*Chiton*).
[Station VIII.] Logs 30, [44].

ACANTHOCHÆTES FASCICULARIS, Linné, sp. (*Chiton*).
Station VIII.

[TONICELLA RUBRA, Linné, sp. (*Chiton*).
Station VIII.]

[NEOMENIA (? CARINATA, Tullberg).
Nymph Bank. A. R. Nichols.]

DENTALIUM ENTALIS, Linné.
[Stations I., IV.] Logs 9, 11, 12, 17, 18, 22, 24, 29, 30, 33, 34, [44 (off Dursey Head; depth, 108 fathoms)], 55, [56 (off Dursey Head; depth, 93 fathoms)], 57; depth, 25 to 808 fathoms.

D. VULGARE, Da Costa, sp. (*Dentale*), = *tarentinum*, Lamarck.
Logs 18, [56 (off Dursey Head; depth, 93 fathoms)].

D. AGILE, M. Sars.
Log. 67. Three fine specimens, two containing the animal.

ENTALINA QUINQUANGULARE, Forbes, sp. (*Dentalim*).
Logs 57, 67. Depth, 100 to 370 fathoms. A few examples, mostly fragmentary.

PULSELLUM LOFOTENSE, M. Sars, sp. (*Siphonodentalium*).
Logs 9, 11, 12, 16, 17, 18, 21, 28, 30, 33, 34, 42, 54, 55, 57, 63, 67; depth, 10 or 20 to 808 fathoms. This species, though so widely distributed in the district as regards both area and depth, only occurs plentifully when a depth of some seventy fathoms is reached. Most of the specimens belong to the form which M. Sars described as specifically distinct under the names of *Siphonodentalium affinis*. Mr. J. T. Marshall, though he retains the specific distinction, declares that one form merges into the other. So true is this, that it is quite impossible to separate specimens when dealing with them in hundreds, as in the case of these Irish examples. The name *affinis* must, therefore, be relegated to varietal rank.

CADULUS SUBFUSIFORMIS, M. Sars, sp. (*Siphonodentalium*).
Log 67. Several live and dead specimens.

C. PROPINQUUS, G. O. Sars.
Log. 67. A single example.

C. JEFFREYSI, Monterosato.
Log 17. Two fragmentary specimens; depth, 90 to 808 fathoms.

ANOMIA EPHIPPIUM, Linné.
Logs 3, 6, 9, 12, 15, 19, 20, 22, 24, 28, 29, 30, 31, 34, 35, 40, 41, 50, 59, 62, 64, 67, [72 (south of Glandore Harbour; depth, 53 fathoms)], B, C.; depth, 0 to 370 fathoms.

Var. ACULEATA, Gmelin.
Station VIII Logs 28, 55, 62, 63, C.

A. PATELLIFORMIS, Linné.
[Station VIII.] Logs 31, [53].

LIMA LOSCOMBII, G. B. Sowerby.
Stations VIII., [XI.] Log 63; depth, 25 to 90 fathoms.

L. SUBAURICULATA, Montagu, sp. (*Pecten*).
[Station VII.]. Logs 6, 12, 33, 34, 42; depth, 25 to 55½ fathoms.

PECTEN MAXIMUS, Linné, sp. (*Ostrea*).
Stations [III.], VIII. Log. 63.

P. VARIUS, Linné, sp. (*Ostrea*).
Station VIII. Log 63.

P. TIGERINUS, Müller.
Stations VI., VIII. Logs, 3, 12, 22, 23, 28, 30, 31, 33, 34, [55]; depth, 30–80 fathoms.

P. INCOMPARABILIS, Risso, = *Testæ*, Bivona.
Logs 12, 28, 33; depth, 30–808 fathoms. Valves only.

P. STRIATUS, Müller.
Logs 29, [72].

P. PUSIO, Linné, sp. (*Ostrea*).
[Station VI.] Logs 3, 22, 28, 30, [35].

P. OPERCULARIS, Linné, sp. (*Ostrea*).
Stations VI., [VIII.]. Logs 3, 12, 22, 28, 30, 33, 34, 41, 50, [53], 62, 70, 72, 73; depth, 3½–808 fathoms.

P. PES-LUTRÆ, Linné, sp. (*Ostrea*), var. SEPTEMRADIATUS, Müller.
Station VI. Log 67; depth, 80–370 fathoms.

P. SIMILIS, Laskey.
Logs 12, 16, 17, 20, 23, 28, 30, 33, 34, [56], 67; depth, 30–120 fathoms.

[P. VITREUS, Chemnitz, sp. (*Pallium*).
Log 59]; depth, 90–370 fathoms.

PINNA RUDIS, Linné.
Logs 3, [56].

MYTILUS EDULIS, Linné.
Stations [VII.], VIII. Logs 6, 30, 35, 62, 63, 64, 70, B, C, F.

MODIOLUS MODIOLUS, Linné, sp. (*Mytilus*).
Log 21.

M. PHASEOLINUS, Philippi, sp. (*Modiola*).
Station VIII. Logs 9, 12, 19, 22, 28, 31, 33, 35, 40, 41, [52], 62.

MODIOLARIA DISCORS, Linné, sp. (*Mytilus*).
Log 26.

M. MARMORATA, Forbes, sp. (*Mytilus*).
Logs 28, 35, 39, 40, 50, [62], 63, 70.

M. COSTULATA, Risso, sp. (*Modiolus*). F.
A few valves.

CRENELLA DECUSSATA, Montagu, sp. (*Mytilus*).
Log 17.

LIMOPSIS AURITA, Brocchi, sp. (*Arca*).
Log 67. A small live specimen.

AXINÆA GLYCIMERIS, Linné, sp. (*Arca*).
Station VIII. Logs 6, 17, 30, 31, 33, 34, 55.

ARCA PECTUNCULOIDES, Scacchi.
Station VII. Logs 17, 18, 56; depth, 40–110 fathoms.

A. LACTEA, Linné.
Log 33.

A. TETRAGONA, Poli.
[Station VIII.] Logs 9, 12, 28, 30, 31, 33, 34, [53 living], 55.

NUCULA NUCLEUS, Linné, sp. (*Arca*).
Stations [IV.], VI. Logs 3, 17, 21, 24, 25, 28, 30, 31, 33, 34, 40, 42, 50, 62, 63, [72].

N. SULCATA, Bronn.
Logs 30, [34].

N. NITIDA, G. B. Sowerby.
Logs 9, 12, 17, 24, 26, 28, 30, 33, 35, 40, 41, 42, 53, 55, 57, 62, 64, 70.

Var. RADIATA, Marshall.
Log 28.

[N. TENUIS, Montagu, sp. (*Arca*).
Log 59].

NUCULANA TENUIS, Philippi, sp. (*Nucula*).
Logs 16, 17, 18, 20, 21, 23, 26, 28, 54, [56 (off Dursey Head; depth, 93 fathoms)], 67.

N. FRIGIDA, Torell, sp. (*Yoldia*).
Log 67.

N. PUSILLA, Jeffreys, sp. (*Leda*).
Logs 11, 12, 28, 40, 42. In no case were live specimens found.

ASTARTE TRIANGULARIS, Montagu, sp. (*Mactra*).
Station VIII. Logs 6, 9, 12, 15, 18, 19, 21, 22, 33, 34, 35, 40, 55, 62.

A. SULCATA, Da Costa, sp. (*Pectunculus*).
Stations [II., IV.], VIII. Logs 3, 16, 17, 30, 31, 33, 34, 35, [48, 56], 57, [59], 67.

A. MONTAGUI, Dillwyn, = *A. compressa*, Montagu, sp., non Linné.
Log 30.

KELLIELLA MILIARIS, Philippi, sp. (*Venus* ?).
Logs 18, 54, 57, 67.

TURTONIA MINUTA, Fabricius, sp. (*Venus*).
Logs 40, 62.

KELLIA SUBORBICULARIS, Montagu, sp. (*Mya*).
Station VIII. Logs 6, 9, 11, 12, 18, 21, 22, 28, 35, 40, 42, [55], 64, 70, [73], C, F. Small valves only.

Var. LACTEA, Brown.
Logs 9, 11, 28. Valves of small size.

LASÆA RUBRA, Montagu, sp. (*Cardium*).
Log 9, 18, 25, 28, 35, 40, 42, 62, B, C, D, E, F.

MONTACUTA BIDENTATA, Montagu, sp. (*Mya*).
Logs 6, 9, 11, 12, 16, 21. 22, 24, 26, 28, 31, 33, 35, [39], 40, 41, 42, 55, 57, 62, 63, 64, 70, 73, C, D, E.

Var. TRIANGULARIS.
Log 63.

M. SUBSTRIATA, Montagu, sp. (*Ligula*).
Station VIII. Logs 9, 11, 18, 20, 22, 28, 33, 42, 55, 73. Valves only.

M. FERRUGINOSA, Montagu, sp. (Mya).
Logs 11, 28, 42, [55]. Valves only.

DECIPULA OVATA, Jeffreys.
Logs 11, 12, 21, 28. A few small valves. The discovery of this species off the south-west of Ireland is a matter of great interest. Jeffreys found a single valve at Station 18 of the "Porcupine" Expedition (outside Donegal Bay). I met with a pair of valves in material from the same dredging. It cannot be, as Jeffreys states, the *Tellimya ovalis* of G. O. Sars, for the latter author figures the hinge, which is of the ordinary *Montacuta* type and very different from that of the species under consideration.

LEPTON SQUAMOSUM, Montagu, sp. (*Solen*).
Logs [62], 63.

L. NITIDUM, Turton.
Logs 6, 9, 12, 21, 26, 28, 30, 33, 35, 40, 42.

Var. CONVEXA, Jeffreys.
Station VIII. Logs 11, 12, 21, 28, 30, 33, 40, 50, 63, 70.
Both type and variety are represented by valves only.

L. SYKESII, Chaster.
Logs 11, 13.

L. CLARKIÆ, Clark.
Station VIII. Logs 11, 12, 22, 28, 39, 42, 63, D. Valves only and everywhere rare. There is a considerable amount of variation in the shape of the different specimens.

L. OBLIQUATUM, Monterosato.
Logs 11, 42, 55, 63. A valve or two from each locality.

CARDIUM ECHINATUM, Linné.
[Stations VII., VIII.] Logs 3, 9, 12, 17, 21, 28, 40, 42, [55, 62, 70, 73].

C. EDULE, Linné.
[Station VIII.] Log 63, C.

C. EXIGUUM, Gmelin.
Logs 6, 11, 12, 31, 33, 35, 40, 50, 62, 63, C.

C. FASCIATUM, Montagu.
Logs 9, 12, 21, 24, 28, 30, 31, 50, 63, 70.

C. NODOSUM, Turton.
Station VIII. Logs 35, 40, 62, 63C, E.

LÆVICARDIUM NORVEGICUM, Spengler, sp. (*Cardium*).
Station VIII. [Log 40.]

ARTICA ISLANDICA, Linné, sp. (*Venus*).
Station VIII. Logs 9, 11, 12, 22, 28, 30, 42, 55, 63.

TAPES VIRGINEUS, Linné, sp. (*Venus*).
Station VIII. Logs 33, 35, [40, 72].

[T. GEOGRAPHICUS, Chemnitz, sp. (*Venus*), var. PULLASTRA, Montagu.
Log 62.]

T. AUREUS, Gmelin, sp. (*Venus*).
Log 35.

[T. DECUSSATUS, Linné, sp. (*Venus*).
Station III.]

GOULDIA MINIMA, Montagu, sp. (*Venus*).
Logs 31, 33, 34.

DOSINIA EXOLETA, Linné, sp. (*Venus*).
Station VIII. Logs 12, [72].

D. LINCTA, Pulteney, sp. (*Venus*).
Stations [III.], VIII. Logs 3, 17, 18, 19, 22, 28, 34, 35, [42], 50, 62, [72].

VENUS CASINA, Linné.
Station VIII. Logs 18, 34, 42, 59, [62, 72].

V. VERRUCOSA, Linné.
[Station VIII.] Logs 21, 28.

V. FASCIATA, Da Costa, sp. (*Pectunculus*).
Station VIII. Logs 30, 34, [72].

V. GALLINA, Linné.
Station VIII. Logs 3, 17, 19, 22, 28, [42], 63.

Var. LAMINOSA, Montagu.
Log 28.

TIMOCLEA OVATA, Pennant, sp. (*Venus*).
[Station I.] Logs 6, 12, 17, 19, 22, 23, 24, 28, 30, 31, 33, 34, 35, [39], 40, 41, 50, 62, [72, 73], C.

LUCINOPSIS UNDATA, Pennant, sp. (*Venus*).
Station VIII. Logs 11, 21, 42, 55.

AXINUS FLEXUOSUS, Montagu, sp. (*Tellina*).
[Station VII.] Logs 9, 11, 12, 19, 20, 21, 24, 26, 28, 35, 42, 50, 55, 62.

A. FERRUGINOSUS, Forbes, sp. (*Kellia*).
Logs 17, 42, 67.

A. INCRASSATUS, Jeffreys.
Log 67.
The rediscovery of this rare species is a matter of considerable interest.

DIPLODONTA ROTUNDATA, Montagu, sp. (*Tellina*).
Station VIII.

[DONAX VITTATUS, Da Costa, sp. (*Cuneus*).
Station VIII. Log 35.]

D. VARIEGATUS, Gmelin, sp. (*Tellina*) = *politus*, Poli.
Station VIII.

GARI FERROËNSIS, Chemnitz, sp. (*Tellina*).
Station VII.]. Logs 9, 12, 25, [40], 50, 62.

G. TELLINELLA, Lamarck, sp. (*Psammobia*).
Station VIII. Logs 6, 21, 22, 35, 62, E.

SOLENOCURTUS CANDIDUS, Renier, sp. (*Solen*).
Station VIII.

S. ANTIQUATUS, Pulteney, sp. (*Solen*).
Logs 30, [50], 62.

SOLEN PELLUCIDUS, Pennant.
Stations VI. [VII., VIII.]. [Logs 42, 55, 62, 73.]

[S. ENSIS, Linné.
Station VIII. Log 40.]

S. SILIQUA, Linné.
Station VIII. Logs 40, 62.

SEMELE CASTANEA, Montagu, sp. (*Donax*).
Station VIII.

[MACTRA SOLIDA, Linné.
Station VIII. Log 35.]

M. ELLIPTICA, Brown.
Station VIII. Logs 3, 6, 12, 19, 22, 33, 34, 35, [40], 63, 72.

M. SUBTRUNCATA, Da Costa, sp. (*Trigonella*).
Log 35.

LUTRARIA ELLIPTICA, Lamarck.
Station VIII. [Logs 35, 70.]

MYA TRUNCATA, Linné.
[Station VIII.] Logs 35, 63.

SPHENIA BINGHAMI, Turton.
Logs 35, 40, 62, 63. Valves only.

CORBULA GIBBA, Olivi, sp. (*Tellina*).
Logs 3, 9, 11, 12, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 28, 30, 31, 33, 34, 35, 40, 42, 50, 55, 59, [62], 63, 70, [72], 73.

SAXICAVELLA PLICATA, Montagu, sp. (*Mytilus*).
Logs 11, 26, 28, [70].

SAXICAVA RUGOSA, Linné, sp. (*Mytilus*).
Logs 3, 9, 11, 12, 15, 19, 21, 22, 24, 28, 30, 31, 33, 34, 35, 40, 42, 55, 62, 63, [70], C, E.

Var. ARTICA, Forbes and Hanley.
[Station XIII.]. Logs 6, 12, 23, 24, 25, 28, [31, 52, 53, 70, 73].

LUCINA BOREALIS, Linné, sp. (*Venus*).
Stations [IV.], VIII. Logs 3, 9, 11, 12, 28, 35, [52], 55, 59, C.

L. SPINIFERA, Montagu, sp. (*Venus*).
Stations [IV.], VI., VII., [VIII.]. Logs 3, 12, 17, 21, 28, 30, 33, [73].

TELLINA CRASSA, Gmelin, sp. (*Venus*).
Station VIII. Logs 6, 11, 22, 30, 33.

T. TENUIS, Da Costa.
Log 22.

T. FABULA, Gronovius.
Logs 35, [70].

T. SQUALIDA, Pulteney.
Station VIII.

T. PUSILLA, Philippi.
Station VI. Logs 6, 9, 11, 22, 24, 28, 30, 33, 42, C, E.

T. DONACINA, Linné.
Logs 24, 30, 40, 50, [52].

[GASTRANA FRAGILIS, Linné, sp. (*Tellina*).
Log 62.]

SYNDOSMYA PRISMATICA, Montagu, sp. (*Ligula*).
Stations [II.], VI. Logs 22, 23, 33, 42, [73].

S. NITIDA, Müller, sp. (*Mya*).
[Stations II., VI., VIII.] Logs 12, 17, 22, 28, 30, [55], 67.

S. ALBA, Wood, sp. (*Mactra*).
Logs 3, 19, 28, [62], 63.

CUSPIDARIA CUSPIDATA, Olivi, sp. (*Tellina*).
Logs 23, [73].

C. COSTELLATA, Deshayes, sp. (*Corbula*).
Logs 17, 18, [55].

[C. ABBREVIATA, Forbes, sp. (*Neæra*).
Station VI.]

PANDORA INÆQUIVALVIS, Linné, sp. (*Tellina*), *Var.* PINNA, Montagu.
[Station II.] Logs 17, 20, [44, 72].

LYONSIA NORVEGICA, Chemnitz, sp. (*Mya*).
Logs 17, 34, [56], 63.

THRACIA PAPYRACEA, Poli, sp. (*Tellina*).
Station VIII. Logs 9, 22, 33, 40, 62.

COCHLODESMA PRÆTENUE, Pulteney, sp. (*Mya*).
Station VIII. Log 22.

II.

NOTES ON IRISH WORMS: 1. THE IRISH NEMERTINES WITH A LIST OF THOSE CONTAINED IN THE SCIENCE AND ART MUSEUM, DUBLIN. By H. LYSTER JAMESON, B.A.

(COMMUNICATED BY DR. SCHARFF.)

[Read April 25, 1898.]

During the autumn of 1897, I was engaged for six weeks re-arranging the collection of Irish Worms in the Science and Art Museum, Dublin; and it occurred to me that it might be worth while to publish, in the case of certain groups at least, lists of the species which are contained in the collection, together with as complete an enumeration of previous records as I could collect from the scattered papers which deal with the Irish Fauna. By so doing, it seemed to me that I might render the facts more accessible to other workers, and at the same time make known the hitherto unrecorded examples which the collection contains.

With this idea in view, I present the following list of Nemertines, which I hope shortly to follow up with remarks on other groups.

The Nemertines in this collection were in part already named. Such as were not already determined, I have been able to identify, with the exception of one or two badly preserved individuals. Under each species, I first enumerate the examples in the Museum; then I give a sketch of the previous Irish records, very doubtful records or uncertain synonyms being omitted. Where the original observer has used an obscure synonym for a well-known species, I give this synonym in brackets ( ). Lastly, I add an account of the general distribution of each species, which I have in great part adopted from Bürger's Monograph (1).

The number quoted before the *year*, in some of the records of specimens in the Museum, refers to the number in the Year Register of the Museum under which the particular individual is entered.

The classification adopted is that of Bürger (1).

PROTONEMERTINI.

Carinella annulata (Montagu) = *C. aragoi*, Joubin.

Examples in Museum, .	Bantry Bay, 199, 1895; Galway, 1871, A. G. More; Dalkey Sound, 116, 1892; Clew Bay, July, 1890; Royal Irish Acad. Exp. Log 72, S. of Glandore, 54 fath., 1888.
Distribution in Ireland, .	Strangford Lough, Belfast Bay, and Co. Down coast (Meckelia trilineata), Thompson (7); Dublin Bay, Haddon, (4); Berehaven, Haddon (5); Valentia, Gamble (3).
General Distribution, .	Atlantic ocean; British, Norwegian and French coasts; Mediterranean; Cape of Good Hope.

Carinella superba (Kölliker).

Examples in Museum, .	Berehaven, Royal Irish Acad. Exp. 1885; Bantry Bay, 43, 1893; Clew Bay, July, 1890, Royal Dublin Society.
Distribution in Ireland, .	Probably some of the records under C. annulata refer to this species.
General Distribution, .	British and French coasts; Mediterranean.

MESONEMERTINI.

Cephalothrix biocculata, Örsted.

Examples in Museum, .	Ballycastle, Co. Antrim, H. Lyster Jameson, and H. Hanna (coll. for Fauna and Flora Committee).
Distribution in Ireland, .	Valentia, Gamble (3).
General Distribution, .	British and French coasts; Mediterranean.

METANEMERTINI.

Eunemertes neesii (Örsted).

Examples in Museum, .	None.
Distribution in Ireland, .	Dunboy, Berehaven, Haddon, (5).
General Distribution, .	Iceland; Norwegian, British, and French coasts; Mediterranean.

Eunemertes gracilis, Johnston.

Examples in Museum, .	None.
Distribution in Ireland, .	Cultra, Co. Down, (Prostoma gracilis, Johnst.), Thompson (7).
General Distribution, .	North Sea, British and French coasts, Mediterranean, Madeira.

Amphiporus dissimulans, Riches (6).

Examples in Museum, .	None.
Distribution in Ireland,	Valentia, Gamble (3).
General Distribution, .	Plymouth, (Riches).

? **Amphiporus pulcher** (Johnston).

Examples in Museum, .	None.
Distribution in Ireland,	? Berehaven, 10 fathoms, Haddon (5).
General Distribution, .	Greenland, N. America, British and Norwegian coasts, Mediterranean.

Amphiporus lactifloreus, Johnston.

Examples in Museum, .	Malahide Sept., 1883, Miss Shannon; Ballycastle, Co. Antrim, H. L. J. and H. H. (coll. for Fauna and Flora Committee).
Distribution in Ireland,	Belfast Bay and adjoining coasts (Borlasia alba, Prostoma lactiflorea, Planaria rosea), Thompson (7); Malahide, Haddon (4); Valentia, Gamble (3).
General Distribution, .	Atlantic part of Polar Sea; British, Norwegian, French, and North American coasts; Mediterranean.

Tetrastemma melanocephalum (Johnston).

Examples in Museum, .	None.
Distribution in Ireland,	Strangford Lough (?) (Prostoma melanocephalum) Thompson (7), (8). Var. *diadema*, Hubrecht, Valentia, Gamble (3).
General Distribution, .	English Channel, Atlantic coast of France, Mediterranean, Black Sea, Madeira.

Tetrastemma flavidum, Ehrenberg,

Examples in Museum, . None.
Distribution in Ireland, Dublin Bay, Haddon (4). Var. *longissimum*, Valentia, Gamble (3).
General Distribution, . British and French coasts, Mediterranean, Red Sea, Madeira.

Tetrastemma candidum (O. F. Müller).

Examples in Museum, . Dublin Bay, May, 1884, A. C. Haddon.
Distribution in Ireland, Dublin Bay, Haddon (4); Valentia, Gamble (3).
General Distribution, . Greenland, Norway, British and French coasts, east coast of North America, Mediterranean, Madeira.

Tetrastemma vermiculus (Quatrefages).

Examples in Museum, . None.
Distribution in Ireland, Valentia, Gamble (3).
General Distribution, . Norwegian, British and French coasts, east coast of United States, Mediterranean, Madeira.

Oerstedia dorsalis (Zool. Danic.).

Examples in Museum, . Seapoint, Dublin Bay, July, 1884, A. C. Haddon.
Distribution in Ireland, Dublin Bay, Haddon (4); Valentia, Gamble (3).
General Distribution, . Norwegian, British, Danish, and French coasts, east coast of North America, Mediterranean, Madeira,

HETERONEMERTINI.

Lineus gesserensis (O. F. Müller).

Examples in Museum, . None.
Distribution in Ireland, Belfast Bay (*Borlasia octoculata*), Thompson (7); (*Borlasia olivacea*), Thompson (7), (8); Valentia, Gamble (3), (*L. obscurus*, Riches = *L. gasserensis* (O. F. M., *fide* Bürger).

General Distribution, . Common on coasts of Greenland, Norway, Denmark, Germany, France, Holland, Belgium, and Britain; east coast of United States; Labrador; scarce in Mediterranean; Madeira.

Lineus longissimus (Gunnerus), = *L. marinus* (Davies).

Examples in Museum, . Salthill, Dublin Bay, 116, 1892, A. C. Haddon; Lambay Island, May 25, 1889; off Baltimore, 190, 1895, A. R. Nichols; Bantry Bay, 43, 1893; Bantry Bay, 150, 1893; Bantry Bay, 199, 1895; Killalla Bay, Ballina, 1893; Ireland, Survey Collection.

Distribution in Ireland, . Portpatrick and Strangford Lough, Thompson (7); Rush, Co. Dublin, Duerden (2); Dublin, Haddon (4); Dalkey, Thompson (7); Valentia, Gamble (3); Berehaven, Haddon (5); Clifden, Thompson (7); Killybegs, Thompson (7).

General Distribution, - British, Norwegian, Danish, German, French and Spanish coasts. Not sufficiently authenticated as a Mediterranean species.

Lineus bilineatus, M'Intosh.

Examples in Museum, . None.
Distribution in Ireland, Valentia, Gamble (3).
General Distribution, . Coast of Scotland, English Channel, Mediterranean, Madeira.

Micrura purpurea (Dalyell).

Examples in Museum, . None.
Distribution in Ireland, . Valentia, Gamble (3).
General Distribution, . Coast of Scotland, English Channel, Mediterranean.

Micrura fasciolata, Ehrenberg.

Examples in Museum, . None.
Distribution in Ireland, . Valentia, Gamble (3).
General Distribution, . British and French coasts and Mediterranean.

Cerebratulus marginatus, Renier, = *C. angulatus*, O.F.M.

Examples in Museum, . Mouth of Kenmare River, Log 11, 1885, Royal Irish Academy Expedition; large specimen from stomach of *Gadus morrhua*, Station 188, Blacksod Bay, Royal Dublin Society Fishing Survey 1891; Roundstone Bay, Survey Collection (?).

Distribution in Ireland, . Berehaven, Haddon (5).

General Distribution, . Greenland and eastern coast of North America, Norway, Great Britain, English Channel, Mediterranean, Madeira.

Cerebratulus fuscus, M'Intosh.

Examples in Museum, . None.

Distribution in Ireland, . Valentia, Gamble (3).

General Distribution, . British, French, and Portuguese coasts, Mediterranean.

PAPERS REFERRED TO.

(1). BÜRGER, O., "Die Nemertinen des Golfes von Neapel." Berlin, 1895.

(2). DUERDEN, J. E., "Notes on the Marine Invertebrates of Rush, Co. Dublin." Irish Naturalist, vol. iii., p. 230.

(3). GAMBLE, F. W., "Notes on a Zoological Expedition to Valentia Island, Co. Kerry." Irish Naturalist, vol. v., p. 129. 1896.

(4). HADDON, A. C., "Report on the Fauna of Dublin Bay." Proc. Roy. Irish Academy, ser. ii., vol. iv., p. 523. 1886.

(5). HADDON, A. C., "Report on the Marine Fauna of S.-W. Ireland." Proc. Roy. Irish Academy, ser. ii., vol. iv., p. 599. 1886.

(6). RICHES, P. H., "Nemertines of Plymouth Sound." Journ. Marine Biol. Assoc., Lond. (2), vol. iii., pp. 1–29. 1893.

(7). THOMPSON, W., "Natural History of Ireland," vol. iv. 1856.

(8). THOMPSON, W., "Additions to the Fauna of Ireland." Ann. Mag. Nat. Hist., ser. i., vol. xviii., p. 387. 1846.

III.

THE ETHNOGRAPHY OF CLARE ISLAND AND INISHTURK, CO. MAYO. BY CHARLES R. BROWNE, M.D.

[Read JUNE 28, 1897.]

CONTENTS.

I.—INTRODUCTION.

The fifth of the local ethnographic surveys, which are carried out annually as a part of the work of the Anthropological Laboratory of Trinity College, was made by me last autumn, the localities chosen being the two islands at the mouth of Clew Bay, Clare Island, and Inishturk.

These were selected as the field of operations for several reasons, as one of the strongholds of the ancient clan O'Malley, and one of its centres of influence, still inhabited by descendants of that clan; and as the population differed in origin both from that of Erris proper, and that of Ballycroy, and might be considered as fairly representative of the people of South Mayo, another reason influencing the decision was the recent acquisition of Clare Island by the Congested Districts Board, and the changes in customs and modes of life to be apprehended from the improvements introduced, so that it became imperative that this district should be surveyed at once, if it was ever to be successfully attempted at all. One of the principles observed in choosing a district for survey is, that localities in which any great change is likely to occur soon should be chosen in preference to those in which the condition of affairs is more settled. In this instance there was especial need of promptness, as the changes had already begun, and have by now advanced so far that much of what is said in this report relative to the dwellings and mode of life of the people is now a record of the past.

II.—PHYSIOGRAPHY.

The two islands dealt with in this report lie outside Clew Bay, at a distance of about 18 to 20 miles from Westport, and about 6 miles from Louisburg, the nearest post town. Clare Island is much the larger of the two, having an area of 3959 acres. Its greatest length is about 6 miles, and it varies in breadth from 1 mile to 3 miles. The coast line all round is high and rocky, except at one place, the bay above which the castle is situated, where there is a stretch of strand backed by a few sandhills. All the rest of the coast is so high and rugged that there are only two other landing places, and these would be of little use if not artificially improved. The cliffs on the east side are low, ranging from 20 to 100 feet above sea-level, and pierced by coves, natural bridges, and caves; but on the north and west they are bold and rugged, rising like a wall from the sea, and attaining at Knockmore, on the west side, an altitude of 1520 feet. The surface is much varied, rising in places into high hills, covered with a thin layer of peat; most of the western half of the island is thus composed of hill and moor, and is used as a commonage. The lower lying part of the island and the central valley are fertile; and it is here that the main part of the population centres. Altogether there are about 1000 acres of arable land; all the rest is moor and mountain. There are several small rivulets among the hills. The rock of the island is sandstone conglomerate at the east end, but elsewhere it is mainly slate.

Inishturk, which lies four miles and a-half to the south-west of Clare Island, is much smaller, its greatest length being 2¼ miles, and its breadth 1 mile. Its coast is very rugged and rocky, and there are brachycephalic and two dolichocephalic. The extremes were 86·6 and 71·2. The cranial height is less than observed in any of the places yet surveyed (the mean vertical index being 63·0 as against 66·2 for Aran 69·2, for Inishbofin and Inishshark, 65·8 for the Mullet, Iniskea, and Portacloy, and 65·6 for Ballycroy.

The cranial curve is even, and there is, as a rule, no occipital projection, the line of the posterior region of the head being continuous with that of the neck. The forehead is broad and upright with well-marked frontal bosses. The glabella and superciliary ridges are of fair size.

Some asymmetrical and abnormal forms of head were met with, including one instance of acrocephaly in Inishturk.

Face.—The face is long, but looks much broader than it really is, owing to the great breadth in the bigonial region. The cheek-bones are prominent. The eyes are deeply set, and often have wrinkles round them, which appear to come rather early, they are placed rather wide apart. They have irides of a blue or light grey, seldom dark grey, or green, and less often dark.

The nose is straight or sinuous, sometimes *retroussé*, but seldom aquiline. It is rather broad in the nostrils, as a rule, the mean nasal index being 69·1; in some cases the nostrils are rounded in form, and visible from the front.

The mouth is large and has lips of medium thickness. The teeth seem to be as a rule sound and even. The angles of the jaws are rather marked. The chin is square and often prominent.

Several abnormalities of the external ear were met with out of the fifty-six men noted. The lobule was attached in thirteen, and absent in fourteen. In some the pinna was slightly flattened out, and in nine the Darwinian tubercle was present.

Skin.—The complexion is fair or ruddy, usually turning a bright red from exposure to the sun, but in a considerable number of cases freckling. As in the people of most of the western districts wrinkles come early.

Hair.—The hair is usually a clear brown; next in order of frequency of occurrence comes dark brown, then black, then fair, and lastly red. The hair is often wavy or curly, and is usually thick and abundant. The beard is of lighter colour than the hair of the scalp. The nigrescence index for the adults of both sexes is 43·35. This description, however, must be taken as a general one, as there are considerable differences observable, especially some between the inhabitants of the two islands which will be treated more fully in another section.

(B.) *Statistics of Hair and Eye Colours:—*

ADULTS.—I. *Males.*

Hair.	Eyes. Light.	Eyes. Medium.	Eyes. Dark.	Totals.	Percentage Hair Colours.
Red, ..	0	0	0	0	—
Fair, ..	5	1	0	6	8·10
Brown, ..	27	8	0	35	47·30
Dark, ..	19	7	0	26	35·14
Black, ..	3	4	0	7	9·46
Totals, ..	54	20	0	74	100·00
Percentage Eye Colours,	72·97	27·03	0·00	100·0	—

Index of Nigrescence, . . 45·96.

ADULTS.—II. *Females.*

Hair.	Eyes. Light.	Eyes. Medium.	Eyes. Dark.	Totals.	Percentage Hair Colours.
Red, ..	0	0	0	0	0·00
Fair, ..	2	2	0	4	12·50
Brown, ..	11	0	0	11	34·38
Dark, ..	13	2	1	16	50·00
Black, ..	1	0	1	1	3·12
Totals, ..	27	4	1	32	100·00
Percentage Eye Colours,	84·38	12·50	3·12	100·00	—

Index of Nigrescence, . . . 40·74.
Combined Index (both sexes), . 43·35.

Children.—I. *Boys.*

Hair.	Eyes. Light.	Eyes. Medium.	Eyes. Dark.	Totals.	Percentage Hair Colours.
Red, ..	1	0	0	1	2·44
Fair, ..	12	0	1	13	31·71
Brown, ..	21	0	0	21	51·22
Dark, ..	3	2	1	6	14·63
Black, ..	0	0	0	0	0·00
Totals, ..	37	2	2	41	100·00
Percentage Eye Colours,	90·24	4·88	4·88	100·00	—

Index of Nigrescence, . . 19·42.

Children.—II. *Girls.*

Hair.	Eyes. Light.	Eyes. Medium.	Eyes. Dark.	Totals.	Percentage Hair Colours.
Red, ..	3	0	0	3	6
Fair, ..	10	0	0	10	20
Brown, ..	27	1	1	29	58
Dark, ..	2	1	5	8	16
Black, ..	0	0	0	0	0
Totals, ..	42	2	6	50	100·00
Percentage Eye Colours,	84·0	4	12	100·00	—

Index of Nigrescence, ... 64·0.

(c) *Physical Proportions.*—The proportions borne to the main measurements to the stature (taken as 100) are of interest, as differing somewhat from those observed in other districts surveyed.

Face.

The face is long in proportion to the stature, though less so than in any of the other localities reported on, the mean being 7·2, as against 7·3 for Ballycroy; 7·6 for the Aran Islands; 7·5 and 7·4 for the Mullet and Inishkea. The canon is 6·68. The extremes noted were 6·5 and 8·3.

Upper Face.—The mean is 4·6, as against 4·4 for Inishbofin; 4·3 for the Mullet; and 4·2 for Ballycroy, thus showing an exceptional length for this part of the face.

Nose.—This does not bear a very constant proportion to the stature, the extremes being 3·4 and 2·5. The mean is 2·9, less than observed in any of the other localities, the lowest of which (the Mullet) had a mean for this proportion of 3·1. The canon is 3·3.

Sitting Height.

The sitting height is, on the average, midway between that of the Mullet (51·3) and Ballycroy (53·1), the mean being 52·1. The extremes were 54·5 and 47·4, a wider range of variation than met with before.

Upper Limb.

Span.—The span stretch was in every case in excess of the stature, and in almost all the cases was exceptionally great. The average of the 56 men measured was 105·7, the same as for Ballycroy.

Hand.—The hand is short for the stature, the mean proportion being 11·2, with extremes of 12·2 and 10·6.

Forearm.—This section of the arm is long, as the mean proportion is 15·1, nearly the same as Ballycroy (15·3), the Aran Islands (15·1), and shorter than the average for the Mullet, &c. The extremes were 16·0 and 14·0.

CEPHALIC INDICES, CORRECTED FOR COMPARISON WITH SKULLS.

No.	Index.	Corrected Indices.	
21	86.6		
45	85.1		
15	84.7		
43	83.0		
41	82.8	8	Brachycephalic.
13	82.2		
22	82.0		
24	82.0		
2	81.9		
28	81.8		
32	81.6		
47	81.5		
30	81.4		
10	80.9		25 Brachycephals.
5	80.8		
6	80.8		
50	80.7		
3	80.6		
7	80.6		
8	80.4		
36	80.4		
1	80.3		
16	80.2		
34	80.2		
25	80.0		
26	79.7		
29	79.6	39	Mesaticephalic.
23	79.4		
40	79.2		
18	79.0		
37	79.0		
42	79.0		
14	78.9		
4	78.7		
39	78.7		
51	78.6		
53	78.6		
54	78.6		
33	78.4		
35	78.4		
46	78.4		29 Mesaticephals.
49	78.3		
27	78.2		
20	77.8		
44	77.6		
31	77.5		
38	77.3		
19	76.9		
12	76.0		
55	75.7		
17	75.5		
56	75.5	9	Dolichocephalic.
48	75.2		
52	75.2		
11	71.4		Dolichocephals.
9	71.2		

(D.) *Detailed List of Measurements:—*

No.	Indices.						Proportions to Stature.—Height = 100.						
	Cephalic.	Height.	Facial.	Bigonial.	Alveolar.	Nasal.	Hand.	Forearm.	Span.	Height Sitting.	Face.	Upper Face.	Nose.
1	80·3	67·6	118·6	96·6	102·1	70.6	12·2	15·2	107·9	52·3	7·0	4·1	3·0
2	81·9	63·2	110·9	87·5	102·0	58·8	11·1	14·4	104·9	53·3	7·4	4·3	2·9
3	80·6	65·4	104·5	89·4	104·3	60·0	11·4	15·3	107·9	51·8	7·9	4·0	2·9
4	78·7	66·0	127·8	108·5	109·9	78·3	11·9	15·9	107·8	51·1	6·6	3·6	2·7
5	80·8	69·2	104·4	78·8	102·0	58·6	10·9	15·4	106·8	53·0	7·9	4·3	3·3
6	80·8	65·7	111·4	87·8	107·4	64·2	11·5	15·7	109·3	51·7	7·6	4·3	3·1
7	80·6	65·3	113·8	91·1	102·0	61·1	11·1	14·9	106·2	52·5	7·1	4·1	3·1
8	80·4	64·4	112·4	87·6	103·2	67·3	11·2	15·2	104·7	53·6	7·1	4·5	2·8
9	71·2	61·5	118·2	97·4	98·0	74·0	10·7	14·3	104·9	52·1	6·8	3·8	2·9
10	80·9	69·6	109·5	84·1	107·4	69·8	10·8	14·3	101·0	53·1	7·0	3·9	3·0
11	71·4	61·4	111·3	88·8	100·0	71·4	10·7	15·1	106·2	51·9	7·2	3·8	2·8
12	76·0	66·5	109·5	93·6	98·9	61·8	11·2	15·7	106·0	51·2	7·0	4·1	3·1
13	82·2	65·5	116·7	93·6	99·0	66·7	11·8	16·2	110·3	51·9	7·5	4·3	3·1
14	78·9	63·2	117·1	91·1	111·7	47·3	10·9	14·8	105·3	53·1	7·6	4·7	3·4
15	84·7	72·0	110·5	89·4	94·8	67·3	11·3	15·6	107·6	53·4	7·2	4·1	3·0
16	80·2	64·1	118·6	93·2	101·1	73·5	10·8	15·6	105·3	54·3	7·1	3·9	2·9
17	75·5	66·3	113·8	91·1	107·5	82·2	10·8	14·6	101·1	53·4	7·3	4·2	2·7
18	79·0	65·6	120·0	97·4	101·0	95·4	11·3	14·0	107·2	52·7	7·0	4·1	2·6
19	76·9	62·5	119·7	95·1	100·0	63·6	10·9	15·0	105·4	54·3	7·0	3·9	3·2
20	77·8	61·0	119·7	88·5	104·3	67·3	11·8	15·6	103·9	52·5	7·0	3·7	2·8
21	86·6	69·0	109·8	84·1	100·0	55·3	11·4	16·9	108·1	49·2	7·3	4·2	3·1
22	82·0	68·0	116·8	97·6	101·0	69·4	11·4	14·8	107·0	52·4	7·2	4·0	2·8
23	79·4	64·4	128·5	107·1	103·3	78·6	11·6	15·5	107·5	52·3	7·2	3·9	2·6
24	82·0	69·6	108·5	83·7	98·9	70·8	11·3	15·5	105·6	50·8	7·6	4·2	2·8

29	79·6	65·3	113·5	86·4	103·1	75·6	11·3	14·3	103·3	54·3	7·1	4·1	2·7
30	81·4	67·0	123·5	95·7	98·9	72·1	11·4	15·9	107·5	47·4	6·5	3·7	2·4
31	77·5	63·7	113·1	90·2	100·0	67·3	11·5	15·5	105·3	52·8	7·3	4·1	2·9
32	81·6	67·9	122·0	94·9	101·0	74·5	11·1	14·8	107·2	52·2	7·3	3·7	2·9
33	78·4	61·9	119·0	94·2	102·0	70·8	11·3	15·6	107·6	51·2	7·0	4·0	2·8
34	80·2	65·1	117·0	94·9	104·3	63·8	10·6	14·9	105·2	51·3	6·9	3·7	2·8
35	78·4	62·9	116·5	95·7	101·1	73·9	10·7	15·8	104·4	52·5	7·3	4·1	2·9
36	80·4	64·9	107·8	81·2	107·5	73·1	12·1	15·2	102·4	52·7	7·8	4·5	3·2
37	79·0	68·0	126·3	74·7	99·0	72·9	11·7	15·3	105·1	53·1	7·1	3·4	2·9
38	77.3	61·9	113·6	91·2	105·3	65·4	10·7	15·3	104·7	52·2	7·2	4·3	3·0
39	78·7	67·6	117·0	96·2	101·1	78·6	10·3	14·7	102·7	54·2	6·5	3·5	2·6
40	79·2	62·5	113·1	88·5	104·4	62·0	11·7	15·6	107·5	51·3	7·6	4·2	3·1
41	82·8	67·2	130·0	109·0	106·4	86·0	10·6	14·6	104·6	52·9	6·9	4·0	2·7
42	79·0	69·5	121·1	96·5	100·0	82·9	11·4	15·0	106·5	54·5	7·0	3·2	2·5
43	83·0	66·0	118·6	93·2	93·8	62·7	11·2	14·5	105·6	53·1	6·9	3·8	3·0
44	77·6	60·7	109·7	90·3	105·0	70·0	11·4	15·0	102·0	51·6	7·8	4·4	3·1
45	85·1	67·6	103·0	80·0	101·1	61·8	11·3	14·4	106·1	51·4	8·3	4·6	3·2
46	78·4	64·2	111·1	87·3	101·1	68·8	11·2	15·6	106·4	51·7	7·4	4·0	2·8
47	81·5	61·2	122·5	88·7	107·1	72·3	10·6	15·1	108·6	52·9	7·3	3·9	2·8
48	75·2	63·9	103·0	80·6	101·0	58·2	10·6	14·4	102·9	52·9	7·5	4·3	3·1
49	78·3	63·9	115·3	88·7	100·0	69·8	11·2	14·7	102·9	50·6	7·0	3·9	2·9
50	80·7	60·6	112·8	85·7	101·0	65·0	11·6	15·7	104·8	52·3	7·7	4·3	3·5
51	78·6	60·7	123·7	93·2	101·0	69·2	11·0	14·1	103·5	54·3	7·2	3·9	3·2
52	75·2	64·9	130·9	102·7	99·0	62·3	12·1	16·0	111·6	50·8	6·9	4·6	3·3
53	78·6	58·2	114·4	98·5	104·3	69·2	11·3	15·3	106·4	50·9	7·4	4·1	2·9
54	78·6	60·6	108·4	87·0	97·9	80·8	11·2	15·3	108·1	47·8	7·6	4·0	2·7
55	75·7	64·1	123·2	103·6	99·0	68·8	11·1	15·2	105·1	53·1	6·7	3·9	2·8
56	75·5	62·3	108·1	91·9	94·7	75·5	10·8	15·4	106·2	50·7	7·0	3·9	2·8
Mean,	79·4	63·0	115·1	91·2	101·9	67·6	11·2	15·1	105·7	52·1	7·2	4·6	2·9

No.	Name.	Age.	Locality of Father's people.	Locality of Mother's people.	Eye Colour.	Hair Colour.	Skin.	Nose profile.	Ea
1	Malley, Patrick, .	20	Clare I.	Clare I.	light-grey	dark	pale	straight	Outstan lobes a
2	Grady, Austin, .	35	,,	,,	blue	brown	ruddy	straight	Outstan lobes a
3	Malley, Martin, .	44	Galway	,,	blue	brown	pale	straight	Flat, lol tached
4	Barrett, Richard,	47	Clare I.	,,	blue	dark	pale	straight	Outstan
5	Burns, Patrick, .	23	,,	,,	blue	brown	ruddy	sinuous	Flat, lol sent
6	Malley, Patrick, .	26	,,	Co. Galway	dark-grey	dark	pale, freckled	straight	Outstan
7	O'Malley, Anthony,	30	,,	Louisburg	green	black	ruddy	straight	Outstan lobes a
8	O'Malley, John,	40	,,	Clare I.	light-grey	brown	ruddy	straight	Flat, lo tached
9	Cannon, Patrick,	38	,,	,,	blue	dark	pale, freckled	straight	Flat
10	Salmon, John, .	27	,,	,,	dark-grey	dark	pale, freckled	straight	Flat, lol tached
11	Toole, John, .	35	,,	,,	blue	fair	pale	straight	Flat, lol sent
12	Murray, Patrick,	41	,,	'Mayo Co.'	blue	brown	pale	straight	Flat
13	Barrett, Patrick,	50	,,	Clare I.	blue	dark	pale	straight	Outstan lobes a
14	Malley, Charles,	33	,,	,,	blue	fair	pale	sinuous	Flat, lol sent
15	Winter, William,	20	,,	,,	light-brown	dark	ruddy	straight	Flat, lol tached
16	Moran, Martin, .	20	,,	,,	blue	dark	pale	straight	Flat, lol tached
17	Burns, James, .	50	,,	,,	blue	brown	pale	sinuous	Flat, lol sent
18	Burns, Anthony,	21	,,	,,	blue	dark	pale	slightly upturned	Flat
19	Moran, Martin, .	27	,,	'Mainland'	light-grey	fair	pale	slightly acquiline	Flat, lol sent
20	Grady, Patrick, .	45	,,	Clare I.	blue	dark	pale	straight	Flat
21	Grady (Austin) . Patrick	20	,,	,,	blue	black	pale	straight	Outstan lobes a
22	Malley, John, .	25	,,	Achill	light-grey	dark	pale	straight	Outstan
23	Hestor, Michael,	50	(?) Louisburg	Clare I.	light-grey	black	pale	straight	Outstan lobes a
24	Malley, Patrick,	50	Clare I.	Killala	dark-grey	dark	pale	straight	Outstan
25	Winter, Denis, .	34	,,	Clare I.	blue	brown	pale	acquiline No. 4	Flat
26	Burke, Michael, .	40	,,	,,	light-grey	dark	ruddy	straight	Flat, lo sent*
27	Malley, Thomas,	29	,,	,,	light-grey	brown	ruddy	upturned	Outstan
28	Winter, John, .	51	,,	,,	green	brown	ruddy	sinuous	Flat

* Darwinian tubercle in both.

...PHALIC.	FACIAL.				NASAL.			AURICULAR RADII.			HEIGHT.		FORELIMB.		
Breadth.	Face length.	Upper Face length.	Breadth.	Bigonial Breadth.	Length.	Breadth.	Internal Bi-ocular brdth.	Vertical.	Nasal.	Alveolar.	Standing.	Sitting.	Span.	Hand.	Forearm.
151	118	68	140	114	51	36	32	127	95	97	1680	880	1814	202	256
158	128	74	142	112	51	30	29	122	98	100	1707	910	1792	190	247
154	132	67	138	118	50	30	30	125	93	97	1671	867	1804	191	255
148	108	58	138	110	45	36	28	124	90	100	1630	832	1758	194	260
160	137	75	143	108	58	34	31	137	100	102	1736	920	1854	190	268
160	131	75	146	115	53	34	31	130	94	101	1720	890	1880	198	270
158	123	71	140	112	54	33	30	128	101	103	1755	932	1845	194	262
156	121	77	136	106	49	33	30	125	92	96	1709	917	1790	193	260
148	115	65	136	112	50	37	32	128	102	100	1693	883	1787	181	243
157	126	70	138	106	53	37	32	135	95	102	1790	950	1808	195	256
150	124	61	138	110	49	35	29	129	101	101	1720	892	1826	185	260
152	126	73	138	118	55	34	32	133	95	94	1800	921	1908	202	283
162	126	71	147	118	51	34	34	129	96	95	1670	867	1842	197	272
150	123	75	144	112	55	26	31	120	94	105	1600	850	1684	175	237
160	123	70	138	110	52	35	32	136	96	91	1720	920	1850	195	268
154	118	66	140	110	49	36	32	123	90	91	1673	908	1762	182	262
148	123	70	140	112	45	37	32	130	93	100	1665	890	1683	180	245
154	115	68	138	112	42	44	33	128	97	98	1645	878	1763	186	231
160	122	69	146	116	55	35	35	130	102	102	1765	860	1862	194	265
162	122	63	146	108	49	33	33	127	94	98	1732	910	1800	205	270
162	132	75	145	111	56	31	31	129	92	92	1790	880	1950	205	285
164	125	71	146	122	49	34	34	136	100	101	1757	922	1880	200	260
154	112	62	144	120	42	33	31	125	92	95	1576	825	1695	183	245
159	129	72	140	108	48	34	34	135	92	91	1690	850	1785	192	260
160	135	70	150	114	54	39	28	125	107	106	1750	900	1880	200	250
153	114	62	144	122	48	35	32	128	95	98	1670	868	1735	180	252
154	125	72	140	108	47	35	32	124	95	97	1671	854	1810	188	260
162	132	79	148	114	57	32	32	130	103	105	1794	920	1947	210	265

No.	Name.	Age.	Locality of Father's people.	Locality of Mother's people.	Eye Colour.	Hair Colour.	Skin.	Nose profile.	Ears
29	Malley, Edward,	19	Clare I.	Clare I.	dark-grey	dark	pale	straight	Outstand lobes at
30	Malley, Thomas,	19	,,	,,	dark-grey	brown	pale	straight	Flat
31	Moran, James, .	20	,,	Louisburg	green	brown	ruddy	straight	Flat, lobe sent
32	Burns, John, .	35	,,	Clare I.	blue	dark	pale	straight	Flat
33	Malley, Michael,	22	,,	,,	light-grey	brown	pale	straight	Outstandi
34	Malley, Edward,	19	,,	,,	light-grey	brown	ruddy	straight	Flat
35	Malley, Thomas,	21	,,	,,	green	brown	pale	straight	Outstandi lobes at
36	Toole, Patrick, .	53	,,	,,	blue	brown	pale	straight	Flat
37	Scuffle, Peter, .	40	,,	,,	light-grey	dark	pale	straight	Outstandi lobes at
38	O'Malley, Edwd.,	52	,,	,,	light-grey	fair	pale	straight	Flat, lobe tached
39	Toole, Patrick, .	24	,, †	,,	green	brown	ruddy	straight	Flat
40	Moran, Michael,	20	,,	,,	blue	dark	pale	straight	Flat, lobe sent
41	Burns, James, .	32	,,	,,	blue	dark	pale	straight	Flat
42	Cannon, Michael,	19	,,	,,	dark-grey	fair-brown	pale	upturned	Outstandi lobes ab
43	Toole, Patrick, .	19	,,	,,	light-grey	black	pale, freckled	straight	Flat, lobe tached
44	Flynn, Michael, .	27	,,	,,	blue	brown	pale	straight	Outstandi
45	Grady, Austin, .	60	,,	,,	blue	dark	ruddy	acquiline, No. 4	Flat ‡
46	Toole, Austin, .	24	Inishturk	Inishturk	dark-grey	dark	pale	straight	Flat
47	Toole, John, .	35	,,	,,	blue	brown	pale	straight	Flat
48	Toole, Patrick, .	53	,,	Castlebar	green	black	ruddy	straight	Outstandi lobes ab
49	Toole, Austin, .	39	,,	Clare I.	dark-grey	black	pale	sinuous	Outstandi
50	Toole, Peter, .	41	,,	,,	blue	black	pale	slightly acquiline	Flat, Darw tubercle
51	Toole, Timothy,	44	,,	Inishturk	green	dark	pale	slightly acquiline	Flat
52	Faherty, John, .	52	,,	,,	dark-grey	black	pale	straight	Flat §
53	Toole, Patrick, .	30	,,	,,	—	—	—	—	Darwinia tubercle
54	Toole, Patrick, .	63	,,	,,	light-grey	dark	pale	straight	Outstandi
55	Flaherty, Michl.,	20	,,	,,	light-grey	brown	ruddy	slightly acquiline	Outstandi
56	Toole, Peter, .	24	,,	,,	dark-grey	brown	pale	straight	Outstandi lobes att

* Darwinian tubercle. † Originally Inishturk. ‡ Darwinian tubercle present.

…PHALIC.	FACIAL.				NASAL.			AURICULAR RADII.			HEIGHT.		FORELIMB.		
Breadth.	Face length.	Upper Face length.	Breadth.	Bigonial Breadth.	Length.	Breadth.	Internal Bi-ocular brdth.	Vertical.	Nasial.	Alveolar.	Standing.	Sitting.	Span.	Hand.	Forearm.
156	118	68	134	102	45	34	29	128	93	101	1660	902	1714	188	238
158	115	65	142	110	43	31	31	130	93	92	1778	842	1912	202	284
158	122	68	138	110	49	33	33	130	93	93	1677	886	1766	193	260
160	118	63	144	112	47	35	31	133	97	98	1625	850	1743	180	240
152	121	70	144	114	48	34	33	120	100	102	1722	882	1853	195	270
154	118	63	138	112	47	30	33	125	94	98	1695	870	1793	180	253
152	115	65	134	110	46	34	37	122	94	95	1580	830	1650	170	250
156	128	75	138	104	52	38	34	126	93	100	1650	870	1690	200	250
158	114	55	144	108	48	35	32	136	96	95	1602	850	1685	187	245
150	125	75	142	114	52	34	33	120	95	100	1735	905	1827	195	265
148	106	57	134	102	42	33	33	127	90	91	1629	883	1673	176	240
152	122	68	138	108	50	31	29	120	90	94	1605	832	1727	187	250
154	110	64	143	120	43	37	28	125	94	100	1604	850	1677	170	234
158	114	52	138	110	41	34	35	139	98	98	1625	885	1731	185	244
161	118	66	140	110	51	32	32	128	96	90	1720	913	1816	193	250
156	124	71	136	112	50	35	31	122	100	105	1600	826	1632	182	240
160	140	78	144	112	55	34	34	127	95	96	1683	865	1785	190	243
160	126	68	140	110	48	33	33	131	92	93	1703	880	1812	190	266
168	124	65	152	110	47	34	33	126	85	91	1695	896	1840	180	256
152	134	78	138	108	55	32	32	129	100	101	1798	952	1850	190	260
163	124	70	143	110	53	37	31	133	100	100	1778	900	1830	200	262
168	133	74	150	114	60	39	33	136	100	101	1720	900	1803	200	270
162	118	64	146	110	52	36	33	125	101	102	1640	897	1697	180	231
152	113	75	148	116	53	33	33	131	97	96	1624	842	1812	197	260
162	132	71	151	120	52	36	33	120	92	96	1768	900	1882	200	272
162	131	70	142	114	47	38	33	125	97	95	1733	830	1873	195	270
156	112	66	138	116	48	33	33	132	98	97	1665	885	1750	185	255
154	124	69	134	114	49	37	31	127	95	90	1757	890	1685	190	270

‡ Darwinian tubercle in right.   ‖ Darwinian tubercle in one ear.

(E) *Analysis of Statistical Tables.*—A belief appears to prevail that the people of Inishturk are darker haired and taller than the people of Clare Island, and the observations taken in this survey seem to indicate the correctness of this opinion. The differences are shown in the following table:—

—	Clare Island.	Inishturk.
Number observed, ...	45	11
Cephalic Index, ...	79·7	77·9
Altitudinal Index, ...	65·4	62·2
Mean Stature, ...	1693 (5 ft. $6\frac{5}{8}$ in.)	1716 (5 ft. $7\frac{1}{2}$ in.)
Proportion to Stature—Span, . .	105·5	106·4
" " " Hand, .	11·2	11·2
" " " Forearm, .	15·1	15·2
Nigrescence Index, ...	31·6	72·1

From this table it will be seen that the Inishturk men are not only taller, but they have also a longer head, as shown by the lower cephalic index. The proportions borne to the stature by hands and forearms being the same in both, and yet the span-stretch in the mean of Inishturk being greater than that of the Clare Islanders, seems to indicate either that the upper arms are longer, or, what seems more likely, from the appearance of the men, that they are broader across the shoulders. Five out of the nine instances of Darwinian tubercle observed were in Inishturk men.

3. Vital Statistics (General and Economic).

(A) *Population.*—The population of these islands, like that of all the others on the west coast, and indeed like that of Ireland in general, is steadily decreasing. The cause of this decrease has been the usual one, emigration. The population of the two islands was, in 1891, 702. In 1831 it was 1616.

Between the years 1851 and 1871 the population of Clare Island had decreased from 745 to 494, and that of Inishturk from 202 to 127. Since then the population of Clare Island has fluctuated, varying between 621 and 557, while that of Inishturk has increased slightly from 127 to 145.

Census.	Population.	Houses.	Inhabitants. per house.	Acres per head.
1851	947	213	4·40	5·89
1861	856	172	4·98	6·50
1871	621	121	5·13	8·98
1881	753	161	4·32	7·47
1891	702	128	5·48	7·95

The density of population is thus seen to be about 81 to the square mile.

The distribution of population, inhabited houses, out-buildings, and farm-steadings in 1891 was as follows:—

Islands.	Area.	Population.			Houses.	Outbuildings and Farm-steadings.
		Persons.	Males.	Females.		
Clare Island,	3959	557	302	255	100	80
Inishturk, . .	1620	145	78	67	28	45
Totals, . . .	5579	702	380	322	128	125

From this table it will be seen that the males exceed the females by 58.

(B) *Acreage and Rental.*—The total area of Clare Island is 3959 acres, and that of Inishturk is 1620 acres. The Poor Law valuation of Clare Island is £507 18*s*., and that of Inishturk is £106 2*s*.

Three-quarters of Clare Island and a large part of Inishturk are commonage and mountain grazing.

The rental of Clare Island before it passed into the hands of the Congested Districts Board is said to have been about £580. The holdings were small and badly fenced, as stated in another section. It is hard to state the size of the average farm, the system of holding in co-partnership (about as bad a mode as the mind of man could devise), making it hard to say how much each man held, but the average size of the cultivated land on each holding was probably about 4 to 4½ acres.

The arable land has now been divided up into definite holdings, fenced, and sold to the people by the Congested Districts Board.

(c.) *Language and Illiteracy.*—I regret to be unable to record the number of Irish-speaking persons in the population; they are all practically bilingual, and do not, they say themselves, speak Irish well now. It was noticeable during this visit that the people were not observed speaking Irish among themselves, the way they did in Inishbofin and Inishark and other places. Several of the older inhabitants informed me that they all knew Irish, but spoke it so badly that they always felt ashamed in speaking it to the people from Achill. The younger generation growing up hardly knows more than a few words and phrases. It is to be regretted that the census returns only give the figures as to Irish-speaking peoples by baronies.

Illiteracy.—The return for this is given by parishes. In the parish of Kilgeever, which includes both these islands, there were in 1891 4847 persons, of whom 1413, or 29·2 per cent., were illiterate.

Population.	Persons.	Male.	Female.
5 years old and upwards,	4847	2504	2343
Number illiterate, .	1413	661	752
Percentage, . .	29·2	26·4	32·1

The rate of illiteracy on the islands is not high, as most of the men met with were able to read and write.

There are two National schools on Clare Island, and one in Inishturk.

(D.) *Health.*—It was found to be very difficult to obtain reliable information on this part of the subject, but there was universal agreement among my informants that the people on the whole are very strong and healthy, and that the diseases from which they suffer are mainly those due to their mode of life and occupations, their food, and most of all to the unsanitary condition of their dwellings, described in another section.

Consanguineous Marriages seem to be of very frequent occurrence on both islands, as might be expected in an insular population; but beyond the family likeness or fixation of type observable among the people, there seems to be little or no perceptible result. The inhabitants of Clare Island frequently intermarry with those of Inishturk, but unions with people from Achill seem to be of rare occurrence.

Diseases.—As before observed, considerable difficulty was experienced in obtaining reliable information on the prevailing complaints; but the following, based partly on personal observation, partly on information received from trustworthy sources, is believed to be correct so far as it goes:—

Insanity.—Two cases known within the past few years (the exact period could not be ascertained).

Idiocy and Imbecility.—None.

Epilepsy is not common, but two cases are known to exist, both mild.

Deaf-mutism.—There are no deaf-mutes on either island, nor could I find that there ever had been any within the memory of any of the inhabitants.

Congenital Blindness and Malformations.—There are no cases of congenital malformations or blindness on either of the islands.

Fevers are stated to be of common occurrence, though not so much so as formerly. Typhus and enteric fever are the most common visitants. With new and improved habitations for the people these scourges ought in future to be of much less frequent occurrence.

Phthisis and "Struma" are said to be unknown on the islands; they certainly are not common.

Bronchitis and Pneumonia are not very common.

Rheumatism, especially lumbago, is one of the most common complaints. A man gathering seaweed or otherwise wet through will simply dry himself before the fire, or let the soaked garments remain on him as they are. Acute rheumatism is said to be unknown here, as on several of the islands visited in other surveys.

Dietetic Diseases.—As might be expected from the nature of the dietary, various forms of dyspepsia are commonly met with. The constant use of very strong tea at most meals is blamed by the older people for much of this, and, no doubt, with considerable justice. As fish forms so large a portion of the daily food, ento-parasites, as might be expected, are a common cause of complaint.

"Gravel" is said to be a very common affection.

Local Affections are few, and not very serious. Skin diseases are the most common of these; those most often suffered from are sea-boils, eczema, acne, and scabies.

Accidents, due to the nature of the occupations pursued by the people, are, as might be expected, pretty numerous, but are seldom very serious.

(E.) *Longevity.*—A good proportion of the inhabitants of these islands seem to attain to a considerable age. There are several very old people on Clare Island, and at the time of my visit there was a man of 100 years of age living in Inishturk. He was very active for so old a man, and in full possession of his faculties.

4. *Psychology.*—This is perhaps the most difficult part of the subject to treat in a report such as this. A stranger and a visitor to the islands can only get a very slight glimpse of the people's character, and naturally the best side is the one which is most likely to be shown him. For other things he has to depend on local informants, and local prejudices are apt to influence these; so the recorder has to sift and weigh carefully before accepting all he hears.

To the casual visitor the people are decidedly attractive. Like all dwellers in out-of-the-way places, they are somewhat shy of and suspicious of strangers at first; but after the crust is broken they are kind, obliging, and communicative. With each other they are rather social, and given to joking and laughing, and they seem to have a rather keen sense of the ludicrous.

They are very excitable, and said to be somewhat quarrelsome at times. The island used formerly have rather a name for outrages, but none of these seem to have been very serious, and they were most likely largely the outcome of this excitable disposition, and to the nature of the social surroundings of the time. They are decidedly talkative, especially among themselves. Drunkenness may be said to be unknown. They are very kindly to one another in times of trouble or distress.

The charge of laziness has been brought against them, and with some degree of justification; but the manner in which they worked when organised by the Congested Districts Board, and when they had some real inducement to do so, leads one to think that they did not work on account of having no real interest in doing so.

5. *Folk-names.*—The following list, kindly supplied to me by Sergeant M'Golderick, R.I.C., comprises all the surnames now to be met with on the islands except those of the police and lighthouse-keepers.

Surnames of Clare Island.

Surname.	Number of Families.	Surname.	Number of Families.
Barrett, ...	3	Lavelle,[1]	1
Burke, ...	1	Malley, ...	32
Burns, ...	5	Mac Namara, ..	2
Byrne, ...	1	M'Donagh, ..	1
Cannon,[1]	2	M'Hale, ...	1
Fergus, ...	1	Moran, ...	6
Flanagan, ...	1	Murray, ...	4
Flynn, ...	3	Ruddy, ...	3
Gallagher,[2]	2	Salmon, ...	2
Gibbons, ...	1	Scuffle,[1]	2
Gordon, ...	1	Toole, ...	5
Grady, ...	8	Winters, ...	4
Hestor, ...	1		

The surnames on Inishturk are Toole (the most common), Malley, and Faherty.

As will be observed Malley is still the most common surname in Clare Island. In 1821 there were sixty-seven families of that name thereon.

The great majority of the names are those of families or clans anciently belonging to the territory of Hy Fiachrach in which these islands were included.

Barrett and Burke are, of course, Welsh or Anglo-Norman, and date from the thirteenth century.

Two names, Salmon and Winters, appear to be English; but the latter may probably be the Anglicised form of some Irish name which I have not been able to trace.

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[1] The names marked thus, are common in Inishbofin, and probably came from there, Scuffle certainly did so.

[2] Gallagher is one of the Ulster names which came into this part of Connaught in the 17th century.

The following list gives the surnames which appear to have been in the district anciently, most of them are considerably altered, and are given in both their ancient and their modern forms.

Modern.	Ancient.
Burns,	Mac Conboirne,
Byrne,	O'Birn.
Cannon,	M'Coinin.
Flynn,	O'Floinn.
Flanagan,	Mac Flannagain.
Lavelle,	O'Maolfabhaill.
McHale,	Mac Cele.
Malley,	O'Maille.
Moran,	O'Moran.
Murray,	O'Muireadhaigh.
Ruddy,	O'Broduibh.
Toole,	O'Tuathal.

IV. Sociology.

1. *Occupations.*—Though living on islands, but few of the men are fishermen by occupation, and those few sell the fish to the others. All are farmers to a greater or less extent, and some few have hardly ever been out of the islands.

The farms or holdings are of very small size, but have (or had, for the state of things described here is now a matter of history) unlimited right of grazing over the greater part of the islands.

The methods of farming are of the most primitive description, and no attempts at improvement seem ever to have been made until the Congested Districts Board took over Clare Island. The holdings were not properly fenced, many of them having their boundaries only indicated by land-marks. As soon as the crops were removed the land all became a common, and remained so during the winter; while the crops were down the sheep and cattle of the neighbours had to be kept away from them by some of the family being constantly on the watch with dogs to drive them away, and send them back to the mountain grazing again. There was thus no inducement to improve, as whatever change for the better was made was sure to be undone again. Another obstacle to improvement was the system of co-tenancy in which families had only a part share in a farm. The right of grazing on the mountains (two-thirds of the area of the islands) was unlimited, the result of which was that a man paying a very small rent might really be a richer man and larger cattle holder than one paying a larger rental.

There are no ploughs or harrows on the islands, all the tillage being spade work. The manures consist of seaweed and farm-yard manure.

An average family has a couple of pigs, a cow or two, a number of fowl, geese, or ducks, and a donkey, or horse; most families keep a brood mare. The fuel used is turf, much of it "scraw" turf raised off the surface of the land which has been completely ruined in some places by this custom. There are no regular bogs, but in some of the hollows among the hills there are small areas in which the peat is from two to four feet in depth. A good deal of kelp is made, for which the people get about £4 per ton. Other occupations are few; there are very few tradesmen on the islands: two weavers make a little frieze and coarse flannel for use on the islands; the other tradesmen are one blacksmith, one carpenter, and two sawyers.

The women attend to the ordinary household work, cooking, spinning, carding, &c.; they also rear fowls and geese which they sell at Westport, and export eggs in considerable quantities. The fish caught is eaten fresh in summer, and salted roughly and dried in the sun on roofs and walls for winter use.

2. *Family Life and Customs.*—The general characters of family life are much the same as those of the other islands (Bofin and Shark) to the south of them, and the description of the life there practically answers for Clare Island and Inishturk also.

Marriages are not a matter of romance as a rule, but are arranged by the parents and relatives of the young people. Some of the wedding customs are curious; the night before a wedding the bridegroom and friends go to the bride's father's house; when they arrive, four bottles are placed on the table, one at each corner, and the parties are treated by some responsible person at each corner. Feasting and story-telling are kept up until morning when all go to the chapel together for the ceremony; after which the bride is taken to the husband's house where feasting is kept up as before the next night.

On the occasion of a death, windows and doors are opened, and it is not considered right for any one to weep until the death actually occurs. Wakes are still held, but they are shorn of many of their old observances. As in Bofin and elsewhere, the grave is not dug until the coffin reaches the graveyard. Two funerals starting together, if there should be such an occurrence as two on the same day, would have a race for the cemetery, for the belief still lingers that the spirit of the person last buried has to sit and watch until the next funeral.

Unbaptized infants are buried in killeens or burial grounds by themselves.

The funeral customs are the same as described in Bofin except that the belief about the ill luck in giving the wood out of the house for the coffin does not prevail here. Tobacco is served out to those present at a funeral, and the unused pipes are placed on the grave as in Ballycroy.

3. *Food.*—The people take three meals in the day; many families take strong tea at each; the dietary consists of tea, flour-bread, potatoes, eggs, and fish (fresh or salted according to season). Indian meal stirabout is eaten when the potatoes are exhausted.

Clothing.—The work-day clothing is mostly home-spun; stockings and flannels are all home manufacture, and of rather course quality. Some native dyes such as lichen and purple loose-strife are in use occasionally. The men are clothed very thickly, wearing layer upon layer of thick heavy homespun flannel, which makes them appear much stouter than they really are.

Most of the women's clothing, and the men's best attire, is imported.

Dwellings.—The houses are much the same as those of Inishbofin, but poorer, usually containing only two apartments, the kitchen and the room. Owing to the absence of lime on the islands, the houses are built of dry stone, and plastered inside; many are now being whitewashed. Many of these houses are very old; I have been in one stated by the inhabitants to be over two hundred years standing. The houses are thatched with sougan thatch over scraws as described in the report on Bofin.

The end of the kitchen farthest from the fire is used as in the other islands as a sort of pen for cattle and pigs at night; it is paved, and has a small channel running out to drain away moisture. At the time of my visit there were only five or six houses on Clare Island, into which the cattle and pigs were not taken every night. The general style of the interior is the same as that of the houses in Bofin or Ballycroy, except that in one wall of the kitchen there is a recess called the *cailliogh*, which contains a bed which can be curtained off from the room. The furniture is scanty, consisting in the kitchen of a table or two, a few stools, a dresser, covered with coarse earthenware, a bench, and a spinning-wheel.

Above the "couples" at the stable end of the kitchen is a sort of loft in which implements, dried fish, &c., are stored. The domestic utensils are the usual three-legged pot, a griddle, a big chest, some piggins, or wooden vessels (now being replaced in Clare Island by imported articles), a *boran*, spinning-wheel, &c.

The "room" is sometimes boarded, and is scantily furnished, a couple of tent beds and chair or two, a chest, a table, a couple of cheap religious pictures (perhaps), and an article of furniture known as the milk chest: it is mounted on four legs, and has a tightly fitting lid. It is used for containing the milk vessels. The sanitary condition of the houses is bad, owing to the absence of proper ventilation, the presence of the cattle and fowl in the houses at night, and the proximity (frequently) of stagnant pools and muck heaps to the doors of the dwellings.

Transport.—The modes of transport on land are very simple, the only two methods of conveying turf, sea weed, fish, or potatoes, being in baskets on the backs of the people themselves, or in panniers slung over the back of a horse or donkey. Stones for building are carried in rough wooden frames of a V-shape known as stone-cleaves.

There are about eighty horses on Clare Island; the number in Inishturk could not be ascertained.

The roads are pretty good, considering that there is no wheel traffic over them.

For conveyance by water as well as for fishing there are boats, twenty-seven of which are sometimes used for fishing; five of these are pookhauns, two hookers, one of which belongs to Inishturk; there are about a dozen curraghs.

V.—FOLK-LORE.

Considerable difficulty was experienced in obtaining much information on the many curious and interesting beliefs and customs still persisting in these islands, but the following items were collected, thanks mainly to Mrs. C. Kelly, Sergeant M'Golderic, R.I.C., and Mr. Edward O'Malley, of Clare Island. Some other information was gathered from the people of Inishturk. The information which I was able to obtain relates mainly to minor folk-lore.

1. *Customs and Beliefs.*—Reference has already been made to funeral and wedding customs. There are customs and beliefs relating to certain days, most of which are the same as those observed and reported on in Inishbofin, &c. The people will not give fire out of the house on May Day lest all good luck might go with it. On St. John's Eve bonfires are lighted, round which the people circle seven times in the name of the Trinity, bowing towards the fire each time.

Coals from this fire are taken home or thrown into the potato fields for luck.

As might be expected a good many things are supposed to bring misfortune or ill-luck, and some curious methods are employed for averting it. If the fishermen in one boat have to obtain bait from those in another, they always exchange by return of a ballast stone or something similar, lest they might take the luck away with them.

There is full belief in the "bad eye," and "overlooking" among the older people.

It is thought to be unlucky to meet a red-haired woman first thing on starting out to work or on a journey.

Nothing must ever be taken away from Caher Island, but all visitors must leave something, a button, fish-hook, coin or something of the sort, in the curious old stone bowl in the ruined church there. It is allowable, however, to take away the clay or gravel from this island, as it is believed that no rat can live on the island or in a house into which this clay is brought.

In his letters to the Ordnance Survey of Ireland, Dr. John O'Donovan mentions that, in his time, the boatmen when passing Caher Island used always to take off their hats and say, umluíġmid do'dia ṁór na n-uile ċuṁaċta agus do Ṗádruig míorḃuílteach, *i.e.* "We bow, submit, or make reverence to the great God of all powers, and to the thaumaturgus Patrick."

Blacksmiths are believed to possess some magical powers, especially powers of cursing. The strongest and most fearful curses can be brought about by the ceremony of "turning the anvil." Another curse is brought about by boring a hole in a coin on the anvil. Whoever wishes to curse in this manner must first undergo a fast for several days, and then must make the hole in the coin in *the name of the devil,* giving utterance at the same time to the evil wished to the person cursed. These ceremonies, however, are looked upon with horror as acts of extreme wickedness.

Ghosts are believed in by many. The belief in fairies, too, is common, and several men are reported to have seen them. One man (John Neddy) claimed to have seen about a hundred of them, clad in white, running on the side of the mountain in the spring of 1896. The legend as to their origin is that found throughout Ireland, that they are fallen angels, condemned to wander the earth until the day of judgment. They are mischievous in disposition, and are believed to damage people and cattle. They carry off or change children, and a tale is told of their having once attempted to steal a child which was rescued from some people passing. As a protection against them a red cord is tied around the wrist of a parturient woman, also round the infant's wrist when born. Cattle having their tails cut or the hairs taken off are thought to have been injured by the fairies. Fairy boats are said to have been seen at Inishturk; and at Clare Island a fairy or phantom ship is reported to have been observed some months ago passing over the land, and lights at sea have been seen to which supernatural origin was ascribed. There are also beliefs about seals which, as in Bofin, are thought to be enchanted people, and which, like the fairies, are credited with having once stolen a girl from Clare Island. It is believed that if any one shoots a seal, the weather will be wet or stormy for the two days following.

2. *Leechcraft and Charms.*—The belief in the efficacy of charms for certain complaints is common; for others, local herb remedies are much used. Some old people have a charm for the aid of women in labour, which they repeat; and they claim that, when they reach a certain point in the repetition of the formula, they know whether the case is going to turn out well or ill.

"Head-measuring," as described in the report on the Mullet district is practised for the cure of headache. For "the rose" (erysipelas) anointing with butter is practised, as described in the report referred to above. There is a woman on Clare Island who gives herbs for coughs and for "the evil"; in the latter case a decoction of nine herbs (boiled in milk) has to be taken before sunrise every day for fifteen days.

All coughs are supposed to be due to pleurisy, and for this the usual remedy is bleeding from the foot. A syrup made with sugar, vinegar, broom-tops, and the roots of nettles is used as an expectorant. A poultice of mashed ferns is applied to burns. A decoction of wild geranium is employed for the cure of cases of "gravel."

Cattle becoming ill are treated by boring the ear, and inserting a thong of goatskin. Should the complaint be worms, the treatment is the old and well-known charm of tying the worm-knot.

In his report to the Ordnance Survey, Dr. O'Donovan says, with respect to Caher Island, 1839:—"Caher.—Any woman or child suffering from epilepsy or 'falling sickness,' would be immediately and *for ever* cured of it after sleeping for a few minutes in the little church of Teampull Phadruig, but more especially on St. Patrick's Bed outside, and some say on any part of the island."

3.—*Legends and Traditions.*—There appears to be a rather large stock of old legends and tales still surviving the shocks of modern innovations on the islands; but, owing to the reticence of the people on the subject, it was found difficult to get even the mention of many of them. A few, however, were obtained, and are given here.

The dun or fort in Inishturk is said by the inhabitants of the island to have been built by pirates, whose boats or galleys used to lie in the little circular basin below it, screened by the high rocks of its narrow and crooked entrance from observation from the sea. These pirates were the last men in Ireland who possessed the secret of making beer from heather tops. The fort was surprised and taken by enemies, who slew all the pirates except two—the chief and his son—to whom they promised life if they would reveal the secret of how to make heather beer. The old man promised to reveal the secret if his son were first killed; this the captors did at once, and then the father broke from his enemies and threw himself over the cliff into the sea, taking his secret with him.[1] It is also said that a few years ago a man digging in the old fort found a pot of gold coins, with which he went off to America. Both these stories were obtained from a very old man in Inishturk.

On Caher Island is a large stone, which lies on the altar of the ruined church, which tradition says was once thrown at St. Patrick by a "bad friend" of his; and he not being able to avoid it, and in imminent danger of being brained by it, made the sign of the cross between him and it, when the stone at once fell harmlessly to the ground.[2] A sea captain once took away this stone from the island, but met with such bad weather that he could not get away from the neighbourhood until he restored it (E. O'Malley).

In spite of the improvements being introduced by the Congested Districts Board, there are some old folk who take a pessimistic view of the future of Clare Island. They say "it may all do for a time, but cannot succeed for long"; and allege, as the reason, that the island is under a curse. The tradition about this is, that once on a time long ago the shore of the one little sandy bay on the island stretched out further than it does now, and that a weaver's cottage stood just above the spot where now a large rock juts out from the middle of the strand. A boat one day came ashore at this spot from a wrecked ship, and a man stepped out from it. The weaver saw the

[1] A variant of this story is that the secret concerned the treasure which the pirates had concealed.

[2] It is doubtful whether the stone mentioned in this story is the large piece of conglomerate known as *leac na naomh* which lies on the altar in the church, or, another stone, a rounded piece of pumice, which is also there.

stranger, and snatching up a cudgel ran out to question him as to who he was and what he did there; but the stranger, being a foreigner, could neither make himself understood nor understand what was said to him. This enraged the weaver, who struck him on the head and killed him on the spot. Now this stranger was the Pope's brother (another version says the brother of the Emperor of Rome), and by some means or other the Pope got to know that his brother, when seeking hospitality, had been murdered on an island far away, so he laid a curse on that island for all time (E. O'M.).

There are several legends about Grace O'Malley; but the only one which could be got in its entirety seems to have been the skeleton on which Maxwell built his novel the "Dark Lady of Doona," as it agrees in most points with the plot of that story.

According to the tradition there was an early romance in Grace O'Malley's life prior to the matrimonial adventures recorded of her in the histories. When she was a girl a young man was cast ashore from a wreck and rescued by Grace, with whom after a time he fell in love. The young couple were married by a priest on the island, at the altar near the holy well at Kinacurragh, and lived very happily together for some time. There was, however, at the period a quarrel between the M'Mahons of Ballycroy and the O'Malleys of Clare Island, and Grace's husband when engaged in a deer hunt in Achill was murdered by one of the M'Mahons. The widow swore vengeance on the whole clan and watched her opportunity, which soon came. A man from Erris came asking aid at Clare Island, and was asked was there nothing to be got in his own district. He said that there used to be, but that a curse had come on the M'Mahons because they had murdered a young man in Achill, so that their prosperity had departed, and that they had been told that the only way to atone for what had been done was to make a pilgrimage to Caher Island at a certain time. Having got this information the O'Malleys lay in wait in their galleys behind Caher, slew a large number of the M'Mahons and captured the rest, including the murderer, who were taken back to Clare Island and hanged there. Grace O'Malley then sailed northwards to Ballycroy, surprised and captured Doona Castle, the M'Mahon's stronghold, and put the garrison to the sword.

VI.—Archæology.

The islands contain many remains of interest to the archæologist, but as in former reports no detailed description of any of them is ventured upon, all that can be done here being to indicate as far as possible what may be worthy of the attention of those who are skilled n this subject, which the writer cannot pretend to be.

Survivals.—The survivals are comparatively few now. Querns have gone altogether out of use. The old wool wheels, cards, and handloom are still to be found in use. As there are no wheeled vehicles, all loads too heavy or bulky to be carried by hand or on the human back are conveyed in pardogues or clieves slung over the backs of horses. Stones for building are carried in stone-clieves, V-shaped wooden frames slung pannier-wise across a horse's back over the usual straw mat and pannier frame. Clothes are still washed as described in the report on Inishbofin. The milk-chest described in a previous section is another survival. Only a few curraghs are now in use, they having been largely superseded by heavier boats.

Antiquities.—There are a good many ancient buildings and monuments on the islands, but only bare mention of them can be made here.

In Clare Island there are—

(1) O'Malley Castle, built on a projecting rock between the one little bay, where there is a good landing-place and a deep narrow cove, to which tradition says there used to be a subterranean passage, as galleys used to lie there. The castle is a square tower of no great size, three storys in height, and built of rough stone. It was used as a police barrack early in the century, and during its occupation as such it was rough-cast outside, and the projecting chambers high up in the walls were weather-slated. A porch to the door was also added, and some of the loopholes in the walls built up. There are traces of an enclosing wall surrounding a sort of court.

(2.) The Abbey—a Carmelite monastery erected in A.D. 1224. This building has been often described. It is remarkable for the frescoes on the roof and for containing the curious old O'Malley monument. At one time a skull and a pair of gold earrings used to be kept in a recess in the wall, and were shown to visitors as the skull and ornaments of Grace O'Malley. Downing writes that the Abbey was built by Dermitius Caladus O'Maly for the Order of St. Bernard, and that Dermitius was buried there.

(3.) There are two holy wells, the well of the festival of the Virgin Mary and the well of St. Bridget. Near these wells are some curiously carved and inscribed stones.

"In Inishturk there is a kill dedicated to St. Columb, and traces of a *doon*."[1] Of the old church nothing but the barest trace now remains, and the dun is not very clearly traceable. It stood on a hill overlooking a very safe little harbour, where tradition says the owners of the fort used to keep their galleys.[2]

Caher Island is full of antiquities; it is best described in the words of Dr. O'Donovan. "Caher Island, called by the Irish *Oilean na Cathrach, Cathair na naomh,* and *Cathair Phadruig,* is esteemed next to Inisglora (Inis Gluaire), the most holy island in that part of Connaught, now entirely uninhabited. No *cathair* or stone fort is on the island. The natives of Inishturk and the opposite coast understand the name as the *city* of the saints, or the city of St. Patrick, and that it was called city in the same way as Armagh, Leighlin, and other distinguished ecclesiastical places."

"It contains a small church in the rude primitive style, which is called *Teampull na naomh* by some and *Teampull Phadruig* by others. There are several penitential *leachtas* or monuments around it, at which the pilgrims pray and go through their circumgyrating round, much in the same way that they do on the Reeks. The names of these monuments are not known. East of the east gable of the church there is a stone inscribed with a cross, called *Leabaidh Phadruig,* which is prayed at during the station. "Within the church and laid on the altar is a farfamed stone called *Leac na naomh,* i. e. the *flag of the saints.* It is of a roundish form and about two feet in diameter, and composed of different kinds of stone, which appear as if they had been artificially cemented together, but the compound is, however, the work of nature." . . . "Whenever anyone on the west shores or on the islands in the vicinity of Caher find themselves aggrieved or scandalized openly and wrongfully, they have always recourse to the miraculous powers of this stone *to elicit the truth.* They first fast and pray at home for a fixed time, imploring that God, through the intercession of St. Patrick, and the other saints who blessed this *flag,* would show that they were *wronged* on such occasions; and after the fasting and praying are over they sail over to the Caher, and *turn Leac na naomh.* After the flag is *turned,* the weather immediately becomes unfavourable, and storms and hurricanes most frequently ensue to the great destruction of boats and curraghs, and some event is ere long brought about which shows clearly to the eyes of all the neighbours that the character of the person who turned the *Leac* had

[1] O'Donovan, *loc. cit.*

[2] "Ordnance Survey Letter," Mayo, p. 471.

been unjustly and wrongfully attempted to be blackened. This may be shown in various ways, such as some great misfortune happening to the scandalizer, or in case of theft the real thief being discovered, &c."

O'Donovan does not mention that on the altar there is also a very curious stone basin, with rounded bottom, two handle-holes and a groove cut all round the side, in which votive offerings are placed by all visitors to the island.

"On the north-west side of Caher Island there is a holy well, which is also prayed at and held in great veneration by the pilgrims." . . . A kind of cloghan or road is shown under the waves leading from this blessed island in the direction of the Reek. It is called Boher na neeve—*via sanctorum*—because it was passed by St. Patrick, by his charioteer Bionnan, the widow's son (who was buried on the Reek), by St. Bridget, and other saints who were along with the apostle.

VII.—History.

A report of this nature would be incomplete without some sketch of the history of the people that it may be seen what changes or admixture the population may have undergone. Unfortunately, however, the materials for such a sketch are extremely scanty, the islands having received very little mention.

The whole surrounding district, north and south, as well as the islands, were inhabited anciently by a Damnonian (Firbolg) tribe, the Clan Huamoir, one of whose chiefs, Modha, gave his name to Inis Modha, or the Clew Bay islands. In the second century, Tuathal Teachtmar, a Milesian or Scotic king, conquered and enslaved the Clan Huamoir, and occupied their territory. From this on, there is a great gap in the records; there is nothing known about the territory except the records of the deaths of some of the chiefs, and a mention in the 9th century of the incursions of pirates (probably Scandinavian). In the 10th century, after the establishment of surnames in Ireland, we find the O'Malleys, descendants of Conn of the Hundred Battles,[1] established as rulers and lords of Umhall, a district whieh comprised the present baronies of Burrishoole, or Murrisk, and here they have remained ever since. In the 14th century we get mention of the O'Malleys as being famed as sailors, a reputation they long held.

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[1] "Another shoot of the race of Conn is the Clann Mailli, valiant the branch (every country is heard selecting them)." Duald Mc Firbis, Genealogies, Tribes, &c., of Hy Fiachrach.

O'Dugan (as quoted and translated by O'Donovan) wrote of them (1372):—

> "A good man never was there
> Of the O'Malleys, but a mariner;
> The prophets of the weather are ye
> A tribe of affection and brotherly love."

In the Annals of Ireland (A.D. 1235) we get the following:—"Donnal and Murtough, two sons of Murray O'Malley, were slain by Donnell, son of Manus, who was son of Murtough O'Connor, and by Niall Roe, son of Cathal, son of Conor (*recte* O'Conor), in Cliara, and was interred there.

Clare Island and its inhabitants came greatly into notice in the 16th century through the deeds of the O'Malleys upon the sea, and especially by those of the famous Grace O'Malley, whose birthplace and one of whose chief strongholds was on the island, where, too, she was buried. As a glance at the list of folk-names will show a large proportion of the population is still composed of O'Malleys. We have no record of any colony or foreign strain such as were introduced in Inishbofin.

The population of Inishturk is composed of Malleys and Tooles, of whom O'Donovan says:—"This island is said to be in the possession of the O'Tooles for an unknown number of centuries; some say they came from Leinster. Mr. Owen O'Toole, the present occupier of Inishturk (1839), says that he always heard from his father and the old shanachies that the O'Tooles of this island are descended from Tuathal O'Malley." This indeed seems to be the most probable origin of the name.

The islands underwent no great change until the present century, when Clare Island passed into other hands. A few years ago, during the "disturbed times," Clare Island got rather a bad name for outrages, but there seem to have been none of them of a very serious nature. The most important change that has yet occurred is the purchase of the island by the Congested Districts Board, and the improvements introduced by it, which it is to be hoped will open up a brighter future to the islanders.

VIII.—CONCLUDING REMARKS.

Little remains to be said. It is evident from the list of surnames given that there has been no great change in the composition of the population during the last three or four centuries; in fact, the bulk of the people are descendants of the ancient inhabitants of this part of Connaught. The taking over of Clare Island by the Congested

Districts Board has already benefited the people greatly, and opened up to them a brighter future. New dwellings have been built, of a type suited to the climate, and composed of materials obtainable on the island, and old ones improved. The commonage has been separated from the arable land by a wall running the whole length of the island; holdings have been enlarged and properly fenced; accommodation roads made; the fishermen instructed in new methods, &c. In the course of these works, the people developed, after a time, abilities hardly expected of them at first; they proved quick to learn and able to work, and they take a pride in telling the stranger that they have paid off their arrears of rent, due to the Congested Districts Board, out of the wages got from their work, without one single case of default.

IX.—Bibliography.

(This list does not profess to be exhaustive.)

Archdall.—"Monasticon Hibernicon."

"Annals of the Four Masters" (*cf.* O'Donovan).

Fulmar Petrel.—"Grania Uaile." (London, T. Fisher Unwin. 1895).

Lewis.—"Gazeteer of Ireland" (1837).

Mac Firbis, Duald (*cf.* O'Donovan).

Maxwell, W. H.—"The Dark Lady of Doona."

"National Gazeteer" (1868).

O'Donovan, John:

"MS. Letters to the Ordnance Survey of Ireland." Now in the Library of the Royal Irish Academy.

"The Annals of the Kingdom of Ireland," by the Four Masters. Translated and annotated by John O'Donovan, LL.D.

"The Genealogies, Tribes, and Customs of Hy Fiachrach, commonly called O'Dowda's Country. From the Book of Lecan in the Royal Irish Academy, and from the Genealogical MS. of Duald Mac Firbis, in the Library of Lord Roden" (Dublin, 1844).

Official:

"Parliamentary Gazetteer of Ireland" (Dublin, 1846).

"Memoirs of the Geological Survey of Ireland."

Annual Report of the Congested Districts Board, 1896.

Royal Society of Antiquaries of Ireland:—Programme of Excursion, 1895.

IV.

THE ASSOCIATIVE ALGEBRA APPLICABLE TO HYPER-SPACE.

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[Read June 27, 1897.]

TABLE OF CONTENTS.

THE Algebra considered in the present Paper is that whose units $i_1, i_2, \ldots i_n$ satisfy equations of the type $i_s^2 = -1$, and $i_s i_t + i_t i_s = 0$.

It seems to be due to W. K. Clifford, and the notation in his Papers on "Applications of Grassmann's Extensive Algebra" and "The Classification of Geometric Algebras" is followed as closely as convenient. It is defined to be Associative and Distributive.

1. A vector, or a right line in n-dimensional plane space regarded as having magnitude and direction, is adequately represented by $\rho = \Sigma i_s x_s$, in which the x are scalars.

Any vector coplanar with two given vectors α_1 and α_2 is expressible in the form $\rho = x_1\alpha_1 + x_2\alpha_2$.

Any vector in the same space of three dimensions as α_1, α_2, and α_3 (which vectors are supposed not to be coplanar) is expressible in the form $\rho = x_1\alpha_1 + x_2\alpha_2 + x_3\alpha_3$; and this process may be extended to spaces of higher order.

The units $i_1, i_2, \ldots i_n$ represent unit line vectors mutually rectangular. Their binary products $(i_s i_t)$ represent unit and *directed* plane areas; ternary products $(i_s i_t i_u)$ represent unit volumes in definite or *directed* spaces of three dimensions; and so on for products of greater complexity formed from distinct units.

2. The following discussion of the affections of a curve in n dimensions will serve not only to illustrate a method, but also to interpret various combinations of symbols in the Algebra under consideration. The method is kinematical, and analogous to that hinted at by Hamilton in his "Elements," and used by Darboux and others with much success:—

Let $\rho = \phi(s)$ be the equation of the curve in terms of the length of the arc (s) measured from a suitable point. The tangent at ρ is parallel to the unit vector

$$\alpha_1 = D_s\rho = \frac{d\phi(s)}{ds}.$$

Passing from ρ to a consecutive point on the curve, the tangent changes its direction, and α_1 becomes $\alpha_1 + D_s\alpha_1 \,.\, ds$. But as α_1 is a unit vector, $S\alpha_1 D_s\alpha_1 = 0$; so $D_s\alpha_1$ is at right angles to α_1; and, writing $D_s\alpha_1 = a_1\alpha_2$, and supposing α_2 to be a unit vector (the principal normal), a_1 is the curvature, or $a_1 ds$ is the infinitesimal angle between the consecutive tangents.

Next, it is easy to establish the equation $D_s\alpha_2 = a_2\alpha_3 - a_1\alpha_1$, and to assign geometrical meanings to the new scalar a_2, and the new unit vector α_3. As $S\alpha_2 D_s\alpha_2 = 0$, then $D_s\alpha_2$ will have no component along α_2.

As $Sa_1a_2 = 0$ for all values of s, $Sa_1D_sa_2 + Sa_2D_sa_1 = 0$; and hence D_sa_2 has the component $-a_1a_1$ along a_1. The new vector a_3 is at right angles to both a_1 and a_2, and is the binormal; a_2ds is the angle between a_2 and $a_2 + D_sa_2ds$, or the angle between the consecutive osculating planes, or a_2 is the torsion.

3. So far, all is the same as for three dimensions; but the expression for D_sa_3 is different for the case of space of four and higher dimensions, and for the case of three dimensions.

Since $Sa_1a_3 = 0$, $Sa_1D_sa_3 + Sa_3D_sa_1 = 0$. But the second term of this differentiated expression is zero, because D_sa_1 has no component parallel to a_3. It thus appears that $Sa_1D_sa_3 = 0$, and that D_sa_3 has no component along a_1. As in the last article, the component parallel to a_2 may be shown to be $-a_2a_2$. There is no component along a_3, and so for three dimensions $-a_2a_2$ represents the whole vector. But, for four dimensions, D_sa_3 may have, and in general will have, a component at right angles to a_1, a_2, and a_3, or out of the space containing these three vectors; and if a_4 is a unit vector along this component,

$$D_sa_3 = a_3a_4 - a_2a_2.$$

4. In order to interpret the meaning of the scalar a_3 a slight digression will be useful.

A curve, unless it is a straight line, will deviate from a tangent. Among the planes drawn through the tangent, one (the osculating plane) will have the closest possible contact with the curve; but the curve will deviate from the plane unless it is a plane curve. Among the spaces of three dimensions that can be drawn to contain the osculating plane, one will fit closest to the curve, but it will contain it only if the curve is tri-dimensional. The curve will in general deviate from this osculating *space*.

If a point moves along the curve with unit velocity, the tangent line will turn round that point with an angular velocity equal to a_1; the osculating plane will turn round that line with a velocity a_2; the osculating tri-dimensional space will *turn round* that plane with a velocity whose amount is a_3. The angles between consecutive lines, planes, and spaces are, respectively, a_1ds, a_2ds, and a_3ds.

In space of many dimensions the angle between two planes *having a common line* is the angle between a pair of lines, one in each plane, both of which are perpendicular to the line of intersection of the planes. As each plane has many lines perpendicular to it, it will not do to define the angle between two planes as being the angle between the perpendiculars to the planes.

Two planes, of course, may not have a line common to both; for instance, the plane of i_1 and i_2, and that of i_3 and i_4 have no common line; but every line in one of these planes is perpendicular to every line in the other.

In like manner, the angle between two spaces of three dimensions having a *common plane* is the angle between a pair of lines, one in each space, and both of which are perpendicular to the common plane. Two consecutive spaces osculating to a curve have common an osculating plane. The angle $a_3 ds$ is the angle between the perpendiculars in these spaces to that common plane.

Three mutually rectangular lines (i_1, i_2, and i_3) determine a space of three dimensions containing all the vectors $x_1 i_1 + x_2 i_2 + x_3 i_3$. The vectors i_1, i_2, and $i_3 \cos\theta + i_4 \sin\theta$ (which are also mutually rectangular) determine a second space having the plane of i_1 and i_2 common to both. In the first space the perpendicular to this plane is i_3, and in the second it is $i_3 \cos\theta + i_4 \sin\theta$, and θ is the angle between these lines, or the angle between these spaces.

Of course two tri-dimensional spaces may have only a line or a point common, or no point may be common to both. Two such spaces must have a common plane when both are contained within a space of four dimensions; a common line, when a space of five dimensions contains them; a common point, when the containing space has six dimensions. In a space of seven dimensions, the spaces represented by

$$\rho = x_1 i_1 + x_2 i_2 + x_3 i_3 \quad \text{and} \quad \rho = a_7 i_7 + x_4 i_4 + x_5 i_5 + x_6 i_6$$

have no point unless the constant a_7 happens to be zero.

5. Continuing the process of the 3rd Article, it is found that

$$D_s a_4 = a_4 a_5 - a_3 a_3, \quad \text{and in general that} \quad D_s a_{m-1} = a_{m-1} a_m - a_{m-2} a_{m-2},$$

until all the independent vectors are exhausted. At last, if the curve is contained in a space of n dimensions, $D_s a_n = - a_{n-1} a_{n-1}$.

In terms of the $n-1$ scalars a_1, a_2, ... a_{n-1}, all the affections of the curve can be expressed. Differentials of any order of the vector ρ to a point on the curve, and of any of the derived vectors α, may be reduced to linear functions of the α with scalar coefficients composed of the scalars a and of their differentials.

6. These formulæ may all be collected into a single type expressed by the equation $D_s \alpha_m = V_1 \Omega \alpha_m$, in which Ω is a sum of binary products

of consecutive pairs of the auxiliary vectors, or more definitely in which

$$\Omega = a_1\alpha_1\alpha_2 + a_2\alpha_2\alpha_3 + \ldots a_{n-1}\alpha_{n-1}\alpha_n = \Sigma a_m\alpha_m\alpha_{m+1}.$$ [1]

This is quite analogous to differentiation for moving axes in three dimensions. In fact, if in three dimensions moving axes through the origin are instantaneously turning round a direction $U\theta$, with an angular velocity $T\theta$, a point P, if rigidly connected with them, moves through a distance $V\theta \,.\, OPdt$ in the element of time dt; thus, $D\varpi = V\theta\varpi dt$ is the small displacement of the extremity of ϖ. It may be added that, if P is not rigidly connected with the moving axes, but moves relatively to them through a distance $d\varpi$, the total displacement is $D\varpi = d\varpi + V\theta\varpi \,.\, dt$.

Things are just the same for the curve. Imagine through the origin a set of n vectors kept parallel to the varying vectors $\alpha_1, \alpha_2, \ldots \alpha_n$, corresponding to a point moving uniformly with unit velocity along the curve; then, for the rate of space variation of the extremity of any vector ϖ,

$$D_s\varpi = \frac{d\varpi}{ds} + V_1\Omega\varpi,$$

where $\frac{d\varpi}{ds}$ is the velocity of this extremity with respect to the moving axes. In particular, if ϖ is fixed relatively to the axes (as are the vectors α),

$$\frac{d\varpi}{ds} = 0, \quad \text{and} \quad D_s\varpi = V_1\Omega\varpi.$$

7. Analogues of the helix in three dimensions, and of the circle in two, are obtained by supposing the scalars $a_1, a_2, \ldots a_{n-1}$ to be constant, instead of being, as in general, functions of the arc s.

I shall examine this simple case, and show how the vector equation of a curve may be found when the scalars a are given and constant.

Using the formula of Art. 5,

$$\alpha_{m+1} = \frac{1}{a_m}(D_s\alpha_m + a_{m-1}\alpha_{m-1}),$$

[1] The product $\Omega\alpha_m$ consists of a sum of ternary products such as $a_1\alpha_1\alpha_2\alpha_m$, and a sum of linear terms such as $a_m\alpha_m\alpha_{m+1}\alpha_m = - \alpha_m\alpha_m \,.\, a_m\alpha_{m+1} = + a_m\alpha_{m+1}$. The former sum is $V_3\Omega\alpha_m$; the latter is $V_1\Omega\alpha_m$.

in general, and, remembering that the a are constant, a_2, a_3, &c., are expressible in terms of α_1, thus:—

$$\alpha_2 = \frac{1}{a_1} D_s\alpha_1,$$

$$\alpha_3 = \frac{1}{a_2} D_s\alpha_2 + \frac{a_1}{a_2}\alpha_1 = \frac{1}{a_1 a_2}(D_s^2 + a_1^2)\alpha_1,$$

$$\alpha_4 = \frac{1}{a_3} D_s\alpha_3 + \frac{a_2}{a_3}\alpha_2 = \frac{1}{a_1 a_2 a_3}(D_s^2 + a_1^2 + a_2^2) D_s\alpha_1,$$

$$\alpha_5 = \frac{1}{a_4} D_s\alpha_4 + \frac{a_3}{a_4}\alpha_3 = \frac{1}{a_1 a_2 a_3 a_4}(D_s^4 + (a_1^2 + a_2^2 + a_3^2) D_s^2 + a_1^2 a_3^2)\alpha_1,$$

&c.

Hence, it is easy to infer the general types of derivation

$$a_{2m}\alpha_{2m+1} = f_m(D_s^2).\alpha_1, \quad \text{and} \quad a_{2m+1}\alpha_{2m+2} = F_m(D_s^2).D_s\alpha_1,$$

where f_m and F_m are rational and integral functions of the order m.

Integration is now possible. For spaces of even order $(2m)$,

$$a_{2m}\alpha_{2m+1} = 0, \quad \text{and} \quad f_m(D_s^2)\alpha_1 = 0;$$

for those of odd order $(2m + 1)$,

$$a_{2m+1}\alpha_{2m+2} = 0, \quad \text{and} \quad F_m(D_s^2)D_s\alpha_1 = 0.$$

Now, the general solution of $f_m(D_s^2)\alpha_1 = 0$ is

$$\alpha_1 = \Sigma(\beta \cos cs + \beta' \sin cs),$$

where c is a root of $f_m(-c^2) = 0$, and the vectors β are constants of integration. These vector constants are generally arbitrary; but the condition that α_1 should be a unit vector, or that its square should be independent of s and equal to negative unity, requires generally the mutual rectangularity of the vectors β, and also the equality of the tensors of β and β'. Thus, the particular form

$$\alpha_1 = b_1(i_1 \cos c_1 s + i_2 \sin c_1 s) + b_2(i_3 \cos c_2 s + i_4 \sin c_2 s) + \ldots$$
$$+ b_m(i_{2m-1} \cos c_m s + i_{2m} \sin c_m s)$$

is obtained in which $i_1, i_2, \ldots i_{2m}$ are any set of mutually rectangular unit vectors, and in which the scalars b are obliged to satisfy the relation

$$b_1^2 + b_2^2 + \ldots b_m^2 = 1.$$

Similarly, for odd spaces,

$$D_s a_1 = \Sigma (\beta \cos cs + \beta' \sin cs);$$

and on integration,

$$a_1 = b_1(i_1 \cos c_1 s + i_2 \sin c_1 s) + b_2(i_3 \cos c_2 s + i_4 \sin c_2 s) + \ldots$$
$$+ b_m(i_{2m-1} \cos c_m s + i_{2m} \sin c_m s) + b_{m+1} i_{2m+1},$$

with the condition

$$b_1^2 + b_2^2 + \ldots + b_{m+1}^2 = 1.$$

As before, the condition $Ta_1 = 1$ reduces the constants of integration to this form.

Finally, as $a_1 = D_s \rho$, the vector to any point on the curve in even space is

$$\rho = \rho_0 + \frac{b_1}{c_1}(- i_1 \sin c_1 s + i_2 \cos c_1 s) + \ldots$$
$$+ \frac{b_m}{c_m}(- i_{2m-1} \sin c_m s + i_{2m} \cos c_m s),$$

and that to any point on the curve in odd space is

$$\rho = \rho_0 + \frac{b_1}{c_1}(- i_1 \sin c_1 s + i_2 \cos c_1 s) + \ldots$$
$$+ \frac{b_m}{c_m}(- i_{2m-1} \sin c_m s + i_{2m} \cos c_m s) + b_{m+1} i_{2m+1} s.$$

For the curve in even space the distance of any point on it from the extremity of ρ_0 is constant, or

$$T(\rho - \rho_0) = \left(\Sigma \frac{b_1^2}{c_1^2}\right)^{\frac{1}{2}}.$$

This curve is, perhaps, more analogous to the circle than to the helix.

8. Reverting to the formula of differentiation for moving axes which was given in the 6th Article in the form $D_s \varpi = V_1 \Omega \varpi$, I shall inquire what the quantity Ω becomes when expressed in terms of the vector units $i_1, i_2, \ldots i_n$, introduced in the last Article. This is an example of a transformation from one set of unit vectors (a) to another set (i), both sets being mutually rectangular.

A verification of the simplest kind (consisting merely in the application of the formulæ $i_1 i_2 . i_2 = - i_1$, and $i_1 i_2 . i_1 = - i_2 i_1 . i_1 = i_2$) shows that the equation $D_s a_1 = V_1 \Omega a_1$ is true, provided a_1 is one of the vectors thus denoted in the last article, and provided also the quantity Ω is defined by the equation

$$\Omega = c_1 i_1 i_2 + c_2 i_3 i_4 + \ldots + c_m i_{2m-1} i_{2m}.$$

This is true, whether the space is of even order ($2m$), or of odd order ($2m + 1$).

In Art. 6, Ω was expressed as a sum of $2m-1$, or $2m$ binary products; it is now reduced to a sum of m binary products. This reduction leads up to the investigation contained in the following article.

9. The general problem announced in the last article may be enunciated thus:—

Given any homogeneous function of any number (N) of the n vector units consisting of a sum of products of any number (m) of distinct units, each multiplied by a given scalar, to reduce this function to a canonical form by a change of the system of units involved.

Let q be the given function (of order m), and i_1 one of the units involved. It may be written in the form $q = -q'i_1 + q''$, in which q' and q'' are both independent of i_1. Multiply into i_1, and

$$qi_1 = V_{m-1}qi_1 + V_{m+1}qi_1 = q' + q''i_1$$

gives separately

$$q' = V_{m-1}qi_1 \quad \text{and} \quad q''i_1 = V_{m+1}qi_1.$$

Now multiply q into q', and take the part (V_1qq') of the product qq', which is linear in the units. This new vector (ϖ_1) will not, in general, be parallel to i_1; but it is a linear function of i_1, expressed by the formula

$$\Phi(i_1) = V_1qq' = V_1qV_{m-1}qi_1 = \varpi_1.$$

The linear vector function Φ defined by the equation

$$\Phi\rho = V_1qV_{m-1}q\rho$$

is easily seen to be self-conjugate, for

$$S\sigma\Phi\rho = S\sigma V_1qV_{m-1}q\rho = S\sigma qV_{m-1}q\rho = SV_{m-1}\sigma q \,.\, V_{m-1}q\rho$$
$$= SV_{m-1}q\sigma V_{m-1}\rho q = SqV_{m-1}q\sigma \,.\, \rho = SV_1qV_{m-1}q\sigma \,.\, \rho = S\Phi\sigma \,.\, \rho.$$

Φ being self-conjugate, just as in quaternions, its axes are all real and mutually rectangular. These axes are the units to be employed in the reduction to the canonical form.

10. As an example, consider the reduction of the general homogeneous quadratic function of N of the n units. It consists of $\frac{1}{2}N(N-1)$ binary products, each of which is multiplied by a scalar.

Then $q = \varpi_1 i_1 + q'$, suppose, where neither ϖ_1 nor q' involve i_1. Here

$$-\varpi_1 = V_1qi_1 \quad \text{and} \quad V_1q\varpi_1 = -i_1\varpi_1^2 + V_1q'\varpi_1 = -V_1qV_1qi_1 = -\Phi i_1.$$

If i_1 is an axis of this function Φ, $V_1 q' \varpi_1$ must vanish, and $\Phi i_1 = i_1 \varpi_1^2$

But $$V_1 q \varpi_1 = \varpi_1 i_1 \varpi_1 + V_1 q' \varpi_1 = - i_1 \varpi_1^2,$$

and therefore $$\Phi \varpi_1 = V_1 q \, V_1 q \varpi = - V_1 q i_1 \, . \, \varpi_1^2 = \varpi_1 \, . \, \varpi_1^2,$$

so that ϖ_1 is also an axis of Φ.

Pursuing this argument, it appears that the homogeneous quadratic in N of the units is reducible to the form

$$q = a_{12} i_1 i_2 + a_{34} i_3 i_4 + \ldots + a_{2m-1,\, 2m} i_{2m-1} i_{2m},$$

in which m is the lesser half of N (viz. $m = \frac{1}{2} N$, if N is even; $m = \frac{1}{2}(N - 1)$, if N is odd). For each binary product uses up two of the N new units, and no unit can occur in more than one binary product.

Thus the inference in Art. 8 concerning the form of the quantity Ω is verified, and it is proved that it is possible to reduce a homogeneous quadratic of N units involving $\frac{1}{2} N (N - 1)$ arbitrary constants to a form involving explicitly but $\frac{1}{2} N$, or $\frac{1}{2}(N - 1)$ constants, and when N is odd, but $N - 1$ unit vectors.

In particular, when three units are involved, $a_{23} i_2 i_3 + a_{31} i_3 i_1 + a_{12} i_1 i_2$ may be reduced to a product of two units multiplied by a constant.

11. In the particular case of a quadratic, the new linear vector function defined by $\psi \rho = V_1 q \rho$ may be profitably considered.

Now $$S \sigma \psi \rho = S \sigma q \rho = S V_1 \sigma q \, . \, \rho = S \psi' \sigma \, . \, \rho,$$

so $$\psi' \sigma = + V_1 \sigma q = - V_1 q \sigma = - \psi \sigma;$$

and this function ψ is the negative of its own conjugate.

Suppose ψ satisfies the symbolic equation

$$f(\psi) = \psi^n - m_1 \psi^{n-1} + m_2 \psi^{n-2} - \&c. = 0,$$

its conjugate satisfies the equation of similar form

$$f(\psi') = \psi'^n - m_1 \psi'^{n-1} + m_2 \psi'^{n-2} - \&c. = 0.$$[1]

But $\psi' = - \psi$, so $\psi^n + m_1 \psi^{n-1} + m_2 \psi^{n-2} + \&c. = 0$;

and this is consistent with the former equation for ψ only, if

$$m_1 = m_3 = \&c. = 0.$$

The symbolic equation is therefore

$$\psi^n + m_2 \psi^{n-2} + m_4 \psi^{n-4} + \&c. = 0.$$

---

[1] A general property for all linear vector functions. For, if

$$f(\psi) = 0, \quad S \sigma f(\psi) \rho = S \rho f(\psi') \sigma = 0;$$

this requires $f(\psi') \sigma = 0$, or $f(\psi') = 0$, as σ is arbitrary.

Now, $\psi^2\rho = V_1qV_1q\rho = \Phi\rho$, or generally $\Phi = \psi^2$. Therefore, the equation satisfied by ψ is simply the square of that satisfied by ψ, and the roots of Φ are equal in pairs. This agrees with the conclusions of the last article.

12. A discussion of the roots and axes of the linear vector ψ presents some points of interest.

If β is an axis, and b the corresponding root,

$$\psi\beta = b\beta, \quad \text{and} \quad b\beta^2 = S\beta\psi\beta = S\beta q\beta = 0.$$

Hence, either b or $\beta = 0$. But all the roots are not zero; so if b does not vanish, β must be of the form $a + ha'$, in which a and a' are two real vectors at right angles to one another and of equal lengths, and h is the imaginary $\sqrt{-1}$ of algebra.[1] β is thus the vector to a circular point at infinity in the plane of a and a'. β being imaginary, b must be imaginary also, and $-b$ must be its conjugate, as is evident on inspection of the symbolic equation in the last article; so b is of the form hg, where g is real.

Replacing b by hg (where $h = \sqrt{-1}$), it is evident, as

$$\psi(a + ha') = hg(a + ha'),$$

that

$$\psi(a - ha') = -hg(a - ha'),$$

also. Hence, adding and subtracting,

$$\psi a = -ga', \quad \text{and} \quad \psi a' = ga;$$

also,

$$\psi^2 a = -g\psi a' = -g^2 a, \quad \text{and} \quad \psi^2 a' = -g^2 a'.$$

Again, if for some other root, $b_1 (= hg_1)$,

$$\psi\beta_1 = hg_1\beta_1, \quad \text{and} \quad \psi\beta'_1 = -hg_1\beta'_1$$

we have

$$S\beta\psi\beta_1 = hg_1S\beta\beta_1 = +S\beta_1\psi'\beta = -S\beta_1\psi\beta = -hgS\beta_1\beta,$$

and if g is not $-g_1$, $S\beta\beta_1 = 0$. In like manner,

$$S\beta'\beta_1 = S\beta\beta'_1 = S\beta'\beta'_1, \quad \text{and if} \quad \beta_1 = a_1 + ha'_1,$$

$$Saa_1 = Saa'_1 = Sa'a_1 = Sa'a'_1 = 0,$$

so the planes of aa' and of $a_1a'_1$ are hyper-perpendicular, or every line in one plane is perpendicular to every line in the other.

---

[1] Verification is easy; for $\beta^2 = (a + ha')^2 = a^2 + h^2a'^2 = a^2 - a'^2$.

Lastly, if an odd number of units is involved, the common perpendicular to all these planes satisfies $\psi\rho = 0$.

There is, of course, a certain indeterminateness about the axes of Φ. The general quadratic function is split up into a sum of *area* vectors in determinate planes which have no line common (and which are hyper-perpendicular); any pair of perpendicular vectors in one of these planes may be taken as canonical units, but the products of pairs are definite.

As a corollary, if the sum of two area vectors is an area vector, the planes of the two given areas have a common line.

13. In the general case for homogeneous functions of order m, if i_1 is an axis of the self-conjugate function $\Phi\rho = V_1 q V_{m-1} q\rho$, and if c_1 is the corresponding root, the series of functions (I), defined by equations of the type $I_1 = V_{m-1} q i_1$, obey the equations

$$SI_1^2 = (-)^m c_1, \quad \text{and} \quad SI_1 I_2 = 0.$$

For $$SI_1^2 = SV_{m-1} q i_1 V_{m-1} q i_1 = (-)^{m-1} S i_1 \Phi i_1 = (-)^m c_1,$$

and $$SI_1 I_2 = SV_{m-1} i_1 q V_{m-1} i_2 q = (-)^{m-1} S i_1 \Phi i_2 = 0,$$

since $$V_{m-1} q i_1 = (-)^{m-1} V_{m-1} i_1 q.$$

As an example, consider the general cubic in four of the units,

$$q = \Sigma a_{stu} i_s i_t i_u.$$[1]

From this $$I_1 = -\Sigma a_{1st} i_s i_t, \quad \text{and} \quad I_2 = -\Sigma a_{2st} i_s i_t,$$

and $$SI_1 I_2 = -\Sigma a_{1st} a_{2st} = -a_{134} a_{234}, \quad \text{since} \quad (i_s i_t)^2 = -1.$$

The six equations $a_{134} a_{234} = \text{\&c.} = 0$, which result if the units are canonical, require all but one of four coefficients a_{stu} to vanish. Thus the cubic reduces to $a_{123} i_1 i_2 i_3$.

Again, for the cubic in five of the units, ten equations of the type

$$a_{134} a_{334} + a_{145} a_{245} + a_{153} a_{253} = 0$$

are found connecting the coefficients when the units are canonical. For variety, instead of solving these ten equations, multiply the cubic into the product $i_6 i_7 \ldots i_n$ of all the units not involved in it. Now,

$$a_{123} i_1 i_2 i_3 \,.\, i_6 i_7 \ldots i_n = -a_{123} i_1 i_2 i_3 (i_4 i_5)^2 i_6 i_7 \ldots i_n = -a_{123} i_4 i_5 \omega,$$

in which ω is the product $i_1 i_2 i_3 \ldots i_n$ of all the units. The result is consequently a quadratic in five units multiplied into ω.

[1] It is convenient to suppose

$$a_{123} = a_{231} = a_{312} = -a_{321} = -a_{213} = -a_{132}.$$

The quadratic may be reduced to $a_{123}i_4i_5 + a_{145}i_2i_3$, and therefore the cubic may be reduced to $a_{123}i_1i_2i_3 + a_{145}i_1i_4i_5$.

Generally, by this process, an m^{ic} in $m+1$ units may be reduced to a linear vector multiplied by ω, and the m^{ic} may consequently be replaced by a single product of m units multiplied by a constant.

Also, an m^{ic} in $m+2$ units may be reduced to a quadratic in the same number of units multiplied into ω. It has already been shown how to reduce a quadratic, so the m^{ic} in $m+2$ units may be considered known in the canonical form.

14. This process does not apply to a cubic in six units, for a cubic in six units is reproduced.

It is easy, by the aid of a geometrical method, to write down examples of cubics reduced to the standard form. Take any three points, 1, 2, and 3; they may be joined to form a triangle (123). Take a fourth point, 4; every triangle formed with this point and a pair of the old points has a side common with the triangle (123). In the last article it was shown that the cubic in four units is reducible to $a_{123}i_1i_2i_3$.

Pursuing this analogy, consider how in a few simple cases a limited number of points can be joined to form triangles which have no side common to two. Adding a fifth point 5 to the four points 1, 2, 3, and 4, but two triangles, (123) and (145), having no side common, can be drawn connecting these five points. (Of course, other pairs of triangles, (512) and (534) for instance, may be drawn to connect the five points. This is merely a matter of selection.) In the last article it was shown that a cubic in five units is reducible to $a_{123}i_1i_2i_3 + a_{145}i_1i_4i_5$.

Adding a sixth point to the five already taken, and two different arrangements are possible. Either four triangles (123), (145), (624), (635), or a pair of triangles (123), (456), can be drawn connecting the six points, and having no side common.

It may be verified at once that the cubic

$$q = a_{123}i_1i_2i_3 + a_{145}i_1i_4i_5 + a_{246}i_2i_4i_6 + a_{356}i_3i_5i_6$$

which corresponds to the first of these arrangements is in the canonical form, and so is the cubic

$$q' = a_{123}i_1i_2i_3 + a_{456}i_4i_5i_6.$$

These cubics belong to distinct types, and cannot be transformed into one another. The square of q' is a scalar $(a^2_{123} + a^2_{456})$, but the square of q is not a scalar.

For seven points, in addition to the four triangles in the first case for six points, (167), (257), and (347) are obtained. In addition to the triangles (123) and (456) in the second case, the triangles (716), (734), and (752) may be constructed. In the first of these cases for seven points, every point of the seven is joined to every other point, so that three new points 8, 9, and 10 must be added before a new triangle can be constructed.[1]

15. It is possible to derive from a given homogeneous function q of order m a series of self-conjugate functions analogous to that of Arts. 9 and 13, which I shall only mention here.

The function referred to is $\Phi\rho = V_1 q V_{m-1} q\rho$. The next function of the series is $F_2 p_2 = V_2 q V_{m-2} q p_2$, where p_2 is a homogeneous quadratic in the units. The general function is

$$F_N p_N = V_N q V_{m-N} q \,.\, p_N.$$

It may also be noticed that the functions I of Art. 13, defined by relations of the type $I_1 = V_{m-1} q i_1$, lead to the following equations:—

$$V_1 q I_1 = V_1 q V_{m-1} q i_1 = \Phi i_1 = c_1 i_1,$$

$$F_{m-1} I_1 = V_{m-1} q V_1 q I_1 = c_1 V_{m-1} q i_1 = c_1 I_1.$$

Thus Φ and F_{m-1} have the same roots. This holds good also for F_N and F_{m-N}.

Further, the series of linear functions defined by the equation

$$\psi_N p_{m-N} = V_N q p_{m-N}$$

may be noticed. These convert a homogeneous function of order $m - N$ into one of order N, and

$$\psi_{m-N} \psi_N p_{m-N} = V_{m-N} q V_N q p_{m-N}$$

shows that $\psi_{m-N}\psi_N$ is the self-conjugate function F_{m-N}.

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[1] After this Paper was read, I saw that if a function can be written in the form

$$q = i_1 I_1 + i_2 I_2 + \ldots + i_m I_m,$$

in which none of the I involve any of the m units, $i_1 i_2 \ldots i_m$, these m units belong to the canonical system, provided $SI_1 I_2 = \&c. = 0$.

In particular, the cubic

$$q = i_1 (a i_3 i_4 + b i_5 i_6) + x i_2 (b i_3 i_4 - a i_5 i_6)$$

is in the canonical form, although it cannot be typified by triangles having no side common.

16. For the sake of facilitating various operations on the general functions of n units, it seems to be useful to introduce certain new symbols or characteristics of operation.

The first of these is K, the analogue of the symbol of conjugation in Quaternions. For present purposes, the effect of the symbol K may be defined as a change of sign of all the units in q, and an inversion of the order in which they occur. From this definition, it is manifest that $K^2q = K.Kq = q$.

If q_m is homogeneous and of order m,

$$Kq_m = (-)^{\frac{1}{2}m(m+1)}q_m.$$

To prove this, if $i_1i_2 \dots i_m$ is a product of m distinct units, its conjugate is $(-)^m i_m i_{m-1} \dots i_2 i_1$, or it is $(-)^m(-)^{m-1}i_{m-1}i_{m-2}\dots i_2i_1i_m$, by the law of interchanges, $(i_1i_2 = -i_2i_1)$; or finally, the conjugate is

$$(-)^m(-)^{m-1}(-)^{m-2}\dots(-)^2(-)^1 i_1i_2\dots i_m.$$

Hence, if $\quad m \equiv 0$, or 3 (mod. 4), $\quad Kq_m = +q_m$;

and if $\quad m \equiv 1$, or 2 (mod. 4), $\quad Kq_m = -q_m$;

and in general, if

$$q = q_{(0)} + q_{(1)} + q_{(2)} + q_{(3)},$$

$$Kq = q_{(0)} - q_{(1)} - q_{(2)} + q_{(3)},$$

provided $q_{(0)}$ is the sum of products in q whose orders $\equiv 0$ (mod. 4).

When using this symbol, it must be remembered that ω, the product of all the n units, obeys the relation

$$K\omega = (-)^{\frac{1}{2}n(n+1)}\omega,$$

or that $K\omega = \omega$, $n \equiv 0$, or 3; and $K\omega = -\omega$, $n \equiv 1$, or 2 (mod. 4). In particular for Quaternions,

$$K\omega = \omega, \quad \text{or} \quad ijk = -1 = -kji.$$

Again, take the conjugate of $i_1q_mi_1$, where q_m is a homogeneous function of the units which does not contain i_1,

$$K.i_1q_mi_1 = i_1Kq_m i_1 = (-)^{m+1}Kq_m,$$

by the rule of interchanges. But

$$i_1q_mi_1 = (-)^{m+1}q_m$$

and the conjugate of the condensed product is equal to the conjugate of the uncondensed product, or in symbols

$$K.i_1q_mi_1 = K.(-)^{m+1}q_m.$$

It is thus proved as a theorem that the conjugate of the product of any two functions of the units is equal to the product of their conjugates in the inverse order, or that $Kpq = KqKp$. Of course the effect of K on ω, the product of all the units, must not be overlooked. It may be agreed to replace ω by a scalar,[1] at least when the number of units is odd; this is not the kind of condensation referred to here, and ambiguity in the present Paper is avoided by retaining the special symbol ω for the product of the units. In this article, and elsewhere throughout this Paper, the word *condensation* simply refers to the degradation of a product (such as $i_1 i_2 i_1$) to a simpler expression (such as i_2).

As a simple example of the conjugate of a product, qKq is always its own conjugate, and so is the generally different expression $Kq \, . \, q$.

17. The second new characteristic of operation is I, which inverts the order of the units in any product, but without changing their signs.

Thus, $$Ii_1 i_2 \ldots i_m = i_m i_{m-1} \ldots i_2 i_1 = (-)^{(m-1)+(m-2)+\ldots+1} i_1 i_2 \ldots i_m$$
$$= (-)^{\frac{1}{2}m(m-1)} i_1 i_2 \ldots i_m,$$
and if q_m is homogeneous and of order m,
$$Iq_m = q_m, \quad \text{if} \quad m \equiv 0, \text{ or } 1 \text{ (mod. 4)},$$
and $$Iq_m = -q_m, \quad \text{if} \quad m \equiv 2, \text{ or } 3 \text{ (mod. 4)}.$$

Just as in the case of the conjugate, the inverse[2] of a condensed product is the inverse of the uncondensed product, and, taking account of ω, in general,
$$I . pq = IqIp, \quad I(qIq) = qIq, \quad \text{and} \quad I(Iq \, . \, q) = Iq \, . \, q.$$

---

[1] The general consideration of ω is given by Clifford. It is briefly this:—
$$i_m \, . \, i_1 i_2 \ldots i_n = i_m \, . \, \omega = (-)^{n-1} \omega \, . \, i_m,$$
where i_m is any one of the n units. Thus, when n is odd, ω is commutative with any (linear) vector ρ, or $\omega\rho = \rho\omega$, and indeed more generally $\omega q = q\omega$, where q is any function of the units. But when n is even, $\omega\rho = -\rho\omega$. These properties sharply separate spaces of odd and even dimensions. Again,
$$\omega^2 = (-)^{\frac{1}{2}n(n-1)} \omega\omega' = (-)^{\frac{1}{2}n(n+1)}, \quad \text{if} \quad \omega' = i_n i_{n-1} \ldots i_2 i_1;$$
or $\omega^2 = +1$ for $n \equiv 0$, or 3 (mod. 4); while $\omega^2 = -1$ for $n \equiv 1$, or 2 (mod. 4). For $n \equiv 2$, Clifford says, "Here ω has clearly the properties of a unit vector" (Collected Works, p. 401). The present writer prefers to regard the ω of even space as a scalar of a new kind, perhaps applicable to the measurement of angles as the ordinary scalar is applicable to the measurement of lengths.

[2] Perhaps the name "Reverse" would have been better, as "Inverse" and "Reciprocal" are usually synonymous.

If, as in Art. 15,

$$q = q_{(0)} + q_{(1)} + q_{(2)} + q_{(3)},$$
$$Iq = q_{(0)} + q_{(1)} - q_{(2)} - q_{(3)},$$
$$Kq = q_{(0)} - q_{(1)} - q_{(2)} + q_{(3)},$$
$$KIq = q_{(0)} - q_{(1)} + q_{(2)} - q_{(3)} = IKq.$$

18. Chiefly on account of symmetry, a third new symbol J may be introduced which merely changes the signs of the units without changing the order. It is evident that $IK = KI = J$, and that the symbols are associative and commutative in operation. The laws of their combination are contained in the symbolic equations

$$I^2 = J^2 = K^2 = IJK = KJI = +1,$$

or, more fully, by

$$I = JK = KJ, \quad J = KI = IK, \quad K = IJ = JI, \quad I^2 = J^2 = K^2 = 1.$$

For a product, $J(pq) = I(KqKp) = JpJq.$

Taking any function $q = q_{(0)} + q_{(1)} + q_{(2)} + q_{(3)},$

previous results afford the relations

$$V_{(0)}q = q_{(0)} = \tfrac{1}{4}(1 + I + J + K)\,q,$$
$$V_{(1)}q = q_{(1)} = \tfrac{1}{4}(1 + I - J - K)\,q,$$
$$V_{(2)}q = q_{(2)} = \tfrac{1}{4}(1 - I + J - K)\,q,$$
$$V_{(3)}q = q_{(3)} = \tfrac{1}{4}(1 - I - J + K)\,q.$$

19. By the aid of the symbol K it is easy to deduce some useful formulæ, as follows:—

The product of any two functions p and q may be written in the forms (see Art. 15)—

$$pq = (p_{(0)} + p_{(1)} + p_{(2)} + p_{(3)})(q_{(0)} + q_{(1)} + q_{(2)} + q_{(3)})$$
$$= (V_{(0)} + V_{(1)} + V_{(2)} + V_{(3)})\,pq.$$

Taking conjugates, the relation

$$K(pq) = (q_{(0)} - q_{(1)} - q_{(2)} + q_{(3)})(p_{(0)} - p_{(1)} - p_{(2)} + p_{(3)})$$
$$= (V_{(0)} - V_{(1)} - V_{(2)} + V_{(3)})\,pq$$

is found, and this, when combined with the former, affords, on addition and subtraction, expressions for $(V_{(0)} + V_{(3)})\,pq$, and for $(V_{(1)} + V_{(2)})\,pq$. Separating the parts of these which are even and odd in the units, the values of $V_{(0)}pq$, $V_{(1)}pq$, $V_{(2)}pq$, and $V_{(3)}pq$ are found. As the formulæ are long, I do not print them here; but there is no difficulty in deducing the correct expressions for any special cases. Consider, for example, a product $p_{(2)}q_{(3)}$. As it is of odd order in the units, it is evident that

$$p_{(2)}q_{(3)} = (V_{(1)} + V_{(3)})\,p_{(2)}q_{(3)}.$$

Taking conjugates,

$$-\,q_{(3)}p_{(2)} = (-\,V_{(1)} + V_{(3)})\,p_{(2)}q_{(3)},$$

and hence $\quad V_{(1)}p_{(2)}q_{(3)} = \tfrac{1}{2}\,(p_{(2)}q_{(3)} + q_{(3)}p_{(2)}) = V_{(1)}q_{(3)}p_{(2)},$

and $\quad V_{(3)}p_{(2)}q_{(3)} = \tfrac{1}{2}\,(p_{(2)}q_{(3)} - q_{(3)}p_{(2)}) = -\,V_{(3)}q_{(3)}p_{(2)}.$

20. The functions q and Kq are not generally commutative. The conditions of commutation are comprised in simple formulæ which I shall now give.

For brevity, let $\quad q = q' + q'', \quad$ and $\quad Kq = q' - q''$,

then $\quad qKq = q'^2 - q''^2 - (q'q'' - q''q'),$

and $\quad Kq\,.\,q = q'^2 - q''^2 + (q'q'' - q''q').$

So the condition of commutation of q and Kq is

$$q'q'' - q''q' = 0;$$

and when this is satisfied,

$$qKq = Kq\,.\,q = q'^2 - q''^2.$$

Now,

$$q'q'' = (q_{(0)} + q_{(3)})(q_{(1)} + q_{(2)}) = (q_{(0)}q_{(1)} + q_{(3)}q_{(2)}) + (q_{(0)}q_{(2)} + q_{(3)}q_{(1)}),$$

in which the parts odd and even in the vector units are separated. So the formulæ of commutation are

$$q_{(0)}q_{(1)} - q_{(1)}q_{(0)} = q_{(2)}q_{(3)} - q_{(3)}q_{(2)},$$

and $\quad q_{(0)}q_{(2)} - q_{(2)}q_{(0)} = q_{(1)}q_{(3)} - q_{(3)}q_{(1)},$

or $\quad V_{(3)}\,(q_{(0)}q_{(1)} - q_{(2)}q_{(3)}) = 0, \quad$ and $\quad V_{(0)}\,(q_{(0)}q_{(2)} - q_{(1)}q_{(3)}) = 0.$

This last step follows from the last article, or directly, since

$$q'q'' - q''q' = K(q'q'' - q''q');$$

this function involves only terms under the signs $V_{(0)}$ and $V_{(3)}$.

21. For a quadratic or a cubic function $q_{(0)}$ is a scalar, and the conditions become

$$q_2q_3 - q_3q_2 = 0, \quad \text{and} \quad q_1q_3 - q_3q_1 = 0.$$

These are identically satisfied for a quadratic, as q_3 does not then exist, or a quadratic is always commutative with its conjugate.

In the case of a cubic function of the units, it is necessary that

$$V_{(0)}q_1q_3 = 0, \quad \text{and} \quad V_{(3)}q_2q_3 = 0,$$

or more simply that

$$V_4q_1q_3 = 0, \quad \text{and} \quad V_3q_2q_3 = 0.$$

If the cubic is $\quad q = a_0 + \Sigma a_1 i_1 + \Sigma a_{12} i_1 i_2 + \Sigma a_{123} i_1 i_2 i_3,$

these are $\quad V_4q_1q_3 = \Sigma\,(a_1a_{234} - a_2a_{134} + a_3a_{124} - a_4a_{123})\, i_1i_2i_3i_4 = 0,$

and $\quad V_3q_2q_3 = -\,\Sigma_s\,(a_{s1}a_{s23} + a_{s2}a_{s31} + a_{s3}a_{s12})\, i_1i_2i_3 = 0,$

and they are identically satisfied for a cubic in three units, that is, for the general function of three units.

Generally for a cubic, let i_1 be defined by the equation $q_1 = a_1 i_1$; then, provided a_1 is not zero, $i_1q_3 - q_3i_1 = 0$, that is, i_1 is commutative with a homogeneous cubic in the units. Consequently, this cubic must contain i_1 as a factor, or $q_3 = i_1 q'_2$, where q'_2 does not involve i_1. Turning to the second condition, suppose $q_2 = a_{12}i_1i_2 + q''_2$, where q''_2 does not involve i_1, and

$$\begin{aligned} q_2q_3 - q_3q_2 &= (a_{12}i_1i_2 + q''_2)\, i_1q'_2 - i_1q'_2\,(a_{12}i_1i_2 + q''_2) \\ &= a_{12}\,(i_2q'_2 + q'_2i_2) + i_1\,(q''_2q'_2 - q'_2q''_2) = 0. \end{aligned}$$

This requires separately $i_2q'_2 + q'_2i_2 = 0$, or i_2 must be a factor of q'_2, or $q'_2 = a_{123}i_2i_3$, say, provided a_{12} is not zero; and also $q''_2q'_2 - q'_2q''_2 = 0$. This last reduces to $q''_2i_2i_3 - i_2i_3q''_2 = 0$, and making the legitimate assumption

$$q''_2 = a_{23}i_2i_3 + a_{24}i_2i_4 + q'''_2;$$

where q'''_2 does not involve i_2, it further reduces to

$$-\,a_{23} + a_{24}i_4i_3 + q'''_2i_2i_3 + a_{23} - a_{24}i_3i_4 - i_2i_3q'''_2 = 0.$$

This requires $a_{24} = 0$ and q'''_2 to be independent of i_3, and the cubic is reduced to

$$q = a_0 + a_1i_1 + a_{12}i_1i_2 + a_{23}i_2i_3 + a_{123}i_1i_2i_3 + q'''_2,$$

in which q'''_2 is independent of i_1, i_2, and i_3.

If, however, a_{12} is zero, the condition is $q_2q'_2 - q'_2q_2 = 0$, in which both functions are independent of i_1. Let q'_2 be reduced to the canonical form, so that $q'_2 = a_{123}i_2i_3 + q^{iv}_2$, in which q^{iv}_2 is independent of i_2 and i_3, and let

$$q_2 = a_{23}i_2i_3 + a_{24}i_2i_4 + q'''_2$$

as before. Then, as formerly, a_{24} is zero, and $q'''_2i_3 = i_3q'''_2$, or q'''_2 is independent of i_3.

Hence, it is proved incidentally that, if two homogeneous quadratics are commutative in order of multiplication, they must be reducible simultaneously to the canonical form.

Thus, when a_{12} is zero, the cubic commutative with its conjugate must be of the type

$$q = a_0 + a_1 i_1 + q_2 + i_1 q'_2,$$

in which q_2 and q'_2 are simultaneously reducible to the canonical form.

Next, if a_1 is zero, or if the cubic is $q = q_0 + q_2 + q_3$, the condition becomes $q_2 q_3 = q_3 q_2$; and it is necessary to ascertain under what circumstances a homogeneous cubic and quadratic can be commutative.

In the first place, they are commutative, if they have no unit vectors common. Again, a cubic linear in the units common to the quadratic cannot be commutative with it. Thus, the cubic may be reduced to the form $q_3 = \Sigma j_1 \beta_1 + \gamma + \gamma'$, where γ' is a function of the units j which do not occur in the quadratic, where the quadratics β are functions of the units occurring in the quadratic and simultaneously reducible with it to the canonical form (or the β are commutative with the quadratic), and where γ is a function of the units in the quadratic alone.

It is only necessary to consider the case in which the function q_3 involves no units not contained in the quadratic q_2.

Now, it is easy to show, when the quadratic is reduced to the canonical form,

$$q_2 = a_{12} i_1 i_2 + a_{34} i_3 i_4 + \text{\&c.},$$

that the cubic can contain no term involving a product of conjugate units (i_1 and i_2, or i_3 and i_4). For, suppose the vectors i_1 and i_2 to be explicitly expressed in the equations of the cubic and quadratic by

$$q_3 = \alpha_{12} i_1 i_2 + \beta_1 i_1 + \beta_2 i_2 + \gamma, \quad \text{snd} \quad q_2 = a_{12} i_1 i_2 + \beta',$$

$$\begin{aligned} q_2 q_3 - q_3 q_2 = (\beta' \alpha_{12} - \alpha_{12}\beta') i_1 i_2 + (\beta'\beta_1 - \beta_1\beta' - 2a_{12}\beta_2) i_1 \\ + (\beta'\beta_2 - \beta_2\beta' + 2a_{12}\beta_1) i_2 + \beta'\gamma - \gamma\beta' = 0\,; \end{aligned}$$

and this requires $\beta'\alpha_{12} - \alpha_{12}\beta' = 0$, which cannot hold if the vector α_{12} is different from zero, for the case in which α_{12} is independent of the units in β' has been specially excluded.

I see no simple step towards completion of the problem.

22. Returning to the value of

$$qKq = Kq \,.\, q = q'^2 - q''^2 = (q_{(0)} + q_{(3)})^2 - (q_{(1)} + q_{(2)})^2\,;$$

when the conditions of Art. 20 are satisfied, it is important to investigate the conditions that this product should be a scalar. For, if q is a product of functions such as $a_0 + \Sigma a_1 i_1$, qKq is necessarily a scalar.

In general, the conditions of Art. 20 holding true,

$$qKq = q_{(0)}^2 - q_{(1)}^2 - q_{(2)}^2 + q_{(3)}^2 + q_{(0)}q_{(3)} + q_{(3)}q_{(0)} - q_{(1)}q_{(2)} - q_{(2)}q_{(1)}$$
$$= V_{(0)}(q_{(0)}^2 - q_{(1)}^2 - q_{(2)}^2 + q_{(3)}^2) + 2V_{(3)}(q_{(0)}q_{(3)} - q_{(1)}q_{(2)}),$$

the insertion of the symbols $V_{(0)}$ and $V_{(3)}$ being justified by the consideration that the function is its own conjugate. If it reduces to a scalar, the odd part must vanish, or

$$q_{(0)}q_{(3)} + q_{(3)}q_{(0)} = q_{(1)}q_{(2)} + q_{(2)}q_{(1)},$$

and also $$(V_{(0)} - V_0)(q_{(0)}^2 - q_{(1)}^2 - q_{(2)}^2 + q_{(3)}^2) = 0.$$

23. Considering specially in the first case a quadratic in the units,

$$qKq = (q_0 + q_1 + q_2)(q_0 - q_1 - q_2) = q_0^2 - (q_1 + q_2)^2 = Kq \, . \, q.$$

If this product reduces to a scalar, the part which is odd in the units must vanish, or $q_1q_2 + q_2q_1 = 0$.

Let $$q_1 = a_1 i_1, \quad \text{and} \quad q_2 = a_{12} i_1 i_2 + \beta,$$

where β does not involve i_1; then, if a_1 is not zero,

$$i_1\beta + \beta i_1 = 2i_1\beta = 0,$$

so β must be zero, and the function is reduced to the Quaternion type

$$q = a_0 + a_1 i_1 + a_{12} i_1 i_2,$$

and involves but two units. It is evident that q_2^2 is for this a scalar.

Again, if q_1 vanishes, suppose q_2 reduced to the canonical form

$$a_{12} i_1 i_2 + a_{34} i_3 i_4 + \&c.$$

Squaring, it is found that

$$q_2^2 = - a_{12}^2 - a_{34}^2 - \&c. + 2a_{12}a_{34} i_1 i_2 i_3 i_4 + \&c.$$

And this will not reduce to a scalar, unless all but one of the coefficients a_{12} vanish. So again, $q_2 = a_0 + a_{12} i_1 i_2$ is of the Quaternion type.

The theorem is thus proved that, if the product by its conjugate ef a quadratic function in any number of units is a scalar, the function is capable of being reduced to the Quaternion type involving but two units.

24. In the second case for a cubic function, in addition to the equations of commutation which reduce to

$$q_1q_3 - q_3q_1 = 0, \quad \text{and} \quad q_2q_3 - q_3q_2 = 0,$$

because q_0 is a scalar, the conditions that $qKq = Kq \, . \, q$ should be a scalar, become

$$2q_0q_3 = q_1q_2 + q_2q_1 \quad \text{and} \quad q_2^2 - q_3^2 = \textit{scalar}.$$

Suppose, in the first place, that $q_0 = a_0$ is not zero, and let

$$q_1 = a_1 i_1, \quad \text{and} \quad q_2 = a_{12} i_1 i_2 + \beta,$$

as before, and $$a_0 q_3 = a_1 i_1 \beta = \tfrac{1}{2}(q_1 q_2 + q_2 q_1).$$

The first condition of commutation is satisfied identically, and the second becomes

$$a_{12} i_1 i_2 \,.\, i_1 \beta - a_{12} i_1 \beta \,.\, i_1 i_2 = 0, \quad \text{or} \quad a_{12}(i_2 \beta + \beta i_2) = 0.$$

Provided a_{12} is not zero, this requires $\beta = a_{23} i_2 i_3$, and therefore

$$q_3 = a_0 + a_1 i_1 + a_{12} i_1 i_2 + a_{23}\, i_2 i_3 + a_0^{-1} a_{23} i_1 i_2 i_3 ;$$

and this is a function of but three units, and satisfies $q_2^2 - q_3^2 = scalar$.

If a_{12} is zero, the conditions of commutation are satisfied identically; but $q_2^2 - q_3^2 = \beta^2(1 + a_0^{-2} a_1^2)$ requires β^2 to be a scalar, and $\beta = a_{23} i_2 i_3$ is a necessary form (see the last article). The cubic is now

$$q_3 = a_0 + a_1 i_1 + a_{23} i_2 i_3 + a_0^{-1} a_{23} i_1 i_2 i_3.$$

If $a_1 = 0$, so that $q_1 = 0$, a_0 or q_0 must likewise be zero, if the function is to remain a cubic.

The conditions now to be satisfied are

$$q_2 q_3 - q_3 q_2 = 0, \quad \text{and} \quad q_2^2 - q_3^2 = \text{scalar}.$$

These conditions are satisfied for the cubic in five units,

$$q = a_{12} i_1 i_2 + a_{345} i_3 i_4 i_5,$$

and doubtless for other forms also.

If $q_0 = 0$, either $q_2 = 0$, or $q_1 = 0$, which is the case just considered. If $q_2 = 0$, $q_1 q_3 - q_3 q_1 = 0$ shows that, if $q_1 = a_1 i_1$, $q_3 = i_1 \beta = a_{123} i_1 i_2 i_3$, because β^2 must be a scalar.

25. Returning to the symbol I of Art. 17, for which, if

$$q = q_{(0)} + q_{(1)} + q_{(2)} + q_{(3)}, \quad Iq = q_{(0)} + q_{(1)} - q_{(2)} - q_{(3)},$$

the conditions of commutation of q and Iq are contained in the equation

$$(q_{(0)} + q_{(1)})(q_{(2)} + q_{(3)}) = (q_{(2)} + q_{(3)})(q_{(0)} + q_{(1)});$$

or, on separating even and odd parts,

$$q_{(0)} q_{(2)} - q_{(2)} q_{(0)} = q_{(3)} q_{(1)} - q_{(1)} q_{(3)},$$

and $$q_{(0)} q_{(3)} - q_{(3)} q_{(0)} = q_{(2)} q_{(1)} - q_{(1)} q_{(2)};$$

or again,

$$V_{(0)}(q_{(0)} q_{(2)} - q_{(3)} q_{(1)}) = 0, \quad \text{and} \quad V_{(1)}(q_{(0)} q_{(3)} - q_{(2)} q_{(1)}) = 0.$$

(Cf. Art. 20.)

For a quadratic, the conditions reduce to $q_2q_1 - q_1q_2 = 0$, or q_2 must be independent of the vector q_1. If q_1 vanishes, the condition is identically satisfied.

For a cubic, q_2 must be independent of q_1; q_1 must be a factor of q_3, if it does not vanish. Otherwise, q_2 and q_3 may be arbitrarily chosen.

26. If $qIq = Iq \cdot q$ is a scalar, it is necessary that

$$q_{(0)}^2 + q_{(1)}^2 - q_{(2)}^2 - q_{(3)}^2 = scalar,$$

and that $$q_{(0)}q_{(1)} + q_{(1)}q_{(0)} = q_{(2)}q_{(3)} + q_{(3)}q_{(2)},$$

or that $$V_{(0)}\left(q_{(0)}^2 + q_{(1)}^2 - q_{(2)}^2 - q_{(3)}^2\right) = scalar$$

and $$V_{(1)}\left(q_{(0)}q_{(1)} - q_{(2)}q_{(3)}\right) = 0.$$

For a quadratic, q_1 or q_0 must be zero, and q_2 must be $a_{23}\iota_2\iota_3$, as its square is scalar. The types are

$$q = a_1\iota_1 + a_{23}\iota_2\iota_3, \quad \text{or} \quad q = a_0 + a_{23}\iota_2\iota_3.$$

For a cubic,

$$q_3q_1 = q_1q_3, \quad q_2q_1 = q_1q_2, \quad 2q_0q_1 = q_2q_3 + q_3q_2,$$

and $q_2^2 + q_3^2 = scalar$ are necessary.

If $q_1 = a_1\iota_1$ $q_3 = \iota_1\beta$, and $q_2 = \beta'$ does not involve ι_1. Also,
$$2a_0a_1 = \beta\beta' + \beta'\beta, \quad \text{and} \quad \beta'^2 - \beta^2 = scalar.$$

Reduce β to the canonical form

$$\beta = b_{23}\iota_2\iota_3 + b_{45}\iota_4\iota_5 + \ldots,$$

and from the first condition it is seen that, in order to be rid of $\iota_2\iota_3\iota_4\iota_5$, &c., it is necessary that $\beta = b_{23}\iota_2\iota_3 + b_{45}\iota_4\iota_5$, and

$$\beta' = s\left(b_{23}\iota_2\iota_3 - b_{45}\iota_4\iota_5\right) + b'_{24}\iota_2\iota_4 + b'_{25}\iota_2\iota_5 + b'_{34}\iota_3\iota_4 + b'_{35}\iota_3\iota_5.$$

The second condition requires (for real functions) $b_{45} = 0$, and β' may be reduced to $$\beta' = b'_{23}\iota_2\iota_3 + b'_{24}\iota_2\iota_4 + b'_{34}\iota_3\iota_4.$$

Thus, $$q_3 = a_{123}\iota_1\iota_2\iota_3, \quad \text{and} \quad q_2 = a_{23}\iota_2\iota_3 + a_{34}\iota_3\iota_4 + a_{42}\iota_4\iota_2.$$

27. If any product (p) of linear vectors is formed, it is obvious that the conditions

$$pKp = Kp \cdot p = scalar, \quad \text{and} \quad pIp = Ip \cdot p = scalar$$

are both satisfied. It would be desirable to prove or to disprove the statement that any function p satisfying these conditions must be a product of linear vectors.[1]

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[1] See p. 96.

As a preliminary, it should be noticed that, if p is a product of an odd number of vectors, it is of the type $p_{(1)} + p_{(3)}$, and a product of an even number of vectors is of the type $p_{(0)} + p_{(2)}$.

Collecting from Arts. 20 and 25, the K and I formulæ of commutation are contained in the equations

$$q_{(0)}q_{(1)} - q_{(1)}q_{(0)} = q_{(2)}q_{(3)} - q_{(3)}q_{(2)},$$
$$q_{(0)}q_{(2)} - q_{(2)}q_{(0)} = q_{(1)}q_{(3)} - q_{(3)}q_{(1)} = q_{(3)}q_{(1)} - q_{(1)}q_{(3)} = 0,$$
$$q_{(0)}q_{(3)} - q_{(3)}q_{(0)} = q_{(2)}q_{(1)} - q_{(1)}q_{(3)}.$$

Next, equating to zero the odd parts of

$$(q_{(0)} + q_{(3)})^2 - (q_{(1)} + q_{(2)})^2, \quad \text{and of} \quad (q_{(0)} + q_{(1)})^2 - (q_{(2)} + q_{(3)})^2,$$

the formulæ

$$q_{(0)}q_{(1)} + q_{(1)}q_{(0)} = q_{(2)}q_{(3)} + q_{(3)}q_{(2)}$$
$$q_{(0)}q_{(3)} + q_{(3)}q_{(0)} = q_{(2)}q_{(1)} + q_{(1)}q_{(2)},$$

which have been already given, are recovered.

Adding and subtracting corresponding pairs of both sets, all the relations hitherto deduced are comprised in these following formulæ :—

$$q_{(0)}q_{(1)} = q_{(2)}q_{(3)}, \quad q_{(1)}q_{(0)} = q_{(3)}q_{(2)};$$
$$q_{(0)}q_{(3)} = q_{(2)}q_{(1)}, \quad q_{(3)}q_{(0)} = q_{(1)}q_{(2)};$$
$$q_{(0)}q_{(2)} = q_{(2)}q_{(0)}, \quad q_{(1)}q_{(3)} = q_{(3)}q_{(1)}.$$

From these, it is evident that

$$q_{(0)}(q_{(1)}^2 - q_{(3)}^2) = 0, \quad \text{and} \quad q_{(2)}(q_{(1)}^2 - q_{(3)}^2) = 0,$$

and

$$q_{(1)}(q_{(0)}^2 - q_{(2)}^2) = 0, \quad \text{and} \quad q_{(3)}(q_{(1)}^2 - q_{(2)}^2) = 0.$$

I shall now examine the signs of the scalar parts in the squares of the functions $q_{(0)}$, $q_{(1)}$, $q_{(2)}$, and $q_{(3)}$, when these functions are supposed to be real.

For p_m a product of m *unit* vectors, $p_m I p_m = (-)^m$, and is positive when m is even. Taking in turn $m \equiv 0$, 1, 2, and 3 (mod. 4), and remembering the nature of the characteristic I, it is found that $p_{(0)}^2$ and $p_{(3)}^2$ are positive, and $p_{(1)}^2$ and $p_{(2)}^2$ are negative. It is evident that the same law governs the signs of the squares of the more general functions $q_{(0)}$, $q_{(1)}$, $q_{(2)}$, and $q_{(3)}$, so that $Sq_{(1)}^2$ and $-Sq_{(3)}^2$ have the same sign, and also $Sq_{(0)}^2$ and $-Sq_{(2)}^2$. Hence, it follows that the equations lately written can be satisfied only by having

$$q_{(0)} = q_{(2)} = 0, \quad \text{or} \quad q_{(1)} = q_{(3)} = 0;$$

at least, when the functions are real.

It is proved then that when

$$qKq = Kq \, . \, q = scalar, \quad \text{and} \quad qIq = Iq \, . \, q = scalar,$$

the function q must be of the type

$$q = q_{(1)} + q_{(3)}, \quad \text{or} \quad q = q_{(0)} + q_{(2)};$$

that is, q must be either even or odd in the units.

All the conditions to be satisfied are not yet exhausted; there remain

$$q_{(1)}q_{(3)} = q_{(3)}q_{(1)}, \quad \text{and} \quad q_{(1)}^2 - q_{(3)}^2 = scalar,$$

for an odd function; or else

$$q_{(0)}q_{(2)} = q_{(2)}q_{(0)}, \quad \text{and} \quad q_{(0)}^2 - q_{(2)}^2 = scalar,$$

for an even function satisfying the general conditions of this article.

As an example of a quartic satisfying all the conditions, the function

$$q = a_{12}\dot{i}_1\dot{i}_2 + a_{3456}\dot{i}_3\dot{i}_4\dot{i}_5\dot{i}_6$$

does not appear to be resolvable into linear factors. Hence it would seem that the conditions of this article do not require a function to be thus resolvable. (Cf. the first paragraph of this article.)

28. Much of the investigation in recent articles will be useful in the consideration of the functions produced on operating by $q\,(\;)\,q^{-1}$ on a vector.

Let ρ and σ be any line vectors, and let

$$\mathrm{P} = q\rho q^{-1}, \quad \text{and} \quad \Sigma = q\sigma q^{-1};$$

then $$\mathrm{P}\Sigma = q\rho q^{-1} \, . \, q\sigma q^{-1} = q\rho\sigma q^{-1}, \quad \text{and} \quad \Sigma\mathrm{P} = q\sigma\rho q^{-1}.$$

Adding these products,

$$\mathrm{P}\Sigma + \Sigma\mathrm{P} = q\,(\rho\sigma + \sigma\rho)\,q^{-1} = q \, . \, q^{-1}(\rho\sigma + \sigma\rho) = \rho\sigma + \sigma\rho,$$

because $\rho\sigma + \sigma\rho$ is a scalar, and therefore commutative with q or q^{-1}. Thus, $\mathrm{P}\Sigma + \Sigma\mathrm{P}$ is always a scalar, when P and Σ have been generated from line vectors. In particular, $\mathrm{P}^2 = \rho^2$, and $\Sigma^2 = \sigma^2$.

Also, as special cases of these general results, let $I_1, I_2 \ldots I_n$ be the functions generated from the unit vectors $i_1, i_2, \ldots i_n$, and it is evident that

$$I_1^2 = I_2^2 = \&c. = I_n^2 = -1, \quad \text{and that} \quad I_1I_2 + I_2I_1 = \&c. = 0,$$

or these new functions obey the laws of the unit vectors.

29. It is easy to show that functions of the kind described in the last article are in general by no means as simple in structure as the simplicity of their laws of combination might lead one to expect.

From the equation $P = q\rho q^{-1}$, or multiplying into q, it is seen that $Pq = q\rho$. Taking conjugates $Kq\,.\,KP = -\rho Kq$, and hence it follows easily that

$$Kq\,(P + KP)\,q = Kq\,.\,q\rho - \rho Kq\,.\,q\,;$$

therefore $P + KP$ will not vanish, unless $Kq\,.\,q$ is commutative with the vector ρ.

Hence, if the operator $q\,(\;)\,q^{-1}$ generates from linear vectors functions which are the negatives of their conjugates, $Kq\,.\,q$ must be a scalar; otherwise it could not be commutative with all vectors. The converse of this is true, also.

In this case, $\quad V_{(0)}P = V_{(3)}P = 0, \quad$ or $\quad P = (V_{(1)} + V_{(2)})\,P.$

Of course, if $\quad Kq\,.\,q = x = scalar, \quad qKq = x,$ also;

for $$q\,(Kq\,.\,q) = qx = xq = (qKq)\,q.$$

30. Next, operating by I, the characteristic of inversion, on

$$Pq = q\rho, \quad \text{and} \quad Iq\,.\,IP = \rho Iq\,;$$

therefore, $$Iq\,(P - IP)\,q = Iq\,.\,q\rho - \rho Iq\,.\,q.$$

Hence, generally, if $\quad P = IP, \quad Iq\,.\,q = scalar,\quad$ and conversely.

In this case, $\quad V_{(2)}P = V_{(3)}P = 0, \quad$ and $\quad P = (V_{(0)} + V_{(1)})\,P.$

31. Combining the results of the last two articles, P reduces to $V_{(1)}P$, if qKq and qIq are both scalars. These restrictions on the generality of q require q to be either even or odd in the units, as has been proved in Art. 27.

As an example, consider the operator depending on

$$q = \cos u\,.\,i_1i_2 + \sin u\,.\,i_3i_4i_5i_6.$$ [1]

It may be verified that

$$q^{-1} = -\cos u\, i_1i_2 + \sin u\, i_3i_4i_5i_6.$$

For this function, $qi_1q^{-1} = q^2i_1 = I_1$, and similarly $I_2 = q^2i_2$, while

$$I_3 = -q^2i_3, \quad I_4 = -q^2i_4, \quad I_5 = -q^2i_5, \quad \text{and} \quad I_6 = -q^2i_6.$$

This very special example shows that, even when P reduces to $V_{(1)}P$, it cannot be assumed to be a linear vector unless some further condition

[1] This form was given towards the end of the article cited.

is imposed besides $qKq = \textit{scalar}$, and $qIq = \textit{scalar}$. Here it may be noted that,

$$Kq^{-1} = (Kq)^{-1} \quad \text{as} \quad qq^{-1} = 1 = Kq^{-1}Kq.$$

32. Another and simpler way of investigating the structure of the functions P as depending on the nature of q is to change the signs of all the units in the equation $Pq = q\rho$.

Manifestly, if q is odd in the units, $q\rho$ is even, and therefore Pq is even, and P must be odd. If q is even in the units, P must still be odd in the units.

Generally, let $q = q' + q''$, and $P = P' + P''$, where q' and P' are odd, and q'' and P'' even in the units; then

$$(q' + q'')\rho = (P' + P'')(q' + q''),$$

and on change of sign of all the units,

$$(q' - q'')\rho = (P' - P'')(q' - q'').$$

Hence, adding and subtracting,

$$q'\rho = P'q' + P''q'', \quad \text{and} \quad q''\rho = P'q'' + P''q'.$$

If, for all values of ρ, P is odd in the units, either q' or q'' must vanish; for otherwise

$$q'\rho q'^{-1} = P' = q''\rho q''^{-1}, \quad \text{and hence} \quad q''^{-1}q'\rho = \rho q''^{-1}q';$$

that is, $q''^{-1}q'$ must be commutative with every unit, and therefore

$$q''^{-1}q' = x = \textit{scalar}, \quad \text{or} \quad q' = xq'';$$

but this is an impossible equation, since q' is odd in the units, and q'' even.

It seems to be impossible for P to be even in the units for all values of ρ.

33. In the particular case in which q is a linear vector (a_1), ρ is changed into its reflection with respect to a_1 by the operator $a_1(\ )a_1^{-1}$. For splitting ρ into two parts, ρ' parallel, and ρ'' perpendicular to a_1,

$$a_1\rho a_1^{-1} = a_1(\rho' + \rho'')a_1^{-1} = (\rho' - \rho'')a_1a_1^{-1} = \rho' - \rho''.$$

Thus the part parallel to a_1 is unchanged, and the part perpendicular to it is reversed in direction.

Reflecting ρ in succession to two lines a_1 and a_2 in order, and supposing ρ' to be the component of ρ in the plane of these two vectors, while ρ'' is the perpendicular component,

$$a_2a_1\rho a_1^{-1}a_2^{-1} = a_2a_1(\rho' + \rho'')a_1^{-1}a_2^{-1} = \rho'' + a_2a_1\rho'a_1^{-1}a_2^{-1}$$

is the result of this double reflection. It is manifest, geometrically, that the component ρ' is turned by this operation through twice the angle between α_1 and α_2 in the plane of these two vectors, and in the direction from α_1 to α_2.

It is also evident that the essential elements in this operator are—(1) the plane of α_1 and α_2, (2) the angle between α_1 and α_2, and (3) the direction of rotation from α_1 to α_2. It is clear that the lengths of the vectors α_1, α_2, and their absolute positions in the plane are not essential, and therefore that the operators

$$\alpha_2\alpha_1(\ )\alpha_1^{-1}\alpha_2^{-1}, \quad \text{and} \quad \alpha'_2\alpha'_1(\ )\alpha'^{-1}_1\alpha'^{-1}_2$$

are equivalent, provided the accented vectors are coplanar with those not accented, and the angle between α_1 and α_2 is equal to that between α'_1 and α'_2, when these angles are measured in the same direction.

It will be noted that the operator here considered is *without effect* on any vector perpendicular to the plane of α_1 and α_2. For, if β is any such vector,

$$\alpha_2\alpha_1\beta = -\alpha_2\beta\alpha_1 = \beta\alpha_2\alpha_1.$$

34. Next, consider the operator $\alpha_3\alpha_2\alpha_1(\ )\alpha_1^{-1}\alpha_2^{-1}\alpha_3^{-1}$, which reflects a line successively to α_1, α_2, and α_3, but which *reverses* the direction of every vector perpendicular to these three vectors. Supposing that the vectors α are not coplanar, let ι_1, ι_2, and ι_3 be any three mutually rectangular units in the tri-dimensional space determined by them.

It is evident, by the law of interchanges, that the operator

$$\iota_1\iota_2\iota_3(\ )\iota_3^{-1}\iota_2^{-1}\iota_1^{-1}$$

reverses the direction of every vector perpendicular to that space, and produces no change on any vector contained in it.

Hence, it appears that the operators

$$\alpha_3\alpha_2\alpha_1(\ )\alpha_1^{-1}\alpha_2^{-1}\alpha_3^{-1}, \quad \text{and} \quad \iota_1\iota_2\iota_3\alpha_3\alpha_2\alpha_1(\ )\alpha_1^{-1}\alpha_2^{-1}\alpha_3^{-1}\iota_3^{-1}\iota_2^{-1}\iota_1^{-1}$$

have the same effect on any vector contained in the above-mentioned space; but the first reverses, while the second leaves unchanged, the direction of any vector perpendicular to that space.

Now, without loss of generality, ι_3 may be taken parallel to α_3; in this case, the second operator reduces to

$$\iota_1\iota_2\alpha_2\alpha_1(\ )\alpha_1^{-1}\alpha_2^{-1}\iota_2^{-1}\iota_1^{-1}.$$

Since all the vectors considered lie in the same space of three dimensions, the planes of ι_1, ι_2, and of α_1, α_2 will intersect in some common line. By the last article, ι_1 and ι_2 may be replaced by any pair of vectors in their plane (j_1 and j_2), provided the inclination of the new vectors is equal to that of the old. Similarly, a_2 and a_1 may be replaced by vectors coplanar with them (a'_2 and a'_1). The operator is now

$$j_1 j_2 a'_2 a'_1 (\ ) a'^{-1}_1 a'^{-1}_2 j_2^{-1} j_1^{-1},$$

and if j_2 and a'_2 are taken to be along the common line of intersection of the planes, the operator reduces further to $j_1 a'_1 (\ ) a'^{-1}_1 j_1^{-1}$.

Thus, it is proved that it is possible to determine an operator $\beta_2\beta_1 (\ ) \beta_1^{-1}\beta_2^{-1}$, which will produce the same effect on vectors co-spatial with a_1, a_2, and a_3 as the operator $a_3 a_2 a_1 (\ ) a_1^{-1} a_2^{-1} a_3^{-1}$, though the first preserves, while the second reverses, the directions of vectors perpendicular to the space.

35. It is instructive to contrast and compare the two operators

$$\beta_2\beta_1 (\ ) \beta_1^{-1}\beta_2^{-1}, \quad \text{and} \quad i_1 i_2 i_3 \beta_2\beta_1 (\ ) \beta_1^{-1}\beta_2^{-1} i_3^{-1} i_2^{-1} i_1^{-1}$$

in greater detail.

As i_1, i_2, and i_3 may be any triad of units in the given space, suppose

$$\beta_1 = i_1, \quad \text{and} \quad \beta_2 = i_1 \cos u + i_2 \sin u,$$

and then
$$\beta_2\beta_1 = -\cos u - i_1 i_2 \sin u,$$

while
$$i_1 i_2 i_3 \beta_2 \beta_1 = -\, i_1 i_2 i_3 \cos u + i_3 \sin u.$$

The essential elements of the two operators are presented in two different ways. The first involves the angle u, and the symbol ($i_1 i_2$) of the plane in which (or parallel to which) the rotation through the angle $2u$ takes place. The second involves u, the symbol of the space ($i_1 i_2 i_3$) containing the plane of the rotation, and that particular perpendicular (i_3) to this plane which is unaffected by the operator. Of course, from i_3, and the product $i_1 i_2 i_3$, the symbol of the plane ($i_1 i_2$) may be deduced.

36. It is desirable to show that, by an operator of the type $q (\ ) q^{-1}$, any set of vector units, i_1, i_2, . . . i_m, may be converted into any other set, $j_1, j_2, \ldots j_m$. The new set is not necessarily in the same space of m dimensions. Indeed, generally a space of $2m$ dimensions will be required to contain both sets. This investigation will also be useful for other reasons.

The vectors being unit, obviously

$$i_1 + j_1 = (1 - j_1 i_1)\, i_1 = j_1 (1 - j_1 i_1),$$

and so the operator $(1 - j_1 i_1) (\ ) (1 - j_1 i_1)^{-1}$ will convert i_1 into j_1, but will leave unchanged any vector perpendicular to both. For brevity, let $q_1 = 1 - j_1 i_1$; then, by the operator, the first unit system (i) is converted into the new system of mutually perpendicular units

$$q_1 i_1 q_1^{-1} (= j_1), \quad q_1 i_2 q_1^{-1}, \text{ \&c.}, \quad q_1 i_m q_1^{-1}.$$

Next, as the vectors involved are units,

$$q_1 i_2 q_1^{-1} + j_2 = (1 - j_2 q_1 i_2 q_1^{-1})\, q_1 i_2 q_1^{-1} = j_2 (1 - j_2 q_1 i_2 q_1^{-1}),$$

and accordingly the new operator $q_2(\ )q_2^{-1}$ will convert $q_1 i_2 q_1^{-1}$ into j_2, and will leave unchanged any vector perpendicular to both; such a vector is j_1. Again, for brevity, let $q_2 = 1 - j_2 q_1 i_2 q_1^{-1}$, and the units are transformed by this double process to

$$j_1,\ j_2,\ q_2 q_1 i_3 q_1^{-1} q_2^{-1} \ldots q_2 q_1 i_m q_1^{-1} q_2^{-1}.$$

Repeating this process, a function $Q = q_m q_{m-1} \ldots q_2 q_1$ is at last found, and the operator $Q(\ )Q^{-1}$ derived from this will convert the set of arbitrary units $i_1 i_2 \ldots i_m$ into the new set $j_1 j_2 \ldots j_m$.

37. Consider a little the formation and structure of these functions q_u and Q_u, if $Q_u = q_u q_{u-1} \ldots q_2 q_1$.

The set of equations—

$$\begin{aligned}
q_1 &= 1 - j_1 i_1, \\
q_2 &= 1 - j_2 q_1 i_2 q_1^{-1}, \\
q_3 &= 1 - j_3 q_2 q_1 i_3 q_1^{-1} q_2^{-1} \\
&\ \vdots \\
q_u &= 1 - j_u q_{u-1} q_{u-2} \ldots i_u q_1^{-1} q_2^{-1} \ldots q_{u-1}^{-1}, \\
&\ \vdots
\end{aligned}$$

lead to equations of the type $Q_u = Q_{u-1} - j_u Q_{u-1} i_u$. Hence, it is easy to see that

$$\begin{aligned}
Q_1 &= 1 - j_1 i_1, \\
Q_2 &= 1 - j_1 i_1 - j_2 i_2 + j_2 j_1 i_1 i_2, \\
Q_3 &= 1 - j_1 i_1 - j_2 i_2 - j_3 i_3 + j_2 j_1 i_1 i_2 + j_3 j_1 i_1 i_3 + j_3 j_2 i_2 i_3,
\end{aligned}$$

and generally

$$Q_m = 1 - \Sigma j_s i_s + \Sigma\Sigma j_t j_s i_s i_t - \Sigma\Sigma\Sigma j_u j_t j_s i_s i_t i_u + \text{\&c.},$$

in which s, t, u, &c., are distinct integers comprised between 1 and m. Of course, in this expression, $j_2 j_1 i_1 i_2 = j_1 j_2 i_2 i_1$ for instance, as the double interchange does not alter the sign of the term.

Naturally, if both sets of units belong to the same space, the operator may be much simplified. For example, the equation

$$j_1 j_2 \ldots j_m = i_1 i_2 \ldots i_m$$

must then be true, so that if i_1 is converted into j_1, i_2 into j_2, &c., and i_{m-1} into j_{m-1}, it will necessarily follow that i_m will be converted into j_m. For this case, then, $Q_{m-1}(\ )Q_{m-1}^{-1}$ will effect the required transformation. Here, also, it is not hard to see that

$$Q_{m-1} = 1 - \Sigma j_s i_s + \Sigma j_s j_t i_t i_s - \text{\&c.},$$

in which the summation still extends from $s = 1$ to $s = m$, &c.; but the last sum consists, when m is odd, of products of $\frac{1}{2}(m-1)$ of the units j with the corresponding units i, and when m is even, it is *half* the sum of products of $\frac{1}{2}m$ units j with the corresponding units i.

For example, for four units, if

$$i_1 i_2 i_3 i_4 = j_1 j_2 j_3 j_4, \quad j_1 j_2 j_3 i_3 i_2 i_1 = j_4^2 \,.\, j_1 j_2 j_3 i_3 i_2 i_1 \,.\, i_4^2 = j_4 i_4.$$

because $$j_4 j_1 j_2 j_3 \,.\, i_3 i_2 i_1 i_4 = i_4 i_1 i_2 i_3 \,.\, i_3 i_2 i_1 i_4 = 1.$$

The Q functions considered in this article are all even in the units. When both sets of units belong to the same space of m dimensions, Q_{m-1} is of the order $(m-1)$; in the units i, when m is odd (when the units j are supposed to be given in terms of i), and when m is even, Q_{m-1} is of the order m.

An obvious remark may be useful. If the operators $q(\ )q^{-1}$, and $p(\ )p^{-1}$ are equivalent in the results they produce on all vectors, or if $q\rho q^{-1} = p\rho p^{-1}$, then $q = p$ to a numerical factor. For $p^{-1}q\rho = \rho p^{-1}q$, or $p^{-1}q$ is commutative with all vectors, and is therefore a scalar.

It is also useful to remark, when the units involved are contained in a space of odd dimensions, if we multiply Q_{m-1} by the product of the m units $(p = i_1 i_2 \ldots i_m)$, that the product pQ_{m-1} is odd in the m units; and that

$$pQ_{m-1}(\ )Q_{m-1}^{-1}p^{-1}, \quad \text{and} \quad Q_{m-1}(\ )Q_{m-1}$$

have the same effect on all units contained in the m-dimensional space, and opposite effects on vectors perpendicular to this space—the first operator reversing, the second retaining their directions.

38. The operators $q(\ )q^{-1}$ which change line vectors into vectors are, of course, a particular class of linear vector functions. If

$$\phi\rho = q\rho q^{-1}, \quad S\sigma\phi\rho = S\sigma q\rho q^{-1} = Sq^{-1}\sigma q\rho = S\phi^{-1}\sigma\rho = S\phi'\sigma\rho.$$

Thus the conjugate (ϕ') of one of these functions (ϕ) is its inverse (ϕ^{-1}).

Consequently, the symbolic equation satisfied by ϕ must be reciprocal. For the same equation is satisfied by ϕ'. Thus, if

$$\phi^n - M_1\phi^{n-1} + \ldots + (-)^{n-1}M_{n-1}\phi + (-)^n M_n = 0,$$

$$(-)^n M_n \phi^n + (-)^{n-1}M_{n-1}\phi^{n-1} + \ldots M_1\phi + 1 = 0$$

is also true; and from this it follows that $M_n = \pm 1$.

Now, if q is an even function of the units contained in a space of m dimensions (as in the recent articles), $q\,(\;)\,q^{-1}$ has no effect on those of the n units perpendicular to this space, and so $(\phi - 1)^{n-m}$ is a factor in the symbolic equation. There remains a factor of order m to be considered, and as this must be reciprocal, it appears that when m is odd, either $\phi - 1$, or $\phi + 1$ must be a factor in it; or, for some particular vector (α), cospatial with the m units, either $\phi\alpha = \alpha$, or $\phi\alpha = -\alpha$.

39. Generally, no other root will be equal to ± 1; but if g is a root, so that $\phi\beta = g\beta = q\beta q^{-1}$, it follows that $g^2\beta^2 = \beta^2$. If then g is not equal to unity, it is necessary that β^2 should be equal to zero.[1] β is then an imaginary vector of the type $\beta = \alpha + h\alpha'$, where α and α' are real perpendicular vectors of equal lengths, and where h is the imaginary of algebra commutative with the units. In this case, $\beta^2 = \alpha^2 - \alpha'^2 = 0$, if α and α' are of equal lengths and at right angles to one another. The conjugate root g' must be the reciprocal of g, and as $g + g'$ is real, it is evident that $g = e^{hu}$, $g' = e^{-hu}$ are proper expressions for these roots.

It is easy to show, if $\beta = \alpha + h\alpha'$, that $\beta' = \alpha - h\alpha'$. For, suppose the real vector σ is the result of operating on an arbitrary vector ρ, by the factor of $(\phi - g)(\phi - g')$ in the symbolic equation, it follows that

$$(\phi - g')\,\sigma = \beta, \quad \text{and} \quad (\phi - g)\,\sigma = \beta';$$

operating on these by $(\phi - g)$, and $(\phi - g')$, respectively, the results must vanish. But σ is a real vector, and $g + g'$ is real, so

$$(\phi - \tfrac{1}{2}(g + g'))\,\sigma = \tfrac{1}{2}(\beta + \beta') = \alpha$$

is a real vector; also

$$\tfrac{1}{2}(g - g')\,\sigma = \tfrac{1}{2}(\beta - \beta') = h\alpha'$$

is a purely imaginary vector, or the product of h by real vector.

These conjugate axes are the lines to the circular points at infinity in their common plane.

Any real unit vector coplanar with β and β' may be represented

$$\tfrac{1}{2}(e^{hv}\beta + e^{-hv}\beta') = \alpha\cos v + \alpha'\sin v.$$

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[1] Compare Art. 12.

Operating on this by ϕ, the result is

$$\tfrac{1}{2}(e^{h(u+v)}\beta + e^{-h(u+v)}\beta') = a\cos(u+v) + a'\sin(u+v).$$

So the operator ϕ merely turns any vector in this plane through an angle equal to u.

40. In the last article it was shown that a pair of conjugate roots and axes of the function ϕ may be expressed by the equations

$$\phi(a + ha') = e^{hu}(a + ha'), \quad \text{and} \quad \phi(a - ha') = e^{-hu}(a - ha'),$$

a and a' being perpendicular and real vectors of equal length, and h being the imaginary of algebra.

For a second conjugate pair distinguished from this pair by the suffix 1, the relations

$$S\beta_1\phi\beta = e^{hu}S\beta_1\beta = S\beta\phi^{-1}\beta_1 = e^{-hu_1}S\beta\beta_1,$$
$$S\beta_1\phi\beta' = e^{-hu}S\beta_1\beta' = S\beta'\phi^{-1}\beta_1 = e^{-hu_1}S\beta'\beta_1,$$

show that, if u is not equal to $\pm u$, it is necessary to have

$$S\beta\beta_1 = S\beta'\beta_1 = S\beta\beta'_1 = S\beta'\beta'_1 = 0.$$

Hence, it is necessary to have

$$Saa_1 = Saa'_1 = Sa'a_1 = Sa'a'_1 = 0;$$

or both the vectors a and a' must be perpendicular to a_1 and a'_1; or the planes of a and a', and of a_1 and a'_1 are hyper-perpendicular.

Hence, it is possible to obtain a clear perception of the properties of the operator $q(\ )q^{-1}$ which converts vectors into vectors. In connexion with any such operator there exists a certain number of hyper-perpendicular planes, and the operator turns the components of a vector in each of these planes through certain definite angles, different in general for each plane.

If the operator involves units contained in an m-space, there are $\tfrac{1}{2}m$ or $\tfrac{1}{2}(m-1)$ such planes, according as m is even or odd. For an odd space, there is one common perpendicular to all these planes, and the operator has no effect on this line.

41. From the last article it appears that the general rotation of a rigid body of m dimensions in m-dimensional space may be resolved into rotations of definite amounts in $\tfrac{1}{2}m$ or $\tfrac{1}{2}(m-1)$ hyper-perpendicular planes.

Now, a rotation in the plane of i_1i_2 may be represented by

$$q_{12}(\ )q_{12}^{-1}, \quad \text{where} \quad q_{12} = \cos\tfrac{1}{2}u_{12} + i_1i_2\sin\tfrac{1}{2}u_{12};$$

and it is easy to see that

$$q_{12}^{-1} = \cos\tfrac{1}{2}u_{12} - i_1i_2\sin\tfrac{1}{2}u_{12}.$$

Operating then on i_1, suppose, it is easily shown that

$$\begin{aligned} q_{12}i_1q_{12}^{-1} &= (\cos \tfrac{1}{2}u_{12} + i_1i_2 \sin \tfrac{1}{2}u_{12})\, i_1 (\cos \tfrac{1}{2}u_{12} - i_1i_2 \sin \tfrac{1}{2}u_{12}) \\ &= i\,(\cos \tfrac{1}{2}u_{12} - i_1i_2 \sin \tfrac{1}{2}u_{12})^2 = i_1 (\cos u_{12} - i_1i_2 \sin u_{12}) \\ &= i_1 \cos u_{12} + i_2 \sin u_{12}, \end{aligned}$$

or i_1 is turned through the angle u_{12} towards i_2.

Hence, if $\quad q_{34} = \cos \tfrac{1}{2}u_{34} + i_3i_4 \sin \tfrac{1}{2}u_{34}, \quad q_{34}(\;)\,q_{34}^{-1}$

turns a line in the plane of i_3i_4 through the angle u_{34}; and

$$q_{12}q_{34}(\;)\,q_{34}^{-1}q_{12}^{-1}$$

turns the component of a vector in the plane of i_1i_2 through an angle u_{12}, and the component in the plane of i_3i_4 through an angle u_{34}. Also, q_{12} and q_{34} are commutative in multiplication, or the rotations in the hyper-perpendicular planes may be effected in any order.

Further, the general operator $Q(\;)\,Q^{-1}$ of Art. 37 affecting m units may be reduced to the type

$$q_{12}q_{34} \ldots q_{2l-1,\,2l}(\;)\,q_{2l-1,\,2l}^{-1} \ldots q_{34}^{-1}q_{12}^{-1},$$

where $2l = m$ or $m - 1$, since these two operators produce the same effects on all vectors.

42. Having seen in Art. 37 that m vectors may be changed into m others, equally inclined but otherwise perfectly general, by an operator of the type $Q(\;)\,Q^{-1}$, it appears that the general displacement about a fixed point of a rigid body of m dimensions in a space of m dimensions may be represented by operating by $Q(\;)\,Q^{-1}$ on the vectors from the fixed point to the various points of the body. The most general displacement of a body is produced by adding to this an arbitrary displacement of translation δ.

The displacement, then, of the point originally at the extremity of ρ is $\delta + Q\rho Q^{-1} - \rho$. If the rotation is made about the extremity of ϵ instead of about the origin, the same motion is produced, provided the new displacement of translation δ' satisfies

$$\delta + Q\rho Q^{-1} - \rho = \delta' + Q(\rho - \epsilon)\,Q^{-1} - (\rho - \epsilon).$$

Hence, $\quad \delta' = \delta + Q\epsilon Q^{-1} - \epsilon = \delta + (\phi - 1)\,\epsilon.$

In spaces of even order it is generally possible to determine ϵ, so that

$$\delta' = 0, \quad \text{or} \quad \delta + (\phi - 1)\,\epsilon = 0.$$

This is not generally possible in spaces of odd order, for in such spaces

$\phi - 1$ generally reduces to zero some vector α;[1] so, if δ has a component parallel to α it cannot be removed.

Thus, in spaces of even order, the general displacement of a body may be effected by rotations of definite amounts in a number of definite hyper-perpendicular planes, one determinate point being held fixed; in spaces of odd order, a translational displacement must be added to the generalized rotation; but by proper choice of base-point this displacement may be made perpendicular to all the planes of rotation.

This is completely analogous to the displacement of a body in two and in three dimensions.

43. A new form may be given to the operator $Q(\ )Q^{-1}$, which clearly exhibits its essential elements.

The expression $q_{12} = \cos\frac{1}{2}u_{12} + i_1i_2\sin\frac{1}{2}u_{12}$ may be written in the forms

$$q_{12} = e^{\frac{1}{2}i_1i_2u_{12}}, \quad \text{or} \quad q_{12} = (i_1i_2)^{\frac{u_{12}}{\pi}}.$$

Thus,
$$Q = e^{\frac{1}{2}(i_1i_2u_{12} + i_3i_4u_{34} + \dots)},$$

or
$$Q = (i_1i_2)^{\frac{u_{12}}{\pi}}(i_3i_4)^{\frac{u_{34}}{\pi}}\dots \text{ \&c.},$$

for the products i_1i_2, i_3i_4, &c., are all commutative,[2] so that it is allowable to write

$$e^{xi_1i_2}e^{yi_3i_4} = e^{xi_1i_2 + yi_3i_4}.$$

Again, if q_2 is any quadratic function of the units, $e^{q_2}(\ )e^{-q_2}$ is an operator which will produce a conical rotation of the general kind; this is because it has been shown in Art. 10 that the general quadratic function may be reduced to the form

$$q_2 = a_{12}i_1i_2 + a_{34}i_3i_4 + \dots,$$

and in $e^{q_2}(\ )e^{-q_2}$, the coefficients a_{12}, a_{34}, &c., are double the angles of the rotations in the corresponding planes.

In the limit, if the rotation is infinitesimal so that the angles, and therefore q_2, are very small,

$$e^{q_2}\rho e^{-q_2} = (1 + q_2)\rho(1 - q_2) = \rho + (q_2\rho - \rho q_2) = \rho + 2V_1q_2\rho,$$

and this agrees with the expression used in Art. 8.

The essential elements in these various expressions are, of course, the angles and the symbols (i_1i_2, i_3i_4, &c.) of the fundamental planes.

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[1] See Arts. 38 and 40.

[2] See Elements of Quaternions, Art. 316 (20).

44. Though intending to return to a special class of operators of the type $p(\ )p^{-1}$, I shall now supplement Clifford's Paper "On the Free Motion under no Forces of a Rigid System in an n-fold Homaloid" by a few remarks.

By Newton's law, if ξ_1 is the impulsive force applied to an element of mass m_1 at the extremity of ρ_1, the momentum generated $(m_1\dot{\rho}_1)$ is equal to the impulse, or $m_1\dot{\rho}_1 = \xi_1$.

From this we may derive the two following equations, on multiplying by ρ_1 and $\dot{\rho}_1$,

$$m_1\rho_1\dot{\rho}_1 = \rho_1\xi_1, \quad \text{and} \quad m_1\dot{\rho}_1^2 = \dot{\rho}_1\xi_1.$$

Now, if m_1 is part of a system, on summation over the entire system, we find

$$\Sigma m_1\dot{\rho}_1 = \Sigma\xi_1, \quad \Sigma m_1\rho_1\dot{\rho}_1 = \Sigma\rho_1\xi_1, \quad \text{and} \quad \Sigma m_1\dot{\rho}_1^2 = \Sigma\dot{\rho}_1\xi_1.$$

Considering two elements of the system, m_1 and m_2, the impulses ξ_1 and ξ_2 may be written more explicitly in the forms $\xi'_1 + \xi_{12}$, and $\xi'_2 + \xi_{21}$, respectively, where ξ_{12} is the impulse on m_1 arising from its connexion with m_2, and ξ_{21} is the impulse on m_2 arising from its connexion with m_1. If these are equal and opposite they cancel in $\Sigma\xi_1$, and $\Sigma\xi_1$ is then equal to the sum of all the external impulses acting on the system.

Again, $\qquad \Sigma\rho_1\xi_1 = \Sigma\rho_1\xi'_1 + \Sigma(\rho_1\xi_{12} + \rho_2\xi_{21}).$

Consider the term

$$(\rho_1\xi_{12} + \rho_2\xi_{21}) = (\rho_1 - \rho_2)\,\xi_{12} \quad (\text{as } \xi_{12} + \xi_{21} = 0);$$

$V_2(\rho_1 - \rho_2)\,\xi_{12}$ will vanish if the mutual impulse acts along the line between the elements; but $S(\rho_1 - \rho_2)\,\xi_{12}$ will not vanish, unless the mutual impulse acts at right angles to that line. On the assumption that the mutual impulse acts along the line joining the elements, ξ_1 may be taken as the external impulse on the element m_1, in the equation

$$\Sigma m_1 V_2\rho_1\dot{\rho}_1 = \Sigma V_2\rho_1\xi_1;$$

but it cannot so be taken in $\Sigma m_1 S\rho_1\dot{\rho}_1 = \Sigma S\rho_1\xi_1$, from which the impulses of constraint do not disappear.

Next, in the scalar equation

$$\Sigma m_1\dot{\rho}_1^2 = \Sigma\dot{\rho}_1\xi_1 = S\Sigma\dot{\rho}_1\xi'_1 + S\Sigma(\dot{\rho}_1 - \dot{\rho}_2)\,\xi_{12},$$

the impulses of constraint (acting along $\rho_1 - \rho_2$) will not disappear, unless $\dot{\rho}_1 - \dot{\rho}_2$ (the velocity of m_1 relative to m_2) is at right angles to the line joining m_1 and m_2 (or at right angles to ξ_{12}). For a rigid body in the equation $\Sigma m_1\dot{\rho}_1^2 = \Sigma S\dot{\rho}_1\xi_1$, ξ_1 may consequently be taken equal to the external impulse on m_1.

Thus, for a rigid body we have the following equations of impulsive motion (which are independent of the mutual actions of the parts of the body):—

$$\Sigma m_1\dot\rho_1 = \Sigma\xi_1, \quad \Sigma m_1 V_2\rho_1\dot\rho_1 = \Sigma V_2\rho_1\xi_1, \quad \text{and} \quad \Sigma m_1\dot\rho_1^2 = \Sigma S\dot\rho_1\xi_1.$$

The above detailed treatment has been given in order to detect, if possible, quantities analogous to couples of higher orders which could not occur in three dimensions. For, if the equation $m_1\dot\rho_1 = \xi_1$ is multiplied by products such as $\rho_1\dot\rho_1$, $\dot\rho_1^2$, &c., it will be found impossible, on summation, to get rid of the mutual impulses.

45. If ρ_0 is the vector to the centre of mass,

$$\rho_1 = \rho_0 + \varpi_1, \quad \text{and} \quad \dot\rho_1 = \dot\rho_0 + \dot\varpi_1 = \dot\rho_0 + V_2\Omega\varpi_1,$$

where Ω is a quadratic function of the units corresponding to angular velocity, and already treated of in Art. 10. Hence, the dynamical equations are, if M is the total mass, ξ the resultant impulsive force, Γ the impulsive couple, and T the kinetic energy,

$$M\dot\rho_0 = \xi, \quad MV_2\rho_0\dot\rho_0 + \Sigma m V_2\varpi V_1\Omega\varpi = \Gamma,$$

and

$$M\dot\rho_0^2 + \Sigma m\,(V_1\Omega\varpi)^2 = -2T;$$

or, if

$$\Sigma m V_2\varpi V_1\Omega\varpi = \Phi\Omega,$$

$$M\dot\rho_0 = \xi, \quad MV_2\rho_0\dot\rho_0 + \Phi\Omega = \Gamma, \quad \text{and} \quad M\dot\rho_0^2 + S\Omega\Phi\Omega = -2T.$$

In these, $\Phi\Omega$ is a linear function of Ω quadratic in the units. Observing that Ω may be expressed in the form $\Sigma V_2\lambda\mu$, where λ and μ are linear vectors,

$$\Phi\Omega = \Sigma\Phi V_2\lambda\mu = \Sigma\,.\,\Sigma m V_2\varpi V_1 V_2\lambda\mu\,.\,\varpi.$$

Now, exactly as in Quaternions,

$$V_1\,.\,V_2\lambda\mu\,.\,\varpi = \lambda S\mu\varpi - \mu S\lambda\varpi,$$

and hence

$$\Phi\Omega = \Sigma V_2\mu\,(\Sigma m\varpi S\lambda\varpi) - \Sigma V_2\lambda\,(\Sigma m\varpi S\mu\varpi) = \Sigma V_2\,(\mu\phi\lambda - \lambda\phi\mu),$$

if ϕ is the linear vector function defined by $\phi\rho = \Sigma m\varpi S\rho\varpi$. This function is self-conjugate, and its axes are consequently real and mutually perpendicular. Let these be $i_1 i_2 \ldots i_m$, and let

$$\varpi = i_1x_1 + i_2x_2 + \&c.$$

Then $\quad \phi i_1 = -\Sigma m\,(i_1x_1 + i_2x_2 + \ldots)\,x_1 = -i_1\Sigma m x_1^2 = -g_1 i_1 \quad$ (say),

and

$$\Sigma m x_1 x_2 = \&c. = 0;$$

so the units $i_1 i_2$, &c., are parallel to the principal axes of inertia of the body.

From this it is evident that

$$\Phi(i_1i_2) = V_2(i_2\phi i_1 - i_1\phi i_2) = (g_1 + g_2)\, i_1i_2 = \Sigma m\,(x_1^2 + x_2^2)\, i_1i_2,$$

or the area vectors of planes containing two principal axes of inertia are the solutions of $\Phi\Omega = c\Omega$, where c is a root of Φ.

46. It is easy to investigate the conditions for the steady motion of a body under no forces. In general (compare Art. 10),

$$D_t\Phi\Omega = \Phi\dot{\Omega} + V_2\Omega\Phi\Omega = \Gamma,$$

where Γ is the couple referred to the centre of mass. If Γ is zero, and if $\dot{\Omega}$ vanishes also, the equation of motion becomes $V_2\Omega\Phi\Omega = 0$.

This is of course satisfied when $\Omega = a_{12}i_1i_2$; but it is also satisfied when Ω is in the canonical form for these units, or when

$$\Omega = a_{12}i_1i_2 + a_{34}i_3i_4 + \ldots$$

So, if an impulsive couple acts on a body which has been so placed that the components of the couple are all contained in principal planes of the body which are hyper-perpendicular to one another, the body will permanently rotate with constant angular velocities in each of these principal planes.

47. The linear function Φ which, by operating on the generalized angular velocity, produces the generalized angular momentum, is by no means the most general of the type to which it belongs. Its roots, $\frac{1}{2}m(m-1)$ in number, are the sums of pairs of the m roots of a self-conjugate linear vector function of the ordinary type; its axes, moreover, are pure area vectors.

Regarded as derived from an ordinary linear vector function, it belongs to an extensive type of functions of which a few examples are now given.

Consider the condition that a function $f(A)$ of a quadratic in the units (A) and itself quadratic in the units, should be expressible in the form

$$f(A) = \Sigma f V_2\lambda\mu = \Sigma V_2(\theta_1\lambda\theta_2\mu + \theta_3\lambda\theta_4\mu),$$

where θ_1, θ_2, θ_3, and θ_4 are ordinary linear vector functions.

It is necessary for all vectors λ and μ that

$$fV_2\lambda\mu = V_2(\theta_1\lambda\theta_2\mu + \theta_3\lambda\theta_4\mu) = -V_2(\theta_1\mu\theta_2\lambda + \theta_3\mu\theta_4\lambda) = -fV_2\mu\lambda.$$

This requires $\quad \theta_2 = \theta_3 = \phi, \quad$ and $\quad \theta_4 = \theta_1 = \theta,$

or else $\quad \theta_1 = \theta_2 = \theta, \quad$ and $\quad \theta_3 = \theta_4 = \phi;$

so the two admissible types

$$f_1V_2\lambda\mu = V_2(\theta\lambda\phi\mu + \phi\lambda\theta\mu), \quad \text{and} \quad f_2V_2\lambda\mu = V_2(\theta\lambda\theta\mu + \phi\lambda\phi\mu)$$

are found.

From a single function ϕ, two functions f of the second order are obtained, defined by

$$f_1 V_2 \lambda\mu = V_2(\lambda\phi\mu + \phi\lambda\mu), \quad \text{and} \quad f_2 V_2\lambda\mu = V_2\phi\lambda\phi\mu.$$

These are the analogues of Hamilton's functions, denoted by χ' and ψ', respectively, and their conjugates are

$$f'_1 V_2\lambda\mu = V_2(\lambda\phi'\mu + \phi'\lambda\mu), \quad \text{and} \quad f'_2 V_2\lambda\mu = V_2\phi'\lambda\phi'\mu.$$

Functions of the third order depending on a single linear vector function ϕ of the linear, or ordinary kind, are

$$f_1 V_3\lambda\mu\nu = V_3(\phi\lambda\mu\nu + \lambda\phi\mu\nu + \lambda\mu\phi\nu),$$

$$f_2 V_3\lambda\mu\nu = V_3(\phi\lambda\phi\mu\nu + \phi\lambda\mu\phi\nu + \phi\lambda\phi\mu\nu),$$

and

$$f_3 V_3\lambda\mu\nu = V_3\phi\lambda\phi\mu\phi\nu.$$

These are the invariants m_1, m_2, and m_3 of ϕ when but three units are involved, or the coefficients in the symbolic cubic

$$\phi^3 - m_1\phi^2 + m_2\phi - m_3 = 0.$$

Following the notation used in a Paper on "Quaternion Invariants of Linear Vector Functions" (Proc. Roy. Irish Acad., 1896), the functions of the type here considered may be expressed by the general equation

$$f.\begin{vmatrix} a_1, a_2, a_3, \ldots a_N \\ a_1, a_2, a_3, \ldots a_N \\ a_1, a_2, a_3, \ldots a_N \end{vmatrix} = \begin{vmatrix} \phi_1 a_1, \phi_1 a_2, \ldots \phi_1 a_N \\ \phi_2 a_1, \phi_2 a_2, \ldots \phi_2 a_N \\ \phi_N a_1, \phi_N a_2, \ldots \phi_N a_N \end{vmatrix},$$

in which the determinant[1] on the left-hand side, operated on by f, consists of the same row of N vectors repeated N times; the determinant on the right consists of rows of these vectors operated on by N ordinary linear functions $\phi_1\phi_2 \ldots \phi_N$.

If N is equal to the number of units involved, the functions (f) degenerate into invariants.

When only a single function ϕ is involved, the axes of these functions are V_N (a product of N axes of ϕ), and the roots are sums of:—(1) the N corresponding roots, (2) products of these in pairs, (3) products in threes, &c.

[1] A convention must be adopted in the expansion of these determinants. It may be comprised in the rule:—Expand as if the constituents were scalar, but preserve the order of the rows.

48. The Theory of Screws in an m-space furnishes another linear function of some interest.

Let $\Gamma_1, \Gamma_2 \ldots \Gamma_m$ represent couples (quadratic functions of the units), and $\xi_1, \xi_2 \ldots \xi_m$ corresponding forces, referred to the origin as base-point; the wrenches determined by these quantities are supposed to be contained in an m-space, and to be independent one of another.

If $t_1, t_2 \ldots t_m$ are scalars, $\Gamma = \Sigma t_1 \Gamma_1$, and $\xi = \Sigma t_1 \xi_1$ are general expressions for the couple and force of any wrench compounded from the given wrenches (Γ_1, ξ_1), (Γ_2, ξ_2), &c. Then it is obvious that the scalars (t) may be chosen, so that a new system of wrenches (Γ'_1, ξ'_1), (Γ'_2, ξ'_2), &c., is obtained in which the forces are all mutually perpendicular; or, dropping the accents, the system depending on the m wrenches may be defined by the m new wrenches

$$(\Gamma_1, i_1)\,(\Gamma_2, i_2), \ldots (\Gamma_m, i_m),$$

where $i_1, i_2 \ldots i_m$ are a set of unit vectors in the m-space.

Now, let $f\rho = -\Sigma \Gamma_1 S i_1 \rho$, and it is evident that $fi_1 = \Gamma_1$, $fi_2 = \Gamma_2$, &c., and generally that $f\Sigma t_1 i_1 = \Sigma t_1 \Gamma_1$; or, if (Γ, ξ) is any wrench of the system, it is obvious that Γ and ξ are connected by the relation $\Gamma = f\xi$.

The function f defines the system of wrenches compounded from m independent wrenches in the m-space, so that this system may be designated by the single symbol f.

49. Again, referred to the origin as base-point, let $\Omega_1, \Omega_2 \ldots \Omega_m$ be the angular velocities (quadratic in the units), and $\sigma_1, \sigma_2 \ldots \sigma_m$ the corresponding linear velocities of any m independent motions in the m-space.

The screw (σ, Ω) is co-reciprocal to (Γ, ξ), if $S\Gamma\Omega + S\xi\sigma = 0$;[1] and it is co-reciprocal to the system $\Gamma = f\xi$, if

$$Sf\xi\Omega + S\xi\sigma = 0, \quad \text{or if} \quad S\xi\,(f'\Omega + \sigma) = 0,$$

where f' is the conjugate of f.[2] In other words, the linear vector $f'\Omega + \sigma$ must be perpendicular to σ.

If then the system of screws $(\Sigma t_1 \sigma, \Sigma t_1 \Omega_1)$ is co-reciprocal to the system $\Gamma = f\xi$, it is necessary that the screws should satisfy $f'\Omega + \sigma = 0$, for otherwise in the given m-space m independent vectors would be perpendicular to σ.

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[1] See Arts. 45, 46 in justification of the expression $-S\Gamma\Omega$ for the work done by a couple.

[2] f' is defined by $SPf\rho = S\rho f'P$, where P is quadratic in the units. In full, if

$$f\rho = -\Sigma \Gamma_1 S i_1 \rho, \quad f'P = -\Sigma i_1 S\Gamma_1 P.$$

Thus, the systems $\Gamma = f\xi$, and $\sigma = -f'\Omega$ are co-reciprocal; or, when a system compounded from m screws is defined by a linear function (f), the co-reciprocal system is defined by the negative of the conjugate of that function ($-f'$).

50. Without changing the origin, it is easy to reduce the function f by making it depend on m co-reciprocal screws.

To this end observe that, if

$$f\rho = -\Sigma\Gamma_u Si_u\rho, \quad f'f\rho = +\Sigma i_v S\Gamma_v \Sigma\Gamma_u Si_u\rho.$$

The function $f'f$ is obviously self-conjugate;[1] its axes are consequently mutually rectangular; and if they are taken as units,

$$f'fi_1 = \Sigma i_v S\Gamma_v \Sigma\Gamma_u Si_u i_1 = -\Sigma i_v S\Gamma_v\Gamma_1 = -i_1 S\Gamma_1^2.$$

This requires generally $S\Gamma_u\Gamma_v = 0$, where u and v are different; and it is obvious that (Γ_1, i_1) and (Γ_2, i_2) are co-reciprocal, because each term of the condition $S\Gamma_1\Gamma_2 + Si_1i_2 = 0$ vanishes. The axes of $f'f$ being i_1, i_2, &c., its roots are $-S\Gamma_1^2$, $-S\Gamma_2^2$, &c.

Next, if P is a quadratic in the units, Γ_1, Γ_2, &c., are axes, and $-S\Gamma_1^2$, $-S\Gamma_2^2$, &c., are roots of the new self-conjugate function

$$ff'\mathrm{P} = \Sigma\Gamma_v Si_v \Sigma i_u S\Gamma_u \mathrm{P} = -\Sigma\Gamma_v S\Gamma_v \mathrm{P},$$

the units being axes of $f'f$.

It may be remarked that, if (Γ, ξ) is a wrench of the system $(\Gamma = f\xi)$, the $(f'\Gamma, -f\xi)$ is a screw of the reciprocal system, for

$$f'\Gamma = f'.(f\xi) = -f'(-f\xi).$$

51. Of course a function such as f, which generates a quadratic in the units from a linear vector can never be self-conjugate, for its conjugate produces a linear vector from a quadratic.

It may, however, be shown to possess a part analogous to the spin-vector of the linear vector functions of Quaternions, and the Theory of Screws affords a convenient approach to this investigation.

Changing the base-point to the extremity of ϵ, the linear velocity becomes $\sigma = \sigma_0 + V_1\Omega\epsilon$, and the couple becomes $\Gamma = \Gamma_0 + V_2\xi\epsilon$, if σ_0 and Γ_0 are the corresponding values for the old origin. Now, if

[1] $S\sigma f'f\rho = Sf\sigma f\rho = Sf'f\sigma\rho$.

$\Gamma_0 = f\xi$, and $\sigma_0 = -f'\Omega$, the systems referred to the new origin become

$$\Gamma = f\xi + V_2\xi\epsilon = F\xi, \quad \text{and} \quad \sigma = -f'\Omega + V_1\Omega\epsilon = -F'\Omega,$$

where F and F' are still conjugate functions. In fact,

$$S\rho\,(f'\Omega - V_1\Omega\epsilon) = S\Omega f\rho - S\epsilon\rho\Omega = S\Omega\,(f\rho + V_2\rho\epsilon),$$

because $$V_2\rho\epsilon = -V_2\epsilon\rho.$$

52. I shall now show that ϵ can be chosen so that for any units

$$\Sigma V_1 i_1 F i_1 = 0.$$

In the first place, it is necessary to show that $\Sigma V_1 i_1 f i_1$ is an invariant, or that it is independent of the particular system of units chosen. Consider the quotient of determinants of order m involving m arbitrary vectors (λ),

$$Q = \begin{vmatrix} f\lambda_1, f\lambda_2, f\lambda_3, \ldots f\lambda_m \\ \lambda_1, \lambda_2, \lambda_3, \ldots\ldots\ldots \lambda_m \\ \cdots \quad \cdots \quad \cdots \quad \cdots \quad \cdots \\ \lambda_1, \lambda_2, \lambda_3, \ldots\ldots\ldots \lambda_m \end{vmatrix} \div \begin{vmatrix} \lambda_1, \lambda_2, \lambda_3, \ldots \lambda_m \\ \lambda_1, \lambda_2, \lambda_3, \ldots \lambda_m \\ \cdots \quad \cdots \quad \cdots \quad \cdots \\ \lambda_1, \lambda_2, \lambda_3, \ldots \lambda_m \end{vmatrix};$$

here the first row of the dividend consists of the results of operating by f on each of the vectors in a certain order, and the $m - 1$ rows which remain are alike, and formed by the vectors in the same order; the divisor consists of m equal rows the same as the equal rows in the dividend. In determinants of this kind, it is lawful to add the columns when multiplied by suitable scalars.[1] Consequently, if $\Sigma t_1\lambda_1 = \lambda'$, any column in the dividend may be replaced by $f\lambda', \lambda', \lambda', \ldots \lambda'$, provided the corresponding column in the divisor is replaced by $\lambda', \lambda', \lambda', \ldots \lambda'$. In fact, everything turns on the distributive property of the function f, expressed by the equation $\Sigma t_1 f\lambda_1 = f\Sigma t_1\lambda_1$. Thus the quotient Q is independent of the vectors λ, which may consequently be replaced by any other set of independent vectors.

