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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

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I.

NOTES ON THE STRUCTURE OF *TMESIPTERIS*. By A. VAUGHAN JENNINGS, F.L.S., F.G.S., Lecturer on Comparative Anatomy to the Birkbeck Institute; and KATE M. HALL. Plates I. to V.

[Read April 27, 1891.]

THE genus Tmesipteris comprises one, or perhaps two species, of Vascular Cryptogams found only in South Australia, Tasmania, New Zealand, and the South Pacific Islands. Its affinities to Psilotum have long been recognised, and the two genera have been classed together by systematic botanists. No complete account of its anatomy has, however, been written, and no details of its structure have, so far as we are aware, been published in English. Such being the case we have thought it might be of service to put together some notes on material collected in New Zealand in 1890; though the following account is by no means exhaustive, and no detailed comparison with allied types has been attempted. If no other purpose is served by the present communication it may at least call the attention of New Zealand botanists to the interesting points yet to be decided with reference to the plant.

Tmesipteris forsteri was so named by Endlicher[1] in 1833: and is probably identical with *T. tannensis*, Bernh. Other so-called species differ only in slight and variable characters. It ranges through New Zealand, New Holland, New Caledonia, Tasmania, and South Australia.

The plant consists of a slender axis which grows among the rootlets covering the trunks of such tree ferns as *Dicksonia antarctica* and *Hemitelia smithii*, and then comes to the surface and forms pendent leaf-bearing shoots.[2] There are no true roots. That part of the axis which penetrates the mass of fern-rootlets, and which for convenience we have referred to as the *rhizome*, may be more or less branched. The aerial part is almost always unbranched; and when dichotomy occurs it has probably no greater morphological significance than the bifurcation of a fern rachis. Towards the distal end of the leafy shoots the single, sessile leaves are replaced by pairs of leaves carried out from the stem on a short lateral axis, and bearing on the upper side at the point of junction a bilocular sporangium. (Plate I.)

I.—The Axis.

As already stated, the axis of the plant consists of two parts; one, which may be termed the rhizome portion, growing amongst the root-fibres of tree-ferns, and the other, or stem portion, hanging free and developing leaves. The rhizome portion near the surface of the trunk averages about 4 mm. in diameter, and is of a brown colour: it often gives off short lateral outgrowths apparently incipient or rudimentary branches, seldom more than $\frac{1}{4}$ inch long, terminating in blunt, rounded apices. The deeper portions are more slender, more branched, and covered with a thick layer of long hairs often longer than the diameter of the axis.

The stem portion is more angular in section, and pale green in colour; it tapers gradually toward the apex. The rhizome part passes gradually into the stem part without any sudden change, and it is difficult to make any morphological distinction between the two structures.

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[1] Endlicher, *Prodromus Floræ Norfolkicæ.*

[2] A variety is occasionally found on the ground, but the position of the rhizome in relation to surrounding objects in those cases does not seem to have been recorded.

M. Bertrand[1] terms the rhizome portion the *stipe*, and the stem portion a *rameau souche :* the intermediate part, or *rameau rampant,* he regards as having the value of *un cladode de stipes.* In the following notes we have referred simply to the "rhizome" or "rhizome portion," and "stem" or "stem-portion," without entering into the question of their morphological value.

The Epidermis consists of a single layer of cells, approximately square in transverse section, but about four times as long as wide. Those of the rhizome portion have the outer wall coloured a bright yellow-brown, and often give rise to tubular hairs composed either of one cell only or of two cells, a long one on a short basal cell.

In the more deeply-seated parts of the rhizome the hairs are long —often longer than the diameter of the axis—closely set, and with protoplasmic contents. Those which are unbroken show a bent extremity similar to that of most root hairs, but we have not been able to trace any connexion between them and the rootlets of the tree-fern. It is possible that these hairs absorb nourishment from the earth enclosed among the rootlets of the tree-fern on which the plant grows, though some features, noticed below, would lead one to suppose that the plant is in part indirectly nourished.

The hairs are absent in the stem portion; and here the outer wall shows a very peculiar thickening, due to the presence of transverse and oblique bands which anastomose so as to form a reticulation on the surface. These thickened lines are strongly marked, but do not project down into the cavity of the cell in ridges to the same extent as in the leaf (Plate II., fig. 14). A distinct and thick cuticle covers the outside, and well marked cuticularized layers are present through the rest of the cellulose wall. Protoplasm and starch granules are present in the epidermal cells of both parts of the axis. Stomata are present, though not frequent, on the stem: they are of the same kind as those of the leaf, but circular, and the transpiratory chamber is narrow.

The *ground tissue* of the axis is of rather remarkable character. In the rhizome the cells are four or five times as long as broad, with horizontal or oblique end walls; in transverse section circular or polygonal, showing distinct thickening (often collenchymatous), and a very evident middle lamella.

Both lateral and terminal walls are covered with bright spots of varying size, some of which are no doubt perforations. Transverse

[1] *Annales Botaniques du Nord de la France,* 1882.

sections showing the end walls recall at once the appearance of the sieve-plates of higher plants. The whole tissue may, in fact, be called a sieve parenchyma (Plate II., figs. 7, 8, and 9).

Protoplasm is abundant, especially in the middle region of the cortex; and when contracted into the centre of the cell remains connected with the wall by distinct threads. These are frequently seen to be in a line with corresponding threads of neighbouring cells, and are continuous with them. Treatment with sulphuric acid and Hoffman's blue brings out this structure very clearly, and also shows that the mass of contracted protoplasm is largely composed of convoluted filaments.

This peculiar appearance of the cell-contents is due to the presence of a fungus like that described by Treub[1] in *Lycopodium cernuum*, and by Bruchmann[2] in *L. annotinum*. As in these cases the protoplasm co-exists with the fungus, and the cell-nucleus can be clearly distinguished, so that the connexion seems to be a sort of symbiosis. The middle zone of the ground tissue is that most attacked, as was observed by Treub; but this is probably only because that zone contains more protoplasm than the peripheral layers. We have not been able to find any fruit on the fungal hyphae, neither can we trace them in from the rhizome hairs, though a few may be seen running along these hairs. Considering the physiological importance which has been attributed by some botanists[3] to intracellular fungi in plant roots, it is interesting to find them here in a plant whose whole habit is so peculiar.[4]

In the stem the cortical cells are much longer, more rectangular, and thicker walled. The side walls show numbers of minute slit-like pits in oblique parallel rows, similar to those of the sclerenchymatous fibres of *Pteris aquilina*. The cells contain very little protoplasm in comparison with those of the rhizome. No hypodermal specialization of the ground tissue is present. On the contrary, the epidermal cells resemble those of the ordinary ground tissue in their form and contents. Beyond the external thickening of the epidermal cells,

[1] Treub, *Annales du Jardin Botanique de Buitenzorg*, vol. v., 1886.

[2] Bruchmann.

[3] Marshall Ward, *Phil. Trans.*, 1887, and literature on "Mycorhiza" generally.

[4] Since this Paper was written, M. Dangueard in *Le Botaniste* (April, 1891), has described the *Mycorhiza* in Tmesipteris. We have not had time to study his account in detail, but it seems he has noted three kinds of hyphæ and spores in the cells, and that he believes some of the hyphæ may be referred to Nectria.

there is, therefore, little difference between the limitary and fundamental tissues.

Round the fibro-vascular system a well-marked differentiation occurs, due rather to the contents than to the structure of the cells. Immediately outside the phloem in the rhizome lies a zone of cells, one to three layers thick, containing a large quantity of starch. M. Bertrand[1] has described this as the "protective sheath" ("gaine protectrice mal cáracterisée"). That term is, however, generally used in England as equivalent to endodermis, a structure which is not typically developed in Tmesipteris. There is no single layer of modified cells round the bundle, and no folding of the radial walls characteristic of a typical endodermis. It would, perhaps, be better, therefore, to use the term "phloem sheath" rather than "protective sheath." The layer is present in the stem, and even in the leaf, though in both cases less evident than in the rhizome, from the absence of the abundance of starch which characterizes it in that region; in younger parts it is represented by one cell-layer. (Plate II., figs. 6, 8, 13.)

Outside this phloem sheath lies a zone of cells conspicuous by their bright brown contents. (Plate II., figs. 5, 6, 8, &c.) In transverse section they appear as a ring of irregular patches surrounding the bundle, and looked at in a tangential section are seen to form a network with elongated meshes. The longitudinal brown masses are connected by transverse anastomoses, so that the tissue resembles in appearance some of the simpler types of laticiferous tissue, such as that of Lactuca. Closer examination shows, however, that the brown substance does not fill up special cavities, but is developed in ordinary cells of the deeper layers of the ground tissue, and the transverse anastomoses generally correspond to the cross walls between them. It may be mentioned that the brown layer is perfectly distinct in *fresh* specimens, and therefore not a result of preservation in spirit. No reaction is obtained by treatment of the brown substance with ferrous sulphate and nitric acid, and by this and other tests the presence of tannin cannot be demonstrated. The colour can be removed by prolonged maceration in strong Eau de Javelle, or caustic alkalis, but resists the action of acids longer than the surrounding tissues. A black colouring results from the addition of caustic potash previous to solution; a reaction that would suggest the presence of tannin were it

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[1] Bertrand, *loc. cit.* (p. 232).

not for the absence of any effect in the case of ferrous sulphate test. It differs from resins in being insoluble in absolute alcohol, but gives dense precipitate of ferric hydrate (when the sheath is dissected out and dissolved in HCl) with ammonia, showing that it contains a large percentage of iron.

The brown zone is absent in the younger parts of the stem, and consists of one layer of cells in the older part (Plate II., figs. 10, 13): in the rhizome two or three layers are often concerned in its formation. M. Bertrand[1] describes this tissue as a zone "*dont les parois cellulaires sont en partie gelifiées*," He regards the brown matter as due to a local or general "*gélification*" and "*humification*" of the cell wall; and compares the change with that seen near the base of the stem in Psilotum. In the development of these brown contents there seems however, little in common with a mucilaginous change in the cell wall as usually understood. There is no stratification in the brown substance; it may be seen (in material preserved in spirits) in any position as regards the cell wall, and sometimes contracted into the cell cavity. The wall of the containing cell is of normal thickness throughout, even when large masses of the brown substance lie against some particular region of it. We have examined sections treated with glycerine and potash, but we can detect no thickening and swelling of the walls similar to that figured by M. Bertrand, either in spirit material or dried specimens.

There seems to be some doubt as to M. Bertrand's[1] use of the term "*gélifiée et humifiée*" as he applies them also to the external wall of the epidermis which, though brown in colour, differs greatly from the brown sheath, both in appearance and behaviour under reagents.

The *fibro-vascular system* forms an axial strand, very distinctly marked even to the naked eye, by the dark surrounding ring. Leaf trace bundles run obliquely across the ground tissue in a line with the midrib, so that they join the main system a little below the base of the leaf.

The xylem forms a central, oval, or transversely elongated bipolar mass in the rhizome portion; but in the stem region there are five or six separate xylem strands. By examining transverse sections at different levels M. Bertrand[1] has shown how these strands in the stem coalesce to form the single one in the rhizome. The xylem elements are large scalariform tracheides with pointed ends, similar in all

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[1] Bertrand, *loc. cit*

respects to those of ferns, and narrower forms in which the unthickened areas vary from simple circular pits to oval bordered pits. These less specialized tracheides are characteristic rather of the younger parts of the stem.[1] The tracheides do not always occupy the centre of the bundle, where there may be two or three rows of long rectangular parenchyma cells.[2] The latter, though they may be in parts absent in the rhizome, occupy the centre of the axis in the younger parts of the "stem."

Examination of the region behind the growing point shows that the tracheides develop round a central core of elongated but unlignified cells. Also that in the earliest formed tracheides, the thickening, though somewhat more irregular than in older tissue, is still of the scalariform type. We have not been able to detect any spiral protoxylem, and in the absence of this element the bundle agrees with that of Psilotum.[3]

The phloem, which completely surrounds the xylem, is of simple structure. It consists of elongated narrow cells, with transverse or oblique end walls, and of long tubes pointed at the ends. The walls of the cells are delicately pitted, and the tubes generally show a row of sieve plates, nearly as wide as the vessel, covered with the brightly refracting granules common in the "sieve-tubes" of the Lycopodiaceæ. We have not been able to detect pores in the pointed ends of the "sieve-tubes," but the transverse walls of the phloem cells are pitted and perhaps porous. The latter most resemble the elements described by Bertrand as sieve-tubes in Psilotum. The figures published by Janczewski,[4] for Lycopodium do not show the end walls. Moreover, the phloem in Lycopodium is coloured blue by iodine,[5] and that of most plants by iodine and sulphuric acid; but we have not been able to obtain reaction by either method in Tmesipteris.

Russow believes that the phloem walls in Tmesipteris are lignified, and compares them with the phloem of many monocotyledonous roots. We have found, however, that with all differentiating stains used the walls of the phloem elements never give the reactions of wood.

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[1] The *Primitive Fibres* of Bertrand. They are not lignified.

[2] Russow, Vergleichende Untersuchungen, *Mem. de l'Acad. Imperiale des Sc. de St. Petersbourg*, vii. series, tom. xix., 1873.

[3] Janczewski, *Mem. de la Soc. Sc. Nat. Cherbourg* v., xxiii.

[4] Janczewski, *loc. cit.* Recorded in *L. clavatum*, *L. annotinum*, and *L. complanatum*. We find it also to be the case in *L. selago* and *L. alpinum*.

[5] Russow, *loc. cit.*

Long nuclei are seen in the phloem cells, and in sections treated with sulphuric acid and Hoffman's blue, a delicate protoplasmic network is shown lining the walls. The phloem therefore consists mainly of elements termed "cambiform tissue" by De Bary.

The *growing point of the stem* we have not been able to work out in detail. The primitive meristem differentiates rapidly into a dermatogen layer externally, and a procambial cylinder round the axis. An apical cell is present, but of small size, and differing little from surrounding cells. In surface view the apical cell is triangular, and segments are cut off on the three sides which rapidly subdivide by radial and tangential walls. (Plate III., fig. 18.) In the instance figured, the only one which the amount of material at our disposal has enabled us to examine, the earlier divisions do not seem to follow any very definite plan. Their arrangement is, however, closely similar to those in Psilotum, as figured by Laubach.[1]

The short *lateral shoots* developed from the rhizome near the surface of the fern-trunk are of exogenous origin, and have essentially the same structure as the main axis. The fibro-vascular bundle is well developed, and large tracheids are found extending right up to the apex. In the ground tissue a large quantity of starch is present.

II.—**The Leaf.**

The leaves in Tmesipteris are sessile, ovate or oblong in general outline, but slightly asymmetric, the upper border being more convex near the base, and the lower border more concave, so that the margin is slightly falcate in outline. In *T. forsteri*, the apex is slightly truncate, and the midrib produced into a prominent mucro. The extent of the truncation and development of the mucro is, however, extremely variable, and raises a doubt as to the value of the species which depend on the leaf characters. Thus, while *T. forsteri* (*T. tannensis*, Bernh.) is said to have acuminate fronds, *T. billardieri* (*T. tannensis*, Labill, *T. truncata*, Desh.) is said to be characterized by their truncation. M. Bertrand adds two forms, one with leaves both truncate and acuminate, and one with some truncate and some acuminate. The fact that in the same plant of *T. fosteri* there may occur leaves tapering

[1] Solms-Laubach *Annales du Jardin Botanique de Buitenzorg*, 1884, vol. iv.

gradually to a point, and others distinctly truncate and mucronate, does not strengthen the view that there is more than one species.

The different form of epidermal cells and variation in pattern due to thickening, noticed by M. Bertrand in *T. forsteri* and *T. billardieri*, seems also to be of little value in specific distinction, when the variation of these characters in one plant is observed.[1]

The leaf, which, like that of Lycopodiaceæ, is of the centric type, consists of several layers of spongy parenchyma bounded by a single layered epidermis, and traversed by a small axial bundle.

The *parenchyma cells* are large and irregular; appearing rounded in cross section, but in surface view oblong and with well-marked lateral outgrowths which give rise to the lacunar nature of the tissue. The areas of the contact of the cells are pitted and marked out by a distinct thickening of the wall; so that if the tissue has been broken up the thickened rings often separate altogether from the rest of the cell wall. The innermost layer of the cell wall is also thicker and more highly refracting than those between it and the middle lamella. In the protoplasmic layer lies an elongated oval nucleus, and numerous starch granules. Some of the parenchyma cells also contain tannin,[2] forming oval drops round the cell nucleus.

The *epidermis* consists of a single layer of cells three or four times as long as broad, but rounded or square in transverse section. The side-walls are waved or sharply zigzag; the angles corresponding to the bases of thickening lamellæ which run across the roof of the cell, and anastomose forming a perfect reticulation, which is, however, not easily seen except by oblique light. In transverse sections the cells are seen to fit closely together; the outer wall or roof is flat or slightly convex, and the side walls approximately straight and vertical to the surface; the inner wall or floor fits irregularly against the parenchyma below, so that the distinction between the latter and the epidermis is by no means sharp. A thin cuticle covers the outer wall, and the wall itself is largely cuticularized: the cuticular portion running down the lateral walls of the cells for about two-thirds of their length. In many

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[1] M. Dangueard (*loc. cit.*) has added several species founded on similarly variable external characters, but he claims to support the value of his distinctions by histological differences.

[2] They give the characteristic greenish-black colouring with ferrous sulphate and nitric acid.

cases the thickening bands crossing the outer wall, send down vertical lamellæ projecting into the cavity of the cell, and sometimes extending halfway across it. (Plate III., fig. 23.) In their contents the epidermal cells of the leaf resemble those of the subjacent parenchyma.

The *stomata* are numerous on both sides of the leaf, and of simple structure. They consist of a pair of simple guard-cells lying between ordinary epidermal cells; there are no subsidiary cells. The guard-cells have the external wall much thickened in the middle, round the cleft, but comparatively thin at each end. There is a well-marked air-space below the stoma. Compared with those of the stem they are longer, and the transpiratory chamber larger.

The *fibro-vascular bundle* of the leaf is similar in structure to that of the axis, though considerably reduced. It consists of three or four scalariform tracheides, surrounded by a ring of elongated phloem cells, with finely-pitted walls and long nuclei. (Plate III., figs. 21, 22.) A sheath of larger rectangular cells encloses the whole. The bundle runs straight along the centre of the leaf to terminate in its mucronate apex, and gives off no lateral offshoots in its course.

Toward the base of the stem the leaves become smaller and pass into little subulate scales about a quarter of an inch or less in length. They have similar structure to the leaves, but contain no fibro-vascular bundle.

III.—**The Sporangia.**

Toward the end of the axis the leaves are replaced by sporangiferous shoots; though ordinary leaves not unfrequently occur singly among these. The axis, however, does not necessarily cease to grow, after developing sporangia: there is frequently subsequent growth by innovation, and a new leafy shoot is formed which later on develops its own series of reproductive organs. This process may be repeated several times. (Plate I., fig. 1.)

The sporangiferous shoot consists of a short cylindrical stalk, about $\frac{1}{4}$ of an inch in length, terminating in a pair of leaves of the normal type with or without the mucro. On the inner face of the shoot and at the base of these leaves is carried the sporangium. The latter when fully developed is a brown spindle-shaped structure pointed at the ends, and constricted in the middle where a transverse septum divides its cavity into two chambers. It is said that occasionally the constriction is almost absent, and that sometimes there are three chambers as in Psilotum[1].

Viewed from the side the two portions are seen to be set at a sharp angle to one another in the full-grown sporangium. When ripe the sporangium opens by a longitudinal slit down the middle line on the side towards the axis. (Plate I., fig. 4*a.*)

The morphological value of these shoots has been a matter of much discussion. Up to a certain date almost all botanists had regarded the whole structure as a morphological leaf, in which a divided sterile portion carried an epiphyllous sporangium on its upper surface. This was the view of R. Brown[2], Hugo von Mohl[3], A. Brongniart[4], Spring[5], Kickx[6], and Mettenius.[7]

Lüerssen[8] compared the sporangium to the multilocular sporangium of the eusporangiate ferns such as Marattia ; and Prantl[9] regards the sporangium as a modified leaf lobe, referring in support of this view to the occurrence of trifid leaves in Psilotum.

Celakovsky[10] has also described the sporangium-bearing organs as morphological fronds, comparing them in their division into barren and fertile portions with those of the Ophioglosseæ.

Juranyi,[11] relying on developmental appearances, was the first to claim for them the value of special shoots with an apical fruit and a pair of leaves growing from below it.

Strasburger[12] defends the same view with certain modifications ; and Gœbel[13] has also adopted it, and stated it in his text-book as proved.

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[1] Thompson, *New Zealand Ferns,* Dunedin.

[2] Robert Brown, *Prod. Flor. Nov. Holl.*

[3] H. von Mohl, *Morph. Betrachtungen über die Sporangium der mit Gefässen Versehenen Cryptogamen,* 1837.

[4] *Hist. des Végétaux Fossiles,* Paris, 1836.

[5] "Monographie des Lycopodiacées," II., *Mem. L'Acad. Roy. Belg.*, xxiv., 1849.

[6] "L'organe reproducteur du *Psilotum triqetrum,*" *Bull. Acad. Roy. Belg.*, ser. ii., vol. 29, 1870.

[7] "Ueber Phylloglossum," *Bot. Zeitung,* 1867.

[8] "Die Farne der Samoa Inseln."

[9] Prantl, "Bemerk. über die Verwandshaft verhältnisse des Gefäss-Cryptogamen." *Verhand. d. Physik. Medicin. Gesellsch. Wurtzburg,* vol. ix., 1876.

[10] Celakovsky, *Abh. des Böhmischen Gesellschaft des Wissenschaften,* VI. Folge, Bd. ii., 1882.

[11] Juranyi, *Bot. Zeitung,* 1871.

[12] *Bot. Zeitung,* 1873.

[13] *Grundzüge des Syst. u. Spec. Pflanzenmorphologie,* Leipzig, 1882.

Eichler and Bertrand[1] also look upon the sporangium-bearing organ as a special shoot.

H. Graf v. Solms-Laubach[2], after investigating the development of Psilotum, more especially in *Ps. flaccidum*, comes to the conclusion that there is nothing to justify these later views, and returns to the older opinion that the whole structure is a phyllome.

So far as our observations on the apex of Tmesipteris have been carried, we are inclined to adopt his view of the case. It is unfortunate that the conclusions drawn by various botanists as to the morphological value of the "sporangiferous shoots" in this group of plants, should have been founded almost entirely on observation of Psilotum rather than of Tmesipteris: and it seems to us that if the latter had been equally studied, recent opinion would have gone more in favour of the views of Solms-Laubach.

The phenomena seen in the development of the lateral outgrowths round the apex, as described by Solms-Laubach for Psilotum, and as sketched below for Tmesipteris, do not offer any grounds of objection to the phyllome theory.

It has to be remembered that while the habit of branching is characteristic of Psilotum, it is at a minimum in Tmesipteris. Moreover, at the apex of Tmesipteris ordinary sterile leaves occur among the fertile "shoots," rising from the growing point in a manner indistinguishable from that of the early stages of the latter. The decurrent ridge running back along the axis from the insertion of the foliage leaf is present in exactly the same form below the "sporangiferous shoot"; indicating that the true base of the leaf is far below the level of the sporangium.

Lastly, if the tissue of the "stalk" be examined it is found that its outer layers consist of that well-marked lacunar parenchyma seen in the leaf, and continuous with that of the leaves above. It is only just round the fibro-vascular bundle that the cells have the straight-walled close-fitting character of the stem ground tissue. The lacunar parenchyma is continued down the decurrent ridge just mentioned; but there is no trace of it in the tissue of the main axis, even where this shows both stomata and chlorophyll.

On histological grounds therefore, it would seem that if a separate sporangium-bearing shoot is present at all, it is surrounded by and coalescent with the base of the pair of associated leaves. There does not, however, seem to be sufficient reason for supposing the

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[1] Bertrand, *loc. cit.* [2] Solms-Laubach, *Ann. du Jardin Bot. Buitenzorg*, 1882.

existence of any morphological branch in the structure: it seems to be simply a leaf modified at the base in a direction which would ultimately bring about some such distinction between rachis and pinnæ as is seen in the ferns.

The preservation of distinctive leaf tissue in the "stalk" indicates that the latter is in a transition stage. The phylogeny of the Psilotaceæ is a question for future study to elucidate; but it seems possible that the structure of the sporangiferous shoots might result from a tendency, on the part of the leaf in a simple Lycopodium type, to close round the base of the axillary sporangium, and so gradually separate it from the main axis.

On examining the *growing apex* of a fertile stem, the early stages of its lateral outgrowths can be seen with great distinctness. Before the development of the sporangia, there seems to be a period of cessation or retardation of apical growth, so that, on looking at the end of a leafy stem, the termination often appears wide, instead of tapering, and leaves are well developed right to the top. (Plate IV., fig. 28.) The uppermost group of leaves curve in over the apex and protect it. By removing those uppermost leaves the actual growing point can be seen at their base, surrounded by whorls of rounded knobs, the young sporangiferous shoots. Later on the growth in length becomes rapid, and the apex assumes a tapering form; the developing shoots being separated by wider intervals. (Plate IV., fig. 27.) On examining more closely the growing region in either case it will be observed that the extreme apex is wide and dome-like, and that rounded projections grow out almost immediately behind it. They are spirally arranged, but so closely approximated as to appear like whorls. The elements of the first two, or sometimes three, cycles retain the simple form, but those succeeding show a well-marked differentiation into three lobes. One lobe is turned toward the axis, and afterward develops into the sporangium; the other two are almost from the first narrower, and soon grow beyond the third and develop into leaves. At first, however, the sporangium lobe is distinctly larger, and seems to form the end of the shoot. The sporangium lobe subsequently elongates in a direction at right angles to the main axis of the plant, and becomes divided by a wall in a plane nearly parallel to that axis. The two chambers are at first anterior and posterior, that is, rather than upper and lower. Subsequent growth of the shoot behind it turns the sporangium forward, so that its long axis becomes vertical, and its septum horizontal.

The histological details of the origin of the sporangium, and the earliest differentiation of its cells, we have not been able to make out in the very limited material in our possession. A tangential section of one of the earliest outgrowths shows a central cell which may be the archesporium separated by five surrounding cells from the limiting dermatogen. At a later stage, the young sporangium consists of a single layered investing membrane, a central mass of archesporial cells, and three or four layers of more elongated, and less granular, cells, filling up the space between the two. As the sporangium grows the limiting layer becomes thicker and yellow. The cells lining it become still more elongated tangentially, and the archesporial cells appear large, square, and granular, with extremely large spherical nuclei. Subsequently, the layer surrounding the archesporial cells (tapetum) breaks up, its cells undergo a mucilaginous change, and finally disappear. The archesporial cells divide crucially, each into four mother-cells, and the spore mother-cells divide by formation of transverse walls into two cells, each of which divides again. The division in the second case also takes place in a cruciate manner, and the arrangement of the developing spores is not tetrahedral as in Lycopodium.

At a later stage the groups of developing spores have the form of spheres divided into quadrants: these when examined in spirit are seen to possess a wall which on slight pressure or drying comes away in flakes. On the addition of water this wall swells up, separating the segments of the sphere from one another, and surrounding the whole group with a mucilaginous envelope. The developing spores elongate and become narrower in proportion, while each develops its own wall; but up to a late stage the groups of four remain intact. The ripe spore is triangular in section, with two straight sides and an outer convex one, like a segment of an orange; the nucleus lies in the middle of the outer face, and after preservation in spirit the protoplasm is mainly aggregated round it, but remains connected by strings with the sides and extremities.

In conclusion we wish to express our thanks to friends in New Zealand for valuable help in collection of material, especially to Mr. G. M. Thompson, F.L.S., and Mr. D. Petrie, M.A., of Dunedin.

EXPLANATION OF PLATES I. TO V.

PLATE I.

Fig. 1. The plant in position.

2. Part of the "rhizome" isolated. The specimen is more than usually branched.

3. Part of the "stem," showing the similar decurrent ridges below the leaf and the sporangiferous shoot.

4. The sporangiferous shoot—
   - (*a*) From the front.
   - (*b*) From the side.
   - (*c*) In longitudinal section.
   - (*d*) With ripe sporangium burst.

EXPLANATION OF PLATES—*continued.*

PLATE II.

Fig. 5. Transverse section of the "rhizome." × 25.

6. Transverse section of its fibro-vascular bundle. × 120.

7. Cells of the ground tissue, with part of the brown sheath, in transverse section. One of them shows the pitted end wall. × 50.

8. Longitudinal section of the "rhizome." × 50.

9. Cell of the ground tissue in longitudinal section, showing the coil of hyphæ round the protoplasm, and their passage through the wall. × 120.

10. Transverse section of the "stem." × 50.

11. Transverse section of its fibro-vascular bundle. × 175.

12. Longitudinal section of the "stem." × 50.

13. Longitudinal section of the fibro-vascular bundle. × 300.

14. Epidermal cell of the "stem," showing the peculiar thickening of the wall. × 200.

15. Stoma from the epidermis of the "stem." × 100.

16. The same in cross section. × 100.

(*a*) Xylem.
(*a′*) "Primitive fibres" (Bertrand) in the axis of the bundle.
(*b*) Phloem.
(*c*) Phloem sheath.
(*d*) Brown sheath.
(*e*) Ground tissue.
(*f*) Epidermis.

Explanation of Plates—*continued.*

Plate III.

Fig. 17. Longitudinal section through a growing point, showing scalariform tracheides developing from procambium. × 25.

18. Surface view of growing point, showing the apical cell. × 300.
19. Transverse section of the leaf. × 25.
20. Epidermis of the leaf with stoma. × 300.
21. Fibro-vascular bundle of the leaf in transverse section. × 300.
22. The same in longitudinal section. × 300.
    (*m*) Mesophyll.
23. Part of transverse section of the leaf, showing the ingrowth of the thickening ridges of the outer wall. × 175.

24, 25. Stoma. × 300.

26. Epidermal cell, seen with oblique light, and showing the thickening of the outer wall. × 300.

Plate IV.

Fig. 27. Appearance of a tip of a stem which is developing sporangiferous shoots; natural size.

28. Apex of a stem just before development of sporangiferous shoots; natural size.
29. The same as 28, after removal of the surrounding leaves. × 30.
30. The same growing point, seen from above. × 30.

31, 32. Stages in development of the sporangiferous shoots. × 10.

33. Longitudinal section of one of the developing shoots. × 10.
34. Tangential section of developing sporangium at an early stage, showing a central cell which is perhaps the archespore. × 60.
35. Longitudinal section at a later stage, where the archesporial cells are distinctly marked off from the surrounding tapetal layers. × 60.
36. Longitudinal section at a later stage, after division of the sporangium into two chambers. × 25.

EXPLANATION OF PLATES—*continued.*

PLATE V.

Fig. 37. Transverse section of a sporangium just before the disintegration of the tapetum. × 50.

38. Transverse section of a sporangium at a later stage, during the disintegration of the tapetum. × 30.

39. Disintegration of the tapetal cells. × 200.

40. Archesporial cells dividing into spore mother-cells. × 200.
    - (*a*) Nucleus breaking up.
    - (*b*) Nuclear division.
    - (*c*) Division complete.
    - (*d*) Pair of cells redividing into spore mother-cells.

41. Spore mother-cells divided into groups of four spores. × 200.
    - (*a*) Groups of developing spores as seen when in spirit.
    - (*b*) The same, showing flaking off the wall.
    - (*c*) The same after addition of water, showing the relative position of the spores, separated by and enclosed in mucilage.
    - (*d*) A similar group in optical section.
    - (*e*) Groups of spores whose mucilaginous investment has more or less fused with that of surrounding groups.

42. Stages in development of the spore.

II.

REPORT ON THE MARINE INVERTEBRATE FAUNA NEAR DUBLIN. By G. Y. DIXON & A. F. DIXON.

[Read April 27, 1891.]

In 1890 the Academy gave us a grant to investigate the Marine Invertebrate Fauna in the neighbourhood of Dublin, and to make observations on such forms as we could succeed in keeping alive.

We now present a report of such observations as we have made.

Metridium dianthus.

This anemone is very plentiful at Dalkey Island, hanging in profusion from the under-sides of the loosely-piled granite rocks at the western end. The orange variety is most common, but very fine specimens of Gosse's var. *sindonea* are also abundant. We have found this species also at Monkstown and on the North Bull Wall, but the specimens were not so fine or so numerous at these localities. Gosse (*Actin. Brit.* p. 13) says the lip is always rufous, or orange red, whatever the hue of the body. No white specimens which we found had a red or orange lip, this part being, so far as we have observed, always of the same colour as the rest of the animal. We call attention to this, not because we doubt the occurrence of such individuals as Gosse describes, but because of the importance attached by Gosse to the presence of the thick orange-coloured substance found by him in the region of the lip inside the wall of the œsophagus, and supposed by him to be a *liver*. (*Actin. Brit.* p. xvii).

There is no question that the number of œsophageal grooves in this anemone is not constant; though most individuals have but one groove, still it is by no means unusual to find a second present. This fact was pointed out so long ago as 1861, by Mr. F. J. Foot, in a Paper read by him before the Dublin Natural History Society,[1] yet it does not seem to be recognized in subsequent accounts of the species. No

[1] *Proc. Nat. Hist. Soc. Dub.*, vol. iii., p. 63. It should be observed, too, that in his list of errata on p. 362, Gosse (*loc. cit.*) adds "the qualifying phrase 'in general' to the character that there is but a single mouth-angle and pair of tubercles."

doubt Mr. Foot describes only one specimen as having two grooves, and, as he immediately goes on to mention some instances of peculiar monstrosities, perhaps readers of his Paper were led to believe that the occurrence of a second œsophageal groove at the opposite end of the mouth to the first groove was also a sport or freak. We have, however, found it to be present far too frequently to justify any such conclusion. We may add also that we found one otherwise normal specimen with three grooves.

Not unfrequently this anemone exhibits the curious mode of reproduction by fission, described by Gosse (*Actin. Brit.* p. 19: *cf.* Van Beneden, *Recherches sur la Faune littorale de Belgique*, pp. 189, 192). As the animal moves from one spot to another it often leaves behind small fragments of the margin of the base, which continue to adhere and develop into full-grown individuals. It would seem as if the parts that thus separate from the parent are not previously in any way specialized, but only remain behind because their adhesion is so strong that the animal finds it easier to tear its own tissues than to loosen their hold. But we have also observed cases in which, before the fission occurred, the flat expanded portion of the body-wall showed signs as though something like a bud were being developed just on the margin of the pedal disk. In such cases a slight nodular thickening of the expanded portion of the body-wall takes place, and an appearance is presented not unlike the slight rise of the cœnenchyma, which in the encrusting forms of the Zoantheæ precedes the growth of a fresh polype; then when the parent moves, these nodular thickenings are left behind, enter on a separate existence, and develop a column, disk, and tentacles of their own. It would appear, however, that these buds do not always part company with the parent animal, at least at an early stage of growth, for we have met with a good number of specimens where a small animal was united to a large one by a common base, presenting all the appearance of a parent and a bud which had continued to grow and thrive together. Gosse has remarked the frequent occurrence in this species of the monstrosity of two disks springing from a single column. Foot records the occurrence of a specimen with two mouths on one disk. We have met with one monstrosity like that described by Foot, and two or three such as Gosse mentions. We may add that one of these specimens with two disks, had one mouth with one groove, and the other mouth with three grooves.

We have examined three very small specimens by means of transverse sections. One of them had two œsophageal grooves, and as might be expected its transverse sections exhibited two pairs of directive mesenteries, a pair corresponding in position with each groove. There were four other pairs of perfect mesenteries, and the arrangement of the perfect mesenteries was exactly the same as that which characterizes the adult *Halcampa chrysanthellum*. The arrangement of the imperfect mesenteries is not so easy to describe, as they were by no means regularly developed in the exocœles. For the purposes of description we will imagine one pair of directives to be set at the top, and the other pair at the bottom of the transverse section, and beginning at the top we will enumerate and describe the mesenteries as they occur on the right hand side of the section when it is so placed. The first exocœle contains but one imperfect mesentery, which is pretty well developed, and has a very considerable filament. Then come the two pairs of perfect lateral mesenteries, there being no imperfect mesenteries developed in the exocœle between them. In the next exocœle, which lies between the second pair of perfect lateral mesenteries, and the directives at the bottom of the section, there is a very small pair of imperfect mesenteries, which at no portion of their entire height present a filament of any length. On the right side of the section then we have but three imperfect mesenteries—one in the first exocœle, none in the second, and two in the third. Now, let us see how the left side of the section is furnished. A glance shows that it is regular, that is, there are two pairs of perfect lateral mesenteries, and a pair of imperfect mesenteries occupies each of the three exocœles, making six imperfect mesenteries on this side. The total number of imperfect mesenteries therefore is nine, which, added to the twelve perfect, gives us twenty-one in all.

In each of the two remaining specimens there was but a single œsophageal groove; and when we cut the sections we found there was but one pair of directive mesenteries. In one of these specimens with the single groove there were twelve perfect mesenteries arranged in the same way as the perfect mesenteries in *Halcampa chrysanthellum*, except that instead of the second pair of directives there was an ordinary pair of mesenteries with the longitudinal muscles developed on their adjacent sides. The imperfect mesenteries were symmetrically arranged in the following manner:—In each of the exocœles adjoining the directives there were three pairs of imperfect mesenteries, two being small pairs situated on either side of a larger pair. An exactly similar number and arrangement were present in the two next the lateral exocœles, while in the two remaining exocœles—those furthest from the directives—there was but a solitary pair of imperfect mesenteries. To sum up, then, there were in this specimen twelve perfect and twenty-eight imperfect mesenteries—forty in all.

In describing the arrangement exhibited by the remaining specimen, we will suppose the transverse section so placed as to have the single pair of directives at the top; and as before, will describe the mesenteries as they occurred, starting from the directives and proceeding downwards on the right side. In the first exocœle there was a single pair of imperfect mesenteries; then came the first perfect pair: the second exocœle contained three imperfect pairs, two small and one large pair between them; then came the second perfect pair, and next in the third exocœle a single pair of imperfect mesenteries; then, exactly opposite to the directives, the third pair of perfect mesenteries; and in the fourth exocœle another single imperfect pair. Next in order one would have expected to find the fourth pair of perfect mesenteries, but the section here presented only one perfect mesentery, and corresponding to it an imperfect one, the two—as the longitudinal muscles were adjacent—constituting a pair, one of which, that nearest the directives, fell short of the œsophagus. The fifth exocœle contained no imperfect mesenteries, so that the fifth pair of perfect mesenteries came immediately next the anomalous pair just described; and finally, in the exocœle separating the fifth pair from the directives was a single pair of imperfect mesenteries. The total number in this specimen, then, was twenty-six, of which eleven were perfect.

Besides the information respecting the mesenteries derived from transverse sections, we have also to record some observations made in the case of a very transparent specimen, which lived for a long time in our possession. This specimen attached itself by the base to the glass front of the tank, so that the lines of the insertions of the mesenteries were very easily counted. Its base showed ten pairs of lines running into the centre from the edge, and between these pairs, ten pairs that did not reach quite so far as the centre, twenty pairs that did not reach more than half way, and forty very minute pairs that only ran in a very short way from the edge. The ten secondary pairs alternated with the ten primary, and the twenty tertiary were developed in the spaces between the primary and the secondary, while the forty minute pairs were distributed one in each space, lying between the larger pairs, the whole arrangement being perfectly symmetrical. This specimen had but a single groove. The transparency of the specimen we have just mentioned enabled us to observe in its mesenteries the presence of the outer series of stomata, which have been described and figured by both Gosse (*Actin. Brit.*, p. 19, Pl. xi. fig. 1) and Hertwig (*Actinien*, p. 63, Pl. ii. fig. 1).

This species sometimes exhibits the phenomenon of a single tentacle, being greatly elongated and arching over the other tentacles. Though this tentacle may continue thus extended for some days, it ultimately returns to its normal condition, when it is not distinguishable from the others. The tentacle so elongated does not seem to bear any special relation to the angle of the mouth.

In this species we have found bifurcated tentacles occurring occasionally.

One large *Metridium dianthus* in our possession while roving through the tank stumbled across a fine specimen of *Bunodes verrucosa.* It poured out an enormous number of acontia over its less aggressive companion with such effect that the *Bunodes verrucosa* never recovered from the attack. Though it had been perfectly established in the tank for several months, and was almost always fully expanded, it at once closed itself, and kept sloughing its epithelium continually, and drooping more and more till it died.

This species, like *Actinia equina*, has the power of floating on the surface of the water, base upwards; the base being slightly depressed in the centre and quite dry. We have observed this habit in springtime only, and in the case of specimens that had been long domesticated in the tank. It is interesting to watch an individual proceeding to float. Having climbed to the surface, it slowly relaxes its hold of the side of the tank, and bends its pedal disk outwards along the top of the water, keeping the centre of the pedal disk concave. Though the animal has been hitherto quite submerged, the pedal disk, as it thus turns outward along the surface, is seen to be absolutely dry, this condition being due to the extremely close contact which it maintains with the substance to which it adheres.

Cereus pedunculatus.

We have found this anemone at Malahide. It had previously been recorded for the county Dublin, having been obtained by A. H. Hassall at Dalkey (*An. and Mag. Nat. Hist.*, vii., p. 285). Every specimen taken at Malahide was imbedded in mud, its pedal disk being attached to a small stone two or three inches below the surface of the mud, from which the tentacles and oral disk just emerged. We did not find any of the anemones, as Gosse did at Weymouth (*Actin.*

Brit., pp. 33, 34), simply resting in the mud, without having the base attached to anything. There is a peculiarity in the colouring of many of the specimens found at this locality which we have not observed in those taken at other places. The peculiarity consists in the presence of a dark wedge-shaped mark on the disk, the point of the wedge touching one corner of the mouth, while the diverging lines which form the sides of the wedge run right out to the tentacles. Usually nine of the principal radii are enclosed in this dark-coloured mark, while the remaining fifteen are much more lightly coloured. This curious division of the disk into dark and light regions is found in varieties otherwise widely differing. It is sometimes somewhat accentuated by the gonidial tentacle at the pale-coloured end of the mouth being pure ivory white. Gosse's variety *sordida* is, as might be expected from the nature of the locality, very common at Malahide. The variety named *versicolor* is also represented, and many specimens which come within Gosse's description of it have conspicuous spots like the Greek letter Sigma on the twenty-four principal tentacles, there being two such spots on the six tentacles constituting the inmost row. A fair number of specimens found at Malahide have the principal radii of a paler hue than the rest of the disk, which is thus decorated by a stellate pattern. We do not think this variety is described elsewhere, but we were greatly interested in finding it, because we believe it must have formed the model from which the late Professor Harvey drew the two sketches to be found in his *Sea-side Book*, pp. 119, 120.

Sometimes the younger forms of this anemone prefer to remain unattached, and lie wallowing on the bottom of the tank with their bases so much distended as to resemble the dilated *physa* of the free or non-adherent actinians. We have observed this habit also in the case of *Cylista viduata*, adult specimens of which often behave in a similar manner.

The very special arrangement of the tentacles and mesenteries at the outer edge of the disk may be observed in transparent specimens of this species. We have not found the same arrangement in any other actinian, and it would seem to be as distinctively characteristic of *Cereus pedunculatus* as the over-hanging salver-shaped disk with the structure of which it is evidently intimately related. If we trace in the external body-wall of the columns the insertions of a pair of principal mesenteries, we shall be able to follow from the base upward the lines which mark them quite easily for at least two-thirds of the column. But when we have traced them up to the point where the column begins to expand outward we find that the two lines converge, and, meeting in a point, do not extend any higher up the external wall of the column. The lines marking the insertions of the secondary mesenteries present the same appearance; a little higher up the column than where those of the primary mesenteries converge and stop we find the insertions of the secondary mesenteries converge and stop too; and so with the tertiary mesenteries also. But though the lines of the insertions of the mesenteries do not mark the column after they have thus converged, it is quite easy to see the esenteries themselves inside rising up to the disk where each pair is crowned with its corresponding tentacle. The mesenteries, however do not extend further from the mouth along the oral disk than the tentacle, and their outer edges, instead of being attached to the body-wall, hang free in the general cavity, until the body-wall, as it gradually contracts, comes under the base of the tentacle to which the mesenteries are attached. Here the mesenteries are attached to the body-wall of the column, and descend from thence to the base in the usual way. But it must not be supposed that the upper part of the column has, on this account, fewer lines of insertions appearing in it than the lower. For the contrary is the fact. Each of the outer tentacles has its own pair of mesenteries, and the insertions of these run down the column from the margin of the disk for a greater or less distance, those corresponding to the tentacles of the outermost row being the shortest. Immediately behind the last row of tentacles there may be seen with a low magnifying power a series of knobs—two between each pair of tentacles—forming the margin of the disk. These knobs are young tentacles.

We have observed the occasional prolongation of a single tentacle in this species. One very bright day in September we saw in nearly all the pools we examined several individuals having each one tentacle prolonged in the manner described by Gosse (*Actin. Brit.*, p. 34). The elongated tentacle was moved in a circular manner, sweeping round the whole animal apparently in search of food. In some cases, but not in all, it was the tentacle at one of the corners of the mouth that was elongated. In one or two instances the elongated tentacle belonged to the second row. We cut off the light from the anemones, and the elongated tentacles were almost immediately withdrawn.

Sagartia miniata, S. rosea, S. venusta, S. nivea.

These anemones may be obtained at Dalkey Island. We have examined the extreme top of the column just under the tentacles in specimens of all four species. They all present a precisely similar appearance, very different, however, from that exhibited by *Cereus pedunculatus*. When the animal is fully extended an observer, placing it between himself and the light, will be able to make out the mesenteries through the body-wall of the column, which is rather transparent towards the top. It will be observed that of the tentacles immediately adjoining the margin, three spring from between each pair of mesenteries; of these three tentacles two are much smaller than the third, and are situated one on either side of it: these smaller tentacles are those which have the scarlet or orange core. The lines of the insertions of the mesenteries are continuous throughout the entire body-wall of the column.

One specimen of *Sagartia venusta* which we kept in confinement displayed a curious condition of the tentacles. As Gosse has observed (*Actin. Brit.*, p. 60), the colour of the tentacles is generally more pellucid at the tip, and more or less opaque in the middle portion. At the junction of these opaque and pellucid regions the tentacles of the specimen in question frequently used to exhibit a deep constriction. When present, this constriction always occurred exactly at the line of demarcation between the pellucid and opaque portions of the tentacle.

Cylista undata.

We have found this species at Monkstown and Dalkey attached to the under surfaces of granite boulders. Many specimens had some of their tentacles forked or knobbed.

Cylista viduata.

This species occurs pretty frequently at Malahide and Howth: the specimens to be obtained at these places are exactly similar to those found in Torbay, a locality for the species known to Gosse. *Cylista viduata* in confinement frequently lies non-adherent at the bottom of the tank; sometimes with its base protruded and swollen, like the physa of the free genera, Peachia and Halcampa. At times it envelopes itself in a thin vesture of slime with confervoid matter imbedded in it, somewhat recalling the habit of the genus Edwardsia. Gosse describes the emission of ova and spermatozoa by the allied species *Cylista undata* in the month of May; we have witnessed a similar phenomenon in the case of *C. viduata*, and at the same season of the year. Both ova and spermatozoa were ejected together, at the same moment, by the same individual; the spermatozoa were in two states —some free, some clustered, the clusters of spermatozoa being each about the same size as an ovum. The ova were not ciliated; neither were they ribbed or ridged, like those which we describe in the case of *Actinia equina.* The ova decomposed, and we failed to rear any of them. At the time of the emission of the generative products, and for a few days subsequently, the tips of the tentacles were filled with spermatozoa so as to be quite opaque. We have never seen any instance of this species been propagated by spontaneous separation of portions of the base. (See Gosse, *Actin. Brit.*, p. 110.)

We have no information derived from transverse sections respecting the arrangement of the mesenteries in this species. The base, however, of one specimen we had was so transparent that it was very easy to see the insertions in this part. The mesenteries followed a perfectly regular hexamerous arrangement. Six primary pairs ran the whole way into the centre; six secondary pairs lay between these, and then there came in regular position twelve tertiary and twenty-four quaternary pairs; none of the mesenteries, except the primary pairs, ran the whole way into the centre from the margin of the base.

ACTINIA EQUINA.

We have found several large specimens, some having white. and some blue marginal spherules, with these organs lobed and warted in an irregular manner. One or two specimens, in which the majority of the spherules were white, had the remainder of these organs red, of the same hue as the rest of the body. A similar departure from the normal uniform colouring of the spherules occurs at times in specimens where the majority of these organs are blue. We have found one or two specimens in which all the spherules were red. As the individuals presenting these variations were in other respects identical, it would seem to be absolutely concluded that Gosse is right in refusing to follow Cocks and Dalyell in establishing a species *A. chiococca.* Each of the marginal spherules contains a prolongation of the general body cavity; and, consequently, these organs can be dilated at the will of the animal. One specimen which we kept in confinement had long fixed its home near the top of the tank, on one of the sides adjoining the glass front. One day we saw that it had its spherules much dilated, and those that were nearest the glass came in contact with it When these organs contracted and withdrew from contact with the glass, we observed that they had left considerable portions of themselves remaining behind, and forming conspicuous blue spots adhering to the glass. On examination of these blue spots, we found them to consist chiefly of the spindle-shaped cells described by Hollard. (*Ann. d. Sci. Nat. Zool.*, 3 ser., vol. xv., p. 272.) The anemone had evidently been engaged in an attempt to sting the glass-front of the tank.

In spring-time mature specimens of this species give birth to numerous ciliated embryos. These are at first minute oval objects, measuring about 1 mm. in the least diameter. But they quickly increase in size, and at the end of a week or ten days the tentacles form at one end, round a depression which has been previously developed. When they are first ejected the embryos are marked with eight or nine obliquely placed ridges, like the skin-markings on the top and front of the fingers of the human hand.

We have cut a series of transverse sections in a large number of very young specimens. The result of these sections was to confirm what we have already stated in the case of *Bunodes verrucosa* (*Proc. Roy. Dub. Soc.*, N. S., vol. vi., pp. 322, 323), and also to show that those mesenteries which do not arise in pairs start from the angle between the oral disk and the body-wall, and grow downward; while those mesenteries which arise in pairs start from the angle between the pedal disk and the body-wall, and grow upward.

A vertical section of a young specimen in which the sphincter muscle was hardly yet developed showed that the epithelium of the œsophagus is directly continuous with that on the middle lobe of the perfect mesenteries, and exactly similar in appearance.

Peachia hastata.

It is not uncommon to find a small species of Pycnogonum *sp.* ?—clinging to *Peachia hastata* just below the tentacles. On one occasion we separated the companions: the anemone at the time was attached to the glass by the suckers on its column on the opposite side to where the Pycnogonum was fixed. The little Pycnogonum was grasped in a forceps, but it adhered so firmly that it did not let go its hold till the anemone was stretched out to at least twice its usual diameter. Curiously enough, the Peachia seemed to suffer no inconvenience from the tugging to which it was subjected.

It would seem that there are either but weak stinging cells or else none at all in the disk and tentacles of this anemone; for gobies and other little fish, which start back from contact with Actinia and Sagartia, rest placidly on the portions of Peachia that extend above the sand.

We found this species very easy to keep in captivity: even those specimens which we injured in digging up survived a considerable time. It is by no means necessary to have sand for them to burrow in. They will lie free at the bottom, and expand themselves to their full length. One that we measured attained the length of four and a-half inches.

One specimen which we had in confinement ejected a quantity of ova. These were small spherical bodies, furnished with short stiff hairs or bristles, sticking out straight from the whole surface. These hairs did not move like cilia.

The smallest *Peachia hastata* that we found measured, when extended, one inch in length. Its conchula was precisely the same as that figured by Gosse (*Actin. Brit.*, p. 239), as belonging to *P. undata*: except for its size and the shape of its conchula this little specimen was exactly the same as all others that we found, and we are inclined to look upon it as being merely an immature *Peachia hastata.* We may add that the alternating opaque white markings on the margin, which Gosse mentions as characteristic of *Peachia undata* were present in all the specimens of *Peachia hastata* that we found. Possibly it may be found necessary to place *Peachia undata* under *Peachia hastata.*

Epizoanthus, *sp.*

The description given by Gosse of *Zoanthus couchii* is very general, and would include many forms which subsequent authors would probably refer to distinct species.

We have obtained at Dalkey Island from between the tide marks an Epizoanthus which would possibly have been placed by Gosse[1] in this species (*Actin. Brit.*, p. 297), though the specimens which we found were very much larger than those whose measurements that writer has given, the polypes being in height quite one-half inch in length from where they emerged from the cœnenchyma to the top of the column, and in diameter reaching in the column one-third of an

[1] Professor Haddon, to whom we have submitted the specimens we obtained at Dalkey Island since this report was written, considers them to belong to a new species which he has named *Epizoanthus wrightii.* His account of the species will shortly appear in a Paper by him and Shackleton in the *Transactions* of the Royal Dublin Society.

inch, and in the disk one-half of an inch, while the tentacles, when fully extended, attained the length of half an inch. The number of tentacles was thirty-two, in two rows of sixteen each, instead of (as Gosse gives) twenty-eight, in two rows of fourteen each. The margin of the column was cut into sixteen teeth. The mouth was a narrow slit, with only one groove. In colour we found two varieties : one, dirty pellucid white ; the other, orange pink. In both varieties the disk was speckled with opaque white, and the tentacles tipped with the same colour. When not fully extended, the tentacles exhibited transverse corrugations. All the specimens we found sprung from a broad, flat, irregularly-shaped cœnenchyma, which adhered to the encrustations on granite boulders, but never to the granite itself. In August we saw one specimen with yellow ciliated bodies (planulae ?) floating in the tentacles. These bodies were irregular in shape, and kept continually changing their outline. When irritated this anemone ejects its craspeda ; these organs are coloured, according to the varieties, either white or orange pink.

The transverse sections which we cut showed that these Dalkey specimens possess sixteen pairs of mesenteries arranged according to Erdmann's "macrotypus."

The differences existing between the Dalkey specimens and the description of the species given by Gosse induce us to believe that his description must have been based on the examination of immature forms, or else that the specimens we found belong to a new and distinct species.

Hyas araneus.

There has lately been a good deal of discussion relating to the habit this crab has of clothing itself with corallines, shells, and other foreign bodies (*Nature*, vol. xli., between pp. 176 and 586 : also *Plymouth Marine Biological Journal*). Those who have written about the matter seem to be of opinion that this habit serves the crab as a protection by rendering it hard to distinguish it from its environment. We believe that the decorations which the animal assumes are useful to it by helping to furnish it with the means of catching its prey. We proceed to state the observations which induced us to form this belief. First of all, there can be no doubt that the crab arrays itself in this curious fashion with a view to concealing itself the more easily. For even though it be quite covered with one disguise, if you move it into a new environment it promptly assumes a new disguise to suit its changed surroundings. For instance, we obtained three specimens of this crab all dressed alike in short sea-weeds, and one evening placed one of them among stones covered with *Sertularia abietina* and *Hydrallmania falcata*, another among some small shells and fine gravel, and the third among a large number of specimens of *Antedon rosaceus*. In the morning each of them had clothed himself to suit his environment. No. 1, who had been placed among the corallines, had arrayed himself with a dense shrubbery of *Sertularia abietina* on his back, with the finer branches of *Hydrallmania falcata* on his legs. He then climbed an empty valve of the shell of *Solen ensis*, which stood nearly upright in a corner of the tank. On the top of this shell he propped himself, his chief support being his last pair of legs, his *chelae* being stretched prominently forward, and the forceps (formed by the two terminal joints) being held wide open and conspicuously displaying its polished white and red tips. But though he maintained his position on the shell for the whole day, he did not remain motionless. On the contrary, he kept swaying himself to and fro with an almost rhythmic motion, every limb remaining rigid save the hindmost legs, whose basal joints formed the places from which the motion started. The following day this Hyas descended from his elevated position, and took up his post among the branches of the *Sertularia abietina*, and here he remained swaying himself to and fro as before. This last position seemed to suit him better, and he occupied it for several days, indeed for all the rest of the time that he was in the tank.

No. 2, who had been placed among the small shells and fine gravel covered himself with these materials, and No. 3, who was given as a companion to the crinoids, broke off portions of their arms and fastened them on his back using the *cirri* to conceal his legs. They both assumed similar positions and exhibited similar motions to those described in the case of No. 1.

So far, then, we are doing the Hyas no injustice in imputing to him the intention of concealing himself when he makes his choice of clothing. But what is the meaning of the rhythmic motion of his body and his stilted attitude? A fortunate accident enabled us to determine this. A few days after we obtained the Hyas we put a number of gobies into the tank. These little fish had their curiosity at once aroused by the red and white tips of the *chelae* moving among the groves of Sertularians, and swam up to observe such an interesting phenomenon. The moment one came within his reach the Hyas suddenly closed all his extended legs like a spring trap, and generally succeeded in making a capture of the poor goby, who was forthwith thrust head-foremost into the mouth of his voracious captor. One

Hyas caught and ate fourteen gobies within a week. We believe, therefore, that the polished white and red tipped *chelae*, the two terminal joints of which are never concealed by the decorations, are held aloft by the crab as a kind of bait, and that the rhythmic motion is added to make the bait still more attractive. It is needless to remark that the capture of the fish is rendered much more easy by the way the crab has himself disguised, so that he is almost unrecognizable among his surroundings. It is quite consistent with the concealment being adopted for the purpose of procuring food that it should also serve to protect the Hyas in its turn from becoming a prey to other animals. But we have never had any animals in the tank which ventured to attack *Hyas araneus* or *H. coarctatus*. It is stated by Bell (*British Stalk-eyed Crustaceans*, p. 34) that *H. araneus* is preyed upon by cod-fish.

Eledone cirrosa.

We kept an *Eledone cirrosa* which we found on the strand at Monkstown for some weeks in the tank. Our specimen was a good rich coral red or crimson, though, of course, continually changing in intensity of shade, and its body was nearly always variegated with paler or even white spots. The colour on the arms was less decided than on the body, and the under sides of the arms which bore the suckers were always white. Frequently, too, the outer portions of the body and the extremities of the arms became a bright iridescent green. The body underneath was always paler than above, and the under side was frequently green instead of red, like the extremities. When it lay quite quiet in the tank, lurking behind a large stone in a corner which it made its home, it generally assumed its palest hues: when on the alert and roving through the tank it was generally its deepest crimson.

All the time that it was with us we are not aware that it ate anything; we supplied it plentifully with shrimps, gobies, and crabs, and though it sometimes seized these animals with its arms it always released them uninjured. We tempted it also with pieces of mussel, but it would not touch them.

The activity of this animal makes it a very pleasing object in a marine aquarium. The grace of its motion has been observed by Johnson (*Proc. Berw. N. H. Club*, i., p. 198), and by J. Gwyn Jeffreys (*British Conchology*, vol. v., p. 146). We believe the ease and steadiness of its movements as it propels itself backward by ejecting water from the funnel are largely due to the position in which it folds its arms, always keeping the bases of two of them—one at either side—sharply projecting, so as to make a pair of lateral keels.

When at rest the arms are coiled backward in curls at the tips; and the animal keeps hold of whatever it is attached to by only one or two of the larger suckers which surround the mouth. When in this state the length of the arms is considerably reduced, and the suckers may appear to be set in a double row as in *Octopus vulgaris*, with which this species appears to have been sometimes confounded (Haddon, *The Zoologist*, 3 ser., vol. x., p. 4). When the arms are extended, however, the suckers are seen to be manifestly set in a single row, and so determine the genus by a characteristic known to Aristotle (*H. A.*, iv., vol. i., p. 525, col. i., l. 15: ed. I. Bekker).

III.