Replacing $\lambda_1\lambda_2 \ldots \lambda_m$ by $i_1 i_2 \ldots i_m$, and remembering the rules of expansion, it is easy to see that the *invariant*

$$Q = \{f(i_1)\,.\,i_2 i_3 \ldots i_m - f(i_2)\,.\,i_1 i_3 \ldots i_m + \&\text{c.}\}\frac{1}{m i_1 i_2 \ldots i_m}$$
$$= \pm\frac{1}{m}\Sigma f(i_1)\,.\,i_1.$$

[1] Compare the Paper already cited "On Quaternion Invariants", (Proc. Roy. Irish Acad., 1896).

In the case of Art. 51, the invariants of F and of f are connected by the relation

$$\Sigma F(i_1) \, . \, i_1 = \Sigma f(i_1) \, i_1 + \Sigma V_2 i_1 \epsilon \, . \, i_1 = \Sigma f(i_1) \, i_1 + (m-1) \, \epsilon,$$

since $\quad V_3 V_2 i_1 \epsilon \, . \, i_1 = 0, \quad$ and $\quad \Sigma V_2 i_1 \epsilon \, . \, i_1 = - \epsilon \Sigma i_1{}^2 + \Sigma i_1 S \epsilon i_1$

It thus appears, by taking

$$\epsilon = - \frac{1}{m-1} \, V_1 \Sigma f(i_1) \, . \, i_1,$$

that $V_1 \Sigma F(i_1) \, i_1$ may be reduced to zero; and also that $V_2 \Sigma f(i_1) \, i_1$ is independent of the position of the base-point.

53. The process sketched in the last article is extremely fertile in the formation of invariants, and in the discussion of the properties of linear functions.

It may be stated generally that, if $f_1 f_2 \ldots f_m$ are any linear and distributive functions of quantities $q_1 q_2 \ldots q_m$, the quotient

$$Q = \begin{vmatrix} f_1 q_1, f_1 q_2 \ldots f_1 q_m \\ f_2 q_1, f_2 q_2 \ldots f_2 q_m \\ f_m q_1, f_m q_2 \ldots f_m q_m \end{vmatrix} \div \begin{vmatrix} q_1, q_2 \ldots q_m \\ q_1, q_2 \ldots q_m \\ q_1, q_2 \ldots q_m \end{vmatrix}$$

is an invariant in so far that the quantities q may be replaced by any linear functions of them with scalar coefficients.

With particular reference to the Theory of Screws, we may select any number of screws

$$(\sigma_1 \Omega_1), \; (\sigma_2 \Omega_2) \ldots (\sigma_N \Omega_N),$$

and we may derive the set of invariants of the type

$$\begin{vmatrix} \sigma_1, \sigma_2 \ldots \sigma_N \\ \vdots \quad \vdots \qquad \vdots \\ \sigma_1, \sigma_2 \ldots \sigma_N \\ \Omega_1, \Omega_2 \ldots \Omega_N \\ \vdots \\ \Omega_1, \Omega_2 \ldots \Omega_N \end{vmatrix} \div \begin{vmatrix} \Omega_1, \Omega_2 \ldots \Omega_N \\ \\ \\ \\ \cdots \Omega_1, \Omega_2 \ldots \Omega_N \\ \end{vmatrix};$$

in the dividend, M rows of σ being followed by $N - M$ rows of Ω, and the divisor being formed by N rows of Ω.[1]

[1] In particular, for a pair of screws on a cylindroid in three dimensions, the ratios

$$\sigma_1 \sigma_2 - \sigma_2 \sigma_1 : \sigma_1 \omega_2 - \sigma_2 \omega_1 : \omega_1 \omega_2 - \omega_2 \omega_1$$

are independent of the particular pair of screws chosen.

54. Before leaving the Theory of Screws, which has been both instructive and suggestive in the study of this Associative Algebra, I shall say a few words on the canonical representation of a screw in hyperspace. By Art. 51, the couple at the extremity of the vector ϵ, arising from a couple Γ_0, and a force ξ at the origin as base point, is $\Gamma = \Gamma_0 + V_2\xi\epsilon$. Multiplying this by ξ^{-1}, and separating the parts of the product of the first and third order in the units, two equations are obtained,

$$V_1\xi^{-1}\Gamma = V_1\xi^{-1}\Gamma_0 + V_1\xi^{-1}V_2\xi\epsilon, \quad \text{and} \quad V_3\xi^{-1}\Gamma = V_3\xi^{-1}\Gamma_0,$$

of which the first contains ϵ, but the second is independent of it. Now, it is easy to see that ϵ may be chosen so that

$$V_1\xi^{-1}\Gamma = 0 \quad (\text{or } V_1\xi\Gamma = 0);$$

and in fact, as $$V_1\xi^{-1}V_2\xi\epsilon = \epsilon - \xi S\xi^{-1}\epsilon,$$

the condition is satisfied, provided ϵ lies on the right line,

$$\epsilon = -V_1\xi^{-1}\Gamma_0 + x\xi.$$

This line is the axis of the screw.

If $\Gamma_0 = f\xi$, so that the wrench belongs to the system f,

$$\epsilon = -V_1\xi^{-1}f\xi + x\xi$$

may be regarded as the equation of the assemblage of the axes of wrenches of the system f, if ξ is allowed to vary arbitrarily. If, however, ξ is constrained to remain parallel to a plane, or if

$$\xi \parallel \xi_1 + t\xi_2,$$

where ξ_1 and ξ_2 are fixed; but t is a varying scalar,

$$\epsilon = -V_1(\xi_1 + t\xi_2)^{-1}f(\xi_1 + t\xi_2) + x(\xi_1 + t\xi_2),$$

or $$\epsilon = -V_1(\xi_1 + t\xi_2)^{-1}(\Gamma_1 + t\Gamma_2) + x(\xi_1 + t\xi_2)$$

is the equation of the locus of the axes of wrenches compounded of two given wrenches; and this locus is the analogue of the cylindroid. Similarly, the equations of the assemblages of the axes of wrenches compounded of any number of given wrenches may be written down. In any of these equations, on putting $x = 0$, the equation of the locus of feet of perpendiculars from the arbitrary origin on the axes is obtained.

In the next place, the function $(V_3\xi^{-1}\Gamma)$ of the third order which is invariantal with respect to a change of base-point, is the analogue of the pitch. It is easy to justify this apparent anomaly, for the effect of the wrench is not confined to any one definite space of three dimensions, but it is distributed in a definite manner in a definite number of spaces of three dimensions; the pitch must then be a function of the units symbolizing these spaces, or of their volume vectors.

To take a concrete example, suppose the origin chosen so that $V_1\xi^{-1}\Gamma = 0$, and suppose the quadratic Γ reduced to the canonical form, so that

$$\Gamma = g_{12}i_1i_2 + g_{34}i_3i_4 + \ldots + g_{2m-1,\,2m}i_{2m-1}i_{2m}.$$

Assuming
$$\xi = x_1i_1 + x_2i_2 + \ldots + x_{2m+1}i_{2m+1},$$

it is evident that, in order $V_1\xi^{-1}\Gamma$ should vanish, ξ must reduce to $x_{2m+1}i_{2m+1}$; for, consider the part linear in i_1 and i_2 in $V_1\xi^{-1}\Gamma$; it is $g_{12}(x_1i_2 - x_2i_1)$ to a numerical factor, and its vanishing requires $x_1 = x_2 = 0$. We may thus take as the canonical forms of a force and couple

$$\xi = i_{2m+1}, \quad \text{and} \quad \Gamma = g_{12}i_1i_2 + g_{34}i_3i_4 + \&\text{c.}$$

In this case the pitch is

$$g_{12}i_1i_2i_{2m+1} + g_{34}i_3i_4i_{2m+1} + \&\text{c.},$$

and the essentials on which it depends are the numerical coefficients g_{12}, g_{34}, &c. (m in number when $2m+1$ or $2m+2$ units are involved),[1] and the symbols of the various spaces of three dimensions $(i_1i_2i_{2m+1})$, $(i_3i_4i_{2m+1})$, &c. (which all contain the force). It should be noticed that a wrench is always expressible in terms of an odd number of units, so that a wrench cannot *fill* (or exhaust all the units of) an even space.[2]

A wrench in four dimensions is a wrench in three. As an example, let

$$\Gamma_0 = a_{12}i_1i_2 + a_{34}i_3i_4, \quad \text{and let} \quad \xi = x_1i_1 + x_3i_3.$$

(This expression for ξ is perfectly general, since i_1 may be taken to be parallel to the component of ξ in the definite plane (i_1i_2), and i_3 may be taken to be parallel to the remaining component of ξ.)

With these values,

$$V_1\xi^{-1}\Gamma_0 = \frac{x_1a_{12}i_2 + x_3a_{34}i_4}{x_1^2 + x_3^2},$$

and
$$\Gamma = \Gamma_0 - \xi V_1\xi^{-1}\Gamma_0 = \frac{(x_3i_1 - x_1i_3)(a_{12}x_3i_2 - a_{34}x_1i_4)}{x_1^2 + x_3^2}$$

is a product of two vectors perpendicular to one another, and to ξ; but three independent vectors are involved in Γ and ξ.

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[1] Of course the *force* is supposed not to vanish.

[2] Confirmation may be obtained from Art. 12, where it was shown to be generally impossible to assign ρ so that $V_1q_2\rho$ should vanish in an even space.

55. The motion of a rigid body has been treated with almost sufficient fullness in Art. 42. In that article it was proved, with even greater generality than here requisite, that ϵ may be chosen in the equation $\sigma = \sigma_0 + V_1\Omega\epsilon$, so as to render σ perpendicular to all the planes of rotation of Ω in an odd space, and zero in an even space. All that remains is to consider how ϵ may be expressed in terms of σ_0 and Ω; or, in other words, to solve for ρ an equation of the type $\varpi = V_1\Omega\rho$, or again, to invert the linear function

$$\phi\rho = V_1\Omega\rho = \varpi.$$

Stated in the last form, $\rho = \phi^{-1}\varpi$ is a definite vector when the equation $\phi\alpha = 0$ is impossible; when it is possible, the solution is indeterminate, but of the form $\rho = \phi^{-1}\varpi + x\alpha$.

In the first place, I shall give a solution of the problem depending on the reduction of Ω to the canonical form

$$\Omega = a_{12}i_1i_2 + a_{34}i_3i_4 + \&c.$$

in $2m$ units (i). Let

$$\epsilon = e_1i_1 + e_2i_2 + \ldots + e_{2m+1}i_{2m+1},$$

in which $2m + 1$ units occur; then

$$V_1\Omega\epsilon = a_{12}(-e_2i_1 + e_1i_2) + a_{34}(-e_4i_3 + e_3i_4) + \&c.;$$

and in this i_{2m+1} does not occur; consequently, i_{2m+1} cannot occur in $\sigma - \sigma_0$. If

$$\sigma_0 = s_1i_1 + s_2i_2 + \ldots + s_{2m+1}i_{2m+1},$$

the simplest legitimate value for σ is $\sigma = s_{2m+1}i_{2m+1}$. Endeavouring to satisfy $\sigma = \sigma_0 + V_1\Omega\epsilon$ under these conditions, it is obvious that

$$e_2 = -\frac{1}{a_{12}}s_1, \quad e_1 = +\frac{1}{a_{12}}s_2, \ \&c.;$$

or that $$e_2 = \frac{1}{a_{12}}Si_1(\sigma_0 - \sigma), \quad e_1 = -\frac{1}{a_{12}}Si_2(\sigma_0 - \sigma), \ \&c.;$$

or again, that

$$\epsilon = -\Sigma i_1Si_1\epsilon = \frac{1}{a_{12}}\{i_1Si_2(\sigma_0 - \sigma) - i_2Si_1(\sigma_0 - \sigma)\} + \&c. + e_{2m+1}i_{2m+1}$$

$$= V_1\Sigma\frac{i_1i_2}{a_{12}}.(\sigma_0 - \sigma) + e_{2m+1}i_{2m+1}.$$

If the new quadratic Ω' is defined by

$$\Omega' = \frac{i_1 i_2}{a_{12}} + \frac{i_3 i_4}{a_{34}} + \&c.,$$

$$\epsilon = V_1 \Omega' (\sigma_0 - \sigma) + e_{2m+1} i_{2m+1},$$

in which e_{2m+1} is arbitrary; and when the base-point is transferred to the extremity of this vector (a definite *point* in even space, because i_{2m+1} cannot occur), the velocity of translation (σ) is reduced to

$$\sigma = - i_{2m+1} S i_{2m+1} \sigma_0,$$

an actual and real vector in odd spaces, but zero in even spaces. In other words, a body moving freely and with perfect generality in an odd space instantaneously contains a line whose position is determined, and the particles of the body situate on that line are moving along it with a determined velocity; but a body moving with equal freedom in an even space has one point instantaneously fixed, and the position of that point is determined.

56. The difficulty in dealing with the equation $\sigma = \sigma_0 + V_1 \Omega \epsilon$ arises solely from the fact that Ω^{-1} is not of the same character as Ω, viz.:— a quadratic in the units; and the reason of this is, the area vectors $(i_1 i_2)$, $(i_3 i_4)$, &c., in Ω are commutative, and not polar in multiplication.
However, multiplying by Ω^{-1},

$$\Omega^{-1}\sigma = \Omega^{-1}\sigma_0 + \Omega^{-1} V_1 \Omega\epsilon = \Omega^{-1}\sigma_0 + \epsilon - \Omega^{-1} V_3 \Omega\epsilon,$$

because $$\Omega\epsilon = (V_1 + V_3)\,\Omega\epsilon.$$

Before going farther, it is necessary to consider the nature of the quantity $\Omega^{-1} V_3 \Omega\epsilon$. I am not yet able to give a satisfactory account of this quantity, as I have not worked out fully the nature of Ω^{-1}. It is not hard to see that Ω^{-1} must be proportional to the product obtained by multiplying together the results of changing the signs of the area vectors in Ω in all possible ways.

Again, $V_3 \Omega\sigma$ is not independent of the base-point, nor do I see how to operate on $\sigma = \sigma_0 + V_1 \Omega\epsilon$, so as to obtain a result independent of ϵ, or to obtain an expression analogous to the pitch of a wrench.

57. I shall now consider a special class of operators $P(\ )P^{-1}$, which permute the units $i_1 i_2 \ldots i_n$ among themselves.

In Art. 36, let

$$j_1 = i_2,\ j_2 = i_3,\ \&c.;\ j_{m-1} = i_m,\ \text{and}\ j_m = \pm i_1.$$

In order to determine the sign, note that

$$j_1 j_2 \ldots j_m = i_1 i_2 \ldots i_m = (-)^{m-1} i_m i_1 i_2 \ldots i_{m-1},$$

or $j_m = i_1$ when m is odd, and $-i_1$ when m is even.

The simplest form of P is

$$1 + i_1 i_2 = P'_2, \quad \text{and} \quad P'_2 i_1 P'^{-1}_2 = i_2, \quad \text{and} \quad P'_2 i_2 P'^{-1}_2 = -i_1.$$

The next simplest is

$$P_3 = 1 + i_2 i_3 + i_3 i_1 + i_1 i_2,$$

and $P_3(\ )P_3^{-1}$ changes i_1 into i_2, i_2 into i_3, and i_3 into i_1.

Instead of using the functions P'_2, P'_4, &c., it is more symmetrical to consider the functions

$$P_2 = i_2 P'_2, \quad P_4 = i_2 i_3 i_4 P'_4, \quad \text{\&c.},$$

and these have the property of changing i_1 into i_2, and i_2 into i_1; and of changing to i_1, i_2, i_3 and i_4 to i_2, i_3, i_4 and $+ i_1$, respectively, though of course they reverse the directions of all vectors perpendicular to those involved. The functions P_{2m} are odd in the units.

58. On reference to Art. 37, the expression for the general function P_{2m+1} is seen to be

$$P_{2m+1} = 1 - \Sigma i_{s+1} i_s + \Sigma i_{s+1} i_{t+1} i_t i_s - \text{\&c.},$$

and the last sum consists of the sum of products of m of the derived units with the corresponding original units.

Of course, great reduction may be made on this. For instance, take the series

$$\Sigma i_{s+1} i_{t+1} i_t i_s = \Sigma i_{s+1} i_{s+u+1} i_{s+u} i_s,$$

if $t = s + u$. Assigning in this series the values 1, 2, 3, . . . m to u, it is evident that

$$\begin{aligned}\Sigma i_{s+1} i_{t+1} i_t i_s = &- \Sigma i_s i_{s+2} + \Sigma i_s i_{s+1} i_{s+2} i_{s+3} \\ &+ \Sigma i_s i_{s+1} i_{s+3} i_{s+4} \\ &+ \ldots \\ &+ \Sigma i_s i_{s+1} i_{s+m} i_{s+m+1}.\end{aligned}$$

In this the greatest value of u is m, because s and $s + 2m + 1$ may be regarded as equivalent for summation purposes, and a term such as $\Sigma i_s i_{s+1} i_{s+m+u} i_{s+m+u+1}$ may be replaced by $\Sigma i_s i_{s+1} i_{s+m+1-u} i_{s+m+2-u}$, so that assigning any positive integer value to u, a former series is fallen back on.

The following illustration will be of use. Imagine a cog-wheel with $2m + 1$ teeth numbered consecutively, covered with a concentric screen having suitable apertures.

If an aperture is arranged to show two consecutive teeth, the series

$$i_1 i_2 + i_2 i_3 + \ldots + i_{2m+1} i_1$$

is illustrated. If two apertures separated by the width of a single tooth are employed, the series $\Sigma i_s i_{s+2}$ is illustrated, and so on. If the aperture is made large enough to expose four consecutive teeth, the series $\Sigma i_s i_{s+1} i_{s+2} i_{s+3}$ is typified. And if there are two apertures, each exposing two consecutive teeth, while $u - 2$ teeth are concealed between these pairs, the arrangement corresponds to the series $\Sigma i_s i_{s+1} i_{s+u} i_{s+u+1}$. The rest of the screen conceals

$$2m + 1 - (u - 2) - 4 = 2m - 1 - u \text{ teeth,}$$

and if this number is greater than $u - 2$, u is less than m.

Take now the triple series

$$-\Sigma i_{s+1} i_{t+1} i_{u+1} i_u i_t i_s = +\Sigma i_s i_{s+1} i_t i_{t+1} i_u i_{u+1},$$

and suppose

$$s < t < u, \quad \text{or} \quad t = s + x, \quad u = s + x + y,$$

where x and y are positive integers. The series is obviously cyclical, as indeed are all the series in P_{2m+1}, so it is sufficient to consider the double series obtained by putting $s = 1$; each term in this double series is the "source" of a single cyclical series which may be written down. The double series is

$$i_1 i_2 \Sigma i_{x+1} i_{x+2} \cdot i_{x+y+1} i_{x+y+2}.$$

The screen must now have three apertures, exposing in general three pairs of consecutive teeth—

$$1 \text{ and } 2, \quad x \text{ and } x + 1, \quad x + y \text{ and } x + y + 1;$$

that is, a pair, $x - 2$ blanks; a pair, $y - 2$ blanks; a pair, and

$$2m + 1 - 2 - (x - 2) - 2 - (y - 2) - 2 = 2m - 1 - x - y = z - 2 \text{ blanks.}$$

In order to find the various arrangements, it is only necessary to consider the integral solutions of

$$x + y + z = 2m + 1, \quad \text{for which} \quad z \geq x, \text{ and } z \geq y.$$

When x, y, and z are as nearly equal as possible, z must be the greatest third of $2m + 1$, and this is the least value of z. Interchanging given values of x and y of course changes the arrangement.

When x or $y = 1$, there are only four terms in the product. For

$$x = 1, \quad - i_1 i_3 i_{y+2} i_{y+3}$$

typifies the series, which may be illustrated on the screen by a tooth, a blank, a tooth, $y - 2$ blanks, two teeth and $2m - y - 2$ blanks. When in addition $y = 1$, the source of the series is $+ i_1 i_4$.

Finally, if $\{12\}$ denotes the cycle or cyclical sum,

$$i_1 i_2 + i_2 i_3 + \ldots + i_{2m+1} i_1,$$

of which $i_1 i_2$ is the source, it may be gathered from what has been proved that

$$\begin{aligned} P_{2m+1} = 1 &+ \{12\} - \{13\} + \{14\} - \&c. \\ &+ \{1234\} - \{1235\} + \{1245\} - \&c. \\ &- \{1345\} + \&c. \ldots + \{123456\} + \&c. \ldots \end{aligned}$$

The functions P_{2m} are sums of cyclical groups of a similar kind, but of odd order in the units; on these functions it would be tedious to delay.

59. It may be noticed that, if P is any one of these functions, and C any cyclical sum of the units in P, $PCP^{-1} = C$.

In particular, $P\Sigma i_1 P^{-1} = \Sigma i_1$; also, if m units are involved, and if $h_1, h_2 \ldots$ are the algebraic roots of $h^m = 1$, $P\Sigma h_1 i_1 P^{-1} = \Sigma h_1 i_2$, and from this, various deductions may be made.

Again, $P^2 i_1 P^{-2} = i_3$, $P^s i_1 P^{-s} = i_{s+1}$, and $P^m i_1 P^{-m} = i_1$;

and generally $P^m \rho = \rho P^m$, or P^m is a scalar.

Also, considering the linear vector function $\phi\rho = P\rho P^{-1}$, when m is even, the symbolic equation is

$$(\phi + 1)^{n-m} (\phi^m - 1) = 0;$$

and when m is odd, it is

$$(\phi - 1)^{n-m} (\phi^m - 1) = 0.$$ [1]

60. The following method may be used in building up, step by step, the functions P:—

Let $\quad q_{12} = 1 + i_1 i_2$, and generally $q_{st} = 1 + i_s i_t$;

then $\quad q_{12} i_1 q_{12}^{-1} = i_2$, and $q_{12} i_2 q_{12}^{-1} = - i_1$,

and no other unit is changed.

---

[1] See Art. 38.

Next, $q_{31}q_{12}(\ )q_{12}^{-1}q_{31}^{-1}$ changes i_1 to i_2, i_2 to i_3, and i_3 to i_1, and no other unit is affected.

Repeating this process an odd number of times, it is evident that

$$\begin{aligned} P_{2m+1} &= q_{2m+1,\,1}\, q_{1,\,2m} \cdots q_{51}q_{14}q_{31}q_{12} \\ &= q_{2m+1,\,1}\, q_{1,\,2m}\, P_{2m-1} \\ &= q_{2m+1,\,1}\, P'_{2m}, \end{aligned}$$

P_{2m+1} and P'_{2m} being the functions defined in Art. 57, for the operators here, and in that article have the same effect on any vector, and the scalar parts of the functions P_{2m+1}, and P'_{2m} are here (as there) equal to unity.

The function $P_{2m} = i_2 i_3 \ldots i_m P'_{2m} = i_2 i_3 \ldots i_m (1 + i_1 i_{2m}) P_{2m-1}$ can be formed without much trouble from P_{2m-1}.

61. The functions P_{2m} and P_{2m+1} have been treated in considerable detail, on account of their direct application to the Theory of Substitutions.

If $x_1, x_2, \ldots x_n$ are n letters, their order may be considered as defined by

$$\rho = x_1 i_1 + x_2 i_2 + \ldots + x_n i_n,$$

if the order of the coefficients of the units in this equation is made to follow the order of the units in the series $i_1, i_2, \ldots i_n$. Operating on ρ by $q_{12}(\ )q_{12}^{-1}$, the result is

$$-x_2 i_1 + x_1 i_2 + x_3 i_3 + \ldots + x_n i_n;$$

that is, disregarding signs, the order of the letters is changed to

$$x_2, x_1, x_3 \ldots x_n;$$

or the positions of x_1 and x_2 are interchanged.

By combination of the q_{st} functions, any substitution whatever may be effected by the operator $Q(\ )Q^{-1}$, in which $Q = \Pi q_{st}$. In this way, all the operations in the Theory of Substitutions are made to depend on the Associative Algebra defined by

$$i_s^2 = -1, \quad i_s i_t + i_t i_s = 0;$$

and, by the device of putting part (Q) of the operator before the operand and part (Q^{-1}) after it, the complex laws of that theory are reduced to the simple laws of combination of the units (i).

The functions P of late articles give rise to cyclic substitutions. As before stated, any two functions q_{12} and q_{34} which have no common suffix are commutative in order of multiplication, and give rise to commutative symbols of operation which may be applied in any order.

62. In the application of this method to the Theory of Substitutions, it is not necessary to attend to the signs in the results of operation, and considerable simplification is thereby gained. I shall now give a few practical rules, in order to avoid unnecessary labour.

If q_{12} and q_{21} are contiguous in a product, they may be rejected; for

$$q_{12}q_{21} = (1 + i_1 i_2)(1 + i_2 i_1) = 2.$$

If q_{12} and q_{12} are contiguous, q_{12}^2 may be rejected; for

$$q_{12}^2 = 1 - 1 + 2i_1 i_2 = 2i_1 i_2,$$

and the operator $i_1 i_2(\ )i_2^{-1}i_1^{-1}$ merely changes the signs of i_1 and i_2. Thus, for substitutions, q_{12} may be replaced by q_{21}.

Again, as $\quad 1 + i_2 i_3 + i_3 i_1 + i_1 i_2 = q_{31}q_{12} = q_{12}q_{23} = q_{23}q_{31},$

$q_{31}q_{12}$ may be replaced by $q_{12}q_{23}$, or by $q_{23}q_{31}$. Hence, having given any product Πq_{st}, the first factor from the left which contains the suffix 1, say q_{1u}, may be carried towards the right till it meets a factor having 1 or u as a suffix. If this factor is q_{1v}, $q_{1u}q_{1v}$ may be replaced by $q_{uv}q_{1v}$, and then q_{1v} may be carried on as before towards the right. If it next meets q_{vw}, $q_{1v}q_{vw}$ may be replaced by $q_{vw}q_{w1}$, and q_{w1} may be still carried on. At last the suffix 1 occurs in no factor but on that on the extreme right, q_{s1}, suppose. If the suffix (s) occurs in any other factor, it may be carried to the right until we get some factor q_{st} immediately to the left of q_{s1}.

63. In this way, so far as the Theory of Substitutions is concerned, the product Πq_{st} may be reduced to a product of the form

$$\Pi_1 q_{st} \cdot q_{m,\,m-1}\, q_{m-1,\,m-2} \ldots q_{32}q_{21} = \Pi_1 q_{st} \cdot \mathrm{P}_1,$$

in which none of the factors in $\Pi_1 q_{st}$ are affected with any of the suffixes 1, 2, ... m. The product $\Pi_1 q_{st}$ may be similarly reduced, so that in general (using the sign $\equiv$ to denote not equality, but equivalence for purposes of substitution),

$$\Pi q_{st} \equiv \mathrm{P}_1 \mathrm{P}_2 \mathrm{P}_3 \ldots,$$

in which the factors P are commutative; the operators $\mathrm{P}(\ )\mathrm{P}^{-1}$ derived from them produce cyclical transposition of definite sets of the letters, and the order in which the operations are performed is immaterial.

V.

NOTE ON CURVATURE OF PEDAL AND RECIPROCAL CURVES. By BENJAMIN H. STEEDE, M.D.

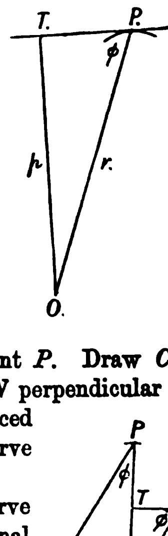
[COMMUNICATED BY MR. C. J. JOLY, ROYAL ASTRONOMER OF IRELAND.]

[Read June 27, 1898.]

1. If ρ be the radius of curvature at any point of a curve, ρ' the radius of curvature at point of contact of corresponding tangent to reciprocal curve, ϕ the angle between radius vector from origin and tangent at the point, then

$$\rho\rho' \sin^3\phi = k^2,$$

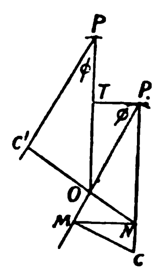
k being radius of reciprocation, a result (given in Williamson's "Differential Calculus," Miscellaneous Examples) which follows directly from the equations



$$\rho = \frac{rdr}{dp}, \quad \rho' = \frac{r'dr'}{dp'}, \quad r'p = rp' = k^2, \quad \frac{p}{r} = \frac{p'}{r'} = \sin\phi.$$

2. Again, let C be centre of curvature for point P. Draw CM perpendicular to radius vector OP, and draw MN perpendicular to the normal PC. Join NO, and let this line produced meet the corresponding normal to the reciprocal curve in C'.

Then C' is centre of curvature of reciprocal curve for point P' which corresponds to point P on original curve.



For, from similar triangles,

$$PN \,.\, P'C' = OP \,.\, OP';$$

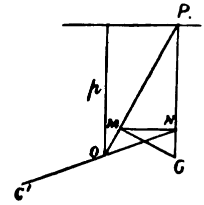
or, since

$$PN = PC \sin^2\phi, \quad \text{and} \quad OP = OT \operatorname{cosec}\phi,$$

$$PC \,.\, P'C' \sin^3\phi = OT \,.\, OP' = k^2,$$

k being radius of reciprocation. Therefore (by 1), if C be centre of one curve, then C' will be centre of curvature for corresponding point of reciprocal curve, and *vice versa*.

3. Or, which is the same thing, being given a curve and its evolute, we have the following construction to describe the evolute of the reciprocal curve:—



PC being a normal to the curve touching the evolute in C.

From C draw CM perpendicular to the radius vector OP.

From M draw MN perpendicular to the normal PC.

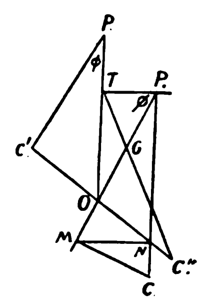
Join NO, and produce this line so that

$$NO : OC' = PN : \frac{k^2}{p}$$

(k being a constant, and P being perpendicular from origin on tangent at P).

Then the locus of C' is the evolute of the reciprocal curve, the fixed point O being taken as the origin, and the constant k as the radius, of reciprocation.

4. Being given the centre of curvature C for any point P of a curve, the centre of curvature for the corresponding point of the first positive pedal is found by the following construction:—



As before, draw CM perpendicular to OP, and MN perpendicular to PC.

Join T, the corresponding point on pedal curve, with G, the middle point of OP.

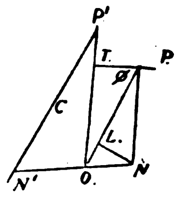
TG will intersect NO in C'', the centre of curvature of the pedal curve, for TG is evidently the normal to the pedal curve; and, since circles of curvature at corresponding points of inverse curves are inverse circles, the centre of curvature of the pedal curve must lie in the line NO, which we have seen passes through the centre of curvature of the reciprocal curve.

By reversing the construction, the centre of curvature of the first negative pedal is determined, and hence—

5. Being given the centre of curvature for any point on a curve, the centre of curvature for the corresponding point on any positive or negative pedal of either the curve or its inverse can be found by a geometrical construction.

6. Again, let any line through the origin O meet a normal to the curve in N, and a corresponding normal to the reciprocal curve in N'.

From N draw NL perpendicular to OP. Then, if k be the radius of reciprocation,



$$P'N'.PN \sin\phi = P'N'.PL = k^2,$$

for the first product is equal to $OP'.OP\sin\phi$, which is equal to k^2.

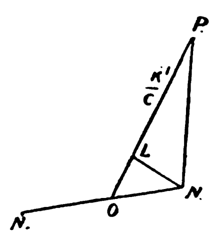
Therefore, if the intercept $P'N'$ of one of the normals is constant, then the projection PL of the intercept PN of the other normal on the corresponding radius vector will be constant.

7. In order, therefore, to describe a curve parallel to the reciprocal of a given curve, and so that the distance between the parallel curves may be equal to a given constant (c), we have the following construction:—

On the radius vector to any point P of the given curve take a point L, so that

$$PL = \frac{k^2}{c}.$$

Let LN drawn perpendicular to OP meet the normal in N.



Join NO, and produce this line, so that

$$NO : ON' = OP : c.$$

Then the locus of N' is the required parallel curve, k being taken as radius of reciprocation.

Applying, for example, the above to a circle and conic, we get a proof of the theorem that "In any conic the projection of the normal on a focal radius vector is constant."

8. If γ be the semichord of curvature for any point on a curve, γ' the semichord of curvature for corresponding point on reciprocal curve, then $\gamma\gamma' = rr'$, r and r' being the corresponding radii vectores; or, since

$$rr'\sin\phi = k^2,$$

$\gamma\gamma'\sin\phi$ is constant, and equal to square of radius of reciprocation.

When two curves touch the angle ϕ for the point of contact, being the same for both curves, the equation

$$\rho\rho' \sin^3\phi = k^2$$

shows that—

9. If two curves touch, the radii of curvature at the point of contact are inversely as the radii of curvature of the reciprocal curves at their corresponding point of contact:

10. Hence, by reciprocation, it may be proved that, if two conics have double contact, the ratio of the radii of curvature of the conics at one point of contact is the same as that at the other point of contact.

VI.

A LIST OF THE SPIDERS OF IRELAND. By GEORGE H. CARPENTER, B.Sc., Lond., Assistant Naturalist in the Science and Art Museum, Dublin.

[COMMUNICATED BY DR. R. F. SCHARFF, ON BEHALF OF THE COMMITTEE APPOINTED BY THE ROYAL IRISH ACADEMY TO INVESTIGATE THE FLORA AND FAUNA OF IRELAND.]

[Read June 27, 1898].

In Ireland, as in most other countries, the spiders have been greatly neglected by naturalists. This is surprising, since their wonderful instincts and habits appeal to the observer, while the details of their structure are of the highest interest to the systematist. Moreover, their distribution may be expected to throw much light on the problems of ancient geography, since they are incapable of crossing any sea-channel of moderate breadth. Accurate lists of the spiders inhabiting the various countries of Europe are therefore greatly to be desired; and it is of special interest to know what species extend their range westward to Ireland.

Early in the present century, Dr. Templeton, of Belfast, formed a collection of spiders, and compiled in MS. a "History of the Irish Arachnida," which was incorporated in Mr. Blackwall's well-known Monograph of the Spiders of the British Isles, published in 1861-4. Several species were herein described as new, from Irish types. Of these, some which seem clearly to be entitled to specific rank, and others whose identity with previously described Spiders appears beyond doubt, are inserted in their systematic position in the present list. There remain five species, described without clear structural detail, whose synonymy cannot be determined, though their identity with species included in the list is highly probable. No good purpose, therefore, can be served by inserting these doubtful names, and I merely enumerate them here to show that they have not been overlooked:— *Theridion auratum*, *Neriene pilosa*, *N. pallidula*, *N. carinata*, *Linyphia nasata*.

These were all collected in the neighbourhood of Belfast; and Dr. Templeton's Ulster collection seems to be no longer in existence. A few spiders collected by him in Leinster are preserved in the Dublin Museum of Science and Art; these were examined some years ago by the Rev. O. P. Cambridge, F.R.S., and have been utilised in the preparation of my list.

Mr. Thomas Workman, of Belfast, has, in recent years, formed a large collection of Ulster spiders. In 1881, he published a valuable list of 125 species in the *Entomologist* and also in the *Proceedings of the Belfast Natural History and Philosophical Society*. My warmest thanks are due to Mr. Workman, not only for having laid so excellent a foundation for future work on Irish spiders, but also for generously allowing me to examine the whole of his collection, and so enabling me to incorporate many Ulster records not included in his list.

Mr. D. W. Freeman, M.B., of Dublin, has also collected spiders extensively in recent years in the counties of Dublin and Wicklow. In 1889, he laid before the Dublin Naturalist Field Club a local list, unfortunately never published. I would heartily acknowledge his kindness in placing this list at my disposal, and in handing me for examination his collection, which is now by his generosity preserved in the Dublin Museum.

Several of Mr. Workman's captures were described as new to science by the Rev. O. P. Cambridge, F.R.S., many of whose various papers on British spiders contain Irish records. In preparing the accompanying list, I have received the greatest help from Mr. Cambridge, who has examined many specimens for me, has lent me types for comparison, and has always been ready to give me the advantage of his great experience in clearing up a doubtful point. I have also received much kind help from Mr. F. O. P. Cambridge, who has examined most of the Tetragnathæ, Lephthyphantes, and Drassi now preserved in the Dublin Museum.

One or two notes on conspicuous species of Irish spiders were due to the late Mr. A. G. More; and during the last few years, I have published short accounts of some of the more interesting species which have come under my notice, or recorded them in the *Proceedings of the Dublin Microscopical Club* and the *Dublin Naturalists' Field Club*.

BIBLIOGRAPHY.

1861. BLACKWALL, J.—A History of the Spiders of Great Britain and Ireland. London, 1861 (Ray Society).

1879. CAMBRIDGE, Rev. O. P.—On some new and rare British Spiders with characters of a new genus. *Ann. Mag. Nat. Hist.*, (5) vol. iv., pp. 190–215, pl. xii.

1879–81. CAMBRIDGE, Rev. O. P.—The Spiders of Dorset, with an Appendix containing short descriptions of those British species not yet found in Dorsetshire. Sherborne, 1879–81. (From *Proc. Dorset Nat. Hist. Ant. Field Club*, vols. i. ii.)

1880. WORKMAN, T.—A Contribution towards a List of Irish Spiders. *Entom.* vol. xiii., 1880, pp. 125–130. Irish Spiders. *Proc. Belfast Nat. Hist. Phil. Soc.*, 1878–9 and 1879–80. pp. 267–282 and plate.

1886. CAMBRIDGE, Rev. O. P.—On some new and rare British Spiders. *Proc. Dorset Field Club*, vol. vii., 1886.

1889. MORE, A. G.—*Dolomedes fimbriatus* in Ireland. *Entom.*, vol. xxii., 1889, p. 117. *Dolomedes fimbriatus*, Clerck, at Killarney. *Nature*, vol. xxxix., p. 511.

1891. CAMBRIDGE, Rev. O. P.—On new and rare Spiders found in 1889 and 1890. *Proc. Dorset Field Club*, vol. xii., pp. 80–98 and plate.

1892. Dublin Microscopical Club Proc. *Irish Nat.*, vol. i., p. 20.

1892. Dublin Naturalists' Field Club Proc., *t. c.*, pp. 101–2, 148, 167.

1893. CAMBRIDGE, Rev. O. P.—On new and rare British Spiders. *Proc. Dorset Field Club*, vol. xiv., 1893, pp. 142–164 and plate.

1893. JOHNSON, Rev. W. F.—Water-spiders in Captivity. *Irish Nat.*, vol. ii., 1893, pp. 99–101.

1893. JAMESON, H. L.—*Argyroneta aquatica* in captivity. *t. c.*, p. 147.

1894. Dublin. Nat. Field Club Proc., *Irish Nat.*, vol. iii., p. 258.

1894. Dublin, Cork, and Limerick Nat. Field Clubs Proc. *Irish Nat.*, vol. iii., pp. 182–4.

1895. CAMBRIDGE, Rev. O. P.—On new and rare British Spiders. *Proc. Dorset Field Club*, vol. xvi., pp. 92–178, pls. A, B.

1895. CAMBRIDGE, F. O. P.—Notes on British Spiders, with descriptions of new species. *Ann. Mag. Nat. Hist.*, (ser. 6), vol. xv., 1895, pp. 25–41, pls. 3, 4.

1895. (i.) CARPENTER, G. H.—Animals found in Mitchelstown Cave. *Irish Nat.*, vol. iv., 1895, pp. 25–35, pl. 2.

1895. (ii.) CARPENTER, G. H.—Irish Field Club Union, Galway Conference, Arachnida. *t. c.*, pp. 254–6.

1895. (iii.) CARPENTER, G. H.—*Attus floricola*, C. K. *t. c.*, p. 348.

1895. MILNE, J. N.—New Irish Spiders from Londonderry. *Irish Nat.*, vol. v., p. 104.

1895. Dublin Naturalist's Field Club Proc. *Irish Nat.*, vol. v., pp. 295, 320.

1896. CAMBRIDGE, Rev. O. P.—On new and rare British Spiders observed in 1895. *Proc. Dorset Field Club*, vol. xvii., 1896, pp. 54–63 and plate.

1896. (i.) CARPENTER, G. H.—Discovery of the genus *Atypus* in King's County. *Irish Nat.*, vol. v., 1896, pp. 167, 213.

1896. (ii.) CARPENTER, G. H.—Notes on the Fauna and Flora of Clonbrock, County of Galway: Spiders. *t. c.*, pp. 225–8, pl. 3.

1896. Dublin Microsc. Club Proc. *Irish Nat.*, vol. v., pp. 51, 312.

1896. Dublin Nat. Field Club Proc. *t.c.*, p. 266.

1896. JAMESON, H. L.—On the Exploration of the Caves of Enniskillen and Mitchelstown for the R.I.A. Flora and Fauna Committee. *Irish Nat.*, vol. v., 1896, pp. 93–100.

1896. O'CONNOR, Frances S.—Spider carrying Snail-shell. *Irish Nat.*, vol. v., p. 299.

1897. CAMBRIDGE, Rev. O. P. — British Arachnida observed and captured in 1896. *Proc. Dorset Field Club*, vol. xviii. 1897, pp. 108–115, and plate.

1897. Dublin Nat. Field Club Proc. *Irish Nat.*, vol. vi., 1897, pp. 307–8.

1898. (i.) CARPENTER, G. H.—The smallest of Stridulating Spiders. *Nat. Science*, vol. xii., 1898, pp. 319–322.

1898. (ii.) CARPENTER, G. H.—Spiders collected at Mote Park, Mount Talbot, and Clonbrock. *Irish Nat.*, vol. vii., 1898, pp. 95–96.

1898. (iii.) CARPENTER, G. H.—Kenmare Conference Spiders. *t.c.*, pp. 206–7.

1898. Dublin Microsc. Club Proc. *t.c.*, p. 164.

Very many friends have helped me by collecting spiders in various parts of the country. Hearty acknowledgment is due to them, as without their exertions the present paper would have been much more incomplete than it is. Valuable gatherings have been made by my wife; by my colleagues, Dr. R. F. Scharff, Mr. A. R. Nichols, and

Mr. J. N. Halbert; by Mrs. R. M. Barrington, Mr. J. L. Copeman, the Hon. R. E. Dillon, Mr. H. L. Jameson, Mr. W. F. de V. Kane, Mr. J. J. F. X. King, the Rev. Dr. R. A. M'Clean, Mr. F. Neale, Miss Sydney Smith, and Mr. R. Welch. And I am very specially indebted to three naturalists resident in different parts of the country who have collected for me at all seasons of the year, and have thus largely aided my survey of the distribution of species in Ireland; these friends are the Rev. W. F. Johnson, of Armagh (now of Poyntzpass), Mr. J. N. Milne, of Londonderry, and Mr. J. J. Wolfe, of Skibbereen. It will be seen also how many valuable records are due to the work of the Royal Irish Academy Flora and Fauna Committee.

In general I have followed the nomenclature of M. Simon, adopting, however, in some cases the generic terms used by MM. Chyzer and Kulczynski. Synonyms have, as a rule, only been given where the name used by me differs from that in the well-known monographs of Blackwall and Cambridge. Under each species is given its distribution in Ireland according to the four political provinces—Ulster, Connaught, Munster, and Leinster; material is as yet far too scanty to attempt a county distribution of Irish spiders. With all but the commonest species, however, I have stated the counties in which specimens have been found. I have also endeavoured, as far as possible, to trace the British and general range of each spider mentioned; for the fact that a certain animal occurs in Ireland will not help us to solve any geographical problem, unless we know where else it occurs. In drawing up these outlines of the range of the species outside Ireland, I have relied upon the books and papers enumerated below:—

Becker, L.—Arachnides d'Espagne (Galice). *Ann. Soc. Ent. Belg.*, tome xxv., 1881, pp. lxv-lxvii.

Bosenberg, W.—Die echten Spinnen der Umgebung Hamburgs. *Jahrb. Hamb. Wissens. Anstalten*, vol. xiv.

Cambridge, O. P.—On the Spiders of Scotland, with a list of species. *Entomologist*, vol. x., 1877, pp. 154-9, 174-181, 202-6.

,, General List of the Spiders of Palestine and Syria. *Proc. Zool. Soc. Lond.*, 1872, pp. 212-304.

Cambridge, F. O. P.—List of the Araneida or Spiders of the Channel Islands. *Trans. Guerney Soc. Nat. Sci.*, 1894.

,, A List of the Araneida of Cumberland and the Lake District. *Naturalist*, 1895, pp. 29-48.

Canestrini, G., & Pavesi, P.—Araneidi Italiani. *Atti. Soc. Ital. Sciens. Nat.*, vol. vii., 1868, pp. 758-872.

CARPENTER, G. H., & EVANS, W.—A List of Spiders (Araneida) collected in the neighbourhood of Edinburgh. *Proc. Royal Phys. Soc. Edinb.*, vol. xii., 1894, pp. 527-588.

„ A List of Spiders collected in the neighbourhood of Aviemore, Inverness-shire. *Ann. Scot. Nat. Hist.*, 1894, pp. 227–235.

„ A List of Spiders collected at Oban, Argyllshire. *Ann. Scot. Nat. Hist.*, 1898, pp. 109–114.

CHYZER, C., & KULCZYNSKI, L.—Araneæ Hungariæ, 2 vols. Budapest, 1892-97.

COLLETT, R.—Oversigt af Norges Araneider. 1 Saltigradæ, Citigradæ. *Christiania Videnskabs-Selskabs Forhandl.*, 1875. 2 Laterigradæ, Orbitelariæ. *Ib.* 1876.

FREIBERG, P. R.—Material zur Araneinen-Fauna des Gouvernments Moskau (abstr. in *Zoolog. Anzeig.*, xviii., 1895, p. 500).

HULL, J. E.—Catalogue of the Spiders (Araneida) of Northumberland and Durham. *Nat. Hist. Trans. Northumb., Durham, and Newcastle-upon-Tyne*, vol. xiii., 1896, pp. 57–107.

KULCZYNSKI, W.—Symbola ad Faunam Aranearum Austriæ inferioris cognoscendam. *Dissert. Math. et Phys. Acad. Litt. Cracoviensis*, vol. xxxvi., 1898.

MARX, Geo.—A Contribution to the study of the Spider-fauna of the Arctic Regions. *Proc. Entom. Soc. Washington*, vol. ii., 1891–3, pp. 186–200.

SCHMIDT, P.—Beitrag zur Kenntniss de Laufspinnen Russlands. *Zoolog. Jahrb.* (*abt. Syst.*), vol. viii., 1894–5, pp. 439–484.

SIMON, E.—Les Arachnides de France. Tomes 1–5. Paris, 1874–84.

„ Matériaux pour servir à la Faune Arachnologique des Iles de l'Océan Atlantique. *Ann. Soc. Ant. France*, (6) vol. iii., 1883, pp. 259–314 (*also Bull. Soc. Ant. Fr.*, vol. xiv., 1889, pp. 300–5).

„ Matériaux pour servir à la Faune des Arachnides de la Grèce. *Id.* (6), vol. iv., 1884, pp. 305–360.

„ Liste des Arachnides recueillis . . . en Laponie. *Bull. Soc. Zool. France*, vol. xii., 1887, pp. 456–465.

„ Arachnides recueillis en Islande. *Bull. Soc. Ant. France*, vol. lx., 1891, pp. clxxvi–vii.

„ Arachnides observés à Miranda-de-Ebro. *Ann. Soc. Esp. Hist. Nat.*, vol. xiii., 1883, pp. 113–126.

„ Aracnidos del gabinete de Historia Natural de la Universidad de Seville. *Actas. Soc. Esp. Hist. Nat.*, vol. xvii., 1838, pp. 37–41.

Family.—Atypidæ.

Atypus piceus (Sulz.).

Atypus Sulzeri, Bl. (Spid. G. B. I.).
Leinster.

The presence of this spider in Ireland was made known by the discovery of its tubular nest at Geashill, King's County, by Mrs. Reamsbotham in May, 1896. The nest was kindly forwarded to me by the Rev. Canon Russell, to whom it had been given by the finder. On submitting it to the Rev. O. P. Cambridge, my opinion as to its being a nest of *Atypus* was confirmed, and I recorded the occurrence (1896). Although, in the absence of an example of the spider, one cannot be absolutely sure of the species, there can be little doubt that the nest was the work of the commoner English species of the genus. *A. piceus* appears to range over the south of England from London and Brighton to Cornwall. It is distributed in Holland, throughout western, central, and eastern France, in southern Germany, northern Italy, Austria, and in western, central, and eastern Hungary.

Family.—Dysderidæ.

Dysdera Cambridgei, Thorell.

D. erythrina, Bl. (Spid. G. B. I.).
Ulster, Leinster.

This spider is much scarcer in Ireland than *D. crocota.* I have never seen a male specimen. Mr. Workman (1880) recorded it from Glenarm and Eden, county of Antrim, and has kindly informed me that the Glenarm specimen was identified by Mr. Cambridge. Females in the Dublin Museum collection from Coolmore, county of Donegal, and Leixlip, county of Kildare are, I believe, referable to this species. Its distribution has been traced in Great Britain, from Dorset to Edinburgh. On the Continent it seems the only species of the genus which is found in central Europe, ranging as far north as Paris and Hamburg. In Hungary it has only been found in the north, though it occurs throughout Italy and Sicily.

Dysdera crocota, Koch.

D. rubicunda, Bl. (Spid. G. B. I.).
Ulster, Connaught, Munster, Leinster.

This species is generally distributed throughout Ireland and not uncommon. It has occurred at Londonderry; Armagh; Kircubbin, county of Down; Inish M'Dara, county of Galway; Castlequin, county of Kerry; Cork; Bray, county of Wicklow; Malahide, Kingstown, and Dundrum, county of Dublin, as well as in Dublin city, where it occasionally inhabits houses; perhaps it is taking to an indoor life. Adults occur in the open (under stones, &c.) from May till August; in houses as early as March. In Great Britain this is a rare species, known to occur only in Dorset, the Isle of Man, and Berwickshire, while, like nearly all its congeners, it is a characteristic Mediterranean form abroad (Crete, Greece, Italy, Croatia, Spain, France northward to Paris), occurring also in the Canaries and Azores, in St. Helena, in South Africa, North America, and extra-tropical South America. This discontinuous range shows clearly that it is an old species; like many other ancient forms of life, it seems able to hold its own in Ireland.

Harpactes Hombergii (Scop.).

Dysdera Hombergii, Bl. (Spid. G. B. I.)

Ulster, Connaught, Munster, Leinster.

This species is doubtless generally distributed in Ireland, though not very commonly. I have received specimens from counties Antrim, Donegal, Sligo, Roscommon (Athlone and Mote Park), Kerry (Killarney, Kenmare, and Ventry), Cork (Skibbereen), Kildare (Borris), Wicklow (Bray), and Dublin. Adults have been found in March, May, June, July, August, and November. This spider is widely distributed in Great Britain, ranging at least as far as Oban. It is the only species of a Mediterranean genus which extends northward into Scandinavia, while it is widely distributed over Central Europe (France, Spain, northern Italy, Germany, Austria, northern, eastern, and western Hungary).

Segestria senoculata (L.).

Ulster, Connaught, Munster, Leinster.

Common all over the country, specimens having been taken in numerous localities from Dublin to Galway and from Donegal and Derry to Kerry. The range of the species extends into the far south-western peninsulas (Ventry, Waterville, Berehaven), as well as into the western islands (Achill, Inishmore (Aran), and Inish M'Dara, near Roundstone). Specimens in all stages of growth are to be found at all seasons of the year. It is a widely distributed spider in Great Britain, ranging north at least to Inverness, while on the Continent it inhabits northern and central Europe, ranging south at least to north-western Spain and southern Italy.

Family.—OONOPIDÆ.

Oonops pulcher, Templeton.

Ulster, Connaught, Munster, Leinster.

This little spider, though widespread, is scarce in Ireland. Specimens have been taken in counties of Down (Rathmullan, Craigdarragh), Antrim (Belfast, Islandmagee), Donegal (Rathmullan), Roscommon (Mote Park), Cork (Skibbereen), and Dublin. It is not a common species in Great Britain, though recorded from Dorset, Kent, Hertfordshire, Cambridgeshire, Durham, Northumberland, Westmoreland, Edinburgh, Perthshire, Aberdeen, and Oban. It occurs in Lapland, the Channel Islands, south-western Europe and the Madeiras and Italy, but is apparently absent from the fauna of Central Europe.

Family.—DRASSIDÆ.

Prosthesima subterranea (Koch).

Drassus ater, Bl. (Spid. G. B. I.).

Prosthesima Petiverii, Cb. (Spid. Dorset).

Leinster.

The only Irish example of this spider known to me is an adult male, taken by Mr. Freeman at Powerscourt, county of Wicklow. According to Mr. Workman the species was found by Templeton "in the neighbourhood of Dublin." It has a wide distribution in England (Dorset, Cambridgeshire, Derbyshire, Northumberland), but is only recorded from the extreme south of Scotland. According to Simon it ranges over the greater part of Europe (southwards to Naples), and occurs in Siberia and in North America. In southern France it occurs only in mountainous districts (Alps, Auvergnes, Pyrenees), while in Hungary it is recorded only from the Carpathians.

[Specimens from the county of Clare and Inishmore, Aran, were erroneously recorded by me (1895, ii.) as belonging to this species. They are really referable to the next.]

Prosthesima longipes (L. Koch).

Munster, Connaught.

This spider has, as yet, only been taken in Ireland, near Ballyvaughan, county of Clare, and on Inishmore (Aran Islands, Galway Bay). The specimens, females not quite mature, were taken in July, 1895. In Great Britain this spider has only been recognised in Dorset. On the Continent it inhabits northern and eastern France, southern Germany, northern and central Hungary, and extends into Siberia.

Prosthesima Latreillei, Simon.

Ulster, Munster, Leinster.

This spider seems to be widespread and not rare over the greater part of Ireland. Mr. Workman's collection contains specimens from Colin Glen, county of Antrim, and Craigdarragh, county of Down, while I have received specimens from Limerick; Cratloe, county of Clare; Kenmare and Dingle, county of Kerry; Skibbereen, county of Cork; Lismore, county of Waterford (1894); and Drogheda. It is remarkable that I have never met with the spider in the counties of Dublin and Wicklow. Adult females, guarding their egg-cocoons, are to be observed in June and July, and half-grown individuals in September. This is a rare species in Great Britain, having only been recorded from the south of England (Isle of Wight, Dorset, Salisbury), but I have seen specimens from the Isle of Man and from Westmoreland. On the Continent, *P. Latreillei* inhabits northern and eastern France, southern Germany, Austria, and Hungary.

Prosthesima pusilla (Koch).

Drassus pusillus, Bl. (Spid. G. B. I.).

Prosthesima nigrita, Cb. (Spid. Dorset).

Ulster, Connaught, Leinster.

This appears to be a scarce species in Ireland, yet not so rare here as in Great Britain. It has occurred in the county of Antrim (Portrush and Giant's Causeway); at Londonderry; Coolmore, county of Donegal; Inishmore (Aran), Galway Bay; and Tallaght, county of Dublin. Adult females were observed in July, and immature specimens in April. The only British localities for *P. pusilla* are Dorset, Cambridgeshire, Northumberland, and Edinburgh. Abroad it inhabits Sweden, France (north and east), Switzerland, Bavaria, Tyrol, Italy, Austria, and Hungary.

Drassodes lapidosus (Koch).

Drassus lapidicolens. Bl. (Spid. G. B. I.).

Leinster.

Evidently a rare and local species in Ireland. Mr. Fred. O. P. Cambridge has kindly examined most of our *Drassi* of this group; and the only examples which he refers to this species were taken on the summit of Carrickgallagher, near Shankill, county of Dublin. The rest of the specimens in the Dublin Museum belong to the next species, *D. cupreus*, which has until recently been confounded with this by arachnologists, though Blackwall discriminated between them.

D. lapidosus has been recorded from numerous localities in Great Britain, but it is probable that most, if not all, of the Scottish specimens are referable to *D. cupreus*. It is said to occur throughout the entire Holarctic Region.

Drassodes cupreus (Bl.).

Drassus lapidosus or *lapidicolens* (in part) of Cambridge and other authors.

Ulster, Connaught, Munster, Leinster.

One of our commonest spiders, occurring all over Ireland. Specimens have been taken at numerous localities, from the counties of Antrim and Donegal to Skibbereen and Berehaven in the county of Cork and Slea Head, at the extreme west of Kerry ; on Lambay Island, off the coast of the county of Dublin, as well as on Inishmore (Aran), and Inish M'Dara, off the coast of the county of Galway, and Achill Island, county of Mayo. Males are to be observed in April, May, and June, females from April till November, being most plentiful in June and July, when the young spiders are hatched from the eggs. Cocoons can then be found beneath stones, guarded by the mother. In our list of Edinburgh spiders Mr. Evans and I only recorded adults of this species up to August. In the south of Ireland, however, they last on into November, and at Altidore, county of Wicklow, I have found a female with her newly hatched brood of young so late as September.

Drassodes troglodytes (Koch).

Drassus clavator, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

Widely distributed, but not common. I have seen specimens from Londonderry; Portrush; Clonbrock, county of Galway; Killarney; county of Wicklow (Newcastle and south of Wicklow town), and Drogheda. This spider with us is adult in summer; specimens taken in September are about half-grown. In Great Britain it seems scarce, though widespread—Dorset, Isle of Man, Cumberland, Northumberland, Edinburgh, Oban, Aberdeen, Inverness-shire; while abroad it occurs throughout the Palæarctic Region from the islands of the Atlantic to Mongolia.

[The immature spider doubtfully recorded as *D. delinquens*, Cb., from county of Wicklow (Dubl. Nat. F. C., 1896), is probably referable to *D. troglodytes*].

Drassodes ferrugineus (Bl.).

Ulster.

This species, described by Blackwall (after Templeton) from a single example from Belfast has never been re-discovered, and the type is lost. From Blackwall's figures, there seems no doubt that it is distinct from our other spiders of the genus.

Family—CLUBIONIDÆ.

Clubiona phragmitis, Koch.

C. holosericea, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

This spider is widespread and common, except in the east of Ireland, where it seems to be scarce. It has occurred in the following localities:—County of Antrim (Belfast, Islandmagee, Glenarm); Armagh; Cavan; Enniskillen; county of Galway (Galway, Leenane, Roundstone, Inish M'Dara); county of Roscommon (Mote Park); county of Clare (Finlough); county of Kerry (Killarney, Clonee Lough); county of Dublin (Portmarnock). Adult males have been found from June till August, females from April till November. *C. phragmitis* is widely distributed in Great Britain—northwards to Aberdeen at least, and inhabits Sweden, France (Guernsey, Corsica), Italy, Germany, Austria, and Hungary (northern and central).

Clubiona pallidula (Clerck).

C. epimelas, Bl. (Spid. G. B. I.).

Ulster, Munster, Leinster.

Not scarce in the neighbourhood of Dublin, but apparently uncommon in the north, south, and west of Ireland. Localities:—Londonderry; Cratloe, county of Clare; Lismore, county of Waterford; Greystones, county of Wicklow; Rathmines and Santry, county of Dublin; Lismullen, county of Meath. Adult males have occurred in May and June, females from May till July. In Great Britain this spider ranges north at least to Loch Lomond and Aberdeen, while on the Continent it is found in Sweden, France, Germany, Austria, and Hungary, extending to the shores of the Adriatic.

Clubiona stagnatilis, Kulcz.

C. grisea, Cb. (Spid. Dorset).

Leinster.

The only known Irish example of this spider is an adult male taken at Santry, county Dublin, in May, 1895, by Mr. J. N. Halbert.

and Durham. It inhabits Sweden, northern and eastern France, Germany, Austria, northern and central Hungary, northern Italy.

[*C. formosa*, Bl. (described after Templeton), is doubtless referable to immature specimens of one of the species recorded here, very probably *C. reclusa*, Cb., a spider so common in Ireland that it is hard to believe that it was unknown to Templeton.]

Clubiona terrestris, Westr.

C. amarantha, Bl. (Spid. G. B. I.).

Ulster, Connaught, Leinster, and Munster.

A common and widespread spider in Ireland. Specimens have been taken at various localities from Londonderry and county of Antrim, to Ferns, county of Wexford; Fermoy, county of Cork; and Kenmare, county of Kerry; from Howth, county of Dublin; to Inishmore (Aran), Galway Bay. Adults are to be found from April to September. *C. terrestris* is generally distributed in Great Britain, ranging north to Inverness at least; and on the Continent it inhabits Sweden, France (Corsica), Spain, Italy (northern and central), Germany, Austria, and Hungary.

Clubiona trivialis, L. Koch.

Ulster, Connaught.

The only Irish localities for this species are Newtown-Hamilton, county of Armagh, and Cong, county of Galway. It is a rare spider in England, though occurring in Northumberland and Dorset; it seems more common in Scotland (Edinburgh, Oban, Inverness, Ross-shire, Orkneys). It occurs in Sweden, Russia, Germany, northern Italy, Austria, and Hungary, extending to the Adriatic shore, but is very rare in France, where it seems confined to the north-east.

Clubiona diversa, Cb.

C. pallens, L. Koch.

Ulster.

As yet this spider has been taken only in county of Antrim (Colin Glen) by Mr. Workman (1880), and in county of Armagh in some numbers at various localities (Armagh, Newtown-Hamilton, Poyntzpass) by the Rev. W. F. Johnson. It is a rare species in Great Britain (Dorset, Cheviots, Edinburgh, Glasgow, Dunkeld). Abroad it is recorded from northern and eastern France, southern Germany, Austria, and eastern Hungary.

Clubiona compta, L. Koch.

Ulster, Connaught, Leinster.

This spider seems to be most plentiful in eastern Ireland. It is common in county of Dublin, where I have received or collected it from many localities—Portmarnock, Lucan, Tallaght, Glendhu (Dublin mountains). The only Ulster localities are Londonderry, county of Antrim, and county of Armagh (Loughgilly and Poyntzpass). In the west it has hitherto been found only at Mote Park, county of Roscommon. It is probably absent from Connemara, and no examples have been yet found further south than Bray, county of Wicklow. Adults occur in April, May, June, and immature individuals have been captured in January and March. It is commoner in Great Britain than the preceding species, occurring in numerous localities from Dorset to Oban and Aberdeen. Abroad, it is recorded from Sweden, northern and eastern France, Germany, Austria, northern and central Hungary, and northern Italy.

Clubiona brevipes, Bl.

Ulster, Connaught, Munster, Leinster.

Apparently this is a scarce spider in Ireland. The only localities known to me are Armagh; Ardara, county of Donegal; Slieve Glah, county of Cavan; Dugort, Achill, county of Mayo; Kenmare, county of Kerry; and Enniskerry, county of Wicklow. It is a common species in England, though it has not been found in Scotland further north than Edinburgh. It occurs in the Channel Islands, throughout France (also in Corsica), and in Sweden, Germany, Austria, and Hungary.

Chiracanthium erraticum (Wlck.).

Clubiona erratica, Bl. (Spid. G. B. I.).

Munster, Leinster.

A scarce spider in Ireland. The only localities where it has occurred are Cratloe, county of Clare (coll. F. Neale), and Bray, county of Wicklow (coll. J. N. Halbert). In Great Britain it is widely distributed—Dorset to Oban and the Grampians; as well as on the Continent—Sweden, northern and central France, Germany, Austria, Hungary, and Italy.

Chiracanthium lapidicolens, Simon.

Clubiona nutrix, Cb. (Spid. Dorset).

Connaught.

The only Irish specimen of this spider as yet known is an adult female taken on Inish M'Dara, off Roundstone, by Mr. J. N. Halbert, when collecting in April, 1896, for the R. I. A. Flora and Fauna Committee. It is a scarce species in Great Britain, though recorded from Dorset, Hertfordshire, Lancashire, Perthshire, and Aberdeen; and on the Continent, though widely distributed (Sweden, France, Italy, Germany, Austria, and Hungary).

Anyphæna accentuata (Wlck.).

Clubiona accentuata, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

Widely distributed, but apparently common only in Leinster; as yet there is but a single locality for each of the three other provinces: Londonderry; Clonbrock, county of Galway; and Kenmare, county of Kerry. In Leinster the species has been observed in counties of Dublin (Lucan), Wicklow (Bray, Rathdrum, and Woodenbridge), and King's County (Tullamore). Adult in April and May, and also in July, August, and September. Very young individuals have been taken both in June and September, so it is possible that there are two generations in the course of the year. It is widespread in Great Britain (Dorset, Perthshire) and on the Continent (Sweden, France, Corsica, Germany, Austria, Hungary, and Italy).

Zora spinimana (Sund.).

Hecaërge maculata, Bl. (Spid. G. B. I.).

Ulster, Munster, Leinster.

Apparently a scarce spider in Ireland. I have collected it at Woodenbridge, county of Wicklow (adult male, September, 1894), and received it from Mr. J. N. Milne (1897), who took specimens near Londonderry, and from Mr. R. Welch, who found an immature female at Kenmare in April, and adults in July, 1898. It is widespread in Great Britain, ranging north, at least, to Oban and Aberdeen. On the Continent it occurs in Sweden, throughout France (also in Corsica), in Germany, Austria, and Hungary, Italy, Syria, and north Africa.

Micariosoma festivum (Koch).

Drassus propinquus, Bl. (Spid. G. B. I.).

Connaught.

The only Irish locality for this spider, as yet, is Inishmore, Aran, Galway Bay, where I took an immature male in July, 1895, when collecting for the R. I. A. Flora and Fauna Committee. In Great Britain this species ranges north, from Dorset to Edinburgh, at least, while on the Continent its distribution is similar to that of the preceding species.

Micaria pulicaria (Sund.).

Drassus nitens, Bl. (Spid. G. B. I.)

Ulster, Connaught, Leinster.

Apparently a scarce spider in Ireland. Specimens have been taken only at Colin Glen and Islandmagee, county of Antrim; Armagh; Achill Island, county of Mayo; Killencoole, county of Louth; and Carrickmines, county of Dublin. Adult in June. This species is widely distributed in Great Britain ranging north as far as the Grampians at least. It inhabits Sweden, France (Channel Islands and Corsica), Germany, Austria, Hungary, and northern Italy.

Agroëca proxima, Cb.

Ulster, Connaught, Munster, Leinster.

Apparently a local spider in Ireland, though widespread. I have but few localities: Portrush; Keishconnor, county of Sligo; Limerick; Portraine, Portmarnock, and North Bull, county of Dublin. Mr. Workman records it (1880) doubtfully from Cave Hill, Belfast. Adult in July and August. The earthen egg-cocoons attached to rushes with young spiders just hatched were found by Mr. F. Neale near Limerick in July, 1897. The only British localities for this spider are Dorset, Edinburgh, and Oban. In France it is generally distributed, but most common in the north; it is a very rare spider in Austria, and does not seem to have been recognized elsewhere on the Continent.

Agroëca celans (Bl.).

Agelena celans, Bl. (Spid. G. B. I.).

Leinster.

The only Irish specimen of this spider is an immature male which I took in the Devil's Glen, near Wicklow, July, 1892. It is a rarity in Great Britain, recorded only from Dorset, north Wales, and Carlisle. On the Continent it is generally distributed in France, and has occurred in Croatia and northern Italy.

Agroëca gracilipes (Bl.).

Agelena gracilipes, Bl. (Spid. G. B. I.).

Ulster, Connaught.

I have seen only two examples of this spider in Ireland, an immature male taken by the Rev. W. F. Johnson at Armagh in May, 1895, and an immature female collected at Roundstone, county of Galway, for the R. I. A. Flora and Fauna Committee by Mr. J. N. Halbert in April, 1896. In Great Britain *A. gracilipes* has been found in the south of England (Dorset, Hants), and in Scotland (Edinburgh, *Philodromus cespiticolis*, Wlck.

Ulster, Connaught, Munster, Leinster.

This spider has occurred in counties of Armagh (Churchill and Slieve Gullion), Roscommon (Mote Park), Cork (Fermoy), Kerry (Parknasilla), and Dublin (Tallaght, Portmarnock). It is adult in May, June, and July. By many authorities this is considered a variety or sub-species of *P. aureolus.*

Philodromus aureolus (Clerck).

Ulster, Connaught, Munster, Leinster.

This spider seems of general occurrence over a large part of Ireland, but I have no specimens from the farther regions of the north, west, or south. It has occurred at Stranmills, near Belfast (1880); at Armagh; in county of Roscommon (Athlone); county of Galway (Clonbrock and Cong); county of Clare (Cratloe); county of Kerry (Clonee Lough); county of Wicklow; county of Dublin (Dundrum, Portmarnock, Santry, Howth); and county of Louth (Dunleer). Adults are found from May till July; young and immature specimens from April till September. *P. aureolus* has a wide range in Great Britain (northwards, at least, to the Grampians), and on the Continent, where it extends from the far north of Norway and Finland to Corsica, Croatia, south Italy, and Greece, eastwards to China and Kamtschatka, inhabiting also North America.

Misumena vatia (Clerck).

Thomisus citreus, Bl. (Spid. G. B. I.).

Connaught, Munster, Leinster.

This handsome spider seems to be confined to the southern half of Ireland, and does not appear to range far westwards. It has occurred at Loughrea, county of Galway; Limerick; Cratloe, county of Clare; Cork; Kildare; Avondale, Ashford, and Enniskerry, county of Wicklow. Adult females have been taken in June, August, and September, a young specimen in July, and an immature male in September. It is common in the southern half of England. In Norway it extends north to 62° lat., while it inhabits Sweden, France, Spain, Germany, Austria, Hungary, Croatia, Italy, Greece, and Crete, as well as Central Asia and North America.

Oxyptila trux (Bl.).

Thomisus trux, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This spider seems to be not scarce in Ireland. Specimens have been found in the county of Donegal (Coolmore); county of Armagh (Armagh, Loughgilly, and Poyntzpass); county of Galway (Clonbrock and Inishmore, Aran); county of Kerry (Dingle); county of Wicklow (Enniskerry); county of Dublin (Terenure); and county of Louth (Drogheda). Adults have been observed in January, February, April, May, and September, immature specimens in January, and quite young individuals in July. It is widely distributed in Great Britain (Dorset, Grampians), and inhabits Belgium, northern and eastern France, southern Norway, Sweden, Germany, Austria, western Hungary, and Poland.

Oxyptila praticola (Koch).

Thomisus incertus, Bl. (Spid. G. B. I.).

Munster, Leinster.

An adult female, which I captured, August, 1895, in the woods at Braganstown, county of Louth (Dublin Nat. F. C., 1895), and another female, taken by Mr. Halbert near Dingle, county of Kerry, in May, 1894, are the only examples of this species yet found in Ireland. It is widely distributed in England (Dorset, Yorkshire), and inhabits southern Norway and Sweden, Belgium, north-eastern France, Germany, Austria, Hungary, Croatia, and northern Italy.

Oxyptila flexa, Cb.

Leinster.

A single male of this spider was taken by Mr. J. N. Halbert at Santry, county of Dublin, in May, 1894. Believing that the species was new to the British Isles, I sent it to Mr. Cambridge, who informed me that it was identical with English specimens which he was then in the act of describing (1895). *O. flexa* has been found in Durham, Leicestershire, Cambridgeshire, and Kent. As yet it does not seem to have been recognised on the Continent. In May, 1895, Mr. Halbert found another male at Portmarnock, county of Dublin.

Oxyptila horticola (Koch).

Thomisus versutus and *T. pallidus*, Bl. (Spid. G. B. I.).

Xysticus atomaria, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

This is a widespread species in Ireland, but appears to be scarcer than *O. trux*. It is recorded by Mr. Workman (1880) from Colin Glen, county of Antrim, and I have seen specimens from Londonderry; county of Galway (Roundstone and Inishmore, Aran); county of Kerry (Dingle and Parknasilla); and Drogheda. Adult males and females occur in April; females also in September; young specimens are found in July and August. This spider ranges northwards in Great Britain, at least to Oban and the Grampians. It inhabits Lapland, Sweden, France, Spain, Germany, Austria, Hungary, Croatia, and Italy.

Xysticus sabulosus (Hahn).

Thomisus sabulosus, Bl. (Spid. G. B. I.).

Connaught.

An adult female, taken near Athlone, by Mr. J. J. F. X. King, in August, 1894, and an immature female collected at Clonbrock, Co. Galway, by Mr. J. N. Halbert, in June, 1896, are the only examples of this species yet found in Ireland. In Great Britain this spider ranges northward to the Grampians. It is found in Sweden, Germany, Belgium, France, north and central Hungary, Spain, and Greece.

Xysticus erraticus (Bl.).

Thomisus erraticus, Bl. (Spid. G. B. I.).

Ulster, Munster, Leinster.

An adult male of this species was sent me in May, 1892, by Miss S. Smith, of Drogheda, who had taken it at Termonfeckan, Co. Louth, while a pair (adult) were captured near Londonderry by Mr. J. N. Milne (1895), in September, 1894, and an immature female was found near the Upper Lake of Killarney, in July, 1898. The species, though scarce, has therefore a fairly wide range in Ireland. In Great Britain it has been found in Dorset, North Wales, and Aberdeenshire, but is uncommon. On the Continent it inhabits southern Norway and Sweden, Belgium, north-eastern France, Germany, Austria, and Hungary.

Xysticus ulmi (Hahn).

Leinster.

An adult female, taken at Howth, in September, 1891, by Mr. W. F. de V. Kane, remains the only Irish example of this spider which I have seen. It is a rare species in Great Britain; recorded only from Dorset and Oxfordshire. On the Continent it inhabits Norway (to 65° N. lat.), Sweden, Belgium, north-eastern France, Germany, Austria, Hungary, and Croatia.

Xysticus cristatus (Clerck).

Thomisus cristatus, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

Generally distributed and very common, ranging from counties of Donegal and Antrim to Wexford and Cork (Skibbereen); and from

Howth and Lambay Island, county of Dublin, to Roundstone in Connemara; extending also into the south-western peninsulas (Parknasilla, Berehaven), and being found 1000 feet up on the hills. Adult females of this species occur all the year round; males are abundant in May and June, but have been noticed also in April and September. Quite young individuals occur in March, June, July, and December, and immature specimens mostly in August and September. Doubtless this species is equally widespread in Great Britain; while abroad it ranges from the extreme north of Norway and Finland to the south of Spain and the islands of the Mediterranean, ascending the Alps to a height of 3000 feet.

Family—AGELENIDÆ.

Cryphoëca sylvicola (Koch).

Tegenaria sylvicola, } Bl. (Spid. G. B. I.).
Agelena Hyndmanii, }

Ulster, Connaught, Munster, Leinster.

A local species in Ireland, but widely spread, and not absent from the south as in Great Britain. Recorded by Mr. Workman (1880) from Colin Glen, county of Antrim; it has been sent to me from Londonderry (Milne, 1895); Belleisle, county of Fermanagh; and Poyntzpass. Mr. D. W. Freeman has taken the spider in county of Dublin; Mr. J. N. Halbert found it on the summit of Slievemore, Achill Island, as well as near the Upper Lake of Killarney. I have collected it at Clonbrock, county of Galway. Adults occur in May, July, September. It is remarkable that, in Great Britain, this species seems absent from the south, ranging from the north of Scotland to Norfolk, since it is widely distributed on the Continent, occurring from the north of Norway and Finland to the south of France, Hungary, and Croatia, and extending eastwards to Siberia.

I have little doubt that *Agelena Hyndmanii* (described from Templeton's Belfast specimens) is a synonym of this species. Blackwall's figures of the eyes show that the species is not an *Agelena* but a *Cryphoëca*. *C. sylvicola* often assumes a greenish-brown hue, and an abnormal specimen might very well appear as green as Blackwall's figure, of *A. Hyndmanii*, which is said in the description to be sometimes brown and black.

Argyroneta aquatica (Cl.).

Ulster, Leinster.

The water-spider is probably not uncommon in the north of Ireland. Mr. Workman records it (1880) from Lurgan; Rev. W. F. Johnson has collected it at several localities in county of Armagh (Lowry's Lough, Loughgilby, Clonmacate, near Lough Neagh); Mr. W. F. de V. Kane, near Monaghan; Mr. R. Welch, at Downpatrick, and at a height of 1100 feet on the Mourne Mountains, county of Down; and Mr. H. L. Jameson on Braganstown Bog, county of Louth. Mr. D. W. Freeman has taken it at Blanchardstown, county of Dublin; and a specimen from the Royal Canal, near Dublin, is in the collection of the late Dr. Templeton. In Great Britain *A. aquatica* ranges north at least to the Grampians. On the Continent it is recorded from Lapland, Sweden, northern France, Germany, Austria, Bohemia, Hungary, Croatia, and northern Italy.

Tegenaria parietina (Fourc.).

T. domestica, Bl. (Spid. G. B. I.).
T. Guyonii, Cb. (Spid. Dorset).
Leinster.

This spider is very rare in Ireland, and from the places where it has been taken can only be considered as doubtfully native. An adult male was found in a house at Greystones, county of Wicklow, by Mr. F. Wynne, in August, 1883. Another adult male was discovered in Guinness's Brewery, Dublin, in 1896; the finder sent it to Professor G. V. Hart, who kindly gave it to the Museum. In Great Britain this species seems confined to the south of England (Dorset, London, Oxford, Cambridge). In France it inhabits dwelling-houses in the north, and lives in the open air in the south. It is distributed throughout southern Europe and northern Africa, extending to the Azores and Canaries.

Tegenaria domestica (Clerck).

T. civilis, Bl. (Spid. G. B. I.).
T. Derhamii, Cb. (Spid. Dorset).
Ulster, Connaught, Munster, Leinster.

Apparently much commoner in the north and east of Ireland than in the south and west. Rathlin Island, county of Antrim; Belfast and neighbourhood (Workman); county of Donegal (Letterkenny, Coolmore, and Bogay); Enniskillen; Omagh; Londonderry; county of Armagh (Armagh, Loughgilly, and Poyntzpass); county of Sligo (Ballymote); Galway; county of Cork (Skibbereen). Common in Dublin and neighbourhood, and occurs in county of Wicklow. Though generally found in houses, it is not confined to them; I have taken a specimen under stones on Ireland's Eye (off Howth, county of Dublin), which is now uninhabited. Adults occur from May till September.

In Great Britain this spider is probably of general occurrence, while its foreign distribution seems cosmopolitan (Europe, Tibet, Ceylon, South Africa, Australia, America, including Labrador).

Tegenaria hibernica, Cb.

Munster, Leinster.

I took the type of this species in September, 1889, between the stones of one of the walls surrounding the "Seven Churches" at Glendalough, county of Wicklow. Recognizing the spider (an adult male) as new to the Britannic fauna, I sent it to the Rev. O. P. Cambridge, who described it as a new species (1891), and it was shown at the Dublin Microscopical Club (1892). The specimen measured about 8 mm. in length. Previously I had collected and received from houses in Dublin and suburbs, specimens of Tegenaria of a much larger size (15-16 mm.) which I referred to *T. atrica*, Koch. In October, 1892, Mr. W. F. de V. Kane sent me an adult male Tegenaria from Kingstown, county of Dublin, 12 mm. long, which was clearly cospecific with the Glendalough spider. This led to a careful examination of the large Dublin males, and their structural identity with *T. hibernica* was at once evident. I sent large specimens of both sexes to Rev. O. P. Cambridge, who described and figured the female (1893), pointing out its divergence from *T. atrica*. I have no doubt that the specimens taken by Dr. Templeton near Dublin, and recorded by Mr. Workman (1880) as *T. atrica*, were in reality *T. hibernica*.

This grand spider is common in houses in Dublin and suburbs; it is usually to be found adult in August, September, and October. A male has been sent me from Cork, by Mr. J. L. Copeman, and a female from Skibbereen, county of Cork, by Mr. J. J. Wolfe. Though usually found in houses, it is not confined to them. The type specimen was taken, as has been stated, out-of-doors in county of Wicklow. Specimens have also been taken in stone walls around Dublin, and Mr. J. N. Halbert has found examples on the North Bull, Dublin Bay, beyond Clontarf.

T. hibernica is closely allied to, if not identical with the Pyrenean and Spanish *T. nervosa*, Simon, and I have no doubt that it is not an introduced species in Ireland, but a member of the old south-western fauna, which has maintained its groundby taking to an indoor life.

Agelena labyrinthica (Cl.).

Connaught, Munster, Leinster.

This spider seems to be common in the south and west of Ireland; rare in the east, and absent from the north. I have received specimens from the counties of Galway (Roundstone and Connemara), Clare (Ballyvaughan), Kerry (Derrynane), Cork (Berehaven, Skibbereen, Fermoy, and Youghal), Waterford (Cappagh), Wexford (Ferns), and Dublin (Portmarnock, Donabate). It is certainly very scarce in the county of Dublin, and I have never met with it in the county of Wicklow. Adults are found in July, August, and September; very young individuals in December, and half-grown specimens in May and June; it appears, therefore, that the young spiders hibernate. In Great Britain, *A. labyrinthica* seems also a southern species; I know of no records for northern England or for Scotland. Abroad it inhabits Sweden, France, Spain, Germany, Austria, Hungary, Croatia, Italy, and Greece.

Textrix denticulata (Oliv.).

Textrix lycosina, Bl. (Spid. G. B. I.).

Ulster, Connaught, Leinster, Munster.

This is one of our commonest and most widespread species, ranging from the counties of Antrim (Rathlin Island) and Londonderry into the far south-western peninsulas (Slea Head and Cloonee Lough, county of Kerry; Bere Island, Glandore, and Skibbereen, county of Cork); from Dalkey Island off the county of Dublin to Achill Island, county of Mayo; Inishmore, Aran, and Inish Mac Dara off the county of Galway. I have taken specimens 2000 feet up on the Wicklow and Kerry mountains. Specimens in all stages of growth are to be found at all seasons of the year. Very widely distributed in Great Britain (Dorset, Sutherlandshire), *T. denticulata* seems commoner in the north than in the south. On the Continent it inhabits Sweden, France (northern and central), north-western France, Germany, Switzerland, Austria, northern and central Hungary, and northern Italy.

Hahnia elegans (Bl.).

Agelena elegans, Bl. (Spid. G. B. I.).

Ulster, Munster.

Adult males and females were sent me from Londonderry in September, 1894, by Mr. J. N. Milne (1895), and another adult pair were collected at Enniskillen by Mr. H. L. Jameson for the R. I. A. Flora and Fauna Committee in July, 1895, while an immature male was found at Kenmare in July, 1898, by Mr. J. N. Halbert.

In Great Britain this spider ranges north to Oban. On the Continent it has been found in Sweden, throughout France (Sark, Corsica), in Germany, Austria, Hungary, Croatia, and northern Italy.

Hahnia montana (Bl.).

Agelena montana, Bl. (Spid. G. B. I.).

Ulster, Connaught.

Specimens of this spider were collected at Portrush by the Rev. W. F. Johnson in April, 1894, and I captured a pair of adults on the summit of Ben Lettery, Connemara, when collecting for the R. I. A. Flora and Fauna Committee in July, 1895. *H. montana* seems generally distributed in Great Britain (Dorset, Grampians), but has not yet been recognized elsewhere.

Family.—DICTYNIDÆ.

Dictyna arundinacea (L.).

Ergatis benigna, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

Evidently a widespread species, though I have as yet but few records—Armagh; Carndonagh, county of Donegal; Mt. Talbot, county of Roscommon; Glencar, county of Kerry; and Tullamore. Adult in May and June. In Great Britain it ranges from Dorset to the Orkneys; and on the Continent inhabits Sweden, France, Germany, Austria, Hungary, Italy, and Croatia, extending eastward to Syria.

Dictyna uncinata, Thorell.

Ulster, Connaught, Munster.

This spider has, as yet, been found in Ireland only near Belfast by Mr. Workman (1880); in the limestone district of eastern Connaught, at Clonbrock, county of Galway, and Mote Park, county of Roscommon; and at Kenmare, county of Kerry. Adult in June and July. Immature individuals occur both in June and September. Its British and general distribution are similar to those of the preceding species.

Dictyna latens (Fab.)

Ergatis latens, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

As yet the only Irish localities whence I have collected or received this species are Londonderry; Clonbrock, county of Galway; shores of Lough Ree; Kenmare, county of Kerry; Tallaght, Howth, and Baldoyle, county of Dublin. Adult in May, June, and July. *D. latens* is common in the south of England, but I know of no records for the north or for Scotland. It inhabits Sweden, France, Spain, Italy, Croatia, and Germany, becoming rare in Hungary, where it is confined to the west.

Amaurobius fenestralis, Strœm.

Ciniflo atrox, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is one of the most abundant and widespread of Irish spiders, occurring from the counties of Antrim and Londonderry to Skibbereen and Baltimore in the county of Cork; from Dalkey Island off the county of Dublin to Inishmore and Aran in Galway Bay. Specimens of all ages are to be found at all seasons of the year. It is a common spider in Scotland (recorded from Sutherlandshire) and northern England, but becomes very rare in the south, a remarkable fact seeing that it occurs throughout France, as well as in Sweden, Germany, Austria, Hungary, Croatia, and northern Italy.

Amaurobius similis (Bl.).

Ciniflo similis, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This species is very common and generally distributed over Ulster and Leinster; usually, though not universally, found in houses and outbuildings. In Connaught and Munster it is decidedly scarcer than *A. fenestralis*. The only western and southern localities known to me are Ballymote, county of Sligo; Clonbrock and Roundstone, county of Galway; Skibbereen, county of Cork; Waterville, county of Kerry. Adults occur all the year round. It is a common species in the south of England, and ranges north at least to Oban and Inverness. It is also generally distributed in France, is recorded from north-western Spain, and has occurred at Hamburg[1] but it seems absent from the Scandinavian, Austrian, and Hungarian faunas. It may probably be regarded as a member of the Lusitanian fauna, which has maintained its ground throughout the British Isles by taking to an indoor life.

Amaurobius ferox (Wlck.).

Ciniflo ferox and *C. mordax*, Bl. (Spid. G. B. I.).

Ulster, Munster, Leinster.

This spider is not scarce in and around Dublin, nor indeed in Leinster generally. Specimens have been taken at Drogheda, Lismullen, county of Meath, and Borris, county of Kildare. In the south-west the only localities known to me are Skibbereen, county of Cork; Kenmare and Caragh Lough, county of Kerry; while in Ulster it has occurred at Armagh, Poyntzpass, and Craigdarragh, county of Down. Adults are found in April, May, and August. A common

[1] According to a note in Mr. Workman's Irish list, but it was possibly introduced there, as it is omitted from Herr Bösenberg's recent Hamburg list.

spider in southern England, *A. ferox* has been traced northward as far as Edinburgh, while abroad it is recorded from Sweden, France, Spain, Germany, Austria, Hungary, Croatia, and Italy.

Family.—PHOLCIDÆ.

Pholcus phalangioides (Fues.).

Munster.

This spider seems to be confined to the south-western province. It was first noticed by Mr. Freeman and myself in an outhouse at Lismore, county of Waterford, in July, 1894 (1894). Since, I have received specimens from Limerick, Skibbereen, and Whitegate, county of Cork and Glencar, county of Kerry. Adults and immature specimens have been found from May until September. In Great Britain this species is confined to the south of England, ranging into Cornwall. It is generally distributed throughout the temperate regions of Europe, Asia, and North Africa, occurring also in the Atlantic Islands (Azores, St. Helena), in South Africa, and in the mountainous and southern parts of South America.

Family.—THERIDIIDÆ.

Ero furcata (Vill.).

Theridion variegatum, Bl. (Spid. G. B. I.).
Ero thoracica Cb. (Spid. Dorset).
Ulster, Connaught, Leinster.

A widespread species in Ireland, but apparently scarce. Mr. Workman (1880) records it from Colin Glen, county of Antrim. Adult females have been found at Londonderry and at Portmarnock, county of Dublin (May), young females on the North Bull, Dublin Bay (June), an egg-cocoon at Ashford, county of Wicklow (June), and a single male at Clonbrock, county of Galway (September). In Great Britain *E. furcata* ranges north to Oban and the Grampians, and occurs in the Isle of Man, while it has a very wide range on the Continent (France, Scandinavia, Germany, Austria, Hungary, Croatia, Italy), occurring also in the Azores and in North America.

Episinus truncatus, Wlck.

Theridion angulatum, Bl. (Spid. G. B. I.).
Munster, Leinster.

The only Irish localities for this spider yet known are Skibbereen, county of Cork, where Mr. J. J. Wolfe found an adult male in the summer of 1897, and Ashford, county of Wicklow, where I took an adult male in June, 1898. It seems to be a southern species; although it extends its range into Scotland and southern Sweden, it is rare in those countries. It occurs in the Channel Islands, throughout France, in central Russia, in Austria, and in Hungary (northern, eastern, and western), and in northern Italy.

Nesticus cellulanus (Clerck).

Linyphia crypticolens, Bl. (Spid. G. B. I.).

Ulster, Leinster.

The only localities whence I have received this spider are Enniskillen, Londonderry, Drogheda (in the Dowth tumulus), and Leixlip, county of Kildare. Adults occur from July to September. Doubtless the spider is widely distributed in Ireland, but, owing to the underground and concealed places where it lives, not often observed. Ranging at least northward to the Grampians in Great Britain, it is distributed over central and southern Europe, but is a very rare spider in northern Germany and Scandinavia, though in Russia it is recorded from the neighbourhood of Moscow.

Theridion bimaculatum (L.).

T. carolinum, Bl. (Spid. G. B. I.).

Ulster, Leinster.

This species is recorded by Mr. Workman (1880) without locality. It is not scarce in eastern Ireland, having been found at Portmarnock and Glendhu, county of Dublin; Maynooth, county of Kildare; Bray and Avoca, county of Wicklow. Adults occur in May and June, also in September. In Great Britain this spider seems only to have been noticed in Dorset and Lancashire. It occurs throughout France (also Channel Islands and Corsica), and in Sweden, Germany, Austria, Hungary, Croatia, and northern Italy.

Theridion lineatum (Clerck).

Ulster, Connaught, Munster, Leinster.

This is one of our commonest spiders. It ranges from Londonderry and the county of Antrim to the counties of Waterford and Cork (Skibbereen); from Dublin to Connemara (found on Inish McDara); and extends into the south-western peninsulas (Kenmare, Derrynane). In Great Britain its range is also general, and it occurs throughout Europe, as well as in North America.

Theridion varians, Hahn.

Ulster, Munster, Leinster.

This appears to be a scarce spider in Ireland. Mr. Workman (1880) records it, without locality. The only specimens which I have seen are a male and two immature females collected by Mr. J. N. Milne near Londonderry, in July, 1894, an adult female, taken in the county of Dublin by Mr. D. W. Freeman, and another adult female from Cloonee Lough, county of Kerry, July, 1898. In Great Britain, *T. varians* ranges north to the Grampians at least, while it is distributed throughout Europe and the Mediterranean region, occurring also in Siberia.

Theridion tinctum, Wlck.

Connaught.

A male and female, not quite mature, taken at Mote Park, county of Roscommon, in June, 1897, are the only Irish examples of this species which I have yet seen. In Great Britain it seems unknown, except in the south of England, while in Europe it inhabits Sweden, France, Corsica, Germany, Austria, Hungary and Croatia, and northern Italy, while it extends its range across Siberia and China to Japan.

Theridion denticulatum, Wlck.

Ulster, Leinster.

Mr. Workman (1880) records this species from the neighbourhood of Belfast, while Mr. D. W. Freeman has taken it in the county of Dublin. It ranges in Great Britain northwards at least to the Grampians, and is distributed throughout Europe, extending to the Azores, North Africa, and Syria.

Theridion tepidariorum, Koch.

Ulster, Leinster.

This spider occurs in greenhouses in Dublin, Belfast, and Londonderry, and probably all over the country. Its title to a place in the Irish fauna is of course exceedingly doubtful; but as it has an almost world-wide range, and lives in the open air in southern Europe, and occasionally in the south of England, it is possible that it may have been indigenous at least in the south of Ireland.

Theridion aulicum, Koch.

T. rufolineatum, Cb. (Spid. Dorset).

Ulster.

This species is recorded by Mr. Workman (1880) without locality.

I have never seen an Irish specimen. Its occurrence in the north of Ireland is remarkable, as in Great Britain it seems confined to the south of England, while abroad it is a distinctly Mediterranean species, inhabiting western and southern France, Spain, Italy, Greece, Madeira, north Africa, and Syria.

Theridion vittatum, Koch.

T. pulchellum, Bl. (Spid. G. B. I.).

Leinster.

Several adults of both sexes, collected by Mr. D. W. Freeman in county of Dublin, are the only Irish examples of this spider which I have seen. In Great Britain it has been found in southern England, north Wales, and Cumberland, while it is distributed throughout Europe and occurs in Japan.

Theridion sisyphium (Clerck).

T. nervosum, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This spider is common in the north and east of Ireland, but I have seen no specimens from county of Donegal or Connemara. The limits of its range, as at present known to me, would be marked by a line passing from Londonderry, through Enniskillen, Mote Park (county of Roscommon), Tuam and Cong (county of Galway), Cratloe (county of Clare), Limerick, and Cloonee Loughs (county of Kerry). To the east of this line it is generally distributed, and it doubtless awaits discovery in more western districts. Adults are found from April to August. In Great Britain *T. sisyphium* ranges far to the north (Sutherlandshire), and inhabits abroad Greenland, Lapland, Norway, Sweden, Finland, France, Corsica, Germany, Spain, Austria, Hungary, Croatia, and Italy.

Theridion simile, Koch.

Ulster.

For this species I am again indebted to Mr. Workman's list (1880), having never seen an Irish example myself. It is found in England, Scotland, Sweden, France, Corsica, Germany, Austria, Hungary, Croatia, and Syria.

Theridion pallens, Bl.

Ulster, Connaught, Leinster.

This little spider was found by Mr. Workman (1880) in county of Antrim. I have received specimens from Armagh; Mote Park, county of Roscommon; Clonbrock, county of Galway; Tullamore, King's

County; Terenure and Tallaght, county of Dublin; Glendalough, county of Wicklow; Laytown, county of Meath. It is adult in May, June, and September. In Great Britain *T. pallens* ranges north to the Grampians. On the Continent it inhabits France, Corsica, Spain, Italy, Germany, and northern Hungary.

Euryopis hæmatostigma (Bl.).

Theridion hæmatostigma, Bl. (Spid. G. B. I.).

Ulster.

This species is described by Blackwall after Templeton, who took specimens at Belfast. It has never been re-discovered; but as it seems undoubtedly distinct from any other species recorded in this list, I insert it under the genus to which it most probably belongs.

Lasæola inornata (Cb.).

Theridion inornatum, Bl. (Spid. G. B. I.).

Euryopis inornata, Cb. (Spid. Dorset).

Leinster (?).

A single adult male of this species, without locality, is in the collection of the late Dr. Templeton in the Dublin Museum. As all the specimens in this collection which are localised were collected in counties of Dublin, Wicklow, and Meath, it is most likely that this individual is from Leinster. In Great Britain this spider seems confined to the south of England. On the Continent it inhabits western and southern France, Spain, Hungary, Croatia, Switzerland, and northern Italy.

Teutana grossa (Koch).

Theridion versutum, Bl. (Spid. G. B. I.).

Steatoda versuta, Cb. (Spid. Dorset).

Munster.

The discovery of this fine spider in Ireland is due to Mr. J. J. Wolfe, who sent me during the summer of 1895 an adult female and a young individual from Skibbereen, county of Cork. It is a very rare species in Great Britain, having been found only at one or two places in the south of England (Winchester, Bristol). Abroad it is a characteristically Mediterranean form, extending to Greece, the Canaries, and Azores. It is a rare species in northern Europe, being occasionally found in houses in Sweden and Finland.

Enoplognatha thoracia (Hahn).

Neriene albipunctata, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

This spider appears to have a wide range on the Irish coast.

Though I have received it from only six localities, these are widely separated: Portrush, county of Antrim; Roundstone, county of Galway; Cloonee Lough, county of Kerry; Skibbereen, county of Cork; North Bull, county of Dublin; and Drogheda, county of Louth. Adult in April and May; also in July and August. It seems to be a scarce spider in Great Britain, but has occurred in Dorset and at Oban in Scotland. Abroad it is found in France, Germany (Hamburg), Austria, and Hungary. The genus is characteristic of the Mediterranean region, several species extending their range to the Atlantic islands, and others being found in the tropics.

Pedanostethus lividus (Bl.).

Neriene livida, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is a common species, apparently spread over the whole country, and ascending the mountains to over 3000 feet. Counties of Antrim, Derry, and Donegal, to Glandore, county of Cork, and Glencar and Derrynane, county of Kerry; Dublin to Achill Island, county of Mayo; and Leenane, county of Galway. Adults have been found in all months from March till November. It is universally distributed in Great Britain (Dorset, Orkneys); and, according to Simon, is spread over the whole of Europe, occurring also in Siberia and in North America.

Theonoe minutissima (Cb.).

Walckenaëra minutissima, Cb. (Spid. Dorset).

? *Theonoe filiola*, Simon (Arach. France).

? *Coressa minutissima*, Simon (Hist. Nat. Araignées).

Onesinda minutissima, Cb. (1895).

Ulster, Connaught.

This tiny spider is possibly widely distributed in Ireland, but I have as yet only seen two females—one taken at Ardara, county of Donegal, by Rev. W. F. Johnson, in July, 1889, and shown at the Dublin Microscopical Club (1896); the other on Leenane Mountain, county of Galway, by Mr. J. N. Halbert, in April, 1897, when collecting for the R. I. A. Flora and Fauna Committee.

There can, I think, be no doubt that the genus *Onesinda*, which Mr. Cambridge established a few years ago for the reception of this minute spider, is identical with *Theonoe* of Simon—the convex sternum, the high clypeus, the strongly inclined maxillæ, and the globular abdomen being characteristic of both descriptions. In all probability the present species is identical with Simon's *T. filiola*, which seems to agree with it exactly in the elongate tarsi, and the position of the hind row of eyes. In the description of the eyes of the front row there is a discrepancy; according to Mr. Cambridge the front centrals of *O. minutissima* are a diameter apart, while M. Simon states that in *T. filiola* they are but a radius apart. But this is often a variable character, and the two descriptions are taken from different sexes. It is, I think, doubtful whether the spider on which M. Simon founded his genus *Coressa* is really *Walckenaëra minutissima*, Cb., since he places it in his group *Erigoneæ*, characterised by parallel maxillæ without terminal claw to the palp. Mr. Cambridge's species, with strongly inclined maxillæ and clawed palps, is undoubtedly a theridiine, nearly related to *Pholcomma*. As the species has been found at Balmoral, Scotland, and Portland, Dorset, it has probably a wide range in Great Britain. *T. filiola*, Simon, is recorded from the departments of Ain and Aube in eastern France.

Pholcomma gibbum (Westr.).

Ulster, Connaught.

This species is recorded by Mr. Workman (1880) from Colin Glen, county of Antrim. A female was found on Leenane Mountain, county of Galway, in April, 1897, by Mr. J. N. Halbert. It has a wide range in Great Britain (Dorset, Isle of Man, Oban, Inverness-shire), and also on the Continent where it extends from Sweden and Russia to Algeria.

Ceratinella breve (Wid.).

Walckenaëra depressa, Bl. (Spid. G. B. I.).

W. brevis, Cb. (Spid. Dorset).

Ulster, Leinster.

This spider has occurred in counties of Donegal (Ardara), Monaghan (Smithborough), Armagh (Loughgilly), and Dublin (Lucan). Adults have been found in June, July, and September. In Great Britain it ranges from Dorset northward at least to Oban and the Grampians, while on the Continent it inhabits Sweden, France, Germany, Hungary, and Croatia.

Ceratinella scabrosa (Cb.).

Walckenaëra scabrosa, Cb. (Spid. Dorset).

Leinster.

A pair of this species were collected at Terenure, county of Dublin, in February, 1894, by Mr. J. N. Halbert. It is a rare spider in England (Dorset, Hertfordshire, Cumberland). Abroad it seems to have been recognised only in France and Hungary (north and west).

Lophocarenum nemorale (Bl.).

Walckenaëra nemoralis, Bl. (Spid. G. B. I.).

Ulster, Connaught, Leinster.

This species has occurred in county of Donegal (Ardara, Rathmullan), county of Armagh (Armagh, Loughgilly, Poyntzpass), county of Dublin (North Bull), and county of Galway (Clonbrock). Adults have been found both in January and June. This spider has been found in Great Britain at various localities from Dorset to Perthshire. It occurs also in France and in eastern Hungary.

Lophocarenum Mengei, Simon.

Ulster.

An adult male and two females of this very remarkable spider were sent me from Armagh, and another female from Smithborough, county of Monaghan, in 1895, by the Rev. W. F. Johnson. This species described from the north of France, has only recently been recognised as a British species by Mr. F. Cambridge (*Ann. Mag. N. H.*, (6) vol. x., 1892), who found it in an island on Elterwater in the Cumbrian Lake district. On the Continent it seems only to have been observed in France.

Cnephalocotes curtus, Simon.

Connaught.

A pair of this rare species was taken on the north-eastern shore of Achill Island, county Mayo, in April, 1898, by Mr. J. N. Halbert. It was first recognised as a British species by Mr. Evans and myself from specimens taken on the shores of the Forth, near Edinburgh, and it has since occurred on the west coast of Scotland (Arran). On the Continent, it seems confined to the shores of the Mediterranean (Marseilles, Alexandria), and there can be no doubt that it is a member of the old south-western fauna, which, like *Mesites Tardyi* among the beetles for example, ranges north into Scotland. Its Irish station marks the path of its northern migration along the old continental coast-line.

Aræoncus humilis (Bl.).

Walckenaëra humilis, Bl. (Spid. G. B. I.).

Leinster.

A male of this species was sent me from Drogheda in June, 1892, by Miss S. Smith, and a pair were found at Tallaght, county of Dublin, in June, 1895, by Mr. J. N. Halbert. There is a male in the Templeton collection without locality. *A. humilis* ranges in Great Britain from Dorset to N. Wales and Edinburgh, and on the Continent from Sweden to Hungary, Italy, and Algeria.

Tiso vagans, Bl.

Neriene vagans, Bl. (Spid. G. B. I.).
N. longimana, Cb. (Spid. Dorset).
Ulster, Connaught, Munster, Leinster.

This spider has occurred at Londonderry; Portrush, county of Antrim; Craigdarragh, county of Down; Poyntzpass, county of Armagh; Achill Island, county of Mayo; Kenmare, county of Kerry; and Tallaght, county of Dublin. Adults have been found in April and May, and also in July and September. It is a widespread species in Great Britain (Dorset, Inverness); and on the Continent it is found in Sweden, Denmark, Germany, and France, extending into Corsica, and ranging high into the Alps. It seems very rare in Hungary.

Savignia frontata, Bl.

Walckenaëra frontata, Bl. (Spid. G. B. I.).
Ulster, Munster, Leinster.

This remarkable little spider is probably widespread in Ireland, though as yet I have records for only four counties—Londonderry, Armagh (Armagh, Poyntzpass, and Loughgilly), Dublin (Dublin, Chapelizod, Portmarnock, Santry, Terenure), and Kerry (Killarney). The first Irish specimen recognised occurred in my room at the Dublin Museum! Adults are numerous from October till February; single males have occurred in May and June. *S. frontata* seems generally distributed in Great Britain (Dorset, N. Wales, Oban, Aberdeen). On the Continent it occurs in Sweden and Germany, but has not been found in France, nor does it seem to extend eastwards to Austria or Hungary.

Diplocephalus permixtus (Cb.).

Walckenaëra permixta, Cb. (Spid. Dorset).
Ulster.

Mr. Workman records this species (1880) from Portavoe, county of Down; it has been sent to me from Armagh and Londonderry. Adults occur in May. *D. permixtus* has a wide range in Great Britain (Dorset, Cumberland, Edinburgh, Aberdeen). On the Continent it has occurred in northern France and in Bavaria.

Diplocephalus speciosus (Cb.).

Plæsiocrærus speciosus, Cb. (1895).
Ulster, Connaught, Leinster.

This seems a widespread species in Ireland. It has occurred at

Loughgilly and Poyntzpass, Co. Armagh; Smithborough, county of Monaghan; Mote Park, county of Roscommon; and Terenure, county of Dublin. Adults have been found in February, June, and October. The species has been recently described by Mr. Cambridge (1895), from Dorset, and seems as yet unknown elsewhere in Great Britain or on the Continent. I regret that, by error, I have recorded this spider (1898, ii.) as *Troxochrus hiemalis*, Bl., a species to which it bears considerable resemblance.

Diplocephalus latifrons (Cb.).

Walckenaëra latifrons, Cb. (Spid. Dorset).
Munster, Leinster.

An adult male of this rare species was taken at Borris, county of Carlow, in March, 1894, by Dr. Scharff, who also secured a female at a height of 1500 feet on the M'Gillicuddy's Reeks, county of Kerry, in September, 1898; on both occasions when collecting for the R. I. A. Flora and Fauna Committee. In Great Britain it is recorded from Dorset, Cumberland, Northumberland, Edinburgh, and Glasgow. On the Continent it inhabits Denmark, Germany, France, Austria, and Hungary.

Diplocephalus fuscipes (Bl.).

Walckenaëra fuscipes, Bl. (Spid. G. B. I.).
Plæsiocrærus fuscipes, Simon (Arachn. France).
Ulster, Connaught, Munster, Leinster.

This is not a common species but it appears to be generally distributed. It has been found at Londonderry; Kenbane, county of Antrim, Smithborough, county of Monaghan; Clonbrock, county of Galway, Borris, county of Carlow; and Killarney. Adults are found in March, and from September till November. *D. fuscipes* is generally distributed in Great Britain; but on the Continent, it seems known only in northern and central France.

Tapinocyba subæqualis (Westr.).

Walckenaëra subæqualis, Cb. (Spid. Dorset).
Leinster.

A single male of this very rare species was taken at Terenure, county of Dublin, by Mr. J. N. Halbert in February, 1894. It has been recorded from Sweden and England (Hampshire), and I know of no other localities for it.

Entelecara erythropus (Westr.).

Walckenaëra erythropus, } Cb. (Spid. Dorset).
Neriene improba, }

Ulster.

Mr. Workman records this species (1880) from the counties of Antrim (Belfast, Islandmagee), and Down (Kircubbin). The Belfast specimens, described under the name of *Neriene improba*, are now known to be *E. erythropus* not fully developed. I have received a single male from Smithborough, county of Monaghan (Rev. W. F. Johnson). This is a scarce species in Great Britain, but has a wide range (Dorset, Edinburgh, Inverness-shire.) Abroad it inhabits Iceland, Sweden, Denmark, northern France, Germany, northern and eastern Hungary.

Entelecara Thorellii (Westr.).

Walckenæra fastigata, Bl. (Spid. G. B. I.).
W. Thorellii, Cb. (Spid. Dorset).

Leinster.

An adult pair of this species were taken at Portmarnock, county of Dublin, in May, 1895, by Mr. J. N. Halbert. It is a very rare spider; the only localities known to me are Southport in Lancashire, Sweden, France (near Paris), and Bavaria (Nuremberg).

Entelecara trifrons (Cb.).

Walckenaëra trifrons, Cb. (Spid. Dorset).

Ulster, Leinster.

This rare spider has occurred at Armagh, and Poyntzpass, county of Armagh, Laytown, county of Meath, and Tallaght, county of Dublin. Adults of both sexes are found from April until June. It is scarce and local in Great Britain (Dorset, Norfolk, Northumberland), while abroad, it has been recorded from northern France, and from Kamtschatka, whence we may infer that, though scarce, it has an extremely wide range.

Styloctetor broccha (L. Koch).

Ulster.

A single adult male from the summit of Slieve Donard, Mourne Mountains, county of Down (R. Welch, October, 1897), is the only example of the spider ever taken in the British Islands. On the Continent it is a very rare alpine species (Tyrol, Great St. Bernard). I have elsewhere (1898 i.) described in detail the remarkable stridulating organ which I discovered in this specimen. The coxa of the fourth leg is drawn out inwardly into a sharp point (fig. 4) and scrapes across a set of ridges and furrows on the lung cover (see fig. 1). I figure the main structural details of this interesting species, which, it will be seen, agree closely with M. Simon's figures and descriptions of *S. broccha.* (Arachn. France, tome v.)

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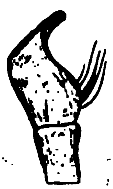

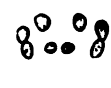

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FIG. 1.—*Styloctetor broccha*, male, side view, showing cephalothorax, palp, and stridulating ridges on lung-look cover.
FIG. 2.—Tibia of palp from above.
FIG. 3.—Eyes, front view.
FIG. 4.—Left coxa and trochanter of fourth pair, seen from beneath.

Dicymbium nigrum (Bl.).

Neriene nigra, Bl. (Spid. G. B. I.).

Ulster, Leinster.

This spider has been found at Smithborough, county of Monaghan, Loughgilly, county of Armagh, and Blessington, county of Wicklow. Adults of both sexes in October. It is widely distributed in Great Britain (Dorset, Aberdeen), and occurs in Sweden, Belgium, France, Germany, and Austria; in Hungary, it is rare and confined to the north.

Dicymbium tibiale (Bl.).

Nereine tibialis, Bl. (Spid. G. B. I.).

Ulster.

Adults of both sexes of this rare spider were found at Ardara, county of Donegal, in May, 1893, by the Rev. W. F. Johnson. In Great Britain it has occurred only in Northumberland (Cheviots), Cumberland, and North Wales. On the Continent it inhabits Sweden, northern and central France, Prussia, Bavaria, and eastern Hungary.

Walckenaëra acuminata (Bl.).

Ulster, Munster, Leinster.

This wonderful species, though scarce, is widely distributed in Ireland. It has occurred in the counties of Derry (Londonderry), Donegal (Ardara), Fermanagh (Belleisle), Armagh (Armagh, Loughgilly, Poyntzpass), Cork (Glengariff), and Dublin (Tallaght, Howth). Adults of both sexes have been found in April and May; females also in September, October, and January. In Great Britain this spider is generally distributed (Dorset, Oban, Inverness), becoming more common in the north. On the Continent it inhabits Sweden, Belgium, France (south to the Pyrenees), Germany, and northern Hungary.

Walckenaëra nudipalpis (Westr.).

Ulster, Connaught, Munster.

This rare spider has recurred at two localities in the county of Armagh (Armagh, Loughgilly); at Mote Park, county of Roscommon; and at a height of 3000 feet on the M'Gillicuddy Reeks, county of Kerry. Both sexes were adult in January, and females in June and September. In Great Britain, *W. nudipalpis* has been found in Dorset, Cambridge, Berwick, Paisley, and Edinburgh. On the Continent it appears to be a northern species, inhabiting Sweden, Denmark, Prussia, Poland, northern Hungary, and the Tyrol. In France it is very rare, and found only in the north.

Wideria antica (Wid.).

Walckenaëra antica, Bl. (Spid. G. B. I.).

Ulster.

As yet this spider has occurred only in the county of Armagh. The Rev. W. F. Johnson sent me a male from Newtown-Hamilton in March, 1892, and a female from Poyntzpass in 1897. The species is widespread in Great Britain (Dorset, North Wales, Edinburgh, Paisley, Aberdeen), and on the Continent, Sweden, Denmark, Germany, France, Austria, Hungary (north and east), and northern Italy.

Cornicularia vigilax (Bl.).

Neriene vigilax, Bl. (Spid. G. B. I.).

Connaught.

A pair of this species, taken at Clonbrock, county of Galway, by

Mr. J. N. Halbert, in June, 1896, are the only examples yet found in Ireland. It is a very rare species in Great Britain (Dorset, North Wales), as also on the Continent, where it has been found in northern and eastern France, Switzerland (where it inhabits high mountain pastures), Germany, Austria, Tyrol, Bohemia, and northern Hungary. It also occurs in North America.

Cornicularia unicornis (Cb.).

Walckenaëra, unicornis, Bl. (Spid. G. B. I.).

Leinster.

Two females of this rare species were taken at Portmarnock, county of Dublin, in June, 1895, by Mr. J. N. Halbert. Widely distributed in England (Dorset—Northumberland), it has occurred abroad in France, Sweden, Germany, and Austria.

Cornicularia cuspidata, Bl.

Walckenaëra cuspidata, Bl. (Spid. G. B. I.).

Munster.

An adult male, which I took at Killarney in November, 1893, when collecting for the Royal Irish Academy Flora and Fauna Committee, is the only Irish example of this spider which I have yet seen. It is a rare species in Great Britain (Dorset, North Wales, Edinburgh). On the Continent it is found in Denmark, northern and eastern France, Belgium, Germany, Switzerland, and northern Hungary; it is also found in Kamtschatka.

Typhochrestus dorsuosus (Cb.).

T. digitatus, Carpenter and Evans (1894).

Leinster.

A male and female of this very rare spider were taken at Laytown, on the coast of the county of Meath, in September, 1897, by Mr. J. N. Halbert. Its discovery as a British species was made only four years ago, when Mr. Evans and I recorded specimens from the shores of the Forth, near Edinburgh, under the name of *T. digitatus*. Mr. Cambridge has since pointed out to us that our specimens are really referable to the closely allied *T. dorsuosus*, also described by him. On the Continent this spider has occurred only in southern France and in Holland.

Neriene rubens, Bl.

Gonatium rubens, Simon (Arachn. France).

Ulster, Connaught, Leinster.

This spider is widespread and common, at least in northern and eastern Ireland. Localities range from the county of Antrim to the summit of Slievemore, Achill Island, county of Mayo; Clonbrock, county of Galway; Tullamore, King's County; and Ferns, county of Wexford. It occurs at numerous places in the counties of Armagh and Dublin. Adult females are to be found throughout the year; males in May and September. *N. rubens* is a widespread and common species in Great Britain (Dorset, Orkneys), and occurs in North America, as well as in most parts of Europe. It seems, however, to die out towards the east, as in Hungary it is only recorded from a single northern locality.

Neriene rubella, Bl.

N. isabellina, Cb. (Spid. Dorset).

Gonatium rubellum, Simon (Arachn. France).

Ulster, Connaught, Leinster.

This species is locally abundant, though less common than the preceding. It has occurred in the counties of Derry, Antrim, Down, Galway (Clonbrock, Loughrea), and Wicklow. Adults only in August, September, and October. In Great Britain it does not seem to extend as far north as *N. rubens*, not having been traced beyond Edinburgh. On the Continent it is found in Sweden, Denmark, Germany, eastern France, Italy, Austria, and northern and eastern Hungary.

Dicyphus bituberculatus (Wid.).

Neriene bituberculata, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

In the northern half of Ireland, at least, this spider is generally distributed and common. Mr. Workman records it from Belfast, and I have seen specimens from the counties of Armagh, Monaghan, Roscommon, Sligo, Galway (as far as Roundstone), Limerick, Carlow, Dublin, and Meath. Males are adult in April and May, females from January to July; immature specimens occur in September and October. The species is widespread in Great Britain (Dorset, Inverness); on the Continent it inhabits Sweden, Denmark, Germany, France (north of the Garonne), and Hungary (northern and eastern).

Dicyphus cornutus (Bl.).

Neriene cornuta, Bl. (Spid. G. B. I.).

Connaught, Munster, Leinster.

This species has occurred at Mote Park, county of Roscommon, at Limerick, and at several places in the county of Dublin (Santry, Portmarnock, Tallaght). Adults of both sexes are to be found in May and June. *D. cornutus* ranges from Dorset to North Wales and Northumberland. Abroad it inhabits Sweden, Denmark, Germany, Poland, Austria, Hungary, and north-eastern France.

Dismodicus bifrons (Bl.).

Walckenaëra bifrons, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster.

The only known Irish localities for this spider are Islandmagee and Colin Glen, county of Antrim; Armagh; Clonbrock, county of Galway; and Kenmare, county of Kerry. Adults from May till July. The species is scarce, though widespread in Great Britain (Dorset, Inverness), probably commoner in Scotland than in England. On the Continent it seems a northern form, occurring in Sweden, Germany, northern France, and northern Hungary.

Stylothorax fuscus (Bl.).[1]

Neriene fusca, Bl. (Spid. G.B. I.).

N. fusca, } Cb. (Spid. Dorset.)
N. agrestis (in part), }

Ulster, Connaught.

This species is recorded from Ireland, by Mr. Cambridge, as *N. agrestis* (*l. c.* p. 115), under which name it appears in Mr. Workman's list. I have seen specimens from Arvagh, county of Cavan; Loughgilly, county of Armagh; and Achill Island, county of Mayo. Adult male in April, females in December and January. *S. fuscus* is a widely-distributed spider in Great Britain (Dorset, Oban) and on the Continent (Sweden, Russia, Hungary, Germany, Italy, France).

Stylothorax retusus (Westr.).

Neriene retusa, Cb. (Spid. Dorset).

Ulster, Connaught, Leinster.

Mr. Cambridge records this spider as Irish without definite locality. I have seen specimens from Armagh, Achill Island, county of Mayo, North Bull and Templeogue, county of Dublin. Adults occur both in spring and autumn. Widely distributed in Great Britain (Dorset, Inverness) though scarce, this species has an immense range abroad—Novaya Zemla and Siberia to North Africa.

[1] Mr. Cambridge has shown that the use of *Neriene*, Bl. (of which *N. rubens* is the type) for this genus by Kulczynski and Simon cannot be followed. It seems that *Stylothorax* (Bertkau, 1883), of which *Neriene apicata*, Bl. is the type, is the correct generic name.

Gongylidium rufipes (Sund.).

Neriene munda, Bl. (Spid. G. B. I.).

N. rufipes, Cb. (Spid. Dorset).

Ulster (?), Munster, Leinster.

Adults of both sexes have been taken at Limerick and in the county of Dublin (Santry, Portmarnock) in May and June, and females in October. Mr. Workman's record (1880) from Portavoe, county of Down, must be regarded as doubtful, as the specimens which stand under this name in his collection are referable to *Dicyphus bituberculatus*. *G. rufipes* (the only species of the genus as now restricted) occurs throughout northern and central Europe (including northern Italy), and is generally distributed in Great Britain.

Trachygnatha dentata (Wid.).

Neriene dentata, Bl. (Spid. G. B. I.).

Ulster, Munster, Leinster.

Not a common species in Ireland. It has as yet been found only at Armagh; Lismore, county of Waterford; Borris, county of Carlow; Tullamore, King's County; and Bray, county of Wicklow. Adults of both sexes in January, March, April, May; females also in July. This species is widespread in Great Britain (Dorset, Inverness), though not common; it occurs throughout Europe, as well as in North Africa and Syria.

Erigone promiscua (Cb.).

Neriene promiscua, Cb. (Spid. Dorset).

Ulster, Connaught, Munster.

Apparently a rare spider in Ireland. Mr. Workman (1880) records it from Islandmagee, county of Antrim. It has occurred also at Loughgilly, county of Armagh, Roundstone, county of Galway (April, 1896), and on the slopes of the M'Gillicuddy's Reeks, county of Kerry (1500 feet). It is scarce though widespread in Great Britain (Sussex, Aberdeen), and occurs on the Continent and western France.

Erigone atra (Bl.).

Neriene longipalpis, Bl. (Spid. G. B. I.).

N. atra, Cb. (Spid. Dorset).

Ulster, Connaught, Leinster.

This species is widespread, and fairly common over the greater part of Ireland. It has occurred in the counties of Down, Derry, Donegal, Galway, Wexford, Wicklow, and Dublin. Adults are to be found from April till October. It is generally distributed in Great Britain, while on the Continent it inhabits northern and central Europe, Novaya Zemla, and Siberia, as well as the Azores.

Erigone dentipalpis (Wid.).

Neriene dentipalpis, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

This spider is probably generally distributed in Ireland. It has occurred in the counties of Armagh, Antrim (Giant's Causeway), Donegal (Ballintra), Galway (Roundstone), Cork (Fermoy), Kerry (Kenmare), and Dublin (North Bull, Phœnix Park). Adults of both sexes have been found from April till September. *E. dentipalpis* is a widespread species in Great Britain (Dorset, Aberdeen), and occurs throughout Europe, extending from the far north of Norway and Finland to Syria, North Africa, and the Azores, and also inhabiting Siberia and North America.

Erigone longipalpis (Sund.).

Neriene longipalpis, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

Probably this species is generally distributed around the Irish coasts. Mr. Workman (1880) recorded it from the county of Down (Glastry), and I noticed specimens in his collection from Craigdarragh, in the same county. It has been sent me from Londonderry; county of Mayo (Achill Island); Galway; county of Kerry (Kenmare); county of Cork (Crookhaven and Glandore); and county of Dublin (Portmarnock and North Bull). Adults occur from April till September. In Great Britain it is of general occurrence (Dorset, Aberdeen), while it is found on all the coasts of northern and central Europe (much rarer inland), extending to Spitzbergen. It is also recorded from Venice.

Maso Sundevallii (Westr.).

Neriene Sundevallii, Cb. (Spid. Dorset).

Maso Westringii, Simon (Arachn. France).

Ulster, Connaught, Munster.

This spider is recorded as Irish by Mr. Cambridge. I have received it from Londonderry, county of Galway (Clonbrock, Oughterard), and Limerick. Adult male in June; females in June, July, and September. *M. Sundevallii* has been taken in Great Britain (in Dorset and at Edinburgh). On the Continent it inhabits Sweden, Denmark, Germany, northern France, Austria, Hungary, and Poland.

Micryphantes innotabilis (Cb.).

Neriene innotabilis, Cb. (Spid. Dorset).
Leinster.

A rare species in Ireland; an adult female which I collected at Bray, county Wicklow, in July, 1895, being the only specimen I have seen. It is a scarce species in Scotland, England, and Germany; and it does not seem to have been recognised in France or Hungary.

Micryphantes viaria (Bl.).

Neriene viaria, Bl. (Spid. G. B. I.).
Ulster, Munster, Leinster.

This species is widespread, but scarce in Ireland. It has been found at Londonderry (Milne, 1895); Parknasilla, county Kerry; Howth and Lucan, county Dublin; and Ovoca, county Wicklow. Adults have occurred in April, June, September, and October. It is a widely distributed species in Great Britain (Dorset, Aberdeen), and on the Continent, occurring also in North America.

Micryphantes fuscipalpis, Koch.

Neriene gracilis, Bl. (Spid. G. B. I.).
N. fuscipalpis (in part), Cb. (Spid. Dorset).
Ulster, Leinster.

Mr. Workman (1880) records this species without locality. I identified a male in his collection from Belvoir, county of Down, and another male was taken on the North Bull, Dublin Bay, in September, 1898, by Mr. J. N. Halbert. These are the only Irish examples I have seen; the apparent scarcity of the species here contrasts with its abundance and wide distribution in Great Britain. It is found in Germany, Austria, and Hungary, but does not seem to have been yet recognised in France.

Micryphantes rurestris, Koch.

Neriene flavipes, Bl. (Spid. G. B. I.).
Neriene fuscipalpis (in part), Cb. (Spid. Dorset).
Microneta fuscipalpis, Carpenter & Evans (1894).
Ulster.

Armagh, whence I received two males and a female in May, 1895, from the Rev. W. F. Johnson, is the only Irish locality known for this spider. It is probably widespread in Great Britain, having been associated with the preceding species, to which it is closely allied.

Certainly it occurs in the Edinburgh district. Abroad it ranges throughout Europe, extending to Siberia, North Africa, and the Azores.

Tmeticus bicolor (Bl.).

Neriene bicolor, Bl. (Spid. G. B. I.).

Linyphia bicolor, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

In the northern half of Ireland, at least, this spider is widely distributed and common. It has occurred in county of Antrim (Belfast, Colin Glen, Islandmagee), county of Donegal (Ardara—var. *concinnus*, Thor.), county of Armagh (Armagh—type and var. *concinnus*, Loughgilly), county of Fermanagh (Enniskillen, Belleisle), county of Mayo (summit of Slievemore, Achill—var. *concinnus*), county of Kerry (3000 feet up on the M'Gillicuddy's Reeks—var. *concinnus*), county of Meath (Laytown), and county of Dublin. The species is adult in Ireland from September till April. It is commoner in the north of Great Britain than in the south, though it is generally distributed in France ranging into Corsica, occurring also in Sweden, Germany, Austria, and Hungary. But in the latter country it seems rare and confined to the north.

Tmeticus prudens (Cb.).

Linyphia prudens, Cb. (Spid. Dorset).

Ulster, Connaught, Munster.

An adult female taken on the summit of Slieve Donard (2790 feet), Mourne mountains, county of Down, by Mr. R. Welch in October, 1897, another adult female found on the summit of Slievemore, Achill island, county Mayo, in April, 1898, and a male found at a height of 3000 feet on the M'Gillicuddy's Reeks, county of Kerry, in September, 1898, are the only Irish examples of this spider yet discovered. The species seems recorded only from the Grampians, the Pentlands, the Cheviots, Dorsetshire, and the Department of Bouches-de-Rhone in the south of France.

Tmeticus sylvaticus (Bl.).

Neriene sylvatica, Bl. (Spid. G. B. I.).

Connaught.

An adult female taken on Leenane mountain, county of Galway, in April, 1897, by Mr. J. N. Halbert, is the only known Irish specimen of this spider. It occurs in Dorset, North Wales, North England, and Scotland; while on the Continent it has a wide range (Sweden, France, Germany, Austria, Hungary).

Tmeticus expertus (Cb.).

Linyphia experta, Cb. (Spid. Dorset).
Ulster.

An adult male taken at Loughgilly, county of Armagh, in January, 1892, by the Rev. W. F. Johnson, is the only Irish example of this rare spider which I have seen. In Great Britain it has occurred in Dorset, Cumberland, Northumberland, and Fife. On the Continent it is known to inhabit north-eastern France and Hungary.

Tmeticus abnormis (Bl.).

Neriene abnormis, Bl. (Spid. G. B. I.).
Linyphia abnormis, *L. linguata*, } Cb. (Spid. Dorset).
Ulster, Connaught, Munster.

A rare spider in Ireland. I have received it from Londonderry where Mr. J. N. Milne (1895) has collected specimens on several occasions, while it has occurred at Leenane, county of Galway, on the summit of Slievemore (2200 feet), Achill island, county of Mayo, and of the M'Gillicuddy's Reeks (3400 feet), county of Kerry. Males have been obtained in May and July; females in April, May, and September. This is a rare species in Great Britain, though it has a wide range (Dorset, Lancashire, Cumberland, Edinburgh, Glasgow, Inverness). Abroad it seems only to have been noticed near Hamburg, and in France and Spain, whence we may conclude that it is a south-western species.

Tmeticus rufus (Wid.).

Neriene rubripes, Bl. (Spid. G. B. I.).
Neriene rufa, Cb. (Spid. Dorset).
Ulster.

The only Irish specimen of this spider which I have seen was collected at Newtown-Hamilton, county of Armagh, in May, 1893, by the Rev. W. F. Johnson. It is a rare species in Great Britain, though widely distributed (Dorset, North Wales, Cumberland, Edinburgh, Inverness). On the Continent it is known to occur in Norway (70° N. lat.), Sweden, Germany, Hungary (where it is rare and confined to the north and east), France (where it also has a north-eastern distribution), and Belgium.

October, January, April, and May. It seems generally distributed, though scarce in Great Britain, as far north as Edinburgh at least. On the Continent it is generally distributed in France (including Corsica), Germany, Austria, and Hungary; but apparently is not found in Sweden. It is recorded from Kamtschatka.

Porrhomma microphthalma (Cb.).

Linyphia microphthalma, *L. incerta*, *L. decens*, Cb. (Spid. Dorset).
Porrhomma Meadii, F. Cb.
Ulster.

Females of this spider were obtained, and recorded (1896) by Mr. Jameson, from the caves of Coolarkin and Marble Arch, near Enniskillen, county of Fermanagh, when collecting for the R. I. A. Flora and Fauna Committee in July, 1895. It has been found on the Pentland hills, Scotland; in coal-pits in Durham, in Hertfordshire, and Dorset; in northern France, and northern Hungary. It is therefore not a typical cave-species like the next.

·*Porrhomma myops*, Simon.

Munster.

This spider inhabits the Mitchelstown Cave in county of Tipperary. The eyes are in all cases more or less degenerate. When visiting the cave in July, 1894, I discovered a male and female, which I described and figured (1895 i.). In the succeeding year, also in July, Mr. Jameson obtained a number of specimens of both sexes (1896); and Mr. G. E. Mason, of London, also took several examples of the spider, which appears not to be uncommon in its underground locality. A single female of *P. myops* has been taken in Dorset by Mr. Cambridge, and it inhabits the Cave of Espezel, Department of Aude, in southern France. I am disposed to regard *Linyphia incerta*, Emerton, from the Bat Cave of Kentucky, as identical with the present species, but M. Simon considers that spider to belong to the genus *Taranucnus*.

[*Porrhomma egeria*, Simon, is recorded from Ireland by Rev. O. P. Cambridge (1895) in error, the specimen which he received from me for examination being Scotch.]

Bathyphantes parvulus (Westr.).

Linyphia parvula, Cb. (Spid. Dorset).
Ulster.

Mr. Workman (1880) records this species from Islandmagee, county of Antrim. I have not seen an Irish specimen. It is a scarce s in England (Dorset, Lancashire) and France (where it is confin the north), but common in Sweden and Prussia, and recorded northern Italy.

Bathyphantes gracilis (Bl.).

Linyphia gracilis, } Bl. (Spid. G. B. I.).
L. circumspecta, }

Ulster, Connaught, Leinster.

This species has been found in counties of Donegal (Coolm Armagh, Mayo (Achill Island), Dublin (Portmarnock, Rathfarnh and Wicklow (Enniskerry, Greystones). Adults occur from Septe till April; the single male from Coolmore was found in July. *B. cilis* ranges from the south of England, at least, as far north as and Aberdeen in Scotland. Abroad it seems a decidedly sout form; unknown in Scandinavia, it inhabits France, Spain, Swi land, Italy, and Austro-Hungary.

Bathyphantes dorsalis (Wid.).

Linyphia Claytoniæ, Bl. (Spid. G. B. I.).
L. dorsalis, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

This spider is recorded from near Belfast by Mr. Workman (18 I have seen specimens from county of Galway (Clonbrock), count Roscommon (Athlone, Mote Park), county of Kerry (Clonee Lou county of Kildare (Maynooth), and county of Dublin (Teren Adults occur from May till August in Ireland. It is generally tributed in Great Britain (Dorset, Perthshire), and occurs in Swe Germany, Austria, Hungary, Belgium, and north-eastern France.

Bathyphantes pullatus (Cb.).

Linyphia pullata, Cb. (Spid. Dorset).

Ulster, Leinster.

The only localities whence I have received this spider Armagh; Braganstown, county of Louth; Santry and Tallaght, co of Dublin. Males are adult in May, females thence until July. species is recorded from Cumberland, Dorset, north-eastern Fra and northern Hungary. As it is exceedingly rare in the last-na country, it may be regarded as a western species.

Bathyphantes nigrinus (Westr.).

Linyphia pulla, Bl. (Spid. G. B. I.).

L. nigrina, Cb. (Spid. Dorset).

Ulster, Leinster.

This species is recorded by Mr. Workman (1880) from Belfast. I have received specimens from Londonderry, Cavan, Armagh, county of Louth (Gormanstown), county of Dublin (Santry and Lucan), and county of Wicklow (Enniskerry). Adults have been found from September till April. *B. nigrinus* has a wide range in Great Britain (Dorset, Aberdeen). Abroad it is recorded from Sweden, Belgium, north-eastern France, Prussia, Austria, and Hungary; but it appears to be scarcer on the Continent than in our islands. It inhabits also North America.

Bathyphantes concolor (Wid.).

Theridion filipes, Bl. (Spid. G. B. I.).

Linyphia concolor, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

This is a widely-distributed spider in Ireland (probably spread over the whole country) but not abundant. It has occurred in counties of Antrim (Ballycastle, Murlough, Islandmagee), Armagh, Mayo (Achill Island), Kerry (Dingle), and Wicklow (Arklow, Greystones). Adults have been found in April and May. The species is generally distributed in Great Britain, and, according to Simon, is spread over the greater part of Europe, occurring also in North America.

Bathyphantes variegatus (Bl.).

Neriene variegata, Bl. (Spid. G. B. I.).

Linyphia variegata, Cb. (Spid. Dorset).

Ulster, Connaught, Munster, Leinster.

This is a scarce spider in Ireland, though probably widespread. The only localities known to me are Colin Glen, county of Antrim, where Mr. Workman took an adult pair in November, 1889; Leenane, county of Galway, where Mr. Halbert took an adult male in April, 1897, when collecting for the R. I. A. Flora and Fauna Committee; M'Gillicuddy's Reeks, county of Kerry (2000 feet up), where I recently (September, 1898) found an immature female when collecting for the same Committee; and Howth and the North Bull, county of Dublin, where immature males were found in April, and adult females in May, 1894. *B. variegatus* has a wide range in Great Britain (Dorset, Sutherlandshire). On the Continent it seems to be a north-western form, as it occurs in Finland, Sweden, France, and northern Hungary.

Lephthyphantes ericæus (Bl.).

Linyphia ericæa Bl. (Spid. G. B. I.).

Connaught.

A single adult female, taken at Keene Bay, Achill, county of Mayo, in April, 1898, by Mr. J. N. Halbert, is the only Irish specimen of this spider which I have seen. It is a common species in Scotland and northern England, but very rare in the south. It does not seem to have yet been recognised on the Continent.

Lephthyphantes flavipes (Bl.).

Linyphia flavipes, Bl. (Spid. G. B. I.).

Lephthyphantes Henricæ, Chyz. and Kulcz. (Aran. Hungar.).

Connaught, Leinster.

An adult male which I took at Glendalough, county of Wicklow, in August, 1893, and two adult males at Clonbrock, county of Galway, in September, 1897, are the only Irish examples of this spider as yet known. Mr. Cambridge (who has kindly verified my determination of these specimens) believes the species to be generally distributed in Great Britain, as it also seems to be on the Continent, since it occurs in Sweden, near Hamburg, in Austria, and throughout Hungary.

Lephthyphantes tenuis (Bl.).

Linyphia tenuis, Bl. (Spid. G. B. I.).

L. tenebricola, Cb. (Spid. Dorset).

Leptyphantes tenebricola, Simon (Arachn. France).

Ulster, Connaught, Munster, Leinster.

This species is very common and probably universally distributed in Ireland. I have seen specimens from many localities ranging between counties of Derry and Antrim, to Crookhaven, at the extreme south-west of county of Cork; from Dalkey Island, off county of Dublin, to Achill Island, county of Mayo, and Roundstone, county of Galway. It ascends the hills to a height of over 2000 feet. Adults may be met with throughout the year. *L. tenuis* is generally distributed in Great Britain (Dorset, Ross-shire), and throughout Europe, extending to the Azores.

Lephthyphantes Blackwallii, (Kulcz.).

Linyphia terricola, Bl. (Spid. G. B. I.).

L. zebrina, Cb. (Spid. Dorset).

Leptyphantes zebrinus, Simon (Arachn. France).

Ulster, Connaught, Munster, Leinster.

This species is as widely distributed as the foregoing, though not so abundant. Localities range from Londonderry and Ballycastle, county of Antrim, to Valentia Island, county of Kerry; from Dublin to Inishmore of Aran, Galway Bay. It occurs up to 2500 feet on the Kerry mountains. Adults are to be found throughout the year. This spider is more southern and western in its distribution than the last, having been found in Sweden, Belgium, France, and Spain, but apparently not in Germany or Hungary, *L. zebrinus* (Menge) being now recognised as a distinct form. In Great Britain, *L. Blackwallii* is generally distributed.

Lephthyphantes pallidus (Cb.).

Linyphia pallida, Cb. (Spid. Dorset).

Munster.

A single adult female was taken in Mitchelstown Cave, county of Tipperary, July, 1895, by Mr. H. L. Jameson (1896), when collecting for the Royal Irish Academy, Flora and Fauna Committee. It was exhibited to the Dublin Microscopical Club (1896). In September, 1898, when collecting in the county of Kerry for the Flora and Fauna Committee, I found another adult female at a height of 3200 feet on the M'Gillicuddy's Reeks. It is a very rare spider in Great Britain, the type pair found by Mr. Cambridge at the roots of heather in Dorset being the only specimens ever taken there. It is widely distributed in France, inhabiting caves and other underground localities, as well as dark woods; and it has also been found near Hamburg, on the Austrian mountains, and in caves in Bavaria.

Lephthyphantes cristatus, Menge.

Linyphia cristata, Cb. (Spid. Dorset).

Ulster, Leinster.

This seems to be a scarce spider in Ireland. An adult male was taken on Slieve Glah, county of Cavan, in October, 1893, by Mr. J. N. Halbert, when collecting for the Royal Irish Academy Flora and Fauna Committee; and in October of the next year, I captured several males near Enniskerry, county of Wicklow. In Great Britain this species is rare, though widespread (Dorset, Berwickshire, Inverness), as also on the Continent (Iceland, Sweden, France, Prussia, Bavaria, Carniola, Austria, Hungary).

Lephthyphantes obscurus (Bl.).

Linyphia obscura, Bl. (Spid. G. B. I.).

Ulster, Leinster.

The only Irish localities known to me, for this spider are Colin

Glen, county of Antrim, where Mr. Workman took an adult male in November, 1889; Londonderry, whence Mr. J. N. Milne sent me a pair of adults in May, 1895; and Glenasmole, in the Dublin mountains, where I found an adult male in June, 1895. In Great Britain, Sweden, and France, this species seems of local, though wide distribution. It extends into Corsica, and occurs in both northern and southern Germany, in Austria, and in northern Hungary.

Lephthyphantes terricola (Koch).

Linyphia alacris, Bl. (Spid. G. B. I.).

Ulster, Connaught.

This spider has been sent me in some numbers from Londonderry by Mr. J. N. Milne (1895). Elsewhere in Ireland, single specimens have been obtained at Colin Glen, county of Antrim; Poyntzpass, county of Armagh; Newcastle, county of Down; and Clonbrock, county of Galway. Adults have been found in May, September, and October. *L. terricola* seems to be a northern and alpine species. Though of wide distribution in Great Britain, it is much commoner in Scotland and the north than in the south of England; while in central and southern Europe it appears to be confined to mountainous districts.

Lephthyphantes minutus (Bl.)

Linyphia minuta (Bl.), Spid. G. B. I.

Ulster, Connaught, Munster, Leinster.

This spider is widely distributed in Ireland: counties of Donegal, Londonderry, and Antrim, to Skibbereen, county of Cork; Dublin to Clonbrock, in county of Galway. The absence of records from Connemara is probably due to want of observation in autumn. Adults are most numerous in September and October, and have been taken in January. In June, July, and August, immature examples occur; some specimens attain maturity in the last-named month. *L. minutus* is generally distributed in Great Britain, extending at least as far north as Inverness-shire. On the Continent it is common in northern Europe, but scarcer in the south. It also inhabits North America.

Lephthyphantes leprosus (Ohl.).

Ulster, Connaught, Leinster.

The only localities where this spider has been taken in Ireland are Londonderry, Athlone, Dublin, and Lucan. Adults have occurred in May, June, July, and August. Like *L. minutus*, this is a widespread species in Great Britain. Abroad it has, in the Old World, a wider range than that spider, extending to Africa, the Azores, and St. Helena, as well as to Syria and Kamtschatka, but it does not appear to have been found in North America.

Lephthyphantes cultus, Cb.

Leinster.

An adult female, probably collected near Dublin, was described under this name by Rev. O. P. Cambridge (1893). No further examples of the spider have been found to my knowledge either in Ireland or elsewhere.

Labulla thoracica (Wid.).

Linyphia cauta, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This fine species is widely distributed in Ireland, but not common, and apparently not extending far to the west. It is recorded by Mr. Workman (1880) from the county of Antrim (Colin Glen, Islandmagee). I have received it from Londonderry, county of Monaghan (Glaslough), county of Fermanagh (Enniskillen), county of Armagh (Loughgilly, Poyntzpass), county of Roscommon (Athlone), county of Galway (Clonbrock), county of Kerry (Killarney and Kenmare), county of Cork (Mitchelstown), county of Wicklow (Glendalough, Delgany), and county of Dublin (Glendhu, 1000 feet). Adult males occur in August and September; females from September till January; young individuals in June, and immature specimens in July and August. *Labulla thoracica* has a wide range in Great Britain (Dorset, Inverness). Abroad it inhabits Russia, Sweden, Denmark, France, Germany, Poland, northern Hungary, and Croatia.

Linyphia clathrata, Sund.

Neriene marginata, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This species is common, and generally distributed in northern and eastern Ireland. I have seen examples from many localities in the counties of Derry, Antrim, Armagh, Monaghan, Down, Louth, Dublin, Wicklow, and Kildare. But the only western localities known to me are Athleague, county of Roscommon; Limerick; and Glengariff, county of Cork. Adults have been found in all months from March till October; young specimens in December and January; and a male, not quite mature, in August. It seems, therefore, that the young are hatched in autumn, and attain maturity in less than twelve months, the adults probably surviving the winter. *L. clathrata* is generally distributed in Great Britain (Dorset, Aberdeen); and has a very wide range abroad (all Europe, Siberia, N. America).

Linyphia hortensis, Sund.

L. pratensis, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

Not a common spider in Ireland. Mr. Workman records it (1880) from the county of Down (Kircubbin), and I have seen specimens from Londonderry and Armagh, from the county of Galway (Clonbrock), county of Kerry (Kenmare), and Drogheda. It is adult in May, June, and July. *L. hortensis* is widespread in Great Britain (Dorset, Aberdeen). In Europe it occurs in Sweden, Germany, France, Austria, Hungary, and northern Italy.

Linyphia pusilla, Sund.

L. fuliginea, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This species is fairly common over a large part of the country, though I have seen no specimens from the far west. Workman records it from the county of Antrim (Colin Glen, Islandmagee, also Glenarm). It has occurred at Londonderry in the county of Armagh (Armagh and Newtown-Hamilton), county of Roscommon (Mount Talbot), county of Galway (Clonbrock), county of Kerry (Killarney), county of Cork (Fermoy), King's County (Tullamore), county of Wicklow (Blessington, Glenmalure, Newcastle, Kilcool), and county of Dublin (Tallaght, Rathfarnham). It is adult in May, June, and July; young individuals occur in March and September. *L. pusilla* is generally distributed in Great Britain (Dorset, Sutherland), and has a very wide range abroad (all Europe, Siberia, and North America).

Linyphia peltata (Wid.).

Linyphia rubea, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is a local and scarce spider in Ireland, though widespread. I have seen specimens from Londonderry, county of Roscommon (Mote Park), county of Galway (Clonbrock), Killarney, county of Wexford (New Ross), and county of Dublin (Lucan). Adult, from April till June; young individuals occur in the latter month, and half-grown specimens have been found in October and November. This species has a very wide range in Great Britain (Dorset, Sutherland). On the Continent it is recorded from Sweden, France, Germany, Austria, and Hungary.

Linyphia triangularis (Cl.).

Linyphia montana. Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is one of the commonest of spiders over the greater part of Ireland, extending from the counties of Derry and Antrim to Wexford; from Dublin to Connemara, Limerick, the county of Clare, Killarney, and Kenmare. *L. triangularis* is a widely distributed spider in Great Britain (Dorset, Ross-shire); and on the Continent; occurring also in Siberia. In Ireland adults occur from June till October, immature specimens being common in July.

Linyphia montana (Cl.).

Linyphia marginata, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This species seems to be spread over the greater part of Ireland, though I have no records from the county of Donegal, Connemara, or the south-west. It has been found at Londonderry, near Belfast (1880), in the county of Armagh (Armagh, Loughgilly, Poyntzpass), county of Roscommon (Athlone), county of Galway (Clonbrock), county of Waterford (Lismore), county of Wicklow (Bray), and the county of Dublin (Tibradden mountain, Templeogue, Terenure, Howth). It is adult in May, June, and July; immature individuals occur in early summer, autumn, and winter. Generally distributed in Great Britain (Dorset, Inverness). *L. montana* is found throughout Europe and in Siberia.

Linyphia insignis, Bl.

Ulster, Connaught, Leinster.

Probably this spider is widely distributed and common in northern and eastern Ireland. It has been found in numbers near Londonderry by Mr. J. N. Milne; Mr. Workman (1880) records it from the county of Antrim, and has also found it in the county of Down (Craigdarragh). I have taken it at Clonbrock, county of Galway; and it is abundant at many places in the counties of Dublin (Santry, Glencullen), Kildare (Leixlip), and Wicklow (Enniskerry, Rathdrum). Adult in September and October. It is generally distributed in Great Britain, but only common in Scotland and northern England. In northern Europe (Scandinavia and Finland) it is common, occurring as far south as eastern Prussia and Hamburg, but in France and Hungary it is very rare, being found only in the neighbourhood of mountains. It also inhabits Siberia and North America.

Stemonyphantes bucculentus (Cl.).

Neriene trilineata, Bl. (Spid. G. B. I.).
Linyphia bucculenta, Cb. (Spid. Dorset).
Linyphia lineata, Sim. (Arachn., France).
Ulster, Connaught, Munster, Leinster.

This species is widely distributed in Ireland, but not common. I have received it from county of Down (Rathmullan), county of Mayo (Achill Island), county of Cork (Skibbereen), county of Wexford (Ferns), and county of Dublin (Baldoyle and Malahide), Adults obtained from September until April; immature in July. *S. bucculentus* is widespread in Great Britain (Dorset, Aberdeen), and is distributed over the whole of Europe, North Africa, northern Asia, and North America.

Drapetisca socialis (Bl.).

Linyphia socialis, Bl. (Spid. G. B. I.).
Ulster, Connaught, Munster, Leinster.

This species is widely distributed in Ireland, and probably not scarce, but overlooked on account of its protective colourings harmonising so well with the tree trunks on which it rests. It has been found near Londonderry, at Islandmagee, county of Antrim; at Clonbrock, county of Galway; Skibbereen, county of Cork; Bray, county of Wicklow; Glendhu (1000 feet) and Malahide, county of Dublin (Dubl. Nat. F. C. 1892). Adult in September and October; immature in July. *D. socialis* (the only species of the genus) has a wide range in Great Britain (Dorset, Inverness-shire), and on the Continent (Norway, Sweden, France, Germany, Austria, northern and western Hungary); extending also to North America.

Bolyphantes subnigripes (Cb.).

Linyphia subnigripes, Cb. (Spid. Dorset).
Ulster.

The type of this species was taken by Mr. Workman, at Windsor, near Belfast (1880); it has never been rediscovered, and does not seem to have been recognised in Great Britain or on the Continent. It has been figured by Mr. Cambridge (1886), who doubts whether it is referable to *Bolyphantes*, or should be the type of a new genus.

Bolyphantes luteolus (Bl.).

Linyphia alticeps, Bl. (Spid. G. B. I.).
Ulster, Leinster.

This is not a common species in Ireland. The only localities whence I have received or collected it are Londonderry, Belfast, Slieve Glah (county of Cavan), and Callary (county of Wicklow). Adults observed in September and October. In Great Britain this spider ranges far north in Scotland, and becomes rare in the south of England. In France it is found only in the Auvergne, the Alps, and the mountains of Corsica. It occurs in the mountains of Hungary, and is common in northern Europe, extending to Finmark. The entire genus is of northern and alpine distribution, a few species occurring in Siberia.

Tapinopa longidens (Wid.).

Linyphia longidens, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is a scarce spider in Ireland, though apparently widely distributed. Specimens have been collected at Armagh, Cavan, Enniskillen, Athleague (county of Roscommon), Killarney (ascends to 3000 feet on the M'Gillicuddy's Reeks), and in county of Dublin. Adults have been found from July till October. *T. longidens* has a wide range in Great Britain (Dorset, Edinburgh, Loch Katrine), North Wales), and on the Continent (Sweden, France, Germany, Austria, Hungary, and Italy). Apparently the genus is confined to Europe.

Family.—TETRAGNATHIDÆ.

Pachygnatha Clerckii, Sund.

Ulster, Connaught, Munster, Leinster.

This spider is common and widely distributed throughout Leinster, and in the eastern parts of Ulster and Connaught. I have received specimens from numerous localities. Londonderry to Borris, county of Kildare; Dublin to Galway, and Ballymote, county of Sligo. Ascends to over 1000 feet on the Mourne Mountains. The only Munster locality I am able to give for the species is Killarney. It has not been found in the south-western peninsulas, nor in Connemara and the western islets, nor yet in county of Donegal. Adults occur all through the year; immature individuals seen most common in the early autumn. In Great Britain this species ranges northwards at least to Oban and Aberdeen, while on the Continent it inhabits Sweden, France, Spain, Germany, Austria, Hungary (north, central, and east), and Italy, as well as Siberia.

Pachygnatha Listeri, Sund.

Connaught, Munster, Leinster.

The only Irish localities for this species at present are Clonbrock, county of Galway (where I took adults of both sexes in September, 1897), Avondale, county of Wicklow (where Mr. Halbert found adults in the same month), and Broadford, county of Clare (where a female was captured by Mr. Halbert in June, 1895). It is a rare species in Great Britain (Dorset, North Wales, Cumberland), while its continental range resembles that of *P. Clerckii.*

Pachygnatha Degeerii, Sund.

Ulster, Connaught, Munster, Leinster.

One of our commonest and most widespread spiders, ranging from county of Donegal, Antrim (Rathlin Island), and Derry to Wexford, Cork, and Kerry, extending into the south-western peninsulas (Slea Head, Derrynane); from Dublin to Achill Island, county of Mayo, and Connemara (Roundstone, Inish M'Dara, and Leenane). Adults are to be found at all seasons of the year. *P. Degeerii* is generally distributed in Great Britain and throughout Europe.

Tetragnatha extensa (L.).

Ulster, Connaught, Leinster, Munster.

This species seems to be widely distributed in Ireland and fairly common. I have localities ranging from the counties of Antrim, Derry, and Donegal, to Skibbereen, county of Cork, and Kenmare, county of Kerry; from Dublin to Ballymote, county of Sligo, Recess, county of Galway, and Limerick. Adults and young are to be found from May until September. It occurs throughout Great Britain, and extends from Lapland to the Mediterranean (Spain, south Italy, and Greece), occurring also in northern and central Asia, as well as in North America (including the Aleutian Isles and Labrador).

Tetragnatha Solandrii, Scop.

Ulster, Connaught, Munster, Leinster.

Evidently much scarcer in Ireland than the preceding form. The only certain localities in Ireland are Londonderry; Ballymote, county of Sligo; Kenmare, county of Kerry; Berehaven, county of Cork; Blessington, county of Wicklow; Lucan, county of Dublin. It is generally distributed in Great Britain, and extends on the Continent from central Norway to Italy.

Tetragnatha obtusa, Koch.

Connaught, Munster, Leinster.

The only localities as yet for this species are Athlone; Clonbrock, county of Galway; Skibbereen, county of Cork; and Lucan, county of Dublin. In Great Britain, it has only as yet been recognised in southern England, though it occurs in central and southern Norway, western and southern France, Corsica, Germany, Austria, Hungary, and Croatia.

Tetragnatha nigrita, Lindl.

Connaught.

Several adult females of this spider were collected near Athlone in August, 1893, by Mr. J. J. F. X. King. It has been recognised in Dorset, Austria, and Hungary.

Family.—ARGIOPIDÆ.

Meta segmentata (Cl.).

Epeira inclinata, } Bl. (Spid. G. B. I.).
E. Mengei, }

Ulster, Connaught, Leinster, Munster.

This is one of the commonest and most universally distributed of all our Irish spiders. Specimens have been received from almost all parts of the country, including Inishmore, Aran; Achill Island, county of Mayo; Valentia, county of Kerry; and Calf Island, Baltimore, county of Cork. It ranges on the hills to 2000 feet and upwards. There are two well-marked generations in the year; the adults of the first (*M. Mengei*, Bl.) being found commonly from April till June, a few apparently lasting on into July, when young individuals (which were hatched in May) are very abundant. In August, September, and October, these become mature; some females live until November. The young spiders of the second brood seem to pass the winter in a half-grown stage. In Great Britain this species is equally common and widespread, while in Europe it ranges from 65° N. lat. in Norway to northern Africa and central Asia.

Meta merianæ, Scop.

Epeira antriada, Bl., and *E. celata*, Bl. (Spid. G. B. I.).

Ulster, Connaught, Leinster, Munster.

Widely distributed and abundant, but less common than the preceding species. I have received specimens from the far north of the counties of Antrim (including Rathlin Island), Derry, and Donegal, and from the south-western peninsulas (Ventry, Derrynane, Skibbereen), as well as from Roundstone in western Connemara. As yet, however, I have no records from the islets, except Achill Island, county of Mayo, and I have not traced the spider above 1000 feet on the hills. Adults are to be found in all months from April till October; but are most numerous in July, August, and September, during which months young and immature specimens are also most frequently to be met with. Its British and general distribution are those of the preceding species; it has, moreover, been found in the Azores.

Meta Menardii, Latr.

Epeira fusca, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This spider is evidently rare in Ireland, though it seems to be widely distributed. Mr. R. Welch captured a female with a cocoon full of newly-hatched young at Castlewellan, county of Down, in October, 1897. Mr. H. L. Jameson (1896) found it in cave-entrances at Enniskillen, in July, 1895, as well as at Keishconnor, county of Sligo, in July, 1894. Mr. Praeger brought me adults of both sexes from Inishmurray, off the coast of the county of Sligo, in June, 1896. Mr. W. F. de V. Kane took a female at Kenmare, county of Kerry, in June, 1895, and a male on the cliffs of Howth, county of Dublin, in June, 1892. Immature females were found at Cloonee Lough, county of Kerry, in July, 1898. There is a female from Lismullen, county of Meath, in the Templeton collection. This spider is only recorded from North Wales, Isle of Man, Durham, Aberdeen, and Ben Aan, in Great Britain, though it is generally distributed in France, and occurs in southern Norway (61° N. lat.), Sweden, Germany, Austria, and Hungary (north, east, and west), Italy, North America, and Madagascar.

Cyclosa conica (Pall.).

Epeira conica, Bl. (Spid. G.B. I.).

Connaught.

The only Irish examples of this species are a female taken at Loughrea, county of Galway, in August, 1893, by Mr. W. F. de V. Kane, and an immature female, taken at Clonbrock, county of Galway, by the Hon. R. E. Dillon, in the summer of 1897. In Great Britain this spider ranges northwards to Banffshire and Inverness-shire, while on the Continent it extends from N. lat. 65° in Norway to northern Italy.

Singa pygmæa (Sund.)

Epeira anthracina + *E. Herii* (in part), Bl. (Spid. G. B. I.).

Leinster.

The only Irish locality for this species is Tullamore, King's County, where two females were taken in June, 1893, by Mr. J. N. Halbert.

In Great Britain it ranges from Dorset into Scotland (Perthshire). On the Continent it extends from Christiania, in Norway, to the Mediterranean.

Singa sanguinea, Koch.

Epeira Herii (in part), Bl. (Spid. G. B. I.).

Connaught.

A female, taken in June, 1896, at Clonbrock, county of Galway, by Mr. J. N. Halbert, is the only Irish example of this spider which I have yet seen. In Great Britain it seems confined to the south of England (Dorset, Hants). It inhabits western and southern France, Germany, Austria, and Hungary.

Zilla x-notata (Cl.).

Epeira similis, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is a very common spider in the counties of Dublin and Wicklow, and is probably generally distributed over the central parts of Ireland to Connemara and Inishmore, Aran, where I took a remarkably dark form of the female in July, 1895. According to Mr. Workman (1880) it is common near Belfast. I have received it from Armagh and Carlingford, but not from Londonderry nor from the county of Donegal. So far as our present evidence goes, it is absent from the far south-west; the only Munster locality I can certify is Limerick. Probably the eggs remain unhatched through the winter, as very young individuals occur in May; they are half-grown in June, and begin to be adult in July; thence, until September, adults are abundant, and I have found a female so late as November. Very common in England, this spider ranges to the far north of Scotland. On the Continent it extends from southern Norway (60°) to the Azores and the Mediterranean, occurring also in North America.

Zilla atrica (Koch).

Epeira calophylla, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

From the evidence at my disposal, this spider seems common in the northern half of Ireland, but rare in the south. It has been found in the counties of Donegal, Derry, Antrim, Cavan, Armagh, Roscommon, Galway, Louth, and Dublin; but my only southern locality is Cloonee Lough, near Kenmare. It appears to reach maturity rather later than the preceding species; I have never found an adult before August, and both sexes are abundant through September and October. I am able to confirm Blackwall's statement—as to which Mr. Cambridge (Spid. Dorset, p. 256) expresses doubt—that this species haunts crevices of rocks as well as herbage. In September the cliffs on the north Dublin coast (Portrane) and Dalkey Island are hung with the snares of these spiders; the long palps of the males rendering any mistake as to the species impossible. Its British and general ranges appear to correspond closely with those of *Z. x-notata.*

Araneus cucurbitinus, Cl.

Epeira cucurbitina, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This species is fairly common in northern and eastern Ireland, but I have no records for the more western parts of Ulster, Connaught, and Munster. Londonderry, Ballyshannon, Clonbrock, Limerick, Kenmare, and Skibbereen are the most western localities from which I have received specimens. This species is found adult from May till August. It is generally distributed in Great Britain (Dorset, Sutherland), and throughout Europe, ranging from 70° lat. in Norway to southern Spain, and eastwards into central Asia.

Araneus diadematus, Cl.

Epeira diadema, Bl. (Spid. G. B. I.).

Exceedingly common, and distributed over the whole country, ascending the mountains to 2000 feet. Specimens have been taken on Dalkey Island, off county of Dublin; Valentia Island, county of Kerry; Achill Island, county of Mayo; and Inishmore, Aran (Galway Bay). The females from the last-named islet are very dark, the white cross-marking on the abdomen being reduced to a few small dots. The ground colour of this spider's abdomen varies greatly. Individuals spinning their snares on furze bushes are usually light brown, agreeing closely with the dried flower of the furze; while specimens taken from a granite cliff on the Wicklow mountains are deep black, the effect of which, in conjunction with the white markings, closely resembles the black mica and white felspar of the rock. The eggs of this species, laid in autumn, hatch out in early summer. Young individuals are found from June till October, and these appear to hibernate and to reappear about half-grown in the following spring; they increase in size through their second summer, reaching maturity sometime as early as July, but as a rule not until August. In September adults are abundant, and may also be observed in October. Very rarely these seem to survive the winter. I have adults of both sexes taken in May, which may be presumed to have attained an age of fully two years.

There can be no doubt that *A. diadematus* is universally distributed in Great Britain, while on the Continent it extends from Iceland and the North Cape (Norway), to the far south of Italy, and also inhabits North America.

Araneus gibbosus (Wlck).

Epeira bicornis, Bl. (Spid. G. B. I.).

E. arbustorum, Cb. (Spid. Dorset).

Connaught.

An immature female, taken at Mote Park, county of Roscommon, by Mr. J. N. Halbert, in June, 1897, is the only example of this spider as yet found in Ireland. In Great Britain it has been observed in the south of England and in North Wales. Apparently absent from Scandinavia, it inhabits France, Corsica, Germany, Austria, Hungary, Croatia, and Greece.

Araneus cornutus, Cl.

Eperia apoclisa, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This common spider appears to range over the whole country, though it is not so universally distributed as *A. diadematus*. I have seen specimens from numerous localities, from Carndonagh, in the far north of county of Donegal, to Kenmare and Dingle, in county of Kerry; Fermoy, county of Cork; and New Ross, county of Wexford. It is very common in county of Wicklow; while in the west of Ireland, it is found all over Connemara, and on the islets of Inishmore (Aran) and Inish M'Dara. Adults of both sexes are to be found from May till October; they are most plentiful in August and September. During July and August, immature individuals are to be observed, but I have never seen very young examples of this species. It is distributed throughout Great Britain, and on the Continent ranges from the far north of Norway to the Mediterranean (southern Spain, Greece and Syria), and across Siberia and central Asia.

Araneus patagiatus, Cl.

Epeira patagiata, Bl. Spid. (G. B. I.).

Ulster, Connaught.

The only Irish localities known to me for this spider are Glenveagh, county of Donegal, where Miss S. Smith took adult males in October, 1892; Athlone, where Mr. J. J. F. X. King found adult males in August, 1894, and the shores of Lough Corrib, near Oughterard, county of Galway, where Mr. R. Welch found adult females in July, 1895. A much scarcer species than the preceding in Great Britain, not traced further north than Carlisle, *A. patagiatus* has an equally wide range in Europe, and occurs in Iceland.

Araneus quadratus, Cl.

Epeira quadrata, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This spider is widely distributed over the country, but appears to be local. I have seen specimens from counties of Donegal (Kilmacrenan and Glenveigh), Roscommon (Roscommon and Athlone), Galway (Clonbrock and Loughrea), Clare (Cratloe), Limerick, Kerry (Killarney, Kenmare, and Parknasilla), Cork (Skibbereen), Kilkenny (banks of the Suir), Queen's County, King's County (Tullamore), Wicklow (south of Wicklow town), Louth (Omeath). Adults occur mostly in July, August, September, and October, but females have been found also in May. Young and immature specimens in June, July, and August. In Great Britain this spider ranges north to Sutherland, though it seems absent from the Northumberland, Durham, and Edinburgh districts. Its continental range is exceedingly wide (Arctic Norway and Finland to the Mediterranean).

Araneus umbraticus (Bl.).

Epeira umbratica, Bl. (Spid. G. B. I.).

Munster, Leinster.

The only Irish localities at present known for this spider are Borris, county of Carlow, where Mr. J. N. Halbert (collecting for the Royal Irish Academy Flora and Fauna Committee) took a young female in March, 1894, and Killarney, where Mr. W. F. de V. Kane found another immature female in June, 1895. This species ranges northwards in Great Britain, at least to the Grampians, while its European distribution is as wide as that of the preceding species.

Araneus Redii, Scop.

Epeira solers, Bl. (Spid. G. B. I.).

Connaught, Munster.

Apparently a scarce and local spider in Ireland, and so far unknown in the north or east. The only localities are Mount Talbot, county of Roscommon; Limerick; Glencar, county of Kerry; and Berehaven, county of Cork. Adult females were obtained at the end of May and early in June; immature specimens in September. Near Berehaven I found this spider up to 1000 feet on the hills. It occurs in Great Britain from Dorset to Cumberland. On the Continent it is a southern species, only occurring in the extreme south of Norway, though it inhabits Sweden, Russia, France, Germany, Austria, Hungary, Croatia, and Greece; occurring also in St. Helena, in south Africa, in central and eastern Asia, and in Japan.

Family.—LYCOSIDÆ.

Pisaura mirabilis (Cl.).

Dolomedes mirabilis, Bl. (Spid. G. B. I.).
Ocyale mirabilis, Cb. (Spid. Dorset).
Connaught, Munster, Leinster.

This spider is common and widely distributed over the southern half of Ireland, but seems to be absent from the north and west. The northern limit of its range as known to me would be indicated by a line running from Bray, county of Wicklow; through Maynooth, county of Kildare; across Ireland to Clonbrock, county of Galway, thence south-westward through Loughrea, county of Galway, Cratloe, county of Clare, and Killarney, to Derrynane, county of Kerry. South and south-eastward of this line, the spider is probably everywhere present in suitable localities, having been observed abundantly in county of Wicklow; at Fermoy, Skibbereen, Glengariff, and Berehaven, county of Cork; and Kenmare, county of Kerry. No doubt localities north-west of this line await discovery. I have found the male adult as early as May, the female from June till August. Females with egg-bags appear in July, young individuals in September, and immature examples in March and April, having come out of their winter retreats.

This is a widespread spider in Great Britain, ranging north as far at least as the Grampians. It is distributed in all European countries, extending to the Azores and Canaries as well as to southern Spain, Italy, and Greece, and eastwards to Turkestan; in Norway it occurs as far north as Trondhjem (63° lat.), and is an excellent example of the north-east and south-west direction of the line limiting the range of animals of the faunistic group to which it belongs.

Dolomedes fimbriatus, Cl.

Connaught, Munster.

This great spider seems to be generally distributed in Connaught, as specimens have been taken at Sligo; Roscommon, Mote Park, and

Mount Talbot, county of Roscommon; and Clonbrock, county of Galway; while in Connemara it is exceedingly abundant on the hill-slopes and lake-shores, extending as far west as Roundstone, but seemingly not to the western islets. In Munster it is more local, being known only from Crumaglaun and the hill-slopes around the Upper Lake of Killarney, where the late Mr. A. G. More (1889) was the first to recognise it as an Irish species. All the specimens known to me have been obtained in June, July, and August. In July the spider can be observed in all stages of growth from the tiny young just hatched from the eggs. It appears therefore that the species takes more than a year to attain its full size.

It is a very local species in Great Britain, recorded, I believe, only from Dorset, Hampshire, Buckinghamshire, Cambridgeshire, Northumberland, and Perthshire. On the Continent it inhabits Norway (to 70° N. lat.), Finland, Sweden, Russia (south to the Crimea), Denmark, Belgium, France (from the north-east across to Bordeaux, but apparently absent in the north-west and south-east), Germany, Switzerland, northern Italy, Greece, the Caucusus, Turkestan, and eastern Siberia.

Lycosa pulverulenta (Cl.).

L. rapax, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This species is widely distributed over Ireland and fairly common, extending from the most northerly localities (including Rathlin Island, county Antrim) far to the south and into the Cork and Kerry peninsulas (Skibbereen, Berehaven, Dingle) as well as into Connemara and Inishmore, Aran. It ascends to 2000 feet on the mountains. In the east I have seen specimens from counties of Louth, Dublin, Wicklow, and Carlow. Adult females have been found in January and March, and from May till August; males in May. Immature individuals occur in March and April, and also in August, September, and October. It is probably universally distributed in Great Britain. I have seen specimens from the Faröe Islands. On the Continent it ranges from 70° N. lat. in Norway and from Russian Lapland to North Africa and Syria.

Lycosa perita (Latr.)

L. picta, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This spider probably occurs on sandhills all round the Irish coast. I have seen specimens from counties of Antrim, Derry, Donegal, Mayo (Achill Island), Galway (including Inishmore, Aran), Kerry (Ventry), Wicklow, Dublin, Meath, and Louth. Adults occur from May till September. *L. perita* is generally distributed in Great Britain. On the Continent it occurs in southern Norway and Sweden, central and southern Russia and the Caucasus, Belgium, France, Spain, Germany, northern and central Hungary, and extends to the Azores.

Lycosa cinerea (Fb.).

L. allodroma, Bl. (Spid. G. B. I.).

Leinster, Munster.

The only Irish localities for this spider known at present are King's River, Blessington, county of Wicklow, where Mr. J. N. Halbert took an adult female in August, 1897, and a young individual two months later; and Kenmare, county of Kerry, where the same collector took half grown females in July, 1898. In Great Britain, this species is rare and apparently confined to the north (Aberdeen, Perthshire, Northumberland, N. Wales), a remarkable fact, seeing that it occurs on the Channel Islands and ranges on the Continent from 63° N. lat. in Norway and northern Russia to the south of France, the Canaries, Spain, Italy, Greece, the Crimea, Caucasus, and Turkestan.

Lycosa leopardus, Sund.

L. cambrica, Bl. (Spid. G. B. I.).

Connaught, Munster, Leinster.

This is a local spider in Ireland, but not rare where it occurs. I have seen specimens from counties of Galway (shores of Lough Corrib, Roundstone), Clare (Killaloe, Finlough), Kerry (Ventry, Kenmare), Cork (Berehaven and Bere Island), and Wicklow (Brittas Bay). Adults occur in May, June, and July; immature specimens also in April and August. *L. leopardus* has a wide range in Great Britain (Dorset to Aberdeenshire, though not recorded for Cumberland, Durham, Northumberland, or Edinburgh). On the Continent it is a southern form, only reaching central Russia and the extreme south of Norway, and occurring rarely in northern Germany, while it extends to Spain, Italy, Corsica, eastern Hungary, the shores of the Adriatic, and Turkestan.

Lycosa ruricola (De Geer).

L. campestris, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is one of our commonest and most widely distributed species, ranging from the shores of Lough Swilly, Londonderry, and the county of Antrim to Calf Island, Baltimore, county of Cork; from

Dublin to Achill, Connemara, Inish M'Dara and Inishmore, Aran, as well as into the far south-western peninsulas (Dingle, Ventry, Caherciveen, Derrynane). Adults occur in Ireland not only in May and June (the months given by Mr. F. Cambridge (1895) for Great Britain), but throughout the year from January till October. The eggs are laid in May; young spiders are found in July and onward through the autumn, half-grown individuals in July, and almost mature specimens in August. It seems, therefore, that these spiders do not reach maturity until the autumn of the year after hatching, and that they survive the winter in the adult state to pair and lay eggs in the succeeding May. This spider is widely distributed in Great Britain (northwards to the Grampians), and ranges on the Continent from Lapland and northern Finland to southern Spain, the Mediterranean Isles, and Greece, as well as to eastern Siberia.

Lycosa terricola, Thorell.

L. agretyca, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This spider is as common and widespread as *L. ruricola* in northern, eastern, and western Ireland, extending into Limerick, Clare, and Connemara, as well as into the islets (Inish M'Dara and Inishmore) off the coast of Galway and Achill, county of Mayo. It has been found at Ferns, county of Wexford, and Skibbereen, county of Cork, whence it may be inferred that it is equally widespread in the south. It occurs over 2000 feet up on the hills. In the south-western peninsulas it has occurred in Dingle and Kenmare. Adults have been noted in all months from March till October, and the life cycle is presumably similar to that of *L. ruricola*. This spider varies greatly in colour as well as in size. Some specimens of the female are bright red-brown, others deep blackish brown. One of the latter variety taken on the shores of Lough Derevaragh, county of Westmeath, was erroneously recorded as *L. andrenivora*, Wlck. (Dublin Nat. F. C., 1892). This species is generally distributed in Great Britain (northward to the Grampians at least), and on the Continent ranges from 65° N. lat. in Norway into north Africa and Turkestan.

Pirata hygrophilus, Thorell.

Lycosa piscatoria, Bl. (Spid. G. B. I.).

Connaught, Munster.

The only Irish examples of this spider yet found are a male from Limerick, taken June, 1895, and a female from Mote Park, county of Roscommon, taken June, 1897, both collected by Mr. J. N. Halbert. A local species in Great Britain, *P. hygrophilus* is recorded only from

Dorset, Buckinghamshire, Durham, and Cumberland. Abroad it inhabits southern Norway and Sweden, the Channel Islands, northern France, Belgium, Germany, Austria, northern and central Hungary, northern, central, and southern Russia, and Turkestan.

Pirata piscatorius (Clerck).

Leinster.

A female taken on Braganstown Bog, county of Louth, by Mr. H. L. Jameson, in April, 1893, is the only Irish example of this species I have yet seen. In Great Britain it is recorded only from Norfolk and Dorset. Abroad it is found in Iceland, Norway and Sweden, north-eastern France, Belgium, Germany, Switzerland, Austria, northern and eastern Hungary, and central Russia.

Pirata piraticus (Clerck).

Lycosa piratica, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This spider is common and widely distributed over the greater part of Ireland. I have records ranging from the county of Antrim (Fair Head), Londonderry, and Donegal to the counties of Wexford (Ballyhyland), and Kerry (Killarney); from the counties of Dublin (Howth) and Wicklow (including the summit of Lugnaquilla, over 3000 feet) to Athleague and Mount Talbot, county of Roscommon; Ballymote, county of Sligo; and Limerick. The species has not, however, been found in Connemara, nor in any of the south-western peninsulas of the counties of Cork and Kerry. Adults are found from May till September, the female with egg-bags in July and August. Very young spiders, newly hatched, occur in January, half-grown specimens in summer time, immature individuals in autumn and spring; hence it seems that the eggs laid in summer hatch out during winter, and that the spider takes eighteen months to reach maturity. It is probably generally distributed throughout Great Britain, while it ranges from Novaya Zemla and the far north of Norway and Russia to Algeria and Syria.

Pardosa agricola (Thorell).

Lycosa fluviatilis, Bl. (Spid. G. B. I.).

Ulster, Munster, Leinster.

Widespread, but scarce in Ireland. The only localities known to me are Rostrevor, county of Down; Drogheda, county of Louth; Bray, county of Wicklow; and Dingle, county of Kerry. Adult females from May till July; in May with egg-bags, and in July carrying the family of newly-hatched spiders. This is another species apparently confined in Great Britain to Scotland (Perth, Aberdeen), the north of England, and North Wales, though it ranges on the Continent from the far north of Norway and Finland to southern France, and eastern Hungary, and Turkestan.

Pardosa monticola, Koch.

Lycosa exigua (in part), Bl. (Spid. G. B. I.)

Connaught, Leinster.

This spider has only been found in Ireland on the east and west coasts:—at Dollymount, Sutton, and Portmarnock, county of Dublin; Brittas Bay, county of Wicklow; Gentian Hill, Roundstone, and Inish M'Dara, county of Galway. It is adult from May till August. It is widely distributed in Great Britain (Dorset, Aberdeen); on the Continent it ranges from the north of Finland and Norway to southern France, Italy, and Croatia. According to M. Simon, it is in France characteristic of the Channel shores and the alpine meadows, being commoner than *P. palustris* in the Pyrenees.

Pardosa purbeckensis, F. Cb.

Connaught.

The only known Irish example of this spider is an adult female taken by me at Gentian Hill, near Galway, in July, 1895, while collecting for the Royal Irish Academy Flora and Fauna Committee. The species was described by Mr. F. Cambridge (1895) from specimens taken on the shores of Poole Harbour, Dorset, and the Solway Firth. It is very closely allied to *P. monticola*, but larger. Apparently it has not yet been recognized on the Continent.

Pardosa palustris (Linn.).

Lycosa exigua, Bl. (Spid. G. B. I.), in part.

L. palustris, Cb. (Spid. Dorset).

Ulster, Munster. Leinster.

This species is common and widely distributed over the greater part of Ireland. It ranges from counties of Antrim (Rathlin Island), Derry and Donegal to Wicklow and Cork (Berehaven); from Dublin to the south-western peninsulas (Derrynane, Mount Brandon); and ascends to 2000 feet on the hills. Adult males occur in Ireland from May until July, females until September. It is of general occurrence in Great Britain and very widely distributed in northern Europe (71° N. lat. in Norway), extending to the Faröe Islands, Iceland, and Novaya Zemla, and southward to the Pyrenees (where it is scarcer than *P. monticola*), southern Germany, central Hungary, and eastward to Turkestan and the Amur.

Pardosa herbigrada (Bl.).

Lycosa herbigrada, Bl. (Spid. G. B. I.).

Ulster, Connaught, Leinster.

Typical examples of this beautiful spider have occurred in Ireland only at Roundstone and Clonbrock, county of Galway (Carpenter, 1896, ii.). With these specimens, however, were found others in which the median yellow band is narrow, more or less dilated behind the eyes, and showing a decided approach to typical *P. palustris*. This variety has also occurred at Londonderry; Arvagh, county of

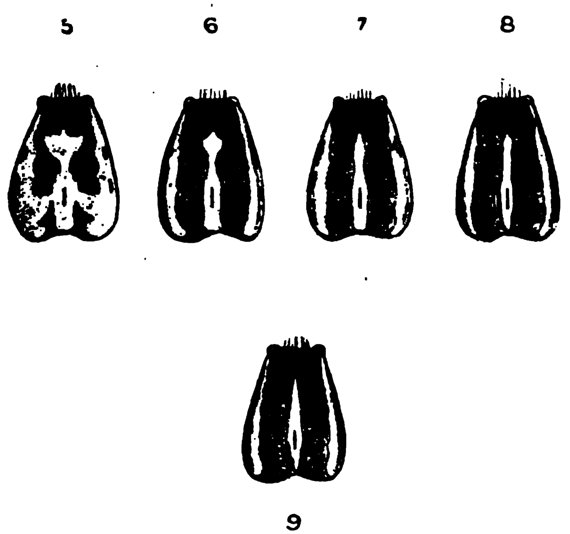


FIG. 5.—*Pardosa herbigrada*, cephalothorax of typical specimen (Clonbrock, county of Galway).

FIGS. 6, 7, 8.—Varieties showing transition to *P. palustris* (Roundstone, county of Galway).

FIG. 9.—*P. Palustris*, typical (county of Kerry).

Cavan; Mulroy Bay, county of Donegal; Athleague, county of Roscommon; Lough Derevaragh, county of Westmeath. Mr. Cambridge is indeed of opinion that they should be regarded as a variety of *P. palustris*; and, in the short paper referred to above, I also expressed this view. But as they are larger than typical *P. palustris*, and occurred in company with *P. herbigrada*, I prefer to consider them a variety of the latter. In any case they go far to bridge the gap between the two, and suggest that *P. palustris* is an offshoot of *P. herbigrada*, the latter exhibiting the light cephalothorax characteristic of the young of dark-hued spiders of this genus, and also showing by its discontinuous distribution that it is an old species. It is recorded from England (Dorset, Northumberland), Scotland (Perthshire, Argyllshire, Inverness-shire, Ross-shire), Norway (Christiana, Stavanger, Trondjem), Guernsey, Germany (Hamburg), Austrian Poland, and Russia (White Sea islands and Caucasus).

Pardosa nigriceps (Thorell).

Ulster, Connaught, Munster, Leinster.

This is a common and widely distributed spider in Ireland, ranging from counties of Donegal, Derry, and Antrim to Wexford and Cork (Skibbereen); from Dublin to Connemara and Inishmore (Aran), as well as into the far south-west (Ventry, Parknasilla, Berehaven). Adult males are to be found in May, but females occur all through the summer until October, carrying their egg-bags from June till August. From my notes as to the occurrence of young and immature individuals, I believe that the eggs are hatched in summer, and that the young spiders do not attain maturity until the spring of the second year. For in May and June newly-hatched individuals are observed; in autumn (September to November) one finds quite young spiders, and also specimens about two-thirds grown, while in spring (March and April) the immature males and females are evidently just about to undergo the final result. *P. nigriceps* is a widespread species in Great Britain (Dorset, Isle of Man, Grampians). It is found in Norway (northwards to 65° lat.), Sweden, and north-eastern France, but apparently not in central or eastern Europe.

Pardosa pullata (Clerck).

Lycosa obscura, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is perhaps the most universally distributed of all Irish spiders, as it occurs in all sorts of localities—waste and cultivated lands and woods, and ascends 3000 feet on the mountains. It ranges over the whole country from north to south and from east to west, occurring on Achill Island, Inishmore (Aran), and in all the south-western peninsulas (Dingle, Derrynane, Berehaven and Bere Island, Crookhaven). Adult males are to be found as early as April, and on until July; females from May till September. The life cycle seems to be the same as that of the preceding species. Irish examples of *P. pul-*

lata vary greatly in size and markings. Many females are small and comparatively pale, with distinctly annulated legs. I have often thought at first sight these must surely be referable to one of the nearly allied species (*P. riparia* or *P. prativaga*), but in all cases the structural characters are clearly those of *P. pullata*. It is probably of universal distribution in Great Britain, but seems to be a northern form on the Continent, extending from the extreme north of Norway to France, Spain, northern Italy, central Russia, and Hungary.

Pardosa prativaga, Koch.

Munster.

The only Irish example of this spider which I have seen is an adult male taken at Finlough, county of Clare, in June, 1895, by Mr. J. N. Halbert. In Great Britain this seems a southern species (Dorset, Sussex). Its foreign distribution resembles that of *P. pullata*, except that in Norway it only ranges to 63° N. lat.

Pardosa lugubris (Wlck.).

Lycosa lugubris, Bl. (Spid. G. B. I.).

Leinster.

This spider is common in spring in the woods of county of Wicklow. Mr. D. W. Freeman was the first to discover it, in the Vale of Clara, and I have taken adults of both sexes (females with egg-bags) in April and May, near Enniskerry and by the banks of Lough Tay. At Woodenbridge, in the Vale of Ovoca, I found numerous adult females with egg-bags, some young spiders just hatched, and an immature male in *September* (1894). So far as I am aware an autumn breeding-time for this species has not been previously noticed. Mr. Halbert found this spider in Clonad Wood, near Tullamore, King's County, in May, 1895. It is a widespread species in Great Britain, ranging north, at least, to the Grampians, while on the Continent it extends from the far north of Norway and Russia to Corsica and the Adriatic coast.

Pardosa amentata (Clerck).

Lycosa saccata, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

This is one of the commonest of Irish spiders. It is spread over the whole country from counties of Donegal, Derry, and Antrim (Fair Head) to Wexford, Waterford, Cork (Glandore), and Kerry (Derrynane); from Howth, county of Dublin, to counties of Sligo, Mayo, and Galway (Roundstone in Connemara). I have no record, however, of its occurrence on the western islets, and it is more confined to the lowlands than *P. pullata*; I have not met with it above 1700 feet on the hills. Adults of this species occur from April till September, the females carrying their egg-bags during June and July. In the latter month adult males seem quite as common as in May. Young spiders just hatched have been noticed in July. In the autumn specimens in various stages of growth are to be observed; some about half grown, others nearly full-sized, but not yet mature. In the early spring the latter become adult, perhaps being then eighteen months old. *P. amentata* is generally distributed in Great Britain, and has abroad as wide a range as the preceding species, extending from Greenland, Iceland, and Lapland to southern Italy.

Family—Attidæ.

Neon reticulatus (Bl.).

Salticus reticulatus, Bl. (Spid. G. B. I.).

Connaught.

A single female of this species was taken at Leenane, county of Galway, in April, 1897, by Mr. J. N. Halbert, when collecting for the Royal Irish Academy, Flora and Fauna Committee, and an immature male at Keem Bay, Achill Island, county of Mayo, in April, 1898. There can be little doubt that it has a wide range in Ireland, since it extends from the south of England at least as far north as Inverness-shire. According to Simon it is found all over France, and it occurs as far north as lat. 60° in Norway. In Germany, it would appear not to be a well-known species, but it is probably present, at least in the south, as M. Kulczynski records it from Austria and Hungary.

Euophrys frontalis (Bl.).

Salticus frontalis, Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster.

This spider has a wide range at least in the north and west of Ireland. It has been found at Londonderry, county of Sligo (Keishconnor), county of Mayo (Keem Bay, Achill Island), Inishmore, Aran, Galway Bay; county of Kerry (Ventry), county of Cork (Cork and Skibbereen). Adult specimens have been taken in May, and immature individuals in April and July. *E. frontalis* is found in England, Wales, and Scotland (Aberdeen), and seems to be widely distributed on the Continent, occurring certainly in France, Italy, Germany, Austria, Hungary, and Sweden, but apparently not in Norway.

Euophrys erratica (Wlck.).

Salticus distinctus, Bl. (Spid. G. B. I.).

Connaught.

It is remarkable that the only Irish locality yet known for this spider (which has a very wide range on the Continent, extending from eastern Hungary, and the Mediterranean islands, to Trondjem in Norway) should be Inishmore (Aran), in Galway Bay. No doubt it awaits discovery in other localities. It is apparently a western and northern species in Great Britain (Exeter, North Wales, Lancashire, Cumberland, Durham, Edinburgh, Inverness).

Heliophanus flavipes (Hahn).

Salticus cupreus (in part), Bl. (Spid. G. B. I.).

Ulster, Leinster.

This spider has been found at Londonderry (Milne, 1895); Portrush, county of Antrim, Donabate, Portrane and Portmarnock, county of Dublin. It is to be found from May until September, and is adult in July and August. *H. flavipes* occurs in England and Wales, but has not yet been noticed in Scotland, though it probably occurs there, as it inhabits Sweden and southern Norway. It is found in France, in northern and western Germany, in Austria, and in northern Italy, but not in Hungary.

Heliophanus cupreus (Wlck.).

Salticus cupreus (in part), Bl. (Spid. G. B. I.).

Ulster, Connaught, Munster, Leinster.

A widespread species in Ireland, and probably not scarce. I have received specimens from Portrush, county of Antrim; Londonderry; Athlone; Inishmore (Aran Isles); Ventry, county of Kerry; Glandore, and Skibbereen, county of Cork; and Howth, county of Dublin. Mr. Workman (1880) records it from an island in Strangford Lough. Adults are found in May and June; immature specimens in April, July, and August. This is the commonest species of the genus in Great Britain (it occurs on the Isle of Man, and ranges northwards to Aberdeen in Scotland), and on the Continent, where it extends from France, Spain, Italy, and Hungary, to central Norway.

Attus floricola (Koch).

Connaught.

This spider was discovered by Mr. Halbert and myself (1895, ii., iii.), on the shores of Lough Corrib (near Oughterard), county of

Galway, in July, 1895, when collecting for the Royal Irish Academy Flora and Fauna Committee. We found both adult and immature specimens. In the succeeding summer, Mr. F. Neale found adult females on the shores of Lough Derg. When first taken it was an addition to the fauna of the British Isles, the species from Brighton, described by Rev. O. P. Cambridge (Spid. Dorset) as *A. floricola*, being really the allied *A. mancus*, Thorell. Mr. Cambridge has, however, since discriminated between the two spiders (1896), and recorded the true *A. floricola* from Warrington, Cheshire (1897).

A. floricola has a wide range in central Europe, extending to Hungary and southern Italy, and northwards into southern Norway and Sweden.

Ergane falcata (Cl.).

Salticus coronatus, Bl. (Spid. G. B. I.).
Hasarius falcatus, Cb. (Spid. Dorset).
Munster, Leinster.

This species has been found near Limerick, by Mr. F. Neale, and has been collected at Killarney (Upper Lake shore), and at two localities in county of Wicklow—the Devil's Glen, and Glenmalure. Adults occur both in May and in July. In Great Britain, it ranges northwards at least to Perthshire. Abroad it has been traced from northern Norway and Finland to Sumatra.

[*Hasarius Adansoni* (Sav.).

This Mediterranean species lives in the conservatories at Glasnevin, and in the University Botanic Gardens, Dublin, and also at Belmont, Belfast, but it has no claim to a place in the Irish list.]

Epiblemum scenicum (Clerck).

Salticus scenicus, Bl. (Spid. G. B. I.).
Ulster, Connaught, Munster, Leinster.

This spider has been taken by Mr. Workman at Craigdarragh, county of Down. It is not scarce in the counties of Dublin and Wicklow. Elsewhere in Ireland, I have only received it from Limerick, and from Cong, county of Galway. It is adult in June and July. It is the commonest spider of the family in Great Britain and on the Continent, where it has a very wide range (from northern Norway and Finland, to southern Spain, eastern Hungary, and Italy). According to Thorell, it also inhabits North America, and it has been recorded from Greenland.

It will be seen that the list contains only 225 species, but I believe that when the spiders of Ireland have been thoroughly worked out, another 100 species at least will be added. The spider-fauna of the British Islands comprises 560 species, and no less than 280 have been already recorded from Scotland.[1] Perhaps a table of the number of species of spiders of each family known from the various countries of the United Kingdom may be of interest. The most striking feature of this summary is the poverty of Attidæ in the Scotch and still more in the Irish fauna.

	Great Britain and Ireland.	England and Wales.	Scotland.	Ireland.
Atypidæ, .	2	2	0	1
Dysderidæ, .	6	6	4	4
Oonopidæ, .	1	1	1	1
Drassidæ, .	24	23	11	8
Clubionidæ, .	35	35	22	20
Sparassidæ, .	1	1	0	1
Thomisidæ .	45	44	16	14
Agelenidæ, .	22	21	10	9
Eresidæ, .	1	1	0	0
Dictynidæ, .	17	16	6	6
Scytodidæ, .	1	1	0	0
Pholcidæ, .	1	1	0	1
Theridiidæ, .	290	283	149	108
Tetragnathidæ, .	9	9	4	7
Argiopidæ, .	31	31	20	16
Uloboridæ, .	2	2	0	0
Oxyopidæ, .	1	1	0	0
Lycosidæ, .	36	33	27	21
Attidæ, .	36	36	13	8
Totals, .	561	547	283	225

[1] For this census of Scotch spiders I am indebted to my friend, Mr. W. Evans, F.R.S.E.

The chief interest to be derived from such a list as the foregoing lies in the allocation of the various species to their faunistic types. The importance of Ireland and its fauna from a distributional standpoint has been lately brought home to naturalists by my friend Dr. Scharff, in whose Paper[1] the various divisions of our animal population are fully discussed. There is difficulty in dealing with the spiders from this point of view, because their distribution is as yet imperfectly known. It may be well, however, in concluding this Paper to put forward a few suggestions, which subsequent knowledge may confirm or modify.

It is clear that a very large proportion of our spider population belongs to that widespread faunistic group which ranges over vast tracts of the Holarctic Region, and includes the most dominant and vigorous members of our fauna. *Segestria senoculata*, *Drassus lapidosus*, *Clubiona terrestris*, *Xysticus cristatus*, *Tegenaria domestica*, *Theridion lineatum*, *Erigone dentipalpis*, *Linyphia triangularis*, *Pachygnatha Degeerii*, *Meta segmentata*, *M. merianæ*, *Araneus diadematus*, *A. cornutus*, *A. quadratus*, *Lycosa pulverulenta*, *Pirata piraticus*, and *Pardosa amentata* are a few typical examples of this group. Some of them have a more or less restricted range in the British Isles; *Pisaura mirabilis*, for instance, which is found as far north as Trondjem in Norway, seems confined to the southern half of Ireland. The north-east and south-west trend of the line which bounds the territory held by such a species as this seems to indicate clearly that it has spread from south-east to north-west.

Another large section of the Irish spiders, though wide-ranging, are more restricted in their distribution than the species just considered. These are absent from the Scandinavian peninsula, or only reach its southern districts, while they range across most of central and southern Europe. In Great Britain they do not range far north, while in Ireland they are, as a rule, confined to the south or to the south and west. Typical examples are *Atypus piceus*, *Micrommata virescens*, *Araneus gibbosus*, *Lycosa leopardus*, *Pirata hygrophilus*, and most, if not all, of the Attidæ. I have elsewhere suggested that the animals of this group have spread in the Irish area from west to east, as well as from south to north, and that they are considerably older than the widespread section which has travelled from east to west; that indeed they lived in the districts south and west of the area of deposition

[1] "On the Origin of the European Fauna," *Proc. R. I. A.* (3) vol. iv. No. 3, 1897. See also G. H. Carpenter, "The Problems of the British Fauna," *Nat. Science*, vol. xi., 1897, pp. 375–386.

of the Pleistocene Drift. *Prosthesima Latreillei* and *Oxyptila praticola* seem members of this section which have been able in Ireland to spread farther east and north than the others.

A comparatively small, but well-marked section of the Irish spider fauna is to be assigned to the northern group. These species are abundant in the north of Europe, but seem to die out towards the south, while some of them re-appear in North America, suggesting the range of such mammals as the Varying Hare. As examples may be given *Prosthesima subterranea, Cryphoeca sylvicola, Textrix denticulata, Amaurobius fenestralis, Erigone longipalpis, Tmeticus Huthwaitii, Bathyphantes nigrinus, Lephthyphantes terricola, Linyphia insignis, Bolyphantes luteolus, Pardosa palustris*, and *P. herbigrada.* It is interesting to notice that several of these species—*Amaurobius fenestralis*, for example—are abundant over the whole of Ireland, while they are absent or very scarce in southern England, notwithstanding that they range far south in France. It is impossible to suggest what can have prevented the southern advance of these species in Great Britain, when we see that they have passed so far on in Ireland and on the Continent. But the fact clearly indicates that they entered our area from the north.

A yet smaller group of Irish spiders can be assigned with confidence to the oldest section of our fauna—the Lusitanian or south-western section, characteristic of south-western Europe and the Mediterranean shores, sometimes with a restricted distribution in Ireland, sometimes extending into western or northern Britain—*Dysdera crocota, Agroëca celans, A. gracilipes, Tegenaria hibernica, Theridion aulicum, Lasaeola inornata, Teutana grossa, Cnephalocotes curtus*, and *Porrhomma myops* are examples of these.

There remain certain species which are decidedly western in their range, and are therefore to be reckoned among the old members of our fauna, though there is not sufficient evidence to warrant us in assigning them definitely to the south-western group; some of them at least may have come into our area from the north. These species, some of which are among the commonest of Irish spiders, are absent from the Austro-Hungarian fauna or only present in the western regions of that country, while a few have not been recognized at all on the Continent. Examples are—*Oonops pulcher, Agroëca proxima, Oxyptila flexa, Hahnia montana, Amaurobius similis, Theonoe minutissima, Neriene rubens, Erigone promiscua, Tmeticus prudens, Bathyphantes pullatus, Lephthyphantes Blackwallii*, and *Pardosa nigriceps.* These western species seem able to hold their ground in numbers in our island, and specially in Ireland, while they are giving way on the Continent before newer and more vigorous rivals.

As changes in the frontiers of states on the map of Europe speak to the politician of the varying fortunes of the struggle between races and nations of men, so the ranges of animal species, as traced out by the naturalist, give hints of the progress of the age-long conflict between the myriads of living creatures for possession of the land.

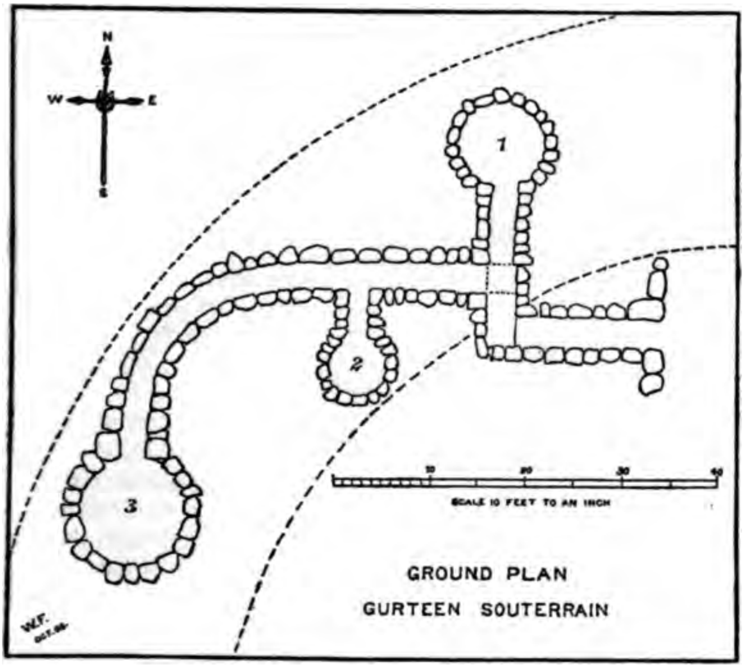
VII.

NOTES UPON A RATH SOUTERRAIN AT GURTEEN, GAINSTOWN, COUNTY WESTMEATH. By REV. WILLIAM FALKINER, M.A. [Plates II., III.]

[Read November 14, 1898.]

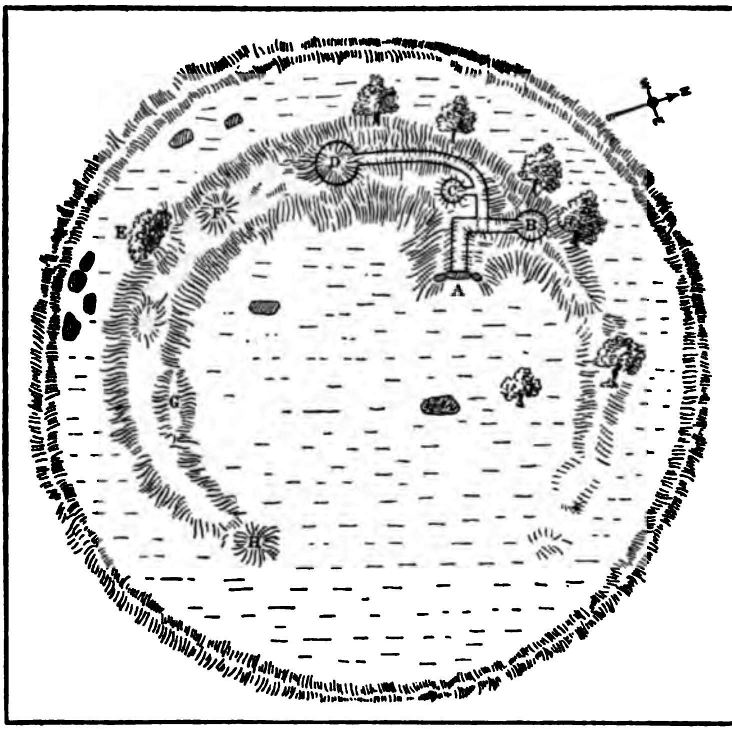
The Rath of Gurteen is situated upon the property of Lord Congleton, within four miles of Mullingar, in the parish of Moyliscar, and about 500 yards from the Roman Catholic church of Gainstown.

In this rath there is a very interesting souterrain which is, I believe, one of the best preserved and most accessible examples of its



kind in existence; but although discovered many years ago very few beyond the residents of the immediate neighbourhood are acquainted with the fact.

The entrance to the souterrain is in the inner enclosure of the rath, and the passages and chambers are all contained, with the exception of the actual entrance, within the thickness of the vallum (sketch plan, A, B, C, and D).



SKETCH PLAN OF GURTEEN RATH AND SOUTERRAIN.

The greater portion of the mound has long since been removed, but in the part still remaining there lie not only the structure which is the subject of these notes, but, I am strongly of opinion, another souterrain as well, as the configuration of the ground, I think, plainly indicates at E, F, G, and H; and this opinion, formed at first sight, is strengthened by the existence of local tradition to the same effect.

The entrance to the souterrain consists of a very strongly constructed doorway formed of jambs of large rough stones surmounted by a cyclopean lintel. (Plate II.)

The portion of the passage leading from this entrance to the vallum is covered by a mound of earth, but this, as well as the vallum itself, has in the course of ages lost much of its original height, the earth of which both are mainly composed having been washed down and their contour changed by the action of those various agencies ever at work in denuding and obliterating ancient earthworks, especially by the untiring continuous labours of that universal leveller the earthworm; but when this rath was in its pristine condition, the vallum and entrance passage leading to it probably presented a sharp and well-defined outline both in plan and section.

The entrance faces the east; and the passage, which is 3 feet by 3 feet, runs in a straight direction for a distance of 17 feet, during which it dips about one foot: here there is a step down of 10 inches, and at the same time an elevation in the roof giving a clear height of 5 feet 10 inches—probably 6 feet originally. At this point the passage takes a direction at right angles for a distance of 8 feet, at the further end of which, and midway between floor and roof, there is a large flat stone, roughly about 9 inches thick, forming a shelf 3 feet long, *i.e.* from side to side of the passage—and 3 feet wide.

Plate III. gives a fairly accurate idea of the interior of the souterrain at this point. The opening upon the right represents the outer passage 17 feet from the entrance. Underneath the stone shelf is seen the entrance to a passage 2½ feet by 2½ feet. The sides and roof are composed of very large and rough unhewn stones. This passage trends slightly to the right, and dips about 10 inches in its length of 9 feet when it leads to No. 1 chamber of beehive shape built of rough stones and closed at the apex by a large, roughly circular flag, evidently about 3 feet in diameter. This chamber is 7 feet high with a diameter of 9 feet at base. The doorway is formed of very large rough stones, but the chamber itself, except in the lowest course, is microlithic.

Returning to what we shall call the ante-chamber:—The entrance to the second passage is placed above the stone shelf to the left. This entrance is 3 feet wide by 2½ feet high, but unfortunately the upper flag-stone or lintel is broken in two at this point, and the passage is rather blocked; there is, however, sufficient room for a person of average size to creep through.

This, I may mention, is the only failure in this ancient building, as from the outer entrance throughout all the ramifications of the souterrain the stones are evidently in their original positions. This passage narrows to 2½ feet wide within a few feet of the entrance, and running in a westerly direction for 12 feet, on the left side we come to an off-set passage at right angles 20 inches by 20 inches, and 5 feet long, leading to No. 2 chamber, also of beehive form, and 6 feet high by 6 feet diameter at base.

Passing this entrance, the main passage, dipping gradually, curves away to the left, until for the last 20 feet or so of its length it runs almost north and south. The total length of this passage is 46 feet. The walls and roof are formed of large rough stones; the floor is of very hard clay with rocks frequently appearing, and in its entire length it dips about 18 inches.

No. 3 chamber, which is the largest, lies at the end of this passage. It is 7½ feet high from floor to apex, and 10½ feet diameter at base. The apex is closed by two large flags with other stones overlying them.

A sectional view of this chamber, and of the rath mound, and a portion of the passage, is here given.

GURTEEN SOUTERRAIN Cº. WEST-MEATH.

Section of Rath Mound Showing Largest Chamber & Portion of Passage.

Dip of passage one foot in ..

Concluding, I may add that to the south of this rath, and in immediate proximity to it, there lie what appear to be the remains of very ancient buildings, in fact, the place is covered with ruins, some comparatively modern, but others, formed of cyclopean and deeply laid stones, which probably mark prehistoric sites.

In bringing the subject of this souterrain before the notice of the Academy, I do not presume to offer any new suggestions as to the age or origin of such structures. As we explore these remains of prehistoric times we are groping in darkness, in more senses than one. Can we hope ever to solve the enigmas they silently propound? Personally I am inclined to the theory that the popular *name* by which these numerous earthworks have invariably been known, contains the fossilized story of their origin.

"Danish" forts or raths they are universally called, and Danish they doubtless are, but not of those later Danes who come within the range of true history, but Danish from the Danans, or "Tuatha de Danans," who, once the masters of this island, were conquered by the great Milesians—conquered but not exterminated, or even banished or expelled—vanquished as kings and owners, but permitted to remain as deities—driven from such lordly sites as Tara's Halls, and compelled to dwell in *green hills and caves of the earth*—deprived of temporal but invested with supernatural powers—magicians, soothsayers from the first. The direct ancestors of Deena-Shee and Banshee—the originals of fairies, "good people," and "*Danny* men," *et hoc genus omne.*

So speak the legends, traditions, folk-lore, and superstitions of our country, supported by the existence on all sides of these venerable and venerated green mounds, "Danish Raths," with their ancient thorn trees, and hidden and mysterious souterrains, the treasure chambers, last refuges, or *laboratories* of a conquered race of reputed magicians.

VIII.

NOTICE OF A CRANNOG AT LOUGH-A-TRIM, KILLUCAN, COUNTY WESTMEATH. BY REV. WILLIAM FALKINER, M.A.

[Read November 14, 1898.]

About twenty years ago a small bog-lake, upon the estate of the Earl of Longford, near Knockaville, County Westmeath, was drained. Its name was Lough-a-Trim, and near the centre of the ground once covered by its waters there was, until a few months ago, a low, circular mound which was known as "The Island." Early in the summer the tenant of the lands conceived the idea of top-dressing the old lake bed with the earth forming this mound, and in the course of levelling it was discovered that the whole island was surrounded by, and studded over with, black oak piles.

I regret that the work of demolition was completed before I had an opportunity of inspecting the place; but having visited it last September, I collected sufficient evidence to convince me that "The Island" marked the site of a most interesting crannog. Fortunately the workman employed in removing the mound is a highly intelligent man, with a decided taste for archæology, and having his wits about him, he carefully observed the construction of the crannog so far as it was brought to light. This most fortunately was not far—as beyond removing a few of the oak piles, and the surface of the island, the original structure has not been interfered with.

At a depth of about 4 feet a rough floor of beams was laid bare, but not removed; a great quantity of ashes, burnt wood and bones was met with near the outer portion of the stockade, but from what I have been able to gather I believe that the principal features of the crannog have entirely escaped.

Upon walking over the ground I was able to observe a quantity of bones, amongst others, those of wild swine—red deer and oxen. I found several boars' jaws, with large tusks still remaining. Also the horns of the ancient crumpled-horned ox.

I was fortunate enough to obtain these interesting objects[1]:—

Nos. 1 and 2, horn combs, well made specimens in a fair state of preservation and several fragments, but all of the same type differing only in detail of ornament. The horn of which these combs are composed is in a wonderful state of preservation, and upon being rubbed with the finger show a perfect polish, and a greasy surface, owing, no doubt, to the lasting nature of the pomatum used by the ladies of Lough-a-Trim in the lake-dwelling times.

The pectinated portions are in separate pieces (No. 3), all exactly similar and beautifully fitted.

No. 4.—Section of comb.

No. 5.—A bone pin of well known type.

No. 6.—Portion of another large horn pin.

No. 7.—A curious stone object roughly shaped, with a knife or other sharp instrument, and scored on both sides. It is of very soft friable sandstone, stained black, probably from contact with burnt remains. This object was probably intended for a polishing-stone, as pumice is used at present in rubbing down articles of metal or wood.

No. 8.—A hammer-stone bearing traces of abrasions at the extremities.

No. 9.—Portion of a whet-stone of ordinary type.

No. 10.—Bronze pin ornamented with dot-and-circle and V-shaped pattern.

No. 11.—Bronze pin with head cross-hatched probably for the reception of enamel.

No. 12.—A small object of iron, probably a holdfast.

No. 13.—The greater portion of an amber ring of rough workmanship.

No. 14.—Portion of wooden ladle.

So much for the "earnest" yielded by this crannog, and from the fact that these objects were found without special search, I think we may reasonably expect greater things upon close investigation.

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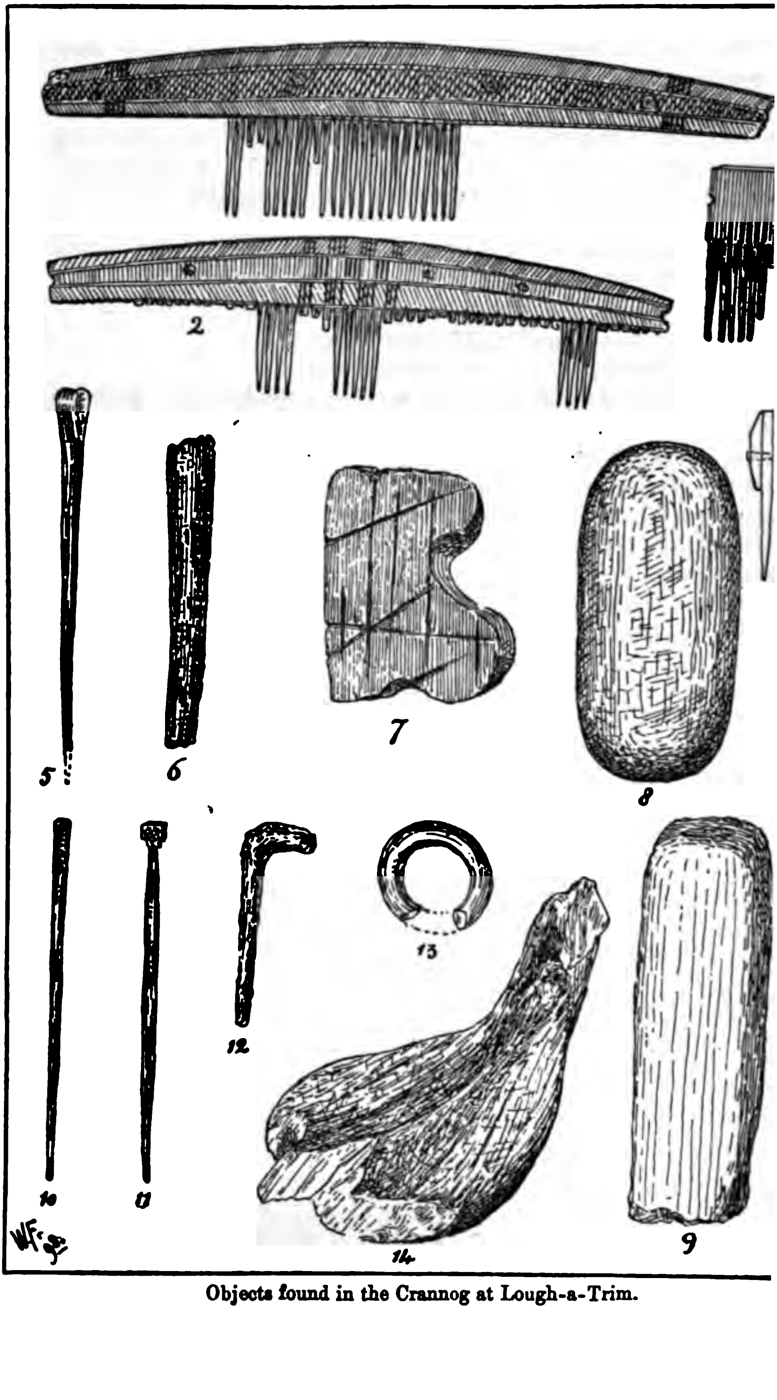
[1] See illustration on next page.



Objects found in the Crannog at Lough-a-Trim.

IX.

SELF-PARASITISM OF *CUSCUTA REFLEXA*. BY HENRY H. DIXON, D.Sc.

[COMMUNICATED BY PROFESSOR E. P. WRIGHT, M.D.]

[Read DECEMBER 12, 1898.]

So far as I know, cases of a parasite sending haustoria into the tissues of its own branches have not been previously recorded. Peirce,[1] indeed, states that he has looked for such cases in Cuscuta, but has failed to find them, and concludes that it is improbable they occur.

Some three years ago I happened to cut sections of the branches of a specimen of *C. reflexa* twining on *Cotoneaster microphylla*. I noticed that in several places haustoria were developed, connecting one branch of the parasite with another. At the time I thought that the development of cork on the surface of the Cotoneaster prevented the penetration of haustoria into it; and that the Cuscuta, unable to support the two branches which were climbing on the host, was utilizing the haustoria to transfer all the available material from one branch to the other, concentrating, as it were, all its resources in the maintenance of one branch.

Recently, however, cases were found from the same material which do not bear out this explanation. Thus, in many instances, the parasite did actually penetrate into the tissues of the stem of Cotoneaster, and specimens were obtained showing that where two branches of the Cuscuta twine on the host, one may simultaneously send haustoria into the Cotoneaster and into its own neighbouring branch. The distance between the two haustoria was in some cases less than one millimetre. Similar examples were found where two branches twined on *Hedera helix*.

These observations would seem to show that the self-parasitism is not dependent on the stimulus of starvation. For in the cases mentioned the parasite was actually simultaneously drawing on the supplies offered by its host, and maintaining connexion with its own branch.

What determines which of the two intertwining branches of the parasite shall form the haustoria seems hard to discover; structurally

[1] "Annals of Botany," 1893, p. 291.

they often appear much the same. However, if the haustoria have been long developed, the branch into which the haustoria have penetrated presents the appearance of being exhausted, *i. e.* the cells of its parenchyma are devoid of starch, and their protoplasm is very scanty. In a case where four branches twined together, A sent haustoria into B, and B into C, and lastly D into C. From this it would appear that the branches are not differentiated into those which will act as hosts and those which will act as parasites. For in this case B took on both parts.

The haustoria developed in these examples of self-parasitism resemble those normally developed; except that, as a rule, the surface of the haustorium advancing in the tissue of the host branch is smoother than that developed in a true host. In the latter case the superficial cells of the haustorium are usually elongate and lobose : in the former they appear polygonal, not much longer in one direction than in another. Another point of difference between the normal haustoria and those formed in the parasite's own tissues is that in the latter case tracheides are seldom developed in the haustorium. This, however, is not a constant difference, and a few specimens were found in which a central stand of tracheides was well developed in a haustorium connecting two branches of the parasite. Of course the small amount of tracheidal elements in the stem of the adult Cuscuta renders a large development of tracheides in the haustorium of the parasite superfluous.

It sometimes happens that the epidermis, beside the connecting haustorium of the two branches, presents a very peculiar appearance. It is well known that where the branch of Cuscuta lies in contact with its host the epidermal cells assume a columnar form. Where the two branches of the parasite come into contact the columnar epidermis may be formed on each. The outer ends of the epidermal cells of both become pointed, and the two epidermises interlock together, so as to form what appears in section a single tissue two cells deep.

When stained this tissue stands out markedly from the other tissues of the branches, not only owing to the shape of the cells, but also on account of the different structure of its nuclei. The nuclei of the other tissues are large when compared with those of other flowering plants, and are very rich in chromatin, and consequently stain vigorously with blue dyes. The nuclei of the interlocking epidermises become relatively enormous and almost fill the whole cell; the blue-staining elements are relatively reduced, while many red-staining bodies (nucleoli) are seen within the nuclear membrane.

X.

NOTE ON SOME SHELL IMPLEMENTS FROM BARBADOS.

By C. G. YOUNG.

[Read January 16, 1899.]

The only stones found in Barbados are a coralline limestone and a sandstone.

The first is very soft, full of air-spaces, and composed of fossils, mostly corals, cemented together. It is friable and cannot stand a blow. The sandstone is also easily broken. Neither of these stones would be of any use for conversion into implements.

In old days the island of Barbados was thickly inhabited by Caribs. It is fertile, the soil being a loose garden mould, and easily worked. A contrast to the tough, blue clay soil of the north coast of South America, washed by the muddy waters from the Amazon. I have been told by present residents in Barbados that some thirty or forty years ago shell implements, such as are now presented to the Academy, were very plentiful, being found in the ground from time to time in the course of cultivation. Now they are not easily obtained. On examination it is easy to detect their origin; in some cases part of the twist in the shell still remains at the upper end. The inequalities on the chipped side were smoothed down to meet the natural free margin of the shell, now the cutting edge of the implement. There are many large shells found in the deep water outside the reef, fished up by divers, which are capable of being converted into implements, but comparing some specimens with these it seems that the "Conch shell" (*Strombus gigas*) is chiefly used.

On the low cliffs near the sea I have frequently come across heaps of fragments of these shells, but never found any formal implements among them.

One shell was capable of being converted into one large implement and many small ones, the small ones requiring much more rubbing than the larger ones to bring them into shape.

In a private collection I saw one that had a very good attempt at ornamentation, the upper end being cut into a rope pattern, as if the worker had imitated the natural spiral of the shell, placing them together.

What use these implements were put to is now only a sp tion; but it is probable that they were used for all purposes, su tilling the ground, fighting, &c. It is still a greater question the people who made and used these implements would have d no large shells were to be found in the sea round them. One t however, is certain, that they would have found other material t these purposes. Smooth stone implements, like those from B Guiana, composed of granite or other igneous rocks, have been f but very few. These were evidently imported.

XI.

THE ETHNOGRAPHY OF GARUMNA AND LETTERMULLEN, IN THE COUNTY GALWAY. By CHARLES R. BROWNE, M.D. [Plates IV. and V.]

[Read November 30, 1898.]

CONTENTS.

I.—Introductory Remarks.

The group of islands which separates Greatmans Bay from Kilkerrin Bay, and which are of interest as containing probably the poorest and most primitive population in Ireland, was chosen as the field for the seventh of the annual local surveys which have, from the first, formed a regular part of the work of the Anthropological Laboratory of Trinity College. It was at first intended that the whole group of islands should be included in the scope of the inquiry, but the field proved too large to be thoroughly worked in the time available, so a selection had to be made, and in consequence the remoter islands of the group, Garumna, Lettermullen, Furnace, and Dinish were chosen; and Lettermore, the most northerly island, and the one nearest the mainland, had to be left unworked. The methods of observation were those employed in previous surveys of this nature, and fully described in earlier reports, and so they need no description in this Paper. It should be stated that these islands were chosen for survey as being a secluded and primitive portion of the old territory of Iar Connaught, as the whole district could not be worked, and that what is said as to mode of life, customs, &c., applies, for the most part, to the state of affairs on the opposite part of the mainland, and especially to the wild and desolate Curraun peninsula to the east of the islands.

II.—Physiography.

The islands surveyed form part of a group which lies at the mouth of Kilkerrin Bay, about ten miles to the north of the Isles of Aran, and at a distance of about thirty miles from Galway. They are separated from each other and from the mainland, by arms of the sea, none of which are very wide, but they have always been greatly cut off from the outer world, as the part of the mainland which lies nearest to them (with the exception of the Crumpann peninsula, which is similar in soil and surface) is wild moor and bog, and very sparsely inhabited.

Garumna is the largest island of the group, measuring about five miles in length by four in greatest breadth. It has an area of 5870 acres, and a population, in 1891, of 1706. It is divided into four townlands, Crulogh, Knock, Maumeen, and Teernea.

Lettermullen lies to the south-west of Garumna, from which it is separated by a narrow channel nearly dry at low water. It measures about a mile and a-half long by a mile wide. It has an area of 787 acres, and a population of 549.

The other islands of the group, Furnace, Crappagh, Dinish, and Inishark, lie beyond Lettermullen. They are much smaller, the largest and best of them, Furnace, having an area of only 218 acres. Their combined area is 497 acres, and their population 251.

The islands are now connected to one another and to the mainland by a chain of causeways and swing-bridges, built, during the last few years, by the Government, and completed in 1897.

The surface of the islands is extremely undulating, but nowhere reaches any great elevation. It mostly consists of rock and moor; and in the centre of Garumna nothing can be seen but bog interspersed with rocky tracts of bare granite, rounded and marked by glacial action, and studded here and there with large boulders of granite, many of which are from ten to fifteen feet, or even more, in diameter. Turn which way one will, great stretches of bare stony ground, thinly covered with peat in the hollows, meet the eye. Near the coast the soil is still rocky, but greener, and it is here that what cultivated land there is is to be met with. The islands contain several lakes, some of them of considerable size, and dotted with islets. These are said to be full of trout. The northern end of Garumna is greener, flatter, and less rocky than the southern and western.

Lettermullen has the same rocky surface as Garumna, but contains no bogs, which necessitates the inhabitants going to Garumna for fuel. Its soil is deeper and of a more clayey nature, and there is more grass and tillage.

Furnace is the greenest and best island of the group.

The shores of these islands are rocky and rough, but nowhere are they high, nor do they rise in any place into cliffs. At a few spots there are small stretches of strand, and the south-west shore of Lettermullen consists of rock and shingle.

The vegetation of the islands is scanty and poor; the soil is thin and unproductive at the best, but the surface has undergone great denudation, partly by nature, but more largely due to the surface turf having been stripped off for fuel for generations past, not only for the use of the inhabitants, but largely for export to the Aran Isles.

Many places on the islands which were green within the memory of man are now bare rock, the thin peaty layer of soil having been stripped off. There are but few trees, and these are chiefly to be found in the northern part of Garumna. The grass is scanty and poor, and even the heather is weak and stunted.

Mr. P. Toole, of Lettermore, estimates the area of utterly unproductive moor and rock in Garumna, at about 2500 acres. A more utterly barren, dreary looking region could hardly be imagined.

The climate is mild, but very wet; snow and frost are seldom experienced in winter, but rain and storms are frequent and severe.

The following description of the island was given in an article by Mr. E. Keogh.[1] It applies, however, only to the eastern end:—

"The general contour is undulating, rising in general slopes or hills, the intermediate valleys in many instances being occupied by small lakes. The geological formation consists of granite rock, of which there is an unstinted supply. Approaching the island from the direction of Carraroe boatslip, the visitor is struck with the appalling desolation of the scene. From the water's edge, across the whole island, the space seems occupied by bare rocks, those on the shore being washed white by the action of the sea. The peaty soil, if ever deposited, has long since been washed away[2] from the greater part of the surface. A perfect maze of granite walls, bounding the holdings and their innumerable sub-divisions, hides out all view of vegetation or of land. There are no trees or shrubs on Garumna, and were it not for the almost numberless cabins that dot the face of the island, one could hardly believe the place inhabited, it appears so utterly uninhabitable."

III.—Anthropography.

1. *Methods.*—No new methods or instruments were used, everything being done exactly on the lines described in previous papers to which the reader is referred. Each district worked possesses difficulties of its own, but this one had none special to it, and the weather, during my visit, was for the greater part of the time more favourable to photography and open-air work than that experienced on some of the other surveys. In doing work of this kind, note-books ruled and headed for nigrescence tables (to be copied out from the cards as they are filled, and save time and trouble both when noting and afterwards), for indices, and for each subject to be investigated, are almost indispensable.

2. *Physical Characters*:—

(a) The *General Physical Characters* of the people are as given below, though some differences are said to exist between inhabitants of the different islands. On the whole, the people are well developed and good-looking, but they seem to age early.

[1] *New Ireland Magazine*, vol. ix., p. 193.
[2] Stripped off for fuel, rather.—C. R. B.

Stature and bulk.—The inhabitants of these islands are of average stature, or slightly above it; there are very few of the men who can really be termed small, and a good proportion of them are of tall stature. The mean height of the 65 adult males measured was 1739 mm., or 5 feet 8½ inches. The extremes were 1650 mm. (5 feet 5 inches), and 1855 mm. (6 feet 1 inch). Of these 65 men, 8 were of 1800 mm. (5 feet 11 inches) and upwards. The general build is stout and square, with great depth of chest, and their muscular strength seems to be far above the average. Their lifting power is especially great. They are very hardy, and capable of bearing a great deal of hunger, fatigue, and wet.

The women seem to be above the average in height, and are very stout and strong. One young woman of 18 who was measured had a stature of 1780 mm. (5 feet 10 inches).

Limbs.—The hands and feet are large and bony, the former being broad, with squarely tipped fingers. In spite of very hard work their hands are well-shaped. The forearm (measured from the styloid process to the head of the radius) is very long for the stature, and the span of the arms (*grand envergue*) is also in many cases great. In no case was this last measurement less than the stature.

The women's feet are large and flat, due to their constantly going barefooted and carrying heavy loads.

Head.—The head is well-shaped. The forehead is upright, with well-marked frontal eminences; glabella and superciliary ridges both rather prominent. The vertex is rounded; the occipital region does not, as a rule, project, but rises straight in the line of the neck. The eyebrows are thick and level, usually lighter in shade than the hairs of the scalp, and, in a large proportion of cases, meet in the middle line.

The mean cephalic index of the 65 men measured was 76·9 (or, deducting two units to reduce to the cranial standard, 74·9). It thus lies on the borderland between dolichocephaly and mesaticephaly. In 17 instances the men measured were brachycephalic, in 37 mesaticephalic, and in 9 dolichocephalic.

Face.—The face is of medium length, with prominent cheek-bones. It narrows in the bigonial region as in the case of the Aran Islanders. The angles of the jaws project somewhat, and are apparently everted. The nose is straight, and generally long and sharply pointed; in many cases it is aquiline. The mean nasial index is 63·4. The mouth is not large, and the lips are of medium thickness; the heavy hanging lower lip so commonly seen in the west of Ireland is not so noticeable a feature among these people as it is among the inhabitants of the islands farther north. The chin is prominent and rounded. The are usually good, sound, and even. The irides of the eyes are us a light blue or blue-grey, seldom green or brown. The ear generally small and well-shaped, and very few abnormalities of were observed.

Skin.—The skin is rather fair, sometimes ruddy, and tu clear red; sometimes freckles on exposure, but in one or two o villages some of the people are darker-skinned, and bronze on exp instead of reddening. Wrinkles come early, and are usually especially on the forehead and about the eyes. The trans furrow at the root of the nose and vertical furrows betwee eyebrows are common. The women do not seem to wrinkle as as the men.

Hair.—The hair is usually a light brown. Next in order o quency of occurrence is dark brown, then fair. Black hair and hair are both infrequently met with. Genuinely black hair is rare. The hair of the scalp is usually wavy, and very often c A considerable proportion of the elderly men are bald. The bear eyebrows are much fairer than the hair of the scalp. In a good portion of cases the beard grows only on the chin, or is very scan the cheeks (when this is the case it is usually reddish in colour). other cases the beard is full and luxuriant, and on these it is e fair or dark brown.

(B.) *Tables of Hair and Eye Colours:*—

ADULTS.—I. *Males.*

HAIR.	EYES.			Totals.	Percent Hair Col
	Light.	Medium.	Dark.		
Red, ..	6	0	0	6	3·2
Fair, ..	20	1	0	21	11·2
Brown, ..	100	7	1	108	58·0
Dark, ..	34	9	1	44	23·6
Black, ..	5	2	0	7	3·7
Totals, ..	165	19	2	186	100·
Percentage Eye Colours,	88·70	10·22	1·08	100·0	—

Index of Nigrescence, ... 16·66.

ADULTS.—II. *Females.*

HAIR.	EYES. Light.	Medium.	Dark.	Totals.	Percentage Hair Colours.
Red, ..	5	1	0	6	3·08
Fair, ..	12	0	1	13	6·67
Brown, ..	88	7	2	97	49·73
Dark, ..	52	10	11	73	37·44
Black, ..	1	0	5	6	3·08
Totals, ..	158	18	19	195	100·00
Percentage Eye Colours,	81·03	9·23	9·74	100·00	—

Index of Nigrescence, ... 33·85.

CHILDREN.—I. *Boys.*

HAIR.	EYES. Light.	Medium.	Dark.	Totals.	Percentage Hair Colours.
Red, ..	4	0	0	4	4·55
Fair, ..	15	0	1	16	18·18
Brown, ..	39	8	6	53	60·22
Dark, ..	10	3	2	15	17·05
Black, ..	0	0	0	0	—
Totals, ..	68	11	9	88	100·00
Percentage Eye Colours,	77·27	12·50	10·23	100·00	—

Index of Nigrescence, ... 5·68.

CHILDREN.—II. *Girls.*

HAIR.	EYES.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	4	0	0	4	5·00
Fair, ..	16	0	1	17	21·25
Brown, ..	34	7	3	44	55·00
Dark, ..	8	2	4	14	17·50
Black, ..	0	0	1	1	1·25
Totals, ..	62	9	9	80	100·00
Percentage Eye Colours,	77·50	11·25	11·25	100·00	—

Index of Nigrescence, . . 6·25.

(c.) *Physical Proportions.*—The proportions borne to the stature (taken as 100) by the main measurements are given in this as in previous reports. They bring out distinctive points not otherwise obtainable, and show considerable differences from those obtained from the measurements of people in other localities.

FACE: The face is long in proportion to the stature, the average being 7·2 (as against 6·6 of the canon) but relatively with the average of other districts surveyed it is short. The extremes noted in the islands were 6·2 and 8·3.

Upper Face.—The mean proportion for this measurement is 4·0, as against 4·4 for Inishbofin, 4·3 for the Mullet and Inishkea, 4·16 for Ballycroy, 4·6 for Clare Island and Inishturk. The extremes noted were 3·3 and 4·7.

Nose.—This does not bear a very constant relation to the stature. The mean for this proportion is 2·9, and the proportions noted varied between 2·4 and 3·5.

SITTING HEIGHT: The proportion borne to the stature by this measurement is about the same as that noted in Clare Island. The mean of the 65 measurements is 52·2, and the extremes noted were 50·5 and 55·8.

Upper Limb: *Span.*—In no case was this less than the body height. The mean of those noted was 104·7, and the extremes 100 and 109·7.

Hand.—The hand is long relatively to the stature, its mean proportion being 11·3. The extremes met with were 10·5 and 12·1.

Forearm.—The forearm is very long, giving a higher mean proportion than that obtained in any other district yet surveyed. The average for the sixty-five men measured is 15·7, as against 15·18 for the Aran series, 15·03 for Inishbofin and Inishshark, 15·43 for the Mullet and Inishkea, 15·3 for Ballycroy, and 15·2 for Clare Island and Inishturk. This measurement was fairly constant in its proportions to the stature. The extremes noted were 14·8 and 16·9 (an exceptional case).

(d.) *Detailed List of Measurements.*—(*See* accompanying Tables, pages 232–238.)

No.	Indices.						Proportions to Stature.—Height = 100.						
	Cephalic.	Height.	Facial.	Bigonial.	Alveolar.	Nasal.	Hand.	Forearm.	Span of Arms.	Height Sitting.	Face.	Upper Face.	Nose.
1	80·0	63·0	109·2	83·0	99·0	65.2	11·7	16·2	105·4	53·0	7·5	3·3	2·6
2	78·9	66·3	100·2	86·4	100·0	56·4	11·5	16·2	101·2	54·1	7·9	4·7	3·5
3	76·5	66·0	107·7	84·6	101·0	68·0	11·1	16·0	107·8	51·5	7·3	3·8	3·1
4	75·7	57·0	105·3	82·7	101·1	61·8	11·8	15·6	107·3	52·0	7·8	4·5	3·2
5	80·1	65·3	103·0	78·8	96·9	61·5	11·4	16·2	104·3	52·2	7·6	4·3	3·0
6	79·8	63·8	105·6	81·6	100·0	52·7	12·1	16·1	103·7	50·7	7·2	4·1	3·2
7	77·2	64·4	113·9	86·8	102·0	72·0	11·4	15·3	106·2	53·2	7·4	4·0	2·9
8	76·5	66·2	114·5	96·7	101·0	61·8	11·6	15·9	106·5	55·8	7·6	4·2	3·3
9	80·2	66·0	106·7	77·6	101·0	67·3	11·1	15·8	103·4	50·1	7·6	4·3	3·1
10	77·5	64·0	108·1	82·2	104·3	55·8	11·2	16·2	105·2	52·2	7·1	3·8	2·9
11	79·4	68·6	114·5	81·1	104·2	66·7	11·2	15·8	105·3	52·2	7·2	3·9	2·8
12	75·9	66·2	108·3	88·3	101·1	55·8	11·5	15·2	105·0	51·2	6·9	4·1	2·9
13	82·3	66·1	114·5	88·7	97·0	64·0	11·6	15·6	107·8	52·0	7·0	3·7	2·8
14	75·0	65·0	121·8	95·8	100·0	62·0	11·7	15·5	104·2	53·0	7·2	4·0	3·0
15	82·5	65·0	101·6	85·5	100·0	63·5	10·7	15·4	101·6	52·4	7·2	4·1	3·0
16	78·4	64·3	101·4	81·2	96·9	63·0	11·0	15·6	104·2	50·4	7·4	4·3	3·0
17	80·0	63·5	101·6	88·0	102·1	71·2	11·4	16·0	104·0	52·1	7·3	3·8	2·9
18	80·0	63·1	107·8	79·6	101·1	54·9	11·5	16·5	109·7	51·6	7·5	4·0	3·0
19	83·0	68·0	120·8	86·7	93·9	73·1	11·6	15·5	106·2	52·8	6·9	4·1	3·0
20	77·0	62·2	113·6	92·8	100·0	56·6	11·0	16·0	102·8	51·3	7·0	4·2	3·0
21	79·8	65·7	107·6	87·8	100·0	57·9	10·9	16·6	102·0	50·5	7·6	4·4	3·3
22	76·0	67·5	122·0	93·2	100·0	77·3	11·0	15·8	104·1	50·8	6·7	3·3	2·5
23	81·4	67·6	125·4	93·2	96·9	71·4	11·1	16·3	104·9	52·6	6·8	3·7	2·8
24	74·3	61·9	111·7	79·6	102·1	77·6	11·9	15·5	109·4	51·4	7·3	4·0	2·8

31	80·0	65·0	114·1	82·7	109·9	58·2	11·6	15·2	104·1	53·6	7·5	4·4	3·2
32	83·0	68·6	110·4	97·6	100·0	60·0	10·7	15·8	103·8	53·3	6·9	4·2	3·0
33	73·3	62·4	104·6	84·6	104·1	68·0	11·4	15·1	107·8	51·3	7·5	4·3	2·9
34	76·2	64·4	105·9	90·3	98·0	55·3	11·1	15·7	104·6	53·6	7·6	4·2	3·1
35	74·3	65·5	115·0	96·1	96·9	64·7	11·5	15·9	105·5	53·1	7·3	4·2	2·9
36	80·0	67·4	100·6	89·3	101·1	72·7	11·5	15·6	104·9	51·1	6·2	3·5	2·4
37	77·8	64·1	113·3	86·6	100·0	64·8	11·0	15·6	103·9	51·5	7·3	4·1	3·1
38	77·3	66·2	102·2	84·4	101·0	55·0	12·1	16·3	109·6	52·4	7·7	4·5	3·4
39	80·4	66·0	106·2	84·9	100·0	66·0	11·6	15·4	102·1	52·7	7·4	3·9	2·8
40	77·3	61·9	104·7	92·2	100·0	60·0	11·0	14·8	107·0	53·2	7·4	4·1	2·9
41	75.3	64·4	107·9	85·7	100·0	68·1	11·0	15·7	104·9	51·0	7·2	3·8	2·7
42	76·5	65·2	115·7	91·3	98·0	71·1	10·7	16·1	104·2	52·5	7·1	3·4	2·5
43	80·0	68·0	118·5	100·0	100·0	53·6	11·0	16·0	104·7	52·3	7·2	4·5	3·2
44	78·3	67·7	114·7	91·8	101·1	60·0	11·2	14·9	106·4	53·2	7·0	3·9	2·9
45	81·4	66·5	115·2	86·4	99·0	67·3	11·0	15·5	102·4	55·1	7·6	4·1	3·0
46	81·3	65·1	107·8	85·2	94·9	66·0	11·0	15·7	101·8	53·6	7·6	4·2	2·8
47	77·0	67·5	112·0	86·4	101·0	69·6	11·1	15·0	106·5	52·0	6·8	3·9	2·5
48	76·0	65·0	108·1	83·8	95·7	67·9	11·7	15·2	104·2	55·0	7·3	4·2	3·0
49	76·9	69·2	113·3	91·7	102·2	66·0	10·9	16·3	105·3	53·1	7·1	3·9	3·0
50	77·5	61·1	117·8	88·3	97·1	61·1	11·8	15·4	103·1	53·6	7·1	4·3	3·2
51	73·8	63·8	103·0	80·3	103·1	54·4	10·6	15·5	103·0	51·4	7·2	4·1	3·1
52	79·2	64·4	114·2	86·6	100·0	51·7	11·3	16·6	107·0	52·9	7·6	4·3	3·5
53	77·8	67.2	104·8	83·3	99·0	73·9	11·4	14·9	103·3	52·3	7·2	3·8	2·6
54	74·8	61·8	112·8	87·1	97·1	61·1	11·7	14·9	106·3	50·5	7·7	4·2	3·1
55	76·6	61·9	100·0	81·4	99·0	55·9	11·0	15·3	103·3	50·5	7·8	4·5	3·4
56	79·0	65·6	98·0	77·6	103·1	57·2	11·3	16·1	104·7	51·7	8·3	4·6	3·5
57	75·8	66·7	117·8	87·2	105·0	69·6	10·6	14·9	100·0	52·0	6·9	3·4	2·7
58	75·5	64·2	121·3	99·1	100·0	69·4	11·0	15·6	104·4	52·7	6·7	3·4	2·9
59	74·2	62·0	112·0	91·4	101·8	60·4	11·8	16·1	102·3	53·7	7·3	3·8	3·1
60	78·3	64·6	121·4	97·4	100·0	73·3	11·0	15·6	102·4	53·4	6·6	3·5	2·5
61	80·2	65·6	107·1	87·3	101·1	62·7	10·5	15·9	101·6	51·8	7·1	3·8	2·9
62	78·5	61·5	118·6	98·3	96·8	52·9	10·8	15·8	102·9	53·0	6·9	4·0	3·0
63	76·4	64·0	112·0	86·4	95·9	60·0	11·2	15·9	104·7	52·2	7·3	4·2	2·9
64	80·0	67·0	110·6	90·0	99·0	61·5	11·6	16·3	107·8	51·9	7·7	4·3	3·0
65	77·6	65·8	118·2	80·0	103·1	68·8	11·6	16·5	104·1	52·0	7·1	3·6	3·0
Mean,	76·9 (74·9)	64·8	110·0	86·7	100·0	63·4	11·3	15·7	104·7	52·2	7·2	4·0	2·9

No.	Name.	Age.	Father's people.	Mother's people.	Eye Colour.	Hair Colour.	Skin.	Nose profile.	Ears.
1	M'Donagh, Michael,	35 (?)	Letter-mullen	Letter-mullen	blue	brown	ruddy	straight	Outstandin
2	Audley, Martin, .	60	,,	,,	blue	dark	pale	aquiline	Flat
3	Loftus, Timothy,	40	,,	,,	grey	red-brown	ruddy	straight	Outstandin
4	Conneely, Bartly,	36	Garumna	Garumna	grey	brown	pale	straight	Outstandin
5	M'Donagh, Mark,	23	Letter-mullen	Letter-mullen	blue	brown	pale	straight	Flat
6	Vaughan, Stephen,	40	,,	,,	blue	dark	dark	straight	Flat
7	Lydon, Colman, .	25	Garumna	Garumna	green	fair	pale	straight	Flat
8	Lee, John, .	40	Letter-mullen	Letter-mullen	blue	dark	ruddy	straight	Flat
9	Flaherty, Patrick,	30	,,	,,	grey	fair	ruddy	straight	Outstandin
10	Joyce, Patrick, .	22	,,	,,	grey	brown	ruddy	straight	Flat
11	Mullin, Patrick, .	45	,,	,,	blue	dark	pale	straight	Outstandir
12	Audley, Joseph,	40	,,	,,	blue	brown	pale	straight	Flat
13	Flaherty, Bartly,	20	,,	,,	blue	fair	ruddy	straight	Flat
14	Farmer, Laurence,	42	Garumna	Garumna	blue	brown	pale	straight	Flat
15	Trayer, Colman,	47	,,	,,	hazel	dark	pale	straight	Flat
16	Lee, Bartly, .	21	Letter-mullen	Letter-mullen	blue	brown	pale	straight	Outstandir
17	Folan, Bartly, .	30	Garumna	,,	blue	brown	ruddy	straight	Outstandir lobes att
18	Flaherty, Patrick,	20	Letter-mullen	Arran I.	blue	brown	pale	straight	Outstandir lobes abs
19	Curran, Martin, .	25	Garumna	Garumna	blue	brown	pale	straight	Outstandir
20	Walsh, Michael, .	20	,,	,,	green	dark	pale	straight	Outstandir lobes att
21	Folan, Patrick, .	50	,,	,,	blue	brown	ruddy	hooked	Outstandir
22	M'Donagh, Michael,	30	,,	,,	grey	brown	pale	straight	Outstandir lobes att
23	Curran, Patrick, .	33	,,	,,	grey	dark	pale	slightly curved	Outstandir
24	Walsh, John, .	24	Letter-mullen	Letter-mullen	blue	fair	ruddy	straight	Flat
25	Berry, John, .	23	,,	,,	hazel	dark	ruddy	retroussé	Flat, lobes sent
26	Walsh, Michael, .	20	,,	,,	grey	brown	ruddy	straight	Flat
27	Beatty, Colman, .	40	,,	,,	blue	brown	ruddy	straight	Flat
28	Walsh, Mark, .	24	,,	,,	blue	dark	ruddy	straight	Flat, lobes tached
29	M'Donagh, Jas.,	25	,,	,,	blue	brown	pale	aquiline	Outstandir lobes att
30	Keely, Thomas, .	22	,,	,,	blue	brown	pale	straight	Outstandir
31	M'Donagh, Michael,	22	,,	,,	blue	red	freckled	straight	Flat
32	Beatty, Malachy,	21	,,	,,	grey	brown	pale	straight	Flat, lobes sent
33	Dirrane, Patrick,	25	,,	,,	blue	black	pale	straight	Flat, lobes sent

...phalic.	Facial.				Nasal.			Radii.			Height.		Forelimb.		
Breadth.	Face length.	Upper Face length.	Breadth.	Bigonial Breadth.	Length.	Breadth.	Internal Bi-ocular brdth.	Vertical.	Nasial.	Alveolar.	Standing.	Sitting.	Span.	Hand.	Forearm.
160	130	68	142	108	46	30	30	126	101	100	1740	922	1835	204	283
150	125	74	128	108	55	31	31	126	99	99	1570	850	1588	180	255
153	130	67	140	110	56	38	33	132	100	101	1765	910	1890	196	283
162	133	76.	140	110	55	34	28	125	95	96	1695	882	1820	200	265
157	132	74	136	104	52	32	32	128	98	95	1735	907	1810	200	282
150	125	71	132	102	55	29	31	120	92	92	1735	880	1800	210	280
156	129	70	147	112	50	36	31	130	100	102	1735	923	1842	198	265
156	124	68	142	120	55	34	34	135	98	99	1635	912	1742	190	260
158	134	76	143	104	55	37	32	130	97	98	1765	895	1825	196	280
155	124	66	134	102	52	29	29	128	93	97	1758	918	1850	198	285
158	124	69	142	113	48	32	32	133	96	100	1743	910	1835	207	275
148	120	71	130	106	52	29	31	129	95	96	1745	893	1832	200	266
158	124	66	142	110	50	32	32	127	100	97	1760	915	1898	205	275
150	119	66	145	114	50	31	31	130	100	100	1650	875	1722	193	256
165	124	71	144	106	52	33	30	132	90	90	1725	915	1753	185	266
156	138	80	140	112	56	34	31	128	96	93	1855	935	1933	204	289
160	126	66	146	111	52	37	33	127	96	98	1750	912	1820	200	280
156	128	68	138	102	51	28	28	123	91	92	1700	878	1865	196	280
166	120	70	145	104	52	38	34	136	99	93	1727	912	1835	201	268
151	125	75	142	116	53	30	29	122	100	100	1780	914	1835	195	283
158	132	77	142	116	57	33	28	130	95	95	1750	883	1786	190	291
152	118	58	144	110	44	34	31	135	98	98	1766	908	1838	195	280
166	118	65	148	110	49	35	34	138	98	95	1740	916	1825	203	285
156	128	70	143	102	49	38	33	130	96	98	1750	908	1913	209	272
154	125	65	145	108	45	36	35	141	100	100	1745	932	1845	190	270
158	120	68	145	110	50	33	34	127	100	100	1770	935	1820	212	279
150	128	72	142	114	51	31	31	133	105	105	1840	927	1938	205	311
154	133	74	140	110	49	30	30	130	95	95	1795	937	1950	205	265
150	128	75	134	116	58	32	32	125	103	110	1800	960	1880	191	287
156	120	63	142	114	46	33	34	132	103	102	1760	930	1820	185	275
160	127	75	145	112	55	32	30	130	103	105	1700	912	1770	198	260
156	125	75	138	122	55	33	33	128	96	96	1800	960	1860	192	285
148	130	75	136	110	50	34	29	126	97	101	1723	885	1850	198	260

No.	Name.	Age.	Locality of Father's people.	Locality of Mother's people.	Eye Colour.	Hair Colour.	Skin.	Nose profile.	Ears
34	Loughlin, Bartly,	20	Garumna	Garumna	grey	dark	pale	straight	Outstandi lobes att
35	Loughlin, Edmond,	22	,,	,,	blue	dark	pale	straight	Flat, lobe tached
36	Flaherty, Michl.,	19	Letter-mullen	Letter-mullen	green	black	pale	straight	Flat
37	Conneely, Martin,	50	,,	,,	green	brown	ruddy	straight	Flat
38	Conneely, Patk.,	35	Garumna	Garumna	grey	brown	pale	aquiline	Outstandi lobes att
39	M'Donagh, Patrick,	30	Letter-mullen	Letter-mullen	blue	brown	pale	straight	Outstandi
40	Lee, Patrick, .	24	,,	,,	grey	brown	ruddy	straight	Outstandi
41	Walsh, John, .	35	,,	,,	blue	brown	pale	slightly aquiline	Flat
42	Lee, James, .	22	,,	,,	blue	brown	pale	straight	Flat
43	M'Donogh, Patrick,	22	,,	,,	grey	brown	pale	straight	Flat, lobe tached
44	Toole, Michael, .	20	,,	,,	grey	brown	pale	straight	Flat, lobe tached
45	O'Donnell, Bartly,	25	,,	,,	grey	red	dark	straight	Flat, lobe tached
46	M'Donagh, William,	30	,,	,,	blue	fair	pale	slightly curved	Outstandi lobes att
47	Walsh, Patrick, .	30	Garumna	Garumna	blue	brown	ruddy	straight	Outstandi
48	Molloy, Thomas,	26	,,	,,	grey	brown	pale	straight	Flat
49	Folan, Patrick, .	25	,,	,,	grey	brown	pale	retroussé	Flat, lobe tached
50	M'Donagh, John,	45	,,	,,	grey	dark	pale	sinuous	Flat, lobe tached
51	Walsh, Martin, .	25	,,	,,	blue	black	pale	aquiline	Flat, lobe sent
52	M'Donogh, Michael,	45	,,	,,	grey	dark	ruddy	aquiline	Outstandi
53	Flaherty, Patrick,	26	,,	,,	grey	fair-brown	freckled	sinuous	Flat
54	Folan, Nathaniel,	23	,,	,,	grey	dark	pale	straight	Flat, lobe tached
55	Folan, John, .	25	,,	,,	grey	brown	freckled	straight	Flat
56	Folan, Patrick, .	24	,,	,,	blue	dark	pale	straight	Flat, lobe tached
57	Barrett, Patrick,	22	,,	,,	grey	brown	ruddy	sinuous	Flat, lobe tached
58	Kelly, Thomas, .	22	,,	,,	hazel	dark	freckled	straight	Flat, lobe tached
59	Kelly, John, .	28	,,	,,	grey	brown	ruddy	straight	Flat
60	M'Donogh, Colman,	22	,,	,,	blue	fair-brown	pale	straight	Outstandi
61	Flaherty, Patk.,	20	,,	,,	grey	dark	pale	straight	Outstandi
62	Folan, Patrick, .	20	,,	,,	green	brown	pale	straight	Flat
63	Joyce, Patrick, .	20	,,	,,	grey	dark	pale	straight	Flat, lobe sent *
64	Devane, Martin, .	31	Kilkerrin	,,	grey	dark	ruddy	sinuous	Flat
65	Coneely, Patrick,	50	Garumna	,,	grey	brown	pale	sinuous	Outstandi

* Darwinian tubercle in both.

…PHALIC.		FACIAL.				NASAL.			AURICULAR RADII.			HEIGHT.		FORELIMB.		
…	Breadth.	Face length.	Upper Face length.	Breadth.	Bigonial Breadth.	Length.	Breadth.	Internal Bi-ocular brdth.	Vertical.	Nasial.	Alveolar.	Standing.	Sitting.	Span.	Hand.	Forearm.
2	154	135	75	143	122	56	31	30	130	98	96	1788	958	1870	199	281
5	154	127	73	146	122	51	33	32	135	96	93	1740	925	1835	200	276
0	152	112	63	124	100	44	32	30	128	95	96	1820	930	1910	210	295
3	154	127	72	144	110	54	35	35	125	99	99	1736	895	1805	191	270
8	153	135	80	138	114	60	33	33	131	97	98	1760	923	1930	213	287
4	156	133	70	141	113	50	33	33	128	100	100	1792	945	1830	208	276
4	150	128	71	134	118	50	30	30	120	93	98	1720	915	1840	190	265
4	146	126	67	136	108	47	32	31	125	98	98	1750	893	1835	193	275
4	156	127	61	147	116	45	32	33	133	102	100	1800	945	1875	193	290
0	160	124	77	147	124	56	30	30	136	95	95	1730	905	1812	190	276
8	155	122	68	140	112	50	30	30	134	94	95	1738	925	1850	195	259
4	158	125	68	144	108	49	33	33	129	96	95	1650	910	1690	181	255
2	156	128	71	138	112	47	31	32	125	98	93	1680	901	1683	185	264
0	154	125	69	140	108	46	32	32	135	99	100	1851	963	1970	205	288
0	152	124	71	134	104	52	36	27	130	92	88	1698	935	1770	199	259
5	150	120	66	136	110	50	33	33	135	92	94	1700	903	1790	186	277
9	162	129	73	152	114	54	33	33	136	103	100	1680	900	1742	198	259
0	155	132	75	136	106	57	31	31	134	96	99	1820	937	1875	193	283
2	160	127	73	145	110	58	30	30	130	100	100	1682	890	1810	191	270
8	154	126	67	132	105	46	34	33	133	96	95	1760	920	1818	201	262
7	155	132	73	149	115	54	33	33	128	103	98	1720	869	1828	202	267
7	151	135	77	135	110	59	33	33	122	96	95	1723	870	1780	190	264
5	154	147	83	144	114	63	36	30	128	97	100	1780	921	1864	202	287
8	154	118	59	139	103	46	32	32	132	100	105	1722	895	1722	182	257
4	154	114	58	144	113	49	34	31	131	106	106	1714	904	1790	188	268
6	154	125	64	140	114	53	32	32	128	109	111	1705	915	1745	199	274
8	155	117	62	142	114	45	33	31	128	94	94	1780	950	1822	196	278
2	154	126	68	135	110	51	32	32	128	95	96	1780	923	1808	186	283
5	153	118	69	140	116	51	27	30	120	95	92	1705	904	1755	184	270
0	151	125	71	140	108	50	30	28	128	94	90	1710	902	1791	191	272
0	160	131	73	145	118	52	32	32	134	96	95	1700	882	1833	198	277
6	152	115	58	136	102	48	33	31	129	96	99	1626	845	1692	190	268

CEPHALIC INDICES, CORRECTED FOR COMPARISON WITH SKULLS.

No.	Index.	A. Corrected Indices.	B. Actual Indices.
19	83.0		
32	83.0	Brachycephalic.	
15	82.5	4	
13	82.3		
23	81.4		
45	81.4		
46	81.3		
39	80.4		
61	80.2		17 Brachycephals.
5	80.1		
1	80.0		
17	80.0		
18	80.0		
31	80.0		
36	80.0		
43	80.0		
64	80.0		
6	79.8		
21	79.8		
26	79.8		
11	79.4	33 Mesaticephalic.	
52	79.2		
56	79.0		
2	78.9		
62	78.4		
16	78.3		
44	78.3		
60	78.5		
37	77.8		
53	77.8		
65	77.6		
50	77.5		
10	77.5		
28	77.4		
38	77.3		
40	77.3		37 Mesaticephals.
7	77.2		
20	77.0		
47	77.0		
49	76.9		
55	76.6		
3	76.5		
8	76.5		
42	76.5		
63	76.4		
34	76.2		
22	76.0		
48	76.0		
12	75.9		
29	75.8		
57	75.8		
4	75.7	28 Dolichocephalic.	
58	75.5		
41	75.3		
25	75.1		
14	75.0		
54	74.8		
24	74.3		
27	74.3		
30	74.3		9 Dolichocephals.
35	74.3		
59	74.2		
51	73.8		
33	73.3		

8. *Vital Statistics* :—

(A) *Population.*—Strange though it may appear when one considers the desolate and barren condition of these islands, yet it is a fact that the population to which they afford a home has hardly been affected by the drain of emigration which has so reduced the number of inhabitants in richer and more fertile districts in the West of Ireland. In spite of the hard conditions of life, and the apparently unattractive nature of the locality, emigration has been slight, and the population has sensibly increased since 1851, as will be seen at a glance at the tables given below :—

Census.	Population.	Houses.	Inhabitants per house.	Acres per head.
1851	1725	224	7·70	4·09
1861	1865	374	4·98	3·79
1871	2196	438	5·01	3·21
1881	2739	478	5·73	2·61
1891	2506	431	5·81	2·81

The density of population is, it will be seen, really greater than appears when account is taken of the poor quality of the soil and of the population of Garumna being practically confined to the belt of land near the shore. The actual density is 228 per square mile of surface. There appear to be signs of a slight decrease from emigration in the decade 1881–1891.

The distribution of population, inhabited houses, and out-buildings, was as follows in 1891 :—

Islands.	Area.	Population.			Houses.	Out-offices and farm-steadings.
		Persons.	Males.	Females.		
	A. R. P.					
Garumna, . .	5870 3 11	1706	846	860	289	114
Lettermullen, .	787 2 5	549	286	263	97	44
Inishark, . .	64 2 19	40	20	20	6	0
Dinish, . .	95 3 3	50	21	29	10	5
Crappagh, . .	117 3 28	31	15	16	4	3
Furnace, . .	218 3 6	130	73	57	25	9
Totals, . .	7155 2 17	2506	1261	1245	431	175

(B.) *Acreage and Rental.*—The total area of the islands is 7155 acres, and the valuation £897.

The holdings are very small, and the area of cultivation per holding averages about 1 acre potatoes, and 1 acre oats, barley, or rye.

The rental varies greatly: in the poorest part of Garumna, about Trabane village, it averages about 15*s.* (the best holding there pays 30*s.*), but for the group of islands the average rental is about £2 to £3.

Owing to the kindness of a friend I am enabled to give the figures for Lettermullen. Valuation, £386 13*s.* Rental, £355 2*s.* 2½*d.*

The small size of the holdings may be judged from the fact that only forty-two of them pay rates.

The tillage land is often held by two or more men in partnership, about as bad a mode of tenure as could be devised, as there is no inducement to effort or improvement, and if one tenant falls behindhand and gets into arrears, he and his partner are both liable to eviction.

There is a great stretch of commonage of a wild and poor description in Garumna.

(C.) *Language and Education.*—But few of the people speak English, and these in conversation with one another, and for all the ordinary purposes of life speak Irish only. The majority of the grown up people met with were purely Irish speaking, and many of the younger men and boys who had learned English at school seemed to be rapidly forgetting that language. In Garumna practically the whole population is Irish speaking, but in Lettermullen a considerable proportion know English well. The cause given locally for this is that the landlord and his family formerly dwelt in Lettermullen. Taking the population as a whole, probably about 80 per cent. speak Irish only. The language is now taught in the schools, and the children learn English through it.

As the islands form part of two parishes, I regret to be unable to give any figures as to the state of education. The parish of Kilcummin had in 1891 a percentage of illiteracy of 55·1; Killanin (in which Garumna is) had at the same time an illiteracy rate of 60·0.

(D.) *Health.*—As before stated the people are, as a rule, robust, stout, and hardy, and capable of bearing fatigue, hunger, and wet to an unusual degree. On the whole the population is a wonderfully healthy one, in spite of the adverse conditions as to dwellings, food, and mode of life. At the same time several cases which will be remarked on later, or seem to show a somewhat greater proportion of unsoundness than has been met with in the other districts surveyed.

For most of the following notes regarding the health of the people, I am indebted to the kindness of Dr. Connolly, the medical officer of the district. I had also the opportunity of seeing many cases personally.

Consanguineous Marriages.—Marriages between persons related in any near degree are not at all as common as in most of our western islands, but it is said that unions of those beyond the prohibited degree are not uncommon. The difficulties of communication in the past, and the strong clannish feeling which still remains, causes most of the marriages to occur within the community, and local feeling is against breach of this unwritten rule. Several of the people (fishermen and kelp-burners) stated that they considered it unlucky to marry out of the islands. Each island, as a rule, too, seems to keep much to itself in affairs of this kind. In spite of this feeling, however, the people of Lettermullen sometimes intermarry with those of Kilkerrin, and those of Garumna with the inhabitants of Aran and Carraroe, places at which the fishermen call habitually. The usual result of these marriages within the community is, as was observed in other places surveyed, a strong personal resemblance among the people, and a certain fixity of physical type.

Diseases.—The following notes embody what information could be obtained as to the state of the population as regards disease. It should be remarked that difficulty was experienced in getting accurate information on some points. Figures are given wherever they could be accurately ascertained. The principal diseases and diseased conditions are as follows:—

Insanity.—Is reported to be rare: all those that have occurred here are said to be melancholia. Two cases have occurred since 1895.

Idiocy and Imbecility.—There are two cases of idiocy in one family in Garumna (the parents were not related in any degree; father from Aran). There is also a case of slight imbecility in Lettermullen.

Cretinism.—A case of cretinism was met with (photograph taken) in the village of Trabane, in Garumna. A male 18 years of age, 3 feet high. There was no relationship between parents or grandparents. Another case, the diagnosis of which was less definite, but apparently of the same nature, was observed in Lettermullen. Parents in this case were distantly related. These are the only cases which have occurred on the islands.

Epilepsy.—Only two cases are known to exist, but there may possibly be more, as cases of this sort in the remoter parts of Ireland do not usually seek professional aid, and probably, if treated at all, come only under the observation of some "wise women."

Deaf-mutism.—There are three cases on the islands, two of them in one family in Lettermullen. In none of the cases were the parents related in any degree. One of these deaf mutes is by trade a carpenter, and is very handy and clever at any work he undertakes.

Blindness.—Several of the old people are blind from cataract, including the grandfather of the cretin in Trabane. There are no cases of congenital blindness on the islands.

Malformations.—There is one case of "club foot" on the islands. I could not get seeing the patient, nor could information as to whether it was congenital be obtained. One informant stated that it was, another that it was not. No cases of hare-lip or cleft palate on the islands. Some cases of malformations, as the result of accident, rheumatism (*arthitis deformans*), and unset fractures are to be met with.

Herniæ.—Dr. Connolly has come across several cases of inguinal hernia in elderly men. These are probably due to strain in gathering seaweed, rowing, lifting, and carrying heavy weights.

Fevers.—During the exceptional distress of last winter and spring influenza was very prevalent. Formerly there used to be an annual epidemic of typhus in the islands, especially in Lettermullen, but of late the number of cases has greatly diminished. No information could be obtained as to other febrile complaints.

"*Constitutional*" *Diseases.*—Contrary to what has been observed in most of the islands visited, phthisis is very common (as well as other tubercular complaints). A great deal of the blame for this must be laid on the wretched nature of the dwellings of the people. During the day they have some ventilation from the open doorway, but at night, the small cabins, consisting of only one or two apartments, and containing from five to eight or more persons, together with cattle, pig, and fowls, the fire on, and the windows not made to open, or non-existent, have no means of ventilation, and become simply hotbeds for disease.

One case of caries of the sternum was observed in Garumna.

Rheumatism is one of the most common complaints, especially in winter. There are a great number of chronic rheumatic cases among the old people.

Malignant tumours are said to be rare or unknown.

Dietetic Diseases.—Dyspepsia, in its various forms, is not uncommon, as might be expected from the nature of the dietary. The use, or rather the abuse, of tea, and the share indian meal plays in the dietary during part of the year, may be counted as the most common causes. Diarrhœa is very common, in fact prevalent, when the indian meal first comes into use as a staple of the dietary.

As in most fish-eating communities entoparasites are a frequent cause of trouble. *Ascaris lumbricoides* is the worm most commonly observed, but Dr. Connolly has also seen others, some of which he could not identify. Cases of "gravel" and vesical calculus are of rather common occurrence it is said, but it is hard to be certain on this point, as all urinary troubles are classed as "gravel," in popular parlance; for instance, one case which really was traumatic stricture of the urethra was termed "gravel" by the people.

Respiratory Diseases.—Bronchitis and pneumonia are, as might be expected considering the hardships and exposure of the peoples' life, common in winter and spring months.

Eye Affections.—Seem to be rather common. Several cases of cataract in old people were noted.

Granular conjunctivitis, aggravated by the smoky condition of the houses, and corneal ulcers frequently come for treatment to Dr. Connolly.

Skin Affections.—Scabies, "sea boils," eczema, tinea tonsurans, and alopecia areata are common.

Venereal Diseases.—Here, as generally throughout the rural districts of the West of Ireland, syphilis and gonorrhœa are unknown.

Diseases of Women.—Few or no cases come for treatment except an occasional case of amenorrhœa.

Accidental Injuries.—Wounds, bruises, fractures, and burns are of common occurrence.

(E.) *Longevity.*—The people of these islands attain to a good old age, and persons of eighty years and upwards are not unfrequently to be met with. Two men died recently on the islands at the reputed ages of 105 and 108 years, respectively. One old man was met with who had walked several miles to get some goods at the shop, as he frequently does, though, to use his own expression, "weak in the legs now." He said that he was born on the 2nd of May, 1796, so that he is now over 102 years old.

4. *Psychology.*—A sketch of the mental characters of the people seems essential in a report such as this, and inquiries on this point have always formed a part of the work of these surveys. Besides personal observation such as could be made during a visit of limited duration, information was sought from people who are brought into daily communication and dealings with the inhabitants, and who, from

their positions and local knowledge, were likely to be reliable informants. Still the difficulty of treating this subject justly is great, as local prejudices and quarrels often affect the views of an informant, and care has to be taken to weigh and sift what reports are obtained, and to compare the views of one with those of another.

The following is believed to be an accurate account so far as it goes. The people of these islands are very shrewd and intelligent, and this applies especially to the inhabitants of Lettermullen. Among themselves they are very social but clannish, the people of the respective islands going together as a rule. They are fond of gossip and chaff, are quick at taking a joke, and have a keen sense of humour. They are passionately fond of music and dancing. In their dealings with one another they are very honest, and will pay up their debts whenever they can. Theft is of very rare occurrence. In time of trouble they are very kind and charitable to one another, and the totally destitute will always be able to obtain help from even the poorest of their neighbours. In spite of the illicit distillation which, for so long, prevailed in this district, the people are as a rule sober and not given to alcoholic excess. Women seldom or never take liquor. Excesses, when they occur, are usually connected with social gatherings of some sort, as wakes, funerals, and weddings. It is on occasions of this nature, too, that fights and quarrels generally arise. When a fight does occur it very rarely takes the form of a hand-to-hand tussle, but the men assail each other from a distance, first with hard words, and finally it may be with stones. One of their most noticeable characters is a strong local and personal pride. They are said to be greatly affected by praise or flattery, but this pride is very touchy and easily offended. From this pride arises a great spirit of emulation, and a certain sense of self respect which often makes people undergo hardships sooner than do what they would think mean or degrading. They show great patience and resignation under trouble or suffering, which seems, in part, to be due to the strong feeling of destiny or fatality which they share with most of the natives of our western districts.

They are extremely moral in their sexual relations, only one case of illegitimacy has occurred among them in the past eight years, and only two within twenty years. In other ways they are very excitable. Their veracity is their weak point. All informants agreed in stating that their word was rather uncertain. When law cases occur, which is seldom, cases of cross-swearing of great ingenuity are common.

Whatever may be said of the people of other western districts, the people of these islands are not idle or lazy. They could not live if they were, as life is one long struggle to them.

As parents they are kind and indulgent. They object strongly to children being caned at school, as they do not usually punish them corporally themselves, or, if they beat them at all, only make a pretence of chastisement, using a bit of straw rope or something of that sort. Family affection is a very marked trait in their character. They are very devout in the practices of their religion.

As might be expected from the nature of their occupations and environment they have a strong faith in the supernatural, and their folk-lore is rich and varied. As boatmen and fishermen they are skilful, hardy, and courageous. With strangers they are at first shy and taciturn, but this is largely due to slight knowledge of English. Once they get over the first suspicion of the stranger they are very communicative as far as the language difficulty will allow. Curiosity and anxiety for news are very marked characters. On the whole the people are decidedly pleasant and attractive, once the first difficulties of acquaintance are got over.

5. *Folk-Names.*—The following list (on pp. 246–247) comprises all the surnames at present to be met with on the islands.

Double surnames, *i.e.* the use of one name when speaking Irish, and another, often a translation or supposed translation, when speaking English, are not known in this district, though common in some other parts of Ireland.

The custom prevails here, as elsewhere, of distinguishing between people of the same Christian name and surname by affixing to the latter the Christian name of the person's father, *e.g.* Tom M'Donogh (Simon).

Surnames of Garumna. No. of Families 279.

Surname.	Number of Families.	Surname	Number of Families.
Allen, ...	1	King, ...	5
Barrett, ...	1	Kilderry, ...	1
Bradley, ...	2	Landy, ...	1
Conneely, ...	14	Lee, ...	4
Cloherty, ...	2	M'Cann, ...	1
Cloonan, ...	2	M'Donogh, ..	47
Conroy, ...	3	Maguire, ...	1
Cooney, ...	3	Malia (Malley) ..	11
Coyne, ...	1	Mannion, ...	1
Crowley, ...	1	Mulkerrin, ...	3
Curran, ...	3	Molloy, ...	1
Devane, ...	1	Mullin, ...	5
Donohoe, ...	2	Murphy, ...	2
Faherty, ...	1	Nee, ...	3
Farmer, ...	3	O'Donnell, ..	6
Flaherty, ...	32	O'Loughlin, ..	13
Feeney, ...	5	Perkins, ...	3
Folan, ...	18	Quinn, ...	2
Gannon, ...	1	Rainey, ...	2
Griffin, ...	12	Trayer (or Traynor)	4
Hernon, ...	3	Toole, ...	4
Hogan, ...	2	Vaughan, ...	1
Hynes, ...	7	Walsh, ...	11
Joyce, ...	16	Wallace, ...	1
Keane, ...	1	Windle, ...	1
Kelly, ...	1	Wynne, ...	1
Kerrigan, ...	1		

Surnames of Lettermullen, Furnace, Inishark, and Dinish.

Surname.	Number of Families.	Surname.	Number of Families.
Audley, ...	2	King, ...	2
Barrett, ...	1	Griffin, ...	1
Beatty, ...	2	Larkin, ...	2
Berry, ...	9	Lee, ...	6
Blake, ...	1	Loftus, ...	3
Conneely, ...	10	M'Donogh, ..	22
Conroy, ...	2	M'Ging, ...	1
Devane, ...	1	Molloy, ...	2
Dirrane,[1]	3	Mulkerrin, ..	3
Feeney, ...	1	Mullin, ...	5
Flaherty, ...	28	Nee, ...	1
Folan, ...	3	O'Donnell, ..	8
Healy,[2]	1	Toole, ...	5
Joyce, ...	1	Vaughan,[3]	6
Keely, ...	1	Walsh, ...	7
Kelly, ...	2		

The sixty surnames given above are all those to be met with on the islands; they are not all native, however, as some of the less common surnames are the names of teachers or other officials, or their descendants. The majority of the names are either (*a*) old West Connaught surnames, either in their original form or in many cases anglicised, or (*b*) the names of members of the Welsh and Anglo-Norman tribes who overran the district in the thirteenth century, (*c*) the names of people from other parts of Connaught (Kelly, O'Loughlin, and Molloy).

[1] Not native. [2] Originally from the Aran Isles.
[3] Originally from Clare.

(*a*) The ancient surnames of this district still prevail here, and the following list gives all those now extant that could be traced:—

Conneely.	Griffin.
Clogherty.	Hynes (O'Heyne).
Conroy.	Keane.
Cooney.	King.
Coyne.	Lee (O'Lee, *vel* O'Lye).
Devane (O'Dubhain).	M'Donogh.
Faherty.	Malia (or Malley).
Flaherty.	Quinn.
Gannon (O'Concannon).	Toole.
Folan.	

The Tooles of this part of Connaught are a branch of the O'Tooles of Leinster who settled in Iar Connaught under the O'Flahertys. The O'Lees were the hereditary physicians to the O'Flahertys. The great bulk of the names are those of adherents of the O'Flahertys and M'Donoghs.

(*b*) The Welsh or Anglo-Norman names on the list are Barrett, Blake,[1] Joyce, and Walsh. Williams is usually the modern form of M'Williams, a branch of the Bourkes (De Burgos). The Joyces settled in the district in the thirteenth century by permission of the O'Flahertys to whom they always acted as adherents and followers.

IV.—Sociology.

1. *Occupations.*—From the poverty of the soil and the overcrowding of the district the people are driven to many shifts to make a livelihood. With one or two exceptions none of the people can be called farmers. The community is one of fishermen and kelp-burners, who till a little land and keep a few cattle and sheep. As has been stated in a previous section the average amount of cultivation for a family is about an acre of potatoes and an acre of oats or barley, or in some cases rye. The fields are small, irregular plots, varying in shape with the conformation of the ground, and taking the shape of the

[1] In the Appendix to O'Flaherty's "H-Iar Connacht," O'Donovan states (p.192) that "Richard Caddle, *dictus niger* or the Black *a quo* Blake," was the common ancestor of all the present families of the name in the West of Ireland. He was Sheriff of Connaught in A.D. 1306 and . . . "bailiffe of Galway under Richard de Burgo, the Red Earl of Ulster in A.D. 1312."

places between the larger rocks. Even these small plots are rendered still smaller by being cut up by rocks cropping to the surface, by large boulders, and by heaps of loose stones gathered off the land. The land is cropped alternately with potatoes and barley or oats until the yield begins to fail, when the spot is let run fallow and another plot is cultivated instead. The principal manure is "black weed" (*Fucus vesiculosus*), which is brought to the land from the seashore in basket loads on the backs of women, the distance it has to be brought varying with the proximity or otherwise of the plot to the shore. The men gather the weed, the women carry it. It need not be said that there is none but spade labour. The fences are lacework walls of loose stones similar to those to be seen generally in Connemara; they are not always sufficient, and on this account the sheep are constantly hobbled, and frequently trespass on the crops. There are considerable stretches of commonage, on which are kept a number of small, weak-looking sheep, mainly for their wool, and some cattle, also of a poor description. The number of sheep per family averages from 5 to 20. About ten per cent. of the families have no cattle.

Very few pigs are kept, and only about one family in every twelve has a horse or a donkey. Fowl and geese are kept, the former being a source of income through the eggs, large quantities of which are exported from this district. Very few ducks are to be seen. Cattle and fowl are taken into the houses for the night, and the pig, if there be one, has often a snug place by the fireside. The sheep are left to find shelter how they can. The cattle are sent out of the islands to the mountains in the late autumn. As before stated they are small and weak, and the mortality among them in winter is high. They are subject to two diseases, locally termed "the cripple" and "pine," to which my attention was first directed by my friend, Mr. G. H. Kinahan. The "cripple" attacks cattle on the mountains, and from what I could ascertain from inquiries seems to be simply rheumatism. The "pine" is simply starvation from insufficient food, and occurs in the islands.

Only a couple of villages in Garumna are composed of fishermen by profession, but practically all the men of Lettermullen fish for lobsters, using lobster pots made of osiers grown in small swampy spots on the islands, and from furze stems. From these osiers, too, are made the baskets and creels so largely used. The prices got for lobsters, which are sold to local dealers, are from half-a-crown a dozen for lobsters under 11 inches in length, and five shillings for those of larger size, in the summer months; up to ten shillings a dozen in winter.

The fish most taken are mackerel, herring, gurnard, cod, ling, glassan, seabream, and a few turbot. Unfortunately there has not up to this been a good market for fish, and it has largely been taken only for home consumption; some of the bream is roughly salted and dried in the sun, and sold to a local shopkeeper, who finds a market for it in the inland parts of Connemara. The fishermen are almost a separate caste, the kelp-burners fish only for home use. Until this autumn nets were not used by the fishermen of these islands.

Now two fishing stations have been opened by the Congested Districts Board, and nets have been supplied to the fishermen. These stations buy cod and ling, in winter and spring months, and mackerel in season, and cure it, the labour engaged in curing being all local.

One of the great means of livelihood is the manufacture of kelp, a very large quantity of which is made in these islands. The process is a very hard and laborious one, as the weed has often to be obtained from a distance. "Red weed" (*laminaria*) only is used,* black weed (*Fucus vesiculosus*) being looked on as an adulteration in kelp. When the supply of red weed off the shores of the islands falls short, boats go off even to the Aran Islands to cut it there. The weed is cut by an instrument having a sickle-like blade, on the side of which are three hooks (the blade cuts the weed and the hooks retain it); this blade is fixed into a handle of from 15 to 20 feet in length; curved two-pronged forks are also used. Large heavy rowing boats are used for weed collecting. It takes twelve boat-loads to make one ton of kelp. The weed is spread out in the sun to dry, and then piled in heaps for burning. Much of the Fucus is often gathered and stacked the winter before it is burned. Regular kilns are not made here, but a bare, rocky flat is selected or the thin soil pared off the rock at a suitable spot. It takes two men from three to four weeks to make one ton. The average amount made in one season is about four tons for a family which owns one boat, six or eight tons for one owning two boats. Men with no family may only be able to make one ton, but two men without family often combine forces and make the kelp in partnership. The price obtained varies with the quality of the product, from £1 10*s*. a ton to £4 10*s*. The kelp is taken by boat to Kilkerrin, and sold to agents. The Lettermullen people are practically all kelp burners.

Until lately another of the local industries was the distillation of illicit spirits, but this has been largely put down since the opening of the causeways connecting the islands. Garumna had a celebrity

* See note, p. 268.

formerly for the quality of the *poteen* made there, which was never distilled from treacle or adulterated.

It is made only from malted barley and oats. The proportion of oats used is one part to three of barley malt. Querns are used for grinding the malt.

Much ingenuity is often displayed in the methods employed to evade the police; the spirits have even been made in boats at sea in some cases. The prices obtained were considered remunerative for the labour and risk incurred. The poteen sold at from 8 shillings to 10 or 12 shillings per gallon according to quality. The stills were made by a travelling tinker who lived in the client's house while making them. The worm was, and is, always of copper, and is the most expensive part of the apparatus.

Trades are few; there are seven weavers who make the homespun flannel and frieze largely used by the people, for making which they receive tenpence a yard. The looms and warping frames are of primitive type. There are five boat-builders in the islands, who can build all the types of boats in local use; three or four tailors, and a carpenter.

There are several general shops at which goods of all kinds may be obtained, and since the causeways have been opened carts from the mainland come through the main roads of the islands and sell goods of various sorts.

There is no regular work for labourers, but occasional work is paid at the rate of 1s. 6d. a day and the man's food. None of the men from this district migrate to England or Scotland as field labourers, but some of them go to the county Clare to dig potatoes, where they are boarded and lodged and get about 9 shillings a week.

In some parts of Garumna turf is cut for export to the Aran Islands and the opposite coast of Clare. A good deal of the denudation of the surface of the island is due to this cause, as Garumna has been for generations the principal source of the fuel supply to Aran and Lettermullen. The price obtained could not be ascertained. The turf exported is mostly carried in boats of about four tons, termed, according to their rig, pookhauns and glouthoges.

The women, besides their ordinary domestic duties, take part in all field work of every description, cut and carry turf and seaweed for manure. In the case of the Lettermullen women they have to carry the turf home in baskets on their backs, a distance of over four miles. They shear the sheep, an operation looked on as woman's work, and, as a rule, only carried out piecemeal, just as much wool being taken as is required, and no more.[1] They card, dye, and spin the wool thus obtained; they rear fowl for the eggs, which are either bartered for goods or are sold to the shopkeepers at a rate varying from 10*s.* the long hundred (120) in winter to 3*s.* 6*d.* in summer. They also gather carrageen moss from the rocks at low water, which they dry in the sun and sell at from fourpence to sixpence a stone. The moss, however, requires picking after purchase, as other weed is often mixed with it.

Even the young children have to take their part in the struggle for existence; they help at carrying home the turf when saved, tend cattle and sheep and keep them out of the crops, and gather periwinkles, which they sell by the "bucket," for which measure they get about 1*s.* 6*d.* in the winter season. These periwinkles all find their way to the London market.

Very little work is done during the winter months. Weed for manure is gathered then, and it is then, too, that poteen is made.

Altogether, the life of these people is one long struggle against adverse circumstances. The margin between a good year and one of distress is, and must be, from the nature of things, a very narrow one, and a bad season means destitution.

2. *Family Life and Customs.*—Families are large, as a rule, and from an early age the children have to help at household and general work. Quite young children do a lot of work in the way of tending cattle and sheep, carrying turf, &c., as back-loads. They go to school, if at all, at about six years of age, and leave at thirteen or fourteen. They are said to be smart and intelligent, but are hindered greatly in their progress by the irregularity in attendance caused by their being kept at home to aid in various kinds of work. The result of the early participation in the struggle for existence is that, to use the words of Mr. Healey, National Teacher of Lettermullen, "there is no childhood, properly speaking. From infants they become little men and women at one step." After leaving school they enter at once into the regular work of grown-up people. Very few of the young folk emigrate, though a larger number do so now than formerly. As before stated there is no annual migration to England or Scotland for field work, but a few go to Clare and the east side of the county Galway. The young people of different sexes are not, as a rule, to be seen together, but go in groups by themselves. Public opinion is very strict on the score of their relationship, and a girl would not be allowed to

[1] The average weight of a fleece is about 1½ lbs. Wool is bought to make up deficiency at the average rate of tenpence a pound.

walk a hundred yards up the road after sunset even with a cousin. Marriages are arranged by the parents, and there is, as a rule, no previous courtship. The fortune is seldom or never money, but consists of two or three cattle, or a couple of sheep, but considerations as to suitability of families, &c., are often taken into account as well as the dowry. Sometimes marriages are occasions of festivity, but in many cases they occur without any social rejoicings, and the young couple go home quietly after the ceremony. The people marry early, the age in the case of men being from eighteen to thirty years, and for girls from sixteen upwards.

After the marriage ceremony the bride and bridegroom go out of the church door together, as it is believed that, if one went out before the other, the first to go out would be the first to die.

The small holdings are constantly subdivided when the young men of a family marry, new houses being raised on the smaller subdivisions in the cases of the elder sons. The youngest son brings his wife home to live with the old people, as a rule, and inherits the father's holding. In these cases the house is often divided by a party wall, and the young couple live in one of the divisions thus formed.

Infants are carefully watched before baptism and at special times, as when about to be vaccinated, lest they should be changed by the fairies or come under any other evil influence. It is customary to put little crosses made of straw into children's clothing when they are taken to be vaccinated. Women frequently carry their infants slung in a shawl on their backs, thus leaving the hands free to knit or do other work. Delivery is, in normal cases, usually effected in the kneeling posture. Unbaptised and stillborn infants who die are not interred in the regular grave-yards, but are buried in the mearing between two holdings. Many old customs and ceremonies relating to deaths and funerals still persist. It is believed that if a person is dying he will expire at half-tide, but that if he lives beyond that he will linger until the next tide. When anyone is dying of phthisis, all the relatives are cleared out of the house lest they might catch the disease as the person dies. After a death the body is usually kept two days before burial. Wakes are still held, but they are shorn of many of the old customs. Now the people merely sit and drink and tell stories. The coffin is always borne to the grave on men's shoulders, as there is no road to the grave-yard, and fences and walls have to be crossed. Cairns are raised at spots where a funeral has stopped on the way to the grave-yard, and the people never pass these without a prayer for the repose of the soul of the person on whose account the cairn was built. It was from the desire to make these monuments more definite and permanent that the curious memorial pillars of the Aran Islands took their origin.

As is usual in the West, the grave is not dug until the funeral reaches the grave-yard, but before this work is begun the coffin is borne thrice round the old church in the direction of the sun. The old *caoine* is still used at all funerals. A good deal of liquor is usually drunk on these sad occasions. The custom of smoking at the grave does not seem to obtain here.

The people are early risers as a rule, except in the case of fishermen, whose hours, of course, cannot be regular. They are timid about going out at night on land, and stay closely to their houses after nightfall. During the winter months little work can be done by the men; the women have the usual household occupations. Formerly there was a strong feeling against selling eggs, but now large quantities are exported. Even still the people look on selling butter as something to be ashamed of. The same is the case as regards milk. The sale of either of these is considered a thing to conceal lest the neighbours should know that the family was reduced to such a state of poverty as to have to do so.[1] For fuel turf either from the bogs, or where these are at a distance, scraw turf (made by raising the thin peaty layer off the rock, a very poor stony fuel), and bog pine are used. The houses are now lighted at night by cheap lamps burning petroleum, but formerly rushlights were used. Fuel is so scarce, and has to be fetched in back-loads for such a distance, that the people of Lettermullen are extremely careful of it, and are sparing in its use.

3. *Food.*—The food consists principally of fish, potatoes, indian-meal stirabout, soda-bread, and tea. Most of the people have never tasted flesh meat, and many would not eat it if offered them. Potatoes last on the average for ten months of the year, and for the remaining two months indian meal has to be fallen back on as the staple of the dietary. In a bad season, however, potatoes may not last until the New Year. Fish is eaten fresh in summer, salted in winter. Many prefer the salted to the fresh fish. The kinds cured for winter use are gurnard, bream, glassan, ling, and pollock. These are split, roughly salted, and dried in the sun on the roofs of the houses. Tea is consumed in great quantities, and is drunk very strong. Two varieties of

[1] All the people are more or less in debt to the shopkeepers, though they pay whenever they can. Barter still exists to some extent, but the system mainly followed now is, that eggs, lobsters, &c., are brought in to the shops and their price either credited to the account of the vender, or the equivalent of their price is given in groceries, tobacco, or other goods.

sea-weed, *oranagh* and *dilisk* are dried, and used as "kitchen" or relish to food. They are both varieties of the same weed (*Rhodymenia palmata*); but the former, which is found attached to mussel-shells, is esteemed the better of the two, and is looked on as a luxury. It is often sold to the inland people at about threepence a pound. Three meals a day are usually taken.

4. *Clothing.*—The working dress of the people is usually much torn and patched, and many of them, especially the children, wretchedly clad. On Sundays and holidays the attire is neater and better. Homespun fabrics are most used and seem to wear best. Some of these are good, and efforts are being made to introduce good patterns and improve the quality; but the most common sort is simply a rough coarse flannel, grey or white in colour for the men, red for the women. The clothing is more uniform in type than noted in other districts owing to the seclusion. The dress of the men is of the usual Connemara type. Flannel shirt and drawers, white coat (*bawneen*), waistcoat, often worn over the coat, and heavy trousers split for a few inches up the outer seam. The clothing is made by local tailors, of whom there are three or four. The head-dress is in many cases the old flat knitted bonnet, of the shape known popularly as Tam o'Shanter. These caps used formerly to be made at home; but most of them are now imported, and they are no longer always blue with red knob and diced border, but many fancy patterns and tartans are worn. This form of head-gear retains its popularity as it is not easily blown off, and so is suitable for wearing in boats when fishing; soft felt hats are also worn. The men wear woollen stockings and heavy boots (which are imported ready-made); a few men were seen wearing *pampooties* or sandals made of raw hide with the hair outside, exactly similar to these worn in the Aran Islands. Most of the elder men in the village of Trabane wear pampooties while fishing, as they are not likely to damage the canvas curraghs in which they fish, as heavy boots would. Women and children go barefooted, except on Sundays.

The dress of the women consists of a close bodice and short skirt of red flannel; a shawl, usually one of the red tartans for which the people seem to have a partiality, is worn over the head and shoulders. In unsettled weather a petticoat of red or white flannel is worn round the neck in cape fashion.

On working days many of the women wear *mittauns*, footless stockings or knitted gaiters. The so-called Claddagh ring, with the device of a heart clasped by two hands, is worn by some of the women. These rings are handed down as heirlooms.

Young boys wear the kilt-like frock of grey or white homespun to a later age than noted elsewhere, sometimes up to thirteen or fourteen years of age. A belief prevails that to put boys into trousers too early is likely to check their growth. Children usually go bareheaded and barefoot. At Trabane National School, on August 22nd, out of fourteen boys present only five had caps. The children are usually the worst clad members of the community, and their clothing is often very ragged. Some of the dyes for the homespuns are obtained from plants growing on the islands. Rag-weed gives a yellow dye; heather, water lily roots, and purple loose-strife give browns and blacks. The red dyes for the women's clothing are bought at the shops, and are usually madder and aniline colours.

5. *Dwellings.*—The houses are of a very poor description, but vary much in type. As a rule they are built of dry stone, without mortar, and thickly plastered inside. In some of the poorer houses, tempered cow-dung is used for plastering. The best houses are those built along the main roads which have only been erected within the past ten years. The worst are those in some of the coast-villages. The floor consists usually of bare rock or large stones, the spaces between being filled up with mortar or beaten clay.

The poorest class of dwellings consist of only one apartment, and are often very small, the smallest seen measuring about 10 feet in length by 8 in breadth internally, and the average size being about 18 feet by 10. A house of this class has, like the rest, two doors or doorways opposite one another, and about 5 feet in height, the one on the windward side being kept closed. The door is composed of a few rough boards. In some cases there is no door, but a straw mat or bundles of furze in a wooden frame take its place. Windows are represented by a couple of holes in the wall, a foot or 18 inches square, sometimes glazed, and in these cases not made to open, sometimes filled with rags or a few sods of turf. These are on the side of the house sheltered from prevailing winds. A house of this sort may appear from the outside to have a chimney, but this is merely a structure built around the hole in the roof at the gable which serves the purpose of letting out the smoke; there is no flue inside, and the hearth is merely a few stones against the end wall of the house. The floor is bare rock. The rafters are made of drift wood or bog timber sawn, and are black from the smoke. The roof is thatch laid on over scraws of turf, and held on by sougans (or straw ropes) fastened down either by pegs driven into the walls, or by large stones tied on to them. About one-third of the dwellings in Lettermullen are of this class, the proportion in Garumna is about the same or a little less.

There is scarcely any furniture in these houses. A couple of chests, one or two small benches, and a rough table, perhaps a rude dresser knocked together from a few boards, and containing a few jugs and cups of rude delft, are all that can be called furniture. In houses of this class there is in very many cases no bed,[1] a litter of dried bracken, and some tattered blankets laid on some boards, or on the floor, takes its place. In some cases the bedstead is a pile of stones,

Cabin in Garumna.

or the wooden frame of the bed is supported on stones at both ends. In two houses visited banks of stones had been built up to form seats. A pot, a tub, some baskets, a tin lamp and a few mugs form the domestic utensils. The only ventilation at night is through the clinks in the stones around the badly fitting door frame.

A better class of house consists of a kitchen, off which are one or two sleeping-rooms formed by partition walls about 7 feet in height, and covered in by a few beams and boards to form a loft in which to

[1] Of ten houses visited in the village of Creggs in Lettermullen only *two* had bedsteads of any sort (23rd August, 1898).

keep domestic stores, &c. This loft is often lighted by an unglazed hole in the gable. These sleeping-rooms may or may not be lit by a window, and are often densely dark. They contain one or two beds stuffed with straw or bracken, the rude bedsteads being made of drift-wood or bog timber. In some cases the sleeping-places are only divided off by a partition wall, or a wooden screen, and the bed is on the floor. The kitchen contains a table, a rude dresser with crockery, a couple of chests, straw ropes stretched across the room for drying clothes, or a couple of benches or stools, a chair (perhaps), baskets, a griddle, and a pot or two. This type of house, if two-roomed, may or may not have a chimney. If there be three rooms there will be a chimney against the central wall. About sixty per cent. of the houses have some sort of

Cabin in Garumna.

division or partition in them. All are thatched as before described. The thatch is put on once in six years, new thatch being laid on over the old. The cattle are taken into the house at night, and fastened at the end of the kitchen farthest from the fire.

The pig, if there be one, has often a snug place beside the fire, and the fowls roost on the couples overhead. In many cases there is a stagnant pool outside the door.

There is a still better class of house which is whitewashed outside (perhaps), has a floor kept neatly sanded; there are glazed windows, on more furniture, and a pig-stye is built outside the house. It is that the reason why there are not more houses of this class is not ignorance or laziness, but lack of means. Spinning wheels are not to be found in every house ; about one family in eight or ten has one, but they are lent from house to house. Querns are to be seen in a few houses, but are becoming very scarce now.

In the northern end of Garumna the houses are larger and better than in the rest of the island, and are thatched in a different manner, the thatch being held down by bands or ropes of twisted osier held in place by pegs.

6. *Transport.*—Formerly all communication between the islands and the mainland had to be by boat, and boats are still largely used, and vary in type with the locality. In one village, only curraghs are in use, which are sailed whenever possible, and usually carry three men. Heavy rowing and sailing boats are used for conveying weed for kelp, hookers are used by the shopkeepers for conveying goods to and from Galway, they are also used for taking turf to Aran and Clare, and for fishing, but boats of about four tons termed, according to their rig, pookhauns and glouthoges are more used for these purposes. These boats are built on the islands. The curraghs are of good size, and they take twenty yards of tarred canvass to cover them. The cost is £4 5*s*.

For internal traffic there are but few beasts of burden, there being only thirty-five horses, and fifty donkeys in Garumna, and only five horses and two donkeys in Lettermullen, so the greater part of the work of carrying turf, sea-weed, &c., is performed by human beings, these things being carried in baskets on the backs of human beings. Before the new roads and causeways were constructed there were no wheeled vehicles on the islands, and even now there are only two carts, both belonging to Mr. P. M'Donogh, J.P. The beasts of burden carry their loads in *cleeves*, or panniers slung from a wooden frame over a straw saddle or pad.

The islands are now connected with one another, and the mainland, by a series of causeways and swing bridges constructed by the Government. Before their completion in 1897 the islands were difficult of access. The old roadways were only rough foot tracks often obstructed by rocks, and very rough and irregular. Roads were laid out and commenced in 1847, but until 1889 they were not completed. Since then good roads have been and are being laid down, partly as Government works, and partly by means of the relief funds raised in times of distress like last year.

Before the construction of the causeway between Lettermore and Garumna people who wanted to get across the channel, if they could not get by boat, had often to wait for days until the water was low enough in the channel to ford, but even when fordable the current was very strong, and people have more than once been swept away, and drowned in the attempt to cross.

V.—Folk-Lore.

Connemara is reputedly rich in folklore, and it may be presumed that a secluded part of it, like this group of islands, still retains much that may have died out elsewhere, but owing to the natural reticence of the people on this subject, especially with strangers, very little information could be obtained, and that only on what may be termed minor folklore. Legends, traditions, and hero tales no doubt exist, but no specimens could be obtained, nor could any information be obtained about them.

The following notes were collected, however, mainly through the kindness of the Rev. E. A. Lavelle, Mr. Michael Lavelle, Mrs. McDonogh of Crappagh, and Mr. P. Healy, National Teacher, Lettermullen.

1. *Customs and Beliefs.*—Much faith is placed in omens or portents, and the number of things considered lucky or otherwise is large. It is considered unlucky to move into a new house on a Monday, while Friday is thought to be the proper day for this. To build an addition to one's house on the west side is thought to be always followed by misfortune. A story is told of a man in Garumna who built on to his house on the west side and got "touched in the head" shortly afterwards (which, of course, was ascribed to his rash action in building in the prohibited direction), and remained so until the addition was altogether removed.

To meet a red-haired woman on starting out in the morning is looked on as an unlucky omen for the day's work. It is unlucky also to see a hare cross one's path, or to mention the name of this animal while fishing. A crowing hen is thought to portend evil, and one which indulges in this habit is killed at once and thrown over the house three times to avert the misfortune which her action would otherwise produce. Undersized lobsters when taken are never put back into the water lest returning anything to the sea which had been taken out of it might spoil the luck of the fishery.

Milk will not be given out of a house on a Monday or on May Day. On the 1st of May also a fire is not put down early, as it is thought to be unlucky for a house to have the "first smoke" on this day. If a person is sick, fire will not be given out of the house in which he is. To trip or fall in a graveyard is looked upon as portending death within a year. Salt is taken in the pocket when going to a funeral, to avert evil influences. The appearance of a number of *primpulans* (*Geotrupes stercorarius*) or large dung beetles flying about in the evening is looked upon as a sign of good weather to come, and it is considered to be a very unlucky action to kill one of these insects. The belief in death warnings or omens is general, and some of these are from the actions of animals, as four magpies seen together, the appearance of ravens about a house. Others are of a supernatural character. It is said that "when a boat is about to be drowned" a man without a head is sometimes to be seen in it. Before a death occurs in a house the sounds of someone making a coffin may be heard outside at night. Near a village or hamlet (Creggs) in Lettermullen is a curious rock in which local rumour says that a child's voice may be heard crying previous to the death of any of the children of this village. The death coach is believed in by most, and a man from this district is said to have seen it on his way to county Mayo, and to have died shortly after. It is thought also that in some cases before a person dies his apparition or wraith may be seen by some of the neighbours to walk past them and suddenly vanish; as apparitions of various kinds are thus still a matter of common faith, the people do not like to be out after nightfall on this account. The spirit of the person last buried in a graveyard has to watch until the next funeral. Mr. Michael Lavelle was informed by some of the people that a Mayo-man cannot be harmed by a ghost "on account of St. Patrick." Among the appearances seen in these islands is a merman of whom the fishermen talk much. He is said to have been a drowned man, and men who claim to have seen him describe him as having long black hair, a flat face, a double chin, and webbed hands. Another water monster said to be sometimes seen is the water horse or *Each Uisge*, which is said to haunt two of the lakes, and of which several stories are told. If, on this creature's emergence from the water, a man sees it first the apparition will do him no harm, but if on the contrary the water-horse should first set eyes on the man the latter will certainly die within the year. A story is told of a woman who lived in a house beside the largest and most southerly of the lakes in Garumna who happened to come suddenly across one of these creatures which shook himself so as to sprinkle the water shaken off over the woman, who became paralysed in consequence.

There is thought to be a connexion of some sort between the people bearing the name of Conneely and seals. They boast that they "have seal's blood in them, and that is why they are such good swimmers." The belief in this connexion is mentioned by O'Donovan, who states that there was an old tradition, "that at a distant period of time several of the clan Conneelys (*Mac Conghaile*), an old family of Iar-Connaught, were by 'Art Magick' metamorphosed into seals!" It does not, however, seem to be the case in these islands that the killing of a seal is looked upon as a very unlucky and heinous action, as is the case in some other places on the west coast.

Many of the people retain a belief in fairies, and some claim to have seen them. The usual story is told as to their origin, *i.e.*, that they are fallen angels who must wander the earth until the judgment. They are malicious if provoked, and hurtful to men and animals.

The *Phuca* is believed only to come out on November Eve, and carries off people to a distance and takes them back again. The banshee is described by those who "have been told by those who have seen her" as like a little woman in a red cloak. She may be heard singing before a death. Infants and parturient women have to be especially guarded against the machinations of these beings; fire, iron, and salt are supposed to avert their influence—for this reason horse or donkey shoes are nailed on the cradle or over the house door. In a paper published some years ago by Professor A. C. Haddon he quotes the following information obtained from Dr. T. V. Costello of Bealadangan, the medical officer for this district:—"On Lettermore Island, which also is in South Connemara, immediately after the birth of a child—which, by the way, is always delivered with the mother in a kneeling posture—the father throws (counting as he does so) *nine* articles of clothing over the mother; the number never varies."

"A piece of the ash from the remains of the peat fire is tied up in a red rag and attached to the cow's tail to prevent the fairies from milking her during the night."

The fairies are believed to carry off and change children, and it is thought that a changeling may be detected by making the child sleep over a weed got from the lakes (*cauleenagh*) over which no fairy can rest.

When the infant is taken to be vaccinated, coals of turf and straw crosses are put into its clothing to avert fairy influence. Men also take out a coal with them when fishing to bring good fortune.

Means are sometimes adopted to propitiate the "good people." The hearths are swept up at night and clean water is left out for them, and when making poteen some leave a little of the "first shot" out in a jug for them. Fairies are believed to pass from one place to another in the day time in whirlwinds. Fairy or phantom boats are also said to be seen from time to time, and a fairy piper is said to be heard at times playing in one of the large granite boulders.

The belief in the evil eye prevails in the district, and one woman is dreaded as having this malign power. It is said that the "bad eye" is acquired by a person through the priest having forgotten some minor part in the rite of baptism. The effect of the evil eye cannot be intentionally produced, but only comes by chance. A story is told of an old woman who met a girl and said she wondered that she could carry such a heavy basket. The girl, when she got home, was seized with severe pains and died soon after, and her death was ascribed to the effect of "the bad eye." The first time an infant is taken out, people spit upon it to protect it from this evil influence and from the fairies.

The customs observed at deaths, funerals, and wakes have been mentioned in another section.

On St. Bridget's Eve and November Eve a peculiar shaped cross of wood, in the form of the suastica, is sometimes nailed on a rafter to keep off fairies and avert other evils.

Bonfires are lighted in Garumna, as in most other places, on June 24. On St. John's Eve (*bealtinne*) in Lettermullen, as Mr. Healy informs me, they often only put up a flag on an oar, or something of that sort, as fuel is so scarce. The people circle round the fire three times, and carry away coals from the fire to throw into the potato fields to produce a bountiful yield. The hunting of the wren on St. Stephen's Day (26th December) is a custom but little observed here.

2. *Charms and Leechcraft.*

(*a*) *Charms.*—Reliance is placed in charms for the relief of various troubles, physical and otherwise. These charms are dispensed by wise women, and one, who lives in the northern part of Connemara, is visited even by the people of these islands that they may consult her about the suitable site for a house or for disease, &c. Should a house be infested with rats, a written charm can be obtained, which is laid near the rat-hole, and it is thought that the oldest rat will take it in his mouth and leave the house, and that the rest will follow him.

Charms are also used for the rose (erysipelas), for toothache, and for worms in children.

(*b*) *Leechcraft.*—The methods in vogue for the treatment of disease vary from charms to herbal simples.

Headache is treated by the method of head-measuring described in the report on the Mullet. Worms in cattle by the tying of the worm knot. The remedy advised for toothache is rather a terrifying one: it is that the person affected should go to a burial ground, bite some of the grass from a grave and chew it. Enlarged glands in the neck may, it is believed, be cured by rubbing them with a dead man's hand. It is doubtful, however, if these are used now. For post-partum hæmorrhage a red cord is tied around each of the woman's fingers.

Whisky, especially poteen, is looked upon almost as a specific for everything. It is used internally for most complaints, and externally for sprains and bruises, and also for rheumatism. A remedy which has been taken for a cold is punch, made thus—poteen is heated in a saucepan, then sugar is added and then cold poteen. A large number of herbs are used, but particulars could only be obtained about the following:—

Watercress (*Nasturtium officinale*) is taken boiled with whisky and loaf sugar for bronchitis.

Flag-root (*Iris pseud-acorus*) is pounded and applied as a dressing to wounds.

Crowfoot (*Ranunculus acris*) is pounded up with fresh butter and used as an ointment for "the rose" (erysipelas).

3. *Legends and Traditions.*—Of these there are probably a number still extant among the older people, but so far, as could be learned, few, if any, of the younger people seem to know them, or else they are unwilling to speak about them. Men seldom can speak of anything before their grandfathers' time, and no one was met with who seemed to know anything about the tower on Golam Head, which is probably only one of the old coastguard signal towers built during the great French war. No man was met with who had heard of any tradition about the old castle of the M'Hughs in Lettermullen. Oilither church is said to have been built by one of the M'Donoghs. O'Donovan mentions that the people of this district in his time (about 1845) had a tradition respecting Greatman's Bay (*Cuan an fir moir*) "The people here relate that the Great man who gave his name to this bay was a giant; that he lived a long time ago, and seized and plundered all the vessels that passed that way. They still show a large hollow rock which they call his churn, *Cuineog an fir moir*; and three other rocks called *Brannradh an fir moir*, which supported the caldron in which he boiled the whales which he caught with a fishing-rod."

VI.—Archæology.

These islands contain but few monuments or ancient buildings, but on the other hand are rich in survivals, the seclusion of the islands, the poverty of the people, and their overcrowding having caused their mode of life to remain in a very primitive state, and preserved in use many ancient implements and articles of daily use.

1. *Survivals.*—The poorest class of houses are a survival of a state of things which is fortunately becoming a thing of the past almost everywhere else. The straw mats used for cutting off the draught from the door on the windy side of the houses, the use of querns for grinding malt or barley meal, the spinning-wheels, cords, warp frames, and rude looms are the principal survivals among domestic implements, if we except the *slish*, a beetle or paddle used for beating clothes when washing them, as described in the report on Inishbofin, and the use of homespun clothing, the dyes of which are in part still obtained from local sources as well as the fashion of the garments. The dress of the young boys seems to be almost identical in form with the woollen frocks dug up out of bogs and preserved in the Academy's Museum. The flat cap, too, and the pampooties or sandals of raw hide are other remains of ancient costume, as are the *mittauns* or footless stockings worn on working days by the women. The so-called "Claddagh" rings worn by some of the women have been mentioned before.

The method of winnowing is the same as that described as still in use in Inishbofin.

Curraghs of the usual west coast type still remain in use in some of the fishing villages. The anchor used for them is an oblong stone fixed in a V-shaped wooden frame. Mention has before been made of the memorial cairns raised where a funeral has stopped.

2. *Antiquities.*—As has been before remarked, these are few in number. There are two old churches, one which is almost complete and is situated in a hollow just below the village of Trabane. It is a small building of uncertain date, and is reputed by tradition to have been built by one of the M'Donoghs. The other, which appears to be an older building, is situated in a very picturesque spot at Shanvalla. It is in a very ruinous condition, only the gable walls being left standing. It has a flat-topped doorway in the west gable, and a fine splayed window in the east one. This is the Oilither church, or *church of the pilgrims*, mentioned by O'Flaherty. In Lettermullen stands all that remains, only two very ruinous walls, of the old

castle mentioned in the "Annals of the Four Masters" as being the residence of Morogh M'Hugh in A. D. 1584. The only other building worth noting is the old tower on Golam Head to the S. W.-of Lettermullen.

Ointher Church, Garumna.

VII.—History.

The earlier history of these islands is shrouded in obscurity. It was probably the same as that of the Islands of Aran.

This part of Ireland was anciently occupied by the Clann Humoir, a Damnonian or Firbolg people who held this territory until the third century, A.D. Connaught was in this century overrun and taken possession of by Milesian settlers, and indeed the province is said to have received the name *Connacht* from its being occupied by the "race of Conn," or the descendants of Eochy Moyvane, king, first of this province and then of Ireland, who himself was a descendant of Conn. One of the three branches of this race of Conn was the Hy Briuin, descendants of Brian, one of the sons of Eochy Moyvane. These took possession of the eastern part of the province of Connaught, and the O'Flahertys, one of their subdivisions, occupied the district of Magh Scola, now known as the barony of Clare, to the east of

Lough Corrib, and occupied Galway itself. At what period the O'Flahertys got possession of Iar Connaught is not certain, but it seems to have been somewhere about the tenth century. O'Donovan says that "the Shoyces or Joyces[1] settled in the district of Partry, west of Lough Mask, near the O'Flahertys, in the middle of the thirteenth century, although the O'Flahertys themselves had no jurisdiction there or anywhere west of Lough Corrib until after A.D. 1235." At this period, owing to the poorness of the soil, Iar Connaught was probably very sparsely inhabited. In the thirteenth century the Anglo-Normans entered upon the scene. Their first appearance on the scene was when William Fitz Adhelme (De Burgo) led a mixed force of Irish and English into Iar Connaught. From that time forth they took advantage of local dissensions to acquire more and more power, until, in 1225, Hugh O'Flaherty, who had joined the sons of Roderick O'Conor against Hugh, King of Connaught, who was leagued with the English, was defeated and compelled to give up the islands in Lough Corrib to Hugh O'Connor, shortly after having been taken prisoner in Galway, where he had held out for a time. The O'Flahertys were then driven out of Moy Seola, and took possession of Iar Connaught, which henceforth became the seat of the tribe, and where they afterwards became as powerful as they had been in Moy Seola. It seems likely that the southern and sterile part of the district, including this group of islands, had been uninhabited, or almost so, before this time, the only people we get mention of in Iar Conaught being the O'Flahertys and the Joyces before referred to. There seems to have been no new element introduced into the population since then.

The "Annals of the Four Masters" record that Morogh M'Hugh lived in the Castle of Lettermullen in 1584, but nothing more. There are no M'Hughs on the islands now. Nothing more seems to be known of the islands until of late years. During the Famine the people had suffered very heavily, and at that time the first regular roads were traced out.

The islands have lately been brought into fuller communication with each other and the outer world by the building of the chain of causeways. These were built in the following order:—The causeway from Garumna to Lettermullen as a relief work in 1886. That from the mainland to Lettermore in 1891, and the final link in the chain, that from Lettermore to Garumna, in 1897.

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[1] A Welsh Tribe.

VIII.—Concluding Remarks.

Very little remains to be said. It would seem that the population of these islands remains practically what it was generations ago, and that the bulk of it is made up of the descendants of the old tribes, the MacDonoghs, the O'Flahertys, and families such as the Lees and Conneelys, Tooles, Folans, and others which were adherents of the Clan O'Flaherty. The other surnames to be found there are mostly those of people who lived in adjacent territories, as the O'Maillis (now Malia) and O'Heynes (Hynes), &c., from neighbouring parts of Galway and Mayo, and the O'Loughlins and Vaughans from the opposite coast of Clare. It may thus be presumed that the people of these islands possess the characteristics of the ancient inhabitants of this Iar Connaght, their ancestors. It may be remarked that the people here are, on the average, taller, more dolichocephalic, and of lower nigrescence index (fairer-haired) than the inhabitants of any district yet surveyed. In cephalic index (76·9, 74·9) and the fairness of skin and hair, they resemble the Aran Islanders, but they are both taller and stouter than the latter.

Very hearty thanks are due to the Rev. E. A. Lavelle and his brother, to Messrs. P. M'Donogh, J.P., of Crappagh, P. Toole, J.P., of Lettermore, Dr. Connolly, Bealadangan, and Mr. P. Healy, National teacher, Lettermullen, for the great assistance they afforded in the work, for the valuable information received from them, and for the great kindness experienced from them all.

Very few books beyond official reports make any mention of these islands. Reference may be made to the Reports of the Congested Districts Board for Ireland, the Census Returns, and the Memoirs of the Geological Survey of Ireland. Mention has been already made of an article by Mr. E. Keogh, entitled, "In Garumna Island," which appeared in the *New Ireland Review*, June, 1898.

The Plates are from photographs taken in Garumna and Lettermullen by C. R. and J. M. Browne.

Note added in the Press.

The term "red weed," used in the mention of kelp manufacture, means the brown *laminaria*, and not any of the really red seaweeds which are *not* used. "Black weed" is looked upon as an adulteration.

XII.

REPORT OF THE WORK DONE IN THE ANTHROPOMETRIC LABORATORY OF TRINITY COLLEGE, DUBLIN, FROM 1891 TO 1898. BY C. R. BROWNE, M.D.

[Read MAY 9, 1898.]

SEVEN years have elapsed since the Anthropometric Laboratory of Trinity College was opened. With the sanction and approval of the Provost and Senior Fellows, a portion of the Museum of Comparative Anatomy was, in 1891, set aside for this purpose, and the necessary instruments were obtained by a grant from the Royal Irish Academy.

The work which it was proposed to carry out was of a two-fold character, viz., peripatetic and local.

At that time the physical anthropology of Ireland might almost be said to have been an untrodden field. Little or no systematic work had been undertaken in that direction, and yet there was no part of the United Kingdom which promised a richer harvest for the investigator. Anyone who has travelled through the country districts of Ireland must be familiar with the very different types which are presented by the inhabitants. It therefore occurred to us that we might employ the anthropometric methods for the purpose of giving assistance to the anthropologist in his endeavours to unravel the tangled skein of the so-called Irish race.

With this object in view, our Laboratory has been transferred each year to a carefully selected district, and the physical characters and habits of the inhabitants have been systematically studied. The Aran Islands, Inishbofin and Inishark, the Mullet, Inishkea and Portacloy, Ballycroy, and lastly Clare Island and Inishturk, have all been visited in this way, and the Academy is familiar with the various reports which have been submitted upon the peoples of these districts.

The local work which we proposed to undertake in our Laboratory was of a somewhat different character. In all our great centres of education we have the most intricate and elaborate machinery for testing the mental capacity of a student, and for estimating his standard of knowledge in different branches; but at the time our Laboratory entered upon its career, only in Cambridge and Eton were there any means, so far as we are aware, in this country by which the physical endowments of the student could be ascertained, and their development watched. And yet these are qualities which, in most walks of life, are of scarce less importance to the individual than the intellectual.

It was therefore determined that, whilst all classes of people should be encouraged to come to the Laboratory for measurement, the local work should be directed mainly to the study of the students of Dublin. Already most valuable and striking results had been obtained and published by Mr. Venn in a similar line of work carried out on the Cambridge students. Mr. Venn divides the Cambridge students into three classes, and distinguishes these by the letters A, B, and C. Class A includes the first class men in any Tripos examination, and also Scholars in the various colleges; class B comprises all remaining "honour men"; whilst in class C are placed the "poll-men," or ordinary degree men, together with those who have had the misfortune to be "plucked" at their examinations. The physical differences detected between these three classes may be stated in Mr. Venn's own words:—

"1. In respect of height, weight, breathing, and squeezing power there is little or no difference between any of the classes.

"2. In respect of eyesight there is a decided inferiority in the A's as compared with the B's and C's taken together; and in respect of 'pull' a similar inferiority of A to B and B to C.

"3. In respect of head measurement there is a decided superiority of A's over B's, and B's over C's."

The students which we have measured have also been classified according to the ability which they have shown at their examinations, and into groups as nearly as possible corresponding to the classes of Mr. Venn. We find the differences between our three classes very slight, and what difference there is appears to be mostly in favour of our middle class B. The detailed results will be found in the body of the paper.

In comparing the Cambridge and Dublin results, it must be borne in mind that in Cambridge no less than 1400 students were tested; whilst in Dublin, although our researches have been carried over a much longer period, we have only been able to induce 257 to come to the Laboratory. In Cambridge the greatest amount of interest was taken in the investigation by teachers and students of all faculties; in Dublin, I regret to say, the interest was almost exclusively confined to the medical students. On account of this we have little to say about head-growth in its relation to University study—a branch of the inquiry which we had hoped to develop in a very special degree. Our observations in this field are so few in number that no deductions can be drawn from them.

The head-measurements which are taken in the Laboratory are the following:—

1. *Cranial length*, i.e., the maximum antero-posterior diameter of the cranium measured from the glabella in front.
2. *Cranial breadth*, or the maximum horizontal breadth of the cranium.
3. *Cranial height*, measured from the line joining the two ear-holes to the bregma.
4. *Auriculo-nasal radius*, or the distance from the bi-auricular line to the naso-frontal suture.
5. *Auriculo-alveolar radius*, or the distance from the bi-auricular line to the alveolar point.
6. *Face-length*, measured from the naso-frontal suture to the point of the chin.
7. *Face-breadth*, or the maximum bi-zygomatic breadth.

For these facial and cranial measurements three instruments are employed. The spring-craniometer, devised by Mr. Henry, the Inspector-General of the Bengal Police is used for Nos. 1, 2, and 7. We prefer this instrument, seeing that in these maximum measurements it does away with the personal element in making the observation. The radial craniometer (Cunningham's) is employed for Nos. 3, 4, and 5, and is found to give very constant results. No. 6 is taken with Flower's craniometer.

The body-measurements which are taken are:—

(1). *Stature*—the heels of the boots being measured and deducted.
(2). *Height sitting.*
(3). *Span of arms.*
(4). *Length of hand*,—from the tip of the middle finger to the styloid process of the radius.
(5). *Length of forearm*,—from the tip of the styloid process to the radio-humeral line.

For these measurements the instruments designed by Mr. Francis Galtro, F.R.S., and made by the Cambridge Scientific Instrument Company, are used.

The weight of the individual, the breathing capacity, the strength of grasp, the condition of the colour sense, and the keenness of eyesight have also been recorded.

We think it best to publish the results which we have obtained in a somewhat bald form. Very few comments are, therefore, made in connexion with the tables of figures which follow. We do not consider that the measurements which have been made are sufficiently numerous to allow us to formulate any broad or comprehensive generalization on the subject. To those interested in anthropometric work, however, we doubt not they will be of use, and it may be well to mention that, although the actual measurements are not published, they are preserved in the Laboratory, and are available for study by all who may wish to enter further into the matter.

1. Persons Measured in Laboratory :—

Individuals measured once only,	451
,, ,, twice,	56
,, ,, three times,	15
,, ,, four ,,	3
,, ,, five ,,	1
Total number of persons measured,	526 [1]
,, ,, measurements made,	625

2. Sex :—

Males,	420
Females,	106

3. Ages of those Measured :—

Males.

Aged 1 to 11 years,	6
,, 12 to 17 ,,	33
,, 18 years,	43
,, 19 ,,	46
,, 20 ,,	54
,, 21 ,,	41
,, 22 ,,	35
,, 23 ,,	29
,, 24 to 28 years,	56
,, 29 to 34 ,,	20
,, 35 to 40 ,,	18
,, 41 to 50 ,,	11
,, 52 to 62 ,,	9
,, 64 to 78 ,,	4
Age not given,	3

[1] In 14 instances the series of measurements was not completely gone through, but in most of these, only one or two items were omitted.

Females.

Aged 4 to 11 years, ...	8
,, 12 to 17 ,, ...	16
,, 18 to 21 ,, ...	25
,, 22 to 25 ,, ...	28
,, 26 to 28 ,, ...	17
,, 30 to 34 ,, ...	7
,, 39 to 49 ,, ...	4
Age not given, ...	1

4. Occupation :—

Males.

Physicians and Surgeons,[1]		25
Dentists, ...		6
Scientific, ...		14
Clergymen, ...		11
Barristers, ...		4
Solicitors, ...		3
Engineers, ...		5
Civil Servants, ...		4
Army, ...		6
Teachers, ...		22
Mercantile, ...		14
Students—		
Medical, ...	169	
Divinity, ...	16	
Law, ...	6	257
Engineering, ...	11	
Arts, ...	55	
Various occupations,[2]		13
None given, ...		12
Children, ...		24
		420

Females.

None given, ...	86
"Student,"	4
Teacher, ...	5
"Science,"	3
"Music,"	5
"Art,"	3
	106

[1] Six of these were in the Army Medical Staff or Indian Medical Service.

[2] 2 journalists ; 1 "B.A. singer" ; 1 "student-army" ; 1 land agent ; 1 "gentleman farmer"; 1 "veterinary"; 1 silk weaver; 1 organ builder; 1 "fitter" ; 1 foreman carpenter ; 1 taxidermist ; 1 constable R.I.C.

5. Nationality of Parents' People :—

Females.

Both parents Irish, ...	49
,, English, ...	16
,, Scotch, ...	6
,, German, ...	6
,, Jewish, ...	1

Mixed Parentage :—

Irish and English, ...	12
,, Scotch, ...	9
,, Italian, ...	1
English and Scotch, ...	5
,, Swiss (French), ...	1
	106

Males.

Both parents Irish, ...	290
,, English, ...	29
,, Scotch, ...	13
,, German, ...	3
,, French, ...	1
,, Swiss, ...	1
,, Greek, ...	1
,, Jewish, ...	1
,, Colonial (coloured, but English descent claimed on both sides), ..	1

Mixed Parentage :—

Irish and English, ...	36
,, Scotch, ...	25
,, French Canadian, ...	1
,, German, ...	1
,, French, ...	1
,, Dutch, ...	1
English and Scotch, ...	5
,, Dutch, ...	2
,, French, ...	2
,, Swedish, ...	1
,, Indian (originally Persian), ..	1
Scotch and U. S. America (probably English), ..	1
No particulars given, ...	5

CLASSIFICATION.

Females.

1. By ages. Physical characters.
2. ,, nationality. Physical characters.

Males.

1. By ages.
2. Nationality.
3. By occupations.
4. Students.
   - (*a*) By ages.
   - (*b*) By classes, according to proficiency in College. [These might be treated as to proportion of athletic in each Class A, B, and C, and by average physical proportions for each class.]

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1. By nationalities. [Mean height, weight, span stretch, cephalic and facial indices, breathing capacity.]
2. By sex and age. [Mean height, weight, breathing capacity, and grasp.]
3. Students. [For each of the three classes: cephalic size and indices, height, weight, breathing capacity, grasp, and keeness of eyesight.]

BY OCCUPATION.

Physicians and Surgeons (25 persons).

	Mean.	Minimum.	Maximum.
Cephalic Index, ..	79·0	72·4	84·5
Altitudinal index, ..	68·8	61·4	76·2
Stature, ...	1748	1645	1879 m.m.
Weight, ...	170·0	132·0	208·0 lbs.
Grasp of right hand, ..	104·6	65·0	141·0 ,,
,, ,, left hand, ..	99·3	68·0	143·0 ,,
Vital capacity, ..	233	162	300 cubic in.
Hand to stature, ..	10·9	10·2	11·9
Forearm ,, ..	14·5	13·8	16·4
Span ,, ..	102·5	99·1	107·7
Height sitting, ..	53·1	51·5	56·3

Grasp of left hand greater than that of right in 5 cases.
Grasp of left hand equal to that of right in 2 cases.

Dentists (6 persons).

	Mean.	Minimum.	Maximum.
Cephalic index, ..	81·3	76·3	88·3
Altitudinal index, ..	67·8	65·3	69·5
Stature, ...	1711	1675	1780 m.m.
Weight, ...	156·3	143.0	174·0 lbs.
Grasp of right hand, ..	108·3	98·0	126·0 ,,
,, left hand, ..	99·5	91·0	113·0 ,,
Vital capacity, ..	221	208	240 cubic in.
Hand to stature, ..	11·1	10·8	11·5
Forearm ,, ..	15·0	13·6	15·6
Span ,, ..	105·4	104·6	108·3
Height sitting, ..	52·8	50·6	53·7

Grasp of left hand greater than that of right in 1 case.

Clergymen (11 persons).

	Mean.	Minimum.	Maximum.
Cephalic index, ..	80·5	76·4	81·7
Altitudinal index, ..	67·3	62·5	74·6
Stature, ...	1731	1673	1798 m.m.
Weight, ...	162·0	126·0	192·0 lbs.
Grasp of right hand, ..	98·0	73·0	121·0 ,,
,, left hand, ..	97·0	74·0	120·0 ,,
Vital capacity, ..	218	172	265 cubic in.
Hand to stature, ..	10·8	10·1	11·4
Forearm ,, ..	14·2	13·8	15·4
Span ,, ..	102·3	94·3	107·2
Height sitting, ..	53·3	51·2	55·3

Span less than stature in 2 cases.
Grasp of left hand greater than that of right in 4 cases.

Teachers (22 persons).

	Mean.	Minimum.	Maximum.	
Cephalic index, ..	78·1	72·1	82·4	
Altitudinal index, ..	66·5	60·4	73·5	
Stature, ...	1737	1637	1824	m.m.
Weight, ...	158·9	133·0	194·0	lbs.
Grasp of right hand, ..	98·3	72·0	125·0	,,
,, left hand, ..	94·2	70·0	116·0	,,
Vital capacity, ..	219	130	294	cubic in.
Hand to stature, ..	10·9	10·3	11·5	
Forearm ,, ..	14·9	13·6	15·6	
Span ,, ..	104·3	100·4	107·9	
Height sitting, ..	53·2	50·1	55·3	

Grasp of left hand greater than that of right in 4 cases, equal to it in 1 case.

Scientific Men (14 persons).

	Mean.	Minimum.	Maximum.	
Cephalic index, ..	79·9	74·6	85·5	
Altitudinal index, ..	69·1	65·2	78·9	
Stature, ...	1732	1614	1830	m.m.
Weight, ...	158·4	127·5	195·0	lbs.
Grasp of right hand, ..	98·1	75·0	128·0	,,
,, left hand, ..	89·7	68·0	103·0	,,
Vital Capacity, ..	236	182	282	cubic in.
Hand to stature, ..	10·8	10·6	11·4	
Forearm ,, ..	14·6	13·9	15·1	
Span ,, ..	102·9	99·5	108·1	
Height sitting, ..	53·6	50·6	55·8	

In three cases head measurements only were taken.
Span less than stature in 1 case.
Grasp of left hand greater than that of right in 1 case.

Mercantile Men (13 persons).

		Mean.	Minimum.	Maximum.
Cephalic index,	..	78·2	75·0	81·5
Altitudinal index,	..	65·4	61·9	71·1
Stature, ..	..	1715	1593	1831 m.m.
Weight, ..	..	168·8	120·0	221·0 lbs.
Grasp of right hand,	..	91·5	69·0	118·0 ,,
,, left hand,	..	84·3	58·0	111·0 ,,
Vital capacity,	..	198	165	286 cubic in.
Hand to Stature,	..	10·9	10·0	11·5
Forearm ,,	..	14·6	13·8	15·7
Span ,,	..	103·4	100·8	107·0
Height sitting,	..	53·6	52·1	55·4

Grasp of left hand greater than that of right in 1 case.
Grasp of left hand equal to that of right in 1 case.

Students (Class A), *Honourmen* (32 persons).

		Mean.	Minimum.	Maximum.
Cephalic index,	..	78·7	73·7	84·9
Altitudinal index,	..	64·4	61·7	76·5 (?)
Head length,	..	196	186	206 m.m.
,, breadth,	..	153	140	164 ,,
,, height,	..	131	124	150 (?) m.m.
Stature, ..	..	1745	1653	1841 m.m.
Weight, ..	..	152·3	129·0	188·0 lbs.
Grasp of right hand,	..	102·4	76·0	130·0 ,,
,, left hand,	..	98·5	67·0	120·0 ,,
Vital capacity,	..	220	180	285 cubic in.

Distance at which standard type could be read *:—

		Mean.	Minimum.	Maximum.
Right eye,	..	60·6	0·0	96·0 c.m.
Left eye,	..	56·9	8·0	96·0 ,,

* 9·7 per cent. were unable to read standard type at 45 c.m.; 51·6 per cent. could read it at distances between 45 and 65 c.m.; and 38·7 per cent. could read it at from 66 to 96 c.m. The standard type was that adopted for use by Mr. Galton (brilliant).

Class B (55 persons).

	Mean.	Minimum.	Maximum.
Cephalic index, ..	79·0	72·6	88·1
Altitudinal index, ..	67·2	62·7	80·1 (?)
Head length, ..	195	176	206 m.m.
„ breadth, ..	154	143	170 „
„ height, ..	133	122	152 (?) m.m.
Stature, ...	1748	1623	1879 m.m.
Weight, ...	152·6	120·0	195·0 lbs.
Grasp of right hand, ..	104·6	71·0	136·0 „
„ left hand, ..	98·2	72·0	128·0 „
Vital capacity, ..	236	163	300 cubic in.

Distance at which standard type could be read * :—

	Mean.	Minimum.	Maximum.
Right eye, ..	62·0	26·0	85·0 c.m.
Left eye, ..	58·1	28·0	85·0 „

Class C, *Pollmen* (94 persons).

	Mean.	Minimum.	Maximum.
Cephalic index, ..	78·6	73·0	86·6
Altitudinal index, ..	67·2	62·0	72·7
Head length, ..	195	181	208 m.m.
„ breadth, ..	153	135	168 „
„ height, ..	130	119	141 „
Stature, ...	1749	1610	1885 „
Weight, ...	155·2	117·5	203·0 lbs.
Grasp of right hand, ..	103·4	80·0	132·0 „
„ left hand, ..	99·6	66·0	128·0 „
Vital capacity, ..	229	150	300 cubic in.

Distance at which standard type could be read†:—

	Mean.	Minimum.	Maximum.
Right eye, ..	58·5	0·0	85·0 c.m.
Left eye, ..	58·6	0·0	85·0

* 14·6 per cent. could not read standard type at 45 c.m.; 41·8 per cent. could read it at distances between 45 and 65 c.m.; and the remaining 43·6 per. cent. could read it at distances varying from 66 c.m. to 85 c.m.

† 18·1 per cent. could not read standard type at 45 c.m.; 34 per cent. could read it at distances between 45 and 65 c.m.; and the remaining 42·5 per cent. could read the standard numerals at distances above 66 c.m.

By Ages.

Females, 4–11 years (8 persons).

Under 10 years. 5–9 years.

	Mean.	Minimum.	Maximum.
Stature, ...	1255	1090	1326 m.m.
Height sitting, ..	706	685	732 ,,
Span, ...	1284	1231	1320 ,,
Weight, ...	59·0	45	71 lbs.
Grasp of right hand, ..	18·0	10	35 ,,
,, left hand, ..	14·4	10	22 ,,
Vital capacity, ..	77	50	88 cubic in.

Span less than stature in 4 cases.
Grasp of both hands equal in one case.

---

10 and 11 years.

	Mean.	Minimum.	Maximum.
Stature, ...	1382	1358	1404 m.m.
Height sitting, ..	747	730	760 ,,
Span, ...	1389	1362	1415 ,,
Weight, ...	71·5	64	80 lbs.
Grasp of right hand, ..	32·3	25	38 ,,
,, left hand, ..	30·0	23	38 ,,
Vital capacity, ..	90	76	109 cubic in.

Span less than stature in 1 case.
Span equal to stature in 1 case.
Grasp of hands equal in 1 case.
Colour sense normal in all.

12–14 years (8 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1503	1420	1579 m.m.
Height sitting, ..	800	764	865 ,,
Span, ...	1514	1427	1598 ,,
Weight, ...	87·8	83·5	107 lbs.
Grasp of right hand, ..	42·9	32·0	55 ,,
,, left hand, ..	38·4	30·0	46 ,,
Vital capacity, ..	112	90	125 cubic in.

Span less than stature in 3 cases.

15–17 years (8 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1597	1506	1769 m.m.
Height sitting, ..	852	787	903 ,,
Span, ...	1607	1487	1702 ,,
Weight, ...	129	107	162 lbs.
Grasp of right hand, ..	65·2	42	85 ,,
,, left hand ..	63·3	36	78 ,,
Vital capacity, ..	143	112	169 cubic in.

Span less than stature in 4 cases.
Left hand grasp greater than right in 4 cases.

18–21 years (23 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1606	1522	1852* m.m.
Height sitting, ..	841	807	940* ,,
Span, ...	1616	1481	1880* ,,
Weight, ...	133·0	97	196* lbs.
Grasp of right hand, ..	63·8	50	84 ,,
,, left hand, ..	55·2	44	78 ,,
Vital capacity, ..	129	83	215 cubic in.

Colour sense normal in all.
Span less than stature in 7 cases.
Grasp of left hand stronger than that of right in 2 cases.
In one case the height sitting was omitted.

22–25 years (28 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1607	1506	1722 m.m.
Height sitting, ..	870	829	934 ,,
Span, ...	1625	1495	1715 ,,
Weight, ...	130·0	106	163 lbs.
Grasp of right hand, ..	71·7	44	86 ,,
,, left hand, ..	63·1	46	90 ,,
Vital capacity,	108	78	198 cubic in.

Colour se[illegible]se normal in all.
Span le[illegible]s than stature in 10 cases.
Grasp [illegible]f left hand stronger than that of right in 4 cases.
Heigh[illegible]t sitting omitted in 1 case.

* The hi[illegible]h maxima are due to one person of 6 ft. being included.

26–28 years (17 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1612	1500	1702 m.m.
Height sitting, ..	862	806	904 ,,
Span, ...	1622	1463	1709 ,,
Weight, ...	128·0	105	156 lbs.
Grasp of right hand, ..	57·3	34	74 ,,
,, left hand, ..	56·5	32	80 ,,
Vital capacity, ..	136	85	180 cubic in.

Colour sense normal in all.
Span less than stature in 5 cases.
Grasp of both hands equal in 1 case.
,, left hand stronger than right in 7 cases.

30–34 years (7 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1628	1558	1690 m.m.
Height sitting, ..	878	858	910 ,,
Span, ...	1621	1542	1721 ,,
Weight, ...	129·0	118	140 lbs.
Grasp of right hand, ..	69·1	39	87 ,,
,, left hand, ..	60·5	40	77 ,,
Vital capacity, ..	145	118	180 cubic in.

Span less than stature in 4 cases.
Span equal to stature in 1 case.
[illegible] of left hand stronger than that of right in 1 case.

39–[illegible]rs (4 persons.).

	Mean.	Minimum.	Maximum.
Stature, ...	1582	1540	1672 m.m.
Height sitting, ..	860	[illegible]	900 ,,
Span, ...	1597	[illegible]21	1665 ,,
Weight, ...	131·0	[illegible]	153 lbs.
Grasp of right hand, ..	65·3	4[illegible]	74 ,,
,, left hand, ..	61·0	38	76 ,,
Vital capacity, ..	132	108	177 cubic in.

Colour sense normal in all.
Span less than stature in 1 case.
Grasp of left hand stronger than that of right 1 case.

Adults, all over 21 years (56 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1582	1540	1722 m.m.
Height sitting, ..	852	806	934 ,,
Span, ...	1622	1463	1721 ,,
Weight, ...	122·2	99	163 lbs.
Grasp of right hand, ..	66·5	34	87 lbs.
,, left hand, ..	60·8	32	90 ,,
Vital capacity, ..	123	78	198 cubic in.

Colour sense normal in all.

Span less than stature in 20 cases = 35·7 per cent.

Span equal to stature in 1 case.

Grasp of left hand stronger than that of right hand in 13 cases, or 23·2 per cent.

BY NATIONALITIES.

Females, 21 years and over, both parents Irish (27 persons).

	Mean.	Minimum.	Maximum.
Cephalic index, ..	80·1	74·3	86·7
Altitudinal index, ..	68·2	62·8	74·9
Facial ,, ..	111·5	100·0	118·9
Gnathic ,, ..	98·6	87·2	104·5
Stature, ...	1609	1506	1702 m.m.
Span, ...	1626	1495	1775 ,,
Weight, ...	130	99	169 lbs.
Vital capacity, ..	138	78	198 cubic in.
Hand to stature, ..	10·9	10·0	11·4
Forearm ,, ..	14·3	13·6	15·0
Span ,, ..	99·5	98·3	105·3
Height sitting,* ..	53·6	50·4	56·2
Nigrescence index, ..	—	7·3	—

* The proportion borne by the sitting height to the stature seems to be greater in short than in tall women.

Females, both parents English (13 persons).

		Mean.	Minimum.	Maximum.	
Cephalic index,	..	78·9	75·7	84·4	
Altitudinal index,	..	65·2	66·1	76·4	
Facial ,,	..	113·8	100·0	137·9	
Gnathic, ,,	..	98·4	89·1	102·2	
Stature, ..	..	1601	1545	1710	m.m.
Span, ..	..	1603	1535	1715	,,
Weight, ..	..	123·9	105·5	144·0	lbs.
Vital capacity,	..	134	98	163	cubic in.
Hand to stature,	..	10·6	10·1	11·4	
Forearm ,,	..	14·3	13·4	15·4	
Span ,,	..	100·1	97·3	102·2	
Height sitting,	..	54·5	51·8	56·0	

Span less than stature in 5 cases.
Span equal to stature in 1 case.

Females, mixed parentage, Irish and English (8 persons).

		Mean.	Minimum.	Maximum.	
Cephalic index,	..	82·5	74·0	86·0	
Altitudinal index,	..	70·2	67·4	74·0	
Facial ,,	..	109·8	103·2	115·4	
Gnathic ,,	..	98·8	91·4	100·0	
Stature, ..	..	1623	1525	1722	m.m.
Span, ..	..	1620	1463	1706	,,
Weight, ..	..	123·4	97·5	153·0	lbs.
Vital capacity,	..	146	85	190	cubic in.
Hand to stature,	..	10·8	10·2	11·6	
Forearm ,,	..	14·4	13·8	15·8	
Span ,,	..	99·8	95·9	102·4	
Height sitting,	..	53·5	52·9	54·2	

Span less than stature in 4 cases.

Females.

Mixed parentage, Irish and Scotch only (3 persons).

„ „ English and Scotch (5 persons).

Females, English and Scotch.

		Mean.	Minimum.	Maximum.
Cephalic index,	..	81·1	77·2	84·4
Altitudinal index,	..	69·2	67·0	71·9
Facial „	..	113·9	107·4	118·1
Gnathic „	..	97·4	93·7	102·0
Stature, ..	..	1582	1500	1687 m.m.
Span, ..	..	1592	1527	1706 m.m.
Weight, ..	..	115·2	105·5	144·5 lbs.
Vital capacity,	..	119	108	180 cubic in.
Hand to stature,	..	10·6	10·3	11·0
Forearm „	..	14·2	13·6	15·0
Span „	..	100·5	98·4	101·9
Height sitting,	..	55·1	53·6	56·1

Span less than stature in 1 case.

Females (104 persons).

Span less than height in 36 cases.
Span equal to height in 2 cases.
Grasp of left hand greater than right in 19 cases.
Grasp of both hands equal in 3 cases.

Males, 12–15 years (13 persons).

		Mean.	Minimum.	Maximum.
Stature, ..	..	1593	1400	1750 m.m.
Height sitting,	..	827	741	926 „
Span, ..	..	1622	1430	1755 „
Weight, ..	..	107·5	74	139 lbs.
Vital capacity,	..	167	120	227 cubic in.
Grasp of right hand,	..	69·4	39	108 lbs.
„ left hand,	..	63·8	36	102 „

Colour sense normal in all.
Span less than stature in 3 cases.
Grasp of left hand greater than that of right hand in 1 case.

Males, 16–17 years (23 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1709	1610	1838 m.m.
Height sitting, ..	894	813	973 ,,
Span, ...	1764	1636	1927 ,,
Weight, ...	137·0	110	159 lbs.
Vital capacity, ..	209	153	280 cubic in.
Grasp of right hand, ..	92·2	70	118 lbs.
,, left hand ..	86·3	60	118 ,,

Colour sense defective in 1 case.
Span less than stature in 2 cases.
Grasp of left hand stronger than that of right in 6 cases. Both hands equal in 1 case.

Males, 18 years (48 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1731	1610	1832 m.m.
Height sitting, ..	912	813	973 ,,
Span, ...	1770	1644	1931 ,,
Weight, ...	145·6	119	196 lbs.
Vital capacity, ..	245	160	300 cubic in.
Grasp of right hand, ..	99·1	68	126 lbs.
,, left hand, ..	95·2	63	129 ,,

Colour sense normal in all.
Span less than stature in 2 cases. Mean taken on 46 cases, this item having been omitted in 2.
Grasp equal in both hands in 2 cases.
Left stronger than right in 12 cases.

Males, 19 years (60 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1747	1641	1913 m.m.
Height sitting, ..	924	843	1008 ,,
Span, ...	1807	1650	1975 ,,
Weight, ...	152·9	120	189 lbs.
Vital capacity, ..	221	130	285 cubic in.
Grasp of right hand, ..	104·0	76	126 lbs.
,, left hand, ..	98·6	67	129 ,,

Colour sense defective in 1 case.
Span less than stature in 1 case.
Grasp of left hand greater than that of right in 15 cases. Both hands equal in 1 case.

Males, 20 years (67 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1752	1612	1885 m.m.
Height sitting, ..	931	857	991 ,,
Span, ...	1793	1653	1989 ,,
Weight, ...	152·8	116	189 lbs.
Vital capacity, ..	230	163	300 cubic in.
Grasp of right hand, ..	104·3	72	140 lbs.
,, left hand, ..	100·8	70	138 ,,

Colour sense normal in all.
Span equal to stature in 2 cases, less than it in 1 case.
Grasp of left hand greater than that of right in 14 cases.

Males, 21 years (50 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1753	1558	1930 m.m.
Height sitting, ..	928	856	999 ,,
Span, ...	1805	1561	1958 ,,
Weight, ...	153·5	124	188 lbs.
Vital capacity, ..	228	125	300 cubic in.
Grasp of right hand, ..	105·6	61	132 lbs.
,, left hand, ..	98·5	61	128 ,,

Colour sense normal in all.
Span equal to stature in 2 cases, less than it in 2 cases.
Grasp of both hands equal in 5 cases, left hand grasp the stronger in 9 cases.

Males, 22 years (44 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1749	1636	1879 m.m.
Height sitting, ..	926	880	994 ,,
Span, ...	1807	1653	1980 ,,
Weight, ...	156·0	119	194 lbs.
Vital capacity, ..	234	160	300 cubic in
Grasp of right hand, ..	103·2	80	132 lbs.
,, left hand, ..	97·7	74	127 ,,

Colour-blind, none.
Span less than stature in 1 case, measurement not taken in 2 cases.
Grasp of left hand greater than that of right in 9 cases. Both hands equal in 2 cases.

Males, 23 years (34 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1755	1643	1896 m.m.
Height sitting, ..	929	857	994 ,,
Span, ...	1803	1665	1994 ,,
Weight, ...	147·2	116	188 lbs.
Vital capacity, ..	240	150	300 cubic in.
Grasp of right hand, ..	102·6	81	141 lbs.
,, left hand, ..	101·4	72	128 ,,

Colour sense defective in 1 case.

Span equal to stature in 3 cases.

Grasp of left hand stronger than that of right in 9 cases. Both hands equal in 1 instance.

Males, 24–25 years (36 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1747	1648	1860 m.m.
Height sitting, ..	921	876	970 ,,
Span, ...	1826	1710	1970 ,,
Weight, ...	162·5	125	203 lbs.
Vital capacity, ..	242	172	300 cubic in.
Grasp of right hand, ..	110·0	76	141 lbs.
,, left hand ..	93·8	78	125 ,,

Colour sense normal in all.

Span greater than stature in all.

Grasp of left hand greater than that of right in 6 cases. Both hands equal in 3 cases.

Males, 26–28 years (30 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1724	1593	1885 m.m.
Height sitting, ..	912	848	1018 ,,
Span, ...	1779	1622	1905 ,,
Weight, ...	156·9	120	208 lbs.
Vital capacity, ..	230	129	300 cubic in.
Grasp of right hand, ..	106·1	52	135 lbs.
,, left hand, ..	101·5	45	143 ,,

Colour sense normal in all.

Span less than stature in 3 cases. Measurement omitted in 2 cases.

Grasp of left hand greater than that of right in 8 cases. Both hands equal in 2 cases.

Males, 29–34 years (20 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1757	1626	1879 m.m.
Height sitting, ..	939	859	1000 ,,
Span, ...	1852	1690	1911 ,,
Weight, ...	168·8	140	202 lbs.
Vital capacity, ..	232	171	300 cubic in.
Grasp of right hand, ..	104·3	73	130 lbs.
,, left hand, ..	97·4	60	130 ,,

Colour sense normal in all.
Span less than stature in 1 case. Span not recorded in 1 case.
Grasp of left hand stronger than that of right in 5 cases.

Males, 35–40 years (22 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1731	1637	1838 m.m.
Height sitting, ..	923	873	967 ,,
Span, ...	1778	1702	1901 ,,
Weight, ...	157·0	132	187 lbs.
Vital capacity, ..	237	165	292 cubic in.
Grasp of right hand, ..	102·8	69	124 lbs.
,, left hand, ..	87·8	58	120 ,,

Colour sense normal in all.
Span greater than stature in all. Span not recorded in 1 case.
Grasp of left hand greater than that of right in 3 cases. Both hands equal in 1 case.

Males, 41–50 years (11 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1707	1614	1781 m.m.
Height sitting, ..	915	865	978 ,,
Span, ...	1758	1643	1883 ,,
Weight, ...	160·1	120	195 lbs.
Vital capacity, ..	205	162	266 cubic in.
Grasp of right hand, ..	97·9	71	125 lbs.
,, left hand, ..	94·0	68	119 ,,

Colour sense normal in all.
Span less than stature in 2 cases.
Grasp of left hand greater than that of right in 2 cases.

Males, 52–62 years (9 persons).

	Mean.	Minimum.	Maximum.
Stature, ...	1729	1645	1785 m.m.
Height sitting, ..	921	877	960 ,,
Span, ...	1774	1685	1848 ,,
Weight, ...	201·7	169	257 lbs.
Vital capacity, ..	190	160	233 cubic in.
Grasp of right hand, ..	96·0	72	118 lbs.
,, left hand, ..	90·4	70	120 ,,

Colour sense normal in all.

Span equal to stature in 1 case.

Grasp of left hand greater than that of right in 2 cases. Both hands equal in 1 case.

Adult Males, 22-50 years (197 measurements).

	Mean.	Minimum.	Maximum.
Stature, ...	1743	1593	1896 m.m.
Height sitting, ..	925	848	1000 ,,
• Span, ...	1758	1622	1994 ,,
Weight, ...	158·7	116	208 lbs.
Vital capacity, ..	234	129	300 cubic in.
Grasp of right hand, ..	105·1	52	141 lbs.
,, left hand, ..	98·0	45	143 ,,

Colour sense defective in 1 case.

Span less than stature in 7 cases. Span equal to stature in 3 cases. Span not recorded in 6 cases.

Grasp of left hand greater than that of right in 42 cases. Both hands equal in 9 cases.

By Nationalities.

Males, 21–60 years. Both parents "Irish" (165 persons).

	Mean.	Minimum.	Maximum.
Cephalic index, ..	79·1	73·5	86·4
Altitudinal index, ..	67·6	60·4	80·1 (?)
Facial, ...	109·9	95·6	128·4
Gnathic, ...	98·5	83·5	108·9
Stature, ...	1748	1626	1885 m.m.
Span, ...	1802	1653	1965 m.m.
Weight, ..	159·9	116	222 lbs.
Vital capacity, ..	227	150	300 cubic in.
Hand to stature, ..	10·8	10·0	11·9
Forearm, ...	14·5	13·4	17·2
Span, ...	100·3	97·5	112·2
Height sitting, ..	53·1	49·7	57·2

Span less than stature in 10 cases.

Males, both parents English (16 persons).

		Mean.	Minimum.	Maximum.
Cephalic index,	..	78·4	72·4	82·5
Altitudinal index,	..	67·9	64·4	75·2 (?)
Facial ,,	..	110·3	100·7	115·8
Gnathic ,,	..	98·9	93	106·7
Stature, ..	..	1735	1614	1823 m.m.
Span, ..	..	1793	1643	1892 m.m.
Weight, ..	..	155·3	127·5	182 lbs.
Vital capacity,	..	226	182	288 cubic in.
Hand to stature,	..	10·8	10·1	11·6
Forearm ..	..	14·7	13·8	15·8
Span ..	..	102·9	94·3	108·2
Height sitting,	..	52·4	50·7	54·2

Span less than stature in 1 case.

Males, both parents Scotch (7 persons.)

		Mean.	Minimum.	Maximum.
Cephalic index,	..	78·4	74·6	81·7
Altitudinal index,	..	67·6	64·1	72·1
Facial ,,	..	109·5	103·0	119·1
Gnathic ,,	..	98·6	94·3	110·9
Stature, ..	..	1745	1645	1830 m.m.
Span, ..	..	1779	1685	1871 m.m.
Weight, ..	..	167·9	152·2	185·5 lbs.
Vital capacity,	..	251·5	216	272 cubic in.
Hand to stature,	..	10·9	10·2	11·3
Forearm ..	..	14·3	13·3	16·4
Span ..	..	101·2	100·2	105
Height sitting,	..	54·2	53·0	55·8

Males, mixed parentage, Irish and English (12 persons).

		Mean.	Minimum.	Maximum.
Cephalic index,	..	79·2	75·0	82·7
Altitudinal index,	..	66·6	61·0	72·2
Facial ,,	..	108·6	97·6	115·2
Gnathic ,,	..	99·9	93·1	105·6
Stature, ..	..	1740	1669	1805 m.m.
Span, ..	..	1819	1675	1960 m.m.
Weight, ..	..	152·5	132	188 lbs.
Vital capacity,	..	233	170	300 cubic in.
Hand to stature,	..	11·3	10·5	11·4
Forearm ..	..	14·6	13·3	17·2
Span ..	..	104·0	100·4	109·3
Height sitting,	..	52·5	50·6	54·2

Males, mixed parentage, Irish and Scotch (10 persons).

		Mean.	Minimum.	Maximum.
Cephalic index,	..	78·2	73·7	83·2
Altitudinal index,	..	67·5	61·4	73·1
Facial ,,	..	104·8	97·1	114·9
Gnathic ,,	..	99·9	91·4	105·0
Stature, ..	..	1809	1707	1913 m.m.
Span, ..	..	1872	1706	1994 m.m.
Weight, ..	..	174·3	144	221 lbs.
Vital capacity,	..	254	195	300 cubic in.
Hand to stature,	..	10·9	10·5	11·5
Forearm, ..	..	14·4	13·8	15·1
Span, ..	..	103·4	100·0	107·2
Height sitting,	..	52·9	50·0	55·7

TABLE OF COMPARISON BETWEEN ADULTS.

Mean.	Males (197 persons.)	Females (56 persons).
Stature, ...	1743 m.m.	1582 m.m.
Height sitting, ..	925 m.m.	852 m.m.
Span-stretch, ..	1758 m.m.	1622 m.m.
Weight, ...	158·7 lbs.	122·2 lbs.
Vital capacity, ..	234 cubic inches.	123 cubic inches
Grasp { Right hand,	105·1 lbs.	66·5 lbs.
Grasp { Left hand, ..	98 lbs.	60·8 lbs.
Proportions to stature, = 100.		
Height sitting, ..	53·1	53·9
Span of arms, ..	100·8	102·5
Span was less than stature in ..	3·6 per cent.	35·7 per cent.
Left hand stronger than that of right in ..	21·3 per cent.	23·2 per cent.

XIII.

A LIST OF THE ROUND TOWERS OF IRELAND, WITH NOTES ON THOSE WHICH HAVE BEEN DEMOLISHED, AND ON FOUR IN THE COUNTY OF MAYO. By THOMAS J. WESTROPP, M.A.

[Read June 13, 1898.]

Few, if any, of our ancient buildings have proved so attractive to antiquaries as the Round Towers. Round them has raged a war of many theories for a century and a-half, and several antiquaries in bulky volumes have striven to raise the veil which covered their mystery. Yet we have nowhere an exhaustive standard survey confining itself to the illustration of fact, and bringing together accurate information on the subject of so much controversy, and so also students have been often repelled from the subject by uncertainty how far their work may have been forestalled.

This paper is merely an attempt to give a bird's-eye view of what has been done during the century by giving the reference to the fullest description of each Tower, with its peculiarities and popular name. It omits, it is true, notice of many valuable papers, but nearly all of these are cited or abstracted in the references here given. In the case of the Towers which time and man have swept away, a description is given, so far as accounts have been preserved. A list is also added of the Round Towers whose basements are square or polygonal. The notes on four of the Towers of County Mayo, not already described in any accessible publication, are taken from the "Ordnance Survey Letters," R.I.A.

Several Round Towers which appeared in former lists have been omitted. Ledwich and other old writers in their works name some of the ruins from towns and villages at some distance from their sites: so Ardmore appears as "Dungarvan," Carrigeen or Dysert Aenghus as "Limerick," Clones as "Monaghan," Dromcliff as "Sligo," Balla as "Mayo," Iniscaltra as "Killaloe," and Roscam as "Galway." These can be recognized in the earlier lists, but when later compilers retained both the real and the incorrect names the confusion was endless, and Round Towers were accredited to places where they most probably had never existed.

Other names not derived from such a source are nevertheless so unsupported by any authority that we may omit them till such facts are produced. Thus in the present notes are omitted the Tower of Singland (near Limerick), Boyle, Ferbane,[1] and Ballygaddy; that of Sier Kieran, which Rev. James Graves considered of very late date; that of Ballyvourney, County Cork, which Du Noyer discovered to be the foundation not of a Round Tower, but of a circular cloghaun,[2] and that of Mutton Island, County Clare, given in the notes to the new edition of Archdall's "Monasticon," but of which neither trace nor tradition was apparent in either 1839, when the Ordnance Survey was made, or in 1887. The Round Tower of Clare Island, to the alleged site of which Mr. Geo. Kinahan has called my attention, as marked on the Geological Survey maps, also requires verification. Finally I must confess to failure in finding any description of the Round Tower attached to the S.-W. angle of Killeevy church in County Armagh.

LIST OF ROUND TOWERS.[3]

COUNTY ANTRIM.

1. **Antrim**: *circumference*, 50 feet; *height*, 93 feet. Perfect. Popularly named "The Steeple." A Celtic cross on stone above lintel of door. Door lintelled, 7 feet 4 inches up. Base of tower has

[1] Perhaps the neighbouring towers of Clonmacnoise.

[2] "Index of Sketches," R.I.A., vol. iv. (1863), No. 10.

[3] Heights, in some cases approximate. Only fullest descriptions are noted. As to references, R.I.A. is, of course, Royal Irish Academy, and R.S.A.I. The Royal Society of Antiquaries of Ireland under its various names—The Kilkenny Society, The Royal Historical and Archæological Association of Ireland, &c. An asterisk prefixed shows that the Round Tower so marked has been destroyed.

Ware's "Bishops" (edited by Harris) gives views of the Round Towers of Cashel, Cloyne, Kilkenny, Kilmacduach, and the two at Clonmacnoise.

Grose's "Antiquities of Ireland" gives those of Kildare, Donoughmore, Kells, Lusk, Swords, Glendalough, Kilkenny, Clonmacnoise, Old Kilcullen, Castledermot, Devenish, Cashel, and Turlough.

Dunraven's "Notes on Irish Architecture" (edited by Miss M. Stokes) gives photographs of those of Antrim, Dysert O'Dea, Devenish, Kilcoona, Kilmacduach, Iniscaltra, Aghadoe, Dysert Aenghus, Monasterboice, Killala, Kells, Timahoe, Dromcliff (Sligo), Cashel, Roscrea, Ardmore, and Glendalough.

"Cloictheachs" named in our Annals. ("Steeples" in "Annals of Clonmacnoise"); Annadown, 1238; Ardbraccan, 1170; Armagh, 996, 1017, 1171; Clonard, 1040; Clonmacnoise, 1124, 1131; Down, 1017; Dromcliff, 1396; Duleek, 1147; Emly, 1059; Fertagh, 1156; Kells, 1076; Louth, 987; Monasterboice, 1097; Roscommon, 1049; Roscrea, 1135; Slane, 950; Tomgraney, 966; Trim, 1281; Tullamaine, 1121; Tullyard, 1171.

three plinths. *Descriptions*, E. Getty, Ulster Journal of Archæology, vol. IV. (1856) p. 132; Lord Dunraven, "Notes on Irish Architecture," vol. II. p. 1.[1]

2. **Armoy**: *c.* 47 feet; *h.* 40 feet. Top stories gone. Door has round head of one stone and a raised band over arch. Sill, 8 feet 6 inches up. Human remains found heaped in tower, 1843. *Description*, E. Getty, *loc. cit.* p. 173.

3.***Carrickfergus**: The State papers for 1588 mention repairs at Carrickfergus to a "wach chouse turret, sometimes called a steple, with certeyne lofts belonging to same." In a map of the town, in 1575, a manifest round tower, with a plinth and a conical roof, is drawn near the end of a church.[2]

4. **Rams Island (Enisgarden, Lough Neagh)**: *c.* 40 feet; *h.* 42 feet. Top stories gone. Door, 8 feet up. Human remains said to have been found under a lime floor. *Description*, E. Getty, *loc. cit.* p. 135.

County Armagh.

5.***Armagh**: This tower was burned between 980 and 996, and again, 1020. Its cap was blown down in a great storm, 1121.[3]

County Carlow.

6.***Kellistown**: (Cil Osnada.) A view of it is given in "Anthologia Hibernica" (1794), p. 105, with this description: "It is built of gritstone, 12 feet internal diameter, and is at present much destroyed." It was about 58 feet in circumference and 30 feet high, and stood north-west of the church; there was a break in the top facing westward. The tower was demolished in 1807. The old view has been re-published by Miss Margaret Stokes.[4]

7. **St. Mullins**: *c.* 51 feet. Base found in repair of ruins as a "National monument." Iron staple of door found in wall. *Description*, P. O'Leary and Robert Cochrane, Journal Royal Society of Antiquaries of Ireland (1892), p. 382. National monument.

[1] The top stone had a socket, and a block of an architrave was built into the cap.
[2] See Ulster Journal of Archæology, vol. iv., p. 131.
[3] Tighernach, Chronicon Scotorum, A. 4 M., and Ann. Clon.
[4] "Early Christian Architecture," p. 75.

COUNTY CAVAN.

8. **Dromlane**: *c.* 52 feet; *h.* 40 feet. Top stories gone. Door has round head of three stones with raised band, 10 feet 2 inches up; tower of two well marked types of masonry. A human skeleton and bones of deer and dogs were found in base. Popular name "Cloictheach." *Description*, E. Getty, *loc. cit.* vol. v. (1857) p. 110. A good illustration in Marcus Keane's "Towers and Temples," p. 306. National monument.

COUNTY CLARE.

9. **Dromcliff**: *c.* 50½ feet; *h.* 40 feet. Top story gone and rest breached. In 1819 it had a door about 20 feet up with raised band. *Descriptions*, Hely Dutton, "Statistical Survey of Clare," p. 307; T. J. Westropp, Journal R.S.A.I. (1894), p. 333.

10. **Dysert O'Dea**: *c.* 61 feet; *h.* 50 feet. Upper stories gone; has a plinth; external string course, like Ardmore; present battlements late mediæval. Door round headed, 13 feet 3 inches up; a brass bell found in base. *Descriptions*, Dunraven's "Notes," vol. II. p. 111; T. J. Westropp, Journal R.S.A.I., *loc. cit.* p. 155.

11. **Holy Island (Iniscaltra, Lough Derg)**[1]: *c.* 46 feet; *h.* 80 feet. Top story gone; base has plinth, floors rested on offsets. Door, 10 feet 7 inches up, has round head. Iron door-staples in wall. *Descriptions*, Lord Dunraven's "Notes," vol. II. p. 3. National monument.

12. **Kilnaboy**: *c.* 52½ feet: *h.* 13 feet. Stump. *Description*, T. J. Westropp, *loc. cit.* p. 28.

13.***Rath-Blamac**: This tower was a mere stump, 8 feet high, in 1838, when it was taken down for building material, and used for the graveyard wall. A curious local legend stated that there was more than one tower at Rath. St. Manaula, of the neighbouring church of Dysert O'Dea, determined to take one for her own use. She uprooted and carried it half-way to Dysert one night; but, being overtaken by St. Blathmac, flung her unwieldy burden from her to its present position near her church, falling on her knees and dinting the rock into an existing double bullaun.

[1] Anciently belonged to County Clare to which it is about to be restored.

14. **Scattery**: *c.* 52 feet; *h.* 100 feet. Nearly perfect. Door (head with corbelling and lintel) on ground level. Popular name, "Clogas Inse Cathaig." *Description*, T. J. Westropp, Journal R.S.A.I. (1897), p. 282. National monument.

15.***Tomgraney**: This was "built" about 964 by Cormac ua Cillen.[1] Brian Boru is recorded to have built or repaired the church and cloictheach at this place.[2] The older peasantry, early in this century, are said to have remembered a fragment of it still standing; but Brash in later days found no trace of such a legend.

COUNTY CORK.

16.***Brigoon**: The upper part is said to have been blown down in a storm in 1720. Only 15 feet remained standing, and this, in 1807, was demolished to build the glebe-house. It was then found to rest on a square base; one quoin-stone had three rows of letters, of which H.U.O — P.P — C were legible (? oɲ ᴅo . . .). Some account of the site is given by Canon C. Moore.[3]

17. **Cloyne**: *c.* 52 feet; *h.* 100 feet. Cap gone; top has late battlements. Door, 11 feet 9 inches up; has lintel. Popular name, "Giolcagh." Human skeletons lay facing eastward in base. Top destroyed before 1739 (Harris), probably in 1683, when bell was hung in it. *Descriptions*, R. R. Brash, Journal R.S.A.I. (1858), p. 261. See also *ibid.*, 1897, p. 339.

18.***Cork—St. Finbarrs**: Shown as the "Round or Watch Tower" on a map of 1545. It appears on Speed's map (1610) as "The Spyre." M. de la Boullaye le Gouz, in his "Tour in Ireland," 1644, describes it thus:—"An old tower, 10 or 12 feet in circumference (*sic*), more than 100 feet high. It was believed to have been miraculously built by S. Baril."

A view of it and the adjoining cathedral is engraved on a silver chalice, 1669, behind a figure of St. Barry.[4] We learn from this that the tower was lofty and battlemented like Cloyne or Kildare, and had a round-headed doorway about 15 feet above the ground, and seven windows. Some soldiers, using it in the attack on the fort in 1690, it was fired upon and shaken, so that

[1] Chronicon Scotorum.
[2] Wars of the G. and G., p. 141.
[3] Journal of the R.S.A.I., 1889, p. 225.
[4] *Ibid.* Vol. V., Ser. IV., p. 445.

eventually the upper part fell, leaving the lower part 40 feet high. It is described in "A Tour in Ireland by two English Gentlemen," 1748, as "a mean spiral structure, low and poorly built." It had been levelled by 1750, and the foundations were seen by Crofton Croker so lately as 1808.[1]

19.***Ross Carbery**: This was a lofty and perfect tower, with a high conical roof, ending in a small finial. The door had a circular head, and the base of the structure below the door-sill was protected, like Clondalkin, with a casing of masonry.[2]

COUNTY DONEGAL.

20. **Raphoe**: The Ulster Journal of Archæology,[3] citing a manuscript of Sir James Ware's notes in the British Museum, says that Dr. John Leslie, when building the episcopal palace, pulled down "a round tower or pyramid at Raphoe Cathedral, and found the bones of a man under it." It stood "on a hill in which the Bishops of Raphoe kept their studies" (*sic*).[4]

21. **Tory Island**: *c.* 51½ feet; *h.* 51 feet. Top nearly destroyed; it has one vaulted floor; other floors rested on joists let into wall. Door has round head of ten stones, and is 8 feet 6 inches up; a bell, fragments of a quern and of urns, and bones of whales and sheep were found in base. *Description*, E. Getty, *loc. cit.* vol. I. (1853) p. 140, and vol. V. (1857), p. 121. National monument.

COUNTY DOWN.

22.***Downpatrick**: This tower was struck by lightning in 1017. It was 66 feet high and 44 feet circumference, the walls being only 3 feet thick. It leaned towards the Cathedral, from which it was 40 feet distant. There was an irregular gap, 10 feet from the top on the west side, and the entrance was 2 feet 6 inches wide at the sill; Harris, in 1744, notes it as a "very high pillar." It was taken down in 1789–90, as Dubourdieu says, "to make way for repairs at the Cathedral," probably for fear it might fall. A less reliable account attributes its demolition to the local landlord.

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[1] See T. Crofton Croker's edition of the "Tour" of M. Le Gouz.

[2] This is shown on the Cathedral seal in Harris' "Ware's Bishops."

[3] Vol. iv., p. 163.

[4] Cited by Bishop Reeves in the Introduction to the "Life of St. Columba," p. liv.

23. **Drombo**: *c.* 51½ feet; *h.* 35 feet. Top stories gone. Door, lintelled 4½ feet up; traces of fire in interior; boars' tusks and bones of oxen; below them a human skeleton, E. and W. *Description*, E. Getty, *loc. cit.* vol. III. (1855), p. 113.

24. **Island Mahee (Nendrum)**: *c.* 44½ feet; *h.* 9 feet. Stump; side breached; no human remains found in base. Identified by Bishop Reeves. *Description*, E. Getty, *loc. cit.* vol. III. (1855), p. 136.

25. **Maghera**: *h.* 25 feet. Lower part remains. Door, 7 feet up. *Description*, E. Getty, *loc. cit.* p. 131. Upper part blown down in 1714 (Seward) and 1704 (Lewis) lying in an unbroken column on the ground. National monument.

COUNTY DUBLIN.

26. **Clondalkin**: *c.* 47 feet; *h.* 89 feet. Perfect; door has lintel; top windows rebuilt. *Descriptions*, Grose, "Antiquities," vol. I., p. 16; Petrie, "Round Towers," p. 95. Section, p. 397. National monument.

27.***Dublin—St. Michael le Pole**: It stood near the disused church in a court off Ship-street, the entrance to which is now marked by a tablet recording the fact. In "the memorial of Gabriel Beranger" (R.S.A.I. Journal, 1870–71, p. 43), that artist's careful view of the building, done in 1766, is given along with the following account:—When the church was granted to be a school-house, the following Chapter minute was recorded: "that Mr. Jones do not pull down the monument or Tower of St. Michael le Pole near his school-house." On August 23rd, 1706, an order to the same effect was issued. "The Free Press," 1778, states that some forty years earlier the tower was much decayed, and was repaired by a lover of antiquities who applied to Dean Swift and others for aid. He erected scaffolds, and had the joints pointed both inside and outside. In 1775 a severe storm so injured the tower that it threatened to fall on the school. The Dean and Chapter being anxious, if possible, to preserve the ancient building, consulted an architect as to the possibility of its repair; no safe plan could be devised, so it was taken down to the level of the school-roof to the great wrath of the citizens. It retained its conical cap in Beranger's time; the top windows had lintelled heads.

28. **Lusk**: *c.* 53 feet; *h.* 95 feet. Cap gone; embedded in the late mediæval belfry. Door has lintel. *Description*, sections and illustrations by H. O'Neill, "Round Towers of Ireland," Part I. (1877), and Grose, vol. I., p. 12. National monument.

29. **Rathmichael**: *c.* 52 feet; *h.* 8 feet. Stump. *Description*, W. F. Wakeman, Journal R.S.A.I. (1891), p. 701.

30. **Swords**: *c.* 55 feet; *h.* 75 feet. Top story and cap rebuilt. Door has lintel and is a few feet above ground, another large ope above it about 20 feet up; all is now thickly ivied. *Views* in Grose, "Antiquities," vol. I., p. 11, and H. O'Neill, *loc. cit.* *Description*, "Fingal and its Churches" (1888), Rev. R. Walsh, p. 61.

COUNTY FERMANAGH.

31. **Devenish (Lough Erne)**: *c.* 49 feet; *h.* 85 feet. Perfect; tapers for half its height only. Door has round head of three stones. There is a richly carved cornice below the cap. *Descriptions*, Getty, Ulster Journal, vol. iv. p. 178; W. F. Wakeman, Journal R.S.A.I. (1873), p. 65; and many others. National monument.

COUNTY GALWAY.

32.***Annadown**: A "cloictheach" was "built" there in 1238 (Annals of Innisfallen). Very doubtful.

33. **Aranmore (Killeany)**: *c.* 49½ feet; *h.* 7 feet. Stump. *Description*, T. J. Westropp, Journal R.S.A.I. (1895), p. 262. A fine coloured drawing is in the Du Noyer collection, Royal Irish Academy. National monument.

34. **Ardrahan**: *c.* 38 feet; *h.* 6½ feet. Only a segment in wall of graveyard. *Description* in "Ordnance Survey Letters" (County Galway), vol. II., R.I.A. Library.

35. **Kilbanon**: *c.* 52 feet; *h.* 50. Top stories gone and west side breached. Door has round head, about 15 feet up, and is 2 feet wide and 5½ feet high. The wall is 4 feet thick and of large and good masonry. The floors were supported on rests. (Manuscript Ordnance Survey Letters of Galway, R.I.A. vol. I. p. 92.) There is a view in "Early Christian Architecture of Ireland" (Miss M. Stokes), Plate xxxvi. National monument.

36. **Kilcoona**: *c.* 53 feet; *h.* 8 feet. Stump. *Descriptions*, Sir W. Wilde, "Lough Corrib" (1867), pp. 78–81; Lord Dunraven's "Notes," vol. II., p. 37, under name "Annaghdown." National monument.

37. **Kilmacduach**: *c.* 56½ feet; *h.* 112 feet. Perfect. Top partly restored. Base has plinth. Door, 26 feet up, has round head. Tower leans over. Birds' bones and oyster shells were found in base; under these, and partly under foundation of tower, were skeletons E. and W. *Descriptions*, T. N. Deane, Report of Board of Public Works (1878, 1879), p. 71; R. Brash, "Ecclesiastical Architecture," p. 100. Dunraven, "Notes," vol. II. p. 18. National monument.

38. **Roscam**:[1] *c.* 56½ feet; *h.* 35 feet. Upper stories gone. Door, 5 feet up, has lintel. *Description*, W. F. Wakeman, Journal R.S.A.I. (1895), p. 284. National monument.

COUNTY KERRY.

39. **Aghadoe**: *c.* 51 feet; *h.* 15 feet. Stump. Doorway now gone; it was 12 feet above ground. *Descriptions*, J. Windele, Journal R.S.A.I. (1852), p. 246; Lord Dunraven, vol. II. p. 35; Gentleman's Magazine (1864), Pt. I. p. 411. National monument.

40.* **Ardfert**: "It was 120 feet in height and esteemed the finest in Ireland," says Archdall,[2] "but being neglected it unfortunately fell to the ground in 1771."[3] Miss Hickson states that, when a child, about 1834, she often saw the "large fragments of the round tower, resembling . . . huge cannon dismounted, lying on the side of the road under the hedge. The tower is said to have fallen in these cylindrical masses during a great storm in 1771." Dr. Beaufort's memoir for a Map of Ireland says it fell all at once, but Seward says only a part fell, and there was hope it could be repaired.[4]

41. **Rattoe**: *c.* 48 feet; *h.* 92 feet. Perfect. Popular name, "Guilcagh," stands on a platform of masonry. Sheela na gig in low relief on jamb of a window. Door, 7 feet up, has round head of 3 stones and a flat band. *Description*, R. Hitchcock, Journal R.S.A.I. (1852), p. 247. National monument.

[1] *Alias* Oranmore or Murroagh.
[2] Monasticon, p. 300.
[3] Journal R.S.A.I., 1895, p. 30.
[4] *Ibid.* (Kilkenny Soc.), 1852, p. 250.

COUNTY KILDARE.

42. **Castledermot**: *c.* 47 feet; *h.* 66½ feet. Top and battlements modern. Door has a lintel. *Description* by Lord Walter Fitz Gerald in Journal of Kildare Archæological Society, vol. I. (1892), p. 82, and same in Journal R.S.A.I. (1892), p. 66.

43. **Kildare**: *c.* 55 feet; *h.* 105½ feet. Top and battlements late. Masonry of tower of two distinct periods. Door, 14 feet up, recessed romanesque work, semicircular ornamented head and angular hood; bracteate coins found in base. *Description*, Fitz Gerald, *loc. cit.*, p. 87; Wilkinson, "Ancient Architecture of Ireland," p. 75, and other sources.

44. **Old Kilcullen**: *c.* 47 feet; *h.* 30 feet. Top gone. Door, 6½ feet up, with round head of two blocks. *Description*, Fitz Gerald, *loc. cit.* p. 81. Miss Stokes, *Ibid.*, 1899, p. 431. National monument.

45. **Oughterard**: *c.* 47 feet; *h.* 34 feet. Top stories gone. Door, 7 feet 6 inches up, with round head and moulding; floors rested on ledges. *Description*, FitzGerald, *loc. cit.* p. 84.

46. **Taghadoe**: *c.* 51 feet; *h.* 65 feet. Top stories gone. Door with round head and flat band; over key-stone is a small figure with upraised arms. *Description*, *loc. cit.* p. 92. National monument.

COUNTY KILKENNY.

47. **Aghaviller**: *c.* 51 feet; *h.* 30 feet. Top stories gone. Door, 13 feet up, with round head of three stones. *Views* in "Early Christian Architecture of Ireland" (Miss M. Stokes), Plate xxiii.

48. **Fertagh**: *c.* 49½ feet; *h.* 101 feet. Cap nearly gone. Door destroyed. The inner head was round; sill 11 feet 3 inches up. There is a good view in the Petrie Sketches, R.I.A., vol. iii. p. xvii, and in Ordnance Survey Letters (MSS. R.I.A.), vol. ii., Kilkenny, p. 127. National monument. The gritstone blocks of the doorway were removed by a farmer to build a hearth. They, however, could not stand the fire, and rapidly split to pieces. Tradition said that the tower was built by St. Kieran of Saighir. It is of fine hammer-dressed masonry.[1] National Monument.

[1] "Ordnance Survey Letters," Co. Kilkenny, MSS. R.I.A. vol. i.

49. **Kilkenny (St. Canice's Cathedral)**: *c.* 46½ feet; *h.* 100 feet. Cap gone; floors rested on offsets. Leans slightly. Door, 12 feet up, has round head of three stones. *Description*, "History of St. Canice's Cathedral" (James Graves and J. Prim), and many other sources.

50. **Kilree**: *c.* 50½ feet; *h.* 93 feet. Cap gone. Late battlements. Door has round head of one block and raised band. *Description and Views*, Trans. R.I.A., vol. xv. (1829), p. 219; "Early Christian Architecture of Ireland," Plate xxiv; Wilkinson, *loc. cit.* National monument.

51. ***Tullamaine**: Destroyed by a storm in 1121.

52. **Tulloherin**: *c.* 50½ feet; *h.* 73 feet. Cap gone; upper story rebuilt; late battlements; leans towards south. Door destroyed, 11 feet up. Popular name "Cloictheach Thulaigh." Eight top lights. *Descriptions and Views*, Trans. R.I.A., vol. xv. p. 220; Rev. E. F. Hewson, Journal R.S.A.I. (1893), p. 208; Ogam inscription in graveyard. National monument.[1]

KING'S COUNTY.

53. **Clonmacnoise (O'Rorke's Tower)**: *c.* 58½ feet; *h.* 62 feet. Upper story rebuilt. Eight top lights. Door has round head. *Description*, R. A. Brash, "Ecclesiastical Architecture of Ireland," p. 65; Dunraven's "Notes," vol. ii. p. 32, and many others. National monument.

54. **Clonmacnoise (Temple Finghin)**: *c.* 49 feet; *h.* 56 feet. Perfect; herring-bone masonry in cap. Windows irregularly spaced. Door on ground level, church attached. *Descriptions*, Brash *loc. cit.* and Dunraven's "Notes," p. 45. National monument.

55. ***Durrow**: It has been inferred that a round tower once stood at this place, from a passage in Adamnan's Life of St. Columba, "lapso de monasterii *culmine rotundo.*"

COUNTY LIMERICK.

56. **Ardpatrick**; *h.* 8 feet. Stump. In its base were found oyster shells, fragments of metal, and lump of amber, and it is said three bells. Local name, "Cluice." *Description*, "Limerick, its History, &c." Maurice Lenihan, pp. 720, 721.

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[1] Kilree is stated to be 120 feet high, and Tulloherin 60 feet high in Trans. R. I. A., vol. xv. pp. 219, 220.

57. **Dysert-Aenghus** (**Carrigeen**): *c.* 54 feet; *h.* 65½ feet. Top stories gone, has plinth. Door, 15 feet up, round headed with mouldings and pellets. "Some bones" found in base. Local name, "Clogas na desert." *Description*, R. Brash, Journal R.S.A.I. (1868), p. 59; Dunraven's "Notes," vol. II. p. 22. National monument.

58. **Kilmallock**: Much repaired, upper part rebuilt, old features removed. *Views*, Dunraven's "Notes," vol. II., and "Early Christian Architecture," p. 90.

COUNTY LONDONDERRY.

59.***Londonderry**: In the "Statistical Survey" of that county and city, 1809, a view is given, which appears in vol. XV. of our Transactions. It shows a portion of a round tower, with a flat-headed doorway with massive lintel, at some height from the ground, and a late conical cap. It was 35 feet high, and was then used as an icehouse, 1808. The vaults are mistaken by Miss Beauford[1] on the later occasion for portion of St. Columba's Monastery. The only relic of its existence is the name of a lane, "The Long Steeple."[1]

COUNTY LOUTH.

60. **Dromiskin**: *c.* 56½ feet; *h.* 55 feet. Upper part and cap rebuilt. Door recessed with round heads. *Description*, Maj.-Gen. Stubbs, Journal R.S.A.I. (1897), p. 101. National monument.

61.***Louth**: Fell in 968. (Annals of Clonmacnoise).

62. **Monasterboice**: *c.* 51 feet; *h.* 110 feet. Top story gone; leans towards N.W. Door has round head and flat band 4 feet up. *Description*, Dunraven's "Notes," vol. II. p. 11. National monument.

COUNTY MAYO.

63. **Aughagower**: The round tower "is called 'Cloigtheach Achaidh Ghabhair.' It is much destroyed, as tradition says, by lightning, which blew off the top of it to Teevnish, a distance of about half a mile, where it was to be seen firmly stuck together until a few years ago, when the stones were taken away and burned into lime. Tradition says that this was the belfry of the adjoining church, and that the bell is still under the bog of Teampull na bfiacal *alias* Knockadoole, where the old people used to hear it 'giving tongue.'"[2] National Monument.

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[1] Trans. R.I.A., vol. XV., p. 217. Or as the Rev. John Bernard, F.T.C.D., tells me, "The Long Tower."

[2] "Ordnance Survey Letters," Co. Mayo (MSS. R.I.A., 14 E. 18), p. 455.

64. **Balla**: *c.* 51 feet; *h.* 84 feet. There is in the graveyard a "round tower locally called ċloʒaꞃ ḃallá—the belfry of Balla —which is, at the greatest calculation, not more than 35 feet high. On the north side, within 2½ feet of the ground, commences the doorway, which is arched above. It is 5 feet 8 inches high and nearly 3 feet at the bottom. On the east side of the tower, near the top, is a quadrangular place for a bell. . . . The bell was placed therein about five years ago. It is not remembered that this tower was ever higher than it is."[1]

65. **Killala**: *c.* 51 feet; *h.* 84. Perfect; floors on offsets. Door, 11 feet up, has round head. *Description*, Dunraven's "Notes," Vol. II. p. 18. National monument.[2]

66. **Meelick**, *c.* 42 feet; *h.* 60. It stands within the churchyard to the north-west. At the height of 15 feet from the ground on the south side there is a door which is circular at the top, 5 or 6 feet high and 3 feet broad. At a height of about 15 feet above the door, a little to the west, is a pointed opening 2½ feet or 3 feet high, and a little more than a foot broad. There is, at the same height, another pointed opening to the north of the door, and north of this last is a square opening one foot every way. It is much higher on the tower and faces exactly to the north. Near the top at the south-east side is a quadrangular opening 1½ feet high and 1 foot broad, and on the east side, at the top, is a square opening of that size, and another not altogether so near the top. The tower is at least 60 feet high, the stones over the door are loose, and there is said to be a floor level with the door."[3] National monument.

67. **Turlough**, *c.* 57 feet; *h.* 70 feet. Attached to the Abbey "stands a round tower, in which there is, at a height of 15 feet from the ground, an arched doorway 5½ feet high and 2½ feet broad, and under it at the ground there is a breach. It appears that there were three floors inside this tower, which received light through small quadrangular openings. . . . At the top, under the conical

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[1] "Ordnance Survey Letters," p. 414.

[2] Called "The Needle Tower," and "The Steeple," in the Diary of the Bishop of Killala, 1798.

[3] "Ordnance Survey Letters," p. 383. A view of the door is given in "Early Christian Architecture of Ireland," Plate xxvi., and in Wilkinson's "Practical Geology, and Ancient Architecture," p. 77.

cap, are four pointed openings, the largest of which is not more than 3 feet high and 1 foot broad. The stones are giving way on the north side. Part of the north-west side of the conical cap is destroyed."[1] The Right Hon. W. Burton, in "A Tour Through Connaught," 1778, states that the height of this tower is 70 feet high, the internal diameter 9 feet, and the walls 5 feet thick, the whole diameter being 19 feet. The "Statistical Survey of County Mayo," 1819, amusingly cites a late tombstone (probably 1598) to fix the date of the round tower in A.D. 98. A good view is given by Rev. H. Bishop in "Pictorial Architecture of the British Isles," p. 4, and an old and disproportioned one in Grose, vol. I., Plate 67. National monument.

COUNTY MEATH.

68.***Ardbraccan**: Fell in 1182. (Annals Clonmacnoise.)

69.***Clonard**: Fell in 1039. (Annals Clonmacnoise and Four Masters.)

70. **Donoughmore**: *c.* 56 feet; *h.* 100 feet. Top rebuilt.[2] Door, 12 feet up; it has round head and flat bands. On the keystone and block above it is figure with extended arms and crossed legs. To each side a projecting stone carved with a face. Two plinths. *Description*, Sir W. Wilde, "The Boyne and Blackwater," p. 161. National monument.

71.***Duleek**: The cap was struck off by lightning, 1147. (Annals F. M.) No trace or tradition remains.

72. **Kells**: *c.* 53½ feet; *h.* 99 feet. Cap gone. Door, 12 feet above street, has round head, with projecting corbels carved, with faces to each side, and a flat band all round. Over arch is a defaced carved lintel. *Description*, Dunraven's "Notes," vol. II. p. 19. National monument.

73.***Slane**: The foreigners burned the "Cloicteach" of Slane, with all its occupants, and a bell, "the best of bells," 945 or 948. Strange to say, a fused mass of bell metal was dug up in the graveyard near the Abbey many years since, and was given to the Rector of Slane, the Rev. John Westropp Brady.

74.***Trim**: Burned by Conor O'Loughlin in 1128 (Ann. Inisf., Lough Cé).

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[1] "Ordnance Survey Letters," Co. Mayo, MSS. R.I.A., 14 E. 19, p. 478.

[2] The cap and four top lights were extant about 1745, see Journal R.S.A.I., 1892, p. 126. See also curiously confused statement of Wilkinson in "Practical Geology," p. 72.

75.***Tullyard**: Burned in 1171 by the fierce warrior O'Ruairc. (Annals Inisfallen.) Dr. Petrie says it fell about the year 1764. ("Round Towers," p. 376.)

COUNTY MONAGHAN.

76. **Clones**: *c.* 51 feet; *h.* 75 feet. Cap gone. Door has lintel, 8 feet up; traces of fire inside. *Descriptions*, Getty, *loc. cit.*; W. F. Wakeman, Journal R.S.A.I. (1874), p. 328; Getty, *loc. cit.* vol. IV. p. 66. National monument.

77. **Iniskeane**: *c.* 51 feet; *h.* 42 feet. Top stories gone; floor rested on corbels. Door, only sill remains, 14 feet 8 inches up. Skeleton lay east and west in base. Glass beads found. *Descriptions*, Getty, *loc. cit.* vol. V. p. 116, and Rev. G. Reade, Journal R.S.A.I. (1854).

QUEEN'S COUNTY.

78.***Killeshin**: "Monday, ye 8th March, 1703. That day the steeple of Killishan undermined and flung down by one Bambrick, imployed by Capt. Woolseley, in three days' work." 170¾ 8th March. "At 3 of ye clock in ye afternoone ye steeple fell to ye ground; being measured it was 105 foot high or in length."[1] The foundations are of similar masonry to the beautiful church near which it stood.

79.***Rosenallis**: A round tower stood at this place in 1819.[2]

80. **Timahoe**: *c.* 57 feet; *h.* 96 feet. Perfect, has three plinths. Door has round head 13 feet 9 inches up, richly carved, recessed, of three orders. *Descriptions*, R. Brash, "Ecclesiastical Architecture," p. 34; Dunraven's "Notes," vol. II. p. 29. National monument.

COUNTY ROSCOMMON.

81.***Kilbarry**: Mr. George A. P. Kelly has recently sent me notes. Some old men showed him where a "steeple" had stood on this site; the same probably that was pointed out to O'Donovan in 1837 (Ordnance Survey letters). The tower was demolished to build a stable. Several of the blocks, dressed to a curve about 18 or 19 feet in diameter, remain set as sills and a seat in a cottage built over fifty years ago. Near it is the ancient church, retaining its round corner shafts, and a romanesque fluted capital, though now defaced.

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[1] Original Diary. Published by R.S.A.I., Journal, 1864-5, p. 303.

[2] Mason's Parochial Survey, 1819, p. 319.

82. **Oran** : *c.* 62½ feet ; *h.* 12 feet. Stump. Mr. G. A. Kelly tells me that about nine courses of regular blocks of conglomerate remain, with a plinth 8 inches wide ; seven courses of limestone blocks rest on the former. There is a large breach in the wall. The interior is 8 feet across, and has been used for burials.

83.***Roscommon** : Burned in 1049. (Chronicon Scotorum).

COUNTY SLIGO.

84. **Dromcliff** : *h.* 40 feet. Top stories gone. Door, 8 feet up, has lintel. *Descriptions*, Colonel Wood Martin's "History of Sligo," vol. I. ; Dunraven's "Notes," vol. II. p. 47. National monument.

COUNTY TIPPERARY.

85. **Cashel** : *c.* 50 feet ; *h.* 80 feet. Perfect. Door, 12 feet up, has round head of six stones and mouldings ; floors rested on joists set in wall. *Descriptions*, Brash, *loc. cit.* p. 91 ; Dunraven's "Notes," vol. II. p. 9 ; and many others. National monument.

86.***Emly** : Burned in 1058 by the men of Turlough O'Brien.

87. **Roscrea** : *c.* 50 feet ; *h.* 80 feet. Top stories gone ; double plinth. Doorway, 9 feet 9 inches up, has round head of three stones, a raised band, and also carvings of a ship and knot. *Description*, Dunraven's "Notes," vol. II. p. 6. National monument.

COUNTY TYRONE.

88.***Errigal Keeroge** : Mason, in 1819,[1] gives the statement of Rev. J. Baldwin that, near the Franciscan Convent of Ballinasaggart, "the foundations of a round tower were to be seen there within ten years, but now even the ruins have disappeared." Scheduled as a National monument.

COUNTY WATERFORD.

89. **Ardmore** : *c.* 52 feet ; *h.* 95 feet. Perfect. Cap had a finial. Door, 13 feet up, has round head and roll moulding on edge. There are three external string courses, like that at Dysert, County Clare. Inside are projecting stone corbels, with faces or scrolls. The door has a round head and moulding, and is 13 feet up. *Descriptions*, R. Brash, *loc. cit.*, p. 111 ; same in Journal R.S.A.I. (1856), p. 35 ; Dunraven's "Notes," vol. II. p. 39 ; Journal R.S.A.I. (1856), p. 35. National monument. Ogams in church.

[1] Parochial Survey, vol. iii., p. 155.

County Wicklow.

90. **Glendalough**: *c.* 52 feet; *h.* 110 feet. Perfect. Cap repaired. Door has round head of three stones and flat band. ***Descriptions***, Dunraven's "Notes," vol. II. p. 15. Journal R.S.A.I., 1894, p. 301. National monument.

ROUND TOWERS WHOSE BASES ARE OF DIFFERENT SHAPES.

91. County Antrim, Trummery: on square base north wall chancel. See E. Getty, Ulster Journal of Archæology, vol. III., 1855, p. 292.
92. County Cork, Kinneagh: hexagonal. Description, Dr. Caulfield, R.S.A.I. Journal (R.H.A.A.I.), 1879, p. 16.
93. County Dublin, Ireland's Eye: on chancel of oratory. Description by R. Cochrane, Journal R.S.A.I., 1893, p. 398.
94. County Kildare, Killashee: square. See Grose's "Antiquities of Ireland," vol. II., p. 84.
95. County Londonderry, Dungiven: on south-west angle of church. See Mason's "Parochial Survey," vol. I., p. 302.
96. County Londonderry, Tamlacht Finlagan: on north-west angle of church, square base. Miss Stokes, "Early Christian Architecture," p. 62.
97. County Wexford, Ferns: on square base. See Journal R.S.A.I., 1895, p. 404.
98. County Wicklow, Glendalough Ivy Church: on square room west of church. See Ledwich, 2nd edition, p. 155. Grose, vol. II., p. 96.

To summarize: we may add that there are thirteen perfect towers, ten of which retain their ancient caps, two most of the cap, and one in which the blocks of the cap have been recovered and rebuilt. Of those which have only lost the cap twelve remain, twenty-seven are three to six stones high, ten are mere stumps, and twenty-eight recorded towers are totally demolished.

In the hope that this paper may lead others to undertake a definite work (collecting facts, and as far as may be avoiding theories), or at least to supply Papers on the numerous towers imperfectly described and illustrated, these notes have been laid before the Academy.

INDEX.

[In the following, the numbers refer to the paragraphs in List.]

XIV.

ON A NEW GENUS OF BACTERIA (*ASTROBACTER*). By A. VAUGHAN JENNINGS, F.L.S., F.G.S.

(Plates VI. and VII.)

[Communicated by the Secretary.]

[Read December 14, 1896.]

The organism that forms the subject of the present note has unfortunately not been observed in the living condition, but its appearance and general characters seem to me sufficiently remarkable to justify my calling to it the attention of those interested in the study of Bacteria. It was found in stagnant water in the neighbourhood of Tübingen by my friend, Mr. Coppen-Jones, of Davos, who kindly placed the material at my disposal for further study and description.

The water contained a great number of specimens of *Spirillum undula*, and special preparations were made by Löffler's method to demonstrate the cilia in this species. In the mounted slides, numerous examples of the organism now under consideration were observed, but, unluckily, only after the material had been thrown away. The photographs reproduced herewith (Pl. VI.) will, however, convince the reader of its actual existence; and if this communication serves no other purpose, it may, at least, lead other observers to look for the same or similar bodies, and to justify or correct the views as to its nature now suggested.

With a moderate magnifying power one observes among the Spirilla a number of deeply-stained star-like bodies composed of a varying number of rays. The more evident examples have some eight or ten rays, but a series of simpler forms will soon be found with six, five, or four rays; then Y-shaped forms, and, finally, simple rods.

One of the latter (Pl.VII. fig. 1) may then be taken as a starting-point; a simple rod-like bacterium with no special characteristics that can be noted in the preparations in question. The next stage is a similar rod bifurcated at the end, producing a Y-shaped form (Pl. VII. figs. 2, 3); and, apparently as a further development of this, come symmetrical tri-radiate types, with the rays spreading at an angle of 120° (Pl. VII. fig. 4).

These simple Y-shaped specimens seem to me undoubtedly due to the longitudinal splitting of the simple rod, and they thus give an explanation of the more complex stars for which it would otherwise be difficult or impossible to account.

It is, of course, true that if a simple bacterium develops a lateral branch, a Y-shaped form will result when the side branch equals in length the shorter portion of the original rod. In the present case the branches of the fork are *always* equal, and some special stress may, perhaps, be laid upon this point, because when these specimens came under my notice, I was studying Mr. Coppen Jones' preparations, illustrating the branching of the "Tubercle Bacillus." In that organism I was able to observe the branching of a simple rod-like form, and to trace this stage into the more complex "hyphal" condition which he has described.* It is not likely, therefore, that in the present case I should have been misled by mere lateral outgrowth.

To return, however, to description:—Four-rayed forms, with acute and obtuse angles between the pairs of rays (Pl. VII. figs. 5, 6), are not uncommon, and all transitions may be found from this type to a regular cruciate such as that of fig. 7. Then come five-rayed examples, again showing much variation in the angle between adjacent rays; and then hexactinellid forms, irregular in some cases, in others as symmetric as a simple snow-crystal (Pl. VII. figs. 8–10).

Of the more complicated specimens those with eight-rays are also often symmetrical, but those with more than eight are almost always irregular in the length and disposition of the rays (Pl. VI. fig. 2; Pl. VII. figs. 12–17).

A zoologist examining the specimens will be struck by the curious parallelism between these different growth-forms and the various types of spicules in sponges. We have forms corresponding to the simple rods and triradiates; the four-rayed type; the tetraxonoids; the symmetrical hexactinellid form of a Hyalonema, and the irregular multiradiates of some fossil genera.

The comparison of the two series is merely one that suggests itself, unavoidably, in looking at the specimens. Still, there may be some

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* Coppen-Jones—Centralblatt fur Bacteriologie 1895.

archaic tendency of cells to radial differentiation, such as reaches its maximum in the Radiolaria.

The component rays of these stars are themselves usually simple rods; but, in some cases, they certainly appear to be in course of bifurcation.

An appearance of such bifurcation might, it is true, be produced if one ray were lying over another in its proximal portion; but in several instances it seems undoubtedly to be a case of real forking.

This raises the question as to the plane in which the rays lie—a question by no means easy to decide. The specimens being very deeply stained and mounted in balsam, it is difficult to be absolutely certain on this point; but in some cases there is sufficient difference in focus to suggest that they radiate in three dimensions. The specimens were dried on the cover-glass in the usual method of mounting, and, under such circumstances, the rays even of a "solid" star would, of course, tend to flatten on its surface.

In a few cases there is a transverse constriction of some of the rays, indicating that the organisms may multiply by abstriction of the distal portions (Pl. VII. fig. 15).

No spores have been observed. Though in some examples single highly-refracting spots are observable near the tip of each ray, these are probably due to plasmolysis.

The remaining feature of importance to which I would call attention is the presence, in a large number of specimens, of a central colourless spot. This seems constant in the older, multiradiate types, but does not occur in the simpler forms. With a high magnification it will be observed, in some cases, that the bases of the rays are rounded off and project somewhat into the light area, while occasional specimens may be seen in which the central space communicates with the exterior (Pl. VII. figs. 16 and 17). This condition suggests that, in course of time, the stars disintegrate by the absorption of the central protoplasm into the several rays which then separate, and become the rod-like bacteria with which we started.

The foregoing description includes all I have been able to observe in the preparations, and the only explanation thereof which seems to me tenable. These numerous stellate organisms cannot be chance aggregates of rods; and it is equally difficult to imagine the development of a successive series of rays from a single point whether a spore or the middle of a rod-like form. No other unicellular organism, so far as I know, affords any evidence in favour of such a view, and the theory of longitudinal fission is a relatively slight strain on the scientific imagination.

We have to consider in the first case whether such longitudinal fission is improbable, and, in the second, what evidence is derivable from other forms of life.

If we accept the view of the physiological necessity for division at the limit of growth there is no difficulty; because though there might be greater expenditure of energy in longitudinal than in transverse division there would be proportionately greater gain in new surface-area. This, it seems to me, holds true whatever opinion may prevail as to the ultimate meaning of cell-division.

No theoretical objection, however, can be of much value if the phenomenon actually occurs in other organisms; and such forms as Gomphonema and Licmophora among the Diatomaceæ, and those Infusoria which divide to form fan-shaped and radial colonies, show that there is nothing impossible in the idea. The multiplication of the cells in primitive columnar epithelia may be analogous.

This view would have been put forward with greater hesitation had it not been for the fact that one form of Schizomycete has already been described which shows similar longitudinal division. In the Annals of the Pasteur Institute, Metschnikoff has called attention to a curious organism which consists of radiating groups of pear-shaped cells. These he regarded as produced by longitudinal fission from a simple form, and gave generic value to the type under the name of Pasteuria.

Taking these facts into consideration, as well as the tendency to radial differentiation of the cell-protoplasm seen in the Radiolaria, or in the embryo discs of an alga like Phycopeltis, one might hazard the suggestion that, while both in unicellular organisms and in tissues the transverse type of fission generally prevails, there are some cases in which an archaic tendency to longitudinal or radial division still predominates.

If future observation proves the occurrence of longitudinal division in this case or in Pasteuria, it may be convenient to separate these forms in a section of Schizomycetes termed "Paraschizæ" in antithesis to a section of "Diaschizæ" which would include the better known bacteria.

I am, however, by no means sure that there is any fundamental difference between the two types of division; and if I have seemed to emphasize the distinction, it is because, when a preliminary note on this organism was communicated to the Botanical Section of the British

Association (Liverpool, 1896), some eminent authorities received the suggestion of "longitudinal fission" with an incredulity that bordered on contempt. The object of this Paper is only to place the facts and figures before them and others who may be interested, and ask for an alternative explanation.

I should add that I am much indebted to Mr. Hildage, late of the Royal College of Science, Dublin, for the time and care he devoted to the production of the photographs reproduced in appended Plates.

XV.

REPORT ON HEPATICÆ COLLECTED AT TORC WATERFALL, KILLARNEY, IN 1897. By DAVID M'ARDLE, of the Royal Botanic Gardens, Glasnevin, and the REV. H. W. LETT, M.A., Loughbrickland, Co. Down.

(Plates VIII. and IX.)

[Read December 12, 1898.]

It was a bright morning in September when we arrived at Torc Waterfall, which is on the Owengarriff River, about four miles from Killarney. Our principal object in calling here on our way to the Dingle Peninsula being to endeavour to verify Mr. Holt's record of the beautiful Lejeunea which bears his name, and was stated to be found by him on rocks within the spray of the waterfall, in 1885, where it grew sparingly among mosses, and the larger Hepatics.

The entrance to the fall is from the Muckross-road through a well wooded glen in the demesne of A. E. K. Herbert, Esq. On account of the exuberance of plant life, the glen has been the resort of many botanists, notably of those interested in Bryology. We followed the river, and admired the splendid specimens of Lastrea and other ferns clothing its banks, or depending from overhanging rocks and crags. We assailed the spray-dashed boulders on which Hepatics love to grow, and we gathered a quantity of fine specimens of the rare *Radula voluta* which quite covered one of the large rocks, and must be often submerged. Close by, the beautiful *Metzgeria hamata,* one of the largest of the species which are found in this country, grew as luxuriantly as it does in its home in the tropics.

Mr. Holt's Lejeunea is far from being plentiful. We found it amongst Trichocolea and Metzgeria, and on a rock which was constantly sprayed by the waterfall a patch was conspicuous by the dark green colour and neatly laid strata of its stems and branches. It is a difficult matter to detect the plant until a portion is placed under the lens of a dissecting microscope, then the mode in which it bears the perianths and amentæ, the shape and red colour of the leaves, especially those of the lower plane, all come into view. Still, we doubt if the occurrence of the red colouring matter is peculiar to *Lejeunea Holtii.*

Lejeunea flava grows on the trunks of trees and among mosses, and the larger Hepaticæ, and on moist rocks very sparingly; *Lejeunea serpyllifolia* is abundant on trees, and on rocks in the bed of the stream, and presents many curious forms. Such is a brief account of some of the rare hepatics we gathered as we slowly worked our way up the stream, and the day was far spent when we arrived at the wall of rocks down which the water tumbles with a loud noise. On the right hand side of the fall is a rocky terrace, covered with *Trichocolea tomentella*, and festoons of Miss Hutchin's Jubula, golden Hypnums, and the silvery *Hookeria lucens*, backed up with a frondose denizen of the tropics, *Dumortiera hirsuta*, var. *irrigua*, which clothes the rocks; the lurid green colour of its fronds is striking; sparkling in the sunshine are the drops of spray with which it is bathed by the waterfall; it is a fitting background for this exuberance of tropical growth—a veritable garden of cryptogams. We followed a well-kept pathway to the summit above the fall, and got some excellent views of the lower lakes and distant mountains. Who can describe the variety of shades and colours of the surrounding woods and mountains in the setting sunshine, and we both exclaimed, verily Killarney's beauty is not overrated.

The following list which is provisional only, contains forty-seven species, many of which are very rare, as *Lejeunea diversiloba*, &c., and six varieties, some of which are of botanical value on account of constant characters and local distribution. In the arrangement of the Lejeunea we have grouped them into sections which correspond to the sub-genera into which Dr. Spruce divides them in his grand work on the Hepaticæ of the Amazon and Andes, where the species of Lejeunea are numerous. We trust it may be useful for identification and reference to the students of these curious plants.

HEPATICÆ.

Sub-Order 1.—Jungermaniaceæ.

Tribe.—Jubuleæ.

1. *Frullania tamarisci*, Dill. L. On the trunks of trees and on rocks common.

   Frullania tamarisci, var. *atrovirens*, Carrington. Stems elongated; leaves elliptic-ovate, apiculate, apex inflexed, of an indigo green colour, but having the line of moniliform cells across the leaves, which is so characteristic in the type. Growing on rocks in shallow patches within the spray of the waterfall.
2. *Frullania microphylla*, Gottsche, Pearson. *Frullania tamarisci*, L. var. *microphylla*, Gottsche ex Carrington in Trans. Bot. Soc. Edin., vol. vii., p. 457, 1863. Pearson in Journal of Botany for November, 1894. On the trunks of trees and on rocks among mosses and the larger hepatics.
3. *Frullania fragilifolia*, Taylor in Trans. Bot. Soc. Edin. 2, p. 43. Among moss on rocks and on trees, rare.
4. *Frullania germana*, Taylor in Trans. Bot. Soc. Edin. 2, p. 43. *Frullania tamarisci*, L. var. *germana*, Carrington, Irish Hepaticæ, p. 457. On rocks, rare.
5. *Jubula Hutchinsiæ*, Hook, Dumort, Hook, Brit. Jung. tab. 1. *Frullania Hutchinsiæ*, Nees, Europ. Leberm. 3, p. 240. On moist rocks and on the fronds of Dumortiera and Trichocolea, within the spray of the waterfall.

Lejeunea, Libert.

Sub-tribe 1.—Holostipæ, Spruce.

Foliole (stipules) undivided.

Section 1.—Homalolejeunea (Spruce, Genus).

6. *Lejeunea Mackai*, Hook, *Jungermania Mackai*, Hook, Brit. Jung., tab. 53. *Phragmicoma Mackaii*, Dumort. Comm., p. 112. On moist rocks, among Metzgeria and Radula.

Sub-tribe II.—Schizostipæ, Spruce.

Foliole with the apex only retuse or emarginate.

Section II.—Harpalejeunea (Spruce, Gen.)

7. *Lejeunea ovata*, Taylor in G. L. et N. Synop. Hep., p. 376. *Jungermania ovata*, Dicks, Pl. Crypt. Brit. 3, p. 11, tab. 8, f. 6. On the bark of trees, decayed wood, and on mosses and the larger hepatics.

Section III.—Eulejeunea (Spruce, Gen.)

Foliole bifid.

8. *Lejeunea serpyllifolia*, Dicks, Libert. in Ann. Gen. Sc. Phys. 6, p. 374. Carr. and Pears. Exs. No. 135, 195. On the trunks of trees and on rocks and stones, common.
9. *Lejeunea patens*, Lindberg. Hep. in Hibernia lectæ, p. 482, 1874. Moore on Irish Hepaticæ, R. I. A. Proc., Ser. 2, vol. ii., p. 615, with excellent figure (plate 43). On damp rocks and on decayed wood, and on the large mosses and hepaticæ.
10. *Lejeunea flava*, Swartz, var. = *L. Moorei*, Lindberg, Hep. in Hibernica lect. p. 487, 1874. Moore on Irish Hepaticæ, p. 615, with excellent figure (plate 44). On decayed wood and among mosses, and on the fronds of Metzgeria, very scarce.
11. *Lejeunea Holtii*, Spruce, Journal of Botany, vol. 25, p. 33, plate 272, 1887. On wet rocks, on Trichocolea, Metzgeria, and with *Lejeunea Mackai*, also found in compact patches of neat strata on rocks near the spray of the waterfall.[1] The only known locality; first found by Mr. G. A. Holt in 1885.

Section IV.—Microlejeunea (Spruce, Gen.)

Foliole constant, with subulate segments, lobule often equaling the lobe.

12. *Lejeunea diversiloba*, Spruce, Journal of Botany, 1887, page 38. *Lejeunea cucullata*, var. *stricta*, N. L. and G. Syn. Hep. p. 390. Carrington Trans. Bot. Soc. Edinb., vol. viii., p. 468, tab. 17, fig. 1. Epiphytic on the larger hepatics, very rare.

[1] We have since discovered the plant in several stations in the Dingle Peninsula.

Section V.—Drepanolejeunea (Spruce, Gen.)

Folioles small, triangularly bipartite to one-third of their length, segments divergent with subulate points.

13. *Lejeunea hamatifolia*, Hook, Dumort. *Jungermania hamatifolia*, Hook, Brit. Jung. tab. 51. On the trunks of trees and among the larger hepatics very scarce.

Section VI.—Cololejeunea (Spruce, Gen.)

Foliole absent.

14. *Lejeunea minutissima*, Smith, Eng. Bot., vol. 23, fig. 1633. On the bark of trees and on the fronds of Metzgeria, &c.
15. *Lejeunea microscopica*, Taylor. *Jangermania microscopica*, Taylor in Fl. Hib. 2, p. 59, Hook. Journal of Botany, 4, p. 97, t. 20. Epiphytic on the larger hepatics and mosses.

Tribe Jungermanieæ.

Sub-Tribe Raduleæ.

16. *Radula complanata*, L. Dum. *Jungermania complanata*, Hook, Brit. Jung. t. 81. On the trunks of trees, and on rocks, common.
17. *Radula voluta*, Taylor in G. L. et N. Synop. Hep., p. 253, 1845. *Radula xalapensis*, N. M. in Ann. Sc. Nat. 2, ser. 5, p. 56. Lindberg Hepat. in Hibernia lectæ, 1874. On rocks in the stream very fine, forming large yellow patches, plentiful.
18. *Radula Carringtoni*, Jack in Flora, p. 385, 1881. *Radula aquilegia*, Taylor, var. *major*. Carrington in Trans. Bot. Soc. Edinb. vii., p. 455, 1863. Lindberg's Hepaticæ in Hibernia lectæ, 1874. On damp rocks with *Metzgeria conjugata* and *Lejeunea Mackaii*.

(Plate VIII.)

This fine species which we had not seen before grew in some quantity amongst the two above-named plants, and also on the moist rocks to which it adhered as closely as the Lejeunea.

The male plant was plentiful, bearing copious amentæ, and is very striking and distinct. The female was scarcer, and grew apart. In no case did we find both growing together, which may account in some degree for the scarcity of fruiting specimens. A careful comparison with *Radula Carringtoni* which was found in the same place by Mr. Holt in 1885, and sent to me with other material by my friend Mr. M. B. Slater, F. L. S., to help my investigation of the plants we found, and an exhaustive description of *R. Carringtoni* by Mr. Pearson in the Journal of Botany for 1882, p. 140, with a translation from Herr Jack's monograph of the Radulæ, where he named the plant in honour of its original discoverer Dr. Carrington, who found it in Killarney so far back as 1861, enabled us without difficulty to identify our specimens as *Radula Carringtoni*, Jack, which had also been found in the same locality by the late G. Hunt, Dr. D. Moore, and Professor Lindberg; all these authorities referred the plant to *Radula aquilegia*, var. *major*.

The following interesting memorandum in the late Dr. D. Moore's handwriting is enclosed in a packet of Radula from Killarney in the Herbarium of the Science and Art Museum, Dublin. Unless this is *Jungermania complanata*, var. *β*, mentioned by Hooker in his British Jungermania, *I do not know it*. The leaves are two-lobed, the upper about one-third the size of the lower, square in shape and closely compressed. The calyces are ventricose and large. The reticulation of the leaves is rather solid, and not very large, colour brown; there are no pencils of rootlets issuing from the stems as in *J. complanata*. Found growing on rocks at Killarney.

The foregoing is a short but accurate description of *Radula Carringtoni*, and is interesting as having been made many years ago by Dr. D. Moore, and valuable as showing that he recognised the plant as a distinct species.

We sent, together with the *Radula Carringtoni*, good specimens of *Radula aquilegia* from Annascaul, in the Co. Kerry, to Mr. Slater, who writes: "I have yours with the fine large specimens of *Radula aquilegia*; it is quite distinct from *R. Carringtoni*, of which you have succeeded in finding plants of both sexes." Mr. Pearson's note in the Journal of Botany is interesting; he writes: "So far as our knowledge extends this species has a very restricted distribution, no other localities than those of the south of Ireland being recorded. It is quite unknown on the Continent, and so far no American or other foreign specimens have been met with."[1] At Torc Waterfall we have gathered specimens of the male plant nearly one inch in length, branched sparingly at either base or apex, but plants appear to be pinnate by the alternate lateral amentæ which are formed of from three to twelve or more pairs of altered leaves. Perianths oblong, tapering, and plaited for the lower third to a narrow base, shorter than that of *Radula complanata*, and less compressed, mouth entire, truncate slightly narrowed, calyptra oblong oval, stalk of capsule emersed for about the length of the perianth. Capsule dark brown, oblong oval, longitudinally striated, spores spherical with a well-marked hyaline ring, elaters few bispiral.

19. *Radula Holtii*, Spruce, Journal of Botany, July, 1887, p. 209. Within the spray of the waterfall on *Dumortiera irrigua*, *Jubula Hutchinsiæ*, *Lejeunea Mackai* and *Radula Carringtoni*. G. A. Holt, June, 1885.

(PLATE IX.)

Very rare. This was the first discovery of the plant in Ireland, when it was named and described by Dr. Spruce in the Journal of Botany. It does not appear to have been again noticed by anyone till September, 1897, when we rediscovered it among *Radula Carringtoni*, and in shallow flabellate patches on the wet rocks near the waterfall, and we were fortunate in finding several perianths on the specimens collected. The perfect fruit, with the capsule is, however, still a desideratum.

Perianth smooth, inversely cone-shaped, gradually tapering from an entire truncate slightly flattened mouth to narrow base. As the complete state of the fruit has not yet been found, the perianth may be more flattened at first. In old perianths of *R. complanata* from which the capsule has fallen, much of the flattening disappears, and the empty perianths are funnel-shaped.

Radula Holtii much resembles in size, colour, and mode of growth, large forms of *Lejeunea serpyllifolia* and *Lejeunea flava*. The lobule or back lobe is only ⅛th the size of the major lobe to which it is closely pressed; it is rounded squarish without any swelling of its fold and is strongly decurrent, and the major lobe is divergent from the apex of the fold. The cells are minute, pitted, and densely chlorophyllose.

[1] It has been discovered near Moidart, Scotland, by Mr. S. M. Macvicar, 10th October, 1898.

Sub-tribe Ptilidieæ.

20. *Trichocolea tomentella*, Ehrhart, Dumort. *Jungermania tomentella*, Ehrh. Beitr. 2, p. 150. Hook, Brit. Jung., tab. 36. Hanging in dense tufts over the rocks within the spray of the waterfall.

Sub-tribe Trigonafthеæ.

21. *Lepidozia setacea*, Web. *Jungermania setacea*, Weber. Spicil. Fl. Gott, p. 143. Hook, Brit. Jung., t. 8. On moist banks and decayed wood, common.
22. *Bazzania trilobata*, Linn. *Jungermania trilobata*. Hook, Brit. Jung., t. 76. *Mastigobryum trilobatum*, G. L. et N. Syn. Hep., p. 230. On wet banks and rocks, common.
23. *Cephalozia divaricata*, Smith, Dumort. *Jungermania divaricata*, Sm. Eng. Bot., t. 719. On a damp bank, rare.

Sub-tribe Scapanoideæ.

24. *Scapania resupinata*, Linn. Dumort. *Jungermania resupinata*, Linn. sp. Pl., 1599. Eng. Bot., tab. 2437. *J. recurvifolia*, Hook, Brit. Jung., t. 21, f. 8. *Martinellia gracilis*, Lindberg, Hepaticæ in Hib., p. 520. Moore on Irish Hepaticæ, p. 640. On rocks near the waterfall, and on stems of trees near the ground, bearing copious gemmæ. This plant has frequently been mistaken for *Scapania nemorosa*. It differs from all forms of that species by the leaves being somewhat curved downwards, having smaller cells and smaller teeth on the leaf margins. The following description will enable students to distinguish it. Tufts wide, compact, cushion-like, not easily separated, colour olive-yellow or olive-brown, and sometimes like the Torc waterfall specimens, pale light green; disposed in strata corresponding to each year's growth. The interior of the tufts is of a fawn or dull green colour. Stems 20–90 mm. long, erect, slightly branched, rigid, wavy, the secondary shoots or innovations are densely leafy, slender with a crisped appearance from the downward curving of the leaves. Root-hairs numerous, long, white, issuing from the base of leaves. Leaves of uniform size, spreading, bifarious, closely imbricated, base amplixicaul unequally 2-lobed for ⅓ or at most ½ their length, more or less ciliately dentate. Lobes folded together in upper

leaves nearly equal; dorsal roundish, blunt or with a small point (apiculate) slightly reflexed; ventral (lobule) one-half the size of the lobe, roundish ovate, concave, crossing the stem. Texture thin but firm, somewhat pellucid, little altered when dry. Cells minute, arranged in concentric circles, especially towards the base of the leaf. Gemmæ mostly the colour of the leaves, sometimes dark reddish, and are then very conspicuous, sphærical, grouped at apex of stem and on the leaf margins, copious.