ON THE ORBIT OF THE BINARY STAR 35 COMÆ BERENICES = Σ 1687. By J. E. GORE, M.R.I.A., F.R.A.S., Honorary Member of the Liverpool Astronomical Society.

[Read May 25, 1891.]

The duplicity of the brighter component of this wide double star was discovered by Struve in the year 1829. The position angle was then about 25°. Recent measures kindly made for me by Mr. Burnham, with the great 36-inch refractor of the Lick Observatory (U. S. A.) show that the position is now about 72°. Although the change of position angle is small I find that the motion has been round the apoastron end of the apparent ellipse, and that hence a considerable arc of the apparent orbit has been described. The change in the mean anomaly amounts, according to my calculations, to about 96·5°.

I have computed the orbit by the following method:—Having plotted all the observations, and drawn the interpolating curve and the apparent ellipse in the usual way, I computed, by Professor Glasenapp's method (*Monthly Notices*, R. A. S., March, 1889), the values of the coefficients in the general equation of the second degree

$$\alpha x + \beta y + \gamma x^2 + \delta xy + \epsilon y^2 + 1 = 0,$$

and obtained the following results:—

$$\alpha = -\ 0{\cdot}01601,$$
$$\beta = +\ 0{\cdot}03089,$$
$$\gamma = -\ 0{\cdot}0002123,$$
$$\delta = -\ 0{\cdot}000449,$$
$$\epsilon = +\ 0{\cdot}00035068.$$

These values were then substituted in the following equations due to the late Polish astronomer, Marian Kowalski:—

$$\frac{\tan^2 i}{q^2} . \sin 2\Omega = \delta - \tfrac{1}{2}\alpha\beta,$$

$$\frac{\tan^2 i}{q^2} . \cos 2\Omega = (\gamma - \epsilon) - \tfrac{1}{4}(\alpha^2 - \beta^2),$$

$$\frac{2}{q^2} + \frac{\tan^2 i}{q^2} = -(\gamma + \epsilon) + \tfrac{1}{4}(\alpha^2 + \beta^2),$$

$$e \sin \lambda = -\frac{q}{2}(\beta \cos \Omega - \alpha \sin \Omega) \cos i,$$

$$e \cos \lambda = -\frac{q}{2}(\beta \sin \Omega + \alpha \cos \Omega),$$

$$a = \frac{q}{1 - e^2}.$$

From these equations the geometrical elements of the real orbit were computed.

The remaining elements, P, the period, and T, the epoch of periastron passage, were computed by the formulæ

$$T = \frac{t' + t}{2} - \frac{M' + M}{M' - M} \cdot \frac{t' - t}{2},$$

$$\mu = \frac{M' - M}{t' - t},$$

$$P = \frac{360°}{\mu},$$

where M and M' are the mean anomalies computed from the geometrical elements for the epochs t, and t', and the corresponding values of θ derived from the earlier and later measures.

The following are the resulting elements which must be considered as provisional until further measures are available :—

Provisional Elements of 35 *Comæ Berenices.*

$P = 228{\cdot}42$ years,	$\Omega = 27° \, 45'$,
$T = 1815{\cdot}72$,	$\lambda = 269° \, 4'$,
$e = 0{\cdot}600$,	$a = 1{\cdot}70''$,
$i = 67° \, 57'$,	$\mu = +\,1{\cdot}576°$.

As far as I know, the orbit of this star has not been previously computed.

The magnitude of the components are, according to Struve, 5 and 7·8.

The position of the star is for 1890, ·0,

R. A. $12^h\ 47^m\ 53^s$,

Decl. + 21° 51′ 36″.

The following is a comparison between the recorded measures and the positions computed from the above elements. The formulæ of computation are as follows :—

(1) $u - 34{\cdot}3776 \sin u = +1{\cdot}576° (t - 1815{\cdot}72)$,

(2) $\tan \frac{1}{2} V = 2{\cdot}0 \tan \frac{1}{2} u$,

(3) $\tan (\theta_c - 27° 45') = 0{\cdot}37541 \tan (V + 269° 4')$,

(4) $\rho_c = 1{\cdot}70'' (1 - 0{\cdot}600 \cos u) \dfrac{\cos (V + 269° 4')}{\cos (\theta_c - 27° 45')}$,

where u is the eccentric anomaly, V the true anomaly for the time t, θ_c the computed position angle, and ρ_c the distance.

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
		°	°	°	″	″	″
1829·99	Struve, ...	25·3	24·89	+ 0·41	1·43	1·02	+0·41
1833·37	Struve, ...	28·4	28·93	− 0·53	1·38	1·12	+0·26
1834·38	Smyth, ...	30·0	29·97	+ 0·03	1·00	1·14	−0·14
1842·39	Dawes, ...	36·6	36·85	− 0·25	1·58	1·34	+0·24
1842·39	O. Struve, ...	39·6	36·85	+ 2·75	—	1·34	—
1843·32	Smyth, ...	42·0	37·57	+ 4·43	1·50	1·36	+0·14
1843·34	Dawes, ...	38·9	37·58	+ 0·32	1·41	1·36	+0·05
1845·31	O. Struve, ...	39·6	39·02	+ 0·58	1·53	1·38	+0·15
1847·57	Mitchell, ...	40·4	40·61	− 0·21	1·32	1·40	−0·08
1848·12	Dawes, ...	39·2	41·00	− 1·80	—	1·40	—
1849·33	Dawes, ...	40·9	41·82	− 0·92	1·55	1·42	+0·13
1851·00	Madler, ...	43·1	42·95	+ 0·15	1·23	1·43	−0·20
1852·32	Mädler, ...	43·9	43·83	+ 0·07	1·23	1·43	−0·20
1853·38	Dawes, ...	43·8	44·65	− 0·85	1·61	1·44	+0·17
1854·38	Mädler, ...	40·5	45·20	− 4·70	1·17	1·44	−0·27
1854·41	Dawes, ...	43·6	45·22	− 1·62	1·50	1·44	+0·06
1855·42	Mädler, ...	44·5	45·90	− 1·40	1·33	1·44	−0·11
1856·39	Mädler, ...	42·2	46·53	− 4·33	1·26	1·44	−0·18
1856·41	Secchi, ...	41·4	46·57	− 5·17	1·31	1·44	−0·13
1856·48	Dembowski, ..	46·1	46·59	− 0·49	1·20	1·44	−0·24
1857·28	Morton, ...	45·4	47·13	− 1·73	1·44	1·44	0·00
1857·45	Dawes, ...	44·7	47·22	− 2·52	1·59	1·44	+0·15
1857·66	Dembowski, ..	46·6	47·36	− 0·76	1·20	1·44	−0·24
1858·12	Mädler, ...	43·3	47·66	− 4·36	1·23	1·44	−0·21
1858·44	Dembowski, ..	42·8	47·88	− 5·08	1·30	1·44	−0·14

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
1860·34	Dawes, ...	47°·7	49°·11	− 1°·41	1″·44	1″·44	0″·00
1862·95	Dembowski, ..	54·3	50·83	+ 3·47	—	1·43	—
1863·31	Dembowski, ..	49·6	51·07	− 0·47	1·26	1·43	−0·17
1865·31	Knott, ...	52·8	52·41	+ 0·39	1·31	1·42	−0·11
1865·94	Dembowski, ..	53·2	52·82	+ 0·38	1·23	1·42	−0·19
1866·42	O. Struve, ...	52·8	53·15	− 0·35	1·17	1·42	−0·25
1868·32	Dembowski, ..	54·3	54·47	− 0·17	1·27	1·41	−0·14
1870·15	Dembowski, ..	57·4	55·67	+ 1·73	1·16	1·40	−0·24
1871·33	Dembowski, ..	57·5	56·48	+ 1·02	1·23	1·40	−0·17
1872·43	Dembowski, ..	56·5	57·25	− 0·75	1·40	1·40	0·00
1873·24	Wilson & Seabroke,	57·0	57·85	− 0·85	1·28	1·39	−0·11
1873·35	Wilson & Seabroke,	58·7	57·92	+ 0·78	1·33	1·39	−0·06
1873·41	Dembowski, ..	55·2	57·96	− 2·76	1·50	1·39	+0·11
1874·26	Wilson & Seabroke,	59·1	58·58	+ 0·52	—	1·38	—
1874·30	Wilson & Seabroke,	56·8	58·62	− 1·82	—	1·38	—
1874·31	Dembowski, ..	57·4	58·62	− 1·22	1·29	1·38	−0·09
1874·34	Gledhill, ...	59·1	58·65	+ 0·45	1·32	1·38	−0·06
1874·40	O. Struve, ...	(51·8)	58·69	(− 6·89)	1·26	1·38	−0·12
1875·30	Wilson & Seabroke,	57·7	59·32	− 1·62	1·40	1·38	+0·02
1875·31	Dembowski, ..	58·2	59·32	− 1·12	1·33	1·38	−0·05
1875·31	Schiaparelli, ..	61·3	59·32	+ 1·98	1·07	1·38	−0·31
1875·32	Wilson & Seabroke,	58·4	59·33	− 0·93	1·27	1·38	−0·11
1875·39	Wilson & Seabroke,	61·1	59·38	+ 1·72	—	1·37	—
1875·43	Wilson & Seabroke,	56·2	59·41	− 3·21	—	1·37	—
1876·30	Doberck, ...	56·04	60·02	− 3·98	—	1·37	—
1876·34	Doberck, ...	(75·15)	60·05	(+15·10)	—	1·37	—
1876·36	Wilson & Seabroke,	58·5	60·07	− 1·57	1·40	1·37	+0·03
1876·38	Doberck, ...	(66·85)	60·08	(+ 6·77)	—	1·37	—
1877·00	Plummer, ...	61·3	60·56	+ 0·74	1·34	1·36	−0·02
1877·24	Doberck, ...	63·00	60·74	+ 2·26	1·53	1·36	+0·17
1877·34	Doberck, ...	59·95	60·82	− 0·87	1·32	1·36	−0·04
1877·38	Schiaparelli, ..	60·97	60·85	+ 0·12	1·16	1·36	−0·20
1881·842	Schiaparelli, ..	66·18	64·33	+ 1·85	0·97	1·30	−0·33
1885·340	Perrotin, ...	65·35	67·06	− 1·71	1·16	1·29	−0·13
1885·423	Schiaparelli, ..	70·19	67·12	+ 3·07	1·00	1·29	−0·29
1886·38	Perrotin, ...	69·9	67·90	+ 2·00	1·22	1·28	−0·06
1887·340	Tarrant, ...	69·46	68·60	+ 0·86	1·30	1·27	+0·03
1891·24	Burnham, ...	72·4	71·82	+ 0·62	1·18	1·25	−0·07

Considering the faintness of the companion star the above comparison is fairly satisfactory.

Assuming that the combined mass of the components is equal to the mass of the sun, we have the "hypothetical parallax."

$$p = \frac{a}{P^{\frac{2}{3}}} = \frac{1\cdot70}{(228\cdot42)^{\frac{2}{3}}} = 0\cdot045''.$$

IV.

ON THE DETERMINATION OF THE MELTING POINTS OF MINERALS. Part I.—THE USES OF THE MELDOMETER. By J. JOLY, M. A., B. E., an Assistant to the Erasmus Smith Professor of Experimental Physics, Trinity College, Dublin. Plate VI.

[Read May 11, 1891.]

There appears to have been no serious attempt made in recent times by mineralogists to effect the determination of the melting points of minerals, with a degree of accuracy in keeping with our present means of measuring high temperatures. Nor has there been any suggestion, to the best of my knowledge, as to the possibility of providing a simple and accurate means of observation. The present Paper is preliminary to one embodying the melting points of the more abundant mineral species, and is occupied with an account of a method of effecting such determinations which it is hoped possesses qualities of simplicity and accuracy. It will be seen that its use necessitates only the most minute quantities of the substance, and hence the method is applicable for dealing with rare mineral species or small quantities of chemically prepared bodies; other applications of the methods beside the determination of melting points are suggested in this Paper. In meeting the expenses connected with the development of the apparatus, I have to acknowledge gratefully a grant made to me by the Royal Irish Academy.

Melting points are constants in molecular physics of much theoretic interest. In many cases the naturally occurring mineral is the sole representative of a particular molecular grouping. The theoretic interest attached to the temperatures at which substances cease to retain the solid state is developed in the writings of Kopp, Carnelley, Van der Waal, Pictet, and others. In the case of minerals, in addition, questions of great geological interest are attached, more especially in connexion with the subject of ejected lavas or contemporaneous igneous rocks, into the temperature of which, at the time of ejection, the factor of great pressure did not enter. There remains the value of melting points as a means of identification—often an important matter. It will be found, for example, that many of the felspars—although related in composition—can be distinguished at once from one another. As a more particular instance I may mention that in this way I first arrived at the identification of iolite in the Dublin granite when present in microscopical crystals.[1] Indeed, when minute quantities of substances are in question the application of this thermal method of identification in many cases exceeds all other physical tests in readiness and surety.

The scale of fusibility of Van Kobell is still quoted in the most recently published mineralogical works. It constitutes a comparative method, beset with errors, even as a means of identification, save under special circumstances. Thus whether a splinter of a mineral will melt in the flame of the blowpipe depends as much, or more, on the shape, conductivity, and dimensions of the splinter as on its melting point. For example, a filament of the fibrous actinolite is more easily fused than a fragment of the compact orthoclase. The melting point of actinolite is, however, some one hundred degrees centigrade above that of orthoclase. Again, the chemical action of the flame may sometimes interfere. But not alone do these sources of error arise in comparing the behaviour of substances in the blowpipe flame, but the scale of Van Kobell is itself highly irregular in its spacing, and even erroneous in the order of fusibilities. Thus the melting points in centigrade degrees of specimens of Van Kobell's standards, as determined by the method to be described later, are as follows:—

		Degs. C.
1.	Stibnite, ...	525
2.	Natrolite, ...	965
3.	Almandine, ...	1265
4.	Actinolite (green), ...	1296
5.	Orthoclase	1175
6.	Bronzite (Diallage), ...	1300
7.	Quartz, ...	1430

The numbers prefixed give the order of fusibilities as ordinarily given for Van Kobell's scale. In some cases the temperatures found must be considered approximate, owing to the fact that the substances become viscous at high temperatures, and do not suddenly change state. A margin of 10° at each side of the number given will very certainly

[1] See *Proceedings, Royal Dublin Society*, vol. v., N. S., pp. 68 and 69.

include a temperature at which melting would, even in the finest dust, fail to occur, or would occur decisively. But notwithstanding the absence of definite temperatures of melting for these substances it is apparent that this scale—although of good service in its time—is unsymmetrical as well as erroneous in the order of melting points.

The "Meldometer" (μελδω, I melt), as I have designated the instrument used in determinations of melting points, is of the following construction:—A ribbon of pure platinum, having a width of about 1·2 mm., is stretched between forceps, furnished each with a binding-screw, and insulated from each other so that on connecting the binding-screws with a battery a current can be passed through the ribbon. Upon the surface of this ribbon the substance to be examined is placed. It is necessary first to reduce the mineral to a fine powder in an agate mortar, and finally grind it with a little water till in the form of a fine fluent paste; a speck of this is *spread* over a small area of the ribbon. The best condition for observing melting is when a few particles are *thinly* spread here and there upon the platinum. A quantity invisible to the unassisted eye may be dealt with, for in all cases the phenomena of melting are observed through a microscope. The microscope having been brought to bear upon the *thin* coating of the powdered mineral upon the platinum, a current of gradually increasing intensity is passed through the ribbon till the mineral melts or volatilizes. In this process the mineral often exhibits very characteristic phenomena. It remains to describe how the temperature of the platinum ribbon at the moment at which the mineral melts may be determined. Commencing, however, with the simplest form of the apparatus, I proceed to describe a form of the meldometer with which observations, *directly* comparative between the substance being investigated and other substances of known melting points, are effected. In cases in which identification is the object in view, we compare the behaviour of the substance with that of the species to which we think it referable from its other characters.

Fig. 1 shows, to real scale, a plan and side elevation of this form of the meldometer intended to rest on the stage of a microscope.[1] It consists of two forceps—one insulated—attached to a disk-shaped brass plate. This latter may be held down on the stage of the microscope

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[1] This form has been already noticed briefly in *Nature*, xxxiii. (1885), pp. 15–16. See also *Journal of the Royal Microscopical Society*, x., p. 1068. A further notice of the meldometer is reported from a Paper read before the British Association at Bath, 1888, in *Industries*, vi., p. 20.

by the stage clamps, and is placed so that the ribbon stretched between the forceps is brought to traverse the field of view. A one-inch foreign objective of cheap pattern is suitable for this work. I have had one in use for some years, and it seems uninjured. These powers have single lenses. If a compound cemented objective is used the Canada balsam used in the cementing melts if observations be prolonged at the higher temperatures. The forceps holding the ribbon close by their elasticity, and are opened by the small screws threaded into the upper member of each forceps. The ribbon is shown cut away where it is held by the forceps. This is done with a scissors before inserting it. The object is to secure a more uniform temperature over the length of the ribbon, which otherwise diminishes rapidly in temperature approaching the forceps by reason of thermal conductivity, the effect being intensified by decreased electrical resistance where the ribbon is colder. The effect of reducing the section is to diminish this loss of heat by conduction, and at the same time the electrical resistance increasing with diminished cross section up to the forceps, causes a development of heat which augments as the cold metal of the forceps is approached. In this way the loss of heat to the forceps is made good, and the central parts of the short strip made more uniform in temperature. Exact uniformity of temperature throughout is not needful, for the method is one of comparison, and if the substances being compared are brought to adjacent portions of the ribbon it may be assumed they are under like conditions as regards temperature.

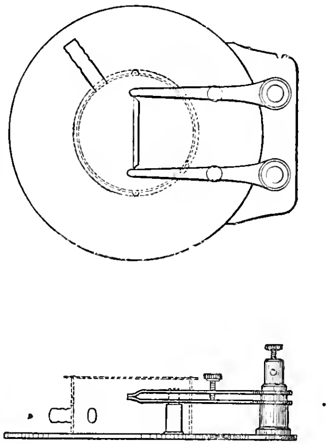

Fig. 1.

The length assigned to the ribbon is conveniently about two centimetres. A storage cell or a couple of grove cells will furnish sufficient current to raise to a blinding white heat and finally fuse the ribbon. The current is regulated as follows:—Two rods of carbon, 51 cms. in length, 17 mms. in diameter, such as are used for electric-arc lighting, having each a resistance of about half an ohm, are clamped at their ends upon a piece of board. A sliding-piece consisting of two sprung brass tubes encircling each carbon, and connected by a cross-piece of brass, can be moved along from end to end of the carbons. At one end the carbons are each furnished with a binding screw, and are insulated from one another save where connected by the sliding piece. This resistance is placed in circuit with battery and meldometer, so that the current flows through more or less of the carbon rods according to the position of the slider. Thus, the total resistance in circuit may be varied by moving the latter, and in this way the quantity of current traversing the circuit controlled. Having placed the two substances to be compared side by side, we can thus expose both to any temperature up to that at which the platinum breaks. It will be found that quartz may be melted before this point is reached, and reduced to a glass which no longer affects polarized light. At these high temperatures the light is very intense, and it is necessary to shield the eye from its effects. A cover glass smoked over a lamp-flame may be placed above the eye-piece of the microscope, but a small piece of neutral-tinted glass, such as is used in snow spectacles, is better for the purpose.

When the platinum is heated in this form of the meldometer, as the forceps are fixed in position, the expansion results in considerable sag of the ribbon. This, however, is only an inconvenience in so far as it necessitates re-focussing the microscope upon the object. By making one of the forceps free to rotate on a vertical axis at the binding screw, and affixing a weak spiral controlling-spring, so that the ribbon is always distended by a small force, this inconvenience may be avoided, or the distance of the forceps apart may be adjustable by a screw. (See figure in the *Journal of the Royal Microscopical Society* x., p. 1068); but the simpler form of the apparatus is preferable.

If we seek to identify the body of course we ultimately compare it with accredited specimens of the body we suspect it to be; and here, even if infusible below the melting point of the platinum, information is often gained by comparing the behaviour of the substances. Often again, the phenomena which precede fusion, accompany it, or succeed it, are of much determinative value. Thus topaz blisters on the surface, glassy bubbles forming and breaking up which throw out viscous threads and emit a gas (fluorine ?) which attacks the platinum, forming coloured rings upon the bright-red metal : iolite turns milk-white. The presence of any considerable quantity of calcium oxide produces this latter effect. Labradorite may be distinguished from the other felspars by this phenomenon. Orthoclase at high temperatures develops large bubbles—which seldom break—throughout the clear viscous liquid into which it is transformed. Tourmaline boils easily, often with effervescence at first, ultimately settling into a quiet boil. Pyromorphite flows into an oily-looking liquid part of which runs along the ribbon till it attains a cooler region near the forceps, where it pulsates backward and forward; a surface-tension phenomenon. On cooling it is seen that a double-coloured slag is produced as if a separation had been effected. Molybdenite sublimes, building up a frail skeleton-like structure over the ribbon, which consists of glistening, tabular, colourless crystals. These again resublime to similar crystals if tumbled back upon the platinum.

Some substances show a change of colour when first heated, as realgar, which blackens, and beryl, which bleaches. Some remain viscous to the last and have no definite melting point, but gradually soften. Beryl is a case of this, and the felspars, in a less degree, possess the property. Other minerals break down suddenly and flood the platinum, as garnet, tourmaline, &c. Finally, the colour of the melted mineral—whether a slag or a glass—affords distinctive characters as in the blowpipe, but in a more extended degree inasmuch as the range of temperature is greater, under perfect control, and the method more cleanly in use, uncomplicated by secondary effects, and the substance is under much better conditions for observation.

As regards the determination of melting points in centigrade degrees by the use of this simple form of apparatus, the closeness with which we can approximate to a true estimate depends on our ability to map out the range of temperature at our command with reliable and sufficiently varied standards of reference. As the construction of such a table or scale of melting points should be based upon the widest possible experience, I do not suggest any complete scale here; but in the second part of this Paper will endeavour to rectify the omission. For the present, it will be seen from the list given at the conclusion of this Paper, that a wide choice exists of comparative substances up to a certain range of temperature, from the determinations of Carnelley and others on metals and pure salts. The scale will have to exclude as far as possible substances which undergo a period of viscosity before decisively melting. To such substances no perfectly definite melting point can, of course, be assigned, and there is much difficulty in determining the temperature at which they begin to soften. It will be best to record in such cases a temperature at which, after a prolonged interval, there are decisive indications of softening, and a second temperature at which the body may be said to melt rapidly, meaning that in a space of four or five minutes there is distinct flooding of the finer dust upon the surface of the platinum. In all cases it is this finer dust that should be most carefully observed. And I may mention here that while at low temperature, a good surface illumination of the ribbon is necessary, at the higher temperatures observations are best made by the light emitted by the platinum itself. Illustrative of the use of the meldometer I may quote here approximate determinations of the melting points of the felspars, which have afforded the following numbers :—

	Degs. C.
Adularia, ...	1175
Oligoclase, ...	1220
Sanidine, ...	1140
Microcline, ...	1175
Labradorite, ...	1230
Albite, ...	1175

These bodies melt rapidly at some 20 degrees higher. The melting points of adularia, microcline, and albite cannot be distinguished from one another. Adularia may be distinguished from albite, however, by the development of bubbles at higher temperatures, as already referred to. It is, of course, possible that there will be small variations of melting point from one sample to another. These bodies well illustrate the phenomena of viscosity. It is instructive to compare the behaviour of these viscous silicates with the behaviour of such a mineral as halite, which runs out suddenly at 772° C. In spite of the uncertainty introduced into the melting points by the phenomenon of viscosity the discriminative value is evident even in the case of this related group of minerals. Thus by comparison we can pick out the substances adularia, microcline, and albite from the others ; or oligoclase, and labradorite, and in a third division sanidine. The phenomena accompanying melting will differentiate the individuals of the two first divisions from one another. When we pass to substances less closely related there is, of course, found a great diversity of melting points, although indeed it is remarkable what a preponderating number of mineral bodies possess melting points ranging within the comparatively narrow limits of 900° C. to 1500° C. (which last is above the melting point of quartz). But this matter is to be considered in the second part of this Paper.

Sublimation.

Although the majority of mineral bodies have melting points ranging over 900° C., some, such as the sulphides, arsenides, and some of the elements can even be brought into the state of vapour upon the meldometer. When this is the case we find that this apparatus affords a means of obtaining sublimates much transcending the blow-pipe (used either with carbon or aluminium) in delicacy, range, and purity. Sublimates may, in fact, easily be obtained from substances which treated in the blowpipe would appear to afford none, as will appear. The mode of procedure is as follows :—A circular cover-glass—not too thin—grasped in a forceps, is held horizontally above the platinum ribbon, as the temperature is being raised. If the sublimate is one which oxidizes, we obtain the oxidized sublimate alone; or the unoxidized sublimate bordered by the oxide, according as we hold the glass further or nearer to the ribbon.

The more volatile elements often afford as sublimates both the element and an oxide of it. The elemental sublimate may often be obtained nearly pure by suitably regulating the temperature. Thus, at low temperatures *arsenic* sublimes as a rich gray-black sublimate, showing the mirror when viewed through the glass. At a higher temperature, especially if the glass is held at a distance of three or four centimetres above the ribbon, the white oxide—the trioxide—only is obtained. Sometimes both element and oxide are together on the one glass, affording an "eye," the pupil of which is the element. This results from the screening action of the outer parts of the ascending column of vapour, the central parts being, in fact, sublimed in the absence of oxygen, which is all absorbed in the outer layers of the vapour. *Magnesium* affords similar eyes surrounded by the white oxide, or in many cases veiled over by it, so that the dark metal is only seen through the glass. The great avidity of this element for oxygen is shown in this fact. *Tin* also affords "eyes." *Thallium* throws a rich black velvety sublimate, fringed with deep ash-red (the oxide ?). This is a very beautiful sublimate, but very fleeting, the black soon fading into a pale grayish-brown colour. If immediately enclosed from the air it retains its original tints a longer time. *Cadmium* may also be sublimed as the metal and its oxide. *Indium* affords a white sublimate, dashed with pink and yellow.

While the metal is thus sometimes obtained with the oxide it more generally affords the oxide only. This is the case, so far as I have observed, with *vanadium*, *lead*, *wolfram*, *bismuth*, *tellurium*, *zinc*, and *antimony*. But, again, sometimes the element appears to sublime without oxidizing. Thus *silver* affords a gray-black veil of the metal, iridescent where thinly deposited. *Gold* is also sublimed. *Sulphur* is another case, the oxide being a gas at atmospheric temperatures. *Mercury* gives a sublimate of a grey colour, consisting of globules of the element.

As regards compounds, the command we have over the temperature in the meldometer enables many very distinct separations to be effected. Thus, dealing with *realgar*, at low temperatures, the substance is sublimed unaltered in a rich yellow sublimate. Somewhat higher a decomposition is effected, the free arsenic showing as a white sublimate of the oxide round a yellow eye of sublimed realgar. As the temperature rises the effect is more and more that proper to arsenic only, the liberated sulphur not appearing; but the eyes remain most generally distinctly touched with realgar. *Orpiment* behaves in a similar manner. *Pyrargyrite*, a compound of silver and antimony sulphides, throws off the antimony first in a rich white sublimate of the oxide, touched more or less with a pale pink cloud, probably the unaltered compound. A bead of silver is left upon the ribbon, which ultimately volatilizes to the gray-black sublimate of silver. *Clausthalite*, the selenide of lead, affords first a sublimate of selenium, a fine ash-red; this then becomes veiled over and intermixed with the rich yellow and whites of the lead oxides, so that a very beautiful marbling is produced, which shows stronger tints of red seen from the back of the glass than from the front.

Many such effects are seen in a similar order with the blow-pipe, but are not produced with the ease, certainty, and cleanliness obtaining with the meldometer. Tests may very conveniently be applied to these sublimates as they repose upon the glass, in the knowledge that the only addition to the original substance can be oxygen. Sublimates also may be obtained from very minute quantities of the substance. This is an advantage in more ways than one. Many of the bodies mentioned above—as arsenic, tin, zinc, bismuth—attack the platinum ribbon at high temperatures, and cut it if more than a very small quantity be used. The metals iron, gold, and silver again amalgamate with it. If it is desired, however, to obtain considerable quantities of the sublimates of the more volatile elements, it is possible by laying upon the ribbon a small slip of thin mica, and upon this the substance, to volatilize considerable quantities of it. Lest it be urged that this apparatus is an expensive one to use owing to the necessity of using platinum, I may mention that a spool of the pure platinum ribbon, having a length of 1700 centimetres wound upon it, is supplied to me by Messrs. Johnson and Matthey, of Hatton Garden, London, at a cost of twenty shillings. This lasts an indefinite time, as a couple of centimetres serves most generally for many observations, and in the case of silicates, may then often be cleaned, so as to be again serviceable, by treatment in acids.

That the platinum, however, volatilizes slowly at high temperature is shown by the fact that if fragments of quartz be heated upon it nearly to their melting point, they will be found to become covered with minute crystals of platinum upon their upper surface.[1]

But the meldometer is capable of affording sublimates which the blowpipe very certainly will not reveal. Thus, for example, *tourmaline* affords a pale whitish-yellow sublimate, the nature of which I have not determined; and *enstatite* volatilizes at the highest temperatures obtainable, very nearly, giving a pale brown sublimate. An addition may be made to this form of the meldometer, which will permit of sublimates being obtained in the absence of free oxygen. This is an annular chamber of light brass open at both sides, and cut into at two points, so that it can be set down upon the base plate of the meldometer, the two slots admitting the forceps without making contact with them. It is provided with two small projections which, entering perforations in the base plate, retain it in position. It is shown dotted in fig. 1. Across the upper surface of this box the cover-glass to receive the sublimate is placed, and the sublimate thrown upon it in the usual manner. A tubular at one side permits of connexion with a supply of CO_2 or other gas which, flowing in very slowly under slight pressure, and escaping around the forceps, replaces the air and stops its entry. If the sublimate is a very heavy one —that is one which falls downward when generated—a second, smaller cover-glass is supported above the floor of the chamber upon a little tripod twisted out of wire, so as to be just beneath the forceps. In this way sublimates of realgar and arsenic may be made to afford the unoxidized substances. As it is necessary in order to obtain an abundant sublimate that there should only be a slow motion of the atmosphere around the platinum, guards are arranged, attached to the base plate beneath the forceps, which close the slots provided in the ring when this is in its place. It is further well to loosely close the opening between the limbs of the forceps with a little cotton wool. A very slow current of inert gas then effectually secures that no air enters while the sublimate is being taken. However, in the use of this arrangement, the sublimate is generally obtained deposited in patterns —often very regular—upon the glass, due to slow swirling currents within the chamber.

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[1] See *Nature*, XLIV. (1891), p. 124.

Pyro-Chemistry.

Before passing from the subject of the secondary uses to which this form of the meldometer may be put, it remains to add that much of the pyro-chemical work done with the blowpipe may with greater ease and delicacy be effected upon the meldometer. Thus, glasses with microcosmic salt or with borax may be made readily upon the ribbon, the colours produced being well seen, and that, too, however deep in tint, where they thin out at the ends along the bright platinum strip.

Again, abandoning the use of the ribbon, we may substitute a platinum wire carrying a loop at its centre, and clamping it in the forceps, form beads of great beauty of the usual form from the action of the hot wire. These may be observed, under the microscope, while hot. Changes of colour, often so characteristic, are very distinctly observed through the microscope directed upon the platinum ribbon. For example, the changes of tint of a glass formed of copper oxide (CuO) with borax, coating the ribbon, as the temperature is *slowly* raised, is from a fine blue through every gradation of tint to a greenish yellow. The command we possess over the temperature enables these successive changes to be very readily observed. Similarly, the oxidizing effects of the blowpipe may be obtained by addition of oxidizing substances, such as potassium nitrate. Thus, as with the blowpipe, a glass formed of the sesquioxide of cerium and microcosmic salt which is a pale yellow when hot, passing to colourless when cold, may by the addition of KNO_3 be intensified to a vivid yellow when hot, to colourless when cold. By the use of reducing agents deoxidation may of course, be effected. In this way a mixture of cupric oxide with carbonate of soda and cyanide of potassium yields, first the lower cuprous oxide as a transparent red crystalline body, and finally the metal which alloys with the platinum. The most minute quantities may be used. I have not had leisure to develop this application of the meldometer, but would call the attention of those versed in pyro-chemistry to the facilities it offers for minute and clean work. The form now described possesses the added advantage that the temperature at which any phenomenon is occurring can be determined with as much facility as we read a thermometer.

Measurement of Temperature on the Meldometer.

The temperature of a homogeneous conductor of constant section, heated by the passage of a current, may be considered uniform throughout; the same at the centre of section as at the surface. The difference is measured probably by hundreds of a degree only. Professor Heinrich Streintz has calculated[1] the temperature difference in certain cases; and it appears that for the present purposes it is certainly unnecessary to take it into consideration.[2] It is allowable further to assume that a fine dust resting upon the surface of a flat conductor, such as is used in the meldometer, is very closely at the temperature of the conductor, especially when near the central line; where, surrounded by neighbouring particles, it is sheltered from draught. It is, indeed, true that for the accuracy of the measurements made on the meldometer it is not necessary to assume that the agreement in temperature should be *exact*, as will be seen, but only that the difference should be about the same from one substance to another. The point here is that the difference being in any case very small there cannot be much diversity in the temperature difference between substance and platinum from one case to another. Assuming then that the average temperature throughout the cross section of the wire is that of its surface, and that the finer dust resting upon this surface is nearly at its temperature, it only remains to measure the temperature of the platinum ribbon in order to determine the temperature of the substance.

First attempts in this direction were directed at determining the temperature in terms of the electrical resistance, a well-known formula of Siemens's being used to express the relation between the two. Subsequently Mr. Callendar[3] compared the readings of the air-thermometer and the platinum resistance thermometer up to 600° C. However, notwithstanding the help thus afforded, the cumbersome apparatus and tedious measurements required in the case of the meldometer in which the resistance has to be determined while a current is traversing the circuit, rendered the method inapplicable. It was accordingly abandoned after much labour had been spent upon it; and at a later date the present form of meldometer devised which depends on the thermal expansion of the ribbon for the estimation of temperature. The general mode of procedure in the present method is as follows:— Using a much longer ribbon than that previously described, we determine its increase of length (by a contrivance to be described)

[1] Poggendorff's *Annalen der Physik und Chemie.*, vol. clx., p. 409.

[2] If, however, the ribbon of platinum be raised nearly to its melting point, it will be found that signs of fusion appear first along the central line.

[3] *Phil. Trans.* Roy. Soc., vol. clxxviii., p. 161.

when a salt of known high melting point is seen to melt upon its surface, and again when two or more other substances, differing from each other in melting point as much as possible, are melting. This is analogous to determining the fixed points on a thermometer, and assumes, as in the latter case, nothing as to the absolute co-efficient of expansion of the working substance. Thus, if we read the movement of the mercury in a thermometer when we raise it from the known temperature of melting ice to the known temperature of boiling water we may evidently, on the assumption of the uniformity of the expansion of the mercury between the two points and of the uniformity of the bore, estimate the temperature of any intermediate reading, using a system of numbering decided upon beforehand. Similarly the assumption is made in the case of the meldometer that there is uniformity of expansion over the limits of known temperature, and for some distance beyond them. In fact, in this method, we take advantage of the experimental work of past observers. Much of this, more especially that of Carnelley and Violle, is very careful. It is sufficient to determine five or six points at various intervals along the scale, and plot the extensions corresponding as ordinates along any uniformly divided line serving as a scale of temperatures. The points so determined are joined by a line which will be found very slightly curved over its lower length, in which we use the experiments of Carnelley. In the upper range—from 900° to 1500° C.—we have very careful data of Violle's, which plot as a line of slowly increasing curvature, convex to the axis of temperature, and meeting tangentially the range covered by Carnelley's experiments. To determine now the melting point of an unknown substance, we obtain the extension corresponding to its point of melting and scale from the chart the temperature proper to this extension. This is all that is required to determine the melting points of minerals to the degree of accuracy attained in the elaborate researches of Carnelley and Violle. Although the extensions, as determined directly, may be thus used to determine unknown temperatures, it is preferable to plot in each case the ratio of the extension to the original length of the ribbon, or the quantity $l_2 - l_1 / l_1$, this value being independent of the length of ribbon used in making the experiments, a length which it is inconvenient to regulate to uniformity on all occasions. The value of this fraction is certainly applicable to all observations made with platinum of the one quality, or to the contents of the one reel if certain precautions be taken which will be described later. In this way a curve once plotted may be kept in use for many observations. The chart (Plate VI.) accompanying this paper is plotted in this manner.

It is necessary before proceeding further to describe the form of meldometer used in determining melting points in the manner just sketched out. The accompanying figure (fig. 2) from a photograph

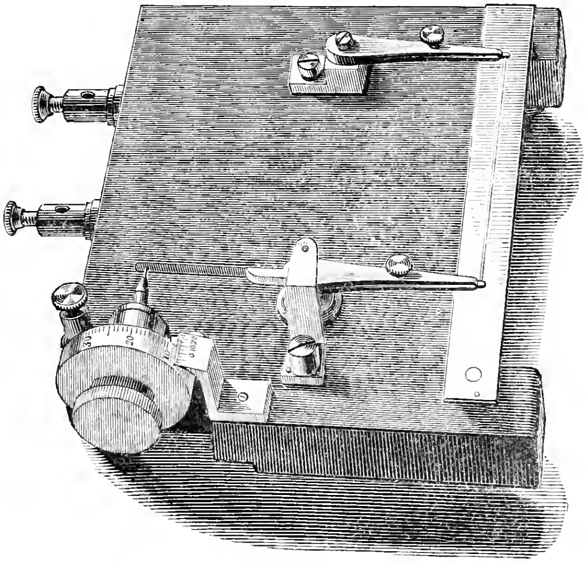

FIG. 2.

shows the apparatus (made by Messrs. Yeates and Son) at present in use. It consists of a rectangular piece of slate, cut into the form shown, on which two forceps are affixed, one rigidly (the further one on the figure), the other so that it is free to rotate round a vertical axis at one extremity, beyond which it is prolonged by a fine flat spring of steel. When these forceps are parallel to one another the distance separating their jaws is closely ten centimetres. This is the length of platinum ribbon whose expansion is measured when making experiments. A small helical spring attached to the vertical axle of the moveable forceps, and to the fixed piece which receives the upper pivot of this axle (this piece conceals it in the figure), serves to confer a *slight* tension on the platinum ribbon, in that it is set to turn the forceps clockwise on its axis. Thus, when the ribbon expands the forceps rotates a little, clockwise. At the further extremity of the spring which prolongs this forceps, a small polished plate of gold is attached, and to meet the surface of this a gold wire, carried at the extremity of the micrometer screw seen on the figure, may be brought on advancing the screw. The point of contact of pin and plate is as nearly as possible at the same distance to the one side of the vertical axis of the forceps as the centre line of the ribbon is to the other, when the latter is in its proper position in the forceps. Thus, the expansion of the ribbon may be measured by the movement of the micrometer screw, if at each change of temperature we get the gold pin to touch the gold plate *exactly*. To effect this without troublesome observations matters are arranged so that the meeting of pin and plate closes a circuit in which a galvanometer and a Leclenchè cell are included. The bed of slate insulates the screw and forceps, and connexions are made as on the diagram (fig. 3). This is an extremely

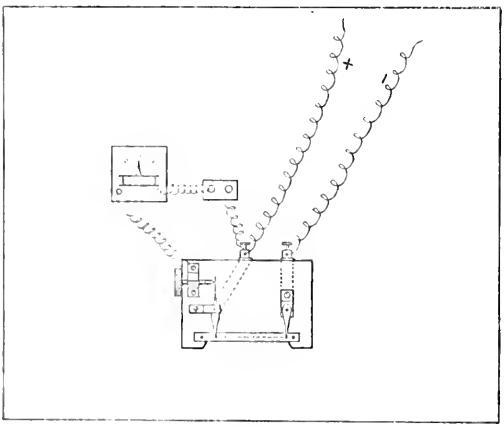

Fig. 3.

sensitive method of reading a small movement. The screw pitch is about the $\frac{1}{4}$th of a mm.; the micrometer head carries 100 parts. Half these last divisions may easily be read, that is to say, the $\frac{1}{800}$th of a mm., or less than the $\frac{1}{20000}$th of an inch, a quantity approaching the limits of the highest powers of the microscope, and indeed little more than two wave-lengths of sodium light. This movement is equivalent to a change of temperature of about 1·5 degrees centigrade. The micrometer screw must have a uniform thread and be reliable in its readings, or error will of course be introduced, just as would be the case with a badly calibrated thermometer. To bring the current into the forceps two large binding screws (seen in fig. 2) are provided. These are attached to copper straps passing beneath the slate bed, and communicating with the forceps. To insure good contact with the movable forceps an annular space around the axle is provided in the slate, into which a little mercury can be poured. A perforated wooden lid, loosely encircling the axle, keeps this mercury from accidentally being spilled out. The bottom of the mercury well is of brass, which receives the pivot of the axle on its upper surface, and at its under surface is screwed to the copper conductor. The forceps close by their elasticity, and are opened for the insertion of the ribbon by the small screws seen on the figure. A slip of polished brass, passing beneath the ribbon, serves to intercept heat from reaching the edge of the slate, and to receive chance fragments of substances falling off the platinum. The slate is cut back beneath this, for it is an object in the construction of this apparatus to preserve the slate from change of temperature. There seems but little heat communicated to the slate. I have not detected any sensible heating, even after prolonged experiments at high temperature. The coefficient of expansion of slate is so small that but little error can, I think, creep in this way.

The platinum ribbon used in this apparatus is similar to that used in the first described form of the meldometer. The resistance of ten centimetres of the ribbon, cold, is 0·43 ohm. A current of 6 ampères raises this length of ribbon to its melting point. The ribbon is cut away at each end where fixed in the forceps, so that its section is reduced considerably where meeting the cold metal of the forceps. This adjustment is very important in this form of the meldometer. Any serious loss of heat by conduction from the ends of the strip produces an effect increasing with the temperature, not in a simple ratio, but more as the square of the temperature, the electrical resistance being affected by the fall in temperature in such a way as to intensify the effect. Thus, the curve found for the extension will be affected; the curvature will tend generally to be diminished at high temperatures, and the position upon the ribbon we assign to the standard substances will also enter as a factor, for there will be inequality of temperature along the ribbon. A reduction of section to about one-fifth the full section will bring up the temperature at the ends sufficiently to reduce the error to a very small amount. It is easy to see, at a full red heat, how far the tint is uniform up to the forceps; but a more exact test may be made by reading melting points within about 12 millimetres from the ends and at the middle, which should afford a difference not exceeding 5° C. at a dull red heat. It will be found that if the ribbon be cut away with a scissors, and clamped as in figure 4, there will be sensible uniformity of temperature over the central six centimetres of the ribbon. I may observe that sometimes in the case of a ribbon very much cut away, and with a particular tension of the spring, keeping it stretched, a transverse vibratory motion of the ribbon takes place when it is heated. This is due apparently to air-currents in the same manner as a flat body thrown into the air falls, with horizontal oscillations, from side to side. This vibratory motion, of course, renders vision indistinct. It may be stopped by bringing a fine platinum wire, fixed to a support, to touch the edge of the ribbon at its central point, but I have only occasionally noticed the phenomenon.

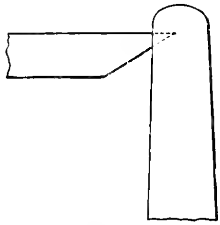

Fig. 4.

Before using a particular ribbon for measurements all traces of kink or bend is got out of it by raising it to a white heat for half a minute. In this connexion it must be mentioned that the pull of the ribbon must be very slight, just sufficient to keep it stretched. A force equivalent to the weight of 1·5 grammes is sufficient. The ribbon I have found it best to use weighs 0·0073 grammes per centimetre run. The maker's number for this is 0·170. A less section is not advisable, as being too much affected by slight draughts. It is essential, of course, that the ribbon be of constant cross-section. There is some advantage in surrounding the ribbon by an open trough-shaped box of platinum-foil from end to end. But while this conduces to steadiness in the temperature of the strip, it has the disadvantage of introducing a fresh difference of conditions towards the ends, except troublesome arrangements are made. On the other hand, the amount of fluctuation obtaining in the case of observations made in a quiet room are small, and often not disadvantageous in observing the melting point. Thus we observe the condition of the substance changing with these small fluctuations; and we set the micrometer so that the galvanometer needle is free when the substance shows the first signs of melting, and is deflected on the instant that solidification takes place. In this way the melting points of non-viscous bodies can be caught with much accuracy. And I may observe here that, although some of Carnelley's observations[1] appeared to indicate a considerable difference between the melting point and the solidifying point of many of the salts he dealt with, this difference is not substantiated by observations on the meldometer. The salt may generally be observed, with

[1] *Journal of the Chemical Society*, vol. i. (1876).

care, in such a state that the zone of liquefaction may be seen advancing from beneath, or retreating downwards at the least fluctuation of temperature. I think the method adopted by Carnelley for determining the point of the solidification was calculated to introduce an error due to radiation.

It is advisable not to assume that a curve plotted for one ribbon is suitable to another one which has replaced it, till we have verified a couple of points upon it, using such easily observed melting points as are given in the sequel. Then, if a speck of silver chloride, and of the black oxide of copper, CuO, be melted upon it, and finally a little palladium, we may assure ourselves upon this point. To avoid any chance of error due to the position of the substance upon the ribbon, no more than the central six centimetres should be availed of for determinations.

For the control of the temperature a higher resistance than that previously described is necessary. As the Rheostat I have in use is new in many particulars, and is very satisfactory, I think it well to describe it. It consists (fig. 5) of eight rods of carbon, having a total

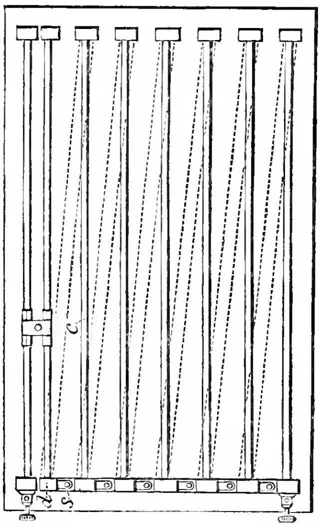

FIG. 5.

resistance of about 4 ohms, fixed horizontally upon a board. Two of these are provided with a sliding cross-connexion ; the others may be, one by one, thrown into circuit, or cut out by a few turns of the screws seen at the front of the board in fig. 5. The raising of one of these screws, for example, permits a brass plate to spring out of contact with the underlying metal, and as the plate is cut out sufficiently to clear it of the shaft of the screw, connexion is broken when the nut is raised, till it is no longer followed by the plate. The current then must traverse the carbon *c*, returning to the point *d* by the dotted connexion. It is evidently possible to secure a perfect gradation of temperature by the use of this resistance, the travel of the slides commanding a greater resistance than that of a single carbon. Thus if, when a certain number of carbons are in circuit, and the bridge has been moved to cut out the entire length of the two bridged carbons, we need still a higher temperature, we restore the bridged carbons to circuit by moving back the slides, and then cut out one of the carbons, after which we begin again to advance the bridge so as gradually to cut out the bridged carbons. In this way we increase the temperature, nor is it necessary to take our attention from the microscope and the manipulations of the micrometer, while making these changes in the resistance.

The diagram (fig. 3, p. 52) shows the convenient disposition of the apparatus when effecting measurements. To observe the objects upon the ribbon a simple form of microscope, mounted on a bracket, projecting from a heavy base, is requisite. This can be moved along and directed to any point of the ribbon. One ribbon, of course, serves for many observations.

A principal advantage of this electrical method of reading the elongation of the ribbon is contained in the fact that so little of the observer's attention is called upon to effect this ordinarily difficult measurement. This is very important, for slight variations of temperature are continually occurring, due to draughts chiefly, and it is essential to be able to seize the reading at the moment the substance melts, especially in the case of bodies which flood out suddenly upon the platinum. The galvanometer needle may be observed simultaneously, with the object in the field of the microscope, if the head be raised a little above the eye-piece. The left hand is kept upon the micrometer screw, and at each small movement of the bridge (effected by the right hand) the elongation is followed by the micrometer, and the behaviour of the substance at the increased temperature observed.

To render it more convenient to observe the deflection of the galvanometer simultaneously with the melting of the substance, or whatever other phenomenon we are observing upon the ribbon, I use the following arrangement:—A small galvanometer coil, wound with fine wire, and containing a freely pivoted magnetized needle is affixed to the eye-piece of the microscope. Projecting from the needle at right angles to its length, and entering a horizontal slot in the eye-piece is a fine index-hand. This moves across the margin of the field, being accurately in the plane of the image formed within the eye-piece by the lower optical train. Its motion is confined to a small arc, the magnetized needle without being stopped by pins at either side. This renders it fairly dead beat. When no current is passing the needle points to the centre of the field under the influence of a small control magnet affixed to the coil. Binding screws enable this galvanometer to be circuited with the larger galvanometer, which stands upon the table, and the Leclanchè battery. This is a *very* great addition to our power of effecting an accurate measurement.

The appearances which characterize melting vary according to the nature and properties of the substance. A viscous substance is seen to round its angles slowly, the smallest fragments going first. If the temperature is well over the softening point the process is rapid, and spreads from small to large fragments, the whole coalescing finally in pools upon the platinum. It is always possible in such cases to fix a temperature at which the substance decisively melts, and one at which prolonged heating seems hardly to effect it. Between those limits the melting point may be assumed to lie. In the case of substances which melt rapidly and recrystallize on solidification, it is easy to fix the melting point very closely. In fact the temperature may be so regulated that the small passing changes of temperature affecting the ribbon determine fusion or solidification; the result being that the salt appears as if vibrating between the solid and the liquid states, rays of crystallization darting across its surface, or again melting at the edges. These bodies are very easily dealt with: the salts selected for calibrating the ribbon, *i.e.* for the construction of the curve, are of this nature—as the carbonate and nitrate of potash, as well as potassium bromide. Silver chloride is also a salt of this nature, but it possesses also the peculiarity of changing colour when melting. Solid, it is a greenish-white, crystalline substance; melted, it is an amber-coloured liquid, deepening in colour with rise of temperature. The passage from the one state to the other is a well marked point. Similar phenomena mark the melting point of silver sulphate. If the substance is a metal the melting point is looked for in either of two ways. We may scrape a little dust off the metal on to the platinum ribbon, and, raising the temperature continually, catch the reading when the little fragments suddenly run down. A second trial, in which we may more carefully approach the melting point, will fix a correct reading. In the cases of silver and palladium, we may observe the behaviour of a pool of the previously melted metal; when such is again just melting a change of colour of the surface is visible. The appearance is as if a red or yellow flush (according to the temperature) passed across the surface; it is very characteristic, and seems due to the smoothing of the rugosities on the solid substances which keep the surface darker by their greater area of radiation. Points determined in this way, in the case of silver and palladium, agree with the points determined, by observation of the breakdown of very small scrapings of the metal. It is to be observed that metals should be determined only on the first or second melting, as there is risk of mutual solution or alloying with the platinum, which would effect the melting point. In general, it may be said that the breakdown of very small fragments, or a rocking motion apparent in the larger fragments, are the readiest, and probably the surest, signs of melting.

Coming now to the consideration of the range possessed by this apparatus for the comparison of melting points—for such it obviously is—it will be convenient to refer to the curve of melting points (Plate VI.) obtained by observations on the meldometer, such as I have described. The points fixed on the lower part of the curve are based, principally in the results of Carnelley (see his Melting and Boiling-point Tables, or the *résumé* of his results given in the *Physikalisch-chemische Tabellen* of Landholt and Bornstein. Carnelley and Williams' observations were made by a calorimetric method, in which they heated a platinum vessel to the temperature at which the salt melts, and plunging the platinum in water determined the quantity of heat contained in the platinum at the unknown temperature.[1] The specific heat of platinum had been measured by Pouillet, by direct comparison with the air-thermometer up to 1200° C.[2] The data so obtained are used by Carnelley. This physicist was so well acquainted with the whole subject that it appears hardly possible to say more in their support than that he was satisfied to accept them as the best basis available whereon to investigate and discuss the periodicity of the melting points of certain groups of compounds.

Violle,[3] finding the variation of specific heat with temperature by reference to the porcelain air-thermometer, determined the melting points of silver, gold, copper, palladium, etc. His determinations therefore rest on a similar basis to those of Carnelley.

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[1] Carnelley and Williams, *Jour. Chem. Soc.*, vol. i. (1876), p. 489.

[2] Pouillet, *Comptes rendus*, vol. iii. (1876), p. 782.

[3] *Comptes rendus*, vol. lxxxv. (1877); vol. lxxxvii. (1878); vol. lxxxix. (1879).

The whole question has been recently reviewed by Herr Carl Barus, for the U. S. Geological Survey. (*Bulletin* No. 54, 1889).

Assuming the reliability of Pouillet's investigations, there appears little doubt that, so far as Carnelley's observations extend (900° C., about), they are probably the most reliable yet made; although it is probable—almost certain, indeed—that there is a *small* minus error increasing with the temperature of melting (see account of his method *loc. cit.*) It is, perhaps, a further proof of their reliability that their agreement *inter se* appears very close. If we assume the co-efficient of expansion of platinum to preserve a fairly uniform value over this range, we find, from observations on the meldometer, that his data closely lie along a common line. The agreement is still closer if we assume a slow, fairly uniform, rate of increase of the co-efficient of expansion (*à priori* probable); and this assumption enables us, also, to extend the line, through the careful results of Violle, for the highest temperatures. Thus, silver 954° C., gold 1045° C., and palladium 1500° C. fall upon such a slow curve as is seen in the plate. Violle's results which, as observed, are also calorimetric, and are admittedly of much value, are, in fact, singled out by Carnelley in his Melting and Boiling-point Tables, as specially reliable. By using these points of Violle's we may extend our knowledge of the melting points of minerals up to (and safely, somewhat beyond) the temperature of 1500° C. with the same degree of accuracy attained in the research of Violle. Pure palladium is supplied by Messrs. Johnson and Matthey. Pure precipitated gold 1045° C. should be used if this substance is experimented on. It is to be spread in fine dust upon the ribbon, and the moment at which the particles break down, seized as the melting point. I have found by interpolation upon the curve that precipitated black oxide of copper, CuO., melts at nearly the same temperature (at 1055° C.), and as this substance breaks down at once, I suggest it as a substitute, giving a convenient point upon the curve between silver and palladium. Its *first* break-down must be observed, as upon remelting phenomena occur which render the melting point difficult to distinguish. Copper (1054° C.) is difficult to deal with, owing to oxidation; on the meldometer it is hard to distinguish its melting point from that of gold.

A single numerical example of the method of finding a point upon the curve may be of service. Thus in the case of silver chloride, at starting we find the head of the screw reading 1098 divisions from the zero point, the temperature being 15° C.; when the salt is melting we find the head reads 1242 or the advance has been 144. Now each of these represents an advance of the $\frac{1}{10000}$th of an inch, the thread being pitched $\frac{1}{100}''$, and the head carrying 100 divisions. We measure when cold the ribbon by a divider, and find it reads 3·80″. In taking this measurement we are not particular to scale the exact whole length; for although the ribbon is cut away at the ends in the manner before described (to favour uniform heating), it is seen to remain dark where *quite* close up to the forceps. It therefore conduces to accuracy to read the length about $\frac{1}{100}$th of an inch less than its full length. The correction is evidently a very immaterial one in any case from the comparative nature of the observations throughout. The fraction $l_2 - l_1 / l_1$ has now the value 144/38000 = 0·00379 which is accordingly plotted; conveniently to the scale 0·0001 to the millimetre. This length is set off perpendicularly from the horizontal scale of temperature at the point 436° C. The melting point is indeed given by Carnelley as 451° C., but the interval of temperature corresponding to the observed expansion is this value less the initial temperature of 15° C. This is the most convenient course to pursue if we wish to carry the curve through 0° C., which should be done if we wish to preserve it for continued use. Fifteen degrees higher up on the curve we may write AgCl, as is done on Plate VI. In this manner the curve is constructed. An unknown temperature is evidently determined from an observed expansion by calculating the value of $l_2 - l_1/l_1$ corresponding to this expansion, and finding from the curve what temperature corresponds to such an ordinate. To this must be added a number of degrees corresponding to the initial temperature.

At the very highest temperatures the platinum ribbon reveals a certain amount of viscous stretching. It was very important to determine the amount of this, and its influence in setting a limit to the range of measurements. Observations were accordingly made in which the temperature was raised by different amounts, and the behaviour of the ribbon observed over intervals of five minutes. Where viscous extension took place the ribbon, of course, did not return to its initial length. The true expansion in such cases was deduced by deducting from the whole extension the observed amount by which it failed to return to the initial length. From the extensions the temperature was computed as described, and the following table obtained:—

Temperature Degs. C.	Duration of Heating		Viscous Extension.
1430,	5 minutes,		0·0
1510,	5 ,,		0·0002
1565,	2 ,,		0·0004
1620,	5 ,,		0·0010
1780 (?)	3 ,,	(stretching rapidly)	0·0033

A viscous extension of 0·0001 introduces an error of about 3° C. It was observed, too, that at the temperature of melting palladium (1500°) a small viscous extension was sometimes apparent, and also upon prolonged exposure to the temperature of melting quartz. But it is evident that the error introduced by this effect, even if neglected, would not at a temperature so high as 1500° C. maintained for five minutes be a source of serious error. I think the allowance for it which can readily be made by reading the new length l_1, after the observation, may be considered to eliminate its effects. Thus producing the curve beyond Violle's result for the melting point of platinum temperatures so high as 1600° C. are determinable, and for their accuracy may with considerable assurance be referred to the degree of accuracy attained by Violle in his determination of the melting point of palladium. So high as 1700° the results obtained with this apparatus will still possess an approximation to this same degree of accuracy.

I submit, then, that contrasting this new method with the scale of Van Kobell, something has been gained. It must be remembered, also, that the apparatus is simple in nature and easily applied. It enables us to determine in a few minutes the melting point of a substance on the same basis of accuracy as that attained by the most careful observers. Only a very minute quantity of material is required, a condition often desirable in dealing with mineral bodies, and often again with bodies prepared by the chemist. Perhaps the peculiar function of the meldometer will be understood from the consideration that from any three or four of his numerous and laborious determinations, Carnelley might, by the use of such an apparatus, have at once arrived at the melting points of the many other substances he dealt with, by interpolation upon the curve of expansions in the same manner in which I propose that mineralogists should determine the melting points of mineral bodies. It is seen that in the apparatus described, the mechanical arrangements are such that there is no magnification of the expansion at the point at which the micrometer is applied. If it was desired to apply this form of platinum-thermometer to more minute measurements, as over a more limited range of temperature, it is of course easy to secure more delicate indications by lengthening the spring, so that we exaggerate at the micrometer the extension of the ribbon, or by lengthening the ribbon itself. Thus doubling the length of the spring with the present dimensions of the ribbon secures a reading closer than one degree centigrade. The applications of such an apparatus—necessitating only the most minute quantities of substances for the determination of their melting points—might be many in chemical research. On the other hand, however, it must be observed that it appears scarcely applicable to the determination of boiling points, at any rate of volatile liquids, my limited experience in this direction indicating that the small quantity of the liquid is soon evaporated, and the indications of boiling difficult to catch.

For determining the curve of melting points, I have found the following substances convenient:—

	Degs. C.
Potassium nitrate, ...	339
Silver chloride, ...	451
,, sulphate, ...	654
Potassium bromide, ...	699
Silver, ...	954
Gold, ...	1045
or Cupric oxide (first fusion), ...	1055
Palladium, ...	1500

For verification of a new ribbon it is sufficient to select silver chlorides, gold (or cupric oxide), and palladium.