Diœcious. Bracts two, with two nearly equal-toothed lobes. Perianth immersed for one-half its length, wedge-shaped, ovate compressed in the bracts; mouth truncate, irregularly cut and fringed with long close decurved teeth. Capsule, small oval, on a short stalk. Spores, minute sphærical, reddish.

25. *Scapania nemorosa*, Linn, Dumort. *Jungermania nemorosa*, Linn. Sp. ed. 3, p. 1598. Hook, Brit. Jung., tab. 28 in part. On damp rocks and banks.

26. *Scapania aspera*, Müll. *Scapania æquiloba*, var. *dentata*, Gottch. *Scapania aspera.* Pearson in Journal of Bot. Decr., 1892, tab. 329. M'Ardle, Musci and Hepaticæ of the County Cavan.[1] On rocks and among mosses on damp banks.

27. *Scapania undulata*, Linn. Dill. *Jungermania undulata*, Linn. Sp. Pl. 1598. Hook, Brit. Junger., tab. 22. On wet rocks and moist banks, common.

28. *Diplophyllum albicans*, Linn. Dumort. *Jungermania albicans*, Hook, Brit. Jung., t. 23. On rocks and banks about the roots of trees, common.

SUB-TRIBE EPIGONEANTHEÆ.

29. *Lophocolea bidentata*, Linn., Dumort. *Jungermania bidentata*, Sm. Eng. Bot., t. 606. On damp banks and on decayed wood, common.

30. *Lophocolea spicata*, Taylor in G. L. et N. Synop. Hepat., p. 167. Carr and Pearson Exic., No. 263. On decayed wood and on damp rocks among Hypnum, fertile.

31. *Plagiochila asplenioides*, Linn., Dumort. *Jungermania asplenioides*, Linn. Sp. Pl., p. 1597. Hook, Brit Jung., t. 13. On banks and on damp rocks, common.

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[1] Proc. R. I. Academy, 3rd Series, vol. iv., p. 612, Pl. xxi., 1898.

Plagiochila asplenioides, L. var. *devexa*, Carr. Brit. Hepat., p. 56. On damp rocks, rare.

Plagiochila asplenioides, L. var. *minor*. Carr., Brit. Hepat., p. 56. Carr and Pearson Exic., No. 88–222. Rare.

32. *Plagiochila spinulosa*, Dicks. Dumort. *Jungermania spinulosa*, Dicks. Crypt. fasc. 2, p. 14. Hook, Brit. Jung., t. 14. On rocks and moist banks, common.

Plagiochola spinulosa, Dicks, var. *inermis*, Carrington, Brit. Hep., p. 60. On moist rocks, rare.

33. *Plagiochila punctata*, Taylor in Lond. Jour. of Bot., 1844, p. 371. *P. spinulosa*, var. *punctata*, Carr., Irish Crypt, p. 19, t. ii., fig. 3, 1863. On damp banks and on rocks among Frullania.

34. *Plagiochila tridenticulata*, Taylor. *Jungermania spinulosa*, var. *tridenticulata*, Hook, Brit. Jung., p. 9, t. 14. On damp rocks among Frullania, rare.

35. *Nardia emarginata*, Ehrhart, Gray. *Jungermania emarginata*, Ehrh. Beitr. 3, p. 80. Hook., Brit. Junger., t. 27. On damp rocks, common.

36. *Saccogyna viticulosa*, Mich. Dumort. *Jungermania viticulosa*, Hook, Brit. Jung. t. 60. On damp banks and on rocks among mosses, common.

Sub-tribe Fossombronieæ.

37. *Pellia epiphylla*, Linn, Dill. *Jungermania epiphylla*, Hook, Brit. Jung., tab. 47, figs. 1, 4, 8, 17. River bank, common.

38. *Pellia calycina*, Taylor Nees. *Jungermania epiphylla*, var. *furcigera*, Hook, Brit. Jung., t. 47, f. 18, et 2, 3, 9, 10, 12. *J. calycina*, Tayl. in Fl. Hib. 2, p. 55. On wet rocks.

Sub-tribe Metzgerieæ.

39. *Metzgeria furcata*, Linn. Dumort. *Jungermania furcata*, Linn., Sp. Pl. 1602. Hook, Brit. Jung., tab. 55, 56. On the trunks of trees and on rocks.

Metzgeria furcata, L. var. *fruticulosa*, Dicks, Lindberg. *Jungermania furcata*, var. *æruginosa*, Hook, Brit. Jung. in textu ad tab. 55, 56. On the trunks of trees.

40. *Metzgeria hamata*, Lindberg. *Jungermania furcata*, var. *elongata*, Hook, Brit. Jung. in textu ad tab. 55 et 56. Lindberg's Monogr. Metzg., p. 25, fig. 5. On damp rocks which are often submerged, very fine specimens.

41. *Metzgeria conjugata*, Lindberg, Monogr. Metzg, p. 29, fig. 6. On the trunks of trees and on damp rocks, fertile.

42. *Aneura multifida*, Linn. *Jungermania multifida*, Hook, Brit. Jung., t. 45. On damp banks, common.

43. *Aneura palmata*, Hedwig. *Jungermania palmata*, Hedw., Theor. Gen. 1 ed., p. 87, tab. 18, figs. 93 et 95. On decayed wood, rare.

44. *Aneura latifrons*, Lindberg. *Jungermania multifida*, Schmid., Icon. Pl. 3, pp. 213–216. 1797. *Aneura palmata*, var. *major*, Nees, Europ. Leber. 3, p. 459. On moist banks among mosses, &c., rare.

Sub-Order 2.—Marchantiaceæ.

45. *Conocephalus conicus*, Linn, Dumort. *Marchantia conica*, Eng. Bot., tab. 504. *Fegatella conica*, G. L. et N. Syn. Hep. 546. On rocks at the waterfall, and on the river bank, common.

46. *Lunularia cruciata*, Linn, Dumort. *Lunularia vulgaris*, Micheli, Nov. Gen. 4, t. 4. Wall at the entrance to the glen which leads to the waterfall, common.

47. *Dumortiera hirsuta*, Swartz, var. *irrigua*, Taylor, sps. *Hygrophylla irrigua*, Taylor de March. in Linn. Trans. xvii., p. 390, tab. 15, f. 1. In the sheltered rocky recesses of the waterfall, plentiful, rare.

EXPLANATION OF PLATES VIII. AND IX.

Plate VIII.

Radula Carringtoni, Jack.

Fig.
1. Plant, natural size.

2. Portion of plant bearing amentæ. × 8.

3. Portion of plant bearing perianths. × 8.

4. One of the amentæ, showing the antheridia in the saccate base of the altered leaves. × 20.

5. Involucral leaves with oval rotundate lobules. Perianth, calyptra and capsule. × 20.

6. Leaf. × 30.

7. Leaf showing lobule, which is half or more the breadth of the superior lobe with which it forms a sharp angle, and upon which it lies flat. × 30.

8. Portion of a leaf showing cells. × 250.

Plate IX.

Radula Holtii, Spruce.

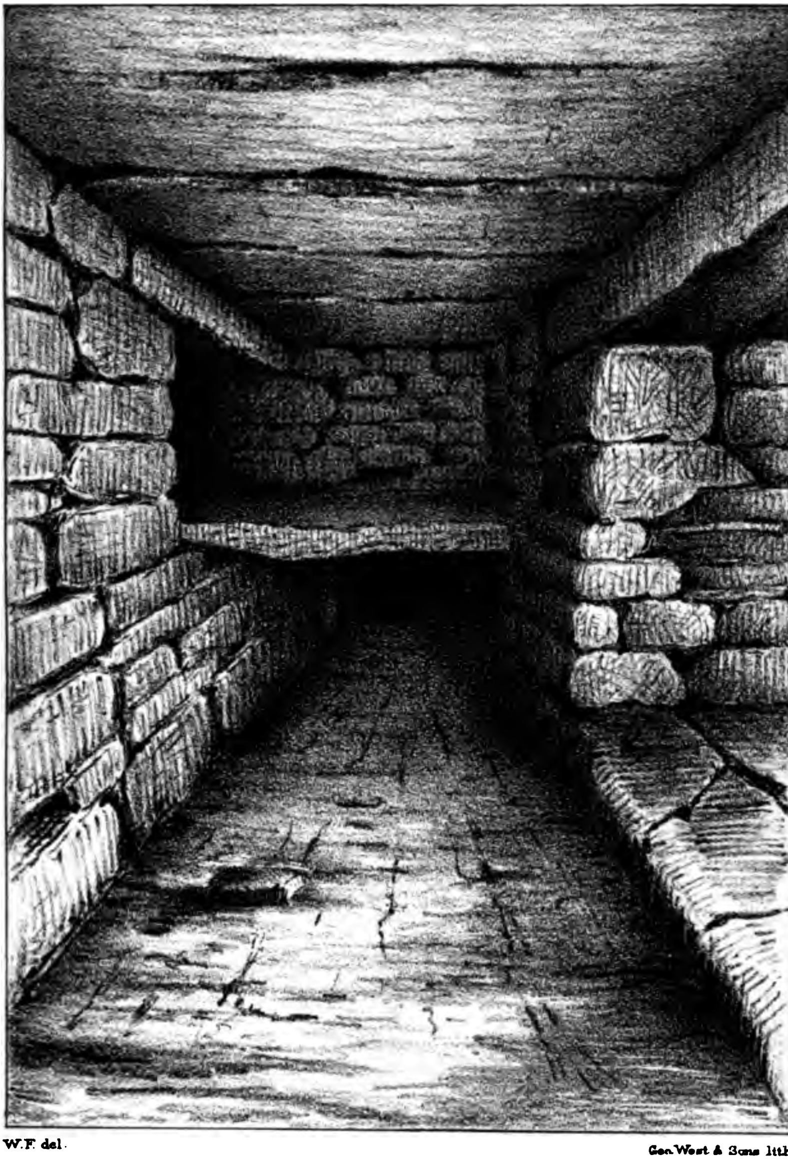
Fig.
1. Plant, natural size.

2. The same (× 20), showing the inversely cone-shaped or trumpet-shaped perianth, branching and leaves with rounded decurrent lobules, $\frac{1}{3}$th the size of the lobe which is sharply divergent from the fold of the lobule (the latter character is unique among European species of Radula).

W.F. del.

ENTRANCE TO SOUTERRAIN AT GURTEEN.

Geo West & Sons lith.



W.F. del. Geo. West & Sons lith.

SKETCH INSIDE SOUTERRAIN SHOWING ENTRANCES TO TWO PASSAGES.

1

2

3

TYPES AT GARUMNA AND LETTERMULLEN.

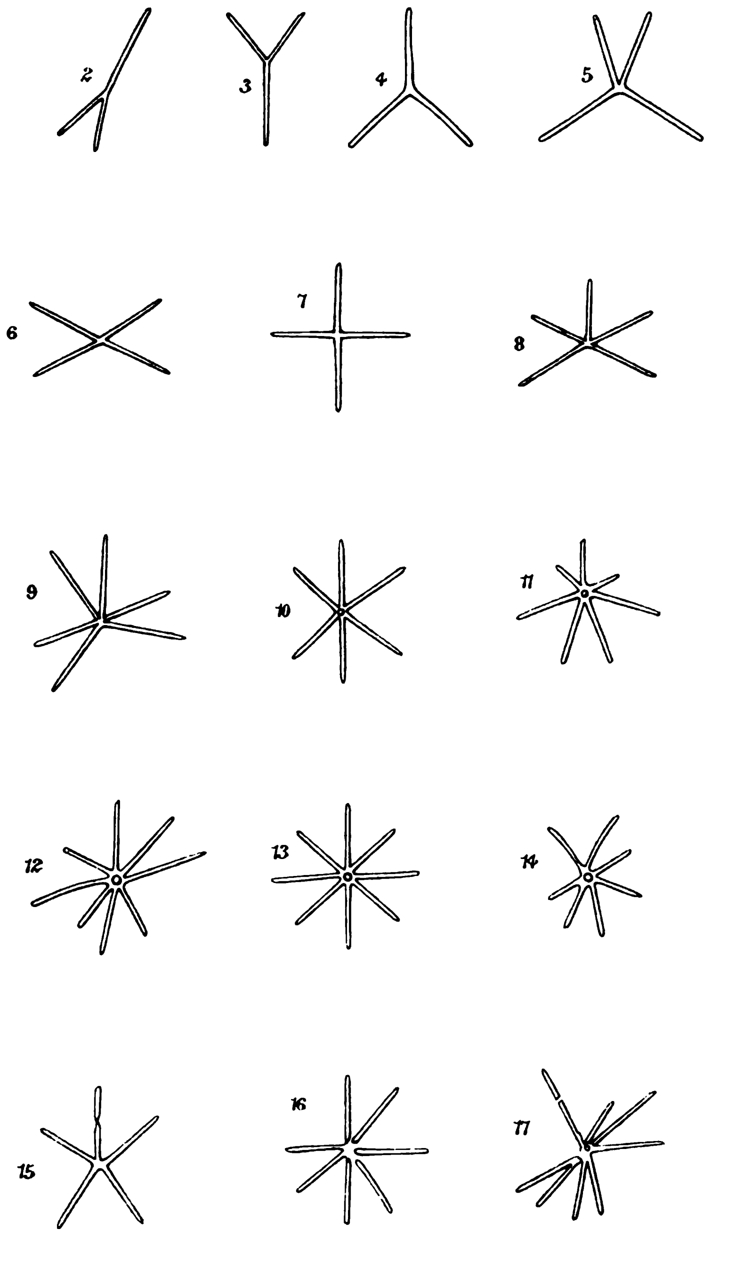
1

2

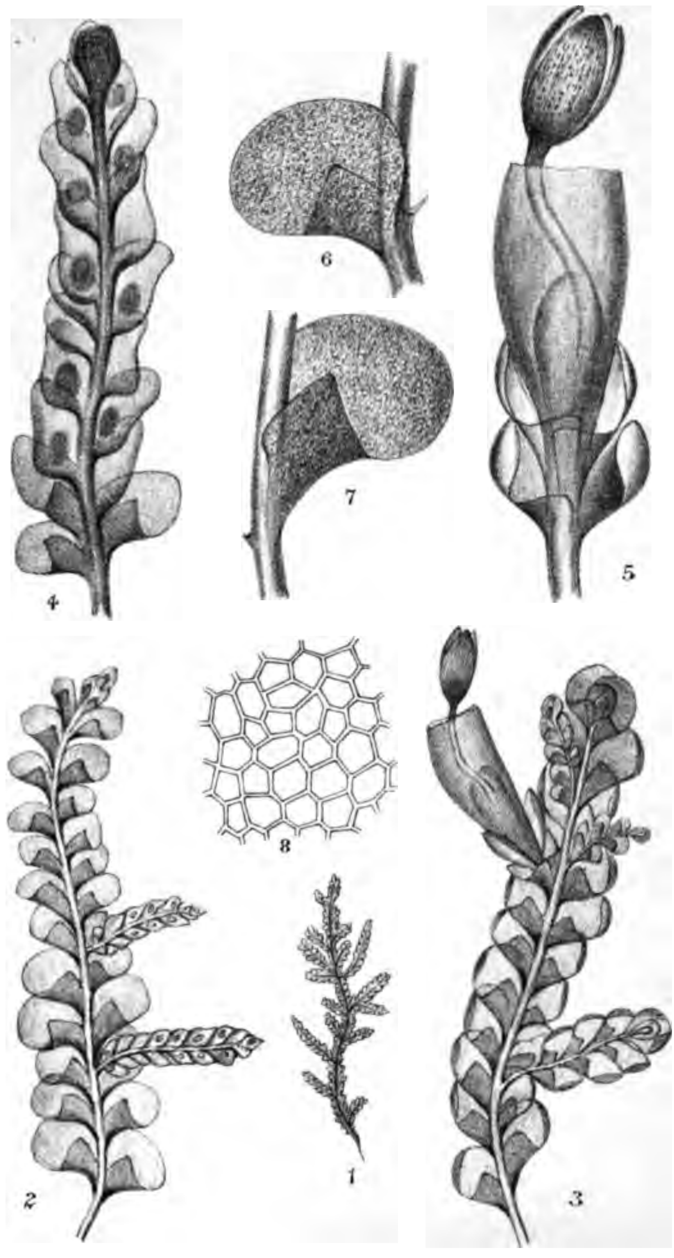
TYPES AT GARUMNA AND LETTERMULLEN.

1

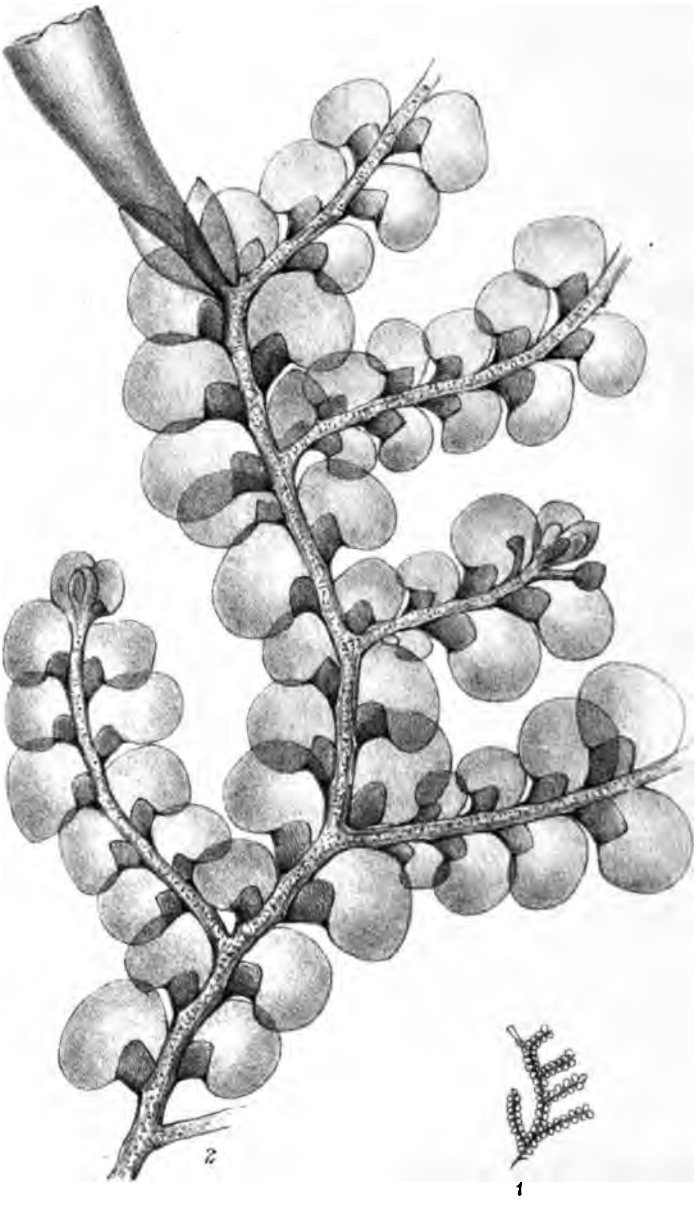
2



del. ad nat. Geo West & Sons lith.



W.N. Allen ad nat. del Feb. 1899 Geo. West & Sons lith.



W N. Allen ad nat del Feb. 1899 Geo. West & Sons lith

XVI.

ON THE GREEK TEXT OF ST. MARK'S GOSPEL.

By PROFESSOR FRIEDRICH BLASS,
Hon. Litt. D., Dublin.

[Read April 10, 1899.]

It is by the request of your Secretary, the Rev. Dr. Bernard, that I have the privilege of addressing you to-day on a subject which may give you some interest.

The textual criticism in St. Mark is of a more difficult order than that in any other Gospel, except perhaps St. John. It is true that every one of the four Gospels presents its special difficulties, even St. Matthew, the text of which is comparatively well established; but nevertheless, when one turns from Matthew to Mark, he feels as if he turned from a smooth path into a stony one, or (which is even more to the point) from firm ground into deep and shifting sands. As sands consist of an infinite number of very small particles, so the textual criticism in Mark resolves itself into a nearly infinite number of small questions, which are, perhaps, more harassing than perplexing, but in any case very trying to the patience of the critic. But do not expect that I shall invite you to walk with me through anything like sands. There are, among these sands, some much bigger particles, or, to abandon a simile which only partially suits the condition of this Gospel, there are besides the many small difficulties some very great ones, which may be of interest to any reader.

You are no doubt aware that there has been a strong, and, upon the whole, victorious tendency, in this country as well as in Germany, to replace the so-called textus-receptus of the New Testament, which had been in authority for centuries, by another textus-receptus, founded upon the evidence of the oldest Greek manuscripts. The different editions of the sacred books, published in this century either in England or in Germany, may disagree in many points; but as the foundation is in every edition the same, the concordance is more prominent than the discrepancies, and so I am well entitled to speak of a new textus-receptus. But I feel quite sure that this is by no means a last and definite stage in textual criticism. The authorities for this text date from the fourth or fifth century; so we have reproduced the text as it was at that time, at least at Alexandria and Cæsarea; but I cannot feel confident that only later centuries brought in the corruption, whereas the first three or four still preserved and transmitted the same words as had been written by the Apostles and Evangelists. On the contrary, in later times the care in transcribing did increase, and not diminish, as is also the case in the classical Greek and Latin authors. So I think that the number of new various readings which sprang up in the tenth century is much smaller than that of those dating from the fifth, and that number again is very much smaller than that of those produced in the second or first century.

But I must not be long on the general aspect of textual criticism in the New Testament. As for St. Mark especially, I think that there was a time when that early Gospel circulated by itself, as an anonymous writing on the life and death of our Lord. I freely state that the tradition which ascribes this writing to Mark, the disciple and interpreter of St. Peter, seems to me quite reliable, as it apparently goes back to no less an authority than St. John himself; but nevertheless the present inscription, *κατὰ Μᾶρκον*, cannot of course be original, but the first words, Εὐαγγέλιον Ἰησοῦ Χριστοῦ, formed the only original title. Nor do I take the little book for a proper literary work like that of St. Luke, but for a rough draught, which we might call a commentarius, or in Greek a *ὑπόμνημα*, as opposite to a *σύγγραμμα*. Now all such anonymous *ὑπομνήματα* were likely to be handled by possessors and transcribers with considerable freedom, which they did not allow themselves in the case of a proper literary work bearing the name of a known author. Every possessor or transcriber—I do not speak of professional scribes, but of a person who transcribed from a borrowed copy a new one for his own use—might feel justified in improving upon the text, either by correcting bad Greek into correct or even elegant Greek, or by adding something to the sense, if he possessed or believed himself to possess an independent knowledge of the same things, either from a written or from an oral source. This went on even in later times, in the case of this Gospel as well as in those of the other Gospels, inasmuch as they were freely interpolated from each other. But these interpolations we are in many cases able to recognize, and consequently to remove from our text (which has been done for many, but for others still remains to be done); whereas for the various readings dating from the earliest times, we can do little more than simply acknowledge them as such. A critic must always bear in mind that he is not a competent judge of every possible question, and that he has, like the ancient Roman judge, three different votes: one for absolving, one for condemning, and the third for pronouncing *N(on) L(iquet)*. Not even as an editor ought he to be compelled to give but one reading for each passage. Well, what are the tests by which he may examine a critical question? In the first place, of course, he may test the case by the authority of witnesses: that is to say, of Greek manuscripts, ancient versions, patristic quotations. But if he is content with this one test, giving his assent to some class of MSS. which he has chosen as his best guides, he devolves his own responsibility on others, which is, indeed, a most simple way of getting rid of perplexity and difficulties, but by no means the safest way to arrive at the truth of things. As a critic, he ought rather to decide as many cases as he can by argument and sound reasoning. Let me put aside for the moment the special difficulty in Mark, that there may be more than one good reading for every passage. In ordinary cases there is but one good reading, and all others except this must be put to the account, not of the author, but of the scribes. How, then, may we arrive at the just partition between the author and the scribes? Well, I say, all blunders, and solecisms, and awkward expressions, and contradictory statements, and so on, are likely to be due to the scribes, and we are guilty of gross injustice towards the author, if we decide otherwise. The authors of our Gospels, and Mark not less than Luke or John, are not to be supposed to have been either ignorant of common Greek, or thoughtless or regardless as to what they wrote. I cannot credit Mark with having written τὰ δαιμόνια-κράζοντες, a neuter substantive with the participle in the masculine. There are in the MSS. more instances than one of this solecism, and our editors, while they justly disregard the evidence of D, and other MSS. like D, when left alone, feel bound in conscience to ascribe the blunder to Mark himself whenever the authority of B joins with D.

I cannot speak here on so many single cases as I should desire, but must be content with a few samples. There is in ch. viii. 22 ff. the well-known narrative of a blind man whom our Lord healed, a narrative given by Mark alone. Jesus comes to Bethsaida, and they bring a blind man unto him, evidently a man of that town or village, although this is not expressly stated. Christ leads him out of the town, and heals him, and then sends him away to his house, saying (I am quoting after the Authorized Version): "Neither go into the town, nor tell it to any in the town." The man, as I said, is to be supposed to live in the town; he is bidden to go to his house, but is forbidden to enter the town. Now, is that possible? The Revised Version, in accordance with the best authorities, leaves out the second injunction, that he is not to tell it, and in this way makes the difficulty remain as it was. But there are a large number of other readings besides, everyone of which is better than either of these two. The longest one runs thus: "He sent him away, saying: Go to your house, and when you enter the town, do not even tell it in the town." Or else, we may read with other witnesses simply: "saying, do not even tell it in the town." The true Mark is both consistent and clear; it is the scribes who have marred the text, and the editors who have not used their own reason, but preferred to follow the thoughtlessness of scribes.

Again, we read in the next chapter (ix. 11 f.): "And they asked him, saying, Why say the scribes that Elias must first come? And he answered and told them, Elias verily cometh first, and restoreth all things; and how is it written of the Son of Man, that he must suffer many things, and be set at nought (?)"[1] I cannot understand this, but can understand what is attested by the MS. D, which introduces one short word more: "*If* Elias cometh first, and restoreth all things: how, then, is it written—?" For the Greek words καὶ πῶς, commonly translated by, "and how," in the altered construction get the meaning, "how then," according to general use in N. T. Greek, which may easily be established. So the sense is this: If the scribes are right in interpreting the prophecy of Malachi, and Elias, as the precursor of the Messiah, is to put all things in readiness for his coming in glory: how is this consistent with the other prophecies, according to which the Messiah himself is to be rejected? Our Lord goes on saying: "But I say unto you, that Elias is indeed come, and they have done unto him whatsoever they listed, even as it is written of him." Here we again find a stumbling-stone in our way. Is there any prophecy that Elias, at his second coming, will be ill-treated or put to death? No, there is none. But as soon as we come to the various readings, that stone also is removed. The Latin k, which preserves a very ancient and independent translation much older than either ℵ or B, renders the words thus: "Elias is indeed come, and has done whatsoever he was to do, even as it is written of him." This is the true Mark, whereas the common text is Matthew introduced into Mark. For Matthew has (xvii. 12): "Elias is come

[1] R. V. with note of interrogation (?), A. V. with a full stop (.).

already, and they knew him not, but have done unto him whatsoever they listed. Likewise shall also the Son of Man suffer of them." So, according to Mark, our Lord goes on saying: "The prophecy on Elias, in its true sense, has also been fulfilled"; for Elias, that is to say John the Baptist, has come and has effected that restoring and preparing which he was to effect, but which is quite different from the worldly ideas of the scribes.

I shall now call your attention to a more difficult problem of textual criticism. In ch. x. 23 ff., the well-known words are: "How hardly shall they that have riches enter into the kingdom of God! . . . Children, how hard is it for them that trust in riches to enter into the kingdom of God! It is easier for a camel to go through the eye of a needle, than for a rich man to enter into the kingdom of God." After these three sayings, we must wonder to read the words of the astonished disciples: "Who then can be saved?" Why, of course, the poor. But there are various readings. In the first place, the second saying is to be purified of an interpolation, which has been done, according to the best authorities, in W. and H's Greek text (but still not in the Revised Version): "Children, how hard is it to enter into the kingdom of God," without the words, "for them that trust in riches." In this way the second sentence becomes general. But the third remains special; and the difficulty becomes even greater. Well, then, we must invert the order, in accordance with D and other Western authority, and make the third sentence come in the second place, and the second in the third. There is also in D a change in the construction of the third sentence, so that it suits the first in form: "How hard*ly* shall they"—"More easi*ly* shall a camel"—"Children, how hard *is* it." I feel quite sure that this order is right, the more so as there are between the first and second sentences the words: "And the disciples were astonished at his *words*," λόγοις in the plural, distinctly implying (as it may easily be established by comparing other passages) that there were originally before this more sayings than one, namely the first and the third. Now, is *this* all? Not yet. I seem to have decided for D against B, and yet I have a strong suspicion that both are right, and both are wrong. How can that be? and how may we obtain a still better text? By making four sentences instead of three, the first two special, the last two general. "How hard*ly* shall they that have riches"— "More easi*ly* shall a camel—than a rich man."— "How hard *is it* to enter."— "*It is* easier for a camel to go through the eye of a needle" —"Who then can be saved?" The last sentences were, by way of interpolation, made specially to refer to rich people, and after that, the fourth, being much the same as the second, was omitted variously in one of the two places, whereas the third (in the vulgar order, the second) still retained some originality, and therefore was preserved.

I must not omit to state that Clement of Alexandria gives a full quotation of the whole passage, evidently from his copy of the Gospel, that is to say, from a MS. of the third or second century. There is, in this quotation, more than one reading in every verse, which is absolutely new, not being attested by any of our MS. or versions. You see what an amount of new readings would come out, if, by some chance, this copy of Clement were recovered. But as to the words in question, Clement's copy was not better than ours; on the contrary, it contained the second saying, which we have made third, in the enlarged and interpolated form. We gather from this, that the interpolation is indeed very old in Mark.

Lastly, I shall say a few words on a very interesting addition, in the beginning of ch. xiii. "And as he went out of the temple, one of his disciples said unto him, Master, see what manner of stones and what buildings are here! But Jesus answering said unto him, Seest thou these great buildings? there shall not be left one stone upon another, that shall not be thrown down." In D, and in Latin versions, and in a quotation of St. Cyprian there are these words more: "And after three days, there will be raised another [namely, another stone] without hands." Now, by this addition, we get at once a very clear explanation for ch. xiv. 57 f: "And there arose certain, and bare false witness against him, saying, We heard him say, I will destroy this temple that is made with hands, and within three days I will build another made without hands." For the words had been spoken in public, so that they might be heard, and consequently misunderstood and distorted, as is commonly the case, by many people. But which is the true sense? We read in Daniel, ch. ii., the explanation of the dream of Nebuchadnezzar given by Daniel. The king had seen an image consisting of gold, and silver, and brass, and iron mixed with clay, and after that he had seen that a stone was cut out of a mountain *without hands* (ἄνευ χειρῶν, the very words in Mark), which smote the image and broke it to pieces. So, says Daniel, "the God of heaven shall set up a kingdom which shall never be destroyed," as "the stone was cut of the mountain without hands, and brake in pieces the iron, the brass, the clay, the silver, and the gold." It is to this same passage in Daniel that Christ refers to in Luke xx. 18:

"Whosoever shall fall upon that stone shall be broken; but on whomsoever it shall fall, it will grind him to powder" (λικμήσει αὐτόν), the same rare word which we find in the Greek version of Daniel. We see, therefore, that Christ really referred this prophecy of the stone to Himself, and consequently appropriated to Himself also these words (Dan. ii. 35): "And the stone that smote the image became a great mountain, and filled the whole earth."

XVII.

ON THE MANUFACTURE OF A GOLD FIBULA PURCHASED FOR MUSEUM OF THE ROYAL IRISH ACADEMY. Notes communicated by EDMOND JOHNSON, AND W. FRAZER, F.R.C.S.I.

[Read May 9, 1898.]

This fibula was damaged when sold to the Royal Irish Academy by its terminal cups being creased and bent, and one of them separated, and liable to be lost or mislaid, so it was resolved to submit it to Mr. Edmond Johnson, M. R. I. A., to have it examined, and its dinges removed. This enabled the mode of its construction to be thoroughly investigated, and the results appear deserving of record, clearly showing the means employed by its fabricator. Its bow or arched portion was hollow and found to be filled with clay or sand. It is the first example of a hollow fibula of gold that has been thoroughly investigated by a practical jeweller.

The bow portion, or central arch of the fibula, was originally in the form of a beaten plate of gold that tapered to a slight extent in shape from its wider centre part towards either end. This plate was made much thinner at its edges than elsewhere, and being hammered and bent round an elongated mould, made possibly of wood or bone, until both edges came together and overlapped, they were united by applying sufficient heat to produce surface fusion of the approximated gold surfaces which converted them into a hollow tube. When sand or clay was packed tight into such a gold tube it could be bent without difficulty into the curved shape it was intended to take.

The hollow cup-shaped terminations situated at both ends of the fibula are composed alike of two separated concave plates of thin metallic gold, the outer border of the inner plate being left of greater size was then bent by hammering upon the outer one to which it was closely united in the process, but not joined by fusion of the approximated parts, only closely overlapping it. The raised lines of the concentric circles forming ridge and furrow ornamentation seen round the outer lips of both plates were produced before putting them together, each being separately adapted by modelling or rubbing the gold into prepared patterns specially made out of either hard wood or bone, either of which would answer for the purpose.

The junction of the hollow gold bow, already bent into its intended curved shape, to the terminal cups, was accomplished by applying strong heat sufficient to cause superficial surface fusion of both metallic surfaces (which is usually done by employing a blowpipe): this observation applies alone to the outer cups, or those concave plates of gold, for both the inner ones lay detached within them, forming separate shells not adhering to the outer plate by fusion or to the gold bow save through their recurved edges in the manner already described.

There was no appearance of any solder, by using an inferior quality of gold, being applied; all the junctions were produced by fusing in strong heat the approximated metallic surfaces, when they firmly united together.

The weight of the fibula was 2 oz. 18 dwt. 17 grains, equivalent to 1409 grains. This fibula was turned up early in this month in a field in the townland of Kilrathmurry, Hill of Down, Co. Kildare, the exact spot being about 1¼ miles due south of the Old Rath of Clonard. It is a moory piece of ground, and there is no tumulus or other object suggestive of antiquity near it.

Two of the sides of the cist were very nearly north and south. The depth of the covering-stone below the surface of the ground is 2 feet.

The largest of the three vessels rested inverted near one corner, the north-western: this, when lifted up by the finders had under it the smallest vessel of the three, among a quantity of burnt bones. The third vessel, of intermediate size, stood mouth upwards near the opposite or south-eastern corner of the cist. (See figures 2, 3, and 4.) The bones have been examined by Dr. C. R. Browne of Trinity College, who finds that they are the remains of one adult, probably, from the size of the mastoid processes, a man, and that the body had been burned. The dimensions of the vessels are as follows:—

Plate XI.—Large urn; height, 12 in.; diameter of mouth, $10\frac{3}{4}$ in.; diameter of base, 4 in.

Plate XII., No. 1.—Small vessel found under large urn; height, $3\frac{1}{8}$ in.; diameter of mouth, $3\frac{5}{8}$ in.; diameter of base, $1\frac{3}{16}$ in.

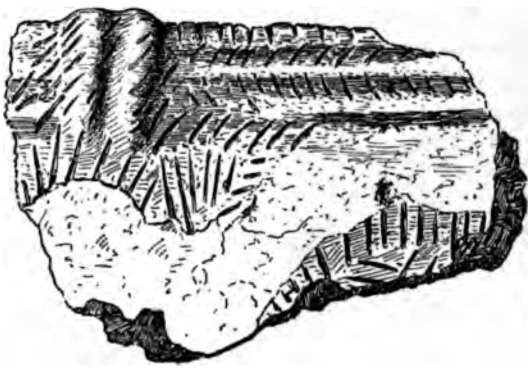
Plate XII., No. 2.—Food vessel; height, $7\frac{1}{2}$ in.; diameter of mouth, $6\frac{1}{2}$ in.; diameter of base, $3\frac{3}{8}$ in.

Fig. 1.

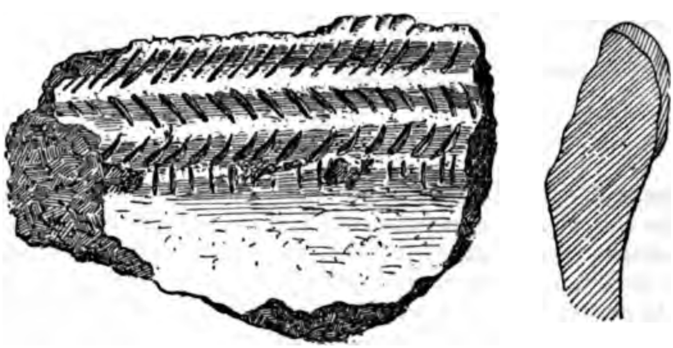
The quality of the pottery is fairly fine, containing no grains of stone.

A noticeable feature of the small vessel found inside the large urn is the recessed bottom or annular foot, shown in section, Plate XII., No. 1.

The sand-diggers stated that earlier in the day, at about the same depth below the surface as this burial, viz. two feet, and at about four feet towards the north-west, they had come upon two earthen vessels, which were not enclosed by stones. When struck they broke up, and the sand fell in upon them; but the men picked out the fragments, which, as above mentioned, were brought to the Museum. On examination three small fragments of a third vessel of smaller size (of the bowl-shaped food-vessel class) were found amongst the fragments of the larger urns. No bones appear to have been found with



(*a*)



(*b*).

FIG. 2 (½).

them. One of the larger of the vessels last mentioned has been restored, fig. 1. It measures: Height, 14 inches; diameter of mouth, 13 to 14 inches; diameter of base, 4½ in. It is quite plain, except for numerous finger impressions, especially at the foot, showing the manner in which it was shaped with the tips of the fingers (see Plate XIV., No. 2, in which a portion of the urn is shown, full size). The fragments of the other vessels were too incomplete to allow of restoration. Portions of the second of the larger vessels are shown, fig. 2 (*a* and *b*, fragments of rim, outside and inside; *c*, fragment of urn below rim; *d*, base).

The men also stated that some two months previously they had come upon "the skeleton of a man," about two feet below the surface and about five or six yards from the stone chamber in a westerly direction. The position of the skeleton was north and south, the head towards the north. At its feet was an earthen vessel containing calcined bones. This was broken by the pickaxe. Some of the fragments and some of the calcined bones were still lying on the ground close by.

(*c*) (*d*)

FIG. 2 (½).

These, with two or three small portions of the skeleton, were brought to the Museum. The fragments of the vessel are sufficient to restore the shape and ornament (Plate XIII., No. 1). The restored dimensions are: height, 5 inches; diameter of mouth, 7 inches; base, 3 inches.

In answer to inquiry made by Mr. Buckley as to any other finds of a similar kind, the men stated that they knew of only one, about five or six years ago. At that time, they said, an earthen vessel was found at a place about fifteen yards from the site of the stone chamber in an almost northerly direction. The vessel was broken in getting it out, and a Dublin curio dealer bought the fragments (these, I believe, are the fragments in the possession of Mr. Longfield) for a few shillings.[1] Beyond indicating approximately the place where it was found, the men were unable to give any information of value.

[1] See Proc. R. I. A. 3rd Ser., Vol. II., p. 400.

At the end of August, when I was not in Ireland myself, the finding of another urn was reported to the Museum. The men employed in the pit, on reaching it, had, according to instructions, covered it over and left it untouched. Mr. Coffey, accompanied by Mr. Alabaster, Mr. M'Googan (our photographer), and Mr. de Sales, foreman of the workshops, at once went out to inspect this new find. It consisted of a single urn. Pl. XIV., No. 1, shows the interment *in situ*. The urn was inverted on a small flagstone, with a few small flagstones placed round it, to keep back the earth, but no covering stone. The interment was immediately under the surface of the ground, and was in fact covered only by the sod. The urn, owing to the absence of a covering stone, was crushed down on the burnt bones, and broken into many pieces. Sufficient of the urn has been restored to enable a drawing to be made, showing the form and ornament (fig. 3). Its dimensions are: height restored, 9 inches; diameter of mouth, 8 inches; diameter of base, 3¾ inches. The interment was taken away as it stood, and has been placed in the Museum in a case adjoining the cist. Nothing was found among the burnt bones except a fragment of a small bone pin or needle (fig. 4).

FIG. 3.

A highly decorated food vessel is in the possession of Mr. Laurence Dunn, of Greenhills, the owner of the sand pit. He states that it was got from the same pit some years ago, as far as he remembers about the time the urn in Mr. Longfield's possession was found. It is in a good state, and the ornament shows much taste in treatment (Plate XIII., No. 2). Its dimensions are: height, 6½ inches; diameter of mouth, 6¼ inches; diameter of base about 2 inches.

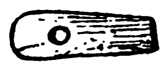


FIG. 4 (½).

As regards the probable date of the interment, my own opinion would be of little value; but Mr. G. Coffey has gone carefully into the matter, and considers that the details of the urns and fragments of urns from this small cemetery furnish a clue from which it is reasonable to draw certain conclusions. The uncremated burial found near it is a disturbing element, but we know that inhumation was practised along with cremation throughout the entire period of the latter practice. The absence, on the vessel found with the skeleton, of ornament impressed with a toothed tool, which appears to be the more characteristic form of decoration on vessels found with body burial, and the developed form of the vessel, render it, in Mr. Coffey's opinion, probable that, although the uncremated interment need not necessarily be associated with the cremated burials, no marked difference in time exists.

Fig. 5.

The fragment (fig. 2, *a*, *b*) is the most interesting piece. It is a portion of the rim of a large vessel with raised applied ornament. The raised portion of the ornament has flaked off this fragment, but is seen on some of the other fragments. This class of ornament points in itself to a late period, but the details of the fragment under consideration furnish a particular reference. The banded form of the rim, and the sort of raised clasp of two cross bands suggesting a handle, recall forcibly the rim and handle-attachment of the bronze chaldrons found in Ireland, and attributed to the close of the Bronze Age or beginning of the Iron Period (fig. 5 (fig. 407, Cat. R.I.A., p. 530), and detail of rim and handle-attachment, fig. 6).

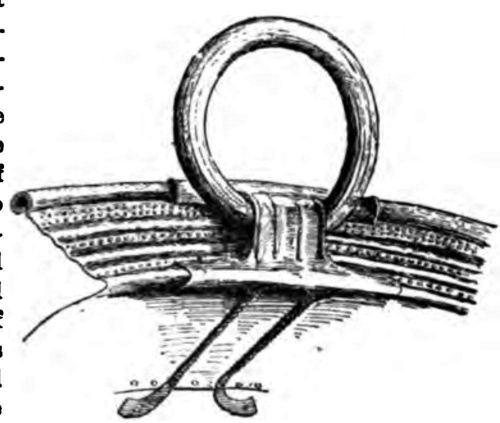


Fig. 6.

The wide sloping-in form of the inside of the rim (fig. 2, *b*), the banding of which takes a distinctly corrugated form, strengthens the

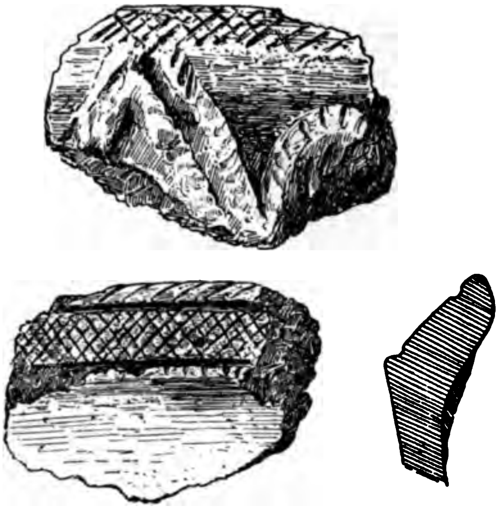


FIG. 7 (½).

resemblance.[1] These points of relation are helped out by a fragment of the rim of a similar urn from the collection of the Royal College of Science, now in the National Museum (fig. 7, outside and inside of rim). The locality of this piece has not been recorded, but there is no doubt that it was found in Ireland. We have here the same deep sloping inner rim, decorated with a band of lattice ornament. It may be compared with the band of ornament on the inner side of the cups of the gold "fibula" (fig. 8). This so-called fibula is of massive gold; it weighs 17 ozs. 10 dwts. It was found with four others in the county Waterford, and belongs, in all probability, to the early Iron Period in this country.

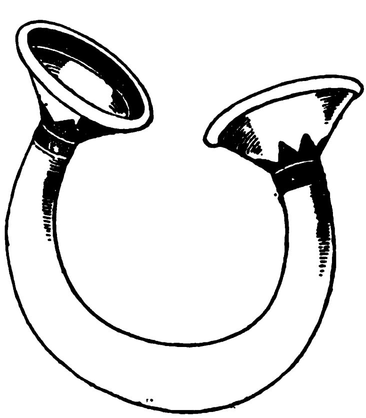


FIG. 8.

[1] The corrugation of the inner slope of the rim occurs also in a large urn with raised ornament in the Grainger collection, Belfast.

Yet a further point of relation is found in the form of the corrugation of the inside of the rim of the urn, figure 9 (Petrie Collection, Museum of the Royal Irish Academy). This urn belongs to the same class as the previous ones. It was found in one of the rude stone monuments at Carrowmore, county Sligo; a bronze ring pin is said to have been found with it. This urn appears to be later than the Carrowmore monuments, and the pin later still. In the absence of details as to the finding of these objects, we must take the urn by itself. The inside of the rim recalls the corrugated rims of the bronze vessel, figure 10. The form of the attachment of the handles of this latter class of bronze vessels corresponds with those of the bronze vessels previously referred to, also to the form of the attachment of the handles of the conical bronze vessels found in Ireland of Danubian type, figure 11 (see page 347).[1] From the close correspondence of the handles of these three classes of vessels, we may conclude that they are not separated by any great difference of time. They may all be referred to the close of the Bronze Age and the beginning of the Iron

Fig. 9.

Fig. 10.

[1] Found at Derrymacash, Co. Armagh; described in *Journ.* R.S.A.I., 5th ser., vol. 7 (1897), p. 437; now in the collection of the Royal Irish Academy: height, 1[illegible]½ inches; diameter of mouth, 11½ inches; bottom, 7½ inches.

Period. It was in a vessel similar to fig. 10 that a large portion of the Dowris find of bronze spearheads, &c., was contained.[1]

The general form of the urn, figure 3, may also be compared with that of the conical bronze vessel, figure 11; the rounded shoulder and narrow lip are common points of style. The recessed bottom of the small earthen vessel (Plate XII.), which was found under the large urn in the cist, is also important; it is undoubtedly a late feature.

The extensive use of the lattice pattern Mr. Coffey considers worthy of notice. It occurs on other examples of Irish sepulchral pottery, but is not very common. The subject of the ornament of our sepulchral pottery has not been yet worked out; but taken with the general absence of impressed ornament, with the exception of some instances on the food vessel (Plate XII.), which appear to recall some early features, it may perhaps be regarded as a late feature.


FIG. 11.

Plate XV. is an illustration of a small cinerary urn in the possession of Captain Walker, of Tykillen, county Wexford. It was found some years ago in a sandpit near his place. Its dimensions are: height, 5 inches; diameter of mouth, 5 inches; diameter of base, 3¾ inches. The form is very unusual. The ornament, both as to the manner of execution, by scoring or inscribing, and the use of the lattice pattern, presents points of relation to the Greenhills vessels. The form is of particular interest; it is undoubtedly late, and much resembles that of a cinerary urn of the Iron Period (apparently copied from a bronze vessel) found near Kélouer, Plouhtinec, Finistère.[2] The concave curve of the bottom of the Wexford urn is also, in Mr. Coffey's opinion, a late feature.

Thus along a different line of evidence we are again led to fix approximately the period of the Greenhills vessels at the end of the Bronze Age, or the beginning of the early Iron Period.

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[1] There are three vessels of this form in the Academy's collection. Fig. 10 is 17½ inches in diameter at the mouth, and 16 inches deep. A fine bronze spearhead, leaf-shaped, with rivet holes, was found in one of the others.

[2] La Poterie aux Époques Préhistorique et Gauloise en Amorique, Paul du Chatellier, Pl. 14, fig. 3.

XIX.

NOTES ON THE LESSER CASTLES OR "PEEL TOWERS" OF THE COUNTY CLARE. By T. J. WESTROPP, M.A.

(PLATES XVI. AND XVII.)

[Read APRIL 24, 1899.]

TRAVELLERS in Ireland are often impressed by the great number of "peel towers,"[1] grandiloquently called "castles," which abound in many districts of this island. This is especially the case on the line of railway from Limerick to Athenry, along which nearly thirty of these buildings are visible, several so close to the line as to be very well seen in all their principal features.

Despite the interest of the structures as a class, and their similarity to the peel towers of Scotland and northern England,[2] few detailed accounts are accessible to students in the journals of the various antiquarian societies, or the county histories. Yet, when we consider their many points of architectural interest, and that they probably owe their origin to the great alterations in society and land tenure (which evidently changed the tribal lands to practically personal properties during the fifteenth century), we may well be astonished at the paucity of students in this important field of Irish archæology.

This paper does not aim at more than a general account of the "castles" of a single district. It treats mainly of the towers built in such numbers especially by the Dalcassian tribes of county Clare, mostly (as shall be seen) during the period from 1430 to 1480. This synchronises with the great change above alluded to, which is strikingly marked by the difference between the two valuable "rentals" of the Macnamaras and O'Briens, about 1380 or 1390,[3] and the Inquisition taken at Galway on the death of John Macnamara Finn in 1585. This change is far too important to be discussed in a brief paper on an

[1] The name "peel" tower is not in use in Ireland. I merely employ it here to equate these little turrets with those of Great Britain. Pill or Pele is a Welch and Manx term for a tower.

[2] "Castellated and Domestic Architecture of Scotland from the twelfth to the eighteenth century," by D. Mac Gibbon and T. Ross, p. 143. "Pele Towers of Northumberland," by Charles Clement Hodges. Reliquary, Jan. 1891, p. 1.

[3] Transactions R.I.A., vol. xv., p. 46.

architectural subject, and requires deeper and wider research and knowledge of the records, laws, and tribal customs than the author of this paper can claim.

The castles in the districts once held by the Macnamaras in the baronies of Bunratty and Tulla are no less than eighty in number. Such instructive records of their origin remain that, by combining these with the study of the structure and ornament of the towers to which they refer, we may use the facts for the purpose of dating similar features, not only in the other "castles," but also in the monasteries and churches of the locality in which similar details occur.

Antiquaries in Scotland consider that the building of "peel towers" in that country commenced in the unsettled times of Robert Bruce, but in Ireland, at any rate in the western counties, the date of such strongholds is usually in the following century. The Irish towers were very probably imitated from the English, and succeeded the earlier raths and cahers which had continued in use till the fourteenth century and often later.

THE EARLIEST CASTLES.

There were several early castles in the county Clare. One of the earliest seems to have been a wooden castle "near the Borowe" (that is to say the great earthen fort of Boromha), close to Killaloe; it was made by the English in 1207.[1] License was given to Robert de Musegros, in January 1248, to build castles in Tradree[2] (Lower Bunratty); of these we find possible remains at Clare Castle, and perhaps in the unrecorded and nearly unknown fortress of Knockanoura, near Ennis. Quin, whose massive corner turrets, gate and curtain walls are embedded in the Franciscan Friary, was built by Sir Thomas De Clare during an interval of peace in 1279.[3] The masons were at work there in 1280, when one of them assassinated Prince Donall O'Brien. This formidable fortress, "round-towered, stone-substantial" Cuvea Macnamara "attacked. Its ditch was crossed, earthworks carried, great gate battered in and hewn down; its strong walls were breached . . . and in the actual castle a huge pile of stuff was given to the flames that ran riot till the whole became a black vaulted hideous cavern." This took place about 1285 or 1286, in revenge for

[1] Annals of Clonmacnoise. The history of the De Clares is given in the Journal R. S. A. I., 1890-91, "The Normans in Thomond."

[2] "Calendar of Irish State Papers," 1248, p. 465.

[3] "Annals of Inisfallen," and "Wars of Turlough," p. 30; the latter by the kindness of Mr. Standish Hayes O'Grady.

another murder. It was so completely defaced that we do not find it again inhabited till the Friary was founded in the following century.[1]

The most southern of the English fortresses—Bunratty—was built by Robert de Musegros before 1253, repaired by Thomas de Clare in 1276, destroyed by O'Brien and Macnamara in 1333, and does not re-appear till Tudor times. We hear vaguely of "many towers" destroyed in the eastern parts of county Clare by Prince Turlough O'Brien in 1281, and that brave soldier built two stone castles, one on an island in Inchiquin Lake, of which the base and portions of doors and windows were recently unearthed by Dr. George U. Macnamara and another at Clonroad, of which we only possess a sketch by Thomas Dyneley in 1681 showing it to have been a peel tower. Finally, the same "Wars of Turlough" mentions "a massive fighting stockade of felled trees," called the "Dangan" of the O'Gradies, signalised by a ghastly massacre of the women and children of that tribe by the Macnamaras in 1314. It will be noticed that during all these wars only actual strongholds were built, while in the fifteenth century (which in county Clare at least was less war vexed) a number of these strong houses was constructed.

The Rentals and Inquisitions.

The very important rentals made for O'Brien and for Maccon (great grandson of Cuvea) Macnamara about 1380 do not suggest, still less record, the existence of a single tower, though several cahers are named. The list of founders of castles in that part of Clare seems, on the other hand, to commence with Rossroe at about that very date, and must be in the main reliable, for whatever diminution we make for the inaccuracies apparent in our copies (in which several of the entries are contradictory), the architectural features, and the negative evidence of the elaborate rental coincide with its testimony. In the early rentals we have theoretical assessments in ounces of silver for the support of the chiefs and their wives, but in the later document the "Inquisition" of 1586, we find the old tribal lands are now Macnamara's "lawful inheritance," while mention occurs of "his owne towne of Quin, gardens, &c.," lands subject to the support of his horses and grooms, and "to Mac Namara's rent"; lands acquitted of rent

[1] Waste, in 1287, Inquisition post mortem of Thomas de Clare. Richard de Clare occupies Quin Church (not castle) on his way to Dysert, 1318. There is a plan of the Norman Castle of Quin in "The Story of an Irish Sept" (by Dr. N. C. Macnamara).

and yearly head rents to Macnamara and the Earl of Thomond, the latter being a faint and last definite relic of the older "kingdom" wherein the house of Blod sat above the house of Cassin for over eleven centuries. But in all other respects the tribal period had apparently vanished though the Brehon laws subsisted for a generation longer.

THE FOUNDERS OF THE TOWERS.

Bearing in mind the possible mistakes in the lists of castle-founders and omitting the entries where the date is doubtful, the copies divergent or the buildings totally destroyed, we can make the following table:—

1380–1402.—*Dangan Iviggin*, by Cuvea, grandson of Lochlain (1310), *circa* 1380. *Neadanura* (Newtown, Clonlara) by Lochlain, son of Maccon, *circa* 1380. *Rossroe* and the body of Quin Abbey, built by Sioda Macnamara before 1402.

1430–1450.—*Ballymarkahan* by Donall (1430), son of Shane an Gabhaltais (1400). *Bunratty* built (*i. e.* repaired) by Maccon, son of Sioda (1433), chief of Clancullen. *Firtane* (Rosslara) by Rory, son of Maccon Ceannmor, 1440 (or perhaps as late as 1480).

1450–1480.—*Ballymulcassell* (Mountcashel) by Conor na Srona O'Brien, who died 1470. *Dromline* by John, son of Maccon, who died 1467.[1] *Garruragh* by Donchad, son of Rory, son of Maccon Ceannmor (1440 or 1480). *Knappogue* and the transept of Quin Abbey, by above John, who died 1467.

1480–1500.—*Ballintlea*, by Sioda, son of Philip mor, his brother Aedh died 1487.[2] *Ballyhennan* (Castlefergus), by Aedh, grandson of Maccon, *circa* 1490. *Bealnafirverna* (O'Brien's Castle), by one of the Bishops of Killaloe, named Turlough (1460–1480). *Bunratty*, further repaired by the above John, who died 1467. *Coolreagh*, by Philip, son of Rory (1487). *Danganbrack*, by John, grandson of Lochlain, 1480. *Moghane*, by Donall, son of Rory, *circa* 1490. *Ralahine*, by Teige, grandson of Maccon, 1490.

1500–1520.—*Ballymullen* (Miltown, Tulla), by Donall, son of Aedh, *circa* 1520.

ELIZABETHAN.—*Enagh* (Stacpole's Court), by Sioda, grandson of Mahon, grandson of Teige (1380), consequently not earlier than 1560. *Lisoffin*, built (repaired) by Rory, son of Mahon, after 1600. The castle was standing, at least in 1584; and seems to date from the previous century. "The Annals of the Four Masters" show that it

[1] Ann. Lough Cé. [2] A. 4 M.

was taken and restored to its rightful owners by the Earl of Thomond in 1599, when, or at an earlier period, it may have received injuries which necessitated extensive repairs.[1]

The architecture of the towers corroborates many of the previous statements. The rude and plain castles of Dangan and Rossroe, and the late insertions in Newtown (implying need for considerable repairs, about 1530) equally tell of early foundations.

A group which dates from about 1410 or 1420, containing Lecarrow, Lismehane, Mountallon, Doon, and Trough has nearly perished, probably from want of experience in the builders; the masonry of the remaining, though prostrate, angle of Lismehane being very coarse. Rosslara is different in plan, though not in features, from other early towers.

The large group, from about 1450 to 1500, and including such fine specimens as Knappogue, Ballyhenon, Ralahine, Mountcashel, Dromline, Moghane, and Danganbrack, enables us to date others of equal merit, such as Ballygriffy, the side tower of Lemeneagh, Derryowen, Dysert O'Dea, and the slightly later, but fine and perfect, towers of Moyree and Ballygriffy, near Corofin. Indeed, that period was the "golden age" of castle-building in Thomond.

The towers of South-western Clare are in nearly all cases identical in design, but so rudely built, and, as a rule, so devoid of ornament that we can only conjecture their dates. The features of Tromra possibly date about 1490, and those of Carrigaholt, from the reign of Elizabeth. However, the plainest towers are very deceptive as to their age; and that we can easily fall into error is shown by the stump of the castle on Scattery Island, which is late Elizabethan, though apparently very old.

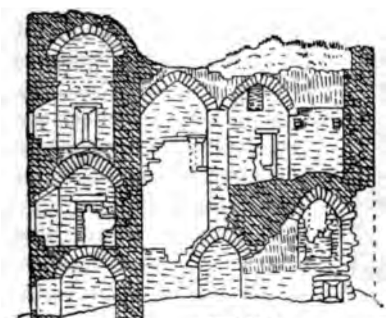
The Design.[2]

Omitting for the present the circular towers, we find a noteworthy similarity of design in the vast majority of the existing "castles"

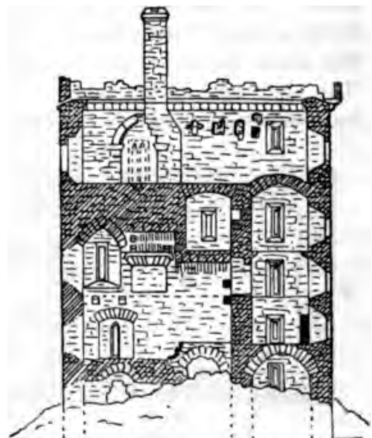
[1] There are illustrations of Bunratty and Dysert O'Dea Castles in the Journal of the Royal Society of Antiquaries of Ireland, 1890, p. 292; of Lemeneagh, in Mr. James Frost's "History and Topography of the county of Clare," p. 130; and of the Cratloes, Danganbrack, and Ralahine, in "The Story of an Irish Sept," pp. 138, 139.

[2] In the longitudinal sections here given I may note that the hatching shows the walls and vaults actually cut by the line of section. The perpendicular shading marks the curve of vaults and arches. The lower parts of Rosslara and Derryowen are deeply buried in fallen debris.

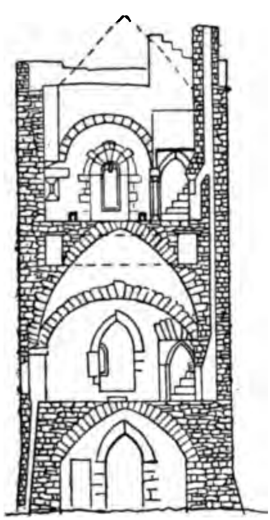
(some 80 of which I have sketched or examined, out of about 100), and the 10 shown in Dyneley's sketches in 1681.



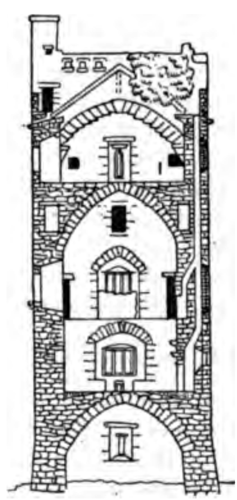
ROSSLARA.



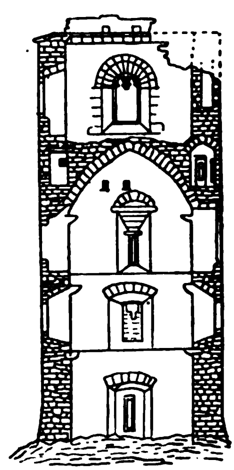
DERRYOWEN.



MOGHANE.



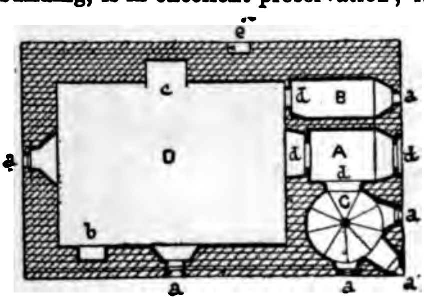
BALLYPORTRY.



SHALLEE.

Longitudinal Sections of the Castles of Rosslara (Fertane) and Derryowen. Cross Sections of the Towers of Moghane, Ballyportry, and Shallee.

The ground floor (usually of oblong plan about 30′ × 40′) consists of a badly lighted room, entered through a short passage, with two doors, the space between them being commanded by a "murdering hole."[1] To one side of this porch (usually the left) is a spiral stair, lit by window slits, often neatly moulded (one or more being cut in the angle quoins); to the other side stands a small guard room. The staircase,[2] except where ruined deliberately, or by the fall of the building, is in excellent preservation; it usually consists of 60 to 100 steps, with a rounded newel for a hand rail; landings seldom, if ever, occur. In (I think) only one instance (Ballygriffy) does a door lead directly from the stairs to the open air.



TYPICAL GROUND-PLAN.

A. Porch.	*a*. Windows.
B. Porter's Room.	*b*. Ambrey.
C. Staircase.	*c*. Fireplace.
D. "Cellar."	*d*. Doors.
	e. Drain.

(B *frequently opens into* A.)

The tower above this consists of two sections: a narrow one over the porch and guard room, including the staircase and a series of small rooms: and a broader section containing, as a rule, two rooms under one vault, and an unvaulted upper room. In the case of the Clonlara castles, the whole of this wing has only one vault, and that one under the roof. Inchovea has two stories above the upper vault. In a few examples there is no trace of vaulting anywhere.[3] As a rule the bottom story is always vaulted; the top story is very rarely so.

Several towers are built high enough to command the level country over an intervening ridge; as Teerovannan and Dunbeg, whose heads are just visible over many miles of bogs, and Magowna, which, even in its truncated condition, overlooks the ridge of Cappanakilla, towards Corofin.

EXCEPTIONAL IN DESIGN.

Gragans Castle has three cross vaults in the lower story, and a straight staircase in the wall. Castletown, near Spancel Hill, has also a straight staircase up the south wall, and a side stair in the east wall which gives access to the roof, which is of stone, there being no other main vault. Bohneill, Lissylisheen, and "De Clare's House"

[1] This is an old term, *e.g.* it occurs in Elizabethan documents. [2] See plan.
[3] As at "Rath" or Scool, Dough and Rockvale or Clondooan.

(an absurd misnomer for the late "court" at Kilnaboy) have large court-yards.

Rosslara had three cross vaults: one over the other, at the inner end; and, so far as can be seen, two longitudinal vaults near the door. But the lower stopped short of the middle space, which was only covered by the upper vault.

Lemeneagh and Urlanmore have large Elizabethan houses attached to the older turrets. Lemeneagh has also a court and porch, with elaborate coats of arms of Conor and Sir Donat O'Brien; the inscription dates 1643, and commemorates the first, and his wife, the notorious Maureen Rhue. There is a large bawn, with corner turrets to the west, and a long garden, with a fish pond and a turret at one angle, to the east. Side buildings were attached to Tomgraney, Colmanstown, Smithstown, near Kilfenora, and many others. Gleninagh has a side wing contemporaneous with the main building, being almost the only example in county Clare of the familiar "L plan," though a few others (like the Castletowns) have slight projections.

ROUND CASTLES AND FORTIFIED HEADLANDS.

Three curious towers remain at Doonagore, Faunaroosca, and Newtown,[1] all three in the old district of the Corcomroes. They are circular, and consist of three stories, two under a beehive vault and an upper one, formerly roofed. A staircase winds round the curve of the wall to the upper room, and thence to the top; the two first have got bauns. Faunaroosca has a door seven or eight feet above the ground leading to the stair, the ground floor being reached by another door, defended by a machicholation. The bawn is of dry stone walls.

There is a doorway or opening at Doonagore 15 feet above the ground: it is 6 feet long, and 3 feet high. On either side are stone holdfasts, grooved, as if to let down a cover from above. Above it is another aperture of equal width, but only a foot high. Doonagore is about 24 feet in diameter and 50 feet high.[2]

There is one example of a headland fortified in mediæval times, Dunlecky. This consisted of a long wall, with loopholes and gate. Access to the parapet was given by a small oblong tower, which probably contained ladders.[3] The place seems (like several other

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[1] The photographs of Newtown and Muckinish are by Messrs. W. Lawrence, of Sackville-street, Dublin.

[2] "S. F." in the Dublin University Magazine, vol. xli., p. 89, compares it with Coucy in Picardy.

[3] See Paper by Mr. George Hewson in the Journal of the Royal Historical and Archæological Association of Ireland, 1879-82, p. 267.

headlands in the neighbourhood) to have been entrenched in primitive times.

External Features.

The chimneys and fireplaces are usually, if not always, afterthoughts, and sometimes close up older windows.[1] There is a triple chimney at Miltown, near Tulla. The four gables capped with lofty chimneys, which form so picturesque a feature in many of the castles in other parts of Ireland, are nearly absent in Clare: Danganbrack, near Quin, being the best example. The latter castle has also circular machicholated parapets at the angles—these being usually oblong—as, *e.g.*, Derryowen, Moyree, Ralahine, etc. A row of corbels runs round the three remaining sides of Kilkeedy Castle.

As a rule a small machicholated gallery, on the parapets, defends the door; and a second outer door scarcely ever occurs. A few castles (*e.g.*, Ballyportry, Moyree, Mountcashel, Dysert, Moghane, and Edenvale) have an outwork or bawn; that at Ballyportry has been nearly levelled; and a newer outwork, with circular turrets at the angles, was constructed near the tower: it has some curious shot holes. Coolistiege has a corner window modified for a later shot hole.[2] The windows are usually mere slits, unless when later ones, with several lights, have been inserted.[3] The upper room has usually one or two large ones, with a central shaft; these have ogee or trefoil heads, and sometimes a hood-moulding. The spandrels are, at times, decorated with flowers, leaves, or knots. Most of the windows were glazed; but some have sockets for shutters, and a drain and hole in the sill to let out any rain that blew in through their opes.

Turrets occur at one angle, as at Tromra, Dunmore, Mountcashel, Dangan, near Fortfergus, and others.

Some of the towers have small circular (or more rarely square) "squints" or shot holes running aslant through the wall on a level with the head of anyone standing at the door.

As a further protection, a long horizontal slit, probably for pouring boiling water on to an assailant, exists above the door, as at Coolistiegue, Moyree, and Ballyportry.

Carvings are rare in the outer walls, except on the windows. There is a very well-cut head on a projecting stone at Castletown, at Tullycommane. I know of no instance of a "sheelanagig" now remaining *in situ* in Clare, but a mutilated example set in Clonlara

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[1] See section of Ballyportry. They also occur at Moyree.

[2] See p. 358, figs. 5 and 6.

[3] See p. 358, figs. 1, 2, 3, and 5.

bridge was probably brought from one of the neighbouring towers of Aharinagh or Newtown.[1]

Finials to the gables are very rare in county Clare. Two occur at Cleenagh Castle.[2]

INTERNAL FEATURES.

The fireplaces are usually quite plain, save for a cornice and chamfered edges.[3] Several are dated,[4] or display initials and even sentences. As at Carrigaholt, "D. B. (Daniel O'Brien) 1603." At Castlefergus, "H. T. E. 1576." At Moghane, "T. M. M° M. N. (Mac Namara) ME FIERI FECIT A.D. 1610." At Dromore, "THIS CASTLE WAS BUILT BY TEIGUE SECOND SONNE TO CONNOR THIRD EARLE OF THOMOND AND BY SLANY WIFE TO THE SAID TEIGUE A.D. 15 " (now removed). At Ralahine (I am told, for it is now inaccessible), "Fear God, remember the poor." At Cahercorcran, "1627." At Moyhill, "1637." At Ballinalackan "1644" on a handsome fireplace.[5] One at Inchovea has spiral pillars. There are small passages and recesses along the haunches of the vaults, and sometimes in the thickness of the wall. These often have ambreys and "cupboard holes." Garderobes often occur in similar recesses of the lower stories, and have "down-puts" in the thickness of the walls.[6] I am not aware of any well existing inside the tower or outworks of these castles.

The doors are pointed or round headed, at the most chamfered or slightly moulded; there is a neatly dressed cross, picked on the soffit of an arch, on the stairs of Lemeneagh.[7] The main vaults in all cases seem to have been turned over wicker work. At Urlanbeg and Mountcashel I have found the osiers embedded in the mortar, and apparently sound; but they fall to dust when handled.

The catches for the bolt, lock, and bars of the doorways are often very neatly cut, most of the doors turned in neat sockets.

In a few cases, a passage crosses the building at the staircase end of the main vault. This rests on arches at Ballyportry, Magowna, and (I think) Ralahine, but on very massive corbels at Kilkeedy.

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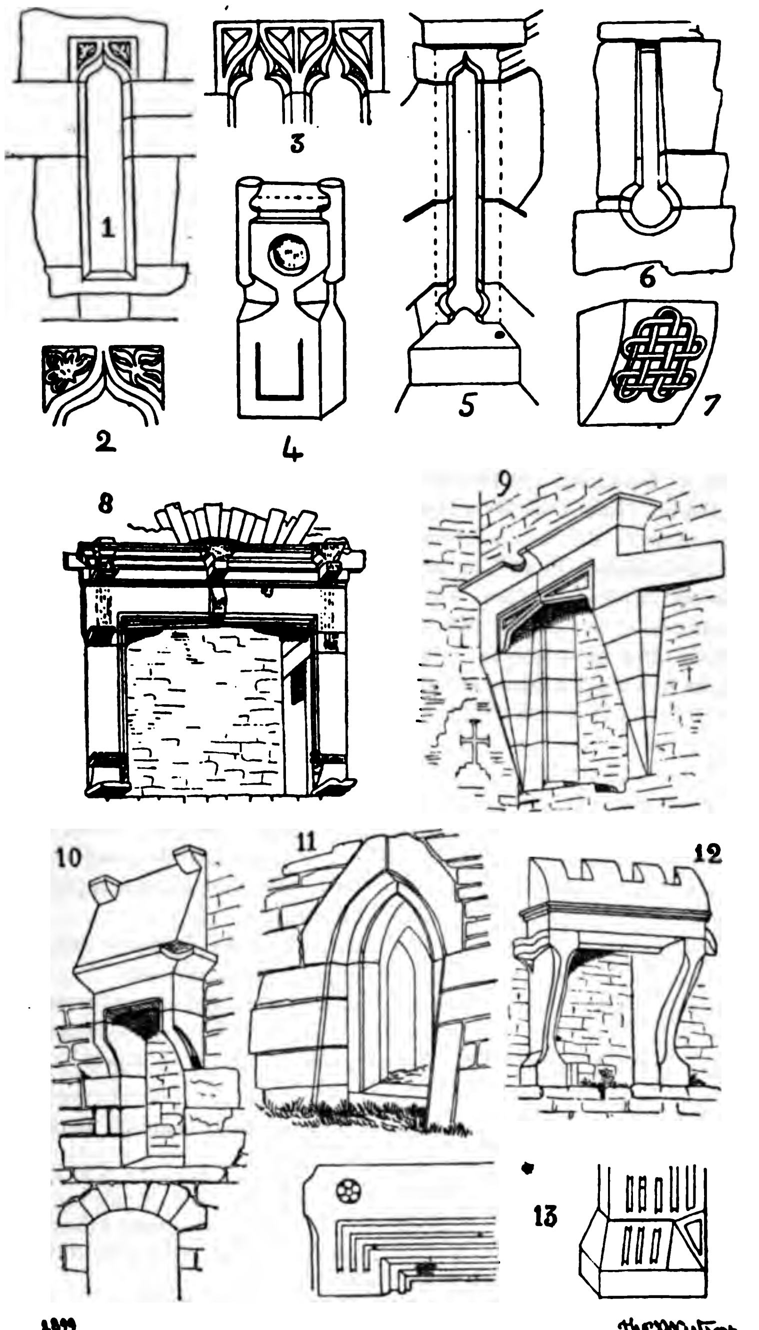
[1] In county Limerick, such figures are found on Tullyvin and Dunnaman "Castles."

[2] See p. 358, fig. 4. [3] See p. 358, figs. 8, 9, 10, 12, and 13.

[4] Whence some local "authorities" have dated the castles themselves. The curious slab, 1587 (?), at Bunratty was read 1187, and theories founded thereon.

[5] See p. 358, fig. 8. [6] One is shown in the section of Moghane.

[7] See Plate XVII., fig. 2.



Architectural Details of "Castles" in County Clare.

(For references, see p. 365.)

FALL OF CASTLES.

Strange to say, most of the towers that have fallen (several in the last twenty years) have broken across the vaults and not (as one should expect from the thrust of the arch) along the crown. The staircase angle has fallen in many others. So solid are the walls that the side of Dough fell out in one piece, and the huge fragments lie or lay on the shore of the creek in the order in which they once stood. The top turret of Dangan, near Ballynecally, is so undercut that it seems to rest only on a core of masonry and some steps, and yet has defied the storms and frosts in this condition as long as human memory extends, and even resisted a recent effort to pull it down with a rope attached to several horses. The whole side slipped out of Shanmuckinish on to the beach.

Lightning has also played its part in the ruin of our castles, especially (it should seem) in cases where animals were kept in the lower rooms. In the opening months of the present year, for example, lightning passed down the chimney of Moyree Castle, burst asunder the massive blocks of an arched fireplace, flinging masses of masonry about the second floor. It then passed through the bottom vault, killing several pigs in the lower room, and struck a farm-house near the castle.

An angle of Lemeneagh also shows several cracks, which tradition attributes to a similar cause.

The tower of Inchiquin Castle was thrown down many years ago by some mischievous pleasure seekers, one of whom borrowed a sledge-hammer and broke a stone beside the door. The greater part of the turret immediately collapsed, though without avenging itself on its destroyers.

THEIR OCCUPANTS AND DESTROYERS.

A French traveller, M. Bouillaye le Gouz, travelling in Ireland during the Civil War of 1644, thus describes the Munster Peel Towers:[1]—"The castles or houses of the nobility[2] consist of four walls, extremely high and thatched with straw; but to tell the truth, they are nothing but square towers without windows, or at least having such small apertures as to give no more light than there is in a prison. They have little furniture, and cover their rooms with rushes, of

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[1] Edition published by Crofton Croker.

[2] I suppose rather "aristocracy" for *noblesse*.

which they make their beds in summer, and straw in winter. They put the rushes a foot deep on their floor and on their windows, and many of them ornament their ceiling with branches." This corresponds with Cuellar's account, that in 1588 the Irish had no furniture and slept on the ground, on a bed of rushes, wet with rain or stiff with frost.

After the reign of Elizabeth more than one family often occupied a tower. To select from many examples. The Patent Roll of 1605 contains a grant to John King of "the upper chamber and a moiety of the cellar and bawn of Castletown Mogrossy, near Spancil Hill." Conor O'Brien held other portions of the same castle from 1604. In 1606 Daniel O'Conor died at Glen Castle, near Ennistymon. He was found to hold "the cellar, chamber, middle room, and half the porter's lodging" (probably the small room near the porch). In 1615 Cumarra Macnamara and James Roche held Cratloekeel and the custom continued till the civil war.

During the latter period we get some curious accounts of the occupants of the Clare castles, but none that throw much light on the buildings. Tromroe was taken by Captain Edmund O'Flaherty, in a sea excursion, from Aran, and its owner and his wife were slain,[1] while Ballyalla stood two sieges of six weeks each, and only surrendered to hunger and thirst. It seems wonderful how this little turret could defy a considerable force of Irish for so long, until we see the great hesitation of the besiegers to approach its walls, and the childish apparatus brought against it, including a "sowe" (or testudo), with augers to bore holes in the door, and a "lethren goon," which "only gave a great report, having 14 pounds of powthar in her and let fly backward, the bullet remaining within."[2]

After the war, the Cromwellian Commissioners dismantled the majority of the towers in 1654. Daniel O'Brien, for example (whose humanity saved many of the settlers twelve years before this time) petitions that his little castles of Dough and Ballinalacken may be spared, "your petitioner is afeared that the said masons out of malice or gain will fall doune the sd stearcase of Dough." This method of dismantling the castles accounts for the almost invariable destruction of the spiral stairs. Indeed it has even been carried out in several, which were retained as barracks by the Puritans.

The following among the peel houses were used for garrisons at

[1] See Appendix to H'Iar Connaught.

[2] Cuffe's Journal of the siege; Camden Society's Publications.

that time:[1]—Ballyalla, Ralahine, Cloghenaghbeg, Danganbrack, Brian's Castle, Inchicronan, Inchiquin, Dysert, Smithstown, Moghane, and probably Carrigaholt and Ballycarr.

After the restoration many were used as dwellings, both by the native gentry and the new settlers; but the darkness and inconvenience led to the erection of lowlier but more habitable additions, or the plain but very comfortable houses now occupied by the county families. At the beginning of the century seven towers were inhabited; I can only recall less than half a dozen now in occupation, such as Knappogue and Creggane. A few very poor families inhabit Dunbeg. A cottager dwells in Dysert. A game-keeper lived in Moghane not many years ago; and Ballyportry is occasionally occupied by travelling tinkers.

LEGENDS.

Legends are rare and seldom tally with history. Omitting the purely supernatural ghost and banshee tales—legends of the violence and cruelty of Maureen Rhue (Mary MacMahon, wife of Conor O'Brien, 1641-51), hang about Lemeneagh, and corbels are shown on which she hanged her retainers, the men by their necks, the women by their hair. The weird and beautiful legend of the swan maiden of Inchiquin, and her marriage with the owner of its castle can only be alluded to here. Moyree has a tradition of a fratricide O'Brien, who there defended himself against his avenging kinsman, Sir Donat O'Brien (1660-80). Dunlecky and Carrigaholt have legends of ill-starred chiefs and ladies; the "Seven" (recte four) castles of Clonlara, of seven hostile brothers.

It only remains for me to thank a few of the many kind friends who have helped me in this subject—Dr. George Macnamara, whose notes on the "founders," and help on the ruins themselves were of the greatest assistance; the late Dr. W. Frazer, whose helpfulness and sympathy with all archæological field work (now, alas, at an end) deserve the fullest recognition; my sisters, Mrs. O'Callaghan and Mrs. Stacpoole; Mr. Standish Hayes O'Grady, who freely gave me extracts from his still unpublished "Wars of Torlough"; Mr. James Mills, and Mr. Robert Cochrane, Secretary of the Royal Society of Antiquaries of Ireland.

LIST OF TOWERS.[2]

BURREN.—*Ballymurphy*, *Ballyvaughan*, Ballyganner (in a caher),

[1] Diocese of Killaloe, pp. 300–313.

[2] Mere sites and foundations given in italics—*p* means nearly perfect; *f*, fragment.

Binroe, or *Ballymahony*, *Cahercloggan* (in a caher), Cappagh, Castle Mael, Castletown (at Tullycommane) *f*, Crughwill *f*, Faunaroosca (round) *p*, *Glencolumbcille*, Gleninagh *p*, *Glensleade f*, Gragans *p*, *Lisdoonvarna* (has a court), *Lissylisheen* (has a court), Muckinish, Newtown *p* (round), Shanmuckinish, *Turlough*. (20.)

Corcomroe.—Ballinalacken *p* (with court), Ballyshanny (in a caher), *Beancorroe*, 1584, *Caherminane*, Cashlaunawogga, Doonagore *p* (round), Doonmacfelim, Dough, Ennistymon (portion forms end of the modern house), *Fanta*, Glen, Inchovea, *Kylemna*, 1584, Liscannor (nearly *p*), *Loughbulligan*, 1584, *Roughan*, Smithstown *p*, *Toomullin*, 1584, Tullagh. (19.)

Inchiquin.—Ballygriffy *p*, *Ballyhogan*,[1] Ballyportry *p* (has court), *Ballytiege*, *Belnalicka*, *Bohneill* (has a court), Bunnakippaun, *Cahercorcaun*,[2] Cahermacrea, *Carrowduff*, Carrownagowl, Cloondooan, Cloonselherny, Cragmoher *f*, Derryowen, Dromore, Dysert *p*, Inchiquin, Inchiquin Island,[3] *Kilkea*, Kilkeedy, *Kilnaboy*, Kilnaboy Court (called in Ordnance Survey "De Clare's house"), *Lackareagh*, Lemeneagh *p* (with court), Maghera, Magowna, *Moyhill* (called "Coort an woyle)," Moyree *p*, *Portlecka*, *Rath*,[4] Scool, Shallee, Tirmacbrain, Turkenagh (late house). (35.)

Ibricane.—*Caherrush*, Doonbeg *p*, Doonmore *p*, Doonogan, Finnor, *Freagh*, *Knockanalban*, Moy, Tromra *p*. (9.)

Moyarta.—Ballyket, Carrigaholt *p*, *Cloghansavaun*, Dunlecky (fortified headland), *Kilkee*, *Knocknagarhoon*, *Moyarta*, 1584, Scattery Island. (8.)

Clonderlaw.—*Cahercon*, Cahermurphy (with court), *Clonderlaw*, Colmanstown, *Crovraghan*, Dangan *p*, Derrycrossaun, *Inisdadrum*, Inismaconey, *Kilmurry MacMahon*, Knockilough (on an islet in a lake). (11.)

Islands.—*Ballymacooda*, 1584, Bealacorick, Clare Castle *p*, *Clonroad*, Cragbrien, *Edenvale* or *Killone* (with a bawn), Inch *f*, *Islandmagrath*, *Tirmaclane*. (9.)

Bunratty Upper.—*Ballyalla*, Ballycarroll, Ballymarkahan, *Castletown*, Castletown *p* (near Spancel Hill), Clooney *p*, Cloonmore, *Cor-*

[1] Named by Bruodin in "Propugnaculum Catholicæ veritatis."

[2] Has got the date, 1627, on part of a fireplace.

[3] Found and excavated by Dr. G. U. Macnamara.

[4] About eighty yards S. W. from the church, used with the stump of a round tower to build the grave-yard wall.

bally, Cregganeowen *p*, Danganbrack *p*, Dangan Iviggin (with court), Deerpark, *Doonmulvihil*, Inchicronan, Inchicronan "Island," Knappogue *p*, Knockanoura (early site), O'Brien's Castle, Quin (Norman fortress), *Quin*, 1584,[1] *Toonagh*. (20.)

BUNRATTY LOWER.—*Ballinaclogh*, or *Stonehall*, Ballingown or Smithstown, Ballintlea, *Ballyareela* or *Mount Ievers*, *Ballycarr*, *Ballyconneely*, Ballyhennan or Castlefergus *p*, Ballymulcashel or Mountcashel *p*, *Ballynecragga*, Bunratty *p*, *Cappa*, *Castledermot* (on an islet in a lake), *Castledonnell*, Cleenagh *p*, *Clonloghan*, 1584, *Clonmoney*, 1584, Cratloemoyle *p*, Cratloekeel, Dromline *p*, *Dromoland*, Dromullan, Drummin, Feenish, Granahan, Kilkishen *p*, Moghane *p*, Ralahine *p*, Rossmanagher *p*, Rossroe *p*, Urlan, Urlanbeg. (31.)

TULLA UPPER.—Ballinahinch, *Bunnavoree*, Caherhurley *f*, Coolreagh *f*, *Fomerla*, Fortanmore or Rosslara, Garruragh *p*, Lecarrow, *Lismehan* or *Maryfort*, Lissoffin, Miltown or Ballymullen *p*, Moynoe *f*, *Scariff*, 1584, Tomgraney *p*, *Tulla*,[2] Tyredagh. (16.)

TULLA LOWER.—Aharinagh *f*, Ballykelly, *Boruma*, 1207, Caher, Castlebawn (on an islet in L. Derg) Coolistiegue *p*, *Drimmeen*, Elmhill (or Doonass, or Rinroe or St. John's), Enagh or Stackpoole's Court, *Glenomra*, *Killaloe*,[3] *Monogeanagh*, *Mountallon*, Newtown or Neadanura, *O'Brien's Bridge*, Teerovannan *p*, *Trough*. (17.)

In all 195 ruins and known sites.[4]

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[1] Possibly the friary which was held by a garrison about that date.

[2] A portion stood in human memory in the market-place, touching the N. W. angle of the graveyard; the door faced the east.

[3] Its foundations were removed from near the Clare end of the great weir.

[4] The following unidentified names appear in the "Castle list," 1584 (MSS., T. C. D.), Scartcashel, Castlecattagh, Sewarro, Bodevoher in Tulla; Ballycasheen in Bunratty; Balhanire (? Ballyganner), Tullowmore (not Tullagh), Beancorroe, Beallagh and Kylemna in Corcomroe; Cahirnally, Ballymonoghan, Nacknasse, Neassalee and Rughaine (not Roughan) in Burren; Carrowduff, in Inchiquin; Enerisby, Inishnawar and Maghowny (not Magowna) in Islands.

Monykippaun, Tulla, Tyredagh, Formerla and Moymore were in ruins in 1613. Patent Rolls, 11 James I.

Dutton states, that out of 118 castles, the following were inhabited in 1808:—Castletown in Burren, Smithstown, Dunmore, Ballyportry, Dysert, Bunratty, Castle Fergus.—(Statistical Survey of Co. Clare).

APPENDIX.

Macnamara's Rental in Vol. XV., Trans. R.I.A., p. 45 (Antiquities). 1390.

"This is the sum of the Lordship of Macnamara—*i.e.* Maccon (*circa* 1390), mac Conmheadha mac Maccon (living 1333), mac Loghlan (executed 1313), mac Conmheadha more (died 1306); according to the testimony of the stewards of the Rodan family, and of the marshal of the country, and to the will of their father and grandfather out of Tuathmore; and the said stewards are Philip O'Rodan and Conor O'Rodan, descendants of the red steward." In the abstract we may state that the Tuathmore (most of the baronies of Bunratty) rents are 168 ounces,[1] and food to Macnamara, and 31½ ounces to his wife ("Lady's rent"). In Tuathnahavon (district near Sixmilebridge) 56 ounces (the stewards being the posterity of Mahon Finn O'Rodan). In O'Flinn (district near Kilkishen) 105 ounces and 1 groat to Macnamara, 1 ounce to his wife (stewards, the Lavelle family). In Glen (Glenomra) 126 ounces and food on the free land once a year. In Congalach (Ogonnelloe) 112 ounces; food between Christmas and Shrove on 5 townlands, and once a year on the free lands (stewards, the O'Rodans). O'Rongaile (Kilnoe and Killuran) 112 ounces; food between Christmas and Shrove on 7 townlands, and food once a year on the free lands. In Eactaoi (Feakle district) 140 ounces to Macnamara, 1 ounce to his wife, and food from Shrove to Easter. Total, Macnamara's rent, 819 ounces 1 groat, and food rights as above; "Lady's rent," 33½ ounces.

Inquisition taken at Galway, 27th January, 1585, before Sir Richard Bingham, Knight, Chief Commissioner of Connaught (Chief Remembrancer's Rolls), on the death of John Mac Namara Fynn.

Macnamara and his ancestors received yearly rents on specified lands in Clare and on Moyluin Island, "near Limerick, the freeholder whereof was always to maintain and keep a cot or boat upon his own proper cost, and charges to serve the same Macnamara up and down the river Shannon"; or failing this, 12 shillings per annum. The Inquisition then gives a long list of lands on which the Chief's rent was chargeable. Macnamara's ancestors always took, from certain

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[1] Silver, probably paid in cattle.

villages, 20 cows (or 30 pence sterling in lieu of each cow), when their eldest sons were married. They also took food for horses and boys from other villages when they kept Christmas or Easter in their house of Dangan, "and not else." Twenty-seven townlands paid certain quantities of oats in lieu of "horse and boy's meat." Macnamara and his "kearntyes and huntsmen had duties off other specified lands." Macnamara himself had all felon's goods, and kept courts baron, he held as his own inheritance, "in the town of Quin, 20 tenements and gardens, many now fallen to ruin and decay." The Earl of Thomond and his ancestors had certain charges on specified townlands in the Barony of Dangenyviggen; also, a compulsory rent called a "borome"[1] of certain cows (or 30 pence for each cow) on the death of each Macnamara. The said Earl, "what tyme he wolde go of a forrey," could claim a footman for each quarter of the said Barony, with food for two days, after which the Earl had to support them. Macnamara could claim one-third of all booties. Other lands are now acquitted of all rent, and the headship and land are now held by English tenure, and not by Irish custom.

CORRECTION.

The lower part of Shallee Castle was blocked up by a haycock and thatched shed in 1894, when I made the sketch section given on p. 353, *supra*.

Since this was engraved I find that the obstacles have been removed, and that the lower story is *vaulted* (as in the other diagrams on same page).

The wicker marks on the vaults made a pleasing fishbone pattern, which is not common in these structures.

EXPLANATION OF FIGURES (p. 358).

1, 2. Window; Newtown, Clonlara.
3. Typical Upper Window.
4. Finial of a Gable; Cleenagh.
5. Window modified by a "shot hole"; Coolistiegue.
6. Late "shot hole"; Ballyportry.
7. Corbel; Lemeneagh.
8, 9, 10, 12, 13. Fireplaces; Ballinalacken, Moyree, Lemeneagh, Teerovannan, and Ballyportry.
11. Typical Door; Moghane, &c.

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[1] When the Macnamaras (following the example of O'Brien) made terms with the English Government in February, 1542, they were granted back their lands, exempt from all "boroughs" hitherto paid to the king. Probably, as Dr. G. Macnamara suggests, their relations with the O'Briens were left unaltered.

XX.

ASTATICS AND QUATERNION FUNCTIONS. By CHARLES JASPER JOLY, M. A., F. T. C. D.; Andrews Professor of Astronomy in the University of Dublin, and Royal Astronomer of Ireland.

[Read May 8, 1899.]

[Abstract.]

In his applications of quaternions to the statics of a rigid system, Hamilton has used the quaternion equations

$$\Sigma\alpha\beta = (c + \gamma)\Sigma\beta = C + \mu.$$

In these, α is the vector from an arbitrary origin to the point of application of the corresponding force β; c is the pitch of the resultant wrench, and γ is the vector to a definite point on its axis which Hamilton called the *General Centre*; $-C$ is the virial, and μ is the resultant couple for the arbitrary origin as base-point.

If we take the first of these equations and suppose the forces rotated as a rigid system round their points of application, each vector β may be replaced by $q\beta q^{-1}$, and the equation becomes

$$\Sigma\alpha q\beta q^{-1} = (c + \gamma)\, q\Sigma\beta q^{-1},$$

c and γ now referring to the rotated system.

If the linear function $\Sigma\alpha q\beta\,(\Sigma\beta)^{-1}$ is briefly denoted by fq, the equation becomes, when multiplied into $q\,(\Sigma\beta)^{-1}$,

$$fq = (c + \gamma)\,q. \qquad \text{(A)}$$

This contains in a very simple manner the essentials of the various systems of forces when the body is fixed while the forces move.

If the body is rotated while the forces are fixed in magnitude and direction, and if the rotation is specified by $q^{-1}(\quad)q$, we find, when each vector α is replaced by $q^{-1}\alpha q$, the equally simple equation,

$$fq = q\,(c + \gamma), \qquad \text{(B)}$$

applicable to the discussion of the force systems when the directions of the forces are fixed in space.

In order to illustrate the use of these equations, we find from (A),

$$c = Sfqq^{-1}, \quad \text{and} \quad \gamma = Vfqq^{-1},$$

which give without ambiguity the pitch and the centre when the rotation is assigned, and hence the wrench is completely determined, and the equation of its axis is

$$\rho = \gamma + tq\Sigma\beta q^{-1}.$$

Or again, we may regard c and q as unknown; and on solution of (A) we find four values of q determining four rotations which place the forces so that their centre is at the extremity of the given vector γ. Or we may seek the rotations which produce wrenches of given pitch, and we see that if

$$\kappa = \frac{Vq}{Sq} = \tan \angle q \,.\, UVq,$$

κ must terminate on the quadric

$$c = S\,\frac{f(1+\kappa)}{1+\kappa}, \quad \text{or} \quad c(1-\kappa^2) = S(1-\kappa)f(1+\kappa);$$

and from this it appears that if we rotate the forces round a direction parallel to a radius vector of this quadric, and through double the angle whose tangent is equal to the length of that radius, the pitch of the resultant wrench will be equal to c.

Or we may seek the locus of centres of wrenches of a given pitch c. This is determined by the equation of the latent quartic of $fq - \gamma q$, when the given value of c is substituted therein. The locus is a cyclide. Or, if we turn to the equation

$$\gamma = Vfqq^{-1},$$

it is seen without trouble that the locus of γ is a region circumscribed by the cyclide corresponding to the wrenches of zero pitch, and by a cylinder of the second order. This cylinder touches where it meets all the cyclides.

Or again, if q is of the form $q_1 + tq_2$, where q_1 and q_2 are given quaternions and t a variable scalar, we find, as t varies, that the rotation takes place round a definite direction but through a varying angle, and that

$$\gamma = Vf(q_1 + tq_2)\,.\,(q_1 + tq_2)^{-1}$$

describes an ellipse, while the corresponding axes of the resultant wrenches describe surfaces which are in general of the fourth degree. These surfaces may be obtained from right hyperboloids by projecting a circular section into an ellipse, and by transporting the generators of *one* system parallel to themselves so as to pass through corresponding points on the ellipse. They become right circular cylinders when the axes are parallel, and hyperboloids of revolution when the axes are of equal pitch—a possible case.

Again, we may write the equation of an axis of a wrench in the form

$$\rho = \gamma + C\tau, \quad \text{where} \quad \tau = q(\Sigma\beta)^{-1}q^{-1} = q\tau_0 q^{-1}$$

is the reciprocal of the vector representing the resultant force, and where $-C$ is the virial of the system at the extremity of the vector ρ.

If we replace γ in (A) by $\rho - C\tau$, or rather by $\rho - Cq\tau_0 q^{-1}$, we have

$$fq - \rho q + Cq\tau_0 = cq. \tag{C}$$

This equation connects the quaternion q specifying the rotation, the vector ρ to an arbitrary point, the virial at that point, $-C$, and the pitch, c, of the resultant wrenches whose axes pass through the point.

If, for a given value of ρ, we form the latent quartic, we have the relation between pitch and virial of each of the force systems whose axes pass through the point. If we regard q and C as unknown, we can, from the latent quartic, determine four values of C, and corresponding to these four different rotations, so that the resultants of the four corresponding force systems are wrenches of given pitch whose axes pass through the given point.

For proper choice of origin, and proper choice of the initial position of the force system, the function f becomes greatly simplified. In its simplest form,

$$fq = eSq + \phi Vq,$$

where the function ϕ is self-conjugate, and one of its latent roots is $-e$, and the others are equal and opposite—say $\pm e'$. In this case,

$$(\phi + e)\Sigma\beta = 0.$$

When this simplification is introduced, it is apparent that the latent quartics are peculiarly simple, being in fact quadratics in c^2. Indeed, the latent quartic of (A) and of (B) is

$$(T^2\gamma + c^2 - e^2)(T^2\gamma + c^2 - e'^2) + T^2(\phi + e)\gamma = 0.$$

The quadrics used in determining the rotations which produce wrenches of given pitch are in this canonical form concentric, and their equations are

$$S\kappa(\phi - c)\kappa = e - c.$$

Some account is also given of the conditions that a body having various degrees of freedom may be in equilibrium under the action of the forces, and of the manner in which the forces may be turned without disturbing the equilibrium of the body.

When dealing with the effect of the force systems when a point of the body is fixed, it may be more convenient to use Hamilton's second equation

$$\Sigma\alpha\beta = C + \mu.$$

This, when the forces are turned, furnishes the relation

$$Fq = (C + \mu)q. \qquad \text{(D)}$$

And, when the body is turned,

$$Fq = q(C + \mu). \qquad \text{(E)}$$

In these, $Fq = \Sigma\alpha q\beta$, and μ is the couple, and $-C$ the virial of the rotated force system for the fixed point as base-point.

Comparing these with (A) and (B), we see that μ and C are related to F in precisely the same manner as γ and e are related to f.

For example, from (D),

$$\mu = VFqq^{-1},$$

so if lines are drawn through the origin to represent the resultant couples, their extremities fill a certain region; the points corresponding to a given direction about which the rotation is performed lie on an ellipse. Also, the points corresponding to a given value of the virial lie on a cyclide; and, with new interpretations, many of the results stated concerning the former equations (A) and (B) apply equally to these new equations (D) and (E).

XXI.

A NOTE ON CERTAIN CURVES CONNECTED WITH THE DOUBLE NORMALS OF PLANE BICIRCULAR QUARTICS AND CYCLIDES. By J. GILBART SMYLY, M.A., Fellow of Trinity College, Dublin.

[Read May 8, 1899.]

Consider a circle S, and a conic F; the bicircular quartic generated from these has four centres of inversion, namely, the centre of S, and the vertices of the common self-conjugate triangle of S and F.

Let
$$S \equiv x^2 + y^2 + 2fx + 2gy + c = 0,$$
$$F \equiv \frac{x^2}{a} + \frac{y^2}{b} - 1 = 0.$$

The polar planes of a point $x'y'$ with regard to S and F are
$$x(x' + f) + y(y' + g) + fx' + gy' + c = 0,$$
$$\frac{xx'}{a} + \frac{yy'}{b} - 1 = 0;$$
if these planes coincide,
$$\frac{a(x' + f)}{x'} = \frac{b(y' + g)}{y'} = -(fx' + gy' + c) = -\lambda.$$

Hence the coordinates of the vertices of the common self-conjugate triangle are
$$-\frac{af}{a + \lambda}, \quad -\frac{bg}{b + \lambda};$$
λ being given by the equation
$$\lambda - c + \frac{af^2}{a + \lambda} + \frac{bg^2}{b + \lambda} = 0. \qquad \text{(i.)}$$

The equation of the quartic is
$$(x^2 + y^2 - c)^2 = 4\left[a(x + f)^2 + b(y + g)^2\right].$$

This equation remains unchanged if we substitute $c - 2\lambda$, $a + \lambda$ $b + \lambda$, $\frac{af}{a+\lambda}$, $\frac{bg}{b+\lambda}$ for c, a, b, f, g, respectively: hence the bicircular quartic may be generated in four ways as the envelope of a circle, whose centre moves on the quadric

$$\frac{x^2}{a+\lambda} + \frac{y^2}{b+\lambda} - 1 = 0,$$

and which cuts the circle

$$x^2 + y^2 + 2\frac{af}{a+\lambda} + 2\frac{bg}{b+\lambda} + c - 2\lambda = 0,$$

orthogonally; λ being zero on a root of (i.).

The curve

$$\begin{vmatrix} \frac{dS}{dx} & \frac{dS}{dy} \\ \frac{dF}{dx} & \frac{dF}{dy} \end{vmatrix} = 0, \quad \text{or} \quad \begin{vmatrix} x+g & y+f \\ \frac{x}{a} & \frac{y}{b} \end{vmatrix} = 0 \qquad \text{(ii.)}$$

is a rectangular hyperbola, and passes through the centres of the circle and conic, and also through the vertices of their common self-conjugate triangle; it also passes through 16 other points closely connected with the quartic:—

At any point T of F draw the tangent TP; from C, the centre of S, let fall the perpendicular CP on TP; on this line take the limiting points t, t'; then t, t' are points on the quartic, and tT, $t'T$ are normals to the quartic at t and t'. If T and P coincide, then tt' is a double normal, and T is its middle point; in this case, CT is normal to the conic. Hence four double normals can be drawn through each centre of inversion.

The coordinates of any centre of inversion are

$$-\frac{af}{a+\lambda}, \quad -\frac{bg}{b+\lambda},$$

and the equation of the corresponding focal conic is

$$\frac{x^2}{a+\lambda} + \frac{y^2}{b+\lambda} = 1. \quad [\lambda = 0, \text{ or a root of (i.)}]$$

The equation of the normal to this conic at $x'y'$ is

$$\frac{x - x'}{\frac{x'}{a+\lambda}} = \frac{y - y'}{\frac{y'}{b+\lambda}} = \theta;$$

if this pass through the centre of inversion,

$$x' = -\frac{af}{a+\lambda+\theta}, \quad y' = -\frac{bg}{b+\lambda+\theta}.$$

These values satisfy equation (ii.).

Therefore, the middle points of the 16 double normals of a bicircular quartic lie on the rectangular hyperbola which passes through the four centres of inversion and the centre of the focal conics.

This curve remains the same if we suppose the radius of the circle to vary: we thus obtain a system of bicircular quartics, having four common concurrent double normals which have the same points of bisection; the locus of the middle points of the 12 other double normals is the rectangular hyperbola under consideration. This curve may also be regarded as the locus of the vertices of the common self-conjugate triangles of a fixed conic and a system of concentric circles.

The 12 double normals of a circular cubic have exactly similar properties.

Cyclides.

Let $$S = x^2 + y^2 + z^2 + 2fx + 2gy + 2hz + d = 0,$$

$$F = \frac{x^2}{a} + \frac{y^2}{b} + \frac{z^2}{c} - 1 = 0.$$

The coordinates of the centres of inversion are

$$-f, \ -g, \ -h, \quad \text{and} \quad -\frac{af}{a+\lambda}, \quad -\frac{bg}{b+\lambda}, \quad -\frac{ch}{c+\lambda},$$

where λ is given by the equation

$$\lambda - d + \frac{af^2}{a+\lambda} + \frac{bg^2}{b+\lambda} + \frac{ch^2}{c+\lambda} = 0.$$

The equation of the cyclide is

$$\left[x^2 + y^2 + z^2 - d\right]^2 = 4\left[a(x+f)^2 + b(y+g)^2 + c(z+h)^2\right].$$

Then, by reasoning exactly similar to that employed for plane bicircular quartics, we obtain the following theorems:—

A quartic cyclide has thirty double normals passing by sixes through the five centres of inversion.

The middle points of these thirty double normals lie on a twisted cubic, the intersection of three rectangular hyperbolic cylinders, which passes also through the five centres of inversion and the centre of the focal quadrics.

In a system of quartic cyclides which have six common concurrent double normals with the same points of bisection, the locus of the middle points of the twenty-four other double normals is a twisted cubic, which may also be regarded as the locus of the vertices of the common self-conjugate tetrahedra of a fixed quadric and a system of concentric spheres.

The coordinates of any point on the twisted cubic may be written in the form

$$-\frac{af}{a+\lambda},\quad -\frac{bg}{b+\lambda},\quad -\frac{ch}{c+\lambda};$$

to this point corresponds the focal quadric

$$\frac{x^2}{a+\lambda}+\frac{y^2}{b+\lambda}+\frac{z^2}{c+\lambda}-1=0;$$

from the point and quadric an infinite system of cyclides connected with a twisted cubic is derived; the equations of this curve are given by

$$\left\|\begin{matrix} x+\dfrac{af}{a+\lambda} & y+\dfrac{bg}{b+\lambda} & z+\dfrac{ch}{c+\lambda} \\[2ex] \dfrac{x}{a+\lambda} & \dfrac{y}{b+\lambda} & \dfrac{z}{c+\lambda} \end{matrix}\right\| = 0,$$

which immediately reduces to

$$\left\|\begin{matrix} x+f & y+g & z+h \\[1ex] \dfrac{x}{a} & \dfrac{y}{b} & \dfrac{z}{c} \end{matrix}\right\| = 0;$$

hence, there is a doubly infinite system of cyclides connected with the same twisted cubic.

If P and Q be any two points on the cubic, the polar plane of P with regard to the quadric corresponding to Q is identical with the polar plane of Q with regard to the quadric corresponding to P; hence, given any point P and a quadric F, the quadric corresponding to any point on the cubic obtained from them can be constructed geometrically.

Also, if any point be taken on the cubic, a quadric can be determined such that the locus of the vertices of the common self-conjugate tetrahedra of the quadric and a system of spheres having the point as centre, is the cubic; the system of quadrics so obtained is confocal.

XXII.

NOTES ON THE TINNECARRA CROMLECH NEAR BOYLE.

By the REV. FRANCIS E. CLARKE, M.D., LL.D.

(Plate XVII.)

[Read June 26, 1899.]

The interesting relic to which these brief notes refer is situated in the townland of Drimminone, and barony of Boyle, in the county of Roscommon, and about two miles from the town of Boyle. It lies 25 yards to the north of the Midland Great Western Railway, close to the crossing, immediately opposite the entrance-gate of Tinnecarra House, the residence of John Powell, Esq., J.P. It is also situated about 200 yards to the north of the river Boyle, where it flows from Lough Gara. The field in which the cromlech stands is in grass, and presents all the marks of attention and cultivation, though for many years it has not been tilled. It belongs to a small farm on the King-Harman estate.

The cromlech stands out by itself a prominent object, when once we pass the high hedge which shuts it out from view of the railway-track. The spectator looks in vain for any large stones, besides those of which it is composed, which are generally supposed to have been brought from the Curlew Hills, about two miles distant to the northward. There are six stones in all, viz. four upright, one that has fallen from its original position, and the large upper covering-stone. The long axis of the cavity faces nearly east and west, orientation deviating less than a point towards the north. The upper stone is silicious sandstone, showing many distinct layers of successive deposits, and is extensively perforated and worn by the corroding influences of exposure. Its greatest length is 13½ feet, and 11 feet in width, with an average thickness of about 20 inches, and has been estimated as being about 17 tons in weight. The ground upon which the structure is reared slopes downwards towards the north. A small mound of earth, evidently for the purpose of securing a level foundation, was piled on the east and north, averaging about 1½ feet from the surface of the surrounding field.

It is evident that there were originally six upright stones supporting the immense horizontal slab above, viz. one at the east and west respectively, and two at each side. Of these, the two on the northern side remain, the one next the east 7½ feet wide, being apparently *in situ*, while its western neighbour, much the smaller of the two, has been violently deflected downwards and inwards. The stone at the eastern end is in its place, and so is the adjacent one on the southern side. This latter stone is 5½ feet wide, and very much split and damaged by weather. Neither the second stone on the southern side, nor the western transverse stone, are erect, but there is a large stone (evidently one of the set), and most probably that belonging to the west extremity, lying partly covered with grass and *débris*, a little distance from the floor of the cavity. The latter is covered over with pieces of broken stone, many of which are quite smooth, and have lost, to a large extent, the evidences of fracture, owing to long exposure to rain and frost. One of the uprights is, therefore, absent altogether, and if the theory be correct that the fallen one was originally the transverse western stone, it follows that the missing support was the second stone on the south at its western end.

Weld, in his "Survey of Roscommon," written in 1832, accounts for the loss of this stone:—"At a short distance to the north of the small mill," he writes, "at the issue of the river from Lough Gara, on the right-hand side of the road going towards the lake, and not far from it, stands one of the largest cromlechs I have seen in Ireland. The sloping upper stone is 15 feet long by 11 feet broad; its greatest thickness 2 feet 6 inches, and its average thickness might, perhaps, be safely set down at 18 inches. It is now supported by four upright stones, but once had a fifth. To this the neighbouring miller, in an evil hour, took a fancy, judging it would make an admirable stone for his mill, and, with much difficulty and labour, he removed it from its place; but just as the operation was on the point of being completed, the stone, to the amazement and terror of the bystanders, flew into a thousand pieces, an occurrence which was interpreted as a judgment upon the miller for his audacious violation of this sacred work of antiquity." "I presume," Mr. Weld continues further on, "that the fracture and disruption of the supporter in this instance might have been attributable to the weight of the upper stone shifting, and coming suddenly upon the upright pillar, beyond what is was able to bear." "The pillars are silicious conglomerate, in a sandstone matrix, such as would have well suited the purposes of the miller."

Now if this be accepted as veracious, it accounts not alone for the disappearance of one of the supports, but also for the presence of the large quantity of loose stones lying on the floor of the chamber, for the hurling of the western transverse stone from its position, for the deflection inwards of one of the two northern stones, and also for the present remarkable obliquity of the enormous superincumbent stone. Mr. Weld evidently did not observe, or, if he did, failed to take into his consideration the large prostrate stone partly buried, and which I believe to have constituted the western wall of the chamber. At present the upper stone only rests on three supports, as it does not touch the eastern transverse stone at all. It is kept from sliding off, and its stability is maintained, by a ledge on its under surface projecting in such a manner as to act like a flange on the upper and inner edge of the north-western longitudinal stone. The latter was violently wrenched from its strictly vertical position, adjacent to its neighbour on the north, which still retains, with the opposite column on the south, and the transverse eastern stone, the original perpendicular. The large upper stone is somewhat heart-shaped, or like an inverted shield, and, as it now lies, is 8½ feet from the ground at its eastern extremity, and but 2½ feet at the south-west.

The first photograph (No. 1) is by Mr. Francis Armstrong, photographer, of Boyle. It is taken from the south-west, and beautifully shows the obliquity of the large stone, and the projecting ledge which impinges upon the edge of the deflected north-western support. The broken stones on the floor are well seen, as also a portion of the large and partly-buried stone, which, I believe, formed the western wall.

The other photograph (No. 2) was taken for me by Master G. H. Odbert, a young amateur, who kindly accompanied me to the site of the cromlech, and photographed it from two different aspects. It shows the east end, the massive extremities of the northern and southern longitudinal blocks, and the eastern transverse wall, 4½ feet high, erected just a yard from the extremities of the sides. The dimensions of this end are 7 feet 8 inches in height from the inferior surface of the upper stone as it at present lies, and 7 feet 6 inches wide. Internally, that is within the transverse eastern stone, the chamber measures but 3 feet 8 inches in diameter.

In conclusion, I need only say that any antiquarian happening to be in the neighbourhood of Boyle would be amply repaid for his trouble by a visit to the cromlech at Tinnecarra.

XXIII.

ON THE CONDITIONS FOR MAXIMUM AND MINIMUM SOLUTIONS IN THE CALCULUS OF VARIATIONS WHEN CERTAIN FLUXIONS OF THE VARIABLES HAVE FINITE AND ARBITRARY VARIATIONS. BY E. P. CULVERWELL, M.A., F.T.C.D.

[Read JUNE 12, 1899.]

ATTENTION has been recently directed to this problem by the investigations of Weierstrass and Zermelo in Germany. The former gave the condition for two dependent variables, y_1 and y_2, when they are connected with the independent variable by an equation such that the three really represent a plane curve, and when only the first differentials appear in the function to be integrated. The latter extended the result to the case where higher fluxions d^ny_1/dx^n and d^ny_2/dx^n appeared, and where these quantities alone might have finite variations, the same equation of connexion holding between the variables.

The investigations were very tedious, but the result was very simple; and in seeking for a proof dependent more or less on geometric ideas, I extended the result, first to one independent and any number of dependent variables, and, by a somewhat longer process, to the case of multiple integrals, and found that I could also give the criterion where any number of higher fluxions were permitted to take finite variations. As I have since seen how to prove the result for all cases of single or multiple integrals by a single and very short method, I am not giving to the Academy the original rather long investigation for multiple integrals, but that for single integrals is here presented.

Since the variations may be finite and arbitrary, they must be capable of sudden changes from one finite value to another, and the very conception of such discontinuity involves the condition that the integral taken along the discontinuous variation must be equal to the sum of the integrals taken from one point of discontinuity to the next. For if it were necessary to treat a sudden change of direction, for instance, as a limiting case of a line changing its direction by turning round a point, so that the angular point of discontinuity was regarded as an indefinitely small circle, and as such might give rise to a finite element in the integration, that would be to treat the variation as continuous, though finite, and not as arbitrary and finite.

For instance, in the case of a plane curve, if OP be the stationary curve, and $Oabc \dots P$ the varied one, the condition is that the integral treated as taken along $Oabc \dots P$ shall be treated as the sum of the integrals taken along Oa, ab, bc, &c.; or, as we may write it—

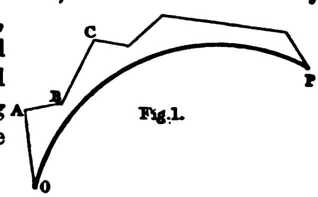

Fig. 1.

$$I(Oabc \dots P) = I(Oa) + I(ab) + \text{\&c.}^1 \qquad (1)$$

It will also be supposed that the *limiting* values of all those quantities which are only permitted to have small variations are given; that the increment of the independent variable is always positive, except where specially stated to be capable of either sign; and that all the quantities involved in the determination of the *stationary* value are continuous.

§ 1. The resulting criteria may be stated in general terms thus:—Let the integral in question be written as

$$I = \iint \dots F\{x_1, x_2, \dots y_1, y_2 \dots y_1^{(r, s, \dots)}, \text{\&c.}, y_1^{(\alpha, \beta \dots)}, \text{\&c.}\} \, dx_1 dx_2 \dots$$

where x_1, x_2, &c., represent the independent variables; y_1, y_2, &c., the dependent variables; and where $y_1^{(r, s, \dots)}$, &c., is meant to include all fluxions such as

$$\frac{d^{r+s+\dots} y_1}{dx^r_1 \, dx^s_2 \dots},$$

which are permitted to take small variations only, while $y_1^{(\alpha, \beta, \dots)}$, &c., includes all those functions which are permitted to take variations of any finite magnitude.

Let also $y^{(a, b, \dots)}$ typify the *lowest* of the $(\alpha, \beta, \dots)$ fluxion, *i.e.*, let it typify those fluxions which, though they are themselves permitted to have arbitrary and finite variations, do not arise from the differentiation of similar fluxions, but from the differentiation of the $y^{(rs \dots)}$ fluxions.

Let also $Y_{ab} \dots$ and $Y_{\alpha\beta} \dots$ typify the functions

$$\frac{dF}{dy^{(a, b, \dots)}}, \quad \text{and} \quad \frac{dF}{dy^{(\alpha, \beta, \dots)}},$$

respectively.

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[1] The cases in which this equation is not admissible are evidently those in which we have to take account of the value of the integral *at* the point of discontinuity—in other words, where we have to regard the discontinuous variation $Oab \dots P$ as a *limiting case of a continuous variation.* Such cases are excluded in this Paper.

Let also the function E be defined as follows:—

$$E = F(x_1, x_2 \ldots, y_1, y_2 \ldots y_1^{(rs\ldots)}, \text{\&c.}, \bar{y}_1^{(\alpha\beta\ldots)}, \text{\&c.})$$
$$- F(x_1, x_2 \ldots, y_1, y_2, \ldots y_1^{(rs\ldots)}, \text{\&c.}, y^{(\alpha\beta\ldots)}, \text{\&c.})$$
$$- \Sigma Y_{ab}(\bar{y}^{(a,b,\ldots)} - y^{(a,b,\ldots)}) = \bar{F} - F - \Sigma, \qquad (2)$$

where $\bar{y}$ is the value of y corresponding to the varied curve.

§ 2. Then the necessary and sufficient conditions that the stationary solution should be a true minimum compared with an integral obtained from it by a permissible variation are

$$Y_{\alpha\beta\ldots} = 0\ (\alpha > a,\ \beta > b,\ \text{\&c.}), \qquad (3)$$

and

$$E > 0. \qquad (4)$$

These conditions, (3) and (4), are to hold throughout the whole extent of the integration when y_1, y_2 have the values derived from the stationary solution, while the fluxions of $\bar{y}_1$, $\bar{y}_2$, &c., have any finite arbitrary values.

§ 3. It will be supposed that the increment of every independent variable is positive throughout the integration unless otherwise stated. In case any independent variable should not fulfil this condition in the solution of any problem, it will only be necessary to take a new independent variable which does satisfy it, treating the old independent variable as a new dependent one. Thus, if we are treating of a plane curve where the independent variable x changes sign, either in the original or varied curve, it is only necessary to introduce a new variable s, to treat x and y as functions of s, and to apply the criteria in the form in which they are given for three variables, instead of that for two variables.

It may sometimes, however, be well to consider the integral in its original form, in which dx does change sign.

§ 4. When it is said that the limiting variations are to be zero, what is meant is that

$$\delta y^{(r,s,\ldots)} = 0, \quad r < a,\ s < b,\ \text{\&c.} \qquad (5)$$

at every limiting point. This is a more general condition than the ordinary one of "fixed limits," because here $\delta y^{(a,\beta,\ldots)}$, &c., may have any finite values at the limits, a modification which immediately follows from the condition that these quantities may have finite values anywhere in the range of integration.

§ 5. Thus the conditions of a permissible variation are—

(*a*) Every variation typified by $\delta y^{(r,s,\ldots)}$ must be continuous throughout the whole extent of integration, and be zero at every limiting point.

where $(k)_2$ is used to represent any function involving k in the second degree *at least.*

Since the variations of the lower fluxions in AB are small, *i.e.* less than k, we may write

$$\int^A F(\bar{y}_1, \bar{y}_2)\, Dx = \int^A \bar{F} Dx + (k)_2,$$

where $\bar{F}$ is what $F(y_1 y_2)$ becomes, when for $y^{(n)}$ and the *higher fluxions only* we write $\bar{y}^{(n)}$ and the corresponding fluxions; in other words, $\bar{F}$ is the F-function which appears in (3).

Hence
$$I(AB) = \int^A \bar{F} Dx + (k)_2.$$

Again, if δ and δ' represent the small variations by which we pass from the stationary solution to AP and BP, respectively, we may write

$$I(AP) = \int_A^P (F + \delta F)\, dx + (k)_2, \quad I(BP) = \int_B^P (F + \delta' F)\, dx + (k)_2.$$

Hence we may write

$$I(ABP) - I(AP) = \int^A \bar{F} Dx + \int_B^P (F + \delta' F)\, dx$$
$$- \int_A^P (F + \delta F)\, dx + (k)_2.$$

If we write
$$\delta'' = \delta' - \delta, \tag{10}$$

we may simplify the above expression by writing

$$\int_B^P (F + \delta' F)\, dx - \int_A^P (F + \delta F)\, dx = \int_B^P (\delta' F - \delta F)\, dx - \int_A^B (F + \delta F) dx$$
$$= \int_B^P \delta'' F - \int^A F Dx + (k)_2.$$

Writing $I(ABP) - I(AP)$ as $I(ABPA)$, we thus obtain

$$I(PABP) = \int^A (\bar{F} - F)\, Dx + \int_B^P \delta'' F dx + (k)_2.$$

Since the solution OP is a stationary one, the integral of $\delta'' F dx$ depends only on the limiting variations, and we get, according to the usual theory,

$I(PABP)$
$$= \int^A (\bar{F} - F)\, Dx + \int_B^P ({}_1Y_{n_1} \delta'' y_1^{(n_1 - 1)} + ({}_1Y_{(n_1-1)} - {}_1\dot{Y}_{n_1}) \delta'' y_1^{(n_1 - 2)} + \text{\&c.})$$
$$+ \int_B^P ({}_2Y_{n_2} \delta'' y_2^{(n_2 - 1)} + ({}_2Y_{(n_2-1)} - {}_2\dot{Y}_{n_2}) \delta'' y_2^{(n_2 - 2)} + \text{\&c.}), \tag{11}$$

where the suffices 1 and 2 at the left-hand side of Y refer to the variable with regard to which the Y functions, whose formation is explained in § 1, are obtained.

According to the conditions (8), the terms at the P limits all vanish.

§ 10. With regard to the terms at the B limits, the fluxions of $\delta''y$ are not all arbitrary, because the condition that both AP and BP are to have contact of the proper order with AB enables us to express some of them in terms of Dx and the functions y and $\bar{y}$.

For, if z represent any fluxion of y_1 up to $y_1^{(a_1-1)}$, inclusive, or of y_2 up to $y_2^{(a_2-1)}$, inclusive; and if Z represent the corresponding $\bar{Y}$ function, we have, by the conditions of continuity in § 4, because $\bar{y}$ and $y + \delta y$ must have contact of the proper order at A.

$$\Big/^{A} \bar{z} = \Big/^{A} (z + \delta z), \quad \text{or} \quad \Big/^{A} \delta z = \Big/^{A} (\bar{z} - z), \tag{12}$$

and

$$\Big/^{B} \bar{z} = \Big/^{B} (z + \delta' z), \quad \text{or} \quad \Big/^{B} \delta' z = \Big/^{B} (\bar{z} - z); \tag{13}$$

from which

$$\Big/^{B} Z\delta z = \Big/^{A} Z\delta z + (k)_2 = \Big/^{A} Z(\bar{z} - z) + (k)_2, \tag{14}$$

and

$$\Big/^{B} Z\delta' z = \Big/^{A} Z(\bar{z} - z) + \Big/^{A} (\dot{Z}(\bar{z} - z) + Z(\dot{\bar{z}} - \dot{z}))\, Dx + (k)_2. \tag{15}$$

Hence, subtracting,

$$\Big/^{B} Z\delta'' z = \Big/^{A} (\dot{Z}(\bar{z} - z) + Z(\dot{\bar{z}} - \dot{z}))\, Dx + (k)_2.$$

It is evident that if Z represent any fluxion except $y_1^{(a_1-1)}$ or $y_2^{(a_2-1)}$, there is no term on the right-hand side of order higher than (k_2), but that if z be either of these fluxions, $(\dot{\bar{z}} - \dot{z})$ is of unrestricted magnitude, and the term involving it becomes important. Therefore, the only important terms at the B-limit which arise from fluxions of an order lower than $\delta''y_1^{(a_1)}$ or $\delta''y_2^{(a_2)}$, are

$$\Big/^{B} ({}_1Y_{a_1}\delta''y_1^{(a_1-1)} + {}_2Y_{a_2}\delta''y_2^{(a_2-1)}),$$

which are now reduced to

$$\Big/^{A} ({}_1Y_{a_1}(\bar{y}_1^{(a_1)} - y_1^{(a_1)}) + {}_2Y_{a_2}(\bar{y}_2^{(a_2)} - y_2^{(a_2)}))\, Dx \ldots \tag{16}$$

The remaining terms at the B-limit are

$$\Big/^{B} ({}_1Y_{n_1}\delta''y^{(n_1-1)} + ({}_1\dot{Y}_{(n_1-1)} - {}_1Y_{n_1})\,\delta''y^{(n_1-2)} + \&c.), \qquad (17)$$

where the last term implied by the &c. is

$$\Big/^{B} ({}_1Y_{(a_1+1)} - {}_1\dot{Y}_{(a_1+2)} + \&c.)\,\delta''y_1^{(a_1)},$$

with corresponding terms for y_2.

Hence the right-hand side of (11) is expressed as

$$\Big/^{A} (\bar{F} - F)\,Dx$$

plus (16) *plus* (17) *plus* the terms in y_2 corresponding to (17).

But, by taking $\delta y = 0$, *i.e.* by taking A on OP, and by adding to the left hand of (11) the terms

$$I(OA) - I(OA),$$

we see at once that either side of (11) is

$$I(OABP) - I(OP),$$

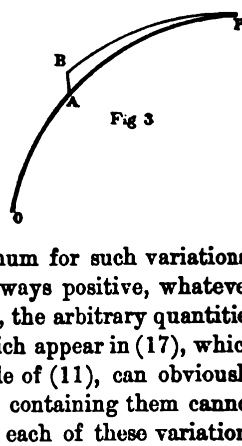

Fig 3

A being on OP. But, in that case, the conditions of a permissible variation are evidently fulfilled by $OABP$, so that if the integral along the stationary solution be a true minimum for such variations, we must have the right-hand side of (11) always positive, whatever be the relative magnitude of Dx, $\delta''y_1^{(n_1-1)}$, &c., the arbitrary quantities which appear in (11). Now the variations which appear in (17), which has been shown to be part of right-hand side of (11), can obviously have either sign, and therefore an expression containing them cannot be always positive, unless the coefficients of each of these variations vanishes; and since B is an arbitrary point, these coefficients must vanish for every point on the curve. Hence we at once get the series of equations

$${}_1Y_{n_1} = 0, \quad {}_1Y_{(n_1-1)} = 0 \;.\;.\;., \quad {}_1Y_{(a_1+1)} = 0,^{1} \qquad (18)$$

with corresponding identities for y_2.

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[1] These conditions follow immediately from the fact that a variation which shall be zero from O to A, and have at A small arbitrary values of $\delta y^{(a)}$, is a permissible one. For the integral is then an integral from A to P with arbitrary values for the limits of the $y^{(a)}$ fluxions at A.

Thus, the right-hand side of (11) is reduced to the terms in $(\overline{F} - F)$ *plus* those in (16); in other words, to the function Edx of § 2. Hence we may write

$$I(OABP) - I(OP) = \int^A EDx,$$

showing that $EDx > 0$ is a necessary condition for a true minimum under the given conditions.

It follows from this expression that, unless Dx is necessarily of determinate sign, the integral cannot have a minimum of the assigned character.

§ 8. It has now to be shown that the condition $EDx > 0$ is *sufficient*. The following slight modification of the method given by Zermelo is interesting, though somewhat longer than the general method given in § 9.

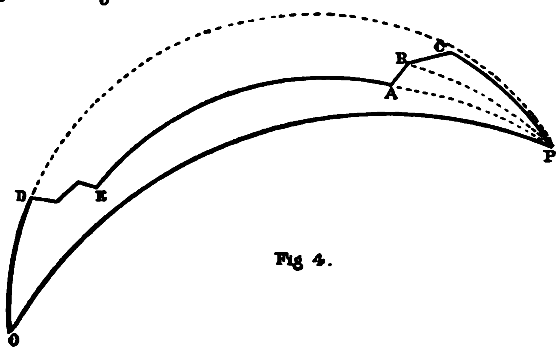

Fig 4.

Let $ODEABCP$ be a variation from OP, the stationary curve, and let the variations be all small, *i.e.* less than k, in the portions OD, EA, and CP; but let the higher fluxions have large variations in DE and AC, as permitted by the conditions.

Join AP by any curve which shall have all its fluxions small, *i.e.* less than k, and shall have contact of the proper order with EA or AB at A, and with OP at P, so that $ODEAP$ is an admissible variation. Similarly, draw BP, so that ABP is part of an admissible variation.

Then it has just been shown that

$$I(AB) + I(BP) - I(AP) = \int^A EDx + (k)_2 = \int^A E \int_A^B x + (k)_2.$$

Similarly

$$I(BC) + I(CP) - I(BP) = \int^B E \int_B^C x + (k)_2.$$

Therefore, adding,

$$I(ABCP) - I(AP) = \int_A^C Edx + \Sigma (k)_2. \qquad (19)$$

Similarly, we may show

$$I(DEAP) - I(DP) = \int_D^E Edx + \Sigma (k)_2. \qquad (20)$$

Adding (19) and (20), and cancelling $I(AP)$ which appears in both, we get

$$I(ODEABCP) - I(ODP) = I(DEABCP - I(DP)$$

$$= \int_D^E Edx + \int_B^C Edx + \Sigma (k)_2, \qquad (21)$$

where the term $\Sigma (k)_2$ may become of the order (k), *i.e.* linear in k, as is evident, because some at least of the terms in $(k)_2$ arose from terms linear in k being multiplied by Dx, so that when we take their sum, we get an integral linear in k_2. Hence replacing, in (21), $\Sigma (k)_2$ by $(k)_1$,

$$I(ODEABCP) - I(OP) = \Sigma \int Edx + (k)_1, \qquad (22)$$

where $I(OP)$ may be regarded either as the integral taken along the stationary solution, or along ODP, as these integrals only differ one from the other by quantities of the order $(k)_2$.

From (21) or (22), it is evident that the condition $Edx > 0$ for all values of x in the integration, whatever the values of $\bar{y}_1$ and $\bar{y}_2$ is *sufficient*, provided only that k be sufficiently small.

§ 9. The general method is as follows:—

Let the integral be

$$\iiint \ldots Fdx_1 dx_2 dx_3 \ldots$$

Let us write ds for $dx_1 dx_2 dx_3, \ldots$ and consider first the case where the integration with regard to ds extends over two portions, one represented by Σ, where *all* the variations are small, and the other represented by σ, where some are finite, as in fig. 5. Then we may write

$$I = \iiint \ldots Fdx_1 dx_2 dx_3 \ldots = \int^S Fds = \int^\Sigma Fd\Sigma + \int^\sigma Fd\sigma.$$

Let also the general variation δ be replaced by $\Delta + \delta'$, where Δ refers only to the variations which may be large, and δ' to those which are only permitted to be small. Then, remembering that we cannot apply Taylor's expansion to the Δ variations except when they are small, the complete difference between the original and varied integral may be written

$$I_{(1+\delta)} - I = \int^{\Sigma} F_{(1+\delta)} d\Sigma + \int^{\sigma} F_{(1+\delta)} d\sigma - \int^{\Sigma} F d\Sigma - \int^{\sigma} F d\sigma$$

$$= \int^{\Sigma} \delta F d\Sigma + (k_2) + \int^{\sigma} (F_{(1+\Delta)} - F + \delta F_{(1+\Delta)}) d\sigma + (k_2)\, d\sigma,$$

where (k_2) indicates quadratic terms.

But since the first variation must vanish always, we have

$$\int^{\Sigma+\sigma} \delta F ds = 0,$$

or
$$\int^{\Sigma} \delta F d\Sigma + \int^{\sigma} \Delta F d\sigma + \int^{\sigma} \delta F d\sigma = 0.$$

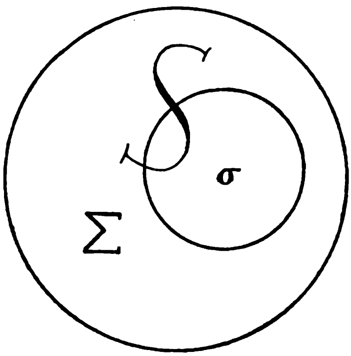

Fig. 5.

Subtracting this from the expression just written,

$$I_{(1+\delta)} - I = \int^{\sigma} (F_{(1+\Delta)} - F - \Delta F)\, d\sigma + \int^{\sigma} (\delta F_{(1+\Delta)} - \delta F)\, d\sigma + (k)_2,$$

where $(k)_2$ is written for small terms of the second or higher orders. Hence

$$I_{(1+\ )} - I = \int^{\sigma} E d\sigma + \int^{\sigma} (k)_1 d\sigma + (k)_2 = \int^{\sigma} E d\sigma,$$

neglecting small terms, because evidently the term ΔF is the term which appears in E. For, in the first place, that the solution is stationary for *small* arbitrary and discontinuous variations of the higher fluxions, gives us the conditions in (3) at once, as stated in the note to equation (18). Hence, in ΔF, the only terms remaining are those corresponding to $Y_{(ab)}\,\Delta y_{(ab)}$, *i.e.* to $Y_{ab}\,(\bar{y}^{(ab)} - y^{(ab)})$.

Hence it is evident that the condition $E > 0$ is *necessary*; for σ may be taken for *any* small portion of the integration.

To show that it is sufficient, it is only necessary to observe that we may extend σ to include any large portion of, or the entire of, the integral.

§ 10. It will be observed that when some of the variations are large, the fact that E is always positive ensures that the integral shall be a minimum, even though the condition relating to the "conjugate point" in small variations be not fulfilled.

Thus an arc of a great circle on a sphere is a minimum compared to all neighbouring lines for which the direction is, for *finite* lengths, inclined at *finite* angles to the direction of the great circle, the *distance* between the two lines being always indefinitely small, and this property evidently holds when the arc of the great circle is greater than a semicircle.

§ 11. It is interesting to observe that we cannot derive the condition for a maximum when the variations are small from the form assumed by the condition $E = 0$ when the varations are small.

§ 12. It may be well to give some examples.

1. The brachistochrone.—Here

$$U = \int \frac{\sqrt{1 + \dot{y}^2}}{\sqrt{y}}\, dx,$$

so that

$$E = \frac{\sqrt{1 + \dot{\bar{y}}^2} - \sqrt{1 + \dot{y}^2}}{\sqrt{y}} - \frac{\dot{y}}{\sqrt{1 + \dot{y}^2}} \cdot \sqrt{y}\,(\dot{\bar{y}} - \dot{y})$$

$$= \frac{\sqrt{1 + \dot{\bar{y}}^2}\sqrt{1 + \dot{y}^2} - (1 + \dot{\bar{y}}\dot{y})}{\sqrt{y}\sqrt{1 + \dot{y}^2}},$$

an expression which is obviously positive, when $\dot{\bar{y}}$ and $\dot{y}$ are different, and when the square roots are taken with positive signs.

In this case, if we give a variation which makes dx negative, we must, in order to get the time of the descent, change the sign of one of the square roots, and we still get Edx positive.

2. If $F(y) = \ddot{y}^2 + 2a\ddot{y}$, and if the points O and P_1 be given, then, whether the tangents at those points be given or not, the stationary solution gives a minimum for small variations of $\dot{y}$, and large ones of $\ddot{y}$. If, however, $\dot{y}$ also may have large variations, it is evident that the stationary solution for *fixed* tangents could not, in general, be a minimum. This, of course, follows either because Y_2 must be zero everywhere, as already proved, or at once from the condition that if the tangent can have a quite arbitrary value throughout, it can have an arbitrary value at the limit. It is easy to see in this case that the stationary solution, when O and P alone are given, does give a true minimum to the integral when $\ddot{y}$ and $\dot{y}$ are both quite arbitrary.

3. If we apply the condition to the well-known evolute problem, where $F(y) = (1 + \dot{y}^2)^2/\ddot{y}$, we find that E can change sign when $\ddot{y}$ alone can have finite variations, thus showing that, not merely is the cycloidal solution not a minimum, when we are allowed to use a series of cycloidal or circular curves, as was long ago pointed out, but also that it is not a minimum, even when the tangent is not permitted to have a finite variation.

§ 13. When there are conditions, the criterion still holds in general (but one must always be prepared for exceptional cases). Take first, problems of relative minima. A single example will suffice to show how the criterion is obtained for all integrals, whether single or multiple.

Let the problem be to find the curve of given length joining O and P, and enclosing the minimum area.

Here, $U = \int y\,ds$, and the solution is got by making

$$\int (y + \lambda\sqrt{1 + \dot{y}^2})\,dx$$

stationary.

There, referring to fig. 1, and following the previous method,

$$\delta U = I(AB) + I(BP) - (AP) = \int_A^B (\bar{y} - y)\,dx + \int_B^P (\bar{y} - y)\,dx\,; \quad (23)$$

but since the length is to be the same in both cases,

$$\int_A^B \lambda\sqrt{1 + \dot{\bar{y}}^2}\,dx + \int_B^P \lambda\sqrt{1 + \dot{\bar{y}}^2}\,dx = \int_A^B \lambda\sqrt{1 + \dot{y}^2}\,dx + \int_B^P \lambda\sqrt{1 + \dot{y}^2}\,dx.$$

Whence, from (23),

$$\delta U = \int_A^B (\bar{y} + \lambda\sqrt{1+\dot{\bar{y}}^2} - (y + \lambda\sqrt{1+\dot{y}^2}))\,dx + \int_B^P (\bar{y} + \lambda\sqrt{1+\dot{\bar{y}}^2} - y + \lambda\sqrt{1+\dot{y}^2})dx$$

$$= \int_A^B (F(\bar{y}) - F(y)\,dx + \Big/_B^P Y_1 \delta y - \int_B^P M\delta y\,dx, \qquad (24)$$

where now F stands for $(y + \lambda\sqrt{1+\dot{y}^2})$, and Y_1 and M are quantities derived from F according to known rules. But since $M = 0$ for the stationary curve, (24) may, neglecting small quantities, be written as

$$\{F(\bar{y}) - F(y) - Y_1(\dot{\bar{y}} - \dot{y})\}\,Dx = Edx.$$

Hence, the general rule is, that whatever be the orders of the highest fluxions in the two integrals, the function E is that formed in the usual way from the function under the integral sign in Euler's method.

§ 14. When we require to make $\int udx$ a minimum subject to an equation of condition $v = 0$, a precisely similar mode of treating the equation shows that we obtain the function E by writing $(u + \lambda v)$ for F; but in that case, of course, the highest fluxions $\bar{y}^{(n)}$, $\bar{z}^{(n)}$, &c., cannot be all arbitrary, because $v = 0$ is to be everywhere satisfied. But in this case it is very necessary to observe that the problem is unmeaning, unless the conditions admit of our taking a variation $OABP$, in which, while the variations are finite in AB, they are zero in OA, and indefinitely small in BP. If, for instance, the problem be the old one of the shortest line in space of given curvature, then if OP be the stationary solution, it will be found impossible to take any line $OABP$ of *constant curvature*, and such that while d^2y/dx^2 and d^2z/dx^2 are *finite* in AB, they are indefinitely small in BP, for this would involve a discontinuity in the curvature at B.

§ 15. Weierstrass shows that, if x, y, $\dot{x}$ and $\dot{y}$ only appear in the function F, the independent variable being t, and if the question be really one relating to a plane curve, there can be no maximum for discontinuous variations such as are here dealt with. For he finds that E is a quadratic function multiplied by $\dot{x}dt$, and as $\dot{x}$ can change sign arbitrarily, the function E can change sign. But as $\dot{x}dt = dx$, this only means geometrically that if dx can *arbitrarily* change sign, there can be no true minimum or maximum, as is at once evident, because, if the independent variable, which we may take as x, may change sign at *pleasure*, it is quite evident that we can never have any maximum or minimum. For instance, take the integral

$$\int_O^P \sqrt{1+\dot{y}^2}\,dx.$$

which, if dx cannot change sign, except when the sign of the square root changes, represents the length of the curve joining O to P, and has a true minimum value corresponding to the straight line. If in it we are at liberty to change the sign of dx arbitrarily, and without changing the sign of the square root, then the integral has no maximum or minimum, but is capable of passing to continually greater or smaller values by suitable variations (*i.e.* by making the quantity under the square root have a larger or smaller value for the positive or negative values of dx, respectively); its value in this case is geometrically represented by the *difference* of the integrals for dx positive and those for dx negative.

The same may be easily seen from the result of this Paper. The integral is increased or diminished in passing from OAP to $OABP$ (fig. 3), according as EDx is positive or negative, and therefore if Dx can have either sign, we can always increase or diminish the integral, whether E can or cannot change sign. Thus, an arbitrary change of sign of the independent variable is always excluded, and if a change of sign in the independent variable occurs in consequence of the form of the curve, the sign of E must change with it.

XXIV.

ON THE DATES OF VOLCANIC ERUPTIONS AND THEIR CONCORDANCE WITH THE SUN-SPOT PERIOD. By JOSEPH P. O'REILLY, C.E.

[Read April 24th, 1899.]

Volcanic eruptions and the phenomena connected therewith have at all times excited the interest of mankind, and have received and continue to receive, on the part of scientific observers, the very closest attention, not only on account of the magnitude of the phenomena involved therein and their great geological significance, but also by reason of the destruction of life and property with which they are not unfrequently accompanied.

Hence in all works on geology this subject is generally very fully treated in all its essential aspects. One particular however, the question of their periodicity, seems either to be avoided or to be treated as not offering sufficiently precise data, to allow of its receiving recognition, reference however being made to the authors who have mainly occupied themselves with this particular branch of the subject.

Reference to the question is made in "Geikie's Text-book of Geology," 1885, p. 193, as follows :—

"Kluge has sought to trace a connexion between the years of maximum and minimum of sun-spots, and those of greatest and feeblest activity (of volcanoes), and has constructed lists to show that years which have been specially characterised by terrestrial eruptions have coincided with those marked by few sun-spots and diminished magnetic disturbance."[1]

"Such a connexion cannot be regarded as having yet been satisfactorily established. Again, the same author has called attention to the frequency and vigour of volcanic explosions at or near the time of the August meteoric showers. But in this case, likewise, the cited

[1] "Ueber Synchronismus and Antagonismus, 8vo., Leipzig, 1863, p. 72. A. Poëy (Compt. Rend. lxxviii., 1874, p. 61) believes that among the 786 eruptions recorded by Kluge between 1749 and 1861, the maxima correspond to periods of minima in solar spots. See, however, *postea*, pp. 250 and 259."

examples can hardly yet be looked upon as more than coincidences. At many volcanic vents the eruptive energy manifests itself with more or less regularity."

The author then cites the cases of Stromboli, Etna, and Vesuvius:—"Much more striking, however, is the case of Kilauea in Hawaii, which seems to show a regular system of grand eruptive periods. Dana has pointed out that outbursts of lava have taken place from that volcano at intervals of from eight to nine years, this being the time required to fill the crater up to the point of outbreak, or to a depth of 400 to 500 feet. But the great eruption of 1868 did not occur until after an interval of eighteen years." (Dana's remarks prove that two successive eruptions took place at sun-spot periods, one in + 1848·6, and the other in − 1867·2, the interval being 18·6 years.) "The same author suggests that the missing eruption may have been submarine."[1]

As regards his references to the pp. 250 and 259 of his text-book, the following lines bear generally on the question:—"Many difficulties, however, remain yet to be explained before our knowledge of volcanic action can be regarded as more than rudimentary," p. 250.

In section II., part 1, "Earthquakes," p. 259, he says, "From what was stated at the beginning of the present section, it is evident that some connexion may be expected to be traceable between the frequency of earthquakes, the earth's position with regard to the moon and sun on the one hand, and changes of atmospheric conditions on the other." He then cites the observations and conclusions of Schmidt and Perry, and adds:—"No connexion has yet been satisfactorily established between the occurrence of earthquakes and sun-spots." He says, p. 248, "There is indeed strong evidence that among the consequences arising from the secular contraction of the globe, masses of sedimentary strata, many thousands of feet in thickness, have been crumpled and crushed, and that the crumpling has often been accompanied by such an amount of heat and evolution of chemical activity as to produce an interchange and rearrangement of the elements of the rocks, this change sometimes advancing to the point of actual fusion . . . Along lines of elevation the pressure is relieved and consequent melting may take place. On these lines of weakness and fracture therefore the conditions for volcanic excitement may be conceived to be developed—water, able soonest to reach there, the intensely heated materials underneath the crust may give rise to

[1] "On the Periodicity of Eruptions," see Kluge, "Neues Jahrbuch," 1862, p. 582.

volcanic explosions. The periodicity of eruptions may thus depend upon the length of time required for the storing up of sufficient steam and on the amount of resistance in the crust to be overcome. In some volcanoes the intervals of activity, like those of many geysers, return with considerable regularity. In other cases the shattering of the crust, or the upwelling of vast masses of lava, or the closing of subterranean passages for the descending water, or other causes, may vary the conditions so much from time to time that the eruptions follow each other at very unequal periods and with very discrepant energy."

If by the term "periodicity" may be understood that a definite or determinable interval of time elapses between successive eruptions of a given volcano, perhaps it would be better to limit the word to that signification, and to use for the regular alternations in the eruption, such as those referred to by Geikie in the cases of Stromboli, Vulcano, (p. 198), &c., the word "throb."

It is in the first mentioned sense that Kluge uses the word "periodicity," and in that sense alone will it be used in the present paper.

Geikie refers, on the note on p. 193 of his text-book, to Kluge's article in the "Neues Jahrbuch" of 1862 "On the Periodicity of Volcanic Eruptions." Now this article[1] has for its object to summarize some of the conclusions arrived at by Kluge, in a much more extended work, not then published, and it tends mainly to show a relation between the *seasons of the year* and the *eruptions of volcanoes* situated in certain latitudes, and does not refer to the sun-spot period at all. In this respect it may be useful to give an outline of the article.[1]

He states that he has been engaged for a length of time on an important work on the periodicity of volcanic eruptions and communicates some of the results. The total number of eruptions included in his catalogue, and of which the years of occurrence, at least, are sufficiently determined, amounts to 1297, which relates to 348 different "localities," since the term volcano can hardly be strictly applied in this case. "By far the greater number of these eruptions belong to the eighteenth and ninteenth centuries, since up to the year 1700 I could only find 368 mentioned." He explains the difficulty of

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[1] "Ueber die Periodicität vulkanischer Ausbrüche," von Herrn Dr. Emil Kluge in Chemnitz. Aus einem Briefe an Professor Bronn.—*Neues Jahrbuch*, 1862, p. 582.

defining precisely the term "*volcanic eruption*" "so that a basis may be determined for future scientific investigation."

As regards the total number above-mentioned, the following were regarded as cases of distinct and separate eruptions:—

1. All normally occurring eruptions of individual volcanoes.
2. All very markedly active repetitions of these, when they present their usual course and character, such as a renewal of lava outflow, formation of new craters after the old ones had become quiescent, etc.
3. All marked paroxysms of mud volcanoes.
4. All mud and water outbursts of individual volcanoes.
5. Ash-showers, more particularly from high volcanoes.
6. Sudden outbursts of smoke, with explosions, after lengthened periods of rest, and during periods of marked earthquake action, when the supposition is allowable, that the lava has not reached the rim of the crater or has opened up for itself subterranean passages.
7. Markedly strong activity in the cases of volcanoes—such as Stromboli, Sangay, Lamangan, etc., which are usually in a state of continual activity,
8. Sudden elevation of large land surfaces of short duration.

He then discusses the relative significance and importance of these different classes. On p. 585 he gives two tables of the distribution of eruptions as regards centuries of occurrence and countries. He says, on p. 585, "One of the most striking results furnished by the table is that showing the repetition of volcanic eruptions with reference to seasons."

"Whilst as regards earthquakes there is generally shown a predominance of winter earthquakes, in the case of volcanic eruptions there is shown a preponderance of these phenomena as regards the summer months, and to such a marked degree that if the sums of the farthest northern eruptions and farthest southern ones be taken together, the result cannot be looked on as purely accidental."

"It is the same result at which I had arrived for the grouping of earthquakes in general and of earthquake periods, and which seems anew to prove that the great world-shaking earthquakes have their origin in causes other than purely local ones limited to circumscribed territories. 787 volcanic eruptions, for which the data are sufficiently correct, distribute themselves as follows over the different months of the year; the commencement of the eruption being always taken (in the cases of normal outbreaks) as the days on which the lava commenced to flow." (Here he gives tables showing this.)

For the northern hemisphere there thus appears for the summer half-year, *i. e.* the months of March to August, 314 eruptions; and for the winter half-year, 267 eruptions.

For the southern hemisphere the summer half-year (September to February), gives 129 eruptions, and the winter half-year 77. On p. 587:—" Although the predominance of eruptions in the summer appears in this way very marked, the matter presents, however, a different aspect when the figures are distributed according to zones, and more particularly when the extreme volcanic districts, such as Iceland, Kamtschatka, and the Aleutian Islands, are compared with Chili for example. (He here gives a table showing this distribution.)

In Iceland the number of eruptions that have taken place in summer is nearly fourfold that of the winter eruptions; and leaving out of count the twelve repetitions of the great eruption of Hekla in the summer of 1766, as also the doubtful eruptions of the extreme north of Norway, which to some extent alters the ratio, nevertheless "the proportion between the two remains as 34 : 13. Still more remarkable is the repetition of the Chilian eruptions (the greater number of which belong to the remarkable years 1822 and 1835), the ratio of which between summer and winter is as 28 : 2. A circumstance worthy of remark is that all the land-elevations of large zones of country (so far as known to me) in the southern hemisphere have happened in the summer half-year:—Chili, 19th November, 1822; 20th February, 1835; November 7th, 1837; and 12th February, 1839; New Zealand, 23rd January, 1855; *Brimstone Island*, 6th September, 1825; Key and Pesang Islands in the Indian Archipelago, 26th November, 1852; Tonga Tabu, 24th December, 1853; Artutaki, 6th February, 1854.

"It seems already to result from the fact that this particular mode of distribution of the eruptions only holds good for high latitudes, whilst, as the equator is approached it becomes less and less marked, that it is not a direct cosmical influence which causes it, but that the eruptions are the direct result of the seasons of the year, of the penetration of warm water, and thawing snow or ice-masses, or the falling of showers of rain. That this opinion receives support from other observations, would seem to result from the undeniable connexion between volcanic eruptions and certain conditions of weather, which more particularly comes out in the case of mud volcanoes, since these have their sources of activity at shallow depths. However, there are not many observations available in this regard; in any case it is important to note that the most fearful and most frequent eruptions of Iceland nearly all happened in summers following remarkably mild winters; that the most violent eruptions of the Indian Archipelago follow immediately the rainy season or take place during it; that permanently active volcanoes show greatly increased activity during this period, etc. Admitting the influence on the development of volcanic activity of the penetration of meteoric water, whether it be in the form of tropical rainfalls, or as molten snow and glacier masses, we must also, at least, ascribe the same influence to sea-water.

"A wider and more important conclusion to be drawn from the rapidity with which volcanic eruptions follow atmospheric changes, is that the focus ("Heerd") of volcanic activity is to be looked for at much less depths than is usually admitted: an opinion which I endeavour to sustain in my extended work, on numerous and various grounds. I am led to admit that that focus is to be found for most volcanoes at no greater depths than 30,000 to 40,000 feet under the sea-level; while for many it may be close under their very basis."

It is thus quite evident that Kluge's Paper of 1862 refers simply to his conclusion, that in high latitudes the eruptions take place mainly in the summer months. There is no reference in the Paper to the sun-spot period in this connexion. It is otherwise as regards his "Treatise on Synchronism and Antagonism" referred to by Geikie in the note on p. 72 of his text-book already referred to. It is in this more extended work that he brings out the relation to be found between volcanic eruptions and the sun-spot period; and as, on the one hand, it contains a great many important and valuable data with reference to the question of vulcanism in general, and, as on the other, that he puts his views in a very clear and precise manner, it may be useful to give at least a summary of the more essential parts of the work and of his conclusions.

In the preface he says it is based on his greater work: this being a complete catalogue of volcanic eruptions, dating back from the year B.C. 1000 to the year A.D. 1863, and embracing 1450 such events.

He requests that the conclusions at which he arrives will only be considered as an attempt to present the complicated question of volcanic phenomena in a simpler and clearer manner than that usually accepted by geological science up to that time.

He commences by the remark, that precisely, as formerly, great significance was attached to the synchronism or periodic alternation between the occurrences of earthquakes in countries widely distant the one from the other, so has attention been directed to the simultaneity or alternation of volcanic eruptions, only generally so far as conclusions might be drawn therefrom, as to the subterranean connection or common focus of energy of all volcanoes.

He shows the necessity of defining what may be understood as "*Synchronism*" in this respect, and examines the different cases that may be brought under this head, as also those representing "*Antagonism*" or alternation of action between volcanoes or volcanic groups. Examining the different cases stated from the point of view of their scientific interest he considers more particularly two specific cases:—

(*a*) Two or more volcanoes enter into eruption simultaneously, and as it were at the same moment, so that it would appear as if the outbursts were the effect of a common cause, acting, however, at different points of the earth's surface.

(*b*) A volcano ceases its activity at the very moment that another enters on a state of activity.

These he considers as typical cases, since they admit of the least amount of illusion, or of play of accident, as to the presumed common cause.

On page 3 he says:—"It may, furthermore, be of importance to examine whether certain spaces of time be, or be not, signalised by numerous simultaneous eruptions, and whether these spaces of time return after some determinate period.

"In the following pages I have sought to bring some of these questions to a decisive answer. The material in hand is, however, not yet sufficiently abundant to allow of more than an approximate determination, meanwhile the results already attained may be of some importance, even should they have no further significance than in proving as untenable certain received theories, or in leading the way to further research.

"Before entering upon the investigation of distinct volcanic countries, the following question may be at once answered. Do certain years distinguish themselves markedly by the great number of their eruptions? A mere glance at the curves given herewith is sufficient to prove that they suddenly and frequently rise, as for the years 1793, 1822, 1835, 1843, 1852, and almost as suddenly fall."

He then enters on a detailed account of the volcanic and seismic events of the year 1822, including some belonging to 1821, to show their frequency and importance during the period considered.

He cites (page 4) the extraordinary low barometer shown to have existed over all Europe on the 25th December, 1821 (*Edin. Philosoph. Journ.*, vol. vii., 1822, p. 155), and on page 6 he cites the eruption of 22nd to 26th October, 1822 (= 1821·80), of Vesuvius, having given rise to showers of ashes, the greatest known since the event of Pompeii (A.D. 79). (It is worth noting that the interval between this date = 1821·80 and 78·65, date of the destruction of Pompeii, is 1742·15, which is nearly = 1742·7 = 11·1 × 157, that is a multiple of the sun-spot period.) He says—"We have here to do with a mass of volcanic phenomena, such as the history of vulcanism rarely reproduces, and it must, therefore, be of importance to examine whether similar eruption years repeat themselves after definite periods, or whether similar phenomena stand in any determinate relation with other periodic natural phenomena. A treatise by Dr. Lamont 'On the 10 year Period of the Daily Variation of the Magnetic Needle and the Relation of Earth Magnetism with the Sunspots' (Poggend. Ann. 4 Reihe, Bd. 26, p. 607, 1862), in which the year 1822 is taken as a minimum sun-spot year, allowed me an opportunity of comparing the eruptions with the sun-spot periods. At once the merest glance showed me that some of the minimum years therein indicated, such as the years 1793, 1843, 1855, distinguish themselves from neighbouring years by their numerous volcanic outbursts. Meanwhile appeared a work by Professor Rudolph Wolf of Bern, on the same subject ('On the 11 year Period of Sunspots and Earth Magnetic Variations,' Poggend. Ann. Bd. 27, p. 502, 1862), which being based on a greater amount of material, raised my opinion on the matter to a certainty that 'years poor in sunspots, which are also marked by a lesser value of magnetic variation, are eruption years, and *vice versa*.'

"In order that the reader may be in a position to decide for himself in the matter, I herewith annex the full table as Wolf has published it in his remarkable work, and add thereto the number of eruptions for each year.

[Page 12.] "As to the existence of a connection between magnetic variations, sunspots, and volcanic eruptions, the consideration of the foregoing does not allow of a doubt." He calls attention to one point in particular, as furnishing a support to the views he advances. It is the periodic return of eruptions after a time interval of about one hundred years (99 to 101), and he adds:—"The connection which appears to exist between sunspots, magnetic variations, and volcanic eruptions affords us, if we accept a 11⅑th years period for the first-mentioned, a practicable ground for the recurrence of a 100 years' period as regards the last-mentioned. From the numerous examples of this recurrence, which may be here stated, I may be allowed to cite the following." Here he cites amongst other cases:—

Etna, . .	1183, 1285, 1381, 1682, 1781, &c.
Vesuvius, . .	685, 983, 1184, 1682, 1783, 1784, 1785; 203, 1306, 1506, 1704, 1705, 1706, 1804, 1806; 51, 1712, 1713, 1813; 1660, 1760, 1860—

in all about 200 different dates arranged in groups, as in the cases here cited.

[Page 14.] "Although chance may often wonderfully intervene, and may be often helped out by clever combinations of data, nevertheless it seems to me that in most of the above-mentioned cases, there is something more than a mere casual coincidence, something, in fact, regular in its nature since the phenomena arise so very frequently in the case of volcanoes which do not present many cases of eruption. It cannot *alone* depend on a periodic return of years *poor* in sunspots, since even years such as 1837, and rich in sunspots, follow one another at intervals of many hundred years. In examining the connection between volcanic eruptions and earthquakes I propose to revert to the subject."

He then enters on the detailed examination of different volcanic districts as regards the examples furnished by them of synchronisms and antagonisms.

"As regards Italian districts, it may be generally admitted that the activities of the two volcanoes, Vesuvius and Etna, alternate, as already shown by V. Hoff ('Geschichte der naturlischen Veränderungen der Erdoberfläche,' V. Hoff, 2 Th. p. 262). A glance at the curves shows this better than the citation of the individual outbreaks."

[Page 16.] Although the alternating activity of the two volcanoes may be accepted as a rule, there occur, however, periods during which both were simultaneously in activity (*e.g.* 1822–1643).

[Page 19.] A somewhat similar relation of alternating activity as shown by Vesuvius and Etna manifests itself in the case of the Italian volcanoes when compared with the Greek ones.

"Hardly in any country (with the exception of Chili more particularly) is it so convincingly demonstrated by simultaneous eruptions of far distant volcanoes, that these eruptions have their origin in a common source, and that the volcanoes are but openings or vents on long lines of fissure as in Iceland. (Follow numerous examples of simultaneous eruptions in his paper).

[Page 22.] Remarkable eruption of Hecla and Katla during a period of activity of Vesuvius in the year 1766.

[Page 23.] "Is this remarkable simultaneity of Icelandic and Italian eruptions merely a simple coincidence, or is it to be attributed to cosmic influences acting at the same time on each volcano, or does the cause lie in a subterranean connection of the molten mass connected with them? It is all the more remarkable, as the year 1766 was a turning point in the sun-spot period, a minimum year of sunspots, and was also signalized by the occurrence of other extraordinary natural phenomena."

[Page 24.] "In the year 1783 arose the Island Nyoë (new Island) near Iceland, followed on the 11th June by the celebrated outburst of Skaptar Jökull.

[Page 26.] "Almost simultaneously with this outburst, *the most fearful known in the history of vulcanism,* there arose one not less terrible on the Japanese Island of Niphon" (compare as to date with Krakatoa, 1883, and as regards the 100 years interval).

[Page 27.] "As regards these remarkable outbursts, it is to be noted that the year 1783 was marked by extreme fewness of sunspots, as well as by other uncommon natural phenomena."

[Page 31.] "If we compare the activity of the three Island groups, Canaries, Azores, and Cape Verd Islands, they will be found to present a well marked example of antagonism."

[Page 34.] The activity of the volcanoes of Kamtschatka, the Kuriles, and Japan, compared with that of the Aleutians, is markedly alternate.

[Pages 35, 36.] Table demonstrating this, with the remark, "A finer example of alternating activity of two distinct volcanic groups cannot better be shown."

[Page 43.] "The most striking example of simultaneous eruptions which perhaps exceeds in greatness that already mentioned in connection with the Phillipines, is that of the year 1772. In the night of the 11th to the 12th August of this year occurred the most terrible outburst of the Papandayang volcano which has taken place in the Island of Java during historic times, and in consequence of which a large part of this mountain, along with the adjacent land, sank into the sea; the extent of land which thus disappeared was 15 English miles long and 6 English miles broad, carrying with it 40 villages and 3000 inhabitants. Before this catastrophe, the volcano was 9000 feet high, now it only attains to 5000 feet. (Compare with Krakatoa in 1883 (1883—1772 = 111 = 100 + 11)).

[Page 46.] "Moreover, the terrible phenomena of the last third of the year 1852 should be here detailed, since they are of so comprehensive and grand a nature, that if the wide extension and extraordinary development in force of subterraneous disturbances be taken as a proof of the existence of a general igneous fluidal earthcore, the phenomena in question stand out in the front line amongst all the events of this nature which have taken place up to the present."

[Page 73.] "The days near to the 13th August seem to play a notable part in the history of vulcanism." (Cites a number of cases in proof thereof.)

[Page 74.] "A summary of all the eruptions marked in my catalogue as having occurred in August gave the following result. The total having taken place in this month was 67. Of these 11 are not fixed as to the day of the month, 44 occurred between the 1st and 15th, and only 12 from the 16th to the 31st. On the 8th there occurred only 5; on the 10th, 3; on the 11th, 4; and on the 12th, 8 eruptions. It is certainly of significance, that this concentrating of eruptions on the days 8th to 12th August coincides with the Laurentius stream of falling stars.

"The days, 8th to 13th November, about which date the November stream of shooting stars occurs, shows also the remarkable number of 13 eruptions.

[Page 76.] "The years 1797, 1798, and 1799 are, according to the above cited tables, minima sun-spot years. They are marked by the occurrence of the following notable eruptions, along with many others of lesser importance. (Cites a number of great eruptions to the point.) The minimum years of the next sun-spot period, the years 1809–12, are likewise notable for a similar aggregation of volcanic phenomena in the Western Hemisphere. (Cites a series of eruptions corresponding to that period.)

[Page 84.] Conclusions.

1. "Certain years distinguish themselves by a remarkable sum of generally extensive earthquakes and volcanic outbursts, whilst others are relatively undistinguished in that respect.
2. "These years, markedly characterised by volcanic phenomena, return at comparatively regular intervals such that they seem to be in connection with a mean yearly period of $11\frac{1}{9}$ years = 11·1 years.

3. "This period of subterranean disturbance stands in an inverse ratio with a period of similar length with reference to sunspots and terrestrial magnetic variations, so that the years in which the sunspots are maxima, and in which the amount of the magnetic variation is also a maximum, are in general poor in volcanic phenomena and earthquakes, and inversely so.
4. "Not only certain years, but also certain days of the year, seem to be more connected with eruptions than others, and moreover seem further to be signalized by the occurrence of remarkable cosmical phenomena."

Here follow ten other conclusions referring to "Synchronisms and Antagonisms," &c., covering pp. 85 to 99 of the work, into the consideration of which it would be out of place here to enter.

It would seem that the complete list of eruptions spoken of by Kluge in his two Papers was not published, and I have not been able to find any trace of such publication subsequent to 1863.

Geikie also refers, in the note on p. 183, to the Paper by Poëy (Comptes. Rend. LXXVIII., 1874, p. 51), wherein he points out the relation between certain of the eruptions cited by Kluge and the sunspot period, but so briefly that I think it desirable to point out more in detail the essential points of Poëy's paper or papers, and their bearing on the question of the connection observable between volcanic eruptions and the sun-spot period.

The first paper (as indeed the two others which follow) appears as a letter to the Secretary of the Academy of Sciences, Paris:—"On the Relations between the Sun-spot Period and the Hurricanes of the Antilles, of the N. Atlantic and of the Southern Indian Oceans."[1] He utilises Meldrum's Paper which appeared on this subject in "Nature" (9th October, 1873, p. 495), and gives a table of some extent showing the relation between the 357 hurricanes of his catalogue and the sun-spot periods. He remarks:—

"It may be noted that the most of the years of maxima of hurricanes fall at an interval of from six months to two years after the years of maxima of sunspots. There may also be observed a "lag" as regards the period of the magnetic variation, auroræ boreales, severe winters and other meteorological phenomena.

Poëy discusses several points in connection with the table—shows

[1] *Compt. Rend.*, 1878, vol. lxxvii., p. 1222.

the general concordance between the years of hurricane maxima and the sun-spot period. He points out that "the seven most severe winters mentioned by Mr. Renou since 1624, all coincide with maxima of sun-spots (1624, 1665, 1707, 1748, 1789, 1830, and 1870) with the exception of the winter of 1665, which coincided with the minimum of 1666; but if the winter of 1677 be considered, during which the Seine was frozen during thirty-five days, the nearest maximum of solar-spots is that of 1675."

A second letter appeared in the same volume of the Comptes. Rend., p. 1343, "On the Relations between the Sun-spot Period, the Hurricanes of Paris and Fécamp, Tempests, and Gales in the North Atlantic."

A third letter appears in the vol. lxxviii. of Comptes. Rend., 1874, p. 51, "On the Relations between Sunspots, the Earthquakes of the Antilles and of Mexico, and Volcanic Eruptions of the Globe in general." He states that taking the three Papers mentioned he has arrived at the following conclusions:—

1. That the phenomena of the atmosphere and of the crust of the earth tend generally to accumulate according to decennial periods somewhere about (*autour des*) the maxima and minima of solar spots.
2. That of these phenomena, some show most energy about the period of the maxima, and others about the period of the minima.
3. That all the phenomena which proceed directly or indirectly from *heat*, approximate to the *minima*, and those having their cause in cold, approximate to the *maxima* of the spots.
4. That this influence of the solar spots is reducible to a simple question of temperature, whence follows (*découle*) by process of evolution and of equivalent transformation, the whole of our terrestrial phenomena.
5. That the earthquakes occurring in the Antilles and in America seem to be as frequent and as intense at the periods of the maxima as at the period of the minima.

He gives a table comprehending 786 volcanic eruptions having occurred in various quarters of the globe between 1749 and 1861. "According to the catalogue of Mr. Kluge, it may be at once observed that the maxima of eruptions correspond to the minima of solar spots, and the minima to maxima of the spots."

It follows from the details hereinbefore given that Kluge's Paper of 1862 dealt only with the relations *between eruptions and seasons of* *the year*, his tables as given supporting strongly his conclusion that eruptions in high latitudes are much more frequent in summer than in winter. His paper or essay on Synchronism and Antagonism, published in 1863, and of which details have been hereinbefore given, brings into connection the *years of eruptions and the sun-spot period*, and in this respect is based on Wolf's list of sun-spot maxima and minima years (published in a complete form in 1870). The same remark holds good as regards Poëy's last paper. *Wolf's list* is therefore the important element in both cases taken in connection with their lists of eruptions, hurricanes, and earthquakes. It is to a certain extent remarkable that this list of sun-spot periods has not, as yet, received any recognition on the part of geologists, as if there were no admissible connection between the phenomena taking place at the surface of the sun and those taking place on the surface of the earth. And yet it can be shown by hundreds of cases mentioned in Mallet's and Perrey's lists of earthquakes that between eruptions, earthquakes, magnetic disturbances and phenomena, and atmospheric perturbations, a close, if not intimate, connection exists, and, consequently, if any one of these sets of phenomena show a distinct relation with the sun-spot period, the others should likewise do so to a greater or less extent. Now, the cyclones and hurricanes of the Indian Ocean, as also the monsoons, on the regular advent and course of which the good and bad seasons of India and South Africa depend, have been carefully studied, and shown to have a relation with the sun-spot period.[1] W. Stanley Jevons, writing on the "Series of Decennial Crises" in *Nature*, vol. xix., p. 34, says:—

"I can entertain no doubt whatever that the principal commercial crises do fall in a series having the average period of about 10·466 years, moreover, the almost perfect coincidence of this period with Brown's estimate of the sun-spot period (10·54) is by itself strong conclusive evidence that the phenomena are causally concerned. The exact nature of the connection cannot at present be established."

D. E. Hutchins, Conservator of Forests, Knysna, S. Africa, published in 1889 a series of lectures on "Cycles of Drought and Good Seasons in S. Africa," bringing into close relation the seasons of that country and the sun-spot period, and considering it as fundamental for the sound agricultural administration of the regions referred to. At p. 109, the author gives a forecast table of the seasons to be expected for the *years from* 1888 *to* 1920, which gives

[1] See Meldrum, *Nature*, 9th Oct., 1873.

expression to his faith in the sun-spot period influence, and which merits attention at present (1899) in view of the disastrous droughts which have reigned in Australia for some years, and which are foretold in the forecast table of this work for the years 1898–99, 1900–1–2–3 ("with mitigation in 1901"). In *Nature*, vol. xxxvi., p. 229, appeared an article on "The 11th year Periodical Fluctuation of the Carnatic Rainfall," which bears to some extent on the question.

Other Papers might be cited, but enough is here given to show that the connection has been observed and taken into consideration by more than one or two observers. As to the relation which may exist between volcanic eruptions and winds and seasons, I would refer in that connection to my address to the Royal Geological Society of Ireland, read the 16th November, 1885,[1] wherein I insisted on the importance of the vast volumes of gases and very fine dust material projected into the upper atmosphere by many of the active volcanoes. These gases and dust tend, on the one hand, to modify the upper currents of the air (and in so far to influence the winds), and on the other, to modify the quantity of heat absorbed by the atmosphere by its greater or less volume, and so become a factor as regards rain seasons, &c., since it has been shown by Aitken that rain is intimately connected with the quantity of dust present in the air. The events which accompanied and followed the eruption of Krakatoa fully illustrated these ideas, and on a scale of the grandest magnitude. (It is worth while mentioning here that the sun-spot period was maximum in 1883·8, the date of the eruption having been 26th, 27th August, 1883 (= 1882·63).)

Why so little attention has been given by geologists to the sun-spot period in relation to the periodicity of phenomena occurring at the surface of the earth, may be explained by the relatively recent date of the publishing of Wolf's work, and by the shortness of the time covered by his list, which does not go farther back than 1610. There is also the want of complete lists of eruptions, earthquakes, auroras, &c., with which to institute a comparison in the different cases which may present themselves for consideration. The tables published by Kluge and by Poëy, only give totals of hurricanes, eruptions, or earthquakes for given sets of years, and could not therefore be checked or controlled, except by comparison with the lists of Mallet, and Perrey, and Falb, a work most onerous and tedious to undertake, and to some extent insuperable in its difficulties, since these lists should be read through as a whole, and so to some extent re-written.

[1] See *Scientific Proceedings R. D. S.*, vol. v., pt. I., p. 17.

Unfortunately Kluge's list of eruptions has not been published (so far as I know), and Mallet's list is mainly concerned with earthquakes.

Had Kluge or Poëy given a chronological list of the eruptions of certain volcanoes, and allowed comparison of their dates with those of the sun-spot period of Wolf, perhaps more attention, and certainly more acceptance of a connection between them, would have been insured. It is therefore from this point of view, that I propose to present the question, and, selecting a certain number of volcanoes, to give a list of their eruptions, and place the date of these in comparison with the sun-spot periods as given by Wolf in his list. It will be more convenient to give this list at once, so that it can be referred to when necessary, marking also the intervals between the different successive dates mentioned therein, and noting the minima by – ("minus,") and the maxima by + (plus).

Date.	Interval.	Date.	Interval.	Date.	Interval.
– 1610·8		– 1712		– 1810·5	
	4·7		6·2		5·6
1615·5 +		1718·2 +		1816·1 +	
	3·5		5·3		7·1
– 1619		– 1723·5		– 1823·2	
	7·0		4·0		6·3
1626 +		1727·5 +		1829·5 +	
	8·0		6·5		4·3
– 1634		– 1734		– 1833·8	
	5·5		4·7		3·4
1639·5 +		1738·7 +		1837·2 +	
	5·5		6 3		6·8
– 1645		– 1745		– 1844	
	4·0		5·0		4·6
1649 +		1750 +		1848·6 +	
	6·0		5·5		7·6
– 1655		– 1755·5		– 1856·2	
	5·0		6·0		4·0
1660 +		1761·5 +		1860·2 +	
	6·9		5·0		7·0
– 1666·9		– 1766·5		– 1867·2	
	8·1		3·4		3·5
1675 +		1769·9 +		1870·7 +	
	4·5		5·9		8·3
– 1679·5		– 1775·8		– 1879	
	5·5		3·7		4·8
1685, +		1779·5 +		1883·8 +	
	4·5		5·3		5·8
– 1689·5		– 1784·8		– 1889·6	
	3·5		4·2		5·3
1693 +		1789 +		1894·9 +	
	5·0		9·5		
– 1698		– 1798·5			
	7·5		5·5		
1705·5 +		1804 +			
	6·5		6·5		

I propose to examine the lists published of the eruptions of the following volcanoes—Hecla, Katla, and Trölladyngia; also those of Etna and Vesuvius. The three first I take from a Paper having appeared in the "Smithsonian Report" of 1885 (Washington, 1886), under the title—"Observations on Volcanic Eruptions and Earthquakes in Iceland within Historic Times, translated and condensed from a History of Iceland by Thomas Thoroddsen, by George H. Bœhmer."

One reason for selecting these Icelandic eruptions, is that the intervals between the eruptions are generally long, and rarely represent a close succession of years which would favour a chance coincidence between the year of occurrence of the eruption and one of the sun-spot period years. Another reason for the selection is, that generally the Smithsonian Papers are carefully prepared, and the data carefully checked.

In this list, Hecla appears with 17 eruptions as follows:—

No.	Date.	Remarks.
1	1104.	
2	1157.	
3	1206, December 4, ..	Lasted till following spring.
4	1222.	
5	1294, ...	With violent earthquakes and formation of crevices.
6	1300, July 10, ...	One of the most violent of the volcano.
7	1341, May 19, ...	Enormous fall of cinders accompanied by an earthquake.
8	1389–90, ...	Lasted to middle of 1390.
9	1436.	
10	1510, July 25.	
11	1554, May (end of), ..	Accompanied by frequent shocks of earthquake.
12	1578, ...	Accompanied by frequent shocks of earthquake.
13	1597, January 3, till March,	Great projection of cinders.
14	1619, July (end of), ..	The ashes carried northward produced intense darkness.
15	1636, May 8, ...	Lasted until following winter.
16	1693, Feby. 13, till August,	Very violent.
17	1766, April 5, ...	Lasted until autumn.

It may be remarked at once, that the eruptions which occurred during the summer months predominate, as indicated by Kluge. As regards the connexion with sun-spot period years of maxima or minima, the four last mentioned can alone be discussed, strictly speaking, since Wolf's list only goes back to 1610·8. For these, however, the correspondence is fairly good.

No. 14, 1619 (July, end of)	= 1618·58, Wolf's list, 1619 minimum.
No. 15, 1636 (May 8th)	= 1635·35, ,, 1634 minimum.
No. 16, 1693 (Feb. 13th to Aug.)	= 1692·12—1692·67, Wolf's List, 1693 maximum.
No. 17, 1766 (5th April)	= 1765·25, Wolf's List, 1766·5 ± 0·5 minimum.

As regards the dates prior to 1610, all that can be attempted is to estimate according to the intervals occurring between them, and any of the known years of Wolf's list, and examine how far these intervals correspond. Taking thus the eruption of 1597, we may ask if this year was, in all probability, a minimum or a maximum year of the sun-spot period. Now the period being in the mean 11·11 (or 11·1 years as more usually taken), the interval between 1619 and 1597 is just 22 years, that is, twice the period; and it may be assumed that the 13th eruption mentioned in the list as occurring January 3rd, till March 1597 (= 1596·08 to 1596·25), corresponds to *a minimum* of sun-spots.

The interval between the twelfth and the thirteenth eruption, that is, between 1597 and 1578 is 19 years, which may or may not represent a double interval between maxima or minima years — in this case; or may represent an interval of years between a maximum and a minimum, or *vice versa*. Thus we have the interval between − 1889·6 + 1870·7 = 18·9 years. We have also the interval between − 1619 and 1578 = 41, which compares well with the interval between − 1889·6 and + 1848·6 = 41 years, as also the interval between − 1645 and 1578 = 67 years, which compares fairly with the interval − 1889·6 and − 1823·2 = 66·4 years. Lastly, I may cite the interval − 1655 and 1578 = 77 years, which is practically a multiple of the sun-spot period, and would make this twelfth eruption correspond to a presumed minimum year, but it may possibly have corresponded with a maximum year.

There is a further circumstance to be noted in this respect, and which may have some value in deciding whether this eruption corresponded to a minimum or to a maximum; it is the character of *the* *winter corresponding to the year in question.* Poëy, in his Paper of Compt. Rend., 1873 (vol. lxxvii., p. 1222), points out a coincidence of a series of severe winters with maxima of sun-spot periods, and if the records of the seasons, such as they may be found in various works be consulted, it will be found that this coincidence frequently presents itself. Now it is mentioned in Arago's works (vol. 5, "Œuvres complètes"), "Sur l'état Thermométrique du Globe Terrestre," p. 418, that the summer of the year 1578 was remarkably warm in France and Belgium. "On ressentit en Belgique des chaleurs excessives La sècheresse dura depuis Mai jusq'en Septembre (Quetelet). On vendangea à Dijon le 22 de ce Mois"; and for the year 1610 (a minimum sun-spot year), he has the record: "L'été fut excessivement chaud et sec, et il y eut grande abondance de vin (Short). Ou vendangea à Dijon le 20 Septembre."

I find, however, no mention as to there having been a severe winter this year. The presumption, therefore, so far as this character is concerned, is that the year 1578, either was a *minimum* sun-spot year, or near to it in date.

The eleventh eruption of 1554, end of May (= 1553·42) shows an interval of 24 from that of 1578, or more correctly – 24·6, that is in excess of the normal interval, 22·2 by 2·4 years. If it be compared with the minimum of 1610·8, the interval comes out 57·4 years, that is in excess of the normal interval by 2·2 years. The winter of the year 1554 is mentioned in our annals as follows:—"This year was a very sad winter, especially from the 21st December to the end of the following spring, either perpetual hail, rain, or tempest."

If it be compared with the year 1597, which may be taken as a minimum year, the interval is 42·6, showing difference from the normal time of 1·8 year. The eruption took place, therefore, within about two years of the sun-spot *minimum*, which probably fell in 1552, the winter of which 1552-3 was a memorable one in the Dutch records for its severity. (See Arago's work cited, for that winter.)

The tenth eruption, that of 1510, 25th July (= 1509·59), shows an interval from 1610·8 of 101·2 years, comparing fairly well with the interval between 1889·6 and 1789 = 100·6 years. Furthermore, the interval between the 11th and 10th eruption is 1554 – 1510 = 44 years, practically the quadruple sun-spot period (44·4). As regards the character of the winter, the following is the passage in regard to it in Arago's work already cited (vol. 5, p. 274):—"1510–1511. Cet hiver est cité comme rigoureux dans les receuils hollandais. En Italie le froid fut très intense; la neige tomba abondamment et la geleé fut assez forte pourqu'au siège de Mirandole les soldats du pape Jules II. pussent traverser les fosses sur la glace (Guichardin, Hist. d'Italie)."

The year 1510 may therefore be taken as a *minimum* year of sun-spots, more particularly for the first-mentioned reasons.

The ninth eruption, that of 1436, shows an interval from the tenth of 74 years, which differs from the normal interval of 77·7 years by 3·7. However, we have actually the interval of 73·5 years between − 1889·6 and + 1816·1, so that the year 1436 may have been a maximum year of the sun-spot period. As regards the winter of that year, the Annals of Ulster give the following entry for 1435 (1435–6):—"An unusual frost and ice occurred in this year, so that the people used to traverse the rivers and lakes of Ireland on the solid ice."

Arago's list says, p. 270: L'hiver de cette année (1435) fut remarquable par la durée and la rigueur du froid. Il dura en Flandre depuis le commencement de Decembre jusqu'au mois de mars et l'épaisseur de la glace fût de plus d'une aune (*Annales Meyers*). En Allemagne beaucoup de personnes moururent de froid (*Chronicon Elvasense*)."

It would be reasonable to presume that the year 1436 was a sun-spot year, either of *maximum* or *minimum*, or at no great interval from one.

Between the ninth eruption of 1436 and the eighth of 1389–90, the interval is 46 years, which exceeds the normal interval of 44·4 by 1·6 year, a sufficiently close approximation to allow of this year 1389–90 being considered as a *minimum* of sun-spots. If it be compared with the minimum year 1610·8 of Wolf's list, the interval comes out 221·8 years (222–221·8 = 0·2), which only differs from the normal interval by 0·2 year. No mention occurs in Arago's work as regards the weather of this year, nor in our annals.

Between the eighth and seventh eruptions, 1389–90 and 1341, the interval is 49 years; this may be interpreted as the difference between a minimum year and a maximum. That this may be so, is proved by the interval which occurs between − 1889·6 and + 1615·5 = 274·1, while between + 1615·5 and 1340·46, the interval is 275·04. As regards the weather of this year, Arago's list mentions, under the date 1341, p. 269: "Le Froid de cet hiver fut si rude en Livonie que beaucoup de soldats de l'armée des croisés eurent le nez, les doigts ou les membres gélés."

It may thus reasonably be assumed that 1341 was a sun-spot year and probably a *maximum*. Between the seventh and the sixth eruptions (1341 and 1300) the interval is 41 years. This compares well with the known interval between − 1889·6 and + 1848·6 = 41 years; and this coincidence points to the year having been probably a *maximum* sun-spot year. As regards the weather of this year, there is no mention made in our annals or in Arago's work. Between the sixth and the fifth eruptions (1300 and 1294) the interval is 6 years, that is about the usual number of years which occur between a *maximum* and a *minimum*. Thus taking the interval between + 1615·5 and 1294, we get 321·5 years, which agrees well with the normal interval represented by 11·1 × 29 = 321·9. It may therefore be assumed that 1294 was a *maximum* sun-spot year. There is no mention in the records as to the character of the weather of this year.

Between the fifth eruption and the fourth (1294 and 1222), the interval is 72 years. This again would point to an interval such as 66·6 + 5·4, that is, a normal interval 66·6, and the usual period from *maximum* to *minimum*. Thus we have the known interval −1889·6 − (+ 1816·1) = 73·5. On the other hand, we have the interval − 1610·8 − 1222 = 388·8, which compares well with the normal interval, 11·1 × 35 = 388·5. It would therefore be allowable to consider this year as a sun-spot year either of *maximum* or of *minimum*. From the fact of there being no mention in the records as to the nature of the weather during this year, it might probably have been a *minimum* year.

The interval between the fourth and the third eruption (1222–1206) is 16 years, which may be interpreted as (11·1 + 4·9), that is an interval from one *minimum* to another, plus the time to the next *maximum*. Thus, if we compare this year with + 1615·5, the difference (+ 1615·5 − 1206) comes out 409·5, which compares well with the normal interval 11·1 × 37 = 410·7.

The records of the Annals of Ulster for the year 1205 are interesting in this respect:—"A great frost and snow from the calends of January to Patrickmass this year." The year 1206 may therefore be assumed to be a sun-spot year.

The year 1157, second eruption, gives with the year 1206, third eruption, an interval of 49 years (the same as between the seventh and eighth eruptions). Compared with −1610·8, it gives the interval − 1610·8 − 1157 = 453·8 years, which approximates fairly to the normal interval 11·1 × 41 = 455·1 years. The entry as regards the weather of the year in Arago's work is as follows:—"L'immensité de la neige et la violence de la gelée détruisirent une grande partie des vignes" (Hermann) (Arago, "Œuv. comp.," vol. 5, p. 206). The interval between the second eruption of 1157 and the first recorded, 1104, is 53 years, which compares well with the known interval –1889·6 and + 1837·2 = 52·4, and would point to the year in question having been a year of *maximum*. Towards this interpretation would also point the interval between + 1615·5 and 1104 = 511·5, which agrees fairly well with the normal interval 11·1 × 46 = 510·6. There is no entry as regards the nature of the weather of this year in the records already referred to. The year 1104 might therefore be considered as a *maximum* sun-spot year from the foregoing data.

The preceding observations in detail on the eruptions of Hecla may be summarized as follows:—

Erup-tion.	Date.	Inter-vals.	Estimated sun-spot years.	Differ-ences.
1	1104 .. .. .. = 1104		+ 1104 ??	—
		53		
2	1157 .. .. .. = 1157		+ 1157 ??	—
		48·93		
3	1206, December 4, .. = 1205·93		± 1206 ??	—
		16·07		
4	1222 .. .. .. = 1222		– 1222 ??	—
		72		
5	1294 .. .. .. = 1294		+ 1294 ??	—
		5·53		
6	1300, July 10, ... = 1299·53		+ 1300 ??	—
		40·95		
7	1341, May 19, ... = 1340·48		+ 1341 ??	—
		48·52		
8	1389–90 .. .. .. = 1389–90		– 1389 ?	—
		47·		
9	1436 .. .. .. = 1436		+ 1436 ??	—
		73·57		
10	1510, July 25, ... = 1509·57		– 1510 ?	—
		43·84		
11	1554, end of May, .. = 1553·41		– 1552 ??	—
		24·59		
12	1578 .. .. .. = 1578		– 1578 ??	—
		18·01		
13	1597, Jan. 3 till March, = 1596·01		– 1596, 01 ?	—
		22·57	Wolf's List.	
14	1619, end of July, .. = 1618·58		– 1619	0·58
		16·86		
15	1636, May 8, ... = 1635·44		– 1634	1·44
		56·68		
16	1693, February 13, .. = 1692·12		+ 1693	0·88
		73·14		
17	1766, April 5, ... = 1765·26		– 1766, 5	1·24

The eruptions of Katla may be summarized as follows:—

No.	Date.	Remarks.
1	**894–934 approximately.**	
2	**1245, ...**	**Projection of cinders and water.**
3	**1262, ...**	**Projection of mass of water, ice, and stones.**
4	**1311, January 25, ..**	**Accompanied by earthquake shocks.**
5	**1416, ...**	**Considerable fall of ashes.**
6	**1580, August 11.**	
7	**1625, September 2 to 14, ..**	**The ashes carried to Bergen in Norway.**
8	**1660, November 3 to 12, ..**	**Fishing-grounds of 38^{m} deep were filled up by the eruption and formed a dry beach.**
9	**1721, May 11, ...**	**Great fall of ashes; lasted during summer and fall.**
10	**1755, September 10 to 16,**	**Great projection of ashes; lasted to August 1756.**
11	**1823, June 26 to July 23,**	**Not so violent as previous eruption.**

It may be remarked that of these eleven eruptions, five come within the period covered by Wolf's list. Taking them therefore from 1823 backwards, we get the following Table showing the correspondence of the dates with those of the sun-spot list:—

Eruptions.	Date.	Intervals.	Sun-spot dates.	Differences.
11	1823, June 26 to July 23, = 1822·50		– 1823·2	0·70
		67·81		
10	1755, September 10 to 16, = 1754·69		– 1755·5	0·31
		34·33		
9	1721, May 11, ... = 1720·36		+ 1718·2	2·16
		70·53		
8	1660, November 3 to 12, .. = 1659·83		+ 1660	0·17
		35·17		
7	1625, September 2 to 14, = 1624·66		+ 1626	1·34

It may thus at once be remarked that nearly half the recorded eruptions of Katla having well-marked intervals of years between them, correspond practically with the sun-spot period dates of Wolf.

The differences between the sun-spot dates and the corresponding eruption dates are small, with the exception of that for the year 1721. The remaining eruptions may be tabulated as follows:—

Eruptions.	Date.	Intervals.	Estimates for sunspot dates.
6	1580, August 11, ... = 1579·60	163·60	+ 1580 ?
5	1416, ... = 1416	106·93	+ 1416 ?
4	1311, January 25, .. = 1310·07	48·07	– 1310·07 ?
3	1262, ... = 1262	17	+ 1262 ?
2	1245 .. .. .. = 1245		– 1245 ?
1	900, approximate.		

As in the previous cases, estimates are also made of the relation of these to the sun-spot period.

The interval between the seventh and the sixth eruption, 1624·66 and 1579·60, is 45·06, which approximates so closely to the normal interval 44·4, that 1580 may be taken as a *maximum* year on that account. We have, however, the interval –1889·6 and –1844 = 45·6, which is also sufficiently close as a value. As there is no record of the weather of the year in question, it remains doubtful under which head to place it.

The interval between the sixth and the fifth eruption (1579·6 – 1416) is 163·6, which differs somewhat from the normal interval 166·5, but which approximates to that between –1889·6 and + 1727·5 = 162·1. Taking the interval between + 1615·5 and the year in question (1416), we have the interval 199·5 which practically represents a normal interval, 199·8 = (11·1 × 18); so that for that reason this year may be taken as a *maximum* sun-spot year. There is no record of the nature of the weather for this year in the works already referred to.

The interval between the fifth and the fourth eruption (1416 – 1310·07) is 105·93, which is not a normal interval, but which corresponds fairly well with the interval between –1889·6 and –1784·8 = 104·8. Moreover the interval between – 1610·80 and 1310·07 is 300·73, which corresponds fairly well with the normal interval

11·1 × 27 = 299·7. For these reasons the year in question may be taken as a *minimum* sun-spot year.

The interval between the fourth and the third eruption (1310·07 and 1262) is 48·07, which exceeds the normal interval 44·4 by 3·67, and which may, therefore, represent the interval between a *minimum* and a *maximum*. Moreover the interval between + 1615·5 and 1262 is 353·5, which differs little from the normal interval, 355·2 (= 11·1 × 32), the difference being only 1·7. This year 1262 may, therefore, be taken as a *maximum* year of sunspots. The record for the weather of this year is thus given in the "Annals of Ulster":—"There was a great drought this year, and a very hot summer." ("Annals of Clonmacnoise.")

The interval between the third and the second eruption is 17 years, which is not very different from that between − 1889·6 and + 1870·7 = 18·9. That is, it may be read as the difference between a *maximum* and a *minimum* year, or *vice versa*. Now if the interval between the sun-spot year, − 1610·8 and 1245, be taken, we get 365·8, which agrees fairly well with the normal interval 366·3 (= 11·1 × 33), so that this year may be taken as a *minimum* sun-spot year.

The eruptions of Trölladyngia mentioned in Bœhmor's Paper are only six in number, and are as follows with the intervals and the estimations as regards their relations with sunspot years:—

Eruptions.	Date.	Intervals.	Sunspot years.
1	1151		+ 1150 ?
		37	
2	1188		− 1188 ?
		152	
3	1340		+ 1341 ?
		20	
4	1360		+ 1360 ?
		29	
5	1389·90		− 1389 ?
		21	
6	1510		− 1510 ?

The fifth and the sixth eruption dates have already been considered along with the Hecla dates, and must of course be taken as being *minima* sun-spot years, as in the case of Hecla.

The interval between the fifth eruption and the fourth (1389 and

1360) is 29 which is not a normal interval, but which corresponds well with the interval between − 1889·6 and + 1860·2 = 29·4, and which would indicate this as a *maximum* sun-spot year. This is supported by the interval between + 1615·5 and 1360 = 255·5 quite as nearly normal (11·1 × 23 = 255·3), and also corresponds with the interval − 1889·6 − (− 1634) = 255·6. There is no record of the weather of this year in the works already referred to.

The interval between this year and the preceding is twenty years, which differs somewhat from the normal interval 22·2.

The interval between + 1615·5 and 1340 is, however, 275·5, which agrees fairly with the normal interval − 1889·6 − (+ 1615·5) = 274·1, and which would point to this year being taken as a *maximum*. This is to a certain extent supported by the record given in Arago's work, p. 269, for the year 1341 (probably the winter of 1340–41): "Le froid de cet hiver fut si rude en Livonie que beaucoup de soldats de l'armée des croisés, eurent le nez, les doigts, ou les membres gélés."

The interval between the third and the second eruption (1340 and 1188) is 152, which differs somewhat from the normal interval 155·4. If, however, the interval be taken between − 1610·8 and 1188, the result is 422·8, which agrees well with the normal interval 421·8 (= 11·1 × 38), and which would point to the year in question being considered as a *minimum* sun-spot year. There is no record of the weather for this year in the works already referred to.

The interval between this and the previously mentioned eruption year is thirty-seven years, which differs so from the normal interval 33·3, that it may be read 33·3 + 3·7, that is an interval of years between a *minimum* and a *maximum*. This is supported by the interval between + 1615·5 and 1151 = 464·5, which differs little from the normal interval 466·2 = 11·1 × 42, so that, taking as a *maximum* sun-spot year the date 1153, the agreement will be sufficient.

The eruptions of Vesuvius and Etna are fairly well known, and have been given with much detail in several well-known works which will be found mentioned under the names of these volcanoes in the articles of the "Encyclopædia Britannica," from which I extract the dates only, commencing with those relative to Ætna.

[TABLE.

Eruptions.	Date.	Eruptions.	Date.
1	7th century B.C. (probably).	38	A.D. 1669, Mar. 8* = 1668·18.
2	In the time of Pythagoras.	39	,, 1682.
3	B.C. 477.	40	,, 1688.
4	,, 426.	41	,, 1693.† = 1692·04.
5	,, 396.	42	,, 1694, March = 1693·16.
6	,, 140.	43	,, 1702, March = 1701·16.
7	,, 134.	44	,, 1723.
8	,, 126.	45	,, 1732.
9	,, 122.	46	,, 1735.
10	,, 49.	47	,, 1744.
11	,, 43.	48	,, 1747.
12	,, 38.	49	,, 1755.‡ = 1754·16.
13	,, 32.	50	,, 1758, Nov. = 1757·84.
14	A.D. 40.	51	,, 1759.
15	,, 72.	52	,, 1763.
16	,, 253.	53	,, 1766.
17	,, 420.	54	,, 1780, May 18 = 1779·38.
18	,, 812.	55	,, 1781.
19	,, 1169.	56	,, 1787.
20	,, 1181.	57	,, 1792.
21	,, 1285.	58	,, 1797.
22	,, 1329, June 28.	59	,, 1798.
23	,, 1333.	60	,, 1799.
24	,, 1371, Aug. 6 = 1370·60.	61	,, 1800.
25	,, 1408, Nov. = 1407·83.	62	,, 1802.
26	,, 1444.	63	,, 1805.
26a	,, 1447.	64	,, 1808.
27	,, 1536, March.	65	,, 1809, March = 1808·16.
28	,, 1537, May.	66	,, 1811.
29	,, 1566, November.	67	,, 1819.
30	,, 1579.	68	,, 1831.
31	,, 1603.	69	,, 1832.
32	,, 1607.	70	,, 1838.
33	,, 1610.	71	,, 1842
34	,, 1614.	73	,, 1852, Aug 26 = 1851·65.
35	,, 1619.	74	,, 1864.
36	,, 1633, Feb. = 1632·09.	75	,, 1865.
37	,, 1646.	76	,, 1879, May 24 = 1878·40.

* One of the most terrible on record. † Early in January. ‡ Early in the year.

Of the total number of eruptions here recorded 43°/₀ come within the period covered by Wolf's tables of sunspot period. Taking the dates from the more recent backwards we have the following table of relative correspondence between the dates and the maxima and minima of the sun-spot period.:—

Eruptions.	Dates.	Sun-spot years. Wolf's list.	Difference.	Eruptions.	Dates.	Sun-spot years. Wolf's list.	Difference.
76	1878·40	– 1879	0·6	53	1766	– 1766·5	0·5
75	1865	– 1867·2	2·2	52	1763	+ 1761·5	1·5
74	1864	+ 1860·2	3·8	51	1759		
73	1851·65	+ 1848·6	3·05	50	1757·84 }	– 1755·5	0·5
71	1842	– 1844	2	49	1754·16 }		
70	1838	+ 1837·2	0·8	48	1747		
69	1832	– 1833·8	1·8	47	1744	– 1745	1
68	1831	+ 1829·5	1·5	46	1735	– 1734	1
67	1819	+ 1816·1	2·9	45	1732		
66	1811	– 1810·5	0·5	44	1723	– 1723·5	0·5
65	1808·16 }			43	1701·16	+ 1705·5	4·34
64	1808 }			42	1693·16 }	+ 1693·	0·16
63	1805	+ 1804	1	41	1692·04 }		
62	1802			40	1688	– 1689·5	1·5
61	1800			39	1682	+ 1685	3
60	1799 }			38	1668·1	– 1666·9	1·2
59	1798 }	– 1798·5	0·5	37	1646	– 1645	1
58	1797 }			36	1632·09	– 1634	1·91
57	1792	+ 1789	3	35	1619	– 1619	0·00
56	1787	– 1784·8	2·2	34	1614	+ 1615·5	1·5
55	1781			33	1610	– 1610·8	0·8
54	1779·38	+ 1779·5	0·12				

The mean difference between the dates as given, and the sun-spot years of Wolf's list is 1·56, which under the circumstances must be allowed to be a close correspondence, and to go far to justify the views put forward by Kluge in this respect. It is also reasonable to assume that for the dates prior to 1610·8, the differences between the sun-spot years and the eruption years would have been found to correspond equally closely, did we possess data relative to the maxima and minima sun-spot years going back sufficiently far. It is very interesting to note that while there are 18 minima years indicated, there are but 13 maxima years; and it further appears, that taking the mean of the differences between the eruption dates and the corresponding sun-spot dates in both cases, the mean difference in the cases of the *minima years* is only 1·09, while in the case of the *maxima years*, it is 2·05, from which might be drawn the inference that the correspondence between volcanic eruptions and *minima sun-spot* years, is much closer than as regards maxima sun-spot years, and seemingly more frequent. In order to complete the list, estimations will be given for the years mentioned in the list, prior to 1610.

Date.	Interval.	Date.	Interval.
1607		1565·85	
	4		29·52
1603		1536·33	
	24		
1579		1535·15	
	13·15		88·15
		1447	

Allowing a usual interval between a minimum and a maximum 3 to 4 years, the year 1607 may be taken as representing a *maximum* sun-spot year; that is supported to some extent by the record of the winter of that year, as given in Arago's work already cited: "L'hiver de 1608, fut longtemps appelé *le grand hiver*. Le froid sèvit presque sans intermittance depuis le 20 Décembre 1607, jusqu'à vers le milieu de Mars 1608 en France, en Angleterre, en Hollande, en Allemagne, en Italie. Les historiens abondent en details sur les effets de la geleé. Dans la partrie septentriónale de l'Europe, tous les fleuves furent pris. La plupart des jeunes arbres perirent, le froid gela une partie des vignes jusqu'à la racine. L'Angleterre vit presque tout son bétail détruit.

"À Londres la Tamise était gélée au point que des chariots chargès la traversèrent.

"Il tomba à Padoue une immense quantité de néige."

The year 1603 may have been a *minimum*. The weather of the year is mentioned in Arago as follows: "Cet hiver fut encore très rigoureux dans le midi de la France. Des charrettes passèrent sur le Rhône congélé" (Arago, *op. cit*).

The year 1579 makes with the year 1610·8, an interval of 31·8 years, which differs from the normal interval by 33·3 − 31·8 = 1·5, an approximation sufficient to allow its being considered as a *minimum* sun-spot year. There is no record of the weather for this year in the works already cited.

The year 1565·85, shows with the year − 1610·8, an interval of 44·95 years, which compares well with the normal interval of 44·4, and would allow of its being taken as a *minimum* year of sun-spots.

The weather of 1593-5 was remarkable on account of the severity of the winter on the Continent and in Great Britain. Arago's work gives the following detail (pp. 275-6): "À Paris cet hiver dura depuis le 20 Decr. 1564, jusqu'au 24 Mars 1565. La gelée dura à Liège du 14 Nov. 1564, à la fin d'Avril 1565. On tint boutique sur la glace dont était couvert l'Escant. En Decembre la Tamise fut prise au point qu'on la traversait sur la glace. En provence le Rhône fut pris dans toute sa largeur à Arles et les oliviers périrent."

The year (1536·33) gives with the maximum year + 1615·5, an interval of 79·17 years, which compares well with the actual interval – 1889·6, and – 1810·5 = 79·1, and even with the normal interval 77·7, the difference being only 1·47. It may therefore be taken as a *maximum* sun-spot year. There is no record as to the winter of this year in the records already referred to.

The interval between 1536·33 and 1447 is 89·33 years. This differs from the normal interval – 88·8 by 0·53 only. On the other hand we have the actual interval – 1889·6 – (+ 1727·5) = 162·1, and for 1447. – 1610·8 – 1447 = 163·8, showing a difference in this case of 1·7. There is no record of the weather of this year in the works already cited, and there is nothing to indicate whether the years should be looked on as a maximum or a minimum, except the regularity of the interval, which would point to its being taken as a *maximum*.

The interval between 1444 and 1447 is 3 years, that is about the usual time from a minimum year to the next maximum. A nearly same interval has sometimes occurred between a maximum and a minimum + 1615·5 and (– 1619) = 3·5. This year makes with –1610·8, an interval of 166·8 years, which only differs from the normal interval, 166·5, by 0·3, so that it may be taken as a *minimum* sun-spot year. The weather record for the year in the Annals of Ulster, is "A wet summer and harvest, with all corn maltish for the most part" (Mc. Firbis' Annals), which, so far as it goes, would point to a minimum.

The interval between 1408 and 1444 is 36 years, which differs from the normal interval by 2·7 years. However the interval between 1408 and 1536·33, which was taken as a maximum year, is 128·33 years, which agrees well with the actual interval – 1889·6 – (+ 1761·5) = 128·1, and which might be taken as pointing to the year in question being considered a maximum. The weather record is given in Arago's work as follows (p. 269, 270):—"L'hiver de 1408 qui sévit sur le Nord de l'Europe et jusqu'aux bords du Danube fut le plus cruel qui eut été depuis 500 ans. Il fut si long qu'il dura depuis le St. Martin

(11 Nov.) jusqu'à la fin de Janvier, et si apre qui les racines des vignes, et des arbres fruitiers gélèrent." The year 1408 may therefore be taken as a *maximum*, for this reason at least.

The interval between 1407·83 and 1370·60 is 37·23 years, which may be considered as a regular interval, 33·3 + 3·90, that is, an interval between two maxima or minima and an interval from a maximum to a minimum, or *vice versa*. Thus we have the interval between – 1610·8 and 1370·6 = 240·2, while we have the interval between a known maximum and minimum – 1889·6 and + 1649 = 240·6. This would suggest that the year in question was a minimum. There is no record of the weather for this year in the works already referred to. As regards the year 1333, it is interesting, in the first place, to compare it with 1444, as regards the interval, 111 years, that is 99·99 + 11 years, which occurs sufficiently frequently in these records to merit attention. It is also notable that the interval between 1370·6 and 1333 = 37·6 is practically the same as that between 1408 and 1370·6 = 37·4, and should lead to the same conclusion, that is that 1333 was a *minimum* sun-spot year. This is further borne out by the interval between – 1610·8 and 1333 = 277·8, which is practically the normal interval 11·1 × 25, and occurs between the years – 1889·6 and – 1610·8 = 278·8. The weather record for this year helps to bear out this interpretation. The Annals of Ulster give under this date :—" 1333. A most seasonable summer." (Grace's Annals.) " It happened to be so dry a summer that at the feast of St. Peter ad Vincula (29th June) there was bread made of new wheat."—Camden's Annals.

The interval between the year 1328·5 and the preceding is 4·50 years, which may point to this year having been a maximum. Thus comparing it with + 1615·5 the interval is + 1615·5 – 1328·5 = 287 years, which represents sufficiently closely the normal interval 11·1 × 26 = 288·6, and allows of the year in question being taken as a *maximum* sun-spot year. There is no record in Arago's work as to the weather of this year. The interval between the year 1285 and the preceding is 43·5, which approximates closely to 44·4, the normal interval and would point to the year having been a *maximum* also. The record of the weather goes some way to support this reading, as, under the head of the year 1285-6, the Annals of Ulster state :—" There was great snow this year, which continued from Christmas to St. Bridget's day " (" Annals of Clonmacnoise "). The interval between the year 1181 and the preceding one is 104 years, which is not a normal interval, but may be compared with the interval – 1889·6 and – 1784·8 = 104·8, which would allow of its being taken as a *minimum* year of sun-spots. There is no record of the weather for this year in the works referred to.

The interval between the year 1169, 4th February, 1168–9, and the preceding is twelve years, which is sufficiently close to the normal interval 11·1 to allow of this year being considered as a *minimum*. The year was remarkable on account of the violence of the eruption. *it is cited as having been "the most tremendous eruption of ancient times."* It is therefore interesting to compare it, as interval, with the date of the equally celebrated eruption of 1669, March 8th = 1668·18, the difference is 500·09, the normal interval would be 11·1 × 45 = 499·50, so that the difference is less than a unit, and as the nearest sun-spot year to 1668·18 was a *minimum*, 1168·09 would be therefore a *minimum*. There is no reference in the works cited to the weather of that year.

The interval between the year 812 and the preceding year is 356·09, which is very near to a normal interval 11·1 × 32 = 355·2, differing only by 0·89. If we take the interval between this year and the *minimum* year – 1610·8, we get 798·8 years, which again is practically equal to the normal interval, 11·1 × 72 = 799·2, so that the year in question may be regarded as a *minimum* year.

The year 420 makes with the preceding one an interval of 392, which, not representing a complete normal interval, may be read 388·5 (= 11·1 × 35) + 3·5, that is an interval between a *minimum* and a *maximum*. But it does not correspond sufficiently well with any of the sun-spot years to allow of its being noted either as a *maximum* or a *minimum*.

The interval between the year 253 and the preceding year is 167, which corresponds well with the normal interval 166·5 = 11·1 × 15. Otherwise there is no indication as to its relation with the sun-spot period.

The interval between the year 72 and the preceding year is 181, which does not represent a normal interval. If the interval be taken with + 1615·5, an interval of 1543·5 is found, which differs slightly from the normal one 11·1 × 139 = 1542·9, but is hardly sufficient of itself to fix the character of the year.

The interval between the year 40 and the last is 32 years, which is sufficiently close to the normal interval 33·3 to allow of its being considered as a sun-spot period year.

The dates about this period, that is the first and second centuries A. D., and the dates prior to these need not be further examined. A single example, however, is worth consideration, that is B. C. 477. If this figure be added to – 1610·8 we get 2087·8, which very closely corresponds with the normal interval 11·1 × 188 = 2086·8. This year may, therefore, have been a *minimum* sun-spot year.

The tabular record of the eruption of Etna prior to 1610 would stand as in the accompanying table, leaving out of consideration the very early dates, as to the accuracy of which doubt may be held.

Eruptions.	Date.	Interval.	Probable sun-spot date.
1	7th century B.C. prob.		
2	Time of Pythagoras.		
3	477 B.C.		− 477 B.C. ??
		51	
4	426 „		+ 426·9 ??
		30	
5	396 „		
		256	
6	140 „		
		6	
7	134 „		
		8	
8	126 „		
		4	
9	122 „		
		73	
10	49 „		
		6	
11	43 „		
		5	
12	38 „		
		6	
13	32 „		
		72	
14	40 A.D.		
		32	
15	72 „		
		181	
16	253 „		
		167	
17	420 „		
		392	

Eruptions.	Date.	Interval.	Probable sun-spot date.
18	812 A.D.		− 812 ?
		356·09	
19	1168·09		− 1168·09 ?
		12·91	
20	1181		− 1181 ??
		104	
21	1285		+ 1285 ?
		143·45	
22	1328·45		+ 1328·45 ?
		4·55	
23	1333		− 1333 ?
		37·60	
24	1370·60		− 1370·6 ?
		37·23	
25	1407·83		+ 1407 ??
		36·17	
26	1444		− 1444 ?
		3	
26a	1447		+ 1447 ?
		88·16	
27	1535·16		
		1·18	
28	1536·34		+ 1536·34 ?
		29·50	
29	1565·84		− 1565·84 ?
		13·16	
30	1579		− 1579 ??
		24	
31	1603		− 1603 ??
		4	
32	1607		+ 1607 ?

The eruptions of Vesuvius are better known historically than those of even Etna, and should therefore furnish the most reliable dates to be had on a question of this nature. The number that are recorded within the period covered by Wolf's sun-spot list is relatively great, while the dates prior to 1610 are not so numerous as in the case of Etna, and so far this simplifies the comparison with sun-spot years of *maxima* and *minima*. The dates are taken from the article in the

" Encyclopædia Brit." on Vesuvius, and also from Phillips' monograph on "Vesuvius," 1869, which seems to be very complete in this regard. It has seemed unnecessary to give the intervals between successive years subsequently to 1694, as the succession is thenceforward nearly continuous, and the numbers being given by Wolf's list renders their consideration superfluous

No.	Date.	Interval.	Estimated Sun-spot Year.	—
1	63 A.D.[1] = 63		+ 62 ??	—
		15·65		
2	79 ,, Aug. 24 = 78·65		− 78·65 ?	—
		124·35		
3	203 ,, .. = 203		− 202·0 ?	—
		269		
4	472[2] ,, .. = 472		+ 472 ?	—
		40		
5	512 ,, .. = 512		− 512 ?	—
		173		
6	685 ,, .. = 685		+ 683 ?	—
		308		
7	993 ,, .. = 993		+ 993 ?	—
		43		
8	1036[3] .. .. = 1036		+ 1035·5 ?	—
		13		
9	1049 .. .. = 1049		+ 1049 ?	—
		89·9		
10	1138·9 .. .. = 1138·9		+ 1138 ?	—
		167·1		
11	1306 .. .. = 1306		+ 1305·5 ?	—
		194		
12	1500 .. .. = 1500		− 1500 ?	—
		130·97	Wolf's List Numbers.	Difference.
13	1631 Dec. 16[4] .. = 1630·97		+ 1626 − 1634	4·97 3·03
		29·53		
14	1660 July .. = 1660·50		+ 1660	0·50
		21·12		
15	1682 Aug. 12 .. = 1681·62		− 1679·5	2·12
		3·38		
16	1685 .. .. = 1685		+ 1685	0
		4		
17	1689 .. .. = 1689		+ 1689·5	0·50
		4·27		
18	1694 April 13 .. = 1693·27		+ 1693	0·27
19	1696 July .. = 1695·50			

[1] Promontory convulsions.
[2] Covered all Europe with fine ashes.
[3] First discharge of liquid lava.
[4] The crater disrupted.

No.	Date.		Interval.	Wolf's List Numbers.	Difference.
20	1697 Sept. 15 ..	= 1696·72	—	—	—
21	1698*	= 1698	—	− 1698	0
22	1701 July 1 ..	= 1700·5	—	—	—
23	1704 Mar. 19 ..	= 1703·21	—	—	—
24	1705 Jan. 19 ..	= 1704·05	—	—	—
25	1706 June 23 ..	= 1705·49	—	+ 1705·5	0·01
26	1707 end of July	= 1706·57	—	—	—
27	1708 Aug. 14 ..	= 1707·62	—	—	—
28	1712 Feb. to Nov.	= 1711·08	—	—	—
29	1713 April 24 ..	= 1712·31	—	− 1712	0·31
30	1714 Jan. 6 ..	= 1713·02	—	—	—
31	1716	= 1716	—	—	—
32	1717 Jan. 6 ..	= 1716·02	—	—	—
33	1718 Sept. 16 ..	= 1717·71	—	—	—
34	1719 July 7 ..	= 1718·51	—	+ 1718·2	0·31
35	1720 May 7 ..	= 1719·27	—	—	—
36	1723 June 26 ..	= 1722·48	—	—	—
37	1724 Sept. 4 ..	= 1723·68	—	− 1723·5	0·10
38	1725 Jan. 10 ..	= 1724·02	—	—	—
39	1726 †	= 1725·27	—	—	—
	1727	= 1727	—	+ 1727·5	0·50
	1728	= 1727·58	—	—	—
40	1730 February..	= 1729·08	—	—	—
41	1732 Nov. 29 ..	= 1731·91	—	—	—
42	1733 Jan. 8 ..	= 1732·02	—	− 1734	1·98
43	1737 May 14 ..	= 1736·29	—	+ 1738·7	2·41
44	1751 Oct. 22 ..	= 1750·89	—	+ 1750	0·89
45	1753 May & June	= 1752·33	—	—	—
46	1754 July ..	= 1753·50	—	—	—
47	1755 Jan. ..	= 1754·01	—	− 1755·5	1·49
48	1759 Nov. 24 ..	= 1758·90	—	—	—
49	1760 Feb. 21 ..	= 1759·09	—	—	—
50	1761 Jan. 8 ..	= 1760·02	—	+ 1761·5	1·48
51	1766 Mar. 28 ..	= 1765·22	—	—	—
52	1767 Mar. ..	= 1766·16	—	− 1765·5	0·34
53	1770 Mar. 14 ..	= 1769·20	—	+ 1769·9	0·70
54	1771 May 14 ..	= 1770·37	—	—	—
55	1773	= 1773	—	—	—
56	1776 June 3 ..	= 1775·42	—	− 1775·8	0·38
57	1777	= 1777	—	—	—
58	1779 May ..	= 1778·33	—	+ 1779·5	1·17
59	1784 Oct. 12 ..	= 1783·78	—	− 1784·8	1·02
60	1786 Oct. 31 ..	= 1785·83	—	—	—
61	1787 July‡ ..	= 1786·50	—	—	—
62	1788 July ..	= 1787·50	—	—	—
63	1789 Sept. ..	= 1788·66	—	+ 1789	0·34
64	1793 Feb. ..	= 1792·08	—	—	—
65	1794 June 12 ..	= 1793·46	—	—	—

* From which year an interval of rest exceeding 10 years has rarely occurred.
† The eruption commenced on April 10, 1726, and continued to end of July, 1728.
‡ Also Ætna.

No.	Date.		Interval.	Wolf's List Numbers.	Difference.
66	1799 January ..	= 1798·08	—	− 1798·5	0·42
67	1804 July 26 ..	= 1803·57	—	+ 1804	0·43
68	1805 Aug. 12 ..	= 1804·63	—	—	—
69	1806	= 1806	—	—	—
70	1809 Sept. 4 ..	= 1808·67	—	—	—
71	1812	= 1812	—	− 1810·5	1·50
	1813	= 1813	—	—	—
	1814	= 1814	—	—	—
72	1816 Aug. 7 ..	= 1815·60	—	—	—
73	1817 Dec. 22 ..	= 1816·90	—	+ 1816·1	0·80
74	1818	= 1818	—	—	—
	1819	= 1819	—	—	—
	1820	= 1820	—	—	—
	1821	= 1821	—	—	—
75	**1822** Feb. 23 ..	= **1821**·15	—	− 1823·20	2·05
76	1828	= 1828	—	—	—
	1829	= 1829	—	+ 1829·5	0·50
	1830	= 1830	—	—	—
	1831	= 1831	—	—	—
	1832	= 1832	—	—	—
	1833	= 1833	—	—	—
77	1834 Aug. ..	= 1833·59	—	− 1833·8	0·21
78	1838 Mar. 6 ..	= 1837·17	—	+ 1837·2	0.03
79	1839 Jan. ..	= 1838·01	—	—	—
80	1841	= 1841	—	—	—
81	1845 April 22 ..	= 1844·31	—	− 1844	0·31
82	1847 Nov. 13 ..	= 1846·87	—	—	—
83	1848 June ..	= 1847·42	—	—	—
84	1849 Dec. ..	= 1848·92	—	+ 1848·6	0·32
85	1850 Feb. 6 ..	= 1849·17	—	—	—
86	1855 Jan. ..	= 1854·01	—	—	—
87	**1858** May 21 ..	= **1857**·42	—	− 1856·2	1·22
88	1860	= 1860	—	—	—
89	1861 Dec. 8 ..	= 1860·92	—	+ 1860·2	0·72
90	1867 Oct. ..	= 1866·75	—	− 1867·2	0·45
91	1871-2	= 1871-2	—	+ 1870·7	0·30

The dates in the list prior to 1631 may be treated in the same manner as were those of Etna and the Iceland volcanoes, that is, an estimation can be made as how far these dates correspond with sun-spot years of maxima or minima.

In the present case these estimations give figures so close as to compare favourably with those arrived at in cases of the previously considered volcanoes.

Thus the eruption year 1500 gives with the sun-spot minimum year −1610·8 an interval of 110·8 years, which practically agrees with the normal interval 111 = (= 11·1 × 10). Moreover the interval between

1630·97 and 1500 is 130·97, which approaches sufficiently the normal interval 133·3, to allow of its being taken as an usual interval, since, as a matter of fact, we have the interval −1889·6 − (+1761·5) = 128·1, differing from the normal interval still more. The weather for this year is thus mentioned in the "Annals of Ulster": "This year (1500), from the middle of September till the end of winter, Ireland endured rains and many tempests." (Ware's "Annals.") "Great inclemency this year which killed almost all the cattle of Erin, and prevented the earth responding to the husbandman." This year may, therefore, be taken as a *minimum* sun-spot year.

The interval between 1500 and 1306 is 194 years, which compares well with the interval occurring between the known sun-spot years −1889·6 and (+) 1693 = 196·6. Moreover, the interval between the year +1615·5 and 1306 = 309·5, which differs only by a unit from the normal interval 310·8 (= 11·1 × 28). The weather of this year is thus mentioned in Arago's work already cited, p. 268: "La gélée fut très forte en France dans cet hiver" (Papon, "Hist. du Province," t. iii.): "La mer fut prise sur les côtes de Flandre et de l'Hollande sur une largeur de 3 lieues (l'Abbé Maim, "Mem. sur les Grandes Gélées, 1792").

The date 1305·5 has been estimated as the *maximum* sun-spot year corresponding to this eruption.

The year 1138–9 makes with the previous one 1306, an interval of 168 years, which differs so little from the normal interval 166·6, that it may be accepted as normal.

Furthermore, the interval between the maximum year + 1615·5 and 1138 is 477·5, which practically agrees with the normal interval 477·3 (= 11·1 × 43). There is no mention in the records of the weather of this year, which has been taken as a *maximum* sun-spot year.

Between the year 1138–9 and 1049 the interval is 89 years, which represents closely the normal interval 88·8 (= 11·1 × 8). Moreover, the interval between the sun-spot years + 1615·5 and 1049 is 566·5, which practically agrees with the normal interval 566·1 (= 11·1 × 51). For those two reasons the year is taken as a *maximum* sun-spot year. There is no mention of the weather of the year in the records already referred to.

Between the years 1049 and 1036 the interval is 13 years, which approximates to the normal interval 11·1, while on the other hand the interval between the sun-spot year + 1615·5 and 1036 = 579·5, which only differs from the normal interval 577·2 (= 11·1 × 52) by 2·3.

If the date 1035·5 be taken as a sun-spot *maximum* year, the agreement becomes practically sufficient.

Between 1036 and 993 the interval is 43, which is so very close to the normal interval 44·4 as to allow of its being estimated as a sun-spot *maximum* year. Moreover the interval between the maximum year + 1615·5 and 993 = 622·5, which differs only by a unit from the normal interval, 11·1 × 56 (= 621·6). As regards the weather of this year there appears the following record in Arago's work already cited, p. 263:—

993.—"Depuis le St. Jean (24 Juin) jusqu'au 9 Novre. c. à d. pendent presque tout l'été et l'automne il fit une sècheresse et une chaleur excessives."

994.—" L'hiver fut très rude en Allemagne et la grêle dura presque sans interruption depuis le 12 Nov. jusqu'au milieu de Mai, le printemps et l'été amenèrent des fleaux de toute sorte."

The interval between 993 and 685 is 308 years, which differs from the normal interval 310·8 = (11·1 × 28) by 2·8 an approximation practically sufficient. On the other hand, the interval between the sun-spot *maximum* year + 1615·5 and 685 is 930·5, which again differs from the normal interval, 932·4 (= 11·1 × 84) by 1·9, so that the year in question may be taken as that of a sun-spot *maximum*. The following record of the weather for 684 occurs in the "Annals of the Four Masters": "There was great frost in this year, so that the lakes and rivers of Ireland were frozen, and the sea between Ireland and Scotland was frozen, so that there was a communication between them on the ice."

The interval between 685 and 512 is 173, which compares fairly with the interval –1889·6 and + 1718·2 = 171·4, the difference being 1·6. On the other hand the interval between this year and the *minimum* sun-spot year –1610·8 is 1098·8, which practically agrees with the normal interval is 1098·9 (= 11·1 × 99), so that this year may be taken as a *minimum* sun-spot year, or more exactly 511, which would give a complete concordance.

Between 512 and 472 the interval is 40, which differs from the normal interval 44.4, but which approximates to the actual interval – 1889·6 and + 1848·6 = 41 years. If the interval be taken between the *maximum* sun-spot year + 1615·5 and this year, we get 1143·5, which very closely agrees with the normal interval 11·1 × 103 (= 1143·3), so that this date may be taken as representing a *maximum* sun-spot year. There is no weather record for this year in the works already referred to.

The interval between 472 and 203 is 269 years, which differs somewhat from the normal interval 266·4 (= 11·1 × 24), but which compares fairly with the interval between –1889·6 and –1619 = 270·6. The interval between this year, 203, and the sun-spot *minimum* year –1610·8 is 1407·8, which differs from the normal interval, 1409·7 (= 11·1 × 127) by 1·9 only. If therefore the year 202 be taken as a *minimum* sun-spot year, the approximation will be sufficient as regards 203.

The interval between 203 and 79, or rather between 203 and 78·65 is 124·35, which exceeds the normal interval 122·2 by 2·15, but if we seek the interval between 78·65 and the sun-spot *minimum* year, – 1610·80, we get 1532·15, which differs by less than an unit from the normal interval 1531·8 (= 11·1 × 138), so that this year may be taken as a *minimum* sun-spot year.

The interval between 78·65 and 63 is 15·65, which exceeds the normal interval 11·1 by 4·55. This may be read as representing the interval from the probable *minimum* of 67·55 to the *maximum* 62, which is here adopted.

From the examination of the figures which result from the comparison of the eruption dates of the volcanoes hereinbefore detailed—Hecla, Katla, Etna, and Vesuvius, with the sun-spot years of *maximum* and *minimum* as given in Wolf's list, covering the period from 1610 to the present—it is evident that the concordance is general, and even greater than might be expected, considering the difficulties inherent, on the one hand to the exact determination of the dates of the commencements of the eruptions cited; and on the other, to the uncertainty which necessarily arises as to the precise month of the year, or even of the year in which the *maximum* or *minimum* occurs. At best these sun-spot dates can only be determined to within a month, even at the present time.

The concordances that may be noted evidently justify the presumption that did we possess the dates of the sun-spot *maxima* and *minima*, for the years anterior to 1610, the same concordance would be found between them and the dates of the eruptions prior to this year. It is much to be regretted that Kluge's list of eruptions has not been published, and it would still be desirable that such a list be made, and that from many scientific points of view.

The concordances noted justify the attempt to estimate the sun-spot dates for the years prior to 1610 with reference to the eruptions of the volcanoes considered which are dated before that year. This has been carried out by utilizing, on the one hand, the multiples of the normal sun-spot period, 11·1 years, of which a table was drawn up, and on the other, a table of the actual intervals found to exist between successive sun-spot *maxima* and *minima*, starting from the most recent date available, and going back to 1610. The results have proved most interesting, as may be judged by the details already given for the different eruption dates prior to 1610, and also by the summaries which follow. As regards the ascertained dates of *maxima* and *minima* of Wolf's list, the following table gives the number of concordances, with the mean differences between the dates of eruptions and sun-spot dates:—

	Concordances.	Mean diff.
Hecla,	4	1·03
Katla,	5	0·94
Ætna,	31	0·56
Vesuvius,	37	0·76

That is, in all 77 concordances, with a general mean difference of 0·706 year.

As regards the eruption dates prior to 1610, for which estimates were made as described, with a view to the determination of the sun-spot year corresponding to each eruption, I have thought it best to set out in a table (see next page) the intervals found between such eruption years, and one or other of the sun-spot dates contained in Wolf's list, comparing the interval found with the multiples of the sun-spot interval or period, 11·1.

It has already been remarked with regard to the concordances shown in the case of Etna, that the *minima* concordance dates predominate with an approximation of 1·09 relatively to 2·05 for the *maxima*. Taking the whole of the concordance dates herein given, as well as the estimated dates, the result comes out, that for the former the *maxima* are 37 in number, with a mean difference of 1·22 between the eruption date and the sun-spot date, while for the *minima* the total is 40, with a mean difference of 0·89. As regards the estimates, the *maxima* show a total of 18, with a mean difference of 1·26, while for the *minima* the total being 15, the mean difference comes out 0·82. That is, the estimates come out pretty much as the actual concordances, which so far proves in favour of their probable correctness.

Sun-spot year of comparison.	Date of Eruption.	Interval in years.	Corresponding multiple of the sun-spot period 11·1	Difference.
− 1610·8 −	1509·50 =	101·2	11·1 × 9 = 99·9	1·30
− 1610·8 −	1389 =	221·8	11·1 × 20 = 222·0	0·20
+ 1615·5 −	1340·46 =	275·	− 1889·6 − (+ 1615·5) = 274·1	0·90
+ 1615·5 −	1294 =	321·5	11·1 × 29 = 321·9	0·4
− 1610·8 −	1222 =	388·8	11·1 × 35 = 388·5	0·3
+ 1615·5 −	1206 =	409·5	11·1 × 37 = 410·7	1·2
− 1610·8 −	1157 =	453·8	11·1 × 41 = 455·1	1·3
+ 1615·5 −	1104 =	511·5	11·1 × 46 = 510·6	1·2
+ 1615·5 −	1416 =	199·5	11·1 × 18 = 199·8	0·3
− 1610·8 −	1310·07 =	300·74	11·1 × 27 = 299·7	1·04
+ 1615·5 −	1262 =	353·5	11·1 × 32 = 355·2	1·7
− 1610·8 −	1245 =	365·8	11·1 × 33 = 366·3	0·5
+ 1615·5 −	1360 =	255·5	11·1 × 23 = 255·3	0·2
− 1610·8 −	1188 =	422·8	11·1 × 38 = 421·8	1·0
+ 1615·5 −	1151 =	464·5	11·1 × 42 = 466·2	1·7
+ 1615·5 −	1536·33 =	79·17	11·1 × 7 = 77·7	1·47
− 1610·8 −	1444 =	166·8	11·1 × 15 = 166·5	0·30
− 1610·8 −	1333 =	277·8	11·1 × 25 = 277·5	0.30
+ 1615·5 −	1328·5 =	287·	11·1 × 26 = 288·6	1·6
1668·18 −	1168·09 =	500·09	11·1 × 45 = 499·50	0·59
1168·09 −	812 =	356·09	11·1 × 32 = 355·2	0·89
− 1610·8 −	812 =	798·8	11·1 × 72 = 799·2	0·4
+ 1615·5 −	72 =	1543·5	11·1 × 139 = 1542·9	0·6
− 1610·8 +	477 =	2087·8	11·1 × 188 = 2086·8	1·0
− 1610·8 −	1500 =	110·8	11·1 × 10 = 111·	0·2
+ 1615·5 −	1306 =	309·5	11·1 × 28 = 310·8	1·3
+ 1615·5 −	1138 =	477·5	11·1 × 43 = 477·3	0·2
+ 1615·5 −	1049 =	566·5	11·1 × 51 = 566·1	0·4
+ 1615·5 −	1306 =	309·5	11·1 × 28 = 310·8	1·3
+ 1615·5 −	993 =	622·5	11·1 × 56 = 621·6	0·9
+ 1615·5 −	685 =	930·5	11·1 × 84 = 932·4	1·9
− 1610·8 −	512 =	1098·8	11·1 × 99 = 1098·9	0·1
+ 1615·5 −	472 =	1143·5	11·1 × 103 = 1143·3	0·2
− 1610·8 −	203 =	1407·8	11·1 × 127 = 1409·7	1·9
− 1610·8 −	78·65 =	1532·15	11·1 × 138 = 1531·18	0·97

XXV.

INVESTIGATION OF THE PREHISTORIC SETTLEMENTS NEAR ROUNDSTONE, CONNEMARA. REPORT OF THE COMMITTEE, CONSISTING OF MESSRS. W. J. KNOWLES, W. H. PATERSON, R. L. PRAEGER AND F. J. BIGGER.

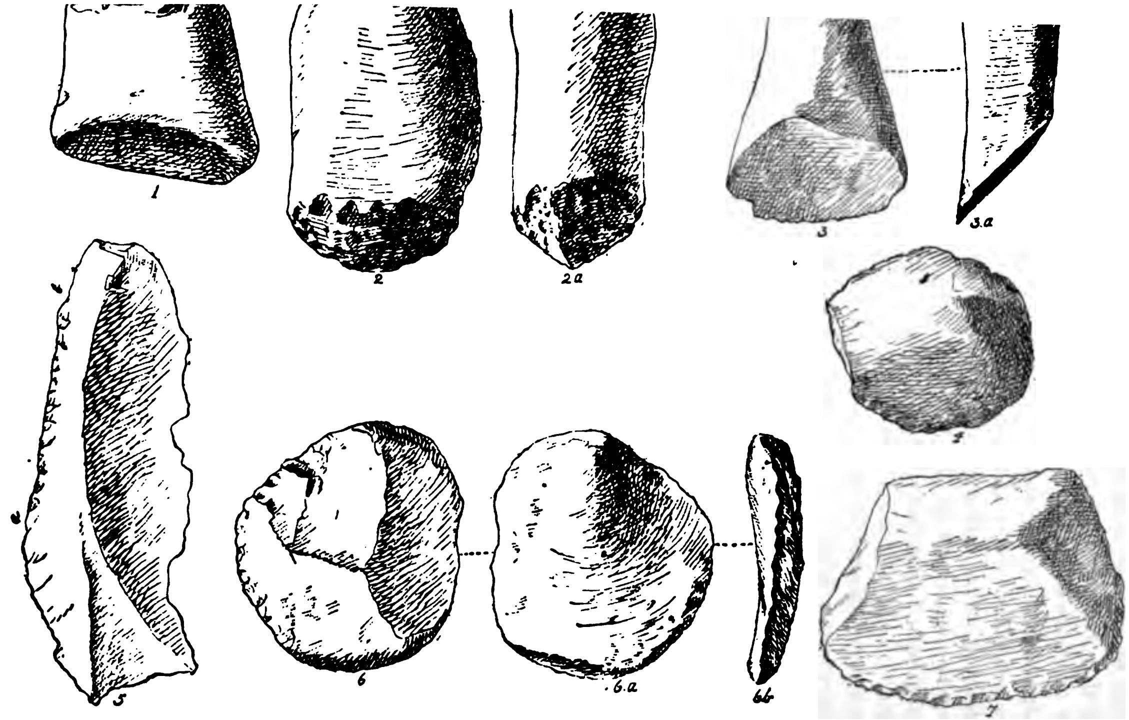
[Read June 12, 1899.]

Your Committee, in company with several other gentlemen, and also ladies, amongst whom were Messrs. George Coffey, F. C. Bigger, W. F. de V. Kane, John M. Dickson, E. T. Tatlow, H. L. Jamieson, Robert Welch, John M'Neill, Alex. G. Wilson, and J. N. Halbert; also Hon. R. E. Dillon, Dr. C. H. Hurst, Mrs. Tatlow, Miss Jamieson, and Miss M'Cormick, visited Roundstone at Easter, 1896, for the purpose of making the appointed investigation.

The day after our arrival we examined the sites near Dog's Bay, which is distant fully a mile from Roundstone. The settlements of this place, which have already been described by F. J. Bigger, M.R.I.A., in an interesting paper, read before the Academy, in November, 1895,[1] extend along the shore, and into a small isthmus dividing Dog's Bay from Gorteen Bay. Portions of old surface on the isthmus looked promising and were first excavated, but they turned out to be very barren of remains. The sites on the mainland close to the neck of the isthmus gave better results, and yielded among other remains several hammer-stones, rude implements, and large flakes of granite and other hard crystalline rocks of the neighbourhood. The flakes were so coarse and large, that it was not easy to convince anyone who was accustomed to seeing flint implements in similar sites in the North, that they were of artificial origin, yet a little examination showed that the flakes, though rude, had bulbs of percussion, and exhibited sufficient evidence of having been struck in a systematic manner from larger pieces of rock by hammer stones. On further examination we found some of the flakes which showed undoubted workmanship round the edges. A hasty survey of the place would show here and there small clumps of stones which indicated the position of hearths

[1] Third Series, vol. iii., No. 5, p. 727.

that were probably the centres of hut sites. Around such places several species of shell fish, broken and split bones of different kinds of mammalia, together with the hammer-stones, flakes, and implements of coarse rock, were spread out to view. Where any of the original surface remained intact, especially if near a hut site, it generally yielded similar remains on being excavated. Where we found a good site from which the sandy covering had not been long removed and from which the remains had not been collected, it was a most instructive sight, as we could see the hammer-stones just as they had been last used by their prehistoric owners, the flakes lying probably on the spots where they had fallen when struck off, or where they had been laid down after being used; and amongst these objects broken and split bones and small heaps of shell fish, the remains of their meals, were also visible. Disappointment was expressed by some that flint was not found, but Connemara is so far removed from the flint producing rocks of the North that it could scarcely be expected to be found here unless there had been commercial intercourse with the North in prehistoric times, which is not likely to have existed, as such intercourse does not seem to have taken place at these times even among neighbouring tribes. The settlements in Connemara appear to be no exception to the rule observed in other places of the same kind, in different parts of the coast of Ireland, that the cutting tools and implements of the people are made solely from the rocks found in their own neighbourhood. Some of the hammer-stones and cutting instruments found at Dog's Bay are shown on p. 435. A hammer-stone and rubber combined is shown in fig. 1. The part shown uppermost in the figure has the usual abraded end of hammer-stones, while the lower end is smoothed as if it had been employed in grinding or rubbing. The material has a grain like quartzite, though of a darkish colour. Two views are shown in figs. 2 and 2*a* of a well marked hammer-stone made from a granite pebble. The abraded end is well marked and has a ridge in the centre as is seen in the side view (fig. 2*a*), showing that each side of the implement must have been alternately inclined in an oblique direction when striking. This is a characteristic of many hammer-stones not only of Neolithic stations but of those of Palaeolithic age, especially of the rock shelters of the South of France. A good number of pebbles, like fig. 3, were found not only here, but at all the stations examined. A flake has been struck off the broad end of the pebble in an oblique direction so as to leave a sharp, axe-like edge. This edge, which is shown on the lower end of the figure, is slightly indented as if injured in the process of hacking or cutting. Such objects have a certain



Stone Implements of native Rock from Roundstone, Co. Galway. (Scale, ½ linear.)

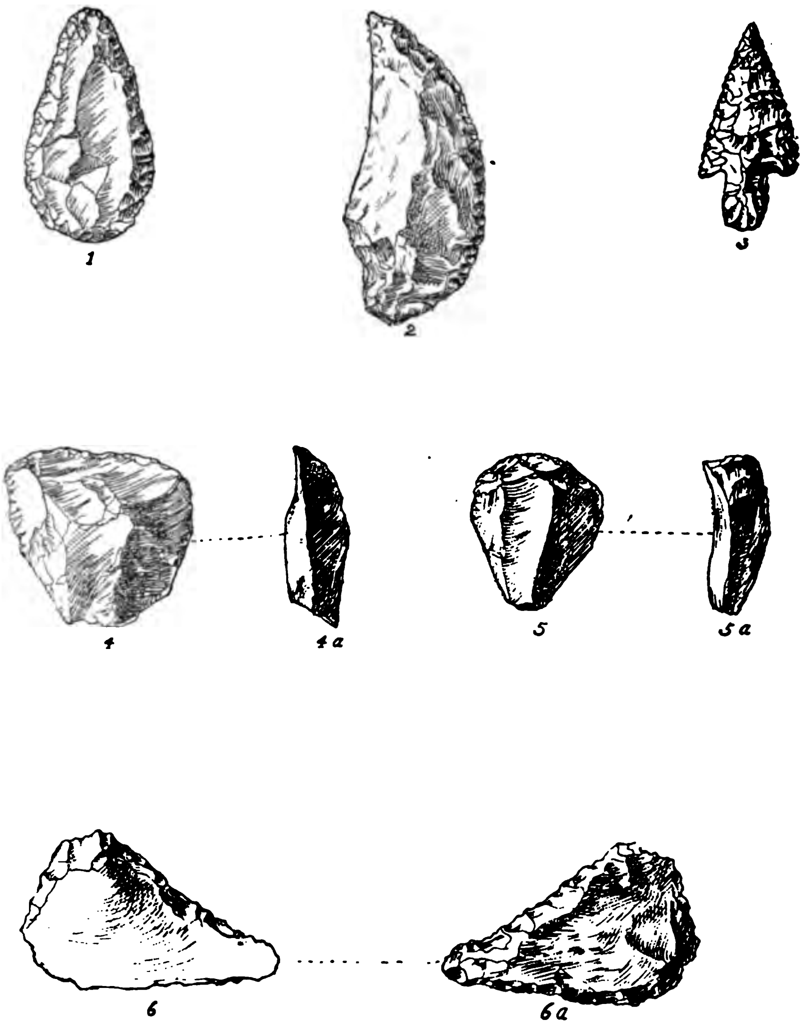
resemblance to kitchen midden axes, but as no special dressing was seen on any specimen collected, we cannot speak with any certainty of their being the implements we suppose them to be. A large flake of quartzite showing what is believed to be rude dressing on the lower edge of the figure is seen in fig. 4. It would be as suitable for removing connective tissue and otherwise preparing skins intended for clothing, as the flint scrapers of our northern sites, or as the flint and sandstone scrapers of the Eskimos which have been used for that purpose in recent times. A long flake which shows a bevelled edge at the part between *a* and *b* of the figure so as to fit it for scraping or cutting is seen at fig. 5. Back front and side views of an implement made from a broad flake of blackish or metamorphic rock are shown in figs. 6, 6*a*, and 6*b*. There is the hollow on the back where a former flake has been removed, and a well marked bulb of percussion on its front face. The edge opposite the bulb appears to have been dressed into its present curved shape. Parts of this edge could have been used for scraping or cutting, but the thickest portion which appears at lower end of the figure is bevelled to each side, leaving a bluntish edge in the centre. The figure of a large stout flake of similar rock to the specimen last described is given in No. 7. From the marks visible on the lower edge, it has evidently been used as a chopper. There were many other interesting specimens found, but it is hoped that those figured will give a general idea of the objects which were obtained during the investigations. Except in the smoothed end of fig. 1, and the bevelled portion of the edge of fig. 6, which may have been ground, though the bevelling may have arisen from the way in which the implement has been used, no object showed traces of grinding or polishing. In this respect the sites of Connemara agree pretty closely with the prehistoric sites of the North, where polished implements, though occasionally found, are of rare occurrence.

Before reading this report the Paper on "Prehistoric Settlements at Portnafeadog," or Dog's Bay, by F. J. Bigger, should be studied, as it was owing to Mr. Bigger's discovery of the site in July, 1895, that it was considered necessary to have the further investigation on which we are now reporting. The Committee found bones of cow, pig, sheep or goat, horse and dog, but all these had been observed by Mr. Bigger on his previous visit. The shells which he found to have been most abundantly used, and which your Committee, on examination, are able to confirm, were *Patella vulgata*, *Littorina littorea*, *Ostrea edulis*, *Mytilis edulis*, and *Buccinum undatum*. Some of the various kinds were in heaps, "proving that they had been gathered separately and so used." There was another kind found by Mr. Bigger, the *Purpura lapillus*, or dog whelk; but it was doubtful whether this kind had been used for food as the other species undoubtedly had been. Several photographs of the various heaps of shells at Dog's Bay, prepared by Mr. Welch, are given as illustrations to Mr. Bigger's Paper, and one of these, Plate XXVII., gives a striking picture of a heap of the *Purpura*, showing all the shells in a broken condition. Shells of this species, either whole or broken, had seldom previously been observed among other remains in sandhills, and certainly never in any quantity; but here there was a large heap, all broken, which seemed to have the same connection with the sites as the shells of other species. We made full inquiry while at Roundstone as to whether the Dog whelk was now used for any purpose, but not even the oldest inhabitant could recollect or remember hearing of its being used as food, or bait, or in any way whatever. The heap of broken *Purpura* supplied us with an interesting problem, which is, perhaps, not yet satisfactorily solved. Mr. Bigger gives exhaustive extracts from ancient literature, showing that in the colouring of their cloaks the Irish used certain dyes, and he suggests that the shells of the *Purpura* may have been broken to obtain the animal for the rich purple dye it affords. If it can be shown that the inhabitants of these ancient settlements used woven fabrics as clothing the dye might be utilized to give them a rich purple colour, but if they had only skins for clothing as is more probable at this early stage, it is doubtful whether they would dye their leather garments, though they may possibly have done so; but savage people, and it is probable that these early inhabitants were in a savage condition, generally ornament their own skins with paint, and it is possible the early inhabitants of Connemara may have used the dye of the *Purpura* for that purpose. There is also the question of their having been used as food, which we have left out of view, but which ought to be considered.

When Mr. and Mrs. Coffey, and Mr. Knowles, were round the Donegal coast in August and September of 1898, they found heaps of the dog whelk in a broken condition in sites similar to those found at Dog's Bay, amongst which were flakes of flint and other indications that they had been used by the Stone Age inhabitants. On making inquiry as to whether anyone in those parts knew of such shells being used they could get no positive information, but two fishermen informed them that about twenty years ago a French vessel was dismasted near Bunbeg and had to put into Innisman, and the sailors, they said, would eat no other kind of shell fish but the dog whelk, a true exemplification of the common and widespread expression:— "One man's meat is another man's poison." The earlier inhabitants of Connemara may possibly have had similar tastes to those French sailors, and we may therefore leave the question of the use of the *Purpura* an open one for the present. We measured the large heap of broken *Purpura* at Dog's Bay, which is shown in the illustration to Mr. Bigger's Paper, and it was found to be 55 yards in length, 15 yards across the broad end, and 3 yards across the narrow end. One square foot was measured, and 200 specimens were picked from this space. Forty or fifty more might have been obtained from among the sand which was now reached, and at the depth of two or three inches further there was nothing but sand.

On the south side of Mannin Bay a large series of hut sites were exposed. There were many hearthstones, shells, broken and split bones, and other evidence of continuous settlement by people of the Stone Age. Shells of the dog whelk were found here mixed with other edible kinds, but no implements so well made or showing artificial markings so good as those of Dog's Bay were found, though broken and split specimens of native rock were scattered about in considerable abundance. The sites near Ballyconeely Bay were also examined, but no implement showing intentional dressing was obtained. Other heaps of dog whelk in a broken state were found here, besides broken rocks, bones of the animals used in food, and the same species of shells as were found at Dog's Bay. No pottery was found in any of the sites, though we hope that on a further and more extended search those sites may, like the more northern ones, yield examples of the pottery usually found on these early Stone Age settlements.

The conclusion your Committee arrive at is that the various sites at Dog's Bay, Mannin Bay, and Ballyconeely are similar to sites found in other sandhills in various places round the coast of Ireland which have already been reported on to the Academy; also that the inhabitants of each district used the rocks found in their own neighbourhood to make into implements. That rude flakes of ordinary igneous or metamorphic rock could have been used as cutting tools by any people, however rude, is hard to realize, though we can readily conceive the use of well made flint implements; but even in the North, where flint is abundant, arrowheads, scrapers, and other implements are often made of the igneous rocks of the neighbourhood. A series of such implements from county Antrim is shown on p. 439. A flake



Implements of Basalt from Co. Antrim, for comparison.
(Scale, ½ linear.)

dressed round the edge, and suitable for scraping or cutting is shown in fig. 1. A knife-like flake, with short handle and well dressed along one side is shown in fig. 2, and fig. 3 shows one of several arrowheads made of fine-grained black rock. Figs. 4, 4*a*, 5, and 5*a* are scrapers, as well made as similar objects in flint, and fig. 6, 6*a* is a side scraper as well dressed as the rather coarse nature of the rock would allow. Such implements as those ought to be found in the south and west of Ireland made of native rock, chert, quartzite, carboniferous slate, and other crystalline rocks. The harder rocks, other than flint or chert, cannot be so neatly worked, and when exposed to the air and moisture easily lose all traces of intentional dressing which they had received, and it is not then easy to identify implements when found in that condition; but they should be searched for, and in no places are they more likely to be found in an uninjured state than in sites in sandhills, such as are the subject of the present report. We are to bear in mind, however, that many of the implements used by these rude people must have been in the condition of mere flakes, without any dressing.

The exploration of all such sites as are preserved to us in sandhills is of prime importance, in order that we may have as true an insight as possible into the habits and mode of life of our earliest inhabitants. All animal remains should be collected, as by this means we may get a better knowledge of our earliest Neolithic fauna. In connection with this it may be mentioned that at Whitepark Bay, among ancient hut sites, like those described, 25 bones of the Great Auk have been found, representing 12 to 20 individuals, and at Waterford, in what seems to have been similar sites, Mr. R. J. Ussher found 17 bones, representing 6 to 8 individuals. It is to be hoped that the knowledge already made known regarding the prehistoric sites preserved amongst our sandhills may stimulate workers to make systematic search among sites not yet explored.

Note added in the Press.

In regard to the human remains reported to have been found at Mannin Bay, such were observed in abundance, in one site, not far above tidal mark, but they were of quite recent interment, some being enclosed in rude coffins. Almost complete skeletons were found wholly or partly on the surface. The local inhabitants took no interest in these remains, so we may conclude some shipwrecked strangers were here deposited.

XXVI.

IRISH PHÆOPHYCEÆ (REPORT OF THE FAUNA AND FLORA COMMITTEE). By THOMAS JOHNSON, D.Sc., F.L.S., Professor of Botany, Royal College of Science, Dublin, and HENRY HANNA, M.A., B.Sc.; assisted by MISS R. HENSMAN and MISS M. C. KNOWLES.

[Read May 8, 1899.]

The number of species of seaweeds recorded for Great Britain and Ireland is some 700, of which some 200 are Phæophyceæ, or brown seaweeds. In 1890, Holmes and Batters, published a Revised List of the British Marine Algæ in the "Annals of Botany," the number of British species there recorded being about 540. Of these the Irish species numbered 235, 73 being Phæophyceæ. The object of this paper is to record some 40 additions made since the year 1891, in part in connexion with the work of the Fauna and Flora Committee. The paper contains accounts of the examination of collections made at many different points on the Irish coast, partly by shore-collecting, partly by dredging, from time to time, since the year 1891. The least known parts of the Irish coast are the extreme north and the coasts of counties Wicklow and Wexford.

It has been well said that many of the most important biological problems are illustrated by, and may find their solution in a study of, the low group of Algæ. Thus Farmer has recently described indirect nuclear division (karyokinesis) in the Fucaceæ—the highest group of brown seaweeds. The Phæophyceæ show a complete gradation from simple conjugation to fertilization in reproduction, and Williams has recently described, for the first time, the mode of reproduction in the common Dictyota, &c., of the Dictyotaceæ.

There is no doubt that there is still a wide field of investigation as to the modes of reproduction of the different members of the Phæophyceæ. In many species the reproductive organs are still either unknown or incompletely known. In relatively very few has here anything like a complete life-history of a species been made out. We have found invagination of sporangia so general that no classificatory importance can be attached to its occurrence. It is highly desirable that the Fauna and Flora Committee should be encouraged to devote attention to this branch of investigation, so important from both a purely biological and an economic point of view.[1]

Speaking of the Phæophyeæ, Janczewski[2] says:—The Phæosporeæ constitute "un groupe de familles nettement caractérisées; le nombre des représentants de chaque famille est quelquefois réduit au minimum possible, à une seule espèce ce qui indiquerait l'existence très ancienne de cette classe dont les représentants auraient été conservés jusqu'à l'epoque actuelle en petit nombre seulement."

Sauvageau suggests that the above supposition may account for the great differences of behaviour exhibited by the reproductive bodies.

From an economic point of view the group is of considerable interest.

The Laminariaceæ, or oar-weeds, are the source of kelp—an important industry to many on the west and north-west coasts of Ireland. It is unfortunate that the term "red-weed" is so generally used to indicate the kind used in kelp-burning, as the true red seaweeds (Florideæ) are not generally, and should not be at all, used. The term "red-weed" indicates a primitive appreciation of colour distinction.

Rubber fistules seem to be displacing the Laminaria stalk fistules. for surgical purposes.

The Fucaceæ, or black-wracks, contain a small percentage of iodine, and are an adulteration in kelp-making; they are mainly used as manure. In Norway, Dr. Foslie tells us, that the black-wracks are banked for some three or four months in alternating layers of ordinary soil, or road-scrapings and seaweed, a foot thick, thus making a much more excellent manure than is obtained by the use of the fresh

[1] The appearance in 1892 of Sauvageau's article, "Sur quelques Algues Phéosporées parasites," marked a distinct advance in our knowledge of the Phæophyceæ. We have met with many cases fully confirming Sauvageau's observations. M. Bornet's discovery of the biological significance of the shell-boring Algæ has been fully illustrated in Irish waters. No one has yet discovered a member of the Phæophyceæ with a shell-perforating habit.

[2] Ed. J. Janczewski. "Observations sur l'accroissement du thalle des Pheosporées," p. 116. (Mem. de la soc. nat. des sciences naturelles de Cherbourg, t. xix., 1875).

seaweed, which has, probably, much to answer for in the potato diseases.

The revised list of Holmes and Batters was prepared under difficulties as regards the Irish Algæ, many species discovered by earlier algologists not having been at the time recorded.

We have had the advantage of seeing the collections made by W. Thompson in the north-east of Ireland; Dr. D. Moore (Co. Antrim); I. Carroll's (the small remainder of his collection saved from the fire, in Queen's College, Cork); Miss A Ball's collection, preserved in the Botanical Collections of the Science and Art Museum, Dublin; and of course the fine herbarium of the late Dr. Harvey, preserved in Trinity College, and under the charge of Prof. E. P. Wright, to whom we are indebted for opportunities of inspecting it. A collection made, more especially at Balbriggan, by Dr. Scott, at the end of the last century, and preserved in the Science and Art Museum, has also been inspected. We have received help in the examination of the collections from Miss Hensman (the west coast collections), and from Miss M. C. Knowles in the south-east collections. To Dr. Bornet, M. Sauvageau, and Prof. Reinke, who have from time to time given us the benefit of their knowledge, we are also indebted.

It is to be regretted that it is extremely difficult to get into communication with correspondents on different parts of the Irish coast willing to send up specimens for determination.

The present list is far from complete—the genus Ectocarpus is still poorly represented, as is the important group of the Tilopteridaceæ. Battersia of the Sphacelariaceæ has not yet been discovered.

The present list contains 111 species, and increases considerably the known distribution of many others; one of the species recorded is new to science, and one new to the British Flora.

We have followed Holmes and Batters (*op. cit.*) in their division of the coast of Ireland into the districts :—

10. From Malin Head to Slyne Head, including the outlying islands.
11. From Slyne Head to Crow Head, including the outlying islands.
12. From Malin Head to Howth.
13. From Howth to Raven Point.
14. From Crow Head to, and including, Raven Point.

We have attempted to save space by the following abbreviations:—

T.	= W. Thompson.	D.	= Doran.
M.	= Dr. D. Moore.	C.	= I. Carroll.
Mc.	= McCalla.	B.	= Miss A. Ball.
H.	= W. H. Harvey.	N.	= Authors of Paper.

PHÆOPHYCEÆ.

Cohort I.—Ectocarpinæ.

Order I.—Desmarestiaceæ.

Desmarestia, Lamx.

This genus is very commonly represented on all the Irish coasts by the first three species. The thallus provides good material for the observation of trichothallic growth.

D. viridis, Lamx.

Unilocular sporangia are described in Crouan's "Florule du Finistère." Occurs on all the coasts.

D. aculeata, Lamx.

Kuckuck (2) describes the unilocular sporangia in the winter state of this species. On all the coasts, one of the commonest species.

D. ligulata, Lamx.

One of us (non fig. 14 in Annals of Botany, v., pl. viii.) described the unilocular sporangia; both extra and intertidal, on all the coasts.

D. Dudresnayi, Lamx. 12.

This is not uncommon on the coast of France, and has been recently dredged by Brebner at Plymouth. It is quite rare in Ireland. There is a specimen in Trinity College Herbarium, collected by G. Sanders in Lough Foyle. One of us, working at Inishbofin, Connemara, in August, obtained a specimen of this plant by dredging in 13 fathoms off the Gunn rock.

Order II.—Dictyosiphonaceæ.

Dictyosiphon, Grev.

The branch-tips are unjointed and cortexed.

D. fœniculaceus, Grev.

This species, common like *Desmarestia viridis*, is distinguished from it by having its branches usually alternating. Plurilocular sporangia are unknown. Occurs on all the coasts.

f. fragilis.

This variety was recorded by Harvey from Kilkee.

Harvey's *Dictyosiphon fragilis* MS. is adopted by Kützing in his "Systema Algarum." The sporangia are collected in clusters as in Striaria, but not in transverse bands. It differs somewhat from *D. fœniculaceus*. West of Ireland. 12.

D. hippuroides, Kütz. 12 N.

Order III.—Punctariaceæ.

Litosiphon, Harv.

The unilocular and plurilocular sporangia are described in the "Études Phycologiques," p. 15.

L. pusillus, Harv.

Common, on all coasts, as fine tufts on the thallus of *Chorda filum*.

L. Laminariæ, Harv.

This species grows on *Alaria esculenta*, Grev., and is not uncommon, on all coasts.

Pogotrichum, Rke.

P. filiforme, Rke. 10 N.

This species grows epiphytically on *Laminaria saccharina*, and is probably to be found on all the Irish coasts.

P. hibernicum, T. J. 11 N.

Grows on *Alaria esculenta*, and is probably, like *P. filiforme*, Rke., to be found on all the Irish coasts.

Phloeospora (Aresch.), Rke.

P. brachiata (Harv). Born. (Stictyosiphon Griffithsianus, Holm. et Batt: *Ectocarpus brachiatus*, in Phyc. Brit. Pl. iv.)

This species grows on *Rhodymenia palmata* and *Fucus serratus* and occurs on the south and east coasts (probably elsewhere). It possesses unilocular sporangia only. Its branching filamentous thallus shows tricho-thallic growth, growing by intercalary acropetal divisions. At the base and here and there only in the general thallus is there a polysiphonous or multiseriate arrangement of the cells. The terminal hair of the branches is equal in diameter to the "central axis" of the branch, and not much less—as in *Stictyosiphon tortilis*, Rke.

Stictyosiphon (Kütz.), Rke.

In this genus plurilocular sporangia only are known; the tips of the branches are jointed and end in three hairs.

S. tortilis, Rke. (includes *S. sub-articulatus*, Hauck, of Holmes and Batters' Revised List). 12 N.

Striaria, Grev.

The tips of the filaments are tapering, the unilocular zoosporangia are arranged in superficial dot-like zones.

S. attenuata, Grev.

11 Mc. 12 D.M. 12 T. 12 H. 14 N.

Desmotrichum, Kütz.

D. undulatum, Rke. 10 N.

The hairs are solitary; the unilocular and the plurilocular zoosporangia project from the thallus surface.

Punctaria, Grev.

The dots on the thallus are in some cases due to the sori of sporangia, in other cases to the tufts of hairs. The two are distinct. Both unilocular and plurilocular sporangia are known in all the British species.

P. plantaginea, Grev.

On all the coasts.

P. latifolia, Grev.

Probably not less common than *P. plantaginea.*

P. tenuissima, Grev.

On all the coasts, probably. One of us formed the opinion some time ago that *P. tenuissima*, though found fertile, is simply the young spring state of *P. plantaginea* and *P. latifolia*, which are not so specifically distinct as is often described. Dr. Moore has one specimen labelled "seemingly intermediate."

Order IV.—Asperococcaceæ.

Myriotrichia, Harv.

M. clavæformis, Harv. 10–14.

M. filiformis, Harv. 10–14.

Asperococcus, Lamx.

The hairs and sori of sporangia occur mixed together; in this respect Asperococcus differs from Punctaria. The plurilocular zoosporangia were discovered by Buffham.

A. echinatus, Grev.

Common, 10–14.

f. vermicularis, Griff.

Common. First noted as distinct by Dr. D. Moore.

A. bullosus, Lamx.

This is the *Asperococcus Turneri* of Harvey's Phyc. Brit. (pl. 11). 10–14.

A. compressus, Griff. 14 N.

Dredged in the south-west of Ireland, during the first excursion of the Fauna and Flora Committee to Bantry Bay; also off Roonane Rock, Dungarvan Bay, October, 1895.

Order V.—Ectocarpaceæ.

Streblonema, Derb. et Sol.

This genus grows endophytically on various other Algæ, forming in the host plant branching intra-cortical hyphæ.

S. Areschougii, Batt.

On *Himanthalia lorea* in Murlough Bay at low water, 1898. N. It occurred in some quantity on *Himanthalia lorea* at Inishbofin, and is probably common all round the coast.

S. fasciculatum, Thur. 11 N. 12 N.

On *Castagnea virescens*.

S. velutinum, Thur. (*Elachistea velutina*, in Harvey's Phyc. Brit. pl. 286).

Occurs on all the coasts on the receptacles of *Himanthalia lorea*, as velvety cushions.

S. luteolum, on Fucus.

Dungarvan Bay, Helvick Pt., Oct. 1896. N.

S. simplex, Holm. et Batt. (*Ectocarpus simplex*, Crn.) 11 N. 13 N.

On *Codium tomentosum* and on *Ceramium rubrum*. The unilocular zoosporangia are unknown. The plant with its plurilocular zoosporangia is described, with illustrations, by Holmes (Journal of Botany, 1887).

S. minimum, Sauvag. 14 N.

Giffordia secunda (Kütz.) Batt. 13 N. 14 N.

This species (*Ectocarpus secundus*, Kütz.) was found on *Alaria esculenta*, *Desmarestia ligulata*, and on *Himanthalia lorea*. Plants of *Giffordia secunda* have alternate unilateral branches.

Bornet made the interesting discovery that the plurilocular sporangia are not all alike. In one, as we have seen it in Bantry Bay material, zoospores are large (female ?), and in the other small (male ?)

Sauvageau has recently shown that heterogamy (oogamy) obtains in this species—the antherozoids produced in the antheridia fertilise the motile oospheres produced in the plurilocular sporangia. Those oospheres which are not fertilised, very often perish instead of germinating parthenogenetically. It would also seem that later in the season the oospheres lose their sexuality, and take on the rôle of zoospores, since it is found the antheridia diminish in numbers, and may disappear altogether at a later season. The bodies which were called antheridia many years ago by Bornet and Thuret are now known to be the true antheridia. The antherozoids contained in the latter are disposed in regular rows, but Bornet and Sauvageau have not been able to demonstrate the nature of the inner structure. The arrangement of the antherozoids suggests that it is chambered, but the walls of the loculi, if they exist, have not been noticed. The antherozoids completely resemble those of Fucus measuring 6–7 μ. by 1–3 μ. There is a relatively large red spot, and the anterior cilium is several times longer than the body of the antherozoid.

Sorocarpus, Pringsh.

S. uvæformis, Pringsh. 11 N.

Roundstone; with plurilocular sporangia only, in grape-like clusters, visible to the naked eye; grows on the larger Algæ, forming tufts not unlike those of *E. confervoides*.

Isthmoplea, Kjellm.

I. sphærophora, Kjellm. (*Ectocarpus sphærophora*, Phyc. Brit., pl. 126.) 11 H. 12 T. + M. N. 14 N.

The unilocular sporangia are globose, sessile, opposite one another, or a ramulus; epiphytic on *Polysiphonia urceolata*, *Ptilota elegans*, etc.

Reinke (Atlas d. deutschen Meeresalgen) thinks Batters' specimen of *I. sphærophora*, with plurilocular sporangia, may be Foslie's *Pylaiella curta*, which he names *Fosliea curta*, though he admits the latter may be the plurilocular stage of *I. sphærophora* with which species it agrees in intercalary growth and mode of branching, but differs in its base, which is uniseriate and merismatic and not thick and pluriseriate as in *I. sphærophora*, Kjellm.

Pylaiella, Bory.

P. litoralis, Kjellm. (*Ectocarpus litoralis*, Phyc. Brit., pl. 197.) 1–12 inches long; sporangia intercalary. 10–14.

f. amphibia, Holm. et Batt. 12. (*Ectocarpus amphibius*, Phyc. Brit., pl. 183.)

Order VI.—Arthrocladiaceæ.

Arthrocladia, Duby.

Filamentous sori of unilocular sporangia.

A. villosa, Duby. 12 N. 13 N. 14 N.

This southern extra-tidal weed is not known on the west or extreme north coasts. Mrs. Gatty records it from the Down and Wicklow coasts. We have frequently dredged it in the districts named.

Order VII.—Elachisteaceæ.

Myriactis, Kütz.

M. pulvinata, Kütz. (*Elachistea pulvinata*, Phyc. Brit.) 10 H. 11 H. and N.

Unilocular and plurilocular sporangia are known. It grows parasitically on *Cystoseira ericoides*, *C. fœniculaceus*; at Kilkee, on *Desmarestia aculeata* also.

Elachistea, Duby.

E. scutulata, Duby.

On all the coasts on *Himanthalia lorea*.

E. flaccida, Aresch. 11 H. 12.

On *Cystoseira fibrosa* and *C. granulata*.

E. fucicola, Fries.

On all the coasts, on *Fucus vesiculosus*.

[**Halothrix lumbricalis**, Rke.

This species not yet recorded for Ireland, forms tufts 1 inch long, not unlike *Elachistea fucicola* or *E. flaccida*, with lateral accumulations, on old leaves of Zostera.]

Giraudia, Derb. et Sol.

G. sphacelarioides, Derb. et Sol. 10 N. 14 N.

This species grows on Zostera, *Desmarestia aculeata*, &c., and might easily be mistaken by the naked eye for small *Sphacelaria cirrhosa*.

Order VIII.—Sphacelariaceæ.

In all the members of this group the cell-wall turns black on treatment with eau de javelle.

i. Sphacelariaceæ crustaceæ.

[*Battersia mirabilis*, Rke.

This interesting species, looking like a Ralfsia, covered with a microscopic Ectocarpus, is not yet recorded for Ireland.]

ii. Sphacelariaceæ genuinæ.

Sphacelaria, Lyngb.

S. radicans, Harv. 12 H. + M. + D. 14 N.

S. olivacea, Pringsh. 12 M.

S. cirrhosa, C. Ag.

On *Desmarestia aculeata*, etc., on all the coasts.

f. fusca, Holm. et Batt. 12 N.

Chaetopteris, Kütz.

Ch. plumosa (*Sphacelaria plumosa*, Lyngb. in Harvey's Phyc. Brit., pl. 87. *Cladostephus plumosus*, Holm. in Alg. Brit. rar. No 1.) 12 H. + T. 13 H.

Cladostephus, C. Ag.

C. spongiosus, C. Ag.

On all the coasts.

C. verticillatus, C. Ag.

On all the coasts.

Halopteris, Kütz.

H. filicina, Kütz. (*Sphacelaria filicina*, Ag., in Phyc. Brit., pl. cxlii.). 10–14.

H. (?) *Sertularia* (Bonn.), Kütz. (*Sphacelaria Sertularia*, Bonn., in Phyc. Brit., pl. cxliii.) 10. 11. H. 14.

Stypocaulon, Kütz.

S. scoparium, Kütz.
On all the coasts.

Order IX.—Myrionemaceæ.

Myrionema, Grev.

M. strangulans, Grev. (*M. vulgare.*)
Common on the Ulvaceæ, on all the coasts.

f. punctiformis (*M. punctiforme*, Phyc. Brit.). 14 Mc.
Forms small spherical tufts, epiphytic on Florideæ (Ceramium, etc.).

Ascocyclus, Magnus.

A. Leclancherii, Magn. (*Myrionema Leclancherii*, Harv. in Phyc. Brit., pl. 41.) 10–14. On *Rhodymenia palmata*, Grev.

A. orbicularis, Rke. 12 N. 14 N.
On Zostera, forming dark patches 1 mm. wide, edges fringed when dry.

Ralfsia, Berk.

a. Stragularia.

R. clavata, Crn. 12 N.
Forms orbicular patches, on stone. (Reinke's "Atlas d. deutsch. Meeresalg.," Tf. 5 u. 6.)

b. Euralfsia.

R. verrucosa, Aresch. 10–14.
This, the common species, is easily separable from its substratum.

Order X.—Chordariaceæ.

Spermatochnus, Kütz.

S. paradoxus, Rkc. (*Stilophora Lyngbyei*, J. Ag., in Phyc. Brit., pl. ccxxxvii.) 10. 11 H. 12 T. 14 N.

Grows on *Zostera*, *Cystoseira*, and *Fucus*. Its branch axils are rounded: the sori are irregular and projecting. Unilocular sporangia are known.

Stilophora, J. Ag.

S. rhizodes, J. Ag.

On all the coasts, except those of counties Wicklow and Wexford. The sori are closer than those of the preceding species. Both unilocular and plurilocular sporangia are known.

Chordaria, C. Ag.

Ch. divaricata, C. Ag. 12 T. + Mc.

Ch. flagelliformis, C. Ag.

On all the coasts.

f. forma, Kjellm. 12 N.

Mesoglœa, C. Ag.

This genus differs from Castagnea mainly in the possession of unilocular sporangia, Castagnea possessing both unilocular and plurilocular sporangia.

M. vermiculata, Le Jol.

This species has been collected on all the coasts except the south, and seems to have been overlooked there, as it occurs on the French and Spanish coasts.

Castagnea, Derb. et Sol.

The medulla is solid or hollow. The plurilocular sporangia are formed from the upper joints of the peripheral filaments. In Mesoglœa the medulla is solid and loose.

C. virescens, Thur. 10–14.

C. Zosteræ, Thur. 11 Mc. + N. 14 N.

C. Griffithsiana, J. Ag. 10. 11 Mc. 13 N.

Very like *Chordaria flagelliformis* in general growth, but differing in structure. Plurilocular sporangia are unknown.

Petrospongium, Nag.

P. Berkeleyi, Nag. 11 N. 12 N. 14 N.

Now known with both unilocular and plurilocular sporangia.

Leathesia, J. E. Gray.

L. difformis, Aresch. 10–14.

Phaeostroma, Kck.

Ph. pustulosum, Kck. 12 N.

Epiphytic on young *Laminaria saccharina*.

Cohort II.—Laminarinæ.

Order I.—Scytosiphonaceæ.

Phyllitis, Kütz.

Ph. Fascia, Kütz.

This species has a dark olive discoid root, thus being easily distinguishable from the Laminarias with branching filamentous root. It has plurilocular sporangia.

Scytosiphon, C. Ag.

S. lomentarius, J. Ag. 10–14.

Order II.—Chordaceæ.

Chorda, Stach.

The unilocular sporangia are distributed over the whole surface. Buffham discovered the plurilocular sporangia, on plants with twisted thallus, in *Ch. Filum*.

Ch. Filum, Stackh. 10–14.

Ch. tomentosa, Lyngb. 12.

Order III.—Laminariaceæ. (The Kelp-weeds.)

Laminaria, Lamx.

Possesses unilocular sporangia only, variously distributed in sori.

L. saccharina, Lamx. 10–14.

f. Phyllitis, Le Jol. 12. (Algvet. Heligoland, p. 255.)

Kuckuck regards this variety as likely, by its intertidal habitat, to remain sterile.

L. hieroglyphica, J. Ag. 12 N.

Foslie regards this as a variety of *L. saccharina* (Lamx.), differing from it in the marginal ornamentation of the lamina.

L. digitata, Edm. 10–14. (The common oar-weed).

f. stenophylla, Harv. 10. 12.

L. hyperborea (Gunn), Fosl. 11. 12.

f. typica, Fosl.

This variety is distinguished by Foslie, its founder, from *L. digitata*, Edm., as follows:—Its base is broad, and the young frond does not split up before the old one falls away. The stem or stalk is rounder, and nearly all the tips of the new lamina are fastened to the old one.

Saccorhiza, De la Pyl.

S. bulbosa, De la Pyl.

On all the coasts at very low water.

Alaria, Grev.

A. esculenta, Grev. 10–14.

Cohort III.—Sporochninæ.

Order.—Sporochnaceæ.

Sporochnus, C. Ag.

S. pedunculatus, C. Ag.

On all the coasts, extra-tidal.

Carpomitra, Kütz.

C. Cabreræ, Kütz. 11. 14. (Miss Ball.)

Cohort IV.—Cutlerinæ.

Order.—Cutleriaceæ.

Aglaozonia, Zan.

A. reptans, Kütz. = *A. parvula*, Grev.

On all the coasts, extra-tidal. We have abundantly confirmed Harvey's prophecy that dredging would reveal this species at all points of the Irish coast.

Cutleria, Grev.

C. multifida, Grev. 10–14. Extra-tidal.

Cohort V.—FUCINÆ.

Order.—FUCACEÆ.

Fucus, Dcne. et Thur.

F. anceps, Ward et Harv. 1.

F. ceranoides, Linn. 10–14.

F. platycarpus, Thur. 1. 12 N. Probably generally.

F. vesiculosus, Linn. 10–14.

f. laterifructa, Grev. 12 M.

f. spiralis, Linn. 11. 12 N. This form is Kjellmann's *Fucus Areschougii*.

f. baltica, J. Ag. 11 Mc. 12.

F. serratus, Linn. 10–14.

Ascophyllum, Stackh.

A. nodosum, Le Jol. 10–14.

A. Mackaii, Holm. et Batt. 10. 11 Mc. 12 M.

Pelvetia, Dcne. et Thur.

P. canaliculata, Dcne. et Thur. 10–14.

Bifurcaria, Stackh.

B. tuberculata, Stackh. 11. 14.

Himanthalia, Lyngb.

H. lorea, Lyngb. 10–14.

Halidrys, Lyngb.

H. siliquosa, Lyngb. 10–14.

Cystoseira, C. Ag.

C. ericoides, C. Ag.

On all the coasts except those of Wicklow and Wexford.

C. granulata, C. Ag. 10–14 probably.

C. discors, C. Ag. 10–11.

A southern form; branches beset with rough points, as if branchlets were broken off.

C. fibrosa, C. Ag. 10. 11. 12 M. 14 N. + T.

Cohort VI.—TILOPTERIDINÆ.

Order.—TILOPTERIDACEÆ.

Tilopteris, Kütz.

T. Mertensii, Kütz. (*Ectocarpus Mertensii*, Ag. Phyc. Brit., pl. cxxxii.) 12 T. + H. + N.

Acinetospora, Born.

A. pusilla, Born. (*Ectocarpus pusillus*, Griff. Phyc. Brit., pl. cliii.)

Dr. Ed. Bornet has figured the unilocular sporangia, which appear to be extremely rare. (Bull. d. l. Soc. de Bot. de France, 1892.)

Cohort VII.—DICTYOTINÆ.

Order.—DICTYOTACEÆ.

Dictyota, Lamx.

Ll. Williams [1] has recently shown that the male reproductive bodies of this plant are true antherozoids, each provided with a single spirally-coiled flagellum. These bodies are highly sensitive to light, and active movement is apparently only brought about under the influence of light-stimulus. The oospheres, when liberated, have no cell-wall, attract the antherozoids, and, if fertilised, begin to germinate at once. If not fertilised, they lose the power of attracting antherozoids, form cell-walls, and, as already described by Thuret and Bornet, germinate parthenogenetically.

Kuckuck,[2] when investigating recently the process of reproduction in *Scytosiphon lomentarius*, found that fertilisation must occur, if at all, before the oosphere enters the resting condition.

D. dichotoma, Lamx. 10–14.

f. implexa, J. Ag. 10–14.

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[1] Ann. Bot., vol. xi., Dec. 1898.
[2] Ber. d. deutsch. Bot. Gesellsch., xvi., pp. 35–37.

Taonia, J. Ag.

T. atomaria, J. Ag. 10 N. 11. 12 H. 14 B.

One of us found this species growing in quantity in intertidal pools, at Bundoran, Co. Donegal.

[**Padina pavonia**, Gaill.

This beautiful southern weed, growing at Torquay, in England, has not yet been found in Ireland.]

Dictyopteris, Lamx.

D. polypodioides, Lamx. (*Haliseris polypodioides*, Phyc. Brit., pl. xix.) 10. 11 Mc. + T + N. 13. 14 H.

One of us found this interesting weed growing in intertidal rock-pools at Miltown-Malbay (Co. Clare).

[BIBLIOGRAPHY.

BIBLIOGRAPHY.

The following works are some of those consulted in the preparation of this report, and will be found of use to students studying the Irish Phæophyceæ:—

HOLMES AND BATTERS, . . "A Revised List of the British Marine Algæ, with an Appendix." Ann. Bot., v. 5, 1890.

J. B. FARMER AND J. LL. WILLIAMS, Phil. Trans. Roy. Soc., v. 190, 1898.

J. LL. WILLIAMS, . . . "The Antherozoids of Dictyota and Taonia," Ann. Bot. xi., 1897.

J. LL. WILLIAMS, . . . "Reproduction of *Dictyota dichotoma.*" Ann. Bot. xii., 1898.

SAUVAGEAU, C., ... "Sur quelques Algues Phéosporées parasites." Journal de Botanique. 1892.

W. H. HARVEY, ... Phycologia Britannica, 1846–51.

SAUVAGEAU, C., ... "Sur quelques Myrionimacées." Annales des Sciences Naturelles. 8ᵉ sér. (Bot.).

BREBNER, G., ... "Algological Notes." Jour. Mar. Biol. Assoc., vol. iv., 1896.

DE-TONI, J. BAPT., . . . Sylloge Algarum, vol. iii., "Fucoideæ," 1895.

THURET ET BORNET, . . . "Études Phycologiques."

REINKE, J., DR., ... "Atlas d. Deutschen Meeresalgen," 1889.

BUFFHAM, T. H., . . . "Plurilocular Zoosporangia of *Asperococcus Bullosus* and *Myriotrichia clavæformis.*" J. of Bot., Nov., 1891.

KÜTZING, ... "Tabulæ Phycologicæ."

KUCKUCK, P., ... "Bemerkungen zur marinen Algenvegetation von Helgoland." 1894.

KUCKUCK, P., ... Ber. d. deutsch. Bot. Gesellsch., xvi., pp. 35, 37.

Foslie, M., ... "Ueber die Laminarien Norwegens." (Christiania vidensk-selsk. Forhandl. 1884, No. 14).

Sauvageau, C., ... "Observations relatives à la sexualité des Phéosporées." Jour. de Bot., 1896–97.

Sauvageau, C., ... "La copulation Isogamique de l' *Ectocarpus siliculosus*. Est-elle apparente ou réelle?" Mem. d. sci. nat. et math. de Cherbourg, t. xxx.

Kjellman, F. R., . . . "Phæophyceæ." Engler & Prantl, D. Nat. Pflanzenfamilien, 1891–96.

Crouan, P. L., et H. M., . "Florule du Finistère." Brest, 1867.

Hauck, F., Dr., ... "Die Meeresalgen Deutschlands und Österreichs," 1885.

Le Jolis, A., ... "Liste des algues marines de Cherbourg," 1880.

Murray, G. R. M., . . . "Introduction to the Study of Seaweeds," 1895.

Batters, E. A. L., . . . "Marine Algæ of Berwick-on-Tweed," 1892.

Farlow, W. G., ... "New England Algæ," 1881.

Johnson, T., ... "Observations on the Phæozoosporeæ." Annals of Botany, viii., 1891.

Johnson, T., ... "Dictyopteris and the Systematic Position of the Dictyotaceæ." Journ. Linn. Soc. Bot., xxvii., 1889. (This paper contains the first suggestion, based on an observation of the antheridia in *Dictyopteris*, that the male cells of the *Dictyotaceæ* were motile.)

"Irish Naturalist" has had notes on Irish Algæ in its pages from time to time.

XXVII.

GEOMETRY OF SURFACES DERIVED FROM CUBICS.

By ROBERT RUSSELL, M.A., F.T.C.D.

[Read June 26, 1899.]

1. It is well known that the locus of a point P, whose polar quadric with regard to a cubic surface is a curve having its vertex at P', is a surface of the fourth degree—the *Hessian*, and that the polar quadric of P' is a cone having its vertex at P. Such points are called corresponding points on the Hessian, and several elegant properties of this surface are to be found in Salmon's "Geometry of Three Dimensions."

If the equation of the cubic surface be written in Sylvester's canonical form

$$ax^3 + by^3 + cz^3 + dv^3 + ew^3 = 0,$$

where

$$x + y + z + v + w = 0,$$

the equation of the Hessian is

$$\frac{1}{ax} + \frac{1}{by} + \frac{1}{cz} + \frac{1}{dv} + \frac{1}{ew} = 0;$$

and if the coordinates of P are x, y, z, v, w, those of P' are

$$\frac{1}{ax}, \quad \frac{1}{by}, \quad \frac{1}{cz}, \quad \frac{1}{dv}, \quad \frac{1}{ew}.$$

It is easy to see that the line joining PP' belongs to a congruency, that is, moves in space subject to two conditions; and it has been shown by Sir William Rowan Hamilton that such lines are in general bitangents to a surface. Several of the properties of this surface which we shall denote by the symbol C are discussed in the following pages.

2. *Points on the surface.*—In order to determine points on this surface, we have to consider where PP' is met by consecutive lines of the congruency.

These are the points of contact of PP' with C.

Let ξ, η, ζ, v, ω be the coordinates of one these points T, then

$$\left.\begin{aligned} \rho\xi &= x + \frac{\theta}{ax} \\ \rho\eta &= y + \frac{\theta}{by} \\ &\cdots\cdots \end{aligned}\right\}, \qquad (1)$$

in passing to points near to PP', ξ, η, ζ, v, ω remain unchanged; therefore,

$$\xi\delta\rho = \delta x\left(1 - \frac{\theta}{ax^2}\right) + \frac{\delta\theta}{ax}, \qquad (2)$$

with four similar equations in y, z, v, w, from which, by putting for ξ, η, ζ . . ., their values from (1), we easily get

$$\left.\begin{aligned} \delta x &= \frac{\delta\rho}{\rho}\,\frac{x(ax^2+\theta)}{ax^2-\theta} - \frac{x\delta\theta}{ax^2-\theta} = \left(2\theta\frac{\delta\rho}{\rho} - \delta\theta\right)\frac{x}{ax^2-\theta} + \frac{x\delta\rho}{\rho} \\ \delta y &= \frac{\delta\rho}{\rho}\,\frac{y(by^2+\theta)}{by^2-\theta} - \frac{y\delta\theta}{by^2-\theta} = \left(2\theta\frac{\delta\rho}{\rho} - \delta\theta\right)\frac{y}{by^2-\theta} + \frac{y\delta\rho}{\rho} \\ &\cdots\cdots\cdots\cdots \end{aligned}\right\}; \qquad (3)$$

and since

$$x + y + z + v + w = 0, \quad \delta x + \delta y + \delta z + \delta v + \delta w = 0,$$

we have for θ the equation

$$\frac{x}{ax^2-\theta} + \frac{y}{by^2-\theta} + \frac{z}{cz^2-\theta} + \frac{v}{dv^2-\theta} + \frac{w}{ew^2-\theta} = 0, \qquad (4)\,[1]$$

which we shall write

$$\Sigma\,\frac{x}{ax^2-\theta} = 0.$$

It contains the irrelevant factor θ; dividing by this, there remains a quadratic.

Denoting the roots of this quadratic by θ_1, θ_2, we see that the line PP' touches C in two points, T and T', whose coordinates are given by putting θ_1 and θ_2 for θ in (1).

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[1] It is easy to see that this equation may be written

$$\Sigma\,\frac{Aa^2x^4 + Bax^2 + C}{ax\,(ax^2-\theta)} = 0, \quad \text{where } A,\ B,\ C \text{ are any three quantities.}$$

In fact, l, m, n can be found, so that

$$\Sigma\,\frac{Aa^2x^4 + Bax^2 + C}{ax\,(ax^2-\theta)} \equiv \Sigma\left(lx + \frac{m}{ax} + \frac{nx}{ax^2-\theta}\right) = 0. \qquad (5)$$

With these values of θ, ϕ, ρ, we have

$$\Sigma \frac{x_1 x_2}{\phi x_1 + x_2} = 0, \quad \Sigma \frac{x_1 x_2}{\theta x_1 + x_2} = 0;$$

and therefore
$$\frac{\phi x_1 + x_2}{a x_1 x_2}, \quad \frac{\phi y_1 + y_2}{b y_1 y_2}, \ldots$$

$$\frac{\theta x_1 + x_2}{a x_1 x_2}, \quad \frac{\theta y_1 + y_2}{b y_1 y_2},$$

are points in the Hessian on the line joining

$$\frac{1}{a x_1}, \frac{1}{b y_1}, \ldots \frac{1}{e w_1} \text{ to } \frac{1}{a x_2}, \frac{1}{b y_2}, \ldots \frac{1}{e w_2}.$$

From (6) we see that they are corresponding points.

5. The coordinates of any point on the line PV may be written

$$\rho\xi = x + \frac{\mu x}{a x^2 - \theta_1}, \quad \rho\eta = y + \frac{\mu y}{b y^2 - \theta_1} \ldots$$

This will be on the Hessian if

$$\Sigma \frac{a x^2 - \theta_1}{a x (a x^2 + \mu - \theta_1)} = 0,$$

which, since
$$\frac{a x^2 - \theta_1}{a x (a x^2 + \mu - \theta_1)} = \frac{p}{a x} + \frac{q x}{a x^2 + \mu - \theta_1}$$

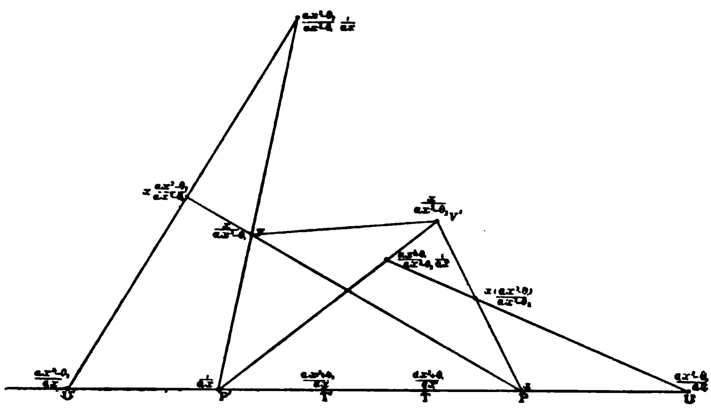
is equivalent to
$$\Sigma \frac{x}{a x^2 + \mu - \theta_1}.$$

We therefore see finally that PV touches the Hessian at P, passes through V, and also through the point for which $\mu = \theta_1 - \theta_2$, and therefore having for its coordinates

$$\rho\xi = x \frac{a x^2 - \theta_2}{a x^2 - \theta_1}, \quad \rho\eta = y \frac{b y^2 - \theta_2}{b y^2 - \theta_1} \ldots$$

In a similar manner we obtain the remaining points in which $P'V'$ PV', and $P'V$ meet the Hessian.

In the figure, all the points marked, with the exception of T and T', lie on the Hessian, and in each case the "x coordinate" is given.



$$\Sigma \frac{x}{ax^2 - \theta_1} = 0 \qquad \Sigma \frac{1}{ax^2 - \theta_1} = 0$$

From these values the pairs that are correspondents are easily seen. We may also verify that the line joining the points

$$\frac{ax^2 - \theta_1}{ax(ax^2 - \theta_2)} \ \ldots \quad x\frac{ax^2 - \theta_1}{ax^2 - \theta_2} \ \ldots$$

touches the Hessian at U; for any point on this line has for its coordinates

$$\rho\xi = \frac{(ax^2 - \theta)(ax^2 - \theta_1)}{ax(ax^2 - \theta_2)}, \quad \rho\eta = \frac{(by^2 - \theta)(by^2 - \theta_1)}{by(by^2 - \theta_2)}; \ \ldots$$

and if this lies on the Hessian, we have

$$\Sigma \frac{x(ax^2 - \theta_2)}{(ax^2 - \theta)(ax^2 - \theta_1)} = 0;$$

or, replacing by partial fractions, and making use of the identity

$$\Sigma \frac{x}{ax^2 - \theta_1} = 0,$$

this equation becomes

$$\Sigma \frac{\theta - \theta_2}{\theta - \theta_1} \cdot \frac{x}{ax^2 - \theta} = 0,$$

and therefore two values of θ are each equal to θ_2.

6. **The inflexional tangents at P are obtained as follows:—**

Let one of them meet VV' in a point whose coordinates are

$$\frac{\lambda x}{ax^2-\theta_2}+\frac{\mu x}{ax^2-\theta_1},\quad \frac{\lambda y}{by^2-\theta_2}+\frac{\mu y}{by^2-\theta_1};\ \ldots$$

then a point on the line joining this to P will lie on the Hessian, if

$$Q = \Sigma\,\frac{1}{ax\left[1+\rho\,\dfrac{\lambda}{ax^2-\theta_2}+\rho\,\dfrac{\mu}{ax^2-\theta_1}\right]} = 0.$$

Now, $Q = 0$, and $\dfrac{dQ}{d\rho} = 0$ are both satisfied by $\rho = 0$, and so also will $\dfrac{d^2Q}{d\rho^2} = 0$, if

$$\Sigma\,\frac{1}{ax}\,\frac{[\lambda(ax^2-\theta_1)+\mu(ax^2-\theta_2)]^2}{(ax^2-\theta_1)^2(ax^2-\theta_2)^2} = 0,$$

or
$$\lambda^2\Sigma\,\frac{1}{ax\,(ax^2-\theta_2)^2}+\mu^2\Sigma\,\frac{1}{ax\,(ax^2-\theta_1)^2} = 0; \qquad (7)$$

or, making use of the identity (5),

$$\frac{\lambda^2}{\theta_2}\,\Sigma\,\frac{x}{(ax^2-\theta_2)^2}+\frac{\mu^2}{\theta_1}\,\Sigma\,\frac{x}{(ax^2-\theta_1)^2} = 0, \qquad (8)$$

thus showing that the inflexional tangents at P or P' divide harmonically the line VV'.

The expressions

$$\Sigma\,\frac{x}{(ax^2-\theta_1)^2},\quad \Sigma\,\frac{x}{(ax^2-\theta_2)^2}$$

admit of representation in another form. If $\Sigma\,\dfrac{x}{ax^2-\theta}$ be reduced to a single numerator and denominator, we get

$$\Sigma\,\frac{x}{ax^2-\theta} = \frac{R\theta\,(\theta^2+P\theta+Q)}{(ax^2-\theta)(by^2-\theta)(cz^2-\theta)(dv^2-\theta)(ew^2-\theta)}$$
$$= f(\theta)\,(\theta-\theta_1)\,(\theta-\theta_2),$$

where θ_1 and θ_2 are roots of $\theta^2+P\theta+Q = 0$;

$$\therefore\quad \Sigma\,\frac{x}{(ax-\theta_1)^2} = 2f(\theta_1)\,(\theta_1-\theta_2),$$

$$\Sigma\,\frac{x}{(ax^2-\theta_2)^2} = 2f(\theta_2)\,(\theta_2-\theta_1);$$

and the above equation for $\lambda : \mu$ becomes

$$\frac{\lambda^2}{(ax^2-\theta_2)(by^2-\theta_2)(cz^2-\theta_2)(dv^2-\theta_2)(ew^2-\theta_2)} - \frac{\mu^2}{(ax^2-\theta_1)(by^2-\theta_1)(cz^2-\theta_1)(dv^2-\theta_1)(ew^2-\theta_1)} = 0.$$

It is unnecessary to write out the corresponding formula for the inflexional tangents at P'.

7. *The class and order of the Congruency.*—The class of the congruency is the number of lines joining corresponding points that lie in a given plane. This number is 3, and the subject is fully discussed (Salmon's "Geometry of Three Dimensions," Art. 529).

That the order is 7 may be seen by considering the number of lines joining corresponding points that pass through the point U on the Hessian (see figure). U being given, so also is V, and V' lies in tangent plane at V; it is in fact the point of contact of any one of the six tangents from the node to the quartic section of the Hessian by the tangent plane at V. The lines joining U to the six correspondents of the points V' are six lines of the congruency, and in addition there is the line UV.

The following is a general analytical investigation of this number for any point:—

If the line joining two corresponding points pass through a fixed point $x'y'z'v'w'$, then,

$$\rho x' = x + \frac{\lambda}{ax},$$

$$\cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot$$

or
$$\frac{axx'}{ax^2+\lambda} = \frac{byy'}{by^2+\lambda} = \frac{czz'}{cz^2+\lambda} = \frac{dvv'}{dv^2+\lambda} = \frac{eww'}{ew^2+\lambda};$$

hence

$$cz^2(axx'-byy') - czz'(ax^2-by^2) + abxy(xy'-x'y) = 0,$$

$$dv^2(axx'-byy') - dvv'(ax^2-by^2) + abxy(xy'-x'y) = 0,$$

$$ew^2(axx'-byy') - eww'(ax^2-by^2) + abxy(xy'-x'y) = 0,$$

$$x+y+z+v+w = 0.$$

$$2z(axx'-byy')$$
$$= \frac{cz'(ax^2-by^2) \pm \sqrt{c^2z'^2(ax^2-by^2)^2 - 4abcxy(xy'-x'y)(axx'-byy')}}{c}$$

$$= z'(ax^2-by^2) \pm \sqrt{z'^2(ax^2-by^2)^2 - 4\frac{ab}{c}xy(xy'-x'y)(axx'-byy')}$$

with two similar equations for v and w; adding these, we have

$$2(x+y)(axx'-byy')$$
$$=(x'+y')(ax^2-by^2)\pm\Sigma\sqrt{z'_2(ax^2-by^2)^2-4\frac{ab}{c}xy(xy'-x'y)(axx'-byy')}.$$

When this expression is rationalised the result is of degree 16; it is satisfied by putting $axx'-byy'=0$, and also by putting $xy'-x'y=0$: there are therefore 14 points common to the surfaces, and therefore 7 lines through $x'y'z'v'w'$ which connect corresponding points.

8. *The tangent planes to the surface C.*—The plane of the two lines which intersect in T will touch C at T', and the plane containing the two that intersect in T' will touch it at T; but we have seen in Art. 3 that the two directions at P, for which consecutive lines of the congruency intersect in T and T', are those joining P to V and V'; we infer therefore that the planes $PP'V'$ and $PP'V$ touch C at the points T and T', respectively.

From the values of the coordinates of these four points, viz. :—

P. . .	$x,$	$y,$	$z,$	$v,$	$w,$
P'. . .	$\frac{1}{ax},$	$\frac{1}{by},$	$\frac{1}{cz},$	$\frac{1}{dv},$	$\frac{1}{ew},$
V. . .	$\frac{x}{ax^2-\theta_1},$	$\frac{y}{by^2-\theta_1},$	$\frac{z}{cz^2-\theta_1},$	$\frac{v}{dv^2-\theta_1},$	$\frac{w}{ew^2-\theta_1},$
V'. . .	$\frac{x}{ax^2-\theta_2},$	$\frac{y}{by^2-\theta_2},$	$\frac{z}{cz^2-\theta_2},$	$\frac{v}{dv^2-\theta_2},$	$\frac{w}{ew^2-\theta_2},$

we immediately deduce that the equation of the tangent plane at T is

$$\Sigma\frac{X}{ax^2-\theta_1}=0,$$

and of the tangent plane at T' is

$$\Sigma\frac{X}{ax^2-\theta_2}=0.$$

It may here be observed, though it will afterwards appear more naturally, that the tangent plane at T touches at T the polar quadric (cone) of V with respect to the cubic, and a similar statement is true for the tangent plane at T'. We easily verify this by considering the polar cone of V, its equation is

$$\Sigma\frac{ax}{ax^2-\theta_1}X^2=0,$$

and it obviously contains the line PP' as a generator; the tangent plane to this cone through PP' is obtained by writing down the polar plane of P' with regard to it, and from its identity with the tangent plane at T, we may define the ***bitangent surface C as the envelope of polar quadrics that are cones.***

9. The polar plane of the point T with respect to the cubic is

$$\Sigma X \frac{(ax^2+\theta_1)^2}{ax^2} = \Sigma ax^2 X + \theta_1^2 \Sigma \frac{X}{ax^2} = 0;$$

this is evidently identical with the polar plane of U, and is therefore the tangent plane to the Hessian at V.

We can now locate the eight poles of the tangent plane to the Hessian at V. Take the point U corresponding to it, and draw the six lines through it which connect a pair of corresponding points; the six points T on these lines are six of the poles, the remaining two, of course, coincide with V itself.

From the above we see that the bitangent surface C may be defined:—

(1.) The locus of points whose polar planes with regard to the cubic touch the Hessian. In this result the square of the Hessian would appear as a factor. If therefore we obtain the condition that the Hessian may be touched by the plane

$$ax^2X + by^2Y + cz^2Z + dv^2V + ew^2W = 0$$

the result is $\quad CH^2 = 0.$

The class of the Hessian being 16, it immediately follows that the degree of C is 24.

(2.) The envelope of polar quadric cones.

10. *The Degree and Class of C.*—In Salmon's "Geometry of Three Dimensions," Art. 510, it is proved that if μ and ν be the order and class of a congruency, and M and N the order and class of the bitangent surface; then

$$M - N = 2(\mu - \nu);$$

putting $$M = 24, \quad \mu = 7, \quad \nu = 3,$$

we have $$N = 16.$$

We shall also determine the value of N directly from geometrical considerations (see Art. 13).

11. Since the polar cones having their vertices at P and P' touch the surface C in two sets of six points that are respectively poles of the planes $P'VV'$ and PVV', they are situated on the curve of intersection of the polar cones of V and V'; but it has already been seen (Art. 7) that these cones have the line PP' as a common generator; therefore the twisted cubic which is the remaining portion of the curve of intersection passes through the twelve contacts of the cones having vertices at P and P'.

12. *The complete intersections of the twisted cubic and the line PP' with C and the Hessian.*—Through the line VV' can be drawn twelve tangent planes to the Hessian distinct from the tangent planes at V and V'; the eighty-four poles of these fourteen planes that lie on the surface C will therefore be situated either on the line PP' or the twisted cubic referred to in Art. 10. Now since the equation of the polar plane of any point on the line PP' is of the form

$$\Sigma X\left(ax^2 + \frac{\lambda^2}{ax^2}\right) = 0,$$

there are always two points harmonic conjugates with regard to PP' which have a given common polar plane passing through the line VV'. The only exceptions are in the cases of the points P and P'. We can now arrange the eighty-four poles of the fourteen planes in the following table:—

Of the eight poles of tangent plane at V two are coincident at U, one at T, and five on the twisted cubic, and we can similarly account for the poles of the tangent plane at V'.

Of the eight poles of the tangent plane at P two are coincident at P', and the remaining six are on the twisted cubic, and similarly for the tangent plane at P'; finally, for each of the remaining ten planes two coincident poles are on the Hessian, two on the line PP', and four on the cubic. These ten pairs of points and the two contacts at T and T' is the complete intersection of PP' with C.

In order to account for the points in which the bitangent surface is met by the twisted cubic, it is only necessary to observe that the polar cone having its vertex at U touches C in six points, one at T, and in five other points on the twisted cubic; these six points being the poles of the tangent plane to the Hessian at V; we see therefore that the twisted cubic touches C in ten points, meets it in two hexads, and in ten tetrads, or seventy-two points in all.

The same cubic intersects the Hessian in U, U', and the points of contact of the ten planes in this article.

13. Let us now recall a property of the Hessian and Cayleyan of a plane cubic curve.

If the line joining a pair of corresponding points PP' on the Hessian meet it again in U, the polar conics of P and P' are pairs of lines touching the Cayleyan, and the four points of contact lie on a line passing through U, which we may call a companion line; the two lines form a polar conic, and this companion line touches the Cayleyan in a point whose polar line with regard to the cubic touches the Hessian at V the correspondent of U.

If the line joining a pair of corresponding points on the Hessian of a cubic surface meet it again in U, U', the polar quadrics of P and P' are cones touching C and the twelve points of contact lie on a twisted cubic passing through U, U', which we may call the companion curve; the line PP' and this curve determine two polar cones, and this companion curve touches C in ten points whose polar planes with regard to the cubic are tangent planes to the Hessian at points V, V', the correspondents of U, U'.

14. *The Class of C.*—In any plane there are three lines joining corresponding points, and for the plane $PP'V$ from Art. 3, we see that of these lines two coincide with PP' and the third is UV. If, therefore, we require to know how many tangent planes to C can be drawn through UV we have at once the solution. The six lines PP' which can be drawn through U, and the six through V (see Art. 7) when joined to UV give twelve tangent planes; but UV being a double tangent line to C four more planes (two coincident pairs) have to be added to the twelve. The *Class is* therefore 16 as was before determined.

15. *The sections of the Cubic and Hessian by the bi-planes*

$$x\sqrt{a} = y\sqrt{b} = z\sqrt{c} = v\sqrt{d} = w\sqrt{e}.$$

If x, y, z, v, w be the coordinates of any point on the Hessian the equation of the tangent plane at the corresponding point is

$$ax^2X + by^2Y + cz^2Z + dv^2V + ew^2W = 0;$$

this plane will pass through the double point 0, 0, 0, 1, -1, if

$$dv^2 - ew^2 = 0.$$

We see, therefore, that the plane $v\sqrt{d} - w\sqrt{e} = 0$ intersects the

Hessian in the line $v = 0$, $w = 0$, and a cubic curve whose equation may be written

$$\left.\begin{array}{r} \dfrac{1}{ax} + \dfrac{1}{by} + \dfrac{1}{cz} + \dfrac{1 + \dfrac{\sqrt{d}}{\sqrt{e}}}{dv} = 0 \\[2ex] x + y + z + v\left(1 + \dfrac{\sqrt{d}}{\sqrt{e}}\right) = 0 \end{array}\right\}, \qquad (8)$$

and that the section of the cubic surface by the same plane is

$$\left.\begin{array}{r} ax^3 + by^3 + cz^3 + dv^3\left(1 + \dfrac{\sqrt{d}}{\sqrt{e}}\right) = 0, \\[2ex] x + y + z + v\left(1 + \dfrac{\sqrt{d}}{\sqrt{e}}\right) = 0 \end{array}\right\}. \qquad (9)$$

From the above we easily infer—

(1.) The curve (8) is the Hessian of the curve (9).

(2.) All points of the Hessian surface on the curve (8) have their correspondents on the same curve, and that these pairs of points are correspondents on the curve (8) in the sense in which the word is used in the geometry of plane cubic curves.

(3.) The line joining a pair of corresponding points on the curve (8) which we know touches the Cayleyan of (9) (see Salmon's "Higher Plane Curves") must touch the bitangent surface in the same point; hence this Cayleyan is part of the section of C by the bi-plane

$$v\sqrt{d} - w\sqrt{e} = 0.$$

(4.) The tangent cones from the node to the Hessian are cubics whose curves of contacts are

$$\left.\begin{array}{r} \dfrac{1}{ax} + \dfrac{1}{by} + \dfrac{1}{cz} + \dfrac{1 + \dfrac{\sqrt{d}}{\sqrt{e}}}{dv} = 0, \\[2ex] x + y + z + v\left(1 + \dfrac{\sqrt{d}}{\sqrt{e}}\right) = 0 \end{array}\right\}. \qquad (8)$$

$$\left.\begin{array}{r} \dfrac{1}{ax} + \dfrac{1}{by} + \dfrac{1}{cz} + \dfrac{1 - \dfrac{\sqrt{d}}{\sqrt{e}}}{dv} = 0, \\[2ex] x + y + z + v\left(1 - \dfrac{\sqrt{d}}{\sqrt{e}}\right) = 0 \end{array}\right\}, \qquad (10)$$

the equations of the cones being

$$\left.\begin{aligned}(x+y+z)(bcyz+cazx+abxy)-abc\frac{(\sqrt{d}+\sqrt{e})^2}{de}xyz=0,\\ (x+y+z)(bcyz+cazx+abxy)-abc\frac{(\sqrt{d}-\sqrt{e})^2}{de}xyz=0\end{aligned}\right\}. \quad (11)$$

These cones have three generators in common

$$0,\ 1,\ -1;\ -1,\ 0,\ 1;\ 1,\ -1,\ 0,$$

and touch along the three corresponding to them

$$1,\ 0,\ 0;\ 0,\ 1,\ 0;\ 0,\ 0,\ 1.$$

15. *The sections of the bitangent surface by the bi-planes.*—Let P be any point on the curve (8), P' its correspondent, U the third point in which the line joining them meets the curve, and U' the point in which it meets $v=0$, $w=0$ of the two contacts of PP' with C, T is on the Cayleyan (Art. 14), and T' is the harmonic conjugate of U', and it is not difficult to prove that the locus of T' for points U' situated on the line $v=0$, $\omega=0$ is a cubic curve[1] which passes through the nodes

$$0,\ 1,\ -1,\ 0,\ 0;\quad -1,\ 0,\ 1,\ 0,\ 0;\quad 1,\ -1,\ 0,\ 0,\ 0.$$

The tangent plane to C at T' is the plane $PP'V$ (Art. 7), which in the case under consideration reduces to

$$v\sqrt{d}-w\sqrt{e}=0;$$

we see, therefore, that this bi-plane touches C along the whole length of the curve (11).

We have now accounted for a sextic section and the square of a cubic, and the remaining curve of the 12th degree is the locus of points in the plane

$$v\sqrt{d}-w\sqrt{e}=0,$$

---

[1] This cubic curve may also be obtained by expressing that the polar of $x, y, z, v, \frac{\sqrt{d}}{\sqrt{e}}v$ touches the $bcYZ+caZX+abXY=0$, the tangent cone to the Hessian at the node. The result is

$$\left.\begin{aligned}\sqrt{bc(ax^2-dv^2)}+\sqrt{ca(by^2-dv^2)}+\sqrt{ab(cz^2-dv^2)}=0\\ x+y+z+v\left(1+\frac{\sqrt{d}}{\sqrt{e}}\right)=0\end{aligned}\right\}, \quad (12)$$

which, when rationalized, has v as a factor and leaves a cubic.

whose polar planes touch the second cubic tangent cone which can be drawn from the node to the Hessian, and whose curve of contact is the curve (10).

It has just been seen that the tangent plane to C at T' is the plane

$$v\sqrt{d} - w\sqrt{e} = 0;$$

and since the node 0, 0, 0, 1, − 1 is the correspondent of every point on the line $v = 0$, $w = 0$, it follows that $PP'V'$, the tangent plane at T, is the plane joining the line PP' to the node, and therefore from the node can be drawn to C two tangent cones whose curves of contact are plane curves, the Cayleyans of the sections of the Hessian by

$$v\sqrt{d} \pm w\sqrt{e} = 0.$$

In addition, through it, pass the six planes

$$x\sqrt{a} = \pm y\sqrt{b} = \pm\sqrt{c},$$

each of which touches it along a cubic curve. (Note, Art. 15.)

The further discussion of the surface is reserved for another paper.

CIST FOUND AT GREENHILLS, TALLAGHT.

URN FOUND AT GREENHILLS, TALLAGHT.

No. 1.

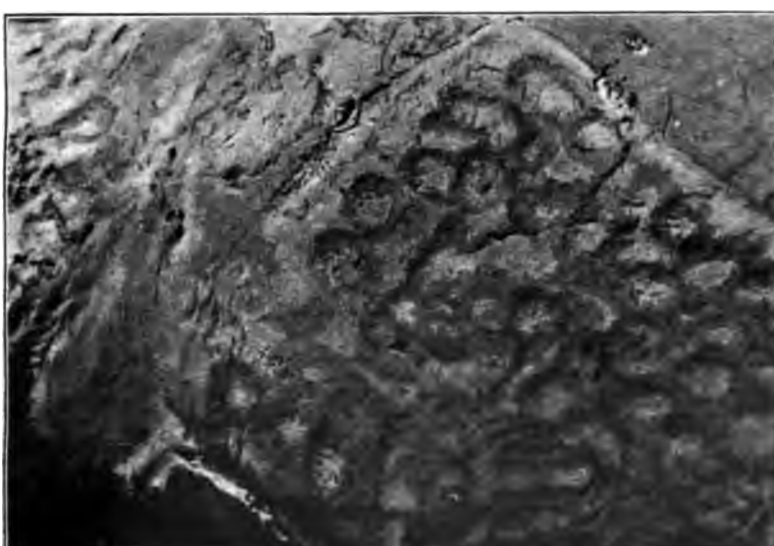
No. 2.

No. 1.

No. 2.

Urns found at Greenhills, Tallaght.

No. I.—THE SECOND CIST *in situ*.



No. II.—FRAGMENT, SHOWING FINGER IMPRESSIONS.

(½.)

Cinerary Urn.

(In the possession of Captain Walker, Tykillen, County Wexford.)

MUCKINISH CASTLE.
(From the East.)

NEWTOWN CASTLE, BALLYVAUGHAN.
(From the South.)

1

2

T. J. Westropp del. Geo. West & Sons lith.

1. MOYREE CASTLE COUNTY CLARE
2. STAIRCASE LEMENEAGH CASTLE COUNTY CLARE.

Tinnecarra Cromlech.
(From the South-West.)

Tinnecarra Cromlech.
(From the East.)

corresponding more or less with the configuration of the land, as follows:—

i. North-East. From Malin Head, Co. Donegal, to St. John's Point, Co. Down.
ii. East. From St. John's Point to Carnsore Point, Co. Wexford.
iii. South. From Carnsore Point to Cape Clear, Co. Cork.
iv. South-West. From Cape Clear to Loop Head, Co. Clare.
v. West. From Loop Head to Erris Head, Co. Mayo.
vi. North-West. From Erris Head to Malin Head.

MAP SHOWING THE SHALLOW AND DEEP WATER DISTRICTS AND THE SIX PROVINCES.

A.—Malin Head. C.—Carnsore Point. E.—Loop Head.
B.—St. John's Point. D.—Cape Clear. F.—Erris Head.

The limits of these provinces are nearly the same as those proposed by Dr. E. P. Wright in "Proc. Dub. Univ. Zool. and Bot. Assoc.," I., 1859, for the distribution of the Irish Actiniæ.

In this list those species that have only been procured in the deep water district are included in square brackets, and can thus be easily distinguished.

The more important varieties are included, but their distribution is not by any means satisfactorily known, as they have only occasionally been recorded.

The Mollusca obtained at Baltimore, September, 1895, and at Dungarvan, October, 1896, by Professor Johnson and myself, for the Fauna and Flora Committee of the Royal Irish Academy, are included in this list; also the Mollusca that were dredged in the Royal Dublin Society Fishing Survey, 1890, 1891, and which were determined by Mr. H. K. Jordan. *Otina otis*, *Alexia denticulata*, *Melampus bidentatus*, and the species of *Paludestrina* (*Hydrobia*) were included by Dr. Scharff in "The Irish Land and Freshwater Mollusca," in *Irish Naturalist*, i., 1892, and are not repeated in this list. I have also omitted a large number of species of Mollusca which have at various times been recorded as Irish, but have been wrongly determined, imported in ballast or otherwise, or have only been found in a fossil state.

The arrangement of the families and genera follows closely that adopted by Cooke in "The Cambridge Natural History," iii., 1895. As regards nomenclature, papers by Chaster, Melvill, Monterosato, Newton, Norman, Smith, &c., have been consulted, but whenever the name in this list differs from that employed by Jeffreys in "British Conchology," I have also given Jeffreys' name.

The general distribution of each species is given briefly, and has been principally derived from Jeffreys' "British Conchology" and his other writings; the "Challenger" Reports, the works of Carus, Dall, Kobelt, Locard, Monterosato, Norman, Sars, Verrill, Watson, &c., have also been referred to.

My best thanks are due to Mr. James Thompson, of Belfast, for the loan of the late Mr. W. Thompson's Manuscript for the 4th volume of the "Natural History of Ireland": to Mr. R. L. Praeger for allowing me to consult his notes on the Mollusca of the North of Ireland: to Professor D'Arcy W. Thompson for a list of Mollusca obtained at Roundstone: and to Mr. G. P. Farran for a list of Mollusca collected at Narin Strand, county Donegal. The species in both these lists were determined by Dr. G. W. Chaster. I am also indebted to Dr. Chaster and Mr. J. T. Marshall for assistance in determining some critical species.

Excluding some very doubtful Irish species, the number of species of marine Mollusca recorded in Thompson's "Natural History of

Ireland," vol. iv., is 350. The total number of species in this list is 546, 67 of which belong entirely to the deep-water district. The number of species of marine Mollusca that have been taken in less than 100 fathoms depth on the British coasts is 605; the number in this list is 479, or rather more than 79 per cent. If we exclude the Ascoglossa and Nudibranchiata which have only been collected at a few places on the Irish coast, this list contains 417 species out of a total of 488 British species, or nearly 86 per cent.

The only shallow-water species peculiar to the Irish Fauna are two Nudibranchs, viz. *Lamellidoris ulidiana*, found by Mr. W. Thompson on oysters from the coast of Down or Antrim, and *Æolis sanguinea*, found in Roundstone Bay by Canon Norman.

The following species taken in the Irish shallow water district do not appear to have been yet recorded from other British coasts, viz.: *Circulus striatus*, *Homalogyra polyzona*, *Homalogyra Fischeriana*, *Retrotortina fuscata*, *Cassidaria rugosa*, *Brachystomia suboblonga*, *Pyrgulina clathrata*, *Turbonilla delicata*, *Neptunea despecta*, *Diaphana quadrata*, *Dexiobranchæa paucidens*, *Lamellidoris muricata*, *Lamellidoris Loveni*, *Dentalium panormitanum*, *Dentalium agile*, *Nucula corbuloides*, *Nuculana pusilla*, *Ostrea cochlear*, *Decipula ovata*, *Lepton obliquatum*, *Lyonsiella abyssicola*, and *Lyonsiella insculpta*. Ten of these species are southern, three are northern, one is pelagic, and the remaining eight belong rather to the deep water district.

List of the more important Works and Papers referring to the Irish Marine Mollusca:—

Adams, B. W.:

'60. Note on *Corbula rosea*. Ann. & Mag. Nat. Hist., (3) vi., p. 455.

'78. British Association Guide to the county of Dublin. Part II. Mollusca, pp. 54–70.

Alcock, T.:

'65. Notes on Natural History Specimens lately received from Connemara. Proc. Lit. and Phil. Soc., Manchester, iv., pp. 192–208. Mollusca, pp. 200–208.

Alder, J.:

'44. Description of some new British species of *Rissoa* and *Odostomia*. Ann. & Mag. Nat. Hist., xiii., pp. 323–328.

ALDER, J. and HANCOCK, A.:

'44. Description of a new Genus of Nudibranchiate Mollusca, with some new Species of *Eolis*. Ann. & Mag. Nat. Hist., xiii., pp. 161–166.

'45. A Monograph of the British Nudibranchiate Mollusca. Ray Society.

ALLMAN, G. J.:

'45. On the Anatomy of *Actæon*, with remarks on the order Phlebenterata of M. de Quatrefages. Ann. & Mag. Nat. Hist., xvi., pp. 145–163.

'46. Note on a new Genus of Nudibranchiate Mollusca. Ann. & Mag. Nat. Hist., xvii., pp. 1–5.

BAILY, W. H.:

'65. Notes on Marine Invertebrata collected on Portmarnock Strand. Proc. Nat. Hist. Soc., Dublin, iv., pp. 251–258.

BALL, R.:

'41. On a species of *Loligo* found on the shore of Dublin Bay. Proc. Roy. Irish Acad., i., pp. 362–364.

'42. Notes of the Acetabuliferous Cephalopoda of Ireland, including two new species of Rossiæ. Proc. R. I. Acad., ii., pp. 192–194.

BENNETT, E. T.:

'25. Description of an hitherto unpublished Species of *Buccinum*, recently discovered at Cork. Zoological Journal, i., pp. 398–399.

BOURNE, G. C.:

'90. Report of a Trawling Cruise in H.M.S. "Research" off the South-west Coast of Ireland. Journ. Mar. Biol. Assoc. (N.S.), i., pp. 306–321. Mollusca, pp. 312–314.

BROWN, T.:

'18. Account of the Irish Testacea. Memoirs of the Wernerian Nat. Hist. Soc., ii., pp. 501–536.

'44. Illustrations of the recent Conchology of Great Britain and Ireland. Second edition.

BROWNRIGG, W. B.:

'60. Occurrence of *Teredo norvegica* at Tankardstown, county Waterford. Proc. Dublin Univ. Zool. & Bot. Ass., ii., pp. 79–80.

BRYCE, J.:

'31. Tables of Simple Minerals, Rocks, and Shells. Belfast.

Bulwer, J.:

'26. On the *Isocardia cor* of the Irish Seas. Zool. Jour., ii., pp. 357–361.

Buxton, E. C.:

'67. *Ianthina fragilis* in Dingle Bay. Zoologist (2), ii., p. 954.

Chaster, G. W.:

'95. Notes on a few of the less known British Marine Mollusca. Journal of Malacology, iv., pp. 56–59.

'97. *Adeorbis unisulcatus*, new species, from the Irish coast. Journal of Conchology, viii., p. 373.

'97a. A day's dredging off Ballycastle, county Antrim. Irish Naturalist, vi., pp. 120–125.

'97b. Notes on the Marine Mollusca of Rathlin Island. Irish Naturalist, vi., pp. 184–187.

'98. A Report upon the Mollusca (excluding the Cephalopoda and Nudibranchiata) obtained by the Royal Irish Academy Cruises of 1885, 1886, and 1888. Proc. R. I. Acad. (3), v., pp. 1–33.

Cockerell, T. D. A.:

'85. The Mollusca of Kerry. Hardwicke's Science Gossip, xxi., p. 279.

'87. Marine Mollusca of Kerry. Zoologist (3), xi., pp. 115–116.

Cooke, A. H.:

'82. On the Mac Andrew Collection of British Shells. Journ. of Conch., iii., pp. 340–384.

Dickie, G.:

'58. Report on the Marine Zoology of Strangford Lough, county Down, and corresponding part of the Irish Channel. Report British Association for 1857, pp. 104–112.

Dillwyn, L. W.:

'17. A Descriptive Catalogue of Recent Shells. Vols. i., ii.

Donovan, E.:

1799–1803. The Natural History of British Shells. Vols. i.–v.

Farran, C.:

'45. Upon the rare species and peculiar habits of the shells of the western coast, and of the characteristic features of Roundstone and Birterbic Bays, Connemara. Seventh Ann. Rep. Dublin Nat. Hist. Soc., pp. 14–16.

'55. On *Pectunculus glycymeris*, and on the local range of Molluscuous animals traced with the dredge. Natural History Review, ii. (*Proc.*), pp. 31–33.

FARRAN, C.:
'57. On *Akera bullata*. Nat. Hist. Rev., iv. (*Proc.*), pp. 74–78.
'60. Observations on the peculiar local position of some species of the Pholadidae on the coast near Dungarvan, &c. Proc. Nat. Hist. Soc., Dublin, i., pp. 135–143. (Reprinted from *Saunders' News-Letter.*)
'60A. On the discovery of *Bulla hydatis*. Proc. Nat. Hist. Soc., Dublin, i., pp. 143–145. (Reprinted from *Saunders' News-Letter.*)

FORBES, E.:
'53. Remarks on a species of *Sepiola* new to Britain, and first procured in the neighbourhood of Belfast. Rep. Brit. Ass. for 1852 (*pt.* 2), pp. 73–74.

FORBES, E. and HANLEY, S.:
'53. A History of British Mollusca and their shells. Vols. i.–iv.

FRAZER, W.:
'71. On the Distribution of *Isocardia cor* along the Irish coast, with Record of its Discovery in Dungarvan Bay by John Good, Esq. Proc. Nat. Hist. Soc. Dublin, v., pp. 189–190.

GALWEY, Miss Honoria:
'88. On the marine shells of Magilligan Strand, county Tyrone [*recte* Derry]. Journ. of Conch., v., pp. 267–270.

GAMBLE, F. W.:
'96. Notes on a Zoological Expedition to Valencia Island, co. Kerry. Irish Naturalist, v., pp. 129–136.

GRAINGER, J.:
'59. On the shells found in the Post-Tertiary Deposits of Belfast. Nat. Hist. Rev., vi. (*Proc.*), pp. 135–151.

HADDON, A. C.:
'86. Recent Contributions to the Marine Invertebrate Fauna of Ireland. Zoologist (3), x., pp. 1–8.
'86A. Preliminary Report on the Fauna of Dublin Bay. Proc. R. I. Acad. (2), iv., pp. 523–531.
'86B. First Report on the Marine Fauna of the South-west of Ireland. Nudibranchiata. Proc. R. I. Acad. (2), iv., p. 632.
'88. Second Report on the Marine Fauna of the South-west of Ireland. Narrative of Cruise. Proc. R. I. Acad. (3), i., pp. 31–45.

HART, H. C.:

'92. Notes on Marine Mollusca collected on the coasts of Donegal and Dublin. Zoologist (3), xvi., pp. 51–56, 105–107, 139–141, 181–183.

'92A. *Spirula*, *Ianthina*, and *Velella* at Lough Swilly, Co. Donegal. Zoologist (3), xvi., p. 414.

HASSALL, A. H.:

'42. A List of Invertebrates found in Dublin Bay and its vicinity. Ann. & Mag. Nat. Hist., ix., pp. 132–134.

HERDMAN, W. A.:

'91. The Biological Results of the Cruise of the s. y. "Argo" round the west coast of Ireland in August, 1890. Proc. Liverpool Biol. Soc., v., pp. 181–212. Mollusca, pp. 204–205.

HOLT, E. W. L.:

'92. Survey of Fishing Grounds, West Coast of Ireland, 1890–1891. Report on the Results of the Fishing Operations. Sc. Proc. Roy. Dublin Soc. (N.S.), vii., pp. 225–387.

HOPKINS, W.:

'55. Occurrence of *Ianthina communis* and *Spirula Peronii* at Kilkee. Nat. Hist. Rev., ii. (*Proc.*), pp. 97–99.

HOYLE, W. E.:

'86. "Challenger" Report, vol. xvi. Cephalopoda.

'91. Note on a British Cephalopod—*Illex eblanæ* (Ball). Journ. Mar. Biol. Ass. (N.S.), ii., pp. 189–192.

HUMPHREYS, J. D.:

'45. Memoranda towards a Fauna of the county of Cork. Marine Mollusca, pp. 9–19.

HURST, C. H.:

'96. Fauna of Belfast Lough. Irish Naturalist, v., pp. 271–272.

HYNDMAN, G. C.:

'58. Report of the Proceedings of the Belfast Dredging Committee. Rep. Brit. Ass. for 1857, pp. 220–237.

'58A. Notice of a curious Monstrosity of Form in the *Fusus antiquus*. Rep. Brit. Ass. for 1857 (*pt.* 2), p. 104.

'59. Report of the Belfast Dredging Committee. Rep. Brit. Ass. for 1858, pp. 282–293.

'60. Report of the Belfast Dredging Committee for 1859. Rep. Brit. Ass. for 1859, pp. 116–119.

JEFFREYS, J. G.:

'47. Descriptions and Notices of British Shells. Ann. & Mag. Nat. Hist., xix., pp. 309–314; xx., pp. 16–19.

JEFFREYS, J. G.:
'48. British Mollusca. Ann. & Mag. Nat. Hist. (2), i., pp. 239–240.
On the recent species of *Odostomia*, a genus of Gasteropodous Mollusks inhabiting the seas of Great Britain and Ireland. Ann. & Mag. Nat. Hist. (2), ii., pp. 330–351.
'50. Supplementary Notes on British Odostomiæ. Ann. & Mag. Nat. Hist. (2), v., pp. 108–110.
'51. Note on the *Chemnitzia Gulsonæ* of Clark. Ann. & Mag. Nat. Hist. (2), vii., pp. 27–28.
'58. Gleanings in British Conchology. Ann. & Mag. Nat. Hist. (3), i., pp. 39–48; (3), ii., pp. 117–133.
'59. Further Gleanings in British Conchology. Ann. & Mag. Nat. Hist. (3), iii., pp. 30–43, 106–120; (3) iv., pp. 189–201.
'60. A Synoptical List of the British Species of *Teredo*, with a notice of the Exotic Species. Ann. & Mag. Nat. Hist. (3), vi., pp. 121–127.
'63. British Conchology, vol. ii.
'64. Remarks on *Stylifer*. . . . Ann. & Mag. Nat. Hist. (3), xiv., pp. 321–334.
'65. British Conchology, vol. iii.
'67. British Conchology, vol. iv.
'69. British Conchology, vol. v.
'69A. The Deep-Sea Dredging Expedition in H.M.S. "Porcupine." Nature, i., pp. 135–137, 166–168.
'76. Preliminary Report of the Biological Results of a cruise in H. M. S. "Valorous" to Davis Strait in 1875. Proc. Roy. Soc., xxv., pp. 177–230.
'76A. New and peculiar Mollusca . . . procured in the "Valorous" Expedition. Ann. & Mag. Nat. Hist. (4), xviii, pp. 424–436, 490–499.
'77. New and peculiar Mollusca . . . procured in the "Valorous" Expedition. Ann. & Mag. Nat. Hist. (4) xix., pp. 153–158, 231–243, 317–339.
On the Mollusca procured during the "Lightning" and "Porcupine" Expeditions, 1868–70:—
'78. Part I. Proc. Zool. Soc., pp. 393–416.
'79. Part II. Proc. Zool. Soc., pp. 553–588.
'81. Parts III., IV. Proc. Zool. Soc., pp. 693–724, 922–952.
'82. Part V. Proc. Zool. Soc., pp. 656–687.
'83. Part VI. Proc. Zool. Soc., pp. 88–115.
'84. Parts VII., VIII. Proc. Zool. Soc., pp. 111–149, 341–372.
'85. Part IX. Proc. Zool. Soc., pp. 27–63.

JORDAN, H. K.:

'90. On the species and varieties of the genus *Fusus* which inhabit the seas surrounding the British Isles. Journ. of Conch., vi., pp. 225–239.

'92. Report on some species of the genera *Buccinum*, *Buccinopsis*, and *Fusus*, dredged off the South-West of Ireland. Proc. R. I. Acad. (3) II., pp. 391–396.

KINAHAN, J. R.:

'59. Notes on Dredging in Belfast Bay, with a list of species [of Crustacea]. Nat. Hist. Rev., vi. (*Proc.*), pp. 79–86.

'60. Report of Dublin Bay Dredging Committee for 1858–59. Rep. Brit. Ass. for 1859, pp. 80–81.

'61. Report of the Committee appointed to dredge Dublin Bay. Rep. Brit. Ass. for 1860, pp. 27–31.

KING, W.:

'62. Preliminary notice of the Organic and Inorganic Objects obtained from the soundings of H. M. S. "Porcupine" off the West coast of Ireland. Nautical Magazine, pp. 600–602, 655–658.

'63. Notice of some Objects of Natural History lately obtained from the Bottom of the Atlantic. Rep. Brit. Ass. for 1862 (*pt.* 2), pp. 108–109.

LEACH, W. E.:

'52. Synopsis of the Mollusca of Great Britain.

MAC ANDREW, R.:

'57. Report on the marine Testaceous Mollusca of the North-east Atlantic and neighbouring Seas, and the physical conditions affecting their development. Rep. Brit. Ass. for 1856, pp. 101–158.

M'CALLA, W.:

'36. [A list of species of shells found near Roundstone.] Mag. Nat. Hist., ix., p. 130.

MACKINTOSH, H. W.:

'84. Report on Irish Zoophytes. Part I. Proc. R. I. Acad., (2), iv., pp. 52–58.

MARSHALL, J. T.:

'90. Dredging off Connemara. Journ. of Conch., vi., p. 250.

'93. Additions to "British Conchology." Journ. of Conch., vii., pp. 241–265.

'94. Additions to "British Conchology." Addenda. Journ. of Conch., vii., pp. 379–385.

MARSHALL, J. T.:
'95. Alterations in "British Conchology." Journ. of Conch., viii., pp. 24–41.
'97. Additions to "British Conchology." Journ. of Conch., viii., pp. 338–372, 385–395.
'98. Additions to "British Conchology." Journ. of Conch., ix., pp. 61–74, 120–128.
'99. Additions to "British Conchology." Journ. of Conch., ix., pp. 129–138, 165–171.

MORE, A. G.:
'70. Report on the Collections made in Kerry [during the summer and autumn of 1868]. Journal Roy. Dub. Soc., v., pp. 389–395.
'75. Notice of a gigantic Cephalopod (*Dinoteuthis proboscideus*), which was stranded at Dingle in Kerry, two hundred years ago. Zoologist (2), x., pp. 4526–4532.
'75A. Some Account of the gigantic Squid (*Architeuthis dux*) lately captured off Boffin Island, Connemara. Zoologist (2), x., pp. 4569–4571. Ann. & Mag. Nat. Hist. (4), xvi., pp. 123–124.

NICHOLS, A. R.:
'93. *Pleurophyllidia loveni*, Bergh in Ireland. Irish Naturalist, ii., p. 176.

NORMAN, A. M.:
'77. On two new British Nudibranchiate Mollusca. Ann. & Mag. Nat. Hist. (4), xx., pp. 517–519.
'90. Addendum to Report of a Trawling Cruise in H. M. S. "Research" off the South-west Coast of Ireland. Journ. Mar. Biol. Assoc., (N. S.), i., pp. 322–323.
'90A. Revision of British Mollusca. Ann. & Mag. Nat. Hist. (6), v., pp. 452–484; (6), vi., pp. 60–91.
'91. *Lepton squamosum* (Montagu), a Commensal. Ann. & Mag. Nat. Hist. (6), vii., pp. 276–278.

PRAEGER, R. L.:
'89. The Marine Shells of the North of Ireland. Report and Proc. Belfast Nat. Field Club, ii., 1887–1888. Appendix, pp. 55–110.
'92. Report on the Estuarine Clays of the North-East of Ireland. Proc. R. I. Acad. (3), ii., pp. 212–289.
'92A. *Odostomia albella*, Lovén, in Ireland. Irish Naturalist, i., p. 61.

PRAEGER, R. L.:

'94. Fauna of Mulroy Bay, Donegal. Irish Naturalist, iii., p. 113.

'96. Report upon the Raised Beaches of the North-East of Ireland, with special reference to their Fauna. Proc. R. I. Acad. (3), iv., pp. 30–54.

'99. Marine Shells from the Kenmare River. Irish Naturalist, viii., p. 164. [Added in press.]

SMITH, E. A.:

'89. Report of a Deep-sea Trawling Cruise off the S. W. coast of Ireland under the direction of Rev. W. Spotswood Green. Mollusca. Ann. & Mag. Nat. Hist. (6), iv., pp. 420–425.

SMITH, J.:

'39. Catalogues of recent shells in the basin of the Clyde and North coast of Ireland; and of shells from the newer pliocene deposits in the British Islands. Mem. Wern. Soc. Edinb., viii., pp. 49–88, 89–128.

STANDEN, R.:

'94. Shells from Co. Donegal. Irish Naturalist, iii., p. 261.

'95. Marine Mollusca. Galway Excursion, 1895. Irish Naturalist, iv., pp. 264–265.

SWANSTON, W.:

'86. First Report on the Marine Fauna of the South-west of Ireland. Mollusca. Proc. R. I. Acad. (2), iv., pp. 623–632.

TATLOW, E. M. (Mrs.):

'99. Marine Shells from South-West Donegal. Irish Naturalist, viii., 235–238. [Added in press.]

TATLOW, E. M. (MRS.) and PRAEGER, R. L.:

'98. Impressions of Achill. Marine Mollusca. Irish Naturalist, vii., pp. 139–140.

THOMPSON, W.:

'35. On some additions to the British Fauna. Proc. Zool. Soc., London, iii., pp. 77–84.

'35A. On the *Teredo navalis* and *Limnoria terebrans* as at present existing in certain localities on the coasts of the British Islands. Edinb. New Phil. Journ., xviii., pp. 121–130.

'40. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist., v., pp. 6–14, 245–257.

'40A. Contributions towards a knowledge of the Mollusca nudibranchia and Mollusca tunicata of Ireland, with descriptions of apparently some new species of Invertebrata. Ann. & Mag. Nat. Hist., v., pp. 84–102.

THOMPSON, W.:
'41. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist., vii., pp. 477–482.
'42. Results of deep dredging off the Mull of Galloway, by Capt. Beechey, R.N., drawn up by W. Thompson, Esq. Ann. & Mag. Nat. Hist., x., pp. 21–24.
'44. Report on the Fauna of Ireland: Div. Invertebrata. Rep. Brit. Ass. for 1843, pp. 245–291.
'44A. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist., xiii., pp. 430–440.
'45. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist., xv., pp. 308–322.
'46. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist., xviii., pp. 383–397.
'47. On the *Teredo norvegica*, &c. Ann. & Mag. Nat. Hist., xx., pp. 157–164.
'47A. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist., xx., pp. 169–176, 237–250.
'48. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist. (2), i., pp. 62–65.
'49. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist. (2), iii., pp. 351–357.
'51. Additions to the Fauna of Ireland. Ann. & Mag. Nat. Hist. (2), vii., pp. 501–502.
'53. Supplementary Report on the Fauna of Ireland. Rep. Brit. Ass. for 1852, pp. 290–296.
'56. The Natural History of Ireland. Vol. iv.

THOMSON, WYVILLE:
'73. The Depths of the Sea. London.

TOMLIN, B.:
'94. *Ianthina rotundata*, Leach. British Naturalist, p. 20.
'95. *Spirula Peronii* in Co. Antrim. Irish Naturalist, iv., p. 348.

TRAILL, W. A.:
'77. On the occurrence of *Pholadidea papyracea* at Glenarm, County Antrim. Journal Roy. Geol. Soc. Ireland (N.S.), iv., pp. 242–244.

TURTON, W.:
'16. Catalogue in *Dublin Examiner*, July.
'19. A Conchological Dictionary of the British Islands.
'22. The Shells of the British Islands.
'34. Descriptions of some nondescript and rare British species of Shells. Mag. Nat. Hist., vii., pp. 350–353.

WALLER, E.:

'58. On the Discovery in Ireland of a new British Shell. Journ. Roy. Dub. Soc., i., pp. 386–388.

'60. On the Discovery in Ireland of New Shells. Journ. Roy. Dub. Soc., ii., pp. 29–34.

WALPOLE, W. W.:

'52. Rare Irish Mollusca. Ann. & Mag. Nat. Hist. (2), ix., p. 356; x., pp. 77–78, 237–238, 310.

'53. Rare Irish Mollusca, &c. Ann. & Mag. Nat. Hist. (2), xii., pp. 366–367.

'53A. Catalogue of Marine Mollusca inhabiting the Dublin coast. Newmann, Zoologist, xi., pp. 4101–4106.

WARBURTON, J., WHITELAW, Rev. J., and WALSH, Rev. R.:

'18. History of the City of Dublin. Vol. ii. Appendix No. xiv. Conchology of Dublin Bay and its vicinity. London.

WARREN, Miss AMY:

• '92. Contributions towards a list of the Marine Mollusca of Killala Bay, Ireland. Journ. of Conch., vii., pp. 98–107.

'92A. Rare Molluscs from Co. Sligo. Irish Naturalist, i., pp. 170–171.

'93. *Trochus duminyi* and *Odostomia delicata* on the Irish Coast. Irish Naturalist, ii., pp. 252–253.

'95. *Donax vittatus*, var. *truncatus* (Marshall, MS.). Irish Naturalist, iv., p. 18.

'95A. *Lepton Sykesii*, Chaster, in Killala Bay. Irish Naturalist, iv., p. 348.

'96. *Spirialis retroversus* in Killala Bay. Irish Naturalist, v., p. 248.

WELCH, R.:

'96. Marine Mollusca of Co. Galway. Irish Naturalist, v., p. 274.

WILSON, A. G.:

'96. *Littorina obtusata* at Bunowen, Connemara. Irish Naturalist, v., p. 248.

WRIGHT, E. P.:

'55. Catalogue of British Mollusca. [Irish species marked.] Nat. Hist. Rev., ii. (*Proc.*), pp. 69–85.

'59. Notes on the Irish Nudibranchiata. Nat. Hist. Rev., vi. (*Proc.*), pp. 86–88.

WRIGHT, E. P. and GREENE, J. R.:

'59. Report on the Marine Fauna of the South and West Coasts of Ireland. Rep. Brit. Ass. for 1858, pp. 176–181.

WRIGHT, S.:
'54. Rare Irish Mollusca. Ann. & Mag. Nat. Hist. (2), xiv., p. 397.
WRIGHT, S. and CARROLL, J.:
'52. Mollusca dredged in Cork Harbour. Ann. & Mag. Nat. Hist. (2), ix., p. 157.

Class.—CEPHALOPODA.

Order.—DIBRANCHIATA.

Family.—OCTOPODIDÆ.

Octopus vulgaris, Lamarck.

. ii., . . [v.], .

Not uncommon (Templeton MSS., fide Thompson, '56); probably *Eledone cirrosa.*

ii. Occasionally, but very rarely, taken off the Dublin coasts in the seine nets (Mackintosh, '84): a specimen labelled "Dublin Bay" is in the Museum of Trinity College, Dublin (Haddon, '86): Bray (A. Macalister, f. Adams, '78).

v. R. D. S. Fish. Survey, 1890, off Achill Head, 220 fms. (Holt, '92).

It is probable that *Eledone cirrosa* has often been mistaken for this species.

Distribution.—Almost cosmopolitan (Hoyle).

[*Octopus arcticus*, Prosch.]

. . . . iv., . .

iv. Two fine females were trawled by H. M. S. "Research" off S.W. Ireland in 1889 (Norman, '90A); depth not stated, but probably more than 100 fms.

Distribution.—Norway. Faroes. S. W. Ireland. ? Greenland. N. E. America.

Eledone cirrosa (Lamarck).

i., ii., iii., iv., v., vi.

i. Lough Foyle and Carnlough (Ordnance Survey, f. Thompson, '56): entrance to Belfast Lough, in a dead univalve shell from 20 fms. (Hyndman and Getty, f. Thompson, '56): Belfast Lough, not unfrequent (Thompson, '56): off Copelands, 15 fms. (Hyndman, '59).

ii. Generally distributed.
iii. Youghal (Ball, '42 ; Ball, f. Thompson, '56).
iv. Generally distributed.
v. R. D. S. Fish. Survey, 1890, 1891, in ling taken on long lines off Loop Head and Slyne Head (Holt, '92): Clew Bay (Dublin Mus.): Westport (Miss M. Ball, f. Thompson, '56).
vi. R. D. S. Fish. Survey, 1891, in ling taken off Tory Island (Holt, '92).

Distribution.—Norway and Faroes to Mediterranean.

Family.—SPIRULIDÆ.

Spirula Peronii, Lamarck.

i., . iii., iv., v., vi.

i. Magilligan (Hyndman, f. Thompson, '56): Portrush (Templeton MSS., f. Thompson, '56; Dublin Mus., coll. by R. Welch): Port Ballintrae (Tomlin, '95): Whitehouse, Belfast Lough (Templeton MSS., f. Thompson, '56).
iii. Youghal (Ball, f. Thompson, '56).
iv. Coast of Kerry (O'Kelly, f. Turton, '19).
v. Clare (Harvey, f. Thompson, '56): Kilkee (Hopkins, '55).
vi. Killala (Glennon, f. Warren in Seventh Annual Report, Dublin Nat. Hist. Soc., 1845): Maghery Strand, Donegal (Cockerell, '87): Donegal coast (Darbishire in Journ. of Conch., vii., 1894): Lough Swilly (Hart, '92A).

Distribution.—Living: West Indies, S. E. Asia, and Australia (Hoyle).

Family.—SEPIIDÆ.

Sepia officinalis, Linné.

i., ii., iii., . v., .

i. Bones washed ashore at Larne (Ord. Surv. Notices, f. Thompson, '56): Carrickfergus (M'Skimin in "History . . . Carrickfergus," Ed. II., 1823): Queen's Bridge, Belfast (Thompson, '56).
ii. Dundrum, county Down (Thompson, '56): Dublin coast (Ball, '42; Baily, '65; Dublin Mus.): off Wicklow (Dublin Mus.).
iii. South of Ireland (Thompson, '44).
v. R. D. S. Fish. Survey, 1890, off Blacksod Bay, a young specimen (A. R. N.).

Distribution.—Scandinavia to Mediterranean. West Africa. Madeira (Watson).

Sepia rupellaria, d'Orbigny. (*S. biserialis*, Jeffreys, Brit. Conch.)

i., ...

i. Magilligan, three specimens of the dorsal plate (Hyndman, f. Ball, '41).

Distribution.—British Isles to Mediterranean.

Family.—SEPIOLIDÆ.

Sepiola scandica, Steenstrup. (*S. Rondeleti*, Jeffreys, B. C.)

i., ii., iii., iv., . .

i. Bangor, Belfast Lough (Drummond, f. Forbes, '53).

ii. Dundrum, Newcastle, co. Down (Thompson, '56): Dublin Bay (Ball, '42; Dublin Mus.): Greystones (A. Macalister, f. Adams, '78).

iii. Youghal (Ball, '42).

iv. Dingle Bay, 28 fms., extremely rare (W. Andrews in Journ. Roy. Dub. Soc., v., 1870).

Distribution.—Norway and Faroes to English Channel.

Sepiola atlantica, d'Orbigny.

i., ii., . iv., v., .

i. Lough Foyle (Ordnance Survey Coll. in Dublin Mus.): Bangor, Belfast Lough (Drummond, f. Forbes, '53).

ii. Dublin Bay (Dublin Mus.).

iv. Bantry Bay (Norman, '90): Dingle Harbour (W. Andrews in Journ. Roy. Dub. Soc., v., 1870).

v. Kilkieran, Galway (Dublin Mus., a specimen collected by A. G. More).

Distribution.—Norway and Faroes to English Channel. ? Mediterranean.

Rossia macrosoma (delle Chiaje).

i., ii., ...

i. Belfast Lough (Grainger, f. Thompson, '56, sub *R. Jacobi*).

ii. Dublin Bay (Jacob, f. Ball, '42, sub *R. Jacobi*; Kinahan, '61).

Distribution.—Norway to Mediterranean.

Rossia Oweni, Ball.

. ii., iii., [iv.], . .

ii. Dublin Bay (Ball, '42; A. Macalister, f. Adams, '78): "Porcupine" Exp., 1869, off Wexford (Hoyle, '86).

iii. R. I. A. Exp., 1886, off Galley Head, 43 fms. (Dublin Mus., determined by W. E. Hoyle).

iv. "Flying Fox" Exp., 1889, 150–200 fms. (Smith, '89).

Distribution.—Sweden. Kattegat. British Isles.

It is doubtful if this species is distinct from *R. macrosoma*.

[*Rossia sublevis*, Verrill.]

. . . iv., . .

iv. "Flying Fox" Exp., 1889, 250 fms. (Smith, '89).

Distribution.—S. W. Ireland. N. E. America. Patagonia (Hoyle).

Norman considers this species identical with *R. glaucopis*, Lovén of N. Europe.

Family.—Loliginidæ.

Loligo Forbesii, Steenstrup. (*L. vulgaris*, Jeffreys, B. C.)

i., ii., . iv., v., .

i. Coast of Londonderry (Ordnance Survey, f. Thompson, '56).

ii. Generally distributed.

iv. Off Tearaght (W. Andrews in Journ. Roy. Dub. Soc., iii., 1862): Bantry Bay and Kenmare River (Dublin Mus.): R. D. S. Fish. Survey, 1891, Ballinskelligs Bay (Holt, '92).

v. Kilrush, co. Clare (Dublin Mus.): R. D. S. Fish. Survey, 1891, off Inishbofin (Holt, '92).

Distribution.—Norway to Mediterranean.

Loligo Marmoræ, Verany.

. . iii., . . .

iii. Off Youghal (Ball, f. Forbes & Hanley, '53).

Distribution.—S. Ireland. Mediterranean.

This species may possibly prove to be identical with *L. media*.

Loligo media (Linné).

i., ii., iii., iv., . vi.

i. North coast of Ireland (Ordnance Survey Coll. in Dublin Mus.): Strangford (Templeton mss., f. Thompson, '56).

ii. Coast of Down (Thompson, '56): Howth (A. R. N.): Dublin Bay (Templeton MSS., f. Thompson, '56): Bray (Ball, '42).

iii. Youghal (Ball, '42).

iv. Bantry Bay (Dublin Mus.): R. I. A. Exp., 1885, mouth of Bantry Bay, 35 fms., and Ballinskelligs Bay (Swanston, 86): R. D. S. Fish. Survey, 1890, 1891, Kenmare River, 20 fms., and Dingle Bay, 40 fms. (Holt, '92).

vi. R. D. S. Fish. Survey, 1890, 1891, Donegal Bay, &c. (Holt, '92).

Distribution.—Norway to Mediterranean.

Family.—OMMASTREPHIDÆ.

Todaropsis Eblanæ (Ball). (*Loligo Eblanæ*, Jeffreys, B. C.)

i., ii., ...

i. N. E. Ireland (Ordnance Survey Coll. in Dublin Mus.): Carrickfergus, Holywood, and Bangor (Thompson, '56): Lough Strangford (Jeffreys, '69).

ii. Dublin Bay (T. W. Warren, f. Ball, '41; Ball, '42; Dublin Mus., a specimen determined by W. E. Hoyle).

Distribution.—North Sea, British Isles, Mediterranean (Hoyle).

Todarodes sagittatus (Lamarck). (*Ommatostrephes todarus*, Jeffreys, B. C.)

. . iii., . . .

iii. Youghal (Ball, f. Jeffreys, '69): Glandore Bay (Allman, f. Thompson, '56).

Distribution.—Iceland. Finmark to Mediterranean.

Architeuthus monachus, Steenstrup.

. . . iv., v., .

iv. Dingle, Kerry, a specimen cast ashore 200 years ago (More, '75, sub *Dinoteuthis proboscideus*); Verrill considers this specimen to have been *Architeuthis monachus.*

v. Off Inishbofin, Connemara, 1875, a specimen (More, '75A, sub *Architeuthis dux*).

Distribution.—Atlantic Ocean.

Class.—**AMPHINEURA.**

Order.—APLACOPHORA.

Family.—NEOMENIIDÆ.

Neomenia carinata, Tullberg.

. . iii., . . .

iii. R. I. A. Exp., 1886, Nymph Bank, 52½ fms., a single young specimen (Haddon, '88): R. D. S. Fish. Survey, 1890, Nymph Bank, 41 fms., a single young specimen. These specimens have been microscopically determined by Professor Thiele of Göttingen.

Distribution.—Scandinavia. Scotland. S. Ireland.

Order.—POLYPLACOPHORA.

Family.—CHITONIDÆ.

Acanthochites fascicularis (Linné). (*Chiton fascicularis*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Generally distributed. Var. *gracilis*, Jeffreys. Lough Strangford (Adair, f. Jeffreys, '65).

ii. Carlingford Lough (Thompson MS.; E. Waller's Coll. in Dublin Mus.): Dublin coast, generally distributed: Bray (T. W. Warren's Coll. in Dublin Mus.): Greystones (Adams, '78).

iii. Youghal (Miss M. Ball, f. Thompson MS.): Cork Harbour (Humphreys, '45): Courtmacsherry (Allman, f. Thompson MS.).

iv. Off Schull (A. R. N.): Bantry (Ball, f. Thompson MS.).

v. Generally distributed.

vi. Mulroy Lake, co. Donegal (Hart, '92).

Distribution. — Finmark to Mediterranean. Canaries. W. of Sahara, "Talisman" (Locard).

Hanleya mendicaria (Mighels). (*Chiton Hanleyi*, Jeffreys, B. C.)

i., . . [iv.], v., .

i. North of the Maidens (Waller Coll. in Dublin Mus.): off Belfast Lough, 80 fms., living (Hyndman, '60).

iv. "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '82).

v. Off Aran Islands, co. Galway (Barlee, f. Thompson, '56).

Distribution.—Loffoden I. to Mediterranean. N. E. America. Caribbean Sea.

Lepidopleurus cancellatus (G. B. Sowerby, jun.). (*Chiton cancellatus*, Jeffreys, B. C.)

i., ii., : ? iv., v., .

i. N. E. coast (Hyndman and Thompson, f. Thompson, '56): off Larne, 18 fms. (Jeffreys, '59): off Maidens, 70–90 fms., living (Hyndman, '59): between Maidens and Isle of Muck, 20 fms., living (Hyndman, '59): Belfast Lough, living (Hyndman, '58, '60): Strangford Lough (Hyndman, f. Thompson MS.).

ii. Newcastle, co. Down (Hyndman, f. Thompson MS.).

iv. ? Dingle Bay (Leach, '52, sub *Chiton tuberculatus*).

v. West of Ireland (Jeffreys, '65): Roundstone (Alcock, '65).

Distribution.—Finmark to Mediterranean. New England.

Lepidopleurus onyx (Spengler). (*Chiton cinereus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Generally distributed.

ii. Newcastle, co. Down (Thompson MS.): Dublin coast, generally distributed: Greystones (Mackintosh, '84).

iii. Youghal (Leach, '52): R. I. A. Exp., 1885, off Galley Head, 54 fms. (Chaster, '98).

iv. Bantry Bay (Leach, '52; Dublin Mus.): Dingle Bay (Leach, '52): "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '82): R. I. A. Exp., 1885, 1886, 5–108 fms. (Swanston, '86, A. R. N.).

v. Birterbuy Bay, living (Walpole, '52): Killary and Clew Bays (Thompson MS.): off Achill (Dublin Mus.).

vi. Ards, Drimnacraig, &c., co. Donegal (Hart, '92).

Distribution.—Iceland. Finmark to Spain.

Trachydermon albus (Linné). (*Chiton albus*, Jeffreys, B. C.)

i., ...

i. North of Ireland (Thompson, '56): Belfast Lough, living (Hyndman, '58; Belfast Mus., f. Praeger, '89): Strangford Lough (Stewart, f. Praeger, '89).

Distribution. — Arctic seas to British Isles. Greenland. N. E. America. N. W. America.

Trachydermon cinereus (Linné). (*Chiton marginatus*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Common all round the coast, under stones, &c.

Distribution.—Iceland. Loffoden I. to Mediterranean. Mogador. S. Africa. Greenland. N. E. America. N. W. America.

Callochiton lævis (Montagu). (*Chiton lævis*, Jeffreys, B. C.)

i., ii., iii., . v., .

i. Belfast Lough (Hyndman, '58; Belfast Mus., f. Praeger, '89): Donaghadee (Drummond, f. Thompson MS.): Strangford Lough (Brown, '44; 7–20 fms., living, very rare, Dickie, '58).
ii. Portmarnock (W., W., & W., '18): Dublin Bay (Turton, '19): Dalkey Sound, rare (Walpole, '53A).
iii. Youghal (Miss M. Ball, f. Thompson MS.): Baltimore, living (A. R. N.).
v. Lahinch (Thompson MS.): Birterbuy Bay, living (Walpole, '52): Clew Bay (Thompson MS.).

Distribution.—Finmark to Mediterranean.

Tonicella rubra (Linné). (*Chiton ruber*, Jeffreys, B. C.)

i., ii., iii., iv., . .

i. Generally distributed.
ii. Newcastle, co. Down (Hyndman, f. Thompson MS.): Carlingford (Thompson MS.; Waller Coll. in Dublin Mus.): Lambay Island (Thompson MS.): Dublin Bay (Ball, f. Thompson MS.): Dalkey Sound and Killiney, rare (Walpole, '53A).
iii. Youghal (Ball, f. Thompson MS.).
iv. Bantry (Ball, f. Thompson MS.): R. I. A. Exp., 1885, Berehaven, 5–25 fms., rare (Swanston, '86).

Distribution.—Iceland. Finmark to English Channel. Greenland. N. E. America. N. W. America. Gulf of Tartary.

Tonicella marmorea (Fabricius). (*Chiton marmoreus*, Jeffreys, B. C.)

i., ii., ...

i. On oysters from Greencastle, Londonderry (Thompson, '56): Belfast Lough, living (Hyndman, '58): Groomsport (Thompson MS.): Bangor (Patterson, f. Thompson, '56): Donaghadee (Drummond, f. Thompson MS.): Strangford Lough (Hyndman and Thompson, f. Thompson, '56; Stewart, f. Praeger, '89).
ii On oysters from Carlingford (Thompson, '56): ? Salthill, Dublin Bay (Walpole, '53A): Dublin Bay, rare (Kinahan, '61).

Distribution.—Spitzbergen. Iceland. Finmark to British Isles. N.E. America. Mexico.

Class.—GASTEROPODA.

Order.—PROSOBRANCHIATA.

Family.—ACMÆIDÆ.

Acmæa testudinalis (Müller). (*Tectura testudinalis*, Jeffreys, B.C.)

i., ii., . . . vi.

i. Generally distributed.
ii. Newcastle dead, Bloody Bridge living, and Glassdrummond (Thompson, '56): Dublin coast (Hassall, '42; &c.): Greystones (Adams, '78): east coast of Ireland (Thompson, '56).
vi. Mweelfinn, Sheephaven, rare (Hart, '92).

Distribution.—Arctic seas to British Isles. Greenland. N. E. America. N. W. America. Mexico and N. E. Asia (Jeffreys).

Acmæa virginea (Müller). (*Tectura virginea*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Generally distributed round the coast.
Distribution.—Iceland to St. Helena. Mediterranean.

Family.—LEPETIDÆ.

Pilidium fulvum (Müller). (*Tectura fulva*, Jeffreys, B.C.)

i., . iii., iv., [v.], .

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead, rare (Dickie, f. Hyndman, '58).
iii. On a stone dredged in deep water at Youghal (Miss M. Ball, f. Thompson, '56): coast of Cork on *Pinna* (Humphreys, f. Forbes & Hanley, '53): R. I. A. Exp. 1885, off S. coast of Cork, 39½–52½ fms. (Chaster, '98).
iv. Off Cape Clear and Mizen Head, 50–60 fms. (M'Andrew, f. Forbes & Hanley, '53): "Porcupine" Exp. 1869, 85–110 fms. (Jeffreys, '82): R. I. A. Exp., 1885, 1886, 5–79 fms. (Swanston, '86, Chaster, '98, A. R. N.)
v. West of Ireland, 100 fms. (King, '62): "Porcupine" Exp. 1869, 165 fms. (Jeffreys, '82).

Distribution.—Arctic and northern seas of Europe and Eastern America. Azores, "Challenger." Off Tripoli, "Shearwater."

Propilidium ancyloïde (Forbes).

i., . . iv., v., .

i. Off Ballycastle, living (Chaster '97A): off Maidens, 70–100 fms., living (Hyndman, '58, '59): Turbot Bank, frequent, dead (Hyndman, '58, '59): off Black Head, 25 fms. (Hyndman, '58): Antrim coast, 18–100 fms. (Hyndman, &c., f. Jeffreys, '65): Strangford Lough, on oysters (Hyndman, f. Thompson, '56).

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '82): R. I. A. Exp., 1885, 1886, 5–44 fms. (Chaster, '98).

v. Coast of Galway, not uncommon on stones and among nullipores (Barlee, f. Jeffreys, '65): "Porcupine" Exp., 1869, 173–208 fms. (Jeffreys, '82).

Distribution.—Iceland. Loffoden I. to Mediterranean. Canaries, "Talisman" (Locard). Davis St., "Valorous."

Family.—PATELLIDÆ.

Patella vulgata, Linné.

i., ii., iii., iv., v., vi.

On rocks, &c., between tide-marks, everywhere round the coast.

Var. *intermedia*, Jeffreys. Cork (Humphreys, f. Jeffreys, '65).

Var. *depressa*, Pennant. Magilligan, occasional (Miss Galwey, '88): Bangor (Belfast Mus., f. Praeger, '89): coast of Down, living (Hyndman, '60): Dublin coast, generally distributed: Greystones (Adams, '78): Sherkin Island, co. Cork (A. R. N.): Roundstone (Alcock, '65): Melmore, Mulroy, co. Donegal (Hart, '92).

Distribution.—Norway to C. Verd I. ? Mediterranean.

Helcion pellucidum (Linné).

i., ii., iii, iv., v., vi.

Generally distributed on Laminariæ round the coast, and apparently also var. *lævis*, Pennant.

Distribution.—Iceland. Finmark to Mediterranean.

Family.—FISSURELLIDÆ.

Fissurella græca (Linné).

i., ii., iii., iv., v., vi.

Generally distributed round the coast, but sparingly.

Distribution.—Shetland to Mediterranean. Madeira. Canaries.

Puncturella Noachina (Linné).

i., . . iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): "Porcupine" Exp., 1869, North Channel, 40 fms. (Jeffreys, '82): mouth of Belfast Lough, 27 fms., one dead specimen (Hyndman, f. Thompson, '56): Turbot Bank (Hyndman, '58, '59; Waller, f. Jeffreys, '58): co. Antrim (Jeffreys, '65).

iv. "Porcupine" Exp., 1869, 90 fms. (Jeffreys, '82).

v. Roundstone (Alcock, '65): "Porcupine" Exp., 1869, 165–208 fms. (Jeffreys, '82): "Argo" cruise, 1890, west of Ireland (Herdman, '91). Var. *princeps*, Mighels & Adams, and var. *levior*, Jeffreys. "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '82).

Distribution.—Arctic seas to Portugal and New England. N. E. Asia. Off Marion I., &c., "Challenger."

Emarginula fissura (Linné).

i., ii., iii., iv., v., vi.

Generally distributed round the coast.

Var. *elata*, Jeffreys. Larne (Jeffreys, '65).

Distribution.—Finmark to Mediterranean. Canaries.

Emarginula rosea, Bell.

i., ... vi.

i. Turbot Bank, dead (Waller, f. Hyndman, '59).

vi. Carrahubbuck, Killala Bay (Marshall, f. Miss A. Warren, '92).

Distribution.—S. England. Ireland to Mediterranean.

Emarginula crassa, J. Sowerby.

i., ii., . iv., . .

i. Off the Maidens, 70–100 fms., dead (Hyndman, '58, '59): off the Maidens, living (Swanston, f. Praeger, '89): off Whitehead, 60 fms., one small living specimen and a few large dead specimens (Waller and Hyndman, f. Hyndman, '59): mouth of Belfast Lough, 20 fms., dead (Hyndman and Getty, f. Thompson, '56): Turbot Bank, dead (Hyndman, '58): off the Copelands, 60 fms., living, very rare (Hyndman, '58).

ii. Kish Bank, off Dublin coast (Thompson, '56): Dublin coast, common (Adair, f. Adams, '78); probably *E. fissura*.

iv. "Porcupine" Exp., 1869, 90 fms. (Jeffreys, '82): R. I.A. Exp., 1885, Berehaven, 5–25 fms., and mouth of Kenmare River, 38–48 fms. (Swanston, '86).

Distribution.—Loffoden I. to British Isles. Off Corunna, "Princesse-Alice."

Family.—HALIOTIDÆ.

? *Haliotis tuberculata*, Linné.

i., ii., ...

i. Dredged near Groomsport, co. Down, October, 1811 (Templeton MSS., f. Thompson, '56).

ii. Bullock, co. Dublin (Turton, '19).

If these records are correct, the specimens were probably accidentally introduced.

Distribution.—Channel Isles to Azores. Canaries. ? Mediterranean.

Family.—PLEUROTOMARIIDÆ.

Scissurella crispata, Fleming.

i., . . . [v.], .

i. Off Ballycastle, dead (Chaster, '97A): off the Maidens, 80 fms., a fresh specimen (Hyndman, '60): mouth of Belfast Lough, 27 fms., two dead specimens (Hyndman, f. Thompson, '56): Turbot Bank, dead, very rare (Hyndman, '58).

v. West of Ireland, 100 fms. (King, '62): "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '83).

Distribution.—Spitzbergen. Finmark to Mediterranean. Azores. Between Marion I. and Prince Edward I., "Challenger." Greenland to Georgia. Off West Indies, "Challenger."

Family.—CYCLOSTREMATIDÆ.

Cyclostrema serpuloïdes (Montagu).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): off Larne, living (Hyndman, '60): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59): Strangford Lough (Dublin Mus.).

ii. Howth (Hart, '92): Dublin Bay (Turton, '19; Waller, f. Kinahan, '61).

iii. Cork (Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, off Galley Head, 54 fms., rare (Chaster, '98).

iv. R. I. A. Exp., 1885, 1886, 5–40 fms., rare (Chaster, '98).

v. Aran I. and Birterbuy Bay (Barlee, f. Forbes & Hanley, '53): between Bunowen and Slyne Head (Welch, '96): Dog's Bay, Connemara, fry very common (Marshall, '99).
vi. Bundoran (Waller Coll. in Dublin Mus.).
Distribution.—Norway to Mediterranean.

Cyclostrema nitens (Philippi).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): north of Ireland (Jeffreys, '65): off the Maidens (Waller Coll. in Dublin Mus.): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59): Strangford Lough (Waller Coll. in Dublin Mus.).
ii. Dublin Bay (Waller, f. Kinahan, '61): east of Ireland (Jeffreys, '65).
iii. South of Ireland (Jeffreys, '65): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–54fms. (Chaster, '98).
iv. R. I. A. Exp., 1885, 1886, Ballinskelligs Bay, and 5–40 fms. (Chaster, '98).
v. West of Ireland (Jeffreys, '65): Roundstone (D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96).
vi. Killala Bay, rare (Miss A. Warren, '92): Narin Strand, co. Donegal (G. P. Farran): Mulroy Bay, dead (Praeger, '94).
Distribution.—Shetland to Mediterranean.

[*Cyclostrema tenerum*, Jeffreys.]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms., a single, but living specimen (Jeffreys, '83).
Distribution.—West of Ireland. Deep water.

Family.—TROCHIDÆ.

Trochocochlea lineata (Da Costa). (*Trochus lineatus*, Jeffreys, B. C.)

. ii., iii, iv., v., vi.

Not found on the E. coast of Ireland further north than Ballywalter, co. Down (Thompson, '56): W. coast as far north as Donegal Bay (Jeffreys, '65; &c.): Narin, co. Donegal (Mrs. Tatlow, '99). It appears to be very rare on the E. coast; and locally distributed, but not uncommon on rocks, stones, &c., between tide-marks on the S. and W. coasts.

Var. *minor*, Jeffreys. Aran I., co. Galway (Jeffreys, '65).

Distribution.—S. England, Wales, and Ireland to Mediterranean. Mogador.

Gibbula magus (Linné). (*Trochus magus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed in the littoral and laminarian zones.

Distribution.—Sweden and Shetland to Mediterranean. Azores. Madeira. Canaries. Senegal. C. Verd I.

Gibbula cineraria (Linné). (*Trochus cinerarius*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Common everywhere on stones, &c., in the littoral and laminarian zones.

Distribution.—Iceland. Finmark to Mediterranean.

Gibbula tumida (Montagu). (*Trochus tumidus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed in the laminarian zone and deeper water.

Distribution.—Finmark to Mediterranean.

Gibbula umbilicata (Montagu). (*Trochus umbilicatus*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Very common on rocks, sea-weeds, &c., between tide-marks.

Distribution.—Hebrides to Mediterranean.

Circulus striatus (Philippi). (*Trochus Duminyi*, Jeffreys, B. C.)

i., ... vi.

i. Portrush, one specimen (Marshall, f. Miss A. Warren, '93).

vi. Bartra, Killala Bay, one imperfect specimen (Miss A. Warren, '92): Bundoran (Waller and Jeffreys, f. Jeffreys, '65; Miss A. Warren, '93): "Porcupine" Exp., 1869, Donegal Bay, 25–40 fms. (Jeffreys, '83).

Distribution.—Ireland to Mediterranean. Morocco.

Margarita helicina (Fabricius). (*Trochus helicinus*, Jeffreys, B.C.)

i., ii., . iv., v., .

i. Portrush (Marshall, '98): off Ballycastle, dead (Chaster, '97A): Larne (Thompson, '56): Belfast Lough (Thompson, '56; living, common, Hyndman, '58): Turbot Bank, dead (Hyndman, '58): Groomsport (Marshall, '98; Waller Coll. in Dublin Mus.): Strangford Lough (Thompson, '56): Newtownards, Strangford Lough, living (Praeger). Var. *fasciata*, Jeffreys. North of Ireland (Hyndman, f. Jeffreys, '65): Portrush (Marshall, '98).

ii. Portmarnock (Warren, f. Thompson, '56; Adams, '78): Dublin Bay (Kinahan, '61).
iv. Kenmare River (Praeger, '99).
v. Connemara (Farran, f. Jeffreys, '65): Roundstone (Standen, '95).
Distribution.—Arctic seas to British Isles. Greenland. N. E. America. N. W. America. N. E. Asia.

Margarita grœnlandica (Chemnitz). (*Trochus grœnlandicus*, Jeffreys, B. C.)

i., ...

i. "Porcupine" Exp., 1869, North Channel, 40 fms. (Jeffreys, '83): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59); these specimens were suspiciously like fossils from a submarine post-tertiary deposit in that locality (Jeffreys, '65).
Distribution.—Arctic and northern seas in both hemispheres to N. Ireland and Labrador.

Margarita cinerea (Couthouy). (*Trochus cinereus*, Jeffreys, B. C.)

i., . . . [v.], .

i. In shell-sand from the Turbot Bank, apparently recent (Waller and Jeffreys, f. Jeffreys, '59); regarded as submarine fossils (Jeffreys, '65).
v. "Porcupine" Exp., 1869, 173 fms., a young and dead specimen, but apparently recent (Jeffreys, '83).
Distribution.—Arctic seas in both hemispheres.

[*Solariella cincta* (Philippi). (*Trochus amabilis*, Jeffreys, B.C.)]

. . . iv., v., .

iv. "Porcupine" Exp. 1869, 370–722 fms. (Jeffreys, '83).
v. "Porcupine" Exp. 1869, 173–422 fms. (Jeffreys, '83).
Distribution.—Shetland to Azores. Florida and West Indies (Dall).

Calliostoma Montagui (W. Wood). (*Trochus Montacuti*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Sparingly but widely distributed on the Antrim and Down shores (Praeger, '89). Monstr. scalariform. Larne (Waller and Jeffreys, f. Jeffreys, '65).
ii. Generally distributed on the Dublin coast, but rare.

Gibbula magus (Linné). (*Trochus magus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed in the littoral and laminarian zones.

Distribution.—Sweden and Shetland to Mediterranean. Azores. Madeira. Canaries. Senegal. C. Verd I.

Gibbula cineraria (Linné). (*Trochus cinerarius*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Common everywhere on stones, &c., in the littoral and laminarian zones.

Distribution.—Iceland. Finmark to Mediterranean.

Gibbula tumida (Montagu). (*Trochus tumidus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed in the laminarian zone and deeper water.

Distribution.—Finmark to Mediterranean.

Gibbula umbilicata (Montagu). (*Trochus umbilicatus*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Very common on rocks, sea-weeds, &c., between tide-marks.

Distribution.—Hebrides to Mediterranean.

Circulus striatus (Philippi). (*Trochus Duminyi*, Jeffreys, B. C.)

i., ... vi.

i. Portrush, one specimen (Marshall, f. Miss A. Warren, '93).

vi. Bartra, Killala Bay, one imperfect specimen (Miss A. Warren, '92): Bundoran (Waller and Jeffreys, f. Jeffreys, '65; Miss A. Warren, '93): "Porcupine" Exp., 1869, Donegal Bay, 25–40 fms. (Jeffreys, '83).

Distribution.—Ireland to Mediterranean. Morocco.

Margarita helicina (Fabricius). (*Trochus helicinus*, Jeffreys, B.C.)

i., ii., . iv., v., .

i. Portrush (Marshall, '98): off Ballycastle, dead (Chaster, '97A): Larne (Thompson, '56): Belfast Lough (Thompson, '56; living, common, Hyndman, '58): Turbot Bank, dead (Hyndman, '58): Groomsport (Marshall, '98; Waller Coll. in Dublin Mus.): Strangford Lough (Thompson, '56): Newtownards, Strangford Lough, living (Praeger). Var. *fasciata*, Jeffreys. North of Ireland (Hyndman, f. Jeffreys, '65): Portrush (Marshall, '98).

ii. Portmarnock (Warren, f. Thompson, '56; Adams, '78): Dublin Bay (Kinahan, '61).
iv. Kenmare River (Praeger, '99).
v. Connemara (Farran, f. Jeffreys, '65): Roundstone (Standen, '95).

Distribution.—Arctic seas to British Isles. Greenland. N. E. America. N. W. America. N. E. Asia.

Margarita grœnlandica (Chemnitz). (*Trochus grœnlandicus*, Jeffreys, B. C.)

i., ...

i. "Porcupine" Exp., 1869, North Channel, 40 fms. (Jeffreys, '83): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59); these specimens were suspiciously like fossils from a submarine post-tertiary deposit in that locality (Jeffreys, '65).

Distribution.—Arctic and northern seas in both hemispheres to N. Ireland and Labrador.

Margarita cinerea (Couthouy). (*Trochus cinereus*, Jeffreys, B. C.)

i., . . . [v.], .

i. In shell-sand from the Turbot Bank, apparently recent (Waller and Jeffreys, f. Jeffreys, '59); regarded as submarine fossils (Jeffreys, '65).
v. "Porcupine" Exp., 1869, 173 fms., a young and dead specimen, but apparently recent (Jeffreys, '83).

Distribution.—Arctic seas in both hemispheres.

[*Solariella cincta* (Philippi). (*Trochus amabilis*, Jeffreys, B.C.)]

. . . iv., v., .

iv. "Porcupine" Exp. 1869, 370–722 fms. (Jeffreys, '83).
v. "Porcupine" Exp. 1869, 173–422 fms. (Jeffreys, '83).

Distribution.—Shetland to Azores. Florida and West Indies (Dall).

Calliostoma Montagui (W. Wood). (*Trochus Montacuti*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Sparingly but widely distributed on the Antrim and Down shores (Praeger, '89). Monstr. scalariform. Larne (Waller and Jeffreys, f. Jeffreys, '65).
ii. Generally distributed on the Dublin coast, but rare.

iii. Off Saltee I., co. Wexford (Walpole, '52): off Bonmahon, co. Waterford, in *Adamsia maculata* (Farran in Proc. Dub. Univ. Zool. and Bot. Ass., ii., 1860): off Cape Clear, 60 fms. (M'Andrew, f. Forbes & Hanley, '53): R.I.A. Exp., 1885, 1886, off S. coast of Cork, 52½–55½ fms. (Chaster, '98).

iv. Bantry Bay, 10 fms. (M'Andrew, f. Forbes & Hanley, '53): Dingle Bay, 54 fms. (Adams, f. More, '70): "Porcupine" Exp., 1869, 90 fms. (Jeffreys, '83): R. I. A. Exp., 1885, 5–48 fms. (Chaster, '98).

v. R. D. S. Fish. Survey, 1890, Kilkieran Bay and Birterbuy Bay (Jordan): Birterbuy Bay, living (Walpole, '52): Roundstone (Alcock, '65; D'Arcy W. Thompson).

vi. Killala Bay (Miss A. Warren, '92).

Distribution.—Hebrides to Mediterranean. Canaries.

Calliostoma striatum (Linné). (*Trochus striatus*, Jeffreys, B.C.)

i., ii., iii., iv., . .

i. Turbot Bank sand, dead (Jeffreys, f. Hyndman, '60; Belfast Mus., f. Praeger, '89); this locality is not given in Jeffreys, '65.

ii. Dublin Bay (Turton, '19).

iii. Cork (Humphreys, f. Thompson, '56; Jeffreys, '65): Baltimore (6 fms., Allman, f. Thompson, '56; Jeffreys, '65).

iv. Bantry Bay (Humphreys, f. Thompson, '56; Jeffreys, '65; Dublin Mus.)

Distribution.—S. England and Ireland to Mediterranean. Azores. Madeira. Canaries.

Calliostoma exasperatum (Pennant). (*Trochus exasperatus*, Jeffreys, B.C.)

i., ii., iii., iv., v., .

i. Turbot Bank, "Dr. Dickie, doubtful" (Hyndman, '58): north of Ireland (Thompson, f. Jeffreys, '65).

ii. Dublin Bay (Turton, '19; very rare, Walpole, '53A; Warren Coll. in Dublin Mus.): ? Wicklow Coast (Warren, f. Thompson, '56).

iii. Cork (Humphreys, f. Jeffreys, '65).

iv. Bantry Bay (Dillwyn, f. Jeffreys, '65).

v. Roundstone (Standen, '95).

The Irish localities are considered doubtful (Jeffreys, '65, '83).

Distribution.—S. England and Ireland to Mediterranean. Azores. Morocco. Madeira. Canaries.

Calliostoma miliare (Brocchi). (*Trochus millegranus*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Glenarm (Stewart, f. Praeger, '89): Belfast Lough (Thompson, '56): Belfast Lough and off Maidens, &c., 10–100 fms., living (Hyndman, '58, '59): Strangford Lough (Thompson, '56; living, Dickie, '58).

ii. Near Dublin (Alder, f. Brown, '44): Dublin Bay (Kinahan, '61; Dublin Mus.): Dalkey Sound (Ball, f. Thompson, '56).

iii. Glandore, co. Cork (Allman, f. Thompson, '56): R. I. A. Exp. 1885, 1888, off Galley Head, 54 fms. and off Glandore, 53 fms. (Chaster, '98, A.R.N.).

iv. Bantry Bay (Humphreys, f. Thompson, '56): "Porcupine" Exp., 1869, 85–180 fms. (Jeffreys, '83): R. I. A. Exp., 1885, 1886, 4–48 fms. (Swanston, '86, Chaster, '98).

v. West of Ireland, 340 fms. (King, '62): Galway and Killary Bays (Thompson, '56): "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '83).

vi. Bundoran (Mrs. Hancock, f. Thompson, '56).

Distribution.—Loffoden I. to Mediterranean. W. Africa.

Calliostoma granulatum (Born). (*Trochus granulatus*, Jeffreys, B.C.)

i., ii., iii., iv., . vi.

i. South-east of the Maidens, 72 fms., one living specimen and one dead (Swanston, f. Praeger, '89): off Black Head, 25 fms., fragments (Hyndman, '59): Belfast Lough, two broken specimens, "perhaps accidentally introduced" (Hyndman, '58).

ii. Dublin Bay (Brown, '18; &c.): off Bray (Brown, '18; Turton, '19; Walpole, '53A; Thompson, '56): Wicklow sand banks (Farran, f. Forbes & Hanley, '53).

iii. Youghal (Ball, f. Forbes & Hanley, '53): coast of Cork (Humphreys, f. Forbes & Hanley, '53): south of Ireland (Fleming in "History of British Animals," 1828; Jeffreys, '65).

iv. "Porcupine" Exp., 1869, 85–180 fms. (Jeffreys, '83).

vi. Kinnegar, Lough Swilly (Batt, f. Hart, '92).

Distribution.—Scotland to Mediterranean. Madeira. Canaries. W. Africa, "Talisman" (Locard).

Calliostoma zizyphinum (Linné). (*Trochus zizyphinus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Abundant everywhere, principally in the laminarian zone.

Var. *Lyonsii*, Leach. Off Larne, 20 fms., one living specimen, and off Black Head, 25 fms. (Hyndman, '59): Belfast Lough, sparingly (Hyndman and Thompson, f. Thompson, '56; Hyndman, '58): Helen's Bay, Belfast Lough (Welch): Strangford Lough, living (Hyndman and Thompson, f. Thompson, '56; Dickie, '58; Welch): Malahide (Lloyd, f. Adams, '78): Dalkey Sound (Walpole, '53A): Sherkin I., co. Cork (A. R. N.). Var. *humilior*, Jeffreys. Bantry Bay (Humphreys, f. Jeffreys, '65). Var. *elata*, Jeffreys. Coast of Antrim, deep water (Jeffreys, '65). Monstr. scalariform. Holywood, Belfast Lough (Miss Templeton, f. Brown, '18).

Distribution.—Finmark to Mediterranean. Azores. Mogador. Madeira. Canaries.

[*Calliostoma suturale* (Philippi).]

. . . iv., . .

iv. R. I. A. Exp. 1888, 345 fms., two specimens (A. R. N.)

Distribution.—S.W. Ireland to W. Africa. Mediterranean.

Calliostoma occidentale (Mighels & Adams). (*Trochus occidentalis*, Jeffreys, B. C.)

. . . iv., . .

iv. "Porcupine" Exp., 1869, 90 fms. (Jeffreys, '83).

Distribution. — Finmark to S.W. Ireland. Greenland. N.E. America.

[*Olivia otaviana*, Cantraine.]

. . . . v., .

v. "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '83).

Distribution.—Norway to Mediterranean. Madeira.

Family.—Turbinidæ.

Phasianella pullus (Linné).

i., ii., iii., iv., v., vi.

Generally distributed in the littoral and laminarian zones.

Distribution.—N. Scotland to Mediterranean. Mogador. Madeira. Canaries. Off Sahara, "Talisman."

[*Leptothyra Bournei*, Norman.]

. . . iv., . .

iv. "Research" Trawling Cruise, 1889, S.W. Ireland, 200 fms., a single living specimen (Norman, '90).

Distribution.—S.W. Ireland. Deep water.

Family.—IANTHINIDÆ.

Ianthina exigua, Lamarck.

. . . iv., v., vi.

iv. Bantry Bay (Mrs. Puxley, f. Jeffreys, in Forbes & Hanley, '53).

v. Kilkee (Mrs. Fisher, f. Thompson, '56; Humphreys Coll., f. Forbes & Hanley, '53): Connemara (Shuttleworth, f. Brown, '44; M'Calla, f. Thompson, '56): Gurteen, near Roundstone (Farran in Proc. N. H. S. Dublin, I., 1860): Roundstone (Alcock, '65).

vi. Coast of Donegal (Jeffreys, '67, '85).

Distribution.—Pelagic. Atlantic and Pacific Oceans. Mediterranean.

Ianthina rotundata, Leach.

i., . iii., iv., v., vi.

Occasionally cast during the summer and autumn on the shores of all the provinces, except Province II.; sometimes living, and with the float attached.

Distribution.—Pelagic. Atlantic Ocean. Mediterranean.

Ianthina pallida, Harvey.

. . . . v., .

v. Kilkee (Hopkins, '55): Miltown Malbay (Harvey, f. Thompson, '40, '56; Humphreys, f. Forbes & Hanley, '53).

Distribution.—Pelagic. Atlantic Ocean. Mediterranean.

Family.—SCALARIIDÆ.

[*Scalaria longissima*, Seguenza.]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 458 fms. (Jeffreys, '84).

Distribution.—S.W. Ireland to Azores. Deep water.

Scalaria clathratula (G. Adams).

i., ii., iii., iv., v., vi.

i. Magilligan (Hyndman, f. Thompson MS.): off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead, rare (Hyndman, '58): off Black Head, 25 fms. (Hyndman, '59).
ii. Dublin Bay (Turton, '19).
iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Cork Harbour (in stomach of red gurnard, Humphreys, '45; common, Wright & Carroll, '52): R. I. A. Exp., 1885, 1886, Lough Hyne, and off S. coast of Cork, 30–54 fms. (Swanston, '86, Chaster, '98, A. R. N.)
iv. Bantry (Jeffreys, f. Forbes & Hanley, '53): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, 4–48 fms. (Swanston, '86, Chaster, '98, A.R.N.).
v. Kilkee (Humphreys, f. Forbes & Hanley, '53): Aran I. (Barlee, f. Forbes & Hanley, '53): Roundstone (Standen, '95): between Bunowen and Slyne Head (Welch, '96).
vi. Bartra and Enniscrone, occasionally (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56; Belfast Mus., f. Praeger, '89): Iniskeen, co. Donegal (Mrs. Tatlow, '99).

Distribution.—Sweden. Shetland to Mediterranean. Morocco. Madeira. New England.

Scalaria Trevelyana, Leach.

i., . iii., iv., v., .

i. Magilligan (a specimen, Hyndman, f. Thompson, '56; a specimen in Thompson Coll. in Belfast Mus., f. Praeger, '89): off Ballycastle, dead (Chaster, '97A).
iii. Off Hook Light, co. Wexford, 45–50 fms. (Walpole, '52): co. Cork (Humphreys, f. Thompson, '56; Wright, f. Jeffreys, '67): Nymph Bank, 50-55 fms., living, and off Cape Clear, 60 fms. (M'Andrew, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 1888, off S. coast of Cork, 30-55½ fms. (Chaster, '98, A.R.N.)
iv. Off Mizen Head, 56 fms., dead (Forbes & Hanley, '53): "Porcupine" Exp., 1869, 85–808 fms. (Jeffreys, '84): Bantry Bay (Dublin Mus.): R. I. A. Exp. 1885, 1886, 1888, 10–345 fms. (Chaster, '98).

v. Aran I. (Barlee, f. Jeffreys, '67; Waller Coll. in Dublin Mus.): Roundstone (Standen, '95): "Porcupine" Exp., 1869, 165–422 fms. (Jeffreys, '84).

Distribution.—Norway to W. Africa. ? Mediterranean.

Scalaria communis, Lamarck.

i., ii., iii., iv., v., vi.

i. Magilligan (Miss Galwey, '88; &c.): off Ballycastle, dead (Chaster, 97A): Larne Lough (Thompson, '56; Ordnance Survey Coll. in Dublin Mus.): Turbot Bank, dead, rare (Hyndman, '58).

ii. Dublin Bay (Brown, '18; &c.): Portmarnock (Brown, '18; &c.)

iii. Duncannon, co. Wexford (Dublin Mus.): Woodstown, near Dunmore (Dublin Mus., coll. by Mrs. Tatlow): Ardmore (Mrs. Mackesy, f. Thompson, '56): Cork Harbour (Humphreys, '45): R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms. (Chaster, '98.)

iv. Bantry Bay (Jeffreys, f. Forbes & Hanley, '53): Dingle (More, '70): Valentia (Cockerell, '87): R.I.A. Exp. 1885, 1886, Berehaven, 5–25 fms., and Valentia Harbour, 4–7 fms. (Swanston, '86, Chaster, '98, A.R.N.)

v. Miltown Malbay (Waller Coll. in Dublin Mus.): Aran I. and Birterbuy Bay (Barlee, f. Forbes & Hanley, '53): Roundstone (Alcock, '65; Standen, '95): between Bunowen and Slyne Head (Welch, '96): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay, rather frequent (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56): "Porcupine" Exp., 1869, Donegal Bay (Jeffreys, '84): Iniskeen, co. Donegal (Mrs. Tatlow, '99): Kinnegar Strand, scarce (Hart, '92).

Distribution.—Finmark to Mediterranean. Canaries.

Scalaria Turtonæ (Turton).

i., ii., iii., iv., v., vi.

i. Magilligan (Grainger, f. Praeger; Waller Coll., and specimens coll. by Praeger, in Dublin Mus.): Belfast Lough, perhaps Pleistocene fossils from the Estuarine Clays (Belfast Mus., f. Praeger, '89): Strangford Lough (Stewart, f. Praeger, '89).

ii. Newcastle, co. Down (Drummond, f. Thompson, '56): Dundalk Bay (Hyndman Coll., f. Thompson, '56; Waller Coll. in Dublin Mus.): Dublin coast (Turton, '19; &c.).

iii. Youghal (Miss M. Ball, f. Thompson, '56): Cork (Humphreys, f. Forbes & Hanley, '53): south of Ireland (Jeffreys, '67).

iv. R.I.A. Exp., 1885, Berehaven, 5 fms., and Dursey Sound, 25 fms. (Chaster, '98): Berehaven (Marshall, '99). Var. *tenuicula*. Berehaven (Marshall, '99).

v. Aran I. (Barlee, f. Forbes & Hanley, '53): Connemara (Dodd and Mellors, f. Marshall, '90; Marshall, '99).

Distribution.—Shetland to Mediterranean. Madeira.

Pherusina minima (Jeffreys). (*Odostomia minima*, Jeffreys, B. C.)

i., . . iv., v., .

i. Off Ballycastle, dead (Chaster, '97A).

iv. R.I.A. Exp., 1885, Berehaven, 5 fms., a single specimen (Chaster, '98).

v. Roundstone (Standen, '95): between Bunowen and Slyne Head (Welch, '96): off Connemara (Dodd and Mellors, f. Marshall, '90).

Distribution.—Shetland to Mediterranean.

Family.—NATICIDÆ.

Amauropsis islandica (Gmelin). (*Natica islandica*, Jeffreys, B.C.)

i., . iii., . . .

i. Belfast Lough, a single young specimen, dead (Jeffreys, f. Hyndman, '60); probably a quaternary fossil.

iii. Cork (Humphreys, f. Jeffreys, '67).

Distribution.—Arctic seas in both hemispheres to British Isles and New England.

Lunatia sordida (Philippi). (*Natica sordida*, Jeffreys, B.C.)

i., ii., iii, iv., v., .

i. Strangford Lough, 7–25 fms., and off entrance, 18–20 fms., dead, very rare (Dickie, '58).

ii. Off Dublin coast, 60 fms. (Walpole, '53): Dublin Bay (Jeffreys Cab., f. Thompson, '56; Kinahan, '61): Dalkey Sound (Waller Coll. in Dublin Mus.).

iii. Off Saltee I., 40 fms. (Walpole, '52): Youghal (Miss M. Ball, f. Thompson, '40): Cork (Humphreys, f. Jeffreys, '67): between Baltimore and Cape Clear (M'Andrew, f. Jeffreys, '67): R.I.A. Exp., 1885, off Baltimore, 30 fms. (Swanston, '86, Chaster, '98).

iv. Bantry Bay, living (Dublin Mus.): off Dingle Bay (M'Andrew, f. Thompson, '56): "Porcupine" Exp., 1869, Dingle Bay, and 85–458 fms. (Jeffreys, '85): off Blasquet I. (More, '70): R.I.A. Exp., 1886, 23–214 fms., living (A.R.N.).

v. Aran I. (Melville, f. Walpole, '53; Barlee, f. Jeffreys, '67): "Porcupine" Exp., 1869, 165–816 fms. (Jeffreys, '85).

Distribution.—Shetland to Mediterranean. Madeira.

[*Lunatia grœnlandica* (Beck). (*Natica grœnlandica*, Jeffreys, B.C.)]

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 458 fms. (Jeffreys, '85).

v. "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '85).

Distribution.—Arctic seas in both hemispheres to British Isles, New England, and N. Japan. Off Kerguelen I. "Challenger."

Lunatia catena (Da Costa). (*Natica catena*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Generally distributed round the coast, usually in the littoral zone.

Distribution.—Sweden to Mediterranean.

Lunatia Alderi (Forbes). (*Natica Alderi*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Common everywhere.

Var. *lactea*, Jeffreys. R.I.A. Exp., 1885, Berehaven, 5–25 fms. (Chaster, '98): Killala Bay (Miss A. Warren, '92). Var. *subovalis*, Jeffreys. Killala Bay (Miss A. Warren, '92). Var. *ventricosa*, Jeffreys. Birterbuy Bay (Walpole, f. Jeffreys, '69).

Distribution.—Iceland. Loffoden I. to Mediterranean. W. Africa, "Talisman" (Locard).

Lunatia Montagui (Forbes). (*Natica Montacuti*, Jeffreys, B.C.)

i., . iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): off Larne Lough, living, (Hyndman, '59): off Maidens, 20–90 fms., living (Hyndman, '59): Belfast Lough, a living specimen (Hyndman, f. Thompson, '56): Turbot Bank, &c., dead (Hyndman, '58, '59): Strangford Lough (Belfast Nat. F. C. "Guide to Belfast," 1874).

iii. Cork, in stomachs of gurnards (Humphreys, f. Jeffreys, '67): R.I.A. Exp., 1885, 1888, off Glandore, 53 fms., and off Baltimore, 30 fms. (Chaster, '98, A.R.N.): off Cape Clear, 45 fms. (M'Andrew, f. Thompson, '56).

[*Solarium siculum*, Cantraine.]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 113–180 fms., two living specimens (Jeffreys, '85).

Distribution.—S. W. Ireland to Mediterranean. W. Africa, "Travailleur" (Locard). Madeira. Canaries.

Family.—HOMALOGYRIDÆ.

Homalogyra atomus (Philippi).

i., . iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): shores of Larne Lough (Jeffreys, '59; living, Hyndman, '60): Belfast Lough (Thompson, f. Jeffreys, '48; Belfast Mus., f. Praeger, '89).

iii. Cork Harbour (Jeffreys, '48): R. I. A. Exp., 1886, Lough Hyne, a good number of fine live specimens (Chaster, '98).

iv. Bantry Bay (Jeffreys, '48): R. I. A. Exp., 1885, 1888, Berehaven (Chaster, '98).

v. Roundstone (Standen, '95; D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96). Var. *vitrea*, Jeffreys. Killala Bay (Marshall, '99).

vi. Enniscrone, shell-sand (Miss A. Warren, '92): Donegal (Warren, f. Forbes & Hanley, '53): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Finmark to Mediterranean. Madeira. Between Marion I. and Prince Edward I., "Challenger."

According to Jeffreys, '67, this species is found all round Ireland; but the above are the only records of its occurrence on the coast that I am acquainted with. It is, however, probably generally distributed and may have escaped detection owing to its minuteness.

Homalogyra polyzona (Brusina MSS.).

i., ...

i. Off Ballycastle, living (Chaster, '97A).

Distribution.—N. Ireland. Mediterranean.

Probably a variety of *H. atomus*.

Homalogyra Fischeriana, Monterosato.

. . iii., . . .

iii. R. I. A. Exp., 1886, Lough Hyne, a single specimen (Chaster, '98).

Distribution.—S. Ireland. Mediterranean.

iv. "Porcupine" Exp., 1869, 85–808 fms. (Jeffreys, '85): R.I.A. Exp., 1885, Berehaven, 5–25 fms., and mouth of Kenmare River, 38–48 fms. (Chaster, '98).

v. Birterbuy Bay, living (Walpole, '52): Galway coast (Barlee, f. Forbes & Hanley, '53): "Porcupine" Exp., 1869, 165–208 fms. (Jeffreys, '85): R.D.S. Fish. Survey, 1890, 1891, Blacksod Bay (Holt, '92).

vi. R.D.S. Fish. Survey, 1890, Inver Bay (Holt, '92).

Distribution.—Iceland. Finmark to Mediterranean.

[*Lunatia angulata* (Jeffreys).]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 251–539 fms. (Jeffreys '85).

Distribution.—Atlantic Ocean and Mediterranean. Deep water.

[*Natica affinis* (Gmelin).]

. . . iv., . .

iv. R.I.A. Exp., 1888, 750 fms., one young specimen, dead (determined by G. W. Chaster).

Distribution.—Arctic seas in both hemispheres to S. W. Ireland, New England, and N. Japan. ? Mediterranean.

Family.—LAMELLARIIDÆ.

Lamellaria perspicua (Linné).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): north of the Maidens, 80 fms., living (Hyndman, '60): off Ballygalley Head, 15–25 fms., one specimen, dead (Hyndman, '59): Belfast Lough, living on Laminariæ, rare (Hyndman, '58): Strangford Lough (Hyndman and Thompson, f. Thompson, '56): off entrance to Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

ii. Coast of Down (Brown, '44): Portmarnock (Adams, '78; Waller Coll. in Dublin Mus.): Dublin Bay (Turton, '19; Hassall, '42; rare, Walpole, '53A).

iii. Cork Harbour (Humphreys, '45): Courtmacsherry Harbour (Allman, f. Thompson MS.): Baltimore Harbour, living (A.R.N.).

iv. Bantry Bay (Jeffreys, f. Forbes & Hanley, '53): R.I.A. Exp., 1885, 1886, Long Island Sound, 3½–5 fms., and Ballinskelligs Bay (Chaster, '98).

v. Miltown Malbay (Harvey, f. Thompson MS.): Aran I. (Barlee, f. Thompson, '56): R.D.S. Fish. Survey, 1890, Kilkieran Bay (A.R.N.): Roundstone (Alcock, '65; Standen, '95).

vi. Bartra and Enniscrone, common (Miss A. Warren, '92): Bundoran (Waller Coll. in Dublin Mus.): R.D.S. Fish. Survey, 1891, Donegal Bay (Holt, '92): Narin Strand, co. Donegal (G. P. Farran): Kinnegar, Lough Swilly, and near Dunfanaghy (Hart, '92).

Distribution.—Norway to Mediterranean. Canaries. N. E. America.

Velutina lævigata (Pennant).

i., ii., iii., iv., v., vi.

Generally distributed round the coast, below low-water mark.

Var. *candida*, Jeffreys. Coast of Antrim (Jeffreys, '67).

Distribution.—Spitzbergen. Iceland. Finmark to Mediterranean. Greenland to New England. North Pacific.

Family.—TRICHOTROPIDÆ.

Trichotropis borealis, Broderip & Sowerby.

i., . . . v., .

i. Off Ballycastle, dead (Chaster, '97A): North Channel (Jeffreys, '67): off the Maidens, 70–100 fms., dead (Hyndman, '58): entrance to Belfast Lough (Thompson, '56; Hyndman, '58, '59): Turbot Bank, living (Jeffreys, '59; Hyndman, '60): off entrance to Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

v. Coast of Galway (Barlee, f. Thompson, '56).

Distribution.—Arctic seas in both hemispheres to coasts of Ireland, N.E., and N.W. America.

[*Trichotropis fimbriata*, Jeffreys.]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms., a single specimen (Jeffreys, '85).

Distribution.—W. Ireland. Deep water.

[*Trichotropis densistriata*, Jeffreys.]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms., a single specimen (Jeffreys, '85).

Distribution.—North Atlantic. Deep water.

Family.—CAPULIDÆ.

Capulus hungaricus (Linné).

i., ii., iii., iv., v., vi.

i. Generally distributed.

ii. Carlingford, living (Hart, '92): Dublin coast (Brown, '18; Kinahan, '61; &c.): "Arklow oyster beds, county Wicklow, whence it used to be brought on oysters to Malahide" (Adams, '78): off Bray (Walpole, '53A): Greystones (Mackintosh, '84).

iii. Woodstown, co. Waterford (Dublin Mus., coll. by Mrs. Tatlow): R. D. S. Fish. Survey, 1890, off Ballycottin (Jordan): Cork Harbour and Kinsale Harbour (Humphreys, '45): R. I. A. Exp., 1885, 1886, 1888, off S. coast of Cork, 30–52½ fms. (Chaster, '98, A. R. N.).

v. Bantry (Warren Coll. in Dublin Mus.): Blasquet Sound, 17 fms. (Dublin Mus.): "Porcupine Exp.," 1869, 113–808 fms. (Jeffreys, '85): R. I. A. Exp. 1885, 1886, 5–44 fms. (Swanston, '86, Chaster, '98).

v. "Argo" cruise, 1890, west of Ireland, young (Herdman, '91).

vi. Killala Bay (Miss A. Warren, '92): Lough Swilly (Rev. J. D. Falkiner, f. Praeger).

Distribution.—Finmark to Mediterranean. Azores, "Princesse-Alice." New England (Verrill). Florida and Bermuda (Dall).

Calyptræa chinensis (Linné).

. ii., . iv., . .

ii. Dublin Bay (Turton, '19; M'Calla, f. Adair, in Jeffreys, '69; specimens labelled "Dublin Bay" are in Dublin Mus.): on the east coast (Thompson, '56). These records are doubtful.

iv. South-west Ireland (Wright & Greene, '59): "Research" Trawling Cruise, 1889, 70 fms., several specimens (Bourne, '90).

Distribution.—S. England, Wales, and Ireland, to Mediterranean. Madeira. Canaries. W. Africa.

Family.—SOLARIIDÆ.

[*Solarium mediterraneum*, Monterosato.]

. . . iv., . .

iv. "Research" Trawling cruise 1889, 400 fms., a single living specimen (Norman, '90).

Distribution.—S. W. Ireland to Mediterranean. Barbary. Canaries.

[*Solarium siculum*, Cantraine.]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 113–180 fms., two living specimens (Jeffreys, '85).

Distribution.—S. W. Ireland to Mediterranean. W. Africa, "Travailleur" (Locard). Madeira. Canaries.

Family.—HOMALOGYRIDÆ.

Homalogyra atomus (Philippi).

i., . iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): shores of Larne Lough (Jeffreys, '59; living, Hyndman, '60): Belfast Lough (Thompson, f. Jeffreys, '48; Belfast Mus., f. Praeger, '89).

iii. Cork Harbour (Jeffreys, '48): R. I. A. Exp., 1886, Lough Hyne, a good number of fine live specimens (Chaster, '98).

iv. Bantry Bay (Jeffreys, '48): R. I. A. Exp., 1885, 1888, Berehaven (Chaster, '98).

v. Roundstone (Standen, '95; D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96). Var. *vitrea*, Jeffreys. Killala Bay (Marshall, '99).

vi. Enniscrone, shell-sand (Miss A. Warren, '92): Donegal (Warren, f. Forbes & Hanley, '53): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Finmark to Mediterranean. Madeira. Between Marion I. and Prince Edward I., "Challenger."

According to Jeffreys, '67, this species is found all round Ireland; but the above are the only records of its occurrence on the coast that I am acquainted with. It is, however, probably generally distributed and may have escaped detection owing to its minuteness.

Homalogyra polyzona (Brusina MSS.).

i., ...

i. Off Ballycastle, living (Chaster, '97A).

Distribution.—N. Ireland. Mediterranean.

Probably a variety of *H. atomus*.

Homalogyra Fischeriana, Monterosato.

. . iii., . . .

iii. R. I. A. Exp., 1886, Lough Hyne, a single specimen (Chaster, '98).

Distribution.—S. Ireland. Mediterranean.

Lacuna puteolus (Turton).

i., ii., iii., . v., vi.

i. Generally distributed, but not common. Var. *conica*, Jeffreys. Co. Antrim (Hyndman, f. Jeffreys, '65).

ii. Portmarnock (Adams, '78): Howth (Hart, '92): Dublin Bay (Turton, '19; Leach, '52): Killiney, &c., rare (Walpole, '53A). Var. *conica*. Ireland's Eye (A. Macalister, f. Adams, '78).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Baltimore (A. R. N.).

v. Kilkee (Thompson, '56): Roundstone (Alcock, '65; Standen, '95): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Mayo, a dwarf form (Marshall, '98): Killala Bay (Miss A. Warren, '92): Bundoran (Belfast Mus., f. Praeger, '89; Waller Coll. in Dublin Mus.): Narin, &c., co. Donegal (Mrs. Tatlow, '99; G. P. Farran): Mweelfinn, &c. (Hart, 92). Var. *conica*. Mayo (Marshall, '98). Var. *auricularis*, Montagu. River Moy, co. Mayo (Miss Warren, f. Marshall, '98). Var. *expansa*, Jeffreys. Killala Bay (Marshall, '98).

Distribution.—Finmark to Spain. Greenland.

Lacuna pallidula (Da Costa).

i., ii., iii., iv., v., vi.

i. Generally distributed on Laminariæ, &c. Var. *neritoidea*, Gould. Groomsport (Marshall, '98).

ii. Malahide (Adams, '78): Dublin Bay (Dublin Mus.): Killiney, &c., rare (Walpole, '53A).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Cork Harbour (Humphreys, '45): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off Baltimore, 30 fms. (Chaster, '98).

iv. R. I. A. Exp., 1885, Berehaven, 5–25 fms. (Chaster, '98): Kenmare River (Praeger, '99). Var. *patula*, Thorpe. Bantry Bay (Barlee, f. Jeffreys, '65).

v. Miltown Malbay (Harvey, f. Thompson MS.): Roundstone (Alcock, '65; Standen, '95): Clew Bay (Thompson, '56): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson MS.): Narin, co. Donegal (Mrs. Tatlow, '99; G. P. Farran): near Dunfanaghy, and at Mweelfinn, Sheephaven (Hart, '92).

Distribution.—Spitzbergen. Iceland. Finmark to W. France. Greenland. N. E. America.

[*Cithna tenella* (Jeffreys). (*Lacuna tenella*, Jeffreys, B. C.)]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 251–539 fms. (Jeffreys, '83): R. I. A. Exp., 1888, 750 fms., one broken specimen (Chaster, '98).

Distribution. — Faroes to Mediterranean. Azores. Morocco, "Talisman." New England (Verrill). New Jersey to Florida. West America (Dall). Off Brazil, "Challenger."

Family.—TRUNCATELLIDÆ.

? *Truncatella truncatula* (Draparnaud).

. . . . . vi.

vi. Bundoran, a specimen among shell-sand (Mrs. Hancock, f. Thompson, '56); probably a mistake (Jeffreys, '67).

Distribution.—England, ? Scotland, ? Ireland to Mediterranean. Madeira. Canaries. Newport, Rhode I., perhaps introduced (Verrill).

Family.—RISSOIDÆ.

Alvania carinata (Da Costa). (*Rissoa striatula*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Larne (Hyndman and Jeffreys, f. Jeffreys, '67): Turbot Bank, dredged sand (Waller, '58; Hyndman, '58; Jeffreys, f. Hyndman, '59).
ii. Portmarnock (Warren Coll. in Dublin Mus.): Dublin Bay (Thompson, '56; Waller, f. Kinahan, '61).
iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Cork Harbour (Wright & Carroll, '52).
iv. Bantry Bay (Jeffreys, '67).
v. Miltown Malbay, rare (Harvey, f. Thompson, '40): Aran I. (Barlee, f. Jeffreys, '67): Achill I. (Mrs. Tatlow & Praeger, '98; Marshall, '98).
vi. Carrahubbuck, Killala Bay, several fine specimens (Miss A. Warren, '92): Bundoran (Thompson, '56; Waller Coll. in Dublin Mus.): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—British Isles to Mediterranean.

Alvania cancellata (Da Costa). (*Rissoa cancellata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A) : off Larne, 18–20 fms (Jeffreys, '67) : Turbot Bank, dredged sand, dead, and off Black Head, 25 fms. (Hyndman, '58, '59) : Strangford Lough, 7–20 fms., and off entrance, 12–15 fms., dead, rare (Dickie, '58).

ii. Portmarnock (Brown, '18; Warren, f. Thompson, '56): Dublin Bay (Turton, '19).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Nymph Bank, 50 fms. (M'Andrew, f. Jeffreys, '67) : R. I. A. Exp., 1885, 1886, off S. coast of Cork, 52½–55½ fms. (Chaster, '98).

iv. Bantry Bay (Miss Hutchins, f. Leach, '52; &c.) : R.I.A. Exp., 1885, 5–44 fms. (Chaster, '98).

v. Aran I. and Birterbuy Bay (Barlee, f. Forbes & Hanley, '53): Birterbuy Bay (Marshall, '98) : Roundstone (D'Arcy W. Thompson).

vi. Carrahubbuck, Killala Bay, occasionally (Miss A. Warren, '92) : Killala Bay (Marshall, '98) : Bundoran (Thompson, '56; Waller Coll. in Dublin Mus.).

Distribution.—Hebrides to Mediterranean. Azores, "Challenger." Madeira. Canaries.

Alvania calathus (Forbes & Hanley). (*Rissoa calathus*, Jeffreys, B. C.)

i., . iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead (Waller, '58; Hyndman, '58).

iii. R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms. (Chaster, '98).

iv. Off Mizen Head, 50 fms., dead (M'Andrew, f. Forbes & Hanley, '53): Bantry Bay (Marshall, '98).

v. Kilkee (Warren, f. Thompson, in Forbes & Hanley, '53): Connemara (Marshall, '98) : Roundstone (D'Arcy W. Thompson).

vi. Killala Bay (Marshall, '98).

Distribution.—Hebrides to Mediterranean. Azores, "Challenger." Canaries. Cape of Good Hope (Sowerby).

A. calathus is now generally regarded as a variety of the following species.

Alvania reticulata (Montagu). (*Rissoa reticulata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): entrance of Belfast Lough, shell-sand (Thompson, '56): Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): Groomsport, shell-sand (Praeger, '92A): Strangford Lough, 7–20 fms., dead, common (Dickie, '58): Ardmillan, shell-sand (Praeger, '89).
ii. Dublin Bay (Alder, f. Forbes & Hanley, '53; a fragment, Waller, f. Kinahan, '61).
iii. South of Ireland (Leach, '52): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms. (Swanston, '86, Chaster, '98, A. R. N.).
iv. Bantry Bay (Thompson and Barlee, f. Thompson, '56): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, 0–79 fms. (Swanston, '86, Chaster, '98).
v. Seafield (Turton, '19): Birterbuy Bay (Jeffreys, f. Forbes & Hanley, '53): Roundstone (Alcock, '65; B. S. Dodd in Journ. of Conch., vi., 1890; D'Arcy W. Thompson): ? "Argo" cruise, 1890, west of Ireland (Herdman, '91).
vi. Enniscrone, one specimen (Miss A. Warren, '92).
Distribution.—Finmark to Mediterranean. Canaries.

Alvania cimicoides (Forbes). (*Rissoa cimicoïdes*, Jeffreys, B. C.)

i., . iii., iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): Larne (Jeffreys, '67; Belfast Mus., f. Praeger, '89).
iii. Cork Harbour (Wright, f. Jeffreys, '67): R. I. A. Exp., 1886, off S. coast of Cork, 39½–52½ fms. (Chaster, '98).
iv. "Porcupine" Exp., 1869, 90 fms. (Jeffreys, '84).
v. West coast of Ireland (Hoskyns, f. Jeffreys, '67): "Porcupine" Exp., 1869, 85–173 fms. (Jeffreys, '84).
Distribution.—Finmark to Mediterranean. Azores.

[*Alvania Jeffreysi* (Waller). (*Rissoa Jeffreysi*, Jeffreys, B. C.)]

. . . . v., .

v. "Porcupine" Exp.," 1869, 816 fms. (Jeffreys, '84).
Distribution.—Finmark to Mediterranean.

Alvania punctura (Montagu). (*Rissoa punctura*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, dead (Hyndman, '58; Jeffreys, f. Hyndman, '59): off Black Head, 15–25 fms. (Hyndman, '59): Strangford Lough (Belfast N. F. C. "Guide to Belfast," 1874).

ii. Dublin Bay (Turton, '19; Jeffreys, f. Forbes & Hanley, '53; Waller, f. Kinahan, '61).

iii. R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–52½ fms. (Chaster, '98). Var. *diversa*, Jeffreys. R. I. A. Exp., 1885, off Baltimore, 30 fms. (Chaster, '98).

iv. Bantry Bay (Turton, '19; Forbes & Hanley, '53): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, 1888, 0–79 fms. (Chaster, '98): Kenmare River (Praeger, '99).

v. Kilkee (Thompson, '56): Roundstone (Alcock, '65; Standen, '95; D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84). Var. *diversa*. Connemara (Marshall, '98).

vi. Bartra and Enniscrone, frequent (Miss A. Warren, '92): Bundoran (Thompson, '56; Waller Coll. in Dublin Mus.): Iniskeen, co. Donegal, rare (Mrs. Tatlow, '99): Narin Strand, co. Donegal (G. P. Farran): Portsalon (Standen, '94). Var. *diversa*. Killala Bay (Marshall, '98).

Distribution.—Finmark to Mediterranean. Canaries.

Alvania Testâe (Aradas & Maggiore), var. *abyssicola*, Forbes. (*Rissoa abyssicola*, Jeffreys, B. C.)

. . iii., iv., v., .

iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–54 fms. (Chaster, '98, A. R. N.).

iv. Off Mizen Head, 60 fms. (M'Andrew, f. Thompson, '56): "Porcupine" Exp., 1869, 370–808 fms. (Jeffreys, '84): R. I. A. Exp., 1885, 1886, 23–214 fms. (Chaster, '98).

v. "Porcupine" Exp., 1869, 85–816 fms. (Jeffreys, '84): ? "Argo" cruise, 1890, west of Ireland (Herdman, '91).

Distribution.—Loffoden I. to Mediterranean.

Manzonia zetlandica (Montagu). (*Rissoa zetlandica*, Jeffreys, B. C.)

i., . iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): coast of Antrim (Hyndman and Jeffreys, f. Jeffreys, '67): Turbot Bank, dead, rare (Hyndman, '58): off Black Head, 25 fms. (Hyndman, '59).

iii. R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms. (Chaster, '98).

iv. R. I. A. Exp., 1885, mouth of Kenmare river, 38–41 fms. (Chaster, '98).

v. Birterbuy Bay (Walpole, f. Thompson, '56): Connemara, (Marshall, '98): "Porcupine" Exp., 1869, 173–208 fms. (Jeffreys, '84).

vi. Killala Bay (Marshall, '98): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Loffoden I. to Mediterranean.

Manzonia costata (Adams). (*Rissoa costata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): off Ballygalley Head, 20 fms., dead, a few (Hyndman, '59): Turbot Bank, dead (Hyndman, '58; Jeffreys, f. Hyndman, '59): Strangford Lough, dead (Dickie, '58; Praeger, '89).

ii. Dublin coast (W., W., & W., '18; not common, Walpole, '53A; Thompson, '56; Kinahan, '61).

iii. South coast of Ireland (Leach, '52): R. I. A. Exp., 1886, Glandore Harbour, 4 fms. (Chaster, '98).

iv. Bantry Bay (Thompson, '56): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, Long Island Sound, 3½–5 fms., Berehaven, 5–25 fms., Ballinskelligs Bay, and Valentia Harbour, 4–7 fms. (Swanston, '86, Chaster, '98, A. R. N.). Var. *minor*, Monterosato. Bantry (Marshall, '98).

v. Tarbert, Galway (Jeffreys, f. Forbes & Hanley, '53): Roundstone (B. S. Dodd in Journ. of Conch., vi., 1890; Standen '95; D'Arcy W. Thompson): Clew Bay (Thompson, '56): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Bartra, rather common (Miss A. Warren, '92): Bundoran (Thompson, '56): Iniskeen, co. Donegal, rare (Mrs. Tatlow, '99): Narin, co. Donegal (G. P. Farran): Portsalon (Standen, '94).

Distribution.—Norway to Mediterranean. Madeira. Canaries.

Zippora membranacea (Adams). (*Rissoa membranacea*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Generally distributed round the coast on sea-weeds, &c.

Var. *minor*, Jeffreys. Dublin Bay (Jeffreys, '67): Killala (Marshall, '99).

Distribution.—Loffoden I. to Mediterranean. Canaries.

Persephone violacea (Desmarest). (*Rissoa violacea*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Bangor, Belfast Lough (Thompson, '56): Belfast Lough, between tide-marks, living, scarce (Hyndman, '58): Strangford Lough, 7–20 fms., dead, common (Dickie, '58).

ii. A specimen obtained at Portmarnock by Warren was referred by Alder to this species (Thompson, '56).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): R. I. A. Exp., 1886, Glandore Harbour, 4 fms. (Chaster, '98).

iv. Bantry Bay (M'Andrew, f. Thompson, '56; Barlee, f. Jeffreys, '67; Marshall, '99): R. I. A. Exp., 1885, 1886, 4–79 fms. (Swanston, '86, Chaster, '98): Kenmare River (Praeger, '99). Var. *ecostata*, Jeffreys. Bantry Bay (Marshall, '99).

v. Kilronan, Aran I. (Standen, '95): Connemara (Farran, f. Alder, '44; &c.): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Carrahubbuck, amongst the rocks (Miss A. Warren, '92): Killala Bay (Marshall, '99): Bundoran (Marshall, '99): Narin, co. Donegal (Mrs. Tatlow, '99). Var. *ecostata*. Killala Bay (Marshall, '99).