The following list of melting points is further added for convenience of reference. It contains melting points principally determined by Carnelley and Violle, and some others signalized by Carnelley in his Melting and Boiling-point Tables as being specially reliable. Those tried and found suitable are marked with an asterisk. Such are free from phenomena of viscosity or decomposition, the substance having generally well-marked change of appearance upon melting.

MELTING POINTS.

Elements.	Degs. C.	Authority.
Platinum, ...	1775·0	*Violle.*
*Palladium, ...	1500·0	,,
Cobalt, ...	1500·0	*Pictet.*
Nickel, ...	1450·0	,,
Copper, ...	1054·0	*Violle.*
*Gold, ...	1045·0	,,
*Silver, ...	954·0	,,
Tellurium, ...	455·0	*Carnelley and Williams.*
Zinc, ...	433·3	*Person.*
Antimony, ...	432·0	*Pouillet.*
Lead, ...	326·2	*Person.*
Cadmium, ...	320·7	,,
Bismuth, ...	268·3	*Rudberg, Riemsdyk.*
Tin, ...	232·7	*Person.*
*Sulphur (rhombic), ..	114·5	*Brodie.*

Metals which oxidize at high temperature as copper, zinc, lead, tin, &c., are difficult of exact observation.

Melting Points—*continued.*

Fluorides.				Degs. C.	Authority.
Magnesium fluoride,	..	MgF_2	about	908	*Carnelley.*
Sodium ,,	..	NaF	,,	902	,,
Calcium ,,	..	CaF_2	,,	902	,,
Strontium ,,	..	SrF_2	,,	902	,,

Sodium fluoride undergoes a period of viscosity.

Chlorides.		Degs. C.	Authority.
Strontium chloride,	$SrCl_2$	825·0	*Carnelley.*
*Sodium ,,	NaCl	772·0	,,
*Potassium ,,	KCl	734·0	,,
Calcium ,,	$CaCl_2$	719·0	,,
Magnesium ,,	MgCl	708·0	,,
Lithium ,,	LiCl	598·0	,,
Cadmium ,,	CdCl	541·0	,,
Lead ,,	PbCl	498·0	,,
*Silver ,,	AgCl	451·0	,,
Tellurium ,,	TlCl	427·0	,,
Tin ,,	$SnCl_2$	249·3	*Carnelley and Williams.*
Bismuth trichloride,	$BiCl_3$	227·0	*Muir.*
Antimony ,,	$SbCl_3$	73·2	*Thorpe.*

Bromides.		Degs. C.	Authority.
Magnesium bromide,	MgBr	708	*Carnelley.*
*Potassium ,,	KBr	699	,,
Calcium ,,	$CaBr_2$	676	,,
Cadmium ,,	CdBr	571	,,
Lead, ,,	$PbBr_2$	499	,,
Silver ,,	AgBr	427	,,

Iodides.		Degs. C.	Authority.
*Potassium iodide,	KI	634	*Carnelley.*
Calcium ,,	CaI_2	631	,,
Sodium ,,	NaI	628	,,
Silver ,,	AgI	527	,,
Lithium ,,	LiI	446	,,
Zinc ,,	ZnI	446	,,
Tellurium ,,	TlI	439	,,
Lead ,,	PbI_2	383	,,
Tin ,,	SnI_2	316	*Carnelley and Williams.*

Melting Points—*continued.*

Oxides.		Degs. C.	Authority.
*Cupric oxide,	CuO	1055	(By interpolation).—*J. J.*
Molybdenum trioxide,	MoO_3	759	*Carnelley.*
Boron trioxide,	B_2O_3	577	,,

Chlorates.		Degs. C.	Authority.
Barium chlorate,	$Ba(ClO_3)_2$	414	*Carnelley.*
Potassium ,,	$KClO_3$	359	,,
Sodium ,,	$NaClO_3$	302	,,

Sulphates.		Degs. C.	Authority.
Sodium sulphate,	Na_2SO_4	861	*Carnelley.*
Lithium ,,	$LiSO_4$	818	,,
*Silver ,,	Ag_2SO_4	654	,,
Tellurium ,,	Tl_2SO_4	632	,,
Cobalt ,,	$CoSO_4$	96–98	*Tilden.*
Ferrous ,,	$FeSO_4$	64	,,
Zinc ,,	$ZnSO_4$	50	,,

Nitrates.		Degs. C.	Authority.
Strontium nitrate,	$Sr(NO_3)_2$	645	*Carnelley.*
*Barium ,,	$Ba(NO_3)_2$	593	,,
Calcium ,,	$Ca(NO_3)_2$	561	,,
*Potassium ,,	KNO_3	339	,,
Sodium ,,	$NaNO_3$	316	,,
Lithium ,,	$LiNO_3$	264	,,
Silver ,,	$AgNO_3$	218	,,
Ammonium ,,	NH_4NO_3	159	*Veley.*

Carbonates.		Degs. C.	Authority.
*Potassium carbonate,	K_2CO_3,	834	*Carnelley.*
Sodium ,,	Na_2CO_3	814	,,
Lithium ,,	Li_2CO_3	695	,,

V.

NOTE ON THE MOON'S VARIATION AND PARALLACTIC INEQUALITY. By REV. M. H. CLOSE, M.A.

[Read June 8, 1891.]

Various writers on celestial dynamics, including some of the first rank, and authors of Treatises, Manuals, &c., of Astronomy, have given an elementary deduction of the Variation inequalities in the moon's motion (without the numerical values) from the action of the solar differential perturbing forces, and also an elementary proof that the shortest axis of the Variation orbit, considered apart from all other inequalities, is directed towards the sun. Newton was the first to do this in the *Principia*, Bk. I., Prop. 66, cors. 2–5. But he has also given us his masterful geometrical exposition of the subject in the third Book of the *Principia*, which was considered by Laplace to be one of the most wonderful parts of that wonderful work. The investigation has been since carried out more fully by the more powerful method of analysis.

As, then, we are not dependent on the said elementary deduction and proof, we incur no great loss when noting what, apparently, has not yet been pointed out, at least in print, viz., that they are quite insufficient for their intended purpose. They were at first put forward in the light of knowledge, otherwise obtained, of the phenomena in question ; and the known correctness of the conclusions to which they seem to lead has concealed the inconsequentiality of the reasoning, both from the original author and from the others who probably have followed him in this matter, even down to the present day.

The accompanying diagrams of the Variation and of the Parallactic Inequality are both given with only such detail as is necessary for the present purpose ; the arrows, of course, represent merely the positions and directions, not the magnitudes, of the various forces.[1]

---

[1] We now adopt the following values :—
Var. in long. $= + (35' 45'') \sin 2e$. Rad. vect. $=$ mean do. $(1 - 0{\cdot}0074 \cos 2e)$.
P. I. in long. $= - (2' 4{\cdot}9'') \sin e$. Rad. vect. $=$ mean do. $(1 + 0{\cdot}00028 \cos e)$.
e being moon's elong. from sun reckoned eastwards up to 360°.

First, we have to consider the elementary deduction of the Variation inequalities in the moon's motion from the action of the solar perturbing forces. For simplicity, the moon's undisturbed orbit is supposed to be circular.

It is said that, as in the quadrants immediately preceding syzygies the solar tangential disturbing force acts *in consequentia*, or in the direction of the moon's motion, *therefore* the moon's velocity is increasing all through those quadrants, reaching its maximum at syzygies; and for corresponding reasons the velocity is decreasing in the other two quadrants, reaching its minimum at both quadratures. All these statements of fact are, of course, quite right.

But the "therefore" is unwarranted; for this argument ignores what, for all we yet know to the contrary, might be a very important element of the question, namely, the evidently necessary deformation of the moon's orbit by the disturbing forces. This deformation would give rise to a tangential component of the earth's attraction on the moon, which we shall call the terrestrial tangential forces; and, so far, we know nothing of the possibilities as to the magnitude, and the effects, of this force.

The sun produces the moon's Variation in longitude in two ways—first by the production of said deformation of the orbit by the whole general action of his disturbing forces, both tangential and radial, which deformation originates said terrestrial tangential forces; and secondly, by the immediate local action of his tangential forces in modifying the velocity of the moon in her orbit. For all that we are told in this argument to the contrary, the effect of the former might be greater (which indeed it actually is) than that of the latter, and it might be in the opposite direction; as it would be if the Variation orbit, with its present ovalness, had its longest axis directed to the sun; this being what learners (for whom this argument is intended) would naturally expect.

Now it so happens that we have only to take the short step fresm the Variation to the Parallactic Inequality to meet with an obtrusive illustration of the antecedent possibility of what we have contemplated. In the Parallactic Inequality orbit, the moon quickens or slackens her pace always in opposition to the solar tangential forces. The reason of this is that the accumulated deformation of the moon's orbit, supposed to be originally circular and devoid of all other inequalities, by the whole general action of the Parallactic Inequality disturbing forces, makes the sunward radius vector a maximum, and the opposite one a minimum. And the difference, though relatively very small, is such that, while the moon is going from opposition to conjunction, the retardation due to her rising against the earth's attraction exceeds the acceleration due to the immediate action of the solar tangential forces; and *vice versa*, when she is going from conjunction to opposition.

So, then, the argument to which we are now demurring would be downright *wrong* if applied to the Parallactic Inequality orbit; and we are given no reason why it must necessarily apply to the Variation orbit.

Let us pause for a moment over the interesting circumstances that the effect of the terrestrial tangential forces on the moon's motion in longitude is greater than the immediate direct effect of the solar ones, both in the Variation and in the Parallactic Inequality. As to the Variation—we can claim for the earth that it is working more than half of this lunar inequality; though we have to admit that it is the sun which has enabled the earth to do this by having produced the Variation deformation of the moon's orbit. In this case the two sets of tangential forces fortunately co-operate; so that the whole result is the sum of their separate effects. (By the way, this circumstance has helped to disguise the inconclusiveness of the above argument.) As to the Parallactic Inequality—we can claim for the earth, not only that it is working the whole of this lunar inequality, but that it is, in addition, cancelling the immediate local effect of the solar tangential forces. In this case, the forces being unfortunately in antagonism, the net result is only the difference of their separate effects. Of course we admit, as before, that it is the sun's own general action in producing the Parallactic Inequality deformation of the moon's orbit which enables the earth to accomplish so much. (See diagram[1].)

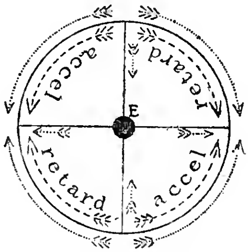

FIG. 1.—Variation.

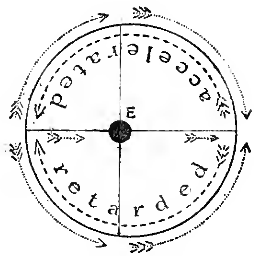

FIG. 2.—Parall. Inequal.

[1] In each diagram the moon's orbit is represented by a continuous line. The solar tangential forces are indicated by the outside arrows drawn with dotted lines, and the terrestrial tangential forces by the inside arrows drawn with broken lines. E is the earth; the sun is to the right. In the second diagram the eccentricity of the earth's position has been magnified 300 times.

Secondly, we have to consider the elementary proof that the shortest axis of the Variation orbit is directed towards the sun. The argument consists of three links (*a*), (*b*), and (*c*), which are so connected that the insufficiency of any one is enough to vitiate the whole chain of the reasoning. But this is not all; it will be found that, curiously enough, each one of the three is, in itself, incapable of bearing the stress put upon it. We give here all the links of the argument; though we have had the first one already in a different connexion.

(*a*) It is said that, as in the quadrant immediately preceding conjunction the solar tangential force is acting in the direction of the moon's motion, until she arrives at conjunction, where the force changes its direction, therefore the moon's velocity is increasing until conjunction is reached, where it is a maximum.

(*b*) It is then said that, the moon's velocity being, thus, a maximum at conjunction, the Variation orbit must be flattest at that point, supposing other things to be equal. But—it is added—other things are even better than equal; because at that point the sun's radial perturbing force directed away from the earth is a maximum; and consequently the whole earthward pull on the moon is a minimum. Therefore—it is added—the moon's velocity being greatest at conjunction, and the deflecting earthward pull least, the Variation orbit is, for two reasons, flattest at that point; and for corresponding reasons, *mutatis mutandis*, it is most curved at quadrature.

(*c*) It is then said, finally, that as the Variation orbit is, thus, flattest at conjunction, and most curved at quadrature, therefore the moon's radius vector must be a minimum at the former, and a maximum at the latter.

In reply to (*a*)—We have seen already that this argument, as it stands, is quite inconclusive. But we may now add that, in its present connexion, it is a veiled, partial *petitio principii;* it goes far towards assuming that the longest axis of the Variation orbit is not directed towards the sun; to *prove* which is its ultimate aim. (It is self-evident that either the longest or the shortest axis must be so directed.)

In reply to (*b*)—This argument contains, very singularly, a statement which is actually *contrary to fact.* It will be found that the increase of the earth's attraction on the moon at conjunction in consequence of the diminution of the moon's radius vector, exceeds the outwardly directed radial perturbing force at that point.[1] This latter force at that point is almost exactly $\frac{1}{90}$th of the earth's mean attraction on the moon. But, adopting Hansen's value of the coefficient in the expression for the Variation change in the moon's radius vector, which expression is $-\frac{1}{136}\cos 2e$, taking the mean value of the radius vector as unity, the r. v. at conjunction will be $1-\frac{1}{136}$; and therefore, taking the mean attraction of the earth on the moon as unity, the attraction at conjunction will be $1+\frac{2}{136}$, *quam prox.* Therefore the whole earthward pull on the moon at that point will be $1+\frac{1}{68}-\frac{1}{90}$, which is more than unity, the mean; and not only that, but, as we know otherwise, a maximum. Therefore, whilst the moon's velocity is a maximum at conjunction, the earthward deflecting force is also a maximum at the same point; and, until we have more information than this argument gives us, we cannot know which of these would overpower the other, as regards their effect on the curvature of the orbit at conjunction. It is not too much to say that this argument (*b*) is founded on the disregard of the very object of its *ultimate* aim, which is to show that the moon's radius vector is a minimum at conjunction. Omitting the false premiss will mend matters but little; for it leaves the argument simply inconclusive. (In the Parallactic Inequality orbit the moon's velocity is greatest at opposition, and least at conjunction; both being points of least curvature.) Corresponding remarks, *mutatis mutandis*, have to be made respecting the curvature at quadrature, where, as just referred to in the footnote, the whole earthward pull on the moon is a minimum, and not, as this argument (*b*) states, a maximum. But notwithstanding what we have seen, the conclusion immediately aimed at by this argument is right, viz., that the orbit is flattest at conjunction and most curved at quadrature.

In reply to (*c*)—This link-argument would be valid if we had some reason for knowing that the orbit was an ellipse, or else approached near enough, practically and for the present purpose, to such a curve; in this case the least curvature and the least radius vector would go together. But, as this argument tells us nothing of the nature of the curve, it may very well be, for all we yet know to the contrary, that this may not obtain in the Variation orbit.

Now it so happens that we have, close at hand, an illustration of the (antecedent) possibility of its not so obtaining. The argument

[1] This is suggested to us by the statement respecting the whole earthward pull on the moon at first quadrature in Airy's *Gravitation*, p. 66; though it by no means follows from that statement.

which we now oppugn would be downright *wrong* if applied to the point of conjunction in the Parallactic Inequality orbit. Supposing the moon's undisturbed orbit to be circular, and neglecting all other perturbations of it, the effect of the Parallactic Inequality forces is, as the equation shows, to draw out the orbit a little on the sunward side and to compress it a little on the opposite side; so that the greatest radius vector is that at conjunction. According, then, to this argument (*c*), we should conclude that the curvature of the Parallactic Inequality orbit at conjunction is greater than the mean. But it will be found on trial that, on the contrary, the radius of curvature, at conjunction, is a maximum (though only a relative one; that at opposition being the absolute maximum[1]). So then the argument (*c*), as it stands, is inconsequential; although the conclusion at which it aims is perfectly right.

Thus each of these three link-arguments proves, on examination, to be insufficient for its purpose, its insufficiency having been masked by the otherwise-known correctness of its intended conclusion.

It might still be urged that, after the improvement of the second by the omission of its false premiss, each of the three arguments is very reasonable, and the antecedent probability of its correctness considerable. We cheerfully grant that this is so; yet this is not demonstration. But besides we must not forget the nature of their connexion as *links*. If we take the antecedent probability in the case of each as $\frac{3}{4}$, we shall be making a very liberal concession; considering the *a priori* certainty that the moon's orbit must be deformed by the perturbing forces, and that we have, as yet, no idea of the possibilities as to the character and the magnitude of the deformation and the effects thereof on the intended conclusions. But if we concede to each the probability of $\frac{3}{4}$, this will give only $\frac{27}{64}$, or well under $\frac{1}{2}$, as the probability of the correctness of the final conclusion, viz. that the shortest axis of the Variation orbit is directed towards the sun. So that the antecedent chances are actually *against* its being right.

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[1] The difference, however, between these two radii of curvature is less than one *inch* and a half!

VI.

THE CISTERCIAN ABBEY OF KILL-FOTHUIR. By THE RIGHT REV. DR. REEVES, Bishop of Down & Connor and Dromore, President of the Academy.

[Read MAY 25, 1891.]

WERE it not for the industry of Gaspar Jongelin, a Belgian monk of the Cistercian Order,[1] this monastery, both name and history, would be now unknown to us. His *Notitia Abbatiarum Ordinis Cisterciensis per orbem universum*, published at Cologne in 1640, recites in chronological order the foundation and early history of all the Cistercian houses of Ireland, and, among them, those of the Diocese of Raphoe, that is, of the County of Donegal: these two—*Samaria* alias *Ashroe*, and *Kill-fothuir*, the former near Ballyshannon, in the extreme south-west of the county, well known; and the latter in the north-east, disguised and forgotten for two centuries.

The name is pure Irish, signifying "church of the wilderness," or "forest," and has in composition an obsolete, but classical, term. As the name of a church or place, it is not to be found in any native Irish record, and our acquaintance with it is derived from this single source.

The following is Jongelin's statement:—"KILL-FOTHVIR, in Diocesi Rapotensi. Monasterium de *Kill-fothuir*, in Tirconallia, circa annum 1194, fundatum est à Domino Eachmharco *Odochartaig*, viro antiqua generis nobilitate & animi fortitudine illustri. Quem postquam Flaithbhertacho O'Moeldoraigh succederet in regimine Tyrconalliæ anno 1197, Annales referunt eodem anno occubuisse in

[1] A native of Antwerp. His name is not found in the *Biographie Universelle*, nor in the *Biogr. Générale*; but there is a brief notice of him in Zedler's *Universal Lexicon* (Leipzig, 1735), Part II., coll. 1111, and in Jöcher, *Allgemeines Gelehrten Lexicon* (Leipzig, 1750), Part II., col. 1961. A good account of him is given by C. De Visch in his *Bibliotheca S. O. Cisterciensis* (Colon. Agrip., 1656), p. 118 *b*. But much the best is that of J. F. Foppens, in his *Bibliotheca Belgica*, tom. i., p. 328 *a* (Bruxelles, 1739).

prœlio, contra Joannem de Curcy. Hoc monasterium, deficientibus paulatim monachis, cessit tandem, et vnitum fuit Monasterio de Ashroe, siue de Sameria, cujus erat filia."[1]

Comparing the orthography of the names in this passage, one is struck with the contrast between this foreign record and the grotesque recital of Irish names of places in the Provinciale Romanum. The fact[2] is, that Malachias Harry, an Irishman, professed at Mellifont, Protonotary Apostolic; and, above all, Father John Colgan, then professor at Louvain, himself a native of Donegal, impressed the narrative with an air of accuracy which an alien could not pretend to.

In identifying the place of this extinct monastery, it was reasonable to suppose that, being an affiliated cell of Ashroe, it would not be in the neighbourhood of the mother church; also, that as the latter was founded by Flaherty O'Muldory, in his principality of Tirhugh, and the former by Echmarchach O'Dogherty, within his patrimony of Tir Enda and Ardmire, now the barony of Raphoe, they should be far asunder, though in the same territory and diocese. This will presently be established by recent authority.

In the lapse of nearly three centuries between the foundation of this monastery and its next appearance on record, it had undergone the change described by Jongelin. After the decay of this abbey it fell from its condition of an affiliated cell to that of a grange or monastic farm, and all architectural traces disappeared, leaving only its cemetery, with a fragment of masonry, and the townland names of the premises, which tell a tale of early importance, and indicate the nature of their original appropriation.

We have no record of the place until the 26th of November, 1588,

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[1] *Jongelinus*, Lib. viii., p. 28. Stevens, in his enlarged translation of Alemand, writes: "There was also in the same County the Abby of *Hilfothuir*, founded in the year 1194, by one of the O'Dogharties; but the Wars oblig'd the Monks to forsake that House, which was at last united to that of *Asrhoe* or *Samaria*, whose Daughter it was. *Jungelin* only makes mention of this House."—*Monast. Hibernicum*, p. 205 (Lond. 1722).

[2] "De Hiberniæ Monasteriis multa nobis suppeditavit Nobilis vir Iacobus Waræus, cuius extant præcipuarum Ecclesiarum Hiberniæ Episcoporum Catalogi; itemque R. Dominus Malachias Harry, professus Cœnobii Mellifontis in Diœcesi Armachanâ, nec non in eodem Regno Protonotarius Apostolicus: Ioannes Colganus, Ordine Franciscanus, et Louanii in Monasterio RR. PP. Moritarum Hibernorum, S. T. Professor, &c."—*Ibid.* p. 20.

This *Malachias Harry* is noticed by De Visch as *Malachias Artry*—"Natione Hybernus," *Biblioth.*, p. 244 (rect. 236), 244 *b*, *Index Nom.* and *Index Cognom.*

when we learn, from an unpublished Exchequer Inquisition,[1] that at that date, among other lands which appertained to the abbey of monks of the order of St. Bernard in the vill of Asseroe, near Bealashannon, was the "Grangia juxta monasterium de *Kylfiore*,"[2] containing one quarter of land, with its tithes and appurtenances.[3]

Twenty years after this, a patent was granted by James I., 12th April, 1608, to Auditor Francis Gofton, of the same abbey and its appurtenances, among which appears "the grange near the monastery of *Kilfoore*, containing one quarter, with the tithes."[4]

Next year, September 12th, an ecclesiastical Inquisition for Donegal was sped at Liffer, by a jury of eighteen natives, who found that "the graunge of *Killfaugher* contayneth one quarter of land, belonges to the late dissolved abbay of Asheroe, and nowe inhabited by the sept of the Brianns,[5] payinge thereout yerely to the said late dissolved abbay of Asheroe the rent of six shillinges eight pence, Irishe, for the said landes."[6]

By another Inquisition sped at Ballyshannon, January 22nd, 1621, it was found that Francis Gofton had, by deed bearing date the 20th of May, 1608, conveyed to Sir Henry Folliott all his interest in the grant of the Ashroe possessions, including "the grainge neare to the monasterie of *Kilfore*, conteyninge one quarter of land, divided into twelve sessioches, bearing the following names: Tample otherwise Shraghmoore (now Kilmonaster Lower, a townland of 212 acres, containing the cemetery and site of the abbey); Gortinerin (now Gortin South), alias Carrigmoore; Gortnagor; Drumremy; Drummanatwoer, otherwise Muninmoore; Anamullin; Maghereshanwalley (now Magherashanvalley); Carigeelan, otherwise Carriglaskey; Lessecrede; Lessmullaugh; [Teb]bredbrock; and Killalloo, otherwise Lagenebrade (now Legnabraid or Cunninghamstown), otherwise Lismanidoyghill; with all the tithes both great and small, oblations, obventions, and mortuaries, yearly arising in and upon [the said] quarter of land." And,

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1 An extremely incorrect abstract of it is given by Archdall (*Monast. Hib.*, p. 94), borrowed from the *King MS.*, p. 403.

2 Rendered by Archdall, "Grange near the mountain of Kyseure," p. 94.

3 Excheq. Inquis., No. 1, 26 Nov., 31° Eliz.

4 *Calendar. Rot. Pat.*, Jac. i., p.129 *a*.

5 Probably the same stock as the family that gave to the island of 50 acres off the west coast of the county, which belonged to Ashroe, called in the Inquisition of 1588, *Ilan Raghlyn Ivryne*, known in former times as Reaċra Muintire birn, the name of *Rathlin O'Birn Island*.

6 *Inquis. Ultoniæ*, *Donegall*, Appendix, p. 20 *b*.

further, they found that "the said quarter of *Kilfore* is meared and bounded on the east with the four sessioches of Shandan" (now the townlands of Shannon Lower and Shannon Middle); on the west with the quarter of Magherashanwalley (now Magherashanvalley); on the north with the quarter of Argery (now Argery Hill);[1] and on the south with the quarter of Balliboggan (now the townland of Ballybogan[2]) and the quarter of Magherecreagh (now Magheracreagh, in the parish of Donaghmore).[3]

This Inquisition was preparatory to the patent of the estate, that Sir Henry, now Lord Folliott, obtained on the 9th of April, 1622, which in the recital specifically mentions "the quarter-land of *Kilfore*, called the Grange of *Kilfore*, alias *Manister-Kilfore*, with the appurtenances, and the several sessioghs, called Sessiogh Tample alias Shraghmore; Gorteinorine alias Carrigmoore; Gortnagor; Dromreny; Drumanatwoer alias Munnimore; Anamullyn; Mahershanvally; Carrigeilan alias Carriglasky; Lessecreedy; Lismullaugh; Tibbredbrocke alias Tibberbrocke; Killulloo alias Legenebrade alias Lissmanedoighell; with all the tithes great and small."[4]

And, finally, on the death of Lord Folliott, November 10th, 1623, an Inquisition, *post mortem*, was held on March 1st, following, wherein was found that he died possessed of the quarter of *Kylfore*, alias *Monaster-Kylfore*, with its appurtenances.[5]

In process of time the bulk of the Ashroe and Ballyshannon estates passed into the Connolly family, while the outlying portions—such as the Grange of *Kiltyerne*, now known as Kiltierney, in the County of Fermanagh,[6] a townland of 323 acres, which is at this day walled in as the Deer Park of Castle-Archdall, and has the remains

[1] The quarter of "Argery Hill" is marked on the Ordnance Survey near the middle of sheet 17, with elevation of 506 feet, where it is the focus of several subdenominations.

[2] So named from the family of O'Bogan, who were herenaghs of it. The real name is Tech-na-comairce, of the Calendars, at May 28—"house of the sanctuary," called *Tegnagomark* in the Taxation of 1300; *Tachnekomeryke*, in 1397; and marked *the Sanctuary* in Mercator's two maps. See Colton's *Visitation*, p. 71; and *Mart. Doneg.*, pp. 140, 141; Ord. Surv., *sheet* 79.

[3] *Inquis. Ulton.*, *Donegall*, Jac. i., No. 10.

[4] *Calend. Rot. Pat.*, Jac. i., p. 541 *a*.

[5] *Inquis. Ulton.*, *Donegall*, Jac. i., No. 13.

[6] Ord. Surv., sheets 6, 11. Cill Tiġernaiġ is in the parish of Magheraculmoney, and derives its name from St. Tighernach, founder and bishop of Cluain-Eois, now Clones. See *Mart. Doneg.*, April 4 (p. 94), and *Four Mast.* (ed. O'Donovan), at 1602 (vol vi., p. 2329).

of an ancient church, with a venerable cemetery—were disposed of, as was *Kilfore* also, a large portion of which, tithe free, fell to the Maxwell family of Birdstown.

When Dr. William King was Bishop of Derry, he instituted a very searching visitation of his diocese, the result of which is still on record. Herein he states of Clonleigh :—"There were anciently two Chappels-of-Ease in this parish, viz. *Tehumrick*, or *Ballybogan*, formerly a parish, and *Kirkminster*, a religious house, but of what sort I cannot learn." Again :—"There is a considerable impropriation in this parish, called Kirkminster; it belongs to Mr. Alexander Maxwell of Strabane. It contains about one-seventh of the parish." Previously to this, in "the Complaint of the Clergy," which is entered in Bishop Downham's "Visitation Book," it is stated, that "In the parish of Clonley, the great tithes in one quarter, called Monaster, detained by the Lord Folliott, the inhabitants, exempting themselves not only from the parish of Clonley, but also from the Diocese of Derry." And down to the date of Disestablishment, the Kilmonasters, Legnabraid, and Gortin South (Maxwell property), being "abbey lands," were exempt from the payment of tithe rent-charge.

Clonleigh is a parish containing 12,364 acres, in the barony of Raphoe, the ancient Tir-Enna, which, with Ardmiodhair, formed the original patrimony of O'Dogherty, who in later times extended his territory northwards into Inishowen, and dispossessed the occupants who were of the Cenel-Eoghain. The river Foyle, which bounds it on the east, divides it here from the County of Tyrone; but Clonleigh, though in the County Donegal, is, as well as all the parishes of Inishowen, in the Diocese of Derry, being an early indication of Cinel-Owen authority in this region. The river Finn, flowing eastwards, joins the Foyle south of Lifford. Further north the Deel[1] enters the Foyle, in the same direction, on the eastern edge of the parish and county, and is crossed at Ballindrait (Baile-an-drochait) by the bridge formerly known as the Droichet-Adhamhnain (Adamnan's Bridge).

Almost all the ground with which this Paper deals is comprised in sheet 70 of the Ordnance Survey. On the north bank of the Deel we find the townland *Ballymonaster* (town of the monastery), 144

[1] The Irish ᴅael, "a cock-chafer," in reference to the blackness of the water. The Scotch settlers have made the hybrid name *Burndale*, and so it appears in M'Crea's County Map, of 1801; but the Ordnance Survey has restored the true name, *Deele River*. The same word gives name to Glenealy in Inishowen. See Reeves, *Adamnan*, pp. lxiv., 405.

acres. Opposite it, on the south bank, is Kilmonaster (church of the monastery) Lower, 213 acres, wherein is the site of the short-lived abbey, with its churchyard; and south of this again is the adjoining townland of Kilmonaster Middle, 258 acres.

Situated here on the extreme south-east of the county, the abbey was at a considerable distance from its mother church—forty miles, or more, in a direct line. The identification of it was long impeded by a careless error of Alemand's,[1] who found Kill-fothuir in Jongelin, and turned its initial into H. This was in 1690. His translator, Captain John Stevens,[2] in 1722, repeated the error; Harris,[3] again, in 1764, transmitted *Hilfothuir* without correction; Archdall,[4] in 1786, stereotyped it; and his editors of 1873[5] loaded the page with irrelevant matter, and left Archdall's inheritance as they found it.

The name of *Kilfore* conveniently expresses the true form, which has come down to us in the stages that I have recited—*Kill-fothuir*, 1197; *Kylfiore*, 1588; *Kilfoore*, 1608; *Kilfaugher*, 1609; *Kilfore*, 1621; *Manister Kilfore*, 1622; *Manister Kylfore*, 1623; *Kirkminster* 1690; *Kilmonaster*, present name.

Sir James Ware had no means of learning, either from Irish or English records, the existence or name of this abbey, and being unacquainted with Jongelin, there is no notice of *Kill-fothuir* in his *Antiquitates Hibernicæ*, either first or second edition.[6]

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[1] *Histoire Monastique D'Irlande* (Par. 1690), p. 198.

[2] *Monasticon Hibernicum* (Lond. 1722), p. 205.

[3] *Ware's Works*, vol. ii., p. 275.

[4] *Monasticon Hibernicum* (Dubl., 1786), p. 99.

[5] *Monasticon Hibernicum* (Dubl., 1873), vol. i., p. 193.

[6] Chap. xxvi., *Donagall*, pp. 186, 187, first ed. (1654); second ed. (1658), pp. 216, 217.

VII.

ON THE BOOK OF ARMAGH. By THE RIGHT REV. DR. REEVES, Bishop of Down & Connor and Dromore; President of the Academy.

[Read April 27, 1891.]

Venerable Bede relates, under the year of our Lord 664, that a multitude of nobles, as well as those of inferior rank—*de gente Anglorum*—who fled from England during the prevalence of the Great Mortality, betook themselves to Ireland, where they found a cordial welcome. His words are:—"Quos omnes Scotti libentissime suscipientes, victum eis quotidianum sine pretio, libros quoque ad legendum, et magisterium gratuitum præbere curabant."[1] From which we may fairly gather that, in the middle of the seventh century, the multiplication of books had largely taken place in Ireland, and to this end, that the art of writing had been practised for a sufficiently long period to guarantee ease and elegance to the work. And so honourable did the title of scribe become, that in the Annals it is often used to *enhance* the celebrity of an abbot or bishop; nay, we sometimes find in the recital of honours, the "accomplished scribe" represented, with the dignity of bishop or abbot, or both, as an accident of office. And when, in process of time, instruction was added to the practice and teaching of penmanship, the more honourable title of *Ferleighinn*,[2] "vir lectionis" or "prælector," was adopted, corresponding in office and function to the *magister* and *magisterium*[3] of Bede, or the *scolasticus quidam de gente Scottorum*,[4] as the teacher is elsewhere designated by the same historian. And thus it came to pass in Armagh, which was a seminary of great and early repute, that the last recorded scribe appears at the year 846,

[1] *Hist. Eccles. Gent. Anglor.*, lib. iii., cap. 27.

[2] On the offices of Scribe and Ferleginn, see Colgan, *Tr. Thaum.*, pp. 631, 632.

[3] On these terms, see Appendix No. xvii. of Smith's edition (Cantab., 1722), p. 746; and Hussey, *in loco*, p. 170.

[4] *Hist. Eccles. Gent. Anglor.*, lib. iii., cap. 13.

and the first Ferleighinn, or Lector, at 894, with succession under the latter title, down to the time of the Invasion.

During this long period there subsisted in Armagh a series of learned men, whose honour, as well as monastic service, was to multiply books, and supply the literary requirements of a studious community. Accordingly, it is recorded at the year 724,[1] that "St. Colman hUamach[2] ('of the cave,' probably a recluse), Scribe of Armagh, died."[1] Again, at 731, that "Ferdomhnach, Scribe of Armagh, died."[3] At 807, that "Torbach, son of Gorman, Scribe, Lector, and Abbot of Armagh—observe the order of his offices—died."[4] Next comes the compiler and writer of the book which I hold in my hand, with his very autograph, so varied in its contents, and so exquisite in its execution, consisting originally of 221 vellum leaves, or 442 pages, now less the first leaf, and four leaves in another part of the volume, all written in double columns. The loss of the first leaf is to some extent compensated for by the recent discovery of its contents in a foreign manuscript;[5] and the other deficiency is the four leaves in the Gospel according to St. Matthew, containing the matter between the word *ad-or-a-verunt*, in chap. xiv., ver. 33, and the words *quod dictum est per Essaiam profetam*, in chap. xxi., ver. 4, that is, according to the modern numbering of the folios, between 41 *b* and 45 *a*, the two insets of *quaternio* ii. These leaves were wanting before the manuscript passed from the hereditary keeper, for there is a memorandum in a small hand of the sixteenth century on the upper margin of folio 45, *hic multa desunt;* and Edward Lhwyd, writing, about the year 1707, observes: "Nota quod in Evangelio secundum Matthæum desiderantur quatuor (ut ego existimo) folia, videlicet a versu tricesimo tertio capituli decimi quarti usque ad versum quintum capituli vicesimi primi,"[6] There is no other chasm, and the volume is otherwise as complete as it was the first day.

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[1] *An. Ult.*, 724 (p. 177, ed. Hennessy); *F. Mast.*, 720 (vol. i., p. 318, ed. O'Donov.).

[2] The Irish name of Cloyne is Cluain uamha, which has led to some confusion. See *Mart. Doneg.*, at Nov. 24 (p. 317).

[3] *An. Ult.*, 731 (p. 186); *F. Mast.*, 726 (vol. i., p. 324).

[4] *An. Ult.* 807 (p. 292); *F. Mast.*, 807 (vol. i., p. 420).

[5] Preserved at Brussels, formerly at Wurtzburg. The supplemental portion is printed in pp. 20–24 of the *Vita S. Patricii*, edited with great learning and skill by the Rev. Edmund Hogan for the Analecta Bollandiana, and in a separate form, Bruxelles, 1882.

[6] O'Conor, *Rer. Hib. SS.*, tom. i.; *Epist. Nuncup.*, p. lvii.

The writer, Ferdomnach, who subscribed his name at the ends of certain portions, in the form *Pro Ferdomnacho ores*,[1] four times in different stages of his work, is thus noticed in the *Annals of Ulster*, at the year 845: "Ferdomnach, sapiens et scriba optimus Airdd Machae" [dormivit];[2] thus rendered into Irish by the Four Masters, at the year 844: "Ƿeaꞃꝺoṁnach, eaᵹnaıḋ ⁊ ꞅcꞃıḃnıḋ ꞇoᵹaıḋe Aꞃꝺa Macha, ꝺécc"[3] Never was there a truer or more modest encomium. To us it appears faint praise when we examine his handiwork, though it be but a solitary example of his skill, which, no doubt, was exercised in many such performances that have disappeared.

The Academy is so fortunate as to possess, in its printed *Proceedings*,[4] the substance of a most able Paper on the date of this manuscript, which was read at the Stated Meeting, November 30th, 1846, being the result of a very careful examination which was undertaken by the Rev. Charles Graves, now Lord Bishop of Limerick. Soon after the manuscript was deposited in the Academy by the then owner, at the instance of our fellow Academician, Arthur R. Nugent, of Portaferry, Esq., who became a Member in January, 1846;[5] and, at a general meeting of the Academy that year, the President announced that the Rev. Francis Brownlow had deposited this ancient MS. in their Museum, with the understanding that it should be taken due care of, and returned to the owner on demand.[6] This well-timed loan soon brought forth the richest fruit; and the Rev. Charles Graves, with that critical acumen, and that exactness of judgment, which have always characterized his investigations, produced one of the most elegant and recondite demonstrations which the Academy, or any learned society, has on record.[7] His conclusions

[1] Of these subscriptions two are now utterly indiscernible, partly by erasure and partly by the iniquitous use of tincture of galls. Of the two that are discernible, one is perfectly legible to good sight, namely, that on fol. 214 *a a*. The other, at fol. 220 *a b*, is capable of identification.

[2] Ed. Hennessy, p. 350.

[3] Vol. i., p. 470 (ed. O'Don.). Ten ecclesiastics of this name, which signifies *Vir-Dominicus*, are recorded in the *Annals of the Four Masters*, all eminent as abbots, bishops, scribes, or teachers, between the years 726 and 1110.

[4] Vol. iii., pp. 316–324.

[5] He was present also when I received the MS. at the hands of his cousin, Mr. William Brownlow, Nov. 4, 1853.

[6] *Proceedings*, vol. iii., p. 259.

[7] There was a supplementary communication on the subject of this MS. made by him on the 11th of January, 1847. See *Proceedings*, vol. iii., p. 356.

are—that the name of the writer was Ferdomnach, and that he finished the Gospel according to St. Matthew on the 21st of September, 807.[1]

Here, then, you have before you the writing of a choice Irish scribe, 1084 years old, and for the most part as legible as if written yesterday. So much for the *time;* now for the *place.* Armagh, beyond question, and within the rath which enclosed the apex of Drum-sailech, as it was called when clothed with osiers; or Rath-Dairi, when St. Patrick first visited it; or, as in the prehistoric period, Ardmacha, which is of older date than two thousand years, and has, in the slightly modified form of *Armagh*, maintained precedence of its other titles. The exact spot was either within the precincts of the existing cathedral, or, what is more likely, in the very ancient abbey of St. Peter and St. Paul, which, in the twelfth century, was St. Malachi O'Morgair's abode, and occupied the space opposite the Public Library, on which the houses of Mrs. Robinson, Mr. Allen, the Parochial House, and the Rectory, with their appurtenances, now stand, within the bounds of two acres.[2]

The received date of St. Patrick's death is 492,[3] that is, about three centuries before the book was written. Now, there is in an early part of the volume a composition commonly known as St. Patrick's *Confession.* It occupies the three folios numbered 22 *a* to end of 24 *b.* At the end of it is a very interesting colophon, in these words: *Huc usque uolumen quod patricius manu conscripsit sua. Septimadecima martii die translatus est Patricius ad caelos.* In the course of it are some obscure passages, opposite to which the scribe has noted in the margin, *incertus liber hic,*[4] evidently referring to certain defects in his exemplar, which he declares to have been the Saint's autograph, probably caused by injuries which the document before him had sustained in the lapse of time. There was, therefore, no attempt upon the copyist's part to antedate his own writing, or even to suggest the idea that his copy was an original. But after his generation had

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[1] Fol. 52 *b*, where the scribe writes in small uncial Greek letters:—

ΕΧΠΛΙΚΙΤ · ΑΕΥΑΝΓΥΕΛΙΩΜ · ΚΑΤΑ · ΜΑΤΤΗΥΜ · ΣΚΡΙΠΤΥΜ · ΑΤΚΥΕ ΦΙΝΙΤΥΜ · ΙΝ ΦΗΡΙΑ · ΜΑΤΤΗΙ.

[2] See on this subject Reeves' *Ancient Churches of Armagh*, p. 28 (Lusk, 1860)

[3] Anno Domini cccexci. "Dicunt Scoiti hic Patricium archiepiscopum defunctum"—*An. Ult.* (p. 30).

[4] This note occurs twice, beside which there are eight places, opposite which is set in the margin the *Zeta* of inquiry.

passed away, and the real history of the work had been forgotten, the notion certainly existed, and was encouraged, that the book itself was written by St. Patrick's own hand; and thus it came to be generally known as the *Canon Phadraig*, or "Patrick's Testament."[1] At first it was naturally regarded in the Church of Armagh, for whose use it was prepared, merely as a recent, yet beautiful, transcript of early documents; but in process of time, when the period of discrimination was past, and the public mind was ready to receive an exaggerated story of its antiquity and authority, it was passed off as the Saint's autograph, especially with the seeming aid of the colophon which has been just mentioned; and then, with a view to silence adverse testimony, it was resolved to obliterate the signatures of the actual scribe by erasion, which was all but successful, so that only two of the four appeals—*Pro Ferdomnacho ores*—can be, on close inspection, recognized. In every case it was plainly the object of some interested person to increase veneration at the cost of historic verity. And, no doubt, the book did rise so much in estimation, that in 937, as we are informed by the Four Masters—"Canoin Phadraig was covered by Donnchadh, son of Flann, king of Ireland."[2] Possibly there may be reference to the remarkable leather satchel which accompanies the book still, and which bears the marks of great antiquity. But I am satisfied that this is not the object intended, as its dimensions are not adapted to the shape of the book, and it is not a *cumhdach* in the true sense of the word.

In the year 1004 it was in such high esteem at Armagh, that it was employed as the fittest receptacle for the record of King Brian Boru's donation to the See. He was the first sovereign of Ireland who was not of the stock of the North, and, at the age of seventy-six, became king in 1002.

In the year 1004 he made a royal progress through Ireland, receiving the submission of the people as he went along, and having arrived at Armagh, he remained in that town for a week, during the

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[1] Among the many uses of the word *Canon*, the Irish occasionally employed it in the sense "Testament." Thus, in the *Life of St. Cainnech of the Cod. Salmanticensis* (first printed by the late Marquis of Ormonde), cap. iv. (p. 4)—"Post hoc cum S. Kannechus apud istum magistrum *utramque canonem legisset* et ecclesiasticas regulas didicisset," &c. Also printed in the Marquis of Bute's magnificent *Actt. Sanctor. Hiberniæ*, cap. 6, col. 364.

[1] *An.*, 917 (vol. i., p. 638, ed. O'Don.). The expression is: Canoin Pattraicc do ċumdaċ lá Donnchadh mac Floinn, rí Ereann.—Donnchadh, son of Flann Sinna, son of Maelsechlann, adopted the patronymic *O'Maelsechlainn*.

course of which he presented twenty ounces weight of gold as an offering, on St. Patrick's altar.[1] On this occasion it probably was that he formally ratified to the Church of Armagh its ancient privileges, as expressed in the brief entry which appears in our MS., on the verso of folio 16, and in a hand which, though evidently ancient, is much later and less elegant than that in which the substance of the volume is written. It is in these words: *Sanctus Patrius iens ad cælum mandavit totum fructum laboris sui tam babtismi tam causarum quam elemoisinarum deferendum esse apostolicæ urbi quæ scotice nominatur ardd macha. Sic reperi in bebliothics scotorum ego scripsi id est caluus perennis*[2] *in conspectu Briain imperatoris scotorum et quod scripsi finituit pro omnibus regibus maceriæ*—"St. Patrick, when going to heaven, decreed that the entire fruit of his labour, as well of baptism and causes, as of alms, should be rendered to the apostolic city, which in the Scotic tongue is called Arddmacha. Thus I found it in the records[3] of the Scots. This I have written, namely, *Calvus Perennis*, in the presence of Brian, supreme ruler of the Scots, and what I have written he decreed for all the kings of *Maceria*."

In this curious record, which confirmed to Armagh the ecclesiastical supremacy of Ireland, there is a total absence of the legal formalities which afterwards came in with the Anglo-Norman

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[1] *An. Ult.*, 1004 (p. 514); *An. F. Mast.*, 1004 (vol. i., p. 752).

[2] *Calvus* = mael, "bald," and putam, "everlasting." See Dr. Atkinson's *Three Shafts*, Vocabulary, p. 438; and his Glossary to the Homilies from the *Leabhar Breac*, p. 889, where there are abundant references. In the *Book of Armagh* we have *Calvus*, a man's name, for Mael (fols. 11 *b a*, 12 *b a*), and *Totus Calvus*, for Tocmael (fol. 13 *b b*); so also, "huc usque *Calvus Patricii* (for Mael-Patraic) depinxit," in the *St. Gall Priscian*, upper marg., p. 157.

[3] *Bebliothicis.* The primary import of βιβλιοθήκη and *bibliotheca* is, a depository for books; and (2) the books so deposited; (3) a collection of books put together in a volume; hence St. Jerome's *bibliotheca* as equivalent to *Biblia sacra.* In this limitation the Irish would style the *Book of Ballymote* or the *Book of Lecan* a *bibliotheca.* We also find the term used to denote the *case* of a single volume; but here it seems to have a general acceptation of libraries or their contents. Alcuin says:—

"Nomine Pandecten proprio vocitare memento
Hoc corpus sacrum, Lector, in ore tuo.
Quid nunc a multis constet Bibliotheca dicta:
Nomine non proprio, ut lingua pelasga docet."
Opp., tom. ii., pt. i. p. 203 (ed. 1777).

On the word, see Reeves' *Adamnan*, pp. 359, 360; his *Memoir of Armagh Library*, p. 5, and above all the *Benedictine Du Cange*, *in voce.*

settlement; and it is quite in keeping with the style of the Celtic memoranda which are preserved in a few ancient Irish MSS. elsewhere.[1] *Calvus Perennis* is the literal equivalent for the Irish name, *Maelsuthain.*[2] The individual who wrote this was the *anmchara* ("soul friend"), or Confessor, of the King, and, as was natural, accompanied him in his expeditions. His death is recorded at the year 1031; thus entered by the Four Masters in their *Annals:* "Maelsuthain, anmchara of Brian, son of Kennedy, departed life."[3] The name was of repute in Kerry; and we accordingly find it in the *Annals of Inisfallen* at 992 and 1014; also in the *Four Masters* at 1009 and 1014. In like manner, *Maceria* is the Latin equivalent for Caiseal (Cashel),[4] of which the sovereigns of Leth Mogha were high kings, on this occasion represented by Brian in his own name and that of his successors. *Maceria,* in the sense of "a stone wall," is still preserved in the Campagna, in the form *masseria,* denoting a fortified farm-house. Archbishop Ussher has printed this document in his *Discourse of the Religion Anciently Professed by the Irish,*[5] but omitting the last clause, possibly through doubt regarding *finituit* and *maceriæ.* Sir William Betham was more adventurous in his translation:—"And what I wrote he confirmed for all kings, with his seal of wax,"[6] as if in the original the last word was *forma ceriæ;*

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[1] As the *Book of Kells* in Meath, the *Book of Mac Durnan* in Canterbury, the *Book of Chad* in Lichfield, the *Book of Llandaff* in Wales, and the *Book of Deer* in Scotland.

[2] This is a rare name; however, we find it in *Annal. Ult.,* 1009—Maelsuċain Ua Cerbaill (where see Hennessy's note, p. 522), upon which the F. Mast. enlarge at *An.* 1009, vol. ii., p. 760). The *An. Inisf.,* at 992, which tallies with 1009 of the *F. Mast.,* have: Maelsaċain hua Cerbail arḋrui na hErenḋ quieuit in Christo in Achuḋ ḋec; where there are probably two errors of O'Conor, one for Maelsucain, and the other for Achaḋḋeo, or Aghadoe (*Rer. Hib. SS.,* tom. ii., pt. 2, p. 52). O'Curry has confounded this lord with our ecclesiastic of later date; but he has added another notice of the name in what follows. (*MS. Materials,* pp. 76–79.)

[3] Vol. ii., p. 822 (ed. O'Don.). The corresponding entry in the *An. Inisf.* is at their year 1014—Maelsuthain sruith senoir hErenḋ quieuit in Christo (*Rer. Hib. SS.,* ii., pt. 2, p. 61).

[4] Caiseal, cognate to *Castellum* and its derivative *Castle.* Lhuyd gives *Caiseal* for *murus.* Caislen is a later form. On the identification of *Caisel* for *Maceria,* see O'Curry's *Lectures on MS. Mat.,* p. 654.

[5] Chap. vii., p. 75 (Lond., 1631); Wks., vol. iv., p. 318. In both, the word *deferendum* is read *deserendum.*

[6] *Irish Antiquarian Researches,* p. 394.

but further on he proposes the reading, *pro omnibus regibus Mac Eriæ.*"[1]

Brian fell at Clontarf in 1014; but the royal sanction which he gave to the claims of Armagh, no doubt, conferred additional importance on this See, and greatly enhanced the value and reverence of the book which was the depository of its record.

In 1134 Niall, son of Aedh, the hereditary coarb of St. Patrick, was compelled by Malachi O'Morgair to retire from Armagh; and the flight is thus described by St. Bernard in his eloge of Malachi: "Porro Nigellus[2] videns sibi imminere fugam, tulit secum insignia quædam Sedis illius, textum scilicet Evangeliorum, qui fuit beati Patricii, baculumque auro tectum, et gemmis pretiosissimis adornatum, quem nominant baculum Jesu,[3] eo quod ipse Dominus (ut fert opinio) eum suis manibus tenuerit, atque formaverit. Et hæc summæ dignitatis et venerationis in gente illa. Nempe notissima sunt celeberrimaque in populis, atque in ea reverentia apud omnes, ut qui illa habere visus fuerit, ipsum habeat episcopum populus stultus et insipiens."[4] In virtue of these two objects, which were practically regarded as the title-deeds of the Primacy, coupled with his ecclesiastical descent, Niall (or Nigellus) was enabled, after two years exclusion, to return to Armagh, and resume his official position.

It was customary, also, as has been the case with other reliquaries down to much later times, to administer oaths on very solemn occasions upon this book, and the person thus sworn was regarded as taking an obligation of an awfully binding nature. He who under the circumstances forswore himself, or afterwards broke a promise ratified upon it, was said "to violate the Canon of Patrick." Of this we have an instance in the *Annals*, at 1179, where the Four Masters relate that "O'Rogan, Lord of Iveagh, died of three nights'

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[1] *Irish Antiquarian Researches*, Appendix., p. xxxviii., where he adds the note: "This passage is in a more modern character than the text of the MS. The last two words I thought at first were *forma Ceriæ*; but, by means of a magnifying glass, I now have no doubt but that the above is correct."

[2] This is St. Bernard's Latin equivalent for *Niall*, in regard to sound rather than sense. He even plays upon the name—"Nigellus quidam, immo vero nigerrimus," tom. i., col. 674.

[3] The baċal Ieṡu had a long history. Its keeper was, in 1135, Flann Ua Sinaiġ, a descendant of Sinach, father of Dubhdalethi, the first of the limited Coarbs (778–793), *a quo* the primatial family of Ui Sionaiġ. See Colgan, *Tr. Thaum.*, p. 263 *a*, and Todd, *Introd. Obits of Christ Church*, pp. viii.–xx.

[4] S. Bernardi, Abbatis *Liber de vita et rebus gestis S. Malachiæ, Hiberniæ Episcopi.*- Opp. ed. J. Mabillon, tom. i., col. 675 (Paris, 1719).

sickness, shortly after he had been expelled for violating the Canoin-Phatruig."[1] In fact the secular arm was authorized to inflict immediate punishment by exile, which the invisible executive followed up by death.

To obtain forcible possession of this book, or to do it material injury, was a venial offence in a stranger, for which reparation could easily be made. In 1177, when John de Courcy took Downpatrick, the Primate fell into his hands, and, with him, this and other sacred reliquaries of his See. The Earl of Ulster, however, soon after, returned St. Patrick's Book to Armagh, where it resumed its customary place of deposit.[2] At the close of the century, we find it again employed to add solemnity to an oath; for, in 1196, Murtough, the son of Murtough O'Loughlin, Lord of Kinel-Owen, was killed by Donough, son of Blosky O'Kane, at the instigation of the Kinel-Owen, who had pledged their loyalty to him before the Three Shrines and the Canoin-Phatruig.[3]

The special custody of the reliquary had probably, before this time, been committed to a responsible officer, in the same manner that the Bell of the Will was consigned to the care of a member of the family of O'Mulchallan,[4] and the Caah of St. Columbkille to the safe keeping of a MacRobhartaigh.[5] In the matter of the Canon-Phadraig the official was probably a member of the primatial family, or one of its collaterals, as the *Maor*, or keeper of the Bachall Isa undoubtedly was, that is, of the Clann Sinaigh.[6] The office was, as regards the *Book of Armagh*, both honourable and lucrative, so that the term *Maor*, that is, the keeper or steward, eventually became a surname, like Stuart in Scotland, where the *Mor-Maor Leamhna*," "High Steward of Lennox," gave name to a family which attained

[1] Thus in the original:—Ua ruaḋaċán Ticcherna ua nEachḋaċ do écc do ġalor tri noiḋċi iar na ionnarbaḋ tré ḟáruccaḋ canóine patraicc dó gan roiṁe.—*An. Chr.* 1179 (vol. iii., p. 48, ed. O'Don.).

[2] *Annals of Inisfallen* (Dublin compilation), cited by O'Donov. on *F. Mast.*, 1177 (vol. iii., p. 31).

[3] The *F. Mast.* say:—Muirċertach mac Muircertaiġ ui Laċlainn tiġearna ċenél eóġain . . . do marḃaḋ lá Donnchaḋ mac blosgaiḋ Ui Caṫáin tré comairle ċenel neoġain iar ttaḃairt na tteora scríne, acus ċánóine Patraig ḋóiḃ im dilsi ḋó. (Vol. iii., p. 102, ed. O'Donov.)

[4] The Bell of St. Patrick, in *Trans. R. I. A.*, vol. ., pp. .

[5] Now *Magrorty*. See Reeves' *Adamnan*, p. 319–321.

[6] The *F. Mast.*, at 1135, record:—Fland Ua Sionaiġ, maor baċla Isa, décc iar naiṫriġe toccaiḋe—"Flann Ua Sinaigh, keeper of the Bachall-Isa, died after good penance" (vol. ii., p. 1048, ed. O'Don.).

to royalty. Our keeper, in consideration of the importance of his trust, enjoyed a substantial endowment long before 1375, for in Primate Sweetman's rental of that year,[1] the sum of five shillings appears as the head-rent "out of the land of the *Baiulator Canonis.*"[2] Of this holding I shall presently speak, but in reference to the office of Bearer, I may here observe that the leather satchel of the MS. had straps attached to the upper corners, so that it could be slung from the shoulders, and, with safety and convenience, be carried in processions and journeys, or even on military occasions, as the Cathach[3] of St. Columbkille certainly was, with the same intent as the Ark of the Hebrews was borne against the Philistines.

Of the family name Mac Moyre—Mac Maer—"Son of Keeper," the earliest instance which I have met with is in the same Primate's Register, at May 26th, 1367, where Thomas Mac Moer is stated to owe him the sum of four shillings, probably a year's rent of his holding under the See of Armagh.[4] In the following century the tenant was reduced to great straits by the usurpations of the O'Neill family in the territory of the Fews, where the Keeper's lands were situate. On the 21st of August, 1427, Primate Swayne granted an indulgence of 40 days to all and singular who should contribute out of their substance to the relief of Moyre-Nakanany, that is *Maor-na-Canoine*, "Steward of the Canon," of the diocese of Armagh, who had been impoverished by depredations that had been made at royal instigation.[5] But Primate May was obliged, not long after, to check the presumption of this official, or his successor, when, in 1455, he, in conjunction with the keeper of St. Patrick's Bell, laid claim to the firstlings of sheep throughout the diocese, and drew down a strict prohibition against paying the exaction to any unauthorized persons, and especially the *Bajulator Canonis* and the *Custos Campanæ.*[6]

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[1] Regist. Sweteman, fol. 31 *a*.

[2] The dictionaries give *Bajulator* with the *u* short; but the Greek word βαΐουλος, = Bajulus, makes it long. See Vet. Schol. on Sophocles, *Ajax*, 549 (vol. iii., p. 41, ed. Brunck, Lond. 1819). This is the origin of the form *Ballivus*, our "Bailiff."

[3] The word Cathach is rendered *prœliator*, or, if the term be admissible, *prœliosus*, with special reference to its *military* purposes. The Primate also had his *Bajulator Crucis*, and the controversy between the Archbishops of Armagh and Dublin was *de bajulatione Crucis*. Reg. Sweteman, fol. 1 *a* and *b*.

[4] Regist. Sweteman, fol. 45 *b*.

[5] The entry is headed *Ballivus Canonis S. Patricii*, Reg. Swayne, Lib. iii., schedule between fols. 80 and 81, *dors.*

[6] Reg. Mey, Lib. iv., fol. 45 *b*.

Whether there was a temporary withdrawal of the Canon from Mac Moyre, or that O'Mulmoid was the *hereditary*, as Mac Moyre was the *official*, name of the family, cannot now be decided; but certain it is that, on the 16th of July, 1484, Mauricius O'Mulmoid, *Bajulator Canonis*, and Petrus O'Mulmoid,[1] *Prior Colideorum*, were witnesses to the oath of fealty which was taken by the Primate's suffragan Meanma,[2] or Menelaus, Mac Carmacain, Bishop of Raphoe.

The next notice of the family that I meet with is the Armagh Inquisition of August 12th, 1609, in which it was found that "the sept of Clann M^c^Moyre and their auncestors, tyme out of mynde, were, and yet are, possessed of the eight townes of land followinge: viz.: Carrilake, Lakanelurganagh, Mullaghin, Drinoolagh, Antaly, Cavannykillye, Lissnamackave, and Aghencorke, with the appurtenances, in the barony of the Fuighes, and held the same of the lord archbusshopp of Ardmagh, by the yerely rent of a marke, Irishe, out of everie of the said townes, amounting in the whole to foure pounds, per an.; but the said jurors do not finde that the said eight townes were att any tyme heretofore in the possession of the lord archbusshopp of Armagh or any of his predecessors."[3] There was also a house in Armagh, which was held under the Abbot of St. Peter's and St. Paul's, called "the serjeant[4] of Ballymoyrie's tenement,"[5] which passed, together with the other possessions of the abbey, to Lord Caulfeild, whose tenant in the premises in the year 1663 was one Art Mac Moyer.[6] The same jury also found "that the sept of the

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1 The family of O'Maelmhuaidh, now O'Molloy, were the chiefs of Feara Ceall, the territory in King's County now represented by the baronies of Ballycowan, Ballyboy, and Eglish.

2 This is a rare name, and there is but one instance of it in the *F. Mast.*, namely, at 1014 (vol. ii., p. 782, ed. O'Don.). Like most other Latinized Irish names, sound, not sense, is the rule of adaptation. Regist. Octaviani, fol. 268 *a*.

3 *Inquis. Ulton.*, Append. i. (p. 5 *b*).

4 This term, "serjeant," for *Maer*, is occasionally employed in records of the 16th and 17th centuries. Thus, at 1587:—"There is a great deal of land pertaining to Armagh, M'Kevan's Land [elsewhere called Bally M'Coan]; the Sargeon's Land; and the mountain between the Fews and the Sargeon's town." *Cal. St. Papers (Ireland)*, vol. ii., p. 337. Again, Aug. 3, 1605:—"The Sergeantes towne, being 8 townes."—Act of Division of Co. Armagh into Baronies, *MS. Armagh*. In 1610, Sergeants-towne.—Speed's Map of Ulster. So, also, in Jannson, *Nouvel Atlas*, tom. iv. (Amst., 1647), map of Ireland (between pp. 29 and 30); map of Ultonia (between pp. 41 and 42). Blaeu, *Atlas*, pt. v., map of Ireland (between pp. 1 and 2); map of Ultonia (between pp. 31 and 32), (Amst., 1654).

5 *Inquis. Ulton.*, *Armagh*, No. 4, Jac. i.

6 *Inquis. Ulton.*, *Armagh*, No 20, Car. ii.

Moyeres,[1] and their auncestors, tyme out of mynde, have been seised of and in Tirahoohill, Feran O'Cagane, Agholiosheane, Liosconalia, Feran Icayneghan, Tolliasna, Ferran M^canabbeletta, Aneighriawry, Aghonaclia, Ade-lloy, and Moylemolgadden, conteyninge one towne, paying thereout yerely to the lord archbushopp of Armagh, for the tyme being, fifteene shillings and nyne pence."[2]

The eight towns of Ballymyre, in the Barony of Upper Fews,[3] now known as Aghincurk, Ballintate, Ballintemple, Cavanakill, Corlat, Knockavannon, Lurgana, and Outleckan, containing 7381 acres, estimated in the Poor Law Valuation at £3490 a-year, constitute a parish in the county and union of Armagh. In the reign of James I., before 1622, through Primate Hampton's surrender and release, the tenantry, under the See, of these lands had passed out of the Mac Moyer family, and George Fayrefax, Esq.,[4] became, at a reserved rent of £114 6*s*. 8*d*., tenant of them and of Bally M'Coan, sixteen townlands in all.[5]

We now leave the keeper for a little, and return to the Book. The famous Doctor James Ussher was raised to the Primacy in 1625, and in 1639 published his celebrated *Primordia*. In the interval, and even previously to 1613, while his uncle Henry was Archbishop of Armagh, he had ample opportunities of becoming acquainted with this ancient monument of the Irish Church, the sole survivor of a once numerous family of native copies of the Canon of the New Testament; not that he was ever possessed of it, or could do more than take extracts from it, because it then had become, like the Bell, the private property of the Keeper's family, who seem to have clung to it with religious tenacity, even in the days of decadence and predial dispossession; or surely it would, like many other literary treasures, have found its way into the Primate's noble and absorbing library. But he had free access to it, and this indulgence argued a liberal and forgiving temper in the proprietor, who had been turned out of his lands, and was now reduced in condition and estate. The Archbishop refers to it in his *Religion of the Ancient Irish*, published in 1631, under the title of "Ancient MS. of the Church of Armagh;" and in

[1] These Moyers may represent the family of some other *Maer*, such as the *Maer na bachla*, or one of the Maers who were managers for the Abbey or See in their dependencies.

[2] *Inquis. Ulton.*, Append. i. (p. 4 *a*).

[3] Ordnance Survey, Armagh, sheets 21 and 25.

[4] He seems to have been brought from Devonshire by Sir Thomas Ridgeway.

[5] Primate Hampton's Returns, in the *Regal Visitation Book of Ulster*, 1622.

his *Primordia*, some twenty times, being the source whence he drew, through Tirechan and Muirchu, the earliest portions of his Irish materials. And it is to be regretted that he has failed to record the history and fortunes of the book, for he could have transmitted to us many curious traditions concerning it, which are now irrecoverably lost.

Sir James Ware was more communicative. In 1656 he published his small octavo of 156 pages, entitled *Opuscula S. Patricii*,[1] of which the first in order is the *Confessio*, and for it he collated our MS., which he calls by the same name as Ussher, and thus describes: "Codex Ecclesiæ Armachanæ suprà memoratus continet, præter Confessionem S. *Patricii*, Biblia sacra à versione D. Hieronymi, & antiquissimum exemplar Sulpitii Severi, de vita S. Martini Episcopi Turonensis, tantóque olim habebatur in pretio, ut familia Mac-Moyeriana tenuerit terras a sede Armachana, ob salvam illius codicis custodiam. Magnam hanc libro venerationem præcipuè conciliavit vulgaris opinio manu ipsius Sancti *Patricii* illum fuisse exaratum. Et certè ad calcem Confessionis ejus, hæc verba leguntur: *Huc usque volumen quod Patricius manu conscripsit suâ.* Deinde; *Septimâ decimâ* Martii *die translatus est* Patricius *ad Cœlos.* Ex characteris tamen genere, satis liquet non autographum esse, sed longè posteriori ævo transcriptum."[2] At the date above mentioned the MS. was probably in the possession of its last hereditary Keeper; for in a blank page on the verso of the 104th leaf there is the autograph memorandum, "Liber Flarentini Miure, June 29th, 1662," and, which is doubly valuable in that it identifies the book as the veritable *Canon Phadruig*, ere it passed into strange hands, where its ancient veneration soon died away. From a letter of the date 1681, lately brought to light, we learn that Florence Mac Moir was a layman, and his calling that of schoolmaster.[3] And it is a curious coincidence, that, at a later

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[1] "S. Patricio, Qui Hibernos ad fidem Christi convertit, adscripta Opuscula" (Lond., 1656).

[2] *Ibid.*, note, p. 94.

[3] Moliti sunt sacrilegum illud parricidium Franciscani duo MacMoyer et Duffy apostatæ scelestissimi, adjunctis sibi Mac Lane parocho quodam et quatuor secularibus, quorum duo sunt ex familia O'Nellorum, tertius ludi magister quidam Florentinus MacMoyer, Franciscani consanguineus, quartus ex familia Hanlonorum, et hi omnes iniquitate insignissimi."—Letter of Dr. James Cusack, Bishop of Meath, in Dr. Moran's *Memoirs of M. R. Oliver Plunket* (Dublin, 1861), p. 307. Lord Massereene, in a letter, calls our keeper Florence Wyer.—*Ib.*, p. 310. See particularly p. 317. Archbishop Plunket styled Florence Mac Moyer and his three lay comrades "open perjurers."—*Ib.*, p. 361.

date, Henry Mulholland, the last hereditary keeper of St. Patrick's Bell—on whose death it passed to his former pupil, Mr. Adam M'Clean—was also the childless teacher of a country school.

The witnesses against Archbishop Dr. Oliver Plunket, of whom Florence Wyre was the principal one, arrived in London in January, 1681; on the 8th of June the Archbishop was arraigned; and on the 1st of July he was executed. But his accusers were not thereupon discharged, for the titular Archbishop of Cashel, on the 30th of June, 1683, stated, in a letter, "that Friar Mac Moyer and another Moyer, a relation of his, both accusers of the unhappy Primate, continue still in prison, where they suffer great privations, and are almost dead from hunger, finding none who will give them food, so abhorred are they by all."[1] Florence Wyre eventually recovered his liberty, and returned to Ireland, but so impoverished that he was unable to redeem his precious book, and regain possession of it. He died at home, on the 12th of February, 1713, and was buried in Ballymyre churchyard, as we learn from the rude inscription on a small flag which lay upon his grave, and was annually insulted with marked indignities.[2] Its preservation is due to the late Mr. Synnot, who had it removed to Ballymoyer House, where it is now preserved. In 1707, while Florence was still living, Edward Lhuyd published the first volume of his *Archæologia Britannica*, at the end of which he gives a catalogue of Irish manuscripts, having in No. IV. this entry:[3] "Arthur Brownlow of Lurgan, Clun Brasil,[4] in the County of Down, has the MS. following." He then recites the titles of twelve works, of which the first three are now in my possession. And he adds the names of some "Books mentioned in a letter lately received from Ireland, as MSS. now extant there."[5] Of these the first on the list

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[1] Dr. Moran's *Memoirs of M. R. Oliver Plunket*, p. 306.

[2] The upper portion of the stone is broken straight across. The missing portion probably had the bracketed line—

[HERE LYETH THE]
BODY OF FLORENCE
WYRE WHO DYED
FEB. THE 12 1713

The fracture ran through the name, but left more than the lower half of the capitals.

[3] *Archæologia Britan.*, p. 436, col. 1.

[4] *Clun Brasil*, i.e. Cluain Breasail, the ancient name of the barony O'Neilland East, in the county of Armagh (not *Down*), wherein Lurgan is situated.

[5] *Ibid.*, p. 436, col. 3.

is "Leabhar Arda Macha," his informant being probably his literary correspondent at Lurgan. This prepares us for the following communication, made to the Marquis of Buckingham, by Dr. Charles O'Conor, in the *Epistola Nuncupatoria* of his great work, bearing date the 15th of February, 1813:—"LI. *Liber Ardmachanus.* Sequentia de hoc libro ex doctissimi Humphredi[1] Lhwydi Schedis descripta, perhumaniter ad me transmisit ex Wallia prælaudatus Tuus Nepos Carolus Williams Wynne[2]:—

"Codex hic, ultra omne dubium, perquam antiquus est, sive manu ipsius S. Patricii partim conscriptus (uti habetur ad calcem folii 24 ti,) sive sit, quod mihi verisimilius videtur, alicujus posterioris ævi opus. Et forsan est ille ipse *Textus Evangeliorum*, quem divus Bernardus, in Vita Malachiæ inter insignia Ædis Ardmachanæ numerat, et *Textum ipsius S. Patricii* fuisse narrat. Ab Usserio et Waræo Liber Ardmachanus, ab indigenis vero Liber Canonum S. Patricii nuncupatur, a Canonibus concordantium inter se Evangelistarum, folio 26to incæptis, sic (ut opinor) nominatus. Liber hic ab Hibernigenis magno olim habebatur in pretio, adeo ut familia illa, vulgo vocata *Mac Maor*, Anglice Mac Moyre, nomen suum a custodiendo hoc libro mutuatum habeat; *Maor* enim Hibernice *Custos* est, et *Maor na Ccanon*, sive *Custos Canonum*, tota illa familia communiter appellata fuit; et octo villulas in agro . . . , terras de Balli Moyre dictas, a sede Ardmachana olim tenuit, ob salvam hujus libri custodiam; in quorum manibus, multis jam retro sæculis, liber hic extitit, usque dum Florentinus Mc Moyre in Angliam se contulit, sub anno salutis humanæ 1680, ut testimonium perhiberet, quod vereor non verum, versus Oliverum Plunket Theologiæ Doctorem, et regni hujus, secundum Romanos, Archipræsulem, qui Londini immerito (ut creditur) furca plexus est. Deficientibus autem in Moyro nummis, in decessu suo, Codicem hunc pro quinque libris sterl. ut pignus deposuit. Hinc ad manus Arthuri Brownlowe gratissime pervenit, qui, non sine magno labore, disjuncta tunc folia debito suo ordine struxit, numeros in

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[1] This is a blunder for *Edwardi*, and it has been perpetuated by Betham (1827), Petrie (1845), and others, with whom the name Humphrey Lloyd was academically familiar. Old Humphrey died an exact century before Edward was born, namely, 1570 and 1670.

[2] "Alias inscriptiones Oghamias, saxis sepulchralibus vetustis, in Australi Hibernia, insculptas, notavit Archæologiæ Auctor doctissimus Lhuydus; quarum nonnullas, ex suis Schedis selectas, humaniter more suo communicavit Vester ex Sorore spectatissimus Nepos, *Carolus Williams Wynne.*"—*Epist. Nuncup.*, p. xxxiii.

summo libri posuit folia designantes, aliosque in margine addidit capita distinguentes, eademque folia sic disposita prisco suo velamine (ut jam videre liceat) compingi curavit, et in pristina sua theca[1] conservari fecit, una cum bulla quadam Romani Pontificis cum eodem inventa.[2] Continet in se quædam fragmenta Vitæ S. Patricii a diversis authoribus, iisque plerumque anonymis, conscripta. Continet etiam Confessionem S. Patricii, vel (ut magis proprie dicam) Epistolam suam ad Hibernos, tunc nuperrime ad fidem conversos. Continet etiam Epistolam quam scripsit Divus Hieronymus ad Damasum Papam, per modum Procemii ad Versionem. Continet etiam Canones decem, in quibus ostenduntur Concordantiæ inter se Evangelistarum, ac etiam breves causas, sive interpretationes uniuscujusque seorsim Evangelistæ, necnon Novum Testamentum, juxta versionem (ut opinor) Divi Hieronymi, in quo reperitur Epistola illa ad Laodicenses cujus fit mentio ad Colossenses. In Epistola prima Johannis deest versus ille, *Tres sunt in cælo*, &c. Continet etiam Hebræorum nominum quæ in singulis Evangeliis reperiuntur explicationes, una cum variis variorum argumentis ad singula Evangelia, et ad unamquamque fere Epistolam referentibus. Continet denique Vitam S. Martini Episcopi Turonensis, (avunculi, ut fertur, S. Patricii,) a Sulpitio Severo conscriptam.—Nota quod in Evangelio sec. Matthæum, desiderantur quatuor (ut ego existimo) folia, scilicet a versu tricesimo tertio capitis decimiquarti, usque ad vers. 5, capitis xxi.—Nota etiam quod Epistolæ Apostolorum non sunt eodem ordine dispositæ, quo vulgo apud nos hodierno die reperiuntur."[3]

From the foregoing evidence we learn that the book was pledged in or about the year 1680, and that it was in Mr. Brownlow's possession before 1707. Who was the holder, or what happened in the

[1] This remarkable Case is to be seen in the Library of Trinity College.

[2] This has gone astray. Supposing that as it was a detached instrument, it might have been consigned to the muniment chest, I requested a search among the old family parchments, and received through a friend the following communication:—"Brownlow House, March 4th, 1854. Dear Mr. Oulton, I have not only heard of, but seen, that old manuscript called the *Book of Armagh*, and William Brownlow was most anxious that I should be the purchaser of it. But I declined, having bad taste enough to think that the money asked for it was absurd. I will have a diligent search made in the deed-box for what you want, and have also written to John Hancocke in hopes he may be able to throw some light on the subject. Believe me yours sincerely, Lurgan." The search was carefully made, but the document could not be found.

[3] *Rer. Hib. Script.*, tom. i.; *Epist. Nuncup.*, pp. lvi.–lviii.

meantime, we are not informed, nor is it essential to know. The important fact in its transmission is, that the new owner was in possession of the book at least seven years before the death of the last hereditary keeper. Strange to say, there is not an individual of the name Mac Moyer or Wyre now living in the parish of Ballymyre, nor is either form of name remembered there; but there is an impression that the discredit brought upon the name in the trial of Archbishop Plunket was such that those who bore it adopted in its stead that of *Maguire*, which was akin in sound, though very remote in structure. The local tradition is that Florence and three brothers resided in the glen of the townland Tate, or Ballintate, called, from the occupants, Glen-a-Wyre, and there were lately those living who remembered the remains of his reputed house in this spot. Among the old people of the parish he was supposed to have been Registrar of Armagh, and the belief was that he was annually cursed by the Pope at Rome, as one who was an apostate from the Faith, and a bitter enemy of the Church.

Compared with the present extinction of the name, the Primate's rental stands out in striking contrast, where we find *Pearce M'Imoyre* tenant of the two balliboes of Knockvenan; *Cormac M'Imoyre*, of two balliboes in Cavanakill; *Patrick M'Imoyre*, in Corlett; *Maurice M'Imoyre*, of two sessiaghs in Mullany; *Tioll M'Imoyre*, and *Shane Mac Imoyre*, and *Patrick M'Imoyre*, with his son *Patrick M'Imoyre*, in the balliboe of Ballintemple and sessiagh of Ballyratill. In the rental of 1620, they all disappear, and George Fairfax, agreeably with the plantation system, is presented as sole tenant under the See.

With the eighteenth century the *Book of Armagh* starts in Brownlow keeping, and thenceforward its history is dormant for over a hundred years. The Arthur Brownlow above mentioned was son of Patrick Chamberlain of Nestlerath, in the county of Louth, who married Lettice, only child and heiress of Sir William Brownlow.[1] Sir William died January 20, 1660, having settled the estate upon his daughter for life, with remainder to her son, who was born in 1644,

[1] In 1610 John Brownlowe, Esq., had a grant of a middle proportion in the county Armagh, containing Lurgan; and next month his son William, gent., had a grant of a small proportion adjacent. On the death of the former the son became possessor of both, was knighted, and dying in 1660, the estates passed to his grandson, William Chamberlain, who assumed the name and arms of Brownlow. See *Calend. Pat. R. of Jac.*, i., p. 165*a* and 165*b*; *Ulst. Inq.*, *Armagh*, No. 7 Car. ii.

and died in February 22, 1712. He was Brownlow No. 1 as regards the *Book of Armagh*. His son, William Brownlow, born in December, 1683, married, in 1712, Lady Elizabeth Hamilton, and died in 1739. He was No. 2. His son, the Right Hon. William, born in April, 1726, M.P. for Co. Armagh, died November, 1794. He was No. 3. His son William, born in September, 1755, died without issue in 1815. He was No. 4. The estate then passed to his brother Charles, but not the Book, for it went to his half-brother, the Rev. Francis Brownlow, as residuary legatee. He was born in 1779, and married Lady Catharine Brabazon. He was No. 5. It was in 1815 that it came into his possession, and, not long after, it was lent to Archbishop Magee for examination. From him it was transferred to Sir William Betham,[1] and, after an interval, to Mr. H. J. Monck Mason. While in the hands of Sir William Betham he prepared a copious memoir of it, which occupies the entire second part of his *Irish Antiquarian Researches*, published in 1827, with several excellent fac-similes. Some supplemental matter on the same subject was communicated by him to the *Christian Examiner*,[2] and appeared in that magazine in May, 1836. Previously to 1844 the Book was in the hands of Mr. Monck Mason. It was in 1836 that the MS. was advertised to be sold by auction, but withdrawn. The particulars of its deposit in the Museum of the Royal Irish Academy in 1846 are to be found in the *Proceedings* at that date.[3] The Rev. F. Brownlow died on the 20th of November, 1847, upon which the possession passed to his eldest son, William Brownlow, of Knapton, Esq.,[4] who renewed the deposit, and permitted the Book to accompany the select objects of the Museum which occupied a place in the Dublin Exhibition of 1853, and bore the following label :—" Exhibited by Wm. Brownlow, Esq., Knapton, Abbeyleix.—An ancient Irish Manuscript of the Gospels, a Life of St. Patrick, &c., written in A.D. 807 by a scribe named Ferdomnach. See *Proceedings*, Royal Irish Academy, vol. iii., p. 317, &c., where this date is proposed by

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[1] " I beg leave, in this place, to express my grateful acknowledgments to his Grace the Archbishop of Dublin, through whose kindness and condescension I first became acquainted with the existence of the *Book of Armagh*, and obtained permission to investigate its contents, and lay them before the public."—*Irish Antiq. Researches*, p. *322.

[2] Third series, vol. i., pp. 308–316 (Dublin, 1836).

[3] *Proceedings*, June 8th, 1846, vol. iii., p. 258.

[4] He was the sixth and last possessor in the Brownlow family, and his death took place on the 19th of July, 1881.

Rev. Charles Graves, though Sir William Betham and Mr. Westwood have given the year 699 as its probable date, and attributed the writing of the MS. to Aidus, Bishop of Sletty. (To be sold.)" [1]

On observing the notice of the owner, I wrote to him forthwith to know whether such was his intention, and, if so, what was the price which he had fixed. His reply was as follows :—

"Knapton, Abbeyleix, *August*, 1853.

"Dear Sir,—I have just returned from Sir Charles Coote's, where your letter respecting the *Book of Armagh* was forwarded to me, which will, I hope, account sufficiently for your not having before received a reply. I beg to say that three hundred pounds is the price that I have put upon the *Book of Armagh*, and I have already been offered within £15 or £25 of that sum by Mr. Smith, of the firm of Hodges and Smith, of Grafton-street. As Lord Lurgan, who is the head of my family, has come of age, I wrote to tell him of my intention of selling it, and recommending him not to allow it go out of the family, but he has not said whether or not he intends purchasing it, if the sum I mentioned is offered for it.

"I am, dear Sir, your very obedient Servant,

"William Brownlow."

By return of post I wrote to say that I wished to have the book at the sum he named, and that I would be prepared to meet him for the purpose on whatever day he should appoint for the transfer. To which the following was his reply :—

"Knapton, Abbeyleix, *Tuesday*, *August* 30*th*, 1853.

"Dear Sir,—Your letter of the 27th, informing me of your intention of becoming the purchaser of the *Book of Armagh* for the sum of £300, reached me this morning. As it is leaving our family, I am delighted at its having fallen into such good hands. As you appear to have no decided objection to its remaining in the Exhibition for some time longer, I would prefer you doing so, as I fear that, having consented to its being exhibited, my taking it away might be thought illiberal; of course I shall not expect you to pay for the Book until it is delivered to you, or any person you may appoint to receive it. I may as well mention that I leave this to-morrow, and shall be at 29, Merrion-square, South, for about five or six days, in case you might happen to be in town. I shall be happy to see you.

"Yours truly,

"William Brownlow.

"Rev. William Reeves, Parsonage, Ballymena."

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[1] The label is preserved by me.

In reply to a letter of mine making further inquiry I received this reply:—

"KNAPTON, *October* 16*th*.

"MY DEAR SIR,—Your letter followed me from this to Kingstown, and has come back again, besides being late on the day you posted it, which will account for your not hearing from me before. I go to Kingstown to-morrow, and will communicate with Mr. Clibborn about the *Book of Armagh*, and let you know on what day I can take the Book from the Exhibition.

"I am, in great haste, yours truly,

"WILLIAM BROWNLOW."

The next communication that came to me was in these terms:—

"11, ADELAIDE-STREET, KINGSTOWN, *Saturday, October* 28*th*, 1853.

"MY DEAR SIR,—I have this moment received your letter of the 26th. I really thought that I had written to you on that day to say that Mr. Clibborn had told me that any day after Tuesday next that you might appoint we might have the Book. Pray excuse this seeming negligence; but having been so busied for the last ten days with doctors, I concluded I could not have written as I intended.

"I am, dear Sir, yours truly,

"WILLIAM BROWNLOW.

"REV. WM. REEVES, Ballymena."

Accordingly it was settled that we should meet at the Academy that day week, which we in due time did, and the exchange for which I earnestly longed was in a very few minutes effected, and thus recorded:—

"Received from the REV. WILLIAM REEVES, D.D., the sum of Three Hundred Pounds, sterling, being the amount payable to me for the Manuscript commonly called the *Book of Armagh*, according to the agreement made between him and me.

"Dated this 4th day of November, 1853.

"WILLIAM BROWNLOW."

Shortly before the consummation of this treaty I received the following letter from a very earnest friend, as follows:—

"T. C. D., *October* 18*th*, 1853.

"MY DEAR REEVES,—I am delighted to hear that the *Book of Armagh* has fallen into such good hands; but is it possible that you have paid £300 for it out of your own means, and are you justified in so doing? I think the Primate would have ventured upon £300; but £500 seemed to terrify him. I am in hopes the money came from him, after all, as on reading over your note, I see the wording of it consistent with this supposition. You may depend upon my closeness and fidelity; but the secret is not so much a secret as you imagine, for Clibborn told me to-day—as a piece of news (without my having made any previous allusion to the subject), that George Smith, the bookseller, was greatly annoyed at having lost the *Book of Armagh;* and when I asked him what he meant by losing the Book, his answer was—'Don't you know that Dr. Reeves has bought it for £500?' I took advantage of the inaccuracy of this last statement to say—'I greatly doubt that; where could Dr. Reeves get so much money?' To which Clibborn answered—'Whether he gave so much for it I do not know, but certain it is that he has bought it.' I mention this to show you that the fact is known, lest you should imagine that I had *blabbed* if it came to your ears that Clibborn and Smith knew of it.

"Yours ever,

"J. H. TODD."

The Book continued my own until the 7th of July, 1854, when, at the instance of my good friend, Doctor Todd, I disposed of it to the then Primate at the same sum which I paid, with a view to his presenting it to the Library of Trinity College, as a safer and more accessible depository than that of Armagh. The conditions are stated in former Dublin University *Calendars*, in the list of "Benefactors of Trinity College," as follows:—

"1854, July 7.—His Grace the Most Rev. Lord John George Beresford, D.D., Lord Primate of Ireland, placed in the hands of the Rev. Dr. Todd, for the purchase of the *Book of Armagh* (on the understanding that the Book is to remain in the hands of the Rev. William Reeves, D.D., until he has prepared his copy of it for publication, and that afterwards it shall be deposited in the Library of Trinity College), the sum of . . . . £300 0 0."

At present the MS. is in my keeping, with a view to publication.

I have mentioned in a foregoing part of my statement that the MS. was advertised for sale by auction in 1831, but withdrawn, and that this occurred in the time of its fifth owner, of the second dynasty; and as it was a critical event in the history of the book, I may be excused if I subjoin the particulars of the transaction.

After the publication of Sir William Betham's *Antiquarian Researches* public attention and curiosity were drawn towards the principal features of the Book; and the MS. remained for a while in the hands of Richard Moore Tims, a religious bookseller in Grafton-street; and as arrangements were a-making for the sale of the valuable and extensive library of Mr. Edward Woods, by Mr. Maguire, the auctioneer, of Suffolk-street, the *Book of Armagh* was sent in for sale, and formed the first item in the *manuscript* portion of the catalogue, of which more than three pages were devoted to its description, with the following preamble :—

"It would be quite superfluous to attempt giving a description of this *extraordinary rare* MSS. after the elaborate view taken of its contents, by our talented Countryman, Sir William Betham, who has devoted the entire of the Second Volume of his valuable Work, entitled *Irish Antiquarian Researches*, to a clear, succinct, and detailed history of this precious document. The following extracts may not be deemed unimportant :—"

Then follow the particulars.

On Monday, the 6th of June, 1831, there appeared in *Saunders' News Letter* this note of preparation :—

"The 'Book of Armagh.'—We have been gratified with the sight of this singularly rare manuscript. Public curiosity has been strongly excited by its appearance. Hundreds of visitors have called during the last ten days at Mr. Maguire's salerooms, for the purpose of inspecting the Book, which was held in so much veneration by our ancestors. We understand it will be sold on to-morrow. We trust those more immediately connected with our public institutions will look to it, and not allow so precious a document to quit the country. It appears to be the general feeling that the heads of our University should not allow the Book to pass into other hands, in which opinion we most cordially agree."

On the day following the sale was accordingly opened, and the Book held up to view and competition, as described by the same journal :—

"On Tuesday great curiosity was evinced by the amateurs and literati of this city, with respect to the sale of this valuable and unique MS. Mr. Maguire's salerooms, in Suffolk-street, where it was to be brought to the hammer, were crowded long before the hour appointed, and as the auctioneer proceeded in the sale, according to the numbers of the catalogue, the anxiety increased among all present. At length the expected moment arrived, and the words, 'The Book' passed from lip to lip, as the spectators looked at each other. The auctioneer held it up to public view, saying: 'Gentlemen, now is the critical period!' At four o'clock the bidding commenced. The first offer was £100; this soon raised to guineas; £150, and then £200, were the next biddings. The last was soon transmuted to guineas. On the respective competitors went, through the several gradations of £260, £300,—guineas,—£360, £370, £380, £390. Here the rivalry seemed to have come to a full stop, and in the interval there was complete silence, until a voice in the crowd cried out: 'I will give five shillings for it.' Laughter followed this very spirited bidding. The auctioneer in vain essayed to rouse the lagging purchasers by saying, 'It's a scandal that it should quit the country! rely on it, it will leave the country unless an advance be made.' All would not do; the fatal once, twice, thrice, were put, and the final monosyllable 'gone' followed. All were anxious to hear who is the purchaser of this gem of antiquity, but no one knew. Some kind Asmodeus from the house of Cochran & Co., of London, we understood, have borne it off in triumph from its native shore. We heard but one feeling expressed amongst the *cognoscenti*, that it was a shame to allow it to leave the country. The whole time occupied on the sale was but five minutes, and in this short space of 'a few brief seconds' did this 'chronicle of the olden time' change masters, to be brought in triumph to another land. We noticed in the room the

Bishop of Cork, the Rev. C. Otway, G. Petrie, J. Hardiman, J. Boyd, Esqrs., &c. &c. The competition, we understand, was principally amongst the trade. Grant & Bolton went as far as £380; Messrs. Milliken to £305."[1]

I believe it was bought in for the owner, by the ten pounds bid over the Dame-street firm. At all events it reappeared after some years in the possession of the family, and was for some time in the hands of Mr. H. J. Monck Mason, as I learn from a memorandum in his handwriting, and dated 1844.

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[1] *Saunders' News Letter*, Wednesday, June 8th, 1831.

VIII.

SOME ANCIENT CROSSES AND OTHER ANTIQUITIES OF INISHOWEN, COUNTY DONEGAL. By WILLIAM J. DOHERTY, C.E.

[Read February 9, 1891.]

I.—The Cross of Donagh.

Domnach-mor-muighe-Tachair is the name by which the church of the parish of Donagh, in Inishowen, Co. Donegal, was known to the Irish Annalists. The parish of Donagh is remarkable, therefore, as containing the site of this church, founded by St. Patrick, as well as for being the birthplace of John Colgan, the celebrated Franciscan Friar, author of the *Acta Sanctorum* and *Triadis Thaumaturgæ*, who was born on the lands that formerly belonged to this ancient church.

Some interesting antiquities are to be found about this venerable site. The Commemorative High Cross standing upon a detached portion of the Relig—now separated from the present graveyard by a road—is a conspicuous object.

This cross is different from any of the high crosses which have been described to the Academy, or of which we have any published notice.

Its broader surfaces face east and west. Its dimension is roughly 4 ft. 6 in. from the surface of the ground to a point indented at the centre of the arms, and from which would appear to have been struck the various *radii* used in outlining the form of the cross. From this centre, with a radius of about 1 ft. 10 in., the head and arms of the monument appear to have been projected. All the exterior and interior lines, convex and concave, are of the curved or circular character. Thus the height of the cross is about 6 ft. 6 in. over the ground, by 3 ft. 8 in.

across the arms. It varies in thickness from 7 in. in the stem to 6 in. under the arms, 5½ in. in the arms, and slightly diminishes towards the top. The width of the stem at the ground-line is 21 in., and the width of the top of the cross is 18 in. The whole has been cut out

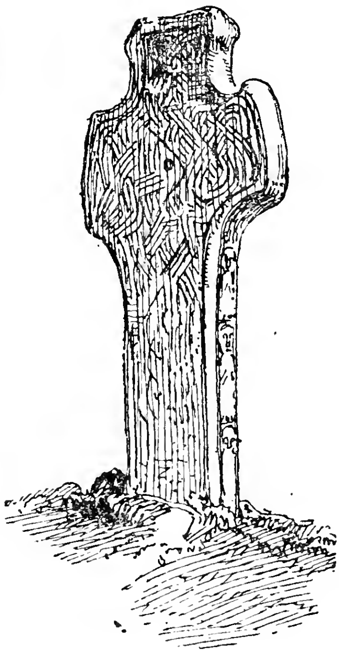

FIG. 1.—THE DONAGH CROSS (WEST SIDE).

of a single stone of hard, laminated sandstone, which, through earth-stresses, has been metamorphosed into a rude quartz-schist. It belongs to the ordinary argillaceous schistose formation found in some of the quarries of the adjacent districts.

Eastern Face.

On the eastern plane, extending half-way up the shaft, is seen the carved outline of a well-defined female face, whilst the projection of the figure towards the ground is draped, with arms extended and slightly raised, evidently intended for a representation of the Virgin. Above the head spring spiral lines of single ribbon interlacings, forming *triquetra* knots that extend upwards over the remaining surface of this face. On each side of the figure to the foot of the cross extend interlacings.

The southern edge of the cross is ornamented with three figures: the first is mitred; the second, like the first, in outline represents a male figure, whilst the third suggests a female. Above appears a rough scroll-work in the form of a serpent. These figures may be intended to represent St. Patrick, St. Columbkille, and St. Bridget.

Western Face.

The western face presents a series of large *triune* interlaced tracery with the central ribbon $1\frac{1}{2}$ in. wide, supported on either side by a ribbon 1 in. wide. The arras of the cross throughout is formed by a bold circular beading about 3 in. in diameter, raised over the surface of the face and edges by about half-an-inch projection.

This ancient cross, not hitherto described, is unique in design, which is of the earliest circular form in its outline and details, and in the marked character of its *triune* ribbon tracery. It is also remarkable on account of the traditional veneration attached to it by the people as mentioned by Colgan.

The figure of the cross will give some notion of its shape; but it was found impossible to fairly interpret the sculpture from the rubbings.

Triune Tracery.

Triplex lines of tracery are of rare occurrence; the only other instance on an Irish cross, known to the author, is that on the "Table Cross of Fahan." On none of the monuments delineated by Miss Stokes from Petrie's collection, are there any *triune* groupings; the interlacings thereon appear in ribbons of either single or double formation. The same remark applies to the decoration of the Celtic crosses of Scotland, as shown in the "Sculptured Stones of Scotland," with only one exception, where the *triune* ribbon appears on the drawing of a cross about whose history nothing seems to be known.[1]

[1] *Sculptured Stones of Scotland*, vol. 2, p. 50, plate XCVII.

Another recorded example, harmonizing with the *triune* tracery of the Inishowen Crosses, appears on a table cross at Margam in Glamorganshire, which bears an inscription in Celtic characters.

An approach to this *Triplex* form in ecclesiastical ornamentation, is to be seen in the *triune* lines, marking several *triquetra* that appear on the boss of an ancient crozier described by Dr. Petrie.[1]

Domnaċ Airgid.

The nearest example—other than the Cross of St. Mura at Fahan —of a *triune* tracery, *i.e.* a narrow band on each side of a broader band, appears in the *runes* of convolving interlaced circles on the second case of the reliquary known as the Domnaċ Airgid. The date of the workmanship on this second case is supposed to lie between the sixth and twelfth centuries.[2]

Dr. Petrie observed that the word Domnaċ, usually applied to a church or a reliquary, is only to be found in the Irish annals during St. Patrick's time, and its application to a reliquary only occurs in the single instance of this gift of the *Domnach* to St. Mac Carthen of Clogher.[3]

We have this curious coincidence, that the Cross of Domnaċ-mor-muighe-Tachair, in the Relig attached to the church founded by St. Patrick, over which the brother of St. Mac Carthen of Clogher ruled, bears the rare and almost similar *triform* interlacings that appear on the Domnaċ Airgid, a reliquary said to have been given by St. Patrick to St. Mac Carthen of Clogher.

II.—The Sancta Maria Bell.

Another object that claims attention in connexion with the site of the Domnaċ-mor of Glenn-Tachair is the bell that now occupies the belfry of the Protestant church of Carndonagh.

It had been traditionally stated that this bell had been in use formerly on the Catholic church previous to the sixteenth century; but no confirmation of the fact could be produced. About a year ago the author, when examining the remains of the sculptured slabs

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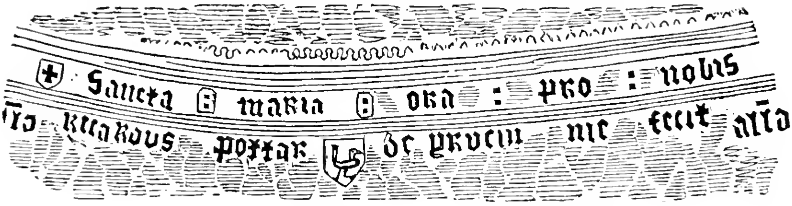
[1] *Ecclesiastical Architecture* (2nd Edition), p. 323, Dublin, 1845.

[2] *Trans. R. I. A.*, vol. xviii., Antiq., pp. 14, 15, 24.

[3] *Ibid.*, pp. 19, 20.

in the churchyard adjoining, suggested to the Rev. Philip O'Doherty, of Carndonagh, the desirability of having the bell examined. This he afterwards had done; and Mr. Robert Moore, Junr., made a complete rubbing of the bell, on which appears the following inscription:—



+ SANCTA : MARIA : ORA : PRO : NOBIS

RECARDUS POTTAR [his Sign or Trade Mark] DE VRUCIN ME FECIT ALLA [*allelujah*].

This legend left no doubt as to the correctness of the tradition; but the questions remained, who was Recardus Pottar, and where was **Vrucin**? If the locality of Recardus Pottar could be found, the date when he cast the bell might be ascertained. The author examined many geographical charts and treatises on geography, ancient and modern, for the word *Vrucin*, but was unable to find it. Believing that *Vrucin* was in the Low Countries, the author sought for information till he found a place called *Vracene*, near Antwerp. Inquiry was made from the *curé* of that commune, in East Flanders; but the *curé* maintained that *Vracene* was never known as *Vrucin*, and that the name Pottar was unknown, although *de Potter* exists there still.

Consequently the date of the bell can at present only be judged from its type and embellishments. It is of the ancient *long-waisted* form.

The question of how it came to find its way to this church in Inishowen arises. The author is of opinion that it may have been on board one of the ships of the Spanish Armada that suffered shipwreck in 1588 within a comparatively few miles of the church of Donagh, where the bell has been discovered. We are told that some vessels of the Armada were fitted out on the Escault, in the vicinity of Vrucin, or *Vracene*, and we are also informed that several articles supposed to be of value were received in Inishowen from the Spaniards who were saved from the wreck of one of their ships driven in at Glanganvey near traiᵹ-breiᵹe.[1]

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[1] *Calendar State Papers* Elizabeth, 1588–1592 (London, 1885).

III.—THE CROSS OF COOLEY (Maġ-bile).

Near the site of the church of Maghbile (Moville) in Bredach Glen, known as the church of Cooley, there is a fine specimen of an ancient monolithic cross. O'Donovan, who visited the place in 1835,

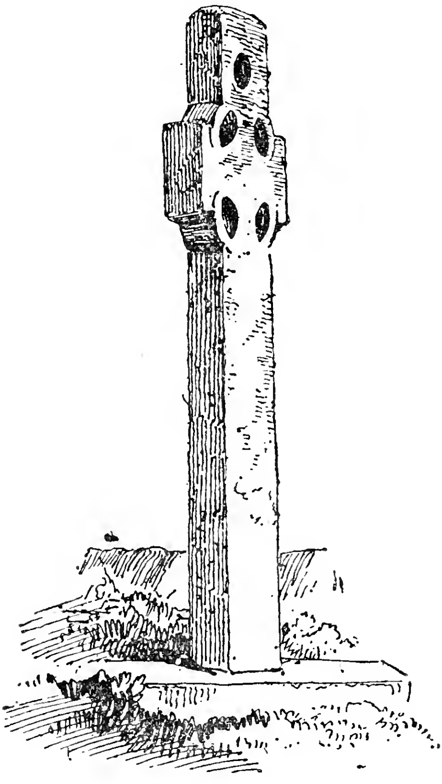

FIG. 2.—THE CROSS OF COOLEY (Maġ-bile).

says: "I saw the old church of Maghbhile, and could not but laugh at the audacity of Lanigan attempting to contradict Colgan, who had often seen the church. It is a very extensive ruin, and an antique cross at the gate, about 8 ft. 6 in. high, as gray as a ghost, and as old as St. Patrick, indicates the great age of the church."[1]

[1] *Ordnance Survey Letters.* O'Donovan, August 17, 1835.

This High Cross of Cooley bears no inscription or decoration, and has four perforations within its circular body, and one perforation in the upper member. The cross faces east and west, has a height of 9 ft. 3 in. over the table slab in which it stands; its width at the arms over all is 31 in., whilst the circular body has a diameter of 22 in. The north of the stem is 15 in., and the arms are also 15 in. deep.

A foot-mark, traditionally ascribed to St. Patrick, is pointed out on the slab in which the cross is fixed.

In the graveyard at Cooley is a small rectangular building, covered with an angular stone roof, after the manner of St. Kevin's "Kitchen" at Glendalough. The building is 8 ft. 6 in. by 6 ft. 6 in., with side walls 2 ft. thick, and about 4 ft. 6 in. high over the present surface. The height to the apex of the roof over the side walls is about 3 ft. 6 in. A lower aperture 15 in. by 12 in. is in the western gable, and a slit-opening 15 in. by 5 in. is placed in the eastern gable at 4 ft. from the ground. It is known now as the "Skull House." This may have been the original oratory.

IV.—Carrowmore Crosses (Both-ċonaır.)

O'Donovan, who visited this place in 1835, speaks of "the beautiful stone crosses on the site of the old church, of which not even the graveyard now remains. Oats grow on the site of the churchyard. The crosses are very conspicuous objects from the road leading from Bunaphobble."

O'Donovan supposed that this was the site of the original parish church of Cooldavagh. But Colgan, who knew the place thoroughly, calls it the monastery of Both-chonais, from which it is probable that the name applied to the Catholic church of the district, Bocan, is derived.

The Rev. William Reeves, in 1853, identified the site of Both-chonais, where, in the townland of Carrowmore, he says he found it "bearing abundant evidence in its crosses and other remains of ancient, though locally forgotten, importance."[1]

The foregoing meagre notice is all that has hitherto appeared on the subject. When in the locality last June, the author, aided by the Rev. Philip O'Doherty and Mr. O'Cannan, made an examination of these crosses, which bear every appearance of being as early, at least, as the tenth century, and may have been erected before that

[1] Reeves' *Columba*, pp. 405, 406.

period. They consist of two high crosses, which are still standing. The first is at the western end of a plateau, on which the outline of a building is clearly traced, and where a portion of the monastery of Both-chonais evidently once stood.

This cross, slightly slanting, is a beautiful stone, standing more than 11 ft. above the ground, 14½ in. wide by 11 in. thick, and has been cut from the laminated sandstone that is to be found at Glengar, in the north-east district of Inishowen. The arms, which extend beyond each side of the stem of the cross 4 in. by 15 in. deep, are placed at about two feet down from the top. This, like the Cooley cross, bears no inscription, and is wholly devoid of any ornamentation or tracery, presenting the outline of a plain cross, as it had been cut out of the quarry.

At this site are the remains of other crosses. On the stem of one which stands 3 ft. high by 2 ft. broad, are carved lines and a circle meridionally divided.

Another high cross, about thirty yards south of the former, stands in the field adjoining. It is also rectangular in form, about 10 ft. high, 2 ft. 5 in. broad at the ground, slightly widening to 2 ft. 8 in. under the arms, which measure 4 ft. 3 in. across, and are 1 ft. 10 in. deep. The thickness of this stone is now 6¾ in.

On the head of the western face is sculptured a radiating glory, with a spray of three rays, giving it the appearance of a triangle. These rays extend to the centre of the arms. This is the only appearance of carving that now exists. The eastern face is plain. In consequence of its exposure to the east, it has suffered from the effects of weathering.

Immediately adjoining the last-described cross, and lying with its surface inclined to the slope of the field, is an irregular-shaped stone, about 5 ft. by 5 ft., on which is carved a small cross, 17 in. by 8½ in., formed by a half-circular sinkage, and a corresponding circular margin, near which is an elliptical sunk water-bowl, used by the peasantry who still frequent the place in making the Turas, or pilgrimage, and out of which they take some portion of the water it may at the time contain.

The cross on this inclined stone is much like those described as found cut on the interiors of caves in Fifeshire.[1]

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[1] *Spalding Club*, vol. 2, pl. xxix. Aberdeen, 1867.

V.—The Cross of St. Buadon of Cluain-Catha (Clonca).

The ruins of a small seventeenth century church, about 48 ft. by 21 ft., known as the Church of Clonca, that occupies an older foundation, lie eastward of Both-chonais, on the road to Culdaff. Outside, west of the boundary wall of the graveyard of this church, are the remains of a High Commemoration Cross, equal in many respects to some of the sculptured crosses described by the late Henry O'Neill.[1]

The portion of the shaft now erect in its original site measures about 10 ft. high by 16 in. by 8½ in. It is divided into panels, and carved with figures representing Scriptural subjects, after the style of the Monasterboice crosses. In the same field is what is stated to be the remaining portion of the cross, consisting of the upper limb, or head of the cross, which gives a further height of about 5 ft. 6 in., or a total height of about 15 ft. 6 in. The appearance of this cross, if restored (as in the figure) would resemble in many respects the model of the restored cross after Henry O'Neill, now in the Museum, Kildare-street. The head of the cross extends over the body by a projection 20 in. wide by 13½ in. high, and 5½ in. thick, so that the sloping sides, beginning at 16 in. wide, taper at the top to 13½ in., whilst the thicknesses of the stem of 8½ in. wide also diminish at the top to 5½ in. The top of the cross extends 2 ft. 9 in. from the centre of the arms. A central small circle, 10 in. in diameter, divides the arms that project 20 in. on each side of the centre, giving an extreme width of 40 in. across the body. The shoulders of the cross are sunken spaces, but not perforated, as in most Irish crosses. The circular rim, or nimbus, is formed by intersecting circles, having a raised boss 7½ in. in diameter in each. A memorial cross of this magnificence is rarely found, and the author regrets that the time at his disposal when visiting the locality of the site would not permit a more careful examination.[2]

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[1] *The Sculptured Crosses of Ancient Ireland.* Henry O'Neill, London, 1857.

[2] Since the above was written the Rev. Philip O'Doherty has kindly sent photographs from which the figures have been copied.

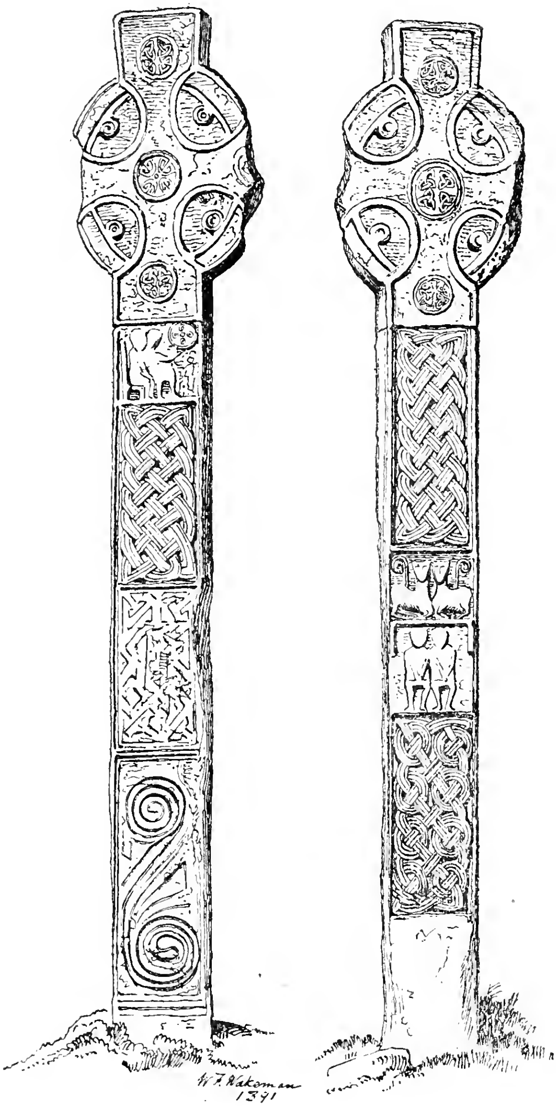

FIG. 3.—THE CROSS OF ST. BUADON OF Cluain-Catha (Clonca).

VI.—An Ancient Monumental Stone.

Within the walls of the old church of Clonca, at the sanctuary end, was discovered the tombstone, of which, through the assistance of Rev. Philip O'Doherty and Mr. Robert Moore, the author is enabled to present to the Academy the rubbing now exhibited.[1]

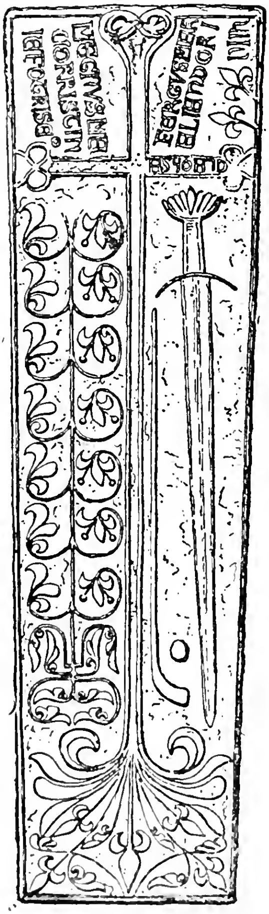

Fig. 4.
An Ancient Stone Monument.

Up to the date of the author's visit local tradition assigned this slab as the property of some local family. This arose from the *caman* that is sculptured thereon being supposed to represent the *caman* and *nagg* by which it was stated a member of this family at Culdaff had been struck with when playing an athletic game, well known throughout other parts of Ireland by the name of "*hurley.*"

The stone is a fine specimen of local limestone, beautifully carved, with a divisional cross, that commences by twined serpents' heads, extending so as to form by graceful curves the terminations of the head and arms of the cross. The foot of the cross ends in various floral embellishments, possibly emblematic.

On the right of the cross is a double-handed sculptured sword, full size, with ornamental pommel and recurved guard. Alongside the sword is the outline of a *caman* and *nagg*, or possibly a representation of the instrument used on the "*links*" in the game of "*goal*," or *golf*. On the left-hand side of the slab is a carved spray of flowers extending over the surface, as a counterpoise to the *caman* and sword.

The inscription, so far as the author has been able to decipher it from the rubbing, on the right, reading from the centre, is—

FERGUS MAEL ALIAN DORISTEN,

[1] The outline here represented is from a drawing of a more recent rubbing taken by Messrs. Moore & O'Cannan.

whilst that on the left, reading towards the centre, appears to be—

MAGNUS MACORRISTIN . IAPOTKISE°.

The letters remaining on the right arm of the divisional cross appears to be ESPOLD, whilst the letters that were formerly on the left arm, if any, seem to have been worn off by age.

The whole carving is in a fine state of preservation, which may be accounted for by its position in the sanctuary of the church. The lettering is of the class found on the sculptured stones on the east coast of Scotland and the Isles.

The author, when first examining the slab, thought it might have been erected in memory of King *Magnus*, slain in Ireland in 1103. It presents a favourable opportunity for the authorities of the Science and Art Museum to have a cast taken for exhibition. It is on the inlet of the sea adjacent, called Traiġ-bréiġe, which formerly was celebrated as a depôt and settlement of Danish colonists who became Hibernicized under the name of *Maelfabhail*, now Anglicized to M'Paul and M'Faal. The author is indebted to Dr. P. W. Joyce for putting him on the way of reading this Irish inscription, and to Dr. George Sigerson for the following, sent to him in a letter :—

"Dr. Joyce was happy in deciphering do rin in, but the rest is not alhoir, as he conjectures. Another inspection of the inscription has shown me the true reading, which is clagh sa. Hence the entire inscription runs thus :—

FERGUS MAC ALIAN DO RIN IN CLAGH SA,

i.e. Fergus Mac Alian made this stone.

"The substitution of A for O in the last two words indicates that Fergus used the Scottish Gaelic. As regards the other (and chief) inscription I must entirely differ. It is, indeed, extremely puzzling as it is given, with the words run together. But I space them as follows :

MAGNUS MAC ORRISTIN IA FO TR̄I SEO.

"The last word but one is contracted, and may thus be lengthened out :—

MAGNUS MAC ORRISTIN IA FO TRIAĊ SEO.

"This, in English, reads :—

Magnus Mac Orristin of the Isles under this mound.

"This gives a good monumental inscription form.

"The isles indicated are those of Scotland held by the Norsemen, from whom the name Magnus came among the Gael. This stone is a double confirmation, supported again by the Scottish form of clagh ra. In addition, allow me to point out that ro and reo are both archaic Gaelic, so that the antiquity of that exquisite and unique monument is placed beyond doubt."

VII.—Rath-Regienden.

At Larach-Irial, the *Rath-Regienden* of Colgan, south from the Catholic church of *Bochan*, at a place known as the Mass Hill, is the remains of a stone circle, elliptical in form, having a diameter of about 66 ft.

This circle formerly consisted of about nineteen stones, of which only ten now remain erect, while another stone lies near where it once stood. The stones are irregular in form, size, and shape, and are of various materials—granite, schist, whinstone, and sandstone. Similar circles were styled Druidical Temples; but since Petrie described the numerous stone circles in Co. Sligo they are generally now spoken of by antiquarians as monumental.

VIII.—Cross at Fahan-Mura.

The ancient table cross of Fahan, mentioned by the author in a former Paper read before the Academy,[1] is worthy of a more extended notice than could be given on that occasion.

The height of the cross over the surface of the ground is 7 ft.; its width 3 ft. 5 in. having a thickness throughout of about 7 in.

Like the high crosses erected elsewhere in Ireland, this cross of Fahan-Mura was doubtless erected to commemorate some distinguished individual. An Irish inscription on the eastern edge exists, but is so worn by age that it is difficult to decipher.

The western face exhibits the sculptured outline of a cross in raised ribbon tracery. The interlacings consist of *triune* ribbons. On both sides of the stem, extending from the surface of the ground for 3 ft. upwards, are the figures of robed ecclesiastics, with faces in profile, turned towards and supporting the stem of the sculptured cross.

The eastern face, also, has a cross, but of a different pattern to that carved on the western face. The head of the cross on this side is

[1] *Proceedings R. I. A.*, 2nd ser., vol. ii., p. 100.

surmounted by a triangular pediment that presents the appearance of the wings of a dove; within the *triune* interlacings are a central boss, with four others in the exterior concaves that form the arms of the cross.

This Table Cross of Fahan is unique in the character of its design and the *triune* form of its tracery. Locally it is said to stand at the head of the burial-place of several bishops, whose names are not remem-

W. E.

FIG. 5.—CROSS AT FAHAN-MURA.

bered. Some other traditions describe it as marking the site of the grave of St. Mura, the founder of the Convent of Fahan.

A marginal heading extends around the edge of the western face, widening out at the apex of the triangle that forms the top of the cross into the flattened form of serpents' heads.

The interlaced design that, by a series of knotted *triquetra* extending into the arms and extremities, forms the carved outlines of the cross, renders it a remarkable specimen among the many recorded examples of crosses of which we have any notice.

IX.—St. Boedan's Bell.

The Bell of St. Boedan, Patron Saint of Culdaff, and who is also known as Daḃaoтóċc, of *Cluain-da-Bhaetog* in Fánaid, in Tireonnell,[1] the author is enabled, through the kindness of Rev. Philip O'Doherty and the owners, to exhibit to the Academy.

The bell has been for many generations in the possession of a family named Duffy[2] of Glack, in the parish of Clonca, in Inishowen. In an Inquisition taken at Lifford, in the reign of James I., this family of Duffy is mentioned as being the Herenaghs of the parish at that date.

Mr. Patrick Doherty, merchant, of Carndonagh, a relative of the Duffy family, obtained the bell, on loan, for the Rev. Philip O'Doherty.

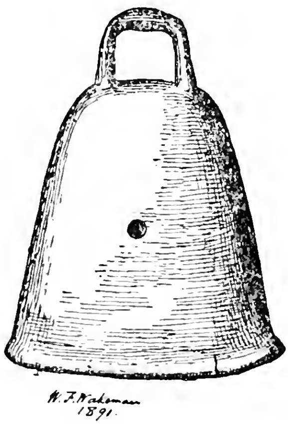

Fig. 6.—St Boedan's Bell.

This bell was exhibited at the meeting of the British Association in Belfast in 1852. Ellacombe, who notices the bell, was unable to give any sketch or particulars.[3]

The Bell of St. Boedan belongs to a class now rare in Ireland. The nearest example in shape, size, and quality of the bronze used in the composition of this bell is that of the Cloᵹ beánnuiᵹċe, or Blessed Bell, called by Dr. Petrie the Bell of Armagh. The inscription in Irish characters on the Armagh bell—i. e. "+ *Pray for Cumascach Son of Ailill*"—helps to determine the date, as the death of that distinguished person is recorded A. D. 904.

The dimensions of the Armagh bell, including the handle, are 11½ in. high by 11 in. by 8 in. at the mouth.

The Bell of St. Boedan, the author believes, belongs to an earlier date than the Armagh bell—to perhaps the transition period, between the early rectangular and the rectangular merging into the circular, or rather elliptical.

This bell is about 11 in. high, including the handle, the latter being 2¼ in. high and 3 in. broad.

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[1] O'Clery's *Calendar*, July 22nd; Reeves' *Columba*, p. 409.

[2] O'Doghie in the Inquisition.

[3] *Church Bells of Devon*, p. 372. Exeter, 1872.

The handle springs from the crown of the bell in two stems of bronze, each half-an-inch in diameter, shaped in the horizontal lifting bar, with a central swelled division to fit the fingers by which the bell was raised.

The mouth of the bell is elliptical, 8¼ in. by 5¼ in.; as against the 11 in. by 8 in., the width of the Armagh bell.

Like this latter, the Culdaff bell has a beaded rim that curves out from the upright on the outside of the mouth. This rim projects about half-an-inch beyond the sides. The shape of this bell, while it retains some of the quadrangular form of the earlier bells, is formed by easy curves. One of the sides is straighter, and the bell is narrower on that side than on the opposite by about 1½ in. This would show that the mould had been irregularly formed, and shaped without accurate measurements. At the top the bell narrows to 3¾ in. by 2 in.

At 4 in. from the mouth—one on each face—is a circular hole, half-an-inch in diameter, believed to have been cast in the bell, or perhaps drilled in the bronze, as in the Armagh bell. These holes may have been made for the purpose of improving the sound, by allowing the sound-waves to escape without being impounded against the narrow surface of the crown.

This may have been necessary in the larger casting, more so than in the ordinary small-sized bronze bells in use during the sixth and seventh century.

The loop from which the clapper of the bell was suspended is broken off, but there remains enough to show the mode of fastening.

The bell at present produces a full mellow tone, though the abrasions at one corner, near the mouth, interfere with its sound.

The Bell of St. Finian of Maġh-bile (Moville)—from a district adjoining the parish of Culdaff in Inishowen—is mentioned by Ellacombe as being of bronze, and very similar to the Bell of St. Boedan.[1]

The Bell of St. Fillian, also noticed by Ellacombe, is of the same class of quadrangular-shaped bronze. The name of St. Fillian, who flourished in the middle of the seventh century, is preserved in Strathfillan on the Clyde; the bell that bore his name is described as having been about 12 in. high, and of an oblong form. An English antiquarian is said to have carried off the bell from the graveyard in the parish of Killin, in Perthshire, about the year 1800, where up to that time it had been preserved.[2]

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[1] *Bells of Devon*, p. 330. [2] *Ibid.*, p. 326.

According to tradition, the Bell of St. Boedan has been for many centuries in the district of Culdaff. Its great age is indicated by its appearance, and it is similar to bells which are probably as old as the ninth century.

Several objects of antiquarian interest have been unearthed in this north-eastern part of Inishowen, chiefly through the exertions of the Rev. Philip O'Doherty.

X.—An Ancient Ciborium.

There is at present in the custody of the Sisters of Mercy, in their convent at Carndonagh, an ancient Ciborium, of which a photograph is submitted to the Academy for inspection.

The following inscription runs along the top of the base of the pedestal:—

ELEEM DNA NAB P R C LEIGH QUI
AYT AN 1695, PRO CONV^{N} MIN
DE ROSSA[1] . . . Y—[ROSS-RIAL IN CONACIA ?].

Underneath the base, opposite the word CONV^{N}, is engraved—

GUARDIANO EXISTENTE F FRANCIS KEALY.