Distribution.—Loffoden I. to Mediterranean. Madeira. Canaries.

Rissoa Guérini, Recluz. (*Rissoa costulata*, Jeffreys, B. C.)

. . iii., iv., . .

iii. Cork (Jeffreys, '67): R. I. A. Exp., 1886, Glandore Harbour, 4 fms. (Chaster, '98).

iv. R. I. A. Exp., 1885, Dursey Sound, 20–25 fms. (Swanston, '86).

Distribution.—England. Wales. Ireland to Mediterranean. Madeira. Canaries.

Rissoa parva (Da Costa).

i., ii., iii., iv., v., vi.

Generally distributed on sea-weeds in the laminarian zone, and very common; also var. *interrupta*, Adams.

Var. *exilis*, Jeffreys. Killala Bay, rare (Miss A. Warren, '92; Marshall, '99).

Distribution.—Finmark to Mediterranean. Madeira. Canaries. N. Atlantic, "Valorous."

Rissoa inconspicua, Alder.

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, dead (Hyndman, '58): off Black Head, 25 fms. (Hyndman, '59).
ii. Portmarnock (one specimen, Thompson, '56; Adams, '78): Dublin Bay (Jeffreys, f. Forbes & Hanley, '53; Walpole, '53A; Waller, f. Kinahan, '61).
iii. Youghal (Miss M. Ball, f. Thompson, '56, sub *Rissoa alba*, Adams): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–55½ fms. (Chaster, '98).
iv. Bantry Bay (Jeffreys, f. Forbes & Hanley, '53): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, 1888, 3½–110 fms. (Chaster, '98).
v. Birterbuy Bay (Jeffreys, f. Forbes & Hanley, '53): Roundstone (Alcock, '65). Var. *variegata*, v. Mohrenstern. Roundstone (B. S. Dodd in Journ. of Conch., vi., 1890).
vi. Enniscrone (Marshall, f. Miss A. Warren, '92): Bundoran, one specimen (Mrs. Hancock, f. Thompson, '56): "Porcupine" Exp., 1869, Donegal Bay, 25–40 fms. (Jeffreys, '84): Mulroy Bay, dead (Praeger, '94).

Distribution.—Finmark to Mediterranean. Madeira. Canaries.

Rissoa albella, Lovén.

i., . iii., iv., v., vi.

i. Turbot Bank (Hyndman Coll. in Belfast Mus., f. Praeger, '89).
iii. R. I. A. Exp., 1886, Glandore Harbour, 4 fms., and Lough Hyne (Chaster, '98).
iv. Bantry Bay, low water (Barlee, f. Jeffreys, '67; Marshall, '99): R. I. A. Exp., 1885, 1886, Long Island Sound, 3½–5 fms., and Berehaven (Swanston, '86, Chaster, '98): Kenmare River (Praeger, '99).
v. Connemara (Marshall, '99).
vi. Killala Bay (Marshall, '99).

Distribution.—Norway to Mediterranean.

R. albella is probably only a variety of *R. inconspicua*.

Onoba striata (Adams). (*Rissoa striata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed round the coast in the littoral, laminarian, and coralline zones, and very common.

Var. *aculeus*, Gould (= *arctica*, Lovén). R. I. A. Exp., 1885, Berehaven (Chaster, '98): Kenmare River (Praeger, '99).

Distribution.—Arctic seas to Madeira. Canaries. ? Mediterranean. Greenland. N. E. America. N. E. Asia.

Ceratia proxima (Alder). (*Rissoa proxima*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan (Thompson, '56): off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead, scarce (Hyndman, '58).
ii. Portmarnock (Jeffreys, f. Forbes & Hanley, '53; Thompson, '56; Adams, '78; Marshall, '99): Dublin (Jeffreys, '67).
iii. Cork (Wright & Carroll, '52; Jeffreys, '67): R. I. A. Exp., 1885, off Galley Head, 54 fms., and off Baltimore, 30 fms. (Chaster, '98).
iv. Bantry Bay (Thompson, '56; Jeffreys, '67; Dublin Mus.): "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '84): R. I. A. Exp., 1885, 1886, 3½–40 fms. (Chaster, '98).
v. Miltown Malbay (Harvey, f. Thompson, '56): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84): off Connemara (Dodd and Mellors, f. Marshall, '90).
vi. Enniscrone, rare (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56).

Distribution.—Loffoden I. to Mediterranean.

Hyala vitrea (Montagu). (*Rissoa vitrea*, Jeffreys, B. C.)

i., ii., iii., iv., v., .

i. Turbot Bank, dead (Waller, f. Hyndman, '59).
ii. Portmarnock, rare (Brown, '18): Dublin Bay (Turton, '19; Kinahan, '61; Jeffreys, '67): Dalkey (Waller Coll. in Dublin Mus.)
iii. South of Ireland (Leach, '52; Jeffreys, '67): Cork Harbour, dead (Wright & Carroll, '52): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–52½ fms. (Swanston, '86, Chaster, '98, A. R. N.).

iv. Bantry Bay, not scarce (Marshall, '99): "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '84): R. I. A. Exp., 1885, 1886, shallow water to 80 fms. (Swanston, 86, Chaster, '98).

v. Aran I. and Birterbuy Bay (Barlee, f. Forbes & Hanley, '53): west of Ireland (Jeffreys, '67): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84).

Distribution.—Norway to Mediterranean.

Setia fulgida (Adams). (*Rissoa fulgida*, Jeffreys, B. C.)

i., . iii., iv., v., vi.

i. Larne Lough, sparingly (Jeffreys, '67).

iii. Cork Harbour (one dead example, Wright & Carroll, '52; Jeffreys, f. Forbes & Hanley, '53): south of Ireland (Jeffreys, '67).

iv. Bantry Bay (Jeffreys, f. Forbes & Hanley, '53): R I. A. Exp., 1885, 1886, Long Island Sound, 5–6 fms., Berehaven, 5 fms., and Ballinskelligs Bay (Chaster, '98).

v. Aran I. (Barlee, f. Forbes & Hanley, '53): Birterbuy Bay (Barlee, f. Thompson, '56): west of Ireland (Jeffreys, '67): Roundstone (Standen, '95): between Bunowen and Slyne Head (Welch, '96).

vi. Killala Bay (Miss A. Warren, '92).

Distribution.—S. England, Wales, and Ireland to Mediterranean. Canaries.

Cingula obtusa (Cantraine). (*Rissoa soluta*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Portrush (Marshall, '99): off Ballycastle, living (Chaster, '97A): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59).

ii. Dublin Bay, one specimen (Kinahan, '61).

iii. Cork Harbour (Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., [1886, Glandore Harbour, 4 fms.] (Chaster, '98).

iv. Bantry Bay (S. Wright, f. Wright & Carroll, '52; Beevor, f. Jeffreys, '67; Marshall, '99): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., [1885, 1886], 0–110 fms. (Chaster, '98).

v. West coast of Ireland (Hoskyns, f. Jeffreys, '67): Aran I. (Barlee, f. Jeffreys, '67): Roundstone (Standen, '95; D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96): Connemara (Marshall, '99).

vi. Killala Bay (Miss A. Warren, '92): Mayo and Sligo (Marshall, '99).

Distribution.—Finmark to Mediterranean.

Cingula semistriata (Montagu). (*Rissoa semistriata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan (Thompson, '56): off Ballycastle, dead (Chaster, '97A): Turbot Bank (Hyndman, '58, '59). Var. *pura*, Jeffreys. Turbot Bank (Jeffreys, f. Hyndman, '59, sub var. *alba*).
ii. Dublin Bay (Waller, f. Kinahan, '61).
iii. Youghal (Miss M. Ball, f. Thompson, '56): Cork Harbour (Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off Baltimore, 30 fms. (Chaster, '98).
iv. Bantry Bay (Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, Ballinskelligs Bay, and 3½–79 fms. (Chaster, '98, A. R. N.).
v. Kilkee (Thompson, '56): Roundstone (D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Killala Bay (Miss A. Warren, '92): Bundoran (Thompson, '56): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Norway to Mediterranean. Madeira.

Cingula trifasciata (Adams). (*Rissoa cingillus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed round the coast between tide-marks; probably also var. *rupestris*, Forbes.

Distribution.—? Iceland. Norway to Gibraltar. ? Mediterranean. Madeira.

Barleeia rubra (Montagu).

. ii., iii. iv., v., vi.

ii. Dublin Bay (Turton, '19; Leach, '52): South Bull, Dublin Bay, one specimen (Hart, '92). Var. *unifasciata*, Montagu. Dublin Bay (Turton, f. Thompson, '56). These records are doubtful.
iii. Cork (Leach, '52; Wright and Jeffreys, f. Jeffreys, '67).
iv. Bantry Bay (Leach, '52; Barlee and Norman, f. Jeffreys, '67): Dingle Bay (Leach, '52): R. I. A. Exp., 1886, Long Island Sound, 3½–5 fms., and Ballinskelligs Bay (Chaster, '98).
v. Kilkee, shell-sand (Thompson, '56): Miltown Malbay (Harvey, f. Thompson, '56): Birterbuy Bay (Waller Coll. in Dublin Mus.): Roundstone (M'Calla, f. Thompson, '56; Alcock, '65; Standen, '95): Connemara (Barlee, f. Jeffreys, '67): Achill I. (Mrs. Tatlow & Praeger, '98; Marshall, '99).

vi. Killala Bay, rare (Miss A. Warren, '92): Mayo and Sligo (Marshall, '99): Bundoran (Jeffreys, '67; Belfast Mus., f. Praeger, '89): Tory I., among sea-weed (Hyndman, f. Thompson, '56).

Distribution.—Norway. England, ? Scotland, Wales, and Ireland to Mediterranean. Madeira. Canaries. C. Verd I.

Family.—SKENEIDÆ.

Skenea planorbis (Fabricius).

i., ii., iii., iv., v., vi.

i. Generally distributed and abundant. Var. *hyalina*, Jeffreys. Portrush (Marshall, '99). Var. *trochiformis*, Jeffreys. Larne Lough (Hyndman, '60; Jeffreys, '67).
ii. Portmarnock (Warren Coll. in Dublin Mus.): Dublin Bay (Kinahan, '61; Waller Coll. in Dublin Mus.): Bullock, Dalkey I., and Greystones (Adams, '78).
iii. Youghal (Ball, f. Thompson MS.): R. I. A. Exp., 1885, Glandore Harbour, 4 fms., and off Baltimore, 30 fms. (Chaster, '98).
iv. Bantry Bay (Turton, '19): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, shallow water to 40 fms. (Chaster, '98): Kenmare River (Praeger, '99).
v. Miltown Malbay (Harvey, f. Thompson MS.): Roundstone (Alcock, '65; Standen, '95): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Killala Bay (Miss A. Warren, '92): Bundoran (Warren, f. Thompson, '56): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Arctic seas to Mediterranean and Madeira in the eastern hemisphere, and to Florida in the western hemisphere. W. America (Dall).

Retrotortina fuscata, Chaster.

. . iii., . . .

iii. R. I. A. Exp., 1886, Lough Hyne, a single specimen (Chaster, '98).

Distribution.—S. Ireland. Tangier.

Family.—JEFFREYSIIDÆ.

Jeffreysia diaphana (Alder).

i., ii., . iv., v., vi.

i. Groomsport (a specimen in Waller Coll. in Dublin Mus.)
ii. Portmarnock, and between tide-marks Dalkey Island (Alder, f. Thompson, '56, sub *Rissoa albella*, Alder).

iv. Bantry (Norman, f. Jeffreys, '59): R. I. A. Exp. [1885, Berehaven, between tides], a single specimen (Chaster, '98).

v. Kilkee (Thompson, '56, sub *R. albella*): Aran I. (Barlee, f. Forbes & Hanley, '53): Achill I. (Marshall, '99).

vi. Enniscrone, rare (Miss A. Warren, '92): Bundoran, in shell-sand (Mrs. Hancock, f. Thompson, '56, sub *R. albella*).

Distribution.—Norway to Mediterranean.

Jeffreysia opalina (Jeffreys).

. . . . v., .

v. Connemara (two dead specimens from Roundstone Bay in J. T. Marshall's Coll., f. Praeger, '92; Marshall, '99).

Distribution.—Shetland to Mediterranean.

Family.—ADEORBIDÆ.

Adeorbis subcarinatus (Montagu).

i., ii., iii., iv., v., vi.

i. Magilligan (Thompson MS.): Belfast Lough, shell-sand (Hyndman, f. Thompson, '56): Turbot Bank, dead (Hyndman, '58; Jeffreys, f. Hyndman, '59): off Black Head, 25 fms. (Hyndman, '59).

ii. Portmarnock (Turton, f. Brown, '18; Adams, '78; Waller Coll. in Dublin Mus.): Dublin Bay (Forbes & Hanley, '53; Kinahan, '61).

iii. Cork (Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, off Galley Head, 54 fms., and Glandore Harbour, 4 fms. (Chaster, '98).

iv. R. I. A. Exp., 1885, Berehaven, 5–25 fms., and mouth of Kenmare River, 40 fms. (Chaster, '98).

v. Miltown Malbay (Harvey, f. Thompson MS.): Aran I. (Barlee, f. Forbes & Hanley, '53): Achill I. (Mrs. Tatlow & Praeger, '98): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '85).

vi. Bartra and Enniscrone, occasionally (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson MS.): Mweelfinn, Sheephaven, two dead specimens (Hart, '92): "Porcupine" Exp., 1869, Lough Swilly (Jeffreys, '85).

Distribution.—British Isles to Mediterranean. Mogador.

The generic name *Adeorbis* properly belongs to the species known as *Circulus striatus*, Philippi, and Turton's name *Tornus* is adopted by Chaster, &c.

Adeorbis imperspicuus, Monterosato.

i., . . iv., v., .

i. Off Rathlin Island, 17 fms., one dead specimen (Chaster, '97).
iv. R. I. A. Exp., 1885, mouth of Kenmare River, 38–44 fms. (Chaster, '98).
v. Roundstone (Chaster, '95).
Distribution.—British Isles. Mediterranean.

Adeorbis unisulcatus, Chaster.

i., . . . v., .

i. Off Rathlin Island, 17 fms., two dead specimens (Chaster, '97).
v. Roundstone (Chaster, '97).
Distribution.—British Isles. Tangier.

Family.—CERITHIIDÆ.

Newtoniella metula (Lovén). (*Cerithium metula*, Jeffreys, B. C.)

i., ...

i. Turbot Bank, dredged sand (Hyndman, '60); probably fossil.
Distribution.—Finmark to Portugal. ? Mediterranean.

Bittium reticulatum (Da Costa). (*Cerithium reticulatum*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed, and very common.
Distribution.—Loffoden I. to Mediterranean. Azores. Madeira. Morocco. Canaries.

Triforis perversa (Linné). (*Cerithium perversum*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): mouth of Belfast Lough (Hyndman, f. Thompson, '56): off Black Head, 25 fms. (Hyndman, '59): Turbot Bank, dead (Hyndman, '58, '59): off entrance to Strangford Lough, 12-15 fms., dead, very rare (Dickie, '58).
ii. Portmarnock (Adams, '78): Dublin Bay (Waller, f. Kinahan, '61).
iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Cork Harbour, a few perfect specimens (Wright & Carroll, '52): R.I.A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–55½ fms. (Swanston, '86, Chaster, '98, A. R. N.).

iv. Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp. 1885, 1886, 3½–41 fms. (Swanston, '86, Chaster, '98).

v. Seafield (Turton, f. Thompson, '56): Miltown Malbay, common (Harvey, f. Thompson, '56): Birterbuy Bay (Farran, f. Thompson, '56; Barlee, f. Thompson, '56): Roundstone (Alcock, '65; Standen, '95; D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56; Belfast Mus., f. Praeger, '89; Dublin Mus.): Narin, co. Donegal (Mrs. Tatlow, '99).

Distribution.—Norway to Mediterranean. Azores. Madeira. Morocco. Canaries. Cape of Good Hope (Sowerby). New England to West Indies. ? California (Dall).

Cerithiopsis tubercularis (Montagu).

i., . iii., iv., v. vi.

i. Magilligan (Thompson, '56): off Ballycastle, dead (Chaster, '97A): off Black Head, 25 fms. (Hyndman, '59): in stomach of a Scaup Duck shot in Belfast Lough (Thompson, '56): Turbot Bank, dredged sand (Hyndman, '58, '59).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): R. I. A. Exp., 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 52½–55½ fms. (Chaster, '98).

iv. Bantry Bay (Thompson, '56): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, Ballinskelligs Bay, and 5–44 fms. (Swanston, '86, Chaster, '98). Var. *nana*, Jeffreys. Bantry Bay (Jeffreys, '67).

v. Miltown Malbay, common (Harvey, f. Thompson, '56): Aran I. (Barlee, f. Jeffreys, '58): Roundstone (Alcock, '65; Standen, '95; D'Arcy W. Thompson): Clifden Bay, 4–10 fms. (Thompson, '56): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay, rather common (Miss A. Warren, '92): Bundoran (Waller Coll. in Dublin Mus.): Iniskeen, co. Donegal (Mrs. Tatlow, '99). Var. *nana*, Jeffreys. Killala Bay (Miss A. Warren, '92).

Distribution.—Norway to Mediterranean. Madeira. Canaries. W. Africa, "Talisman." N. E. America. Florida (Dall). Queen Charlotte's I.

Cerithiopsis Barleei, Jeffreys.

. . iii., iv., v., .

iii. Wexford coast, 40 fms. (Walpole, f. Jeffreys, '69) : Cork (Wright, f. Jeffreys, '67) : R. I. A. Exp. 1885, 1886, 30–52½ fms. (Chaster, '98).

iv. R. I. A. Exp., 1885, Ballinskelligs Bay, and 5–44 fms. (Chaster, '98).

v. Co. Galway (Barlee and Jeffreys, f. Jeffreys, '67) : "Porcupine" Exp., 1869, 165 fms. (Jeffreys, '85).

Distribution.—S. England and Ireland to Mediterranean.

Cerithiopsis concatenata (Conti). (*C. pulchella*, Jeffreys, B. C.)

i., . . iv., v., .

i. Turbot Bank, dead, rare (Waller, f. Hyndman, '58, sub *Cerithium metula*; Waller, f. Hyndman, '59, sub *Cerithiopsis pulchella*).

iv. R. I. A. Exp., 1885, S. entrance to Dursey Sound, 25 fms, and Ballinskelligs Bay (Chaster, '98).

v. Between Bunowen and Slyne Head (Welch, '96).

Distribution.—S. England and Ireland to Mediterranean. Hatteras (Dall).

Cerithiopsis costulata (Möller).

i., . . [iv.], . .

i. Turbot Bank, dead (Jeffreys, f. Hyndman, '59, sub *Cerithium niveum*; Waller f. Hyndman, '59, sub *Skenea costulata*); regarded as fossil (Jeffreys, '67).

iv. "Porcupine" Exp., 1869, 251–539 fms. (Jeffreys, '85).

Distribution.—Iceland. Finmark to S. W. Ireland. Spain, "Travailleur" (Locard). Greenland to Bay of Fundy.

Family.—TURRITELLIDÆ.

Turritella communis, Risso. (*T. terebra*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed round the coast, and common.

? Var. *nivea*, Jeffreys. Killiney Bay (Walpole, '53A). Var. *gracilis*, Jeffreys. Cork Harbour (Humphreys, f. Jeffreys, '67) : Cork (M'Andrew Coll., f. Cooke, '82) : Bantry Bay (Jeffreys, '67).

Distribution.—Loffoden I. to Mediterranean. W. Africa.

Family.—CÆCIDÆ.

Cæcum trachea (Montagu).

i., ii., iii., iv., v., vi.

i. Turbot Bank (Hyndman Coll. in Belfast Mus., f. Praeger, '89): Strangford Lough (Waller, f. Jeffreys, '69).

ii. Portmarnock (Hart, '92): Dublin Bay (Waller, f. Jeffreys, '69).

iii. Youghal (J. Wright, f. Wright & Carroll, '52): Cork Harbour (Jeffreys, f. Forbes & Hanley, '53).

iv. Bantry Bay (Thompson, '56; &c.): R. I. A. Exp. 1885, 1886, Long Island Sound, 3½–5 fms., Berehaven, 5–25 fms., and off Dursey Head, 35–40 fms. (Swanston, '86, Chaster, '98, A. R. N.).

v. Miltown Malbay (Harvey, f. Thompson, '40): Aran I. (Barlee, f. Jeffreys, '67): Roundstone (B. S. Dodd in Journ. of Conch., vi., 1890; D'Arcy W. Thompson): Connemara (Marshall, '99).

vi. Mayo and Sligo (Marshall, '99): Bundoran (Thompson, '44).

Distribution.—British Isles to Mediterranean. Madeira. Canaries.

Cæcum glabrum (Montagu).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Belfast Lough, shell-sand, deep water (Hyndman, f. Thompson, '56): Turbot Bank, dead, rare (Hyndman, '58).

ii. Dublin Bay (Waller, f. Kinahan, '61).

iii. Cork Harbour (Wright & Carroll, '52; Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., Lough Hyne, and off S. coast of Cork, 30–52½ fms. (Chaster, '98).

iv. Bantry Bay (Brown, '44; Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 0–40 fms. (Swanston, '86, Chaster, '98).

v. Miltown Malbay (Harvey, f. Thompson, '40): Roundstone (Alcock, '65; Standen, '95; fry very common, Marshall, '99; D'Arcy W. Thompson).

vi. Killala Bay (Miss A. Warren, '92): Bundoran (Thompson, '44; Dublin Mus.).

Distribution.—Norway to Canaries. ? Mediterranean. Hatteras and Florida (Dall).

Family.—CHENOPODIDÆ.

Chenopus pes-pelecani (Linné). (*Aporrhaïs pes-pelecani*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Of general occurrence all round the coast, principally in the coralline zone.

Var. *albida*, Jeffreys. Dublin Bay (Waller, f. Jeffreys, '67).

Distribution.—Iceland. Finmark to Mediterranean.

Chenopus serresianus (Michaud). (*Aporrhaïs Macandreæ*, Jeffreys, B. C.)

. . . iv., v., .

iv. "Porcupine" Exp,. 1869, 85–722 fms. (Jeffreys, '85): off Valentia (Waller, f. Norman in Journ. of Conch., II., 1879 ; Waller Coll. in Dublin Mus.): "Research" Trawling Cruise, 1889, 200 fms. (Bourne, '90, sub *Aporrhais pes-carbonis*).

v. "Porcupine" Exp., 1869, 85–183 fms. (Jeffreys, '85).

Distribution.—Finmark to Mediterranean.

Family.—CYPRÆIDÆ.

Amphiperas patula (Pennant). (*Ovula patula*, Jeffreys, B.C.)

i., . iii., . v., .

i. Magilligan (one specimen, Mrs. R. A. Hyndman, f. Thompson, '56; one specimen, Grainger Coll., f. Praeger): Castlerock, one specimen, and Port Stewart, two specimens (Grainger Coll., f. Praeger): Turbot Bank, a single specimen, dead (Waller, f. Hyndman, '58).

iii. Off Saltee I., co. Wexford (Walpole, '52): R. I. A. Exp., 1885, off Baltimore, 30 fms. (Chaster, '98).

v. Aran I. and Birterbuy Bay (Barlee, f. Thompson, '56).

Distribution.—S. England and Ireland to Mediterranean.

Trivia europæa (Montagu). (*Cypræa europæa*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed all round the coast from low-water mark to 100 fms.

Var. *minor*, Marshall. West coast of Ireland (Marshall, '93).

Distribution.—Iceland. Finmark to Mediterranean.

Erato lævis (Donovan). (*Marginella lævis*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Magilligan (Hyndman, f. Thompson, '56; Mrs. Tatlow, f. Praeger): off Ballycastle, dead (Chaster, '97A): Belfast Lough (Hyndman, f. Thompson, '40).
ii. Portmarnock (Warren, f. Thompson, '44A).
iii. Cork Harbour, rare (Humphreys, '45).
iv. Calf I. (Dublin Mus., coll. by Mrs. Townsend): Bantry Bay (Warren, f. Thompson MS.): co. Kerry (Dublin Mus., coll. by A. G. More).
v. Miltown Malbay, rare (Harvey, f. Thompson, '56; Dublin Mus., pres. by Miss. J. Locke): Aran I. (Ball, f. Thompson, '56): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Killala Bay, rare (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '44A; Waller Coll. in Dublin Mus.): R. D. S. Fish. Survey, 1890, Killybegs (Holt, '92): Inisbarnog, co. Donegal, one specimen (Mrs. Tatlow, '99).

Distribution.—Shetland to Mediterranean.

Family.—Cassididæ.

Cassidaria rugosa (Linné).

. . . iv., [v.], .

iv. North of Valentia, 40 fms., one dead specimen (Rev. G. B. Anderson, f. Haddon, '88): R. I. A. Exp., 1886, 265 fms., two living specimens (Haddon, '88): R. I. A. Exp., 1888, 345 fms., one living specimen (A. R. N.): "Research" Trawling Cruise, 1889, 400 fms., two specimens (Bourne, '90).
v. R. D. S. Fish. Survey, 1890, 40 miles off Achill Head, 220 fms., living (Holt, '92).

Distribution.—West Ireland to Mediterranean. Off Morocco and W. of Sahara, "Talisman" (Locard).

[*Cassidaria echinophora* (Linné).]

. . . . v., .

v. "Porcupine" Exp., 1869, 183 fms., fragments (Marshall, '94).

Distribution.—West Ireland. Mediterranean.

Family.—PTEROTRACHEIDÆ.

[*Carinaria mediterranea*, Péron & Lesueur.]

. . . iv., . .

iv. R. I. A. Exp., 1888, 56 miles off Dursey Head, depth 345 fms., four mutilated specimens taken in the tow nets (A. R. N.): "Flying Fox" Exp., 1889, S.W. Ireland (Green in Ann. & Mag. Nat. Hist. (6), iv., 1889).

Distribution.—Pelagic. Both sides of North Atlantic. Mediterranean.

Family.—EULIMIDÆ.

Eulima ephamilla, Watson.

. . . iv., . .

iv. R. I. A. Exp., 1886, Berehaven, 10–20 fms., one specimen (determined by J. T. Marshall).

Distribution.—British Isles. Off Pernambuco, "Challenger."

Eulima subulata (Donovan).

i., ii., iii., iv., v., vi.

i. Belfast Lough, dead (Grainger, '59).

ii. Dundrum, co. Down, 8–10 fms. (Hyndman and Thompson, f. Thompson, '56): Dublin (Ball, f. Thompson, '56).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Youghal (Ball, f. Thompson, '56): Cork Harbour (Humphreys, '45): between Baltimore and Cape Clear, 30 fms. (M'Andrew, f. Thompson, '56).

iv. Bantry Bay (Humphreys, f. Jeffreys, '67): "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '84): R. I. A. Exp., 1885, Berehaven, 5–25 fms., and mouth of Kenmare River, 38–48 fms. (Swanston, '86, Chaster, '98).

v. Birterbuy Bay, 12 fms. (Farran, f. Thompson, '56): "Porcupine" Exp., 1869, 165–183 fms. (Jeffreys, '84). Var. *nana*, Jeffreys. "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84).

vi. Bundoran, a specimen (Warren, f. Thompson, '56).

Distribution.—S. England, Wales, and Ireland to Mediterranean. Azores. Madeira. Canaries.

Eulima bilineata, Alder.

i., ii., iii., iv., [v.], vi.

i. Off Ballycastle, dead (Chaster, '97A): "Porcupine" Exp., 1869, North Channel, 40 fms. (Jeffreys, '84): Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): Strangford Lough, 7–20 fms., living, very rare, and off entrance, 12–15 fms., dead (Dickie, '58).
ii. Dublin Bay (Waller, f. Kinahan, '61): Portmarnock (Warren, f. Thompson, '40).
iii. Cork Harbour (Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 1888, 30–55½ fms. (Chaster, '98).
iv. Bantry Bay (Forbes & Hanley, '53): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, 5–44 fms. (Swanston, '86, Chaster, '98).
v. "Porcupine" Exp., 1869, 183–422 fms. (Jeffreys, '84).
vi. Killala Bay (Miss A. Warren, '92).

Some of the localities assigned to *E. subulata* probably refer to *E. bilineata*.

Distribution.—Finmark to Mediterranean. W. Africa, "Talisman." C. Hatteras to W. Indies (Dall).

Eulima polita (Linné).

i., ii., iii., iv., v., vi.

i. Entrance to Belfast Lough (Ordnance Survey Collectors and Hyndman, f. Thompson, '56): Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): Bangor, 8 fms., living (Swanston, f. Praeger, '89): Strangford Lough, 8–10 fms. (Hyndman and Thompson, f. Thompson, '56): Strangford Lough, 7–20 fms., dead, and off entrance, 12–15 fms., living, very rare (Dickie, '58).
ii. Dublin Bay (Thompson, '42; Walpole, '53A; Waller, f. Kinahan, '61): Dalkey Sound (Walpole, '53A).
iii. Off Porbally, Dunmore, 14 fms. (Walpole, '52): off Sherkin I., dead (A. R. N.).
iv. Bantry Bay (rare, Brown, '18; Humphreys, '45; Thompson, '56; M'Andrew Coll., f. Cooke, '82): R. I. A. Exp., 1885, 1886, Berehaven, 5–25 fms. (Chaster, '98).

v. Birterbuy Bay (Barlee, f. Thompson, '56 ; Warren Coll. in Dublin Mus. ; R. D. S. Fish. Survey, 1890) : Roundstone (D'Arcy W. Thompson) : Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Bartra and Enniscrone, a few examples (Miss A. Warren, '92) : Bundoran (Waller Coll. in Dublin Mus.).

Distribution.—Finmark to Mediterranean.

Eulima intermedia, Cantraine.

i., . iii., iv., v., .

i. Off Ballycastle, living (Chaster, '97A).

iii. Cork (Humphreys, f. Jeffreys, '67).

iv. R. I. A. Exp., 1885, Berehaven, 5 fms. (Chaster, '98).

v. Aran I. (Barlee, f. Jeffreys, '67) : Birterbuy Bay (Walpole, f. Jeffreys, '69).

Distribution.—Finmark to Mediterranean. Madeira. Canaries. C. Verd I. New England to Barbadoes (Verrill, Dall).

Eulima incurva (Renier). (*E. distorta*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A) : "Porcupine" Exp., 1869, North Channel, 40 fms. (Jeffreys, '84) : Belfast Lough, shell-sand, deep water (Hyndman, f. Thompson, '56) : Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59). Var. *gracilis*, Forbes & Hanley. Turbot Bank, dead, rare (Hyndman, '58) : off entrance to Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

ii. Portmarnock (Warren, f. Thompson, '56 ; Adams, '78) : Dublin Bay (Waller, f. Kinahan, '61).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56) : Cork Harbour (Jeffreys, f. Forbes & Hanley, '53) : R. I. A. Exp., 1885, 1886, 1888, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–55½ fms. (Chaster, '98).

iv. Bantry Bay (Jeffreys, f. Forbes & Hanley, '53 ; Farran, f. Thompson, '56) : Dingle Bay, 54 fms. (Adams, f. More, '70) : R. I. A. Exp., 1885, 1886, 5–48 fms. (Swanston, '86, Chaster, '98). Var. *gracilis*. R. I. A. Exp., 1886, Berehaven, 10–20 fms. (determined by J. T. Marshall).

v. Miltown Malbay (Harvey, f. Thompson, '56) : Aran I. (Barlee, f. Forbes & Hanley, '53) : Birterbuy Bay (15 fms., Farran, f. Thompson, '56 ; Barlee, f. Thompson, '56) : Roundstone (Alcock, '65; Standen, '95; D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96): "Porcupine" Exp., 1869, 165–183 fms. (Jeffreys, '84). Var. *gracilis.* "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84).

vi. Enniscrone, occasionally (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Loffoden I. to Mediterranean. Azores. Madeira. Canaries. W. Africa, "Talisman." New England. W. Indies. Mazatlan. N. Japan.

Eulima stenostoma, Jeffreys.

. . . iv., . .

iv. "Porcupine" Exp., 1869, 90–722 fms. (Jeffreys, '84).

Distribution.—Finmark to Mediterranean. Between Iceland and Greenland, "Valorous." N. E. America. Georgia (Dall).

Stilifer Turtoni, Broderip.

. ii., ...

ii. Dublin (Humphreys, f. Jeffreys, '67).

Distribution.—Norway. British Isles to Mediterranean. Canaries.

Family.—PYRAMIDELLIDÆ.

Jordaniella nivosa (Montagu). (*Odostomia nivosa*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Groomsport (Waller, f. Jeffreys, '58): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59).

ii. Dublin Bay (Turton, '19; Adams, '78).

iii. Cork (Jeffreys, '67).

iv. R. I. A. Exp., 1885, Berehaven, and S. entrance to Dursey Sound, 25 fms. (Chaster, '98).

v. Kilkee, shell-sand (Alder, '44): Roundstone (Standen, '95; D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96).

vi. Carrahubbuck, occasionally (Miss A. Warren, '92): Bundoran, one specimen (Mrs. Hancock, f. Thompson, '56): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Shetland to Channel Isles.

The generic name *Jordaniella* has been proposed by Chaster for this species and *Odostomia truncatula*, Jeffreys.

Jordaniella truncatula (Jeffreys). (*Odostomia truncatula*, Jeffreys, B. C.)

i., ...

i. Off Ballycastle, dead, one of the specimens with the operculum and remains of the animal (Chaster, '97A): Turbot Bank, dredged sand, one specimen (Jeffreys, f. Hyndman, '59): off Black Head, 25 fms. (Hyndman, '59).

Distribution.—S. England. Ireland to Mediterranean.

Odostomia unidentata (Montagu).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, dead (Hyndman, '58, '59): Twin Islands in Belfast Harbour (Swanston, f. Praeger, '89): Strangford Lough, 15–20 fms., a specimen (Hyndman and Thompson, f. Thompson, '56): off entrance to Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

ii. Dublin Bay (Turton, '19).

iii. Youghal (Ball, f. Thompson, '40): Clonakilty (Dillwyn, f. Jeffreys, '48): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms. (Chaster, '98).

iv. Dingle Bay (Leach, '52): "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '84): R. I. A. Exp., 1885, 1886, Valentia Harbour between tides, and 10–110 fms. (Swanston, '86, Chaster, '98).

v. Miltown Malbay, not rare (Harvey, f. Thompson, '56): Aran I. and Birterbuy Bay (Barlee, f. Jeffreys, '50): Roundstone (M'Calla, f. Thompson, '56; D'Arcy W. Thompson): Connemara (Dublin Mus., pres. by J. T. Marshall): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay, rare (Miss A. Warren, '92): Bundoran (Waller Coll. in Dublin Mus.): Mulroy Bay, dead (Praeger, '94).

Distribution.—Iceland. Finmark to Mediterranean. Madeira. Canaries. W. Africa, "Talisman." New England (Verrill). Florida (Dall). Off Brazil, "Challenger."

Odostomia turrita, Hanley.

i., . iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, dead (Waller, f. Hyndman, '59).

iii. R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off Baltimore, 30 fms. (Chaster, '98).

iv. Bantry Bay (Dublin Mus., pres. by J. T. Marshall): R. I. A. Exp., 1885, 1886, Berehaven, 10–20 fms., and S. entrance to Dursey Sound, 25 fms. (Chaster, '98). Var. *striolata*, Alder. Bantry Bay (Norman, f. Jeffreys, '67). Var. *nana*, Marshall. R. I. A. Exp., 1886, off Berehaven, 37½ fms. (Chaster, '98).

v. Birterbuy Bay (Barlee, f. Jeffreys, '50): Roundstone (Standen, '95; D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay, occasionally (Miss A. Warren, '92): Mulroy Bay, dead (Praeger, '94).

Distribution.—Finmark to Mediterranean. Madeira. Canaries. Off Brazil, "Challenger."

Odostomia plicata (Montagu).

i., ii., iii., iv., v., vi.

i. Belfast Lough (Hyndman and Thompson, f. Thompson, '56): Bangor and Turbot Bank, dead, rare (Hyndman, '58, '59): Strangford Lough (Hyndman and Thompson, f. Thompson, '56).

ii. Portmarnock (Warren, f. Thompson, '56; Hart, '92): Dublin Bay (Turton, '19; Leach, '52).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): Cork (Jeffreys, '67): R. I. A. Exp., 1886, Glandore Harbour, 4 fms. (Chaster, '98).

iv. Bantry Bay (Jeffreys, '48; Leach, '52; M'Andrew, f. Thompson, '56): R. I. A. Exp., 1885, 1886, Berehaven, 5–10 fms., and Ballinskelligs Bay (Chaster, '98): Kenmare River (Praeger, '99).

v. Aran I. (Barlee, f. Jeffreys, '48): Roundstone (M'Calla, f. Thompson, '56).

vi. Killala Bay, common (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56): Donegal (Dublin Mus., pres. by J. T. Marshall): Narin Strand, co. Donegal (G. P. Farran): Inch I., Lough Swilly, rather scarce (Hart, '92).

Distribution.—Norway to Mediterranean. Madeira.

O. turrita has been frequently mistaken for the present species, and Cork is the only Irish locality vouched for by Jeffreys in "British Conchology."

Odostomia acuta, Jeffreys.

i., . iii., iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead (Alder, f. Hyndman, '58).

iii. R. I. A. Exp., 1885, off Baltimore, 30 fms. (Swanston, '86, Chaster, '98). Var. *umbilicata*, Alder. Cork Harbour (Wright, f. Jeffreys, '58, sub var. *alba*).

iv. Bantry (M'Andrew Coll., f. Cooke, '82): R. I. A. Exp., 1885, 1886, 5–44 fms. (Swanston, '86, Chaster, '98). Var. *umbilicata.* Bantry Bay (M'Andrew, f. Jeffreys, '67).

v. Aran I. (Barlee, f. Jeffreys, '48): Roundstone (D'Arcy W. Thompson).

Distribution.—Loffoden I. to Mediterranean. Madeira. Canaries.

Odostomia umbilicaris (Malm).

. . . iv., . .

iv. R. I. A. Exp., 1886, off Berehaven, 37½ fms., a single specimen (Chaster, '98).

Distribution.—Finmark to British Isles. ? Mediterranean.

Odostomia conspicua, Alder.

i., . iii., iv., . .

i. Turbot Bank, dead (Alder, f. Hyndman, '58).

iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 52½–54 fms., young specimens (Chaster, '98).

iv. R. I. A. Exp., 1885, 70–79 fms. (Swanston, '86).

Distribution.—Loffoden I. to Mediterranean. Madeira (Watson).

Odostomia conoidea (Brocchi).

i., . iii., iv., v., .

i. Off Ballycastle, living (Chaster, '97A).

iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–52½ fms. (Chaster, '98). Var. *australis,* Jeffreys. Cork (Jeffreys, '67): R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms., a single specimen (Chaster, '98).

iv. "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '84): R. I. A. Exp., 1885, 1886, 4–80 fms. (Swanston, '86, Chaster, '98, A. R. N.).

v. "Porcupine" Exp., 1869, 183–208 fms. (Jeffreys, '84). Var. *australis.* Aran I. and Birterbuy Bay (Barlee, f. Jeffreys, '48, '50).

Some of the "Porcupine" specimens probably belong to var. *australis.*

Distribution.—Finmark to Mediterranean. Madeira. Canaries.

Odostomia Lukisi, Jeffreys.

. . . . v., vi.

v. Off Connemara (Dodd and Mellors, f. Marshall, '90).
vi. Bundoran, in drift shell-sand (Waller, f. Jeffreys, '67).
Distribution.—Shetland to Mediterranean.

Brachystomia pallida (Montagu). (*Odostomia pallida*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Belfast Lough, common: Strangford Lough (Thompson, '56): Ardmillan, Strangford Lough, shell-sand (Praeger, '89).
ii. Dublin Bay (Turton, '19; Leach, '52; Kinahan, '61).
iii. ?Off Hook Light, co. Wexford, 45–50 fms. (Walpole, '52): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–52½ fms. (Chaster, '98).
iv. R. I. A. Exp., 1885, 1886, shallow water to 25 fms. (Chaster, '98).
v. Aran I. (Barlee, f. Jeffreys, '48): Birterbuy Bay (Barlee, f. Jeffreys, '48; Walpole, '52): Connemara (Dublin Mus., pres. by J. T. Marshall). Var. *crassa*, Thompson. Birterbuy Bay (Barlee, f. Jeffreys, '67): Roundstone, a specimen (M'Calla, f. Thompson, '56). Monstr. Birterbuy Bay (Barlee, f. Jeffreys, '67).
vi. Killala Bay (Miss A. Warren, '92): Mulroy Bay, dead (Praeger, '94).
Distribution.—Loffoden I. to Mediterranean.

Brachystomia albella (Lovén). (*Odostomia albella*, Jeffreys, B. C.)

i., . . iv., v., .

i. Groomsport, a single specimen in shell-sand (Praeger, '92A).
iv. R. I. A. Exp., 1885, S. entrance to Dursey Sound, 25 fms. (Chaster, '98): Kenmare River (Praeger, '99).
v. Roundstone (Jeffreys, '48).
Distribution.—Finmark to Mediterranean. Madeira.

Brachystomia rissoides (Hanley). (*Odostomia rissoides*, Jeffreys, B.C.)

i., . iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank (Jeffreys, f. Hyndman, '59). Var. *nitida*, Alder, and var. *dubia*, Jeffreys. Turbot Bank (Jeffreys, f. Hyndman, '59). Var. *alba*, Jeffreys. Turbot Bank (Waller, f. Hyndman, '59).

iii. R. I. A. Exp., 1886, Glandore Harbour, 4 fms. (Chaster, '98).
iv. R. I. A. Exp., 1885, Berehaven, S. entrance to Dursey Sound, 25 fms., and Ballinskelligs Bay (Chaster, '98). Var. *alba*. Bantry Bay (M'Andrew, f. Jeffreys, '48).
v. Aran I. (Barlee, f. Jeffreys, '48): Roundstone (Barlee, f. Jeffreys, '48; Standen, '95; D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Killala Bay (Miss A. Warren, '92): Bundoran (Belfast Mus., f. Praeger, '89; Waller Coll. in Dublin Mus.): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Norway to Mediterranean. Madeira. W. Africa, "Talisman." Between Marion I. and Prince Edward I., "Challenger."

Brachystomia suboblonga (Jeffreys).

. . iii., [iv.], . .

iii. R. I. A. Exp., 1886, 13 miles S.W. of Galley Head, 43 fms., one specimen, dead (determined by J. T. Marshall).
iv. "Porcupine" Exp., 1869, 251–539 fms. (Jeffreys, '84).

Distribution.—S. W. Ireland to Mediterranean. C. Verd I., "Talisman."

Liostomia clavula (Lovén). (*Odostomia clavula*, Jeffreys, B.C.)

i., . iii., iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): Church Bay, Rathlin I., a live specimen (Chaster, '97B).
iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms. (Chaster, '98).
iv. "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '84): R. I. A. Exp., 1885, 1886, 5–79 fms., abundant (Chaster, '98). Var. *robusta*, Chaster. R. I. A. Exp., [1885, mouth of Kenmare River, 38–44 fms.] (Chaster, '98).
v. "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84): off Connemara (Dodd and Mellors, f. Marshall, '90).

Distribution.—Loffoden I. to Mediterranean.

[*Liostomia electa* (Jeffreys).]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 251–539 fms., a single but perfect specimen (Jeffreys, '84).

Distribution.—North Atlantic. Deep water.

[*Ondina nitens* (Jeffreys).]

. . . . v., .

v. "Porcupine" Exp., 1869, 422 fms. (Jeffreys, '84).

Distribution.—Faroe Channel. W. Ireland to Mediterranean. Azores. Deep water.

Ondina diaphana (Jeffreys). (*Odostomia diaphana*, Jeffreys, B. C.)

. . iii., iv., v., .

iii. R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms. (Chaster, '98).
iv. R. I. A. Exp., 1885, 5–48 fms. (Swanston, '86, Chaster, '98).
v. Off Connemara (Dodd and Mellors, f. Marshall, '90): Roundstone (Standen, '95): between Bunowen and Slyne Head (Welch, '96).

Distribution.—Norway to Bay of Biscay. ? Mediterranean.

Ondina divisa (J. Adams). (*Odostomia insculpta*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59).
ii. Dublin Bay (Waller, f. Kinahan, '61).
iii. R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–55½ fms. (Chaster, '98).
iv. R. I. A. Exp., 1885, 1886, 10–79 fms. (Chaster, '98).
v. Roundstone (D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96).
vi. Killala Bay (Miss A. Warren, '92): Bundoran (Waller Coll. in Dublin Mus.): Mulroy Bay, dead (Praeger, '94).

Distribution.—Iceland. Loffoden I. to Portugal.

Ondina obliqua (Alder). (*Odostomia obliqua*, Jeffreys, B. C.)

. . iii., iv., . vi.

iii. Cork Harbour (Jeffreys, '48; Wright & Carroll, '52).
iv. Bantry Bay (Jeffreys, '48).
vi. West of Ireland [prob. Bundoran] (Thompson, f. Alder, '44): Bundoran, two specimens (Thompson, '44A).

Distribution.—Sweden to Brittany. ? Mediterranean.

Ondina Warreni (Thompson). (*Odostomia Warreni*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead (Waller, f. Hyndman, '59).
ii. Portmarnock, two specimens (Warren, f. Thompson, '56).
iii. South coast of Ireland (Forbes & Hanley, '53).
iv. R. I. A. Exp., 1885, Berehaven, 5–25 fms. (Chaster, '98).
v. West coast of Ireland (Forbes & Hanley, '53): Birterbuy Bay (Barlee, f. Jeffreys, '67): Roundstone (D'Arcy W. Thompson): between Bunowen and Slyne Head (Welch, '96).
vi. Enniscrone and Carrahubbuck (Miss A. Warren, '92): Bundoran, a specimen (Mrs. Hancock, f. Thompson, '56): Narin Strand, co. Donegal (G. P. Farran). Var. *intermedia*, Marshall. Killala Bay (Marshall, '93).

Distribution.—Norway to Mediterranean. Madeira, "Talisman" (Locard).

Pyrgulina dolioliformis (Jeffreys). (*Odostomia dolioliformis*, Jeffreys, B. C.)

. . iii., . . .

iii. R. I. A. Exp., 1885, off Baltimore, 30 fms., two or three broken specimens (Chaster, '98).

Distribution.—Hebrides to Mediterranean.

Pyrgulina excavata (Philippi). (*Odostomia excavata*, Jeffreys, B. C.)

i., . . iv., v., vi.

i. Turbot Bank, dead (Waller, f. Hyndman, '59).
iv. Bantry Bay (Barlee, f. Thompson, '56, sub *Rissoa Harveyi*).
v. Miltown Malbay (Harvey, f. Thompson, '56, sub *R. Harveyi*; Humphreys, f. Jeffreys, '67): Aran I. (Barlee, f. Jeffreys, '48).
vi. Killala Bay, rare (Miss A. Warren, '92): Bundoran (Warren, f. Thompson, '56, sub *R. Harveyi*; Waller Coll. in Dublin Mus.).

Distribution.—British Isles to Mediterranean.

Pyrgulina decussata (Montagu). (*Odostomia decussata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59): co. Antrim (Belfast Mus., f. Praeger, '89).
ii. Portmarnock, rare (Brown, '18): Dublin Bay (Turton, '19; Kinahan, '61).
iii. South of Ireland (Leach, '52): R. I. A. Exp., 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 52½ fms. (Chaster, '98, A. R. N.).
iv. Bantry Bay (Jeffreys, '67): R. I. A. Exp., 1885, 5–79 fms. (Chaster, '98).
v. Aran I. (Barlee, f. Jeffreys, '48): Connemara (Dublin Mus., pres. by J. T. Marshall).
vi. Bundoran (Waller Coll. in Dublin Mus.).

Distribution.—Shetland to Mediterranean.

Pyrgulina spiralis (Montagu). (*Odostomia spiralis*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan, very sparingly in shell-sand (Miss Moody, f. Thompson, '56): off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): off entrance to Strangford Lough, 12–15 fms., dead, rare (Dickie, '58).
ii. Portmarnock (Warren, f. Thompson, '56): Dublin Bay (Waller, f. Kinahan, '61).
iii. Cork Harbour (Jeffreys, '48): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–55½ fms. (Chaster, '98).
iv. Bantry Bay (Jeffreys, '48): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, 5–110 fms. (Swanston, '86, Chaster, '98).
v. Birterbuy Bay (Barlee, f. Jeffreys, '48): Roundstone (D'Arcy W. Thompson).
vi. Carrahubbuck, sparingly (Miss A. Warren, '92): Sligo (Dublin Mus., pres. by J. T. Marshall): ? Bundoran (Thompson, '56): Mulroy Bay, dead (Praeger, '94).

Distribution.—Finmark to Mediterranean.

Pyrgulina interstincta (Montagu). (*Odostomia interstincta*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): Groomsport, shell-sand (Praeger, '92A).
ii. Portmarnock (Thompson, '56): Dublin Bay (Jeffreys, '48; Waller, f. Kinahan, '61).
iii. Cork (Jeffreys, '48): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–55½ fms. (Chaster, '98). Var. *terebellum*, Philippi. Cork Harbour (Jeffreys, '67).
iv. Bantry Bay (Barlee, f. Jeffreys, '50): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp. 1885, 1886, shallow water to 79 fms. (Swanston, '86, Chaster, '98). Var. *suturalis*, Philippi. Bantry Bay (Jeffreys, '48).
v. Birterbuy Bay (Jeffreys, '48; Barlee, f. Thompson, '56): Roundstone (D'Arcy W. Thompson): Connemara (Dublin Mus., pres. by J. T. Marshall): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Carrahubbuck, sparingly (Miss A. Warren, '92): Bundoran (Waller Coll. in Dublin Mus.): Mulroy Bay, dead (Praeger, '94).

Distribution.—Loffoden I. to Mediterranean. Madeira. Canaries.

Pyrgulina indistincta (Montagu). (*Odostomia indistincta*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): Strangford Lough and off entrance, dead, very rare (Dickie, '58).
ii. Portmarnock (Hyndman and Warren, f. Thompson, '56): Dublin Bay (Jeffreys, '48; Waller, f. Kinahan, '61).
iii. Youghal (Miss M. Ball, f. Thompson, '56, sub *Rissoa Balliæ*): Cork Harbour (Jeffreys, '48): R. I. A. Exp., 1885, 1886, 1888, Lough Hyne, and off S. coast of Cork, 30–52½ fms. (Chaster, '98, A. R. N.). Var. *simulans*, Chaster. R. I. A. Exp., 1886, Lough Hyne (Chaster, '98).

iv. Bantry Bay (Jeffreys, '48): R. I. A. Exp., 1885, 1886, 5–80 fms. (Chaster, '98). Var. *simulans*. R. I. A. Exp., 1885, 1886, 37½–40 fms. (Chaster, '98).

v. Birterbuy Bay (Barlee, f. Jeffreys, '48): Roundstone (D'Arcy W. Thompson): Connemara (Dublin Mus., pres. by J. T. Marshall): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84).

vi. Carrahubbuck, sparingly (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56).

Distribution.—Norway to Mediterranean. Madeira. Canaries.

Pyrgulina clathrata (Jeffreys). (*Odostomia clathrata*, Jeffreys, B.C.)

. . . . v., .

v. Birterbuy Bay (two specimens, Barlee and Jeffreys, f. Jeffreys, '67; two specimens, Dodd and Mellors, f. Marshall, '90).

Distribution.—W. Ireland. Mediterranean. Madeira. Canaries.

Pyrgulina scalaris (Philippi). (*Odostomia scalaris*, Jeffreys, B.C.)

i., ii., iii., iv., . vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59). Var. *rufescens*, Forbes. Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): off Groomsport, dead, rare (Waller, f. Hyndman, '58): co. Antrim (Jeffreys, '67): Lough Strangford, dead, very rare (Dickie, '58, Jeffreys, '67).

ii. Dublin coast, very rare (Ball and Warren, f. Thompson, '56, sub *Chemnitzia Jeffreysii*).

iii. Var. *rufescens*. ? Off Hook Light, co. Wexford, 45–50 fms. (Walpole, '52): Cork Harbour, one dead example (Wright & Carroll, '52).

iv. R. I. A. Exp., 1885, S. entrance to Dursey Sound, 25 fms. (Chaster, '98): Dingle Bay, 54 fms. (Adams, f. More, '70). Var. *rufescens*. R. I. A. Exp., 1886, Valentia Harbour, 4–7 fms. (Chaster, '98).

vi. Mulroy Bay, dead (Praeger, '94).

It is possible that some of the localities referred to the typical form should be assigned to the variety, and *vice versa*.

Distribution.—Finmark to Mediterranean. Madeira.

Pyrgulina interrupta (Totten). (*Odostomia rufa*, var. *fulvocincta*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Church Bay, Rathlin I., living (Chaster, '97B): north of Ireland (Jeffreys, '67): Turbot Bank, dead (Alder, f. Hyndman, '58). Var. *rufa*, Philippi. Church Bay, Rathlin I., a few specimens (Chaster, '97B): "Porcupine" Exp., 1869, North Channel, 40 fms. (Jeffreys, '84): Turbot Bank (Jeffreys, f. Hyndman, '59). Var. *crenata*, Brown. Church Bay, Rathlin I., living (Chaster, '97B).

ii. Portmarnock (Miss Ball and Warren, f. Thompson, '56; Adams, '78): Dublin Bay (Kinahan, '61): Dalkey Sound (Adams, '78): east of Ireland (Jeffreys, '67). Var. *rufa*. Portmarnock, &c., dead, rare (Walpole, '53A): Dublin Bay (Jeffreys, '48).

iii. South of Ireland (Jeffreys, '67): R. I. A. Exp., 1885, off Galley Head, 54 fms. (Swanston, '86, Chaster, '98).

iv. Bantry Bay (Humphreys, f. Jeffreys, '48; M'Andrew, f. Jeffreys, '48, '67): Dingle Bay (Leach, '52): R. I. A. Exp., 1885, 1886, 37½–79 fms. (Swanston, '86, Chaster, '98).

v. Var. *rufa*. Birterbuy Bay (Barlee, f. Jeffreys, '48): "Porcupine" Exp., 1869, 173–208 fms. (Jeffreys, '84).

vi. Bundoran (Belfast Mus., f. Praeger, '89). Var. *rufa*. Mulroy Bay, dead (Praeger, '94).

Some of the localities assigned to the var. *rufa* may possibly belong to the typical form.

Distribution.—Loffoden I. to Mediterranean. Madeira. Canaries. N.E. America. Florida and W. Indies (Dall).

Turbonilla lactea (Linné). (*Odostomia lactea*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

Generally distributed in the laminarian and coralline zones, and common.

Distribution.—Finmark to Mediterranean. Azores. Morocco. Madeira. Canaries.

Turbonilla pusilla (Philippi). (non *Odostomia pusilla*, Jeffreys, B.C.)

i., ii., iii., iv., v., .

i. Church Bay, Rathlin I., one live and several dead specimens (Chaster, '97B).

ii. Portmarnock (Marshall, '93): Dublin Bay (Jeffreys, '48, sub *Odostomia lactea*, var. *d*, Chaster, '97B).

iii. Var. *lactoides*, Monterosato MS. R. I. A. Exp., [1885, off Baltimore, 30 fms.] (Chaster, '98).

iv. Bantry Bay (Jeffreys, '48, sub *O. lactea*, var. *d*): R. I. A. Exp., 1885, 1886, Berehaven and off entrance, 5–37½ fms., fragments (Chaster, '98): Kenmare River (Praeger, '99).

v. Birterbuy Bay (Barlee, f. Jeffreys, '48, sub *O. lactea*, var. *d*; Walpole, f. Jeffreys, '69). Var. *minuscula*, Marshall. Connemara (B. S. Dodd, f. Marshall in Journ. of Conch., vi., 1891).

Some of the specimens from Birterbuy Bay may belong to *Odostomia pusilla* of Jeffreys, which has been renamed *Turbonilla innovata* by the Marquis of Monterosato.

Distribution.—British Isles to Mediterranean. Madeira (Watson).

Turbonilla delicata (Monterosato).

i., . . . v., vi.

i. Portrush (Marshall, '93).

v. "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84): Roundstone Bay, 12 fms. (Marshall, '93).

vi. Bartra, one specimen, and Bundoran, one specimen (Marshall, f. Miss A. Warren, '93): "Porcupine" Exp., 1869, Donegal Bay, 25–40 fms. (Jeffreys, '84).

Distribution.—Ireland to Mediterranean.

Eulimella Scillæ (Scacchi). (*Odostomia Scillæ*, Jeffreys, B. C.)

i., . iii., iv., . .

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank (Waller and Hyndman, f. Hyndman, '59; Waller, '60): off Black Head, 25 fms. (Hyndman, '59).

iii. R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms. (Chaster, '98).

iv. "Porcupine" Exp., 1869, 90–722 fms. (Jeffreys, '84): R. I. A. Exp., 1885, 5–48 fms. (Swanston, '86, Chaster, '98).

Distribution.—Finmark to Mediterranean. Azores. Madeira. Canaries. W. Africa, "Talisman." C. Hatteras to W. Indies (Dall).

[*Eulimella compactilis* (Jeffreys). (*Odostomia Scillæ*, var. *compactilis*, Jeffreys, B.C.)]

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 251–539 fms., a single specimen (Jeffreys, '84).

v. "Porcupine" Exp., 1869, 183 fms., a single specimen (Jeffreys, '84).

Distribution.—Loffoden I. to off S. W. Ireland.

Eulimella acicula (Philippi). (*Odostomia acicula*, Jeffreys, B. C.)

i., . iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, dredged sand (Waller and Jeffreys, f. Hyndman, '59). Var. *obeliscus*, Jeffreys. North-east Ireland (Waller, f. Jeffreys, '67).
iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–52½ fms. (Chaster, '98, A. R. N.).
iv. Bantry Bay (Jeffreys, '48; M'Andrew Coll., f. Cooke, '82): Dingle Bay, 54 fms. (Adams, f., More, '70): R. I. A. Exp., 1885, 1886, 1888, 4–120 fms. (Chaster, '98).
v. Aran I. and Birterbuy Bay (Jeffreys, '48): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '84): Roundstone (D'Arcy W. Thompson).
vi. Mulroy Bay, dead (Praeger, '94).
Distribution.—Norway to Mediterranean. Corea.

Eulimella ventricosa (Forbes). (*Odostomia acicula*, var. *ventricosa*, Jeffreys, B. C.)

i., . iii., iv., v., .

i. Turbot Bank, dead (Waller, f. Hyndman, '59, sub *E. affinis*).
iii. R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms. (Chaster, '98).
iv. R. I. A. Exp., 1885, 1886, 70–110 fms. (Chaster, '98).
v. Aran I. (Barlee, f. Jeffreys, '58).
Distribution.—Loffoden I. to Mediterranean. Madeira. C. Verd I., "Talisman."

Eulimella nitidissima (Montagu). (*Odostomia nitidissima*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A).
ii. Portmarnock (rare, Brown, '18; Thompson, '56): Dublin Bay (Turton, '19): east of Ireland (Jeffreys, '67).
iii. Cork Harbour (Jeffreys, f. Forbes & Hanley, '53): south of Ireland (Jeffreys, '67).
iv. R. I. A. Exp., 1885, 1886, 3½–25 fms. (Chaster, '98).

v. Miltown Malbay (Harvey, f. Thompson, '56): Aran I. (Barlee, f. Jeffreys, '58): Roundstone (Barlee, f. Thompson, '56; Standen, '95): between Bunowen and Slyne Head (Welch, '96): west of Ireland (Jeffreys, '67).

vi. Bartra and Enniscrone (Miss A. Warren, '92): Bundoran (Thompson, '56): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Finmark. British Isles to Mediterranean. Madeira.

Family.—MURICIDÆ.

Trophon muricatus (Montagu).

i., ii., iii., iv., v., .

i. Magilligan, living (Rev. J. D. Falkiner, f. Praeger): off Ballycastle, living (Chaster, '97A): off Larne Lough, 20 fms., and off Black Head, 25 fms., living (Hyndman, '59): off the Maidens, 70–100 fms., Turbot Bank, off Groomsport, and Donaghadee, dead, common (Hyndman, '58, '59): Strangford Lough and off entrance, dead (Dickie, '58).

ii. Portmarnock (Brown, '18; Adams, '78): Dublin Bay (Turton, '19; Kinahan, '61): North Bull (Hart, '92): strands of Merrion, &c. (Walpole, '53A): Dalkey Sound (Walpole, '53A; Adams, '78): Greystones (Mackintosh, '84).

iii. Off Saltee I., 40 fms. (Walpole, '52): Cork Harbour, rare (Humphreys, '45).

iv. Bantry Bay (M'Andrew, f. Thompson MS.): "Porcupine" Exp., 1869, S. W. Ireland (Jeffreys, '69A): R. I. A. Exp., 1885, 70–79 fms. (Swanston, '86, Chaster, '98).

v. Aran I. (Barlee, f. Jeffreys, '67).

Distribution.—British Isles to Mediterranean. Azores, "Talisman" (Locard). ? N. E. America.

Trophon barvicensis (Johnston).

i., ii., iii., . . .

i. Off Ballycastle, living (Chaster, '97A): off Larne Lough, 20 fms., and off Black Head, 25 fms., living (Hyndman, '59): Belfast Lough, 8–10 fms., and Turbot Bank, dead (Hyndman, '58, '59): off Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

ii. Dublin Bay (Kinahan, '61): Dalkey Sound, very rare (Walpole, '53A).

iii. Cork (Humphreys, f. Jeffreys, '67): R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms., dead (A. R. N.).

Distribution.—Finmark to Mediterranean. Morocco, "Travailleur" (Locard).

T. barvicensis is probably only a variety of *T. muricatus*.

Trophon clathratus (Linné). (*T. truncatus*, Jeffreys, B. C.)

i., ii., iii., iv., v., .

i. Magilligan (Hyndman, f. Thompson MS.): off Ballycastle, living (Chaster, '97A): off Larne Lough, 20 fms., off Black Head, 25 fms., and off the Maidens, 70–90 fms., living (Hyndman, '59): Belfast Lough, 6–10 fms., living (Hyndman, '58): Belfast Lough (Dublin Mus., coll. by R. L. Praeger): Turbot Bank and off the Maidens, &c., dead (Hyndman, '58, '59): Strangford Lough, 7–20 fms., and off entrance, 12–15 fms., dead, rare (Dickie, '58). Var. *alba*, Jeffreys. Off Ballycastle, living (Chaster, '97A).

ii. Trawled off Skerries (Walpole, '52): Dublin Bay (Turton, '19; Walpole, '53A; Kinahan, '61; Warren, f. Adams, '78): east of Ireland (Jeffreys, '67).

iii. Ardmore (Mrs. Mackesy, f. Thompson MS.): Youghal (Ball, f. Thompson MS.): south of Ireland (Leach, '52; Jeffreys, '67): R. I. A. Exp. 1885, 1886, off S. coast of Cork, 30–52½ fms. (Chaster, '98). Var. *alba*. R. I. A. Exp., 1885, off Baltimore, 30 fms., a live specimen (Chaster, '98).

iv. South-west Ireland (Leach, '52): "Porcupine" Exp., 1869, 85 fms. (Jeffreys, '77): R. I. A. Exp., 1885, 4–80 fms. (Swanston, '86, Chaster, '98).

v. Roundstone (Standen, '95).

All the above records refer to var. *truncata*, Ström.

Distribution.—Arctic seas in both hemispheres to British Isles, New England, and Japan.

Ocinebra erinacea (Linné). (*Murex erinaceus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. North of Ireland, dead, frequent (Praeger, '89): Belfast Lough, deep water, living, rare (Hyndman, '58): off Rockport, Belfast Lough, 3 fms., living (Praeger, '89): Cultra, living (Praeger).

ii. Warrenpoint, living, common (Miss Smythe, f. Praeger): Dublin coast, generally distributed: Greystones (Mackintosh, '84).

iii. Woodstown, near Dunmore (Dublin Mus., coll. by Mrs. Tatlow): Dungarvan (A. R. N.): Youghal (Ball, f. Thompson MS.): Ballycottin, Cork, &c. (Humphreys, '45): co. Cork (Dublin Mus.): Sherkin I. (A. R. N.).
iv. Co. Kerry (Dublin Mus.): Kenmare River (Praeger, '99): Valentia (Cockerell, '87; Waller Coll. in Dublin Mus.): Dingle (Cockerell, '85).
v. Miltown Malbay (Harvey, f. Thompson MS.): Aran I. (Dublin Mus., pres. by E. P. Wright; R. D. S. Fish. Survey, 1890): Roundstone (Alcock, '65): Killary and Clew Bays (Thompson MS.).
vi. Killala Bay (Miss A. Warren, '92): Donegal, all round the coast, scarce (Hart, '92).

Distribution.—British Isles to Mediterranean. Azores. Madeira.

[*Pseudomurex lamellosus* (Cristofori & Jan).]

. . . iv., . .

iv. "Porcupine" Exp., 1869, S. W. Ireland, 110 fms. (Wyv. Thomson, '73).

Distribution.—S. W. Ireland. Gulf of Gascony. Mediterranean. W. Africa, "Talisman" (Locard).

Purpura lapillus (Linné).

i., ii., iii., iv., v., vi.

Very common everywhere, on rocks and stones between tide-marks.

Distribution.—Arctic seas in both hemispheres to Mogador, Canaries, and New England. N. W. America. Mexico.

Family.—COLUMBELLIDÆ.

[*Columbella haliæeti*, Jeffreys.]

. . . iv., v., .

iv. R. I. A. Exp, 1886, 1888, 110–750 fms. (Chaster, '98, A. R. N.): "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).
v. Off west of Ireland, a very young specimen (Hoskyns, f. Jeffreys, '67): "Porcupine" Exp., 1869, between Galway and Porcupine Bank (Jeffreys, '69A).

Distribution.—Finmark to Setubal and Azores. Mediterranean. Greenland. N. E. America.

Family.—NASSIDÆ.

Nassa reticulata (Linné).

i., ii., iii., iv., v., vi.

Generally distributed round the coast in the littoral and laminarian zones.

Distribution.—Norway to Mediterranean. Azores. Madeira (Watson).

Nassa incrassata (Ström).

i., ii., iii., iv., v., vi.

Generally distributed round the coast at and below low-water mark.

Var. *simulans*, Jeffreys. Connemara (Barlee, f. Jeffreys, '67).

Distribution.—Iceland. Finmark to Mediterranean. Azores. Morocco. Senegal. Madeira. Canaries.

Nassa pygmæa (Lamarck).

i., ii., . iv., v., vi.

i. ?Turbot Bank, dead, rare (Dickie, f. Hyndman, '58): Turbot Bank, living (Waller, f. Hyndman, '59).
ii. Dublin Bay (Kinahan, '61).
iv. Bantry Bay, 12–15 fms., a dead specimen (M'Andrew, f. Thompson, '56).
v. West of Ireland, 60 fms. (Dublin Mus., coll. by A. G. Melville): Roundstone (Alcock, '65).
vi. Killala Bay (Miss A. Warren, '92).

Distribution.—Norway. Sweden. S. England and Ireland to Mediterranean. Azores.

Family.—BUCCINIDÆ.

Neptunea antiqua (Linné). (*Fusus antiquus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i., ii., iii. Generally distributed and common. Var. *alba*, Jeffreys. Carrickfergus (Belfast Mus., f. Praeger, '89). Var. *striata*, Jeffreys. Portmarnock, one specimen (O'Kelly, f. Brown, '18): south-east and south Ireland (Jeffreys, '67): south of the Tuskar Lighthouse (Dublin Mus., pres. by C. Farran): Dungarvan, very abundant (Farran in Ninth Ann. Rep. Dublin N. H. S., 1849; A. R. N.): Waterford coast (Jordan, '90):

S. W. Ireland [R. I. A. Exp., 1888, off S. coast of Cork, 50 fms.], one specimen, living (Jordan, '92). Var. *gracilis*, Jeffreys. Off Cape Clear (Jeffreys, '67). Monstr. Off Groomsport, a specimen (Vance, f. Hyndman, '58A).

iv. Bantry Bay (Humphreys, '45): R. I. A. Exp., 1885, Berehaven, 5–25 fms. (Swanston, '86).

v. Roundstone (Standen, '95).

vi. Killala Bay (Miss A. Warren, '92).

Distribution.—Norway to Bay of Biscay.

Neptunea despecta (Linné). (*Fusus despectus*, Jeffreys, B.C.)

. . . iv., [v.], .

iv. S. W. Ireland [R. I. A. Exp.], 1885, [mouth of Kenmare River, 38–48 fms.], a dead specimen (Jordan, '92).

v. "Porcupine" Exp., 1869, between Galway and Porcupine Bank (Jeffreys, '69A).

Distribution.—Arctic seas to S. W. Ireland, New England, and Japan. Off Portugal, "Challenger."

N. despecta is probably only a variety of *N. antiqua*.

Sipho islandicus (Chemnitz). (*Fusus islandicus*, Jeffreys, B. C.)

. . iii., [iv.], [v.], .

iii. Wexford coast, one specimen (Walpole, f. Jeffreys, '67): between the Pembrokeshire and Waterford coasts, living (Jordan, '90, '92).

iv. S. W. Ireland [R. I. A. Exp. 1888, 345 fms.], a living specimen (Jordan, '92).

v. "Porcupine" Exp., 1869, between Galway and Porcupine Bank (Jeffreys, '69A).

Distribution.—Spitzbergen (Friele). Iceland. Finmark to Gulf of Gascony. Morocco, "Talisman" (Locard). Greenland. N. E. America.

Sipho gracilis (Da Costa). (*Fusus gracilis*, Jeffreys, B. C.)

i., ii., iii., iv., . vi.

i. Magilligan (Hyndman, f. Thompson MS.): off Ballycastle, dead (Chaster, '97A): Belfast Lough and off entrance, living, frequent (Hyndman, '58, '59, '60; Praeger, '89).

ii. Dublin coast, common (Brown, '18; &c.): Greystones (Mackintosh, '84).

iii. Youghal (Ball, f. Thompson MS.): Cork Harbour (Humphreys, '45): R. I. A. Exp. 1885, off Glandore, 40 fms. (Swanston, '86). Var. *Belliana*, Jordan. Off Wexford and Waterford coasts, 20–30 fms., living (Jordan, '90).

iv. Bantry Bay (Humpheys, '45): off Dingle (W. Andrews in Journ. R. D. S., III., 1862): "Research" Trawling Cruise, 1889, 400 fms. (Bourne, '90): S.W. Ireland [R. I. A. Exp. 1886, off Dursey Head, 93 fms.] (Jordan, '92): S. W. Ireland [R. I. A. Exp. 1888, 345 fms.] (Jordan, '92).

vi. Killala Bay (Miss A. Warren, '92).

Distribution.— Arctic seas to Bay of Biscay. Morocco, "Talisman" (Locard). ? Mediterranean. Bering Strait.

Sipho propinquus (Alder). (*Fusus propinquus*, Jeffreys, B. C.)

. . . iv., v., .

iv. R. I. A. Exp., 1885, Berehaven, 5–25 fms., and off Skelligs, 70–79 fms. (Swanston, '86, Jordan, '92, Chaster, '98). Var. *intermedia*, Jordan. S. W. Ireland [R. I. A.] Exp., 1886, [off Dursey Head], 108 fms., an immature specimen (Jordan, '92). Var. *nana*, Jordan. S. W. Ireland [R. I. A. Exp. 1885, off Skelligs, 70–79 fms.] (Jordan, '92). Var. *incrassata*, Jordan. S. W. Ireland [R. I. A. Exp. 1886, off Berehaven, 37½ fms.] (Jordan, '92).

v. R. D. S. Fish. Survey, 1891, west of Clare I., 45–60 fms. (Jordan).

Distribution.—Finmark to Gulf of Gascony.

Sipho Jeffreysianus (Fischer). (*Fusus Jeffreysianus*, Jeffreys, B. C.)

. ii., iii., iv., v., .

ii. Off Skerries (Walpole,'52): off Dublin coast, 60 fms. (Walpole,'53): Dublin Bay (Kinahan, '61): from beach near Wexford after a storm, several specimens (Jordan, '90).

iii. Off Saltee I. (Walpole, '52): Waterford coast (Walpole, f. Jeffreys, '67): off Waterford coast, 20–30 fms. (Jordan, '90): Cork (Humphreys, f. Walpole, in Jeffreys, '67, '69).

iv. Bantry Bay (Humphreys and Jeffreys, f. Jeffreys, '67): S. W. Ireland [R. I. A. Exp. 1885, mouth of Bantry Bay, 35–40 fms.] (Jordan, '92).

v. Off Aran I. (Melville, f. Walpole, '53).

S. Jeffreysianus is probably only a variety of *S. propinquus*, and has been recorded by Walpole and others under this name.

Distribution.—S. England and Ireland to Spain. ? Mediterranean.

Sipho fusiformis (Broderip). (*Fusus fenestratus*, Jeffreys, B. C.)

. . iii., [iv.], [v.], .

iii. Between Pembrokeshire and Waterford coasts, a dead but fresh specimen (Jordan, '92): outside Cork Harbour, 40 fms. (Humphreys, '45): S. W. Ireland [R. I. A. Exp. 1888, off S. coast of Cork, 50 fms.], dead (Jordan, '92).

iv. Between Cape Clear and Newfoundland, two specimens, living (Stutchbury, f. Jeffreys, '67): "Porcupine" Exp. 1869, 180–458 fms. (Wyv. Thomson, '73): "Flying Fox" Exp., 1889, 110 fms., a very fine specimen (Smith, '89).

v. "Porcupine" Exp., 1869, between Galway and Porcupine Bank (Jeffreys, '69A).

Distribution. — Greenland. Finmark to Portugal. Morocco, "Talisman" (Locard).

Liomesus Dalei (J. Sowerby). (*Buccinopsis Dalei*, Jeffreys, B. C.)

. . iii., [iv.], [v.], .

iii. Co. Cork, in intestines of red gurnard and haddock (Humphreys, '45, Jeffreys, '67).

iv. S. W. Ireland [R. I. A. Exp., 1888, 345 fms.], two dead specimens (Jordan, '92).

v. West of Ireland, 100 fms. (King, '63, Jeffreys, '67): R. D. S. Fish. Survey, 1890, off Achill Head, 144 fms., two dead specimens (A. R. N.).

Distribution.—Loffoden I. to S. Ireland.

Buccinum undatum, Linné.

i., ii., iii., iv., v., vi.

Very common all round the coast and at all depths.

Var. *littoralis*, King. Carrickfergus (Belfast Mus., f. Praeger, '89): Killeany, Aran I. (Standen, '95). Var. *striata*, Pennant. Off the Maidens, 60 fms., living (Hyndman, '60). Var. *zetlandica*, Forbes. Bunowen, co. Galway (Farran, f. Thompson, '56): west of Ireland (Jeffreys, '67). Monstr. *carinatum*, Turton. Portmarnock, Bullock, and Bray (Turton, '19): east and south of Ireland (Thompson, '56): south and west [prob. east] of Ireland (Jeffreys, '67). Monstr. *acuminatum*, Broderip. Cork (Jeffreys, '59).

Distribution.—Arctic seas in both hemispheres to S. W. France and New England.

Buccinum Humphreysianum, Bennett.

. . iii., iv., v., .

iii. Youghal (Ball, f. Thompson, '56): Cork Harbour, and outside, 40 fms. (Bennett, '25; Humphreys, '45): co. Cork, 40 fms. (Armstrong, f. Jeffreys, '67): S. W. Ireland [R. I. A. Exp., 1886, 1888, off S. coast of Cork, 50–52½ fms.], living (Jordan, '92).

iv. Bantry Bay (Mrs. Puxley, f. Leach, '52; Armstrong, f. Forbes & Hanley, '53; Humphreys, f. Thompson, '56): "Porcupine" Exp., 1869, off Valentia, 110 fms. (Jeffreys, '69A): S. W. Ireland [R. I. A. Exp., 1886, off Skelligs, 70–80 fms.], one specimen, living (Jordan, '92). Var. *ventricosum*, Kiener. S. W. Ireland, one dead specimen (Jordan, '92).

v. West coast of Ireland (Barlee, f. Thompson, '56): Connemara (King, f. Jeffreys, '67).

Distribution.—Finmark to Bay of Biscay. ? Mediterranean.

Family.—FASCIOLARIIDÆ.

[*Troschelia berniciensis* (King). (*Fusus berniciensis*, Jeffreys, B. C.)]

. . . iv., v., .

iv. S.W. Ireland [R. I. A. Exp. 1888, 345 fms.], two dead specimens (Jordan, '92).

v. R. D. S. Fish. Survey, 1890, off Achill Head, 220–500 fms. (one living specimen determined by H. K. Jordan and three dead specimens in Dublin Mus.).

Distribution.—Finmark to Bay of Biscay. Azores, Morocco, W. Africa, and Canaries, "Talisman" (Locard). North Atlantic, "Valorous."

Family.—CONIDÆ.

Teretia anceps (Eichwald). (*Defrancia teres*, Jeffreys, B.C.)

i., . iii., iv., v., .

i. Turbot Bank, dredged sand (dead, rare, Hyndman, '58; Waller, '60).

iii. Cork Harbour, dead (Wright & Carroll, '52): R.I.A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms. (Chaster, '98).

iv. Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, 35–110 fms. (Swanston, '86, Chaster, '98, A. R. N.).

v. Birterbuy Bay (living, Walpole, '52; one dead specimen, 14 fms., Barlee, f. Thompson, '56): Connemara (Jeffreys, '67): off the west of Ireland, deep sea soundings (Hoskyns, f. Jeffreys, '67). Var. *alba*, Jeffreys. West of Ireland (Jeffreys, '59).

Distribution.—Finmark to Mediterranean. Azores Morocco. Madeira. Canaries.

Bellardiella gracilis (Montagu). (*Defrancia gracilis*, Jeffreys, B.C.)

. ii., iii., iv., v., .

ii. Trawled off Skerries (Walpole, '52): Portmarnock, rare (Thompson, '56): Dublin Bay (Brown, '18; Turton, '19; Warren, f. Adams, '78; Hart, '92): Bray, rare (Thompson, '56): east of Ireland (Jeffreys, '67).

iii. Cork Harbour, one living and two dead specimens (Wright & Carroll, '52): south of Ireland (Jeffreys, '67): R. I. A. Exp., 1885, 1886, 1888, off S. coast of Cork, 30–52½ fms. (Chaster, '98, A. R. N.).

iv. R. I. A. Exp., 1885, Berehaven, 5–25 fms. (Swanston, '86): Valentia Harbour (Waller Coll. in Dublin Mus.).

v. Birterbuy Bay, dead (Walpole, '52): Aran I. (Barlee, f. Forbes & Hanley, '53): west of Ireland (Jeffreys, '67).

Distribution.—Shetland to Mediterranean. Azores. Morocco. Madeira. Canaries.

Clathurella Leufroyi (Michaud). (*Defrancia Leufroyi*, Jeffreys, B.C.)

i., ?ii., iii., . v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank sand, dead, but very fresh, and off the Copelands, 40 fms., a single broken specimen (Hyndman and Waller, f. Hyndman, '59).

?ii. Portmarnock (a specimen, Warren, f. Thompson, '56; Hart, '92). It is doubtful if Warren's specimen really came from Portmarnock, as Birterbuy Bay is the only locality given in a manuscript list of Irish shells by Mr. Warren; Hart's record probably refers to the next species.

iii. Cork (Humphreys, f. Jeffreys, '67).

v. Connemara (Barlee and Jeffreys, f. Jeffreys, '67): Birterbuy Bay (Thompson MS.; Warren Coll. in Dublin Mus.).

vi. Killala Bay (Marshall, f. Miss A. Warren, '92).

Distribution.—Norway to Mediterranean. Azores. Madeira. Canaries.

Clathurella linearis (Montagu). (*Defrancia linearis*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, dead, and off Black Head, 25 fms. (Hyndman, '58, '59): Strangford Lough, 7–20 fms., and off entrance, 12–26 fms., dead, rare (Dickie, '58).
ii. Portmarnock (Warren, f. Thompson MS.; Adams, '78): Dublin Bay (Turton, '19; Kinahan, '61): Dalkey Sound, &c., not uncommon (Walpole, '53A).
iii. Off Bonmahon, co. Waterford, in *Adamsia maculata* (Farran in Proc. Dub. Univ. Zool. and Bot. Ass., II., 1860): Cove, co. Cork (Ball and Forbes, f. Thompson MS.): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 39½–55½ fms. (Chaster, '98, A. R. N.).
iv. S.W. Ireland, dredged (M'Andrew, f. Thompson MS.): R.I.A. Exp., 1885, 1886, 4–80 fms. (Chaster, '98, A.R.N.).
v. Miltown Malbay (Harvey, f. Thompson MS.): Roundstone (Alcock, '65; Standen, '95; D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Killala Bay, common (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson MS.; Waller Coll. in Dublin Mus.): Narin, &c., co. Donegal (Mrs. Tatlow, '99): Mweelfinn, Sheephaven (Hart, '92).

Distribution.—Iceland. Finmark to Mediterranean. Madeira. Canaries.

Clathurella reticulata (Renier). (*Defrancia reticulata*, Jeffreys, B.C.)

i, . iii., iv., v., .

i. North of the Maidens, deep water, a single dead specimen (Jeffreys, f. Hyndman, '60): Turbot Bank sand (Jeffreys, f. Hyndman, '59, sub *Mangelia scabra*).
iii. Cork (Humphreys, f. Jeffreys, '67).
iv. Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 38-80 fms., very rare (Swanston, '86, Chaster, '98).
v. Birterbuy Bay (Walpole, f. Jeffreys, '67).

Distribution.—Norway to Mediterranean. Madeira.

Clathurella purpurea (Montagu). (*Defrancia purpurea*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Belfast Lough, shell-sand, dead, rare (Hyndman, '58): Bangor (Belfast Mus., f. Praeger, '89): Cultra, shell-sand on beach (Praeger, '89): off entrance to Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

ii. Portmarnock (Brown, '18, '44): Dublin Bay (Turton, '19).

iii. Ardmore (Mrs. Mackesy, f. Thompson MS.): Youghal (Miss M. Ball, f. Thompson MS.): Great Island, below Cove, co. Cork (Humphreys, '45): R.I.A. Exp., 1886, Glandore Harbour, 4 fms. (Chaster, '98).

iv. R. I. A. Exp. 1885, Berehaven, 5 fms. (Chaster, '98): Valentia (Cockerell, '87).

v. Miltown Malbay (Harvey, f. Thompson MS.): Birterbuy Bay, living (Walpole, '52): Roundstone (Standen, '95; D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Carrahubbuck, Killala Bay, a few specimens living at low water (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson MS.; Waller Coll. in Dublin Mus.): Iniskeen, co. Donegal (Mrs. Tatlow, '99).

Distribution.—Norway to Mediterranean. Madeira. Canaries.

Mangilia striolata (Scacchi). (*Pleurotoma striolata*, Jeffreys, B. C.)

i., ? ii., . iv., v., vi.

i. Turbot Bank (Hyndman, '58).

ii. ?Portmarnock, two specimens (Farran, f. Thompson, '56, sub *Pleurotoma Farrani*).

iv. Bantry Bay, 12–15 fms. (M'Andrew, f. Thompson, '46): R. I. A. Exp., 1885, Berehaven, 5–25 fms., two specimens (Chaster, '98).

v. Aran I. (Barlee, f. Forbes & Hanley, '53; Waller Coll. in Dublin Mus.): Birterbuy Bay, living (Walpole, '52): Connemara (Forbes, &c., f. Jeffreys, '67).

vi. Iniskeen, co. Donegal (Mrs. Tatlow, '99).

Distribution.—Norway to Mediterranean. Morocco. Madeira. Canaries.

Mangilia attenuata (Montagu). (*Pleurotoma attenuata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Turbot Bank sand, dead (Waller, f. Hyndman, '60): off entrance to Strangford Lough, 18–20 fms., dead, very rare (Dickie, '58).
ii. Portmarnock (Warren, f. Adams, '78): Dublin Bay (Turton, '19; Leach, '52).
iii. Cork Harbour (Humphreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1886, Lough Hyne (A. R. N.).
iv. Bantry (Jeffreys, '67): "Porcupine" Exp., 1869, S. W. Ireland (Jeffreys, '69A): coast of Kerry (Dublin Mus., coll. by A. G. More): R. I. A. Exp., 1886, mouth of Kenmare River, 23–38 fms. (Chaster, '98).
v. Roundstone (Alcock, '65): R. D. S. Fish. Survey, 1890, Clew Bay, one dead specimen (A. R. N.).
vi. Bundoran (Belfast Mus., f. Praeger, '89).

Distribution.—Norway to Mediterranean. Canaries.

Mangilia costata (Donovan). (*Pleurotoma costata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan (Thompson MS.): off Ballycastle, dead (Chaster, '97A): Belfast Lough, 10 fms., dead, rare, and Turbot Bank (Hyndman, '58): off Black Head, 25 fms., and Turbot Bank dredged sand (Hyndman, '59): off Strangford Lough, 12–15 fms., dead (Dickie, '58). Var. *coarctata*, Forbes. Near the Turbot Bank, dead (Hyndman, '60).
ii. Portmarnock (Brown, '18; Hart, '92): Dublin Bay (Brown, '18; Turton, '19; Kinahan, '61): Dublin coast, general (Walpole, '53A).
iii. Ardmore (Mrs. Mackesy, f. Thompson MS.): Youghal (Ball, f. Thompson MS.): Cork Harbour (Humphreys, '45): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–55½ fms. (Chaster, '98).
iv. Bantry Bay (Humphreys, '45; &c.): Kenmare River (Praeger, '99): Valentia (Cockerell, '87): Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, shallow water to 80 fms. (Chaster, '98, A. R. N.). Var. *coarctata*. About Bantry Bay (M'Andrew, f. Thompson, '47A).

v. Roundstone (Alcock, '65; Standen, '95; D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Carrahubbuck (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson MS.; Waller Coll. in Dublin Mus.): Narin, co. Donegal (Mrs. Tatlow, '99).

Distribution.—Finmark to Mediterranean.

Mangilia rugulosa (Philippi). (*Pleurotoma rugulosa*, Jeffreys, B. C.)

. . . . v., .

v. Birterbuy Bay (Walpole, f. Jeffreys, '69).

Distribution.—S. England. W. Ireland to Mediterranean.

Mangilia brachystoma (Philippi). (*Pleurotoma brachystoma*, Jeffreys, B. C.)

i., ii., iii., iv., . .

i. Co. Antrim (Waller, f. Jeffreys, '67); specimens from Belfast Lough are in Waller Coll. in Dublin Mus.

ii. Portmarnock Strand (Hart, '92).

iii. Cork Harbour (Humphreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms. (Chaster, '98, A. R. N.).

iv. Bantry Bay (Barlee, f. Thompson, '56): R. I. A. Exp., 1885, 1886, shallow water to 80 fms. (Swanston, '86, Chaster, '98).

Distribution.—Norway to Mediterranean.

Mangilia nebula (Montagu). (*Pleurotoma nebula*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan (Thompson MS.): off Ballycastle, dead (Chaster, '97A): Turbot Bank shell-sand, dead, rare (Hyndman, '58): Bangor (Thompson MS.): Strangford Lough (Hyndman, f. Thompson MS.).

ii. Portmarnock (rare, Brown, '18; Hart, '92): Dublin Bay (Brown, '18; &c.).

iii. Youghal (Ball, f. Thompson MS.).

iv. Var. *elongata*, Jeffreys. Off Blasquet I., co. Kerry (More, '70).

v. Roundstone (Alcock, '65; Standen, '95): Achill I. (Mrs. Tatlow & Praeger, '98). Var. *abbreviata*, Jeffreys. Co. Galway (Barlee, f. Jeffreys, '67). Var. *elongata*. Aran I. (Barlee, f. Jeffreys, '67).

vi. Killala Bay (Miss A. Warren).

Distribution.—Finmark to Mediterranean. Madeira. Canaries.

Mangilia lævigata (Philippi). (*Pleurotoma lævigata*, Jeffreys, B. C.)

. . . . v., vi.

v. Connemara, two specimens (Farran, f. Thompson, '56): Roundstone (Standen, '95). Var. *minor*, Jeffreys. Connemara (Alcock, f. Jeffreys, '67).
vi. Narin, co. Donegal, very abundant (Mrs. Tatlow, '99).

Distribution.—S. England. W. Ireland to Mediterranean. Azores.

Hædropleura septangularis (Montagu). (*Pleurotoma septangularis*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan (Hyndman, f. Thompson MS.): Belfast Lough, 10 fms., living, rare, and Turbot Bank, dead (Hyndman, '58): off Black Head, 25 fms., and Turbot Bank, dredged sand (Hyndman, '59): Bangor (Belfast Mus., f. Praeger, '89): Strangford Lough, 7–20 fms., living (Dickie, '58).
ii. Portmarnock (Adams, '78): Dublin Bay (Brown, '18; Turton, '19; Leach, '52; Kinahan, '61): Dalkey Sound (Walpole, '53; Adams, '78).
iii. Youghal (Ball, f. Thompson MS.): Cork (Leach, '52; Humphreys, f. Thompson, MS.).
iv. Bantry Bay (Humphreys, '45; Leach, '52; Barlee, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, Berehaven, 5–25 fms., and mouth of Kenmare River, 38–48 fms., rare (Swanston, '86): Dingle Bay (Leach, '52).
v. Miltown Malbay (Dublin Mus.; Harvey, f. Thompson MS.): Galway (Barlee, f. Forbes & Hanley, '53): Birterbuy Bay (Walpole, '52): Roundstone (D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Killala Bay (Dublin Mus., pres. by Miss A. Warren): Bundoran (Mrs. Hancock, f. Thompson MS.): Narin, co. Donegal, rare (Mrs. Tatlow, '99).

Distribution.—Norway to Mediterranean. Azores. Madeira. Canaries.

[*Spirotropis carinata* (Bivona). (*Pleurotoma carinata*, **Jeffreys, B. C.**)]

. . . iv., . .

iv. "Porcupine" Exp., 1869, off Valentia, 110 fms. (Jeffreys, '69A).
Distribution.—Finmark to Mediterranean. Morocco. Canaries, "Talisman" (Locard).

[*Typhlomangilia nivalis* (Lovén). (*Pleurotoma nivalis*, **Jeffreys, B. C.**)]

. . . iv., . .

iv. R. I. A. Exp., 1886, off Dursey Head, 214 fms., a single specimen, dead (A. R. N.): R. I. A. Exp., 1888, 345 fms., a small live specimen (Chaster, '98).
Distribution.—Finmark to Bay of Biscay. Portugal, "Travailleur" (Locard).

Bela rufa (Montagu). (*Pleurotoma rufa*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Generally distributed, sparingly. Var. *lactea*, Jeffreys. Port Ballintrae, co. Antrim (Hyndman, f. Jeffreys, '67). Var. *ulideana*, Thompson. Strangford Lough (Hyndman and Thompson, f. Thompson, '45).
ii. Portmarnock (Brown, '18; Adams, '78): Dublin coast (Hart, '92): Dublin Bay (Turton, '19; &c.)
iii. Youghal (Miss M. Ball, f. Thompson MS.).
iv. Bantry Bay (Leach, '52).
v. Roundstone (Alcock, '65; Standen, '95): "Argo" Cruise, 1890, west of Ireland (Herdman, '91). Var. *ulideana*. Connemara (Farran, f. Jeffreys, '67).
vi. Donegal coast (Hart, '92).
Distribution.—Scotland to Bay of Biscay. ? Mediterranean.

Bela turricula (Montagu). (*Pleurotoma turricula*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Generally distributed.
ii. Trawled off Skerries (Walpole, '52): Dublin coast (Hart, '92): Portmarnock (Brown, '18; Adams, '78): Dublin Bay (Turton, '19; Kinahan, '61; Dublin Mus.): Dalkey Sound (Adams, '78).

iii. Youghal (Ball, f. Thompson MS.): Cork Harbour (Humphreys, '45): south coast of Ireland (Leach, '52).

iv. Bantry (Humphreys, f. Thompson MS.).

v. Roundstone (Alcock, '65; Standen, '95): Clifden (Forbes, f. Thompson MS.): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Donegal coast (Hart, '92).

Distribution.—Arctic seas to W. France. Spain, Portugal, and Morocco, "Travailleur" (Locard). Greenland. ? N. E. America. N. Japan (Jeffreys).

Bela Trevelyana (Turton). (*Pleurotoma Trevelyana*, Jeffreys, B. C.)

i., ? ii., ...

i. Turbot Bank, dredged sand (Jeffreys, f. Hyndman, '59): off Black Head, 25 fms. (Hyndman, '59). Regarded as fossil (Jeffreys, '67).

? ii. East coast of Ireland (Turton, f. Thompson, '56): Portmarnock, a specimen (Warren, f. Thompson, '44A). Probably erroneous.

Distribution.—Iceland. Finmark to British Isles. Gulf of Gascony, "Travailleur" (Locard). Greenland. ? N. E. America. W. America.

Order.—OPISTHOBRANCHIATA.

Sub-order.—TECTIBRANCHIATA.

Family.—ACTÆONIDÆ.

Actæon tornatilis (Linné).

i., ii., iii., iv., v., vi.

i. Generally distributed on sandy ground below low-water mark.

ii. Dundalk, abundant (Hyndman, f. Thompson MS.): Dublin coast, generally distributed.

iii. Woodstown, co. Waterford (Dublin Mus., coll. by Mrs. Tatlow): Youghal and Cork (Humphreys, '45): R. I. A. Exp., 1885, 1886, 1888, Glandore Harbour, 4 fms., and off S. coast of Cork, 30-53 fms. (Chaster, '98, A. R. N.).

iv. Bantry (Humphreys, '45; Dublin Mus.): Dingle (Cockerell, '85): Finne Strand, Kerry (Cockerell, '87): S. W. Ireland (Wright & Greene, '59): R. I. A. Exp., 1885, 35–48 fms. (Swanston, '86, Chaster, '98).

v. Miltown Malbay, rare (Harvey, f. Thompson MS.): **Achill I. (Mrs. Tatlow & Praeger, '98).**

vi. Killala Bay (Miss A. Warren, '92): **Ballysodare and Bundoran** (Mrs. Hancock, f. Thompson MS.): **Iniskeen, co. Donegal, rare** (Mrs. Tatlow, '99): **Kinnegar Strand, scarce (Hart, '92).**

Distribution.—Iceland. Loffoden I. to **Mediterranean. Morocco.**

Family.—TORNATINIDÆ.

Tornatina obtusa (Montagu). (*Utriculus obtusus*, **Jeffreys, B. C.)**

i., ii., . iv., v., vi.

i. Off Larne Lough, dead (Hyndman, '59): **Turbot Bank, dead,** scarce, and off Black Head, 25 fms. (Hyndman, **'58, '59): Belfast Lough** (Jeffreys, '67; Dublin Mus.): **Holywood Shore** (Dublin Mus., coll. by R. Welch): **Strangford Lough, dead** (Dickie, '58; Praeger, '89). Var. *Lajonkaireana*, **Besterot.** Turbot Bank, dead (Jeffreys, f. Hyndman, '60).

ii. Portmarnock (Brown, '18; Adams, '78; **Hart, '92): Dublin Bay** (Turton, '19; Walpole, '53A).

iv. R. I. A. Exp., 1886, Valentia Harbour, 4–7 fms., **dead (A. R. N.).**

v. Estuary of the Shannon (Jeffreys, '67): **west of Ireland (Thompson, '44).** Var. *Lajonkaireana.* Aran I. (Jeffreys, '59).

vi. Killala Bay, occasionally (Miss A. Warren, '92): **Iniskeen, co.** Donegal, rare (Mrs. Tatlow, '99).

Distribution.—Iceland. Finmark to Mediterranean. **Greenland** to New England.

Tornatina mammillata (Philippi). (*Utriculus mammillatus*, Jeffreys, B. C.)

i., . iii., iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank, **dead (Waller,** f. Hyndman, '59).

iii. R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–52½ fms. (Swanston, '86, Chaster, '98).

iv. Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 5–79 fms. (Swanston, '86, Chaster, '98).

v. Birterbuy Bay (Barlee, f. Forbes & Hanley, '53): **Roundstone** (D'Arcy W. Thompson).

Distribution.—Finmark to Mediterranean. Madeira. **Canaries.**

Tornatina truncatula (Bruguière). (*Utriculus truncatulus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan (Belfast Mus., f. Praeger, '89): off Ballycastle, living (Chaster, '97A): Turbot Bank, dead (Hyndman, '58, '59): Twin I. in Belfast Harbour (Swanston, f. Praeger, '89): Groomsport, shell-sand (Praeger).
ii. Portmarnock (Adams, '78; Hart, '92): Dublin Bay (Turton, '19; Waller, f. Kinahan, '61): Dalkey Sound (Warren Coll. in Dublin Mus.).
iii. R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., Lough Hyne, and off S. coast of Cork, 30–52½ fms. (Swanston, '86, Chaster, '98, A. R. N.).
iv. Dingle Bay, 54 fms. (Adams, f. More, '70): R. I. A. Exp., 1885, 1886, shallow water to 79 fms. (Swanston, '86, Chaster, '98).
v. Birterbuy Bay, dead (Walpole, '52): Roundstone (Alcock, '65; Standen, '95; D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).
vi. Killala Bay (Miss A. Warren, '92): Narin, co. Donegal (Mrs. Tatlow, '99; G. P. Farran): Mulroy Bay, dead (Praeger, '94).
Distribution.—Finmark to Mediterranean. Madeira. Canaries.

Cylichnina umbilicata (Montagu). (*Cylichna umbilicata*, Jeffreys, B. C.)

i., ii. iii., . v., vi.

i. Off Ballycastle (Chaster, '97B): Turbot Bank sand, dead (Hyndman, '58; Waller, f. Hyndman, '59).
ii. Dublin Bay (Turton, '19): east of Ireland (Thompson, '56).
iii. Cork Harbour (Wright & Carroll, '52, sub *Cylichna strigella*): south of Ireland (Thompson, '56).
v. Miltown Malbay (Harvey, f. Thompson MS.): Aran I. (Barlee, f. Thompson, '56, sub *C. strigella*): Birterbuy Bay (Walpole, '52, sub *C. strigella*): Roundstone (D'Arcy W. Thompson): west of Ireland (Thompson, '56).
vi. Killala Bay (Miss A. Warren, '92): Bundoran (Thompson, '45, sub *Volvaria subcylindrica*): Mulroy Bay, dead (Praeger, '94).
Distribution.—Loffoden I. to Mediterranean. W. Africa. Cape of Good Hope (Sowerby).

[*Cylichnina ovata* (Jeffreys). (*Cylichna umbilicata*, var. *conulus*, Jeffreys, B. C.)]

. . . iv., . .

iv. "Flying Fox" Exp., 1889, S. W. Ireland, 1000 fms. (Smith, '89).

Distribution.—Both sides of North Atlantic. Mediterranean. Deep water.

Cylichnina nitidula (Lovén). (*Cylichna nitidula*, Jeffreys, B. C.)

i., . iii., iv., . .

i. Off Ballycastle, dead (Chaster, '97A): off Larne, co. Antrim (Jeffreys, '67): Belfast Lough, very rare (Jeffreys, '59).

iii. Cork Harbour (Wright & Carroll, '52): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms., abundant (Swanston, '86, Chaster, '98).

iv. "Porcupine" Exp., 1869, S. W. Ireland (Jeffreys, '69A): R. I. A. Exp., 1885, 1886, 3½–110 fms., abundant (Swanston, '86, Chaster, '98, A. R. N.).

Distribution.—Finmark to Mediterranean. Madeira (Watson). N. E. America.

Volvulella acuminata (Bruguière). (*Cylichna acuminata*, Jeffreys, B. C.)

i., ii., iii., iv., v., .

i. Off Black Head, 25 fms. (Hyndman, '59): Turbot Bank, a single specimen, dead (Waller, f. Hyndman, '58).

ii. Portmarnock, very scarce (Hart, '92).

iii. Off south of Ireland, a dead specimen (M'Andrew, f. Thompson, '56): R. I. A. Exp., 1885, off Galley Head, 54 fms. (Chaster, '98).

iv. Off Mizen Mead, 60 fms., and Bantry Bay (M'Andrew, f. Thompson, '56): R. I. A. Exp., 1885, 1886, 37½–48 fms. (Swanston, '86, Chaster, '98).

v. Aran I. (Barlee, f. Thompson, '56): Birterbuy Bay, 12–15 fms. (Barlee, f. Thompson, '49).

Distribution.—Norway to Mediterranean.

Family.—SCAPHANDRIDÆ.

Scaphander lignarius (Linné).

i., ii., iii., iv., v., vi.

Generally distributed round the coast, principally in the coralline zone.

Var. *alba*, Jeffreys. Bangor (Belfast Mus., f. Praeger, '89): west of Ireland (Jeffreys, '59).

Distribution.—Finmark to Mediterranean.

[*Scaphander punctostriatus* (Mighels). (*Scaphander librarius*, Jeffreys, B. C.)]

. . . iv., . .

iv. R. I. A. Exp., 1888, 345 fms., a small, broken, dead specimen (Chaster, '98).

Distribution.—Iceland. Finmark to Mediterranean. Azores. Morocco. W. Africa, "Talisman" (Locard). North Atlantic, "Valorous." N. E. America. Gulf of Mexico and Barbadoes (Dall).

Bullinella cylindracea (Pennant). (*Cylichna cylindracea*, Jeffreys, B. C.)

i.. ii., iii., iv., v., vi.

i. Magilligan (Thompson MS.): off Ballycastle, living (Chaster, '97A): off Larne Lough, dead (Hyndman, '59): Turbot Bank, dead (Hyndman, '58): Strangford Lough, 7–20 fms., dead, rare (Dickie, '58).

ii. Dundrum (Thompson MS.): Portmarnock (Brown, '18; Adams, '78; Hart, '92): Dublin Bay (Turton, '19; Kinahan, '61): South Bull, scarce (Hart, '92): Dalkey Sound, rare (Walpole, '53A).

iii. Ardmore (Mrs. Mackesy, f. Thompson MS.): Cork Harbour (Humphreys, '45): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–52½ fms. (Swanston, '86, Chaster, '98).

iv. R. I. A. Exp., 1885, 1886, 8–48 fms. (Swanston, '86, Chaster, '98, A. R. N.).

v. Birterbuy Bay, dead (Walpole, '52): Roundstone (Alcock, '65; Standen, '95).

vi. Killala Bay (Miss A. Warren, '92): **Bundoran (Mrs. Hancock, f. Thompson, '45; Belfast Mus., f. Praeger, '89): Narin, co.** Donegal (Mrs. Tatlow, '99): **Kinnegar Strand and Inch I.,** Lough Swilly (Hart, '92).

Distribution.—Finmark to Mediterranean. W. Africa. **Madeira.** Canaries. St. Helena. Ascension I. and Tristan da Cunha, "Challenger."

Diaphana hyalina (Turton). (*Utriculus hyalinus*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Off the Maidens, 80 fms., dead (Hyndman, '60).

ii. Portmarnock (Warren, f. Thompson, '56; Adams, '78): **Dublin** Bay (Kinahan, '61): Dublin (Jeffreys, '67): **Dalkey Sound** (Waller Coll. in Dublin Mus.).

iii. Cork (Humphreys, f. Forbes & Hanley, '53; Jeffreys, '67).

iv. S. W. Ireland (Wright & Greene, '59): R. I. A. Exp., 1885, 1888, 5–41 fms. (Chaster, '98).

v. Galway (Jeffreys, '67): Birterbuy Bay (Walpole, f. **Thompson,** '56): Roundstone (D'Arcy W. Thompson): "**Porcupine**" Exp., 1869, 183 fms. (Jeffreys, '77).

vi. Bartra, shell-sand (Miss A. Warren, '92): Ballysodare and **Bundoran** (Mrs. Hancock, f. Thompson, '56): Donegal (**Jeffreys,** '67): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Spitzbergen. Finmark to Mediterranean. ? **Madeira.** Canaries. Greenland to New England.

Diaphana expansa (Jeffreys). (*Utriculus expansus*, Jeffreys, B. C.)

. . . . v., vi.

v. West coast of Ireland (Marshall in Journ. of Conch., vi., 1889).

vi. Bartra, Killala Bay (Marshall, f. Miss A. Warren, '92).

Distribution.—Finmark to Bay of Biscay. Mediterranean (Monterosato). Greenland.

Diaphana quadrata (Monterosato).

. . . iv., . .

iv. R. I. A. Exp., [1885, mouth of Kenmare River, 38–44 fms.], two specimens (Chaster, '98).

Distribution.—S. W. Ireland. Mediterranean.

Family.—BULLIDÆ.

Bulla utriculus, Brocchi.

i., . iii., iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): Groomsport, a single specimen, living (Hyndman, '58): Turbot Bank, dead, very rare (Dickie and Hyndman, f. Hyndman, '58).

iii. Cork Harbour (Humphreys, f. Thompson, '56).

iv. R. I. A. Exp., 1885, 1886, 1888, 5–750 fms. (Swanston, '86, Chaster, '98, A. R. N.): R. D. S. Fish. Survey, 1890, off the Skelligs, 80 fms. (Jordan).

v. Aran I. (Barlee, f. Jeffreys, '67): Birterbuy Bay, very fine, living (Walpole, '52).

Distribution.—Norway to Mediterranean. Canaries. ? N. E. America.

[*Bulla semilævis*, Seguenza.]

. . . iv., . .

iv. "Flying Fox," Exp., 1889, S. W. Ireland, 1000 fms. (Smith, '89).

Distribution.—S. W. Ireland to Azores. Morocco, "Talisman" (Locard). ? C. Hatteras to West Indies. Deep water.

Bulla hydatis, Linné.

. ii., iii., iv., v., vi.

ii. Balbriggan (Turton, '19; J. Adair, f. Adams, '78).

iii. Cork Harbour (Humphreys, '45).

iv. Bantry Bay (Leach, '52; Mrs. Puxley, f. Jeffreys, '67).

v. Birterbuy Bay (Farran, '60A): R. D. S. Fish. Survey, 1890, Birterbuy Bay and Roundstone Bay (Holt, '92): Westport, Clew Bay, one specimen (Thompson MS.).

vi. R. D. S. Fish. Survey, 1891, Killybegs (Holt in R. D. S. Report of Council, 1891, Appendix C.).

Distribution.—England, Wales, and Ireland to Mediterranean. Madeira. Canaries, Ascension I., and St. Helena (Smith).

Acera bullata, Müller.

i., ii., . iv., v., vi.

i. Lough Foyle, Larne, Belfast, and Strangford Loughs on the *Zostera* banks, living, abundant (Praeger, '89): Belfast Lough, on the *Zostera* banks, living, abundant (Hyndman, '58): Strangford Lough, 15–25 fms., living (Dickie, '58). Var. *nana*, Jeffreys. Larne Lough (Jeffreys, '67).

ii. Generally distributed in muddy bays, &c.

iv. Bantry Bay (Mrs. Puxley, f. Forbes & Hanley, '53): **R. I. A.** Exp., 1886, Berehaven, 5–10 fms., living (A. R. N.): **R. D. S.** Fish. Survey 1890, Kenmare River (Jordan): **Valentia** (Cockerell, '87; Dublin Mus., coll. by Rev. A. Delap): **Kerry** (Dublin Mus., coll. by A. G. More).

v. Oozy bays, west of Ireland (Thompson, f. Forbes & Hanley, '53): Roundstone (Thompson MS.; R. D. S. Fish. Survey, 1890; Warren Coll. in Dublin Mus.): R. D. S. Fish. Survey, 1890, Inishbofin Harbour, 1–5 fms. (A. R. N.): Clew Bay, 3 fms. (Forbes & Hanley, '53). Var. *Farrani*, Norman. Birterbuy Bay, living (Farran, '57): Kilkieran Bay (Dublin Mus., coll. by A. G. More).

vi. Inch I., co. Donegal (Hart, '92).

Distribution.—Finmark to Mediterranean. **Madeira (Watson).** Canaries.

Family.—PHILINIDÆ.

Philine aperta (Linné).

i., ii., iii., iv., v., vi.

Generally distributed and plentiful all round the coast in oozy bays, &c.

Var. *patula*, Jeffreys. Dublin Bay and Connemara (Jeffreys, '67).

Distribution.—Norway to Mediterranean. Canaries. C. Verd I., "Challenger." Cape of Good Hope. Philippines. &c.

Philine nitida, Jeffreys.

i., . iii., iv., . vi.

i. Off Ballycastle, living (Chaster, '97A).

iii. R. I. A. Exp., 1885, off Baltimore, 30 fms., one small specimen (Chaster, '98).

iv. R. I. A. Exp., 1886, 10–38 fms., three small specimens (Chaster, '98).

vi. Bartra and Enniscrone (Marshall, f. Miss A. Warren, '92).

Distribution.—British Isles to Mediterranean.

Philine scabra (Müller).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, dead, rare (Hyndman, '58): Groomsport, a very large specimen (Waller, f. Jeffreys, '67).
ii. Portmarnock (Warren, f. Thompson, '56): Dalkey Sound, rare (Walpole, '53A).
iii. Off Saltee I., 40 fms. (Walpole, '52): Cork, in stomach of a sole (Humphreys, f. Thompson, '56): R. I. A. Exp., 1885, 1886, 30–54 fms. (Swanston, '86, Chaster, '98).
iv. R. I. A. Exp., 1885, 1886, 5–79 fms. (Swanston, '86, Chaster, '98, A. R. N.).
v. Miltown Malbay (Harvey, f. Thompson MS.): co. Galway (Barlee, f. Jeffreys, '67): Roundstome (D'Arcy W. Thompson).
vi. Bartra and Enniscrone (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56). Var. *circa*, Marshall. Killala Bay (Marshall in Journ. of Conch., vi., 1889).

Distribution.—Iceland. Finmark to Mediterranean. Madeira (Watson). Greenland.

Philine catena (Montagu).

. ii., iii., iv., v., vi.

ii. Dublin Bay (Jeffreys, '67): Dalkey Sound, very rare (Walpole, '53A).
iii. Cork (in stomach of a sole, Humphreys, '45; Jeffreys, '67): south coast of Ireland (Leach, '52).
iv. "Porcupine" Exp., 1869, S. W. Ireland (Jeffreys, '69A): R. I. A. Exp., 1885, 1886, Berehaven, 5–25 fms. (Chaster, '98): Valentia (Gamble, '96).
v. Miltown Malbay, rare (Harvey, f. Thompson, '56): Aran I. (Barlee, f. Jeffreys, '67): Roundstone (Alcock, '65; D'Arcy W. Thompson).
vi. Bartra and Enniscrone, occasionally (Miss A. Warren, '92): Bundoran (Jeffreys, '67; Thompson Coll. in Belfast Mus., f. Praeger, '89; Waller Coll. in Dublin Mus.). Var. *zona*, Jeffreys. Bartra and Enniscrone (Miss A. Warren, '92).

Distribution.—Loffoden I. to Mediterranean.

Philine angulata, Jeffreys.

i., ... vi.

i. Off Ballycastle, dead (Chaster, '97A): Larne (Jeffreys, '67). Var. *circumlustra*, Marshall. Portrush (Marshall, '93).

vi. Enniscrone, one imperfect specimen (Marshall, f. Miss A. Warren, '92). Var. *circumlustra*. Killala Bay (Marshall, '93).

Distribution.—Norway. British Isles. Mediterranean (Monterosato). N. E. America.

Philine quadrata (S. Wood).

i., . . iv., v., .

i. Off the Maidens, 80 fms., dead (Hyndman, '60).

iv. South-west Ireland (Wright & Greene, '59).

v. Aran I. (Barlee, f. Jeffreys, '67).

Distribution.—Finmark to Azores. Mediterranean (Monterosato). Azores. St. Helena. Greenland. N. E. America (Verrill).

Philine punctata (Clark).

i., ii., . iv., v., vi.

i. Var. *cingulata*, Marshall. Portrush (Marshall, '93).

ii. Portmarnock (Adams, '78): Dublin Bay (Warren, f. Jeffreys, '67).

iv. Bantry Bay (Norman, f. Jeffreys, '67): R. I. A. Exp., 1885, 1886, Berehaven, 5–25 fms., and mouth of Kenmare River, 23–38 fms. (Chaster, '98): Valentia (Gamble, '96).

v. Kilkee (Thompson, '56): Miltown Malbay (Harvey, f. Thompson, '56): Roundstone (Standen, '95).

vi. Bartra, occasionally (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56; Jeffreys, '67): Narin Strand, co. Donegal (G. P. Farran). Var. *cingulata*. Bartra (Marshall, f. Miss A. Warren, '92).

Distribution.—Norway to Mediterranean. Greenland.

Philine pruinosa (Clark).

. . iii., iv., v., .

iii. R. I. A. Exp., 1885, off Baltimore, 30 fms., very rare (Chaster, '98).

iv. R. I. A. Exp., 1885, 1886, 23–79 fms., very rare (Chaster, '98).

v. Birterbuy Bay, 12–15 fms., a single dead specimen (Barlee, f. Thompson, '56).

Distribution.—Loffoden I. to British Isles. Mediterranean.

Family.—LIMACINIDÆ.

Limacina retroversa (Fleming). (*Spirialis retroversus*, Jeffreys, B. C.)

i., . iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97 A).
iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–54 fms. (Chaster, '98).
iv. R. I. A. Exp., 1885, 1886, 1888, Ballinskelligs Bay, and 4–345 fms. (Chaster, '98): off Mizen Head, 60 fms., dead specimens, and var. *Mac Andrei*, F. & H. (M'Andrew, f. Forbes & Hanley, '53).
v. Aran I. (Barlee, f. Thompson, '56): Roundstone (Alcock, '65; Standen, '95).
vi. Bartra (Miss A. Warren, '92, '96): Bundoran, shell-sand (Mrs. Hancock, f. Thompson, '56): R. D. S. Fish. Survey, 1891, Donegal Bay (Holt,' 92): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Pelagic. Loffoden I. to Lat. 50° N., and Davis Strait to New England (Pelseneer).

?[*Peracle diversa* (Monterosato).]

. . . iv., . .

iv. "Flying Fox" Exp., 1889, 1000 fms., dead shells (Smith, '89).

Distribution.—Pelagic. ?S.W. Ireland. Morocco, "Travailleur" (Locard). Mediterranean (Monterosato). Georgia, Florida, Bermuda, and W. Indies (Dall).

Family.—CAVOLINIIDÆ.

Clio pyramidata, Linné.

. . . iv., . [vi.]

iv. R. I. A. Exp., 1885, 1888, 4–345 fms. (Chaster, '98, A. R. N.): "Flying Fox" Exp., 1889, off S. W. Ireland, on surface, abundant (Green in Ann. & Mag. Nat. Hist. (6), iv., 1889).
vi. R. D. S. Fish. Survey, 1891, 45 miles N.N.W. of Black Rock, co. Mayo, on surface (A. R. N.).

Distribution.—Pelagic. Atlantic Ocean from Spitzbergen and Davis Strait to Lat. 40° S., Mediterranean Sea, Indian and Pacific Oceans (Pelseneer).

Carolinia trispinosa (Lesueur).

. . iii., [iv.], . .

iii. Youghal, a specimen washed ashore (Ball, f. Thompson, '56).

iv. "Porcupine" Exp., 1869, off Valentia, 110 fms. (Jeffreys, '69A): R. I. A. Exp., 1885, 1888, 120–750 fms., fragments (Chaster, '98): R. I. A. Exp., 1888, in tow-nets at Lat. 51° 1′ N., Long. 11° 50′ W., depth 750 fms., dead (A. R. N.): "Flying Fox" Exp., 1889, 250–1000 fms., dead shells (Smith, '89).

Distribution.—Pelagic. Both sides of Atlantic from Lat. 60° N. to 40° S., Mediterranean Sea, Indian and Pacific Oceans (Pelseneer).

Family.—Aplysiidæ.

Aplysia punctata, Cuvier.

i., ii., iii., iv., v., vi.

Generally distributed all round the coast in the laminarian zone, and not uncommon.

Distribution.—Norway to Mediterranean. Madeira. Canaries.

The generic name *Aplysia* should be replaced by *Tethys* (Pilsbry in Ann. & Mag. Nat. Hist. (6), xvi., 1895).

Family.—Pneumodermatidæ.

Dexiobranchæa paucidens, Boas.

. . . . v., .

v. Roundstone (D'Arcy W. Thompson, f. W. T. Calman).

Distribution.—Atlantic Ocean on the route from Brazil to Europe (Pelseneer).

Family.—Clionidæ.

Clione limacina (Phipps). (*Clione papilionacea*, Jeffreys, B. C.)

. . . iv., . .

iv. Several small specimens were taken in the tow nets, 57 miles off Dursey Head, in the R. I. A. Exp., 1886 (A. R. N.): off Valentia (Dublin Mus., pres. by F. W. Gamble).

Distribution.—Pelagic. Arctic seas to S. England and Virginia.

Family.—PLEUROBRANCHIDÆ.

Pleurobranchus membranaceus (Montagu).

i., ii., iii., iv., v., .

i. Belfast Lough, and off Groomsport, 6–8 fms., living (Hyndman, f. Thompson, '56; Hyndman, '58): Carrickfergus (Dublin Mus.).
ii. Portmarnock (Adams, '78): Dublin Bay (Kinahan, '61).
iii. Cork Harbour, a living specimen (Humphreys, '45).
iv. R. I. A. Exp., 1888, Berehaven, 7 fms., living (A. R. N.).
v. Aran I. and Birterbuy Bay (Barlee, f. Forbes & Hanley, '53).
Distribution.—British Isles to Mediterranean.

Pleurobranchus plumula (Montagu).

. ii., iii., iv., v., .

ii. Portmarnock (Warren Coll. in Dublin Mus.): Dublin Bay (Kinahan, '61).
iii. R. I. A. Exp., 1888, off S. coast of Cork, 50 fms., living (A. R. N.).
iv. Bantry Bay (Norman, f. Jeffreys, '67; Dublin Mus.): Valentia (Gamble, '96).
v. Miltown Malbay, very rare (Harvey, f. Thompson, '56): Roundstone (Alcock, '65; M'Calla, f. Thompson MS.; Dublin Mus.): R. D. S. Fish. Survey, 1890, Blacksod Bay, living (A. R. N.).
Distribution.—Norway to Mediterranean. Madeira (Watson).

Sub-order.—ASCOGLOSSA.

Family.—HERMÆIDÆ.

Hermæa bifida (Montagu).

i., . iii., iv., . vi.

i. Belfast Lough (Getty and Hyndman, f. Thompson, '56).
iii. Coast of Cork (E. P. Wright, '59): Baltimore (A. R. N.).
iv. Coast of Kerry (E. P. Wright, '59).
vi. Bundoran (J. E. Duerden in Irish Naturalist, v., 1896).
Distribution.—Sweden. British Isles. W. France. Mediterranean.

Hermæa dendritica (Alder & Hancock).

. . iii., iv., v., vi.

iii., iv. Coasts of Cork and Kerry (E. P. Wright, '59).
v. "Argo" Cruise, 1890, Inishbofin (Herdman, '91).
vi. Bundoran (J. E. Duerden in Irish Naturalist, v., 1896).
Distribution.—Norway. Sweden. British Isles. W. France. Mediterranean.

Alderia modesta (Lovén).

. . iii., . . .

iii. Skibbereen, co. Cork, in salt marshes (Allman, '46).
Distribution.—Sweden. Belgium. British Isles.

Family.—ELYSIIDÆ.

Elysia viridis (Montagu).

. . iii., iv., v., .

iii. Dungarvan, co. Waterford, one specimen (A. R. N.): dredged abundantly in the harbours of Glandore, Castletownsend, and Crookhaven, 1844 (Allman, '45).
iv. Valentia (Gamble, '96; Dublin Mus., a specimen coll. by A. C. Haddon).
v. Roundstone (Dublin Mus.).
Distribution.—Finmark to Mediterranean.

Family.—LIMAPONTIIDÆ.

Limapontia capitata (Müller). (*L. nigra*, Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—Finmark to Brittany.

Acteonia corrugata, Alder & Hancock.

. . . iv., . .

iv. Valentia, (Gamble, '96).
Distribution.—Norway. England. S. W. Ireland. W. France.

Sub-order.—NUDIBRANCHIATA.

Family.—ÆOLIDIDÆ.

Æolis papillosa (Linné).

i., ii., iii., iv., v., .

i. Belfast Lough (Ordnance Coll., f. Thompson MS.; Dublin Mus., a specimen coll. by Miss S. Thompson): Donaghadee (Thompson MS.).
ii. Malahide (Lloyd, f. Thompson, '40 A; Dublin Mus.): Lambay I. (Thompson, '56): Dublin Bay (Kinahan, '61).
iii. Courtmacsherry Harbour, co. Cork (Allman, f. Thompson, '56, sub *Eolis Cuvierii*).
iv. Bantry Bay (Leach, '52, sub *Eolidia Cuvieri*): Valentia (Gamble, '96).
v. Lahinch, co. Clare (Forbes and Thompson, f. Thompson, '56, sub *Eolis zetlandica*): Roundstone (M'Calla, f. Thompson MS.).
Distribution.—N. Europe to S. W. France. N. E. America.

Æolis glauca, Alder & Hancock.

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—Denmark to Mediterranean.

Æolis sanguinea, Norman.

. . . . v., .

v. Inishlacken, Roundstone Bay, 1874, low water, spring tides (Norman, '77).
Distribution.—W. Ireland.

Cratena Peachii (Alder & Hancock). (*Eolis Peachii*, Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—British Isles.

Cratena paradoxa (Quatrefages). (*Eolis angulata*, Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—Sweden. British Isles. W. France.

Cratena amœna (Alder & Hancock). (*Eolis amœna*, **Jeffreys, B. C.**)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—British Isles.

Cratena olivacea (Alder & Hancock). (*Eolis olivacea*, **Jeffreys, B. C.**)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—Norway to English Channel. ? W. France (Hecht).

Tergipes despectus (Johnston). (*Eolis despecta*, **Jeffreys, B. C.**)

. ii., ...

ii. Kingstown (Haddon, '86A).
Distribution.—Norway. British Isles. N. E. America.

Embletonia pulchra (Alder & Hancock).

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—British Isles to Mediterranean.

Amphorina cærulea (Montagu). (*Eolis cærulea*, Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—S. England. S. W. Ireland to Mediterranean.

Galvina exigua (Alder & Hancock). (*Eolis exigua*, Jeffreys, B. C.)

. ii., . iv., . .

ii. Rush, co. Dublin (J. E. Duerden in Irish Naturalist, iii., 1894): Kingstown (Haddon, '86A).
iv. R. I. A. Exp., 1885, Berehaven (Haddon, '86B).
Distribution.—Norway to Mediterranean. N. E. America (Verrill).

Galvina tricolor (Forbes). (*Eolis tricolor*, Jeffreys, B. C.)

i., ...

i. Castle Chichester, Belfast Lough, one specimen (Hyndman, f. Thompson, '56, sub *Eolis violacea*).
Distribution.—Norway to W. France.

Galvina Farrani (Alder & Hancock). (*Eolis Farrani*, Jeffreys, B.C.)

. ii., iii., iv., . .

ii. Malahide, one specimen (Alder & Hancock, '44).
iii. All along the south coast (E. P. Wright, '59).
iv. Valentia (Haddon, f. Gamble, '96): Ventry Bay (E. P. Wright, '59).

Distribution.—British Isles to Mediterranean.
G. Farrani is now often used with *G. tricolor.*

Galvina picta (Alder & Hancock). (*Eolis picta*, Jeffreys, B.C.)

. ii., . iv., . .

ii. Malahide (Alder & Hancock, '45; a single specimen, Alder and Farran, f. Thompson, '56, sub *Eolis pallida*).
iv. Valentia (Gamble, '96).

Distribution.—Norway to Mediterranean. ? N. E. America.

Coryphella rufibranchialis (Johnston). (*Eolis rufibranchialis*, Jeffreys, B. C.)

. ii., . . . vi.

ii. Dublin Bay (Hassall, '42).
vi. R. D. S. Fish. Survey, 1891, Lough Swilly, 6–8½ fms. (Holt, '92).

Distribution.—Finmark to Mediterranean. N. E. America. Bering Sea.

Coryphella gracilis (Alder & Hancock). (*Eolis gracilis*, Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).

Distribution.—Denmark. British Isles. Mediterranean.

Coryphella Landsbergii (Alder & Hancock). (*Eolis Landsburgi*, Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).

Distribution.—Norway to Mediterranean.

Coryphella lineata (Lovén). (*Eolis lineata*, **Jeffreys, B. C.**)

. ii., . iv., . .

ii. Kingstown (Haddon, '86A).
iv. Valentia (Dublin Mus., specimens coll. by F. W. Gamble).
Distribution.—Norway to Mediterranean.

Favorinus albus (Alder & Hancock). (*Eolis alba*, **Jeffreys, B. C.**)

. ii., . iv., . .

ii. Malahide, two specimens (Alder & Hancock, '44).
iv. Valentia (Gamble, '96).
Distribution.—Norway to Mediterranean.

Facelina Drummondi (Thompson). (*Eolis Drummondi*, Jeffreys, B. C.)

i., ii., iii., iv., . .

i. Belfast Lough (Thompson, '56): Bangor, co. Down (Drummond, f. Thompson, '56).
ii. Newcastle, co. Down (Thompson, '56): Kingstown (Haddon, '86A).
iii. R. I. A. Exp., 1888, off Glandore, 53 fms. (A. R. N.).
iv. Valentia (Dublin Mus., coll. by F. W. Gamble).
Distribution.—Norway to Mediterranean.

Facelina coronata (Forbes & Goodsir). (*Eolis coronata*, Jeffreys, B. C.)

. ii., iii., iv., . vi.

ii. Rush, co. Dublin (J. E. Duerden in Irish Naturalist, iii., 1894): Malahide (Alder & Hancock, '45; Farran, f. Thompson, '56; Dublin Mus.): Dublin Bay (Alder & Hancock, '45).
iii. Glandore Bay (Allman, f. Thompson, '44A).
iv. R. I. A. Exp., 1885, Berehaven (Haddon, '86B): R. D. S. Fish. Survey, 1890, Valentia (Holt, '92): Valentia (Gamble, '96).
vi. Bundoran (J. E. Duerden in Irish Naturalist, v., 1896).
Distribution.—Norway to Mediterranean.

Facelina punctata (Alder & Hancock). (*Eolis punctata,* Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—S. England and S. W. Ireland to Mediterranean.

Antiopa cristata (Delle Chiaje).

. . iii., . . .

iii. Cork Harbour (Dublin Mus., coll. by A. C. Haddon): Baltimore Harbour, a specimen (A. R. N.).
Distribution.—Shetland to Mediterranean.

Antiopa hyalina, Alder & Hancock.

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—British Isles. W. France (Hecht).

Proctonotus mucroniferus (Alder & Hancock).

. ii., ...

ii. Malahide (Alder & Hancock, '44; Haddon, '86A).
Distribution.—Scotland. Ireland. W. France (Hecht).

Hero formosa (Lovén).

. . . iv., . .

iv. R. D. S. Fish. Survey, 1890, off Dingle Bay, 74–80 fms., one specimen (A. R. N.).
Distribution.—Loffoden I. to English Channel.

Family.—LOMANOTIDÆ.

Lomanotus Genei, Vérany. (*L. marmoratus,* &c., Jeffreys, B. C.)

. . . iv., . .

iv. Valentia (Gamble, '96).
Distribution.—Norway. British Isles. Mediterranean.

Family.—DOTONIDÆ.

Doto fragilis, Forbes.

. . iii., iv., v., .

iii. Cove, co. Cork (Ball and Forbes, f. Thompson MS.): coast of Cork (E. P. Wright, '59).

iv. Coast of Kerry (E. P. Wright, '59): Valentia (Gamble, '96).

v. R. D. S. Fish. Survey, 1890, Galway Bay, 20 fms. (Holt, '92): Clew Bay (Ball, Forbes, and Hyndman, f. Thompson, '56).

Distribution.—Christiania to Mediterranean.

Doto pinnatifida (Montagu).

. . . iv., . .

iv. Valentia (Gamble, '96).

Distribution.—England. S. W. Ireland. Guernsey. W. France.

Doto coronata (Gmelin).

i., ii., iii., iv., . .

i. Off Copeland I., 35 fms. (Hyndman, f. Thompson, '56).

ii. Malahide (Alder & Hancock, '45): Dublin Bay (Alder & Hancock, '45; Kinahan, '61): Kingstown (Haddon, '86A).

iii. Glandore Bay (Allman, f. Thompson, '56): coast of Cork (E. P. Wright, '59).

iv. Coast of Kerry (E. P. Wright, '59): R. I. A. Exp. 1885, Bantry Bay (Haddon, '86 B): Valentia (Gamble, '96).

Distribution.—Finmark to Mediterranean. N. E. America.

Family.—DENDRONOTIDÆ.

Dendronotus frondosus (Ascanius). (*D. arborescens*, Jeffreys, B. C.)

i., ii., . iv., . vi.

i. Off Maidens, 20–90 fms. (Hyndman, '59): Strangford Lough (Hyndman and Thompson, f. Thompson, '56, sub *Tritonia lactea*).

ii. Malahide (Alder & Hancock, '45; Alder and Farran, f. Thompson, '56): Dublin Bay (Alder & Hancock, '45): Kingstown (Haddon, '86A).

iv. Valentia (Dublin Mus., coll. by F. W. Gamble).

vi. R. D. S. Fish. Survey, 1891, Boylagh Bay, 20 fms. (A. R. N.).

Distribution.—Spitzbergen. Iceland to S. W. France. Greenland. N. E. America. Bering Strait.

Family.—PLEUROPHYLLIDIIDÆ.

Pleurophyllidia Lovéni, Bergh.

. . . iv., . .

iv. R. I. A. Exp., 1888, Long Island Sound, 4 fms. (A. R. N.): Bantry Bay (Nichols, '93).

Distribution.—Norway to English Channel.

Family.—TRITONIIDÆ.

Tritonia Hombergii, Cuvier.

i., ii., . iv., . .

i. Belfast Lough (M'Calla, f. Thompson MS.).
ii. Off Howth (Ball, f. Thompson '56; Dublin Mus.): Dublin Bay (Hassall, '42; Kinahan, '61): Greystones (Mackintosh, '84).
iv. R. D. S. Fish. Survey, 1891, Dingle Bay, 40 fms. (Holt, '92).

Distribution.—Norway to Mediterranean.

Tritonia plebeia, Johnston.

i., . iii., . . .

i. Belfast Lough (M'Calla, f. Thompson MS.).
iii. Cork Harbour, (Ball and Forbes, f. Thompson, '56).

Distribution.—Norway to Mediterranean.

Family.—DORIDIDÆ.

Archidoris tuberculata (Cuvier). (*Doris tuberculata*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Belfast Lough (Templeton and Drummond, f. Thompson, '56): Drumnasole (Dublin Mus.).[1]
ii. Dublin coast, generally distributed.
iii. Youghal (Ball, f. Thompson, '56): Courtmacsherry Harbour, common (Allman, f. Thompson, '56): Baltimore (A. R. N.): S. coast of Ireland (Leach '52).
iv. R. I. A. Exp., 1888, Long Island Sound, 4 fms. (A. R. N.): Bantry Bay (Dublin Mus.): R. D. S. Fish. Survey, 1890, off the Skelligs, 52–62 fms. (A. R. N.): Valentia (Gamble, '96): "Research" Trawling Cruise, 1889, 70 fms. (Bourne, '90).
v. Kilkee (Dublin Mus., coll. by G. Y. Dixon): Roundstone (Thompson MS.).
vi. R. D. S. Fish. Survey, 1891, Broadhaven Bay (A. R. N.).

Distribution.—Finmark to Mediterranean. ? N. E. America.

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[1] Carrickfergus (M'Skimin in "History of Carrigfergus," 2nd ed.).

Archidoris flammea (Alder & Hancock). (*Doris flammea*, Jeffreys, B.C.)

. . . iv., v., .

iv. S. W. Ireland (Wright & Greene, '59).
v. R. D. S. Fish. Survey, 1890, Birterbuy Bay (A. R. N.).
Distribution.—British Isles.

Jorunna Johnstoni (Alder & Hancock). (*Doris Johnstoni*, Jeffreys, B.C.)

. ii., . iv., . .

ii. Skerries, co. Dublin (Hyndman, f. Thompson, '56, sub *Doris obvelata*).
iv. Valentia (Gamble, '96).
Distribution.—Norway to Mediterranean.

Cadlina obvelata (Müller). (*Doris repanda*, Jeffreys, B. C.)

. . . . v., .

v. Roundstone, a specimen between tide-marks (Ball, &c., f. Thompson, '56).
Distribution.—Spitzbergen and Finmark to Mediterranean. Greenland. N. E. America.

Rostanga coccinea (Alder & Hancock). (*Doris coccinea*, Jeffreys, B. C.)

. . iii., . . .

iii. Castlehaven, Cork Harbour (Greene, f. E. P. Wright, '59).
Distribution.—Norway to Mediterranean.

Family.—POLYCERIDÆ.

Ægires punctilucens (d'Orbigny).

. ii., iii., iv., v., .

ii. Howth, co. Dublin (Dublin Mus., a specimen coll. by H. Hanna).
iii. Courtmacsherry Harbour, co. Cork (Allman, f. Thompson, '56).
iv. Valentia (Gamble, '96).
v. R. D. S. Fish. Survey, 1890, Blacksod Bay (A. R. N.).
Distribution.—Norway to W. France. ? Mediterranean.

Triopa claviger (Müller).

i., . . iv., v., .

i. Strangford Lough (Hyndman and Thompson, f. Thompson, '56).
iv. R. I. A. Exp., 1885, Dursey Sound (Haddon, '86B): Valentia (Gamble, '96).
v. Lahinch, co. Clare (Thompson, '56).
Distribution.—Norway to W. France.

Polycera quadrilineata (Müller).

i., ii., iii., iv., v., .

i. Entrance of Strangford Lough, three specimens (Hyndman and Thompson, f. Thompson, '56): Strangford Lough, two specimens (Hyndman and Thompson, f. Thompson, '56, sub *P. typica*).
ii. Off Howth, 4 fms. (A. R. N.): Malahide and Dublin Bay (Alder, f. Alder & Hancock, '45): Salthill (Haddon, '86A).
iii. Kinsale (Ball and Forbes, f. Thompson MS.).
iv. R. I. A. Exp., 1888, Bantry Bay, 7 fms. (A. R. N.): Valentia (Gamble, '96): R. D. S. Fish. Survey, 1890, off Ventry Harbour, 20 fms. (A. R. N.).
v. Roundstone Bay (Forbes, f. Alder & Hancock, '45): R. D. S. Fish. Survey, 1890, Cleggan Bay, 7–12 fms. (Holt, '92).
Distribution.—Norway to Mediterranean.

Polycera Lessonii, d'Orbigny.

. ii., iii., iv., v., .

ii. Dublin Bay (Alder, f. Thompson, '44A, sub *P. citrina*). Var. *ocellata*, Alder & Hancock. Malahide and Dublin Bay (Alder, f. Thompson, '44A).
iii. Var. *ocellata*. Castletownsend (Allman, f. Thompson MS.).
iv. Var. *ocellata*. Valentia (Gamble, '96).
v. Var. *ocellata*. R. D. S. Fish. Survey, 1890, Cleggan Bay, 7–12 fms. (Holt, '92).
Distribution.—Iceland. Sweden to Mediterranean. Greenland. N. E. America.

Family.—GONIODORIDIDÆ.

Acanthodoris pilosa (Müller). (*Doris pilosa*, Jeffreys, B. C.)

i., ii., iii., iv., ? v., .

i. Belfast Lough (Drummond, f. Thompson, '56; Hyndman, f. Thompson, '56, sub *Doris sublævis*).
ii. Dublin Bay (Hassall, '42; Allman, f. Thompson, '56): Salthill, common (Haddon, '86A).
iii. Baltimore Harbour (A. R. N.): south of Ireland (Thompson, '44).
iv. Valentia (Gamble, '96).
v. ? West of Ireland (Thompson, '44).

Distribution.—Iceland. Finmark to Mediterranean. N. E. America.

Lamellidoris aspera (Alder & Hancock). (*Doris aspera*, Jeffreys, B. C.)

. ii., iii., iv., . .

ii. Malahide (Alder and Farran, f. Thompson, '56).
iii. Young specimens, and according to Alder, most probably of this species were found at Glandore Bay, co. Cork, by Allman (Thompson, '56).
iv. Valentia (Gamble, '96).

Distribution.—Greenland. Sweden to Spain. N. E. America.

Lamellidoris muricata (Müller). (*Doris muricata*, Jeffreys, B. C.)

i., ...

i. Belfast and Strangford Loughs (Hyndman and Thompson, f. Thompson, '56).

Distribution.—Finmark to Denmark. N. E. Ireland. N. E. America (Verrill).

Lamellidoris ulidiana (Thompson). (*Doris ulidiana*, Jeffreys, B. C.)

i., ...

i. Three specimens were obtained among oysters brought to Belfast market from the neighbouring coast of Down or Antrim (Thompson, '56).

Distribution.—N. E. Ireland.

Lamellidoris bilamellata (Linné). (*Doris bilamellata*, Jeffreys, B. C.)

i., ii., iii., iv., . .

i. On oysters from Greencastle, Londonderry (Thompson, '56, sub *Doris affinis*): Larne (Ordnance Coll., f. Thompson MS.): Belfast Lough, 10 fms. (Thompson, '56).
ii. Lambay I., between tide-marks (Thompson, '56): Williamstown, Dublin Bay (Hassall, '42).
iii. South of Ireland (Thompson, '44).
iv. Valentia (Gamble, '96).

Distribution.—Iceland. Finmark to W. France. Greenland. N. E. America.

Lamellidoris inconspicua (Alder & Hancock). (*Doris inconspicua*, Jeffreys, B. C.)

. ii., ...

ii. Dublin Bay (E. P. Wright, '59).

Distribution.—Denmark. British Isles. W. France.

Lamellidoris Lovéni (Alder & Hancock). (*Doris Lovéni*, Jeffreys, B. C.)

. . . iv., . .

iv. Bantry Bay, 1858, a single specimen between tide-marks (Norman, f. Jeffreys, '69).

Distribution.—Norway. Sweden. S. W. Ireland.

Goniodoris nodosa (Montagu).

i., ii., iii., iv., v., .

i. Donaghadee (Drummond, f. Thompson MS.).
ii. Malahide (Alder & Hancock, '45; Haddon, '86A; Dublin Mus., a specimen coll. by J. G. Sumner): Lambay I., between tide-marks (Thompson, '56, sub *G. elongata*): Dublin Bay (Alder & Hancock, '45): Seapoint (Hassall, '42): Salthill (Haddon, '86A).
iii. Cove, co. Cork (Ball and Forbes, f. Thompson MS.): Courtmacsherry Harbour (Allman, f. Thompson, '56, sub *Doris barvicensis*).
iv. R. I. A. Exp., 1885, Dursey Sound, 20–25 fms. (Haddon, '86B): Valentia (Gamble, '96).
v. Killary Bay (Ball, Forbes, and Hyndman, f. Thompson, '56).

Distribution.—Norway to W. France.

Goniodoris castanea, **Alder & Hancock.**

. . . iv., . .

iv. R. I. A. Exp., 1885, Dursey Sound, 20–25 fms. (**Haddon, '86a**).
Distribution.—British Isles. W. France. **Mediterranean.**

Idalina elegans (Leuckart). (*Idalia elegans*, **Jeffreys, B. C.**)

. . . . v., .

v. Birterbuy Bay (Barlee, f. Jeffreys, '69; **Dublin Mus.**).
Distribution.—Denmark to Mediterranean.

Idalina Leachii (Alder & Hancock). (*Idalia Leachii*, **Jeffreys**, B. C.)

. . . . v., .

v. Birterbuy Bay (Barlee, f. Jeffreys, '69).
Distribution.—British Isles.

Idalina aspersa (Alder & Hancock). (*Idalia aspersa*, **Jeffreys**, B. C.)

. ii., iii., . v., .

ii. Off Bray Head, 7 fms. (Ball, f. Thompson, '56).
iii. R. I. A. Exp., 1888, off S. coast of Cork, 50 fms. (A. R. N.).
v. Birterbuy Bay, not uncommon (Barlee, f. Jeffreys, '69).
Distribution.—Sweden to S. W. France.

Ancula cristata (Alder).

. ii., iii., . . .

ii. Malahide (Alder & Hancock, '45): Dublin Bay, common (Alder, f. Thompson, '44A).
iii. R. I. A. Exp., 1888, off co. Cork, 24 fms. (A. R. N.).
Distribution.—Iceland. Norway to English Channel.

Class.—**SCAPHOPODA.**

Family.—DENTALIIDÆ.

Dentalium panormitanum, Chenu.

. . . iv., . .

iv. "Porcupine" Exp., 1869, 85–180 fms. (Jeffreys, '82).
Distribution.—S. W. Ireland to Mediterranean. **Off Senegal, "Talisman."**

Dentalium vulgare, Da Costa. (*D. tarentinum*, Jeffreys, B. C.)

. ii., . iv., v., .

ii. Eastern shores of Ireland (Thompson, '56): Dublin Bay, dead, rare (Walpole, '53A; Kinahan, '61): Dalkey Sound (dead, Walpole, '53A; Adams, '78).

iv. Bantry Bay (Mrs. Puxley and Humphreys, f. Jeffreys, '65: Standen in Journ. of Conch., viii., 1896): R. I. A. Exp., 1885, 1886, 79–93 fms. (Chaster, '98, A. R. N.).

v. Western shores of Ireland (Thompson, '56): Miltown Malbay (Warren, f. Thompson MS.): Aran I. (Barlee, f. Jeffreys, '65): "Porcupine" Exp., 1869, Galway Bay, 15–20 fms. (Jeffreys, '82): R. D. S. Fish. Survey, 1890, Galway Bay (A. R. N.): Birterbuy Bay (Walpole, '52): R. D. S. Fish. Survey, 1890, Blacksod Bay (A. R. N.).

Distribution.—Belgium. England, Wales, and Ireland to Mediterranean.

[*Dentalium candidum*, Jeffreys.]

. . . iv., v., .

iv. "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '82).

Distribution.—Both sides of North Atlantic. Deep water.

[*Dentalium ænigmaticum*, Jordan.]

. . . . v., .

v. West coast of Ireland, 1000 fms., two specimens in British Museum (Smith, f. Jordan in Proc. Mal. Soc., London, i., 1895).

Distribution.—Faroe Channel. W. Ireland. Deep water.

Dentalium agile, M. Sars.

. . . iv., [v.], .

iv. "Porcupine" Exp., 1869, 90–722 fms. (Jeffreys, '82): R. I. A. Exp., 1888, 345 fms., three fine specimens, two containing the animal (Chaster, '98).

v. "Porcupine" Exp., 1869, 173–422 fms. (Jeffreys, '82).

Distribution.—Finmark to Mediterranean. Azores. Canaries. N. W. Africa. Ascension I. N. E. America. Gulf of Mexico.

[*Dentalium striolatum*, Stimpson. (*D. abyssorum*, Jeffreys, B. C.)]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '82).

Distribution.—Spitzbergen. Finmark to Mediterranean. Azores. W. Africa, "Talisman" (Locard). Greenland. N. E. America.

Dentalium entalis, Linné.

i., ii., iii., iv., v., .

i. Antrim and Down coasts, living in some profusion, 5–90 fms. (Praeger, '89).

ii. Ireland's Eye and Howth (Hart, '92): Dublin Bay (Walpole, '53A; Kinahan, '61; Warren Coll. in Dublin Mus.).[1]

iii. "Porcupine" Exp., 1869, 74 fms. (Jeffreys, '82): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 40–55½ fms. (Swanston, '86, Chaster, '98).

iv. Bantry Bay (Humphreys, '45): "Porcupine" Exp., 1869, 85–808 fms. (Jeffreys, '82): R. I. A. Exp., 1885, 1886, 5–110 fms. (Swanston, '86, Chaster, '98, A. R. N.): R. D. S. Fish. Survey, 1890, Dingle Bay (A. R. N.).

v. Aran I. (Barlee, f. Jeffreys, '65): Galway Bay (M'Andrew Coll., f. Cooke, '82): Roundstone (Alcock, '65; Standen, '95): "Porcupine" Exp., 1869, 165–208 fms. (Jeffreys, '82).

Distribution.—Iceland. Finmark to Spain. N. E. America. N. W. America.

[*Dentalium subterfissum*, Jeffreys.]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '82).

Distribution.—Both sides of North Atlantic. Deep water.

Pulsellum lofotense (M. Sars). (*Siphonodentalium lofotense*, Jeffreys, B.C.)

i., . iii., iv., v., .

i. Church Bay, Rathlin I., a small dead specimen (Chaster, '97B).

iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms. (Chaster, '98).

iv. "Porcupine" Exp., 1869, 90–808 fms. (Jeffreys, '82): R. I. A. Exp., 1885, 1886, 1888, 10–345 fms. (Chaster, '98).

v. "Porcupine" Exp., 1869, 85–816 fms. (Jeffreys, '82).

Distribution.—Loffoden I. to Mediterranean. N. E. America.

[1] Portmarnock, rare (Brown, '18).

[*Pulsellum quinquangulare* (Forbes).]

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '82): R. I. A. Exp., 1886, 1888, 100–345 fms. (Chaster, '98).

v. "Porcupine" Exp., 1869, 173–422 fms. (Jeffreys, '82).

Distribution.—Loffoden I. to Mediterranean. C. Verd I., "Talisman" (Locard). W. Indies.

[*Cadulus olivi* (Scacchi).]

. . . iv., . .

iv. "Flying Fox" Exp., 1889, 1000 fms., two specimens (Smith, '89).

Distribution.—Norway to Mediterranean. Senegal and W. Africa, "Talisman." ? N. E. America.

Cadulus subfusiformis (M. Sars).

. . . [iv.], v., .

iv. R. I. A. Exp., 1888, 345 fms., several live and dead specimens (Chaster, '98).

v. "Porcupine" Exp., 1869, 85 fms. (Jeffreys, '82).

Distribution.—Loffoden I. to Mediterranean. W. Africa, "Talisman." New England.

Cadulus Jeffreysi, Monterosato. (*Cadulus subfusiformis*, Jeffreys, B.C.)

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 85–808 fms. (Jeffreys, '82): R. I. A. Exp., 1885, 110 fms., two fragmentary specimens (Chaster, '98).

v. "Porcupine" Exp., 1869, 85–816 fms. (Jeffreys, '82).

Distribution.—Norway to Mediterranean. Josephine Bank and Azores, "Josephine." W. Africa, "Talisman." St. Helena (Smith). New Jersey to W. Indies (Dall).

[*Cadulus propinquus*, G. O. Sars.]

. . . iv., . .

iv. R. I. A. Exp., 1888, 345 fms., a single example (Chaster, '98).

Distribution.—Norway. North Atlantic. Mediterranean.

Class.—PELECYPODA.

Order.—PROTOBRANCHIATA.

Family.—Nuculidae.

Nucula tenuis (Montagu).

i., ii., . iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): near the Maidens, deep water, living (Hyndman, '59; Belfast Mus., f. Praeger, '89): coast of Down (Brown, '44).

ii. Portmarnock (Warren, f. Thompson, '56): Dublin Bay (Jeffreys, '63): Dalkey Sound, rare (Walpole, '53A).

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '79): R. I. A. Exp., 1886, off Dursey Head, 214 fms., dead (A. R. N.).

v. "Porcupine" Exp., 1869, Galway Bay, 15–20 fms., and 165–208 fms. (Jeffreys, '79).

Distribution.—Arctic seas in both hemispheres to Mediterranean and New England. W. America. N. E. Asia.

Nucula corbuloides, Seguenza.

. . . iv., . .

iv. "Porcupine" Exp., 1869, 90–364 fms. (Jeffreys, '79): "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).

Distribution.—North Atlantic. Mediterranean. W. Africa. Deep water.

[*Nucula cancellata*, Jeffreys.]

. . . iv., v., .

iv. "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '79).

Distribution.—Both sides of North Atlantic. Deep water.

Nucula sulcata, Brown.

. ii., iii., iv., v., .

ii. Dublin Bay (Clark and Warren, f. Thompson, '56; Branscombe and Warren, f. Jeffreys, '63): off Dublin coast (Farran f. Thompson, '47A; Walpole, '53A).

iii. Nymph Bank, 50–60 fms., very young specimens (M'Andrew, f. Thompson, '56): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 54–55½ fms. (Chaster, '98, A. R. N.).

iv. Between Cape Clear and Mizen Head, 40 fms., very young specimens (M'Andrew, f. Thompson, '56): Bantry Bay (Humphreys, f. Jeffreys, '63): "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '79).

v. "Porcupine" Exp., 1869, Galway Bay, 15–20 fms., and 165–208 fms. (Jeffreys, '79).

Distribution.—Norway to Mediterranean. Canaries.

Nucula nucleus (Linné).

i., ii., iii., iv., v., vi.

Generally distributed in sand and gravel.

Var. *radiata*, Forbes & Hanley. Off Larne Lough, one specimen, living, and off Black Head, 25 fms. (Hyndman, '59): off Groomsport, living, rare (Waller, f. Hyndman, '58): Dublin Bay, not uncommon (Kinahan, '61): Dalkey Sound, rare (Walpole, '53A): off Hook Light, co. Wexford, 45–50 fms. (Walpole, '52).

Distribution.—Loffoden I. to Mediterranean. Morocco. Cape of Good Hope (Sowerby).

Nucula nitida, G. B. Sowerby.

i., ii., iii., iv., [v.], .

i. Off Ballycastle, dead (Chaster, '97A): off Black Head, 15 fms., living, and 25 fms. (Hyndman, '59): Turbot Bank, dead (Hyndman, '58): Belfast Lough (Dublin Mus.): off Donaghadee, 20 fms., and Copeland I., 12 fms., living (Hyndman, '59): Strangford Lough, 4–25 fms., living, rare (Dickie, '58).

ii. Dundalk (Thompson, '56): Portmarnock (Thompson, '56; Hart, '92): Dublin Bay (Kinahan, '61): Dalkey Sound (Walpole, '53A; Adams, '78): Killiney Bay, &c. (Walpole, '53A).

iii. Youghal (Thompson, '56): Cork Harbour (Wright & Carroll, '52): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–54 fms. (Chaster, '98): off Cape Clear, 30 fms. (M'Andrew, f. Forbes & Hanley, '53). Var. *radiata*, Marshall. R. I. A. Exp., 1885, off Baltimore, 30 fms. (Chaster, '98).

iv. "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 1886, 1888, 3½–110 fms. (Chaster, '98).

v. "Porcupine" Exp., 1869, 165–183 fms. (Jeffreys, '79).

Distribution.—Norway to Mediterranean.

[*Nuculana pernula* (Müller). (*Leda pernula*, Jeffreys, B.C.)]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 251–539 fms. (Jeffreys, '79).

Distribution.—Arctic seas in both hemispheres to W. France and New England. Bering Strait.

Nuculana minuta (Müller). (*Leda minuta*, Jeffreys, B.C.)

i., ii., . iv., v., .

i. Generally distributed in sand, &c., in the coralline zone and deeper water.

ii. Portmarnock (Brown, '44; Warren, f. Thompson, '56): Dublin Bay (Brown, '44; living, rare, Kinahan, '61): Dalkey Sound and Killiney Bay, very rare (Walpole, '53A).

iv. Bantry Bay (Leach, '52): "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '79).

v. West of Ireland, rare (Turton, '19).

Var. *brevirostris*, Jeffreys. All the Irish coasts (Jeffreys, '63).

Distribution.—Arctic seas in both hemispheres to W. France, New England, and Japan.

[*Nuculana messanensis* (Seguenza).]

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '79).

v. "Porcupine" Exp., 1869, 422–816 fms. (Jeffreys, '79).

Distribution.—Norway to Mediterranean. Azores. Morocco. Canaries. New England to Barbadoes (Dall). North Atlantic, "Valorous."

[*Nuculana pustulosa* (Jeffreys).]

. . . iv., v., .

iv. "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '79).

Distribution.—North Atlantic. Deep water.

[*Nuculana frigida* (Torell).]

. . . iv., v., .

iv. R. I. A. Exp., 1888, 345 fms. (Chaster, '98).

v. "Porcupine" Exp., 1869, 165 fms. (Jeffreys, '79).

Distribution.—Arctic seas to Mediterranean and New England. N. Japan.

Nuculana tenuis (Philippi). (*Leda pygmæa*, Jeffreys, B.C.)

i., . iii., iv., [v.], .

i. Off Ballycastle, dead (Chaster, '97A): on the Antrim coast (Jeffreys, '63): Turbot Bank (Waller Coll. in Dublin Mus.): Belfast Lough (Belfast Mus., f. Praeger, '89).
iii. R. I. A. Exp., 1885, off Baltimore, 30 fms. (Chaster, '98).
iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 1886, 1888, 7–345 fms. (Chaster, '98, A. R. N.).
v. West of Ireland, 100 fms. (King, '62): "Porcupine" Exp., 1869, 106–422 fms. (Jeffreys, '79).

Distribution.—Loffoden I. to Mediterranean.

[*Nuculana lenticula* (Möller).]

. . . . v., .

v. "Porcupine" Exp., 1869, 165 fms., valves only (Jeffreys, '79).

Distribution.—Arctic seas to S. W. Spain. Morocco, "Travailleur" (Locard). Greenland. New England (Verrill & Bush).

[*Nuculana lucida* (Lovén). (*Leda lucida*, Jeffreys, B.C.)]

. . . . v., .

v. "Porcupine" Exp., 1869, 165–816 fms. (Jeffreys, '79).

Distribution.—Arctic seas to Mediterranean and New England.

[*Nuculana pusio* (Philippi).]

. . . ? iv., v., .

iv. ? "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).
v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '79).

Distribution.—Both sides of North Atlantic. Mediterranean. Deep water.

[*Nuculana Jeffreysi* (Hidalgo).]

. . . . v., .

v. "Porcupine" Exp., 1869, 165 fms. (Jeffreys, '79).

Distribution.—Both sides of North Atlantic. Off Ascension I., "Challenger." Deep water.

[*Nuculana expansa* (Jeffreys).]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '79).

Distribution.—Both sides of North Atlantic. Deep water.

[*Nuculana insculpta* (Jeffreys).]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '79).
Distribution.—Both sides of North Atlantic. Deep water.

Nuculana pusilla (Jeffreys).

i., . iii., iv., . .

i. Off Ballycastle, a perfect though dead specimen and two valves (Chaster, '97A).
iii. R. I. A. Exp., 1885, off Baltimore, 30 fms., dead (Chaster, '98).
iv. R. I. A. Exp., 1885, 1886, 3½–44 fms., dead (Chaster, '98).
Distribution.—Ireland to Mediterranean.

Order.—FILIBRANCHIATA.

Family.—Anomiidæ.

Anomia ephippium, Linné.

i., ii., iii., iv., v., vi.

Common, attached to shells, stones, &c., from low-water mark to the greatest depths.

Distribution.—Iceland. Finmark to Mediterranean. Azores. Madeira. N. E. America. Tristan da Cunha and off Brazil, "Challenger." Corea.

Anomia patelliformis, Linné.

i., ii., iii., iv., v., vi.

Generally distributed on shell-banks, &c., round the coast, from low-water mark to great depths.

Var. *striata*, Lovén. North of Ireland, 12–25 fms., living (Praeger, '89): off Larne Lough, living (Hyndman, '59): Belfast Lough and off entrance, dead (Hyndman, '58, '59): Strangford Lough and off entrance, living (Dickie, '58): Dublin Bay (Kinahan, '61): Dalkey Sound, very rare (Walpole, '53A): Achill I. (Mrs. Tatlow & Praeger, '98).

Distribution.—Loffoden I. to Mediterranean. Azores. W. Africa, "Talisman" (Locard). N. W. America.

Family.—ARCIDÆ.

Arca lactea, Linné.

i., . iii., iv., . .

i. Turbot Bank, dead (Hyndman, f. Thompson, '56; Hyndman, '58; Waller, f. Hyndman, '59).
iii. R. I. A. Exp., 1886, off S. coast of Cork, 52½ fms. (Chaster, '98).
iv. Bantry Bay (Mrs. Puxley, f. Forbes & Hanley, '53).

Distribution.—British Isles to Mediterranean. Canaries. W. Africa. Cape of Good Hope (Sowerby). Red Sea.

[*Arca nodulosa*, Müller.]

. . . . v., .

v. "Porcupine" Exp., 1869, 173–208 fms. (Jeffreys, '79).

Distribution.—Loffoden I. to Mediterranean. Azores. Madeira. Canaries. W. Africa. Florida (Dall).

Arca tetragona, Poli.

i., ii., iii., iv., v., vi.

i. Derry coast, single valves, frequent (Praeger, '89): Magilligan, single valves (Thompson, '56; Miss H. Galwey, '88): Portrush, *in situ* (Ordnance Collectors, f. Thompson, '56): off Ballycastle, living (Chaster, '97A): off Copelands, 50 fms., in limestone, living (Hyndman, '58): Turbot Bank, dead (Hyndman, '58, '59).
ii. Dublin Bay, rare (Turton, '19, sub *A. Noæ*).
iii. Cork Harbour, one specimen (Humphreys, '45): south of Ireland (Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 30–55½ fms. (Swanston, '86, Chaster, '98).
iv. "On the islands called the Calves" (Turton, '22): Bantry Bay, not uncommon: Kenmare (Humphreys, f. Thompson, '56): Valentia (Cockerell, '87): R. I. A. Exp., 1885, 1886, 5–80 fms. (Swanston, '86, Chaster, '98, A. R. N.).
v. Coast of Galway (Ball, f. Thompson, '40): R. D. S. Fish. Survey, 1890, Galway Bay (A. R. N.): Aran I. (Dublin Mus., coll. by E. P. Wright): "Argo" Cruise, 1890, off Aran I., 24 fms., living (Herdman, '91): Birterbuy Bay (Farran, '45; &c.): Roundstone (Alcock, '65; &c.): Clifden Bay (Farran, f. Thompson, '56): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay, one perfect specimen and single valves (Miss A. Warren, '92): Inisbarnog, co. Donegal (Mrs. Tatlow, '99).

Distribution.—Finmark to Mediterranean. Azores. W. Africa. Madeira. Canaries. C. Verd I.

[*Arca obliqua*, Philippi.]

. . . . v., .

v. "Porcupine" Exp., 1869, 173–422 fms. (Jeffreys, '79).

Distribution.—Norway to Mediterranean. Azores. Josephine Bank.

Arca pectunculoides, Scacchi.

. . iii., iv., [v.], .

iii. Off Cape Clear, 45 fms., a living specimen and a valve (M'Andrew, f. Thompson, '56).

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 35–110 fms. (Chaster, '98): R. I. A. Exp., 1886, 93 fms., living (A. R. N.).

v. West of Ireland, 100 fms. (King, '62, Jeffreys, '63): "Porcupine" Exp., 1869, 173–422 fms. (Jeffreys, '79).

Distribution.—Arctic seas in both hemispheres to Mediterranean and West Indies. Morocco, "Talisman" (Locard). Madeira (Watson).

Pectunculus glycymeris (Linné).

i., ii., iii., iv., v., vi.

Generally distributed round the coast from low-water mark to about 100 fms., and often gregarious.

Distribution.—Finmark to Mediterranean. W. Africa. Madeira. Canaries. N. Japan.

[*Glomus nitens*, Jeffreys.]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '79).

Distribution.—Both sides of North Atlantic. Off the Rio de la Plata, "Challenger." Deep water.

[*Silicula fragilis*, Jeffreys.]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '79).

Distribution.—North Atlantic. Deep water.

[*Limopsis aurita* (Brocchi).]

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '79): R. I. A. Exp., 1888, 345 fms., a small live specimen (Chaster, '98).

v. West of Ireland, 340 fms., two valves (King, '63, Jeffreys, '63): "Porcupine" Exp., 1869, 173–208 fms. (Jeffreys, '79).

Distribution.—Both sides of North Atlantic. Mediterranean. Deep water.

[*Limopsis cristata*, Jeffreys.]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '79): "Flying Fox" Exp., 1889, 1000 fms. (Smith '89).

Distribution.—Both sides of North Atlantic. Deep water.

[*Limopsis minuta* (Philippi). (*L. borealis*, Jeffreys, B.C.)]

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 370–808 fms. (Jeffreys, '79).

v. "Porcupine" Exp., 1869, 422 fms. (Jeffreys, '79).

Distribution.—Both sides of North Atlantic. Mediterranean. Cape of Good Hope (Jeffreys).

Family.—MYTILIDÆ.

Mytilus edulis, Linné.

i., ii., iii., iv., v., vi.

Universally distributed round the coast and gregarious; usually in the littoral zone.

Var. *incurvata*, Pennant. Very common on the rocky coasts. Var. *pellucida*, Pennant. Belfast Lough (Thompson, '56): Cultra (Stewart, f. Praeger, '89): Dublin coast (Brown, '18; &c.): Bray (Adams, '78).

Distribution.—Almost cosmopolitan.

Modiolus adriaticus (Lamarck). (*Mytilus adriaticus*, Jeffreys, B.C.)

i., ii., . iv., v., vi.

i. "Porcupine" Exp., 1869, Lough Foyle, 10 fms. (Jeffreys, '79): ? Turbot Bank, and off the Maidens, 75 fms., dead (Hyndman, '58): Belfast Lough (Hyndman and Thompson, f. Thompson, '56; living, Hyndman, '58; Praeger, '89): Strangford Lough (Belfast Mus., f. Praeger '89).

ii. Carlingford Lough (Praeger, '89): Portrane, scarce (Hart, '92): Malahide, one or two specimens (Lloyd, f. Thompson, '56): Portmarnock, very rare (Warrèn, f. Thompson, '56).

iv. In or near Bantry Bay (M'Andrew, f. Thompson, '56): Kerry (Dublin Mus.).

v. Birterbuy Bay (Farran, '45; Walpole, '52): Roundstone (Dublin Mus.).

vi. Near Rathmullan, Lough Swilly, rare (Hart, '92).

Distribution.—Finmark to Mediterranean. Canaries.

Modiolus modiolus (Linné). (*Mytilus modiolus*, Jeffreys, B.C.)

i., ii., iii., iv., v., vi.

i. Generally distributed and common. Var. *ovata*, Jeffreys. Co. Antrim (Jeffreys, '63).

ii. Dublin coast, common: Courtown, co. Wexford (Mrs. Tatlow). Var. *ovata*. Portmarnock (Jeffreys, '63). Var. *umbilicata*, Pennant. Dublin Bay, rare (Brown, '18).

iii. Cork Harbour, common (Humphreys, '45). Var. *umbilicata*. Cork Harbour (Humphreys, f. Jeffreys, '63): Cove, co. Cork, plentiful (Turton, '19).

iv. Coast of Kerry (More, '70): R. I. A. Exp., 1885, mouth of Kenmare River, 48 fms. (Chaster, '98).

v. Roundstone (Alcock,'65): Achill I. (Mrs. Tatlow & Praeger, '98): R. D. S. Fish. Survey, 1890, 1891, Blacksod Bay (Holt, '92).

vi. Killala Bay (Miss A. Warren, '92): Donegal, common (Hart, '92).

Distribution.—Iceland. Finmark to Brittany. N. E. America. Bering Strait to California and Japan.

Modiolus barbatus (Linné). (*Mytilus barbatus*, Jeffreys, B.C.)

. . iii., . v., vi.

iii. Dungarvan, living (A. R. N.): Youghal, very rare (Ball, f. Thompson, '56).

v. Birterbuy Bay (Barlee, f. Thompson, '56): R. D. S. Fish. Survey, 1890, Roundstone, valves (Jordan): Roundstone (Dublin Mus.): Killary and Clew Bays, 3–12 fms. (Thompson, '56).

vi. Killala Bay, occasionally (Miss A. Warren, '92).

Distribution.—S. and W. England, Wales, and Ireland to Mediterranean. Japan, "Challenger."

Modiolus phaseolinus (Philippi). (*Mytilus phaseolinus*, Jeffreys, B.C.)

i., . iii., iv., . vi.

i. Off Ballycastle, living (Chaster, '97A): off Belfast Lough, and off the Maidens, 70–90 fms., living (Hyndman, '59, '60): Turbot Bank (Hyndman, '59): Strangford Lough, living, rare (Dickie, '58).

iii. R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–52½ fms. (Chaster, '98): Skibbereen, co. Cork (A. R. N.).

iv. "Porcupine" Exp., 1869, 85–808 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 1886, 3½–79 fms. (Chaster, '98, A. R. N.): Bantry Bay (Dublin Mus.).

vi. Broadhaven (Dublin Mus.): Killala Bay, rare (Miss A. Warren, '92).

Distribution.—Iceland. Finmark to Mediterranean.

Crenella rhombea (Berkeley).

. . . . v., vi.

v. Connemara (Dodd, f. Marshall, '97).

vi. Bundoran, co. Donegal (Waller, f. Jeffreys, '69).

The collection of Mr. George Humphreys made in the last century contained a single valve labelled 'Ireland' (Jeffreys, '63).

Distribution.—S. England and Ireland to Mediterranean. Madeira. Canaries.

Crenella decussata (Montagu).

i., ii., . [iv.], . .

i. Off Ballycastle, dead (Chaster, '97A): Larne Lough, 4–5 fms., one specimen, living (Hyndman, '59): off Larne Lough, Black Head, &c., living (Hyndman, '59): Turbot Bank (dead, rare, Hyndman, '58; living, Hyndman, '59): Groomsport, shell-sand (Praeger, '92A): Strangford Lough, a few odd valves (Hyndman and Thompson, f. Thompson, '56): entrance to Strangford Lough, 18–20 fms., living, very rare (Dickie, '58).

ii. Dalkey Sound, a single valve (Adams, '78).

iv. R. I. A. Exp., 1885, 110 fms. (Chaster, '98).

Distribution.—Arctic seas in both hemispheres to Mediterranean and Gulf of Mexico. N. Pacific.

Order.—PSEUDOLAMELLIBRANCHIATA.

Family.—AVICULIDÆ.

Avicula hirundo (Linné).

. ii., iii., iv., . .

ii. Dublin Bay, near the Pigeon House (Turton, '19): Dublin Bay (Warren, f. Thompson, 56). It is doubtful if these records are correct. In the Warren Coll. in the Dublin Mus., there is a single valve of this species, which according to Mr. Warren's MS. Catalogue was found at Portmarnock. Jeffreys examined this specimen and discovered on the same tablet a young shell of a tropical species of *Avicula* (or *Meleagrina*).

iii. Off Mine Head, fragments from trawlers (Wotton, f. Marshall, '97).

iv. Bantry Bay (Miss Hutchins, f. Fleming in "A History of British Animals," 1828): S.W. Ireland, 50–60 fms. (Wotton, f. Marshall, '97).

Distribution.—S. England and Ireland to Mediterranean. Azores. W. Africa, "Talisman" (Locard). Madeira. Canaries. St. Helena (Smith). New England and Caribbean Sea (Verrill).

Pinna rudis, Linné.

i., ii., iii., iv., v., .

i. Generally distributed, but not common.

ii. Coasts of Down and Louth (Thompson, '56): off the coast of Down (Hart, '92): Skerries, co. Dublin (Rutty in "Natural History of the County of Dublin," i., 1772): Tuskar Rocks, Wexford (Hart, '92): coast of Wexford (Dublin Mus.).

iii. Youghal (Ball, f. Thompson, '56): Nymph Bank, living, very common (Miss M. Ball, f. Thompson, '56): Cork Harbour (Humphreys, '45): Cove, co. Cork (Turton, '19; Humphreys and Ball, f. Thompson, '56): off Kinsale Harbour (Humphreys, '45): off Cape Clear (Lieut. Wilson, f. Thompson, '56; dead, M'Andrew, f. Thompson, '56).

iv. Bantry Bay (S. Wright, f. Brown, '18): R. I. A. Exp. 1885, 1886, 30–93 fms. (Swanston, '86, Chaster, '98, A. R. N.): R. D. S. Fish. Survey, 1891, off Ballinskelligs Bay, 55 fms. (Holt, '92): "Research" Trawling Cruise, 1889, 70 fms. (Bourne, '90).

v. Coast of Clare (Farran, f. Warren MS. Cat.): Birterbuy Bay (Barlee, f. Thompson, '56).

Distribution.—British Isles to Mediterranean. Azores. Madeira. Canaries. C. Verd I., "Talisman" (Locard).

Family.—OSTREIDÆ.

Ostrea edulis, Linné.

i., ii., iii., iv., v., vi.

Abundant in suitable localities round the coast, from low-water mark to about 50 fms., and usually gregarious.

Distribution.—Iceland. Norway to Mediterranean. Mogador. N. E. America.

Ostrea cochlear, Poli.

. . . iv., . .

iv. "Porcupine" Exp., 1869, 85-110 fms. (Jeffreys, '79).

Distribution.—S. W. Ireland to Mediterranean. W. Africa, "Talisman" (Locard). Madeira. Canaries.

Family.—PECTINIDÆ.

Pecten pusio (Linné).

i., ii., iii., iv., v., vi.

Generally distributed on rocky coasts, oyster-beds, and old bivalve shells, &c., from about 5 fms. to moderate depths.

Distribution. —Norway to Mediterranean. Azores. Canaries. N. W. and S. Africa. C. Verd I.

Pecten varius (Linné).

i., ii., iii., iv., v., vi.

Common all round the coast from low-water mark to about 50 fms.

Var. *purpurea*, Jeffreys. Cork Harbour (Humphreys, f. Jeffreys, '63): Bantry Bay (Barlee, f. Jeffreys, '63). Var. *nivea*, Macgillivray. Kingstown, Dublin Bay, very rare (Walpole, '53A): Glengariff, Bantry Bay (Barlee, f. Jeffreys, '63).

Distribution.—Norway to Mediterranean. C. Verd I., "Talisman" (Locard).

Pecten pes-lutræ (Linné). (*P. septemradiatus*, Jeffreys, B. C.)

i., . . iv., [v.], .

i. Specimens supposed to be from Lough Foyle were in Dr. Farran's Coll. (Thompson, '56): Magilligan, a single valve (Miss Galwey, f. Hart, '92): ? Turbot Bank, rare (Dickie, f. Hyndman, '58): Turbot Bank, 80 fms., a single valve (Hyndman, '60).

iv. "Porcupine" Exp., 1869, 90-722 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 70-79 fms. (Chaster, '98): R. I. A. Exp., 1888, 345 fms., portion of a valve (A. R. N.): "Research" Trawling Cruise, 1889, 400 fms., a single specimen (Bourne, '90).

v. "Porcupine" Exp., 1869, 422 fms. (Jeffreys, '79).

All the records, except perhaps some of the "Porcupine," refer to var. *septemradiata*, Müller.

Distribution.—Finmark to Mediterranean. W. Africa and Canaries, "Talisman" (Locard).

[*Pecten aratus* (Gmelin).]

. . . . v., .

v. "Porcupine" Exp., 1869, 173-208 fms. (Jeffreys, '79): a small single valve, in a semi-fossil state, was taken by Captain Hoskyns in 340 fms., off the west coast of Ireland (Jeffreys, '63).

Distribution.—Loffoden I. to W. Africa. C. Verd I. ? Mediterranean.

Pecten opercularis (Linné).

i., ii., iii., iv., v., vi.

Generally distributed and plentiful on sandy coasts.

Var. *lineata*, Da Costa. Belfast Lough (Thompson, '56; Praeger, '89): Portmarnock and Wicklow coast (Warren, f. Thompson, '56): Dublin coast (Warburton, Whitelaw, & Walsh, '18): Bray (Brown, '18): Cork and Bantry (Humphreys, '45). Var. *tumida*, Jeffreys. Cork (Humphreys, f. Jeffreys, '63). Var. *elongata*, Jeffreys. Birterbuy Bay (Barlee, f. Jeffreys, '63).

Distribution.—Iceland. Loffoden I. to Mediterranean. Azores. ? Madeira. ? Canaries.

Pecten maximus (Linné).

i., ii., iii., iv., v., vi.

Generally distributed in the laminarian zone and deeper water.

Distribution.—Norway to W. Africa. ? Mediterranean. ? Madeira. ? Canaries.

Pecten tigerinus, Müller.

i., ii., iii., iv., v., vi.

i. Generally distributed, but not common.

ii. Portmarnock (rare, Brown, '18; Miss Willan and Hart, f. Hart, '92): Ireland's Eye, valves (Hart, '92): Dublin Bay (Turton, '19; Kinahan, '61): Dalkey Sound and Killiney Bay (Walpole, '53A): Bray (Brown, '18; Walpole, '53A): Greystones (Mackintosh, '84).

iii. Cork Harbour (Humphreys, '45): "Porcupine" Exp., 1869, 74 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30-55½ fms. (Chaster, '98, A. R. N.).

iv. R. I. A. Exp., 1885, 1886, 5–80 fms. (Swanston, '86, Chaster, '98, A. R. N.): "Research" Trawling Cruise, 1889, 70 fms. (Bourne, '90).

v. Aran I. (Dublin Mus., pres. by E. P. Wright): Roundstone, a specimen (Jeffreys, f. Thompson, '56): R. D. S. Fish. Survey, 1890, Roundstone Bay, 5 fms. (Holt, '92): "Argo" Cruise, 1890, west of Ireland (Herdman, '91).

vi. Enniscrone, single valves (Miss A. Warren, '92).

Distribution.—Iceland. Finmark to Spain.

Pecten striatus, Müller.

i., ii., iii., iv., v., .

i. Off the Maidens, 70–90 fms., and off the Copelands, 12–20 fms., living (Hyndman, '59): off Black Head, 25 fms. (Hyndman, '59): Turbot Bank, single valves (Hyndman, '58): "Porcupine" Exp., 1869, near Belfast, 70 fms. (Jeffreys, '79): Strangford Lough, a single specimen (Hyndman and Thompson, f. Thompson, '56): Strangford Lough, 7–25 fms., dead, very rare (Dickie, '58): north of Ireland (Jeffreys, '63).

ii. East of Ireland (Jeffreys, '63).

iii. Nymph Bank (Warren Coll., f. Thompson, '56): east of Cape Clear, 40-45 fms. (M'Andrew, f. Thompson, '56): south of Ireland (Jeffreys, '63): R. I. A. Exp., 1885, 1888, off Glandore, 40–53 fms. (Chaster, '98, A. R. N.).

iv. "Porcupine" Exp., 1869, 90–180 fms. (Jeffreys, '79).

v. Birterbuy Bay (Barlee, f. Thompson, '56): Roundstone (Dublin Mus., coll. by W. M'Calla): "Porcupine" Exp., 1869, Galway Bay, 15–20 fms., and 165-173 fms. (Jeffreys, '79): west of Ireland (Jeffreys, '63).

Distribution.—Finmark to Mediterranean. New England (Verrill).

Pecten incomparabilis, Risso. (*P. Testæ*, Jeffreys, B. C.)

i., . iii., iv., v., .

i. Off Ballycastle, living (Chaster, '97A): Larne (Jeffreys, '63): on the Antrim and Down coasts, living (Waller and Hyndman, f. Hyndman, '60).

iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–52½ fms., valves (Chaster, '98).

iv. "Porcupine" Exp., 1869, 90–808 fms. (Jeffreys, '79): R. I. A. Exp., 1885, mouth of Kenmare River, 40 fms., valves (Chaster, '98).

v. Birterbuy Bay (Jeffreys, '63).

Distribution.—Loffoden I. to Mediterranean. Azores.

Pecten similis, Laskey.

i., . iii., iv., v., .

i. Off Belfast Lough, dead (Thompson, '56; Hyndman, '58, '59; Waller Coll. in Dublin Mus.): off Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

iii. R. D. S. Fish. Survey, 1890, off Ballycottin, 41 fms. (Jordan): off Cape Clear, 45 fms., numerous valves (M'Andrew, f. Thompson, '56): "Porcupine" Exp., 1869, 74 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–55½ fms. (Chaster, '98).

iv. "Porcupine" Exp., 1869, 85–722 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 1886, 1888, 35–345 fms. (Swanston, '86, Chaster, '98, A. R. N.).

v. "Porcupine" Exp., 1869, Galway Bay, 15–20 fms., and 165–208 fms. (Jeffreys, '79).

Distribution. — Finmark to Mediterranean. Madeira. Jamaica. Corean Sea.

Pecten vitreus (Chemnitz).

. . . iv., [v.], .

iv. "Porcupine" Exp., 1869, 90–722 fms. (Jeffreys, '79): R. I. A. Exp., 1886, 214 fms., a young specimen (Marshall, '97, A. R. N.).

v. "Porcupine" Exp., 1869, 208 fms. (Jeffreys, '79).

Distribution.—Arctic seas to W. Africa and Florida. Mediterranean. W. Patagonia, Japan, and off Philippines, "Challenger."

Family.—LIMIDÆ.

[*Lima Sarsii* (Lovén).]

. . . . v., .

v. "Porcupine" Exp., 1869, 422 fms. (Jeffreys, '79).

Distribution.—Finmark to Mediterranean. W. Africa, "Talisman." St. Helena (Smith).

[*Lima subovata*, Jeffreys.]

. . . iv., . .

iv. "Flying Fox" Exp., 1889, 1000 fms., one valve (**Smith, '89**).

Distribution.—Arctic seas to Mediterranean. **Azores. N. W. Africa. N. Atlantic, "Valorous." New England.**

Lima elliptica, Jeffreys.

i., . . [iv.], [v.], .

i. Off Ballycastle, dead (Chaster, '97A).

iv. "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '79).

v. "Porcupine" Exp., 1869, 208 fms. (Jeffreys, '79).

Distribution. — Loffoden I. to Mediterranean. **Newfoundland.** Gulf of Mexico. N. Japan.

The older writers did not separate this species from *L. subauriculata* (Jeffreys, '63, Chaster, '97A).

Lima subauriculata (Montagu).

i., ii., iii., iv., v., vi.

i. Belfast Lough and off entrance, dead (Thompson, '56; **Hyndman**, '58, '59): Groomsport, shell-sand (Praeger, '92A): **Strangford** Lough, dead, rare (Thompson, '56; Dickie, '58).

ii. Co. Wicklow (J. Adair, f. Adams, '78).

iii. R. I. A. Exp., 1886, off S. coast of Cork, 52½–55½ fms. (Chaster, '98, A. R. N.).

iv. Bantry Bay (Norman, f. Jeffreys '59): R. I. A. Exp., 1885, 1886, 20–40 fms. (Swanston, '86, Chaster, '98).

v. Aran I. (Barlee, f. Jeffreys, '58): Birterbuy Bay, living (Walpole, '52): Roundstone (Alcock, '65; &c.): west of Ireland, 100 fms. (King, '62): "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '79).

vi. Killala Bay, a valve (Miss A. Warren, '92).

Distribution.—Iceland. Norway to Mediterranean. **Madeira.** Canaries. Greenland. N. E. America. N. W. America.

Lima Loscombii, G. B. Sowerby.

i., ii., iii., iv., v., .

i. Generally distributed, but not common.

ii. Dublin Bay, rare (Kinahan, '61): Kish Bank (Farran, f. Adams, '78): Dalkey Sound, living (Walpole, '52): Bray (Turton, '22): off co. Wicklow (J. Adair, f. Adams, '78).

iii. Cork (Humphreys, '45): R. I. A. Exp., 1885, off Baltimore, 30 fms. (Swanston, '86).

iv. "Porcupine" Exp., 1869, 90 fms. (Jeffreys, '79): R. I. A. Exp., 1885, 1886, off Berehaven, 5–25 fms. (Chaster, '98).

v. "Porcupine" Exp. 1869, Galway Bay, 15–20 fms. (Jeffreys, '79): Birterbuy Bay, living (Walpole, '52): Roundstone (Alcock, '65): R. D. S. Fish. Survey, 1890, Roundstone, a valve (Jordan).

Distribution.—Finmark to Mediterranean. Azores. Canaries. Tristan da Cunha, "Challenger."

Lima hians (Gmelin).

i., ii., . . v., vi.

i. Coast of Derry (Ordnance Survey Coll. in Dublin Mus.): off Larne, a single valve (Waller Coll. in Dublin Mus.): Belfast Lough, 7 fms., one specimen (Ordnance Mus., f. Thompson, '56): Belfast Lough (one specimen in Belfast Mus., f. Praeger, '89; Praeger, '94).

ii. Killiney Bay, 15 fms., a live specimen (Walpole, '52): Greystones (Mackintosh, '84).

v. Dog's Bay, Roundstone (Standen, '95).

vi. Mulroy Bay, Donegal, plentiful (Hart, '92; living, Darbishire, f. Praeger, '94).

Distribution.—Loffoden I. to Mediterranean. Azores. Madeira. Canaries. Off Bermuda, "Challenger." W. Indies (Dall).

Order.—EULAMELLIBRANCHIATA.

Family.—ASTARTIDÆ.

Astarte sulcata (Da Costa).

i., ii., iii., iv., [v.], .

i. Generally distributed in sand and mud; also var. *scotica*, Maton & Rackett. Var. *elliptica*, Brown. Belfast Lough (Belfast Mus., f. Praeger, '89).

ii. Portmarnock (Brown, '44): Howth, &c., single valves (Hart, '92): Dublin Bay, uncommon (Kinahan, '61): Dalkey Sound, scarce (Walpole, '53A): Bray (Turton, '19; living, Brown, '44): Greystones (Mackintosh, '84). Var. *scotica.* Coast of Down (Brown, '44): Dalkey Sound, scarce (Walpole, '53A): Bray, not common (O'Kelly, f. Thompson, '56). Var. *elliptica.* Dalkey Sound, very rare (Walpole, '53A): Greystones (Mackintosh, '84).

iii. Youghal and Cork, scarce (Thompson, '56): **Cork, in red gurnard** (Humphreys, '45): "Porcupine" Exp., 1869, **74 fms. (Jeffreys,** '81): **R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms.,** and off S. coast of Cork, 39½–55½ fms. (**Swanston, '86, Chaster,** '98). Var. *scotica.* Youghal (Ball, f. **Thompson,** MS.): Cork, one specimen in haddock (Humphreys, '45).

iv. Bantry Bay (Mrs. Puxley, f. Forbes & Hanley, '53): "Porcupine" Exp., 1869, 85–458 fms. (Jeffreys, '81): **R. I. A. Exp.,** 1885, 1886, 1888, 5–480 fms. (**Swanston, '86, Chaster, '98,** A. R. N.): "Research," Trawling Cruise, 1889, 400 fms., a specimen (Bourne, '90). Var. *minor*, Jeffreys. "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '81).

v. "Porcupine" Exp., 1869, 165–208 fms. (Jeffreys, '81). Var. *minor.* "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '81).

Distribution.—Arctic seas to Mediterranean. Morocco. Canaries. Greenland. N. E. America. Gulf of Mexico.

Astarte Montagui (Dillwyn). (*A. compressa*, Jeffreys, B.C.)

i., . iii., iv., . .

i. Single valves of the smooth variety were dredged off Larne, 25 fms. (Jeffreys, '59); regarded as sub-fossil (Jeffreys, '63).

iii. R.I.A. Exp. 1885, off Galley Head, 54 fms. (Chaster, '98).

iv. Bantry Bay (Dillwyn, f. Forbes & Hanley, '53).

Distribution.—Arctic seas to British Isles. Gulf of Gascony. C. Sagres, "Porcupine." N. E. America. ? N. W. America.

Astarte triangularis (Montagu).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Belfast Lough and off entrance (Hyndman, f. Thompson, '56; Hyndman, '58, '59): Turbot Bank, living (Hyndman, '58): Groomsport, shell-sand (Praeger, '92A): Strangford Lough, 10 fms. (Hyndman, f. Thompson, 56): Strangford Lough and off entrance, living, very rare (Dickie, '58).

ii. Portmarnock (Turton Cat., f. Thompson, '56; Brown, '44): Dublin Bay (Turton, '19; Waller, f. Kinahan, '61): Dalkey Sound (Walpole, '53A; Thompson, '56; Irish Naturalist, i., 1892).

iii. Cork Harbour, a few dead specimens (Wright & Carroll, '52): R. I. A. Exp., 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 52½–55½ fms. (Chaster, '98).

iv. R. I. A. Exp., 1885, 1886, 3½–79 fms. (Swanston, '86, Chaster, '98).

v. Kilkee (Wright & Carroll, '52; Warren Coll., f. Thompson, '56): Aran I. (Barlee, f. Jeffreys, '58): Roundstone (D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Enniscrone (Miss A. Warren, '92).

Distribution.—Shetland to Mediterranean. Canaries.

Family.—ARCTICIDÆ.

Arctica islandica (Linné). (*Cyprina islandica*, Jeffreys, B.C.)

i., ii., iii., iv., [v.], vi.

i. Generally distributed and abundant in sand and mud.

ii. Very common.

iii. Wexford coast, a very large specimen (Walpole, f. Jeffreys, '69): Youghal (Ball, f. Thompson, MS.): Cork Harbour (Humphreys, '45): S. shore of Ireland (Forbes & Hanley, '53): R. I. A. Exp., 1885, off S. coast of Cork, 30–54 fms. (Chaster, '98).

iv. In or near Bantry Bay (M'Andrew, f. Thompson, '56): "Porcupine" Exp., 1869, 808 fms., living (Jeffreys, '81): R. I. A. Exp., 1885, 1886, 5–44 fms. (Chaster, '98, A. R. N.).

v. "Porcupine" Exp., 1869, 165 fms. (Jeffreys, '81).

vi. Killala Bay, single valves, occasionally (Miss A. Warren, '92): Donegal coast, rare (Hart, '92): "Porcupine" Exp., 1869, Lough Swilly, 3–13 fms. (Jeffreys, '81).

Distribution.—Iceland. Finmark to W. France. Gulf of Cadiz, "Talisman" (Locard). Greenland. N. E. America.

Isocardia cor (Linné).

i., ii., iii., iv., v., .

i. Magilligan (Frazer, '71): Giant's Causeway (Turton, '19): near the Copelands (Clealand, f. Thompson, '56): Belfast (Turton, '19): Bangor, Belfast Lough (Templeton MS. Journal, f. Thompson, '56): Strangford Lough, 4–8 fms., dead, very rare (Dickie, '58).

ii. Living specimens have been obtained at various localities off the east coast.

iii. Off Dunmore, co. Waterford, living (Hart, '92): Dungarvan Bay (Good, f. Frazer, '71): Cork Harbour, a single valve (Humphreys, '45): Cove, co. Cork (S. Wright, f. Brown, '18, '44).

iv. Bantry Bay (Turton, '19; &c.): **R. D. S. Fish. Survey, 1890, off the Skelligs, 52–80 fms. (Holt, '92).**

v. "Porcupine" Exp., 1869, 85–816 fms. (Jeffreys, '81).

Distribution.—Norway to Mediterranean. Azores. W. Africa. North Atlantic, "Valorous."

Family.—Lucinidæ.

Loripes lacteus (Linné).

i., . iii., iv., v., .

i. Turbot Bank, dead, rare (Hyndman, '58). Possibly erroneous.

iii. Off Baltimore Harbour, 30 fms. (M'Andrew, f. Thompson, '56): south of Ireland (Jeffreys, '63).

iv. Bantry Bay, 12–15 fms. (M'Andrew, f. Thompson, '56). Var. *Desmarestii*, Payraudeau. Bantry Bay (Jeffreys, '63).

v. West of Ireland (Jeffreys, '63).

Distribution.—British Isles to Mediterranean. Morocco. Madeira. Canaries. C. Verd I., "Talisman" (Locard). ? New England to Gulf of Mexico.

Lucina spinifera (Montagu).

i., ii., iii., iv., v., .

i. Magilligan (Dublin Mus.): Red Bay, co. Antrim, a valve (Thompson, '56): off Donaghadee, 20 fms., living (Hyndman, '59): Turbot Bank and off Belfast Lough, dead (Hyndman, '58, '59): "Porcupine" Exp., 1869, near Belfast, 70 fms. (Jeffreys, '81).

ii. Portmarnock (? Turton Cat., f. Thompson, '56; Brown, '44; Harvey, f. Thompson, '56; A. Macalister, f. Adams, '78): Dublin Bay, a valve (Kinahan, '61): off Dublin Bay, rare (Walpole, '53A).

iii. Cork Harbour (Wright & Carroll,' 52; Humphreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 1888, off S. coast of Cork, 30–54 fms. (Chaster, '98, A. R. N.): off Cape Clear, 60 fms. (M'Andrew, f. Forbes & Hanley, '53): "Porcupine" Exp., 1869, 74 fms. (Jeffreys, '81).

iv., v. Generally distributed.

Distribution.—Norway to Mediterranean. Azores. W. Africa. Madeira. Canaries.

Lucina borealis (Linné).

i., ii., iii., iv., v., vi.

Generally distributed and common.

Var. *gibba*, Jeffreys. Bantry Bay (Norman, f. Jeffreys, '63). A small variety inhabits brackish water in Aran I. (Thompson, '56, Jeffreys, '81).

Distribution.—Iceland. Finmark to Mediterranean. Azores. Morocco. Madeira. C. Verd I. ? N. America. ? Philippines.

Axinus flexuosus (Montagu).

i., ii., iii., iv., v., vi.

i. "Porcupine" Exp., 1869, Lough Foyle, 10 fms. (Jeffreys, '81): Magilligan (Mrs. Tatlow, f. Praeger): off Ballycastle, dead (Chaster, '97A): Belfast Lough, &c., dead (Hyndman, '58, '59): Belfast Lough (Grainger, '59; Dublin Mus.): Strangford Lough (Hyndman and Thompson, f. Thompson, '56; dead, rare, Dickie, '58).

ii. Dublin coast, generally distributed, but not common.

iii. Woodstown, co. Waterford (Dublin Mus., coll. by Mrs. Tatlow): Youghal (Ball, f. Forbes & Hanley, '53): below Cove, valves (Humphreys, '45): S. coast of Ireland (Leach, '52): R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off Baltimore, 30 fms. (Chaster, '98): off Sherkin I. (A. R. N.): off Cape Clear, 30 fms. (M'Andrew, f. Forbes & Hanley, '53).

iv. Bantry (Humphreys, f. Forbes & Hanley '53): R. D. S. Fish. Survey, 1890, Kenmare River (A. R. N.): Valentia (Cockerell, '87): R. I. A. Exp., 1885, 1886, 4–79 fms. (Swanston, '86, Chaster, '98).

v. Birterbuy Bay, living (Walpole, '52): R. D. S. Fish. Survey, 1890, Birterbuy Bay (Jordan): Roundstone (Alcock, '65): Killary and Clew Bays (Thompson, '56): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '81). Var. *polygona*, Jeffreys. "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '81).

vi. Bartra, frequent, but not living (Miss A. Warren, '92): off Bundoran (Thompson, '56): Donegal coast, frequent (Hart, '92): Mulroy Bay, living and plentiful (Darbishire, f. Praeger, '94).

Distribution.—Arctic seas to Mediterranean. Canaries. Off Sahara, "Talisman." Greenland. Labrador to Gulf of Mexico. N. W. America. Corea.

[*Axinus incrassatus*, Jeffreys.]

. . . iv., v., .

iv. R. I. A. Exp., 1888, 345 fms. (Chaster, '98). **Var.** ***succisa*, Jeffreys.** "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '81).
v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '81).

Distribution.—Both sides of North Atlantic. Mediterranean. Deep water.

Axinus croulinensis (Jeffreys).

. . . iv., [v.], .

iv. "Porcupine" Exp., 1869, 90–722 fms. (Jeffreys, '81).
v. "Porcupine" Exp., 1869, 422 fms. (Jeffreys, '81).

Distribution.—Loffoden I. to Mediterranean. Azores. Madeira. Canaries. W. Africa, "Talisman." New England (Verrill & Bush). Bermuda, "Challenger."

Axinus ferruginosus (Forbes).

. ?ii., . iv., [v.], .

ii. Dublin Bay (A. Macalister, f. Adams, '78). Probably erroneous.
iv. "Porcupine" Exp., 1869, 90–722 fms. (Jeffreys, '81): R. I. A. Exp., 1885, 1886, 1888, 37½–345 fms. (Chaster, '98).
v. Off west coast of Ireland, 210 fms. (Hoskyns, f. Jeffreys, '63): "Porcupine" Exp., 1869, 173–208 fms. (Jeffreys, '81).

Distribution.—Arctic seas to Mediterranean. Azores. Madeira. Off Sahara, "Talisman." Greenland to New England.

[*Axinus subovatus*, Jeffreys.]

. . . . v., .

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '81).

Distribution.—North Atlantic. Deep water.

Diplodonta rotundata (Montagu).

. . iii., iv., v., .

iii. South coast of Ireland (Fleming in "A History of British Animals," 1828; Leach, '52): Youghal (Ball, f. Forbes & Hanley, '53): south of Ireland, not uncommon (Jeffreys, '63).
iv. Bantry Bay (Brown, '18; &c.): Ventry Harbour (More, '70).

v. "Porcupine" Exp., 1869, Galway Bay, 15–20 fms. (Jeffreys, '81): Galway Bay (Hart, '92): Aran I. (Barlee, f. Jeffreys, '58): Birterbuy Bay (Barlee, f. Thompson, '56): R. D. S. Fish. Survey, 1890, Blacksod Bay (A. R. N.): west of Ireland, not uncommon (Jeffreys, '63).

Distribution.—British Isles to Mediterranean. W. Africa, "Talisman" (Locard). Madeira. Canaries.

Montacuta ferruginosa (Montagu).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): off Black Head, 25 fms. (Hyndman, '59): Turbot Bank (Waller and Jeffreys, f. Hyndman, '59): "Porcupine" Exp., 1869, off Belfast, 70 fms. (Jeffreys, '81).

ii. Portmarnock (Walpole, '53A; Adams, '78; Warren Coll., f. Thompson, '56, sub *M. ovata*): Dublin Bay (Turton, '19): Dublin coast (Thompson, '56).

iii. Youghal (Jeffreys, f. Forbes & Hanley, '53): Cork Harbour (Wright & Carroll, '52; Humphreys, f. Forbes & Hanley, '53): south coast of Ireland (valves in Hyndman Cab., f. Thompson, '56, sub *M. ovata*): R. I. A. Exp., 1885, off Baltimore, 30 fms., valves (Chaster, '98): between Baltimore and Cape Clear, 30 fms. (M'Andrew, f. Thompson, '56).

iv. Bantry Bay (Norman, f. Jeffreys, '59): R. I. A. Exp., 1885, 1886, 23–44 fms., valves (Chaster, '98, A. R. N.).

v. Birterbuy Bay (Barlee, f. Forbes & Hanley, '53): Roundstone (Alcock, '65; Standen, '95): "Porcupine" Exp., 1869, 183–816 fms. (Jeffreys, '81).

vi. Enniscrone (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson, '56, sub *M. ovata*).

Distribution.—Finmark to Mediterranean. Mogador. Madeira. ? Greenland. New England.

Montacuta donacina, S. V. Wood.

i., ... vi.

i. Church Bay, Rathlin I., two valves (Chaster, '97A).

vi. "Porcupine" Exp., 1869, Lough Swilly, 3–13 fms. (Jeffreys, '81).

Distribution.—Shetland to Algiers.

Montacuta substriata (Montagu).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): "Porcupine" Exp., 1869, North Channel, 40 fms. (Jeffreys, '81): entrance to Belfast Lough, living (Thompson, '56; Hyndman, '58): off Strangford Lough, 12–15 fms., living, very rare (Dickie, '58).

ii. Portmarnock, rare (A. Macalister, f. Adams, '78): Dublin Bay (Kinahan, '61).

iii. R. I. A. Exp., 1885, 1886, 1888, off S. coast of Cork, 30–52½ fms., valves (Chaster, '98).

iv. Bantry Bay (Jeffreys, f. Forbes & Hanley, '53; Dublin Mus.): "Porcupine" Exp., 1869, 370–722 fms. (Jeffreys, '81): R. I. A. Exp., 1885, 1886, 5–79 fms., valves (Chaster, '98): "Flying Fox" Exp., 1889, 50–60 fms. (Smith, '89).

v. Aran I. (Barlee, f. Forbes & Hanley, '53): "Porcupine" Exp., 1869, 85–208 fms. (Jeffreys, '81).

vi. Enniscrone, valves only (Miss A. Warren, '92).

Distribution.—Finmark to Mediterranean.

Inhabits the ventral spines of various species of Echinoidea.

Montacuta bidentata (Montagu).

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Cushendall (Belfast Mus., f. Praeger, '89): off Black Head, 25 fms. (Hyndman, '59): Turbot Bank, dead (Hyndman, '59; Swanston, f. Praeger, '89): Bangor (Hyndman and Thompson, f. Thompson, '56).

ii. Portmarnock (Forbes & Hanley, '53; Walpole, '53A): Dublin Bay (Turton Cat., f. Thompson, '56; Waller, f. Kinahan, '61).

iii. About Cork (Turton Cat., f. Thompson, '56): Cork Harbour (Wright & Carroll, '52; Humphreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 1888, 0–52½ fms. (Chaster, '98, A. R. N.).

iv. Bantry Bay (Humphreys, f. Forbes & Hanley, '53): "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '81): R. I. A. Exp., 1885, 1886, 1888, 0–120 fms. (Chaster, '98, A. R. N.): Kenmare River (Praeger, '99). Var. *triangularis*. R. I. A. Exp., 1886, Berehaven, 10–20 fms. (Chaster, '98).

v. "Porcupine" Exp., 1869, 165–816 fms. (Jeffreys, '81): Roundstone (Standen, '95): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay, occasionally (Miss A. Warren, '92): Bundoran (Warren, f. Thompson, '56; Waller Coll. in Dublin Mus.): Narin Strand, co. Donegal (G. P. Farran): Mulroy Bay, valves (Praeger, '94): "Porcupine" Exp., 1869, Lough Swilly, 3-13 fms. (Jeffreys, '81).

Distribution.—Finmark to Mediterranean. Madeira. New England.

Montacuta Dawsoni, Jeffreys.

. . . iv., . vi.

iv. "Porcupine" Exp., 1869, S. W. Ireland (Jeffreys, '69A): Bantry Bay (Marshall, '97).

vi. Bartra I., a valve (Marshall, f. Miss A. Warren, '92): Donegal coast (Marshall, '97).

Distribution.—Norway to Bay of Biscay. Palermo (Monterosato). Greenland. Davis Strait, "Valorous."

Decipula ovata, Jeffreys.

. . iii., iv., [v.], .

iii. R. I. A. Exp., 1885, off Baltimore, 30 fms., valves (Chaster, '98).

iv. R. I. A. Exp., 1885, 38–48 fms., valves (Chaster, '98).

v. "Porcupine" Exp., 1869, 183 fms., valves (Jeffreys, '81, Chaster, '98).

Distribution.—Loffoden I. to W. Africa.

Family.—KELLYELLIDÆ.

Kellyella miliaris (Philippi).

. . . iv., . .

iv. R. I. A. Exp., 1885, 1886, 1888, 75–345 fms. (Chaster, '98).

Distribution.—Loffoden I. to Mediterranean.

Jeffreys regarded *K. miliaris* as the fry or very young of *Isocardia cor.*

Turtonia minuta (Fabricius).

i., ii., iii., iv., v., vi.

i. Abundant among sea-weeds, &c.

ii. Generally distributed.

iii. Coast of Wexford and Waterford (Forbes & Hanley, '53): Dunmore, co. Waterford (Walpole, '52): Cork Harbour (Humphreys, f. Forbes & Hanley, '53).

iv. R. I. A. Exp., 1886, Long Island Sound, 3½–5 fms., and Berehaven, 5–10 fms. (Chaster, '98).

v. Coast of Clare (Warren Coll., f. Thompson, '56): Aran I. and Birterbuy Bay (Barlee, f. Forbes & Hanley, '53): Roundstone (Alcock, '65; Standen, '95): Achill I. (Mrs. Tatlow & Praeger, '98).

vi. Killala Bay (Miss A. Warren, '92): Narin Strand, co. Donegal (G. P. Farran).

Distribution.—Iceland. Finmark to Mediterranean. Greenland. N. E. America. Bering Strait.

Family.—Erycinidæ.

Kellia suborbicularis (Montagu).

i., ii., iii., iv., v., vi.

i. "Porcupine" Exp., 1869, Lough Foyle, 10 fms. (Jeffreys, '81): Magilligan (Belfast Mus., f. Praeger, '89): off Ballycastle, dead (Chaster, '97a): Larne (Waller Coll. in Dublin Mus.): Belfast Lough, 10 fms., dead, and Turbot Bank (Hyndman, '58): Strangford Lough, 7–25 fms., and off entrance, 12–15 fms., living (Dickie, '58).

ii. Portmarnock (Adams, '78): North Bull, Dublin Bay (Warren, f. Adams, '78): Dublin Bay (Turton, '19; Warren, f. Thompson, '56; Kinahan, '61): Dalkey Sound, &c. (Walpole, '53a).

iii. Tramore Bay, co. Waterford (Walpole, '52): Youghal (Ball, f. Thompson ms.): below Cove, co. Cork, in stone (Humphreys, '45): Lough Hyne, living (A. R. N.): R. I. A. Exp., 1885, 1886, 1888, off S. coast of Cork, 4–50 fms. (Chaster, '98, A. R. N.). Var. *lactea*, Brown. R. I. A. Exp., 1885, off Baltimore, 30 fms., small valves (Chaster, '98).

iv. Generally distributed. Var. *lactea*. R. I. A. Exp., 1885, mouth of Kenmare River, 38–44 fms., small valves (Chaster, '98).

v. Generally distributed.

vi. Killala Bay (Miss A. Warren, '92): Bundoran (Thompson, '56): Iniskeen, co. Donegal (Mrs. Tatlow, '99): Narin Strand, co. Donegal (G. P. Farran): Mulroy Bay, valves (Praeger, '94).

Distribution.—Finmark to Mediterranean. Canaries. Kerguelen Sound, "Challenger." New England, N. W. America, Mazatlan, and Indian Ocean (Jeffreys)..

Lasæa rubra (Montagu).

i., ii., iii., iv., v., vi.

Generally distributed and abundant; a favourite habitat for this species is among clusters of *Mytilus edulis* on exposed rocks.

Distribution.—" Apparently world-wide " (Jeffreys).

[*Lasæa pumila* (S. V. Wood).]

. . . . v., .

v. " Porcupine " Exp., 1869, 422 fms. (Jeffreys, '81).

Distribution.—North Atlantic. Mediterranean. Corea.

Lepton squamosum (Montagu).