Of the history of the Ciborium nothing is known, except that it was left by the founder of the convent, the Rev. Paul Bradley of Carndonagh, a former parish priest. According to a local tradition it was dug up from a bog near Drumaville, where it had been hidden. It may have been one of the Ciboriums saved from the wreck of the Convent of Donegal, and mentioned by Fr. Donatus Mooney as having been in the convent previous to 10th August, 1601, when the convent was invested by Niall-Garve O'Donnell and his English directors, and when the friars fled to some mountain district, carrying with them the reliquaries of the convent.

The Ciborium was the gift of the Rector Provincial, C. Leigh, who died in 1695. It does not follow that it was not in the convent of Donegal in 1601, as it is clear the inscription was engraven thereon by direction of the existing guardian, Rev. Francis Kealy.

The names of the guardians of the Franciscan convents in Ireland during the seventeenth century are not at present accessible.

The author is indebted for a photograph and the particulars to Rev. Philip O'Doherty of Moville.

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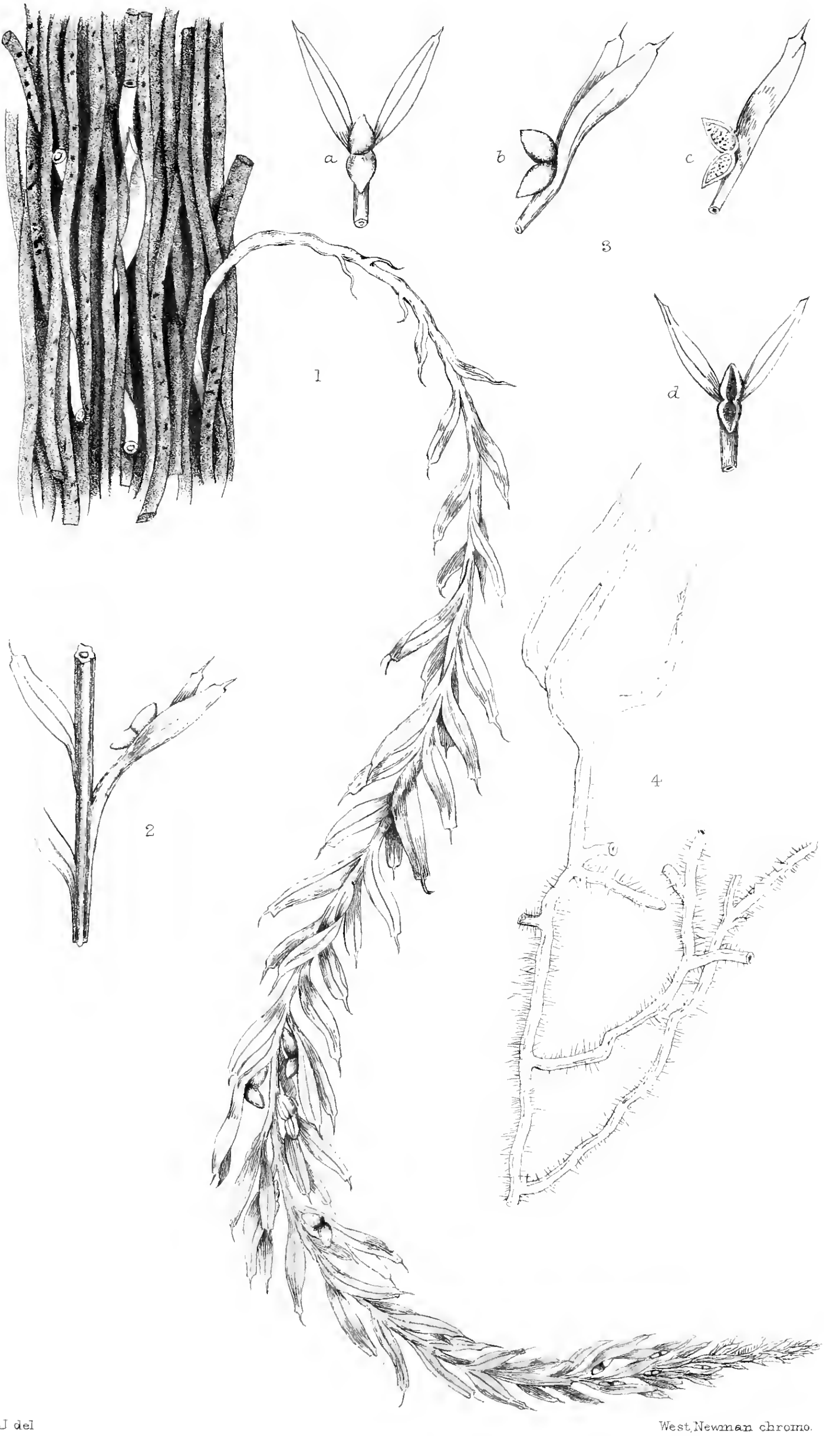
[1] It is probable that this is intended for Ross-Rial in Conacia, from which Lady Finola O'Donnell obtained the brethren with which to found the convent of Donegal in 1474.



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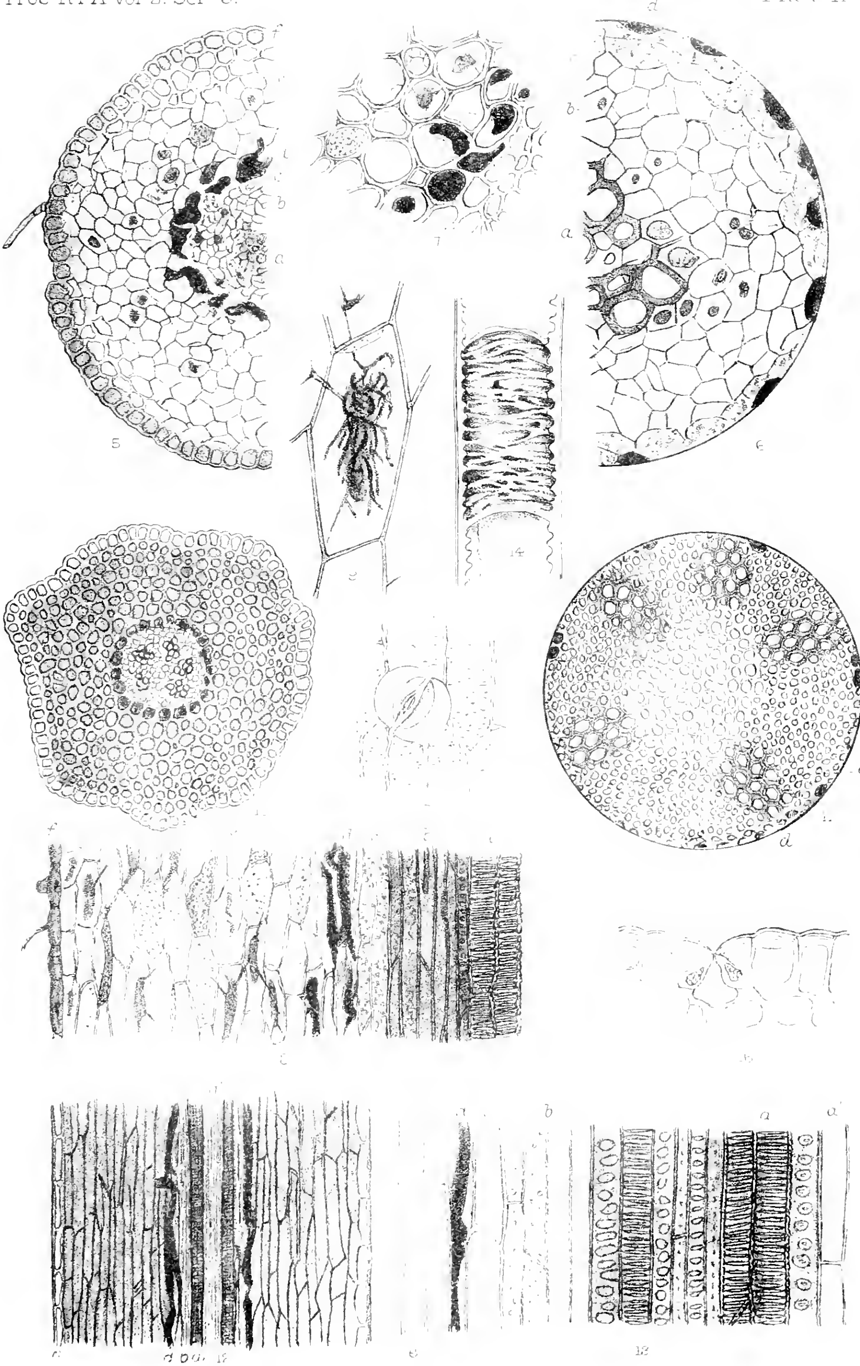

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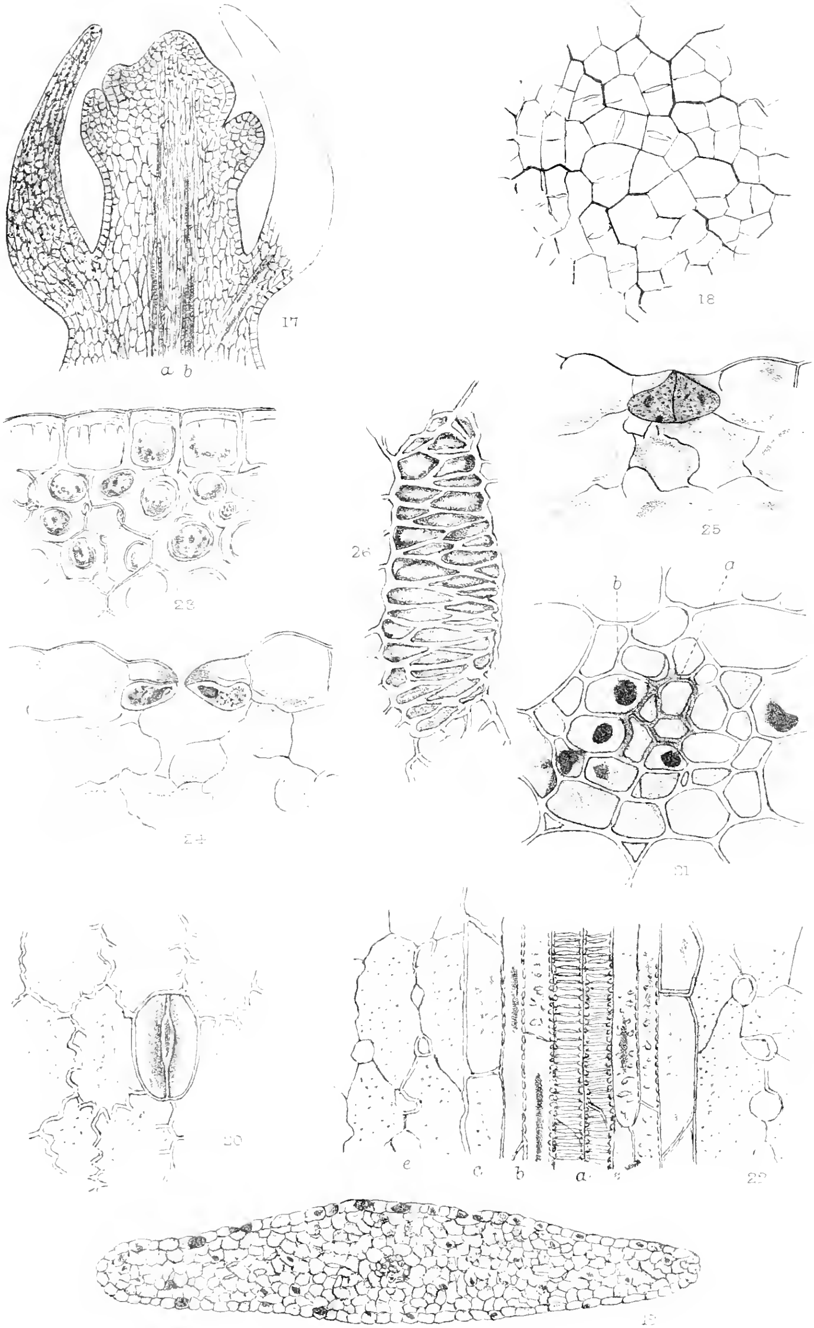

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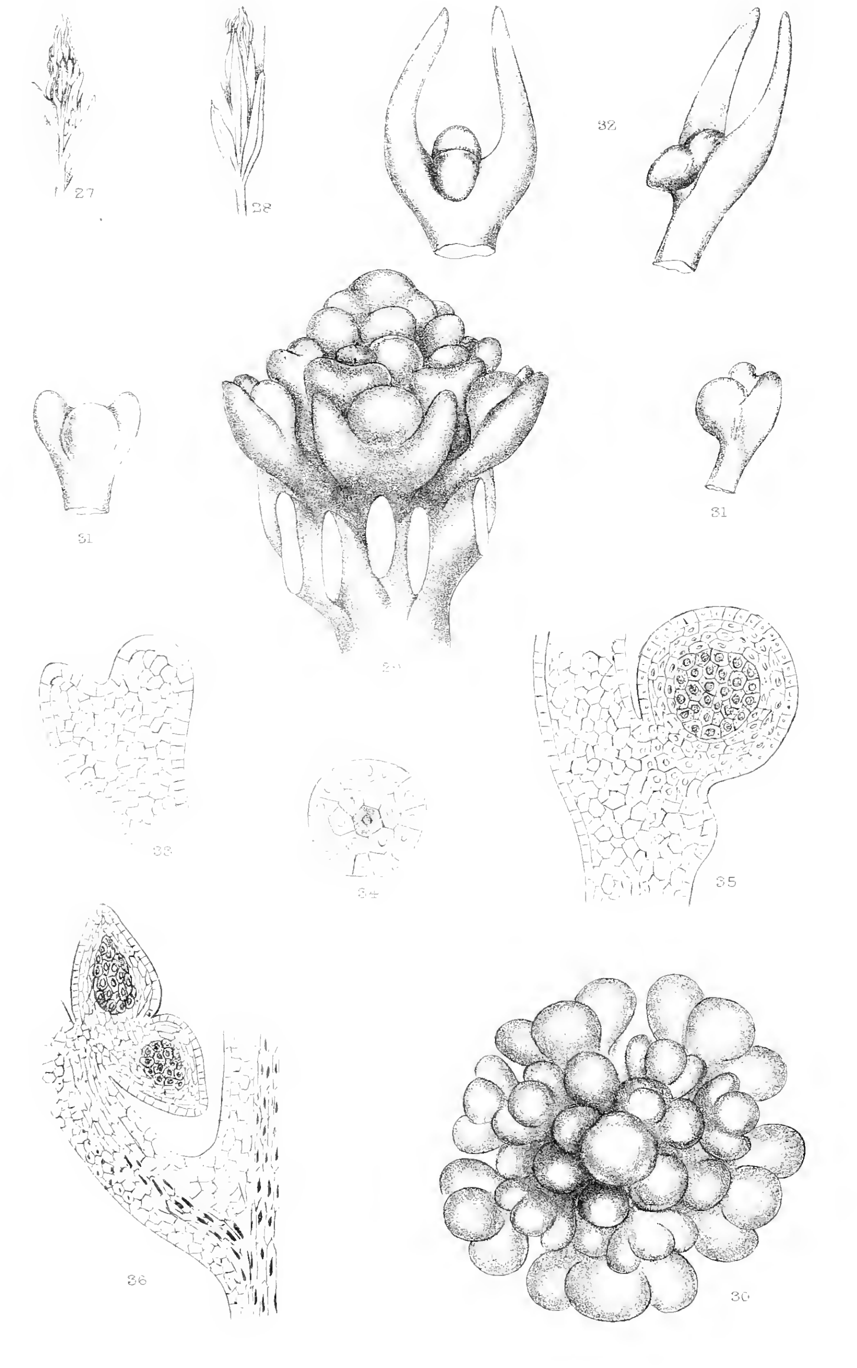
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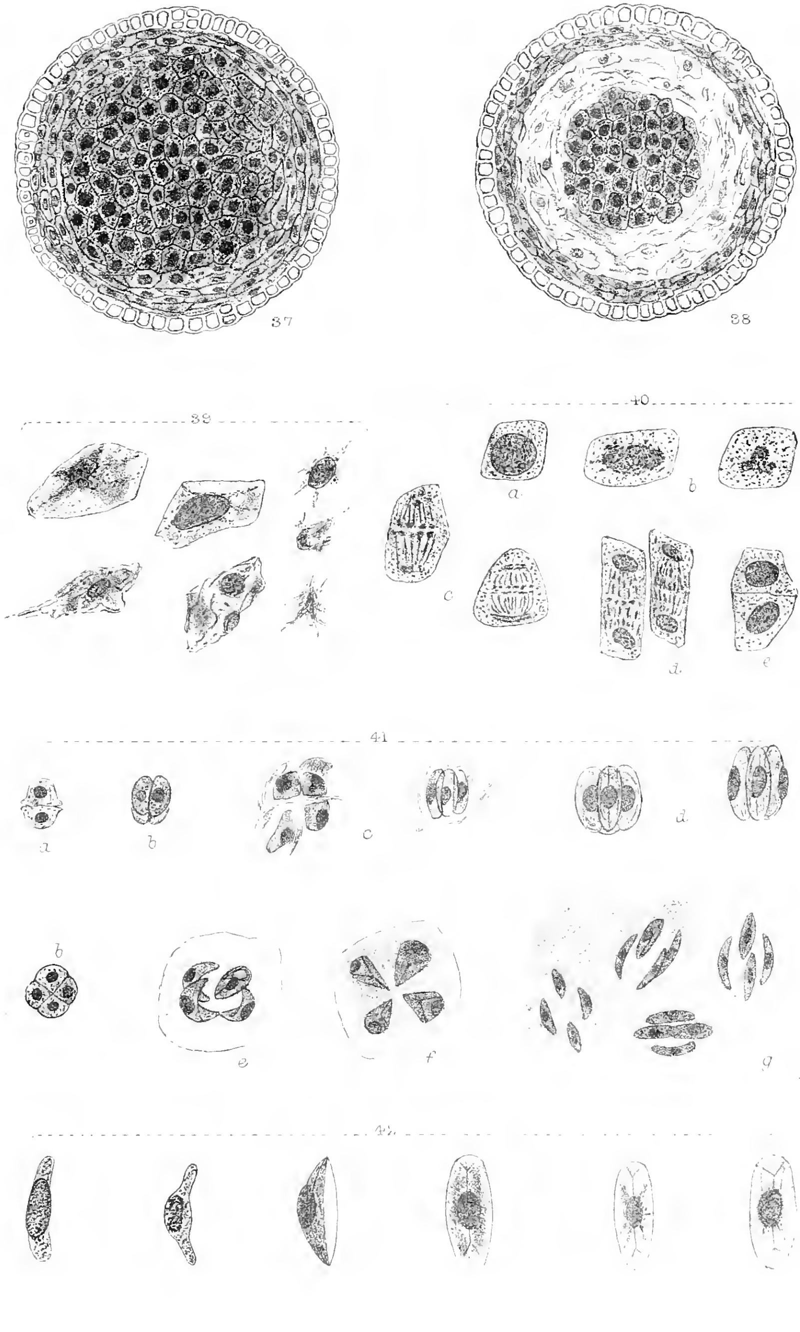

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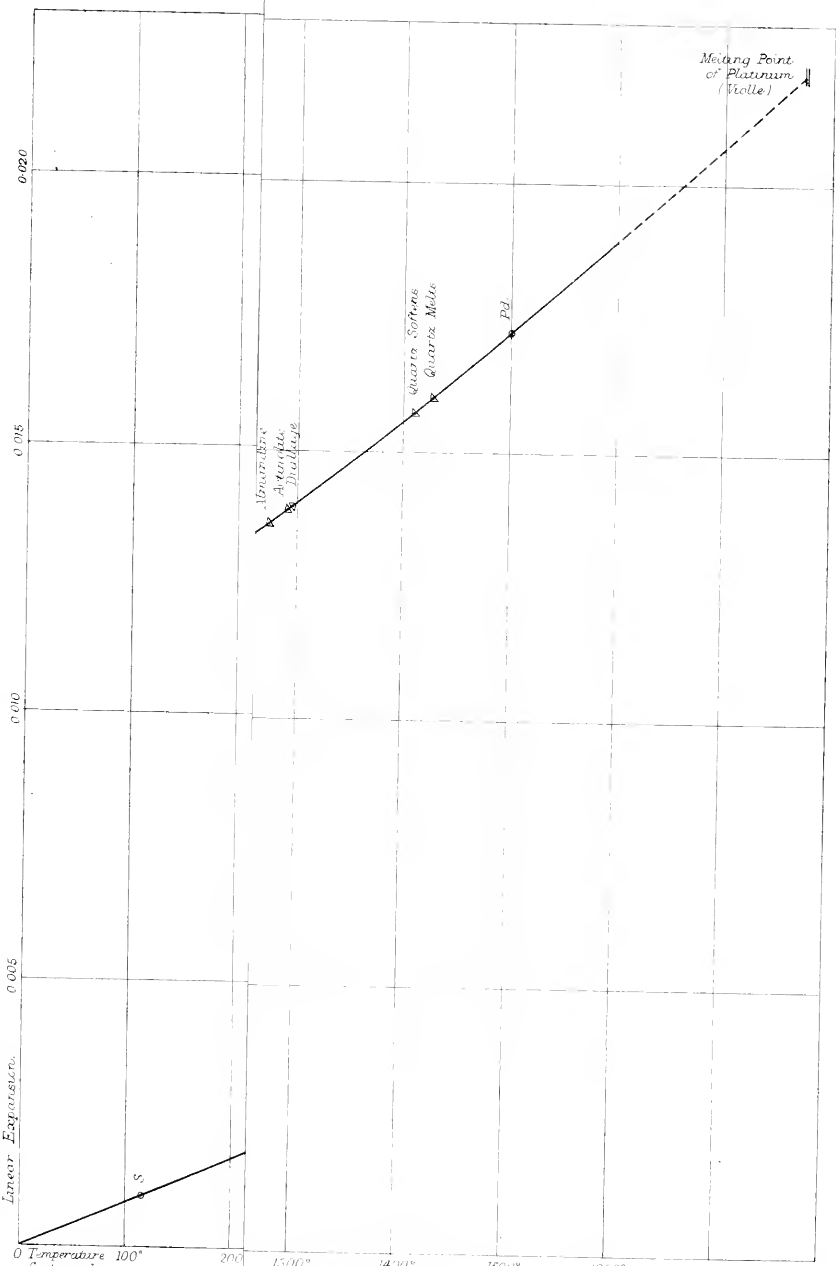

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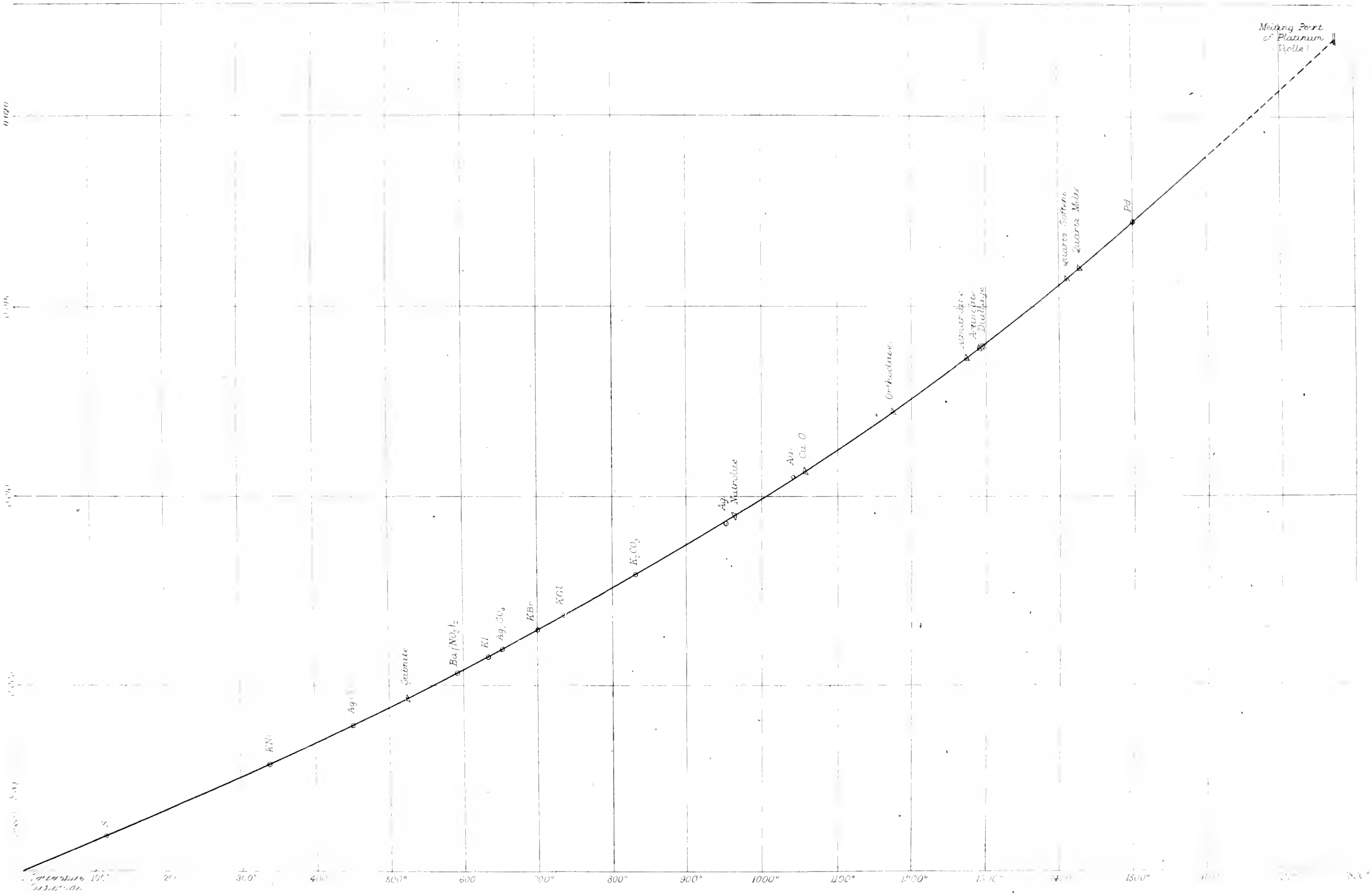
CURVE OF MELTING POINTS



IX.

A STUDY OF THE INTRAVASCULAR COAGULATION PRODUCED BY THE INJECTION OF WOOLDRIDGE'S TISSUE-FIBRINOGEN.

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[COMMUNICATED BY D. J. CUNNINGHAM, M.D., F.R.S.]

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I propose in this Paper: (1) to endeavour to define the physiological tests for tissue-fibrinogen; (2), to report the results of experiments directed to the isolation of this substance by means of the physiological tests; (3), to deal shortly with the chemistry of the substance so isolated; and (4), to discuss certain alterations in the physiological reaction to injections of tissue-fibrinogen which can be brought about by changes in the condition of the animal which is the subject of injection. Lastly, I shall venture to put forward an hypothesis to explain the connexion between the positive and the negative phases of coagulation observed after injections of tissue-fibrinogen.

The Physiological Tests for Tissue-fibrinogen.

We have two methods for applying a physiological test for the presence of tissue-fibrinogen in a solution; (*a*), we can test it as to whether its addition to an extravascular plasma produces a coagulation there; or (*b*), we can inject it directly into the vessels, and determine whether this injection is followed by intravascular coagulation.

These tests will need to be explained in some further detail, and we may first take up *the tests with extravascular plasma.*

We have some six varieties of extravascular plasma at our disposal. These are: (1), cold horse plasma; (2), 5 per cent. NaCl plasma; (3), decalcified plasma (the oxalated plasma of Arthus and Pagès); (4), "peptone" plasma; (5), 10 per cent. $MgSO_4$ plasma; and (6), leech-extract plasma. The behaviour of these six plasmas on addition of tissue-fibrinogen is as follows:—

Cold horse plasma.[1]—The coagulation which occurs spontaneously on warming is increased in rapidity by the addition of tissue-fibrinogen, and the quantity of fibrin formed is largely increased (Rauschenbach).

Five per cent. NaCl *plasma.*[2]—The coagulation which occurs spontaneously on dilution is increased in rate and in firmness by addition of tissue-fibrinogen.

Oxalated plasma.[3]—The coagulation which occurs spontaneously on the restoration of the abstracted calcium salts is similarly increased in firmness and in rapidity.

Peptone plasma.[4]—Clots upon the addition of tissue-fibrinogen.[5]

Ten per cent. $MgSO_4$ *plasma.*[6]—Does not clot upon addition of tissue-fibrinogen.[7] Is not spontaneously coagulable.

Leech-extract plasma.[8]—Does not clot upon the addition of tissue-fibrinogen. Is not spontaneously coagulable.

We have thus seen that of our available plasmas peptone plasma is the most readily applicable test for tissue-fibrinogen. Even in the case of this extravascular plasma we have, however, to be upon our guard against fallacies which may arise by mistaking a coagulation due (*a*) to simple dilution, or (*b*) to the addition of calcium salts with a coagulation due to the addition of tissue-fibrinogen.

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[1] Obtained by receiving horse blood into a freezing mixture.

[2] Obtained by receiving blood into an equal volume of 10 per cent. NaCl solution.

[3] Obtained by receiving blood into one-tenth of its volume of 1 per cent. oxalate of potassium solution.

[4] Obtained by the intravascular injection of albumose.

[5] This plasma also clots on dilution, but there is seldom any difficulty in distinguishing between a coagulation due to this cause and a coagulation due to the addition of tissue-fibrinogen. The dilution has generally to be carried very far before coagulation is obtained, and the coagulum obtained is in the form of the thinnest transparent jelly, whereas with tissue-fibrinogen the clot is firm and opaque. Peptone plasma also clots on the addition of a salt of calcium. The fact that it clots when filtered through a clay cell is possibly referable to this cause.

[6] Obtained by receiving blood into an equal volume of a 20 per cent $MgSO_4$ solution.

[7] The absence of coagulation on adding tissue-fibrinogen to this plasma is evidence that the coagulative properties possessed by such solutions are not referable to the presence of free fibrin-ferment.

[8] Obtained by the addition of leech extract to blood.

The intravascular test for tissue-fibrinogen.—This is constituted by the sum-total of the reactions of the system to an intravascular injection of tissue-fibrinogen. I shall, in a few words, resume the main facts as elicited by Wooldridge's work upon this subject.

In the dog.—An injection of tissue-fibrinogen into the blood-vessels leads to a modification of the blood in two opposite directions: (*a*) to a modification in the direction of increased coagulability (constituting Wooldridge's positive phase of coagulability); and (*b*), to a modification in the direction of decreased coagulability (constituting Wooldridge's negative phase of coagulability). Under ordinary circumstances we see both effects from an intravascular injection of tissue-fibrinogen, the positive phase of coagulation being marked by intravascular thrombi in the whole of the portal venous system, and the negative phase being evidenced by a loss of coagulability in the blood of the extra-portal tracts. Wooldridge also pointed out that the condition of affairs was altered to the advantage of the positive phase of coagulation, when the injection was made into an animal during the period of active digestion. In such cases he observed that the coagula were not limited to the portal tract, but occurred also in the right heart and in the pulmonary artery.

In the rabbit.—Wooldridge described the effects of the injection of his coagulating fluid to be in all cases a complete thrombosis of every part of the vascular system to which it obtained access. I believe that a negative phase was not observed by him.

In the cat.—I do not find that Wooldridge published any statements as to the effect of tissue-fibrinogen when injected into the vascular system of the cat. The phenomena are in the highest degree inconstant, sometimes only a very slight coagulation being obtained in the portal system; at other times extensive coagulations are obtained throughout the venous system. The causes of these variations will be dealt with at a later stage of this Paper.

Such are the ordinary reactions obtained on injection of a simple extract of either the thymus or the testicle; and we may provisionally accept these as constituting the intravascular test for tissue-fibrinogen. When, however, we come to apply these reactions in experiments upon the isolation of the coagulating principle in these extracts, a great defect of sensitiveness becomes apparent in the intravascular as contrasted with the extravascular tests, and in many cases where an apparently negative result on injection of a solution leaves us in doubt as to whether the solution injected does or does not contain tissue-fibrinogen, the extravascular tests afford us invaluable assistance.

Experiments directed towards the Isolation of the active Constituent of the coagulative Extracts of the Cellular Organs.

We may first, following Wooldridge, proceed to precipitate the extracts of the organs (thymus, testicle) with dilute acetic acid, and having separated off the filtrate from the precipitate we can apply to both the tests for the presence of tissue-fibrinogen.

When we test the filtrate obtained in this way, by injecting large quantities of it intravascularly after previous neutralization, we find that it appears to act as a perfectly inert fluid. Similarly, when we test it with peptone plasma, we do not find that this filtrate has any greater effect in producing coagulation than dilution with distilled water has.

It is therefore evident that the substance which is the cause of coagulation must be looked for in the acetic acid precipitate.

We can easily verify that it can be found there, by adding a small portion of the precipitate to some peptone plasma, when we obtain firm coagulation in the course of a minute or two.

Having thus assured ourselves that the substance which is the cause of coagulation has not been destroyed by the precipitation, and that it is present in the precipitate, the next step to be taken was to endeavour to extract it from the precipitate, and to obtain it in the form of a solution.

In order to accomplish this I subjected the acetic acid precipitate to either prolonged extraction in the warm chamber or to prolonged agitation in the shaking machine, with salt solutions of various strengths and with dilute solutions of both alkaline carbonates and caustic alkalies, and then proceeded to apply the physiological tests for tissue-fibrinogen to the filtrates obtained. It is easy in this way, especially when applying the tests with extravascular plasma, to satisfy oneself that an appreciable solution of tissue-fibrinogen takes place only where an alkaline solution has been applied as a solvent. On the other hand, the results of intravascular injection of even such solutions as give a very distinct positive reaction with peptone plasma present, at first, certain difficulties of interpretation, as the following protocols will show :—

Rabbit 53, Feb 14th, 1891.—Injected into the jugular 19 cc. of a filtered 2·5 NaCl extract of bulls' testicles. Death—Universal clotting in the venous side of the vascular system ; slight clot in left heart ; no clot in aorta.

Rabbit 55, Feb. 14th, 1891.—Injected 35 cc. of a filtered 1 per cent.

Na_2CO_3 solution of the acetic acid precipitate obtained from the above extract. No apparent result.

(Then ran in 10 cc. of the same solution in which a little of the acetic acid precipitate had been suspended. Death—Coagulation universal throughout the vascular system.)

Here we have an instance of a negative result with the filtered alkaline solution, which I found it difficult to account for at the stage of my work which I had then reached. I repeated the experiment over and over again, with solutions which were as concentrated as I could make them, but I did not in any case succeed in obtaining an immediate intravascular coagulation with these solutions, though the coagulability of the blood was always increased by injecting them, and in some cases was increased to the point at which coagulation took place absolutely instantaneously after the blood had left the vessels.

Finally, however, I found that a solution which gave intravascular coagulation could be obtained by reprecipitating the tissue-fibrinogen from the filtered 1 per cent. Na_2CO_3 solutions, and then redissolving the precipitate (after decanting off the supernatant fluid) by rendering the solution slightly alkaline.

I will quote one out of several essentially similar protocols in support of the above statements.

Feb. 27th, 1891.—Took a large quantity (exact quantity not noted) of the 1 per cent. Na_2CO_3 solution of the acetic acid precipitate from the watery extract of bulls' testicles. Precipitated the tissue-fibrinogen from this solution by acetic acid and NaCl.[1]

Dissolved the precipitate by the addition of a little Na_2CO_3, and filtered the more or less viscid solution thus obtained through calico before proceeding to the injection.

Rabbit 98.—Injected a few drops of the solution into the jugular vein, which immediately became so firmly blocked with clot that no more of the solution could be run in. Injection continued through the external iliac vein; death occurs immediately, no clot found in the I. V. C. (too little admixture of blood?). Right and left heart clotted perfectly solid; aorta blocked with clot.

It is thus plain that we have here, in the increase of the positive phase up to the point of intravascular coagulation, obtained also the intravascular test for the presence of tissue-fibrinogen in the 1 per cent. Na_2CO_3 solution of the acetic acid precipitate, and that we have thus

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[1] The addition of NaCl aids the precipitation both here and also in case of the nucleo-albumen prepared from yeast.

confirmation of the result previously obtained with the more sensitive extravascular plasma (peptone plasma).

It may, however, be objected that there is a defect in conclusiveness in the above experiments in so far as it has not been shown that intravascular coagulation can be obtained with a clear filtered non-viscid solution of the isolated tissue-fibrinogen, and that there is therefore a possibility of the mechanical properties of the solution (the viscidity) having some causal relation to the production of the intravascular coagulation.

That this objection, though a perfectly justified one from the *à priori* standpoint, does not afford the true explanation of the facts will, I think, become apparent upon the consideration of the following propositions :—

(1.) The non-viscid filtered watery extract of the glandular organs inaugurates coagulation, both when added to extravascular plasma and also when injected intravascularly (*vide, inter alia*, protocol rabbit 53, *supra*).

(2.) The non-viscid filtered 1 per cent. Na_2CO_3 solution of the acetic acid precipitate obtained from (1) coagulates extravascular plasma; and though it does not produce intravascular coagulation, it increases the coagulability of the blood when injected (*vide supra*).

(3). The viscid solution obtained by adding more of the acetic acid precipitate to (2) (*i.e.* by adding more of the precipitate to the alkaline solution than that solution is able to carry through the filter) will coagulate both extravascularly and intravascularly (*vide* protocol rabbit 55, *supra*).

(4). The viscid solution obtained by reprecipitating the tissue-fibrinogen from (2) will coagulate both extravascularly and, when injected without filtering through paper, will coagulate also intravascularly (*vide* protocol rabbit 68).

(5.) The viscid solution (3), when boiled, will coagulate extravascularly, but not intravascularly (Wooldridge, repeatedly verified by myself). N.B.—No apparent mechanical change occurs in these solutions on boiling.

It is plain, therefore, that viscid solutions, even when they possess a certain amount of coagulative power (a sufficient amount of coagulative power to coagulate extravascular plasma), do not by virtue of their mechanical properties produce intravascular coagulation.

Similarly we have evidence, in the case of solution (1), that the solutions which produce intravascular coagulation need not possess any noticeable degree of viscidity.

We therefore appear to be justified in assuming that the absence of intravascular coagulation, when solutions (2) and (5) are injected, is referable to an insufficient degree of concentration in the tissue-fibrinogen contained in those solutions, such deficiency being brought about in the case of solution (2) by the retention of the tissue-fibrinogen on the filter, and in the case of solution (5) by the alteration or disintegration of the tissue-fibrinogen under the influence of heat. The fact that every one of these five solutions gives the reaction with extravascular plasma is evidence that they all contain fibrinogen, though in various degrees of admixture. This is also evidenced by the fact that they all produce, when injected, a modification of coagulation in the direction of increased coagulability.

That we should not be able to produce or obtain a sufficiently concentrated filterable (*i.e.* non-viscid) solution of tissue-fibrinogen will not appear strange on considering (*a*) the loss of solubility constantly entailed upon albuminous substances by precipitation, and (*b*) the fact that the filtered original watery extract (*i.e.* the saturated filtered solution of unprecipitated tissue-fibrinogen) is only just sufficiently concentrated to produce intravascular coagulation. (We require to inject very considerable quantities to obtain this effect—*vide e.g.* protocol rabbit 53, where *circ.* 20 cc. had to be injected.) It will thus be seen that (*a*) we could hardly expect to be able to reconstitute a solution of tissue-fibrinogen of the strength of the original unprecipitated saturated solution, and (*b*) that intravascular coagulation could hardly be expected with a solution which was at all less concentrated.

In point of fact, this appears to be the condition of things with which we have to deal with here.

Having thus, I believe, entirely confirmed Wooldridge's statement as to the solubilities of tissue-fibrinogen, I proceeded by means of these solubilities to separate out the tissue-fibrinogen from the albuminous substances of other solubilities present in the watery extracts in order to investigate the chemical properties of the thus far-isolated substance. I have discussed these chemical properties elsewhere;[1] but may, perhaps, shortly recapitulate them here.

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[1] *Transactions of the International Congress for Hygiene:* London, 1891. Published in an abbreviated form in the *British Medical Journal* of Sept. 19th, 1891.

Chemical Properties of Tissue-Fibrinogen.

Tissue-fibrinogen is slightly soluble both in water and in dilute NaCl solutions, but is soluble to an appreciable extent only in dilute alkaline solutions. Its alkaline solutions are not coagulated on boiling, and the tissue-fibrinogen can be reprecipitated from these solutions by acidifying slightly with acetic acid. Tissue-fibrinogen solutions give the xantho-proteic and the biuret[1] reactions in the cold. In the case of the biuret reaction, a certain amount of time has to elapse before the reaction reaches its maximum intensity. Nitric acid in the cold produces a coagulum which dissolves to a considerable extent upon agitation with excess of the acid. This coagulum disappears almost entirely on heating, and falls out to a considerable extent on cooling the solution. When subjected to a peptic digestion, a clear solution of tissue-fibrinogen deposits a heavy precipitate of a substance which is soluble in alkalies, and which is rich in phosphorus.

I pointed out (*loc. cit.*) that these chemical characters entitle us to classify tissue-fibrinogen among the nucleo-albumens; and I showed that we had some confirmation of this conclusion in the fact that it was possible to obtain intravascular coagulation by the injection of a solution of a nucleo-albumen obtained from yeast.[2]

It will be seen that certain of the above reactions, notably the biuret and the xantho-proteic reactions obtained in the cold, and the disappearance of the nitric acid precipitate on warming, and its reappearance on cooling, would naturally suggest the presence of

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[1] That the biuret reaction obtained is a true biuret reaction, and a very distinct one, may be gathered from the following experiment:—A portion of the solution is divided into two equal parts, and one of these is digested with hydrochloric acid and pepsin for twelve hours. At the end of that period it is filtered and neutralized, and its biuret reaction is then compared with that of the original solution, equal portions of the fluids and of the reagents being of course employed in either case. In the case of the digested solution the biuret reaction develops immediately, while it develops only gradually in the case of the original solution. At the end, however, of two hours the reaction is almost quite as marked in the one solution as in the other, and there is no difference whatever in the tints obtained. It is, however, to be noted that there is a shade of purple in biuret reaction when it is observed immediately after the addition of the reagents. As, however, the disintegration of the tissue-fibrinogen by the caustic alkali proceeds the last trace of blue disappears, the shade of red then obtained, of course, varying with the concentration of the solution.

[2] Rauschenbach (Dissert. Dorpat., 1882) had already proved that the addition of yeast-cells increases the rapidity of coagulation and the amount of fibrin formed in cold horse plasma.

albumose in our 1 per cent. Na_2CO_3 solution. Certain of the physiological evidence obtained, viz. the occurrence of a negative variation (to be referred to more particularly in a subsequent portion of this Paper) in certain conditions after the injection of these solutions, suggested the same conclusion.

In view of these considerations I therefore took the precaution of very carefully washing out my acetic acid precipitates with salt solutions of moderate strengths, and afterwards with distilled water, in order, by such treatment, to remove any trace of the ordinary albumoses which might contaminate the tissue-fibrinogen. I found, however, that such treatment altered nothing either in the physiological or the chemical reactions of my solution, and it thus became evident that these reactions were either (*a*) due to an admixture of dys-albumose, which, as described by Kühne, possesses the same solubilities as those which have been determined to characterize tissue-fibrinogen, and which consequently would be inseparable from it, or (*b*) that they were of the essence of the tissue-fibrinogen.

The latter of these two assumptions appears to me, upon general grounds, to afford the more natural explanation of the facts, and there do not appear to me to be any real chemical difficulties in the way of making the assumption that a substance which is not albumose may give what pass current as the characteristic chemical reactions of an albumose. In support of this view I urged (*loc. cit.*) the following considerations, and I may perhaps be allowed to recapitulate their substance here :—

(*a*) It would seem to be self-evident that any substance, from which nitric acid would split off an albumose, would give the albumose reaction with that acid in precisely the same manner as free albumose does.

(*b*) The colour reactions (*e.g.* the xantho-proteic and biuret reactions) are only by courtesy allowed to rank as evidence of the presence of proteids, as they, strictly speaking, afford evidence only of the presence of certain chromogens, which occur invariably among the disintegration products of the proteids. Further, the distinction which is drawn between these colour reactions, as obtained at ordinary temperatures, and as obtained after the application of heat, is based only upon certain differences of stability which obtain between the various proteids; and it plainly does not therefore follow that a proteid which can be disintegrated at ordinary temperatures by the action of strong acids or alkalies must be always either an albumose or a peptone. Indeed we have direct evidence in the case of both the nucleo-albumens obtained from yeast that both these colour reactions can be obtained in the cold with proteids which do not belong either to the one or to the other of the classes above referred to.

We may therefore, without doing violence to any facts, assume that these reactions do belong to the essence of the tissue-fibrinogen. We have additional justification for this assumption in the fact that when we acidify our solution and boil it, the filtrate will no longer give any biuret reaction; further, in the fact that when we neutralize, and then precipitate our solution, by the addition of strong alcohol, the coagulum obtained will no longer, after standing some weeks under alcohol, yield up, upon extraction with water, any substance which will give a biuret reaction. These facts appear to me to be strong evidence in favour of the view that our 1 per cent. Na_2CO_3 solution of the washed acetic acid precipitate is not contaminated with any free albumose.

We have now to pass on to the consideration of the

Alterations which are produced by the Action of Heat in the Chemical and Physiological Reactions of a Tissue-Fibrinogen Solution.

We are indebted to Wooldridge for the observation that when tissue-fibrinogen solutions are boiled they lose their power of inaugurating intravascular coagulation, while they still retain their power of coagulating peptone plasma. I have repeatedly verified this observation; and I believe that this modification in the physiological reactions is attributable to a partial disintegration undergone by the tissue-fibrinogen, by means of which the coagulative power of the solution is reduced to a point at which it is no longer able to inaugurate intravascular coagulation, although the solution still retains enough coagulative power to bring about the coagulation of peptone plasma. If this view of matter is correct we ought to find confirmation of it, on comparing the chemical reactions of the boiled with those of the unboiled solution. We have already seen (*vide supra*) that when we precipitate the unboiled solution by the addition of acetic acid, and when we make this precipitation more complete by boiling, we obtain a filtrate which no longer gives us any biuret reaction. When we now repeat this experiment with a solution of tissue-fibrinogen which has been previously boiled for some little time in the presence of free alkali, we still, as before, obtain a precipitate when we acidify with acetic acid (this being a precipitation of presumably unaltered, or at any rate only partially altered, tissue-fibrinogen); but the filtrate obtained by filtering off this precipitate now gives a marked biuret reaction. I take it that this biuret reaction is probably referable to an albumose[1] produced by the disintegration of the tissue-fibrinogen.

We have further evidence of a disintegration produced by boiling in the fact that a watery suspension of the thoroughly washed acetic acid precipitate acquires a distinctly acid reaction on boiling, and we have also evidence which points in the same direction in the fact that free phosphates can be demonstrated in the boiled solutions of tissue-fibrinogen.

I would, however, guard against being supposed to assert that the demonstrable chemical disintegration products are at all to be regarded as an adequate measure of the disintegration effected; for the alterations obtained in the physiological reactions are often out of all proportion to the demonstrable chemical changes effected by the application of heat, to which, as will appear from the following protocols, the tissue-fibrinogens are peculiarly sensitive:—

Rabbit 58, 20th Feb., 1891.—Injected 12cc. of a watery extract of testicles into the jugular. Cessation of respiration in about one minute after completion of injection.

P.M.—Right heart, one solid clot; aorta and left heart, empty; S. and I. V. C., clotted, firm; portal vein also clotted firmly.

Took another portion of the *same* watery extract; boiled and filtered off the hardly appreciable coagulum. Injected this boiled extract after cooling into—

Rabbit 59.—18 cc. injected into jugular; no apparent effect from this injection. Rabbit killed with chloroform, and no trace of clotting detected anywhere.

Took a third portion of the extract, and heated it in a waterbath to 50° C. Injected this after cooling into—

Rabbit 60.—22 cc. were injected; no apparent result. Continued the injection with 16 cc. of the unboiled watery extract. Death follows instantaneously, and the post-mortem discloses universal coagulation in both the venous and arterial vascular systems.

The above rabbits were chosen almost exactly of the same size, and had been kept under the same conditions.

In addition to the above experiments with rabbits, I made a number of experiments in the same direction with dogs, using tissue-fibrinogen solutions which had been subjected to a boiling temperatur for many hours. In three experiments with such solutions I obser only a negative phase of coagulability, the blood in each case remai

[1] See note A at end of Paper, p. 146.

liquid for many hours after shedding, and giving all the reactions of albumose blood. I may remark that at the time when I made these experiments I was inclined to emphasize the results obtained as affording evidence of a disintegration of tissue-fibrinogen into albumose under the influence of heat. Further study of the phenomena obtained after the injection of albumose-free solutions of tissue-fibrinogen, however, showed that a negative variation of coagulability is part of the reaction of the system to such an injection, and that it is, in fact, the most noticeable part of that reaction when only a small quantity of tissue-fibrinogen has been injected. The view I am therefore inclined to take of these experiments in the dog with boiled tissue-fibrinogen solutions is that there may have been a certain amount of residual, not-yet-disintegrated tissue-fibrinogen present, and the negative variation observed may have, perhaps, been referable to this.

The Modifications that can be effected in the Reaction of the System to Injections of Tissue-Fibrinogens by Modifications induced in the Physiological Condition of the Animal which is the subject of Injection.

I have already in a previous communication (*Jour. of Phys.*, 1891, No. 2) referred to this question in connexion with a discussion of the causes which determine the coagulation, obtained upon the injection of tissue-fibrinogen solutions, to the portal system. I there endeavoured to show that Wooldridge's tentative hypothesis, which proposed to explain the occurrence of coagulation in this vascular area by assuming an absorption into the blood from the intestinal tract of some substance favourable to coagulation, was an hypothesis which further study of the facts showed to be at any rate a very improbable one.

I there also endeavoured to show that the determination of the coagulation to the portal tract was probably due to an excess of CO_2 present in the blood of that system. In support of this view I adduced the protocols of certain experiments with injections of tissue-fibrinogen, which went to show that a rise of the general CO_2 tension of the blood, whether brought about by clamping the trachea, or by causing the animal to breathe an atmosphere containing an abnormally large percentage of CO_2, was followed by a coagulation throughout the whole vascular system; and I also showed that causes which might be assumed to cause a local increase of CO_2 tension gave rise to the occurrence of intravascular coagulation in the particular vascular areas which were involved.

I have made a few further experiments with the view of collecting additional evidence as to the effects of modifications of the CO_2 tension in the interior of the vessels upon the course of coagulation. I may classify these experiments under the two headings of (*a*) experiments directed to the determination of the effect of a general rise or fall of the CO_2 tension in the blood upon the course of intravascular coagulation, and (*b*) experiments directed to the determination of the effect of a local rise or fall of CO_2 tension upon the conditions of coagulability in particular districts.

Further Experiments upon the effect of a general rise or fall of CO_2 *Tension upon the occurrence of Intra-Vascular Coagulation.*

In addition to the experiments upon this subject reported in my previous communication, experiments (which I believe I am justified in regarding as conclusive as to the effect of increased venosity in producing an enormously greater increase of coagulability to a tissue-fibrinogen solution), I have made further experiments in two different directions with the view of determining whether an increase of CO_2 in the blood is responsible for the increased coagulability.

(1). *In rabbits.*—By administering hydrochloric acid to them in large quantities for some time before I proceeded to make the injection of tissue-fibrinogen.

I was led to make these experiments from the following considerations:—Walther had shown that when a rabbit has, by administration of 0·9 grs. of HCl per kilo. within 24 hours, been converted into an "acid rabbit," its blood contains a very much smaller quantity of CO_2 than a normal rabbit, the diminution being due to a diminution of the CO_2 carrying power of the blood brought about by the conversion of the carbonates, normally present in the blood, into chlorides.

I succeeded, by following Walther's instructions, in converting my rabbits into "acid rabbits," but experienced great difficulty in administering chloroform to and making my injections of tissue-fibrinogen in such enfeebled rabbits. I however satisfied myself in two cases that the blood of rabbits which had received the full quantity of acid (0·9 grs. per kilo. in 24 hours) still responded with an intravascular coagulation to an injection of tissue-fibrinogen. I did not pursue the matter further, because further consideration convinced me that the results obtained could be at best only equivocal, it being evident that as the CO_2 carrying power, and therefore the volume of CO_2 carried away from the tissues, was reduced, there would probably occur in the tissues a corresponding increase of CO_2 tension, and such an increase would react in the direction of increasing the CO_2 tension in the blood.

(2). *In dogs.*—By increasing and diminishing the quantity of blood circulating in the system, in order by this means to distribute the CO_2 over a smaller or a larger quantity of blood.

These experiments ought evidently to be conducted in couples, a considerable portion of blood being drawn off from the one animal, and being then, after decalcification, injected into the circulation of the other dog. This process of addition and subtraction being, of course, to be followed by the injection into either animal of an equal quantity of the same coagulating fluid.

I have as yet made only the first of such a series of experiments, the protocols of which I shall subjoin; but I have, on the other hand, had many opportunities of observing that injections of tissue-fibrinogen produce much more extensive coagulations than they would under ordinary circumstances when they are injected into animals which have been previously extensively bled.

The protocols just referred to are as follows:—

Dog 87, June 20th, 1891.—Wt. *circ.* 7 kilos. Withdrew 210 cc. of blood from the carotid, receiving 135 cc. of it into 15 cc. of 1 per cent. oxalate of potassium solution. Then injected 33 cc. of coagulating fluid into the jugular vein. Death.

P. M. discloses extensive clotting in the right heart and S.V.C.; also throughout the portal tract, with the exception of the splenic vein. Stomach almost empty.

Dog 88 (same date).—Wt. *circ.* 7 kilos. Injected 150 cc. of the oxalated blood through the jugular (10 minutes had elapsed since it was collected). Increased frequency of respiration was observed, but this passed away very soon. Then injected 50 cc. of the same coagulative fluid used in last experiment. Death.

P. M. discloses a *bright arterial clot* in the portal district, excepting only the splenic vein, which was unclotted. Merest trace of clot in the right heart, and none elsewhere in the system. Stomach empty.

I would lay a certain weight upon these protocols when taken together with the observations which I have frequently made as to the increased coagulability to tissue-fibrinogen after hæmorrhage.

Further Experiments made to ascertain whether a local Increase of CO_2 *Tension is followed by a corresponding local Intravascular Coagulation in the Vascular Areas involved.*

I have already shown (*Jour. of Phys.*, No. 2, 1891) that the electrical stimulation of a motor nerve leads to the production of an intravascular coagulation in the veins which carry off the blood from the particular muscles, which are thereby thrown into tetanic contraction; and I have there pointed out that the analogy of the results obtained by inducing a general rise of CO_2 tension probably warrants us in referring this intravascular coagulation to a local increase in the CO_2 tension in the venous blood deriving from the tetanized muscles. I now desired to see whether this observation was capable of being extended to the nerves of the heart also.

I planned my experiments upon this point with a view to ascertaining whether the chemical differences, which, upon Gaskell's well-known theory concerning the nerve-supply of the heart, must almost necessarily be assumed to exist between the coronary venous blood as it flows back from the heart during the phases of anabolism and katabolism, would manifest themselves in any sensible differences of coagulability of the coronary blood during those phases.

I therefore performed the experiments of which I here subjoin the abstracted protocols :—

Cat, June 5th, 1891.—Stimulated the vagus (the distal cut end) at about *the middle* of the neck with an interrupted current just bearable on the tongue. While stimulation was proceeding ran in 18 cc. of coagulative fluid slowly into the jugular vein. Death.

P. M. discloses intravascular coagula in the right heart, I. V. C., down to junction of iliacs; also in S.V.C. Blood in coronary veins quite liquid. No coagula in left heart or aorta.

Cat, June 5th, 1891.—Dissected down to the sympathetic at the root of the neck, and traced the branches joining the vagus, and further down in the neck a branch leaving the vagus to course inward towards the heart. Stimulated this branch with the same current as above, and ran in the coagulative fluid (13 cc.) as before, while the stimulation was being continued.

P. M. discloses some clot in the right heart (auricle), and in the I. V. C., also a trace of clot in the portal vein. No intravascular clots in the coronary veins.

Dog 97, June 8th, 1891.—Stimulated the vagus high up in the neck with an interrupted current (too strong to be agreeable on the tongue), and ran in 20 cc. of coagulative fluid while the stimulation was proceeding. Death.

P. M. discloses that the S. and I.V.C. and the right heart and pulmonary are clotted solid. No clot in the coronary vessels or in the portal vein.

Dog 104, June 22nd, 1891.—Dissected down to a nerve which went off downwards and inwards from the stellate ganglion, where it adjoins the vagus. (This nerve was afterwards dissected out, and was found to be traceable up to a point where it entered the pericardium). Stimulated with a current, which was agreeably strong when tested upon the tongue, I was not able to determine whether stimulation produced an acceleration of the heart-beat. Injection of coagulative fluid was made after stimulation had been continued for about a minute, and the stimulation was continued till almost the end of the injection (when the thread which had been attached to the cut central end of the nerve accidentally became detached). Death.

P. M. disclosed a typical venous clot in the portal vein, and no clot elsewhere in the body, the negative phase of coagulation being well marked in the blood of the extra-portal regions. No clot whatever in the coronaries.

Dog 105, June 23rd, 1891.—Dissected out the accelerator nerve, and had the acceleration produced by stimulation verified repeatedly through the kindness of my fellow-worker, Dr. Armand Ruffer. Ran in the coagulative fluid during the stimulation, as before.

P. M. revealed a moderate amount of clotting in the systemic veins; also, of course, in the portal vein; no clotting whatsoever in the coronary veins.

It will be seen that stimulation of the vagus (in Gaskell's view, the "anabolic") nerve does not, in either the cat or the dog, lead to the formation of intravascular clots in the coronary system, but that it leads to the generalizing of the coagulation by bringing the heart to a standstill, and thus interrupting the normal flow of blood. I have no doubt that if the vagus was able to keep up the cardiac inhibition for a sufficient period, we should by this means be able to obtain intravascular coagula in the coronary vessels in precisely the same manner as we can obtain them by increasing the general CO_2 tension of the blood (clamping the trachea, &c.). I think, however, that it is plain that stimulation of the vagus does not lead to any considerable *local* increase of CO_2 tension, for we might reasonably expect that this would manifest itself in the production of intravascular coagula in the coronary veins, especially when, as here, a local rise of CO_2 tension would be able to summate itself with a rise of general CO_2 tension, referable to a partial interruption of the circulation.

Further, we may, I think, conclude from the above protocols, that a stimulation of the accelerator (in Gaskell's view the "katabolic") nerve does not give rise to any considerable alteration in the coronary blood in the direction of increased coagulability.

With regard, however, to the general question of the cause of the determination of intravascular coagulation to particular areas, we have not, however, as will be seen upon a review of the experiments recorded in this Paper, obtained much fresh information. We have, on the other hand, I think, seen that the conclusions drawn from my original experiments still remain in harmony with the facts, and that the factor of the increased tension of CO_2 still seems to preserve its importance. At the same time, there can, of course, be no doubt that other factors also come into consideration here, and among these probably the factor of temperature is not without its influence. It is, for instance, evident that the determination of the coagulation to the portal tract, and possibly also the coagulation obtained in the veins of tetanized muscles might be explained with reference to a greater heat-production in the areas to which the blood they contain has been distributed.

In order to arrive at some knowledge as to the influence of this factor of temperature I therefore performed the following experiments:—

Dog 58, April 11th, 1891.—Poured 400 to 500 cc. of water, which had been cooled down to 0·5° C., into this dog's stomach, using a funnel and an œsophageal tube for this purpose. Then proceeded immediately to administer ether and chloroform. The animal struggled a good deal during both these processes, and possibly the œsophageal tube may have led to some interference with respiration. Injection of tissue-fibrinogen begun ten minutes after the administration of the cold water. A thermometer in the rectum was now standing at 35·3° C. When 46 cc. had been run in, the dog gave a general spasm, and died.

P.M. disclosed universal clotting in the I.V.C., S.V.C., aorta, heart, and portal system. Stomach quite empty, except for water.

It is evident from the results of the above experiment that a diminution of more than two degrees centigrade in the temperature of the blood will not prevent the occurrence of the most wide-spread intravascular coagulation, if the conditions are such that we are justified in assuming that the CO_2 in the blood is not diminished. In the present case, as we have seen, the CO_2 may be assumed to have been present in certainly not diminished quantities; and I believe that we are therefore entitled to conclude that the coagulation-favouring influence of CO_2 will make itself felt, whether the temperature of the blood is normal or sub-normal. With regard to the influence of cold upon the processes of tissue-fibrinogen coagulation, it was evident that no conclusion could be arrived at from the above experiment, as the conditions had been complicated by the occurrence of struggling. I endeavoured now to eliminate this factor in the following manner :—

Dog 61, April 13th, 1891.—Chloroformed and then cooled down the animal in a bath of iced water until the temperature in the rectum had sunk to 35·5° C. (the same temperature as had been indicated in the rectum in the case of the last experiment). The process of cooling had occupied some considerable time. When this temperature had been reached, the full amount of coagulating fluid was injected into the jugular, into which a cannula had been already previously inserted. No alteration of condition was observed; and upon killing the animal, no intravascular coagulation was to be found.

In this experiment, where, as has been seen, the conditions were not complicated by any struggling, and in which we are, upon general grounds, able to infer that the amount of CO_2 in the blood must have been considerably diminished, no intravascular coagulation was observed to follow the injection of a full quantity of tissue-fibrinogen.

The results of these experiments upon the influence of temperature upon intravascular coagulation evidently requires to be supplemented by experiments upon the effects of locally increasing the temperature of the blood. I have not yet undertaken these.

Modifications introduced into the Physiological Condition of the Animals by the Administration of Alkaloids.

I have not much of importance to communicate under this heading in addition to the facts already communicated in my previous Paper. These I have confirmed and extended to the extent that the clot which is obtained in the portal system is always more or less arterial in character (sometimes it is of a very vivid arterial colour) when the animal has received a hypodermic injection of atropin; and in one case I have seen the whole venous[1] system filled with bright arterial clots. I do not propose to discuss these results further than to say that they seem to me to point to some marked interference with the reducing power of the tissues upon the blood that circulates through them. From general considerations one would, of course, feel inclined to ascribe this to a paralysis of secretory nerves and of nerves to unstriped muscle.

I have also made a considerable number of observations upon the influence of morphia on the processes of coagulation, but I cannot

[1] The generalization of the clot in this case was no doubt connected with the fact that the animal had become very restless from the effects of the atropin.

record any invariable difference obtaining in animals which have received hypodermic injections of morphia as contrasted with normal animals, except, perhaps, that the portal clots are often found to present a brick-red, instead of the normal dark venous, colouration.

Hypothesis as to the Nature of the Changes that occur when a Tissue-fibrinogen Solution is injected intravascularly.

The occurrence of both a positive and a negative phase after injection of tissue-fibrinogen solutions is so paradoxical a phenomenon that one cannot help seeking for some *nexus* by means of which it should be possible to connect the occurrence of one of these phases with the occurrence of the other. That Wooldridge, who described these phenomena, did not put forward any hypothesis to explain them, must, I believe, be attributed solely to the fact that none of the facts, which had as yet been observed in the connexion with tissue-fibrinogen coagulation, were able to afford a clue to the true explanation of the manner in which these phenomena were correlated. When, however, the next few steps had been taken in the study of the matter, and I had observed that the blood, which was collected from the negative phase areas, presented all the characteristics of albumose blood, and when I had further ascertained that the tissue-fibrinogen solutions employed gave a biuret reaction in the cold, these facts, when brought into connexion, naturally suggested the hypothesis that the negative phase of coagulation was due to an admixture of albumose with the injected tissue-fibrinogen. I followed up this clue for some considerable time, but I finally, as has been seen, had to abandon it, when in a succession of experiments I obtained both the positive and the negative phases of coagulation well marked with solutions of fibrinogen, which I had satisfied myself to be perfectly free from albumose. I had therefore to cast about for a more tenable hypothesis; and I believe that the following one will be found to be at any rate in harmony with the facts as far as they have been at present ascertained. I have, then, perhaps, some reason to hope that it may eventually turn out to afford the true explanation of the facts.

The suggestion I would make is that the tissue-fibrinogen, when injected into the blood, is there disintegrated, and that the albumose, set free by this disintegration, conditious the liquidity and the loss of coagulability that characterize the negative phase.

In order to bring this hypothesis to the test of facts, it will be convenient to begin by summing up the consequences, which we would feel justified in assuming would follow from the facts, the occurrence of which is assumed under the hypothesis. I have attempted to do this in the following series of statements.

(1). The positive phase of coagulation ought to occur immediately after the injection of tissue-fibrinogen into the blood, and ought to be characterized by the presence of unaltered tissue-fibrinogen in the blood.

(2). The negative phase ought to be always subsequent in time to the positive phase; it ought to be characterized by a diminution of the coagulative power of the blood, which should only reach its maximum after the lapse of a certain interval of time.

(3). The diminution and disappearance of the positive phase ought to be marked by the disappearance of the tissue-fibrinogen, as such, from the blood.

(4). Further, the blood of the negative phase should acquire the properties of albumose (peptone) blood.

(5). We might expect that the albumose, which is assumed to be set free in the blood, should appear in the urine.

(6). We would expect that the distribution of the areas of positive and negative variation after tissue fibrinogen injections should have its counterpart in the conditions of coagulability of the blood in the various vascular areas after injections of albumose, and the conditions of coagulability obtaining in peptone blood ought to be subject to a modification in the direction of coagulability by the increase of the CO_2 tension, since we have found this to obtain in the case of tissue-fibrinogen injections.

(7). Lastly, we ought not to find any pronounced negative-phase of coagulability in animals whose blood cannot be kept liquid by "peptone" injections.

I hope to be able to show that there is not one of these conditions which cannot be shown to have been realized, either in the experiments of other observers or in my own experiments upon this subject. I shall treat the matter under the above tabulated headings:—

(1). *The positive phase of coagulation ought to occur immediately after the injection of tissue-fibrinogen into the blood, and ought to be characterized by the presence of unaltered tissue-fibrinogen in the blood.*

(2). *The negative phase ought to be always subsequent in time to the positive phase, and it ought to be characterized by a diminution of the coagulative power of the blood, which should only reach its maximum after the lapse of a certain interval of time.*

We may group these together, as the same protocols will supply us with evidence that the sequence of the phenomena is in accordance with the requirements of the hypothesis as stated under these headings.

Dog 119.—The acetic acid precipitate from a fresh extract of testicles was carefully washed as described above, and a thin solution was then made in 1 per cent. Na_2CO_3, and was filtered through calico, but not through paper. Cannulæ inserted into the external jugular vein and into the carotid.

Samples of a few cc. each time were withdrawn from the carotid to test the condition of coagulability of the blood, and an assistant took down in writing from my dictation (*a*) the times at which the samples were withdrawn; (*b*) the times at which injections of tissue-fibrinogen were made into the jugular vein; and (*c*) the reports I made at intervals of about a minute upon the condition of coagulability in the various samples.

Sample No. 1.—Withdrawn 5.43 p.m.; begins to clot, 5.46; almost solid, 5.47; can invert, 5.51. *Time,* 8 *minutes.*

Ran in 10 cc. of tissue-fibrinogen solution, 5.43 p.m.

Sample No. 2.—Withdrawn 5.44; liquid, 60 minutes afterwards. *Time, more than* 60 *minutes.*

Ran in 10 cc. more of tissue-fibrinogen solution, 5.44½.

Sample No. 3.—Withdrawn 5.45; liquid, 1 hour afterwards. *Time, more than* 60 *minutes.*

Sample No. 4.—Withdrawn 5.46½; liquid, 1 hour afterwards. *Time, more than* 60 *minutes.*

Sample No. 5.—Withdrawn 5.48; liquid, 1 hour afterwards. *Time, more than* 60 *minutes.*

Ran in 10 cc. more solution, 5.48.

Sample No. 6.—Withdrawn 5.50; still liquid, 5.53; can invert, 5.58 p.m. *Time,* 8 *minutes.*

Sample No. 7.—Withdrawn 5.51; liquid, 5.53; clot begins, 5.55; half solid, 5.57; solid, can invert, 6.4 p.m. *Time,* 13 *minutes.*

Ran in 10 cc. more, 5.54.

Sample No. 8.—Withdrawn 5.53; half solid, 5.59; solid, 6 p.m. *Time,* 7 *minutes.*

Ran in 10 cc. more, 5.54.

Sample No. 9.—5.55; solid at 6 p.m. *Time,* 5 *minutes.*

Ran in 10 cc. more solution at 5.56.

Sample No. 10.—Withdrawn 5.56; solid at 6 p.m. *Time,* 4 *minutes.*

Ran in 10 cc. more.

Sample No. 11.—Withdrawn 5.58½; solid at 6.2 p.m. *Time,* 3½ *minutes.*

Sample No. 12.—Withdrawn 6 p.m; solid, 6.4 p.m. *Time,* 4 *minutes.*

Sample No. 13.—Withdrawn 6.2½; liquid at 6.6; solid at 6.9 p.m. *Time,* 6½ *minutes.*

Sample No. 14.—Withdrawn 6.7 p.m; liquid at 6.10; clot begins, 6.12 ; solid at 6.14½. *Time,* 7½ *minutes.*

Ran in 20 cc. more, 6.13 p.m.

Sample No. 15.—Withdrawn 6.14; half solid, 6.15; record of complete coagulation wanting.

Sample No. 16.—Withdrawn 6.14½; half solid, 6.15; quite solid, 6.16½. *Time,* 2 *minutes.*

Sample No. 17.—Withdrawn 6.16; solid, 6.20. *Time,* 4 *minutes.*

Sample No. 18—Withdrawn 6.19; half solid, 6.20; solid, 6.22. *Time,* 3 *minutes.*

Sample No. 19.—Withdrawn 6.22; half solid, 6.23; solid, 6.26. *Time,* 4 *minutes.*

Ran in 15 cc. more, 6.23 p.m.

Sample No. 20.—Clots almost instantaneously.

Clamped trachea, 6.26 p.m.

At 6.27 p.m. proceeded to inject 20 cc. more of the coagulative fluid, but the injection came to a standstill of itself after a very few cc. had been run in, the respiratory movements having suddenly ceased.

P. M. disclosed complete thrombosis of both sides of the heart, and of the first portion of the aorta. There was naturally, therefore, no clot in the portal vein.

The bladder contains some 20 cc. of acid urine, in which an extremely well marked biuret reaction can be developed by the addition of NaOH and $CuSO_4$.

We have thus in this experiment, if for the moment we leave samples 2 to 5 inclusive, out of consideration, a gradual increase of coagulability in the blood as a consequence of successive small injections of tissue-fibrinogen, the gradual curve of ascent being, however, marked by partial remissions in the direction of a negative phase, wherever time enough was allowed between the injections for a reaction to make itself felt. These remissions are, for instance, well seen on comparing samples 6 and 7 together, or again on comparing samples 11, 12, 13, 14. There is also, I think, a perfectly similar remission in the case of samples 16, 17, 18, 19, the more rapid coagulation recorded upon the protocol for sample 18 being probably referable to either an inaccuracy of observation, or to a rise of CO_2 tension due to an unrecorded temporary cessation of respiration, such as would be brought about by the administration of a fresh supply of the anæsthetic. With regard to the apparent primary character of the negative phase of coagulability which samples 2 to 5 appear to establish the existence of, I can only state my belief that an unobserved positive phase of coagulability might have been placed upon record if the samples had been collected immediately after the injection of the tissue-fibrinogen. I omitted to collect these samples early enough, because I was at the moment occupied with supervising the injection.

The evidence, however, of Groth's (Dissert. Dorpat. 1884) experiments with leucocytes, in which the phenomena are absolutely identical with those that are observed after injections of tissue-fibrinogen, is quite conclusive as to a positive variation universally preceding the occurrence of a negative variation, even though it might be a positive variation of such short duration that it was necessary to have an assistant to draw off the sample of blood during the actual moment that the injection was proceeding. As to the shortness of the duration of this positive phase, I will quote the following extract from Groth's (Dissert. Dorpat., 1884) Paper:—"Ebenso ausnahmlos aber war die Dauer dieser bis zum Aeussersten gesteigerten Gerinnungsenergie des Blutes nur nach Minuten, ja selbst nach Secunden zu bemessen, und es folgte dann ein ebenso plötzlicher Nachlass bis zur vollständigen Gerinnungsunfähigkeit."

With regard to the general question of the injection of a pure tissue-fibrinogen solution being succeeded by a negative as well as by a positive phase, the protocol which has just been quoted would be sufficient evidence; but I shall venture to quote another couple of protocols which appear to me to throw some light upon the great influence which the concentration of the coagulative fluid exercises upon the results obtained from an injection.

Dog 109.—Weight *circ.* 7 kilogrammes. Made a thick suspension of the washed acetic acid precipitate strained it through calico. Injected 5 cc. of this thick suspension into the jugular vein. Death occurs instantaneously, both venæ cavæ and both sides of the heart being filled up with one solid clot. No clot in the portal V.; blood from the unclotted vascular areas clots normally. Here evidently the tissue-fibrinogen was injected in so concentrated a form that the system was unable to cope with it, or to break it down into albumose.

Took another portion of the same coagulative fluid, which had been injected into dog 109, and diluted it with four times its volume of water, and proceeded, as in protocol of dog 119 (quoted above), to determine the condition of coagulability by means of samples drawn from the carotid.

Dog 110.—Weight *circ.* 7 kilogrammes.

Sample No. 1.—Withdrawn 3.20 ; firmly clotted, 3.21. *Time*, 1 *minute.*

Ran in 5 cc. of the diluted coagulating fluid into the jugular at 3.21 p.m.

Sample No. 2.—Withdrawn 3.22 ; semi-fluid still at 3.23 ; solid, could invert at 3.24. *Time*, 2 *minutes.*

Sample No. 3.—Withdrawn 3.23 ; at 3.25 still liquid ; 3.27 half solid ; solid at 3.29. *Time*, 6 *minutes.*

Sample No. 4.—Withdrawn 3.25½ p.m ; half solid, 3.29 ; solid, at 3.31 p.m. *Time*, 5½ *minutes.*

Sample No. 5.—Withdrawn 3.30 ; half solid 3.35 ; solid, 3.37 p.m. *Time*, 7 *minutes.*

Injected another 5 cc. of coagulating fluid at 3.31 p.m.

Sample No. 6.—Withdrawn 3.32½ ; half solid, 3.39 ; solid, 3.42. *Time*, 9½ *minutes.*

Sample No. 7.—Withdrawn 3.34 ; half solid, 3.42 ; solid, 3.48. *Time*, 14 *minutes.*

Sample No. 8.—Withdrawn 3.40 ; solid, 3.52 p.m. *Time*, 12 *minutes.*

Injected another 5 cc. of the coagulating solution at 3.41 p.m.

Sample No. 9.—Withdrawn 3.43. ; solid at 3.52. *Time*, 9 *minutes.* 3.47, injected 5 cc. more. 3.50 p.m. injected another 5 cc.

Sample No. 10.—Withdrawn at 3.51 ; half solid at 3.52 ; solid at 3.56. *Time*, 5 *minutes.*

Sample No. 11.—Withdrawn at 3.54 ; solid at 3.56. *Time*, 2 *minutes.*

Trachea clamped ; no intravascular coagulation produced, but blood coagulates very rapidly after leaving the vessels.

In the above quoted protocol, as will be seen, the injection of 25 cc. of the diluted coagulating fluid (corresponding to 5 cc. of the undiluted fluid) did not produce a trace of intravascular coagulation ; while the same quantity, injected in a much more concentrated form, led to very extensive intravascular coagulation in a dog of almost exactly the same size which had been kept under similar conditions. It will be seen that the intervals between the injections in this case were in contradistinction to those in the case of dog 119 (*vide supra*) ; at first so prolonged that the general curve obtained in the first samples (samples 2 to 7) is one in the direction of negative variation, and only turns in the direction of a positive variation (samples 8 to 11) when the intervals between the injections were considerably shortened. Even then, as we have seen, the positive phase had not become sufficiently pronounced to lead to the formation of intravascular coagula, even when the conditions for the formation of these were made as favourable as possible by the clamping of the trachea.

(3.) *The diminution and disappearance of the positive phase ought to be marked by the disappearance of the tissue-fibrinogen, as such, from the blood.*

(4.) *The blood of the negative phase should acquire the properties of albumose (peptone) blood.*

Wooldridge has put observations on record, which show that tissue-fibrinogen has ceased to be present, as such, in the blood of the negative-phase areas. He found that the centrifugalized plasma obtained from such blood gave no trace of a precipitate upon the addition of acetic acid. With regard to the agreement in reactions which obtains between albumose (peptone) plasma and the plasma derived from the negative-phase areas after tissue-fibrinogen injections the following observations are, I believe, conclusive: (*a*) both these plasmas clot upon the addition of tissue-fibrinogen; (*b*) both plasmas clot (except in very exceptional cases) on passing a stream of CO_2 through them; (*c*) both plasmas clot on dilution; and, except in rare instances, (*d*) upon the addition of a few drops of a 1 per cent. solution of $CaCl_2$; (*e*) further, both plasmas have a tendency to undergo spontaneous coagulation after a lapse of, say, 12 to 24 hours.

(5.) *Albumose if set free in the system in considerable quantities would naturally find its way into the urine.*

We have already seen (*vida supra*, protocol of dog 119[1]) that this is what actually takes place. The conditions necessary for the discovery of albumose in the urine, under such circumstances, are evidently (1) that the dog should survive the injection of tissue-fibrinogen for some little time, and (2) that the blood-pressure should not have become lowered to such an extent, that no secretion of urine

[1] The biuret reaction there observed cannot have been due to the presence of tissue-fibrinogen, because the reaction of the urine was distinctly acid.

takes place. Wooldridge had already placed on record the great sinking of blood-pressure that takes place after injections of tissue-fibrinogen; and he had recognized it as being something similar to what takes place after injections of "peptone."[1]

(6.) *The distribution of the areas of positive and negative variation after injections of tissue-fibrinogen ought to have its counterpart in conditions of coagulability of the blood in the various vascular areas after injections of albumose, and an increase of coagulability ought to be observable in "peptone" blood as a consequence of a rise of the* CO_2 *tension in the vessels.*

We may take the first clause of this proposition by itself, and may quote the following protocol (which is only one of two similar ones) as evidence that the facts actually are as they are assumed under the hypothesis to be:—

Dog 12.—Weight *circ.* 3.5 kilogrammes. Experiment begun 5.5 p.m., 20th August, 1891. Ran in 18 cc. of a 10 per cent. solution of Grübler's peptone into the jugular. The characteristic deep and rapid respirations are observed. Two minutes after released clamp on carotid, and collected—

Sample No. 1—Withdrawn, 5.10 p.m.; loosely clotted at 5.25; nearly solid at 5.30 p.m. *Time,* 20 *minutes.*

Sample No. 2.—Withdrawn 5.12; not clotted at 5.35. *Time, more than* 23 *minutes.*

Sample No. 3.—Withdrawn 5.13; not clotted at 5.35. *Time, more than* 23 *minutes.*

Opened the abdomen, and isolated the portal vein, and pricked a small hole in its wall with a needle. In this manner collected—

Sample No. 4—as the blood poured out. This was at 5.17. Can invert this tube at 5.18. *Time,* 1 *minute.*

Sample No. 5.—Withdrawn from the carotid at 5.20; quite liquid at 5.35 p.m. when observations were broken off.

Sample No. 6.—Collected from Vena Portæ. As a precaution against obtaining blood which had stagnated in the vein since applying the clip at 5.17, a certain quantity of blood was allowed to flow away from the vein before this sample was collected. Time of collection of sample, 5.22; can evert the tube at 5.24. *Time,* 2 *minutes.*

Sample No. 7.—Withdrawn from the carotid at 5.23; still liquid at 5.35.

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[1] See note B at end of Paper.

Sample No. 8.—Withdrawn from the Vena Portæ at 5.24, the blood having been escaping from the vein ever since the last portion was withdrawn, the clip having been imperfectly adjusted, and the opening in the vein having been previously enlarged. Clots loosely at 5.30. *Time*, 6 *minutes.*

Sample No. 9.—This sample consisted of all the rest of the blood in the body which was drawn off through the carotid. It was still liquid when the experiment had to be broken off at 5.35, and was loosely clotted by the next morning. Before breaking off the experiment, the solid cylinders of clot which had formed in the test tubes, which had received the portal blood, were shaken out; none of the other tubes could be inverted without spilling their contents.

We have thus evidence that the blood in the portal tracts retains its coagulability when the arterial blood has been rendered, to a great extent, incoagulable by an injection of albumose.

We have further to adduce evidence that arterial peptone blood can be made to regain coagulability by increasing the tension of CO_2 in the vessels.

I have made some five experiments in this direction, and in all of them evidence of an increase of coagulability was obtained. I will quote the protocol of one of these experiments.

Dog 118.—Weight *circ.* 6 kilogrammes.

Drew off from carotid 85 cc. of blood for a purpose foreign to the present experiment. Then ran in 20 cc. of a 10 per cent. peptone (Grübler's) solution the animal at the same time receiving a fresh supply of chloroform which gave rise to a temporary cessation of respiration. This was at 4.39 p.m.

Sample No. 1.—Withdrawn from the carotid at 4.39½; clots solid almost immediately. Breathing improves.

Withdrew specimens of blood at 4.40, 4.40½, and 4.41 p.m. Labelled these Nos. 2, 3, 4.

Again withdrew *Samples* 5, 6, 7, between 4.42 and 4.45 p.m. At 4.45 put a clamp upon the trachea.

Sample 8.—Withdrawn at 4.45½.

Sample 9.—Withdrawn at 4.46; is very venous in colour.

Sample 10.—Withdrawn at 4.47; is very venous in colour.

Removed clamp from the trachea; breathing has apparently entirely ceased, but is speedily revived by artificial respiration (kneading the chest).

Samples 11 *and* 12.—Drawn off between 4.48 and 4.49.

Sample 13.—Drawn off at 4.49½.

Samples 14 *to* 25.—Drawn off at, as nearly as possible, half-minute intervals, between 4.50 and 5 p.m. Death.

At 5 *p.m.*—Specimens 2 and 3 are firmly clotted; the tubes can be inverted. Specimen 4 is liquid. Specimen 5 is partly liquid. Specimens 6, 7, 8, 9 are entirely liquid. Specimens 10, 11, 12 are distinctly clotting. Specimens 13 to 25 are perfectly liquid.

At 5.15 *p.m.*—Specimens 1 to 9 as before. Specimens 10 and 13 are half-solid. Specimens 11 and 12 are firmly clotted; can invert the test-tubes. Specimens 14 to 25 still perfectly liquid. Observations discontinued for the day.

Next morning.—Distinct cylinders of clot are shaken out of the tubes containing specimens 2, 3, 10, 11, 12, 13, the other specimens being still perfectly liquid.

This, as has been said, is only one of five experiments in which the clamping of the trachea was found to restore the coagulability to peptone blood.

I was now anxious to determine further whether an increased coagulability could be determined to exist in peptone blood returning from tetanized muscles. I was not able to satisfy myself that this was actually the case, but in the course of the experiment I came across the fact, which, indeed, might have been inferred from the facts about peptone blood which had been already determined. This was the fact that the venous blood still preserves its coagulability when the arterial blood has become uncoagulable by a peptone injection. This holds, I think, universally of peptone blood. With regard to the question of the relative coagulability of portal as compared with systemic venous blood, I have observed, in two experiments, a superior coagulability of the portal blood, but I do not, in the absence of further experiment, desire to lay any stress upon the observation.

Enough has, however, been elicited,[1] with regard to the conditions of coagulability in peptone blood, to justify the statement that the

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[1] The facts which have been established above—viz. the retention of normal coagulability in peptone venous blood and the restoration of coagulability to peptone arterial blood by clamping the trachea—seem, when taken in connexion with Lahousse's observations (Du Bois' *Archiv.*, 1889) on the great diminution of CO_2 in peptone blood, and Bohr's observations (*Centralblatt f. Phys.*, Sept., 1888) upon the greatly reduced excretion of CO_2 after peptone injections, to point strongly to the conclusion that the modification introduced by peptone in the coagulability of the blood is, in great part at least, attributable to a disturbance of its normal gaseous composition. Such an hypothesis would explain the restoration of coagulability to peptone blood on passing a stream of CO_2 gas through it; and it would further

distribution of the areas of the negative phase of coagulation after an injection of tissue-fibrinogen would be explicable upon the assumption that it was conditioned by the presence of albumose, and that it was only where this influence was in abeyance, owing to an excess of CO_2, that the coagulating influence of the unaltered tissue-fibrinogen was free to exert its full effect.

Lastly, we have to examine whether it is true that—

(7). *A negative phase makes itself felt in full force only in the case of such animals as are markedly susceptible to the anti-coagulative effect of albumose injections.*

With respect to this question it may, I think, be asserted with confidence that the dog, which is, as far as is known, the only animal in which albumoses can be relied upon to keep the blood permanently liquid, is also the only animal in which the negative-phase, after tissue-fibrinogen injections, can become absolute, *i. e.* can lead to an entire loss of spontaneous coagulability.

With regard to the occurrence of a negative phase in the rabbit after tissue-fibrinogen solutions which are free from albumose, I will quote the following protocols, rabbit 100.

Rabbit 100, June 26th, 1891.—Injected 20 to 25 cc. of a filtered 1 per cent. Na_2CO_3 solution of the washed acetic acid precipitate into the jugular vein. No apparent result, and no intravascular coagulation detected upon *post-mortem* examination, when the animal was killed a few minutes after by drawing off the blood from the carotid. The blood clots in 2 minutes when a stream of CO_2 is passed through it; it also clots rapidly on dilution with water. Spontaneous clotting

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explain the fact that the addition of peptone to blood is comparatively ineffectual in vitro.

Similarly it would explain the fact, put on record by Fano, that an injection of peptone to be effectual must be made very rapidly. This observation of Fano's, I may observe, is perfectly correct. I have repeatedly run in as much as 4 to 5 grs. of peptone per kilogramme in a dog in the form of a very concentrated solution without producing the characteristic convulsive dyspnœa obtained upon rapid injection of 0·3 to 0·5 grs. per kilogramme in the form of a 10 per cent. solution. The difficulty in rendering the blood liquid by a peptone injection after the administration of morphia is also, I believe, connected with the difficulty of obtaining the customary dyspnœic reaction under such circumstances. In a word, the phenomena in the case of albumose injections may be summed up in the proposition—no dyspnœic reaction, no loss of coagulability.

begins in 30 minutes, and the blood becomes firm at the end of 45 minutes.

Rabbit 101.—Injected 20 to 22 cc. of the 1 per cent. Na_2CO_3 solution into the marginal vein of the ear through an hypodermic needle. No result apparent from this injection. Bled to death by opening the carotid. No intravascular coagulation to be detected by *post-mortem* examination. The collected blood at first shows no sign of spontaneous coagulability, but an immediate coagulation is obtained by passing a stream of CO_2 gas through it. Similarly, dilution with water or addition of some of the acetic acid precipitate produces immediate coagulation. Blood begins to clot spontaneously in 25 minutes.

It is thus seen that a negative phase of coagulation, though not by any means a pronounced one, can be obtained with tissue-fibrinogen in the rabbit. I however have succeeded in obtaining quite as marked a retardation of coagulability in the rabbit by the injection of ordinary albumoses.

With regard, again, to the negative phase in the cat, I have not in my experiments succeeded in obtaining any such marked negative variation.

With this I have completed such evidence as I am able to offer in support of the hypothesis I have advanced to explain the interconnexion of the positive and negative phases observed after tissue-fibrinogen injections.

Notes added in Press.

A.—Hoffmeister (Ztschft. f. Phys. Chem., 1880), has shown, in connexion with pus, that the mere addition of an alkali in the cold, splits off a large quantity of "peptone" from the leucocytes. These leucocytes of course constitute one of the mother-substances of tissue-fibrinogen.

B.—A copious excretion of albumoses or peptone also takes place in the urine of rabbits after hypodermic injections of sterile-fibrinogen solutions. The urine of such rabbits is acid on reaction. It gives no coagulum on boiling, but gives a biuret reaction. It gives a heavy flocculent precipitate on addition of alcohol. This precipitate when collected will dissolve readily in either cold or boiling water (even after it has been standing for three or four days under absolute alcohol), and will then give very distinct xantho-proteic and biuret reactions.

P.S.—The tissue-fibrinogen employed in the experiments reported above was in all cases prepared from bulls' testicles.

X.

CROP AND STERNUM OF OPISTHOCOMUS CRISTATUS: A CONTRIBUTION TO THE QUESTION OF THE CORRELATION OF ORGANS AND THE INHERITANCE OF ACQUIRED CHARACTERS.

By HANS GADOW, Ph. D., M.A., Strickland Curator and Lecturer on the Advanced Morphology of Vertebrata in the University of Cambridge. (Plates VII. and VIII.)

[COMMUNICATED BY D. J. CUNNINGHAM, M.D., F.R.S.]

[Read June 22, 1891.]

Several adult specimens of Opisthocomus in the Cambridge Museum, and a series of well-preserved nestlings and embryos entrusted to me for examination by the Rev. Dr. Haughton, have enabled me to inquire into the peculiar structures of this neotropical bird. This inquiry revealed an instance in which an obviously primary modification, itself referable to mechanical strain during the life of the adult, seems to have caused other organic changes which are repeated in the embryo at a time before such a strain could come into play. It is easily demonstrated, by examination of the embryos, that these characters are inherited, but if, and how, they were acquired, is a question which necessitates a special investigation.

Six or seven similar cases I have recently published elsewhere.[1]

The alimentary canal, notably the peculiar crop of the Hoazin, has been well described in its general features by L' Herminier;[2] but it has hitherto never been figured correctly, nor has its correlation

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[1] "Description of the Modifications of Certain Organs which seem to be illustrations of the Inheritance of Acquired Characters in Mammals and Birds."—Zoologische Jahrbücher, Abtheilung f. Systematik, Bd. v. (1890), pp. 629–646, Taf. xliii., xliv.

[2] "Recherches anatomiques sur quelques genres d'oiseaux rares ou encore peu connus sous le rapport de l'organisation profonde. Par L'Herminier, médecin à la Gouadeloupe."—Annales des Sciences naturelles, 2de série, Tome 7ème. Zoologie, 1838, pp. 96–107, § 1. Sur le Sasa, Opisthocomus (Hoffmansegg).

with other organs been examined.[1] After removal of the skin from the breast of an adult bird there appears a huge, apparently simple sac, which extends from the level of the upper ends of the coracoid bones down to within 2 cm. of the hinder margin of the sternum. The sac is formed by an enormously elongated, widened, and doubled-up portion of the middle of the œsophagus, and is consequently a true crop. The originally anterior and ventral margins of this œsophageal loop are much bulged out, while the posterior and dorsal margins of the loop touch each other, and are partly connected by loose tissue. The whole loop is, moreover, turned sidewards, so that its upper or cervical half lies on the left, the lower or thoracic half on the right side of the breast. The walls of the crop are greatly thickened, partly owing to the strongly-developed outer or annular muscular coating, and partly through the presence of about twenty prominent and rough folds, which, parallel to each other, project from the ventral and lateral walls into the lumen of the organ. Each of these folds averages about 6 mm. in breadth and 3 mm. in height. Some of the folds are continued into that part of the œsophagus which connects the crop with the proventriculus. This portion is about 12 cm. long, and only 1 to 2 cm. wide, twisted and irregularly constricted. It passes, of course, into the thorax between the clavicles, but, owing to its length and bulk in general, it has shoved the stomach so far back that the gizzard, in spite of its smallness, appears partly below the left posterior margin of the sternum. The last 1·5 cm. of the œsophagus are narrow, very thin-walled, and smooth inside. The proventriculus is small, less than 2·5 cm. in length, and scarcely much wider than the duodenum; it is much constricted off from the gizzard, which latter is of the size and shape of a large olive. The walls of the gizzard are thin and weak, although they are lined with a

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[1] Dr. E. P. Wright has kindly drawn my attention to the following Paper which had escaped my notice :—"On the Habits and Anatomy of *Opisthocomus cristatus*," Illig., by Dr. C. G. Young. Notes from the Leyden Museum, vol. x., 1888, pp. 169–171, pl. VIII. Dr. Young has observed the "stinking pheasant" in its native haunts in British Guiana. The birds live together in great numbers on the low shrubs bordering the tidal portion of the Berbice river, especially on *Drepanocarpus lunulatus* and *Caladium* (*Arum*) *arborescens*, the leaves, possibly also the seeds, of which plants they eat. They are entirely arboreal, build a loosely constructed nest on the top of a low bush, and most probably feed their young from the crop. The young, when hatched, are covered with a light coat of brown down, and at once creep about with the assistance of their sharply hooked claws. Dr. Young's description and figures of the crop, stomach, and windpipe are somewhat peculiar, and justify my introductory remark.

brown and somewhat hardened cuticular coating. The pylorus is wide, but provided with a valvular sphincter.

It cannot be doubted that the mechanical work of preparing the food for digestion goes on almost exclusively in the crop. There the food of the Hoazin, which according to L' Herminier and others consists chiefly of the leaves of *Arum arborescens*, L., is triturated, so that only the comminuted particles of the food pass into the stomach, there to be acted upon by the gastric juice. L' Herminier not quite happily compared this arrangement—unique among birds—with that of ruminant mammals. W. Marshall (inedited description of a preparation of Opisthocomus in the Leyden Museum, figured in Bronn's *Thierreich*, Bd. Voegel, Taf. xxxv.) suggested that this bird uses its strongly muscular crop for pressing out the juice of the Arum leaves, and that it then ejects the hard remains through the mouth. Probably such a process of "pressing" does take place, but no regurgitation, because I have found the whole of the intestinal canal of the two adult specimens filled with the same comminuted stuff, which had accumulated in the stomach and in the colon-like portion of the œsophagus.

At any rate we have here an instance in which one organ, the gizzard, has been much reduced in strength and size, because it has been relieved of its chief function through the assumption of this very function by another organ, the crop. There is no other instance known that in birds the crop acts otherwise than as storeroom for a large quantity of food. On the other hand, somewhat similar cases of the correlation of the gizzard with other portions of the alimentary canal are common enough, *e. g.* the extremely small size of the Pelican's gizzard, since in these birds the large œsophagus, and the wide proventriculus with its strong gastric juice, are sufficient for the dissolution of the food.

However, the most interesting feature in connexion with the œsophagus, crop, and stomach of the Hoazin are not the peculiar shape and structure of the parts themselves, but the changes which the latter have produced in other organs.

The wide and thick-walled crop does not simply hang down in front of the neck, as it does in the common fowl, nor is it partly shunted sidewards and backwards upon the neck, as in many other birds, but it rests directly upon the breast bone. More than two-thirds of the length of the crista sterni[1] are suppressed, or rather the keel has

[1] While I was making these investigations the last work of the late Prof. W. K. Parker has been issued, June 1st, 1891. I have, therefore, only to refer to the

been shoved backwards, while the anterior margin of the keel has been drawn out to a great extent. The median furcular apophysis is fused with this drawn-out anterior margin of the keel, and also with the spina sterni between the feet of the two coracoid bones. Moreover, the upper ends of the clavicles, although still strong, are anchylosed and co-ossified with the upper ends of the coracoids. Lastly, the clavicles are so much depressed that they stand parallel with the shafts of the coracoids.

The large pectoral muscles (*M. pectoralis*) arise from the ventral and posterior half of the sternum, from the ventral half of the short keel, from the much-elongated and stretched ligamentum cristi-claviculare, and, lastly, from the long and sharp-edged continuation of the median furcular apophysis. The muscles themselves are strong in their posterior portion, which is covered directly by the skin, but they are much weaker and thinner in their anterior half, which is overlaid by the crop.

The second pectoral (*M. supracoracoideus, s. subclavius*) has scarcely been affected by the pressure from the crop; but owing to the length of the lig. crist. claviculare and the partial suppression or removal of the keel, it arises to a considerable extent from this ligament, and touches its fellow, while a normally developed keel naturally separates the two muscles from each other.

All these modifications seem to have been caused by the close apposition of the large and hard crop upon the ventral side of the shoulder girdle and sternum. This pressure, of course, cannot be that of gravity, because in the ordinary position of the bird the crop does only partly rest upon the sternum, and we cannot assume that the thorax has been pressed in by the weight of the crop. The anterior portion of the thoracic cavity, is, however, perceptibly diminished, and this can only be explained by the thorax having been prevented from expanding ventrally where it came into conflict with the crop. The narrowed space of the thoracic cavity, and the circumstance that it contains an unusually long and widened portion of the œsophagus, is correlated with the backward position of the proventriculus and gizzard. Both, although much reduced in size, are placed so far back in the thoracic cavity as I have observed in no

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beautiful illustrations, and to the description of the embryonic development of the skeleton by this indefatigable worker.

"On the Morphology of a Reptilian Bird, *Opisthocomus cristatus*." By Prof. W. K. Parker, F.R.S., Trans. Zool. Soc. Lond., xiii., pt. 2, pp. 43–85, pls. VII.–X. Read February 4th, 1890.

other birds. Moreover, even the heart has assumed a very narrow and conically elongated shape, probably owing to the mutual pressure of the organs crowded into the thorax, namely, œsophagus and proventriculus, liver, lungs, airsacs, and heart.

The Hoazin also differs from all other birds by the strength and width of its ribs. The sternal portions of the three middle ribs are very thick, and the dorsal portions of most of the ribs are broadened out to such an extent as to touch each other. Uncinate processes do not exist as separate lamellæ, they being fused completely with the posterior margins of the broadened ribs to which they belong. It is possible that the thoracic frame has thus been strengthened in order to withstand further compression; and even if this view be discarded, the necessity of having to carry the huge crop, with its contents, may have caused this strengthening of the thorax, so that after all there seems to exist an intimate connexion between this crop and the peculiarly modified thorax.

If we assume that the large crop of the Hoazin has produced the depression of the furcula, its partial fusion with the sternum, and the distortion of the anterior margin of the keel, we should naturally expect that at least somewhat similar modifications occur in other birds which possess a large crop. This is actually the case. However, we must not forget that the crop of the Hoazin is unique in its structure, and that there exist many birds whose large crops simply rest between the arms of the furcula, which are in this case widened or opened, or birds in which the crop simply hangs down in front of the neck, and does hardly come into permanent contact with either furcula or sternum. Shape and strength of the furcula stand also in close correlation with another factor, namely, with the power of flight, although it must be observed that rudimentary clavicles are by no means incompatible with well-developed power of flight, *e. g.* in the Platycercinæ, a family of the Parrots.

These considerations naturally complicate our problem, but the following analytic cases may help towards its solution:—

All the Columbæ have a large, soft-walled crop; by inference we conclude that such an organ was also largely developed in Pezophaps and in Didus. In both these genera, which were, however, flightless, the clavicles are reduced to narrow splints, which in Pezophaps closely approach, and which in Didus even touch, the coracoids. In nearly all the living pigeons, birds notorious for their power of flight, the clavicles are likewise very slender, and slightly curved inwards and towards the vertebral column, not convex and curved outwards, as is the rule in birds. The keel of the sternum is very high and long, in conformity with the strong muscles of flight, which arise therefrom, and the crop actually rests upon, and is supported by, the anterior margin of the keel.

The Psittaci have, likewise, a fair-sized, but very thin-walled crop. The clavicles of many genera show features similar to those of the Columbæ.

The Rasores, or gallinaceous birds, all possess a crop which is often large and heavy, but thin-walled; it hangs down from about the middle or beginning of the last third of the neck. The furcula is, as a rule, curved outwards, the keel is strong and high, but recedes so far backwards (the anterior margin being consequently much elongated) that neither itself nor the pectoral muscles come into collision with the globular sac-like crop. In Meleagris the furcula is pressed down and straight, bearing in this respect an unmistakable resemblance to Pezophaps and Opisthocomus.

In all the other birds which possess a crop this organ is either a long, but not sac-shaped, dilatation, or, if more or less globular and pouch-like, it is received by the widened interclavicular space.

It seems, therefore, justifiable to correlate the distortions of the skeletal parts of the Hoazin with its peculiarly-developed alimentary canal, notably with the crop, and to look upon this crop as the cause of the skeletal modifications. To take the reverse view, to consider the recession of the keel and the depression of the furcula as the primary feature which then, so to say, invited the crop to lodge itself in this pre-formed space, would be a mode of argumentation which could scarcely be maintained seriously. Moreover, nestlings and embryos afford the clue to the question.

In nestlings which are about a week old all the peculiarities of the old Hoazin are already present, with the unimportant exception that the long median furcular apophysis is not yet completely fused with the anterior margin of the keel. The whole crop is already ventrally placed upon the breast bone.

Similar conditions prevail in embryos of the last week before hatching. The keel is already far reduced, but not so far as in the later stages, and there is still a wide space between it and the crop, where, with the help of the lig. crist. claviculare, the large pectoral muscles meet each other subcutaneously. The heart still agrees in its shape with that of the majority of birds.

In younger embryos, which do not yet show any traces of feathers, except a few papillæ, and which correspond with chicks' embryos of five to six days, the whole crop, although presenting already the adult configuration, rests between the clavicles; the furcular apophysis is not yet fused with the anterior margin of the keel, and the latter is just beginning to be formed by the elevated margins of the two sternal plates of cartilage, which posteriorly are not yet completely united. The length of the keel is still comparatively greater, and the lig. crist. claviculare is correspondingly shorter than it is in the later stages. The heart appears between the posterior halves of the sternal plates, and still retains the shape which is typical of embryonic birds.

The ontogenetic development of the Hoazin shows, consequently, two important features. First, the crop assumes its peculiar shape at a very early period, certainly long before it can be functional, and also earlier than in birds of similar size and of similar length of the incubating period. Secondly, although we see that, and how, the crop, by its downward growth, gradually encroaches upon, and modifies, the conformation of neighbouring organs, some of these modifications of the sternal apparatus are already pre-formed to a considerable extent, before they are actually necessitated. They are inherited.

The embryonic development of the Hoazin shows a faithful but slightly condensed repetition of those changes which its ancestors have acquired through adaptation to a peculiarly isolated life and diet.

EXPLANATION OF PLATES VII. AND VIII.

Plate VII.

Fig. 1. Dorsal view of the crop and stomach of an adult *Opisthocomus cristatus*, natural size. The tract from the crop to the gizzard has been opened to show its internal structure.

,, 2. Ventral view of the crop, after an opening has been cut into its walls, half natural size.

,, 3*a*. Ventral view of two nestlings after removal of the skin, two-thirds natural size. Fig. 3*b* shows the crop, short keel, stomach, right lobe of liver, and duodenum.

Plate VIII.

,, 4. Ventral view of an embryo of the last week of incubation, after removal of the skin, natural size. To show the formation of the crop, distance of the latter from the comparatively long sternal crest, and the meeting of the two pectoral muscles.

,, 5. Ventral view of the crop of an embryo of about five to six days of incubation, showing its position still within the interclavicular spaces, the length of the sternal crest, and the position of the heart (H), two-thirds natural size.

,, 6. Ventral view of the heart of the same embryo, for comparison of its shape with that of the nestling, two-thirds natural size.

,, 7. Ventral view of the heart of the nestling of fig. 3*a*, natural size.

,, 8. Side view of part of the skeleton of an adult *Opisthocomus cristatus*, three-eighths natural size.

,, 9. Side view of the sternum and shoulder girdle of an adult *Meleagris mexicana*, one-fourth natural size.

,, 10. Side view of the sternum and shoulder girdle of an adult *Goura coronata*, one-fourth natural size.

Figs. 3, 8, 9, and 10 were drawn from photographs.

XI.

ON SOME RECENTLY DISCOVERED FRAGMENTS OF AN OLD LATIN VERSION OF HOLY SCRIPTURE. By Rev. J. H. BERNARD, B.D., F.T.C.D.

[Read January 11, 1892.]

In the year 1883 Signor G. F. Gamurrini, the librarian of a lay-brotherhood established at Arezzo, in Tuscany, found among the books entrusted to his care a Latin MS. of considerable interest. Gamurrini published an account of his discovery in *Studi e Documenti di Storia e Diritto* (1884), and in 1887 issued a volume containing the text of the MS., with introduction, fac-similes, and notes. The MS. is said to be written in an eleventh-century hand, and its discoverer considers it tolerably certain that it was the work of a monk at Monte Casino. It is mutilated at the beginning and end, and many pages are missing in various parts; but it contains a portion of the lost treatise *De Mysteriis* by S. Hilary of Poitiers and two hitherto unknown hymns by that bishop, together with the account of a journey to the Holy Land made by a female pilgrim.

The *Peregrinatio* has excited more interest than the treatise by S. Hilary. Gamurrini issued a second edition in 1888. It was published by the Russian Palestine Society in 1889, and has also been edited in this country by myself for the Palestine Pilgrims' Text Society, with a translation and notes (1891). It is sufficient here to state simply that it contains a picturesque and vivid account of a pilgrimage to the East made by a noble lady of Gaul between the years 379 and 388 A.D. This date may be regarded as quite certain from the internal evidence of the narrative. The name of the lady is doubtful, and will probably always remain so; but Gamurrini has made out a plausible case for identifying the adventurous traveller with S. Silvia of Aquitania (a sister of Rufinus, who was Prefect of the East under Theodosius the Great), of whose journey from Jerusalem to Egypt there is a notice in the *Historia Lausiaca* of Palladius. For my present purpose, however, the name is of no importance; but the date and nationality of the pilgrim are to be remembered. Her account was written before the year 388, and she came from Gaul, probably from Aquitania.

The treatise ascribed to S. Hilary in the MS. is one with the name of which we are acquainted from the information supplied by Jerome, who speaks (*De Script. Eccles.* in Hilario) of "Liber Hymnorum et Mysteriorum alius." And there is no doubt that we have in the MS. discovered by Gamurrini this lost treatise preserved for us. It is a work on the allegorical and mystical significance of the lives and sayings of Old Testament characters. Hilary was a follower of Origen in his methods of exegesis, as we know from his Commentaries on S. Matthew and on the Psalms; and the treatise before us is very similar in style to these, which are among his best known and most characteristic works. The two alphabetical hymns which follow the *Tractatus de Mysteriis* are apparently from the *Liber Hymnorum*, spoken of by Jerome. From the nature of this book *On Mysteries*, it is plain that a good deal will turn on exact verbal citation of Scripture; an author who finds a deep spiritual meaning in every word is not likely to quote carelessly or at random. And hence the large number of passages from Scripture cited by Hilary afford valuable evidence as to the text of the Latin Version of the Bible which he habitually read. He died in 368 A.D., before S. Jerome's labours on the Vulgate had been accomplished; and thus the version used by him was, as is well known, one of those described by scholars as an "Old Latin" version.

Much yet remains to be done before it can be said that we have materials for generalizing as to the number and specific character of these pre-Hieronymian Versions of Scripture. Sabatier's monumental work (Biblior. Sacr. Versio Latina Antiqua, 1751) still remains the standard source of information on the subject; but Sabatier does not distinguish from each other the different types of text. He speaks of a *versio antiqua*; whereas it is more than probable that there were several *versiones antiquæ* current in different parts of Christendom before they were superseded by Jerome's labours.

Vercellone (Variæ Lectiones Vulg. Lat. Bibliorium, 1860–4) added to the materials amassed by Sabatier, and fragments of the Old Testament are being gradually gathered from different quarters to enrich the all too scanty store. A large portion of the Pentateuch is extant in a Lyons MS., edited by M. Ulysse Robert (*Versio Lugdu-*

nensis); and Bishop Wordsworth's well-known labours in the field of Old Latin Biblical Texts will, it may be hoped, enable him to formulate some general conclusions on this perplexing literary problem. Meanwhile, any additional facts are valuable, and I have collected in this paper the citations from Scripture that occur in the newly-discovered work of Hilary and in the *Peregrinatio*, which are both pre-Hieronymian. I have kept these distinct, though they probably represent the same ancient version. I have printed, in parallel columns, Sabatier's text as a kind of standard of comparison; and I have added the renderings of the *Codex Lugdunensis* of the Pentateuch, and the *Codex Usserianus* of the Gospels, wherever they are available and of interest.

Mr. F. C. Conybeare, in the *Expositor* for July and August, 1891, called attention to the fact that in the old Latin version of part of the *Quæstiones in Genesin* of Philo, fragments of a pre-Hieronymian text of Genesis were embedded. He noted that these presented affinities to the Lyons MS.; and it will be seen, I believe, that, as we might expect, they also agree fairly well with Hilary's version.

If any doubt is felt as to whether Hilary in these citations is not translating for himself direct from the Greek, rather than using an existing Latin version, it will be dispelled at once by considering the close parallels to the readings of the *Codex Lugdunensis*, which are here preserved. And the similarity of the citations in Nos. 44–47 to those of the same passages which may be instanced from other writings of Hilary affords a guarantee that he is not quoting at random. On the whole, these fragments considerably strengthen the evidence for a distinct Gallican recension of the Latin Bible.

I have added a few simple critical notes, but am not prepared to venture on any generalizations. I may say, however, that I do not find such a correspondence between Lucian's recension of the Septuagint (as printed by Lagarde, Göttingen, 1883), and this Gallican version of the Latin Bible, as Vercellone observed between Lucian's text and the O. L. Versions generally. See Nos. 7, 12 (*bis*), 13, 14, 15 [?], 55, in all of which cases the Gallican recension agrees with Cod. Alexandrinus (A) (as regards order of words, &c.), against Lucian's Greek text. No. 28 (*bis*) is the only case among these fragments where I notice that Hilary's old Latin favours Lucian against A. The slavish literalness of these ancient Latin translations makes this a more reliable inference as to the Greek text followed than might appear at first sight; but of course the number of instances examined is far too small to admit of any sound generalization.

In a few cases (Nos. 14, 19, 56, 57) verses are here printed, the O. L. version of which was not previously known; and in other cases (7, 9, 53, 55) passages hitherto known only in part are completed.

The numbers in square brackets following the citations refer to the folios of the original MS. as numbered by Gamurrini.

S. Hilary.	Uersio Antiqua.

1. Gen. ii. 23:

Hoc nunc os de ossibus meis et caro de carne mea. haec uocabitur mulier, quia de uiro suo sumpta est, et eritis duo in carne una [p. 2].	Hoc nunc os de ossibus meis et caro de carne mea: haec uocabitur mulier, quoniam ex uiro suo sumpta est, . . . et erunt duo in carne una.

Vercellone, referring to the version given by Sabatier, as compared with the Vulgate, which has *uirago*, remarks:—Angelomus dicit 'in quibusdam codicibus invenitur *mulier*. Nimirum ita legebatur in Itala, quamquam haud desunt prisci auctores apud Sabatierium cum Vulgato facientes.'

2. Gen. iv. 7:

Nonne si recte offeras, recte tu non dividas, peccasti? [p. 6].	Nonne si recte offeras, recte autem non dividas, peccasti?

Autem is faithful to the Greek; *tu* is probably a copyist's blunder.

3. Gen. iv. 23, 24:

Dixit autem Lamech mulieribus suis, Adae et Sellae: Audite uocem meam mulieres Lamech, intuemini uerba mea; quoniam uirum occidi in uulnere mihi; et iuuenem in liuore meo. quoniam septies uindicatum est de Cayn, de Lamech autem septuagies septies [p. 6].	Audite uerba mea uxores Lamech, auribus percipite uerba mea: quia uirum occidi in uulnus meum, et iuuenem in liuorem meum, quoniam septies uindicabitur de Cain, de Lamech autem septuagies septies.

Hilary's version here follows the Greek more closely than that printed by Sabatier from Jerome. But Jerome, in another citation of the same passage, reads *in uulnere meo . . . in liuore meo* with Hilary.

4. Gen. iv. 25:

Excitauit mihi Deus semen aliud pro Abel, quem occidit Cain [p. 8].	Suscitauit enim mihi Deus semen aliud pro Abel, quem occidit Cain.

5. Gen. v. 28, 29:

Et Lamech genuit filium, et uocavit nomen eius Noe, dicens: Hic requiescere faciet nos ab operibus nostris et a tristitiis manuum nostrarum, et a terra cui maledixit Dominus Deus [p. 8].	. . . Et uocavit nomen eius Noe, dicens: Iste requiescere nos faciet ab operibus nostris et a tristitia, et a terra cui maledixit Dominus Deus.

The insertion of *manuum nostrarum* accords with the Greek.

S. HILARY.	UERSIO ANTIQUA.
6. GEN. vii. 1 :	
Introibis autem arcam tu, et filii tui, et uxor tua, et uxores filiorum tuorum [p. 9].	Intra tu et omnis domus tua, in arcam.

There is probably some confusion here with Gen. viii. 16: the quotation, although preceded by the words *scriptum enim est*, is not accurate. Cf. No. 7.

7. GEN. viii. 15, 16 :	
Dixit Dominus Deus ad Noe dicens: Exi de arca tu, et uxor tua et filii tui, et uxores filiorum tuorum [p. 10].	Dixit Dominus Deus ad Noe: Exi de arca tu, et uxor tua, et filii tui.

(1) *dicens* and *et uxores filiorum tuorum* are both justified by the Greek.
(2) The order *uxor tua et filii tui* agrees with A against Lucian's version.

8. GEN. xix. 24 :	
Pluit sulfur et ignem Dominus a Domino [p. 26].	Pluit Dominus . . . sulphur et ignem a Domino.

This is not a direct citation.

9. GEN. xxv. 30, 32:	
Da mihi gustare de coctura hac, quia deficio. Propter hoc appellatum est nomen eius Edom . . . ecce ego morior, et quo mihi hos primatus? [p. 11].	Da mihi gustum de coctione rubea ista, quia deficio. Propterea uocatum est nomen eius Edom . . . ut quid mihi primatus?

The reading of the old Latin Version in Philo's *Quaestiones in Genesin* has remarkable affinities with Hilary's reading: it is—Gustemus de hac coctura. Quare uocatum est nomen eius Edom . . . ecce ego pergam mori et [ad] quid mihi primitiae istae? Cf. No. 35.

10. GEN. xxvii. 21 :	UERS. LUGD.
Accede ad me, et pertentabo te, fili, si tu es filius meus Esau aut non [p. 13].	[*Itala deest.*] Accede ad me, ut palpem te, fili, si tu es filius meus Esau aut non.

The old Version in Philo (l. c.) has: Approxima [mihi], et palpabo te, fili, si tu es filius meus Esau. *Ut palpem* in the Lyons MS. is not so near the Greek καὶ ψηλαφήσω as either Hilary's version or that in Philo.

11. GEN. xxvii. 22 :	UERSIO ANTIQUA.
Uox quidem uox Iacob, manus autem manus sunt Esau [p. 13].	Uox quidem uox Iacob, manus autem manus Esau.

The old Version in Philo (l. c.) has: Uox quidem uox Iacob, manus uero manus Esau. The counterpart of *sunt* does not appear in the Greek.

S. Hilary.

12. Gen. xxvii. 27-29 :

Ecce odor filii mei, sicut odor agri pleni, quem benedixit Dominus ; et det tibi Dominus a rore coeli desusum, et ab ubertate terrae habundantiam frumenti et uini ; et seruient tibi gentes, et adorabunt te principes : et esto dominus fratris tui, et adorabunt te filii patris tui : et qui maledixerit te, maledictus erit, et qui benedixerit te, benedictus erit [p. 11].

Uersio Antiqua.

Ecce odor filii mei, sicut odor agri pleni quem benedixit Dominus. Et det tibi Deus de rore coeli, et de ubertate terrae et multitudinem frumenti et uini. Et seruiant tibi gentes, et adorent te principes ; et fiere dominus fratris tui, et adorabunt te filii patris tui : et qui maledixerit te, maledictus, et qui benedixerit te, benedictus.

The old Version in Philo (l. c.) has : Ecce, odor filii mei sicut odor agri pleni, quem benedixit Deus. Dabit tibi Deus de rore coeli et de pinguedine terrae. Seruient tibi gentes. Adorabunt te principes. Esto dominus fratris tui. Qui te maledixerit, maledictus erit ; et qui te benedixerit, benedictionibus repleatur.

Uers. Lugd.

Ecce odor fili mei sicut odor agri pleni quam benedixit Dominus Deus ; et det tibi Deus a rore caeli desusum et a pinguidine terrae multitudinem frumenti et uini et olei ; et seruiant tibi gentes, et adorent te principes ; et fias dominus fratris tui, et adorabunt te fili patris tui : et qui te maledixerit, maledictus erit, et qui te benedixerit benedictus erit.

As to the variants, we learn from the Greek :—

(1) The first *Dominus* in Hilary is right, as against *Deus.*

(2) The second *Dominus* should be *Deus.*

(3) *Det* corresponds to δώῃ, the reading of A against δώσει (Lucian's recension).

(4) *Desusum* = ἄνωθεν is present in A, but not in Lucian's text.

(5) *Adorabunt* (προσκυνήσουσι) has the authority of A and Lucian against *adorent* = προσκυνησάτωσαν (D E).

13. Gen. xxvii. 37-40 :

Si dominum illum feci tuum, et omnes fratres eius feci illi seruos, frumento et uino confirmaui eum : tibi autem quid faciam, fili ? . . .

Ecce ab ubertate terrae erit habitatio tua, et a rore coeli desusum, et in gladio tuo uiues et fratri tuo seruies : erit autem, cum deposueris iugum ipsius a collo tuo [p. 13].

Uersio Antiqua.

Dominum tuum feci illum, et omnes fratres eius feci seruos ; tritico et uino confirmaui eum : tibi autem quid faciam fili ? . . .

Ecce a fertilitate terrae erit habitatio tua, et a rore coeli desuper, et super gladium tuum uiues et seruies fratri tuo : erit autem cum deposueris et solueris iugum illius a collo tuo.

The old Version in Philo (l.c.) has : Si dominum illum feci tibi, et frumento et uino confirmaui eum, tibi quid faciam fili? . . .

Uers. Lugd.

Si dominum tuum feci eum, et omnes fratres eius feci ipsius domesticos, tritico et uinofirmaui eum ; tibi autem quid faciam fili ? . . .

UERS. LUGD.

A pinguedine terrae erit inhabitatio tua, et de rore coeli desusum, Super gladium uiues, fratri tuo seruies; erit ergo cum deposueris, et exoluas iugum tuum de collo tuo.

Ecce a potu terrae erit commoratio tua, et a rore caeli desusum. Et super gladium tuum uiues et fratri tuo seruies. Erit autem, cum deposueris et resolueris iugum ipsius de collo tuo.

From the Greek we see:—

(1) *si* is right (εἰ).
(2) The order *illum feci tuum* is right.
(3) The second *feci* has the authority of A; Lucian's recension omits it.
(4) *In gladio* is apparently not so near to ἐπὶ τῇ μαχαίρᾳ as *super gladium;* cf. No. 26.
(5) The order *fratri tuo seruies* is right.

S. HILARY.

14. EXOD. xv. 25, 27:

Ibi posuit Deus iustificationes et iudicia, et ibi temptauit eum. . . . Et uenerunt in Elym, et erant ibi duodecim fontes aquarum et septuaginta arbores palmarum, consederunt autem ibi ad aquas [p. 18].

[*Itala deest.*]

An addition to the Old Latin text, following the Greek closely. In the order of the words *temptauit eum* it agrees with A B against Lucian's recension.