. ii., iii., iv., v., .

ii. Dublin Bay, single valves, rare (Kinahan, '61): Dalkey Sound and Killiney Bay (Walpole, '53).

iii. Cork Harbour, a single valve (Forbes, f. Humphreys, '45): Cork Harbour, odd valves frequent, and two young living specimens (Wright & Carroll, '52).

iv. In or near Bantry Bay (M'Andrew, f. Thompson, '56): Bantry Bay (Norman, '91; Dublin Mus.): Glengariff, dredged alive just off the harbour (Span, f. Marshall, '97): R. I. A. Exp., 1886, Berehaven, 5–20 fms. (Chaster, '98, A. R. N.).

v. Aran I. (Barlee, f. Forbes & Hanley, '53): Birterbuy Bay (Walpole, '52; Barlee, f. Thompson, '56): adjoining Roundstone Bay, one specimen (Harvey, f. Thompson, '56): " Porcupine " Exp., 1869, 165 fms. (Jeffreys, '81).

Distribution.—Norway to Mediterranean.

Lepton Sykesii, Chaster.

. . . iv., v., vi.

iv. R. I. A. Exp., 1885, mouth of Kenmare River, 38–44 fms., and Ballinskelligs Bay, 27 fms. (Chaster, '98).

v. Dog's Bay, Roundstone (Standen, '95).

vi. Killala Bay (Chaster, f. Miss A. Warren, '95A; Marshall, '97).

Distribution.—Ireland. S. England. Channel Isles.

Lepton nitidum, Turton.

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Turbot Bank sand, living (Waller, f. Hyndman, '59): off Black Head, 25 fms. (Hyndman, '59).

ii. Dublin Bay (Waller, f. Kinahan, '61).

iii. R. I. A. Exp., 1885, 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 30–54 fms., valves (Chaster, '98). Var. *convexa*, Alder. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–54 fms., valves (Chaster, '98).

iv. Bantry Bay (Lyons, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 3½–48 fms., valves (Chaster, '98). Var. *convexa*. Bantry Bay (M'Andrew, f. Forbes & Hanley, '53): R. I. A. Exp., 1885, 1886, 1888, 3½–48 fms., valves (Chaster, '98).

v. Aran I. (Barlee, f. Jeffreys, '58): Roundstone (Standen, '95). Var. *convexa*. Aran I. (Barlee, f. Jeffreys, '58). Var. *pisidialis*, Jeffreys. Connemara, 12 fms. (Marshall, '97).

vi. Killala Bay (Miss A. Warren, '92).

Distribution.—Norway to Mediterranean.

Lepton Clarkiæ, Clark.

i., . iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A).

iii. R. I. A. Exp., 1885, 1886, Lough Hyne, and off Baltimore, 30 fms., valves (Chaster, '98).

iv. Bantry Bay, dead specimens only or valves (Marshall, '97): R. I. A. Exp., 1885, 1886, Berehaven, 5–25 fms., Valentia Harbour, between tides, and 37½–44 fms., valves (Chaster, '98).

v. Aran I. (Barlee, f. Jeffreys, '63): Roundstone (Standen, '95): off Connemara, not uncommon (Dodd and Mellors, f. Marshall, '90).

vi. Killala Bay (Miss A. Warren, '92): Bundoran (Waller Coll. in Dublin Mus.): Mayo, Sligo, Bundoran (Marshall, '97): Portsalon, Donegal (Standen, '94).

Distribution.—Shetland to Channel Isles.

Lepton obliquatum, Monterosato.

i., . . iv., . .

i. Church Bay, Rathlin I., eleven valves (Chaster, '97B).

iv. R. I. A. Exp., 1885, 1886, 10–44 fms., valves (Chaster, '98).

Distribution.—Ireland. Mediterranean.

Family.—Galeommidæ.

Galeomma Turtoni, Sowerby.

i., . iii., . v., .

i. Off Ballycastle, a broken valve (Chaster, '97A).

iii. Nymph Bank, an imperfect valve (M'Andrew, f. Thompson, '56).

v. West of Ireland (Battersby, f. Jeffreys, '69).

Distribution.—S. England and Ireland to Mediterranean.

Family.—TELLINIDÆ.

Tellina balaustina, Linné.

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 90 fms. (Jeffreys, '81).

v. "Porcupine" Exp., 1869, 106–173 fms. (Jeffreys, '81): Aran I. (Barlee, f. Forbes & Hanley, '53): Birterbuy Bay (a living specimen and two valves, Barlee, f. Thompson,'56; Jeffreys, '63): Galway Bay, a single valve (Dublin Mus., coll. by A. G. More): west of Ireland, five single valves (M'Andrew Coll., f. Cooke, '82).

Distribution.—Shetland to Mediterranean. Morocco. Madeira. Canaries.

Tellina crassa, Pennant.

i., ii., iii., iv., v., vi.

i. Magilligan, single valves (Grainger, f. Praeger): off Ballycastle, dead (Chaster, '97A): off Larne Lough, 20 fms., a single living specimen, and off Black Head, &c., dead (Hyndman, '59): Belfast Lough, dead (Hyndman, f. Thompson, '56; Hyndman, '58): Orlock Point, single valves (Praeger, '89): off Strangford Lough, 12–15 fms., dead (Dickie, '58).

ii. Balbriggan, a single specimen (Thompson, '56): Portmarnock (Warren, f. Adams, '78): Dublin coast (Thompson, '56): Dublin Bay (Brown, '18; Kinahan, '61): Dalkey Sound (Walpole, '53A): Greystones (Mackintosh, '84).

iii. R. I. A. Exp., 1885, 1886, off S. coast of Cork, 52½–54 fms. (Chaster, '98).

iv. Generally distributed, and especially abundant in Bantry Bay.

v. Roundstone (Alcock, '65).

vi. Enniscrone, one specimen (Miss A. Warren, '92): Ballysodare (Mrs. Hancock, f. Thompson, '56).

Distribution.—Norway to Mediterranean. ? Senegal. Japan.

Tellina balthica, Linné.

i., ii., iii., iv., v., vi.

Very common all round the coast, between tide-marks.

Var. *minor*, Jeffreys. Bantry Bay (Humphreys and Jeffreys, f. Jeffreys, '63).

Distribution.—Arctic seas to Morocco. ? Mediterranean. Madeira. ? C. Verd I. N. E. America. Bering Strait. N. Japan.

Tellina squalida, Pulteney.

i., ii., iii., iv., [v.], vi.

i. Magilligan (Hyndman, f. Thompson MS.): off Ballycastle, dead (Chaster, '97A): Red Bay, co. Antrim (Mrs. J. T. Tennant, f. Thompson, '56): Brown's Bay, Magee I., dead (Hyndman, '59): off Black Head, 15 fms., dead (Hyndman, '59): Turbot Bank, dead (Hyndman, '58).

ii. Dundalk (Hyndman, f. Thompson, '56): Dublin coast (Brown, '18; &c.).

iii. Durgarvan, dead (A. R. N.): Youghal (Ball, f. Thompson MS.): Cork (Humphreys, '45).

iv. Bantry Bay (Humphreys, '45; Jeffreys Cab., f. Forbes & Hanley, '53): R. I. A. Exp., 1885, Berehaven, 5–25 fms. (Chaster, '98): Valentia (Cockerell, '87).

v. "Porcupine" Exp., 1869, 165 fms., valve (Jeffreys, '81).

vi. Narin, co. Donegal (Mrs. Tatlow, '99): Lough Swilly, &c., fresh specimens (Hart, '92): Rathmullan, Lough Swilly (Falkiner and Grainger, f. Praeger; Dublin Mus.).

Distribution.—Sweden. British Isles to Mediterranean. Azores. Morocco. Madeira. Canaries.

Tellina tenuis, Da Costa.

i., ii., iii., iv., v., vi.

Frequent round the coast on sandy shores.

Distribution.—Finmark to Mediterranean. Mogador. Madeira (Watson).

Tellina fabula, Gronovius.

i., ii., iii., iv., [v.], vi.

i. Generally distributed in sandy bays.

ii. Dublin coast, common.

iii. Dunmore, co. Waterford (Dublin Mus., coll. by Mrs. Tatlow): Ardmore (Mrs. Mackesy, f. Thompson, '56): Youghal (Ball, f. Thompson MS.): Cork Harbour (Humphreys, '45): R. I. A. Exp., 1886, Glandore Harbour, 4 fms., (Chaster, '98): off Sherkin I. (A. R. N.).

iv. Bantry Bay (Humphreys, '45): R. I. A. Exp., 1888, Berehaven, 7 fms. (A. R. N.): Dingle (Cockerell, '85).

v. "Porcupine" Exp., 1869, 165 fms. (Jeffreys, '81).

vi. Killala Bay (Miss A. Warren, '92): Bundoran (Mrs. Hancock, f. Thompson MS.): Narin, co. Donegal, rare (Mrs. Tatlow, '99): "Porcupine" Exp., 1869, Lough Swilly, 3–13 fms. (Jeffreys, '81): Rathmullan Strand, Lough Swilly, living (Rev. J. D. Falkiner, f. Praeger).

Distribution.—Loffoden I. to Mediterranean. Mogador. Cape of Good Hope.

Tellina donacina, Linné.

i., ii., iii., iv., v., vi.

i. Off Larne Lough, one specimen, living (Hyndman, '59): Turbot Bank, dead (Hyndman, '58): Strangford Lough (Hyndman and Thompson, f. Thompson, '56; 4–8 fms., dead, Dickie, '58).

ii. "In the stomach of a haddock, taken on the open coast of Down" (Thompson, '56): Portmarnock (Brown, '18; Thompson, '56; J. Adair, f. Adams, '78; Hart, '92): Dublin Bay (Turton, '19; Brown, '44; Kinahan, '61): Dalkey (Walpole, '53A; Ball, f. Thompson, '56): Bray (M. J. O'Kelly, f. Brown, '18). Var. *distorta*, Jeffreys. Dublin Bay (Walpole, f. Jeffreys, '69).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): R. I. A. Exp., 1885, off Galley Head, 54 fms. (Chaster, '98): Baltimore and Sherkin I. (A. R. N.).

iv. Abundant, especially in Bantry Bay. Var. *distorta*. Bantry Bay (Walpole, f. Jeffreys, '69).

v. Co. Clare (Warren Coll., f. Thompson, '56): Aran I. (Dublin Mus., pres. by E. P. Wright): Birterbuy Bay (Farran and Barlee, f. Thompson, '56): Roundstone (Alcock, '65; Standen, '95; Dublin Mus.).

vi. Broadhaven (Dublin Mus., coll. by A. G. More): Narin, co. Donegal (Mrs. Tatlow, '99).

Distribution.—British Isles to Mediterranean. Azores, "Challenger." W. Africa, "Talisman" (Locard). Madeira. Canaries.

Tellina pusilla, Philippi.

i., ii., iii., iv., v., vi.

i. Magilligan, fresh specimens (Grainger, f. Praeger): off Ballycastle, dead (Chaster, '97A): Turbot Bank sand, dead, valves united (Hyndman, '60).

ii. Portmarnock (Warren, f. Adams, '78): Dublin Bay, living, very rare (Kinahan, '61): Dalkey Sound, very rare (Walpole, '53A).

iii. Cork Harbour (Wright & Carroll, '52): Cork (Humphreys, f. Jeffreys, '63): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–54 fms. (Chaster, '98).

iv. R. I. A. Exp., 1885, 1886, Ballinskelligs Bay, and 5–79 fms. (Swanston, '86, Chaster, '98).

v. Galway (Barlee, f. Thompson, '56): Roundstone (D'Arcy W. Thompson): Achill I. (Mrs. Tatlow & Praeger, '98): "Porcupine" Exp., 1869, 208 fms. (Jeffreys, '81).

vi. Killala Bay (Miss A. Warren, '92): Inisbarnog, co. Donegal, rare (Mrs. Tatlow, '99).

Distribution.—Finmark to Mediterranean.

Gastrana fragilis (Linné).

?i., ?ii., iii., iv., v., vi.

i. Killough, co. Down (Brown,'44); probably in the estuarine clay.

ii. Clontarf, Dublin Bay, in the blue clay, semi-fossil (Turton, '19; &c.).

iii. Ardmore (Mrs. Mackesy, f. Thompson, '56): south of Ireland (Jeffreys, '63).

iv. Bantry Bay (Brown, '18; &c.): R. I. A. Exp., 1886, Berehaven, 5–10 fms., valves (A. R. N.): Kenmare River (Praeger, '99): Valentia (Turton, '19; &c.).

v. Galway Bay (Dublin Mus., pres. by A. G. Melville, and in Waller Coll.): Birterbuy Bay, living (Farran, '45): west of Ireland (Jeffreys, '63).

vi. Enniscrone, one valve (Miss A. Warren, '92): Lough Swilly, fresh single valves (Grainger and Praeger, f. Praeger in Proc. Belfast N. F. C., 1889–90).

Distribution.—Drontheim. British Isles to Morocco. Mediterranean. Greenland.

Family.—SCROBICULARIIDÆ.

Scrobicularia piperata (Gmelin).

i., ii., iii., iv., v., vi.

i. Belfast Lough, dead (Thompson, '56; Hyndman, '58): does not appear to live on N.E. coast between Lough Swilly and Carlingford Lough (Praeger, '92).

ii.–vi. Generally distributed on mud banks.

Distribution.—Norway to Mediterranean. Mogador. ? Senegal. Japan.

Syndosmya alba (W. Wood). (*Scrobicularia alba*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed in sand and mud round the coast.

Var. *curta*, Jeffreys. Larne (Jeffreys, '63): Strangford Lough (Waller, f. Jeffreys, '63). Var. *oblonga*, Marshall. Bantry Bay (Marshall, '97).

Distribution.—Loffoden I. to Mediterranean. Azores. Morocco. W. Africa, "Talisman" (Locard).

[*Syndosmya longicallus* (Scacchi).]

. . . iv., . .

iv. "Porcupine" Exp., 1869, 113–458 fms. (Jeffreys, '81).

Distribution.—Loffoden I. to Mediterranean. Azores. W. Africa. Canaries. New England (Verrill). Gulf of Mexico (Dall).

Syndosmya nitida (Müller). (*Scrobicularia nitida*, Jeffreys, B. C.)

i., ?ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Larne Lough, 4–5 fms., living (Hyndman, '59): off Belfast Lough, living, rare (Hyndman, '58): Turbot Bank, &c., dead (Hyndman, '58, '59): Belfast Lough, a valve found in a plaice (Getty, f. Thompson, '56): Strangford Lough, 6 fms., two specimens (Hyndman and Thompson, f. Thompson, '56): Strangford Lough, 15 fms., and off entrance, 25–26 fms., living (Dickie, '58).

ii. ? Near Baldoyle (Hart, '92).

iii. R. I. A. Exp., 1885, off Galley Head, 54 fms., and off Baltimore, 30 fms. (Chaster, '98): off Cape Clear, 60 fms. (M'Andrew, f. Forbes & Hanley, '53).

iv. "Porcupine" Exp., 1869, 85–808 fms. (Jeffreys, '81): R. I. A. Exp., 1885, 1886, 1888, 5–345 fms. (Swanston, '86, Chaster, '98, A. R. N.): R. D. S. Fish. Survey, 1891, Kenmare River (Jordan).

v. Galway Bay (Dublin Mus., pres. by A. G. Melville): Birterbuy Bay (Barlee and Farran, f. Forbes & Hanley, '53): Killary Bay, two specimens (Forbes, &c., f. Thompson, '56): "Porcupine" Exp., 1869, 85–183 fms. (Jeffreys, '81). Var. *ovata*, Jeffreys. Birterbuy Bay (Barlee and Jeffreys, f. Jeffreys, '63).

vi. "Porcupine" Exp., 1869, Donegal Bay, 25–40 fms. (Jeffreys, '81).

Distribution.—Iceland. Finmark to Mediterranean. Between Gibraltar and Azores, "Josephine." Morocco.

Syndosmya prismatica (Montagu). (*Scrobicularia prismatica*, Jeffreys, B. C.)

i., ii., iii., iv., [v.], vi.

i.–iv. Generally distributed on sandy coasts, but sparingly.
v. "Porcupine" Exp., 1869, 173 fms. (Jeffreys, '81).
vi. Enniscrone, a few valves (Miss A. Warren, '92).
Distribution.—Iceland. Finmark to Mediterranean.

Syndosmya tenuis (Montagu). (*Scrobicularia tenuis*, Jeffreys, B. C.)

i., ii., . . v., vi.

i. Larne Lough (Thompson, '56).
ii. Lissenhall, near Swords (Adams, '78): Portmarnock (Warren, f. Thompson, '56).
v. Birterbuy Bay (Farran, f. Thompson, '56).
vi. Fahan and Inch I., co. Donegal, rare (Hart, '92).
Distribution.—Norway. British Isles to Mediterranean.

Family.—Donacidæ.

Donax vittatus (Da Costa).

i., ii., iii., iv., v., vi.

Generally distributed and common on sandy shores.

Var. *truncata*, Marshall. Magilligan (Waller Coll. in Dublin Mus.): south and west of Ireland (Marshall, '97): Killala Bay (Miss A. Warren, '95).

Distribution.—Norway to Mogador. ? Mediterranean.

Donax variegatus (Gmelin). (*D. politus*, Jeffreys, B.C.)

. ii., iii., iv., v., .

ii. Dublin Bay (Leach, '52).
iii. Cork (Leach, '52).
iv. Bantry Bay (Humphreys, '45; Leach, '52; &c.).
v. Connemara (Brown, '44): Aran I. (Barlee, f. Thompson, '56): Roundstone (Dublin Mus., coll. by A. G. More).
Distribution.—S. England and Ireland to Mediterranean.

Family.—MESODESMATIDÆ.

Ervilia castanea (Montagu). (*Amphidesma castaneum*, Jeffreys, B. C.)

. . iii., iv., v., .

iii. Cork (Humphreys and Jeffreys, f. Jeffreys, '63).
iv. R. I. A. Exp., 1885, Berehaven, 5–25 fms. (Chaster, '98).
v. Coast of Galway, with the valves united (Barlee, f. Thompson, '56).

Distribution.—Belgium. S. England and Ireland to Mediterranean. Azores. Madeira. Canaries. C. Verd I., "Talisman."

Family.—MACTRIDÆ.

Mactra solida, Linné.

i., ii., iii., iv., v., vi.

Generally distributed on sandy coasts in the littoral zone, and common.

Var. *truncata*, Montagu. Generally distributed. Var. *elliptica*, Brown. Generally distributed, but in deeper water than the typical form.

Distribution.—Iceland. Finmark to Spain. ? Mediterranean.

Mactra subtruncata (Da Costa).

i., ii., iii., iv., v., vi.

Generally distributed, but not so common as the preceding species.

Var. *striata*, Brown. Strangford Lough (Brown, '44): Irish coasts (Jeffreys, '63). Var. *inæqualis*, Jeffreys. Strangford Lough (Adair, f. Jeffreys, '63).

Distribution.—Finmark to Mediterranean. Mogador. ? Madeira. Canaries.

Mactra stultorum, Linné.

i., ii., iii., iv., v., vi.

Generally distributed on sandy coasts in the littoral zone, and very common.

Var. *cinerea*, Montagu. Magilligan (Thompson, '56): Portmarnock (Walpole, '53A; Thompson, '56; Adams, '78): Youghal (Ball, f. Thompson, '56).

Distribution.—Norway to Mediterranean. Mogador. Canaries

Family.—VENERIDÆ.

Meretrix chione (Linné). (*Venus chione*, Jeffreys, B. C.)

. ii., ...

ii. Dalkey Sound, 14 fms., one valve (Walpole, '52).

Distribution.—S. and W. England, Wales, and Ireland to Mediterranean. Azores. W. Africa, "Talisman" (Locard). Madeira. Canaries.

Gouldia minima (Montagu). (*Circe minima*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Generally distributed, but not common.

ii. Portmarnock, very rare (Warburton, Whitelaw, and Walsh, '18): Dublin Bay (Turton, '19; Waller, f. Kinahan, '61): Dalkey Sound, very rare (Walpole, '53A).

iii. Youghal, very rare (Miss M. Ball, f. Thompson, '56): R. I. A. Exp., 1886, off S. coast of Cork, 39½–55½ fms. (Chaster, '98).

iv. Bantry Bay (Humphreys, '45; Barlee and M'Andrew, f. Thompson, '56).

v. Miltown Malbay, rare (Harvey, f. Thompson, '56): Birterbuy Bay (Walpole, '52; Farran and Barlee, f. Thompson, '56): Roundstone (Alcock, '65; D'Arcy W. Thompson; Dublin Mus.).

vi. Erris, co. Mayo (Miss Bingham, f. Thompson, '56): Killala Bay (Miss A. Warren, '92).

Distribution.—Norway to Mediterranean. Azores. W. Africa, "Talisman" (Locard). Madeira. Canaries.

Dosinia exoleta (Linné). (*Venus exoleta*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Very common all round the coast in sandy bays, &c.

Distribution.—Finmark to Mediterranean. Senegal.

Dosinia lincta (Pulteney). (*Venus lincta*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

Generally distributed all round the coast and common.

Distribution.—Iceland. Loffoden I. to Mediterranean. Morocco.

Venus verrucosa, Linné.

i., ii., iii., iv., v., vi.

i. Magilligan, a young shell (Hyndman Cab., f. Thompson, '56).
ii. Balbriggan, Portmarnock, and Dublin Bay (Brown, '44): Bray (Turton, f. Thompson, '56): Wexford, rare (Brown, '18).
iii. Youghal (Jeffreys, f. Forbes & Hanley, '53): south of Ireland, common (Jeffreys, '63): R. I. A. Exp., 1885, off Baltimore, 30 fms. (Chaster, '98): off Sherkin I., valves (A. R. N.).
iv. Generally distributed.
v. Coast of Clare (Ball, f. Thompson, '56; Jeffreys, '63): Birterbuy Bay (Farran, f. Thompson, '56): Roundstone (Alcock, '65): Clifden Bay (Hyndman and Thompson, f. Thompson, '56): west of Ireland, common (Jeffreys, '63).
vi. Ballysodare, co. Sligo (Mrs. Hancock, f. Thompson, '56): Narin, co. Donegal, one valve (Mrs. Tatlow, '99).

Distribution.—British Isles to Mediterranean. Canaries. C. Verd I. Africa, America, and Indian Ocean.

Venus casina, Linné.

i., ii., iii., iv., v., vi.

Generally distributed all round the coast.

Distribution.—Finmark to Mediterranean. Azores. Madeira. Canaries.

Venus fasciata (Da Costa).

i., ii., iii., iv., v., vi.

Abundant all round the coast in sand and gravel.

Var. *radiata*, Jeffreys. Bantry Bay and off Aran I., Galway Bay (Jeffreys, '63).

Distribution.—Finmark to Mediterranean. Madeira. N. Japan.

Venus gallina, Linné.

i., ii., iii., iv., v., vi.

Very common on sandy ground all round the coast.

Var. *laminosa*, Montagu. Probably generally distributed.

Distribution.—Iceland. Finmark to Mediterranean. Caspian. Mogador. N. Japan.

Venus ovata, Pennant.

i., ii., iii., iv., v., vi.

Very common all round the coast, and at all depths.

Distribution.—Iceland. Finmark to Mediterranean. Azores. W. Africa, "Talisman" (Locard).

Lucinopsis undata (Pennant).

i., ii., iii., iv., v., vi.

i. Magilligan (rare, Miss H. Galwey, '88 ; fresh specimens, Rev. J. D. Falkiner, f. Praeger) : Portrush, a fresh specimen (Miss Richardson, f. Praeger, '89) : off Ballycastle, living (Chaster, '97A): Belfast Lough and off Maidens, dead (Hyndman, '58, '59): Belfast Lough (Brown, '18 ; Grainger, '59): off White Head, valves united (Swanston, f. Praeger, '89): Cultra, a dead valve (Praeger).

ii. Dublin coast, generally distributed on sandy shores.

iii. Youghal (Ball, f. Thompson MS.): Cork (Humphreys, '45): off Cape Clear, 30 fms., living (M'Andrew, f. Forbes & Hanley, '53).

iv. South of Calf I. (A. R. N.): Bantry Bay (Humphreys, '45; M'Andrew Coll., f. Cooke, '82): Ventry Harbour (More, '70): R. I. A. Exp., 1885, 1886, 5-48 fms. (Swanston, '86, Chaster, '98). Var. *æqualis*, Jeffreys. Bantry Bay (Humphreys, f. Jeffreys, '63).

v. Birterbuy Bay (Farran, f. Thompson MS.): Killary Bay (Thompson, '56): "Porcupine" Exp., 1869, 183 fms. (Jeffreys, '81). Var. *ventrosa*, Jeffreys. Aran I. (Barlee, f. Jeffreys, '63).

vi. Pullaheeny, one valve (Miss A. Warren, '92) : Buncrana, &c. (Hart, '92): Rathmullan and Buncrana (Rev. J. D. Falkiner, f. Praeger).

Distribution.—Finmark to Mediterranean. Mogador.

Tapes virgineus (Linné).

i., ii., iii., iv., v., vi.

Frequent in sand and among nullipores.

Var. *sarniensis*, Turton. Generally distributed. Var. *elongata*, Jeffreys. Larne (Hyndman, f. Jeffreys, '63): Belfast Lough (Belfast Mus., f. Praeger, '89) : Bantry Bay (Jeffreys. '63).

Distribution.—Finmark to Mediterranean.

Tapes geographicus (Chemnitz). (*T. pullastra,* Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

All the records refer to the northern form, the var. *pullastra,* Montagu, which is abundant round the coast in the littoral zone.

Var. *perforans,* Montagu. Generally distributed in holes and crevices of rocks. Var. *ovata,* Jeffreys. Cork (Humphreys, f. Jeffreys, '63). Var. *oblonga,* Jeffreys. Cork (Wright, f. Jeffreys, '63): Bundoran (Jeffreys, '63).

Distribution.—Finmark to Mediterranean. Mogador. Cape of Good Hope. Japan.

Tapes decussatus (Linné).

i., ii., iii., iv., v., vi.

i. Portrush, a specimen with the valves united (Miss Richardson, f. Praeger, '89): Belfast Lough, opposite Jordanstown, dug out of the sand in the living state (Grainger, '59): Belfast Lough, in the alluvial deposit, dead, rare, and not known to be now living in the Lough (Hyndman, '58): Strangford Lough, fresh looking single valves (Praeger). It appears to be very rare in the living state in this province.

ii.–vi. Common and generally distributed in sand, &c., near low-water mark.

Var. *quadrangula,* Jeffreys. Cork (Humphreys, f. Jeffreys, '63): Bantry Bay (Barlee, f. Jeffreys, '63).

Distribution.—Norway to Mediterranean. N. Japan, Indian and Pacific Oceans.

Tapes aureus (Gmelin).

i., ii., iii., iv., v., vi.

i. Portrush, fresh specimens (Miss Richardson, f. Praeger, '89): Belfast Lough, living, common (Hyndman, '58; Grainger, '59): Turbot Bank, dead, rare (Hyndman, '58): Carrickfergus Bay (Macdonnell, f. Brown, '18; not uncommon, Kinahan, f. Waller in Nat. Hist. Rev., vi., 1859 (*Proc.*), p. 86): Holywood and Cultra, single valves (Praeger): Strangford Lough, living (Thompson, '56; Praeger): Strangford Lough, 7–20 fms., dead (Dickie, '58).

ii. Malahide (Adams, '78): Portmarnock (Turton, f. Brown, '18; Sanders in Nat. Hist. Rev., vi., 1859 (*Proc.*), p. 86): Dublin Bay (Turton, f. Brown, '18): Clontarf, in the blue clay (Turton, '19, sub *Venus nitens* and *V. ænea*).

iii. Youghal (Ball, f. Forbes & Hanley, '53) : **Youghal and Cork** (Leach, '52): **R.I.A. Exp., 1886, Glandore Harbour, 4 fms.** (Chaster, '98): off Sherkin I. (A. R. N.). **Var.** ***quadrata***, Jeffreys. Cork (Humphreys, f. Jeffreys, '63).

iv. Generally distributed. Var. *ovata*, Jeffreys. **Bantry Bay (Jeffreys, '63).**

v. Coast of Clare (Ball, f. Thompson, '56): **"Porcupine" Exp., 1869, Galway Bay, 15-20 fms. (Jeffreys, '81): Birterbuy Bay** (Farran and Barlee, f. Forbes & Hanley, '53): **Roundstone** (Alcock, '65): Clifden and Clew Bays (Thompson, '56).

vi. "Porcupine" Exp., 1869, Donegal Bay, 25–40 fms. (Jeffreys, '63): Killybegs (Mrs. Tatlow, '99): **Mweelfinn, Sheephaven (Hart, '92)**: Lough Swilly (Swanston, f. Praeger, '89 ; **Hart, '92**).

Distribution.—Loffoden I. to Mediterranean.

Venerupis irus (Linné).

. ii., iii., iv., v., vi.

ii. Howth, imbedded in limestone (Turton, '19): **east of Ireland** (Jeffreys, '65).

iii. Tramore Bay (Walpole, '52): Clonea, near **Dungarvan (Farran, '60)**: Youghal (Ball, f. Brown, '44 ; **Humphreys, '45**): **south** of Ireland (Jeffreys, '65).

iv. Coast of Kerry (Dublin Mus., coll. by A. G. More).

v. Coast of Clare (Kinahan in Proc. N.H.S. Dublin, III., 1863, p. 103): Miltown Malbay (Harvey, f. Thompson, '56) : **Birterbuy Bay, living** (Farran, '45): Roundstone (D'Arcy **W. Thompson**): Achill I. (Mrs. Tatlow & Praeger, '98): **west of Ireland** (Jeffreys, '65).

vi. Killala Bay, very common (Miss A. Warren, '92): **Bundoran** (Thompson Coll. in Belfast Mus., f. Praeger, '89 ; **Waller Coll.** in Dublin Mus.).

Distribution.—S. England, Wales, and Ireland to **Mediterranean. Madeira.** Canaries.

Family.—CARDIIDÆ.

?*Cardium aculeatum*, Linné.

. ii., ...

ii. Portmarnock and Dublin Bay (Brown, '18, '44). **Probably an** error.

Distribution.—? Norway. British Isles to Mediterranean. **Mogador. Madeira (Watson).**

Cardium echinatum, Linné.

i., ii., iii., iv., v., vi.

i. Generally distributed.

ii. Dublin coast, common: Courtown, co. Wexford (Mrs. Tatlow): coast of Wexford (Dublin Mus.). Var. *expansa*, Jeffreys. Dublin Bay (Warren, f. Jeffreys, '63).

iii. Youghal (Miss M. Ball, f. Thompson MS.): Cork (Humphreys, '45; Leach, '52): "Porcupine" Exp., 1869, 74 fms. (Jeffreys, '81): R. I. A. Exp., 1885, 1888, off S. coast of Cork, 30–50 fms. (Chaster, '98, A. R. N.).

iv. Generally distributed.

v. Roundstone (Alcock, '65; Standen, '95): Achill I. (Mrs. Tatlow & Praeger, '98): "Porcupine" Exp., 1869, 85–183 fms. (Jeffreys, '81).

vi. Killala Bay, common (Miss A. Warren, '92): R. D. S. Fish. Survey, 1890, Inver Bay (Holt, '92): Lough Swilly (Hart, '92; Rev. J. D. Falkiner, f. Praeger).

Distribution.—Iceland. Finmark to Mediterranean. Morocco. Madeira. Canaries.

Cardium tuberculatum, Linné.

. . iii., iv., . .

iii. Youghal and Cork (Leach, '52).

iv. Bantry Bay (Leach, '52; Humphreys, f. Jeffreys, '63): Dingle Bay (Leach, '52).

Leach's records are doubtful; this species may have been confounded with *C. echinatum*.

Distribution.—British Isles to Mediterranean. Madeira. Canaries.

Cardium exiguum, Gmelin.

i., ii., iii., iv., v., vi.

i. Generally distributed.

ii. Lissenhall, near Swords (Adams, '78): Portmarnock (Brown, '18; Warren, f. Adams, '78; Hart, '92): Dublin Bay (Turton, '19; Kinahan, '61): Cahore, co. Wexford (Miss Massy).

iii. Cork Harbour (Humphreys, '45; &c.): Cove, co. Cork (Turton, '19): R. I. A. Exp., 1886, Glandore Harbour, 4 fms., and off S. coast of Cork, 39½–52½ fms. (Chaster, '98, A. R. N.): Sherkin I. (A. R. N.).

iv. Bantry Bay (Miss Hutchins, f. Leach, '52; Humphreys, f. Forbes & Hanley, '53): Kenmare River (Praeger, '99): Dingle Bay (Leach, '52): Dingle (Cockerell, '85): R. I. A. Exp., 1885, 1886, Ballinskelligs Bay, and 3½–44 fms. (Chaster, '98).

v. Generally distributed.

vi. Enniscrone, a few specimens (Miss A. Warren, '92): "Porcupine" Exp., 1869, Donegal Bay, 25–40 fms. (Jeffreys, '81): Narin, co. Donegal, very rare (Mrs. Tatlow, '99): Mweelfinn, Sheephaven, dead valves sparingly (Hart, '92): Fort Stewart, Lough Swilly (Praeger).

Distribution.—Finmark to Mediterranean. Madeira (Nobre).

Cardium fasciatum, Montagu.

i., ii., iii., iv., v., vi.

i. Generally distributed.

ii. Dundalk Bay (Hyndman, f. Thompson, '56): Portmarnock (Warren Coll., f. Thompson, '56): Dublin coast (Hart, '92): Dublin Bay (Turton Cat., f. Thompson, '56; Kinahan, '61): Dalkey Sound (Walpole, '52; Adams, '78; A. R. N.): Killiney Bay frequent (Walpole, '53A).

iii. Dungarvan (A.R.N.): Cork Harbour (Humphreys, '45; frequent Wright & Carroll, '52): R. I. A. Exp., 1885, 1886, off S. coast of Cork, 30–54 fms. (Chaster, '98).

iv. Bantry Bay (Humphreys, f. Forbes & Hanley, '53): in or near Bantry Bay (M'Andrew, f. Thompson, '56): "Porcupine" Exp. 1869, 808 fms. (Jeffreys, '81): R. I. A. Exp. 1885, 1886, 1888 4–48 fms. (Chaster, '98).

v. Birterbuy Bay (Walpole, '52; Barlee, f. Thompson, '56): Roundstone (Alcock, '65; D'Arcy W. Thompson).

vi. Enniscrone, valves (Miss A. Warren, '92): Ballysodare, co. Sligo (Mrs. Hancock, f. Thompson, '56): Donegal Bay (Dublin Mus.): Donegal shores, not unfrequent (Hart, '92).

Distribution.—Iceland. Finmark to Mediterranean. ? Azores Mogador. Canaries. Cape of Good Hope (Sowerby).

Cardium nodosum, Turton.

i., ii., iii., iv., v., vi.

i. Off Black Head, 25 fms. (Hyndman, '59): Belfast Lough (Hyndman and Thompson, f. Thompson, '56; Hyndman, '58): Turbot Bank, dead (Hyndman, '58, '59): off Copelands, 12 fms., living (Hyndman, '59): Strangford Lough (Hyndman and Thompson, f. Thompson, '56): Strangford Lough, 7–20 fms., and off entrance, 12–20 fms., living, common (Dickie, '58).

ii. Ireland's Eye (Hyndman, f. Thompson, '56): Dublin Bay (Kinahan, '61; Dublin Mus.): Dalkey Sound (Walpole, '52; Adams, '78): Killiney Bay (Walpole, '53A).

iii. R. I. A. Exp. 1886, Glandore Harbour, 4 fms. (Chaster, '98, A. R. N.).

iv. Bantry Bay (Humphreys, f. Forbes & Hanley, '53; Thompson, '56): Glengariff (Marshall, '97): Valentia (Cockerell, '87): R. D. S. Fish Survey, 1890, off the Skelligs, 80 fms. (Jordan): R. I. A. Exp. 1885, 1886, Ballinskelligs Bay, and 3½–25 fms. (Chaster, '98). Var. *ovata*, Jeffreys. Bantry Bay (Marshall, '97).

v. Generally distributed.

vi. Killala Bay (Miss A. Warren, '92).

Distribution.—Finmark to Mediterranean. Morocco, "Travailleur" (Locard).

Cardium edule, Linné.

i., ii., iii., iv., v., vi.

Common everywhere in sandy bays.

Var. *rustica*, Chemnitz. Aran I. (Ball, f. Forbes & Hanley, '53): "Porcupine" Exp., 1869, Galway Bay, 15–20 fms. (Jeffreys, '81).

Distribution.—Iceland. Finmark to Mediterranean. Caspian. Morocco. Canaries.

Cardium minimum, Philippi.

i., ii., iii., iv., v., vi.

i. Off Ballycastle, dead (Chaster, '97A): Larne Lough, 4-5 fms., and Turbot Bank, dead (Hyndman, '58, '59): off South Rock, co. Down, 50 fms. (Hyndman, f. Thompson, '56, sub *C. Loveni*): Strangford Lough, 7–20 fms., dead, very rare (Dickie, '58).

ii. In stomachs of sole and plaice taken off the east coast (Farran, f. Thompson, '56, sub *C. Loveni*): Portmarnock (Marshall, '97): off Dublin Bay, very rare (Walpole, '53A).

iii. R. D. S. Fish. Survey, 1890, off Ballycottin (A. R. N.): R. I. A. Exp., 1888, off Glandore, 53 fms. (A. R. N.).

iv. In or near Bantry Bay (M'Andrew, f. Thompson, '56, sub *C. Loveni*): "Porcupine" Exp., 1869, 85–722 fms. (Jeffreys, '81): R. I. A. Exp., 1886, off Dursey Head, 93 fms. (A. R. N.): "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).

v. Aran I. (Barlee, f. Jeffreys, '58): Birterbuy Bay (Farran, f. Thompson, '56, sub *C. Loveni*): "Porcupine" Exp., 1869, 85–422 fms. (Jeffreys, '81).

vi. R. D. S. Fish. Survey, 1890, Inver Bay (Holt, '92).

Distribution.—Finmark to Mediterranean. Morocco, "Travailleur" (Locard).

Cardium norvegicum, Spengler.

i., ii., iii., iv., v., vi.

Generally but sparingly distributed round the coast.

Var. *gibba*, Jeffreys. Bantry Bay (Jeffreys, '63). Var. *rotunda*, Jeffreys. Birterbuy Bay (Barlee, f. Jeffreys, '63).

Distribution.—Finmark to Mediterranean. W. Africa. Madeira. Canaries. C. Verd I., "Challenger."

Family.—PSAMMOBIIDÆ.

Psammobia ferröensis (Chemnitz).

i., ii., iii., iv., v., vi.

Generally distributed round the coast in sand and among nullipores.

Distribution.—Iceland. Finmark to Mediterranean. N. W. Africa. Azores. Canaries.

The generic name *Gari* of Schumacher slightly antedates Lamarck's name *Psammobia* and has been sometimes adopted.

Psammobia costulata, Turton.

i., . iii., iv., v., .

i. Turbot Bank dredged sand, a single valve (Jeffreys, f. Hyndman, '59).

iii. Cork (Humphreys, f. Forbes & Hanley, '53 and Jeffreys, '63).

iv. Bantry Bay (Humphreys, '45).

v. Birterbuy Bay (Walpole, f. Jeffreys, '63): "Porcupine" Exp., 1869, 208 fms. (Jeffreys, '81).

Distribution.—Norway to Mediterranean. Azores, "Hirondelle." Morocco. Madeira. Canaries.

Psammobia tellinella, Lamarck.

i., ii., iii., iv., v., vi.

i. Generally distributed in sand, &c.

ii. Dublin coast (Hyndman and Thompson, f. Thompson, '56): Portmarnock, (Brown, '44; Warren, f. Thompson, '56; A. Macalister, f. Adams, '78): Dublin Bay, very common (Kinahan, '61): Dalkey Sound and Killiney Bay (Walpole, '53A).

iii. Youghal and Cork (Humphreys and Jeffreys, f. Forbes & Hanley, '53): R. I. A. Exp., 1886, Glandore Harbour, 4 fms. (Chaster, '98, A. R. N.): Sherkin I. (A. R. N.).

iv. Generally distributed. Common in Bantry Bay.

v. Aran I. (Barlee, f. Thompson, '56): Birterbuy Bay (Walpole, '52; Farran and Barlee, f. Thompson, '56): R. D. S. Fish. Survey, 1890, Roundstone (A. R. N.): Roundstone (D'Arcy W. Thompson).

vi. Inisbarnog, co. Donegal, one specimen (Mrs. Tatlow, '99).

Distribution.—Loffoden I. to Mediterranean.

Psammobia vespertina (Chemnitz).

i., ii., iii., iv., v., vi.

i. Magilligan, a single valve (Mrs. Tatlow, f. Praeger): Larne Lough (Thompson, '56): Dalepoolin, a fine fresh specimen with valves united (Grainger, '59): Cultra, co. Down, fresh valves (Praeger, '89): Strangford Lough, a single valve (Praeger).

ii. Portmarnock (Turton, f. Thompson, '56; Baily, '65): Dublin Bay (Turton, '19): "in several situations on the eastern coast of Ireland" (Brown, '44). These records require confirmation.

iii. Youghal (Ball, f. Thompson, '56): Cork Harbour, one specimen (Humphreys, '45): Lough Hyne, co. Cork (Dublin Mus., pres. by Mrs. Townsend).

iv., v. Generally distributed. Var. *lactea*, Jeffreys. Kenmare River (Jeffreys, '63). Var. *livida*, Jeffreys. Bantry Bay (Humphreys, f. Jeffreys, '63).

vi. Pullaheeny, Killala Bay (Miss A. Warren, '92): between Buncrana and Fahan, two specimens (Hart, '92): Rathmullan, living (Grainger and Falkiner, f. Praeger).

Distribution.—Norway to Mediterranean. Mogador. ? Senegal. Canaries. Cape of Good Hope (Sowerby).

Family.—MYIDÆ.

Mya arenaria, Linné.

i., ii., iii., iv., v., vi.

Abundant in sand and mud in the littoral zone all round the coast.

Distribution.—Arctic seas in both hemispheres to W. France and C. Hatteras. N. Pacific.

Mya truncata, Linné.

i., ii., iii., iv., v., vi.

Common in sand and mud all round the coast.

Var. *abbreviata*, Jeffreys. Antrim coast, 80 fms., a young live specimen (Jeffreys, '65).

Distribution.—Arctic seas in both hemispheres to Portugal and New England. ? Mediterranean. N. Pacific.

Sphenia Binghami, Turton.

i., ii., iii., iv., v., vi.

i. Off Ballycastle, living (Chaster, '97A): Turbot Bank, living, rare (Hyndman, '58): Belfast Lough, not uncommon, dead (Hyndman, '60): Groomsport (Waller Coll. in Dublin Mus.).

ii. Dalkey Sound, a living specimen (Kinahan, '61): Dalkey Sound, 14 fms., in thick valves of *Ostrea edulis* (Walpole, '52): Bray, two valves (Harvey, f. Thompson, '56).

iii. Cork Harbour (Wright & Carroll, '52): R. I. A. Exp., 1886, Glandore Harbour, 4 fms., valves (Chaster, '98).

iv. R. I. A. Exp., 1886, Long Island Sound, 3½–5 fms., and Berehaven, 5–20 fms., valves (Chaster, '98): Valentia (Cockerell, '87).

v. Birterbuy Bay (Barlee, f. Thompson, '56).

vi. Carrahubbuck, Killala Bay, valves (Miss A. Warren, '92).

Distribution.—Loffoden I. to Mediterranean.

Corbula gibba (Olivi).

i., ii., iii., iv., v., vi.

Common all round the coast in the laminarian zone and deeper water.

Var. *rosea*, Brown. Off Dublin Bay (Walpole, '53): Dalkey Sound, living (Adams, '60): "Porcupine" Exp., 1869, 808 fms. (Jeffreys, '81): R. I. A. Exp., 1885, S.W. Ireland, 70–79 fms. (Swanston, '86).

Distribution.—Finmark to Mediterranean. Canaries.

Corbulomya mediterranea (Costa). (*Corbula mediterranea*, Jeffreys, B.C.)

. . iii., . . .

iii. Cork, valves only (Humphreys, f. Jeffreys, '65, '81); the specimens may have been imported in ballast with *Petricola lithophaga* (Jeffreys, '65).

Distribution.—Channel Isles. S. Ireland. Mediterranean.

Lutraria elliptica, Lamarck.

i., ii., iii., iv., v., vi.

Common all round the coast in sand and mud in the laminarian zone.

Var. *alterutra*, Jeffreys. Coast of Galway (King, f. Jeffreys, '63).

Distribution.—Norway to Mediterranean.

Lutraria oblonga (Chemnitz).

i., ii., iii., iv., . .

i. Magilligan (Hyndman, f. Thompson, '56).
ii. Specimens supposed to be from Lambay I. are in Warren Coll. in Dublin Mus.
iii. About Cove, rare (Turton Cat., f. Thompson, '56).
iv. Bantry Bay (Humphreys, '45).

Distribution.—S. England and Ireland to Mediterranean. Mogador. Senegal. C. Verd I. Cape of Good Hope (Sowerby).

Family.—SOLENIDÆ.

Solenocurtus candidus (Renier). (*Solecurtus candidus*, Jeffreys, B.C.)

i., ii., . iv., v., .

i. Magilligan, two single valves (Grainger, f. Praeger): Turbot Bank sand, dead (Hyndman, '60): Strangford Lough (Waller Coll. in Dublin Mus.): off entrance to Strangford Lough, 12–15 fms., dead, very rare (Dickie, '58).

ii. Portmarnock (Lloyd, f. Thompson, '56; Adams, '78): Howth (Tardy, f. Turton, '19): Dublin Bay, single valves (Kinahan, '61).

iv. Bantry Bay, common.

v. Off Birterbuy Bay (Farran, '55): Roundstone (Alcock, '65).

Distribution.—Shetland to Mediterranean. Madeira. Canaries.

Solenocurtus antiquatus (Pulteney). (*Solecurtus antiquatus*, Jeffreys, B.C.)

i., ii., iii., iv., v., .

i. Red Bay and Larne Lough (Thompson, '56): off Black Head, 20 fms., dead, but valves fresh and united (Hyndman, '58): off Black Head, 15 fms., dead (Hyndman, '59): Turbot Bank, dead, rare (Hyndman, '58): Strangford Lough, 8–10 fms., (Thompson, '56): Strangford Lough, 4–25 fms., and off entrance, 12–15 fms., dead (Dickie, '58).

ii. Dublin coast (Ball, f. Thompson, '56): off Skerries, trawled (Walpole, '52): Portmarnock (Brown, '18): Dublin Bay (Turton, '19, sub *Solen fragilis*; Brown, '44): Dalkey Sound (Walpole, '53; valves, Kinahan, '61): Killiney Bay (Walpole, '53).

iii. R. I. A. Exp., 1885, off Galley Head, 54 fms. (Chaster, '98).

iv. Bantry Bay (Leach, '52): R. I. A. Exp., 1886, Berehaven, 5-10 fms., and Valentia Harbour, 4–7 fms. (Chaster, '98, A. R. N.).

v. Off Birterbuy Bay (Farran in Proc. N. H. S., Dublin, i., 1860, p. 148).

Distribution.—Sweden to Mediterranean. Morocco, "Talisman" (Locard). Madeira. Canaries.

Ceratisolen legumen (Linné).

i., ii., iii., iv., v., vi.

i. Magilligan (Dublin Mus.; Grainger, f. Praeger): Belfast Lough, a single valve in the lighthouse deposits (Millen, f. Grainger, '59); possibly recent: N.E. Ireland, dead, very rare (Praeger, '92).

ii. Newcastle, co. Down (Belfast Mus. and Swanston, f. Praeger, '89): coast of Louth (Thompson, '56): Dublin coast (Brown, '18; &c.): plentiful on the east coast from Belfast to Cork (Brown, '44): east of Ireland (Jeffreys, '65): Cahore, co. Wexford (Miss Massy).

iii. South of Ireland (Leach, '52; Jeffreys, '65).

iv. Bantry Bay (Humphreys, '45).

v. West of Ireland (Jeffreys, '65): Roundstone (Standen, '95).

vi. Killala Bay, frequently cast up alive after storms (Miss A. Warren, '92): Lough Swilly shores, Horn Head, &c., frequent (Hart, '92).

Distribution.—? Scandinavia. S. and W. England and Ireland to Mediterranean. Mogador. ? Senegal. ? Guinea. Cape of Good Hope (Sowerby).

Solen pellucidus, Pennant.

i., ii., iii., iv., v., vi.

i. Common in sand and mud.
ii. Dundalk Bay (Hyndman, f. Thompson, '56): Dublin coast (Turton Cat., f. Thompson, '56): Portmarnock (Brown, '44; Hart, '92): Dublin Bay (Dublin Mus.): North Bull (Hart, '92): Dalkey Sound (Adams, '78): Killiney Bay (Walpole, '53A; Kinahan, '61).
iii. Cork Harbour, rare (Humphreys, '45): R. I. A. Exp., 1888, off S. coast of Cork, 50 fms. (A. R. N.): off Sherkin I., living (A. R. N.): off Cape Clear, 60 fms. (M'Andrew, f. Forbes & Hanley, '53): "Porcupine" Exp., 1869, 74 fms. (Jeffreys, '81).
iv. Generally distributed.
v. Birterbuy Bay, living (Walpole, '52): R. D. S. Fish. Survey, 1890, Blacksod Bay (A. R. N.): "Porcupine" Exp., 1869, 165–183 fms. (Jeffreys, '81).
vi. Donegal coast (Hart, '92): Buncrana, living, common (Rev. J. D. Falkiner, f. Praeger).

Distribution.—Loffoden I. to Mediterranean. Cape of Good Hope (Sowerby).

Solen ensis, Linné.

i., ii., iii., iv., v., vi.

Common on sandy coasts.
Distribution.—Finmark to Mediterranean.

Solen siliqua, Linné.

i., ii., iii., iv., v., vi.

Very common on sandy coasts.
Var. *arcuata*, Jeffreys. Many parts of coast of Ireland (Jeffreys, '65). Monstr. Ballyholme, co. Down (Swanston, f. Chaster in Irish Naturalist, vii., 1898).

Distribution.—Norway to Mediterranean.

***Solen vagina*, Linné.**

i., ii., iii., iv., v., vi.

i. Magilligan (Thompson, f. Forbes & Hanley, '53) : Larne Lough, a specimen (Thompson, '56) : off Bangor, co. Down, dead (Patterson, f. Forbes & Hanley, '53; Hyndman, '58).
ii. Dublin coast, generally distributed.
iii. Cork Harbour (Humphreys, '45) : sandy beaches of co. Cork (Thompson, f. Forbes & Hanley, '53).
iv. Bantry Bay, &c. (Humphreys, '45).
v. Western coasts, Ireland (Brown, '44) : Roundstone (Standen, '95).
vi. Lough Swilly, one perfect specimen (Hart, '92).

***Distribution.*—Norway to Mediterranean. Azores. Cape of Good Hope (Sowerby). ? Red Sea.**

Family.—GLYCIMERIDÆ.

Saxicavella plicata (Montagu). (***Panopea plicata*, Jeffreys, B. C.**)

. . iii., iv., [v.], vi.

iii. R. I. A. Exp., 1885, off Baltimore, 30 fms. (Chaster, '98).
iv. Bantry Bay (Walpole and Jordan, f. Jeffreys, '69) : R. I. A. Exp., 1885, 1888, Berehaven, 7 fms., and mouth of Kenmare River, 38–44 fms. (Chaster, '98, A. R. N.).
v. "Porcupine" Exp., 1869, 165–183 fms. (Jeffreys, '81).
vi. "Porcupine" Exp., 1869, Donegal Bay, 25-40 fms. (Jeffreys, '81): Mulroy Bay, valves, dredged (Darbishire, f. Praeger, '94).

Distribution.—Loffoden I. to Mediterranean. Madeira. Canaries. Off Sahara, "Talisman." Corea (Marshall).

Saxicava rugosa (Linné).

i., ii., iii., iv., v., vi.

Generally distributed round the coast from low-water mark to great depths, and very common; also var. *arctica*, Linné.

Var. *præcisa*, Montagu. Killala Bay (Miss A. Warren, '92). Var. *pholadis*, Linné. Valentia (Cockerell, '87): Killala Bay (Miss A. Warren, '92). Var. *cylindrica*, S. Wood. West coast of Ireland (Marshall, '97).

Distribution.—Cosmopolitan.

Family.—GASTROCHÆNIDÆ.

Gastrochæna dubia (Pennant).

. . iii., . v., .

iii. Tramore Bay, in limestone boulders (Walpole, '52): Clonea, near Dungarvan, in limestone (Farran, '60): Youghal, in limestone (Ball, f. Thompson, '56): Spike I., Cork Harbour (Humphreys, '45): south of Ireland (Jeffreys, '65).

v. Aran I. (Ball, f. Thompson, '56): Birterbuy Bay, living, upon valves of *Lutraria* (Farran, '45): Birterbuy Bay (Walpole, '52; Barlee, f. Forbes & Hanley, '53; Warren Coll. in Dublin Mus.): Roundstone (Alcock, '65): west of Ireland (Jeffreys, '65).

Distribution.—S. England, S. and W. Ireland to Mediterranean. Madeira. Canaries. C. Verd I. St. Helena (Smith).

Family.—PHOLADIDÆ.

Pholas dactylus, Linné.

i., ii., iii., iv., v., vi.

i. Near Carrickfergus Castle and other parts of Belfast Lough, living (Thompson, '56): near Carrickfergus, living, also on co. Down shore (Hyndman, '58): Carrickfergus, Greenisland, and Cultra, living (Praeger, '89): Cultra, living (Grainger, '59).

ii. Portmarnock, single valves (Adams, '78; Hart, '92): Howth, one valve (O'Kelly, f. Brown, '18): Dublin Bay (Kinahan, '61): Merrion Strand (Walpole, '53A): Greystones, rather scarce (Mackintosh, '84).

iii. Clonea, near Dungarvan, in a submerged bog, one specimen (Farran, '60): Youghal (Ball, f. Thompson, '56): Ballycottin (in turf, living, S. Wright, '54; Miss Ball, f. Thompson, '56).

iv. Valentia, in a submerged bog, living (Dublin Mus., pres. by Rev. A. Delap).

v. Connemara (Dublin Mus.).

vi. Kinnegar, Rathmullan (Mrs. Batt, f. Hart, '92).

Distribution.—? Norway. British Isles to Mediterranean. Cape of Good Hope (Sowerby).

Pholas candida, Linné.

i., ii., iii., iv., v., vi.

i. Belfast Lough, living, common (Thompson, '56; &c.): Strangford Lough, 7–20 fms., dead, rare (Dickie, '58).

ii. Portmarnock, valves (Adams, '78; Hart, '92): near Howth, a few valves (Hart, '92): Dublin Bay, rare (Brown, '18): Merrion Strand (Walpole, '53A): Wexford (Hart, '92): Cahore, co. Wexford (Miss Massy).

iii. Woodstown, near Dunmore (Dublin Mus., coll. by Mrs. Tatlow): Clonea, near Dungarvan, in a submerged bog, living, numerous (Farran, '60): Youghal (Ball, f. Thompson, '56): Ballycottin, in turf, living (S. Wright, '54).

iv. Kenmare River (Praeger, '99): Dingle (Cockerell, '85).

v. Birterbuy Bay (Farran, f. Thompson, '56).

vi. Buncrana (Hart, '92; Rev. J. D. Falkiner, f. Praeger).

Distribution.—? Norway. British Isles to Mediterranean. Mogador.

Pholas parva, Pennant.

i., ii., ...

i. Whitehouse Point, Belfast Lough (Ordnance collectors, f. Thompson, '56): in submerged peat, co. Down side of Belfast Lough, dead (Drummond, f. Hyndman, '58).

ii. Portmarnock, single valves, formerly (Miss Willan, f. Hart, '92): Dublin Bay (Warren, f. Jeffreys, '65).

Distribution.—British Isles to Mediterranean.

Pholas crispata, Linné.

i., ii., iii. . . .

i. Castle Chichester (Swanston, f. Praeger, '89): Belfast Lough (Brown, '18; &c.): Bangor, co. Down, &c., in submerged peat, living (Hyndman, '58): Cultra, living (Praeger, '89).

ii. An estuary near Dublin, fine examples (Forbes & Hanley, '53): Portrane, single valves (Hart, '92): Malahide (Walpole, '53A; J. Adair, f. Adams, '78): Portmarnock (Brown, '18; Walpole, '53A; Hart, '92): near Lambay I., large specimens trawled, in decayed wood (Ball in Nat. Hist. Rev., i., 1854 (*Proc.*), p. 98): Dublin Bay (Kinahan, '61): Cahore, co. Wexford (Miss Massy).

iii. Clonea, near Dungarvan, in a submerged bog, living, numerous (Farran, '60): Youghal (in hard clay, Humphreys, '45; Ball, f. Thompson, '56): Ballycottin (in hard clay, Humphreys, '45; in turf, living, S. Wright, '54; Miss Ball, f. Thompson, '56).

Distribution.—Iceland. Finmark to France. N. E. America. W. America. N. Japan.

Pholadidea papyracea (Turton).

i., ii., iii., . . vi.

i. Portrush, two specimens (Ordnance Coll., f. Thompson, '56): Glenarm Bay (Trail, '77): off the Maidens, 70–90 fms., living (Hyndman, '59, '60, Jeffreys, '59): Castle Chichester (Hyndman, f. Jeffreys, '65; Praeger, '89): Turbot Bank, two single valves (Hyndman, '58, sub *Pholas striata*). Var. *aborta*, Jeffreys. Off the coast of Antrim, 80 fms., in lumps of sandstone (Jeffreys, '59).

ii. A specimen was supposed to have been dredged between Howth and Lambay I. (Thompson, '56).

iii. Clonea, near Dungarvan, one specimen in a submerged bog (Farran, '60): Ballycottin, in turf (S. Wright, '54).

vi. Pullaheeny, Killala Bay, a valve (Miss A. Warren, f. Marshall, '97).

Distribution.—S. England. Ireland to Spain. Morocco, "Talisman" (Locard).

Xylophaga dorsalis (Turton).

. ii., iii., iv., v., .

ii. Off Skerries, living (Walpole, '52): Ringsend, Dublin Bay (Harvey, f. Thompson, '56): Dublin coast (Warren, f. Thompson, '56).

iii. Waterford (Humphreys, f. Jeffreys, '65).

iv. Bantry Bay (Humphreys, f. Jeffreys, '65): "Porcupine" Exp., 1869, 364 fms., valves (Jeffreys, '81).

v. Roundstone (Waller Coll. in Dublin Mus.).

Distribution.—Loffoden I. to Mediterranean. Azores, "Hirondelle." Madeira (Watson). N. E. America.

Family.—Teredinidæ.

Teredo norvegica, Spengler.

i., ii., iii., . v., .

i. Belfast, in the bottom of a vessel arrived from the tropics (Thompson, '56): Belfast Lough, dead (Hyndman, '58): Donaghadee, living (Thompson, '56).

ii. Kingstown (Ball, f. Thompson, '56).

iii. Bonmahon, co. Waterford (Brownrigg, '60): Clonea, near Dungarvan, in roots of a fir tree in a submerged bog (Farran, '60).

v. Miltown Malbay, in drift timber (Thompson, '56): Galway coast (Standen, '95): Achill I. (Thompson, f. Forbes & Hanley, '53).

Distribution.—Finmark to Mediterranean. N. E. America.

Teredo navalis, Linné.

i., . iii., . . .

i. Magilligan, occasional (Miss H. Galwey, '88): Belfast, in the timbers of a ship returned from a foreign voyage (Thompson '56).

iii. Cove, co. Cork (Humphreys, '45); probably *T. norvegica*.

Distribution.—Norway to Mediterranean. New Jersey to Texas (Dall).

Teredo megotara, Hanley.

i., ii., iii., . v., vi.

i. Whitepark Bay, in drift wood (Chaster, '97A): Larne, co. Antrim in drift wood (Patterson, f. Jeffreys, '60, sub *T. nana*): in drift wood dug up at Belfast (Hyndman, f. Jeffreys, '65). Var. *excisa*, Jeffreys, and var. *stratior*, Jeffreys. In drift wood dug up at Belfast (Hyndman, f. Jeffreys, '65).

ii. Merrion, in drift wood (Ball, f. Carte in Nat. Hist. Rev. i., 1854 (*Proc.*), p. 98): Killiney Bay, in pine, after a gale (Walpole, '53A): coast of Dublin, in drift wood (Jeffreys, '65).

iii. Coast of Waterford, in drift wood (Jeffreys, '65).

v. Coast of Galway, in drift wood (Jeffreys, '65).

vi. Killala Bay, in drift timber, several times (Miss A. Warren, '92).

Distribution. — Norway to Mediterranean. Madeira. N. E. America.

Teredo malleolus, Turton.

i., . iii., . v., .

i. Belfast, in the timbers of a ship returned from a foreign voyage (Thompson, '56).

iii. In blocks of pine taken up floating off Waterford (Farran in Ninth Ann. Rep. Dublin N. H. S., 1849).

v. Miltown Malbay (Harvey, f. Jeffreys, '65): near Roundstone (Walpole, f. Thompson, '56).

Distribution.—S. England. Wales. Ireland. France. Azores. Madeira. W. Indies.

Teredo bipennata, Turton.

. . iii., . v., .

iii. Waterford (Humphreys, f. Forbes & Hanley, '53): from the mast of a vessel cast ashore at Youghal (Ball, f. Thompson, '56).

v. Coast of Clare (Warren in Nat. Hist. Rev. i., 1854 (*Proc.*), p. 98): Miltown Malbay (Harvey, f. Thompson, '56): Roundstone (Walpole, f. Jeffreys, '65).

Distribution.—England and Ireland to Mediterranean. Madeira. W. Florida and W. Indies (Dall). W. America.

Teredo cucullata, Norman.

i., ...

i. Belfast, in teak, with *T. fimbriata* (Thompson, f. Jeffreys, '65).

Distribution.—England. Ireland. Guernsey. W. Indies, probably (Jeffreys).

Teredo fimbriata, Jeffreys.

i., ...

i. Belfast, in the timbers of a ship returned from a foreign voyage (Thompson, '47A, sub *T. bipalmulata*, Jeffreys, '65).

Distribution.—British Isles. New England to Gulf of Mexico. W. America.

Family.—PANDORIDÆ.

Pandora inæquivalvis (Linné).

i., . iii., iv., v., .

i. Off Ballycastle, dead (Chaster, '97A): off Black Head and Donaghadee, 15–20 fms., living (Hyndman, '58, '59): off Carrickfergus (Hyndman, f. Thompson, '56): Turbot Bank, &c., dead (Hyndman, '58, '59; Praeger, '89): Strangford Lough (Hyndman and Thompson, f. Thompson, '56): off entrance to Strangford Lough, 18–20 fms., living (Dickie, '58).

iii. South coast of Ireland, extremely rare (Leach, '52, sub *P. rostrata*): R. I. A. Exp., 1888, off Glandore, 53 fms. (A. R. N.): off Cape Clear, 60 fms. (M'Andrew, f. Forbes & Hanley, '53).

iv. Below Bantry (Warburton, Whitelaw, and Walsh, '18): "Porcupine" Exp., 1869, 85–180 fms. (Jeffreys, '81): R. I. A. Exp., 1885, 1886, 38–110 fms. (Swanston, '86, Chaster, '98, A. R. N.).

v. Birterbuy Bay (Walpole, '52): "Porcupine" Exp., 1869, 85–208 fms. (Jeffreys, '81).

Var. *pinna*, Montagu (= var. *obtusa*, Jeffreys, B.C.) is the form generally recorded above, and probably all the records refer to this variety, which has a wider distribution and frequents deeper water than the typical form.

Distribution.—Arctic seas. British Isles to Mediterranean. Morocco. Madeira. Canaries. N. E. America. W. America (Dall).

Family.—VERTICORDIIDÆ.

Lyonsiella abyssicola, M. Sars.

. . . iv., . .

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '81).

Distribution.—Arctic seas in both hemispheres to Azores and New England.

[*Lyonsiella subquadrata* (Jeffreys).]

. . . iv., v., .

iv. "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).

v. "Porcupine" Exp., 1869, 816 fms. (Jeffreys, '84).

Distribution.—Both sides of North Atlantic. Deep water.

Lyonsiella insculpta (Jeffreys).

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '81).

v. "Porcupine" Exp., 1869, 85 fms. (Jeffreys, '81).

Distribution.—Both sides of North Atlantic. Mediterranean.

[*Lyonsiella gemma* (Verrill).]

. . . iv., . .

iv. "Flying Fox," Exp., 1889, 1000 fms. (Smith, '89).

Distribution.—W. Ireland. New England. Deep water.

Family.—LYONSIIDÆ.

Lyonsia norvegica (Chemnitz).

i., ii., iii., iv., v., vi.

i. Magilligan (Miss H. Galwey, f. Hart, '92): Belfast Lough (Thompson, '56): both sides of Belfast Lough, living in 8–12 fms., and Turbot Bank, dead, rare (Hyndman, '58): off Crawfordsburn dead, but fresh and valves united (Stewart, f. Praeger, '89) Donaghadee (Waller Coll. in Dublin Mus.): Strangford Lough (Thompson, '56; 15–25 fms., living, very rare, and 4–8 fms dead, Dickie, '58).

ii. Warrenpoint (Brown, '44): Dublin coast (Ball, &c., f. Thompson '56): Portmarnock (J. Adair, f. Adams, '78; Miss Willan f. Hart, '92): Dublin Bay (Jeffreys, f. Forbes & Hanley, '53 Kinahan, '61): Dalkey Sound and Killiney Bay (Walpole, '53

iii. Cork, a single valve in red gurnard (Humphreys, '45): R. I. A. Exp., 1886, off S. coast of Cork, 55½ fms. (Chaster, '98).

iv. Bantry Bay, two valves (Miss Hutchins, f. Brown, '18): in or near Bantry Bay (M'Andrew, f. Thompson, '56): "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '81): R. D. S. Fish. Survey, 1890, off the Skelligs, 80 fms. (Holt, '92): R. I. A. Exp., 1885, 1886, 10–110 fms. (Chaster, '98, A. R. N.).

v. Birterbuy Bay (Walpole, '52; Farran and Barlee, f. Thompson, '56): R. D. S. Fish. Survey, 1890, Birterbuy Bay, dead (Holt, '92): Roundstone (Alcock, '65; Warren Coll. in Dublin Mus.): "Porcupine" Exp., 1869, 85–183 fms. (Jeffreys, '81).

vi. Lough Swilly, a single fresh valve and a broken one (Hart, '92).

Distribution.—Loffoden I. to Mediterranean. Madeira. Canaries. N. Pacific.

Family.—ANATINIDÆ.

Cochlodesma prætenue (Pulteney). (*Thracia prætenuis*, Jeffreys, B. C.)

i., ii., iii., iv., v., vi.

i. Magilligan (fresh specimens, Hyndman and Thompson, f. Thompson, '56; a valve, Praeger, '89; Grainger, f. Praeger): off Ballycastle, dead (Chaster, '97A): off Larne Lough, 20 fms., a single valve (Hyndman, '59): off Black Head, 20 fms., dead, valves united, rare (Hyndman, '58): off Black Head, 15 fms., dead (Hyndman, '59): Turbot Bank, dead, scarce (Hyndman, '58): Belfast Lough, rare (Brown, '18): coast of Down (Patterson, f. Forbes & Hanley, '53).

ii. Portmarnock (Brown, '44; Kinahan, '60): Dublin sandy coasts (Thompson, '56): Dublin Bay (Turton, '19; Kinahan, '61): Dalkey Sound, very rare (Walpole, '53A): Killiney Bay (very rare, Walpole, '53A; Dublin Mus., pres. by Hon. Miss Lawless).

iii. Below Cove, rare (Humphreys, '45). Var. *curta*, Jeffreys. Cork Harbour (Jeffreys, '65).

iv. Bantry (Miss M. Ball, f. Thompson, '56; Dublin Mus.): Kenmare River (Jeffreys Cab., f. Forbes & Hanley, '53): coast of Kerry (Jeffreys, '65; Dublin Mus.): R. I. A. Exp., 1885, 5–40 fms. (Chaster, '98).

v. Coast of Galway (Jeffreys, '65): "Porcupine" Exp., 1869, Galway Bay, 15–20 fms., and 85 fms. (Jeffreys, '81).

vi. Bartra, a few perfect specimens (Miss A. Warren, '92).

Distribution.—Iceland. Loffoden I. to Mediterranean.

Thracia papyracea (Poli).

i., ii., iii., iv., v., vi.

Generally distributed round the coast on sandy shores in the laminarian zore; also var. *villosiuscula*, Macgillivray, which usually frequents deeper water.

Var. *gracilis*, Jeffreys. Bantry Bay (Jeffreys, '65).

Distribution.—Iceland. Loffoden I. to Mediterranean. Morocco. Madeira. Canaries. Florida to W. Indies (Dall).

Thracia pubescens (Pulteney).

i., ii., iii., . v., .

i. Belfast Lough (Thompson, '56): Turbot Bank, dead, scarce (Hyndman, '58).
ii. Near Dublin (Warren, f. Thompson, '56).
iii. Cork Harbour (Humphreys, '45; Wright & Carroll, '52).
v. Birterbuy Bay (living, Walpole, '52; Barlee, f. Forbes & Hanley, '53; a specimen in Warren Coll. in Dublin Mus.).

"The reputed Irish localities are doubtful: this species has been often mistaken for the adult of *T. papyracea*: the only specimen in Mr. J. D. Humphreys's extensive collection of shells from Dublin Cork, and Bantry was marked by him 'England'" (Jeffreys, '65).

Distribution.—British Isles. France. Mediterranean. Morocco Madeira. Canaries.

Thracia convexa (W. Wood).

i., ii., iii., iv., v., .

i. Lough Foyle, single valves (Rev. J. D. Falkiner, f. Praeger): off Black Head, two broken specimens, but with ligament fresh (Hyndman, '58): Strangford Lough (Thompson, '56; 4–25 fms. dead, Dickie, '58).
ii. Off Skerries (Walpole, '52): off Dublin coast, three full-grown specimens with animal in a fresh state (Warren, f. Thompson '56): Portmarnock, single valve (Kinahan, '60): Dublin Bay (Turton, '19; Warren Coll. in Dublin Mus.).
iii. Cork Harbour, rare (Humphreys, '45).
iv. Bantry Bay (M'Andrew, f. Thompson, '56).
v. Birterbuy Bay, dead (Walpole, '52): Roundstone, valve (Alcock '65).

Distribution.—Norway to Mediterranean. Sitka.

Thracia distorta (Montagu).

i., ii., iii., iv., v., vi.

i. Near Belfast, in limestone (Grainger, f. Thompson, '56).

ii. Portmarnock (Warren Coll., f. Thompson, '56): Dublin Bay (rare, Brown, '18; living, Turton, '19; Harvey, f. Thompson, '56; living, rare, Kinahan, '61): Dalkey Sound, rare (Walpole, '53A): Bray (Harvey, f. Thompson, '56).

iii. Tramore Bay, in limestone (Walpole, '52): Youghal, in limestone (Ball, f. Thompson, '56): Cork Harbour, rare (Humphreys, '45). Var. *truncata*, Turton. Cork (Jeffreys, '65).

iv. Bantry Bay (rare, Humphreys, '45; Norman, f. Jeffreys, '59): dredged in or near Bantry Bay (M'Andrew, f. Thompson, '56, sub *Venus sinuosa*).

v. Roundstone (living, Alcock, '65; D'Arcy W. Thompson): R.D.S. Fish Survey, 1890, Roundstone, one valve (Jordan).

vi. Carrahubbuck, frequent, though rarely found alive (Miss A. Warren, '92).

Distribution.—Finmark to Mediterranean. Florida to Honduras (Dall).

?[*Thracia truncata* (Brown).]

. . . iv., . .

iv. West of Cape Clear, 1000 fms. (King, '63, Jeffreys, '65).

Distribution.—Arctic seas in both hemispheres.

Order.—SEPTIBRANCHIATA.

Family.—POROMYIDÆ.

Poromya granulata (Nyst & Westendorp).

. . . iv., . .

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '81).

Distribution.—Finmark. Loffoden I. to Mediterranean. Morocco, "Travailleur." ? Madeira. New England to W. Indies.

Family.—CUSPIDARIIDÆ.

Cuspidaria cuspidata (Olivi). (*Neæra cuspidata*, Jeffreys, B. C.)

. . iii., iv., v., .

iii. R. I. A. Exp., 1888, off S. coast of Cork, 50 fms. (A. R. N.): off Cape Clear, 60 fms. (M'Andrew, f. Thompson, '56; Warren Coll. in Dublin Mus.).

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '81): R. I. A. Exp., 1885, off Dursey Head, 35–37 fms. (Chaster, '98).
v. Aran I. (Barlee, f. Jeffreys, '65): "Porcupine" Exp., 1869, 165–208 fms. (Jeffreys, '81).

Distribution.—Spitzbergen. Finmark to Mediterranean. Morocco, Talisman." Madeira. Canaries ? Greenland. ? China Sea.

Cuspidaria rostrata (Spengler). (*Neæra rostrata*, Jeffreys, B. C.)

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '81).
v. "Porcupine" Exp., 1869, 85–208 fms. (Jeffreys, '81).

Distribution.—Loffoden I. to Mediterranean. Azores. Morocco. C. Verd I., "Talisman" (Locard). New England to W. Indies. Off Patagonia.

Cuspidaria abbreviata (Forbes). (*Neæra abbreviata*, Jeffreys, B. C.)

. . . iv., v., .

iv. R. I. A. Exp., 1885, off Skelligs, 70–79 fms. (Swanston, '86).
v. "Porcupine" Exp., 1869, 85–208 fms. (Jeffreys, '81).

Distribution.—Finmark to Mediterranean. Morocco, "Talisman" (Locard).

Cuspidaria costellata (Deshayes). (*Neæra costellata*, Jeffreys, B. C.)

. . . iv., v., .

iv. "Porcupine" Exp., 1869, 85–110 fms. (Jeffreys, '81): R. I. A. Exp., 1885, 1886, 23–110 fms. (Chaster, '98, A. R. N.).
v. "Porcupine" Exp., 1869, 85–208 fms. (Jeffreys, '81).

Distribution.—Norway to Mediterranean. Azores. Madeira. Canaries. New England to W. Indies.

[*Cuspidaria Greenii*, Smith.]

. . . iv., . .

iv. "Flying Fox" Exp., 1889, 1000 fms. (Smith, '89).

Distribution.—Faroe Channel. S. W. Ireland. Deep water.

XXIX.

SOME PROPERTIES OF THE GENERAL CONGRUENCY OF CURVES. (Abstract.) By CHARLES J. JOLY, M.A., F.T.C.D., Andrews' Professor of Astronomy in the University of Dublin, and Royal Astronomer of Ireland.

[Read June 26, 1899.]

I.—The general equation of a congruency of curves may be represented by three equations of the type—

$$x = f(u, v, w), \quad y = g\,(u, v, w), \quad \text{and} \quad z = h\,(u, v, w),$$

where f, g, and h are functions of three parameters u, v, and w. Of these parameters two, u and v, serve to select an individual curve of the doubly infinite system, and w specifies the individual points upon that curve. Now these three equations establish a transformation or correspondence between three variables, u, v, and w, and three others, x, y, and z, and this transformation may be considered as producing a congruency in the region (xyz) from a system of parallel right lines in the region (uvw). Corresponding to any assumed direction of this parallel system we have in the region (xyz) one of a doubly infinite system of congruencies. All these are of the same order, and all have the same focal surface. The order is the number of points in the region (uvw) which correspond to a given point in the region (xyz), and the focal surface is the locus of points in the latter region for which two of the correspondents in the former region coincide. This focal surface is represented by combining the original equations with the result of equating to zero the Jacobian of x, y, and z with respect to u, v, and w.

II.—It is shown, moreover, that every curve belonging to any of the system of congruencies touches the common focal surface in a certain definite number (A) of points, and that a determinate number (B) of virtual foci* are situated upon every curve. The loci of virtual foci are different for the different congruencies.

III.—The congruencies in general are of the same class (M) and of the same rank (R) if we agree to represent the class of a curvilinear congruency by the number of its curves which osculate a given plane, and to denote by its rank the number of tangents which can be drawn to its curves so as to pass through a given point and to lie in a given plane.

IV.—Taking any small pencil of curves of a congruency it is possible to draw through any point in the pencil a determinate element of surface ultimately normal to all the constituent curves. The measure of curvature, or the product of the principal curvatures of the element, represents the characteristic known as the *Density* of the congruency, or preferably of the pencil, at the point. Double the mean curvature or the sum of the principal curvatures seems to deserve the name *Concentration* of the pencil. It may also be described as the convergence of the directions of the curves, that is $S\nabla U\tau$ where $U\tau$ is a unit vector tangent to a curve of the pencil at the point. Or, again, the name is justified because it is proved that the concentration is the coefficient of contraction of the normal cross-section as we pass along the pencil. Related to a congruency we have in general surfaces of zero density and surfaces of zero concentration.

V.—It is generally possible to determine one or more surfaces orthogonal to all the curves of a congruency. Some curious relations connect the various surfaces mentioned, for instance the locus of Virtual Foci and the locus of Zero Density touch one another along a curve situated upon this orthogonal surface.

VI.—The transformation must obey certain conditions whenever one of the transformed congruencies is orthogonal to a family of surfaces. In fact it is shown that the system of parallel lines in the region (u, v, w) must be parallel to an edge of a certain quadric cone, or that

* In general, selecting any point on any assumed curve of a congruency it is possible to find two adjacent curves and two adjacent points on the curves, so that the lines joining these points to the assumed point are at right angles to the curves through their extremities. When these two lines coincide the assumed point is said to be a virtual focus in analogy with the definition of a virtual focus of a rectilinear congruency.

a variable quadric cone must have one edge fixed in direction. This is equivalent to the system of conditions that four conics should have a common point, and a system of differential equations involving the differential coefficients of x, y, and z in the third order with respect to u, v, and w must be satisfied.

VII.—Finally, some calculations are made in the somewhat manageable case of universal curves concerning the numerical characteristics of congruencies of this special type.

XXX.

SOME APPLICATIONS OF HAMILTON'S OPERATOR ∇ IN THE CALCULUS OF VARIATIONS. By CHARLES J. JOLY, M.A., F.T.C.D., Andrews' Professor of Astronomy in the University of Dublin, and Royal Astronomer of Ireland.

[Read DECEMBER 11, 1899.]

IN cases similar to those treated by Tait (Quaternions, 3rd ed., p. 403), we may throw the integral into the form $\int f d\rho$, $f(\ )$ being a linear and distributive function of a vector. The conditions for a stationary value of the integral become $fV\nabla Vd\rho\delta\rho = 0$ over the curve, and $f\delta\rho = 0$ at the limits. In the first of these equations ∇ operates on f alone and *in situ*.

Again for surface integrals of a somewhat similar type, the conditions for a stationary value of the integral $\iint FVd\rho d'\rho$ are $F\nabla = 0$ over the surface, and $F\lambda = 0$ over the bounding curve. Here, as before, ∇ operates on the linear and distributive function F alone and *in situ*, and λ is the normal to a given surface upon which the boundary is constrained to lie.

Surface integrals of the type $\iint uTVd\rho d'\rho$ are reduced to this form by writing $U\nu = UVd\rho d'\rho$ and $TVd\rho d'\rho = -SU\nu Vd\rho d'\rho$. Observing that $S\nabla U\nu = -(K_1 + K_2)$ where K_1 and K_2 are the principal curvatures at the point, $F\nabla = 0$ becomes in this case

$$\frac{du}{dn} + (K_1 + K_2)u = 0.$$

XXXI.

THE FAUNA AND FLORA OF VALENCIA HARBOUR ON THE WEST COAST OF IRELAND.

(Plates XIX. to XXI.)

[Communicated by Dr. R. F. Scharff, June 26th, 1899.]

CONTENTS.

Part I.—*The Pelagic Fauna.*

PREFACE.

The west coast of Ireland has for a long time been the hunting ground of marine naturalists. Its extreme western position, with a fine indented coast-line broken up into numerous sheltered bays, has induced many to investigate its own peculiar fauna and to search after rare Atlantic species.

In the spring of 1895, Mr. W. I. Beaumont, Mr. F. W. Gamble, and I agreed to form a party for investigating those groups of animals in which we were particularly interested, and it so happened that these groups—Medusæ, Turbellaria, Nemertea, and Nudibranchiata—had received very little attention from previous workers on the west coast.

On the strong recommendation of Prof. A. C. Haddon we decided to make Valencia Harbour our headquarters, as that locality appeared to be the most suitable for our requirements—a well sheltered harbour with dredging grounds and a good tide from the ocean. We arrived there at the beginning of April, and were so fortunate as to obtain the use of an empty house close to the shore. This we converted into a temporary laboratory for two months.

The successful results of this visit led us to organize another expedition to the same place for the summer of 1896. The Royal Society gave us a grant for the hire of a trawler for exploring the ground outside the harbour; and the trustees of the Fishermen's Hall at Valencia kindly allowed us the use of the building. This large hall was most suitable for our requirements, possessing many windows and an ample supply of large tables. Two anterooms were also available, one we used for sorting over and keeping in dishes the material collected, and the other for photographic purposes.

On this occasion the party consisted of six naturalists, the new members being Prof. F. E. Weiss, Mr. A. O. Walker, and Mr. M. D. Hill. It was necessary to organize more definitely our work and duties. Mr. Gamble took charge of the dredging operations, and his colleagues were Mr. Beaumont and Mr. Hill. Prof. Weiss devoted his attention to the collecting of marine algae, and Mr. Walker dredged specially for crustacea. The whole of the tow-netting, as on the first visit, fell to my share.

During our visits we enjoyed the kind hospitality of the Knight of Kerry and Lady Fitz Gerald.

The Rev. A. Delap and Mrs. Delap gave us all a hearty welcome, and a great part of our success is due to their advice and kindness. The Misses Delap, who had for some years taken a great interest in the marine fauna of the harbour, gave us invaluable assistance, and their work is recorded in most of the reports.

To all who so kindly received us and made our visits so pleasant, and to those who helped us in our work, we desire to express our sincere thanks.—E. T. Browne.

PART I.—*The Pelagic Fauna.*

I.—NOTES ON THE PELAGIC FAUNA (1895–98). BY E. T. BROWNE, B.A., University College, London.

The energies of the marine zoologists who have worked on the west coast of Ireland have chiefly been devoted to the sedentary animals obtained by dredging and shore-searching, but the pelagic forms collected by tow-netting have been rather neglected. It was the scarcity of records relating to the medusæ that led to my visit, but although the tow-nettings were usually taken for medusæ, and most of my time occupied in examining them whilst alive, still I noted the occurrence of animals belonging to other groups which were identifiable, and when possible preserved a few specimens.

The Misses Delap most willingly continued the tow-nettings after our departure in 1896, and sent me the material, preserved in formalin, for examination. They also frequently recorded the temperature of the sea, and kept notes on the changes in the pelagic fauna. Their tow-nettings extended from October, 1896, to December, 1898. Over a hundred bottles of general tow-net material have been sent to me, in addition to numerous bottles containing delicate animals, like Medusæ, specially preserved. This material has formed the main foundation of the various reports on the pelagic fauna.

It was not my intention, nor that of the Misses Delap, to investigate thoroughly the whole pelagic fauna of Valencia Harbour. Such an undertaking can only be successfully carried out by many specialists at a properly equipped Biological Station. Certain groups have received more attention than others, and an attempt has been made to record the principal and characteristic inhabitants of the harbour taken with the tow-net.

It was a great pleasure to find friends who were willing to help in the examination of the material.

Professor W. A. Herdman received the pelagic Tunicates, and has kindly written a report upon them (page 748).

Mr. I. C. Thompson most generously undertook to examine all the

Copepoda—a laborious undertaking, especially as the Copepoda usually formed the chief bulk of the tow-nettings (page 737).

Mr. J. T. Cunningham has written a report upon the few larval fishes taken during my first visit in 1895 (page 752).

Mr. F. W. Gamble has identified the various Chætognatha (p. 745).

The four reports mentioned above are treated as separate publications, each complete in itself; and I have added one on the Medusæ, on account of its disproportionate length. The remaining pelagic animals belonging to various groups, for the identification of which I am mainly responsible, are placed together in this part under Faunistic Notes (page 676).

Valencia Harbour, and its Surroundings.

(See Chart I., p. 671, and Chart II., p. 754.)

The harbour occupies the unique position of being the most westerly port in Europe, the lighthouse at its entrance standing in longitude 10° 19′ 16″ W., and latitude 51° 56′ 0″ N. It is situated at the northern end of Valencia Island, which is separated from the mainland by a narrow channel like a tidal river in general appearance. This channel, with 1 to 4 fms. of water at low tide, is about six miles in length, extending from Valencia Harbour to Port Magee, situated at its southern entrance. The tide does not enter at one end of the channel and pass out at the other, but comes in at both ends: the two tides meeting in the channel about midway, so that the action of the tide in Valencia Harbour is just like that in a tidal river.

Most of the tow-nettings were taken in Valencia Harbour Channel, between the lighthouse at the entrance and the ferry pier at Knightstown. This channel is about two miles in length, 5–7 fms. deep at low water, and does not exceed half a mile in width. It has a narrow entrance from the ocean, facing the north-west, and not quite a quarter mile across. A little way inside is an isolated reef of rocks lying in mid-channel, and just uncovered at low tide, round which the tide flows at a good pace. In this locality the tide is strong enough to keep afloat and to extend fully a large tow-net fastened to a boat at anchor, the ideal method of tow-netting. The flow of the flood-tide is marked one and a half knots on the Admiralty Chart, and the ebb-tide two knots. The narrow entrance with the rocky reef just inside, followed by a curving of the channel to eastwards, affords an excellent

Chart I.

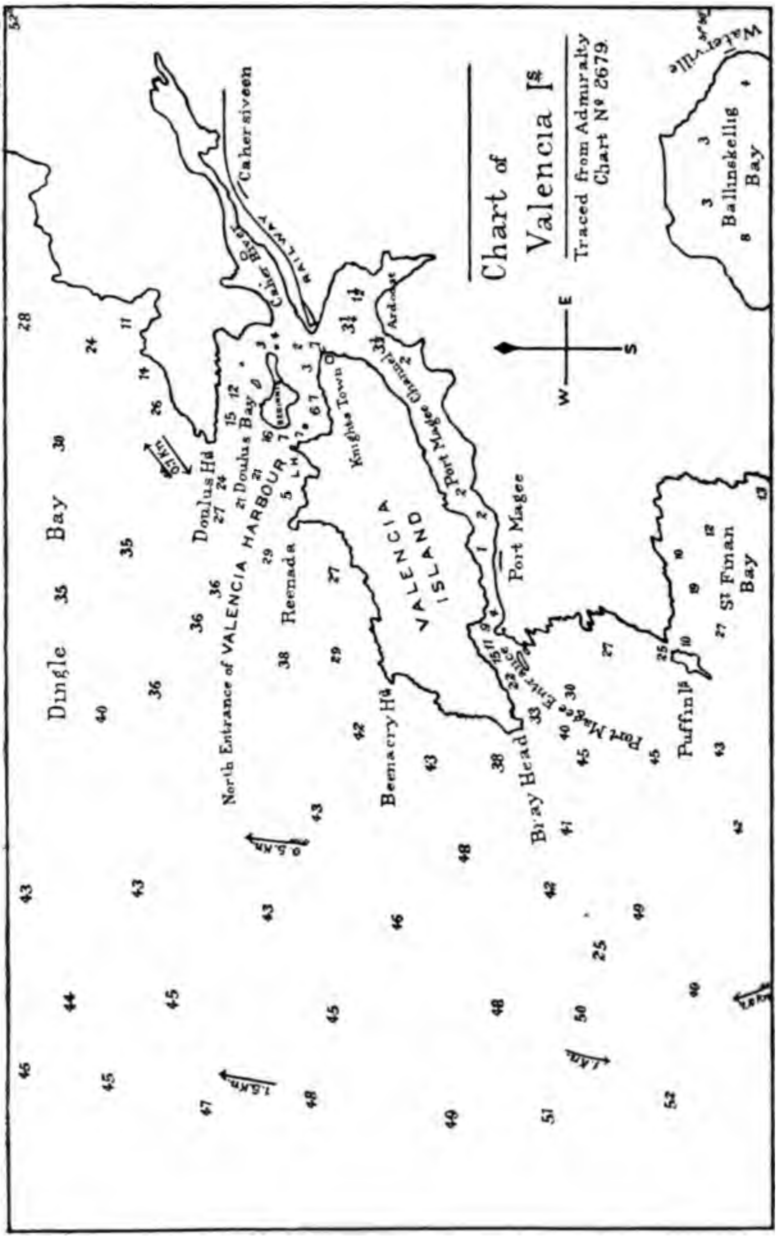
Chart of
Valencia Is
Traced from Admiralty
Chart No 2679
Dingle Bay
VALENCIA
ISLAND
North Entrance of VALENCIA HARBOUR
Doulus Hd
Doulus Bay
Reenada
Knights Town
Cahersiveen
RAILWAY
Port Magee
Port Magee Channel
Port Magee Entrance
Beenacry Hd
Bray Head
Puffin Is
St Finan
Bay
Ballinskellig
Bay
Waterville
W
E
S

natural protection from the swell of the Atlantic. The part of the channel which forms the anchorage grounds is completely sheltered. It is a splendid place for tow-netting, and easily reached in ten minutes from the ferry pier. The tow-nettings were usually taken during the flood tide, as the water was then quite clean and the fauna less scattered.

When the sea permitted, tow-nettings were occasionally taken outside the harbour entrance (14–18 fms.), and in Doulus Bay (12–20 fms.) on the north side of Beginnis Island. There is a second entrance to the harbour through Doulus Bay and round the north side of Beginnis Island, but a sand-bar and shallow water render it less favourable for tow-netting, besides which the main harbour channel has to be crossed to get to it.

A very small river, the Cahir, empties itself into Valencia Harbour. The great bulk of its water passes out into Doulus Bay, and only after very heavy rains is its water, brownish from the peat bogs, visible in the Harbour Channel. At other times the amount of fresh water in the harbour is insignificant. During heavy gales, which are particularly severe on this exposed coast in winter time, the harbour is completely churned up, and the destruction of the pelagic animals is very great.

The main flood-tide runs northwards along the coast of Kerry. Off Valencia Island the stream is about seven miles away, running direct from the Skelligs to the Blasket Islands. A branch of the main stream, of considerable size and strength, passes along the shores of Valencia Island and round Doulus Head into Dingle Bay. It is from this stream that the harbour is supplied.

Sea Temperatures and Climate.

Sea Temperatures.—During my visits the surface temperature of the sea was taken on every occasion on which the tow-net was used. The Misses Delap have also recorded a large number of readings from February, 1896 to December, 1898. As a rule the temperatures were taken from a boat, but during stormy weather from the rocky shore near Reenagiveen Point. Although the readings are not sufficiently accurate for physical observations, yet they are quite near enough for biological purposes. The following table shows the temperatures for each month of the year:—

THE SURFACE TEMPERATURE OF THE SEA IN VALENCIA HARBOUR.

	Valencia Harbour.				Dingle. Mean.	Berehaven. Mean.
	1895.	1896.	1897.	1898.	(1879–82).	(1879–82).
	F.° °	° °	° °	° °	°	°
Jan. 1–7			47–48	49		
8–14			46·5–48	50	44	45
15–22			45·5–46	50·5		
23–31		48	44·5–45			
Feb. 1–7		49	46–46·5	49		
8–14		49		49	46	46
15–22			48	49·5		
23–28		49	48·5			
Mar. 1–7			46	46–49		
8–14		50–51	46–48	49	49	48
15–22		50				
23–31		51	50	48		
Apr. 1–7	49		48			
8–14	49–50	52	51		51	49
15–22	50–51	53		50		
23–30	51–52	53	50	50·5		
May 1–7	51	54				
8–14	52–53		50–51	52·5–54	56	54
15–22	52–53		52–54	52		
23–31	54	54	53	52		
June 1–7		56–57	53–56			
8–14		58	56	58	58	56
15–22		60–60·5				
23–30		59·5	56–57	57·5–58		

Dingle and Berehaven.—The Mean Surface Temperature of the Sea for the Month (1879–82).—From the *Meteorological Atlas*, 1883.

The Surface Temperature of the Sea in Valencia Harbour—*continued.*

	Valencia Harbour.				Dingle. Mean.	Berehaven. Mean.
	1895.	1896.	1897.	1898.	(1879–82).	(1879–82).
July 1–7	F.°	56°–57°	56°·5	56°	°	°
8–14		58	56·59		59	57
15–22		60–60·5	58	58		
23–31		59·5	59·5–60·5			
Aug. 1–7		57–60·5	58	59·5		
8–14		56·5–59		60	60	59
15–22		58–58·5		59·5		
23–31		59	58	59–60		
Sept. 1–7		58	57	59		
8–14		57	55·5	61	58	57
15–22		57	57	59·5		
23–30		56–57		59·5		
Oct. 1–7		54–58	55			
8–14		50–52	55		52	53
15–22		50–52	55·5	57		
23–31		50	50	57–58		
Nov. 1–7		49–50	54	54		
8–14		50	55–55·5	56·5	49	50
15–22				54		
23–30		49–50	54			
Dec. 1–7		48–49	47·5–54	52		
8–14				50–52	45	47
15–22		45·5	50	50		
23–31		48	49	48		

Dingle and Berehaven—The Mean Surface Temperature of the Sea for the Month (1879–82).—From the *Meteorological Atlas*, 1883.

The maximum summer temperature has not exceeded 61° F. The minimum winter reading was 44°·5 F. in the winter of 1896–7, but in the following winter 47°·5 was the lowest reading.

Climate.—From 1867 to 1892 Valencia Island was honoured with a first-class Meteorological Station, which now stands on the adjacent mainland. Mr. J. E. Cullum has been the Director of this important Observatory almost since its foundation, and has recently published a useful paper on the "Climatology of Valencia Island, County Kerry" (Quart. Journ. Roy. Meteor. Soc., vol. xxii., 1896), from which I take a few abstracts.

Air-Temperature.—The island enjoys a very equable climate, suffering neither from frosty winters nor hot summers. Mr. Cullum, in his remarks on a table showing the mean monthly air-temperatures for a period of twenty-three years (1869–91), states:—"The first three months (of the year) exhibit a striking uniformity in the mean temperature (Jan. 45°·2, Feb. 45°·3 Mar. 45°·4), a feature which extends back to December. A rise of 2°·7 occurs between March and April, and the curve continues to ascend briskly for the next two months (May. 52°·1, June, 56°·6). The rise then slackens, and the actual maximum of the monthly mean temperatures, 59·2, appears in August. The descent is more uniform, and more rapid than the ascent has been, as in the space of four months the lowest point is again reached, in December, with a mean temperature of 45°."

"It is somewhat remarkable that there are no clearly marked periods of either spring or autumn. Throughout the four months of winter the total change of mean monthly temperature does not exceed 0·6, while no approach to such uniformity is noticeable at any other season. The maximum in August coincides with the known maximum in sea-surface temperature of the same month; but there is no corresponding coincidence of a minimum of air-temperature in February, when the sea-surface is at its coldest."

Sunshine.—"The mean annual amount (1881–1890) is 33·8 per cent., corresponding to 1486·5 hours of sunshine. The year commenced with a percentage of 21·9 in January, rising to a maximum of 43·3 in May. The figure then sinks to 31·7 in July, but rises to a second maximum of 35·9 in August; when this is past, the figures show a gradual decrease, until the minimum of 19·3 appears in December."

"In considering the individual months, we find that there is but little difference between April, May, and June, the respective numbers being 40·9, 43·3, 39·9."

Rainfall.—"The average yearly amount for the four lustr (1871–1890) is 58·26 inches, and the number of rain-days is 248.'

"The curve for the twenty years is a very simple one, with maximum of 6·45 inches in January, and a minimum of 3·29 inches i May. There is a decided indication of a second minimum in Septem ber; but the figures suffice to show that, without controversy, Valenci belongs to the region of winter rains."

FAUNISTIC NOTES.

(TABLES I. and II. on pages 692, 693).

It is somewhat disappointing to find that oceanic animals are not numerous at Valencia as the geographical position of the place woul lead one to suppose. To bring the Atlantic forms within the range the coast tides a good surface drift towards land, such as is produce by moderate winds blowing in one direction for a few weeks, is re quired.

I have drawn up a table (I.) to show the occurrence of the princip members of the fauna of the harbour from July, 1896, to Decembe 1898. Special tables for the Medusæ and Copepoda will be found the end of their respective reports.

Another table (II.) is constructed to show the months in whic certain pelagic animals either appeared in shoals from the ocean, or, members of the littoral fauna, occurred in such abundance that a cons derable number of specimens could be taken in a short haul with t tow-net. On certain occasions a particular animal occurred in su vast quantities that tow-netting for anything else was almost usele For instance:—*Cupulita* on October 8th and 9th, 1897; *Pleurobrach* on May 13th, 1897, and at times in June, July, and August, 189 *Oikopleura* on June 11th, 1898; *Thalia* on September 5th, 1896; a *Limacina* in July, 1897.

RADIOLARIA.

Radiolarians, belonging to the genus *Acanthometron*, were at tim very abundant in the harbour, and usually came in shoals.

1896. Shoals in August and September.
1897. Shoals in August, September, and October.
1898. Shoal in August.

SIPHONOPHORA.

Velella spirans (Forskål).

This beautiful Siphonophore occasionally drifts into the harbour, and has been taken by the Misses Delap in the following months:—

1895. June. Two specimens.
1896. (None seen).
1897. July to September. Common in July.
1898. June, July, October, and November. A few specimens taken in each month.

The smallest specimen measured 23 mm. in length, and the largest 40 mm.

The margin of the disc is nearly smooth and not deeply notched. The tentacles are usually in a single row, but in places two rows are present. A few specimens taken with Medusa-buds upon the gonostyles.

Velella has been frequently recorded from the west coast of Ireland, and is often found stranded on sandy beaches after westerly gales.

It is very rare on the south coast of England; Cocks (1849), however, recorded a shoal at Falmouth in 1848, when hundreds were found on the beach after a south-westerly gale.

Muggiæa atlantica, Cunningham.

Muggiæa atlantica, Cunningham, 1892, Journ. Mar. Biol. Assoc., vol. ii., p. 212.

Although this species has but recently received a name, it is by no means a recent addition to the British Fauna. It was first briefly described by Peach in 1849 from specimens found in Fowey Harbour, Cornwall. It has also been confused with *M. Kochii*, which is very much like it in general appearance.

At Valencia this little Siphonophore occurs during the summer and autumn.

1896. From July to November 13th. Usually a few specimens taken on each occasion the tow-net was used. Some of the specimens were infested with a minute Cercaria, which lived in the mesoglœa of the nectocalyx.

1897. Only two specimens taken in July. One seen in Octobe and a few in November.

1898. It was taken from September 3rd to November 19th and was very abundant during October. The necto calyx of the largest specimens measured about 7 mm in length. Medusoid gonophores bearing either ov or spermatozoa were common in October.

There is not sufficient evidence at present to show that thi Siphonophore is a regular member of our southern fauna; i may be only a frequent visitor. Since it was first described b Cunningham, in 1892, it has been recorded almost yearly fo the Plymouth district, where it has at times occurred in shoal During the same period it has been frequently found in Fal mouth Harbour by Vallentin.

Bourne (1890) probably took this species off the south-wes coast of Ireland in 1889, but has recorded it under the name o *M. Kochii.*

Cupulita Sarsii, Haeckel.

Agalmopsis elegans, Sars (*partim*), 1846, "Fauna Littoralis Nor vegiæ," Part I., p. 32, pl. vi.

Cupulita sarsii, Haeckel, 1888, Siphonophora, "Challenger" Report, p. 234.

Haeckel, in the Report on the Siphonophora of the "Chal lenger" Expedition, has separated the original *Agalmopsi elegans* of Sars into two species. One form has retained it original name; the other has been transferred to the genus *Cupulita*, and given the new specific name of *sarsii*.

There are three genera very closely related, and distinguished principally by the shape of the tentilla.

Halistemma. Tentilla with a naked cnidoband and a simple ter minal filament.

Cupulita. Tentilla with an involucrate cnidoband and a simple terminal filament.

Agalmopsis. Tentilla tricornuate, with a terminal ampulla and two-paired horns.

Sars has figured three kinds of tentilla for *Agalmopsis ele gans*:—tricornuate (Plate v., figs. 7, 8); involucrate (Plate v., figs. 5, 6); and an oval form without a spiral cnidoband (Plate vi., fig. 10).

The drawings of the Valencia specimens made by the Misses Delap clearly show that a colony has two forms of tentilla. An involucrate form (like Sars, Plate v., fig. 6) and an oval form without a spiral cnidoband (Plate vi., fig. 10). In some colonies the latter form is only present; in others both forms are present—the involucrate form occupying the central portion of the siphosome.

The tricornuate form has not yet been seen in any of the Valencia specimens.

1895. Small colonies about an inch in length were not uncommon during April and May. The largest was taken on April 18th, and measured 5 inches. The colonies were of a brilliant red colour, and the tentilla were of a simple oval shape.

The Misses Delap found colonies in July, and several on September 28th; the largest was 14 inches in length when fully extended.

1896. It was scarce during my visit in the summer, and only four small colonies, less than an inch in length, were found. A few nectocalyces were taken in the tow-net on November 6th.

1897. It occurred from March to November. Abundant about the middle of April, in May, and July. A specimen taken in April measured 10 inches in length, and had fourteen pairs of nectocalyces. Very abundant during September and October; some seen with sixteen pairs of nectocalyces.

1898. It was taken from March to December. Fairly common in August. Very abundant in October.

This Siphonophore is one of the animals which suffers badly from the destructive power of gales. In October, 1897 and 1898, *Cupulita* was very abundant, but almost disappeared after the first heavy gale. The Misses Delap informed me that after a very rough sea, early in November, 1898, the tow-net was full of isolated pneumatophores.

It belongs to the fauna of the Atlantic. Sars found his specimens on the coast of Norway. Greene (1857) has recorded *Agalmopsis elegans*, Sars, for Kingstown Harbour. At Port Erin, in April, 1894, I found several small specimens of a Siphonophore about an inch in length, and recorded its occurrence under the name of *Halistemma*, Sp.? (Fauna of Liverpool Bay, vol. iv., p. 279.) Subsequently I changed the name to *Agalmopsis elegans*, Sars. (10th Ann. Report L.M.B.C., p. 30.) I have again examined these specimens in my collection, and find that they are similar to the small specimens of *Cupulita sarsii* taken in Valencia Harbour. The Port Erin specimens have all the tentilla of the simple oval form without a spiral cnidoband. Until a spiral cnidoband had been actually seen it was easy to go astray over the small oval tentilla, and I considered them to be tentilla in the process of development. It has not yet been found on the south coast of England.

Anthozoa.

Arachnactis albida, Sars.

Arachnactis albida, Fowler, 1897, P. Z. S., p. 803.

Only a few specimens of this floating Actinian have been taken in the harbour. They were found during May, 1895 and 1897, and belonged to early stages.

This species has been recorded from Norway, the Faeröe Channel, and the Hebrides. It is apparently new to the west coast of Ireland, and Valencia Harbour at present is its southernmost record.

Arachnactis bournei, Fowler.

Arachnactis bournei, Fowler, 1897, P. Z. S., p. 805.

This little brownish anemone, a floating larval form not yet traced to any known adult, was at times not uncommon in the harbour.

1895. April 5th to 18th, a few seen on every occasion on which the net was used. Absent in May. A single specimen taken on July 8th.

1896. Not uncommon during April.

1897. Taken from March to June.

It has been recorded from St. Andrews, Plymouth, Falmouth, and the Isle of Man.

Ctenophora.

Three species belonging to three different families are found in the harbour. Their size and beauty make them conspicuous objects at the surface of the sea on a calm day; their abundance is a marked feature in the pelagic fauna of the harbour.

A note of warning may prevent disappointment, and perhaps the loss of valuable specimens, by stating that formalin is a bad preservative for Ctenophores.

I have preserved a good many specimens of *Pleurobrachia* and *Beroe* in formalin of various percentages up to 10 per cent., and have used sea-water as well as fresh-water for the solutions. At first the specimens look splendid, and keep so for several months; but within a year a great change takes place. They gradually become opaque and flabby, and shrink up until the ciliated bands almost touch one another. Formalin is quite useless for *Bolina*, the specimens break up at once and simply melt away.

Formalin 5 per cent. solution is an excellent killing re-agent for *Beroe* and *Pleurobrachia*; but when the specimens are fixed, I advise the gradual introduction of alcohol until a 70 per cent. strength is reached.

Pleurobrachia pileus, Modeer.

This is the commonest species in the harbour, and occurs almost all the year round. It is widely distributed throughout the British area.

1895. During April and the early part of May, a few specimens were taken on every occasion on which the tow-net was used. Towards the end of May it became more abundant. (Notes were only kept during April and May.)

1896. On my arrival in July *Pleurobrachia* was present in the harbour, and remained until November. It was very abundant at the end of July, swimming in shoals near the surface. On several days in August it was just as numerous. Large specimens up to 25 mm. in length were common during August. From September to November small forms, 2–4 mm. in length, were common and occasionally abundant, even in November.

1897. It was taken from January to November. Very scarce during the early part of the year. Small specimens abundant from May to July. Large specimens, 15–20 mm., were abundant during August and September, but scarce in October. Young stages, 2–4 mm. in length, were taken during October to the end of November; at times they were very abundant.

1898. It occurred from March to November. During May young stages, 2–3 mm., were common. Early in July specimens, 3–5 mm., and at the end of the month, 6–12 mm., were abundant. During August and September both early stages, 2–4 mm., and large adults, 15–25 mm., were abundant.

I am inclined to believe that there are two generations in a year. The larval forms, so numerous in the autumn, which survive the winter storms by remaining near the bottom in fairly deep water, reach the adult condition early in the following year, and produce the spring generation which is found during April and May. This generation growing rapidly during the warm summer months produces the autumn generation, which is more numerous, having been reared under more favourable circumstances.

M'Intosh (1889) gives an excellent account of the distribution of this species at St. Andrews for the year 1888.

Bolina norvegica (Sars). Sp.?

The identification of this common but beautiful lobate Ctenophore has yet to be verified. When I was at Valencia I had no means of identifying the species, owing to the absence of the necessary books, and the numerous attempts to preserve specimens by different methods all terminated in absolute failure. The early larval stages killed in Flemming's solution and transferred to alcohol were passable, but the large specimens contracted almost beyond recognition.

1895. Only three specimens taken in April, and a few occasionally during May. Most were young stages. The largest specimen measured 32 mm. in length.

1896. From July to the end of September there was a mixture of early stages and large adults. During July young forms, 1–10 mm. in length were common, but adults over two inches were scarce. August was the principal month for large specimens. They were abundant on August 1st, 4th, 10th, and 24th; and very abundant (in shoals) on August 12th, 15th, and 22nd. The adult specimens ranged from 60 to 80 mm. in length, and 30 to 40 mm. in width. There was a considerable decrease in numbers after the first week of September. The last specimen was seen on September 24th, two days after a heavy gale.

1897. It was taken from May to October. Abundant in June. Very large specimens common during September and early in October.

1898. It occurred from May to November. Fairly common in the summer. A specimen taken early in September measured 85 mm. in length and 50 mm. in width.

Lobate Ctenophores have on several occasions been recorded in British seas. As a rule on each occasion a fresh name has been used, and no attempt has been made to give a full and careful description with good figures. Whether there are really several genera and species, or only a solitary species, is a subject for future investigation.

The following references may be of use to future workers on the lobate forms:—

Bolina hibernica, n.s., Patterson, 1838, Trans. Roy. Irish Acad., vol. xix., p. 96. 1839, p. 154. Lough Larne. Dublin Bay. June, 1838.

= *Alcinoe hibernica*, Thompson, 1856, Nat. Hist. Ireland, vol. iv., p. 447.

Alcinoe rotunda, n.s., Forbes and Goodsir, 1839, Rep. Brit. Assoc., p. 856. Kirkwall Bay.

Alcinoe smithii, n.s., Forbes and Goodsir. Ailsa Craig. Irish coast.

Mnemia norvegica of Sars. Greene, 1857, Nat. Hist. Review, vol. iv., p. 175.

"I have frequently obtained specimens of it, which were fully two inches in length; it is, however, a very fragile animal. Kingstown Harbour. 1856."

Mnemia norvegica, Haddon, 1886, Proc. Roy. Irish Acad., vol. iv., p. 615.

Numerous specimens on the south-west coast of Ireland.

= *Bolina hibernica*, Patterson.

Lesueuria vitrea of Milne Edward. M'Intosh, 1888, Ann. Nat. Hist., ser. 6, vol. ii.

St. Andrews. Very abundant. The largest measured 3½ inches in length.

M'Intosh, 1890, Ann. Nat. Hist., ser. 6, vol. v., p. 40.

Young *Lesueuria* occur in April, and are abundant in May and June. Occasionally captured in November and December, about ⅝–1½ inches long. The adults appear to spawn in

July and gradually die off, leaving the young to develop during winter.

M'Intosh, 1889, Report, Fishery Board for Scotland, Part iii., pp. 259–300.

A full account of its occurrence at St. Andrews in 1888.

Bolina hydatina of Chun. Garstang, 1894, Journ. Mar. Biol. Assoc., vol. iii.

Found at Plymouth in May, 1892, and 1894.

Bolina hydatina, Vallentin, 1893, Journ. R. Instit., Cornwall, vol. xi.; 1896, vol. xiii., p. 45; 1897, vol. xiii., p. 254.

Falmouth Harbour, June, 1892. Abundant in June, 1894; May, 1895; May, 1897. Some measured 5·4 cm. in length.

Mnemia norvegica, n.s., Sars, 1835, Beskrivelser og Tagttagelser, &c. Norway.

Beroe bilobata, Dalyell, 1848, Rare and Remarkable Animals of Scotland, vol. ii., p. 254, plate liv.

Bolina norvegica (?) Hartlaub, 1894, Arbeiten Biol. Anstalt, Helgoland, Bd. i. Heligoland.

Beroe ovata, Eschscholtz.

1896. *Beroe* was not seen in July, but on August 1st a specimen, about 10 mm. in length, was taken. From the middle of August to the middle of September it was a common object in the harbour, and at times quite abundant. Most of the specimens were large, 50–75 mm. in length. Early stages, 2–3 mm., were common on September 14th, and again in November.

1897. During January and February a few young stages, 2–4 mm. in length, were taken. It was not seen during March and April; and only one specimen of a young stage was captured in May. From June to November this Ctenophore was nearly always present in the harbour. It was very abundant during July and October. The largest specimens were taken in September and October.

1898. It was first seen in July, and remained until November. Very abundant during August and September. In the autumn very large specimens, up to 90 mm. in length and 50 mm. in breadth, were common. Small specimens, 4–6 mm. in length, were taken about the middle of August and during October.

The quick disappearance of the large Ctenophores in the autumn is, I believe, mainly due to gales and rough seas in shallow water. The flimsy construction of *Bolina* renders it specially liable to destruction by rough seas, but *Beroe* is less so. *Pleurobrachia* is the least liable to destruction owing to its shape, comparative smallness, and the firmer consistency of its mesoglæa.

Beroe apparently has only one generation in the year. Its breeding season is during the summer months, when the adults are so plentiful. The larval forms which survive the winter probably live in deep water. They seek the surface early in the summer, and are carried by surface currents towards the shore and by the tide into the harbour.

Beroe ovata has a wide distribution. Large specimens swarm off the Shetlands and the Hebrides, and also at times at St. Andrews, during the summer. Haddon (1886) found it exceedingly abundant off the west coast of Ireland. It is apparently rather rare on the south coast of England. I have only seen a few small specimens at Plymouth.

ECHINODERMATA.

Larval forms, known as *Pluteus*, *Bipinnaria*, and *Auricularia*, were not uncommon during the spring and autumn, and at times were quite abundant.

Bipinnaria asterigera, Sars.

Bipinnaria asterigera, M'Intosh, 1898, Ann. Nat. Hist. Ser. 7. vol. ii., p. 105, pl. ii.

A single specimen of this fine *Bipinnaria* was taken on November 25th, 1895. It measured about 6 mm. in length, and had twelve arms with corrugated margins. The Bipinnaria carried a well-developed little starfish, which belongs to the genus *Luidia*.

NEMERTEA.

Pilidium.

Two specimens of this larval form were taken in April, 1895. Its occurrence may have been more frequent, as it is not very likely that such a small and delicate form would be in a recognisable condition in unassorted tow-net material sent a long distance by post.

POLYCHÆTA.

No special records were kept of the numerous larval forms exce a few, which I happen to know by name; only two are record here.

Magelona.

The free-swimming larval form was found on the followi dates:—

1895. In May; abundant on the 24th. Specimens measur 1 to 2 mm. in length. July 5th, one specimen, 3 m in length.

1896. March 16th. A few specimens about 2 mm. in lengt August 28th and September 1st, a solitary specim on each date.

1897. July 19th, 29th, and August 5th, a solitary specimen each date.

1898. March 30th and April 24th, a solitary specimen on ea date.

Mitraria.

This rare larval form was only seen in 1895. A sudd swarm entered the harbour on April 10th, and disappeared April 22nd. A few specimens were also taken between M 13th and 27th.

This larval form has been very rarely found in Briti seas. It has been recorded from Plymouth (Bourne, 188 and Falmouth (Vallentin, 1891).

Watson (1898, 12th Ann. Rep., Liverpool Biol. Soc., p. 1 has succeeded in connecting Mitraria with a Polychæte call *Owenia filiformis.*

Autolytus, Sp. ?

A few females, carrying eggs, were taken during the sprin in the years 1895–98. It was twice seen in July, 1897, a once early in November, 1896 and 1897. The male, kno as *Polybostrichus*, was only seen twice, on April 10th, 189 and March 8th, 1898.

Tomopteris onisciformis, Eschscholtz.

This beautiful, transparent, free-swimming Polychæte is regular inhabitant of Valencia Harbour. During the ear part of the year, from January to April, it is rather scarce, and only a few specimens are occasionally taken. Up to the end of March most of the specimens are about 6 mm. in length; but a few are larger, ranging up to 10 mm. In April fine adult specimens are taken, 25–30 mm. in length. In May large specimens are occasionally taken, and young ones, about 2–3 mm. in length, make their first appearance. During May and June the adult specimens gradually disappear, and their place is taken by their more numerous offspring. In July *Tomopteris* becomes fairly common, and at times even abundant. Most of the specimens are about 6 mm. in length, but some are quite young stages, about 2–3 mm., and a few belong to later stages, 10–13 mm. The association of early and intermediate stages tends to show that the breeding time of the adults extends over several months. The early stages taken in May probably come from eggs liberated in April, and are represented by the larger specimens taken in July; and the early stages taken in July come from eggs liberated at the beginning of June. During August most of the specimens are 5–12 mm. in length; but a few up to 30 mm. are taken. From the middle of September until late in October is the breeding season of this summer generation; and early in October young stages, 2–4 mm. in length, make their appearance, and soon become abundant. At the end of October there is again a mixture of different stages, just as in May, consisting of young and intermediate forms 2–12 mm. in length, and a few adults over 20 mm. About the middle of November a rapid decrease in numbers takes place, and by the end of the month *Tomopteris* becomes quite scarce. What becomes of all the numerous stages is a problem yet to be solved. Probably the winter storms may account for the destruction of a good many.

It is clear from the sudden appearance of numerous young specimens that there are two distinct generations in a year, one in the spring and the other in the autumn. The intermediate and adult specimens taken in the spring are, I believe, the survivors of the autumn generation. These have passed safely through the winter with a considerable loss in numbers; but their offspring, reared under more favourable circumstances, apparently do not suffer such a loss in numbers, and produce a larger generation in the autumn.

In the autumn of 1897 the young individuals formed a large shoal in the harbour. They were also very abundant in the same season of 1898.

The largest specimen of *Tomopteris* was taken on May 1st, 1895. It measured, when alive, 55 mm. in length, with sixteen pairs of parapodia, and about six rudimentary pairs on the tail. The body contained a large number of ova.

Amphipoda.

Parathemisto oblivia, Kroyer.

This little Amphipod, kindly identified for me by Mr. A. O Walker, was taken often in the summer and autumn. At times it became quite abundant, especially in August, 1896, and September, 1897. All the specimens were very small, and belonged to young stages.

Mollusca.

Ianthina communis, Lamarck.

A solitary specimen was found stranded on the shore in the harbour by the Misses Delap, on August 31st, 1896, and was brought to the Laboratory. When placed in sea-water it soon became active, and lived for three days. I found several clusters of eggs, some of which had reached the veliger stage, with a dark brownish spiral shell.

Ianthina always remained fully expanded when the sun was shining upon it, but a shadow suddenly thrown across the aquarium would immediately cause the animal to contract.

This Mollusc has often been recorded from the west coast of Ireland.

Atlanta, sp.?

Atlanta, M'Intosh, 1890, Ann. Nat. Hist., ser. 6, vol. v., p. 47, pl. viii., figs. 3, 4.

A single specimen taken on August 7th, 1896. The shell agreed in general appearance with the figures given by M'Intosh, who found his specimens at St. Andrews in September, 1888.

PTEROPODA.

Limacina retroversa (Fleming).

Limacina retroversa, Pelseneer (1887).

This species may be regarded as a regular inhabitant of the harbour. It often occurred in dense shoals, and formed a layer of considerable thickness at the bottom of the tow-net can.

1895. A few specimens were taken once in April. On May 6th a shoal entered the harbour and remained until the 17th, when a sudden decrease took place.

1896. It was very abundant during May, June, and July. Early in August it suddenly became very scarce, and finally disappeared at the beginning of October.

1897. It was taken from June to December. Very abundant in July and at the end of October.

1898. It was seen from July to October, and again in December. Abundant at the end of July and during the early part of October.

Clione limacina (Phipps).

Clione limacina, Boas (1886); Pelseneer (1887); M'Intosh (1898).

Clione borealis, Pallas.

A few specimens of this Pteropod were occasionally taken in the harbour, 1896. It occurred from the end of July to September 10th. Larval stages were found about 1½ mm. in length, with median and posterior ciliated bands, as figured by M'Intosh (1898; pl. ii., fig. 6), and also younger stages with three ciliated bands.

The adult stage was taken in August; the largest specimen measured 17 mm. in length. This is small as compared with Arctic specimens, 35–40 mm.

1897. A few specimens were taken from July 19th to October 8th. Some were larval stages and others adults.

1898. A few specimens seen in August; one in October; and one on December 26th.

The home of this species is in the Arctic Ocean. It is not uncommon in the northern part of the British area, but rarely taken in the south. A solitary specimen was found by Leach at Falmouth, which is its southernmost record.

Dexiobranchæa ciliata (Gegenbaur), Sp. ?

Dexiobranchæa ciliata, Boas (1886); Pelseneer (1887); Gegenbaur 1855).

Only a few larval stages with ciliated bands were taken in the harbour in 1896, on August 4th and 8th, and September 2nd.

All the specimens were of about the same age, and agreed in general appearance with a figure given by Gegenbaur (1855, Taf. iv., fig. 11).

This species has been recorded from the Faeröe Channel and other parts of the North Atlantic, and also from the Mediterranean.

Phoronidea.

Phoronis hippocrepia, Wright.

Actinotrocha.

The larval stage commonly called *Actinotrocha* was only taken during the spring.

1895. It was not uncommon during April and May. A stage, 5 mm. in length, about ready to start its sedentary life, was taken on May 13th.

1897. A single specimen was seen on March 23rd.

The larval form has been recorded for Scotland and the south coast of England, but I have not met with any records of it for the west coast of Ireland. August and September appear to be the principal months for its occurrence at Plymouth and Falmouth.

Hemichordata.

Balanoglossus.

Tornaria krohnii, Bourne, 1889, Journ. Mar. Biol. Assoc., vol. i., n.s., pp. 63–68, pl. vii.

The larval form commonly called *Tornaria* was taken only on two occasions.

1897. July 3rd, four specimens.

1898. July 22nd, two specimens.

These specimens agreed in general appearance with the species which is at times not uncommon at Plymouth in August and September.

REFERENCES.

BOAS.—1886. *Spolia Atlantica*, K. dansk. Vidensk. Selsk. Striv. 6 Raekke. Bd. iv., p. 159.

BOURNE, G. C.—1890. Report of a Trawling Cruise in H.M.S. "Research" off the S.W. Coast of Ireland. Journ. Mar. Biol. Assoc., vol. i., n.s., pp. 306-323. (Plymouth.)

COCKS, W. P.—1849. Contributions to the Fauna of Falmouth. 17th Annual Report, Roy. Cornwall Polytechnic Soc., pp. 38-101. (Falmouth.)

GARSTANG, W.—1894. Faunistic Notes at Plymouth during 1893–4. Journ. Mar. Biol. Assoc., vol. iii., pp. 210–235.

GEGENBAUR.—1855. Untersuchungen über Pteropoden und Heteropoden.

GREENE, J. R.—1857. On the Acalephæ of the Dublin Coast. Nat. Hist. Rev., vol. iv. (London.)

HADDON, A. C.—1886. First Report on Marine Fauna of the S.W. Coast of Ireland. Proc. Roy. Irish Acad., vol. iv., ser. 2, pp. 599–638. (Dublin.)

HERDMAN, W. A.—1891. The Biological Results of the Cruise of the S.Y. "Argo" round the West Coast of Ireland, August, 1890. Trans. Liverpool Biol. Soc., vol. v., pp. 181–212. (Liverpool.)

M'INTOSH, W. C.—1888. Notes from St. Andrews Bay. Ann. Nat. Hist., ser. 6, vol. ii., p. 464.

1889. On the Pelagic Fauna of the Bay of St. Andrews during the Months of 1888. Part I. Annual Rep. Fishery Board for Scotland, No. 7, pp. 259–309.

1890. Part II. Report, No. 8, pp. 270–282.

1898. Ann. Nat. Hist., ser. 7, vol. ii., p. 103.

PELSENEER.—1887. Reports on the Pteropoda. "Challenger" Reports, vol. xix. and vol. xxiii.

VALLENTIN, R.—1891. Additions to the Fauna of Falmouth. 59th Annual Report Roy. Cornwall Polytechnic Soc., pp. 92–100.

1893–1897. (A Series of Papers on the Fauna of Falmouth Harbour.) Journ. Roy. Instit., Cornwall. 1893, vol. xi., p. 304. 1896, vol. xii., p. 204. 1896, vol. xiii., p. 43. 1897, vol. xiii., p. 254. (Truro.)

Monthly Distribution of certain Pelagic

	1896. Summer.		1896. Autumn.			1896–1897. Winter.			
	July	Aug.	Sept.	Oct.	Nov	Dec.	Jan.	Feb.	Mar.
Muggiæa atlantica, ...	×	×	×	×	×	..	..	..	..
Cupulita sarsii, ...	×	×	×	×	×	..	..	..	×
Velella spirans, ...	..	..	..	..	..	..	..	..	..
Bolina norvegica, ...	×	×	×	..	..	..	..	..	..
Pleurobrachia pileus, ...	×	×	×	×	×	..	×	×	×
Beroe ovata, ...	..	×	×	..	×	..	×	×	..
Tomopteris onisciformis, . . .	×	×	×	×	×	×	×	×	×
Sagitta bipunctata, ...	×	×	×	×	×	×	×	×	×
Parathemisto oblivia, ...	..	×	..	×	×	..	..	..	..
Clione limacina, ...	×	×	×	×	..	..	..	..	..
Limacina retroversa, ...	×	×	×	×	..	..	..	..	..
Thalia democratica-mucronata, .	..	×	×	..	..	..	..	..	..
Doliolum tritonis (sp. ?), . . .	×	×	×	×	..	..	..	..	..
Oikopleura flabellum (sp. ?), . .	×	×	×	×	..	..	×	×	×

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Table showing the Months in which Pelagic

	1896. Summer.		1896. Autumn.			1896–1897. Winter.			
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Corymorpha nutans, ...	..	..	..	..	..	..	..	..	..
Sarsia prolifera, ...	..	×	..	..	..	..	..	..	..
Dipleurosoma typicum, ...	..	..	..	..	..	..	..	..	..
Euchilota pilosella, ...	..	..	..	..	..	..	..	..	..
Laodice calcarata, ...	..	..	×	..	..	..	..	..	..
Obelia nigra, ...	..	×	..	..	..	..	..	..	..
Phialidium cymbaloideum, . . .	..	..	..	..	..	..	..	..	×
Phialidium temporarium, . . .	..	..	..	..	..	..	..	..	..
Solmaris corona, ...	..	..	..	..	..	..	..	..	..
Pelagia perla, ...	..	×	..	..	..	..	..	..	..
Cupulita sarsii, ...	..	..	..	..	..	..	..	..	..
Pleurobrachia pileus, ...	×	×	×	×	×	..	..	..	..
Bolina norvegica, ...	×	×	×	..	..	..	..	..	..
Beroe ovata, ...	..	×	..	..	..	..	..	..	..
Tomopteris onisciformis, . . .	..	..	..	..	..	..	..	..	..
Sagitta bipunctata, ...	..	..	..	×	×	..	..	..	..
Limacina retroversa, ...	×	..	..	..	..	..	..	..	..
Thalia democratica-mucronata, .	..	×	×	..	..	..	..	..	..
Oikopleura flabellum (sp. ?), . .	..	..	×	..	..	..	..	..	..

LENCIA HARBOUR.

m July, 1896, to December, 1898.

1897. ummer.		1897. Autumn.			1897–1898. Winter.			1898. Spring.			1898. Summer.			1898. Autumn.			'98 W.
July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
×	..	..	×	×	..	..	..	..	..	..	..	..	×	×	×	×	..
×	×	×	×	×	..	..	..	×	×	×	×	×	×	×	×	×	×
×	×	×	..	..	..	..	..	..	..	..	×	×	..	..	×	×	..
×	×	×	×	..	..	..	..	..	..	×	×	×	×	×	×	×	..
×	×	×	×	×	..	..	..	×	×	×	×	×	×	×	×	×	..
×	×	×	×	..	..	..	..	..	..	..	..	×	×	×	×	×	..
×	×	×	×	×	..	×	×	×	..	×	..	×	×	×	×	×	×
×	×	×	×	×	×	×	?	×	×	×	×	×	×	×	×	×	..
×	..	×	×	×	..	..	..	..	..	..	..	..	..	..	×	..	..
×	×	×	×	..	..	..	..	..	..	..	..	..	×	×	×	..	×
×	×	×	×	×	×	..	..	..	..	..	..	×	×	×	×	..	×
..	..	×	..	..	..	..	..	..	..	..	..	..	×	..	..	..	..
×	×	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	×	×	×	..	..	..	..	..	×	..	×	..	..	..	..

LENCIA HARBOUR.

urred in Shoals, or in Great Abundance (1896–1898).

1897. ummer.		1897. Autumn.			1897–1898. Winter.			1898. Spring.			1898. Summer.			1898. Autumn.			'98 W.
July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
..	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..	..	..
×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
×	×	..	..	..	..	..	..	..	..	..	×	×	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	×	×	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	×	×	..	..	..	..
×	..	×	..	..	..	..	..	..	..	..	..	×	×	..	..	..	..
×	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	×	×	..	..	..	..	..	..	..	..	..	×	..	..	..	..
×	..	×	..	..	..	..	..	..	..	..	..	×	..	×	..	..	..
×	×	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..
×	..	×	×	..	..	..	..	..	..	..	..	..	..	×	..	..	..
×	..	×	×	..	..	..	..	..	..	..	×	×	×	×	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	×	×	..	..	..
×	..	..	×	..	..	..	..	..	..	..	..	×	×	×	..	..	..
×	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	×	×	..	..	..	..	..	..	..	..	..	..	×	×	..
×	..	..	×	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	×	..	..	..	..	..	..	..	×	..	..	..	..	..	..

II.—Report on the Medusæ (1895–98). By E. T. Browne, B.A.,

University College, London.

INTRODUCTION.

Prefatory Remarks.

Very few species of Medusæ have been recorded for the west coas of Ireland; and, owing to the vagueness of the descriptions originall given to these forms, the records are now in most cases of little value Consequently it was impossible to form an idea as to whether th Medusoid fauna was similar to that of the English coasts or totall different from it; and it was equally impossible to determine wha share the true Atlantic Medusæ took in adding to the richness of th littoral fauna.

Though the Medusæ of the west have remained in a neglecte condition, there have been periods of great activity on the easter coast, more especially in the Dublin Bay district, where the labour of Ray Greene (1857) and Haddon (1885) have produced valuabl contributions to our knowledge of the British Medusæ.

The northern shores of Ireland and the Belfast district claim th early work of Templeton (1836), Patterson (1859), Forbes, an Thompson; and the southern shores that of Allman.

It was necessary for the progress of my research on the Britis Medusæ that I should investigate the fauna of the west coast Ireland. The first visit to Valencia Harbour, on the coast of Kerr was made in 1895, during April and May, with my friends Mr. W. Beaumont and Mr. F. W. Gamble, to both of whom I am indebted fo much kindness and help. The second visit to the same locality wa made during the summer (July to September) of 1896, when I was member of a small expedition to investigate more thoroughly the faun of the harbour.

This Report, however, is mainly based upon a series of tow-netting taken by the Misses Delap, of Valencia Island, to whom I am greatl indebted, not only for specimens, but also for valuable notes and draw ings. I must take the responsibility for the contents of this Repor and the identification of the species; but it is chiefly owing to th Misses Delap that the Medusoid fauna of Valencia Harbour is now better known than that of any other locality within the British area.

It will be seen from the list of species that most of the Medusæ belong to one or other of the two orders—Anthomedusæ and Leptomedusæ. These orders contain nearly all the species usually found in our seas. Though only a few Medusæ have been connected with Hydroids, yet probably an alternation of generations will be ultimately proved to exist in all the species belonging to the two orders. Up to the present time no evidence has been found of the direct development of a Medusa from a Medusa in either the Anthomedusæ or Leptomedusæ.

The Medusæ belonging to the other orders, the Trachomedusæ and the Narcomedusæ, may be regarded as visitors to our shores. Their natural habitat is the open ocean, and their development is probably direct, as we have no evidence of the existence of any Hydroid form belonging to them.

Our Medusæ may, therefore, be divided into two groups:—(*a*) Littoral (Anthomedusæ and Leptomedusæ; (*b*) Oceanic (Trachomedusæ and Narcomedusæ). Certain species of the Leptomedusæ may be regarded as visitors to British waters, as they have been very rarely recorded (such an one is *Octorchis*); but they may be common elsewhere, and probably belong to Hydroids inhabiting grounds far away from our shores.

The geographical position of Valencia Harbour makes it difficult there to distinguish the regular inhabitants of the coast from the oceanic species and the casual visitors; but, by comparing them with Medusæ found at places further from the Atlantic, an approximately correct estimate can be obtained. For this comparison I select two places:—Plymouth, and Port Erin, in the Isle of Man, where the Medusoid fauna is fairly well known to me.

The Valencia Medusæ compared with Species found at Plymouth and Port Erin.

All the Anthomedusæ found at Valencia have, with one exception, been taken at or near Plymouth. This exception is *Margelis pyramidata*, which has only been recorded from the west coast of Scotland. Since this species almost certainly comes from a Hydroid belonging to the genus *Bougainvillia*, or a closely allied genus, its distribution must mainly depend upon the distribution of that Hydroid, which may live in fairly deep water off the Atlantic coasts of Ireland and Scotland.

I have taken at Port Erin nearly all the Valencia Anthomedusæ; and, from the known distribution of the missing species, they, with all probability, will eventually be found there, except, perhaps, *Margelis pyramidata*.

My visits to Port Erin have been principally during April and May, and not during the summer months: consequently my knowledge is somewhat limited to the spring forms.

The Leptomedusæ of Valencia do not show so close an agreement with those of Plymouth as the Anthomedusæ, but the difference is not great. There are only three species which I have not taken at Plymouth: —*Dipleurosoma typicum*, *Melicertidium octocostatum*, and *Laodice calcarata*.

Dipleurosoma typicum is a remarkable Medusa; and until more is known about its distribution, and especially its life-history, my remarks must be of a speculative nature. There ought now to be no difficulty in tracing its life-history, as the ova remain attached to the Medusa until the planula stage is reached,[1] and the planulæ could be reared in a "Plunger" aquarium, such as is used in the Plymouth laboratory. This Medusa was very scarce during my visit in 1896; but the Misses Delap reported shoals in 1897 and 1898. It has not often been recorded, but its distribution is wide:—Newfoundland, Norway, south coast of Ireland, Kingstown Harbour, and Brighton. Its occurrence at Brighton (1879) tends to show that the Medusa passed up Channel on that occasion.

The second species, not taken at Plymouth, *Melicertidium octocostatum*), is a member of our northern fauna. It is common in Scotland, but rarely taken in the southern part of the British area. It was only taken once at Valencia in 1897, and has only been once recorded for the English Channel—at Falmouth, by Cocks, when it was abundant in the summer (1849). This species has such well-marked characters (eight radial canals and eight large gonads) that there should not be the slightest difficulty in determining the sole member of the genus. It is not likely, then, that this species would have escaped observation at Plymouth if taken in the tow-net.

The third species, *Laodice calcarata*, has a wide distribution; but its exact range cannot be decided until the "good species" of the

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[1] *Dipleurosoma typicum*.—Last summer the Misses Delap successfully reared several dozen planulae up to a hydroid form. The hydroids are still alive in an aquarium, but have remained stationary in growth throughout the winter. From the description and drawings kindly sent to me by the Misses Delap I am inclined to think that the hydroids have not developed very far. It will be best to wait for further development before publishing a description of the hydroid, which, at its present stage, appears to belong to the genus *Cuspidella* (March, 1900).

genus have been finally determined. There may be only one species, or several. According to Agassiz it has a Hydroid form (*Lafoëa calcarata*, of Agassiz), found in Buzzards Bay, on the Atlantic coast of North America. The Hydroid has yet to be found on this side of the Atlantic. The Medusa may be easily recognized by its sensory clubs (cordyli) on the margin of the umbrella. It has been rarely recorded in British seas. Forbes and Goodsir, I believe, found specimens in 1851 on the west coast of Scotland; a solitary specimen was taken by me at Port Erin in May, 1894;[1] and one specimen was found in my examination of Dr. Fowler's collection from Kirkwall Bay in 1896. These are the only British records that I know of, and up to the present time it has not been taken in the English Channel.[2] This species has occurred every year (1895–98) at Valencia. It appears to be an inhabitant of the Atlantic coast of Ireland and Scotland. The Port Erin specimen probably drifted down through the North Channel.

I am inclined to add *Polycanna forskalea* as a fourth species, found at Valencia, and not at Plymouth. It has occurred regularly at Valencia, 1896–98, whereas I have only seen a single specimen of the Æquoridæ at Plymouth (June, 1898). It was a few millimetres in diameter, and too young for the determination of the species. At present there is the usual difficulty about determining the different species of the genus; and, until this is done, a distribution list is useless. Forbes certainly found this species in the outer Hebrides (1851); and young stages of *Æquorea* have been recorded by Greene for the south-west coast of Ireland. According to Goodsir, this large Leptomedusa has a hydroid stage.

At Port Erin the following Leptomedusæ have not been recorded, but some of them ought to be found there in the summer:—*Agastra caliculata* (the Hydroid *Campanularia caliculata* of Hincks is recorded for the Isle of Man by Miss Thornely), *Dipleurosoma typicum*, *Euchilota pilosella* (probably occurs in the summer),[3] *Octorchis gegenbauri*, and *Polycanna forskalea*.

All the Trachomedusæ may be regarded as true Atlantic forms;

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[1] *Laodice calcarata*, taken at Port Erin in May, 1899. Chadwick, H. C. 13th Ann. Rep. L. M. B. C., p. 35.

[2] *Laodice calcarata*. Intermediate stages were common in the Scilly Islands. July, 1899.—E. T. B.

[3] *Euchilota pilosella*, taken at Port Erin, from June to August, 1899. Chadwick, H. C. 13th Ann. Rep. Liverpool Mar. Biol. Com., p. 35.

and of the three Valencia species—*Aglantha rosea*, *Gossea circinata*, and *Liriantha appendiculata*—only the latter has occurred at Plymouth; it was very abundant there in 1893, and a few in 1897. Until I found this species at Valencia, the English Channel, where it was first found by Forbes in 1846, was its only known habitat. Only a few specimens were taken at Valencia in 1896 and 1897. Apparently it is an occasional visitor to our shores. *Aglantha* is a typical Atlantic Medusa. It was taken at Valencia in 1895 and 1896, and has been recorded from the Shetlands, St. Andrews, and Heligoland. *Gossea circinata*, the rarest of the Valencia Medusæ, has only been taken at Croisic, on the coast of Normandy, unless it be ultimately proved that *Gossea corynetes* of Gosse, taken at Ilfracombe in 1852, and not since recorded, be a younger stage. Both species of this genus may be regarded as typical visitors to the British shores.

Solmaris corona was the only species of the Narcomedusæ which was taken at Valencia; it was very scarce in 1895–96, but abundant in 1897–98. At Plymouth, in September, 1895, I found two young stages of a *Solmaris*, which may belong to this species.

Amongst the Scyphomedusæ, *Pelagia perla* may be regarded as an Atlantic species, which arrives at times in shoals on the west coast of Ireland and Scotland. It has never been recorded for Plymouth. Forbes, however, found specimens off the coast of Cornwall in 1846.

None of the Trachomedusæ or Narcomedusæ, nor *Pelagia*,[1] have been recorded for the Isle of Man. It will be seen that the majority of the species found in Valencia Harbour occur at Plymouth and Port Erin, and the remainder mark the character of an Atlantic port, viz.: *Dipleurosoma*, *Laodice*, *Polycanna*, *Aglantha*, *Solmaris*, and *Pelagia*. With tow-netting carried on almost continuously for three years, I expected to find more Atlantic Medusæ than have been met with.

Notes on the Tables.

(Tables facing p. 736.)

The Valencia Medusæ are conveniently divided into three series, corresponding to the three tables placed at end of this Report.

Table I.—The first series is quite distinct, and contains only those Medusæ taken by me during April and May, 1895.

Table II.—The second series contains the results of my tow-nettings during the summer (July to September), 1896.

[1] *Pelagia perla*. A shoal at Port Erin early in October, 1899. Chadwick, H. C. 13th Ann. Rep. L. M. B. C., p. 34.

In Tables I. and II. the Medusæ are recorded for each day on which the tow-net was used. The species are arranged according to the dates of capture; and by the use of figures and symbols an attempt has been made to convey an idea of their abundance.

Table III.—This series contains the results of the tow-nettings and the observations of the Misses Delap, extending from October, 1896, to December, 1898. To make this table more useful for the comparison of one year with another, I have added to it my own records for July, August, and September, 1896, so that the Medusæ of three summers are shown. The table is arranged on a different plan from the first two; it is simply a monthly record of the species present in the harbour, and the quantity is mentioned in the notes on the different species.

The order of the species is arranged on nearly the same plan as in the previous tables. The species which usually make their first appearance early in the year and during the spring are placed at the top of the table, followed by the regular summer forms, the rarer species being placed towards the bottom. The Medusæ on the upper half of the table may be regarded as the common annual inhabitants of the harbour.

There is a conspicuous blank for the winter months of 1897–8, owing to the scarcity of tow-nettings, mainly due to the bad weather so common on that coast in winter time. A special effort was made for December, 1898, as I particularly wanted to find out more about the occurrence of Medusæ during the winter months. I received eight tow-nettings taken on eight different days in the month by the local ferryman, James Higgins, under the directions of the Misses Delap, but found only one Medusa. The month was notorious for gales, and the contents of the tow-net chiefly consisted of broken algæ and Copepods.

The great decrease of Medusæ during October, and especially in November is, I am inclined to think, chiefly due to the heavy seas off that coast during the autumn gales. The first gale in the autumn plays great havoc with the pelagic fauna. I noticed this myself after a gale with a heavy sea at the end of September in 1896; and a tow-netting taken after the first gale in October, 1898, was full of the remains of *Solmaris* and other delicate animals.

The tow-nettings taken in the autumn contain young and immature stages of several species of Medusæ, including *Lar sabellarum*, *Phialidium cymbaloideum*, *Tiara pileata*, which one would expect to be found during the winter months, but these forms either completely disappear or become very scarce. I do not think their disappearance is due to the decrease of temperature, for the usual winter surface temperature of the sea at Valencia is about 48° F., and the maximum in the summer does not exceed 61° F.; so that the difference between winter and summer is only about 13° F. Occasionally in winter the sea is below 48° F., but never for any length of time, and the extreme minimum for the three years (1896–98) was 44°·5 F. Copepods form the principal food supply of the Medusæ, and they are fairly plentiful throughout the winter, therefore the decrease can hardly be due to starvation. I am inclined to think that it is the rough seas which play havoc with the delicate littoral animals; and those which escape and turn up early in the spring as mature forms, have passed the winter in deep water far away from the coast. These small Medusæ are quite at the mercy of the tides and currents; they certainly have the power of increasing or decreasing their depth in the water, but not of swimming against the stream, like the large *Rhizostoma.* It seems to be a matter of chance whether they reach deep water or get smashed on the coasts in winter.

Two papers on British Medusæ, written by myself, and published in the "Proceedings of the Zoological Society of London," contain descriptions and figures of some of the Medusæ taken at Valencia in 1895 and 1896.

In reports of a faunistic nature I do not think it is necessary to give the full lists of synonyms and references relating to the commoner species, and the few references which are given have been selected for their usefulness. The geographical distribution is only given for the rarer and more interesting species, and when omitted it may be understood that the species is widely distributed throughout the British area.

CRASPEDOTA.

Order.—ANTHOMEDUSÆ.

Amphinema dinema (Peron et Lesueur).

Saphenia dinema, Forbes, 1848, p. 25, pl. ii.

Amphinema titania, Haeckel, 1879, p. 50, Taf. iv.

Amphinema dinema, Browne, 1896, P. Z. S., p. 475.

In 1896–98 this Medusa made its first appearance in July and disappeared in September, except in 1898, when it remained until October. A few specimens taken occasionally during each month. The largest measured 6 mm. in length.

The top of the umbrella is ornamented with a cone-shaped process, which is very long and pointed in the Valencia specimens, and about the same length as the umbrella.

This species has only been twice recorded outside the English Channel; by Gosse from Ilfracombe, and by Forbes from the Shetlands.

It may be easily recognised by its two fine crimson or purplish tentacles.

Cladonema radiatum, Dujardin.

Cladonema radiatum, Hincks, 1868, p. 68, pl. xi.; Allman, 1872, p. 357, pl. xvii.

In October, 1898, Miss M. Delap found the Hydroid in an aquarium which had been used for keeping alive various animals taken from the harbour. The Hydroid, owing to its minuteness, was not discovered until it had produced a considerable network of stolons. It was probably introduced into the aquarium at the planula stage in the process of adding a fresh supply of sea-water.

Early in April Medusa-buds were first noticed upon the hydranths, and at the end of the month a young Medusa was seen swimming in the aquarium.

The Hydroid, I believe, has not yet been found in its natural habitat, but has always mysteriously appeared in marine aquaria.

While I was occupying a table at the Plymouth Marine Laboratory in the autumn of 1897, I received from Mr. Rupert Vallentin some adult Medusæ of *Cladonema radiatum* taken in Falmouth Harbour. Two specimens were placed in an aquarium, but soon disappeared. On my arrival at Plymouth, in the following April, I found in the aquarium several Hydroid colonies of *Cladonema*, which evidently had developed from the eggs liberated from one of the Medusæ. The colonies budded off Medusæ during May and June.

The Medusa is a remarkable creature, for it is able to attach itself by means of special suckers upon its tentacles to any fixed object, such as a rock, a piece of sea-weed, or the glass sides of an aquarium. I often watched the little Medusæ in the aquarium at Plymouth, and never saw them use their tentacles for crawling, but only for attachment. They remain at rest for long periods, with their tentacles expanded on the

wait for prey, generally a Copepod. I
caught by a tentacle the Medusa starts
great skill conveys the unfortunate Copep

In the sea the Medusa probably lives
have never taken a specimen in a tow-n
has seen a few specimens swimming at th
Falmouth Harbour.

There are very few records either fo
free-swimming Medusa. It has been f
Belgium; at St. Malo, in France; Messi
on the coasts of Kent, Devon, and Cornw

Clavatella prolifera, Hincks.

Clavatella prolifera, Hincks, 1868, p. 73, pl
p. 384, pl. xviii.

In April, 1895, Mr. Gamble found sev
Medusa crawling over seaweeds taken f
high tide-mark. The specimens were
colour.

In September, 1896, the Misses Delap
mens on seaweeds from a rock pool.

The Hydroid form has not yet been f
but it is very minute, and scarcely v
eye.

Corymorpha nutans, Sars.

Corymorpha nutans, Allman, 1872, p. 388, pl.
P. Z. S., p. 463, pl xvi.

Steenstrupia rubra et flaveola, Forbes, 1848, p

Steenstrupia galanthus, Haeckel, 1879.

In 1895–98, the Medusa occurred in
appears about the end of March, or ear
maturity early in May, and disappears du
becomes very abundant towards the end
rapidly in June; stray specimens may b
August, and probably come from Medu
developed unusually late in the spring.
was taken on July 27th, 1896; it measu
length.

The Medusæ on liberation from the Hy
in length and width; they grow to about

3 mm. in width. A few of the Valencia specimens measured 6 mm. in length.

The abundance of the Medusæ clearly shows that the Hydroid must be very abundant somewhere in the neighbourhood of Valencia Island, but it has yet to be found. This Hydroid is a difficult object to dredge, as it usually lives rooted in sand.

Cytæandra areolata (Alder).

Cytæandra areolata, Haeckel, 1879; Browne, 1897, P. Z. S., p. 817, pl. xlviii.

A very scarce Medusa, occurring at irregular intervals from April to November. Solitary specimens were taken on the following dates:—

1895, April 12th and 29th, May 14th, July 8th.
1896, July 18th, Nov. 2nd.
1897, September 8th.
1898, July 27th (two specimens).
An adult with ripe ova was taken in April, 1895.

This Medusa is probably liberated from one of the species belonging to the Hydroid genus *Podocoryne*.

Dipurena ophiogaster, Haeckel.

Sarsia strangulata, Allman, 1871, p. 46, fig. 17.

Dipurena ophiogaster, Haeckel, 1879, p. 29.

In 1896, only a few specimens were taken during the summer.

In 1897, it first appeared in May and disappeared in September; fairly common during June.

In 1898, it was very scarce, only seen in May and September.

The largest specimen measured 5 mm. in length and width. The manubrium, when fully expanded, was 40 mm. in length, and carried four oval masses of generative cells, in addition to a large mass of cells adjacent to the stomach.

This species was first taken by Allman on the south-west coast of Ireland, and figured in his monograph under the name of *Sarsia strangulata*. I have retained Haeckel's specific name, as there is an American species called *Dipurena strangulata* (MacCrady, 1857).

Haeckel records *D. ophiogaster* from Granville in Normandy, and from Jersey. I have also taken it at Jersey and Plymouth.

Dipurena halterata (Forbes).

Slabberia halterata, Forbes, 1848, p. 53, pl. vi

Slabberia catenata, Forbes and Goodsir, 1851,]

Dipurena halterata, Haeckel, 1879; Browne, 1
pl. xlix.

This is a scarce Medusa at Valencia, but recorded from other localities, though its from Mull to Jersey.

In 1895, taken once in April, July, and

In 1896, once in July and September.

In 1897, once in August and September.

In 1898, once in April, twice in June November.

Solitary specimens were usually taken 1898, the Misses Delap had the good fort teen adults, and kindly sent them to me fo umbrella of the smallest measured 5 mm. i and that of the largest 8 mm. in length a This Medusa is remarkable for having very matocysts, forming conspicuous rings at t tentacles. By these rings the species may b from *D. ophiogaster*. The number of rings the tentacles of the specimens taken in Ju five, as the following list shows:—

Umbrella-length, mm.	Number of rings on each of the four tentacles.	
5.	1, 2, 2, 3.	
5.	2, 2, 2, 2.	The la
5.	4, 4, 4, 4.	shape
6.	3, 3, 3, 3.	tocys
7.	3, 4, 3, 5.	with
8.	1, 3, 3, 4.	

In the earliest stage, about 1 mm. in le terminal cluster of nematocysts; the rings uppermost one of the series is the youngest

Forbes first found *Slabberia halterata* in Mounts Bay, Cornwall, in 1836, and described the species with one large terminal cluster of nematocysts on each tentacle. Off Mull, in 1851, Forbes found some specimens of the same genus having, in addition to the terminal cluster, five to six rings of the nematocysts on the lower half of each tentacle. He regarded the presence of the rings as a specific character, and described a second species under the name of *S. catenata*. In other details the Mull specimens agree fairly well with the first-named species. The specimens taken at Valencia show the connexion between the two species of Forbes; and I consider *S. catenata* to be the fully developed adult stage of *S. halterata*.

All the Valencia specimens have the peculiar linear swellings upon the four radial canals; they have the appearance of immature gonads. In the adult the generative cells are arranged in large clusters upon the manubrium.

Abnormal specimen.—One specimen, taken in July, 1898, had an interesting abnormality, which I have not seen before among the Sarsiadæ.

There was an extra tentacle attached to one of the four normal tentacles. It was like its companion in size; but its basal bulb was smaller, and joined to its neighbour. The ocellus was very small, faintly coloured, and only just visible.

Ectopleura dumortierii (van Beneden).

Ectopleura dumortierii, Hincks, 1868, p. 124, pl. xxi.

In 1895–96, not a single specimen was taken.

In 1897, the Medusa appeared at the end of April and disappeared early in October. Usually one or two specimens were taken on each day of tow-netting. On April 27th, nine specimens were taken; the smallest about 1 mm. in diameter, and the largest 4 mm. in length and 2½ mm. in width. Specimens with ova were taken in May.

In 1898, it was found from March to June; usually very scarce.

This Medusa is liberated from the rare Hydroid *Ectopleura dumortierii*, which has only been twice recorded: by Van Beneden at Ostend; and by Hincks, who found it on driftwood cast ashore at Point of Ayr, Isle of Man. The free-swimming Medusa has been taken at Heligoland (Hartlaub); St. Andrews (Crawford); Plymouth (E. T. B.).

Euphysa aurata, Forbes.

Euphysa aurata, Forbes, 1848, p. 71, pl. xiii.; Haeckel, 1879; Browne, 1896, P. Z. S., p. 474.

In 1895, during my visit in the spring, this Medusa was usually present in the tow-net. The smallest specimen measured ¾ mm. in length, and the largest about 3 mm.

In 1896, only two specimens were taken in August; one was quite an early stage, about 1 mm. in length, and the other an adult with ova. The Misses Delap sent me two immature specimens taken early in November.

In 1897–98, it appeared in April and disappeared in June. A solitary specimen was taken in September, 1897.

This Medusa never became abundant; usually only a few were specimens taken at one time.

It reaches maturity in May. The life-history of the species is still unknown.

Euphysa aurata may be distinguished from *Corymorpha nutans* by not possessing a pointed, cone-shaped process on the top of the umbrella; and from *Hybocodon prolifer* by not having the tentacular side of the umbrella longer than the opposite side, and by not possessing Medusa-buds.

Hybocodon prolifer, L. Agassiz.

Hybocodon prolifer, Agassiz, 1862; Allman, 1872; Browne, 1896, P. Z. S., p. 466.

Amphicodon amphipleurus, Haeckel, 1879, p. 37, Taf. i.

Amphicodon fritillaria et globosus, Haeckel, 1879.

In 1895, I arrived at Valencia about the time the Medusa was disappearing, and only a few specimens were taken during the first fortnight in April. All the specimens had reached maturity; some with ova upon the wall of the stomach, others with free Actinulæ inside the umbrella-cavity.

In 1897, a solitary specimen was taken on February 15th, with eight Medusa-buds upon the base of the large tentacle. Another specimen was taken on June 1st.

In 1898, none were seen.

The Medusa is liberated from the Hydroid *Hybocodon prolifer*, which has not yet been recorded in British seas. The Medusa, at first, has only one solitary tentacle, but later on develops two more, one on each side of the first tentacle.

The Medusa usually occurs in the spring, reaches maturity in April, and disappears early in the summer. Apparently it is not a common species at Valencia.

Lar sabellarum, Gosse.

Lar sabellarum, Allman, 1872; Hincks, 1872, p. 313, pl. xix.; Browne, 1896, P. Z. S., p. 468, pl. xvi., and 1897, p. 818, Woodcuts, 1–9.

Willsia stellata, Forbes, 1848, p. 19, pl. i.

This Medusa is liberated from the Hydroid *Lar sabellarum*, which has been recorded from only two localities—Ilfracombe (Hincks) and Plymouth (E. T. B.). The Hydroid colony forms a fringe round the tube of a Sabella; it is very minute, and, unless specially searched for, may be easily overlooked. The Medusa has been frequently recorded from several British localities, and is not uncommon in the summer.

At Valencia the Medusa was one of the common objects in the tow-net; it was nearly always present, but never in any great numbers. The youngest stage (with six tentacles, 1 mm. in diameter) was the most plentiful, only occasionally absent. It was taken every month, from July, 1896, to November, 1897, but was very scarce during the winter. Its presence in winter time is not conclusive evidence that the Hydroid liberates Medusæ all the year round. They may have been budded off late in the autumn, and remained at the first stage until the following spring.

The second stage (with twelve tentacles, umbrella about 2 mm. in diameter) has not been seen in the winter; it first appears in April.

The third stage (with eighteen tentacles, about 3 mm. in diameter) comes on in May.

The adult stage (with twenty-four tentacles, about 4–5 mm. in diameter) appears in July and remains until November.

To judge from the number of early stages taken, the principal period for the liberation of the Medusæ from the Hydroid is during the spring and summer.

Lizzia blondina, Forbes.

Lizzia blondina, Forbes, 1848, p. 67, pl. xii.; Browne, 1896, P. Z. S., p. 475.

In 1895, six specimens were taken at the end of May.

In 1897, two specimens found on June 9th.

I cannot account for the extreme scarceness of this Medusa at Valencia, and speculation is somewhat useless until its life-history is known. Its distribution extends from the Shetlands to Cornwall; it was very abundant off the Eddystone in September, 1897, and May, 1898.

This species may be distinguished from *Margellium octopunctatum* by the constant presence of four simple unbranched oral tentacles, each terminating in a single cluster of nematocysts. In *Margellium* the oral tentacles have at least two terminal and two lateral clusters of nematocysts.

Margelis autumnalis (Hartlaub).

Bougainvillia autumnalis, Hartlaub, 1897, p. 465, Taf. xv.

In 1896, six specimens were taken early in August. It was the only species of Margelis seen during my visit in the summer.

In the tow-nettings sent to me by the Misses Delap eight specimens were found early in November.

Margelis bella (Hartlaub),

Bougainvillia bella, Hartlaub, 1897, p. 470, Taf. xv.–xvi.

A solitary specimen taken in May, 1895, and two during August, 1897.

Margelis principis, Steenstrup.

Margelis principis, Haeckel, 1879, p. 88, Taf. vi.

Margelis britannica, Browne, 1896, Irish Naturalist, p. 180.

In 1895, this Medusa was not uncommon during April and May.

In 1897, only a few specimens taken during April and May.

The smallest specimen measured 1½ mm. in length. Oral tentacles twice branched. Four tentacles in each of the marginal groups.

The largest specimen measured 7 mm. in length and 8½ mm. in width. Oral tentacles five times dichotomously branched. 24–26 tentacles in each of the four marginal groups.

In large specimens the umbrella is globular, and about as long as wide. The stomach is on a broad but short peduncle; it has four large perradial lobes, which in some specimens reach over the top of the umbrella-cavity. Upon the sides of these lobes the gonads develop, and, when viewed from the top of the umbrella, they represent a short, thick, perradial cross.

The large compound tentacular bulbs are either epaulette-shaped or well curved; but in the intermediate stages the bulbs are only slightly curved. In these specimens the tentacular bulbs are not so large and not so much curved as in specimens taken at Plymouth and Port Erin.

The tentacular bulbs are of a dark brown colour, with longitudinal rows of pigment corresponding to the tentacles in position. The ocelli are large and black.

Dr. Hartlaub has recently published a revision of the genus *Bougainvillia* in his Report on the Hydromedusæ of Heligoland. I have here used Haeckel's generic name *Margelis* in place of *Bougainvillia*, as I prefer the latter name for those Medusæ which have been traced to Hydroids belonging to the genus *Bougainvillia*. Up to the present none of the Valencia species have been traced to Hydroid forms.

I believe the Valencia specimens belong to the species which I have called *Margelis principis* in my Report on the Medusæ of the Isle of Man (1895). But Hartlaub's revision causes me to reconsider the correctness of the former identification. If the exact position of the gonads is to be taken as one of the characteristic features in determining the species of this genus, then my specimens certainly do not agree with Haeckel's figures of the specimens in the Copenhagen Museum, collected by Streenstrup. It was the very large epaulette-shaped or crescent-shaped tentacular bulbs in the Port Erin specimens which led me to adopt the name of *M. principis*, for they corresponded with the figures given by Haeckel. As I have already used the name *M. principis* for these Medusæ with large epaulette-shaped bulbs, it will be best to continue the use of the name until the correct determination of the species has been made.

I have rarely seen specimens with the large epaulette-shaped tentacular bulbs, and it is probable that they represent this species, at its maximum growth, with the greatest number of tentacles.

Margelis pyramidata (Forbes and Goodsir).

Hippocrene pyramidata, Forbes and Goodsir, 1851, p. 312, pl. x.; Haeckel, 1879, p. 635.

In 1897, about twenty specimens were found in the tow-nettings taken during June and July.

The smallest specimen measured 2 mm. in width. Six tentacles on each of marg tacles twice dichotomously branched.

The largest specimen was 4 mm. in width. Eight tentacles on each marginal 3–4 times dichotomously branched. The in shape. The stomach is situated upon shaped peduncle. The gonads form na from the stomach, along the radial can the peduncle. The compound tentacula roundish; of a reddish orange colour in f In the early stages the peduncle is very was first found by Forbes and Goodsir Haeckel off Handa Island, west coast of

Margellium octopunctatum (Sars).

Lizzia octopunctata, Forbes, 1848, p. 64, pl.

Rathkea octopunctata, Haeckel, 1879, p. 97.

Margellium octopunctatum, Haeckel, 1879, P. Z. S., p. 479.

Margellium gratum, Haeckel, 1879, p. 95.

In 1895, during April and May this common object in the tow-net; it was ve middle of April. I was able to collect a mens, and to form a series, showing th Medusa from its earliest free-swimming growth. The Medusa at its maximum previously found in Europe, but only America, where it has been found and under the name of *Lizzia grata*.

In 1896, during my visit in the summ seen. I was surprised to see specimen sent to me by the Misses Delap, taken and November 6th. These specimens earliest stage, with Medusa-buds upon t stages of development. There appears swarm, which lasted about a fortnight. this species in the autumn, nor do I know It is common in the spring, and has a ve

In 1897, it first appeared in Janua May; it was very scarce early in the

March and April. A solitary specimen, with Medusa-buds, was taken on July 29th.

In 1898, it was taken in March; abundant in April, and finally disappeared in June.

Podocoryne carnea, Sars.

Podocoryne carnea, Hincks, 1868, p. 29, pl. v.; Allman, 1872, p. 349, pl. xvi.; Browne, 1896, P. Z. S., p. 463.

This Medusa is liberated from the Hydroid *Podocoryne carnea*, which is commonly found on shells of *Nassa*. The Hydroid was not taken at Valencia.

The Medusa was rarely found in the tow-net, and only on the following dates:—

1895. April 10th. A solitary specimen, with 8 tentacles.

1896. September 1st. A solitary specimen, with 8 tentacles.

1897. January 15th. A solitary specimen, with 7 tentacles.
February 15th. Two specimens.

All the specimens belonged to the earliest free-swimming stage.

Sarsia gemmifera, Forbes.

Sarsia gemmifera, Forbes, 1848, p. 57, pl. vii.

Codonium gemmiferum, Haeckel, 1879, p. 15.

A rather scarce Medusa at Valencia, and only taken on the following dates:—

1896. A few specimens in July and August; the largest 2–3 mm. in length. All had Medusa-buds upon the manubrium.

1898. A single specimen taken in June, and a few in July.

The distribution of this species ranges from the Shetlands to the English Channel, but it has not often been recorded.

Sarsia prolifera, Forbes.

Sarsia prolifera, Forbes, 1848, p. 59, pl. vii.; Haeckel, 1879, p. 18.

Syncoryne prolifera, Allman, 1871, p. 83, fig. 38.

In 1896, on July 18th, the first day of my using the tow-net, a few specimens were taken. The Medusa was present in the harbour until August 1st, but not abundant. On August 3rd and 4th not a specimen was seen; but on August 7th a great shoal arrived. Within half an hour I obtained over 300 specimens. By August 10th, the Medusa had again become scarce, and was last seen on August 15th.

The great shoal on August 7th was probably due to accumulation of specimens produced by rapid gemmation the increase of the number of sexual individuals. The s was probably formed off the coast early in August, and carried into the harbour by the tide. The rapid decrea remarkable; for within a week there was a complete di pearance.

The specimens taken in July were budding off Medusæ the basal bulbs of the tentacles, and the generative cells only just visible on the stomach of a few individuals. Ne all the specimens taken on August 7th possessed genera cells, and the Medusa-buds were either very small or absen

In 1897, it appeared in June and disappeared in Aug very abundant in July.

In 1898, it appeared in May and remained until Septeml

The distribution of this species is somewhat notewor Forbes first found it in Penzance Bay in 1846; and s then it has been recorded for Falmouth, Fowey, Plymo Jersey, and the Orkney Islands. The latter is a genuine re by Busch (1851), with a figure of the Medusa.

Sarsia tubulosa (Sars).

Sarsia tubulosa, Forbes, 1848, p. 55, pl. vi.; Haeckel, 1879, p.

In 1895, a few specimens occasionally taken during A and May.

In 1896, not present during my visit from July to Septem

In 1897, it first appeared in February and disappeare August. On April 24th, four specimens were taken, umbrella 9–10 mm. in length. On April 27th, a speci captured, which measured 8½ mm. in length and 8 mm width.

In 1898, it was taken from April to July. A fine speci was captured on May 23rd; the umbrella measured 9 mm length and width.

This species is well distributed throughout the British It reaches maturity about April or May.

Tiara pileata (Forskål).

Tiara pileata, Haeckel, 1879, p. 58, Taf. iii.

Oceania episcopalis, Forbes, 1848, p. 27, pl. ii.

In 1895, during my visit in April and May, a few young intermediate stages (smallest 5 mm. in length) were taken in the tow-net, and many fine large specimens caught swimming at the surface in a cove close to Doulus Head on May 21st. These large specimens showed considerable variation in the shape of the umbrella and in coloration. The apex or crown of the umbrella had five distinct shapes, ranging from a long narrow-pointed process, like a spike on the top of a helmet, to a large globe-shaped mass of jelly; the intermediate forms making connecting links between the extremes.

The colour of the stomach and tentacular bulbs in most of the specimens was reddish brown, in a few bright crimson, and in others a pale translucent brown, which is the usual colour of the younger stages. The largest specimens measured 20–28 mm. in length; one possessessed 38 tentacles.

In 1896, during my visit in the summer, a few specimens were taken in August. All belonged to the intermediate stages; the largest measured 10 mm. in length, and had 8 tentacles and 8 adradial bulbs.

In 1897, it first appeared in April and disappeared in October; abundant throughout the summer. The earliest stage, with two tentacles, was taken in April and October. Early in October some large specimens were taken, and measured 35–45 mm. in length and 20 mm. in width; also young stages about 5 mm. in length, and intermediate stages up to 20 mm.

In 1898, it appeared in March and disappeared early in November. It was not nearly so abundant as in 1897. Large specimens were again taken in October and early in November.

Hartlaub (1895) succeeded in rearing in an aquarium the Medusæ liberated from the Hydroid *Perigonimus repens* (in a later publication, 1897, the Hydroid name is changed to *P. vestitus*, Allman) to a stage sufficiently advanced to show its connection with the early free-swimming stages of *Tiara pileata*. Since then I also have reared Medusæ liberated from *Perigonimus* at the Plymouth Laboratory, and am able to confirm Hartlaub's observations.

There is a difference of opinion with regard to the names to be used for Medusæ liberated from Hydroids. At present there are two distinct systems of classification in use, one for the Hydroid forms, the other for the Medusæ. So long as the Medusa remains attached to its Hydroid it receives the Hydroid name; but directly it swims away on its own career it usually changes its name. This double system is useful in cases whe the Medusa has not yet been traced to its Hydroid; but whe once the connection has been firmly established, in my opinio the Medusa ought to be called by its Hydroid name, if tl latter has priority. My reason for not using the Hydroid nam in this case is due to some doubt which I have with regard the right specific name to be given to the Hydroid.

It does not come within the scope of the present Report enter into details concerning the different species of Peri nimus; but a revision of the genus is needed.

Order.—LEPTOMEDUSÆ.

Agastra caliculata (Hincks).

Hydroid form.

Campanularia caliculata, Hincks, 1868, p. 164, pl. xxxi.; Gia 1898.

Medusoid form.

Agastra mira, Hartlaub, 1897, p. 504, Taf. xxii.

Leptomedusa. Gen.? Sp.? Browne, 1897, P. Z. S., p. 8 pl. xlix.

Hartlaub first described the free-swimming Medusa under t name of *Agastra mira*, and his specimens were obtained Heligoland in 1895 and 1896, in the autumn.

At Valencia, in May, 1895, I found a single specimen of tl Medusa, and in August, 1896, three more specimens. These described and figured in the "Proceedings of the Zoologic Society" without giving a name, as I felt almost certain th these peculiar little Medusæ, without a stomach or tentacle must have been recently liberated from a Hydroid colony. F this reason I preferred to wait for the discovery of its Hydroi

Fortunately there has not been a long delay, as Giard h found the Hydroid *Campanularia caliculata* of Hincks abunda at Wimereux, and has been able to find Medusæ in the gon thecæ which agree with the description given by Hartlaub *Agastra mira*. As Giard points out, the genus *Campanular* is confined to certain Hydroids which do not possess Medus but have simple sporosacs. He has suggested the removal this species from the genus *Campanularia* to a new genu which he proposes to call *Agastra*, after the generic nam given by Hartlaub to the Medusa. Now I see no reaso for there being two specific names, one for the Hydroid and another for the Medusa, and according to the rules of nomenclature Hincks's name has priority.

Hincks states that the Hydroid is not common. It is recorded for Pegwell Bay, near Ramsgate; Dorsetshire; Ilfracombe; Kinsale, Co. Cork; Courtmasherry Harbour, Cork; and Jersey.

Dipleurosoma typicum (Boeck).

Dipleurosoma typica, Axel Boeck, 1866.

Dipleurosoma stuvitzii, Axel Boeck, 1866.

Ametrangia hemisphærica, Allman, 1873, "Nature," vol. ix., p. 73.

Dipleurosoma irregulare, Haeckel, 1879, p. 636.

Dipleurosoma typicum, Haeckel, 1879, p. 155.

Dipleurosoma hemispherica, Haddon, 1885; Browne, 1897, P.Z.S., p. 826, pl. xlviii.

In 1895, a solitary specimen was taken in April, and a few in May.

In 1896, only three specimens were taken during August.

In 1897, a single specimen was taken on June 30th, and on July 19th a great shoal appeared, and remained in the harbour until the middle of August. A great decrease took place early in September, and the final disappearance on October 9th. The smallest specimens were about 3 mm. in diameter, and the largest did not exceed 8 mm.

In 1898, it first appeared in May and disappeared in October. Abundant during June and July.

The few specimens taken in 1895 and 1896 showed that this Medusa had a very irregular radial canal system. Though I was able to identify the specimens as *Ametrangia hemisphærica* of Allman, yet I felt sure that the species had not been correctly described. Fortunately the Medusa was abundant in 1897 and 1898, so that the Misses Delap were able to send me a large number of specimens, which have enabled me to give a better description of the radial canal system, and to connect Allman's species with *Dipleurosoma typicum* of Boeck. Allman's specimens were taken on the south coast of Ireland, and the following is his description (from "Nature," 1873):—

"Umbrella hemispherical, about half an inch across the umbrella-margin. Tentacles more than a hundred, very exten-

sile, three to four inches long when fully expanded, s
when contracted. Each tentacle has a bulbous base,
a distinct ocellus. No marginal vesicles. Velum of mod
width. Manubrium forms a small projection from the su
of the umbrella, and terminates in four rather indistinct
From the base of the manubrium three wide canals are sen
at equal distances; these gradually contract in diameter,
finally enter the ring canal. The symmetry of the radi
canals is confined to these three primary trunks. From
wide proximal ends each sends off branches, some of which
be traced to the margin, where they join the ring canal, v
others end blindly in the substance of the umbrella.
branches are very irregular in number, length, and directio

The generative elements are formed in oval sporsacs, devel
one on each of the three primary canals at the spot wher
wider base passes into the narrow continuation. The
remain in the sac until the planula stage is reached.
planula breaks out of the sac and remains attached to
outer wall for some time. Nearly spherical in shape, it n
acquires cilia, and possesses little or no power of locomo
The gastric cavity is fully formed. Further development
known. Very abundant. South coast of Ireland."

Haeckel, in 1879, found a few specimens at Brighton,
noticed the variability of the canal system. In his "Sy
der Medusen" he has placed the species in the genus *Dip*
rosoma, under the name of *D. irregulare*, and gives Alln
A. hemisphærica as a doubtful synonym. The genus con
two other species, *D. typicum*, Boeck, and *D. amphithec*
Haeckel.

Haeckel's definition of the genus *Dipleurosoma* is as follow

"Cannotidæ, with six branched radial canals leavin
bilateral stomach in two opposite groups, three canals in
group, with irregular branches. The main canals and t
branches generally enter the ring canal. Six gonads on
undivided part of the main canals near the stomach."

This description is based on *D. amphithectum*, and no
D. typicum or *A. hemisphærica*.

D. amphithectum has a bilateral stomach with six main ca
The gonads are on these canals close to the stomach, and
lateral branches of the main canals are between the gonads
the ring canal.

I have made rough diagrams of the canal systems of 200 specimens taken in Valencia Harbour in 1897, and have selected twelve diagrams (figs. 1–12) to illustrate the irregular arrangement of the radial canals. These specimens clearly show that this species does not agree with Haeckel's definition of the genus *Dipleurosoma*. I do not wish to make a new genus for this species, especially as Boeck originally founded the genus *Dipleurosoma*; but Haeckel's definition must be ultimately altered and *D. amphithectum* removed to another genus.

NOTES ON THE VALENCIA SPECIMENS. (Plates XX., XXI.)

Stomach.—In the majority of the specimens the stomach is longer than it is wide, and the usual type is shown in fig. 3; but it may be triangular (fig. 4), or nearly round (fig. 5), or very irregular (fig. 11). In all the figures only the base of the stomach is drawn, so as not to make the diagrams too complicated. The walls of the stomach meet about the centre, and terminate in a mouth with four lips. Nearly all the specimens preserved in formalin have the mouth fully expanded, forming a simple ring.

I believe that the irregularly shaped stomach is due to the outgrowth of the radial canals, and to a subsequent outgrowth of the stomach itself. The base of the stomach has the appearance of ground glass, divided by a number of clear lines which meet about the centre. These transparent lines correspond in position with some of the large canals (figs. 8 and 11), and, I believe, mark the original position of the radial canals. The stomach has grown outwards and taken in a part of the radial canals. The enlargement, also, of the radial canals at their exit from the stomach is a process connected with the growth of the stomach, converting a portion of the canals into lobes of the stomach. Upon this outgrowth I base my views that all the radial canals leave either the stomach itself or a lobe of the stomach, and that the primary canals, in the young Medusa, are not subsequently branched, as in the figure given by Haeckel of *D. amphithectum.*

Radial Canal System.—At present I have no clue to the number and the position of radial canals in the earliest free-swimming stage. All the specimens belonged either to intermediate stages or to the adult form, mostly to the latter. The radial canal system may conveniently be divided into three types, which are not absolutely distinct, as a blending of the types occurs in some specimens.

(*a*) A roundish stomach, with four or more canals about equal distances apart.

(*b*) A triangular stomach, with three primary canals, one from each corner of the stomach, and the usual accessory canals, in different stages of development. (Allman's type.)

(*c*) An elongated stomach, with a canal at each end and two canals on each side; also with accessory canals. (Boeck and Haeckel's type.)

The number of radial canals leaving the stomach (including those which had not reached the ring canal) were counted in 217 specimens taken in 1897; the result is given in the following table:—

The number of Canals leaving the Stomach.	The number of Specimens.
5.	3.
6.	8.
7.	18.
8.	31.
9.	43.
10.	32.
11.	31.
12.	25.
13.	11.
14.	5.
15.	6.
16.	2.
17.	1.
18.	1.

I do not think that there is any tendency on the part of the Medusa to produce permanent blind canals, but that the aim of every canal on leaving the stomach is to unite with the ring canal. In two specimens I noticed a short canal running out from the ring canal and directed towards the stomach. As the radial canals are so irregular in number and position it is not possible, until the earliest stages have been seen, to express a definite opinion as to the normal type. Scarcely two specimens have the canals in exactly the same position, and they apparently develop in no definite order.

Generative Organs.—According to Haeckel's definition of the genus there ought to be six gonads; Allman gives only three. The Valencia specimens used in the above table show that the gonads may be upon all the canals, or only on a few; the number of gonads ranges from one to twelve, and five is the most frequent number. The females were in excess of the males in the proportion of about four to three. The ova remain attached to the ovary until the planula stage is reached.[1]

Distribution.—South-east coast of Norway (Boeck). Newfoundland (Stuwitz). South coast of Ireland (Allman); Kingstown Harbour (Haddon). Brighton (Haeckel).

Euchilota pilosella (Forbes).

Thaumantias pilosella, Forbes, 1848, p. 42, pl. viii.; Gosse, 1853. p. 334.

Euchilota pilosella, Browne, 1896, P. Z. S., p. 484.

In 1895, during April and May, three specimens were taken; one was an early stage, about 2 mm. in length; the others were adults, the largest 20 mm. in diameter.

In 1896, only a very early stage was taken in August.

In 1897, it first appeared in April and disappeared in October; abundant throughout the summer.

In 1898, it first appeared in July and disappeared in October; abundant during July and August. The largest specimen measured 22 mm. in diameter.

This Medusa is not uncommon on the British coasts during the summer.

Eutima insignis (Keferstein).

Eutima insignis, Haeckel, 1879, p. 192; Browne, 1896, P. Z. S., p. 492.

In 1896, it was only taken on three occasions during my visit in the summer; a single specimen on July 22nd and August 19th; and it was common just outside the harbour on August 10th.

In 1897, it was not seen by the Misses Delap.

In 1898, it only occurred in July. Four large specimens taken with ova along the whole length of the peduncle. Diameter of the umbrella 10–12 mm.

Under *Saphenia mirabilis* I have commented on the probable relationship of that Medusa with this species.

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[1] See footnote on page 696.

Laodice calcarata, Agassiz.

Laodice calcarata, Haeckel, 1879, p. 134; Browne, 1897, P. Z. S., p. 823, pl. xlix.

In 1895, three specimens were taken in April and three in July.

In 1896, five specimens were taken in July and August. On September 3rd we visited Puffin Island (a few miles south of Valencia), and there Mr. Gamble found a few specimens close to the rocks. On the two following days a small shoal entered Valencia Harbour, but soon disappeared. It consisted almost entirely of fine adult specimens, 20–27 mm. in diameter.

In 1897, it first appeared in May and disappeared in November. It was fairly common in August and September and again in November.

In 1898, it first appeared in June and disappeared in November; very abundant during July and August.

The specimens taken in 1896 were nearly colourless, but the largest specimens taken in 1897–98 had pinkish gonads. This species has not often been recorded in British seas.

Melicertidium octocostatum (Sars).

Stromobrachium octocostatum, Forbes, 1848, p. 30, pl. iv.

Melicertidium octocostatum, Haeckel, 1879, p. 136.

A solitary specimen was taken in the harbour by the Misses Delap on July 19th, 1898, and sent to me for identification. It measured 6 mm. in length and 4 mm. in width; the gonads were fairly well developed.

This species, I believe, belongs to our northern fauna, and occasionally drifts southwards. It was first taken by Sars off the Norwegian coast, and has been several times recorded off the Scottish coasts:—Bute (Forbes), Arran (Landsborough), St. Andrew's (M'Intosh), Cromarty Firth (Romanes). It was abundant in Lamlash Bay, in Arran, during August, 1897, when Messrs. Jenkinson and Montagu, of University College, London, found some fine specimens.

Greene (1857) has recorded it for Dublin Bay, and two specimens were taken by me at Port Erin in 1893. Forbes found it common in the bays on the north-west coast of Ireland in 1839. It has only once been recorded for the English Channel, at Falmouth, by Cocks (1849), when it was abundant in the summer.

Obelia nigra, sp. nov.

I have found this Medusa common at Valencia, Plymouth, and Port Erin, in the Isle of Man, but have not been able to trace it to any described species that I know of. For the time being, until its Hydroid has been traced, I propose to call it *Obelia nigra*, taking the black colour of certain basal bulbs of the tentacles as a specific character, by which it may be distinguished from the other species of the genus.

Description of an adult specimen:—

Umbrella slightly curved; stomach short, with a quadrangular base, and with a small cone-shaped (apical) process in the substance of the umbrella; mouth with four lips; eight marginal sense-organs, with a single otolith in each. Tentacles, 150–200. The basal bulbs of the tentacles are of two kinds; the majority are colourless, but others, varying in number and position, contain a dark brown or black pigment. There are usually six coloured basal bulbs in each quadrant; they are about twice the size of the colourless bulbs, and are situated on the inner side of the tentacles. The total number varies between 22 and 27. In some specimens, in addition to the completely coloured bulbs, there are bulbs only partly coloured, with just one or two small patches of colour. In one specimen 30 such bulbs were counted, but usually only two or three are present. They have the appearance of bulbs developing pigment. The gonads are globular in shape, and situated at about two-thirds the length of the radial canals from the stomach, but never on the inner half of the canal. Diameter of the umbrella, 4–5½ mm.

In 1895, at Valencia, this species was taken from April 15th till the termination of my visit at the end of May. It became very abundant after May 14th. In a tow-netting made on July 8th by the Misses Delap many specimens were found.

In 1896, it was present nearly throughout my visit in the summer. Up to August 24th it was by no means common, often very scarce. On August 28th, a great shoal entered the harbour, and over 500 specimens were preserved. They were mostly young specimens, but many adults were present. The shoal, decreasing in size, remained until September 14th, when the Medusa completely disappeared. In the tow-nettings sent by the Misses Delap I found the species again on September

30th, during October, and until November 13th; only a specimens in each tow-netting.

In 1897, the Misses Delap record the species in their from February to November. It was very abundant in and September.

In 1898, it appeared in March and disappeared in Novem very abundant in July and August.

A variation in the number of radial canals occurre only seven of the 450 specimens (taken on August 2 1898):—

One specimen with one canal and one radial gonad upon

Five specimens with three canals and three gonads.

One specimen with five canals and five gonads.

Other species of *Obelia* were taken; but as the specin were in formalin they were not identified.

Octorchis gegenbauri, Haeckel.

Octorchis gegenbauri, Haeckel, 1879, p. 171, Taf. xiii.; Brow 1896, P. Z. S., p. 494.

This Medusa has only been recently added to the Bri Fauna. A solitary specimen was taken at Plymouth in 1 and previous to that date it was only known in the M terranean.

In September, 1896, I took a young stage in Vale Harbour, and the Misses Delap fortunately captured two specimens in 1897, and sent them to me, along with g sketches from life for identification. As very little is kn about this species, a description of the Valencia specimens be of use.

September 21st, 1896. This specimen was not in good dition when captured, so that full details cannot be giv Umbrella about 6 mm. in diameter; manubrium about 6 mm length. Four perradial tentacles and four interradial bu from which tentacles probably develop later on. Many tuber on the margin of the umbrella, and probably each one wit lateral cirrus. Eight marginal sense-organs, each with ab 10–12 otoliths, arranged in a semicircle. Gonads present al the outer third of the radial canals on the sub-umbrella, also on the radial canals along the peduncle of the stoma but quite immature. The Medusa was perfectly colourl just like clear glass in water.

July 30th, 1897. An intermediate stage, with umbrella about 10 mm. in width and 7 mm. in length. Manubrium about 25 mm. in length. Mouth and stomach 2 mm. in length; mouth with four lips having a folded margin. Four very long perradial tentacles, but no traces of interradial tentacles. Marginal tubercles, 87, nearly every one with a single cirrus. Eight marginal sense-organs (otoliths not visible owing to the specimen being in formalin). Gonads present, about 4 mm. in length, on the outer half of the four radial canals on the sub-umbrella, but not extending to the margin. Gonads also present on the peduncle, about half-way down, about 5 mm. in length; one on each radial canal, side by side, forming an oval mass. The gonads on the sub-umbrella and on the peduncle of the stomach both contained immature ova.

September 11th, 1897. A fine adult specimen. Umbrella about 17 mm. in width and 11 mm. in length. Velum about 1½ mm. in width. Manubrium, contracted, 22 mm. in length; the base of the manubrium about 10 mm. in diameter, and having the appearance of a long funnel. Stomach and mouth about 3½ mm. in length. Mouth with four lips, which have a closely folded margin. Eight long tentacles of about equal size. About eighty marginal tubercles, nearly every one with a cirrus. Eight marginal sense organs (otoliths not visible). The gonads on the sub-umbrella start near the margin, extend over the top of the sub-umbrella cavity, and terminate a little way down the peduncle. Gonads are also present in the centre of the peduncle. Both sets contain ova; the ova on the sub-umbrella were less advanced than on the peduncle.

In my description of the species taken at Plymouth, in 1895 (P. Z. S., 1896), I stated—"On each of the four radial canals, about the middle of the peduncle, there is an oval mass of ova, and also a genital band probably containing spermatozoa, extending along the radial canals from the base of the peduncle nearly to the margin of umbrella." It appears from the Valencia specimens that the sexes are separate, but I have not yet seen the male. In the Plymouth specimen I recognised ova upon the peduncle, but could not find any on the sub-umbrella, where there was simply a homogeneous mass of cells resembling an immature mass of spermatozoa; but I am inclined now to regard it as an immature ovary.

The Valencia specimens show that the Medusa has at fir
four perradial tentacles, and that the four interradial tentacle
are of later growth.

Phialidium cymbaloideum (van Beneden).

Phialidium cymbaloideum, Browne, 1896, P. Z. S., p. 491, pl. xvii

In 1895, during April and May, a large number of specimen
were collected, and a series formed to show the development o
the Medusa from the earliest stage to the adult form.

In 1896, from July to September, the Medusa was ver
scarce. Nearly all the specimens belonged to intermediat
stages; a specimen of the earliest stage was taken on Augus
28th. Early in November the intermediate stages wer
abundant, but the Medusa was not taken in December. Th
appearance of the young and intermediate stages in the autum
shows that the Hydroid liberates Medusæ in the autumn a
well as in the spring.

In 1897, it first appeared in January and disappeared in
October.

On January 27th early stages were taken, and on February 2nd
a large specimen, 7 mm. in diameter, which probably came from
the autumn stock of the previous year. Early in March
the earliest and intermediate stages were abundant; a slight
decrease occurred in April, but during May and June the
number again increased, so that in July the Medusa became
very abundant, both intermediate and adult specimens being
present. After a rapid decrease in September the Medus
finally disappeared in October. Apparently there was n
autumn brood as in the previous year.

In 1898, the Medusa first appeared in March and disappeared
in October. It never became abundant at any time during the
summer.

This Medusa is probably liberated from a Hydroid belonging
to the genus *Campanulina*, so that the abundance of the Medusa
and its first appearance depend upon the breeding activity of
the Hydroid. It is a very common British species, and may be
distinguished by its thick umbrella, and by the presence of only
eight marginal sense organs which have more than one otolith
in each. The youngest stage has four tentacles and four mar-
ginal sense organs; but the presence of at least two otoliths in
each sense organ distinguishes this species from the young

stages of other species. Another point, which may often help to determine the species (especially when the specimens are in alcohol or formalin and the sense organs are not visible), is the presence of four interradial black pigment spots at the base of the stomach, visible when looking down upon the top of the umbrella. These black spots are occasionally not present, and sometimes very faint, so that they cannot be relied upon as a specific character.

Phialidium temporarium, Browne.

Phialidium temporarium, Browne, 1896, P. Z. S., p. 489, pl. xvii.

In 1895, during April and May this species was present in nearly every tow-netting, especially the young stages; but it never became really abundant. The adult form was taken in May; the largest specimen measured 20 mm. in width and 11 mm. in height, with 38 tentacles and 1–3 marginal sense-organs between every two tentacles. The average size of the adult is 10–15 mm. in width, with about 32 tentacles and 1–2 sense-organs between the tentacles. In this species there is one otolith in each sense-organ; two otoliths sometimes occur as a variation, but are never present in all the sense-organs.

In 1896, it was a common object in the tow-net during my visit in the summer. Most of the specimens were adults; the early stages were not taken. The specimens of *P. temporarium* taken in 1895 were of the usual yellowish brown colour, and a few were reddish brown. In 1896 I found brilliantly coloured specimens more numerous than those of the normal colour. The basal bulbs of the tentacles were of a bright orange colour; the gonads and the lips of the mouth faintly coloured with purple, and the stomach of the usual yellowish brown colour. A single specimen was taken with the basal bulbs of the tentacles and the gonads of a brilliant reddish purple.

In 1897, the Medusa first appeared in February and disappeared in November. It was common throughout the summer and abundant in September and October. Young stages were plentiful in the spring, and the purplish-coloured specimens in May.

In 1898, it first occurred in March and disappeared in October. Common throughout the summer; abundant in August.

This is one of the commonest of the British Medusæ, and is probably liberated from the Hydroid *Clytia johnstoni*. I have

found it necessary to give a new specific name to this spe
so as to make sure of its identity and to save further trou
as the literature connected with the two genera *Thauma*
and *Phialidium* is in a hopeless state of confusion, ma
brought about by the early observers not recording
marginal sense organs. The same set of Medusæ are descr
in two distinct families by Haeckel—Thaumantidæ (s
organs without otoliths) and Eucopidæ (sense organs w
otoliths). The early and the intermediate stages have
been classified into distinct genera and species, which
divided between the two families.

Polycanna forskalea (Forbes).

Æquorea forskalea, Forbes, 1851, P. Z. S., p. 272, pl. iv.

Polycanna forskalea, Browne, 1897, P. Z. S., p. 828.

In 1896, a single specimen was found on September 4th, on the following day five specimens were taken in a hand- and others seen swimming too deep down to be captured. September 7th another specimen was taken. These specim have been fully described in the P. Z. S., 1897.

In 1897, eighteen specimens were taken by the Misses D on July 26th; the largest about 40 mm. in diameter. ' specimens were taken on July 30th and one on August 7th.

In 1898, specimens were taken on the following dates:—

July 25th. Two specimens; largest about 65 mm.
July 30th. Three specimens.
August 23rd. Two specimens; largest about 130 mm.
October 11th. Two damaged specimens.
November 5th. One large specimen of a bright pink colour.

The specimens taken in 1896 agreed with the descrip given by Forbes for a Medusa which he called *Æquorea forsk* (Peron), and found by him in the Outer Hebrides. I think the descriptions given by the writers previous to Forbes rather incomplete, and for the present I prefer to call species *P. forskalea* (Forbes), and to leave the questio priority for further investigation.

Greene (1858) has recorded an *Æquorea* (sp.?) for Dublin and for several places on the south-west coast of Ireland w it occurred in considerable numbers. From the descrip given it appears to be a young stage (umbrella not excee an inch in diameter) of an *Æquorea* or a *Polycanna*.

Medusæ belonging to the Polycannidæ have rarely been taken in British seas.

Saphenia mirabilis (Wright).

Saphenia mirabilis, Haeckel, p. 192; Browne, 1896, P. Z. S., p. 493, pl. xvii.

In 1895, two specimens taken at the end of May; one 4 mm. in diameter, the other 9 mm.

In 1896, from July to September, only a few specimens taken. The smallest 3 mm. in length and width; the largest 10 mm. in width and 8 mm. in length.

In 1897, none seen.

In 1898, six specimens taken in July. The smallest 7 mm. in width; the largest 13 mm. in width and 9 mm. in length.

Some of the specimens had generative cells along the whole length of the peduncle.

One specimen with ten marginal sense-organs instead of the normal eight. Two specimens with marginal bulbs containing black pigment in the centre; usually the bulbs are colourless.

In three hauls with the tow-net, taken on August 10th, 1896, just outside Valencia Harbour, I found four specimens of *Saphenia mirabilis* and seven specimens of *Eutima insignis*. These two genera agree in every important detail, with the exception of the number of tentacles. *Saphenia* has two (opposite) tentacles and *Eutima* has four tentacles. Among these specimens some were of the *Saphenia* type, and some of the *Eutima* type; but others showed a difference in the size of the four tentacles. They had two long opposite tentacles and two tentacles much smaller, varying in length in the different individuals. I have two series of specimens taken at Plymouth, and another series taken at Valencia, in 1898, which show the same thing. In some of the specimens one pair of tentacles is just developing, whilst the opposite pair are very long. This leads me to believe that *Eutima insignis* is really the adult form (showing the maximum growth) of *Saphenia mirabilis*, though the latter may have ripe gonads.

This species is not uncommon in the British seas, and usually occurs in the summer months.

Tiaropsis multicirrata (Sars).

Tiaropsis multicirrata, Haeckel, 1879, p. 179.

In 1895, two specimens taken in April; both ver stages, about 1 mm. in diameter.

In 1897, a solitary young stage taken in April.

This Medusa appears to be very rare at Valencia; b not uncommon in other parts of the British area.

Greene (1857) has recorded it for Belfast under the n *Thaumantias pattersoni*.

It is not uncommon at Port Erin, Isle of Man, in the

Vallentin (1897) found this species very abundant in Fa Harbour during May and June, 1895. "The sea, in protected places in the harbour, was almost solid with exa

Order.—TRACHOMEDUSÆ.

Aglantha rosea (Forbes).

Circe rosea, Forbes, 1848, p. 34, pl. i.

Aglantha rosea, Browne, 1897, P. Z. S., p. 833, pl. xlix.

In 1895, only a few specimens were taken during Ap May. The Misses Delap sent me a specimen in Jul informed me that it was abundant during September.

In 1896, a solitary specimen was taken on Januar During my visit in the summer it was by no means comr

In 1897 and 1898, not a single specimen was seen.

Aglantha rosea has eight marginal sense-organs, whic tinguish it from *A. digitalis*, with only four sense-organ

This species has been recorded from Shetland Islan Andrew's, and Heligoland. It is an inhabitant of the A Ocean, and an occasional visitor to our shores.

Liriantha appendiculata (Forbes).

Geryonia appendiculata, Forbes, 1848, p. 36, pl. 5.

Liriantha appendiculata, Haeckel, 1879; Browne, 1896, P. p. 495.

Only a few young stages were taken in August and N ber, 1896, and in November, 1897.

It is an Atlantic Medusa which occasionally visit British coasts. It was first taken by Forbes in the E Channel in 1846. I found it very abundant at Plymo 1893, but scarce in 1897.

Gossea circinata, Haeckel.

Gossea circinata, Haeckel, 1879, p. 252, pl. xviii.

To the numerous tow-nettings taken by the Misses Delap we are indebted for the addition of this very rare Medusa to the Valencia fauna. It was first taken on October 24th, 1898, when two specimens were secured and sent to me for identification. On October 29th nine, and on November 9th twelve specimens were taken, and many seen too deep down to be captured. All these specimens, well preserved in formalin, were sent to me for examination; but before giving an account of them, it will be well to state briefly what has already been published on the genus.

According to Haeckel, the genus *Gossea* contains only two species—*G. corynetes* of Gosse, and *G. circinata* of Haeckel—and neither of these species has been recorded since its first discovery. Gosse found his specimens at Ilfracombe (Devonshire) in September and October, 1852. He has given a good description of the species, with coloured figures, in his well-known book, "A Naturalist's Rambles on the Devonshire Coast." Gosse placed his new species temporarily in the genus *Thaumantias*, which in those days contained a miscellaneous group of species now dispersed among many genera.

Louis Agassiz (1862), having recognised its true position, made for it a new genus, *Gossea*, named after its discoverer. I have two reasons for writing on Gosse's species; first, because it may ultimately be proved to be an early stage of *G. circinata;* and, secondly, because Haeckel has changed Gosse's description of the species to such an extent that he makes really another species of it.

Gosse described the Medusa with twenty-four tentacles, "arranged in eight bundles of *three* each, at the points of junction of the four radiating vessels, and midway between them. One in each group is minute and rudimentary." In notes on some more specimens, taken a few weeks later, Gosse states:—"The subsidiary tentacle in each group of three was less disproportionately small in these specimens." With the exception of the grouping of the tentacles *G. corynetes* agrees fairly well with the description of *G. circinata*, so that there is need to give a further account from Gosse.

Haeckel, in his "System der Medusen," has altered Go description in the following manner:—Sixteen large c shaped tentacles, in eight groups of *two* each. Between t twenty-four sense-organs (eight adradial groups of three e and eight short and delicate spiral tentacles. It will be that Haeckel has removed the smallest tentacle from each g and placed it alone by itself. Gosse clearly states that the t tentacles are close together, and his excellent illustrations f bear out his description.

The examination of the Valencia specimens throws light the subject, and shows that the position of the tentacl regulated by the order of their development.

Gossea circinata is distinguished from *G. corynetes* by Hae by possessing eight groups of three tentacles in each, and s spiral tentacles, one about midway between every two gro If Haeckel had kept strictly to Gosse's description of *G.* *netes*, then both species would have been alike in the nu of tentacles in each group, and the difference would have in the additional eight single solitary tentacles found *G. circinata*.

The following is an abstract of Haeckel's description of *G* *circinata*:—Umbrella semicircular, a little broader than h Stomach one-third as long as the length of the umbrella; m with four crenated lips. Gonads club-shaped swellings o pying about two-thirds of the radial canals, and leaving ends free. Twenty-four large club-shaped tentacles, in e groups of three each; between them twenty-four marg sense-organs (eight adradial groups of three each). Eight s and small spiral tentacles.

Some of the Valencia specimens agree fairly well w Haeckel's description, but others show that more short tenta are developed upon the margin of the umbrella. None, h ever, correspond to the specimens taken by Gosse; and for reason I have kept the two species apart for the present, tho I am strongly of opinion that Gosse's specimens are a st younger than those described by Haeckel. Some of the Valen specimens are a stage older than Haeckel's specimens. If size of a tentacle is regulated by its age, then the order of growth of the tentacles can be demonstrated. In each group tentacles are of different sizes—large, medium, and small; same order existing in all the groups. The eight large tentac represent the primary series, and tend to show that the Medusa at a very early stage has only eight simple tentacles (four perradial and four interradial); then the second series develops, forming eight groups of two tentacles each; and a little later, a third series appears, forming three tentacles in each group (Gosse's *G. corynetes*). The next series consists of eight isolated adradial tentacles, separated from the groups by sense-organs, and about midway between the groups (Haeckel's *G. circinata*). Some of the Valencia specimens, as already stated, have other very minute tentacles, which are irregular in position, and usually separated by sense-organs from the other tentacles. One specimen had as many as ten just budding out, without bands of nematocysts. All the tentacles are built on the same principle, differing only in size and in the number of rings of nematocysts upon them. In the largest tentacles about fifty conspicuous circular bands of nematocysts are present, and a large terminal cluster; in the smaller tentacles only one or two bands are usually present. The tentacles, when partly contracted, have the appearance of clubs, as figured by Gosse; hence his specific name.

The sense-organs are not very regular in position. There are either two or three together in a group; but the groups become separated in some of the specimens by the development of the tiny tentacles. The number of sense-organs is not quite constant. I counted twenty-nine in one specimen, and they were divided into the following groups by the tentacles:—3, 4, 4, 4, 2, 4, 4, 4. In another specimen, with twenty-four sense-organs, the numbers ran thus:—3, 3, 3, 4, 3, 3, 2, 3. Each sense-organ contained a single otolith.

The smallest specimen measured 5 mm. in length and 7 mm. in width; the largest 8 mm. by 12 mm.

The Misses Delap inform me that this Medusa is a strong and rapid swimmer. The colour of the stomach is greenish; the mouth, gonads, and tentacles pinkish.

Haeckel found his specimens at Croisic, near St. Nazaire, South Brittany.

NARCOMEDUSÆ.

Solmaris corona (Keferstein and Ehlers).

Ægineta corona, Keferstein und Ehlers, 1861, p. 94, Taf. xiv., figs. 7

Solmaris corona, Haeckel, 1879, p. 358.

In 1895, three specimens were taken in July by the Mis Delap.

In 1896, only a solitary specimen in a damaged conditi was taken on July 17th.

In 1897, it first appeared in July, and disappeared in Nove ber; very abundant from July to the middle of September.

In 1898, it first appeared in July and disappeared in Nove ber; abundant during July and September.

Although the Valencia specimens do not agree in every det with the description given of *Solmaris corona*, yet the rese blance is so close that I do not feel justified in adding a n species to the genus.

The specific characters are mainly based upon the number sense-organs upon each lobe on the margin of the umbrel upon the shape of the lobe; and upon the number of tentacl All of these organs increase in number with the growth of t Medusa.

The following are the principal characters of *S. corona* tak from Haeckel's monograph:—

Umbrella three to four times as broad as high (14 m broad, 4 mm. high). 27–30 lobes on the margin of the u brella; nearly rectangular, twice as long as broad. Geni band, simple, smooth; in the outer half of the lower wall the stomach. 27–30 tentacles, twice as long as the diame of the umbrella. 60–80 sense organs (2–3 on each lobe).

The specimens sent to me were difficult to work upon, owi to the contraction and curling up of the lobes of the umbre and the disappearance of most of the sense-organs in the f malin; but some diagrams and sketches, made by the Mis Delap from living specimens, helped me considerably in t determination of the species.

In taking the diameter of the umbrella as a guide to the s of the specimens, the following table shows that an increase the number of lobes, tentacles, and sense-organs takes pla along with the growth of the Medusa:—

Diameter of Umbrella, mm.	Number of Tentacles and Lobes.	Number of Sense-organs on each Lobe.
2-3.	12–16.	1.
4.	15–18.	
5.	17–29.	1–2.
6.	21–29.	1–3.
7.	22–30.	
8.	30.	
10.	36.	
12.	25–35.	

A comparison of the Valencia specimens with the description given by Haeckel, shows that the umbrella is a little smaller, and that there are a few more lobes and tentacles. The lobes are not twice as long as broad, but only slightly longer. The lobes increase in number by longitudinal division, so that they are not all of the same shape, some being much broader than others. The sense-organs were of a pale yellowish colour; they varied from one to three in number on each lobe, but more than three together were never seen. The genital band agreed with Haeckel's description. In most of the specimens it was on the outer half of the stomach, but in a few it extended over the outer two-thirds. In specimens about 3 mm. in diameter the generative cells were just visible, and nearly ripe in specimens of about 6 mm. in diameter.

Solmaris corona has only been recorded from Naples.

ACRASPEDA.

Order.—DISCOMEDUSÆ.

Aurelia aurita (Linn.).

In 1895, a few adult specimens were seen during June.

In 1896, a single Ephyra was taken on February 14th. The adult form was not seen in the harbour during the year. (Miss C. Delap saw a great quantity of large adult specimens off Fenit Pier, Tralee Bay, in May.)

In 1897, six Ephyræ were taken on January 14th, and a few in February. Some adult specimens seen in the harbour during July.

In 1898, a few Ephyræ taken in February and March. Adult specimens seen from May to August; only a few at a time, and usually in a damaged condition.

The scarceness of the Ephyræ during the spring seems to indicate that the Scyphistoma stage is either absent or very scarce in the harbour.

Chrysaora isosceles (Linn.).

In 1895, very abundant in the harbour from the middle of June to the middle of July. Some about 9 inches in diameter.

In 1896, none seen.

In 1897, four specimens seen on July 27th.

In 1898, a few damaged specimens seen during July and August.

Cyanea lamarckii, Peron et Lesueur.

In 1895, during the early part of August the harbour was full of large specimens.

In 1896–97, none were seen.

In 1898, about a dozen damaged specimens seen on August 23rd and 24th.

Pelagia perla (Slabber).

Pelagia cyanella, Forbes, 1847, p. 390, pl. ix.

In 1895, none seen.

In 1896, on July 23rd, August 31st, and September 4th shoals entered the harbour; on the latter date very abundant.

In 1897, shoals arrived in July, August, and November.

In 1898, none seen.

Pelagia floats in with the tide, swimming close to the surface, as the tide recedes large numbers are usually left stranded on the shore.

The umbrella is a little broader than high, about 2½ to 4 inches in diameter. The buccal arms about 2½ to 4½ inches in length. The tentacles are about 4 inches in length when contracted, but are capable of extending to several feet. Colour usually purplish, occasionally brownish purple or pale mauve.

Pilema octopus (Linn.).

Rhizostoma pulmo, Forbes, 1848.

Pilema octopus, Haeckel, 1879.

In 1895, a specimen was seen by the Misses Delap on October 10th. It was swimming fast against the tide. Umbrella about 2 feet in diameter; the combined length of the umbrella and arms about 4 feet. The colour of the umbrella was pale green, with a deep reddish margin. Arms bright blue.

In 1896, a specimen was captured by Mr. F. W. Gamble on September 1st, between Bray Head and Puffin Island. Mr. Gamble informs me that slightly over a hundred young Horse-Mackerel (*Caranx trachurus*) were seen sheltering under the umbrella. When first seen the little fish formed a zone as they hovered round the Medusa. On the capture being made with a bucket the fish were found hidden away in the sub-genital pouches. The size of the fish varied from 16 to 45 mm. in length; they were sent to Mr. E. W. L. Holt for identification (Holt, 1895, Journ. Mar. Biol. Assoc., p. 119 and p. 340). The association of young fish with *Rhizostoma* has been noticed by Gadeau de Kerville (1894) at Granville. The same species of fish was also found by him. Some other specimens of *Rhizostoma* were seen off the mouth of the harbour early in September by Mr. W. I. Beaumont. Some of these were also accompanied by little fish.

In 1897–98, none were seen.

REFERENCES.

AGASSIZ, L.—1862. Contrib. Nat. Hist. U.S.A., vol. iv. (Boston.)

ALLMAN, G. J.—1871–72. Monograph of the Gymnoblastic Hydroids. Ray. Soc.

1873. On some Recent Results with the towing-net on the South Coast of Ireland. Nature, vol. ix., pp. 73–74.

BOECK, A.—1866. Vidensk. Meddel., pp. 131–140. (Copenhagen.)

BROWNE, E. T.—1896. On British Hydroids and Medusæ. Proc. Zool. Soc., pp. 459–500, pls. xvi., xvii. (London.)