15. EXOD. xvi. 4:

UERSIO ANTIQUA.

Dixit Dominus ad Moysen: ecce ego pluam uobis panes de coelo, et exiet populus, et colliget unius diei in diem, ut temptem eos, si ingredietur in legem meam an non [p. 19].

Dixit autem Dominus ad Moysen: ecce ego pluam uobis panes de coelo, et exiet populus, et colliget unius diei in diem, ut tentem illos si ambulabunt in lege mea an non.

(1) From the Greek it would seem that *autem* should be present after *dixit.*

(2) The only Greek variant of importance affects the word *colligit* = συλλέξουσι (A B) or συνάξουσι (Lucian).

16. EXOD. xvi. 12:

Ad uesperam editis carnem, et mane replemini pane [p. 19].

Ad uesperam edetis carnes, et mane replebimini panibus.

Sabatier gives the better readings here *edetis* (ἔδεσθε), and *replebimini panibus* (πλησθήσεσθε ἄρτων), but *carnem* is nearer the Greek than *carnes.*

17. EXOD. xxv. 40; cf. Heb. viii. 5:

. . ut omnia secundum speciem quam in monte uidisset, faceret in terra . . . [p. 23].

. . ut facias omnia secundum speciem quam ostendi tibi in monte . . .

UERS. LUGD.

This is not a direct citation.

. . Haec facies secundum formam quae demonstrata est tibi in montem . . .

S. Hilary.	Uersio Antiqua.
18. Deut. xxviii. 66: Uidebitis uitam uestram pendentem in conspectu oculorum uestrorum nocte et die, et timebitis, et non credetis uitae uestrae [p. 17].	Et erit uita tua pendens in ligno ante oculos tuos . . . et non credes uitae tuae.

Sabatier quotes another rendering from Novatian: Uidebitis uitam uestram pendentem nocte ac die et non credetis ei, which agrees with Hilary. We have apparently got fragments of two distinct O. L. versions of this verse. Cf. No. 23.

S. Hilary.	Uersio Antiqua.
19. Josh. ii. 11 . . . : . . . Deumque eorum esse suum in coelo et in terra deorsum [p. 24]. This is not a direct citation.	[*Itala deest.*]
20. Ps. xlvi. 2: Omnes aquae plaudite manibus [p. 17].	Omnes gentes plaudite manibus.

Aquae is strange, but it cannot be a transcriber's error, from the context in which the passage is cited by Hilary.

S. Hilary.	Uersio Antiqua.
21. Ps. lxxvi. 17: Uiderunt te aquae, Deus [p. 17].	[*Id.*]
22. Ps. lxxix. 9: Uineam enim ex Ægypto transtulit et plantauit Dominus [p. 10]. This is not a direct citation.	Uineam ex Ægypto transtulisti . . . et plantasti eam.
23. Ps. lxxxix. 4; cf. 2. Pet. iii. 8: Quia anni mille in conspectu Domini tamquam dies una [p. 20].	Quoniam mille anni ante oculos tuos Domine, sicut dies unus.

Sabatier cites in a note from Cassiodorus, *mille enim anni in conspectu Dei tanquam dies una.* Cf. No. 18.

S. Hilary.	Uersio Antiqua.
24. Ps. cxiii. 1: Domus Iacob de populo barbaro [p. 22].	[*Id.*]
25. Isa. v. 7: Uineam Domini Sabaoth domus Israel est [p. 10].	Uinea enim Domini Sabaoth, domus est Israel.

Uineam is probably merely a transcriber's blunder.

S. Hilary.	Uersio Antiqua.
26. Jer. xi. 19 :	
Super me cogitauerunt cogitationem dicentes : Uenite iniciamus lignum in pane eius [p. 17].	In me cogitauerunt cogitatum dicentes : Uenite mittamus lignum in panem eius.

(1) *super* is perhaps a more natural rendering of ἐπί than *in :* cf. No. 13.

(2) *iniciamus* is nearer ἐμβάλωμεν than *mittamus;* and it occurs in a citation given by Sabatier *in loc.* from Rufinus.

(3) *pane* is probably a transcriber's blunder (εἰς τὸν ἄρτον).

27. Hosea, i. 2:	
Uade, accipe tibi uxorem fornicationis, quam fornicando, fornicabitur terra a Domino [p. 21].	Uade, tolle tibi uxorem fornicationis; . . . quia fornicans, fornicabitur terra post Dominum.

Quia fornicans is nearer διότι ἐκπορνεύουσα than Hilary's rendering; but the Latin translator of Irenaeus has *quoniam fornicando fornicabitur terra a Domino.*

28. Hosea, ii. 18–24 :	
Disponam autem illis ea die in testamentum cum bestiis agri et uolatilibus coeli et serpentibus terrae et arcum et frameam et bellum conteram de terra; et conlocabo te in spe ipsi, in aeternum. . . . Sponsabo te mihi in iustitia et fide, et cognosces Dominum ; et erit in illa die dicit Dominus ; exaudiam coelo, et coelum terrae, et terra exaudiet frumentum et uinum et oleum ; eaque exaudiet Israel : et seminabo eam mihi super terram, et diligam non dilectam, et dicam non populo meo, populus meus tu [p. 21].	Et disponam eis testamentum in die illa cum bestiis agri et cum uolatilibus coeli et cum reptilibus terrae : et arcum et gladium et bellum conteram de terra; et habitare eos faciam in spe . . . in sempiternum. . . . Sponsabo te mihi in iustitia et . . . fide, et scies quia ego Dominus ; et erit in die illa dicit Dominus ; exaudiam coelum et coelum exaudiet terram, et terra exaudiet frumentum uinum et oleum ; et haec exaudient Iezrael : et seminabo eam mihi super terram, et miserebor eius quae fuit Absque misericordia, et dicam non populo meo, populus meus es tu.

(1) *Conlocabo te* = κατοικιῶ σε (Lucian); A has κατοικιῶ αὐτοὺς.

(2) *Cognosces Dominum* is a more direct rendering of the Greek than that printed by Sabatier.

(3) *Diligam non dilectam* = ἀγαπήσω τὴν οὐκ ἠγαπημένην (Lucian); A has ἐλεήσω τὴν οὐκ ἠλεημένην, followed by *Uersio antiqua.*

29. S. Matt. v. 4 ; cf. Ps. xxxvi. 11 :	
Beati mites, quoniam ipsi hereditabunt terram [p. 23].	Beati mites quoniam ipsi possidebunt terram.

Sabatier cites Hilary's reading in his note, as having both MS. and patristic authority ; Hilary quotes the verse thus in his Commentary on St. Matthew.

30. S. Matt. v. 5:	
Beati lugentes, quia consolabuntur [p. 5].	Beati qui lugent quoniam ipsi consolabuntur.

S. Hilary.	Uersio Antiqua.
31. S. Matt. x. 34: Non ueni pacem mittere sed diuisionem [p. 24].	Non ueni mittere pacem sed gladium.

This reading is apparently due to a reminiscence of S. Luke, xii. 51.

32. S. Matt. xi. 28–30: Uenite ad me omnes qui laboratis et onerati estis, et ego uos reficiam: tollite iugum meum super uos, et discite quia mitis sum et humilis corde; et inuenietis requiem animabus uestris. Iugum enim meum suave est, et onus meum leue est [p. 9].	Uenite ad me omnes qui laboratis et onerati estis, et ego uos reficiam: tollite iugum meum super uos, et discite a me, quia mitis sum et humilis corde; et inuenietis requiem animabus uestris. Iugum enim meum suaue est, et onus meum leue est.
33. S. Matt. xii. 29: [Nemo enim uasa fortis diripiet], nisi prius fortem alligauerit [p. 15].	. . . nisi prius alligauerit fortem.
34. S. Matt. xv. 24: Ad oues perditas domus Israel [p. 15].	Ad oues quae perierunt domus Israel.

This does not occur in a direct citation; but yet Hilary's reading is supported by authorities both MS. and patristic, given in Sabatier's note.

35. S. Matt. xix. 4: Non legistis, quia qui fecit ab initio masculum et foeminam fecit? et dixit: propter hoc dimittet homo patrem et matrem . . . et erunt duo in carne una [p. 2].	Non legistis, quia qui fecit ab initio, masculum et feminam fecit eos? et dixit: propterea relinquit homo patrem aut matrem . . . et erunt duo in carne una.

Cod. Usser. and the St. Germain MS. (g_1) edited by Bishop Wordsworth have *propter hoc*. Cf. No. 9.

36. S. Matt. xxiii. 34, 35: Ideo ecce mitto ad uos prophetas, et sapientes, et scribas; et ex illis occidetis in synagogis, et persequimini eos de ciuitate in ciuitatem, ut ueniat super uos omnis sanguis iustus, qui effusus est super terram, a sanguine Abel iusti usque ad sanguinem Zachariae filii Barrachiel, quem occidistis inter templum et altare [p. 6].	Ideo ecce ego mitto ad uos prophetas, et sapientes uiros, et scribas; et ex illis occidetis . . . in synagogis uestris et persequemini de ciuitate in ciuitatem; donec ueniat super nos omnis sanguis iustus, qui effusus est super terram, a sanguine Abel iusti usque ad sanguinem Zachariae filii Barachiae, quem occidistis inter templum et altare.

Cod. Usser. has *ego* after *ecce;* and *ut* (with g_1) for the *donec* of the *uersio antiqua.*

S. HILARY.	UERSIO ANTIQUA.
37. S. MATT. xxvii. 25 :	
Sanguis eius super nos et super filios nostros [p. 6].	[*Id.*]
Cod. Usser. has *hujus* for *eius*.	
38. S. LUKE vi. 25 :	
Ueh his, quia ridunt [*sic*], quia flebunt [p. 5].	Uae uobis qui ridetis nunc ; quia . . . flebitis.
39. S. JOHN, xi. 49–51 :	
Unus autem ex his Cayphas nomine, cum esset summus sacerdos anni illius, dixit eis: uos nescitis nihil, nec percipitis, quia expedit nobis, ut unus homo moriatur pro plebe, et non uniuersa gens pereat. Hoc autem a se non dixit, sed cum esset sacerdos anni illius prophetauit [p. 7].	Unus autem ex ipsis Caiphas nomine, cum esset Pontifex anni illius, dixit illis : uos nescitis quidquam, nec cogitatis, quia expedit nobis, ut unus moriatur homo pro populo, et non tota gens pereat. Hoc autem a semetipso non dicebat, sed cum esset Pontifex anni illius prophetauit.

Cod. Usser. runs as follows :

Unus aut*em e*x eis caifas nomine cum esset summus *sac*erdotum anni illius dixit eis uos scitis nihil neque cogitatis quia expedit nobis ut unus homo moriatur pro plebe et non uniuersa gens pereat. Hoc autem ab se no*n* dixit sed cum esset summus sacerdos anni illius profetauit.

This presents remarkable affinities with Hilary's citation.

S. HILARY.	UERSIO ANTIQUA.
40. ROM. ix. 24–26 :	
Uocavit nos non tantum ex Iudaeis, sed etiam ex nationibus, sicut et in Osee dicit: Uocabo eum, qui non populus meus, populus meus, et non dilectam, dilectam. Et erit in loco quocumque, uocabuntur non populus meus, illic uocabuntur filii Deii uiui [p. 21].	Uocavit nos non solum ex Iudaeis, sed etiam ex gentibus, sicut et in Osee dicit : Uocabo non plebem meam, plebem meam : et non dilectam, dilectam. Et erit : in loco ubi dicitur eis : non plebs mea uos ; uocabuntur filii Dei uiui.

Cf. No. 28. Hilary erroneously prefaces this citation by the words *dicens ad Corinthios*.

S. HILARY.	UERSIO ANTIQUA.
41. 1 COR. ii. 13 :	
Spiritalibus spiritalia comparantes [p. 3].	[*Id.*]
42. 1 COR. xv. 47 :	
Secundus homo de coelo et Adam coelestis [p. 1].	Secundus homo de coelo . . .

S. Hilary.	Uersio Antiqua.
43. 2 Cor. iv. 8: Angustiam sustinentes, inopiam tolerantes, sed non abrelinquimur: deicimur sed non perimus, semper passiones Iesu in corpore circumferentes ut uita Iesu Christi in corpore nostro manifestetur [p. 15].	Aporiamur, sed non destituimur; persecutionem, patimur, sed non de relinquimur; deicimur sed non perimus; semper mortem Christi in corpore nostro circumferentes, ut et uita Iesu Christi in corpore nostro manifestetur.
44. Eph. iii. 6: Esse gentes coheredes et corporales et comparticipes pollicitationis eius in Christo [p. 4].	Esse gentes coheredes et concorporales et participes per promissionis in Christo.

Hilary, *in Ps.* 138, given in Sabatier, cites the verse exactly as here, except that he has *concorporales*.

45. Eph. v. 32: Hoc mysterium magnum est, ego autem dico in Christo et in ecclesia [p. 2].	Sacramentum hoc magnum est, ego autem dico in Christo et in ecclesiam.

Hilary, *in Ps.* 138, cites the verse exactly as here.

46. Phil. iii. 21: [Qui potens sit secundum eumdem apostolum] conforme efficere corpus humilitatis nostrae corporis gloriae suae [p. 4].	Qui transfigurauit corpus humilitatis nostrae, conformatum corporis gloriae suae.

This is not a direct citation; but it is strikingly similar to other citations of this verse by Hilary given in Sabatier's note.

47. Col. i. 15, 18; cf. 1 Cor. xv. 23: [Cum enim 'primitiae Christus' sit], primogenitus creaturae; . . . primogenitus ex mortuis [princeps etiam sacerdotum] ut sit in omnibus primatum tenens [p. 5].	Primogenitus omnis creaturae . . . primogenitus ex mortuis, ut sit in omnibus ipse primatum tenens.

This is not a direct citation.

48. 1 Tim. ii. 14: Quoniam Adam non peccauit, sed mulier peccans transgressione fuit. Saluabitur autem propter filiorum procreationem, si tamen in fidem manserint [p. 2].	Et Adam non est seductus, sed mulier seducta in praeuaricatione fuit. Salua autem fiet per filiorum creationem, si perseuerauerint in fide.
49. Heb. iv. 12: Qui et uerbum acutum est, penetrans usque ad diuisionem animae [p. 23].	Uiuum enim uerbum Dei et ualidum et acutum, omni gladio acutissimum et penetrans usque ad diuisionem animae.

This is not a direct citation.

PEREGRINATIO.	UERSIO ANTIQUA.
50. GEN. xv. 18: Flumen magnum Eufraten [p. 48].	[*Id.*]
51. GEN. xlvii. 6: In meliori terra Egypti colloca patrem tuum et fratres in terra Iessen, in terra Arabiae [p. 39].	In terra optima colloca patrem tuum et fratres tuos. UERS. LUGD. In meliori terra fac morari patrem tuum et fratres tuos.

This citation seems to be somewhat amplified by the pilgrim.

52. EXOD. iii. 5; cf. S. MARK, i. 7: Solue corrigiam calciamenti tui, locus enim in quo stas, terra sancta est [p. 35].	UERSIO ANTIQUA. Ne accesseris huc, nisi solueris calciamentum de pedibus tuis, locus enim in quo stas, terra sancta est. UERS. LUGD. Solue calciamentum de pedibus tuis, locus enim in quo tu stas, terra sancta est.

The first part of the verse probably owes its form to a reminiscence of S. Mark, i. 7; in which *Uersio Antiqua* has "solvere corrigiam calciamentorum eius."

53. DEUT. xxxii. 49: Ascende in montem Arabot, montem Nabau, qui est in terra Moab contra faciem Ierico: et uide terram Chanaan, quam ego do filiis Israel in possessionem: et morere in monte ipso, in quem ascenderis [p. 40].	Ascende in montem Abarim . . . et morere ibi.

(1) We have here the O. L. of this verse in full, which was hitherto unknown.
(2) *Arabot* is probably a transcriber's blunder for *Abarim*; but cf. No. 54.
(3) The Greek for the last line is: ἐν τῷ ὄρει εἰς ὅ ἀναβαίνεις [ἐκεῖ], of which the pilgrim's text is a fuller rendering than that printed by Sabatier.

54. DEUT. xxxiv. 6: Sepulturam illius nullus hominum scit [p. 42].	Nemo scit sepulchrum eius usque in diem istum.

Sabatier cites in a note a reading from S. Ambrose, which is also given by Vercellone from an anonymous author:—

Nemo scit sepulturam eius usque in hodiernum diem.

In the *Peregrinatio*, *sepultura* is apparently taken to mean the *act* not the *place* of burial: "No one knows *how* he was buried."

Peregrinatio.	Uersio Antiqua.
55. Deut. xxxiv. 8 : Et plorauerunt filii Israel Moysen in Arabot Moab et Iordane contra Iericho quadraginta diebus [p. 41].	Planxerunt filii Israel Moysen diebus triginta.

(1) We have here preserved a complete O. L. rendering of this verse.

(2) *Quadraginta* is probably a mere blunder; Vercellone notes a reading of *Brev. Goth.*, *viginti diebus*.

(3) The order of the words *filii Israel Moysen* agrees with A B against Lucian's recension of the Greek.

(4) The Vulgate translates 'Αραβώθ of the LXX correctly by *campestribus*; it is the plural of the familiar עֲרָבָה = *desert plain*.

56. I. Kings, xix. 5 : Quid tu hic Helias? [p. 34].	[*Itala deest.*]

This is an addition to our knowledge of the O. L. text.

57. Lam. i. 12 : Attendite et uidete [p. 43].	[*Itala deest.*]

This may not be a citation from Scripture, as there is nothing in the context to mark it as such, but yet I think it worth printing.

58. S. Matt. xxi. 9 : Benedictus qui uenit in nomine Domini [p. 59].	[*Id.*]
59. S. Matt. xxiv. 4 : Uidete, ne quis uos seducat [p. 65].	[*Id.*]
60. S. Luke, xxii. 40 ; cf. S. Mark, xiv. 38 : Uigilate ne intretis in temptationem [p. 66].	Orate ne intretis in tentationem.
61. S. Luke, xxii. 41 : Et accessit quantum iactus lapidis et orauit [p. 66].	Et ipse secessit ab eis quasi ad iactum lapidis et . . . orabat.

Cod. Usser. has : Et ipse discessit ab eis quantum iactus lapidis et . . . orabat.

62. S. John, xii. 1 : Cum uenisset Iesus in Bethania ante sex dies paschae [p. 63].	Iesus ergo ante sex dies paschae uenit in Bethaniam.

This is not a direct citation.

63. 2 Cor. xii. 3 : Siue in corpore siue iam extra corpus fuero [p. 55].	Siue in corpore siue extra corpus.

As this is not a professed citation, the presence of *iam* is not significant.

XII.

ON THE ORBIT OF THE BINARY STAR ι LEONIS (Σ 1536). By J. E. GORE, M.R.I.A., F.R.A.S., Honorary Member, Liverpool Astronomical Society.

[Read June 22, 1891.]

This binary star was discovered by the elder Struve in the year 1827. The change of position angle since its discovery has not been large, but I find that the motion has been round the apoastron end of the orbit, which accounts for its slow motion during the last 60 years.

By the method described in my Paper on 35 Comæ Berenices I have computed the orbit, and find the following provisional elements:—

Provisional Elements of ι Leonis (Σ 1536).

$P = 116{\cdot}27$ years	$\Omega = 46^\circ\ 37'$,
$T = 1919{\cdot}90$,	$\lambda = 216^\circ\ 15'$,
$e = 0{\cdot}818$,	$a = 1{\cdot}66$.
$i = 40{\cdot}39'$,	$\mu = -\ 3{\cdot}096^\circ$.

The following is a comparison between the recorded measures and the positions computed from the above elements. Some of the measures are rather discordant, probably due to the comparative faintness of the companion star. The components were rated 3·9 and 7·1 magnitude by Struve; 4·2 and 8·5 by Secchi; 4·8 and 7·9 by Dembowski, and 4·4 and 7·5 by Leavenworth. Flammarion thinks the smaller star variable in brightness and colour:—

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
1827·81	Struve, ...	97°·0	97°·48	− 0°·48	2″·29	1″·89	+ 0″·40
1830·62	Struve, ...	93·0	94·75	− 1·75	1·99	2·03	− 0·04
1833·34	Struve, ...	90·4	92·38	− 1·98	2·17	2·14	+ 0·03
1834·00	Dawes, ...	91·8	91·85	− 0·05	2·44	2·16	+ 0·28
1835·33	Struve, ...	90·3	90·83	− 0·53	2·40	2·21	+ 0·19
1836·40	Smyth, ...	90·5	90·05	+ 0·45	2·4	2·24	+ 0·16
1837·39	Struve, ...	90·1	89·32	+ 0·78	2·41	2·29	+ 0·12
1839·32	Smyth, ...	87·7	87·97	− 0·27	2·4	2·35	+ 0·05
1840·29	Dawes, ...	87·6	87·32	+ 0·28	2·44	2·38	+ 0·06
1840·59	O. Struve, ...	91·0	87·13	+ 3·87	2·67	2·39	+ 0·28
1841·23	Challis, ...	86·0	86·74	− 0·74	2·41	2·41	0·00
1841·29	Dawes, ...	86·8	86·70	+ 0·10	2·52	2·41	+ 0·11
1841·32	Mädler, ...	86·6	86·68	− 0·08	2·29	2·41	− 0·12
1841·40	O. Struve, ...	(92·3)	86·63	(+ 5·67)	2·22	2·41	− 0·19
1842·22	Mädler, ...	86·3	86·13	+ 0·17	2·27	2·44	− 0·17

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
1842·27	Dawes, ...	85°·3	86°·10	− 0°·80	2″·45	2″·44	+ 0″·01
1842·32	Challis, ...	89·3	86·07	+ 3·23	2·61	2·44	+ 0·17
1842·34	O. Struve, ...	87·5	86·06	+ 1·44	2·49	2·44	+ 0·05
1842·59	Kaiser, ...	88·2	85·84	+ 2·36	2·30	2·44	− 0·14
1843·27	Dawes, ...	85·3	85·48	− 0·18	2·63	2·46	+ 0·17
1843·38	Smyth, ...	86·0	85·43	+ 0·57	2·5	2·46	+ 0·04
1844·28	Challis, ...	87·4	84·85	+ 2·55	2·84	2·49	+ 0·35
1846·31	Mädler, ...	82·8	83·70	− 0·90	2·31	2·54	− 0·21
1847·35	Mädler, ...	81·3	83·08	− 1·78	2·35	2·56	− 0·21
1847·36	O. Struve, ...	86·3	83·07	+ 3·23	2·29	2·56	− 0·27
1847·72	Dawes, ...	83·6	82·87	+ 0·73	2·47	2·57	− 0·10
1848·30	Jacob, ...	81·2	82·55	− 1·35	2·84	2·59	+ 0·25
1849·29	Dawes, ...	81·6	82·00	− 0·40	2·64	2·62	+ 0·02
1849·36	O. Struve, ...	83·1	81·96	+ 1·14	2·23	2·62	− 0·39
1851·28	Mädler, ...	80·0	80·95	− 0·95	2·47	2·66	− 0·19
1851·37	O. Struve, ...	83·6	80·90	+ 2·70	2·42	2·66	− 0·24
1851·55	Dawes, ...	80·6	80·80	− 0·20	2·61	2·67	− 0·06
1852·37	O. Struve, ...	78·9	80·37	− 1·47	2·40	2·68	− 0·28
1852·38	Mädler, ...	79·0	80·37	− 1·37	2·42	2·68	− 0·26
1853·20	Jacob, ...	79·7	79·96	− 0·26	2·44	2·69	− 0·25
1853·29	Smyth, ...	81·3	79·91	+ 1·39	2·5	2·69	− 0·19
1853·34	Mädler, ...	78·9	79·89	− 0·99	2·70	2·69	+ 0·01
1853·35	Morton, ...	83·2	79·89	+ 3·31	2·71	2·69	+ 0·02
1853·96	Jacob, ...	78·7	79·58	− 0·88	2·63	2·70	− 0·07
1854·37	Mädler, ...	78·8	79·37	− 0·57	2·53	2·70	− 0·17
1854·38	Dawes, ...	79·5	79·37	+ 0·13	2·55	2·70	− 0·15
1855·27	Fletcher, ...	81·7	78·83	+ 2·87	(2·09)	2·71	(− 0·62)
1855·95	Dembowski, ..	80·4	78·42	+ 1·98	(2·2)	2·72	(− 0·52)
1856·25	Dembowski, ..	78·6	78·23	+ 0·37	2·48	2·73	− 0·25
1856·26	Secchi, ...	76·4	78·23	− 1·83	2·26	2·73	− 0·47
1856·37	Mädler, ...	76·1	78·18	− 2·08	2·48	2·73	− 0·25
1857·08	Dembowski, ...	79·4	77·90	+ 1·50	2·5	2·74	− 0·24
1857·37	Mädler, ...	76·0	77·78	− 1·78	2·38	2·74	− 0·36
1858·21	Jacob, ...	76·6	77·43	− 0·83	2·64	2·75	− 0·11
1858·34	Dembowski, ..	76·7	77·38	− 0·68	2·6	2·75	− 0·15
1858·35	Mädler, ...	75·1	77·38	− 2·18	2·46	2·75	− 0·29
1858·38	O. Struve, ...	80·8	77·36	+ 3·44	2·70	2·75	− 0·05
1860·29	Dawes, ...	76·0	76·43	− 0·43	2·68	2·77	− 0·09
1861·18	Powell, ...	74·5	76·00	− 1·50	—	2·78	—
1861·42	O. Struve, ...	75·3	75·87	− 0·57	2·58	2·78	− 0·20
1862·25	Main, ...	73·9	75·47	− 1·57	2·72	2·79	− 0·07
1862·39	O. Struve, ...	76·6	75·40	+ 1·20	2·58	2·79	− 0·21
1863·23	Dembowski, ..	76·7	75·00	+ 1·70	2·51	2·79	− 0·28
1865·40	Dawes, ...	72·1	73·96	− 1·86	2·80	2·80	0·00
1865·70	Engelmann, ...	76·8	73·81	+ 2·99	2·92	2·80	+ 0·12
1866·08	Dembowski, ..	74·9	73·63	+ 0·27	2·56	2·80	− 0·24
1866·28	Talmage, ...	75·8	73·54	+ 2·26	2·91	2·80	+ 0·11
1866·32	Kaiser, ...	71·5	73·52	− 2·02	2·75	2·80	− 0·05
1866·36	O. Struve, ...	76·0	73·43	+ 2·57	2·80	2·80	0·00
1867·24	Talmage, ...	76·8	73·10	+ 3·70	2·91	2·79	+ 0·12
1867·27	Main, ...	72·8	73·09	− 0·29	2·75	2·79	− 0·04
1868·21	Talmage, ...	76·8	72·64	+ 4·16	3·06	2·79	+ 0·27
1868·24	Dembowski, ..	73·3	72·63	+ 0·67	2·55	2·79	− 0·24
1868·36	O. Struve, ...	76·3	72·57	+ 3·73	2·66	2·79	− 0·13
1868·40	Main, ...	72·8	71·96	+ 0·84	2·84	2·79	+ 0·05
1869·19	Talmage, ...	78·9	72·17	(+ 6·73)	2·85	2·79	+ 0·06

Epoch.	Observer.	θ_o	θ_c	$\theta_o - \theta_c$	ρ_o	ρ_c	$\rho_o - \rho_c$
1869·24	Brunnow, ...	74°·0	72°·15	+ 1°·85	2″·73	2″·79	− 0″·06
1870·26	Dembowski, ..	71·7	71·65	+ 0·05	2·53	2·79	− 0·26
1870·44	Gledhill, ...	71·7	71·57	+ 0·13	2·6	2·79	− 0·19
1871·24	Dembowski, ..	71·7	71·20	+ 0·50	2·54	2·78	− 0·24
1871·27	Main, ...	75·9	71·19	+ 4·71	2·88	2·78	+ 0·10
1871·32	Gledhill, ...	72·0	71·16	+ 0·84	2·5	2·78	− 0·28
1871·37	Talmage, ...	78·2	71·14	(+ 7·06)	—	2·78	—
1872·27	Dembowski, ..	70·6	70·72	− 0·12	2·54	2·78	− 0·24
1872·27	Wilson & Seabroke,	70·3	70·72	− 0·42	3·2	2·78	+ 0·42
1872·35	Wilson & Seabroke,	71·0	70·68	+ 0·32	—	2·78	—
1872·41	Talmage, ...	77·0	70·65	(+ 6·35)	2·71	2·78	− 0·07
1873·19	Wilson & Seabroke,	70·1	70·24	− 0·14	2·57	2·77	− 0·20
1873·22	Dembowski, ..	70·1	70·23	− 0·13	2·66	2·77	− 0·11
1873·23	Wilson & Seabroke,	70·5	70·23	+ 0·27	2·7	2·77	− 0·07
1873·25	Wilson & Seabroke,	68·8	70·22	− 1·42	2·81	2·77	+ 0·04
1873·28	Ferrari, ...	73·2	70·20	+ 3·00	(2·01)	2·77	(− 0·71)
1873·29	Gledhill, ...	71·2	70·20	+ 1·00	2·7	2·77	− 0·07
1874·10	Gledhill, ...	67·0	69·83	− 2·83	2·7	2·76	− 0·06
1874·12	Gledhill, ...	67·5	69·82	− 2·32	2·7	2·76	− 0·06
1874·13	Gledhill, ...	71·0	69·81	+ 1·19	2·7	2·76	− 0·06
1874·17	Gledhill, ...	68·0	69·79	− 1·79	2·69	2·76	− 0·07
1874·22	Dembowski, ..	71·1	69·77	+ 1·33	2·57	2·76	− 0·19
1874·22	Wilson & Seabroke,	69·8	69·77	+ 0·03	2·71	2·76	− 0·05
1874·32	Talmage, ...	76·6	69·72	(+ 6·88)	2·46	2·76	− 0·30
1875·19	Dembowski, ..	70·1	69·28	+ 0·82	2·54	2·76	− 0·22
1875·28	Wilson & Seabroke,	68·5	69·23	− 0·73	2·77	2·76	+ 0·01
1875·31	Dunér, ...	70·6	69·22	+ 1·38	2·58	2·76	− 0·18
1875·32	Schiaparelli, ..	68·1	69·22	− 1·12	2·73	2·76	− 0·03
1875·36	Main, ...	67·6	69·20	− 1·60	3·08	2·76	+ 0·32
1875·99	Doberck, ...	69·64	68·88	+ 0·76	—	2·75	—
1876·10	Doberck, ...	66·27	68·82	− 2·55	—	2·75	—
1876·24	Doberck, ...	65·61	68·75	− 3·14	—	2·74	—
1876·25	Doberck, ...	66·13	68·75	− 2·62	—	2·74	—
1876·29	Wilson & Seabroke,	70·3	68·73	+ 1·57	2·73	2·74	− 0·01
1876·30	Doberck, ...	64·74	68·72	− 3·98	—	2·74	—
1876·31	Wash. Obs., ..	69·4	68·72	+ 0·68	2·81	2·74	+ 0·07
1876·32	Doberck, ...	69·09	68·72	+ 0·28	—	2·74	—
1876·33	Doberck, ...	67·04	68·71	− 1·67	—	2·74	—
1876·33	Doberck, ...	64·02	68·71	− 4·69	2·88	2·74	+ 0·14
1876·34	Doberck, ...	62·36	68·71	(− 6·35)	2·97	2·74	+ 0·23
1876·35	Wilson & Seabroke,	70·5	68·70	+ 1·80	2·69	2·74	− 0·15
1876·36	Wilson & Seabroke,	70·2	68·69	+ 1·51	2·62	2·74	− 0·12
1876·36	Talmage, ...	69·2	68·69	+ 0·51	2·46	2·74	− 0·28
1877·10	Plummer, ...	67·7	68·34	− 0·64	2·86	2·72	+ 0·14
1877·20	Doberck, ...	66·43	68·29	− 1·86	2·80	2·72	+ 0·08
1877·21	Doberck, ...	62·88	68·29	− 5·41	2·81	2·72	+ 0·09
1877·24	Doberck, ...	64·46	68·28	− 3·82	2·76	2·72	+ 0·04
1877·26	Doberck, ...	64·27	68·26	− 3·99	3·04	2·72	+ 0·32
1882·37	Doberck, ...	66·73	65·65	+ 1·08	2·83	2·64	+ 0·19
1882·37	Doberck, ...	63·67	65·65	− 1·98	2·59	2·64	− 0·05
1883·07	Engelmann, ...	64·57	65·27	− 0·70	2·760	2·63	+ 0·13
1884·20	Perrotin, ...	63·95	64·72	− 0·77	2·577	2·61	− 0·033
1884·661	Schiaparelli, ..	63·95	64·43	− 0·48	2·544	2·60	− 0·056
1887·278	Tarrant, ...	62·41	62·92	− 0·51	2·72	2·53	+ 0·19
1887·708	Schiaparelli, ..	62·21	62·73	− 0·52	2·392	2·52	− 0·128
1889·16	Leavenworth, ..	62·00	61·83	+ 0·17	2·56	2·49	+ 0·07

The residuals are for the most part small, and the elements seem to represent the measures as closely, perhaps, as could be expected, considering the small arc of the apparent orbit hitherto described by the companion star.

On the assumption that the combined mass of the components is equal to the mass of the sun, the "hypothetical parallax" will be

$$p = \frac{a}{P^{\frac{2}{3}}} = 0{\cdot}07''.$$

So far as I know, an orbit for this star has not been previously computed.

XIII.

SAINT FIACRE DE LA BRIE.

By JOSEPH CASIMIR O'MEAGHER.

[Read November 9, 1891.]

Mr. Olden's able notice of St. Fiacre in the Dictionary of National Biography is so complete that but little remains to be said on the subject; however, when visiting recently the Cathedral city of Meaux I elicited the following few facts which it may be interesting to record:—

The French account of the saint tells us that he was the eldest son of Eugene IV., Roi d'Ecosse. The Martyrology of Donegal makes him son of Colman, son of Eogan, of the race of Colla-da-crioch; and Mac Firbis gives his pedigree thus:—Fiachra, son of Colman, son of Eoghan, son of Biodan, son of Oiloil, son of Suibhne, son of Maelduin, son of Fionn, son of Inchada, son of Colla-da-crioch, who we know was fifth in descent from Conn "of the hundred battles."

This history goes on to say that Fiacre received his religious instruction from St. Conan, Bishop of Sudarn, a place I am unable to identify, and, being anxious to lead a contemplative life, he secretly left his father's court.

On arriving at the sea-side he found a ship which carried him by "le souffle de Dieu" to Normandy, whence he proceeded on foot to Meaux. There he visited St. Faro, who gave him a piece of land in the Forest of Brodiliun, now called La Brie, conditionally on his undertaking to enclose it within a day. St. Fiacre set to work, and on the moment a trench opened before his spade; but while thus engaged a wicked woman, who had earned through her bad conduct the name of Becnaude, instead of being moved by this miracle, began to revile the holy man and to accuse him of sorcery. She followed St. Faro to Meaux, and persuaded him to return to Brodiliun in order to see for himself what had been done through the machinations of Beelzebub. Coming back to the forest she again attacked the saint, and told him that the bishop was coming to drive him away. On hearing this St. Fiacre became dejected, and, abandoning his work, sat down upon a rock near him, when at once "la pierre s'amollit comme de la cire et reçoit l'empreinte de la partie du corps qui s'était appliqué dessus; ceux," writes Dom Toussaint Duplessis, "qui sont affligés d'hémorroïdes vont y asseoir avec modestie, et je sais de manière à n'en pouvoir douter que plusieurs hommes et femmes y ont trouvé une certaine et parfaite guérison."

Down to the Revolution of 1793 the original hollow stone was preserved in the chapel of the Priory which replaced St. Fiacre's Hermitage.

A curious tradition of St. Fiacre is preserved in Scotland. "Qhen King Hary had destroyet sundry boundis of Britaine with great heirschippis and slauchter he invadit the landes and kirk of Sacnt Fiacre and be vengence of God he was stricken with sic infirmite that na ingine of man micht cure him. . . . The medicinaris . . . said it was the melede of Sacnt Fiacre."

But to return to the French narrative:—

On the death of St. Fiacre's father, Ferchard, his youngest son, succeeded to the Crown; but, being tainted with Pelagian heresy then rampant in Erin, and having by his crimes incurred the hatred of his people, a Convention was held which deposed him. It was then unanimously resolved to offer the Crown to Fiacre, and thereupon it was decreed that an embassy should be sent to Clotaire II., King of Neustrie,[1] to ask him to assert his authority and compel Fiacre to leave his kingdom and return to Erin to receive the Crown of his father. The saint having had a revelation of this project, prayed to God "with tears in his eyes" that he might not be tempted to quit his cell. This prayer was heard, and when the ambassadors arrived he told them plainly that he proposed to remain where he was, and, fearing the delegates might insist further, he assumed by Divine permission the appearance of a leper, which at once made him ineligible for the throne.

There is a rude oil painting in the "Salle de Cathéchisme" of the Cathedral of Meaux of the Irish deputation offering St. Fiacre golden vessels. The saint is represented as a good-looking young man, wearing a white robe over which is a black scapular, and holding a spade in his right hand, while with his left he motions away the precious gifts proffered him by three warriors whose horses are held by a turbaned negro. To the left of the picture are three kneeling women supplicating the saint not to leave La Brie. The figures are life-size. I was informed by the Vicaire that this curious picture is over two hundred years old.

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[1] Clotaire II. was the son of Chilperic and Frédégonde.

When St. Fiacre died in 670 he was interred in his cell, and shortly after his death he was honoured as the protector and patron of La Brie.[1]

In the year 1478 Louis XI. had the shrine of St. Fiacre covered with silver plates, the monks of the Priory having ten years before spent a considerable sum on its decoration.

This reliquary was made in the form of a Gothic church, the ridge poll being covered with fleurs-de-lys and decorated with dolphins, the arms of the kings of France.

On the side of the shrine carved in low relief are portrayed some striking passages of Fiacre's life. One of the figures represents Becnaude insulting the saint, another the wicked woman vomiting a serpent, and a third depicts a sick woman lying on a bed invoking the just man whom she had slandered.

When Louis XIII. was dying he made a vow to embellish this shrine. Anne of Austria, his widow, in order to carry out his wish spent 1200 golden ecus in decorating it with argent doré. Louis, her husband, is represented here attired in a royal mantle kneeling before the altar of St. Fiacre, and invested with the collar of his order. Over his head an angel is holding the arms of France, and on the entablature are six angels bearing crowns of flowers. In the space between these figures, and at the four corners, massive fleurs-de-lys are inserted, while under a dome supported by eight pillars is a figure of St. Fiacre dressed as a friar, holding a spade in his hand.

In 1565, during religious troubles, the friars having been turned out of their monastery hid the shrine in a small hut which had been erected on the side of their pond; afterwards they carried it to the Chateau Villemorénel, and for their own safety took to the woods. Dalibert, a native of St. Fiacre, and a Canon of Meaux, discovered their retreat and persuaded them that in order to ensure the safety of the relics of their patron saint they should deposit them in the Cathedral of Meaux. The shrine was removed to Meaux on the 13th September, 1568. Subsequently, the friars applied to have it returned to them, but their application was not acceded to. When Louis XIV. was returning, in 1683, from the conquest of Alsace, and came to visit St. Fiacre's tomb, the friars petitioned him for the restoration of their shrine. Unfortunately for them, Bossuet, the "Eagle of Meaux," was

[1] La Brie in the time of Cæsar was inhabited by the Meldi, afterwards formed part of the kingdom of Neustrie, later on the provinces of Champagne and Ile de France, and is now divided into the departments of Seine et Oise, Seine et Marne and Aisne, Marne and Aube.

present and remonstrated against its removal. The shrine is still to be seen in the sacristy of the cathedral, as well as a silver-gilt statuette of St. Fiacre, 20 centimetres high, which has at its base a medallion containing a relic of the saint. In the apse of the cathedral there is a chapel dedicated to St. Fiacre, constructed in the style of the thirteenth century. The stone altar which stands upon four pillars was erected in 1866, and consecrated in 1870. The beautiful railing which encloses the chapel was put up in 1888.

The cathedral, a noble Gothic edifice, was begun in the twelfth century and continued until the sixteenth century. Its restoration was commenced in 1832, and carried on to 1874. The cathedral is 260 feet long, and its vaulted roof 105 feet high.

At St. Fiacre, a village of 300 inhabitants, built upon a table-land seven miles from Meaux, the feast of the saint (August 30) is attended by numerous pilgrims, who come provided with a special service-book containing "Messe de St. Fiacre, Vespres de St. Fiacre, Litanie de St. Fiacre," and some hymns in his honour—one of them being addressed to "St. Fiacre, patron des jardiniers," commencing thus:—

> "Glorieux patron de La Brie
>   Sois favorable à nos voeux,
> Pèlerins toute notre vie,
>   Suivons le chemin des cieux."

This saint's feast is celebrated in the Church of St. Ferdinand, Vaugirard, Paris, with great pomp; the chancel on that day is beautifully decorated with flowers sent by the master gardeners, who come to the service in evening dress, their wives wearing fashionable costumes, while the working gardeners with their families attend in holiday attire.

I have to thank the Vicaire of Meaux and Mr. Marshal of Paris for their courtesy in assisting me to acquire some of the foregoing details of this old Irish saint.

XIV.

GREEK IN GAUL AND WESTERN EUROPE DOWN TO A.D. 700.

By REV. GEORGE T. STOKES, D.D.

[Read February 8, 1892.]

Some short time since a question was incidentally raised, at a meeting of this Academy, as to the extent to which the Greek language prevailed in Gaul during the first six centuries of our era. This happens to be a subject to which I have given a great deal of attention, and which also bears directly upon the history of Ireland. I therefore think that it is a question which may well engage our attention. I propose to take the subject in two divisions :—

(1) How far did a knowledge of the Greek language exist in Gaul between the period of the Christian era and the year 600 ? and

(2) How did the knowledge of the Greek tongue get to Ireland? which will resolve itself into the further question, What communication existed between Gaul and Ireland in the fifth, sixth, and seventh centuries ?

Both of these lines of inquiry seem to me peculiarly suitable to the office and work of the Royal Irish Academy.

Now let us take the first point. How far did a knowledge of Greek exist in the country called Gaul, or rather the provinces of the Gauls, during the first six or seven centuries? I am sure that speaking before such a learned body I might assume that everyone present knows that the southern parts of Gaul were in pre-Christian times thoroughly Greek. Massilia, or Marseilles, was a Greek colony from Phocæa, where Phœnician or Carthaginian influences mingled their forces, rendering Marseilles a great centre, where the most diverse intellectual and religious tendencies found a point of contact and of interaction. There are two books in the College Library very little known, which I recommended for purchase some thirteen years ago. They are styled: the one, Lentheric's "La Grèce et L'Orient en Provence," and the other, Lentheric's "Les Villes Mortes du Golfe de Lyon," "The Dead Cities of the Gulf of Lyons," which give us striking evidence of the religious Syncretism existing in Southern Gaul two thousand years ago. In these books we shall find Gallic and Massiliot religious inscriptions dating back to pre-Christian times, some of them dealing with Greek Pagan life, and others setting forth the inscriptions upon a Baal temple, raised by Phœnician settlers long prior to the days when we have any literary or historical remains to instruct us. Prior to the Christian era, then, Marseilles was a centre of Greek and Phœnician influences, and of these influences we have the still existing remains recorded in the works of this learned French engineer, whose books were published so lately as the year 1878. But now coming to historic times, and a period close to the Christian era, let me cite some authorities to show the prevalence of Greek in Southern Gaul, at that crisis in the world's history. Cæsar is a pretty well-known authority, and one that is most valuable for the habits and customs of that district. His treatise "De Bello Gallico" is one to which all historians refer, and he does not leave us without information upon this very point concerning which we are inquiring. In the Sixth Book of the Gallic War, and in the 14th chapter, when treating of the Druids, Cæsar witnesses concerning the prevailing use of the Greek language in Gaul, saying: "Neither do the Druids think it lawful to commit their discipline to writing, since in almost all their business, whether public or private, they use Greek." This quotation alone is sufficient to establish the common use of the Greek language in Southern Gaul during the century immediately preceding the birth of our Lord. The Druids simply refused to commit their peculiar discipline to writing, because all ordinary writing was in Greek.

Now let us see how this matter stood in Southern Gaul during the first century. I cannot produce Christian testimony for the first century, simply because that Christianity, having been first preached in Gaul during the second half of that century, had not yet time to produce a great writer, or at least one who has reached our times. Greek was certainly, however, one of the current languages of Southern Gaul during the first century; for if we take up Suetonius, and turn to his account of the Roman emperors, we shall find that Caligula exhibited Greek plays at Lyons for the amusement of the people, and went further still, for he established prizes for the encouragement of Greek oratory.[1] Greek plays would not have been exhibited, and Greek oratory would not have been cultivated, unless the Greek language was understood and spoken. This piece of evidence shows that in the first century

[1] See Suetonius, "Caligula," cap. xx.

Greek was current in Lyons, for Caligula reigned from 37 to 41 A.D. Now let us come to the second century. Here we can produce abundant Christian testimony. Eusebius, the Church historian, has preserved for us the most ancient document concerning the Gallic Church in the celebrated Epistle of the Churches of Lyons and Vienne, detailing the terrible persecution they underwent about the year 178. This long Epistle was written by the Christians of Lyons to their brethren in Asia Minor, and was in Greek. Irenæus, again, one of the most celebrated Church Fathers, and one who lived through that same persecution, and succeeded the Bishop of Lyons who was martyred on that occasion, was a copious writer whose works we still possess; and Irenæus, you will observe, wrote all his works in Greek. The language, then, of the Christians of Southern Gaul at the end of the second century was Greek.

Now let us advance to the third century. We here may use a new source of information. One of the most learned and valuable works which that great French scholar and archæologist, Edmond le Blant, has produced, is his "Christian Inscriptions of Gaul," in two large quarto volumes, the only copy of which possessed by any Dublin library will be found in Trinity College. Le Blant gathered up carefully every Christian inscription now extant, or of which he could find any record in France, appending to each a long and learned dissertation.[1] Among the very earliest of his "finds" is that numbered 4, where we have the Autun Inscription given at full length. The Autun Inscription is well known by archæologists, and has been often described and often debated from a theological as well as a historical point of view. My interest in it is, however, on this occasion, of a purely linguistic character. This monument is a Greek inscription written in verse. There are eleven verses, the opening words being *Ιχθύος Ουράνιου θεῖον γένος ἤτορι σεμνῷ*, in which the writer describes the Christians as the Divine Race of the Heavenly Fish, referring to a well-known symbol used in the primitive ages of the Church. The author of this inscription must have been a man of reading and culture, because he uses rare words and expressions drawn from Homer. He, for instance, uses the word *ἦτορ* for the heart, a Greek word found only in Homer, Simonides, Pindar, and a chorus of Aeschylus; while he uses a Homeric phrase, *θεῖον γένος*, to describe the adherents of the Christian faith. This inscription is attributed to the close of the third century, say about

[1] The dissertations dealing with our subject, in addition to his preface, p. cxv., are Nos. 38, 211, 225, 248, 521, 557, 613.

the year 300, while, when we turn to Lentheric's works, we find a long Pagan inscription written in Greek in the time of the Emperor Alexander Severus and Julia Mammæa, his mother, the friend and disciple of the celebrated Origen. That inscription was written about the year 225. Alexander Severus is celebrated for his Syncretistic tendencies in the matter of religion. He wished to enrol Christ among the Roman gods, and was willing to recognize Christianity, if it would take its place among the established religions of the empire, side by side with the poetic paganism of Greece and the weird mystic rites of Mithras and of Egypt. This Gallic Greek inscription shows the same tone, for it unites the rites and worship of Egypt and of Serapis with those of Jupiter and Venus. (See Lentheric's "La Grèce," &c., p. 485.) Here, then, you have evidence showing that in Gaul among Christians and Pagans alike, Greek was the language of the grave as well as of life, of lamentation and sorrow as well as of flattery and adulation.

We now come to the fourth century. People generally have no difficulty in admitting the extensive use of Greek in the West till the early part of the fourth century, but they have a vague kind of idea that after that period the Roman Empire broke up, and that neither Latin nor Greek survived the wreck, but that all Europe was in a hopeless state of ruin, confusion, and ignorance for the following thousand years. Now this is all a vast mistake, begotten largely of the utter neglect and contempt with which our Universities have treated the languages, literature, and history of the later Roman Empire. I must not, however, allow myself to get too far away from my main point. I shall therefore merely say, that the Roman Empire remained as firm and stable as ever all through the fourth century, and Greek continued to prevail in Gaul throughout that century. Let me give you a few proofs. Upon the death of Constantine the Great the Roman Empire was divided into three portions. The West was assigned to the eldest son, Constantine the Younger, as he is usually called. He was a Greek by education. He must have had a large Greek following and a crowd of Greek courtiers. Constantine found, too, that celebrated Greek writer, St. Athanasius of Alexandria, living at Treves when he set up his throne there; and when Constantine died, three years later, in 340, a funeral oration was pronounced over his body at Arles, which was couched in the Greek language, and is still extant in the same language.[1]

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[1] This funeral oration will be found in Greek at the end of the "Roman History" of Eutropius, p. 703, as published by Havercamp at Leyden, in 1729.

It is no wonder, then, that when you turn to Le Blant's books you find numerous Greek funeral inscriptions coming from Treves and its neighbourhood, while three hundred years ago they were much more numerous, vast quantities of them having disappeared through neglect and civil commotions.[1]

Remember now one fact: I have shown the continuous existence of Greek in Gaul down to the year 400, and that not only in the southern districts of the country, but far away in the north-east of the country at Treves, upon the banks of the Moselle. Let us, however, come to the fifth and sixth centuries, a time when the ordinary student regards France as reduced to a state of primitive barbarism through the invasion of the savage hordes who swept down upon the defenceless victim. Surely, many people conclude, no knowledge of Greek can then have survived. Yet this was the period of St. Patrick, and the time when active intercourse with Ireland, through Christian missionaries, began to arise. Hence the difficulty, how did Greek, and Hebrew too, get into Ireland? And now, strange as it may seem, I can produce far more abundant evidence of the existence of Greek in Gaul, north, south, east, and west, during the next two centuries than at any other period. The authorities are so numerous that I can barely glance at them. St. Jerome, for instance, was an eminent author whose writings are full of information concerning the manners and customs of his time. He died about the year 420. He wrote in Palestine, but he lived many years at Treves and in other parts of Gaul. He gives us some very interesting glimpses of the Irishmen of his day, and shows us that our reputation was much the same in his time as it is still amongst the uneducated and more credulous English lower classes of the present day. St. Jerome saw Irish troops in Roman pay at Treves. He tells us they were very brave, but kept their courage up by eating human flesh, so that it was very dangerous for any plump or well-fed children to be caught straying near their barracks. Now St. Jerome, in the preface to the second book of his Commentary on Galatians, gives us some information on the very point about which we are inquiring. He tells us that the inhabitants of Arles, Marseilles, and their co-provincials, were tri-

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[1] See "Christian Inscriptions of Gaul," t. I., p. 327, where Le Blant quotes some Latin verses of Conrad Celtes, the last of which says of Treves—

"Sepulcra graecis vidi epitaphiis
Inscripta, busta et stare sub hortulis,
Et manibus sacrata functis
Vena suprema reperta in agro est."

lingual, speaking with equal facility Greek, Latin, and Celtic.[1] Gaul, and specially Southern Gaul, became, in fact, in the earlier part of the fifth century—that is, just about the time of St. Patrick—a special centre of Greek and Oriental influences. We have manifold evidence on this point. We still possess, for instance, a Rescript of the Emperor Honorius, dated in 418, addressed to the Prefect of Gaul, confirming and extending the power of a kind of local Parliament which had existed in Gaul from the earliest times. The history of that institution is most interesting, and throws much light upon Roman methods of managing their great Empire from the time of Augustus downwards.[2] The Emperor Honorius endeavoured to use and develop this local legislature so as to strengthen Roman power against the invaders. In his Rescript issued for this special purpose, he gives us a glimpse of the active intercourse maintained by Gaul with the farthest East, telling us, in the high-flown language then used, that the city of Arles was the centre to which "the wealthy Orient, perfumed Arabia, luxurious Assyria, fertile Africa, beautiful Spain, and brave Gaul brought their richest treasures." But it was not trade alone which brought Greek and Eastern customs and languages into Gaul at this period. Religion, as the most powerful force that works upon man, told in the same direction. Southern Gaul became the favourite centre towards which Greek, and Syrian, and Egyptian Monasticism tended, establishing in Southern Gaul, in the early days of the fifth century, the celebrated Monastery of Lerins where St. Patrick is said to have been trained for his missionary work. There was one man connected with the monastery of Lerins whose career shows how close was the connexion, how frequent the intercourse between Egypt, Syria, Greece, and Gaul, in the fifth century.[3] John Cassian is one of the most famous Gallic writers of the fifth century; and Cassian spent a good half of a very long life in the East and in Egypt. He spent seven years among the Monks of Nitria in Egypt, where the celebrated Nitrian manuscripts were found fifty years ago. He lived in Palestine, and served as archdeacon to St. Chrysostom at Con-

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[1] See Dr. Lightfoot's "Galatians," Introd., pp. 12, 13.

[2] See *Macmillan's Magazine*, November, 1882, where I gave an account of this fact, so little known to the usual run of historians, under the title "Home Rule under the Roman Empire."

[3] Sidonius Apollinaris tells us of a St. Abraham, who was a sufferer in the persecution raised by the Persian King Isdegerdes. He was born on the Euphrates, passed over into France, ruled a monastery there, and died about 476. See Le Blant, "Dissert.," No. 557; "Ireland and the Celtic Church," pp. 3, 173.

stantinople about the year 400; and then after working as a Greek ecclesiastic at Constantinople, he came to Gaul, where the remaining half of his life was spent organising and developing the monastic institutions which had been transplanted thither from Egypt. Syriac and Greek must have been for Cassian almost his mother tongue. During the fifth and sixth centuries Cassian's monastery of Lerins was in the most close and active communication with Syria, Egypt, and the East. In fact, whenever an inhabitant of Gaul felt called to a specially devout life, and wished to enjoy the highest spiritual privileges, he went off from Marseilles to Egypt, as we see from the case of Justus, who was Bishop of Lyons during the earlier years of the fifth century. He got tired of his work as bishop. He wished to lead a more devout and meditative life. He therefore retired to the deserts of Nitria in Central Egypt, just as naturally as when we want a little change and refreshment we run over to Harrogate, Wiesbaden, or Switzerland.[1]

But it was not religion alone which spread Greek and Oriental influences all over France during the fifth, sixth, and seventh centuries; trade and commerce, as we have already hinted, invited their presence and made it welcome. Salvianus is one of the best known writers of the latter half of the fifth century. He lived at Cologne and Treves. He gives, in his treatise "De Gubernatione Dei," a sad picture of the disordered state of society in Gaul as the fifth century dragged along its weary course; and he tells us that all their towns and cities were filled with crowds of Syrians whose cupidity and extortions were disgraceful. Salvianus's death may be roughly fixed at 460. If we then pass over a space of 120 years to the year 589, we shall come to the Council of Narbonne.

Now the decrees of Church Councils and Synods are not generally regarded as valuable historical documents; and yet this is a great mistake. No documents are half so valuable for the illustration of social life when the ancient order was breaking up, and the nations of modern Europe were in the throes of birth, as the records of the obscure councils held in Gaul from the fifth to the tenth century. The Council of Narbonne, for instance, met in 589, and passed a series of Canons, preserved in Mansi's great work, "Collectio Conciliorum," the fourth of which ordained that "Every man, bond or free, whether a Goth, Roman, Syrian, Greek, or Jew, should rest on Sunday." You

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[1] See his epitaph in Le Blant, t. i., p. 62, No. xxvii.; and Justus (11), in Smith's "Dict. Christ. Biog."

see from this simple enactment what an amalgam of nations and tongues met at Narbonne in the south at the close of the sixth century; while then, if we turn our attention to the North of France, we find it was just the same. Gregory of Tours is an unexceptionable authority for that period. He was Bishop of Tours during the last quarter of the sixth century; and he gives us, in his "Historia Francorum," a vivid and an awful picture of what a devil's caldron Gaul, in its length and breadth, just then was. He tells us, in the eighth book of his History, of the triumph of one of the wicked Burgundian Princes of that time—Gontran by name—and of his victorious entry into the city of Orleans, and gives information upon the very point we are discussing, telling us that the people of Orleans met him with shouts of acclamation, uttered in Latin, Hebrew, and Syriac[1]; while again if we turn our eyes away to Arles, and ask for an authority that Greek prevailed there in the sixth century, I produce the life of St. Cæsarius, Bishop of Arles, about 520, where we are told that he prepared hymns to be sung by the laity in Divine service; "some in Greek, others in Latin, that their thoughts might be prevented from wandering"; a statement which that great giant in ancient learning, the celebrated Mabillon, considered an ample and conclusive proof that in the sixth century Greek was spoken in the city of Arles.[2]

I think I have now produced a sufficient number of authorities to establish my contention that Greek was one of the current tongues of Gaul throughout its length and breadth, from the first down to the seventh century. I set out with a second object in view, and that was to show how Greek and Hebrew got to Ireland, and to discuss the intercommunication between Gaul and Ireland between the fifth and ninth centuries. But then I remember the advice of a very celebrated preacher of the last century: "It is far better to send the people away longing than loathing"; and therefore, lest I should send you away

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[1] Le Blant, in his Introduction, p. cxv., calls special attention to the fact that many Gallic writers of the sixth century describe the language of all the Orientals as Syriac, meaning thereby Greek, which was then spoken throughout the Eastern Empire. Cf. St. Jerome in his commentary on Galatians, lib. ii., Præf.; and Dr. Lightfoot's "Galatians," Introd., p. 12, note 2. The "Life of Columbanus," by the Abbot Jonas, describes a Syriac woman, living at Orleans, as the only person who sympathized with him when the Queen of Burgundy was deporting him to Ireland.

[2] See "Vita S. Cæsarii," i. 11, in Mabillon; "AA. SS. ord. Ben." i. 662; Le Blant, t. ii. p. 269, Diss. 521; Cæsarius (3) in "Dict. Christ. Biog."

not longing for, but loathing Greek in Gaul, I pray your permission to defer the completion of this portion of my task unto a future meeting of this Academy.

Note added in Press.

Since I read this Paper on "Greek in Gaul," I have studied Mr. Rendel Harris's work on the "Codex Bezae," published in 1891 as No. 1 of vol. ii. in the Cambridge "Texts and Studies." This able and learned work confirms, from the critical point of view, the results at which I have arrived by the line of historical research. Professor Harris shows that "Codex Bezae," now at Cambridge, is a Greek manuscript of the New Testament, written in Gaul in the sixth century, at which period also it was translated into Latin, the Latin being now found side by side with the Greek. Greek was not therefore an unknown language in Gaul in the sixth century. Chapter xviii. of this work is, from my point of view, an extremely interesting one. In it Professor Harris shows conclusively, by many historical proofs—some of which I gave in my Paper, others of which I omitted—that the whole of Gaul was permeated by Greek and Oriental influences during the sixth century. One brief extract will show that the newest school of critical inquirers into the history of the Sacred Text agree with my view. On p. 179 Mr. Harris says: "The Western Church, especially in Gaul, was constantly and from the first under Oriental and Greek influence. First and foremost among these influences was the presence of traders. . . . And that this influence of Eastern traders is not limited to Marseilles and the neighbourhood may be seen from the stories in 'Gregory of Tours'; for example, a Syrian trader got himself appointed Bishop of Paris apparently by unfair means, and when elected applied to the Church offices the principle that to the victor belong the spoils." This bishop's name was Eusebius, and his date is A.D. 591. As soon as he was appointed he dismissed all Gauls from clerical offices, substituting Syrians in their places, so that there must have been a considerable Oriental colony at that time in Paris (see Eusebius [70] in the "Dict. Christ. Biog.").