1896. The Medusæ of Valencia Harbour, County Kerry. Irish Naturalist, pp. 179–181. (Dublin.)

1897. On British Medusæ. Proc. Zool. Soc., pp. 816–835., pls. xlviii., xlix.

1898. On the Pelagic Fauna of Plymouth for September, 1897. Jour. Mar. Biol. Assoc., vol. v., pp. 186–192. (Plymouth.)

FORBES, E.—1847. Ann. Nat. Hist., vol. xix., p. 390, pl. ix. (London.)

1848. British Naked-Eyed Medusæ. Ray. Soc.

1851. On a Species of Æquorea inhabiting the British Seas. Proc. Zool. Soc., pp. 272–275, pl. iv.

Forbes, E., & Goodsir. J.—1851. On some rare and remarkable Ma Invertebrates, new to British Seas. Trans. Roy. Soc. E vol. xx., pp. 307–315, pls. x., xi. (Edinburgh.)

Giard, A.—1898. Sur l'éthologie du *Campanularia caliculata*, Hin Comptes rendus, Soc. Biol. Paris (10), T. 5, No. 1, pp. 17-20

Gosse, P. H.—1853. Naturalist's Rambles on the Devonshire C (London.)

Greene, J. R.—1857. On the Acalephæ of Dublin Coast. Nat. I Rev., vol. iv., pp. 242–250, pls. xiv., xv. (London.)

Haddon, A. C.—1885. Prelim. Report on the Fauna of Dublin I Proc. Roy. Irish Acad., ser. 2, vol. iv., pp. 523–531. (Dubli

1886. First Report on the Marine Fauna of the South-west of land. Proc. Roy. Irish Acad., ser. 2, vol. iv., pp. 599–638.

Haeckel, E.—1879. Das System der Medusen. (Jena.)

Hartlaub, C.—1894. Cœlenteraten Helgolands. (Arbeiten I Anstalt Helgoland.) Wiss. Meeresuntersuchungen, Bd. i., 161–206. (Kiel.)

1895. Die Polypen und Quallen von *Stauridium productum Perigonimus repens*. Zeitschr. f. wiss. Zool., Bd. lxi., pp. 142– Taf. vii.–ix. (Leipzig.)

1897. Die Hydromedusen Helgolands. Wiss. Meer., Bd. ii., 449–512, Taf. xiv.–xxiii. (Kiel.)

Hincks, T.—1868. British Hydroid Zoophytes. (London.)

1872. On the Hydroid *Lar sabellarum*, Gosse, and its Reproduc Ann. Nat. Hist., ser. 4, vol. x., p. 313, pl. xix. (London.)

Keferstein, W. und Ehlers, E.—1861. Zool. Beitrage gesammelt in Neapel und Messina. (Leipzig.)

Patterson, R.—1859. On a new Naked-Eyed Medusa. Proc. Du Univ. Zool. and Bot. Assoc., vol. i., p. 279.

Templeton, R.—1836. A Catalogue of Species of Rayed Animals fo in Ireland, as selected from the Papers of the late R. Temple &c. Mag. Nat. Hist., vol. ix., pp. 301–305, 417–422. (Lond

Vallentin, R.—1897. Notes on the Fauna of Falmouth for the y 1895–96. Journ. Roy. Instit. Cornwall, vol. xiii., p. (Truro.)

University College, London,

June 6th, 1899.

To face page

I. Ve "Arabic" figures show the actual number taken.

	May.											
	3	6	8	9	10	13	14	17	21	22	24	27
Corymorp	III	III	III	III	III	III	VI	III	II	II	II	I
Hybocodo	..	..	..	..	..	..	..	..	..	..	..	..
Margelliu	III	III	..	..	..	..	III	..	III	III	III	..
Tiaropsis	..	..	..	..	..	..	..	..	..	..	..	..
Phialidiu	III	III	III	III	III	III	IV	IV	III	III	III	III
Phialidiu	IV	III	III	II	III	III	II	IV	V	II	III	III
Lar sabell	III	III	..	..	..	V	III	..	..	IV	..	III
Margelis	IV	..	II	..	(1)	(1)	..	(1)	(1)	..	..	I
Tiara pile	..	(2)	II	(2)	..	..	II	(1)	III	II	..	..
Podocory	..	..	..	..	..	..	..	..	..	..	..	..
Dipurena	..	..	..	..	..	..	..	..	..	..	..	..
Cytæandr	..	..	..	..	..	..	(1)	..	..	..	..	..
Obelia ni	III	III	III	..	..	..	VII	VII	VI	VII	VII	VII
Sarsia tul	..	(1)	..	..	..	I	III	..	..	(1)	I	I
Euphysa	III	(1)	II	(1)	..	II	III	III	III	III	IV	IV
Laodice c	..	..	..	..	..	..	..	..	..	..	..	..
Euchilota	..	..	..	..	..	..	(1)	..	..	..	..	..
Dipleuros	..	..	(2)	..	..	II	III	II	..	..	I	..
Aglantha	..	..	..	(1)	..	..	I	I	..	II	(1)	..
Margelis	..	..	(1)	..	..	..	..	..	..	..	..	..
Lizzia bl	..	..	..	..	..	..	..	..	..	..	(2)	(4)
Saphenia	..	..	..	..	..	..	..	..	..	..	(1)	(1)
N	8	9	9	6	4	8	13	9	8	10	11	10

I. V
o " figures show the actual number taken.

			September.								
	28	31*	1	2	4*	5*	7	10	14	18	21
Sarsia pro	..	..	..	..	..	..	..	..	..	..	..
Dipurena	..	..	..	(1)	..	..	(1)	..	..	..	(1)
Cytæandr	..	..	..	..	..	..	..	..	..	..	..
Solmaris	..	..	..	..	..	..	..	..	..	..	..
Phialidiu	I	..	II	III	..	..	(1)	(3)	III	..	IV
Phialidiu	(4)	..	..	..	..	..	..	..	..	..	III
Obelia ni	II	..	V	VI	..	.	IV	V	IV	..	..
Laodice c	..	..	..	..	VII	IV	..	..	..	..	..
Pelagia p	..	VI	..	..	..	..	..	..	..	..	..
Sarsia ge	..	..	..	..	..	..	..	..	..	..	..
Eutima ir	..	..	..	..	..	..	..	..	..	..	..
Saphenia	..	..	..	..	..	..	..	..	(1)	..	..
Aglantha	(2)	..	..	(1)	..	..	..	..	..	..	III
Lar sabell	V	..	IV	III	..	..	(3)	I	(1)	I	IV
Dipurena	..	..	..	..	..	..	..	..	..	..	(1)
Corymorp	..	..	..	..	..	..	..	..	..	..	..
Amphiner	..	..	..	(1)	..	..	..	..	..	..	..
Margelis	..	..	..	..	..	..	..	..	..	..	..
Liriantha	..	..	..	..	..	..	..	..	..	..	..
Euchilota	..	..	..	..	..	..	..	..	..	..	..
Euphysa	..	..	..	..	..	..	..	..	..	..	..
Dipleuro	..	..	..	..	..	..	..	..	..	..	..
Tiara pil	..	..	..	..	..	..	..	..	..	..	..
Podocory	..	..	(1)	..	..	..	..	..	..	..	..
Polycann	..	..	..	..	(1)	(5)	(1)	..	..	..	..
Octorchis	..	..	..	..	..	..	..	..	..	..	(1)
Numbe	5	..	4	6	..	..	5	3	4	1	7

ea.
* Tow-nettings not taken on these dates.

To f

ecember, 1898.

	n.	1897–1898. Winter.			1898. Spring.			1898. Summer.			1898. Autumn.			'98 W.
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
L	×	..	..	..	×	×	×	×	×	×	×	×	×	×
Ol	×	..	..	..	×	×	×	×	×	×	×	×	×	..
Pl	..	..	..	..	×	×	×	×	×	×	×	×	..	..
Pl	×	..	..	..	×	×	×	×	×	×	×	×	×	..
Ti	..	..	..	..	×	?	×	×	×	×	×	×	×	..
M	..	..	..	..	×	×	×	×	..	..	..	..	..	..
Co	..	..	..	..	×	×	×	×	×	×	..	..	..	..
Ec	..	..	..	..	×	×	×	×	×	..	..	..	..	..
Sa	..	..	..	..	..	×	×	×	×	..	..	..	..	..
H	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ti	..	..	..	..	×	..	..	..	..	..	..	..	..	..
E	..	..	..	..	..	×	×	×	..	..	..	..	..	..
Eu	..	..	..	..	..	..	..	..	×	×	×	×	..	..
Di	..	..	..	..	..	×	..	×	×	..	..	..	×	..
Di	..	..	..	..	..	..	×	..	..	..	×	..	..	..
Sa	..	..	..	..	..	..	×	×	×	×	×	..	..	..
Di	..	..	..	..	..	..	×	×	×	×	×	..	..	..
L	×	..	..	..	..	..	..	×	×	×	×	×	×	..
Sc	×	..	..	..	..	..	..	..	×	×	×	×	×	..
A	..	..	..	..	..	..	..	..	×	×	×	×	..	..
P	..	..	..	..	..	..	..	..	×	×	..	×	×	..
S	..	..	..	..	..	..	..	×	×	..	..	..	..	..
S	..	..	..	..	..	..	..	..	×	..	..	..	..	..
E	..	..	..	..	..	..	..	..	×	..	..	..	..	..
O	..	..	..	..	..	..	..	..	..	..	..	..	..	..
O	..	..	..	..	..	..	..	..	×	..	..	..	..	..
[illegible]	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[illegible]	..	..	..	..	..	..	..	..	×	..	..	..	..	..
[illegible]	..	..	..	..	..	..	..	..	..	..	×	..	..	..
[illegible]	..	..	..	..	..	..	×	..	..	..	..	..	..	..
[illegible]	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[illegible]	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[illegible]	×	..	..	..	..	..	..	..	..	..	..	..	..	..
A	..	..	..	..	..	..	..	..	..	..	..	..	..	..
G	..	..	..	..	..	..	..	..	..	..	..	×	×	..
A	..	..	..	×	×	..	×	×	×	×	..	..	..	..
E	×	..	..	..	..	..	..	..	..	..	..	..	..	..
C	..	..	..	..	..	..	..	..	×	×	..	..	..	..
C	..	..	..	..	..	..	..	..	..	×	..	..	..	..
[illegible]	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	7	..	..	..	10	10	15	16	23	16	13	11	9	1

III.—REPORT ON THE FREE-SWIMMING COPEPODA (1895–98).

BY ISAAC C. THOMPSON, F.L.S.

THE collection of material from which this Report is compiled consisted of ninety-six bottles of Plankton taken by surface tow-net on ninety-six separate days during the years 1895 to 1898, by the Misses Delap, of Valencia Island, and by Mr. E. T. Browne, of University College, London. During the summer of 1896, Mr. Browne had as companions Mr. A. O. Walker, F.L.S., of Colwyn Bay, and Mr. F. W. Gamble, of Owens College, Manchester. Both of these gentlemen have kindly sent me material they collected by tow-net, and it is included in the present Report.

All the material collected for examination was immediately preserved in formalin. A 5 per cent. solution appears to be the strength best suited for these delicate Crustaceans, and is probably as efficient a preservative as is known.

The free-swimming Copepoda of our coasts vary in size from 1 mm. to 4 mm. in length. The mode of examination which I have found the best and quickest is as follows:—After carefully shaking the material in the bottle, a quantity is poured into a shallow open glass plate about 4 inches long, 2 inches wide, and ½ inch deep. Such a plate (which I have been able to obtain only from Messrs. Cogit & Co., Paris) is curved inside like a watch-glass, and the contents can be rapidly gone over by means of a strong lens, or a simple dissecting microscope, or still better on the large flat stage of a Swift's Stephenson binocular microscope, using a 2-inch objective. Every portion is thus systematically examined; and those animals identified or required for further examination are easily picked out with a very fine needle, or better with the lower part of a cat's whisker cut flat at the end and mounted.

The collection includes in all thirty-seven species, the majority of which are entirely free-swimmers. The others are all flesh-feeders, living mostly in tidal pools and shallow water. Many of the latter are very small, and it is probable that their number might have been considerably increased had a net of smaller mesh been employed, as many species would doubtless pass through the 50 to the inch mesh, which was the one uniformly used.

LIST OF SPECIES OF COPEPODA FOUND.

Family.—Calanidæ.

Calanus finmarchicus, Gunner.
Calanus propinquus, Brady.
Rhincalanus cornutus, Dana.
Pseudocalanus elongatus, Boeck.
Bradyidius armatus, Vanhöffen.
Centropages hamatus, Lilljeborg.
Centropages typicus, Kroyer.
Isias clavipes, Boeck.
Temora longicornis, Müller.
Metridia longa, Lubbock.
Candace pectinata, Brady.
Anomalocera patersoni, Templeton.
Parapontella brevicornis, Lubbock.
Acartia clausii, Giesbrecht.
Acartia discaudata, Giesbrecht.

Family.—Cyclopidæ.

Oithona similis, Claus.
Cyclopina littoralis, Brady.

Family.—Harpacticidæ.

Longipedia coronata, Claus.
Ectinosoma atlanticum, Brady and Robertson.
Ectinosoma spinipes, Brady.
Laophonte hispida, Brady and Robertson.
Laophonte curticauda, Boeck.
Thalestris longimana, Claus.
Thalestris clausii, Norman.
Thalestris peltata, Boeck.
Harpacticus chelifer, Müller.
Harpacticus fulvus, Fischer.
Alteutha purpurea, Philippi.
Alteutha interrupta, Goodsir.
Porcellidium viride, Philippi.
Idya furcata, Baird.

Family.—CORYCÆIDÆ.

Corycæus anglicus, Lubbock.
Corycæus speciosus, Dana.
Oncæa mediterranea, Giesbrecht.

Family.—MONSTRILLIDÆ.

Thaumaleus claparedii, Giesbrecht.
Thaumaleus thompsonii, Giesbrecht.

Family.—CALIGIDÆ.

Caligus rapax, Milne Edwards.

On Tables I., II., III., appended to this Report, will be found a record of the distribution of Copepoda over various months of 1895-98, as follows:—

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	July.	Aug.	Sep.	Oct.	Nov.	Dec.	
1895				×	×	×	×		×				Table I.
1896							×	×	×	×	×	×	Table II.
1897	×	×	×	×	×	×	×	×	×	×	×		Table III.
1898	×	×	×	×	×								

We have thus a record of the various species taken in each month throughout the year, and in the corresponding months of two or three years, which should enable us to obtain a fair knowledge of the general distribution of the free-swimming Copepoda of this district.

NOTES ON THE SPECIES.

CALANIDÆ.

Calanus finmarchicus found in every bottle from 1895 to 1898, constituting sometimes nearly the entire bulk.

Calanus propinquus occurred very sparingly, and only during January and February, 1897. It differs from *C. finmarchicus* chiefly in the profusely plumose character of the setæ, and in the fifth swimming feet, and the diverging caudal segments of the male.

Rhincalanus cornutus, a rare deep sea species, occurred tw viz. in August and early in October, 1896. It has geographical range, being reported from the North Southern Atlantic Oceans, as well as intermediate, b ported from the Mediterranean and the Canary Island readily recognized by its long projecting cruciform rost by its long antennæ.

Pseudocalanus elongatus was found in almost every bot during each month from 1895 to 1898. At times it w abundant.

Bradyidius armatus (= **Pseudocalanus armatus**) was found occasions only, viz. September, 1895, and February, The other recorded habitats are Greenland; West coast land; and rarely in the L. M. B. C. District, off the Man.

Centropages hamatus was generally present in the tow-nets th out the year.

Centropages typicus was much less frequently met with. Bot species are commonly met with in about the same relati portions round the British coasts.

Isias clavipes occurred in several of the spring and summer ings, but seldom in any quantity. Its recorded range e from Norway, around the British Isles, and as far so Gibraltar and the Canary Islands.

Temora longicornis was common throughout the collection exc mid-winter. Its range extends to both sides of the Atla

Metridia longa, a species not usually common, occurred in mor half the bottles, and on some occasions in fair numbers, cially during the winter months. The gradually tapering antennæ and the leaf-shaped terminations to the swimmin distinguish it readily. Its first recorded British habitats the Valencia neighbourhood (Brady's "Free and Semi-pa Copepoda of the British Islands," vol. i., p. 42). I have it very sparingly in Liverpool Bay and in parts of the Scott reports it from the Forth.

Candace pectinata, a species generally rare in our seas, has pro be not uncommon in the Valencia district. It was first re by Drs. Brady and Robertson at a depth of 40 fathoms o Scilly Islands. Professor Herdman took it once durin

Atlantic traverse, between Rockall and North coast of Ireland. I have on several occasions found it on the west coast of Scotland, and Scott reports it from the Forth. The "Challenger" took it about Australia, the Philippine Islands, and between Ascension and the Azores. I found it common about the Canary Islands. It and the other members of the genus *Candace* are at once distinguished by the dark-coloured antennæ, spines, and plumes, and terminal spines of the swimming feet.

Anomalocera patersonii. This very conspicuous and beautifully coloured species was found on only three occasions throughout the four years. It is very variable in its distribution, often occurring in immense profusion, but it is otherwise uncommon. On more than one occasion I have seen the surface of the sea, for many miles around the Isle of Man so densely covered with this animal as to make it distinctly recognizable from the ship's side.

Parapontella brevicornis, hitherto reported only from the English Channel, around the British Isles, and as far north as the Shetland Isles, occurs sparingly throughout the collection. A shoal of it, however, was taken in November, 1896, although none were found for a considerable period before or after.

Acartia clausii was very common through the collection.

Acartia discaudata was only once noticed; it, very possibly, may have escaped detection on some other occasions.

CYCLOPIDÆ.

Oithonia similis was, as might be expected, common throughout the collection.

Cyclopina littoralis, a common pool species, was only once taken.

HARPACTICIDÆ.

Ectinosoma atlanticum is a very minute, open sea lover, and was probably much more common than recorded, having escaped through the tow-net meshes.

Alteutha purpurea, one specimen of which was sent to me from Valencia, taken in December, 1898, is a most important find, the only previously known British habitat, I believe, being Tarbert Loch, Clyde, as recorded by Scott and Brady, and where I have occasionally also found it. Its deep reddish purple colour conspicuously distinguishes it.

Alteutha interrupta, a fairly common species about our coasts, bably often escaped the net.

Longipedia coronata,
Ectinosoma spinipes,
Laophonte hispida,
L. curticauda,
Thalestris longimana,
T. clausii,
T. peltata,
Harpacticus chelifer,
H. fulvus,
Porcellidium viride,
Idya furcata,

Are all more or less commo shallow water and tidal round our British shores their presence here indic they are all free-swimme times, but mostly of seda habits.

CORYCÆIDÆ.

Corycæus anglicus was fairly plentiful in the tow-nets on se occasions in the late autumns of 1896 and 1897. It was recorded by Lubbock from Weymouth in 1857. Brady Robertson found it later in the West of Ireland, and it been found on our south and west coasts; its only oth corded habitat being Heligoland and the North Sea.

Corycæus speciosus is, so far as I am aware, new to Britain, alth it is quite possible that it may have been mistaken for C *glicus*, which it strongly resembles. The position of the and the strongly divergent caudal stylets in these speci seem to clearly indicate its identity with *Corycæus spec* Dana. I found several specimens, some with ovisacs i late autumns of 1895-97, so it appears to have arrived the end of the summer, and would probably succumb t first severe cold.

Oncæa mediterranea was found sparingly by Mr. G. C. Bourne, Plymouth, in 1889 (Report on the Pelagic Copepoda coll at Plymouth in 1888-89); but I am not aware that i hitherto been reported elsewhere in Great Britain, or i north of the Mediterranean. I have found it common the Canary Islands. Two or three specimens only occur September, 1895.

The occurrence of the two southern species *Corycæus spe* and *Oncæa mediterranea* is specially interesting, as indic most probably Atlantic drift influence.

MONSTRILLIDÆ.

Great interest attaches to this family through the recent important discovery of Professor Giard, of Paris, and confirmed by M. Malaquin, that the early stages of one or more species of this group are spent parasitic in the body-cavity of certain worms. (See Comptes Rendus, 16 novembre 1896, and 28 decembre 1896, and 11 janvier 1897).

Thaumaleus claparedii was taken only once, in April, 1895.

Thaumaleus thompsonii was taken twice on three occasions, viz. in August and November, 1896, and April, 1897.

CALIGIDÆ.

Caligus rapax was found in the tow-net on three occasions in the months of December, 1896, January, 1897, and December, 1898.

The various species of the genus Caligus, though all fish parasites, are not uncommonly found as free swimmers, particularly at night.

The distribution of Copepoda in deep or shallow water hardly affects this collection, as it may all be classed as "Littoral Plankton," having been taken either at the surface or at a depth of from one to ten fathoms. There are, therefore, no specimens in the collection which can be classed as specially deep-sea forms.

In connexion with this collection, I would refer naturalists to a paper by Professor Herdman, F.R.S., entitled "The Biological Results of the Cruise of the S.Y. "Argo" round the West Coast of Ireland in August, 1890 (Trans. Liverpool Biol. Soc., vol. v., p. 181). The townet material obtained on the "Argo" cruise was placed in my hands for examination by Professor Herdman, the results being given in his paper.

Both collections, but more especially that of Valencia, furnish evidence of the truth of the remarks made by Professor Herdman in his Presidential Address to the Biological Section at the Ipswich Meeting of the British Association, in 1895, as to the relatively large number of genera of animals represented by the species in shallow waters, and its bearing on the Darwinian principle that an animal's most potent enemies are its own close allies. In the Valencia group the thirty-seven specimens recorded belong to twenty-six genera, the genera being, therefore, to the species as about five to seven; and in the "Argo" group thirty-two species belong to twenty-three genera, the relative proportion being about the same in both. While we l doubtless, still much to learn as to the causes which influenc distribution of the free-swimming forms of Copepoda, we can h now expect to add very many to the number of those already kn although we may easily add many to the already recorded speci this or other districts. But with the vastly more numerous loving, sedentary, and wholly or semi-parasitic species of Copepod case is differen Investigations as to the food of fishes have sl us that even scarce species, and but recently known Copepoda, the case of *Jonesiella hyanæ*, are found largely in the stomac young fishes, being evidently selected by them as their chief food probably found in quantities near to the spawning grounds. this aspect even apparently lifeless mud has, under the micros much to teach us. In addition to the examination of deposits, evident that Sponges, Cœlenterates, Echinoderms, Worms, Moll Nudibranchs, and Ascidians will richly reward careful search; judging from past results, they are the hosts of many highly orga species of Copepoda, each specially adapted to its particular host sometimes to that alone.

In conclusion, I would express the hope that we may at a fi time be enabled to know as much about the distribution of the Val sedentary species of Copepoda as we now do of the free-swimmers

Bibliography.

Brady, G. S., and Robertson, D.—1873. "On Marine Copepoda t in the West of Ireland." Ann. and Mag. Nat. Hist., se vol. xii.

Herdman. W. A.—1891. "The Biological Results of the Cruise o S.Y. 'Argo' round the West Coast of Ireland in August, 18 Trans. Biol. Soc., Liverpool, vol. v., pp. 181–212. (Conta table, compiled by I. C. Thompson, showing the distributi the Copepoda).

Malcolmson, S. M.—1886. Copepoda. "First Report of the M Fauna of the South-west of Ireland." Proc. Roy. Acad., Du ser. 3, vol. iv., p. 636.

Thompson, I. C.—1896. "Free-swimming Copepoda from the W Coast of Ireland." Trans. Biol. Soc., Liverpool, vol. x., 92–102.

Thompson, I. C.—1897. "Further Report upon the Free-swimn Copepoda of the West Coast of Ireland." Trans. Biol. S Liverpool, vol. xi., pp. 127–131.

To face page 744.

	May.				June.	July.	September.	
	5	8	14	27	27	8	6	16
Calanus finma	×	×	×	×	×	×	×	×
Pseudocalanus	..	×	..	..	..	×	×	×
Centropages ty	..	..	×	..	×	..	×	×
Temora longic	..	..	×	×	×	×	×	×
Thalestris pelt	..	..	..	..	..	..	..	..
Centropages h	×	..	..	×	×	×	..	×
Candace pectir	..	..	..	×	..	×	..	×
Acartia clausii	×	×	×	×	×	×	×	..
Oithona simili	..	×	×	×	×	×	×	×
Thaumaleus cl	..	..	..	..	..	..	..	..
Parapontella b	..	..	..	..	..	..	..	..
Thalestris long	..	..	..	..	..	..	..	..
Metridia arma	×	..	..	..	..	..	×	×
Ectinosoma sp	..	..	..	×	..	..	×	..
Anomalocera p	..	..	..	..	..	×	..	..
Harpacticus c	..	..	..	..	..	×	..	×
Isias clavipes,	..	..	..	..	..	..	..	×
Bradyidius ar	..	..	..	..	..	..	..	×
Ectinosoma at	..	..	..	..	..	..	..	×
Laophonte cu	..	..	..	..	..	..	..	×
Corycæus spe	..	..	..	..	..	..	..	×
Oncœa medite	..	..	..	..	..	..	..	×
Number of sp	4	4	5	7	6	9	8	15
Depth of tow-	2	2	10*	3	..	..	..	..
Sea temperatu	51	52	53	54	..	..	..	..

To face page 744.

S = Scarce.

	'TEMBER.				OCTOBER.						NOV.	DEC.
	10	18	21	30	2	13	14	15	17	23	23	15
Calanus finmar	C	F	C	F	C	C	F	A	A	F	F	A
Pseudocalanus	C	F	C	C	A	C	A	C	C	A	A	A
Temora longico	C	F	C	A	A	C	A	A	A	A	..	..
Metridia longa,	F	..	C	F	..	F	F	..	..	A	F	..
Centropages ha	..	F	S	C	..	..	C	..	..	F	..	..
Candace pectin	F	..	C	..	F	F	..	..	F	..	..	..
Acartia clausii,	F	F	C	A	A	C	A	A	C	F	A	A
Oithona similis,	F	..	F	C	C	C	C	C	C	F	F	..
Parapontella br	..	..	..	..	..	..	..	..	..	..	A	..
Thaumaleus th	..	..	..	..	..	..	..	..	..	..	S	..
Rhincalanus co	..	..	..	..	S	..	..	..	..	..	..	..
Isias clavipes,	..	..	F	..	..	..	..	..	..	..	..	..
Anomalocera p	..	..	..	..	..	..	..	..	..	..	..	..
Thalestris long	..	..	..	..	..	..	..	..	..	..	..	..
Ectinosoma spi	..	..	..	..	..	..	..	..	..	..	..	..
Centropages ty	..	..	S	C	C	..	C	..	..	..	..	..
Longipedia cor	..	..	..	..	..	..	..	..	..	..	..	..
Cyclopina litto	..	..	..	..	..	..	..	..	..	..	..	..
Corycæus angli	..	..	S	F	..	F	F	..	F	..	..	..
Corycæus speci	..	..	..	F	..	..	..	..	..	..	..	..
Porcellidium v	..	..	..	..	..	S	..	..	..	..	..	..
Laophonte hisp	..	..	..	..	..	..	..	..	S	..	..	..
Caligus rapax,	..	..	..	..	..	..	..	..	..	..	..	..
Number of spe	7	5	11	10	8	9	9	5	8	7	7	3
Depth of tow-	3	4	3	2	2	3	5	4	3	2	2	1½
Sea temperatu	57	58	57¼	56	56	50	51	50½	52	50	49	45½

To

TTING

to M

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IV.—THE CHÆTOGNATHA. BY F. W. GAMBLE, M.SC.,

Owens College, Manchester.

The following Report, on the Chætognatha of Valencia Harbour, is based upon collections representative of a long series of tow-nettings made by Mr. E. T. Browne in 1895 and 1896, and by the Misses Delap during 1896–8. The most notable feature of these gatherings is a specimen of *Sagitta furcata*, a species only recently described from the South Atlantic and the Sargasso Sea, and the only representative in the collection sent to me of the *Hexaptera* group. It is very probable, however, that deep-sea tow-nettings off the Valencia coast will reveal the presence of other members of this group. Two additional forms, *Sagitta bipunctata* and *Spadella cephaloptera*, complete the list of the Chætognatha at present known from Valencia Harbour.

Sagitta bipunctata, Quoy et Gaimard.

The series of tow-nettings made by Mr. Browne showed that this widely distributed species was taken during our first visit to Valencia (April and May, 1895), and during the second (July to September, 1896). The Misses Delap record it as occurring in the harbour every month from October, 1896, to December, 1898, except during February of the latter year, when a very few tow-nettings were made.

From notes kindly supplied to me by Mr. Browne, I am able to add a statement of the size and abundance of this species in Valencia Harbour at different times of the year. In the spring, *Sagitta bipunctata* is not abundant, and, indeed, on some occasions, very scarce. The specimens measure from 10 to 35 mm. in length; so that many of them are full grown. About the end of July and early in August, the young stages, measuring 3 to 5 mm. in length, become common; while in in October small specimens (up to 6 mm.) and full-grown adults (20–25 mm.) occur together in the same gatherings. About the end of October and early in November a vast shoal is formed, composed chiefly of specimens, 10–15 mm. in length, and evidently belonging to the summer's brood. These shoals of *Sagitta bipunctata* have occurred regularly at the same time

each year, and they last until either the middle of]
ber (1897 and 1898), or until early in January (1896 and
Professor M'Intosh has made similar observations on th
tognatha of St. Andrews Bay.

Sagitta furcata, Steinhaus (1896).

3·3 cm. long. In general appearance closely sim
S. hexaptera. Eight pairs of hooks. Six anterior an
posterior pairs of teeth. Paired fins oval. Anterior fi
narrow, placed a short distance in front of the larger p
ones. Caudal fin bifid. One specimen taken in V
Harbour on 28th April, 1895.

For a long time I hesitated between describing this e
as a new species and regarding it as a variety of *Sagitt*
ptera. Recently, however, my friend, Dr. O. V. Darl
drew my attention to a dissertation, "Die Verbreitu
Chætognathan im Sudatlantischen und Indischen Ocea
O. Steinhaus, in which two new forms are described fr
rich collection made by the German "Plankton Exped
Both of them are closely allied to *S. hexaptera*; *S. pla*
which has similarly shaped fins, is, however, smaller (
long), and has well developed "lateral-fields"; *S. f*
which is over 2 cm. in length, and has very narrov
backwardly-placed anterior fins. The single specimen
at Valencia agrees so well with the excellent figure
description given by Steinhaus, that I have little dou
regarding it as *Sagitta furcata*, although future investi
may necessitate a reduction in the increasing number of s
resembling *S. hexaptera*, which at present are regar
distinct.

The anterior fins in the Valencia specimen are remai
narrow, and their anterior ends lie well behind the mid
the body. The posterior ones appear oval in outline, not
gular, as in *S. hexaptera*. The caudal fin is distinctly
and produced laterally into a pair of well-developed lobes
non-muscular margins of the body are as well developed
S. hexaptera. The hooks, instead of varying between si
seven (as in the latter species), are eight in number, th
four and the first being smaller than the rest. In the
way the teeth agree with those of *S. furcata*, though they
the terminal five-rayed "star," as in *S. hexaptera*.

"olfactory organ" could not be demonstrated; but the ventral ganglion agreed in comparative size and position with Steinhaus' figure. The reproductive organs were not fully developed.

If this determination be correct, the range of *S. furcata* is considerably extended. Steinhaus describes it as being a fairly constant and occasionally abundant element of the plankton collected in the Equatorial Current, where it was obtained by the use of a net drawn to the surface from a depth of 400 metres. Two other localities, both in the Sargasso Sea, are recorded for *S. furcata*; but further north the species disappeared. Hence its occurrence in the west of Ireland is a considerable extension of its previously known range.

Spadella cephaloptera, Busch.

This species was occasionally taken when the tow-net was used close to the bottom, especially amongst rocks covered with sea-weed.

One specimen taken with a crimson alimentary canal.

REFERENCES.

M'INTOSH, W. C.—1890. Ann. Nat. Hist., ser. 6, vol. vi., p. 174–182.

STEINHAUS, O.—1896. Die Verbreitung der Chætognathen im Sudatlantischen und Indischen Ocean. Inaug. Dissert. (Kiel).

STRODTMANN.—1892. Die Systematik der Chætognathen. Arch. f. Naturg., Bd. i., Heft. 3.

V.—The Pelagic Tunicata. By Professor W. A. Herdman, F.R.S., University College, Liverpool.

Mr. E. T. Browne has asked me to examine a small collection of Pelagic Tunicata which he made at Valencia in the summers of 1895 to 1898. I have done so with much pleasure, because of the special interest that attaches to the occurrence of the Salpidæ and Doliolidæ in our seas. These forms do not, strictly speaking, belong to the British fauna, but occasionally stray into our western waters from their proper home in the Atlantic. Apparently at such times the meteorological and other environmental conditions, taken along with the reproductive phase of the animal, conspire to bring an enormous number of individuals of the one species into a limited area. A typical case of this is seen in the remarkable shoal of *Thalia democratica-mucronata* described in Mr. Browne's notes, as visiting Valencia early in September, 1896. Similar shoals of *Salpa* have been described in the past by M'Intosh and others as occurring in the Outer Hebrides.

Salpidæ.

Thalia democratica-mucronata, Forskål.

(See Transtedt, Bidrag til Kundskab om Salperne—Vidensk. Selsk Skr., 6te Række, 2 det. Bd. viii., p. 365; and "Challenger" Report on Tunicata, Part iii., p. 79.)

The solitary forms are especially large (up to 2 cm. in length), larger than any collected during the "Challenger" Expedition, and have the proliferous stolons, or "chains," very well developed.

The aggregated forms show various stages in development, and have their chains more or less broken up. Some individuals, not united in chains, are very large (up to 2 cm. in length). These are preserved in formalin, and they show the dilated form and watery consistency of the test better than any of the specimens preserved otherwise; but the muscle bands and other internal tissues are not in such good histological condition.

[A single asexual form, about 10 mm. in length, with a yellow "nucleus" was taken in the harbour on July 31st, 1896. No more were seen until August 22nd, when four small specimens of the sexual form with a blue "nucleus" were found. Three of these were joined together in a chain, and the other was free. On August 24th a dozen sexual forms and one asexual form were taken; three days later two dozen sexual forms were found left by the tide in a rock pool. These individuals may be regarded as the forerunners of an immense shoal which, during this period, must have been some distance off the coast. The shoal entered the harbour on August 31st, and consisted of both sexual and asexual forms. Since August 11th there had been a long spell of light north-westerly breezes, with an occasional shifting towards the north. On August 29th the wind backed to the west and south-west, and blew moderately strong, but again returned to its old position for the two following days.

The Salps were usually seen quite close to the surface of the sea, and it is probable that the long spell of north-westerly breezes gradually brought the shoal towards the shore. On the same day (August 31st) two other Atlantic forms came into the harbour—a shoal of *Pelagia perla* and a solitary specimen of *Ianthina*.

The shore in the harbour upon which the wind was blowing was lined with blue Salps in chains of various lengths, and as the tide receded the rock-pools were filled, and specimens left stranded upon the brown seaweed glistened brightly in the sun.

On September 3rd, we took a boat from Port Magee and visited Puffin Island, about four miles south of Valencia Island. The Port Magee Channel was crowded with Salps, and the coves around Puffin Island, viewed from the top of the cliffs, were of a beautiful dark violet colour, produced by living masses of Salps. The Salps remained in the harbour in such great abundance, until September 7th, that at times it was not possible to use the tow-net near the surface; for in a few minutes the tow-net bottle became solidly packed, and delicate organisms, like Medusæ, were crushed almost beyond recognition. The asexual forms were scarce compared with the sexual or "aggregated" forms, united in chains up to 6 inches in length.

After September 6th, the shoal rapidly decreased, partly by wreckage and partly, perhaps, by a change in the wind to a south-easterly direction; and on September 14th, the last specimens of the great shoal were seen.

In 1897, a few specimens of *Thalia* were found in September.

In 1898, only a single specimen of the asexual form was taken on August 6th.

Preservation.—There was no difficulty in preserving the isolated specimens either in formalin or alcohol, but the "chains" broke up when placed directly into formalin, or in corrosive sublimate, or picric acid. Still I found that "chains" could be preserved without breakage in a mixture of corrosive and a few drops of acetic acid. From this fixing solution the specimens could be transferred either to formalin or alcohol without further damage. I have some specimens of these Salps preserved in formalin (10 cc.) and sea water (90 cc.); they have been in the original solution over two and a half years, and are still in excellent condition.—E. T. B.]

Doliolidæ.

Doliolum (sp. ?).

? *Doliolum tritonis*, Herdman. (See Trans. Roy. Soc. Edin., xxiii., p. 101.

The specimens of *Doliolum* are all in the blastozooid or "nurse" form, and probably all belong to one species. It is impossible, however, to say with certainty in the present state of our knowledge of the genus what that species is. It may well be *Doliolum tritonis*, which is, in the sexual condition, the commonest species in that part of the Atlantic, but the blastozooid of *D. tritonis* has never with certainty been obtained. Borgert, in the latest paper on the subject, says of this species; "Amme, unbekannt," and "unbekannt" it must remain until some one traces the life-history of the species, or until we find the blastozooid and the known gonozooid in quantity together in the same area. That would not be absolute proof, but strong presumptive evidence of identity. Now, apparently, this was not the case at Valencia. So far as the collection shows, no gonozooids were obtained.

[1895. Two small specimens taken in May.

1896. Taken from July to October. Usually very scarce, but a few occasionally present in the tow-net during August.

Most of the specimens were young blastozooids (asexual form with stolon), 1 to 3 mm. in length. Some had a few buds upon the dorsal process. A large blastozooid with the adult wide muscle bands was taken on September 21st. It measured 8½ mm. in length, and had a number of buds on the dorsal process, which was about 1½ mm. in length.

1897. A single specimen taken in July, and four in August and October.

1898. (None seen.)—E. T. B.]

APPENDICULARIIDÆ.

Oikopleura (sp. ?).

? *Oikopleura flabellum*, J. Müller.

? *Oikopleura dioica*, Fol.

All the specimens, both "Valencia" and "Port Erin," seem to belong to the one species; and that species is probably what I call *Oikopleura flabellum*. Lohmann, in his recent work on the Appendiculariidæ, considers that *O. flabellum* is a synonym of Fol's *O. dioica*. I cannot follow him in this. Even if it be definitely proved that the two names represent the same species, still *flabellum*, as a name, has priority (J. Müller, 1846) over *dioica* (Fol, 1872), and the latter must lapse.

[1895. Abundant during April and the early part of May. Absent towards the end of May.

1896. Common during July, August, and September; at times very abundant. Scarce in October.

1897. Taken from January to May, but very scarce during the early part of the year. Very abundant in October. A few seen during November and December.

1898. Abundant in June. Common in August.

Some of the specimens were of a bright crimson colour.—E. T. B.]

LIVERPOOL, 16*th March*, 1897.

VI.—On Young Stages of Teleosteans. By J. T. Cunningham

The specimens were taken in a tow-net during April an
1895, by Mr. E. T. Browne.

Pleuronectes flesus (Common Flounder).

One specimen; left eye still on lower surface, but s
dislocated towards the dorsal edge. Ventral fin rays, 38
dorsal, 63 or 64. Mouth shows characters of genus
nectes.

Zeugopterus punctatus (Largest Top-knot).

(1) Early stage, with no indications of fin-rays in
membrane; two large periotic spines on each side, a
bands of pigment on the fin membrane.; 7·5 mm. lon
fig. 94, pl. xii., of Holt's Memoir in Sci. Trans. Roy.
Soc., vol. v., ser. 3.

(2) Symmetrical stage, with one dorsal periotic spi
ventral one not visible. Dorsal and ventral fin rays be
to appear. Ventral caudal rays somewhat advanced, b
minal part of notochord scarcely bent up; 12·5 mm. lon

Zeugopterus unimaculatus (One-spotted Top-knot).

(1) Symmetrical stage before the appearance of fi
yolk all absorbed; 6 mm. long.

(2, 3) Symmetrical stage, with ventral fin rays just ind
over 64 in number; dorsal rays in same condition.
protuberances along edge of opercular bone and behind o
One specimen younger than the other; 7 mm. and 8 mm

(4) Advanced stage, with eyes on left side of head;
advanced in development; ventral, 67 or 68 in number;
long.

It is worth noting that Holt obtained a numerou
of these same larval stages in the course of the Irish
His specimens were taken in bottom tow-nets, coast of D
May, 1891. It would appear that the species is fairly c
in Irish bays, and that its young are reared in the b
which reason they are so commonly taken in tow-nets.

Trigla gurnardus (Grey Gurnard).

(1) A large specimen, 11 mm. long, with very large pectorals; ventral fin rays just indicated, 18 or 19 in number; dorsal rays opposite these, and in same stage. Caudal rays more advanced than dorsal or ventral, and notochord somewhat bent up.

(2) A newly-hatched specimen, 3·5 mm. long, with no mouth, yolk not reduced, oil globule at posterior end of yolk, and rectum immediately behind yolk, perhaps belongs to this species.

Gadus (Sp. ?).

A specimen, 9·5 mm. long, with three dorsal and two ventral fins, just indicated by the fin rays, and caudal rays symmetrically disposed above and below notochord.

Gadus (Sp. ?).

A larval specimen, 3 mm. long; yolk all absorbed; rectum not reaching edge of fin membrane; a vesicle in fin membrane above the head.

Centronotus gunellus (Butter-fish).

A specimen, 10 mm. long, with no fin rays, except the first commencement of the caudal below the end of the notochord.

Liparis (Sp. ?).

Three specimens, with globular body, short tail, caudal rays commencing unusually long distance in front of notochord; dorsal and ventral fins indicated, as one above and one below, reaching nearly to caudal fin.

PART II.—*The Benthos* (*Dredging an*

VII.—REPORT ON THE RESULTS OF DREDGIN
BY W. I. BEAUMONT, B.A.

(CHART II.)

INTRODUCTION.

Valencia Harbour.—The term Valencia I
to cover the whole stretch of water shut o
Atlantic by the Island of Valencia and i
Beginnis. It appears to be very usual to 1
portion of the area, lying chiefly between Val
which is used as a harbour by shipping, sin
sufficiently deep for vessels of quite moder
convenient, however, for our purpose to inc
only Port Magee Sound, the long reach s
from the mainland, which at its south-we
deeper Port Magee channel before opening
Lough Kay, between Beginnis and the mainl

SHORE-COLLECTING.

The extensive and varied shores of the
facilities for shore-work. The rise and fall
very moderate; being only 11 feet at sprin
The shore is bounded for the most part
and there are areas more or less covered with
spits of sand and gravel, sand-banks, Zostera
submerged peat-bog.

ROCKY AND STONY PARTS OF THE SHO
grounds of this description are near Knig
Island. From Knightstown, westward to
slate-reefs with intervening strips of sand
stones. The under sides of the latter are
species of Sponges, Polyzoa, and Botryllo
with which are many Turbellaria. Her
abundant, and Polychæte worms, such a
Myrianida pennigera (frequently found witl

Chart II

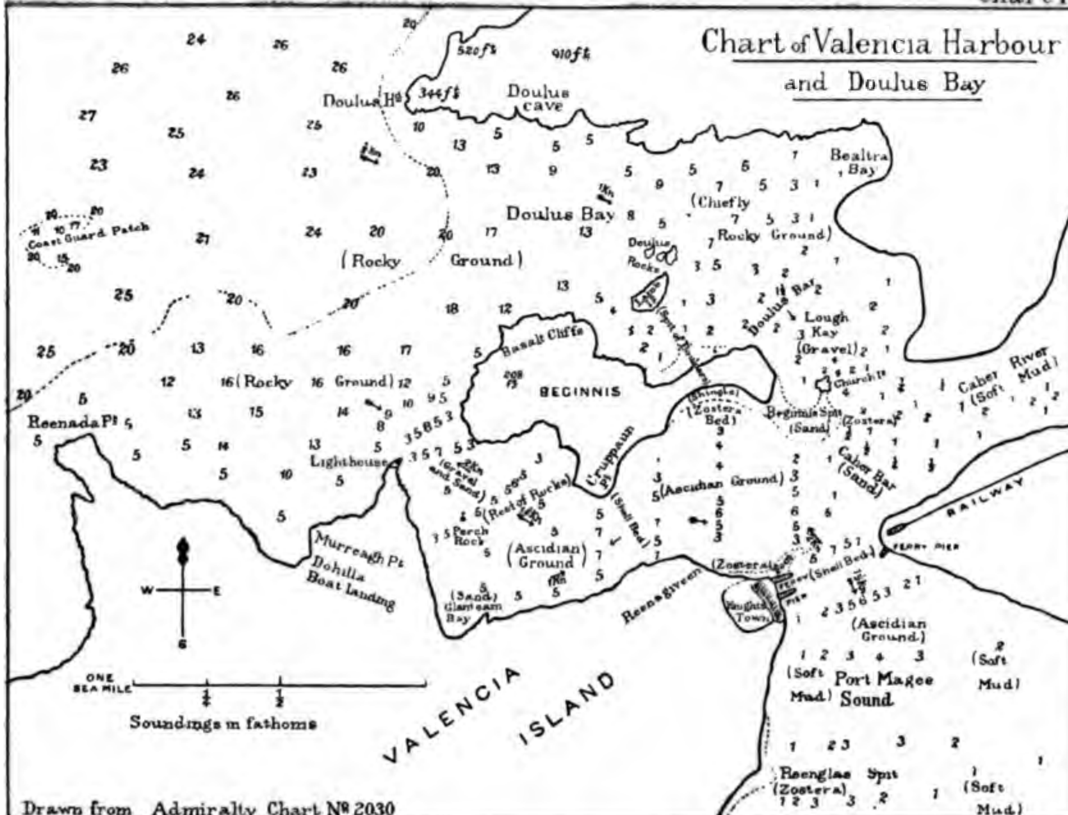
Chart of Valencia Harbour
and Doulus Bay
Doulus Hd
Doulus cave
Doulus Bay
Bealtra Bay
(Chiefly Rocky Ground)
(Rocky Ground)
Coast Guard Patch
Doulus Rocks
Lough Kay
(Gravel)
Basalt Cliffs
BEGINNIS
Beginnis Spit
Caber Bar (Sand)
Caber
River
(Soft Mud)
(Ascidian Ground)
(Zostera Bed)
(Shell Bed)
Reenada Pt
Lighthouse
Perch Rock
(Sand)
Glanleam Bay
Murreagh Pt
Dohilla Boat Landing
Reenagiveen
Knightstown
RAILWAY
FERRY PIER
Port Magee Sound
Reenglas Spit
(Zostera)
VALENCIA ISLAND
ONE SEA MILE
Soundings in fathoms
W
E
S
Drawn from Admiralty Chart Nº 2030

Siphonostoma diplochaetos. The Gephyrean *Phymosoma papillosa* also occurs. Besides the commoner littoral forms of Nudibranchiate Mollusca, fine specimens of *Æolidiella glauca* and *Antiopa hyalina* were obtained here; and the Pynogonida *Phoxichilidium femoratum* and *Anoplodactylus femoratum.*

At Reenagiveen there are some good rock-pools at various levels, some of which are well stocked with Anemones, including several species of Sagartia; and with the "burrowing" urchin (*Strongylocentrotus lividus*). Algæ from these pools and the neighbouring reefs (and here may be included similar material from the stone-piers at Knightstown) yielded a number of small organisms of interest: the creeping Medusa *Clavatella prolifera*, Nemertines of the genus *Tetrastemma*, including the rare *T. nigrum*, Riches, many Rhabdocœle Turbellaria, and the Opisthobranch Mollusca *Limapontia nigra*, *Actæonia corrugata*, and *Runcina Hancocki.* The Archiannelid *Dinophilus tæniatus*, Harmer, was also abundant in the spring.

Beyond Reenagiveen the rocks are more precipitous for some distance, while the west shore of Glanleam Bay resembles that nearer Knightstown, and has a similar but impoverished fauna. Southward, from Knightstown Ferry-pier, past the Telegraph Station, the shore is covered with stones of small size. Under one of these the Hydroid *Rhizogeton fusiformis*, Agassiz, belonging to a genus not previously known on this side of the Atlantic, was found; another member of the apparently scanty Hydroid fauna of Valencia, *Coryne vaginata*, was common here and on the adjacent stone piers. Nudibranchs were also fairly abundant, especially *Lamellidoris bilamellata* and *Facelina coronata.*

Church Island is a small rock situated between Beginnis and the mainland, and connected with the former by a sand-spit which dries at spring-tides. On its southern and western sides are many stones of negotiable size which shelter a fairly rich and varied fauna, on the whole very similar to that of Knightstown shore. Most noteworthy here was the discovery of parasitic Copepoda living embedded in colonies of the compound Ascidian *Morchellium.*

These have been described as new species (*Aplostoma Beaumonti* and *Aplostoma hibernica*) by Messrs. T. and A. Scott.[1]

On the north side of Beginnis, running out towards Lamb Island, there is a bank of boulders with a fauna like that of Church Island.

[1] Ann. and Mag. Nat. Hist., Series 6, vol. xvi., 1895, pp. 359–60, Pl. xvi., xvii. In this Paper a description and figures are also given of another parasitic copepod from Valencia, *Lomanticola insoleno*, gen. et sp. n., which was found living in the Nudibranch *Lomanotus marmoratus* by Mr. Gamble.

Here *Lamellaria perspicua* was abundant, a
degree of variation, the appearance of differen
ing to the particular species of Ascidian affect

Outside the harbour, near Murreagh Poi
where boulders, many of huge size, lie scatt
This, in spite of its exposed position, we foun
ground. *Myriothela phrygia*, *Coryphella graci*
were the most interesting forms found, the
abundant.

The rocky shores of Port Magee Chann
some extent, but did not yield anything w
near Knightstown.

Banks and Spits of Sand and Gravel.-
repay further investigation (by digging) than

Beginnis Spit is a bank of clean sand at t
where sand-eels, *Arenicola marina*, and other s
may be obtained.

Ballycarbery Sands.—On the north side
the ruins of Ballycarbery Castle, are extensiv
dibulum is plentiful here at low-tide levels
(*Eupagurus bernhardus*) with good colonies
were also seen in the shallows.

The Foot, a bank of muddy sand and g
stones, runs out from Knightstown Breakwat
direction. Here in the spring *Æolidia papil*
ing); *Fecampia erythrocephala* and *Leptopla*
stones in companies of four or five); *Carin*
found between tide-marks), and other Nemer

Reenglas Spit is formed of mud or very
good deal of scattered gravel, but much of i
Zostera. There are also large shallow pools i
Strongylocentrotus lividus is to be seen in hu
side in great clusters on the Nullipore-encr
the floor of the pools; there is no attempt
this species to be capable of such exercise.

Ardcost Foot on the shore of Lough Mask
Synapta was obtained here by digging.

The *Submerged Peat-bog*, near Ardcost, w
water of spring-tides, may be noticed here.
rows in the peat, and also to some extent in
tree-stumps which still remain apparently *in*

affects the wood; and numerous Polychæte worms and the Gephyrean *Thalassema neptuni* harbour in the peat.

Zostera Beds occur in Beginnis Bay, along the eastern margin of Beginnis Spit to the south of Church Island, west of the Foot near Knightstown, and at Reenglass. Most of these are in part accessible at low water of the best spring-tides.

On some of the Zostera beds the Lucernarians—*Haliclystus auricula* and *Lucernaria campanulata*—occur. South of Church Island, the first-named may be picked off the Zostera in hundreds, and the latter is by no means scarce.

HULKS, DRIFT TIMBER, &c.—These may be conveniently noticed here. During our stay at Valencia, in 1896, two hulks were beached after lying afloat in the harbour for many months. The whole of their under-surface to the water-line was covered with a luxuriant growth of *Tubularia larynx* and *Ascidiella aspersa*, with a sprinkling of *Lepas anatifera*, and, in one case, a few fronds of *Laminaria saccharina*. On the happy hunting-grounds afforded by the Hydroid, Nudibranchs crawled in enormous numbers, many of them far exceeding the dimensions usual with their species. *Cavolina* (*Cuthona*) *aurantiaca* and *Coryphella lineata* were abundant on both hulks; *Facelina Drummondi*, *F. coronata*, *Dendronotus arborescens*, and *Lamellidoris bilamellata* on one or other only, though occurring on both; while *Cavolina olivacea*, *Galvina picta* and *G. exigua*, and *Doto coronata* were present in small numbers only.

Another animal occurring in extraordinary abundance on one hulk was the Pycnogonid *Phoxichilus spinosus*, while on both a few specimens of *Ammothea echinata* and *Anoplodactylus petiolatus* were found. In other groups there were noted the Turbellaria, *Leptoplana* (*tremellaris* ?), *Vorticeros auriculatum*, *Plagiostoma vittatum*, *P. Girardi*; Nemertines, *Tetrastemma dorsale*, *T. melanocephalum*, *T. vermiculatum*; young *Antedon bifida*; *Cypræa europæa* and young *Pecten opercularis*.

The appearance of fine colonies of *Tubularia indivisa* and *Coryne vaginata*, on a mooring buoy and boat belonging to Mr. Delap, which had been afloat a few weeks only, gave Mr. Browne an opportunity of observing the rapid growth of these Hydroids under favourable conditions; and also of comparing their habit when grown in such a situation with that of colonies occurring under stones in the littoral zone. *Lepas anatifera* also appeared on the boat, and attained full size in an equally short time; while the whole surface of another boat which was raised after lying at the bottom of the harbour for some months, and of several large drift logs, was covered by this species to the exclusion of other organisms.

Dredging.

Scope of the Work.—During our first visit of 1895, dredging was conducted entirely fro most part by our own labour. Our operati practically confined to the sheltered waters o were indeed made to dredge outside wheneve mitted a small boat to venture into Doulus Ba and more are readily accessible. But we fou rough, and our results[1] were absolutely *nil* when the dredge apparently pitched on a sn the rocks (though it fouled immediately) for one *Echinocardium pennatifidum* were brough

During our second visit, in the summer of extensively carried on in the harbour, and i made to explore the deeper water outside wit the Royal Society of London. Our endeav not meet with a large measure of success. I unable to obtain the services of a sea-goin with the owners of the only suitable vessel t of the coast having fallen through,[2] a sailing the St. Patrick of Dingle, was engaged for o

Now apart from the length of time occ home, a sailing vessel has very obvious dis frequently either too much wind for dredgin particularly so in the west of Ireland, wher and westerly winds soon raise a swell whi difficult. Taking advantage of every favou was only able during the month to go out days, and on two of these it was impossibl wind. Again, from our experience of fisl Britain, we anticipated that our crew would acquaintance with the nature of the bottom i proved to be the case. In point of fact the

[1] The following year Mr. Walker obtained seve fms. at the mouth of Doulus Bay by using a bottom iron rake (a stone is equally efficacious on rough may be worked with good effect on any kind of botto

[2] Subsequent information regarding her efficiency was after all a great misfortune.

sufficient to enable them, in the ordinary pursuit of their calling, to give all "foul ground" a very wide berth. The limited opportunities vouchsafed to us by the meteorological conditions were in consequence largely frittered away in discovering that the greater part of the area, which circumstances permitted us to explore, was from our point of view particularly barren, and in a vain search for something better. Altogether we came to the conclusion from our experience that the hiring of a sailing smack for the purpose of dredging is not a satisfactory investment unless one is highly favoured in the matter of weather.

DREDGING GROUNDS OF VALENCIA HARBOUR.

Valencia Harbour, using the term in the wide sense already indicated, has over the greater portion of its area a muddy bottom. Its shallower parts, Cahir river and most of Port Magee Sound (where the depth does not much exceed 1½ fms.) are floored with soft black mud in which the dredge or trawl sinks deeply, and serves at once as an anchor. *Philine aperta* is a prominent species on this ground as on similar ground in other districts. We also record *Limapontia nigra*, *Elysia viridis*, young specimens of *Aplysia*, and the ubiquitous *Polycera quadrilineata*, also *Henricia sanguinolenta*, *Maia squinado*, and several common Nemertines; while Mr. Walker, however, with his ingenious rake and townet arrangement, succeeded in capturing twenty-three species of Crustacea in two hauls on ground of this description near Knightstown.[1]

Ascidian Ground.—In the deeper portion of the harbour near Knightstown (4 to 7 fms.) the bottom, though chiefly mud, has a much firmer consistency, the strong scour of the tide probably preventing the accumulation here of much soft material. This area, which may be termed the harbour proper, extends from the Harbour Rock or Perch to Knightstown, where it bends round the Foot and penetrates about a mile into Port Magee Sound. Its characteristic and dominant feature from a faunistic point of view (excepting in those parts to be presently described as Shell Beds) is the abundance of *Ascidiella aspersa*; the dredge, after a short haul, coming up full of large specimens of this species, firmly attached to one another in clumps of about half-a-dozen.

These colonial masses do not appear to be definitely attached to

[1] "Malacostraca from the West of Ireland." Trans. Liverpool Biol. Soc. Vol. xii., 1898, p. 161.

the bottom, but to be merely seated on, or
embedded in, the stiff mud.[1] In the beginni
of the colony starts sedentary life on a mor
small stone or shell. A few dead shells are s
and such extraneous objects as peats, acciden
ferrying turf over from the mainland, form a
animals. But since the bulk of the organ
dredging are more or less dependent on the
attachment or shelter, these latter certainly a
of the ground, to which we consequently
ground. It is needless to name here the ani
the ground to be next considered. Most of
the harbour are to be found on these two gr
reference to the various tables accompanyin

Shell-beds.—In the channel between Kr
and off Gruppaun Point, there are considerabl
of *Cardium*, *Mya*, and, in particular, *Pecten m*
specimens of the last named. *Ascidiella asp*
any rate scarce; the functions performed by it
of the bottom fauna being taken on by the sh
earlier explorations pointed to a much more n
the Shell-beds and the adjacent Ascidian gro
fauna, than proved on further investigation t
fact, there are a comparatively small numb
either ground, though the Shell-beds present
both in species and individuals.

There remain in the neighbourhood of Kni
to be noticed :—

Lough Kay and Cahir Passage.—A strong
and often a considerable swell sweeps round
bottom is rather clean gravel, with a limi
species also found on the Shell-beds.

Glanleam Bay.—Clean sand, with very
probably burrowing animals exist there wh
fails to capture.

Mouth of Harbour.—The bottom of the cha
of the harbour, as far in as the Perch reef, is
sand. In this, at first sight, barren material

[1] *Ascidiella aspersa* may be seen growing in simila
of Salcombe Harbour and the R. Yealm (in Devon),

animals, of which the most noteworthy is an undetermined species of *Polygordius*, probably identical with a form inhabiting similar ground near Port Erin, in the Isle of Man, and off Prawle Point, Devon. The following, though not peculiar to this station, seem to be characteristic: *Polyophthalmus pictus*, *Glycera capitata* (juv.), *Ebalia tuberosa*, *Anapagurus Hyndmanni*, *Embletonia pulchra*. Other Nudibranchs, *Facelina coronata*, *Galvina picta*, *G. exigua*, and *Polycera quadrilineata*, recorded from here, were found on Laminaria, which was probably not *in situ*.

PORT MAGEE CHANNEL.—On several days, when the weather was unsuited to outside work, the "St. Patrick" sailed down to Port Magee, and dredging was carried on from her boat. A number of stations were investigated; but, unfortunately, care was not taken to note their exact position or to keep separate the resulting material. Two interesting grounds, however, were discovered, differing in the nature of the deposit from anything found at the Knightstown end of the harbour.

Port Magee Nullipore Ground.—In the channel opposite the Coastguard Station, below Port Magee village, there is an extensive deposit of growing Nullipore, *Lithothamnion coralloides*, Cr., and *L. coralloides, flabelligera*, Fosl., in about 4 fms. The fauna is a rich one, resembling, on the whole, that of the Knightstown Shell-beds, but with several additional species. Red encrusting sponges are abundant, and on these were found *Archidoris flammea* and *Platydoris planata*, also red *Phoxichilus laevis*. Polyclad Turbellaria, and Nemertines in particular, were abundant, all the species of the latter group found in Valencia Harbour being represented.

Port Magee Fine Slate Gravel.—Further down the channel, in about 15 fms. (?), the bottom was found to consist chiefly of thin laminæ of slate broken up into small fragments not usually exceeding 6 mm. in diameter. Adhering to these was a small but adult Lucernarian, apparently a new species.

DREDGING GROUNDS OFF VALENCIA.

Dingle Bay Trawling Ground.—An area of several square miles, situated approximately midway between Doulus Head and Blasket Island, was investigated with dredge and trawl, the depth being between 30 and 40 fms. The bottom everywhere was found to be fine, muddy sand, and the fauna, from our point of view, very limited. It is essentially trawling rather than dredging ground; but, even after towing for 2½ hours, the 35 ft. beam-trawl of the "St. Patrick" brought up a very scanty collection of Invertebrates belonging to a few common and widely-distributed species. Similar ground in the Irish Sea and in the English Channel, off Plymouth, appears to be much more productive; perhaps the more frequently prevailing and heavier seas in Dingle Bay may account for its apparent barrenness, though Ballinskelligs Bay, which seems to have a more extensive fauna, is equally exposed and shallower. However, since fish manage to subsist in considerable numbers on this very ground, other organisms of some kind presumably abound, but are not readily caught by the ordinary means employed by the naturalist.

The characteristic species occurring on this ground are: *Paraphellia expansa* (originally described from the S.W. of Ireland by Professor Haddon [1]), *Astropecten irregularis*, *Ophiura ciliaris*, *Echinocardium pennatifidum*, *Spatangus purpureus*, *Thyone raphanus*, *Eupagurus bernhardus* (with *Hydractinia*), *Eup. Prideauxii* (with *Adamsia palliata*), *Ebalia Cranchii*, *Atelecyclus heterodon*, *Hyas coarctatus*, *Inachus dorynchus*, *Dentalium*, *Cardium echinatum*.

Dingle Bay, about 3 miles N.N.E. of Doulus Head, 25 to 30 fms. *ca.* Mr. Gamble made several hauls of the dredge in this locality. At one station the following were taken on coarse sand:—*Caryophyllia Smithii*, *Terebratulina caput-serpentis*, *Actæon tornatilis* (*Tornatella fasciata*), and a small Doris, belonging to a possibly undescribed species previously taken at Port Erin.[2]

Wild Bank.—At the N.E. end of the Wild Bank (S.E. of Great Blasket Island), on rough bottom of stones, with weed, in 20–15 fms., there were caught:—*Carinella superba*, *Tetastremma dorsale*, *Polynoë imbricata*, *Phyllodoce* sp., *Pionosyllis* sp., masses of Sabellaria tubes, *Thalassema neptuni*, *Stenorhynchus*, *Aplysia punctata*.

Two hauls in about 20 fms.—one somewhat to the east of the above, the other at the west end of the Bank—showed a fauna similar to that of the Trawling Grounds.

Off Reenada.—About 3 miles N.W. of Valencia lighthouse, 36 fms. *ca.* Mr. Walker's Station 8.[3] Bottom sand, with a few stones and Nullipores. One haul was made here on August 28, the results being similar to those on the Trawling Grounds already noticed, with the addition of *Luidia fragilissima*, *Henricia sanguinolenta*, *Synapta digitata*, *Inachus dorsettensis*, *Anapagurus Hyndmanni*.

[1] First Report on the Marine Fauna of the S.W. of Ireland. Proc. R. I. Acad. (ser. 2), vol. iv,, 1886, pp. 616–17.

[2] Trans. Liverpool Biol. Soc., vol. x., 1896, p. 42.

[3] Trans. Liverpool Biol. Soc., vol. xii., 1898, p. 163.

1¾ *miles S.W. of Bray Head.*—45 fms. *ca.* Mr. Walker's Station 7.[1] Bottom, coarse sand (chiefly comminuted slate), pebbles, and a few shell fragments ; all very much water-worn, the shells consisting of mere stumps of the more massive forms, such as *Aporrhais.* We were surprised to find evidence of strong wave-action at so great a depth, even on the open Atlantic coast. The species taken here were *Carinella inexpectata*, Hub. (previously found only at Naples), *Polygordius* sp., *Glycera capitata, Phascolion Strombi, Synapta inhærens, Anapagurus Hyndmanni, Galathea intermedia.*

DISTRIBUTION TABLES.

The accompanying tables have been prepared as the readiest means of presenting the results of our shore-collecting and dredging at Valencia. It will be obvious that they are very far from complete as regards many divisions of the animal kingdom. In point of fact no attempt was made to obtain complete collections, except in the case of those groups which specially interested us, and of which special Reports have been prepared; while several classes were entirely neglected (*Porifera, Polyzoa, Tunicata,* &c.). It will accordingly be understood that the apparent poverty of species, in some of the lists which follow, does not warrant the assumption that those groups are but indifferently represented in the fauna of Valencia Harbour.

CŒLENTERATA.

(Table, pp. 766–769).

The few Hydroids which we succeeded in finding were studied by Mr. Browne, whose results appeared in the Irish Naturalist (vol. vi., 1897, pp. 241 *et seq*). The following list (pp. 766 and 767) is taken from his paper. It is a remarkable fact that hardly any of the Hydroids obtained are Medusa-producing species; yet the swarms of Hydromedusæ in the harbour bespeak an abundant hydroid fauna somewhere in the neighbourhood. A special Report on the *Lucernaridæ* follows (p. 806).

TURBELLARIA.

(Table, pp. 770, 771. Special Report, p. 812).

NEMERTEA.

(Table, pp. 772, 773. Special Report, p. 815).

[1] *Loc. cit.*, p. 163.

MOLLUSCA.

(Tables, pp. 774–781.)

Apart from the *Opisthobranchiata*, which are dealt with in special Report (p. 832, Distribution Tables, pp. 777–781), very littl attention was devoted to the Mollusca, as is evident from the ver limited and imperfect list of species which follows.

ANNELIDA AND GEPHYREA.

(Tables, pp. 782–785.)

In this case, also, our list is very incomplete, being composed almos entirely of species which we were able to identify at the time Polychætes—Polynoids, Syllids, Nereids, and others which do no figure in the list—were, as a matter of fact, abundant in Valenci Harbour. For the identification of specimens of the Gephyrean recorded here we have to thank Canon Norman.

BRACHIOPODA.

A specimen of *Terebratulina caput-serpentis* was dredged on coarse sand, about 2 miles N.N.E. of Doulus Head.

CRUSTACEA.

(Tables, pp. 786–795.)

A certain number of Crustacea (almost entirely Decapoda) were recorded by Mr. Gamble and myself; but the following list is due, in large measure, to the energy of Mr. A. O. Walker, the results of whose short visit to Valencia in August, 1896, have been published with other material in a paper on "Malacostraca from the West of Ireland" (Trans. Liverpool Biol. Soc., vol. xii., 1898, pp. 159 *et seq*). From this the Valencia records have been extracted and incorporated in the accompanying table. The lists of Schizopoda, Cumacea, Isopoda, and Amphipoda are derived entirely from this source; in the case of the Decapoda, Mr. Walker's records are denoted by the letter W. The attempt to assign the species taken by Mr. Walker to particular areas in Valencia Harbour is, to a large extent, approximate, no precise information being available respecting certain of his Stations, which appear to cover more than one sort of ground. Uncertainty with regard to this point is indicated by the symbol "x," as in other tables.

Concerning other Crustacean groups, there is nothing to record here beyond recalling the common occurrence of *Lepas anatifera* on floating timber (p. 757), and the finding of three new species of parasitic Copepoda (p. 755).

PYCNOGONIDA.

(Table, p. 798).

We are indebted to Mr. G. H. Carpenter for the identification of the species of Pycnogonida.

ECHINODERMATA.

(Table, pp. 796, 797).

The accompanying table probably includes most of the species occurring in the Harbour; but is, no doubt, incomplete with respect to their distribution, the occurrence of common species not having been fully recorded.

[TABLES

CŒLENTERATA.	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
		Shore.				Dredging and Trawling Grounds.															
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell-beds; 5–7 fms.	Lough Kay; gravel; 3–4 fms.	Mouth of Harbour; gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank; rough ground; 15–20 fms.	2½ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds; fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. of Doulus Hd.; coarse sand; 25 fms. *ca.*	1¾ mi. S.W. of Bray Hd.; coarse gravel and sand; 45 fms.
Hydroida:																					
Clava multicornis (Forskal), . . .	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C. squamata (O. F. M.), . . .	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Coryne vaginata, Hincks, ...	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Eudendrium ramosum (Linn.), . . .	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
Hydractinia echinata (Fleming), . .	..	..	..	—	..	..	..	—	—	..	..	—	..	..	..	..	..	..	—	..	..
Myriothela phrygia (Fabr.), . . .	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Antennularia antennina (Linn.),	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
A. ramosa, Lamk.,	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Campanularia flexuosa, Hincks,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Clytia Johnstoni (Alder),	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Obelia geniculata (Linn.),	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Halecium Beanii (Johnst.),	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
Sertularella polyzonias (Linn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.	..
Sertularia cupressina, Linn.,	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..
S. pumila, Linn.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
S. operculata, Linn.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Syncoryne, sp.,	The medusæ belonging to these Hydroids were taken in the harbour, but the Hydroids were not found. (E. T. Browne.)																				
Bougainvillia, sp.,																					
Perigonimus, sp.,																					
Corymorpha nutans, M. Sars,																					
Hybocodon prolifer, Ag.,																					
Podocoryne, sp.,																					
Lar sabellarum, Gosse,																					
Zygodactyle, sp.,																					

[1] The Medusa was discovered by Mr. Gamble, creeping among Algæ in a rockpool at Reenagiveen.

CŒLENTERATA. (*continued.*)	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell-beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank: rough ground; 15–20 fms.	2¼ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. of Doulus Hd.: coarse sand; 25 fms. *ca.*	1¼ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
		Shore.					Dredging and Trawling Grounds.														
Stauromedusæ:																					
Haliclystus auricula (Rathke),	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lucernaria campanulata, Lamx.,	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lucernaria, sp. nov.,	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..
Alcyonaria:																					
Alcyonium digitatum, Linn.,	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..

Metridium dianthus (Ellis),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Cereus pedunculatus (Penn.),	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sagartia miniata, Gosse,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
S. venusta, Gosse,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
S. nivea, Gosse,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Adamsia palliata (Bohadsch.),[2]	..	..	..	..	..	..	..	—	..	..	—	—	..	..	..	..	..	..	..	..	..
Actinia equina, Linn.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anemonia sulcata (Penn.),	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Urticina crassicornis (Müll.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Bunodes verrucosa (Penn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Paraphellia expansa, Haddon,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	—	..	..
Epizoanthus Couchii (?),	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
Cerianthus Lloydii, Gosse,	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Caryophyllia Smithii, Stokes,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..

[2] The parasitic larva of *Halcampa* was frequently found on medusæ of the genus *Phialidium*, townetted in the Harbour.

TURBELLARIA	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
		Shore.				Dredging and Trawling Grounds.															
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground: firm mud; 3–7 fms.	Shell-beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground: 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank: rough ground; 15–20 fms.	2¾ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. of Doulus Hd.: coarse sand; 25 fms. *ca.*	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
Convoluta paradoxa, Oersted,	..	..	—[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Promesostoma marmoratum (Schultze),	..	..	—[1]	..	..	—*x*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Microstoma sp.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Proxenetes flabellifer, Jensen,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
P. gracilis, v. Graff,	..	..	..	..	..	—*x*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Macrorhynchus Naegelii (Kölliker),	..	..	—	..	..	—*x*	..	—*x*	..	..	—[2]	..	..	..	..	..	..	..	..	..	..
M. helgolandicus, Metsch,	..	..	—[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M. croceus (Fabr.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hyporhynchus armatus (Jensen),	..	..	..	..	..	—*x*	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Plagiostoma Girardi (Schmidt),	—	..	—	..	..	—x	..	—x	—	..	..	..	..	..	..	..	..	..	..	..	..
P. vittatum (Frey and Leuck.),	—	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Vorticeros auriculatum (O. F. M.),	—	..	..	..	..	—x	..	..	..	..	—[2]	..	..	..	..	..	..	..	..	..	..
Enterostoma, sp.?	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..	..	..
Cylindrostoma quadrioculatum (Leuck.),	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..	..	..
Monotus lineatus (O. F. M.),	..	..	—[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M. fuscus (Oersted),	..	..	—[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fovia affinis (?), Stimpson,	..	..	—[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Stylochoplana maculata, Quatr.,	..	..	—	..	..	..	..	—	..	..	..	..	—	..	—x	..	..	..	..	..	..
Leptoplana tremellaris (O. F. M.),	sp.?	..	—	—	..	—	..	—x	—	..	—[2]	..	..	..	..	..	..	..	..	..	..
Prostheceraeus vittatus (Montagu),	..	..	..	..	..	..	..	—	—	..	..	..	—	..	..	..	..	..	..	..	..
Cycloporus papillosus, Lang.,	..	..	—	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..
Eurylepta cornuta (O. F. M.),	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Oligocladus sanguinolentus (Quatr.),	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Stylostomum variabile, Lang.,	..	..	—	..	..	—	..	—	—	..	..	—	—	..	—x	..	..	..	..	..	..

x This symbol is used where there is any doubt, not with regard to the identification of specimens, but respecting the precise nature of the ground where they were obtained. All the species so marked in the column headed "Zostera-beds," were found in material, chiefly Zostera and drift weed, resulting from a haul of the dredge in 1–2 fms. along the shore near Reenagiveen. There is certainly a small patch of Zostera somewhere there; but the Rhabdocœles, four of which belong to species only taken on this one occasion, may have been in the drift weed.

[1] Among Algæ growing in the Reenagiveen pools or on Breakwater Pier.

[2] Possibly in drift weed.

NEMERTEA.	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area										Port Magee.			Doulus Bay.	Dingle Bay.				
		Shore.				Dredging and Trawling Grounds.															
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank: rough ground; 15–20 fms.	2¾ mi. N. W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. o Doulus Hd.: coarse sand, 25 fms. *ca.*	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
Carinella annulata[1] (Montague), ...	..	..	..	..	..	..	..	—	— *x*	— *x*	..	—	..	..	..	..	..	..	..	..	..
C. superba, Kölliker, ...	..	..	..	—	..	..	..	—	—	—	— *x*	—	—	..	—	..	—	..	..	..	..
C. inexpectata, Hubr., ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—
Cephalothrix bioculata (Œrsted), . . .	..	..	—	—	..	..	..	—	—	— *x*	..	—	..	..	—	..	..	..	..	..	..
Nemertes Neesii (Œrsted), ...	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Nemertopsis tenuis, Bürger, ...	..	..	..	..	..	— *x*	..	—	—	..	—	..	—	..	—	..	..	..	..	..	..
N. flavida (?), ...	..	..	—	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Amphiporus lactifloreus (Johnst.), . . .	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Tetrastemma candidum (O. F. M.),	—	..	—	—	..	—x	..	—	—	—x	—	—	—	..	—	..	..	..	..	..	..
T. melanocephalum (Johnst.),	—	..	—	..	..	—x	..	—	—	—	—x	..	—	—	—	..	..	..	..	..	..
T. vermiculatum (Quatr.),	—	..	—	..	..	..	..	—	—	—	—	..	—	..	—	..	..	..	..	..	..
T. cephalophorum (?), Bürger,	..	..	..	..	..	..	..	..	—	..	—x	..	—	..	—	..	..	..	..	..	..
T. Robertianæ, McI.,	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
T. dorsale (Abild.),	—	..	—	..	..	—x	..	—	—	—	—	..	—	—	—	..	—	..	—x	..	..
T. nigrum, Riches,	..	..	—	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..	..	..
Lineus gesserensis (O. F. M.),	..	—	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L. lacteus (?) (Grube),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L. longissimus (Gunnerus),	..	..	—	—	..	—	..	—	—	..	..	..	—	—	—	..	..	..	..	..	..
L. bilineatus, McI.,	..	..	..	..	..	..	..	—	—	..	—	..	—	—	—	..	..	..	..	..	..
Micrura purpurea (Dalyell),	..	..	—	—	..	..	..	—	—	—	..	—	..	..	..	..	..	..	—x	..	..
M. fasciolata (Ehr.),	..	..	—	..	..	—x	..	—	—	—	—	..	—	—	—	..	—	..	—x	—	..
Cerebratulus fuscus, McI.,	..	..	..	..	..	..	..	—	—	—	—	—	..	..	..	..	..	..	..	—[2]	..

x This symbol is used where there is any doubt, not with regard to the identification of specimens, but respecting the precise nature of the ground where they were obtained.

[1] = *Carinella Aragoi*, Joubin; *C. McIntoshi*, Bürger.

[2] Species doubtful, but probably *C. fuscus*.

Saxicava rugosa (Linn.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Teredo navalis (?)	..	..	..	..	—[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Scaphopoda:																					
Dentalium entale, Linn.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..
Polyplacophora:																					
Chiton fascicularis, Linn.,	..	..	—	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..
Gastropoda:																					
Patella vulgata, Linn.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Helcion pellucidum (Linn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Emarginula, sp.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fissurella græca (Linn.),	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Trochus magus, Linn.,	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
T. zizyphinus, Linn.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
T. cinerarius, Linn.,	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Littorina obtusata (Linn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L. littorea (Linn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

[1] In the wood of the old tree stumps, not in the peat itself. Submerged timber structures in the Harbour are commonly attacked. *Pholas* burrows in both wood and peat at Ardcost.

[2] Dead shells only.

MOLLUSCA.

(*continued.*)

	Valencia Harbour.															Stations outside Valencia Harbour.					
		Port Magee.	Valencia Harbour—Knightstown area										Port Magee			Doulus Bay.	Dingle Bay.				
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank: rough ground; 15–20 fms.	2¾ mi. N W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N E. o Doulus Hd.: coarse sand, 25 fms. *ca.*	1⅜ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
		Shore.				Dredging and Trawling Grounds.															
Gastropoda—*continued*:																					
Turritella terebra (Linn.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..
Lamellaria perspicua (Linn.),	..	..	—	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
Aporrhäis pes-pelicani (Linn.),	..	..	..	..	..	..	..	—	—	..	..	..	.	..	..	..	..	—[3]	..	..	—[3]
Purpura lapillus (Linn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Buccinum undatum, Linn.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Fusus sp.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—[3]	—[3]	..	..
Nassa incrassata (Ström.),	..	..	..	..	..	..	..	—[3]	..	..	—[2]	..	..	..	..	..	..	..	..	..	..
Cypræa europæa, Mont.,	—	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

MOLLUSCA.

TECTIBRANCHIATA.

	Submerged surfaces of hulks and boats	Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
		Shore.				Dredging and Trawling Grounds.															
		Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell beds; 5–7 fms.	Lough Kay; gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank: rough ground; 15–20 fms.	2¾ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30-40 fms	2–3 mi. N.N.E. o Doulus Hd.: coarse sand, 25 fms. *ca.*	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
Actaeon tornatilis, Linn.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..
[1]***Acera bullata***, O. F. M.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Philine aperta (Linn.),	..	..	..	..	..	—	—	—	..	..	..	—	..	..	..	..	..	..	..	..	..
P. catena (Mont.),	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
P. punctata (Clark),	..	..	—[2]	..	..	..	—	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Aplysia punctata, Cuv.,	..	..	—	..	..	..	..	—	—	..	..	—	..	..	—	..	—	..	..	..	..
Pleurobranchus plumula (Mont.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Runcina Hancocki, Forbes,	..	..	—[2]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
***R.* sp.**,	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..

[1] We were informed by the Rev. A. Delap that numbers of *Acera bullata* were to be seen in the Harbour at times. [2] Among Algæ in Reenagiveen pools.

MOLLUSCA.

NUDIBRANCHIATA.

	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
	Submerged surfaces of h[illegible]ks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground: firm mud; 3–7 fms.	Shell beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. ca.	Fine slate gravel; 15 fms. ca.	Exact locality uncertain.	Rough ground; 20 fms. ca.	Wild Bank: rough ground; 15–20 fms.	2½ mi. N.W. of Valencia Light-house: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. of Doulus Hd.: coarse sand; 25 fms. ca.	1½ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
		Shore.				Dredging and Trawling Grounds.															
Aeolidia papillosa (Linn.),	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Aeolidiella glauca, (A. & H.),	..	..	—	..	..	..	..	—	—	..	—	..	..	..	—	..	..	..	..	..	..
Cuthona Peachii, A. & H.,	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
Cavolina aurantiaca, A. & H.,	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C. amoena, A. & H.,	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
C. olivacea, A. & H.,	—	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Amphorina caerulea (Mont.),	..	..	..	..	..	..	..	—	—	—x	..	..	..	..	..	..	..	..	..	..	..
Tergipes despectus (Johnst.),	..	..	—	..	..	..	..	..	..	..	..	—	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

G. picta, A. & H.,	—	..	..	..	..	..	..	—*x*	..	..	—[2]	..	..	..	..	..	..	..	..	..	..
G. Farrani, A. & H.,	..	..	..	..	..	—	..	—*x*	..	..	..	..	..	..	—	..	..	..	..	..	..
Coryphella gracilis, A. & H.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C. Landsburgii, A. & H.,	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
C. lineata, (Lovén),	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Favorinus albus, A. & H.,	..	..	—	..	..	..	..	..	—	..	..	..	..	..	—	..	..	..	..	..	..
Facelina coronata (Forbes),	—	..	—	—	..	..	..	..	..	..	—[2]	..	..	..	..	..	..	..	..	..	..
F. Drummondi (Thomp.),	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
F. punctata (A. & H.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Antiopa cristata (d. Ch.),	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
A. hyalina, A. & H.,	..	..	—	..	..	..	..	..*x*	—	—*x*	..	..	..	..	—	..	..	..	..	..	..
Lomanotus portlandicus, Thomps.,	..	..	..	—[3]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L. marmoratus, A. & H.,	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	.
Doto coronata (Gm.),	—	..	..	..	..	..	..	—	—	—	—	—	..	..	..	..	..	..	..	..	..

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[1] Among Algæ growing in rockpools at Reenagiveen.

[2] On Laminaria, probably not *in sitû*.

[3] On the beach at Ardcost; probably not its natural habitat.

MOLLUSCA.

NUDIBRANCHIATA.

(continued.)

	Submerged surfaces of hulls and boats.	Shore. Port Magee. Rock and stones.	Shore. Valencia Harbour, Knightstown area. Rock and stones.	Shore. Valencia Harbour, Knightstown area. Banks of sand and gravel.	Shore. Valencia Harbour, Knightstown area. Ardcost peat-bog.	Dredging and Trawling Grounds. Valencia Harbour, Knightstown area. Zostera-beds.	Valencia Harbour, Knightstown area. Soft mud; 0–3 fms.	Valencia Harbour, Knightstown area. Ascidian ground: firm mud; 3–7 fms.	Valencia Harbour, Knightstown area. Shell beds; 5–7 fms.	Valencia Harbour, Knightstown area. Lough Kay: gravel; 3–4 fms.	Valencia Harbour, Knightstown area. Mouth of Harbour: gravel and sand; 7 fms.	Valencia Harbour, Knightstown area. Glanleam Bay: sand; 0–4 fms.	Valencia Harbour, Port Magee. Nullipore ground; 4 fms. ca.	Valencia Harbour, Port Magee. Fine slate gravel; 15 fms. ca.	Valencia Harbour, Port Magee. Exact locality uncertain.	Stations outside Valencia Harbour. Doulus Bay. Rough ground; 20 fms. ca.	Stations outside Valencia Harbour. Dingle Bay. Wild Bank: rough ground; 15–20 fms.	Stations outside Valencia Harbour. Dingle Bay. 3¼ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Stations outside Valencia Harbour. Dingle Bay. Trawling grounds: fine muddy sand; 30–40 fms	Stations outside Valencia Harbour. Dingle Bay. 2–3 mi. N.N.E. o Doulus Hd.: coarse sand, 25 fms. ca.	Stations outside Valencia Harbour. 1¼ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
Doto pinnatifida (Mont.),					.	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
D. fragilis, Forbes,					.	..	..	—	—	—	..	..	..	..	..	..	..	..	..	..	..

Polycera Lessonii (d'Orb.),	..	..	—[1]	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
P. quadrilineata (O. F. M.),	—	..	—	..	..	..	—	—	—	—x	—[4]	..	..	..	—	..	..	..	..	..	..
Acanthodoris pilosa (O. F. M.),	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lamellidoris bilamellata (Linn.),	—	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L. aspera, A. & H.,	..	..	—	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..	..	..
L. sp. (?),	..	..	—	..	..	..	..	..	—	—	..	..	—	..	..	..	..	..	..	..	..
Goniodoris nodosa (Mont.),	..	..	—	..	..	..	..	..	—	..	..	..	—	—	..	..	..	..	..	..	..
Idalia pulchella (?), A. & H.,	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
I. Leachii, A. & H.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..
Hermæa bifida (Mont.),	..	..	..	..	..	..	..	—x	—	..	..	..	..	..	—	..	..	..	..	..	..
H. dendritica, A. & H.,	..	..	—[5]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Elysia viridis (Mont.),	..	..	—	..	..	—	—	—x	—	..	..	..	..	..	..	..	..	..	..	..	..
Limapontia capitata (O. F. M.),	..	..	—[1]	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Actæonia corrugata, A. & H.,	..	..	—[1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

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[1] Among Algæ growing in rockpools at Reenagiveen.

[4] On Laminaria, probably not *in situ*.

[5] On *Codium* at Reenagiveen and Beginnis.

Myrianida pennigera (Mont.),	..	..	—	..	..	..	..	—*x*	—*x*	..	..	..	..	..	..	..	..	..	..	..	..
Polynoe imbricata (?) (Linn.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..
Lepidonotus, sp.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Halosydna gelatinosa, Sars,	..	..	—	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
Hermadion, sp.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..
Acholöe astericola, d. Chiaje,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—
Phyllodoce maculata, O. F. M.,	..	..	..	..	..	..	..	—*x*	—*x*	..	..	..	..	..	..	..	..	..	..	..	..
Phyllodoce, sp.,	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophryotrocha puerilis, Clap.,	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..
Glycera capitata, Oersted,	..	..	..	—	..	..	..	..	..	..	—	..	..	sp. ? —	..	..	..	.	..	..	sp. ? —
Chaetopterus variopedatus, Ren.,	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..
Cirratulus cirratus (?)	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Polymnia nebulosa (Mont.),	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lanice conchilega (Pall.),	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

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[1] Among Algae in Reenagiveen rock-pools and on Breakwater pier.

ANNELIDA. (continued.)	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
		Shore.				Dredging and Trawling Grounds.															
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell-beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. ca.	Fine slate gravel; 15 fms. ca.	Exact locality uncertain.	Rough ground; 20 fms. ca.	Wild Bank: rough ground; 15–20 fms.	2½ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds; fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. of Doulus Hd.: coarse sand; 25 fms. ca.	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
Polychæta—*continued*:																					
Polyophthalmus pictus (Duj.),	..	..	—	..	..	..	..	..	—	—	—	..	..	..	..	..	..	..	..	..	..
Arenicola marina (Linn.),	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
A. ecaudata, Johnst.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
A. Grubei, Clap.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Siphonostoma diplochætos, Otto,	..	..	—	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..

Myxicola infundibulum, Grube,	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Sabellaria alveolata (?) [1]	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..
Hirudinea:																					
Pontobdella muricata (Linn.),	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..
Gephyrea:																					
Thalassema Neptuni, Gaert,	..	..	—	..	—	..	..	..	—	..	..	..	..	..	..	..	—	..	..	..	..
Phymosoma papillosum,	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Phascolosoma tenuicinctum,	..	..	—	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Phascolion Strombi, Mont.,	..	..	..	..	..	..	..	—	—x	..	..	..	..	..	..	..	..	..	..	..	—

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[1] Identified as *S. alveolata* at the time. According to the experience of Hornell, with respect to the range in depth of the two species, *S. alveolata* and *S. spinulosa*, in the Irish Sea (Trans. Liverpool Biol. Soc., vol. v., 1891, pp. 226, 227, and 260), the occurrence of *S. spinulosa* would appear more probable where the depth was at least 15 fms.

CRUSTACEA.	Submerged surfaces of hulls and boats.	Port Magee. Rock and stones.	Valencia Harbour–Knightstown area. Shore. Rock and stones.	Shore. Banks of sand and gravel.	Shore. Ardcost peat-bog.	Zostera-beds.	Soft mud; 0-3 fms.	Ascidian ground; firm mud. 3-7 fms.	Shell beds; 5-7 fms.	Lough Kay: gravel; 3-4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0-4 fms.	Port Magee. Nullipore ground; 4 fms. ca.	Port Magee. Fine slate gravel; 15 fms. ca.	Port Magee. Exact locality uncertain.	Doulus Bay. Rough ground; 20 fms. ca.	Dingle Bay. Wild Bank: rough ground; 15-20 fms.	Dingle Bay. 2½ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Dingle Bay. Trawling grounds: fine muddy sand; 30-40 fms.	Dingle Bay. 2-3 mi. N.N.E. o Doulus Hd.: coarse sand, 25 fms. ca.	1½ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
Podophthalmata:																					
Cancer pagurus, Linn., ...	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..
Xantho florida (Mont.), ...	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Inachus dorsettensis (Penn.),	..	..	..	..	..	..	..	..	—*x*	..	..	..	..	..	..	..	..	—*w*	..	..	..
I. dorynchus, Leach,	..	..	..	..	..	..	..	..	—	—*wx*	..	..	..	..	..	..	..	..	—	..	..
Stenorhynchus rostratus (Linn.),	..	..	..	..	..	..	..	—*x*	..	..	..	..	..	..	..	..	—sp.?	..	..	..	..
Maia squinado (Herbst),	..	..	..	..	..	..	—	—*x*	..	..	..	..	..	..	..	..	..	..	..	..	..
Hyas coarctatus, Leach,	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	—	..	..
Eurynome aspera (Penn.),	..	..	..	..	..	..	..	—	—	..	..	..	—	..	..	..	..	..	..	..	..
Ebalia tuberosa (Penn.),	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..
E. tumefacta (Mont.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..
E. Cranchii, Leach,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—*w*	—	..	..
Eupagurus Bernhardus (Linn.),	..	..	..	—	..	..	..	—	—	..	..	..	..	..	..	..	—	..	—	..	..
E. Prideaux, Leach,	..	..	..	..	..	..	..	..	—*x*	..	—	—	..	..	..	..	..	..	—	..	..
Anapagurus Hyndmanni (Thompson),	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	—*w*	..	..	—*w*
Porcellana longicornis (Linn.),	..	..	..	..	..	..	..	..	—	..	—	..	..	..	..	..	..	..	..	..	..
P. platycheles (Penn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

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[1] There is some uncertainty respecting the identification of the Portunus recorded as *P. depurator*, specimens of which were not kept. *P. depurator* is apparently less abundant in the West of Ireland than on the S.W. coast of England, being supplanted to some extent by other species (*P. corrugatus* and *P. arcuatus*), which are relatively scarce in the last-named locality.

[2] Specimens of *Polybius Henslowii* were forwarded from Valencia early in the present year (1899), by Miss C. Delap, with the report that a considerable number had been brought in by a trawling smack.

[3] This pelagic species occurs at times in Valencia Harbour, and is well-known to the Misses Delap; a few specimens were seen during the summer of 1896.

CRUSTACEA—*continued*.	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
		Shore.				Dredging and Trawling Grounds.															
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground: firm mud; 3–7 fms.	Shell-beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground: 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank: rough ground; 15–20 fms.	1¾ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. of Doulus Hd.: coarse sand; 25 fms. *ca.*	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
PODOPHTHALMATA—*continued*:																					
Galathea squamifera, Leach,	..	..	—	..	..	..	..	—*x*	..	..	..	..	..	..	..	..	..	..	..	..	..
G. dispersa (?),	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..
G. intermedia, Lillj.,	..	..	..	..	..	..	..	..	—*x*	—10*x*	..	..	..	..	..	..	..	..	..	..	..
G. strigosa, Fabr.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[4]*Homarus vulgaris*, M. Edw.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

Schizopoda:																					
Lophogaster typicus, M. Sars,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	.	—
[6]*Nyctiphanes norvegica* (M. Sars),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[8]*N. Couchii* (Bell),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[6]*Macromysis flexuosa* (O. F. M.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M. neglecta (G. O. Sars),	..	..	..	..	..	..	—	..	..	—x	..	—x	..	..	—	..	..	..	..	..	..
M. inermis (Rathke),	..	..	..	..	..	..	..	..	..	—x	..	—x	..	..	—	..	..	..	..	..	..
Schistomysis ornata (G. O. S.),	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..
[7]*Heteromysis formosa*, S. I. Smith,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Leptomysis lingvura, G. O. S.,	..	..	..	..	..	..	..	..	..	—x	..	..	..	..	..	—	..	..	—x	..	..
Mysidopsis angusta, G. O. S.,	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..
M. gibbosa, G. O. S.,	..	..	..	..	..	..	—	..	..	..	..	..	..	—	..	..	..	..	..	..	..
[8]*Siriella armata* (M. Edw.),	..	..	..	..	..	..	—	..	..	—x	..	—x	..	..	—	..	..	..	..	..	..
S. Clausii, G. O. S.,	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Gastrosaccus spinifer (Goës),	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..

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[4] Fished commercially in the district. English collecting vessels visit Valencia.

[5] Common in Valencia Harbour (A. O. W.).

[6] Townetted in the Harbour by E. T. Browne (A. O. W.).

[7] Valencia Harbour, Shore (A. O. W.).

[8] One specimen taken in Valencia Harb., at surface, by Miss C. Delap (Holt and Beaumont, *Trans. Royal Dublin Society*, 1900.

[8] *Astacilla longicornis* (Sowerby),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[9] *Idotea linearis* (Linn.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[8] *I. emarginata* (Fabr.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[9] *I. marina* (Linn.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[10] *I. granulosa*, Rathke,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[11] *I. viridis* (Slabber),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Janira maculosa, Leach,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..
[11] *Janiropsis breviremis*, G. O. Sars,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Amphipoda:																					
[8] *Hyperia galba* (Mont.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[12] *Parathemisto oblivia* (Kröyer),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[11] *Hyale Nilssonii* (Rathke),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Lysianax ceratinus, A. O. W.,	..	..	..	..	..	..	..	—x	..	—x	..	—x	..	..	..	..	..	..	..	..	—
L. Costæ (M. Edw.),	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[8] *Socarnes erythrophthalmus*, Robertson,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Hippomedon denticulatus (Spence Bate),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—

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[8] Valencia Harbour, per F. W. Gamble (A. O. W.). (*Hyperia galba* from Pelagia.)

[9] Generally distributed (A. O. W.).

[10] Valencia Harbour, per A. C. Haddon (A. O. W.).

[11] Valencia Harbour, Shore (A. O. W.).

[12] Valencia Harbour, Dingle Bay, &c., young specimens only (A. O. W.).

CRUSTACEA—*continued*.

Area	Locality	Division	Ground
			Submerged surfaces of hulks and boats.
VALENCIA HARBOUR.	Port Magee.	Shore.	Rock and stones.
VALENCIA HARBOUR.	Valencia Harbour—Knightstown area.	Shore.	Rock and stones.
			Banks of sand and gravel.
			Ardcost peat-bog.
		Dredging and Trawling Grounds.	Zostera-beds.
			Soft mud; 0–3 fms.
			Ascidian ground: firm mud; 3–7 fms.
			Shell beds; 5–7 fms.
			Lough Kay: gravel; 3–4 fms.
			Mouth of Harbour: gravel and sand; 7 fms.
			Glanleam Bay: sand; 0–4 fms.
	Port Magee.		Nullipore ground; 4 fms. *ca.*
			Fine slate gravel; 15 fms. *ca.*
			Exact locality uncertain.
STATIONS OUTSIDE VALENCIA HARBOUR.	Doulus Bay.		Rough ground; 20 fms. *ca.*
	Dingle Bay.		Wild Bank: rough ground; 15–20 fms.
			2½ mi. N.W. of Valencia Light-house: sand; 36 fms.
			Trawling grounds: fine muddy sand; 30–40 fms.
			2–3 mi. N.N.E. of Doulus Hd.: coarse sand; 25 fms. *ca.*
			1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.

Perioculodes longimanus (S. Bate), . .	..	..	..	..	..	..	..	—x	..	—x	..	—x	..	..	..	..	..	..	..	..	..
Synchelidium haplocheles (Grube), . .	..	..	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	—
Halimedon parvimanus (S. Bate), . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	—
Iphimedia minuta, Sars, ...	..	..	..	..	..	..	..	—x	..	..	..	—x	..	..	—	..	..	..	..	..	..
[11] *Apherusa borealis* (Boeck), . . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[6] *A. bispinosa* (S. Bate), ...	..	..	..	..	..	..	..	..	..	..	..	..	..	—	—	..	..	..	..	..	..
[6, 11] *A. Jurinii* (M. Ewd.), ...	..	..	..	..	..	..	—	..	..	—x	..	..	..	..	..	..	..	..	..	..	..
Paratylus Swammerdamii (M. Ewd.), .	..	..	..	..	..	..	..	..	..	—x	..	..	..	..	—	..	..	..	..	..	..
P. uncinatus (Sars), ...	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..
P. vedlomensis (S. Bate), ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	—
Dexamine spinosa (Mont.), ...	..	..	..	..	..	..	—	—x	..	..	.	—x	..	..	—	..	..	..	..	..	..
[11] *Tritæta gibbosa* (S. Bate), . . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Guernea coalita, Norman, ...	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—
Melphidippella macera, Norman, . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..
[6, 11] *Amathilla homari* (Fabr.), . . .	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..

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[6] Townetted in the Harbour by E. T. Browne (A. O. W.).

[8] Valencia Harbour, per F. W. Gamble (A. O. W.).

[11] Valencia Harbour: Shore (A. O. W.).

CRUSTACEA—*continued*.	VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.				
	Submerged surfaces of hulks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell-beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. *ca.*	Fine slate gravel; 15 fms. *ca.*	Exact locality uncertain.	Rough ground; 20 fms. *ca.*	Wild Bank: rough ground; 15–20 fms.	2¾ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N.E. of Doulus Hd.: coarse sand; 25 fms. *ca.*	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
		Shore.				Dredging and Trawling Grounds.															
AMPHIPODA—*continued*.																					
Gammarus locusta (Linn.),	..	..	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..
G. campylops, Leach,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—
Gammarella brevicaudata (M. Edw.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..
11 *Melita palmata* (Mont.),	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Mæra othonis, M. Edw.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..
Megaluropus agilis, Norman,	..	..	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..
Cheirocratus Sundevalli (Rathke),	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..
C. assimilis (Lillje.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—

Leptocheirus pilosus, Zadd.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—
Gammaropsis maculatus (Johnst.),	..	..	.	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..
Megamphopus cornutus, Norman,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—
Microprotopus maculatus, Norman,	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[9]*Photis longicaudatus* (S. Bate),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[11]*Amphithoë rubricata* (Mont.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[11]*Pleonexes gammaroides*, S. Bate,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—
[6]*Ischyrocerus minutus*, Lillje.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
[11]*Podocerus falcatus* (Mont.),	..	..	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..
P. cumbrensis, Stebbing and Robertson,	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..
Erichthonius abditus (Templeton),	..	..	..	..	..	..	..	—x	..	..	..	—x	..	—	..	..	..	..	..	..	..
[11]*Corophium Bonellii*, M. Edw.,	..	..	..	..	..	..	—	—x	..	..	..	—x	..	..	..	..	..	..	..	..	..
Phtisica marina, Slabber,	..	..	..	..	..	..	—	—x	..	—x	..	—x	..	..	..	..	..	..	..	..	..
Caprella acanthifera, Leach,	..	..	..	..	..	..	—	—x	..	—x	..	—x	..	..	..	..	..	..	..	..	..
C. acutifrons, Latr.,	..	..	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	..	..	..
Parvipalpus capillacea (Chevr.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..

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[6] Townetted in the Harbour by E. T. Browne (A. O. W.).

[9] Valencia Harbour, per F. W. Gamble (A. O. W.).

[11] Valencia Harbour: Shore (A. O. W.).

		VALENCIA HARBOUR.															STATIONS OUTSIDE VALENCIA HARBOUR.					
		Port Magee.	Valencia Harbour—Knightstown area.										Port Magee.			Doulus Bay.	Dingle Bay.					
		Shore.				Dredging and Trawling Grounds.																
ECHINODERMATA.	Submerged surfaces of h. ks and boats.	Rock and stones.	Rock and stones.	Banks of sand and gravel.	Ardcost peat-bog.	Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground: firm mud; 3–7 fms.	Shell beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Nullipore ground; 4 fms. ca.	Fine slate gravel; 15 fms. ca.	Exact locality uncertain.	Rough ground; 20 fms. ca.	Wild Bank: rough ground; 15–20 fms.	2½ mi. N.W. of Valencia Lighthouse: sand; 36 fms.	Trawling grounds: fine muddy sand; 30–40 fms.	2–3 mi. N.N.E of Doulus Hd.: coarse sand; 25 fms. ca.	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.	
Synapta inhaerens (O. F. M.																						

Asterina gibbosa (Penn.),	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Henricia sanguinolenta (O. F. M.),	..	..	—	..	..	..	—	..	..	..	..	..	—	..	—x	..	..	—	..	..	..
Asterias glacialis, Linn.,	..	..	—	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..
A. rubens, Linn.,	..	..	—	..	..	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..
Ophiura ciliaris (Linn.),	..	..	..	..	..	..	..	—x	..	..	..	..	..	..	..	..	—	..	..	..	..
O. albida, Forbes,	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..
Amphiura elegans (Leach.),	..	..	—	..	..	..	..	—x	—	..	—	..	..	..	..	..	..	..	..	..	..
Ophiactis Ballii (Thompson),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—x	..	..
Ophiopholis aculeata (Linn.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophiocoma nigra (Abild.),	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ophiothrix fragilis (Abild.),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Echinus miliaris, Linn.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
E. esculentus, Linn.,	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..
Strongylocentrotus lividus (Lamk.),	..	..	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Echinocyamus pusillus (O. F. M.),	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..
Spatangus purpureus, O. F. M.,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	—	..	—
Echinocardium pennatifidum, Norman,	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	—	..	—

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[1] Recorded by Gamble as obtained by digging on Ardcost shore.

[2] Species doubtful.

PYCNOGONIDA.	Submerged surfaces of hulls and boats.	Shore. Port Magee. Rock and stones.	Shore. Valencia Harbour—Knightstown area. Rock and stones.	Shore. Banks of sand and gravel.	Shore. Ardcost peat-bog.	Dredging and Trawling Grounds. Zostera-beds.	Soft mud; 0–3 fms.	Ascidian ground; firm mud; 3–7 fms.	Shell beds; 5–7 fms.	Lough Kay: gravel; 3–4 fms.	Mouth of Harbour: gravel and sand; 7 fms.	Glanleam Bay: sand; 0–4 fms.	Port Magee. Nullipore ground; 4 fms. ca.	Port Magee. Fine slate gravel; 15 fms. ca.	Port Magee. Exact locality uncertain.	Stations outside Valencia Harbour. Doulus Bay. Rough ground; 20 fms. ca.	Dingle Bay. Wild Bank: rough ground; 15–20 fms.	Dingle Bay. 2½ mi. N.W. of Valencia Light-house: sand; 36 fms.	Dingle Bay. Trawling grounds: fine muddy sand; 30–40 fms	Dingle Bay. 2–3 mi. N.N.E. o Doulus Hd.: coarse sand, 25 fms. ca.	1¾ mi. S.W. of Bray Hd.: coarse gravel and sand; 45 fms.
Nymphon gracile, Leach,	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..
N. gallicum, Hook,	..	..	—	—	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ammothea echinata (Hodge),	—	..	—	..	..	..	..	—	—	..	..	—	..	..	..	..	..	..	..	..	..
Pallene brevirostris (Johnst.),	..	..	..	..	..	..	..	—x	—	..	..	—	..	..	..	..	..	..	..	..	..
Phoxichilidium femoratum (Rathke),	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Anoplodactylus petiolatus (Kr.),	—	..	..	..	..	..	..	—	—	..	..	—	..	..	..	..	..	..	..	..	..
Phoxichilus spinosus (Mont.),	—	..	..	..	..	—x	..	—x	—	..	..	—	..	..	..	..	..	..	..	..	..
P. laevis, Grube,	..	..	..	..	..	..	..	..	..	..	..	..	—	..	..	..	..	..	..	..	..
Pycnogonum littorale (Ström),	..	..	—	..	..	..	..	..	—	..	..	..	..	..	..	..	..	..	..	..	..

x This symbol is used where there is any doubt, not with regard to the identification of specimens, but … of the ground where they were obtained.

VIII.—REPORT ON THE ALGÆ. BY PROF. F. E. WEISS, B.Sc., Owens College, Manchester.

When I accepted the kind invitation of my friends, Mr. E. T. Browne and Mr. F. W. Gamble, to make use of the facilities which the establishment of a temporary Biological Station on Valencia Island offered, I went there with no special intention to investigate the Algal flora of that interesting district from a systematic point of view, but mainly to make some additions to the herbarium of the museum at the Owens College, and also to make preparations of the reproductive organs and collect material for the use of my students. That in so doing I should come across some forms unrecorded for the district and sometimes even for Ireland was to be expected, and I gladly avail myself of this opportunity of putting them on record, so that the useful "Revised List of British Marine Algæ," published by Messrs. E. M. Holmes and E. A. L. Batters[1] may be further completed as far as the distribution of some of the species in Ireland is concerned. According to the division of the coast-line into tabulation areas by Messrs. Holmes and Batters, which are prefixed to their revised list and amended in the appendix published in the notes at the end of vol. v., Valencia would be included in district 11, which embraces the coast from Slyne Head to Crow Head, including the outlying islands.

There is no doubt that this coast-line is very rich in seaweeds, and has been far less explored than many other regions. Indeed, Professor Johnson pointed out the need for a more thorough investigation of the seaweeds of the south and west of Ireland; and I feel sure that a more systematic search than I was able to undertake would reveal many more forms which are still unrecorded for the west of Ireland. But apart from any gain to our knowledge of the distribution of species by establishing their occurrence in the various tabulation are as, every collector of seaweeds would be interested in those forms which are well known to occur on the west coast of Ireland, and which are in some measure typical of its Algal flora. Thus *Petrocelis cruenta, Nemalion multifidum, Ceramium acanthonoton*, all stated by Harvey in his *Phycologia Britannica*, to be common on the west coast of Ireland,

[1] Annals of Botany, vol. v., 1890.

are abundant on the rocks at Valencia, while some of the rarer form such as *Cladophora rectangularis* and *Stenogramme interrupta*, whic occur in deeper water below low tide-mark, are occasionally throw up, or may be dredged in the channels between the island and th mainland. *Cladophora rectangularis*, a beautiful and delicate green Alg first recorded in 1832 by M. Borrer for Torquay as a very rare form, wa afterwards found to be abundant by M'Calla in 1840 in Roundston Bay, where it can be dredged at depths of 4 to 6 fms. In this localit it is washed up in large quantities at the close of the summer, and i carted off for manure. *Stenogramme*, growing probably at simila depths, is also not new to Ireland, having been found both on th north and also on the south coasts, regions 10 and 14 of Holmes and Batters, but is new to the western area. In England it is only known from the south coast.

Another interesting form which attains to great perfection on the west coast of Ireland is *Delesseria hypoglossum*, of which Miss C. Delap has recently sent me as luxurious a specimen as that figured in the *Phycologia Britannica*, which illustration was made from an exceptionally beautiful specimen obtained by Miss Hutchinson in Bantry Bay.

In the list of Algæ which follows, the figure (11) after the name denotes that this figure, indicating the west of Ireland tabulation area, should be added to Messrs. Holmes and Batters' Revised List. In some cases these records were overlooked by Messrs. Holmes and Batters; in other cases the species have been recorded since the publication of their list. The letters n.I. and n.d. prefixed to the name indicates that as far as I have been able to ascertain these forms have not been previously recorded for Ireland (n.I.) or for the district (n.d.)

I append the full list of Algæ collected by me during the month I spent at Valencia, not with any pretensions to a complete or exhaustive list of that locality, for, as I have stated above, I was not specially concerned with working out the Algal flora of the district, but because I think the list may be both of local and of general interest, as representing forms most commonly met with on the island, and therefore typical of the locality.

A LIST OF SPECIES TAKEN.

CYANOPHYCEÆ.

Lyngbya majuscula, Harv.
Rivularia nitida, C. Ag.

CHLOROPHYCEÆ.

Enteromorpha ramulosa, Harv. (11)
E. compressa, Grev.
Cladophora hutchinsiæ, Harv.
C. rupestris, Kütz.
C. rectangularis, Harv.
Codium adhærens, C. Ag. (10) (11) (12)
C. tomentosum, Stackh. (11)

PHÆOPHYCEÆ.

Desmarestia aculeata, Lmx.
D. ligulata, Lmx.
Myriotrichia clavæformis, Harv. var. *minima*, [Holm. et Batt.
Streblonema velutinum, Thur.
Elachista fucicola, Fries.
Sphacelaria cirrhosa, C. Ag.
Myriactis pulvinata, Kütz.
Myrionema strangulans, Grev.
Ascocyclus orbicularis, Rke. (11)
n.d. *Spermatochnus paradoxus*, Rke. (11)
Chordaria flagelliformis, C. Ag.
Mesoglœa vermiculata, Le Jol.
Castagnea zosteræ, Thur. (11)
Leathesia difformis, Aresch.
Chorda filum, Stackh.
Laminaria saccharina, Lmx.
Saccorhiza bulbosa, Dela Pyl.
Aglaozonia reptans, Kütz. (11 & 12)
Fucus ceranoides, Linn.
F. vesiculosus, Linn.
F. serratus, Linn.
Ascophyllum nodosum, Le Jol.

Pelvetia canaliculata, Dene et Thur.
Halidrys siliquosa, Lyngb.
Cystoseira ericoides, C. Ag.
Himanthalia lorea, Lyngb.
Dictyota dichotoma, Lmx.
D. implexa, J. Ag.

RHODOPHYCEÆ.

Chantransia virgatula, Thur.
sp. nov. *C. endozoica*, Darbish. (11)
Nemalion multifidum, J. Ag.
n.d. *Scinaia furcellata*, Bivona. (11) (12)
Gelidium corneum, Lmx.
Chondrus crispus, Stackh.
n.d. *Stenogramme interrupta*, Mont. (11)
Callophyllis laciniata, Kütz.
Callymenia reniformis, J. Ag.
Cystoclonium purpurascens, Kütz.
Calliblepharis ciliata, Kütz.
n.d. *C. jubata*, Kutz (11)
Lomentaria articulata, Lyngb.
Champia parvula, Harv. (11)
Chylocladia ovalis, Hook.
Plocamium coccineum, Lyngb.
Nitophyllum laceratum, Grev.
Delesseria alata, Lmx.
D. hypoglossum, Lmx.
D. sinuosa, Lmx.
D. sanguinea, Lmx.
Bonnemaisonia asparagoides, C. Ag.
Laurencia pinnatifida, Lmx.
Chondria dasyphylla, C. Ag.
Polysiphonia elongata, Grev.
P. fruticulosa, Spreng.
P. nigrescens, Grev.
Dasya coccinea, C. Ag.
Spermothamnion turneri, Aresch.
Griffithsia setacea, C. Ag.
Monospora pedicellata. Solier.
Rhodochorton floridulum, Naeg.

Callithamnion tetragonum, C. Ag.
n.d. *C. seirospermum*, Griff. (11)
Campsothamnion thuyoides, C. Ag.
Plumaria elegans, Bonnem.
Ptilota plumosa, C. Ag.
Antithamnion plumula, Thur.
Ceramium ciliatum, Ducluz.
Dumontia filiformis, Grev.
Dudresnaya coccinea, Bonnem.
Dilsea edulis, Stackh.
Petrocelis cruenta, J. Ag.
n.d. *Cruoria pellita*, Lyngb. (11)
Hildenbrandia prototypus, Nardo.
Lithothamnion polymorphum, Aresch.
n.d. *L. lenormandi*, Rosan. (11)
L. coralloides, Cr.

Some few remarks are necessary in elucidation of these records.

In the Irish Naturalist (vol. iv., p. 241) Prof. Johnson states that "it would be comparatively easy for us to make a list of species found, not recorded in Holmes and Batters' list. Such a proceeding would be out of place, as there are many species in collections made by earlier workers known to us not recorded."

I cannot think but that the rendering of the Revised List of Holmes and Batters more complete would be very useful to all those who, like myself, are less acquainted with the collections of earlier workers, and I am sure Prof. Johnson would earn the gratitude of many workers by so doing.

I shall have to refer to some of the omissions in the Revised List. With regard to *Codium adhærens*, which appears in Holmes and Batters' Revised List as unrecorded from Ireland, it will be found that Harvey has added a note in his *Phycologia Britannica* to the effect that it was first recorded for Ireland by Mr. D. Moore in 1834, who found it on Rathlin Island, Antrim, and subsequently Mr. G. Hyndman discovered it on Tory Island, so that the figures 10, 11, 12 should be added to the list.

Codium tomentosum must also have a wider distribution than that mentioned in the Revised List, for Harvey describes it as common on the shores of the British Islands. That it is not new to Ireland is obvious from the fact that Prof. Johnson refers in the "Irish Naturalist" (vol. i.) to *Streblonema simplex* (Crn.), an Epiphyte on

Codium tomentosum, found by him in 1891, b
and at Castletown, Berehaven.

Ascocyclus orbicularis, which was recor
Johnson and Miss Hensman (Irish Nat., vol.
common on the leaves of *Zostera*, and on th
uncommonly, small growths of *Castagne*
Mesogloea virescens, var. *zostericola*, of the *Ph*
plant is not new to Ireland, though not
Ireland in the Revised List, for Harvey men
M'Calla in Roundstone Bay, and it has sinc
by Prof. Johnson from the same locality (
p. 241).

Aglaozonia reptans has, since the publica
been recorded by Prof. Johnson for both the
for Belfast Lough, *i.e.*, for areas 11 and 12.

The most interesting discovery I made
sence of a small red seaweed beneath the cu
mens of *Alcyonidium gelatinosum*. The *Al*
appearance, so uniformly had the Alga sp
horny covering of the Polyzoon. From tim
branches were put forth, apparently thro
covering. I put these specimens, of which
tions, retaining their original colour, into
Darbishire for description; and he has pub
Alga in the *Berichte der Deutschen Botanisch*
No. 1, 1899. He finds the Alga to be a ne
to which, from its peculiar mode of life,
endozoica. A *Chantransia* of somewhat sin
ing endophytically, *i.e.*, growing in tissues
Chordaria flagelliformis, has been described
under the name of *Chantansia microscopic*
known to be attacked by a green Alga, *E*
Phillipsii, Batt.,[2] and by a brown Alga, *En*

Scinaia furcellata, Bivona, which was not
the Revised List, has since been recorded fro
Lough by Professor Johnson and Miss Hen
p. 252).

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[1] Batters, E. A. L., 1896. Journal of Bo
[2] Batters, E. A. L., 1897. Journal of Bo
[3] Gran, H. H., 1897. Videnskabsselskab

Calliblepharis jubata, which is new to the district, was not uncommon, and the specimens were characterised by exceedingly long and tangled cilia.

Champia parvula, not reported in the Revised List for Ireland, has been recorded by Prof. Johnson and Miss Hensman, and *Callophyllis* has been collected by H. Hanna at Achill Island (Irish Nat., vol. vii., p. 143).

Monospora pedicellata, Sol., the *Callithamnion pedicellatum* of the *Phycologia Britannica*, is of interest, as having been recorded by Harvey himself from Valencia.

The Corallinæ are Algæ of very variable character, and not easy of determination, but *Lithophyllum lenormandi* (Rosan.) recorded by Prof. Johnson from Belfast Lough (Irish Nat., vol. 5, p. 253), may now, I think, be safely added to the west coast flora from the specimens I collected. *Lithothamnion coralloides*, Cr., and *Lithothamnion coralloides, flabelligera*, Fosl., were dredged in large quantities in Port Magee Channel.

In conclusion I wish to acknowledge my indebtedness to Prof. M. Foslie, to Mr. E. M. Holmes, Dr. O. V. Darbishire and Mr. H. Murray for their assistance in the identification of some of the above-mentioned Algæ.

IX.—REPORT ON THE LUCERNARIDÆ. By W. I. BEAUMONT, B.A.

Order.—**STAUROMEDUSÆ.**

Family.—LUCERNARIDÆ.

Genus.—HALICLYSTUS.

Haliclystus auricula (Rathke).

Haliclystus auricula, James Clark, Prodrom. Lucern. Journ. Boston Soc. Nat. Hist., 1863, p. 559; and Monog. Lucern., Smiths. Contrib., 1881.

H. auricula, Haeckel, System Medusæ, 1879, p. 389.

H. octoradiatus, Lamarck et auct. plur. (*nec* Haeckel, *nec* James Clark).

Found by us on Zostera in Valencia Harbour in spring and summer. Very abundant near Church Island. Probably to be found all the year round. The Misses Delap report it plentiful in January.

Haliclystus does not appear to attain large dimensions at Valencia; specimens measuring 12 mm. in diameter, inclusive of the arms, are very numerous, but none exceeding this by more than about 2 mm. have come under my notice. In some localities the species attains a diameter of 20 to 30 mm. According to Hornell[1] the common *Haliclystus*[2] of the Channel Islands is to be found half grown in June, averaging then about 12 mm. across the disc, while large adults of 18 to 25 mm occur in the early months of the year. Through the kindness of the Misses Delap I have recently had an opportunity of examining a number of *Haliclystus* collected at Valencia in January. They do not differ appreciably in size from those gathered by us in spring and summer. Evidently large individuals are very rare, or retire to some less accessible situation. Sexual maturity is attained by these individuals, though only

[1] "Nat. Science," iii., 1893, p. 33.

[2] Hornell names this Jersey species *H. octoradiatus*. Whether it is the same species as the one dealt with in this paper I am unable to say. The only specimen from Jersey which I have seen is *H. auricula*.

half grown compared with those found in some localities. A number of them deposited ova in our laboratory in May, some of which developed to the planula stage.

Haliclystus has been known on the Atlantic coast of Europe since the beginning of the century, and has been described by a number of the older naturalists under the names *Lucernaria auricula* and *L. octoradiatus.*

As to the possibility of recognizing two distinct species the authorities do not agree, and, moreover, if two distinct species be recognised, both specific names have been applied to each species by one author or another. Any fresh attempt to unravel this tangle or to re-determine the species described by the older naturalists is outside my present purpose. I have deemed it sufficient to rely on the descriptions of James Clark and of Haeckel. These are substantially in agreement, and it must be understood that in what follows the specific names *H. auricula* and *H. octoradiatus* are invariably used in accordance with the definitions of those authors.

With regard to the distribution of the two species defined by them, however, James Clark and Haeckel differ. The former considered that there were two totally distinct European species: one, the *Lucernaria auricula* of Rathke,[1] Johnston, and others, which he regarded as identical specifically with the common American form, the subject of his elaborate monograph in the Smithsonian Contributions; the other the *Lucernaria octoradiata* of Sars and Keferstein,[2] of which he gives a description in his "Prodromus," founded on those of the last-named naturalists, and confirmed by an inspection of some young specimens received from Keferstein. James Clark does not appear to have had an opportunity of examining *Haliclystus auricula* from Europe, but American specimens sent by him to Michael Sars were pronounced by the latter to be the "*L. octoradiata*, Lamarck (*L. auricula*, Johnston, Sars *olim*, non Fabricius)," Sars apparently holding his own *H. octoradiata* to be distinct from that of Lamarck.

Haeckel takes a different view. His *H. octoradiatus* and *H. auricula* are defined in accordance with the descriptions of

[1] Müller's Zool. Danica, iv., 1806, p. 35.

[2] Sars, Skandinav. Naturforsch. Kjöbnh., 1860, p. 693; Keferstein, Zeitschrift. Wissenschaft. Zool., 1862, p. 2 *et seq.*

James Clark; but he suggests that it is improbable that the same species should occur on both sides of the Atlan refers all the European members of the genus to the species, and retains the name *auricula* for the Americ only. Although, strictly, that name being older than *octo* should be used for the (on his view) single European s

From this view I strongly dissent. In the course of nation of very many *Haliclystus* from Valencia, Falmo Plymouth,[1] as well as single specimens from Jersey Isle of Man, I have entirely failed to meet with a sing specimen agreeing with the descriptions of *H. octoradi* have seen only few large specimens, but all are in my *H. auricula*. The rest may be arranged according to s series, exhibiting the stages of growth and evolu character. There appears to me no reason for doubti they are one and all members of the same species characters appropriate to their size.

The distinguishing features of the two species ar (taken chiefly from Haeckel, who gives concise diagnose

H. octoradiatus—Arms arranged at equal distances ap perradial and interradial bays of the sub-umbrellar margi equal; marginal anchors (colleto-cystophores) egg-sha almost club-shaped, smaller than in *H. auricula*; each ar 30–60 tentacles; genital bands arranged at equal di apart, each band composed of 20–30 large sub-equal s arranged in two longitudinal rows.

H. auricula.—Arms approximated in pairs, the perradi of the sub-umbrellar margin twice as wide and deep interradial; marginal anchors coffee-bean shaped, large arm bearing 100–120 tentacles; genital bands approxim pairs, broadly triangular in shape, each band consisting o 125 saccules arranged in 6–8 longitudinal rows, the size saccules increasing from the interradial border across th to a maximum on the perradial border.

Haeckel also speaks of some difference in the shape ar portions of the umbrella; a matter of little practical v the case of animals so apt to change their shape eve

[1] It has been customary at the Plymouth Laboratory to label the loca *H octoradiatus*. I am not aware by whom, and upon what grounds, the d nation was originally made.

moments, as may be readily seen on inspection of plate i., in James Clark's monograph. The character of the gonads is regarded by both Haeckel and James Clark as the most important point, and is stated to be sufficient to distinguish the two species at a glance. In applying the above definitions to my specimens, it will be convenient to consider first those organs and the tentacles; not losing sight of the fact that the tentacles and the genital saccules increase in number during growth, and that the above diagnoses apply to full-grown animals about 25 mm. in diameter.

In large Plymouth specimens, 18 mm. across the bell, we find about 120 tentacles on each arm, the gonads broadly triangular and arranged in pairs, each consisting of upwards of 80 saccules arranged in 6–7 rows, the size of the saccules increasing from the interradial to the perradial border of each band.

It must be admitted that these agree closely with *H. auricula*, and certainly do not fall in with the definition of *H. octoradiatus*. A few somewhat smaller Plymouth specimens, having 60–100 tentacles on each arm and 50–60 saccules in each genital band arranged in 4–5 rows, bridge over the gap between the first named and the largest specimens from Valencia, and those from elsewhere of about the same size, 7–8 mm. diameter. These have on each arm 50–70 tentacles and about 33 saccules in each gonad in 3–4 rows, the perradial saccules the largest.

Individuals of 5–6 mm. have 40–60 tentacles on each arm, and about 25 saccules in 3 rows in each genital band. And so one passes on to the smallest that I have seen, about 3 mm. in diameter; having 9–12 tentacles to each arm, and about 10 saccules in a genital band, which consists of a single row of saccules for about one-third of its length at each end and a double one in the middle. Yet even in some of the very small individuals the greater size of the saccules of the perradial border is already evident. From these facts the conclusion may fairly be drawn, that we are dealing with a series belonging to one species; and since those of largest size conform very closely to *H. auricula*, I am compelled to believe that all are *H. auricula*.

Of course it may be pointed out that the Valencia *Haliclystus* is mature and breeding, and has not the full characters of an adult *H. auricula*. But it may be reasonably advanced that they have characters appropriate to *H. auricula* of their size;

and that they certainly do not agree with *H. octoradiatus*, the largest of them, though only half as big as full-si specimens of the latter, have already as many, or even m tentacles on each arm and saccules in a genital band than maximum number given for that species; and the saccules different in arrangement as well as in number. The fact t sexual maturity may be attained in a Medusa before it reached its maximum growth and development has been rec nised by Browne[1] among the Hydromedusæ; more especia in the case of *Lizzia blondina*, where it has led to young sta of the same animal being described not only as distinct spec but even genera.

Dealing now with the other characters: the approximat of the arms in pairs is exhibited, more or less, by all the spe mens which I had examined with respect to this point. It hardly be regarded as a point of much value unless w strongly marked; it is shown in varying degrees by differ specimens, and I am inclined to think by the same individ in different states of expansion, being influenced by the st of contraction of the muscle-bands. The marginal anchors very variable in size. Of two equal-sized individuals, one m have anchors twice as large as the other. They are sometin egg-shaped in preserved specimens, showing little or no tr of a longitudinal furrow; but usually they are much wrinkl especially if large, and a longitudinal furrow is visible in ma In living animals which I have examined there is in most ca a well-marked longitudinal furrow, suggesting resemblance a coffee-bean; and a ring of pigment surrounds a pale and oft slightly raised spot, which marks the vestige of the tenta head possessed by the anchor in its early stages. These featu are not quite so conspicuous as in James Clark's figures (Mo graph, Pl. i., fig. 17), but they agree very closely. Apparent in our specimens the anchors assume the adult condition wh the animal is of smaller size than is the case in the Americ form. But the size at which this takes place is by no mea constant. I have come across a few specimens, 6 mm. diameter, having capitate anchors, resembling James Clar figs. 25–27, Pl. iii., while most individuals of that size ha anchors of adult form. According to Hornell (*loc. cit.*) a lar

[1] Journ. Mar. Biol. Assoc., 1898, vol. v., p. 188.

proportion of half-grown specimens of the Jersey *Haliclystus*, averaging 12 mm. in diameter, exhibit some traces of this feature; "in a few rare cases the apex of the colletocystophore bore a perfect capitate tentacle precisely the same in structure to the normal tentacle, saving that the stalk was extremely short"; from this all gradations were noticed down to "a slight rounded swelling at the apex, with presence of a few ordinary nematocysts of the tentacles." He speaks of these tentacle-crowned colletocystophores as malformations, being apparently unaware that it is the normal condition in young anchors.

The evidence of these minor features is in no way opposed to the conclusion drawn from the more important character of the tentacles and genital bands.

Genus—LUCERNARIA.

Lucernaria campanulata, Lamouroux.

Calvadosia campanulata, James Clark, Prodrom. Lucern. Journ. Boston Soc. Nat. Hist., 1863, p. 557.

Lucernaria campanulata, Haeckel. System Medusæ, 1879, p. 392.

This species was found living on the Zostera near Church Island, Valencia Harbour, in the summer of 1896. It was fairly abundant, though less so than Haliclystus; Mr. Browne, who collected large numbers of both species in order to study variation, estimated the relative abundance as about 1 to 5. A few specimens were sent to me by the Misses Delap, in January, 1899, from the Zostera-beds near Church Island and Knightstown.

The largest specimen I have examined measures rather over 30 mm. in height, including stalk, and 25 mm. in width, including arms; the diameter of the bell without arms being nearly 15 mm. It is preserved in formol.

Previously recorded from the south of England and Wales (?), but not from the coast of Ireland.

Lucernaria, nov. sp.

A Lucernarian, not apparently referable to any described species, was dredged in about 15 fms., near the entrance of Port Magee Channel. It is a very small form with an unusully long stalk, living attached to the tiny bits of slate laminæ, which form a chief constituent of the bottom deposit. A detailed description will shortly be published.

X.—Report on the Turbellaria. By

The Turbellaria have received scant noti
faunistic workers on the coasts of Ireland.
that in the following list of seven Polyclad
are added to the Irish list: *Stylochoplana*
losus, *Oligocladus sanguinolentus*, *Stylostom*
The species of Rhabdocœles require co
their identification, and there is no doubt
may be found, especially among the Acœlo

(*a*) Polycladida

Stylochoplana maculata, Quatrefages.

Not uncommon among brown we
giveen, on Beginnis shore, and al
ground in the harbour.

Leptoplana tremellaris (O. F. Müller).

Common everywhere under st
usually occurring in groups.

Prostheceræus vittatus (Montagu).

The muddy shores of estuaries
this fine species. It is taken in t
accumulates in bivalve-shells dred
the coralline-ground at Port Mage

Eurylepta cornuta (O. F. Müller).

Dredged on sponge-covered shel
and Shell-beds of the harbour, an
Port Magee channel.

Cycloporus papillosus, Lang.

On compound Ascidians (chiefly
from the shores of Murreagh Point,
Island.

Oligocladus sanguinolentus (Quatrefage

Dredged on shells in the harbour

Stylostomum variabile, Lang.

Between tide-marks at Reenagiveen and Church Island; also dredged in the harbour.

(*b*) TRICLADIDA.

Two specimens of a marine Triclad were taken by Mr. Beaumont at half-tide amongst Algæ growing at Reenagiveen. One measured 1–4 mm., the other 3 mm. in length. Their immature condition precluded a satisfactory determination. Body with median brown pigmented area, and with brown intestinal cœca. About one-third of its length from the anterior end the body has a broad, white band. Head with smooth margin.

(*c*) RHABDOCŒLIDA.

Convoluta paradoxa, Oersted.

In coralline tide-pools at Reenagiveen.

Promesostoma marmoratum (Schultze).

Among corallines in pools at half-tide, Reenagiveen and Church Island.

Proxenetes flabellifer, Jensen.

Amongst weeds on the shore west of the Foot.

Macrorhynchus Nægelii (Kölliker).

Abundant between tide-marks at Church Island, and frequently dredged on the Ascidian ground of the harbour.

Macrorhynchus croceus (Fabricius).

On *Laminaria* at Church Island.

Macrorhynchus helgolandicus, Metsch.

Amongst *Laminaria saccharina* in the "purple urchin" pools at Reenagiveen.

Hyporhynchus armatus (Jensen).

From Hydroids and Laminaria collected on the under-surface of the hulk beached on 28th July, 1896.

Hyporhynchus penicillatus (Schmidt).

From the same locality.

Provortex rubrobacillus, Gamble (1893).

This species, taken with the two foregoing, was fir by me on the New Grounds in Plymouth Sound in 189

Plagiostoma vittatum (Frey and Leuckart).

Among *Laminaria* from the same hulk.

Plagiostoma Girardi (Schmidt).

Abundant between tide-marks, and in all dredgings f harbour.

Vorticeros auriculatum (O. F. Müller).

From weeds on one of the Hulks; also dredged amon in Glanleam Bay.

Cylindrostoma quadroculatum (Leuckart).

Amongst red Algæ on the shore at Reenagiveen.

Monotus lineatus (O. F. Müller).

Monotus fuscus (Oersted).

Both these forms are abundant at half-tide mark i between the Coast-guard Station and Glanleam Bay.

Reference.

Gamble, F. W.—1893. British Marine Turbellaria. Quart. Micro. Sci., vol. xxxiv., pp. 433–528, pl. 39–41.

XI.—REPORT ON THE NEMERTEA. By W. I. BEAUMONT. B.A.

INTRODUCTION.

ON both our visits to Valencia, Nemertines were obtained in considerable numbers in the harbour. In all, twenty-three species are here recorded. All of these are to be found in Valencia Harbour itself, with the exception of *Carinella inexpectata*. This species, of which a single specimen was dredged in 45 fms. to the south-west of Valencia Island, is an addition to the Atlantic fauna. *Nemertopsis tenuis* is also an addition to the British list; but it has been described by Joubin (1894) from the coast of Brittany as a variety of the species well known to British naturalists as *Tetrastemma flavidum* (here transferred to the genus *Nemertopsis*, and probably not identical with *Tetrastemma flavidum*, Bürger), and I am not quite convinced of its specific rank. The species referred with some doubt to *Tetrastemma cephalophorum*, Bürger, was known to occur at Plymouth and Port Erin, but had been recorded as *Prosorhochmus Claparedi* (Riches, 1893; Beaumont, 1895).

There has recently appeared a list of Irish Nemertines (Proc. Royal Irish Acad. (ser. 3), vol. v., 1898) compiled by R. B. Jameson from existing records, including those named on my authority in Gamble's account of our first visit to Valencia (Irish Nat., 1896).

The classification of Bürger has been followed.

Order.—PROTONEMERTINI.

Family.—CARINELLIDÆ.

Genus.—CARINELLA.

Carinella annulata (Montagu).

Carinella annulata, Bürger (1895), p. 523; (*pro parte*) M'Intosh, Hubrecht, &c.

Carinella Aragoi, Joubin (1894); Beaumont (1895); Gamble (1896).

Carinella M'Intoshi, Bürger (in earlier publications); Riches (1894).

There can be little doubt that this species is the type of Montagu's *Gordius annulatus*, and not the one following under the name *Carinella superba*. The latter appears to have been recognised by Montagu, as also by M'Intosh, but regarded merely as a variety. Unfortunatel separated as distinct species by Jou name *annulata* was retained for the and new names were given to the ty by Bürger, in his Naples Monograp accordance with the strict rule of n deplore such shuffling of names as The present species is readily dis by the curved ciliated grooves o absence of a longitudinal white lin

Dredged in Valencia Harbour on ground. Not uncommon in 1895; 1896.

Carinella superba (Kölliker).

Carinella superba, Bürger (1895), p. 5

Carinella annulata, Bürger (in earlier p Riches (1893); Gamble (1896); (*pr*

British examples of this specie differ from the description of Bürg of elongated black pigment spots (P margin of the head, like those descri and *C. nothus*, Bürger.

Two small individuals (about 25 Wild Bank in Dingle Bay, resemble (1895; pl. i., fig. 13) in shape o individual measuring 12 mm. in w line was absent. But in all these were arranged as in *C. superba*, and young individuals of that species.

Commonly dredged in Valenci Nullipore ground in Port Magee found under stones between tide-m Bank, Dingle Bay (15–20 fms.).

Carinella inexpectata, Hubrecht.

Carinella inexpectata, Hubrecht (188 537.

I refer here a single specime Bray Hd., 45 fms.; bottom cle agreed closely in external characte tion. When the animal was well extended, the head was flattened and lancet-shaped in outline, but it was not well marked off from the body. The secondary grooves, running forward from the main cephalic grooves, were very distinct on the dorsal surface and sides of the head, eight on each side; on the ventral surface they were less distinct. I know of no other species of Carinella with secondary cephalic grooves. No eye-spots were present. With the exception of the colourless anterior portion of the head, the whole animal was of a brilliant vermilion colour; the ventral surface somewhat paler than the dorsal. Along each side of the body ran a pale line which on the head curved down on to the ventral surface to meet its fellow in front of the mouth. Minute specks of opaque white (? gland-cells) were scattered all over the surface of the body. Length, 15 mm.; width, 1 mm., or somewhat less when well extended.

Distribution.—Previously known only from Naples where it appears to be extremely rare.

Order.—**MESONEMERTINI.**

Family.—CEPHALOTHRICIDÆ.

Genus.—CEPHALOTHRIX.

Cephalothrix bioculata (Oersted).

Generally distributed in Valencia Harbour on the dredging grounds.

Order.—**METANEMERTINI.**

Family.—NEMERTIDÆ.

Genus.—NEMERTES.

Nemertes Neesi (Oersted).

Common under stones between tide-marks, and frequently attaining a large size.

Genus.—NEMERTOPSIS, Bürger.

Nemertopsis tenuis, Bürger (1895), p. 550.

Nemertopsis tenuis, Bürger (1895), p. 550.

Tetrastemma flavidum, var. *longissimum*, Joubin (1894), p. 158; Gamble (1896).

Several small Nemertines dredged in Valencia Harbour in

1895 were identified as *T. flavidum*, var. *longissimum*, Joubin. Several more were obtained at Valencia in 1896, and I have since found the species not infrequently in Plymouth Sound. I think there is little doubt that Bürger is right in identifying Joubin's variety *longissimum* with his own new species *Nemertopsis tenuis*; and its removal from the Tetrastemmidæ to the family Nemertidæ, with a new generic name, is certainly justified by the relative shortness of its rhynchocoelom, which is confined to the anterior half of the body (or less). In some individuals the proboscis is not longer than one-fourth or fifth of the total length of the animal. The relations of this form to *Tetrastemma flavidum* will be discussed below.

In form and colour *Nemertopsis tenuis* bears a strong resemblance to *Cephalothrix bioculata*, as pointed out by Joubin and Bürger; in point of fact, small examples are indistinguishable to the naked eye.

Distribution. — Plymouth Sound; Falmouth Harbour (W. I. B.); Brittany (Joubin); Naples (Bürger).

Nemertopsis flavida (M'Intosh).

Tetrastemma flavidum, M'Intosh (1874), p. 170; Riches (1893), p. 13; Joubin (1894), p. 157; ? Bürger (1895), p. 585.

The Nemertine here referred to is not uncommon at Plymouth and is considered by both Riches and myself to be the *Tetrastemma flavidum* of M'Intosh. Since, however, the rhynchocœlom does not usually extend back more than half the length of the animal, never as much as two-thirds in my experience, I have placed it in the genus *Nemertopsis* among the *Nemertidæ*. It is undoubtedly closely related to *N. tenuis* (and consequently it is difficult to believe that it can be the same species as the *Tetrastemma flavidum* of Bürger), and, indeed, I am still in doubt whether to regard the two as varieties only, as does Joubin, or as distinct species.

N. tenuis appears to me to be somewhat more slender, and in particular to be more tapered towards either end than *N. flavida*, which maintains a more even thickness throughout. The difference, however, is slight, and may depend on the state of extension of the animal.

The rhynchocœlom appears to be relatively shorter in *N. tenuis* than in *N. flavida*, being usually only about one-fourth of the length of the body in the former, and nearly one-half in the latter. In *N. tenuis* the blood is usually so deeply coloured that the blood-vessels appear conspicuously red under a simple lens (in large individuals they can be easily seen with the naked eye), which is not the case in *N. flavida*. There is no appreciable difference in the armature of the proboscis in the two forms; in both, the central stylet agrees with M'Intosh's figure of that structure in *T. flavidum*. In both, the gut is much less cut up into cæca than is the case in the Tetrastemmidæ.

A single specimen (10 mm. long) was taken at Valencia between tide-marks, belonging, I believe, to this species; and probably also several other small individuals, but they were taken at a time when I had not clearly distinguished between *N. flavida* and *N. tenuis*. Moreover young examples may prove difficult to determine.

Family—AMPHIPORIDÆ.

Genus—AMPHIPORUS.

Amphiporus lactifloreus (Johnston).

Generally distributed round the shores of Valencia Harbour under stones between tide-marks.

Amphiporus dissimulans, Riches.

Amphiporus dissimulans, Riches (1893, p. 10).

? *Amphiporus roseus*, Joubin (1894, p. 128).

This species is not known to occur outside the British area, but the suggestion of Riches that it may be identical with the *A. roseus* of Joubin, found at Roscoff and Banyuls, appears probable. It is at any rate certain that *A. roseus*, Joubin, is not the *A. pulcher*, M'Intosh, as the former author imagines. Joubin gives us no information as to the central stylet apparatus and the position of the cerebral organs in *A. roseus* (in which points *A. dissimulans* agrees with *A. lactifloreus*, and differs markedly from *A. pulcher*), but his drawings of the head of *A. roseus* (fig. 16, p. 129) prove that it is not the *A. pulcher* of M'Intosh, which has secondary grooves running forward from the cephalic furrows, similar to those of *A. marmoratus* and *Drepanophorus*. *Amphiporus pulcher*, Bürger, is apparently another distinct species. It has the cerebral organs behind the brain, but it appears to lack two of the most characteristic features of the British *A. pulcher*, viz. the secon cephalic furrows and the reserve stylet in the central s apparatus; neither of these points is mentioned by Bürger is the latter shown in his large anatomical figure (1895, p fig. 8).

Five specimens, ranging in length from 2 to 7 cm., dredged in Valencia Harbour. They agreed with those fou Plymouth.

Distribution.—Plymouth Sound (Riches); Falmouth bour; Isle of Man (?)[1] (W. I. B.).

Family—TETRASTEMMIDÆ.

Genus—Tetrastemma.

Since dealing with the Port Erin Nemertines, in 189 my experience has tended towards further confirmation c view of expressed by Riches (1893) regarding the unsatisfa nature of the specific characters in the genus *Tetraste* especially in *T. candidum* and its allies.

I am more than ever convinced that the presence, shap exact position of patches of pigment on the head are fe of very doubtful value in the discrimination of species. I hoped that a complete revision of the genus on more satisfa lines would appear in the Naples Monograph. Unfortu Bürger, in his systematic account, has done little more add a number of new species; for the most part very i quately characterized, and based, in some cases, on specimens.

[1] Since writing my Report on Port Erin Nemertines (1895) I have had oppo ties of examining small examples of *A. dissimulans*. They have the same transparent milk-white appearance as the adults, and they are stouter than spe of the Port Erin *Amphiporus* of the same length. The latter are of a bro yellow or dull orange colour, due largely to pigment in the skin, and entirel the opaque white specks (gland cells) so plentifully scattered all over the s of *A. dissimulans*. I am now disposed to consider the Port Erin animal as w specific rank. The two are found in quite distinct habitats:—*A. dissim* always, so far as I know, among muddy stones and shells in enclosed hart while the Port Erin *Amphiporus* occurs on clean ground (shells, Nullipore gravel) in the open sea.

Tetrastemma candidum (O. F. Müller).

No specimens exactly agreeing with Bürger's *T. candidum* have come under my observation. In particular I have never seen one in which the cephalic furrows showed conspicuously as brown streaks. It is very usual in this and allied forms to find a concentration of the orange granules (frequently present in the skin) along the cephalic grooves; but the fact is not obvious except under the microscope. Nor have I observed the cerebral organ to be particularly small.

The many specimens of *Tetrastemma* lacking pigment bands on the head, and coming under the broad heading *T. candidum* (as usually defined) fall into three sets :—

(**A**). The common form in the harbour both on the dredging grounds (5-8 fms.) and between tide-marks. Rarely exceeding 10 mm. in length. Body slender. Head flattened, spathulate in outline. Eyes medium in size, about equal, anterior pair more widely separated than the posterior. Colour variable : pale dull yellow, deep apricot yellow, green, dull brownish orange; due chiefly to gut, the outer tissues being pale flesh-colour or yellowish. Gonads, when well developed, may give a grey look to the general colour. In none was there a patch of opaque white flakes (gland cells) present on the head, or a line of opaque white along the middle of the dorsum. In a few there were traces of brown pigment between the anterior and posterior eyes on each side, or more rarely between and somewhat posterior to the anterior eyes.

Central stylet apparatus slender; length of the stylet two-thirds to three-quarters that of the handle, which is usually moderately constricted in the middle, the posterior end more swollen than the anterior, but the shape varies a good deal. Generally two reserve stylets in each pouch.

The greater number examined were males with well developed testes, but a few ripe females were also found.

(**B**.) Not common, a few specimens dredged on shell-beds, and in Port Magee Channel on Nullipore ground. All were females. They were similar to the form described by myself from Port Erin (1895), and by Riches from Plymouth (1893). Length, 20–30 mm. Body slender, less than 1 mm. wide when well extended. Head very similar in shape to *T. melanocephalum* (var. *coronatum*). Eyes like those in (A), medium in size; black and distinct.

Colour, yellow, pale, or deep apricot yellow, due
alimentary tract. A patch of opaque white flakes (gl
stands out conspicuously on the head between the tw
of eyes, and from this in most cases a streak of white
along the mid-dorsal line to the tail.

This is possibly the *T. glanduliferum* of Bürger,
development of opaque white fields and lines is so un
allied forms as to make one suspicious of its value as
character. It is also, except for the absence of a
pigment on the head, very like *T. diadema*, Hubrecht.

(C) On the Nullipore ground in Port Magee Chann
form was found, possibly a distinct species. These we
in external features to certain specimens noted at
(1895, p. 365), but the central stylet apparatus was
All the specimens examined (over twenty) were males
developed gonads, though measuring only from 4–
length.

Body comparatively stout and round; head also
rounded, fairly well marked off from the body; the
grooves very pronounced. Eyes distinctly large.

Colour, deep orange-red, due largely to orange
material in the skin. No opaque white on head or
head being of the same deep colour as the body. In a fe
little brown pigment was present behind the anterio
each side. · Central stylet apparatus much as in (A).
reserve stylet pouch three stylets usually present.

Tetrastemma melanocephalum (Johnston).

Tetrastemma melanocephalum, M'Intosh (1874).

Tetrastemma coronatum (?), Hubrecht, Joubin, Bürger.

I shall consider under the head of *T. melanocephalum*
Tetrastemmidæ with pigment patch on the head.
examined a very large number, but have failed to as
with certainty to the numerous species recognised by B

The common form everywhere in Valencia Harbour
at Port Erin and Plymouth) appears to be the *T. coro*
Hubrecht; but it does not agree in all respects with
description.

The body is slender, an example 20–25 mm. long, w
extended, being less than 1 mm. wide. The head is
less spathulate in shape, but is more pointed in some ind

The colouring is very variable; the majority are yellow or yellowish green: pale yellow due entirely to gut; deep yellow where yellow granules are present in the skin; the various shades of green may be produced by the blending of the yellow gut and outer tissues with green ovaries, or green gut and yellow ovaries. A few specimens of a peculiar brownish pink were met with.

The pigment patch on head is usually dark brown, often with a purplish tinge; in some cases it is bright chesnut. In shape it is highly variable; in the greater number it is crescentic, the horns of the crescent just reaching and sometimes concealing the anterior eyes, and the convex posterior margin extending about half way between the anterior and posterior pairs of eyes. Specimens were also seen with the crescentic band situated nearer the posterior eyes, and others with the horns of the crescent directed backward. In a considerable number of individuals the patch was oval or oblong, placed transversely across the head, concealing the anterior eyes usually, but in no case extending to the posterior eyes. Again a number of specimens were observed in which the patch was interrupted by an unpigmented space in the middle. These latter show varying degrees of approach towards *T. vermiculatum*, and amongst them are examples having the pigmentation of Bürger's *T. falsum*[1] (1895, pl. xxix., fig. 32). In many individuals probably the majority, patches of scattered flakes of opaque white stand out more or less conspicuously on the head, both in front of and behind the pigment-band. In many cases a narrow streak of similar gland-cells runs back along the mid-dorsal line to the posterior end of the body, where it usually spreads out fan-wise. This white line may consist merely of a single row of scattered dots; it may be incomplete anteriorly or posteriorly, and may be present in individuals which have no white patches on the head.

[1] *T. falsum* is a very doubtful species based on a single specimen. Apart from pigmentation it is distinguished by the possession of eight eyes, in other words each of the four typical Tetrastemma eyes is double: an unreliable character in a single specimen, for it is by no means unusual to meet with specimens of *Tetrastemma* in which one eye is broken up into two, or into several scattered dots, and I have seen a specimen of the form under consideration in which the two posterior eyes were double.

This form appears, on the whole, to approach very closely to *T. coronatum*, Hub.; but in the frequent possession of opaque white fields and lines, it presents characters claimed exclusively by Bürger for *T. diadema* and *T. glanduliferum*. It must be obvious, however, from the above details, that the relative development of conspicuous patches and lines of gland-cells, like the exact disposition of cephalic pigment, is a matter of far too inconstant a nature to be of specific value. Yet these characters have been largely relied on by Bürger, and others, in the useless multiplication of species.

Among the specimens of *T. coronatum* at Naples, Bürger has observed sexual dimorphism. Females are about twice as long as males, and of a different colour. I have not found this to be the case at Valencia. Examples of both sexes were noted, with well-developed genital organs, measuring less than 1 cm., and as much as 3 cms. in length.

On the Coralline ground in the Port Magee Channel, a number of specimens were dredged quite distinct from the above. These measured from 5 mm. to 12 mm. in length, and were relatively stout and round in figure. The head wide, rounded, and fairly well-marked off. Eyes, large. In colour they were a very deep rich yellow (approaching the colour of fig. 16, pl. iii., in the Naples Monograph), depending largely on the presence of yellow and orange granules in the skin, the gut beneath being also yellow. A patch of dark brown pigment of oblong or oval shape, concealed the anterior eyes within its straight or convex anterior margin, while posteriorly the pigment was scantier, so that the hinder margin was ill-defined. Males and females were present in about equal numbers; individuals of both sexes, even of the smallest size, having well-developed gonads.

It is probable that this, and the short thick deep-yellow form from the same locality, described under *T. candidum*, are the same species, the pigment band on the head not being a constant character. Individuals intermediate with respect to this point have been already mentioned (p. 822).

Tetrastemma vermiculatum (de Quatr.).

Common, and generally distributed in Valencia Harbour on the shore and dredging grounds, but hardly so abundant as *T. melanocephalum*. There seems little to distinguish this species from its allies, apart from the pigment bands on the head; and examples intermediate in pigmentation are not infrequently met with, as already noticed. The more oval shape of the head is not a constant feature, and the median white dorsal line, considered by Joubin its most reliable character, is frequently absent in specimens having the two pigment bands of *T. vermiculatum*, and, on the other hand, is often present in allied species.

Examples of both sexes, from 1 cm. to 2 cm. in length, were noticed, with well-developed gonads.

Testrastemma cephalophorum (?) Bürger.

Tetrastemma cephalophorum, Bürger (1895, p. 583)

Prosorhochmus Claparedi, Riches (1893, p. 20); Beaumont (1895, p. 369).

The Nemertine here, with some hesitation, referred to the *Tetrastemma cephalophorum* of Bürger, is identical with that described from Plymouth by Riches (1893),[1] and by myself from Port Erin (1895) as *Prosorhochmus Claparedi*.

I now believe the determination of this form as *Prosorhochmus* to have been an error. In the absence of any really useful characters in the diagnoses of the genus at that time available, I was chiefly influenced by the very characteristic form of the central stylet apparatus, which bore a marked resemblance to M'Intosh's figure of that structure in *P. Claparedi*. The possibility of our animal being a distinct species was pointed out, our specimens when well extended presenting little resemblance to the figures of *P. Claparedi*; but the remarkable shape of the head in the latter, was sometimes assumed by individuals when contracted, and the possibility of the drawings having been made from contracted specimens was recognised.

In Bürger's classification (1895), *Prosorhochmus* is removed from the family Tetrastemmidæ, and appears as the type of a new family, the Prosorhochmidæ, whose members are characterised by attaining a great length (compared with Tetrastemmidæ); by the arrangement of their four eyes in a rectangle with long axis transverse; by the small, almost rudimentary, cerebral

[1] I have also found the species under consideration during the past two years at Plymouth; and having been able recently to submit living specimens to Mr. Riches, all doubt concerning the identity of his species, and that met with by myself, has been set at rest.

organs, and greatly developed head g hermaphrodite. The Nemertine ur conform with this diagnosis in ever as in *Tetrastemma*, the cerebral org head gland is small, and the sexes ar is no doubt that it belongs to the ' genus *Tetrastemma*, since the shape central stylet can hardly be reckon In general appearance my specimens figure of *T. cephalophorum* fairly we respects with his somewhat brief d points of difference which, if constan form to separate specific rank. Bür open to the suspicion of being based of his new species, on a single speci loath to add another species to an al

The points of difference are these: animal, though well marked off from a rhomboid in outline, is much m represented by Bürger (*op. cit.* pl. iii notched in front (the notch becon contraction). One individual, hov closely in form of head to Bürger's fi (in section) and stout, as Bürger's d width of a 15 mm. example as 1¾ 22 mm. in length, measured by m 1½ mm. thick when fully extended. is hardly borne out by his draw difference is found with regard to th Bürger describes and represents in a (pl. xxix., fig. 42) the central stylet and long, approaching the handle in this structure in a number of individu 20). The handle is long, and has th conical form like *T. cephalophorum*; stout, averaging about half the leng with a fairly wide range of variation tension of the reddish brown pigment to the dorsal surface of the head as fa and in front of these, the conspicuo white flakes (gland cells) which ar over the surface of the body also. Of the latter, no mention is made by Bürger; he merely says the head is pale yellow. As to the former point, it is not a constant feature; in some specimens the area between the anterior and posterior furrows is more deeply pigmented than any other part of the animal, but I have seen individuals in which it is quite pale. The reddish brown pigment consists of granules arranged in a fine-meshed network. The gut, usually deep yellow, contributes to the general colour-effect, as also the pinkish ovaries in ripe females. Should future investigation prove these differences to be constant, I would suggest the name *Tetrastemma dissimulans* for the British form.

In Valencia Harbour this species was not found at all abundantly. It was not discovered at all in 1895. In 1896 eight specimens were dredged; they were from 12–22 mm. in length, and included examples of both sexes with genital products approaching maturity.

Distribution.—Plymouth (Riches, W. I. B.); Isle of Man; Falmouth (W. I. B.); Naples (Bürger).

Tetrastemma Robertianæ, M'Intosh.

Tetrastemma Robertianæ, M'Intosh (1874, p. 166).

A single example was dredged in Valencia Harbour, in 1896, close to the shore near Reenagiveen, in 1–2 fms. (muddy ground, with Zostera and Ascidians). In material from the same haul were several species of Turbellaria not obtained at Valencia on any other occasion.

Our specimen was 15 mm. in length, and of stout figure. The head of rhomboidal shape, as in M'Intosh's woodcut (*op. cit.* fig. 12, p. 167), but somewhat wider than there represented. At each side of the head, just in front of the notches formed by the anterior furrows, was a distinct angle, emphasized by the presence of a projecting tuft of long cilia. On the ventral surface, immediately behind the subterminal proboscis pore, was a transverse fold. The cephalic furrows, which were indistinct on the ventral surface in M'Intosh's specimens, were clearly seen to run transversely for a short distance from the sides of the head, and then bend forward (the cerebral canal probably opening at the point where the course changes) to meet at the posterior end of the mouth opening. The eyes were large; the anterior distinctly larger than the posterior. The colour-

ing was as in M'Intosh's coloured
fig. 1), except that the dark pig
the posterior eyes, as in M'Intosl
dark pigment is quite different in
ment bands of *T. melanocephalum* and
the microscope it appears as a mo
polygonal) areas, the centres of w
borders. The space between the eye
of opaque white (gland cells), from
dinal white band ran along the mi
to the posterior end. This band
rows of white dots, which were at
pigment bands, and could be traced u
anterior end. The central stylet ap
a specimen taken by myself at Port E
figure (fig. 5, p. 65); the handle bei
the middle, and the posterior portion
the anterior. The stylet was about t
handle. The animal was not sexuall

Distribution.—Previously found on
land; and Loch Maddy, Outer He
Erin (W. I. B.).

Tetrastemma dorsale (Abildegaard).

Œrstedia dorsalis, Bürger (1895, p. 592)

The ordinary littoral variety, marl
chestnut, is common on all the dred
Harbour, and also among weeds betw

A pale variety, marbled with brow
Bürger's var. *cinctus* (*op. cit.* pl. iii., f
rial dredged in Dingle Bay, probably c
fms. A similar variety occurs at Po
depth (bottom: gravel, shells, and Nul
among the Cellaria which abounds on
(20–30 fms.).

One or two examples approachi
also dredged in shallow water in Lou
pore ground at Port Magee.

Tetrastemma nigrum, Riches.

Tetrastemma nigrum, Riches (1893, p. 14

This unusually distinct species is a

Britain. Joubin's figure (1894, pl. iii., fig. 59), which he suggests may be *T. nigrum*, represents the common littoral variety of *T. dorsale*.

Several examples were dredged in Valencia Harbour, on Ascidian ground, and others were obtained among weed from between tide-marks.

Distribution.—Plymouth (Riches, W. I. B.); Falmouth Harbour; Port Erin (W. I. B.).

Order—HETERONEMERTINI.

Family—LINEIDÆ.

Genus—LINEUS.

Lineus gesserensis (O. F. Müller).

Lineus gesserensis, M'Intosh, Bürger.

Lineus obscurus (Desor), Hubrecht.

Common round the shores of Valencia Harbour, under stones and amongst weeds. Colour, dark red, reddish brown, dark green. Largest specimen, 17 cm. long.

Lineus lacteus (Grube).

Some slender creamy-white Nemertines, probably of this species, were found in the fine gravel on the shore near Reenagiveen. Only one perfect specimen was obtained. It measured between 3 and 4 cm. in length, and was more slender than is usually the case with *L. gesserensis* of that length. The anterior end was pale brown, the brain region red, and the rest of the animal creamy white. There were two eyes on one side, three on the other.

The mouth was situated at a distance behind the brain equal to the interval separating that organ from the anterior extremity of the head, which is in accordance with the statement of Bürger. In M'Intosh's figure of *L. lacteus* (1874, pl. xix., fig. 3) the mouth is shown somewhat further back than this. No note was made of the position of the side organs in this specimen; they are in front of the mouth in *L. lineus* and behind it in *L. gesserensis*, according to Bürger; but they appear in front of the mouth in M'Intosh's drawings of both species. On the whole this animal approached more nearly to *L. lacteus*.

REFERENCES.

1. M'INTOSH, 1874.—A Monograph of British Annelids. Pt. i., Nemertines.

2. HUBRECHT, 1880.—Notes from the Leyden Museum, p. 95.

3. RICHES, 1893.—The Nemertines of Plymouth Sound. Journ. Mar. Biol. Assoc., vol. iii. (n.s.), pp. 1 *et seq.*

4. JOUBIN, 1894.—Faune France, Les Nemertines.

5. BEAUMONT, 1895.—The Nemertines of Port Erin, Isle of Man. Trans. Biol. Soc., Liverpool, vol. ix., pp. 354, *et seq.*

6. BÜRGER, 1895.—Fauna und Flora, Golfes von Neapel. Die Nemertinen.

7. GAMBLE, 1896.—Notes on a Zoological Expedition to Co. Kerry. Irish Naturalist, vol. v., p. 230.

8. JAMESON, 1898.—Notes on Irish Worms. Proc. R. Irish Acad., ser. 3, vol. v., 1898, pp. 34–39.

XII.—Report on the Opisthobranch
Beaumont, B.

Introductio

At the request of my colleagues I have
on the Opisthobranchiate Mollusca obse
to Mr. Gamble, who had gained some
Plymouth previous to our first visit t
determination of species was to a large ex
the most part, however, specimens were
the few cases where he is solely respon
notice is made of the fact.

Altogether 48 species[1] of Nudibranchs
found; of which all but two of the form
in Valencia Harbour itself—a very fa
shallow-water species. Better opport
harbour would, no doubt, have added a
forms to our list; from which, for exa
distributed a genus as *Tritonia* is absent.

Our most interesting finds were:—
species lost sight of, apparently, since t
cock); a large specimen of *Lomanotus* (the
as I know, and serving to throw some l
genus); a specimen of a small *Doris* (p
Sea by one of us, and believed to be an u
example of the rare *Idalia Leachii*.

Another feature of interest was the
certain Æolids (*Carolina aurantiaca*, *Coryp*
mondi, *F. coronata*) and of *Dendronotus a*
two hulks which were beached after lyin
for a year or more. Here they had bee
colonies of *Tubularia larynx*, and many in
size. Some of these species were not fou

It has not been thought necessary to
distribution except in a few cases. The
ture of Bergh (1892, System der Nudibra
been followed, for the most part, in the ar
chiata (all references to Bergh are to that

[1] Inclusive of 5 species of

species the name is given under which it appears in the classic monograph of Alder and Hancock (referred to as A. & H.), by means of which the determination of species was almost entirely effected. For distribution, Norman's Revision of the British Mollusca (Ann. Mag. Nat. Hist., series 6, vi., 1890) has been relied on largely, while the records of Garstang for the Plymouth district, published in various faunistic papers in the Journal of the Marine Biological Association, and of Herdman for the Irish Sea (Trans. Liverpool Biol. Soc.; Summary in Annual Report, Brit. Assoc., 1896, p. 446), are referred to under their names.

Sub-order—**NUDIBRANCHIATA.**

Section I.—KLADOHEPATICA.

Family—ÆOLIDIADÆ.

Sub-family—ÆOLIDIADÆ PROPRIÆ.

Genus—ÆOLIDIA.

Æolidia papillosa (Linn.).

Eolis papillosa, Alder & Hancock.

Fairly common on the shores of Valencia Harbour, and attaining large dimensions.

Genus—ÆOLIDIELLA.

Æolidiella glauca (A. & H.).

Eolis glauca, A. & H.

Eolis angulata, Gamble, Irish Naturalist, v., 1896.

Cratena paradoxa, Nichols, Proc. Roy. Irish Acad., ser. 3, vol. v., 1900, p. 587.

A large specimen, with the green and red colouring of Alder and Hancock's drawing, was found by Miss Maud Delap in a rock-pool at Reenagiveen. Small examples, averaging about 12 mm. in length, were commonly dredged in various parts of the harbour, and one was found between tide-marks at Dohilla.

In these small individuals and in similar ones which are common in parts of Plymouth Sound, the papillæ exhibit no green colour, the hepatic cœca being fawn colour or pale brown, and the outer parts usually red and freely speckled with opaque white. There is thus a decided superficial resemblance to Alder and Hancock's drawing of *Eolis angulata*, but our specimens invariably have very numerous papillae, the more anterior rows of which are sub-divided laterally, a character of *Æolidiella glauca* which appears to distinguish it from the closely related *Æ. Alderi*, and from *Eolis angulata*. This point has been apparently overlooked by Vayssiére, who unites the two latter species with *Æ. glauca*. Unfortunately Alder and Hancock give no information respecting the radula of *E. angulata*, but the fact that they place the species in the sub-genus *Cavolina* in close company with such species as *C. concinna* and *C. olivacea* shows that they did not regard it as closely related to *Æ. glauca*.

The radula of Plymouth and Valencia specimens agrees in character with *Æ. glauca*.

Sub-family—CRATENIDÆ.

It appears to me that, in some cases at least, Bergh's very minute sub-division of the Æolids is unsatisfactory. In particular the sub-families Cratenidæ and Tergipedinæ are insufficiently characterised (not to say erroneously). Take, for example, the genus *Amphorina* (Tergipedinæ): apart from some slight and not easily seized difference in the shape of the papillæ, *Amphorina* approaches in external features and radula very closely to *Cratena*. According to Bergh's diagnoses, however, *Amphorina* has an armed penis and a single otolith in each otocyst, while *Cratena* has its penis unarmed and otocysts containing otoconia. But in point of fact all the Cratenæ which I have had an opportunity of examining (*C. amœna*, *C. olivacea*, and *C. viridis*) have a single otolith in each otocyst, and, with the possible exception of the last-named, have an armed penis, essentially like that of *Amphorina*-*Cavolina* (*Cuthona*) *aurantiaca*, placed by Bergh provisionally among the Cratenidæ, also has a penis of similar character. Obviously either a revision of the characters of sub-families and genera is necessary or a re-assortment of species. Under these circumstances I have provisionally revived the genus *Cavolina* as used by Alder and Hancock.[1]

Genus—CUTHONA.

Cuthona Peachii, A. & H.

Eolis (*Cuthona*) *Peachii*, A. & H.

A single specimen, which I refer to this little-known species, was dredged in Valencia Harbour in May, 1895, on the Pecten

[1] *Cratena paradoxa*, Nichols (fide Gamble), Proc. Roy. Irish Acad., ser. 3, vol. v., 1900, p. 587, = *Acol. glauca*, juv.

bed near Gruppaun Point. The exact habitat of this individual was not ascertained; for a knowledge of the usual *local* of the species we have to thank the vigilance of my friend, Mr. E. W. L. Holt. When dredging in Falmouth Harbour in the summer of 1897, Mr. Holt pointed out to me a small Æolid in the midst of a colony of *Hydractinia echinata* on a shell tenanted by *Eupagurus Bernhardus.*

I at once recognised it as the species previously taken in Valencia Harbour. An examination of many Hydractinia colonies, since then, has resulted in the discovery of two or three more specimens only, so that its apparent rarity cannot be entirely accounted for by the excellent chance of escaping discovery it possesses in virtue of the remarkable resemblance of its papillæ to the surrounding polyps. I have not found any record of *C. Peachii* since the time of Alder and Hancock.

The Valencia example was about 12 mm. in length. The head and foot exhibited the characteristic shape shown in Alder and Hancock's drawings, which serves to distinguish *C. Peachii* from all other British Æolids save *C. nana*; and in relative width my specimens agree much better with *C. Peachii* than with the last-named. They show also a close resemblance to *C. Peachii* in colouring, except that the hepatic cœca of the Valencia example were pale brown; the Plymouth and Falmouth specimens were more in accordance with Alder and Hancock in this particular, which contributed not a little to the remarkably inconspicuous appearance of their owner among the *Hydractinia* polyps. The papillæ were very numerous and crowded, and extended forward on each side of the head in the form of a ruff. Any arrangement of the papillæ in definite rows was difficult to make out. The teeth of the radula of the Valencia specimen agree fairly well with Alder and Hancock's figure of a tooth of *C. Peachii*; they show, however, some approach to *C. nana* in the stronger development of the lateral denticulations (numbering five on each side) than is represented in the figure.

Apart from the general agreement with *C. Peachii* rather than with *C. nana*, the latter species is put completely out of court by the statement of Alder and Hancock respecting its spawn, which must be very different from the coral-pink spawn deposited by my Falmouth specimen, since it is said to resemble the broad semi-circular coil of *Cratena olivacea* (figured by A. & H., Fam. iii., pl. 26).

C. Peachii is very sluggish in its habits, and has a remarkable power of adhesion to the substratum on which it is resting, a quality shared by *Calma glaucoides*, a species of similar form and habits.

I have followed Alder and Hancock in placing this species in the genus *Cuthona*, since, in shape and radula, it appears closely related to *C. nana*. With respect to the otocysts and jaws I have no information.[1] In Bergh's "System" it appears provisionally under the head of *Cratena*, on what grounds I do not know.

Distribution:—Fowey, Cornwall; Cullercoats, Northumberland (A. & H.). Falmouth Harbour; English Channel off Plymouth (W. I. B.)

Genus—Cavolina.

Cavolina aurantiaca, A. & H.

Eolis (*Cavolina*) *aurantiaca*, A. & H.

Cuthona (?) *aurantiaca*, Bergh.

In great abundance on the colonies of *Tubularia larynx*, which had grown on two hulks moored in Valencia Harbour for about a year. This species, like some others occurring on the hulks, was found by us nowhere else, though we dredged on several occasions in the immediate vicinity.

The numerous specimens examined agreed in every way with Alder and Hancock's description and figures, except that in very many cases the papillæ were not tipped with orange.

I have met with specimens having white-tipped papillæ at Plymouth and in the Isle of Man. Among a batch of individuals found on *Tubularia* and *Coryne* in the last-named locality, some had the tips of the papillæ opaque white, others deep yellow, while the rest formed a graduated connecting series. I have only seen one example as highly coloured as Alder and Hancock's drawing. This was dredged in Millbay Channel, Plymouth Sound, and in the same haul were colonies of the orange-coloured hydroid *Garveia nutans* as well as *Tubularia indivisa*. The radulæ of the last-named individual

[1] My intention to examine these and other internal characters was frustrated by the accidental carrying away of the Plymouth specimens in the laboratory circulation.

and of an example with pale tipped papillæ present no appreciable difference. In both, the teeth have the characteristic shape shown in Alder and Hancock's figure (pl. 47, fig. 17), but there are several very minute denticles present, between the large denticles, which are not shown in the figure.

Bergh places this species provisionally in the genus *Cuthona.* Its foot is very wide in front, but it has not the wide head of the latter genus, the most notable external character of *Cuthona nana* and *C. Peachii*; and its radula is very different. Its penis and otocysts are similar to those organs in *Cavolina amœna* and *C. olivacea* as already stated.

Cavolina amœna, A. & H.

Eolis (*Cavolina*) *amœna,* A. & H.

Cratena amœna, Bergh.

Not uncommon in Valencia Harbour on both shell-beds and Ascidian ground.

Cavolina olivacea, A. & H.

Eolis (*Cavolina*) *olivacea,* A. & H.

Cratena olivacea, Bergh.

Dredged not infrequently on the same grounds as the last species. Several were also found on the bottom of one of the hulks.

Genus—AMPHORINA.

Amphorina cœrulea (Montagu).

Eolis (*Galvina*) *cœrulea,* A. & H. Monograph (Appendix, p. 11); and Ann. & Mag. Nat. Hist., series 3, vol. v., 1860.

(?) *Æolis molios,* Herdman. Proc. Roy. Phys. Soc., Edinb., vol. vi., 1881.

Found on most of the dredging grounds of Valencia Harbour, but not abundant. The description of the papillæ in this species given by Alder and Hancock (*loc. cit.*) is wanting in the accuracy usual with those authors. They say, "central gland . . . green below and dark-blue above; outer surface of the papilla above pale blue, below pale green; a few yellow freckles in front; tips strongly capped with orange red, banded below with a ring of bright yellow; extreme points colourless

and pellucid." In point of fact tl
bottle-green throughout; the brillia
the middle part of a papilla being
from small flecks of opaque superfi
below the blue there is usually
posteriorly) of yellow or orange, alsc
tip of the papillà the cnidogenous s
orange, or sometimes crimson. Tl
sheath is pale transparent green. T
yellow or orange colour is subject to
individuals, and in the different papi
often some of the opaque material
light, especially when the back-grou
by the hepatic cœum is lacking. Pr
tion of the papillæ of *Æ. molios* i
appears in his account of the speci
think, to separate it from *A. cœrulea*

I have removed *Amphorina* from th
since, except, perhaps, for the slight
papillæ, it is, as seems to me, mucl
immediately foregoing species than
Tergipedinæ.

Distribution.—S. coast of Englan
W. I. B.); ? Arran (Herdman); W.
terranean (Trinchese, Vayssiére, &c.

Sub-family—TERGIPED

Genus—TERGIPES

Tergipes despectus (Johnston).

Eolis (*Tergipes*) *despecta*, A. & H.

Specimens were obtained on th
Harbour, and were identified by
found in weed from the shore at Ree
the mouth of the harbour respectivel

Genus—EMBLETONI

Embletonia pulchra, A. & H.

Embletonia pulchra, A. & H.

Dredged not infrequently in v

Harbour in 1895; not very abundant anywhere; perhaps most common on the gravel at the mouth of the harbour. Only taken in 1896 at Port Magee (coarse sand, 10½ fms.). The colour of the papillæ (due to the hepatic cœca) is by no means constant. One specimen was noted having these organs yellowish brown; another dirty greenish brown.

Genus—GALVINA.

Galvina exigua, A. & H.

Eolis (*Galvina*) *exigua*, A. & H.

One of the characteristic species of the sandy gravel in the channel at the mouth of the harbour, where it was dredged on several occasions. Taken once in Glanleam Bay, and also found on one of the hulks.

Galvina picta, A. & H.

Eolis (*Galvina*) *picta*, A. & H.

A small specimen, coloured as in Alder and Hancock's drawings, found on Laminaria dredged at the mouth of the harbour in 1895, and an almost colourless individual obtained in the same locality in 1896 agreed in shape with *G. picta* rather than with *G. Farrani*. The latter species is, however, so variable that it appears to me by no means easy in some cases to decide between the two.

Galvina Farrani, A. & H.

Eolis (*Galvina*) *Farrani*, A. & H.

Galvina tricolor, Garstang, Journ. Mar. Biol. Assoc., 1890, n.s. vol. i., p. 437.

Eolis tricolor (pro parte) Friele and Hansen (nec *E. tricolor*, Forbes, A. & H).

Abundant on the Zostera beds in Valencia Harbour. Specimens were found also on algæ, chiefly Laminaria, dredged at the mouth of the harbour and near Port Magee; and on one of the hulks.

This species varies very much in the extent and depth of its colouring. In addition to examples resembling the type as depicted by Alder and Hancock, we found at Valencia much more richly pigmented individuals such as occur also with some frequency on the Zostera beds in the Plymouth di (see Garstang's description, *loc. cit.*). Most of these h coloured examples agreed with their more typical compani their slender elongate form ; but other specimens wer with at Valencia showing some approach to *G. picta* in shape and colour, so that we were in doubt to which s they should be referred. Indeed, it appears to me dou whether *G. Farrani* and *G. picta* can be specifically d guished; and there seems little reason to regard *Eolis Ade* Thompson, and the *E. Robertianæ* and *E. andreapo* M'Intosh as more than colour varieties of *G. Farrani*. O other hand, *G. Farrani* is, in my opinion, quite distinct *G. tricolor*, to the synonymy of which it was relegate Friele and Hansen. This view is now shared by Mr. Gars who informs me that he was not acquainted with the re *tricolor* in 1890 when he wrote his account of the Opistho chiata of Plymouth. In point of fact *G. tricolor* is one c commonest Nudibranchs on the trawling grounds in 20–3 off the south coast of Devon and Cornwall, but the reso of the Plymouth Laboratory did not at that time perm much exploration in the Channel. Besides inhabiting t different ground, *Galvina tricolor* differs from *G. Farra* attaining much greater size ; it is in particular a much and stouter form, and its papillæ are larger and more infl and so crowded as to be usually much flattened by m pressure.

Sub-family.—CORYPHELLIDÆ.

Genus.—Coryphella.

Coryphella gracilis, A. & H.

Eolis (*Coryphella*) *gracilis*, A. & H.

Found frequently in the spring of 1895 under stones o shore near Knightstown and at Dohilla.

Coryphella Landsburgii, A. & H.

Eolis (*Coryphella*) *Landsburgii*, A. & H.

This widely-distributed species was dredged on two occa only in Valencia Harbour in 1895 : not at all in 1896.

Coryphella lineata, A. & H.

Eolis (*Coryphella*) *lineata*, A. & H.

Found in extraordinary abundance on *Tubularia* growing on the bottoms of the two hulks, and reaching much greater dimensions than those given by Alder and Hancock. Not a single specimen was found by us except on the hulks.

Sub-family—FAVORINIDÆ.

Genus—FAVORINUS.

Favorinus albus, A. & H.

Eolis (*Favorinus*) *albus*, A. & H.

Found under the stones on the shore near Knightstown and at Church Island, and dredged on Shell-beds and Ascidian ground, and in Port Magee Channel. Not abundant.

Sub-family—FACELINIDÆ.

Genus—FACELINA.

Facelina coronata (Forbes).

Eolis (*Facelina*) *coronata*, A. & H.

One of the commonest Nudibranchs at Valencia; found under stones at low tide at all suitable parts of the shore; very abundant on one of the hulks, a few only on the other; dredged once on Laminaria at the mouth of the harbour.

Facelina Drummondi (Thompson)

Eolis (*Facelina*) *Drummondi*, A. & H.

A few were found on each of the hulks; most of these were of very large size, exceeding the maximum dimensions given by Alder and Hancock. One measured over 5 cm. in length when by no means well extended, but this dimension gives little idea of their size; their width and the length of their papillæ being proportionately greater than in most Æolids.

The one measured had seven or eight groups of papillæ on each side; Alder and Hancock say four to six. In colour most of our specimens were closely similar to Alder and Hancock's drawing. One was much paler, the hepatic cœca being pale brown with dark brown apex.

No specimens of this species were found elsewhere by us.

Facelina punctata, A. & H.

Eolis (*Facelina*) *punctata*, A. & H.

A single specimen was found un
Glanleam Bay in 1895.

Sub-family—JANI]

Genus—Antiopa

Antiopa cristata, delle Chiaje.

Antiopa cristata, A. & H.

Janus cristatus, Bergh.

Dredged on the Shell-bed off K
in 1896.

Antiopa hyalina, A. & H.

Antiopa hyalina, A. & H.

Janus hyalinus, Bergh.

Two examples were found in a cr
giveen in 1895. In 1896 the spe
half-dozen occasions in various parl
Port Magee.

Family—LOMANO

Genus—Lomanot

Lomanotus portlandicus, Thompson.

Lomanotus portlandicus, Thompson, A
vol. v., 1864, p. 48.

Lomanotus Hancocki, Norman, Ann. M
20, 1877, p. 518 ; and Ser. 6, v

Lomanotus varians, (*pro parte*) Garstar
vol. i. (n. s.), 1889, p. 185.

Lomanotus genei (?), Verany, Cat. A
Genova e Nizza. Genova, 1846

Lomanotus Eisigii (?), Trinchese, J.
Mediterr., vol. ii., 1889, p. 207.

A large specimen of *Lomanotus*,
by Miss Maud Delap lying on th
1895. There seemed little doub
there, but had been accidentally st

So far as I know, only three large specimens of *Lomanotus* had previously been obtained in Britain, viz.: two examples dredged in Weymouth Bay by Thompson (*L. portlandicus*) and one by Norman off Berry Head, Torbay (*L. Hancocki*). Two more have been recently found at Plymouth by myself. In the case of not one of these does the precise habitat appear to have been discovered.

I was at first disposed to follow Garstang in uniting all the British Lomanotidæ as one species. I certainly agree with him that the specific distinctions laid down by the authors of the four British specimens will not hold good. With Garstang's criticism of the specific characters I fully agree; apart from details of colouring, my three large specimens agree precisely with the descriptions of *L. portlandicus* and *L. Hancocki*, except as regards one point in each case; the pleuropodial fold on each side is continuous with the sheath of the rhinophore, and the rhinophores are finely laminated. With all due deference to the great experience of the authors of those species I confess to attributing these differences to imperfect observation on their part. So far as external structure is concerned there seems indeed little reason to doubt the justice of Garstang's conclusion that the small specimens he studied were merely the young of the large species. But examination of a number of small individuals during the last two years, in addition to the larger ones already mentioned, has brought out a distinct and apparently constant difference in colour. Small specimens of *Lomanotus*, rarely exceeding 12 mm. in length, are not uncommon at Plymouth on *Antennularia*. Except when very small (6 mm. or less), they are deeply pigmented with various shades of brown with a superficial sprinkling of opaque yellowish white, producing a marbled pattern, and rendering them decidedly opaque. These are undoubtedly the *Eumenis* (*Lomanotus*) *marmorata*[1] of Alder and Hancock. They have been described in some detail by Garstang. My large specimens, on the other hand, were, considering their size, very transparent. One was

[1] The entire margin of the rhinophoral sheaths of *E. marmorata* was doubtless an individual peculiarity of the single specimen seen by Alder and Hancock. The erroneous representation of the anterior part of the pleuropodial fold in their drawing may possibly be explained by the fact that this specimen was somewhat injured, though the same error seems to have been made in describing *L. portlandicus*.

of a pale yellowish flesh-colour, a
was of a rich golden brown colour,
closely resembling that of some
same haul of the dredge. The col
minute scattered granules in the
except under the microscope, and
the transparency of the tissues.
material present was confined to t
velar processes and of the papillæ
and pleuropodium. Apart from t
colour of the papillæ was deeper
the dorsal surface, while the
latter.

The colouring of the specimens
differed slightly in detail, but not t
any of my specimens. They c
towards *L. marmoratus*, and they a
and "very transparent" respective
to say impossible, to believe that t
ever pigmented like *L. marmora*
moreover, found one individual, on
Cellaria, trawled in the English Ch
was undoubtedly a young example
living specimens of *L. marmoratus*
compare it, but it appeared to me to
to have the pleuropodium more dev
in the last-named. This may have
sion, however. The outer tissues
dorsal surface having a faint orange
a few scattered microscopic speck
orange; and moderately transpare
coloured digestive organs showed
cesses and the papillæ of the rhino
podium were tipped with bright or
examples. I should judge one
(15 mm. long) dredged south of th
belong to this form also.

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[1] *Scinaia purcellata* and *Delesseria sanguinea*.

[2] That described first (*loc. cit.*, p. 186). The ot
locality (described p. 187) were obviously *L. marm*

So far as the evidence goes, then, we have in British waters two well-marked forms of *Lomanotus*; the marbled brown Antennularia-haunting *L. marmoratus*, rarely much exceeding 12 mm.[1] in length; and *L. portlandicus*, in which brown pigment is entirely lacking, which may attain a length of 6 cm., and of whose habitat we have no information beyond the finding of a single small specimen on *Cellaria*. Whether these are entitled to be considered distinct species, in the absence, so far as known, of structural difference, or only well-marked colour-varieties, must be left for future investigation. In particular we have no information as to whether the small *L. marmoratus* are mature; no one, so far as I am aware, having found them spawning.

With regard to the two Mediterranean species, *L. genei* and *L. Eisigii*, I have only had access to the description in the "Prodromus Faunæ Mediterraneæ" of Carus. So far as one can judge, there seems little reason to regard them as distinct from one another. *L. portlandicus* apparently only differs from them in unimportant details of colouring of distinctly less moment than those which distinguish the last-named from *L. marmoratus*, so that Garstang's relegation of *L. portlandicus* to the synonymy of *L. genei* will probably be justified in the future. On the other hand, I understand from Mr. Garstang that he is now more disposed than formerly to consider *L. marmoratus* distinct.

All my specimens of *L. portlandicus* were observed to swim by a powerful lashing motion of the body from side to side. When indulging in this movement the lateral margins of the foot were closely applied together. One of those taken at Plymouth deposited spawn in the shape of a long white thread (under 1 mm. in thickness) thrown into a loose, elongate, irregular, spiral coil.

Distribution.—South-west coast of England (Thompson; Norman; W. I. B.); west of Ireland (W. I. B.); Mediterranean (?) (Verany; Trinchese).

[1] One specimen, 18 mm. long, is the only example of *L. marmoratus* I have seen exceeding 12 mm.

Lomanotus marmoratus, A. & H.

Eumenis (*Lomanotus*) *marmoratus*, A. &
Lomanotus flavidus, A. & H.
L. varians (*pro parte*), Garstang (1889
L. genei (*pro parte*) Garstang, Jour
vol. i., 1890, p. 426.
L. genei, Gamble, Ann. Mag. Nat. I
p. 379, pl. xvii.
L. genei, Gamble, Irish Naturalist, vol
L. genei, Herdman (*fide*, Beaumont), 1
1896, vol. x., p. 42; and Annual
p. 446.

Small specimens of Lomanotus
were found on several occasions liv
in Valencia Harbour. They were
belonging to the same species which
and described as *L. genei* (*loc. cit.*)

In dealing with the last species
conviction that the small marbled l
be regarded as a well-marked and
it be not specifically distinct from
Hancock's *L. flavidus* was, in my
L. marmoratus rather than *L. portl*
individuals have been described b
p. 427), and observed by myself a
mens of different size shows tha
mentation begins to appear in indi
gradually becomes more and more
the papillæ become leaf-like.

Distribution.—S.W. of England
W. I. B.); Isle of Man (W. I. B.)

Family—DOTON

Genus—Doto.

Doto coronata (Gmelin).

Doto coronata, A. & H.

We found this the most abundan
ing grounds in Valencia Harbour i

ring chiefly on *Antennularia.* In the summer of the following year only a single example was seen; it was found on one of the hulks.

Doto pinnatifida (Montagu).

Doto pinnatifida, A. & H.

Dredged on three occasions in Valencia Harbour, probably on *Antennularia.* I have seen a considerable number of examples of this species; it is by no means uncommon in the Plymouth district. I consider it a well-defined species; apart from structural features, its colouring is fairly constant and characteristic, enabling one familiar with its appearance to distinguish it at a glance from its British allies.

Distribution.—S. Devon (Montagu; W. Garstang; W. I. B.); Isle of Man (W. I. B.); Guernsey (Alder); Roscoff (Hecht).

Doto fragilis (Forbes).

Doto fragilis, A. & H.

Common both in 1895 and 1896 on Hydroids (more particularly *Antennularia*) dredged on the Shell-beds in Valencia Harbour.

Family—DENDRONOTIDÆ.

Genus—Dendronotus.

Dendronotus arborescens (O. F. M.).

Dendronotus arborescens, A. & H.

Very numerous, and of large size on one of the hulks; a few only on the other. Not found by us anywhere else at Valencia.

Section II.—Nudibranchiata Holohepatica.

Family.—DORIDIDÆ CRYPTOBRANCHIATÆ.

Sub-family—Archidorididæ.

Genus—Archidoris.

Archidoris tuberculata (Cuv.).

Doris tuberculata, A. & H.

Common on the rocky parts of the shores of the harbour.

Archidoris flammea (A. & H.).

Doris flammea, A. & H.

A few specimens were found by M (? *Hymeniacidon*) dredged on the K on the Nullipore ground in Port Ma

Doris, sp. nov ?

A single specimen of a small *Doris*, found at Port Erin by Mr. J. C. Si Liverpool Biol. Soc., x., 1896, p. 4 undescribed species, was dredged on of Doulus Head (25 fms., *ca.*).

Sub-family—KENTRODO:

Genus—*Jorunna*.

Jorunna Johnstoni (A. & H.).

Doris Johnstoni, A. & H.

Found under stones at low tide n

Sub-family—PLATYDOI

Genus—PLATYDOR

Platydoris planata (A. & H.).

Doris planata, A. & H.

A single example was dredged o Port Magee Channel in 1896, in tl *flammea*.

Family—DORIDIDÆ PHANER

Sub-family—POLYCE:

Genus—ÆGIRUS

Ægirus punctilucens (d'Orb).

Ægirus punctilucens, A. & H.

One of the commonest Nudibranc on most of the dredging grounds, and rocky parts of the shore.

Genus—TRIOPA.

Triopa claviger (O. F. M.).

Triopa claviger, A. & H.

A common form, found on Zostera and Algæ, and under stones at low tide; and dredged on Shell-beds, on sandy gravel at the mouth of harbour, and on Nullipore ground at Port Magee.

Genus—POLYCERA.

Polycera Lessonii (d'Orb).

Polycera Lessonii, A. & H.

Polycera ocellata, A. & H.

Palio Lessonii, Bergh.

Most authorities now regard *P. ocellata*, A. & H., as a variety of *P. Lessonii*. Specimens recorded by Gamble as *P. ocellata* were dredged on several occasions on Shell-beds in 1895, besides being found once on the shore. In the following year the only record is of *P. Lessonii* dredged in the harbour, the exact locality being doubtful.

Polycera quadrilineata (O. F. M.).

Polycera quadrilineata, A. & H.

One of the commonest and most generally distributed Nudibranchs on all the dredging grounds in the harbour. Occasionally found on the shore also.

Sub-family—GONIODORIDIDÆ.

Genus—ACANTHODORIS.

Acanthodoris pilosa (O. F. M.).

Doris (Acanthodoris) pilosa, A. & H.

Found under stones on the rocky parts of the shore on several occasions in 1895; spawning in April. Not found in 1896 at all.

Genus—Lamellidoris.

Lamellidoris bilamellata (Linn.).

Doris (*Lamellidoris*) *bilamellata*, A. & H.

Very abundant on a limited area of one of the hulks beached in 1896; none found on the other. In 1895 it was found once on the shore near Knightstown.

Lamellidoris aspera, A. & H.

Doris (*Lamellidoris*) *aspera*, A. & H.

Not at all common in Valencia Harbour. Dredged on Ascidian ground on one occasion each year; and found once on the shore of Church Island.

Lamellidoris (sp. ?).

A small *Lamellidoris*, attaining a length of 6 mm., was frequently found adhering to the under sides of stones on the shore, and to Pecten and other shells dredged in the harbour. We failed to identify it satisfactorily with any of Alder and Hancock's species. In most of its external features it agreed best with *L. pusilla*, but the tubercles of the mantle were more clavate, and were decidedly spiculose. In these points it agreed with *L. inconspicua*. The radula of a preserved specimen, examined recently, is somewhat intermediate in character between *L. inconspicua* and *L. oblonga* (A. & H., pl. 46, figs. 13 and 14), approaching more closely to the latter.[1] The Valencia animal was, however, certainly not *L. oblonga*, with which I am quite familiar.

Genus—Goniodoris.

Goniodoris nodosa (Montagu).

Goniodoris nodosa, A. & H.

This species, which at Plymouth is one of the most abundant and generally distributed of Nudibranchs, was far from common at Valencia. I find it recorded as taken on the shore twice in

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[1] Alder and Hancock state that the hook of the inner denticle in *L. oblonga* may be denticulated, though they represent it smooth in their figure. It is certainly denticulated in two specimens examined at Plymouth. They do not figure the radula of *L. pusilla*, but state that it resembles that of *L. inconspicua*.

1895 (spawning in April), and dredged twice in 1896 (on Shell-beds and on the Port Magee Nullipore ground, respectively).

Genus—IDALIA.

Idalia pulchella (?), A. & H.

Idalia pulchella, A. & H. (Appendix p. v.)

Idaliella pulchella, Bergh.

A possible example of this species dredged on Pecten ground in April, 1895, is thus described by Gamble:—"One-eighth inch long. Body steep-sided, white speckled with brown and opaque white and dotted with yellow. Two long pairs of pallial processes anteriorly. Rhinophores laminated posteriorly for three-quarters of their length. Two pairs of very small, and one larger posterior bifurcated pair, of processes at the sides of the two branchial plumes, and exceeding the latter in size."

Idalia Leachii, A. & H.

Idalia Leachii, A. & H.

A single specimen of this species was dredged on the trawling ground in Dingle Bay, in about 35 fms., bottom fine muddy sand. It was probably about 25 mm. long when extended (in the preserved state it measures almost 20 mm.), and in form agreed almost exactly with Alder and Hancock's description. Though widely distributed in British seas (from South Devon to Shetlands), it does not appear to have been recorded from Ireland or from outside the British area.

Sub-order—**ASCOGLOSSA.**

Family—HERMÆIDÆ.

Genus—HERMÆA.

Hermæa bifida, (Montagu).

Hermæa bifida, A. & H.

Dredged on several occasions on Shell-beds in the harbour, and at Port Magee among Algæ.

Hermæa dendritica, A. & H.

Hermæa dentritica, A. & H.

Found on *Codium* growing on the rocks at Reenagiveen and on the north side of Beginnis.

Family—ELYSIIDÆ.

Genus—Elysia.

Elysia viridis (Montagu).

Elysia viridis, A. & H. (Appendix, p. xxiii.).

Moderately common among Algæ on the shore, and am refuse weed in the more muddy parts of the harbour.

Family—LIMAPONTIIDÆ.

Genus—Limapontia.

Limapontia capitata (O. F. M.)

Limapontia nigra (Johnst.), A. & H. (Appendix, p. xxiv.).

Found among Algæ collected between tide marks at Re giveen and Church Island, and dredged in Cahir River muddy ground (Gamble).

Genus—Actæonia.

Actæonia corrugata, A. & H.

Actæonia corrugata, A. & H.

Found in weed material from rocky parts of the shore.

Sub-order—**TECTIBRANCHIATA**.

Section I.—Bulloidea.

Family—ACTÆONIDÆ.

Genus—Actæon.

Actæon tornatilis, Linn.

Tornatella fasciata, Forbes and Hanley.

A single specimen was dredged in Dingle Bay, on co sandy bottom in about 25 fms., to the north of Doulus H and was determined by Mr. Gamble.

Family—BULLIDÆ.

Genus—Acera.

Acera bullata, O. F. Muller.

Acera bullata, Forbes and Hanley.

We were informed by the Rev. A. Delap that this spe was at times plentiful in Valencia Harbour.

Family—PHILINIDÆ.

Genus—PHILINE.

Philine aperta, (Linn.)

Philine aperta, Forbes and Hanley.

Dredged in the more muddy parts of the harbour.

Philine catena (Montagu).

Philine catena, Forbes and Hanley.

Dredged on Shell-beds once in 1895, and once in 1896 (Gamble).

Philine punctata (Clark).

Philine punctata, Forbes and Hanley.

Dredged some half-dozen times in 1895 on Ascidian ground and Shell-beds, and on muddy ground in Cahir River (Gamble).

Section II.—APLYSIOIDEA.

Family—APLYSIIDÆ.

Genus—APLYSIA.

Aplysia punctata, Cuv.

Aplysia hybrida, Forbes and Hanley.

Dredged in various parts of Valencia Harbour, but not found in any abundance. Many of the specimens were very small, 8–10 mm. Similar young individuals were also found among Algæ collected on the shore at Reenagiveen and Church Island.

Section III.—PLEUROBRANCHOIDEA.

Family—PLEUROBRANCHIDÆ.

Genus—PLEUROBRANCHUS.

Pleurobranchus plumula (Montagu).

Pleurobranchus plumula, Forbes and Hanley.

Found under stones at low tide on the rocky parts of the shore in 1895. Not found in 1896.

Family—RUNCINIDÆ.

Genus—RUNCINA.

Runcina Hancocki, Forbes.

Runcina Hancocki, Forbes and Hanley.

Twice found on the shore near Knightstown, probably amo weeds in rock pools. (Gamble).

Runcina (sp. nov. ?).

A small Tectibranch somewhat similar to the last species external character, about 3 mm. long, and of a deep vin red colour, was dredged several times on Ascidian ground the harbour. We thought at first that it might be the you of some known species, but it is more likely a new speci Having lately found this form in the river Yealm near Pl mouth, I hope to be able to come to a more definite conclusi respecting its position.

Geo West & Sons lith.

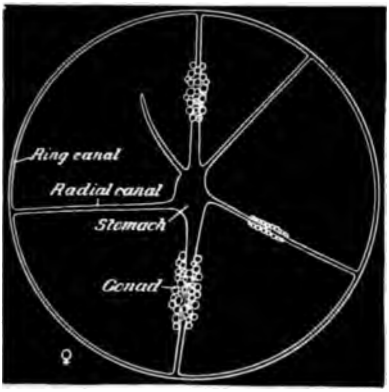

Fig. 1.

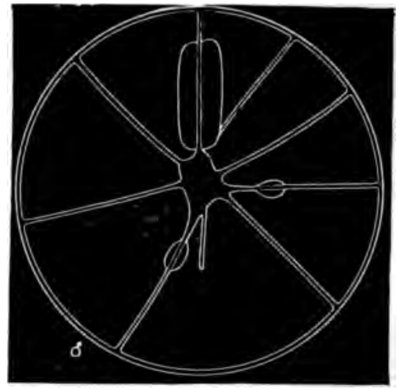

Fig. 2.

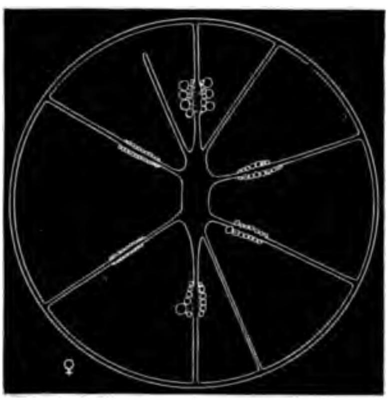

Fig. 3.

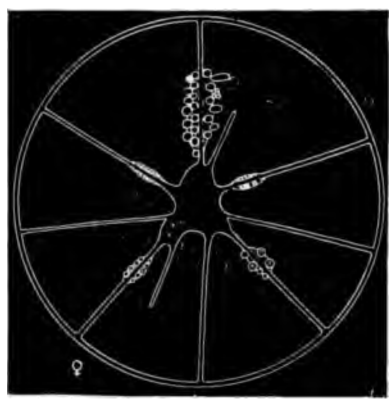

Fig. 4.

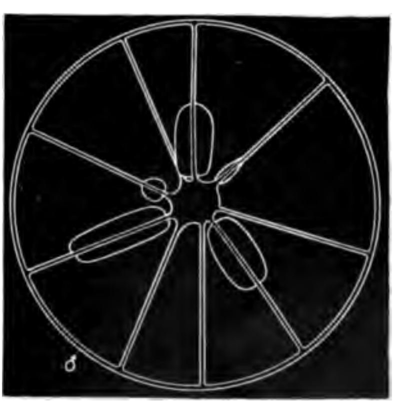

Fig. 5.

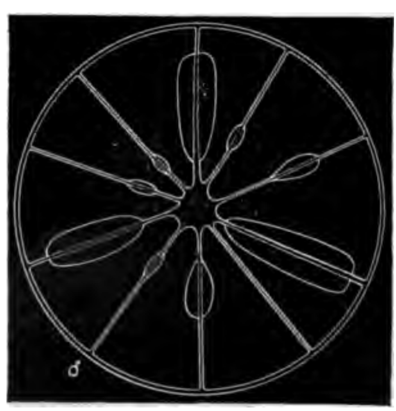

Fig. 6.

DIPLEUROSOMA TYPICUM—RADIAL CANAL SYSTEM.

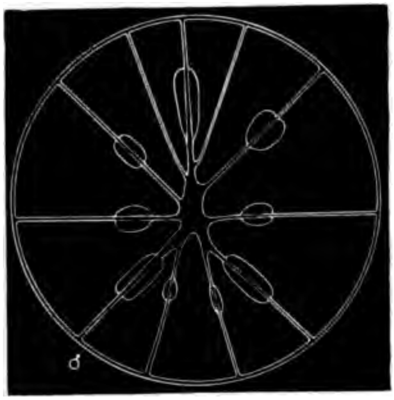

Fig. 7.

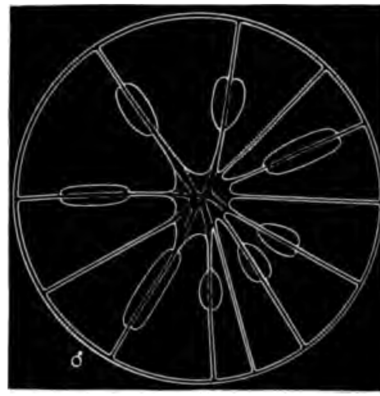

Fig. 8.

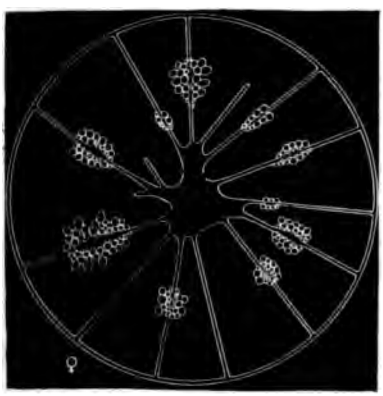

Fig. 9.

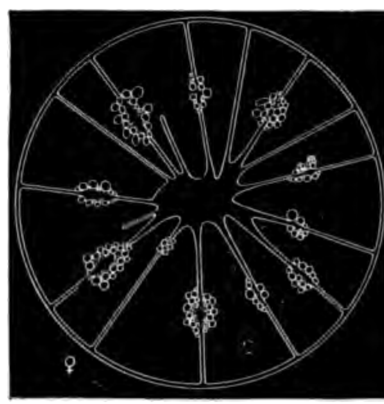

Fig. 10.

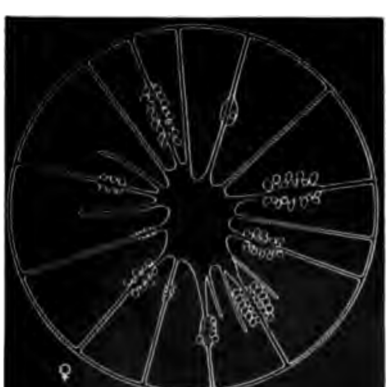

Fig. 11.

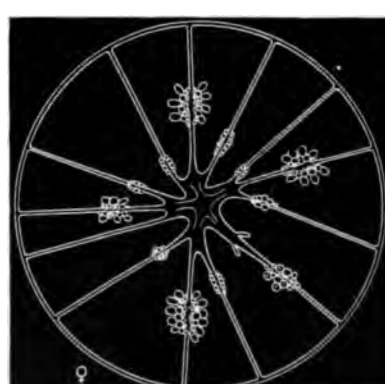

Fig. 12.

DIPLEUROSOMA TYPICUM—RADIAL CANAL SYSTEM.

INDEX SLIP.

Browne, Charles R.—The Ethnography of Clare Island and Inishturk, County of Mayo.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1898, pp. 40–72.

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Browne, Charles R.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1898, pp. 40–72.

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Roy. Irish Acad. Proc., S. 3, vol. 5, 1898, pp. 40–72.

Joly, Charles Jasper.—The Associative Algebra applicable to Hyperspace.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1898, pp. 73–123.

Algebra, Associative, applicable to Hyperspace.
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Roy. Irish Acad. Proc., S. 3, vol. 5, 1898, pp. 73-123

Steede, Benjamin H.—Note on Curvature of Pedal and Reciprocal Curves.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1898, pp. 124–127.

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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 366–369.

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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 366–369.

SMYLY, J. GILBART.—Notes on certain Curves connected with the double Normals of plane bicircular Quartics and Cyclides.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 370-373.

Quartics, plane bicircular, and Cyclides, Curves connected with the double Normals of.
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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 370-373.

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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 370–373.

Paterson, W. H., Praeger, R. L., Bigger, F. J., and Knowles, W. J.—
Investigation of Prehistoric Settlements near Roundstone, Connemara.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 433–440.

Praeger, R. L., Bigger, F. G., Paterson, W. H., and Knowles, W. J.—
Investigation of Prehistoric Settlements near Roundstone, Connemara.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 433–440.

Bigger, F. G., Knowles, W. J., Paterson, W. H., and Praeger, R. L.—
Investigation of Prehistoric Settlements near Roundstone, Connemara.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 433–440.

Ireland, County of Galway, Prehistoric Settlements near Roundstone, Connemara.
Knowles, W. J., Paterson, W. H., Praeger, R. L., and Bigger, F. J.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 433–440.

Johnson, Thomas, and Hanna, Henry.—Irish Phæophyceæ.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 441–461.

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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 216–218.

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Ireland, County of Westmeath, Rath Souterrain at Gurteen.
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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 216–218.

Crannog at Lough-a-Trim, Killucan, County of Westmeath, Ireland.
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Ethnography of Garumna and Lettermullen, in the County of Galway, Ireland.
Browne, Charles R.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 223–268.

Ireland, County of Galway, Ethnography of Garumna and Lettermullen.
Browne, Charles R.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 223–268.

Dixon, Henry H.—Nest-parasitism of Cuscuta reflexa.
Roy. Irish Acad. Proc., S. 3, vol. 6, 1900, pp. 219–220.

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Young, C. G.—Note on some Shell Implements from Barbados.
Roy. Irish Acad. Proc., S. 3, vol. 6, 1900, pp. 221–222.

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Roy. Irish Acad. Proc., S. 3, vol. 6, 1900, pp. 223–268.

Ethnography of Garumna and Lettermullen in the County of Galway, Ireland.
Browne, Charles R.
Roy. Irish Acad. Proc., S. 3, vol. 6, 1900, pp. 223–268.

Ireland, County of Galway, Ethnography of Garumna and Lettermullen.
Browne, Charles R.
Roy. Irish Acad. Proc., S. 3, vol. 6, 1900, pp. 223–268.

BROWNE, CHARLES R.—Report of the Work done in the Anthropometric Laboratory of Trinity College, Dublin, from 1891 to 1898.
Roy. Irish Acad. Proc. S. 3, vol. 5, 1899, pp. 269–293.

Anthropomètric Laboratory of Trinity College, Dublin, Report of Work.
Browne Charles R.
Roy. Irish Acad. Proc. S. 3, vol. 5, 1899, pp. 269-293.

Ireland, Dublin, Trinity College, Report from Anthropometric Laboratory.
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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 269–293.

WESTROPP, THOMAS J.—List of the Round Towers of Ireland.
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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 294–311.

JENNINGS, A. VAUGHAN.—On a new Genus of Bacteria (Astrobacter).
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 312–316.

Bacteria, On a new Genus of (Astrobacter).
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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 312-316.

M'ARDLE, DAVID, and LETT, H. W.—Report on Hepaticæ collected at Torc Waterfall, Killarney, in 1897.
Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 317–328

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Roy. Irish Acad. Proc., S. 3, vol. 5, 1899, pp. 317–328.

Hepaticæ from Torc Waterfall, Killarney, 1897.
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