On p. 137 Professor Harris points out that Greek forms and words were introduced into the Vulgar Latin of Gaul by the Eastern Colonists, whence they then passed into the Old French, instancing cata (κατά) and ana (ἀνά). This use of Latinized Greek words prevails also among the sixth and seventh century Hiberno-Latin documents. Dr. Reeves notes this very point, and gives many illustrations of it from the "Antiphonary of Bangor," from Adamnan, Aldhelm, and others, in a note on p. 158 of "St. Columba's Life," where he instances Greek words like pantes ta erga, sophia, pneuma, basileus, and many others. Professor Harris's work is important for the philologist, as it shows that one cannot hope to understand the origin and history of the Romance languages without a careful study of "Codex Bezae" and a recognition of the Greek as well as Latin influences which presided over the birth of modern French (see *e.g.* chap. iv. of Prof. Harris's book).

XV.

THE KNOWLEDGE OF GREEK IN IRELAND BETWEEN A.D. 500 AND 900. By REV. GEORGE T. STOKES, D.D.

[Read February 22, 1892.]

In my previous Paper I endeavoured to prove by a long induction of facts and statements, gathered from very various quarters, that Greek was well known and studied, used in epitaphs and inscriptions, and even spoken in Gaul down to the seventh century of our era. I did not contend that Greek was the language, the mother tongue of Gaul, because that would have been absurd. Celtic, the Gallic tongue, was throughout that period the mother tongue of the vast mass of the population, specially in the country, while a rude Latin was probably the popular tongue of the towns. Gregory of Tours is a sufficient proof of this. But I did show by quotations from contemporaneous authors that Greek was known by ecclesiastics, abbots, monks, priests, and ascetics, and by numerous Orientals scattered all over the country, amounting in fact in some places to colonies so numerous that special arrangements had to be made for Greek hymns and Greek usages in public worship, as at Arles, Treves, and Orleans. Our own city of Dublin will furnish an apt illustration of my contention. Surely every member of this Academy would consider that there is now a knowledge of Greek, that Greek is not an unknown tongue in this city. And yet no one thinks that we mean thereby that Greek is spoken in our streets, but that it is taught in our schools, and read in our colleges; and that in Trinity College there are a few gentlemen who could write Greek rapidly enough, and who might manage to make a fair shift to speak a few grammatical sentences in that language. This is the total amount of my contention—this was, I must again repeat, the original proposition I intended to prove—and I laboured to prove that small point because it is absolutely necessary to show that Greek was known in Gaul during the fifth and sixth centuries in order to explain its presence in Ireland between the years 500 and 900. Let me borrow an illustration from modern scientific adventure. A week or two ago I read a paragraph in the *Spectator* which stated that Dr. Nansen proposed to make an attempt to reach the Pole by a new route, as he was convinced that a current flowed from the coast of Siberia to the coast of Greenland, and why? simply because things were found on the Greenland coast which could only have come from Siberia. Let us apply this method of reasoning to our subject. We have proved by the solid evidence of history that Greek existed in Gaul in the fifth or sixth century. We find it existing in Ireland at just the same period. We conclude then that there must have been a current of communication which carried Greek from Gaul to Ireland at that time. The current could not have come through England, because England was then the prey of the savage and bloodthirsty Saxons. The line or current of communication must have been direct from France, and that current of communication we identify with the numerous Christian missionaries, especially with the Greek, Egyptian, Syrian and other Oriental monks who then sought Ireland either for the purposes of active Christian labour or of devout meditation. These men were the agents who propagated in Ireland a knowledge of the Greek tongue. How, you may ask, did these monks get to Ireland? This point resolves itself into the further query, Have we any evidence that there was regular trade and commerce with Ireland during the centuries which elapsed, say, from 400 to 900 A.D.? I think that we have such evidence, real and tangible, indeed, though scanty, as necessarily must be the case where so little of the literature of that time has survived.

The first proof which I shall produce of this communication I derive from the Confession of St. Patrick. In that document I find our national saint telling of his escape from this country, where he was kept in slavery. He fled two hundred miles to the south of Ireland, where he found a ship. Here are his own words: "After this I took flight and left the man with whom I had been six years; and I came in the strength of the Lord, who directed my way for good; and I feared nothing till I arrived at the ship. And on that same day on which I arrived the ship moved out of its place, and I asked the sailors that I might go away and sail with them . . . . and after three days we reached land." Now I cannot offer a conclusive proof that the land thus referred to, at which St. Patrick arrived, was Gaul; still the majority of the authorities believe it was Gaul, and not Great Britain. Possibly St. Patrick embarked at Wexford or Waterford, where a ship with a favourable wind could easily reach the coast of France in three days. The next earliest notice of commercial traffic between France and Ireland is found in an unprinted life of St. Kieran of Clonmacnois, contained in a manuscript called the Liber Kilkenniensis, now in Marsh's Library. St. Kieran was the founder of Clonmacnois, and lived about the year 550, and in his Life in this MS. we read: "In those days when the brethren of St. Kieran were reaping their cornfields, Gallic merchants came to St. Kieran and filled an immense vessel with wine, which St. Kieran gave to the brethren." Wine merchants from Gaul were found in the middle of the sixth century far away at Clonmacnois on the banks of the Shannon, and at the very centre of Ireland. I now pass to another very early authority. St. Columbanus was the apostle of Burgundy and Switzerland. He was born in Leinster in the year 543, was educated at Bangor, and died at Bobbio in North Italy in 615. He migrated to Gaul in middle life about the year 585, together with St. Gall and eleven other disciples. Columbanus proved a very troublesome person for the wicked and immoral princes, male and female, who then ruled in Gaul. He boldly reproved Queen Brunehault, whose power extended over the North of France, and whose immoralities were notorious. She retorted by ordering his arrest at the Monastery of Luxeuil, and his immediate deportation to Ireland. He was carried, therefore, by the soldiers entrusted with the captive to the port of Nantes, as the well-known point of departure for Ireland. The local governor and the local bishop both lent themselves to the designs of the queen, and tried to get rid of Columbanus as quickly as possible. There is a letter of his still extant, written to his former disciples telling them of his feelings as he was waiting for the vessel that was to carry him away. And there is a passage in his life written by his contemporary and successor at Bobbio, the Abbot Jonas, which shows that the port of Nantes was a port of resort for Irish bound vessels. When Columbanus and the soldiers who escorted him came to Nantes they inquired for a vessel—"quæ vexerat commercia cum Hibernia"—which had carried on trade with Ireland. So that Nantes and Ireland, and Irish towns, probably Wexford, or Waterford, or Cork, were then in active trade communication with one another.[1]

Now let us take another proof of ancient commercial intercourse between France and the west of the British Islands. Let us resort for this purpose to documents whose trustworthiness and undoubted authenticity have been established by the learned labours of our

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[1] See the whole story in the "Life of Columbanus," by Jonas, in Migne's "Pat. Lat.," t. lxxxvii., col. 1037, and his epistle to his disciples in the Works of Columbanus in Migne's "Pat. Lat.," t. lxxx., col. 273.

late President, Dr. Reeves. I mean, of course, Adamnan's "Life of Columba," and Adamnan's treatise *De locis sanctis.* Adamnan's treatise on the "Holy Places of Palestine" was written in the closing year of the seventh century; and was indited from the mouth of a Gallic bishop who had spent a long time visiting the East. He took ship at Rome for some port on the west coast of France, but was driven by the winds to the shores of Iona, where he landed, and spent a whole winter instructing Adamnan in the story of his travels. Then he was sent back to France, but how? He could scarcely have travelled in the curracles which sufficed for the Celtic monks when they visited Ireland. But, when we turn to Adamnan's "Life of Columba," lib. i., cap. 28,[1] we have the whole matter explained. In that chapter we are told of one of the marvellous prophecies of St. Columba, how he announced the destruction of a city in Italy by fire from heaven, and how his prophecy was confirmed by "the Gallic sailors who, coming from Gaul before the year was finished, and arriving at Cantire, reported the same story." This incident reveals to us the fact that the present Campbeltown, at the mouth of the Clyde, was, in the times of Columba and Adamnan, the regular resort of Gallic ships and Gallic traders, who once a-year brought the news of the outer world to the dwellers in these northern regions; affording, too, a means of escape to any unfortunate travellers, like Arculf, who might have been wrecked on these wild coasts. That was about the year 690. Let us now advance another hundred years to the close of the eighth century, and we shall find an undoubted historical document which tells us of the active communication kept up between Gaul and the remotest parts of Ireland. I have already shown you that French wine merchants penetrated to Clonmacnois about the year 550. It was exactly the same two centuries and a-half later, as we know from Archbishop Ussher's *Sylloge Epistolarum Hibernicarum,* opp. vol. iv., p. 466, where you will find an epistle written by the celebrated Alcuin to Colcu, the senior lecturer or president of the school of Clonmacnois. Now this letter, written in the year 794, is most important for our purpose. It was written in answer to a previous epistle received by Alcuin from Colcu. It gives the Clonmacnois professor all the gossip of the time: how the Emperor Charles was fighting, conquering, and converting the tribes of Germany and the savage Sclaves; how the Greek fleet had lately come to Italy; and how the Saracens were threatening Christendom. The letter then proceeds to tell of a quarrel

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[1] Reeves's edition of Adamnan's "Life of Columba," p. 57.

which had arisen between Charlemagne and King Offa of Britain,[1] and had caused a cessation of all mercantile intercourse between England and France, Alcuin's exact words being, "ita ut utrinque navigatio interdicta negotiantibus cesset." He then terminates his letter, telling Colcu that he was sending by his messengers various acceptable presents of oil and money, partly as his own gift, and partly from Charlemagne's bounty intended for the relief of the monastic brethren and of the anchorites scattered throughout the whole of Ireland. Now observe this: communication between England and France had then ceased. Therefore Alcuin's messenger must have come by sea direct to Ireland.

I have now quoted undoubted documents, dated about 550, 590, 690, and 790, proving that communication between France and Ireland was active and continuous.[2] I think I need not labour more at this point. If I cared to pile up evidence, I might refer you to the ancient records in "Ussher, Antiquities" (Works, vi., 303), touching the enormous confluence of Gauls, Teutons, Swiss, and Italians, to Lismore in the days of St. Cathaldus, about the year 700. I might point to the numerous statements which show how steady and constant was the reverse flow of emigrants from Ireland to Gaul; so that, as a writer of the ninth century put it, the habit of wandering had become a second nature with Irishmen. But I prefer to rely my case upon the testimony of these four ancient witnesses: (1) "St. Kieran's Life"; (2) the "Life and Epistle of St. Columbanus"; (3) Adamnan's "Life of Columba," and his "Treatise on the Holy Places"; and (4) Alcuin's "Epistle to Colcu": and I deduce from them this conclusion—That, if trade and commerce were so direct and active, a knowledge of Greek, which (as I showed by the solid testimony of indubitable facts) existed in Gaul down to the seventh century, might easily have passed over by the same route to the venerable men and devoted scholars who then lived and laboured and taught in Ireland. Greek and Oriental scholars and monks may have easily passed along this trade route over to Ireland from Gaul, where, as I showed, they were found in great numbers at Lerins and elsewhere. This is a natural presumption. And then, when we take up ancient Irish docu-

[1] See Offa (4), King of Mercia, A.D. 757-796, in "Dict. Christ. Biog.," vol. iv., p. 7.

[2] In O'Curry's "Manners and Customs of Ancient Irish," vol. iii., p. 526, he gives an ancient Irish poem which celebrates the fair of Carman, held at Wexford from Pagan times down to the twelfth century. There was a special market in that fair for the foreigners who sold silver and gold ornaments: cf. p. 531.

ments, we find our presumption justified; for, in the litany of Aengus the Culdee (printed in Ward's "Life of St. Rumold," pp. 204–207), we have the amplest confirmation of our presumption. Ward was a learned Franciscan of Louvain, and a contemporary of the celebrated Colgan in the middle of the seventeenth century. He composed a "Life of St. Rumold," in which he used the litany of Aengus the Culdee, which he found among the records of the monastery of Donegal, in a manuscript at that time 700 or 800 years old. That ancient litany was, in Ward's opinion, written at least in the ninth century; and it expressly commemorates vast numbers of foreigners—saints, scholars, and pilgrims—who found their way by sea to this country between the years 500 and 800. He enumerates Gauls, Saxons, Britons, Romans, Latins; he expressly mentions, "Septem ex monachis Egypti in Deserto Uilaig,"—seven Egyptian monks in the desert of Uilaig. Mark that point; for it is important. For I have shown you, in my previous Paper, that Egypt and Gaul were in constant communication in the fifth century. Ward then tells of St. Abbanus, who, in the sixth century, crossed the sea, doubtless from the harbour of Wexford, where his uncle, St. Ibar, was abbot of Begerin, a well-known island in that land-locked bay, leading with him 150 monks; and then, returning to Ireland, brought back with him 150 pilgrims—"Romanos et Latinos." I do not think I need say more on this point—because any person who will not be convinced by this evidence must simply have hardened his heart, so that he will not believe—and will conclude this part of my Paper with a quotation—not from any ancient document—but with a quotation from one who, by this Academy at least, will be regarded as a conclusive authority. Our late revered President, in his edition of Adamnan's "Columba," p. 57, note 1, remarks: "There existed at this period (that is, the sixth century) frequent intercourse between the British Isles and Gaul"; and then goes on to note the instance of St. Columbanus embarking at Nantes for Ireland, and the visit of the French wine merchants to Clonmacnois, as conclusive proof of that intercourse.

I now proceed to the second division of my subject. I have to show not only that it is possible that the knowledge of Greek, and of Hebrew too, *may* have passed over to Ireland, but that it actually *did* pass over. Let me here repeat about Ireland what I have already said about Gaul. I do not propose to show that Greek was spoken in Ireland, or that it superseded the use of Celtic in the sixth, seventh, and eighth centuries. That would be the very height of folly. But I do propose to show that there was a knowledge of Greek in Ireland between the sixth and ninth centuries. Let me illustrate my point. I maintain that Greek is known in Ireland in this month of February, 1892, but that does not mean that Greek has superseded the use of English, even in Trinity College, much less throughout Ireland at large. A few words, which you will find on p. 218 of my own "Ireland and the Celtic Church," exactly state my position. "The Book of Armagh bears witness to the existence of Greek studies in the Primatial City." Greek was studied, and therefore was known, in the school of Armagh and in all the great monastic schools of Ireland when the Book of Armagh was written; that is what I propose to prove, as I proved a similar proposition in the case of Gaul. I trust you will not allow your attention to be diverted to any side issues, but will keep it steadily fixed on the points which I have already proved or now propose to prove; for these I must say are the only issues I have maintained. Here, too, let me call your special attention to a preliminary point. The determination of this question does not depend in the very slightest degree on a knowledge of the Irish tongue, or of Celtic manuscripts of the twelfth, thirteenth, and fourteenth centuries. A man might be the most profound scholar in the mysteries of old, and middle, and new Irish. He might, like scholars formerly belonging to this Academy, have the most complete command over the Celtic language, whether in its ancient form or in its modern vernacular modifications, and yet be the veriest child in this matter. This investigation is simply a historical investigation, and depends on historical research, a region where modern scientific philology lends but very little help indeed. Now in dealing with this part of my subject I shall simply follow the chronological method I have hitherto pursued. I will not ask you to take my own unsupported word for anything, but will show by a succession of ancient authorities that Greek, and Hebrew too, were known in Ireland from the beginning of the sixth to the end of the ninth century. The first instance I shall cite is taken out of a manuscript ("Life of St. Brendan of Clonfert") contained in the so-called Liber Kilkenniensis in Marsh's Library. This life has been published by an eminent Irish scholar, Cardinal Moran, of Sidney. St. Brendan was a celebrated traveller, and he visited in the course of his travels St. Gildas of Wales, who lived between the years 500 and 560. Brendan gives us a glimpse of the Greek scholarship of Gildas; for he tells us, "The Holy Gildas had a missal written in Greek letters, and that book was placed upon the altar."[1] Dr. Reeves quotes this very passage in his

[1] The use of Greek in the Gallican Sacramentary continued in France to the time of Gildas and Brendan. In the works of St. Germanus or Germain of Paris

edition of Adamnan, p. 354, in order to illustrate the fact that Greek was known among the ancient Irish monks; while again, discussing the constitution of the Monastery of Iona, he says (p. 352):—"The primary subject of study (at Iona) was the reading of Holy Scripture, and in particular the committing to memory the Book of Psalms. Besides the Holy Scripture there was the study Scripturarum tam liberalium quam Ecclesiasticarum, the former including the Latin and the *Greek* languages."

The next authority I shall cite will be Columbanus. He lived from about 540 to 620. He is a good witness for the practice of the second half of the sixth century. We have abundance of his works still extant, and all of undoubted authenticity. He was educated at first on an island in Lough Erne, where, while still a very young man, he composed a commentary on the Book of Psalms, which has, within the last ten years, been printed for the first time by Ascoli at Milan. In that commentary he discusses points of Hebrew scholarship as in his exposition of the 110th Psalm. His works previously known display the same range of scholarship. In his Epistle to Pope Boniface he plays upon his own name, Columba, and turns it into Greek and Hebrew, περιστερά and Jonah or יונה. This point has not escaped the eagle eye of Dr. Reeves, who points out, in his Adamnan (p. 5), that exactly the same identification of the name of Columba with the Hebrew Jonah and the Greek περιστερά finds place in Adamnan's second preface to "St. Columba's Life." So much for the sixth century. I now pass to the seventh century. I here cite as a witness the letter of Cummian of the Columban Monastery of Durrow, in the King's County, written to Segienus, Abbot of Iona, in the year 634. That epistle is a marvellous composition. You will find it in Ussher's "Sylloge Veterum Epistolarum Hibernicarum." It discusses the vexed question concerning the time of keeping Easter, which was then troubling all Ireland. Cummian took the Roman side as against the Columban view. I call it a marvellous composition because of the vastness of its learning. It quotes, besides the Scriptures and Latin authors, Greek writers like

there is an exposition of the Gallican ritual, published towards the close of the sixth century, which lays down the following rule for Mass:—"Aius vero ante prophetiam cantatur in Graeca lingua. Incipiente praesule Aius psallit, dicens latino cum greco." See Martene, *Thesaurus Anecd.* v. 91; and J. Rendel Harris, *Codex Bezae*, p. 18. The early Gallican use was, I believe, the ritual followed and the liturgy used in Wales and Ireland—a view which this story about St. Gildas confirms. I have in "Ireland and the Celtic Church," p. 318, given another instance of identity between early Irish and Gallican rites.

Origen, Cyril, Pachomius, the head and reformer of Egyptian monasticism, and Damascius, the last of the celebrated Neo-Platonic Philosophers of Athens, who lived about the year 500, and wrote all his works in Greek. Cummian discusses the calendars of the Macedonians, Hebrews, and Copts, giving us the Hebrew, Greek, and Egyptian names of months and cycles, and tells us that he had been sent as one of a deputation of learned men a few years before to ascertain the practice of the Church of Rome. When they came to Rome they lodged in one hospital with a Greek and a Hebrew, an Egyptian and a Scythian, who told them that the whole world celebrated the Roman and not the Irish Easter. This long letter, which takes up twelve closely printed pages of Ussher, proves the fact to demonstration that in the first half of the seventh century there was a wide range of Greek learning, not ecclesiastical merely, but chronological, astronomical, and philosophical, away at Durrow, in the very centre of the Bog of Allen. The next witness I summon is Aileran, called the wise or sapiens, Abbot of Clonard, twenty-five miles west of Dublin. He died in the great plague which ravaged Ireland in the year 664 and 665, and proved fatal to a great many of our ancient scholars. He wrote a great deal, but the only work which remains extant is his commentary on the genealogy of our Lord, which has been printed in Mign's "Patrologia Latina," t. lxxx., col. 328. He takes each name, discusses its meaning in Hebrew, Greek, and Latin, deducing conclusions which might not, perhaps, be accepted by modern critics, but which prove his extensive scholarship. Here, however, it may be said, these Hebrew references which you speak of do not show that the writers knew anything at all of Hebrew save what they might have picked up out of St. Jerome's massive commentaries on the Bible. I cannot, however, accept such a view. The Irish scholars of the sixth and seventh centuries knew the Hebrew text, and used the Hebrew text of the Old Testament, as we expressly learn from Ussher's "Antiquities" (Works, vol. vi. p. 544), where he tells us of St. Caminus, of Inis-caltra, in Lough Derg, that he himself (Ussher) had seen St. Camin's Psalter, "having a collation of the Hebrew text placed on the upper part of each page, and with brief scholia added on the exterior margin," a passage which, in Dr. Reeves's opinion, proves that the Hebrew language was studied by the ancient Irish scholars about the year 600.[1]

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[1] Ussher's words are: "Habebatur psalterium, cujus unicum tantum quaternionem mihi videre contigit, obelis et asteriscis diligentissime distinctum; collatione cum veritate Hebraica in superiore parte cujusque paginae posita, et brevibus

Augustine, the Irish monk of the seventh century, affords another proof for my argument. He wrote a book on the "Difficulties of Scripture," which was long attributed to St. Augustine of Hippo, but which proves its Hibernian origin by several facts. Augustine mentions St. Manchan, of Lemanaghan, in the King's County, and St. Baithen, who lived beside the Hill of Usnagh, between Mullingar and Athlone, in the county Westmeath, and died in the great plague of 664, to which I have just now alluded. But that is not the only proof of this Augustine's Irish origin which his writings afford; for he tells us of the animals inhabiting Ireland, the ebb and flow of the tides on the Irish coast, and the natural forces by which Ireland was separated from the continent of Europe; upon all which points I beg to refer to Dr. Reeves's Memoir, printed in our own *Proceedings* (vol. vii., p. 514). Among other evidences of his Greek and Oriental knowledge which this Augustine, who lived in the second half of the seventh century, gives, he quotes the "Chronicle of Eusebius."

But I must not weary you with too great a multitude of details, and must therefore hasten on to the eighth century. Here I summoned to my assistance the names of Bede and of Alcuin. They were English scholars it may be replied. But then they were English scholars who gained their knowledge at Irish hands; for the North of England, where they were both trained, was in the eighth century covered with Irish schools. Here let me quote an authority whom most people will allow to be decisive on a question of early English history. I refer to Dr. Stubbs, now Bishop of Oxford. He wrote the articles on Bede and Alcuin in the "Dictionary of Christian Biography"; and in them he tells us that Bede was trained at Jarrow under Trumbert, the disciple of St. Chad, and Sigfrid, the fellow-pupil of St. Cuthbert, under Boisil and Eata; "from these," Dr. Stubbs says, "he derived the Irish knowledge of Scripture and discipline." Now, Bede was a good scholar. Dr. Stubbs tells us that "he certainly knew Greek, and had some knowledge of Hebrew." Alcuin, too, was largely trained under Irish influences, and he retained, as his epistles and correspondence prove, the liveliest interest in the Irish schools, sending subsidies even from the distant Court of France away to the poor scholars of Clonmacnois. Alcuin, according to Dr. Stubbs, was acquainted with the Latin poets; knew Greek and some Hebrew. Let me conclude this brief notice of the eighth century by calling your

scholiis ad exteriorem marginem adjectis." Dr. Reeves expresses his opinion on this point in the Index he appended to Ussher's works.

special attention to the fact that we know of two native Greek scholars who passed, the one into Ireland, the other into England, about this period. Virgil, the Geometer Abbot of Aghabo, in the Queen's County, left Ireland for Salzburg, in Upper Austria, about the year 740. Ussher, in his "Sylloge" (iv. 462), tells us that his companion on that missionary journey was Dobdan, a Greek; and then adds: "I should wonder, indeed, that a Greek should come from this Ireland of ours, unless I knew that at Trim a church exists which to this day retains the name of the Greek Church." Dobdan was a learned man, and became an eminent teacher at Salzburg. Surely he must have imparted a knowledge of Greek to the monks and students of Aghabo.[1] And now for the other. Theodore, of Tarsus, came into England as Archbishop of Canterbury about the year 670. His great work in England was educational. He established a celebrated school at Canterbury. Among the students who flocked to it were large numbers of Irishmen whom, we are told by an ancient chronicle, he treated as a wild boar does a pack of hounds. Greek was there studied with such success that Bede, writing sixty years afterwards, tells us that "there are still living at this day some of Theodore's scholars who are as well versed in the Greek and Latin tongues as in their own, in which they were born" (Bede, iv. 2).

I now come to the ninth century. I hope you will be satisfied with two writers drawn from this period. Sedulius was Abbot of Kildare about the year 820. He was a learned man, as his commentaries on the Epistles of St. Paul show. These commentaries have been printed in various shapes, and have been reprinted of late years in the "Patrologia Latina" of the Abbé Migne. Well now take up his "Commentary on the Romans," and you will find Sedulius showing his Greek and Hebrew learning in connexion with the very first verse of that Epistle, "Paul, an apostle of Jesus Christ." He takes the word "apostle." He gives it in its Greek shape ἀπόστολος; in its Hebrew shape, writing it in correct Hebrew characters without vowel points,[2] and then discusses the difference between ἀπόστολος and ἄγγελος. They cannot have been such an ignorant lot after all in the monastery of Kildare in the year 820. Now, let us hear Ussher on Sedulius and his knowledge of Greek. That

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[1] The writer of the article on Dobdan in the "Dictionary of Christian Biography" differs from Ussher, and will not admit that Dobdan was a Greek.

[2] "It occurs but once in the LXX, in 1 Kings, xiv. 6, as a translation of שלוח."—Lightfoot, "Galatians," p. 93. Lond. 1866.

eminent scholar wrote a work on the religion of the ancient Irish, where he poured out the treasures of his learning in a more popular shape than was usual with him. He deals with this very point in vol. iv. of Elrington's edition of his works, p. 245, where he says: "As for the edition of the Scriptures used in Ireland at those times, the Latin translation was so received into common use among the learned that the principal authority was still reserved to the original fountains. Therefore doth Sedulius in the Old Testament commend unto us the Hebrew verity, and in the New correct oftentimes the vulgar Latin according to the truth of the Greek copies." And then Ussher goes on to give us four or five pages of examples to prove his case, with which I need not trouble you. I shall only remark that Sedulius could scarcely have corrected the vulgar Latin by the Greek text, unless he knew Greek and used the Greek text. But then it is the habit to decry men like Ussher. They are old-fashioned. They knew nothing of the latest results of modern scientific research. So I appeal to another authority about Sedulius. The "Revue Celtique" is not an old-fashioned authority. The first volume was published during the years 1870–72. Now, in vol. i., on p. 264, you will find an article by an eminent French scholar, Charles Thurot, on some grammatical works by Sedulius, Abbot of Kildare. Sedulius published commentaries on Priscian, Donatus, and Eutychius. Some of these still survive in MS. in France. Thurot, describing one of them in this short article, touches upon our point, and says: "Sedulius makes parade of his Greek knowledge. He employs Greek words without necessity, and translates into Greek a part of the definition of the pronoun." Or take another authority, who can scarcely be yet called old-fashioned. Cardinal Mai published, in 1825, a great work, in ten volumes, called "Veterum Scriptorum Nova Collectio." In the 9th volume, pp. 159–181, you will find a work of Sedulius's on the Gospels, which Mai discovered in the Vatican Library, containing numerous proofs and marks of his Greek and his Hebrew scholarship.

So much for Sedulius: and now for one other case belonging to the ninth century, which one will be Johannes Scotus Erigena. I need not dwell on Scotus. He went from Bangor to the Court of France, and was the ornament of that Court in days when learned men flocked thither from every quarter. The works of the pseudo-Dionysius the Areopagite had just then been brought from the East, and were creating great interest in learned circles. The only person found capable of translating them was Johannes Scotus, who gained all his knowledge at Bangor on Belfast Lough. Perhaps the best proof I can give you of the attainments of Scotus Erigena will be found in the astonishment created by them in the highest and most literary circles of that time. Anastasius Bibliothecarius was a famous man in the ninth century, and is still a famous man. He was the librarian of the Roman Church; Vatican Librarian we should now say, like Cardinal Mai. The Emperor Charles the Bald, the patron of Johannes Scotus, sent his translation of Dionysius to the Pope. Anastasius acknowledged them in a letter still preserved in Ussher's "Sylloge" (Works, iv. 483), where Anastasius expresses his astonishment at the Greek attainments of Johannes Scotus in the following words: "I wonder how that barbarian, placed in the outskirts of the world, could understand and translate such things." The exact Latin being: "Mirandum est quoque, quomodo vir ille barbarus, in finibus mundi positus, talia intellectu capere, in aliamque linguam transferre valuerit."[1] This letter of Anastasius was written in 865; and with Johannes Scotus Erigena and his Greek scholarship and Greek translations, I think I may end my list of historical witnesses whom I have summoned to support my contention.

I have now given you, century by century, numerous quotations to prove that Greek was not an unknown tongue in Ireland from the year 500 to the year 900 A.D. But then, a persistent objector might say: Oh! you have only proved that the Irish scholars knew enough of Greek to stumble their way through a verse of the Greek Testament with the help of St. Jerome's Commentaries. You have not shown that they could write Greek as Irenæus, for instance, wrote it in Gaul in the second century. This objection is, indeed, a splendid specimen of the fallacy called *ignoratio elenchi*. I originally undertook merely to show that there was sufficient knowledge of Greek in Ireland and in Gaul to enable people to translate the Scriptures. Then when I have done this, an objector may say, "Oh, you have not proved at all that the Irish scholars could write and speak Greek"; a very different thing indeed from my original contention. But I will condescend to my supposed critic, because, even on this point I think I can satisfy you, though, by the way, if writing Greek and producing Greek manuscripts and Greek works be the only proof of Greek knowledge and scholarship, I fear very much that Greek must be an unknown tongue in Trinity College, Dublin, or at Oxford or Cambridge; for I have never heard of an original Greek manuscript being produced in any of these Universities.

[1] John, in another letter, appeals to the Greek text, from which he translated as bearing out his views (Ussher iv, 478).

But I am quite willing to accept this test; and my reply is this: We have at least a dozen Greek MSS., principally Biblical, which owe their origin to this country;[1] and surely men who wrote Greek MSS. must have known the Greek language.

As I have delayed you so long I must be very brief on this point, perhaps the most convincing of all that I have advanced. I have spoken concerning Sedulius, Abbot of Kildare about 820, and given you some proofs of his knowledge of Greek, derived from his theological and grammatical works. But what will you say when I tell you that I have here with me this afternoon a transcript of a Greek manuscript written with his own hand. Montfauçon was a great scholar, who lived in the first half of the last century. He produced more than 150 years ago a Greek work, "Palæographia Græca," where he describes (iii. 7, p. 236) a Psalter written in Greek by the hand of Sedulius, Abbot of Kildare, with this signature in his own writing, CHΔYΛIOC CKOTTOC EΓΩ EΓPAΨA. That Psalter was, in Montfauçon's time, preserved in a convent of Lorraine. It has been since removed to Paris, and is now in the library of the Arsenal. But Montfauçon is old-fashioned, though he gives us a transcript of a page of this Psalter which is accurate enough. Let us therefore hear a modern authority, and he shall be a German; free, therefore, from any narrow prejudices. Gardthausen is generally regarded as the great modern authority on Greek Palæography. He is a professor at Leipzig, where he published his work, "Griechische Paläographie," in 1879. Listen to him on this point. On p. 427, having told us that Alcuin learned Greek from Irish monks at York, he then proceeds, on p. 428: "Scanty but very characteristic remains of these Irish-Greek books are to be found in a remarkable Psalter belonging to the Library of the Arsenal in Paris, as well as in the 'Codex Boernerianus,' and the 'Codex Sangallensis,' of which Rettig has published fac-similes. Both give the Greek text with a Latin translation. The ornaments are thoroughly Irish. Both manuscripts were certainly written by Irish monks." Now, that is the verdict of the greatest living German authority on Greek Palæography. Does he think that

[1] This is simply an elementary fact in textual criticism of the N. T.: see, for instance, Scrivener's "Introduction," p. 170; Westcott and Hort, "Introd. to N.T." p. 149; where these learned Cambridge divines speak of the "preservative power of the seclusion of Greek learning in the West." A study of these Hiberno-Greek MSS., with their Latin translations, might have an important bearing on the text of the "Itala." Cf. also "Columbanus and his Library," in the *Expositor* for June and August, 1889.

the Irish scholars were ignorant of Greek in the ninth century? Or take up two authorities with which I did think all students of Irish philology were thoroughly acquainted. The first shall be Zimmer. Zimmer's "Glossæ Hibernicæ" was published at Berlin in 1881. Read Zimmer's preface and what do you find? On p. xxiv. he describes a manuscript, now at Carlsruhe, written probably at Clonmacnois about A.D. 850. That manuscript contains the *Gloria in excelsis* in Greek, with an interlinear Latin translation. On p. xxxiii. of the same preface we find Zimmer giving us a regular Latin treatise on the "Codex Boernerianus," now at Dresden, which is a copy of St. Paul's Epistles written in Greek by an Irishman, who proves his nationality by a poem in Irish, and by Irish glosses and comments which he appends to the text. The poem, I may remark, puzzled all the scholars of the Continent till our own distinguished Academician, Dr. John O'Donovan, took it, showed that it was Irish, and not Anglo-Saxon, as they imagined, and duly translated it into English.[1]

Then take up another modern authority. D'Arbois de Jubainville published at Paris, in 1883, his Catalogue of Irish MSS.—a book called usually "La Litterature Epique de l'Irlande." On p. cxiv. of his historical preface he tells us of an Irish MS. at Laon which contains a Greek glossary or lexicon. On p. cxxiv. he tells of the Greek Gospels at St. Gall, with an interlinear Latin translation, all written by an Irish monk. On p. cxxvi. he describes an Irish manuscript of the eighth or ninth century, belonging to the Monastery of St. Paul in Carinthia, in which a Greek lexicon and a portion of a Greek grammar have been found; the Greek lexicon and the Greek grammar having been also duly noticed in Windisch's "Irische Texte," part I., p. 313, published in 1880. But why should I weary the Academy with more evidence, and yet I have far more. I have only touched the very fringe of this subject. These eighth and ninth century Greek manuscripts, covered with Irish glosses and Irish poems and Irish notes, have engaged the attention of palæographers and students of the Greek texts of the New Testament during the last two centuries. Montfauçon was not the only scholar of the last century who dealt with them. Wetstein, who died in 1754, in his monumental work on the Greek Testament, discussed them. Westwood dealt with the Hiberno-Greek MSS. in his "Palæographia Sacra," and Keller discussed them in the Transactions of the Antiquarian Society of Zurich in the year 1851. Matthæi,

[1] This poem will be found in Scrivener, as quoted above, and in the *Expositor* for June, 1889, p. 471.

in 1791, wrote a special work on the Dresden Manuscript with the Pauline Epistles in Greek. Rettig, in 1836, published a large folio volume, giving a transcript and fac-similes of the Hiberno-Greek Gospels at St. Gall. That folio has been for the last fifty-six years lying on the shelves of our College Library.[1] While to crown the matter, I shall conclude with quoting an authority which will be conclusive for the greater part of this Academy. Our late revered President was, as we all know, a man of singular self-repression, who consented to bury a vast deal of his immense learning in articles contributed to fugitive periodicals. In the year 1848, for instance, he contributed two articles to the *Irish Ecclesiastical Journal* (vol. v., p. 136), the only copy of which now existing in any Dublin library is found in Trinity College. The first of these articles dealt with the very topic—the knowledge of Greek in Ireland—which I have been now discussing. Dr. Reeves first goes through a number of different Hiberno-Greek MSS. The Codex of St. Gall, containing the Greek Gospels,[2] the Codex of Dresden, containing the Greek Epistles, the Codex Augiensis at Cambridge, the Greek Psalter of Sedulius, are all duly analysed; and then he concludes his article with this statement—the last quotation with which I shall trouble you:—"The foregoing examples are sufficient proof of the early cultivation of the Greek language by the natives of Ireland."

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[1] The full title of this work is, "Antiquissimus quatuor Evangeliorum Canonicorum Codex Sangallensis Graeco-Latinus Interlinearis." H. C. M. Rettig., Turici, 1836.

[2] Dr. Reeves says of this copy of the Gospels, in the articles referred to: "In the library of St. Gall is an exceedingly ancient and valuable MS. of the Four Gospels written in uncial Greek. The Greek characters are very similar to the occasional uncial letters which appear in the Book of Armagh." And again: "There can be no doubt that the writer of this MS. was an Irishman, or, at least, of the Irish School, which was *unquestionably* the most advanced of its day in sacred literature"; language of that eminent scholar which fully bears out my statement in "Ireland and the Celtic Church," that the Greek writing in the Book of Armagh is an evidence of Greek studies in the primatial city.

XVI.

ON A NEW SPECIES OF LERNÆOPODA FROM THE WEST COAST OF IRELAND; AND POLPERRO, CORNWALL. BY W. F. DE VISMES KANE, M.A. (Plates IX. and X.)

[Read JANUARY 25, 1892.]

Order,	. .	**COPEPODA.**
Sub-Order,	. .	**Lernæidæ.**
Family,	. .	LERNÆOPODIDÆ, Blv.
Genus,	. .	LERNÆOPODA, Blv.
Species,	. .	BIDISCALIS.

THE genus Lernæopoda, Blv., is composed of forms very nearly allied to those of Achtheres, the latter being chiefly distinguished from it and the rest of the family by its having preserved the thoracic segmentation, a character occurring elsewhere only in the immature stages of species, such as *L. galei*, *L. elongata*, Grant, and the present one, *L. bidiscalis*. Traces, however, of such segmentation are also distinguishable in the adult, *L. galei*. It seems, therefore, desirable to merge these two genera as was suggested long since by Van Beneden. The genus Brachiella is also linked to Lernæopoda by one species *B. pastinaceæ*, but the long neck which is generally characteristic of that genus allies it more closely with Anchorella. The family of Lernæopodidæ possess the following appendages according to Kürz:—Two pairs of antennæ, one pair of mandibles, one pair of maxillæ, and two pairs of maxillipeds. Posteriorly most species are further provided with two or more abdominal (?) lobes, and the females with two multiserial ovisacs as in Cyclops. Also I find that the males of *L. bidiscalis*, and *L. galei* are also furnished with a pair of cephalic lobular processes, projecting downwards from between the two pair of maxillipeds, the use and homology of which I am at a loss to decide, and which seem to have escaped the notice of previous observers. They will be again referred to in the description of the male. This new species was found by me in June, 1890, when on a cruise in the S.S. Fingal with the Rev. W. S. Green, H.M. Inspector of Irish Fisheries. When long-line fishing off the coast between Valentia and the Skelligs a number of Tope (*Galeus vulgaris*) were taken, and I observed that nearly all the males had their claspers torn and ragged at the tip, and this mutilation was evidently not the result of the accident of their capture. On further examination I noticed that in many cases a specimen of this parasite was fastened in the wounds. None were to be found in any other situation, nor more than one on each clasper.

On one specimen, however, I took two *L. galei* from the depression behind the ventral fins, and also a specimen of *L. bidiscalis* from each clasper. I secured in all fourteen females of this latter new species. In colour they are uniformly dingy white, with the ovisacs yellower, and the anterior portion of the head is margined with bright orange antennæ.

The Rev. Canon Norman, to whom two specimens were sent, identified them as similar to two which he received about twenty-five years ago, from Polperro, of a bright vermilion colour, found on the smooth-hound (*Mustelus canicula*). These he obligingly sent me for comparison, and they proved identical in every respect except in colour. This, however, it would appear, is a very inconstant character also in *L. galei*, Kr., of which Van Beneden ("Ann. des Sciences Naturelles, 1851") states that he had examples from four different genera of Plagiostoma, namely, *Mustelus vulgaris*, *Trygon pastinaceæ* (in the nasal fossæ), Galeus (pectoral fins) and *Scyllium canicula* (claspers). All were almost perfectly similar except as to colour; but those found by him on Scyllium were most like those found by Kroyer on the Galeus; *i.e.* with slenderer body and longer "arms." Some had yellow bands on the head, in others the head, arms, talons, and antennæ were of a bright red, and in others the anterior part of the thorax only. The colour, moreover, was not destroyed by alcohol, a peculiarity I also noted of the red antennæ of *L. bidiscalis* except after prolonged immersion for a year or more. Van Beneden mentions also that the colour was the most vivid in those from Trygon and Mustelus. On careful examination of my specimens of the new species considerable variation was found to exist, although all agreed in general characteristics. The size and shape of the thorax varied somewhat, being more oval in some (Pl. IX., fig. 8), while in others it was squarer and shorter (Pl. IX., fig. 3). In some, too, the dorsal and ventral surfaces were divided longitudinally into two swollen lateral regions, with a more depressed intermediate area, wrinkled transversely (Pl. IX., figs. 1 & 2), especially at the edge, some of the depressions appearing to represent annular furrows. The variation in the distension of the lateral portions no doubt depends upon the quantity of ova present in the respective specimens. Van Beneden remarks a somewhat analogous formation on both surfaces of the thorax of *Brachiella Chavesii*, female, which he says suggests traces of ancestral segmentation. The brachiform maxillipeds of *L. bidiscalis* also varied a little in their proportionate length, being considerably shorter in one specimen than the rest. (In *B. Chevreuxii*, Van Beneden has found a similar shortening of the maxillipeds in some individuals.) But in every instance their swollen character was preserved, tapering rapidly from the distal to the proximal end, which was furnished with a broad, fleshy, and extremely conspicuous terminal disc (Pl. IX., figs. 6 and 7). In one instance an aberration was noticed in which the disc of one arm was not fully developed, and did not much exceed in size that of *L. galei* (Pl. X., fig. 7). The ovisacs varied, as might be expected, in thickness as well as in length, and Canon Norman's two specimens appeared to have them better developed and blunter at the end than any of mine. At the date of my captures, mid-June, the ovisacs appeared in some cases to be of full size, and in one or two examples on the point of rupture, the nauplius being fully developed in the terminal ova. The present species differs markedly from *L. galei*, by the contour and length of its arms, thorax, and other features. The *L. obesa* of Milne Edwards approaches it in some particulars, but neither the conspicuous discoid terminations to the brachiform maxillipeds nor the so-called abdominal lobes are described as present.

The tenaculum by which *L. bidiscalis* is attached to its host is shaped like a shallow saucer of reddish chitin, and in two instances, one of which was a very young female (Pl. IX., figs. 1, 6), there were observable in the central depression two colourless spots which probably are the terminal insertions of muscular attachments. In none could I find any bulbous process, such as that I have noticed in *Anchorella uncinata*. I notice that Van Beneden (*père*) describes that of the last-named species and *A. rugosa* as being cup-shaped (Ann. des. Sc. Nat., 1851.) The various and remarkable forms of tenacula of this family require further study. Being difficult to detach without injury from the tissue of the host, they are frequently absent in specimens, in others only a portion remains, and in others a mass of cartilaginous tissue envelops them, and masks their real character. This accounts for the fact that the processes described by one author are sometimes sought for in vain by another, and that they are frequently not delineated in figured species. How they are primarily inserted into the host, and how they maintain so firm a grip is worth consideration. It is possible that the discoidal terminations of the arm-like maxillipeds are at first capable of acting like suckers, and that subsequently in such species as are provided with a bulb, as *Basanistes huchonis* and *Anchorella uncinata*, or with a cup-shaped process as in Lernæopoda, &c., this grows up gradually into the tissue of the host, and by the irritation thus produced becomes encysted in an envelope of cartilage, or tough skin. This appears certainly to be the case with the dendriform tenacula of *Lernæa branchialis*, and I have more than once noticed when dissecting out its ramifications that an active inflammation had been set up in the branchial cartilaginous membrane of the host. Before leaving this subject I would wish to call attention to a very remarkable character stated by Van Beneden to exist in the cup-shaped tenaculum of the new Brachiella he has described under the name of Chevreuxii, namely, certain solid accessories, "qu'on designerait sous le nom de mandibles ou de machoires si elles se trouvaient à la bouche." If an apparatus of this sort is found attached generally to tenacula, the method of their penetration is to a large extent explained. It is to be regretted that no figure accompanies this interesting reference. I have been unable to detect any similar appearance in the present species, unless it be the whitish filaments already referred to. These are apparently, however, only muscular cores from the two maxillipeds, round which the cup is formed. The chitinous process, whether cup or bulb, appears to be only a modification of the chitinous talons which form the normal terminations to the maxillipeds generally.

Reproductive Organs.—I have not been able to find that any observations have been made as to the mode in which impregnation takes place among the Lernæopodidæ. The discovery of spermatophores attached to the genital orifices of a female of the species now described is therefore of interest. Their position and appearance, which is that of transparent ovoid sacs with peduncles crossing each other between the genital styles, exactly resemble those figured by Claus[1] on *Lutkenia asterodermi*, and also in general character those of *Caligus pectoralis*. The peduncles are so attenuated at their proximal end that I failed at first to trace their attachment, but eventually succeeded in following their course to the extremity of the styles, where they were fixed to a transparent membranous cap which closed the pore. I also succeeded in discovering similar spermato-

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[1] "Beiträge zur Kentniss der Schmarotzerkrebse," Zeits. f. Wiss. Zool. xiv. 365.

phores extruded from between the genital styles of males of *L. bidiscalis* (Pl. x., fig. 4, ss.) and *L. galei.* The peduncles were not visible, and seemed to be still included in the ducts, the apertures of which lie at the inner bases of the styles, reminding one of the similar provision in Astacus. This observation throws some light upon the homology of the styles borne by both sexes of these species. It would appear probable that they are true thoracic appendages, analogous to the ultimate and penultimate thoracic legs, in the male and female Astacus respectively. And it seems likely that those of the male are used in the application of the spermatophores, and that the peculiar shape of their distal extremity is adapted for the purpose. The styles of the female vary much in projection and shape, being sometimes cylindrical and sometimes bell-shaped as in Pl. x., fig. 9.

In M. P. J. Van Beneden's recent Memoir on two new Brachiellæ, he describes the males of both species as provided with " a unique appendage which can be nothing else than a penis." It springs from immediately behind the maxillipeds, and is directed backwards when protruded. The situation strikes one as differing from that of the genital apparatus of the family in general, but there are three species the males of which have been found to possess an analogous organ. Van Beneden (*père*) describes that of *Anchorella rugosa*, and though he does not say that the appendage is double, he figures two testes. In Kürz's figure and description of *Anchorella emarginata*, male, he mentions a pair of papillæ of three segments, pointing forwards, in the same position, and in *Cestopoda amplectens*, male, he indicates a protuberance with two pores similarly placed. Again, in Steenstrup and Lütken's figure of the male of *Brachiella appendiculata* there appears to be an indication of some such protuberance. It is to be wished that in respect to *Brachiella Chavesii* and *B. Chevreuxii* mention had been made of the number and position of the genital pores. By analogy with those above referred to we should expect the apparatus to be either paired, or if single, to possess two orifices. I regret that I have been unable to consult a work of M. C. Vogt, in which he figures the males of certain species referred to in the Memoir above cited.

I have to acknowledge my indebtedness to the Rev. Canon Norman for kind assistance and for bibliographical references.

Description of Female.

Length.—12 to 13 mm., of which ovisacs, 8 ; thorax, 3 ; head, 2.

Colour.—Grayish white, with yellowish ovisacs. Sometimes entirely crimson.

Head.—Pyriform as seen from side, very slightly domed on vertex, but oblong, with the frontal margin narrower as seen from above. Longer and flatter than that of *L. galei.* Protected above by a chitinous shield serrated anteriorly.

Antennules.—One pair, erect and slender; composed of a coxopodite and three longer joints, the last bearing a few setæ.

Antennæ.—One pair, springing from close beneath the edge of the chitinous cephalic shield, and lying along the frontal margin. They are stout and of a similar number of joints as the antennules ; the extreme one being prehensile with blunt fleshy exopodite and endopodite. In the specimens taken by me they were of a bright orange, which persisted after alcoholic immersion for a lengthened period.

Mouth.—Consisting of a siphon directed forwards from the frontal margin of the head plate. The aperture fringed with ciliæ.

Mandibles.—One pair, situated within the siphon, provided at the terminal portion with 10 teeth, the four last being the largest, with 3 minute ones intercalated between them, suggesting when focussed the appearance of a double row. The mandibles of *Brachiella pastinaceæ* figured by Kürz seem very similar.

Maxillæ.—One pair ; with three blades at the anterior end, and one nearer the base.

Maxillipeds.—Two pair, which represent the outer and inner pair of rami of the second pair of maxillæ of Cyclops (cf. Hartog, "Morphology of Cyclops," Trans. Linn. Soc., 1888). (*a*) The anterior or inner maxillipeds are small, two jointed, situated beneath the head at about half its length, ending in a powerful talon. (*b*) The posterior and outer pair are large arm-like appendages, springing from close to the base of the inner pair, irregularly swollen, translucent, and fleshy, tapering rapidly from the base and terminating in a very large fleshy circular or ear-shaped disc. These two discs approximate at the inner edge, and thence conjointly give rise to a dark reddish chitinous saucer-shaped tenaculum.

Thorax.—Short, thick, quadrangular or oval, generally about one-fourth longer than broad, usually protuberant at the lower corners. In some specimens the dorsal and ventral surfaces show a central area, depressed and wrinkled transversely to the length. Two genital papillæ with pores, anterior to the anal aperture.

Abdomen.—Aborted, or perhaps represented by two fusiform appendages attached to the extremity of the thorax, between and in front of the junction of the ovisacs. Between their bases is the anal aperture.

Ovisacs.—Yellowish. Blunt at ends. Eggs arranged in multiserial order of 3 to 4 in breadth, and presenting hexagonal outlines.

DESCRIPTION OF MALE.

Length.—3·5 mm., usually attached to the back or side of the female.

Head.—Similar in shape to that of the female, but with antennules and antennæ proportionally longer, and projecting erect from base. The siphon is directed downwards, and not forwards as in the female, and just above it, below the cephalic shield, is a single eye slightly projecting in profile. The mandibles and maxillæ similar to those of the female.

Maxillipeds.—Not very disproportionate to each other in size. The inner pair similar to those of the female, but larger. The outer pair slightly exceeding the inner in length, two jointed, with the basal joint large, and the second joint short, broad, flat, and cheliform, something like the beak of a parrot.

Intermaxilliped processes are seen projecting like a pair of transparent lobes with a granular centre between the two pair of maxillipeds. Those of a young specimen I examined were proportionally much longer than those of adult specimens, suggesting that they may be survivals of ancestral appendages. These may possibly be what Van Beneden refers to[1] when speaking of the maxillipeds of *L. galei*; he says, "On voit entre elles des pieces très distinctes du squelette cutanée."

Thorax.—Very small proportionally to the head, bluntly oval in shape, without traces of segmentation, except in immature specimens, which in both sexes are divided into five segments, which is also the case with *L. galei* and (Steenstrup and Lütken) *L. elongata*. The remarks of Van Beneden, in his recent Memoir on *Brachiella Chavesii*

[1] "Recherches sur quelques Crustaces Inf.," Ann. des Sc. Nat. 1851.

upon the segmentation of *Charopinus Dalmanni,* figured by Kroyer, may be, perhaps, thus explained.[1]

Two genital styliform appendages project from the posterior ventral surface corresponding in situation to those of the female, slender in the middle, but broader at the distal end.

Between their bases are the orifices from which the spermatophores are extruded.

Abdomen.—Aborted as in the female. The two abdominal lobes are much stouter and broader, and of irregular ovoid shape. They bend backwards and upwards until they rest upon the dorsal surface of the thorax. In the immature stage they are almost globular, and project backwards from the point of attachment without any upward curve.

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[1] "Deux Lerneopodiens nouveaux." P. J. Van Beneden. Bull. Acad. Roy. De Belgique, No. 7, 1891.

EXPLANATION OF PLATES.

PLATE IX.

FIG.

1. *Lernæopoda bidiscalis*, an immature male, showing segmented thorax.
2. The same, ♀, showing dorsal area flattened.
3. The same, showing ventral aspect.
4. The same, with a more oval thorax and larger outer maxillipeds.
5. An adult male.
6. Outer and inner maxillipeds of female with saucer-like tenaculum.
7. Do. do. another aspect.
8. Dorsal aspect of a female highly magnified.
9. Head of do. seen from above, showing antennules, antennæ, and labrum.
10. Mandible.
11. Maxilla.
12. Siphon of female protruded from buccal aperture.
13. Mandible highly magnified.

PLATE X.

FIG.

1. Immature female of *L. bidiscalis* highly magnified.
2. Immature male do. do., showing intermaxilliped process.
3. Adult male do., *s.* = spermatophore.
4. Do., ventral aspect, showing situation of intermaxilliped processes and spermatophores.
5. Extremity of outer maxilliped of male.
6. Discs and tenaculum of female.
7. Do., with unequally developed discs.
8. Intermaxilliped process.
9. Genital papillæ of female with pores.
10. Do. do. of male.

XVII.

REPORT ON THE ESTUARINE CLAYS OF THE NORTH-EAST OF IRELAND. By R. LLOYD PRAEGER, B.E., M.R.I.A.

[Read February 22, 1892.]

The term estuarine clays, as used in the present report, is intended to signify those deposits, mostly of clay, which have accumulated in our existing bays and estuaries since the close of the Glacial period—a definition propounded by Mr. S. A. Stewart, of Belfast, who first pointed out the important evidence which these beds furnish as to the latest fluctuations of the sea-level on our shores. The estuarine clays have been described under the names of silt, drift, diluvium, alluvium, alluvion, and blue clay; the areas which they cover are commonly known as slob-lands, while the clay itself is locally called slob, sludge, or sleech. In their typical form, they consist of tough, homogeneous, unctuous blue clays, entirely free from admixture of gravel, sand, or pebbles, and containing a marine fauna rich in Mollusca, Entomostraca, and Foraminifera, which differs somewhat from that inhabiting the adjacent waters at the present day. The estuarine clays occupy large areas in and around many of the bays of the North-east of Ireland, and as they present beds of considerable thickness, which have been continuously laid down, and as their fauna lived on the spot where it is now entombed, they afford perhaps the best view of the geological history of the long interval that has elapsed since the close of the Great Ice Age—a more complete record, certainly, than the much studied contemporary raised beaches, which are too often but current-heaped remnants, with a miscellaneous fauna washed into them from the neighbouring waters. That the estuarine clays cannot be treated as mere recent deposits of mud, but are duly entitled to a place in the Post-tertiary series, is shown by the difference between their fauna and that of the adjoining waters, as well as by the fact that they are either contemporaneous with, or older than the aforementioned raised beaches, such as those at Larne, Kilroot, and Greenore, which have never been refused a place in the geological succession.

The typical succession of Post-tertiary beds in the North of Ireland estuaries, in ascending order, is as follows :—

1. Boulder clay.
2. Re-assorted Boulder clay.
3. Sands and gravels.
4. Submerged peat.
5. Lower estuarine clay.
6. {Upper estuarine clay. / Raised beaches.}

The Boulder clay, with its boreal fauna and scratched and polished pebbles, need only be mentioned here as the base on which the succeeding deposits are laid. Overlying it, in the Belfast estuary (which, on account of the extensive development of the beds there, and the excellent opportunities that have on various occasions been afforded for their inspection, may well be taken as a type), and elsewhere, is a fine, hard, red clay without pebbles, evidently produced by the washing down of the Boulder clay, and, with the next-mentioned bed, probably corresponding in age with the eskers. It is succeeded by fine red sands, generally unfossiliferous except for a few worn Foraminifera to attest their marine origin. These sands are extensively developed around Belfast; a full account of them and the associated strata, showing their distribution and characters, by James Mac Adam, F.G.S., will be found in the Journal of the Geological Society of Dublin, vol. IV., part ii., No. 2 (1850), to which the reader is referred.

The red sands are succeeded by a deposit of a widely different nature—the submerged peat—a well-marked zone, which can be traced, usually underlying estuarine clay, not only around the Irish shores, but at many spots on the coasts of England and Scotland. At Alexandra Dock, Belfast, it was found twenty-seven feet below high-water mark; near Connswater, and at Tillysburn, Holywood, Ballyholme, Carrickfergus, Glenarm, Ballintoy, and Portrush, it may be, or has been seen between tides; at Downpatrick, in the estuary of the Quoile, it is again far below low water. It yields a flora of marsh plants—sedges, flags, and rushes; branches and fruit of hazel, alder, oak, willow, and Scotch fir, especially the first-named; elytra of beetles are frequent, and mammalian remains occur. It is the first bed showing the ushering in of the temperate conditions still existing, and may be considered the base of the estuarine clay series.

Resting on the peat, in the typical section which is being described, is the estuarine clay proper, which displays two zones, differing both in lithological and in faunal characters—a lower bed, which is essentially a littoral clay, and is known as the Scrobicularia zone, and an upper bed, which has been deposited in at least five fathoms of water, and which Stewart has named the *Thracia convexa* zone, from the abundance of that bivalve at Belfast. At Belfast, Magheramorne, and Downpatrick, both zones are represented. The deposits at Bann, Kilroot, and Newcastle are typical Scrobicularia clays; the Larne, Newtownards, and Kircubbin beds are intermediate; while the Lough Foyle and Greenore clays show less characteristically the Thracia zone.

The method employed in determining approximately the depth of water in which any bed was laid down, was to select a number of its most abundant and characteristic shells, and note the *minimum* depths in which those species now live in local waters, the upper bathymetrical limit being usually more constant and better known than the lower; by taking the average of these minima, a minimum depth is arrived at which is in all likelihood pretty near the mark. Tried by this criterion, it would appear that the Thracia clays of Magheramorne, Belfast, and Downpatrick, accumulated in some five fathoms minimum; the Lough Foyle beds and Greenore in two to three fathoms; Larne and Kircubbin in one to two fathoms; the other in the littoral zone.

The Scrobicularia clay typically consists of brownish-blue, somewhat sandy clay, containing abundance of the roots and leaves of the grass-wrack, *Zostera marina*, and charged with a vast number of shells belonging to a comparatively limited number of species which have their habitat between tide-marks. The following are characteristic :—*Mytilus edulis*, *Cardium edule*, *Tapes decussatus*, *Tellina balthica*, *Scrobicularia piperata*, *Hydrobia ulvæ*. The upper or Thracia clay is remarkably pure, fine, and unctuous, and light blue in colour. Its fauna is less in actual numbers, but much greater in variety, and is characterized by shells belonging to the laminarian and coralline zones, such as *Montacuta bidentata*, *Cardium echinatum*, *Lucinopsis undata*, *Scrobicularia alba*, *Thracia convexa*, *Turritella terebra*. The raised beaches which fringe our north-eastern shores are in general contemporaneous with these deep-water clays, and frequently, like them, repose on clays of the Scrobicularia zone; they (the raised beaches) do not come within the scope of the present Paper, but it may be remarked that at Larne the well-known Curran gravels overlie the estuarine clay to a depth of twenty feet, containing flint implements and marine shells to their base; at Kilroot, the raised beach which has been described by Professor Hull,[1] rests on Scrobicularia clay; at Ballyholme, the blackish zone overlying the submerged peat, which represents the estuarine clay, is topped by twenty-two feet of marine gravels; and at Greenore and Dundalk stratified shelly gravels fifteen feet in thickness cover the clay. Occasionally the uppermost bed is of a different nature. Thus, at the Bann the Scrobicularia clay is covered with a considerable thickness of stratified brownish river sand representing the Thracia zone; and at another spot by six feet of blown sea-sand; and at Belfast (Alexandra Dock), resting on the deep-water clay, there is a bed of yellow sand full of shells washed out of the underlying stratum, capped by some six feet of littoral clays, still in course of formation, and crowded with *Mya arenaria* and *Cardium edule*.

The fauna which characterizes the estuarine clays shows that a long period must have elapsed between the close of the Glacial epoch and the deposition of even the lowest bed of the series, and what a length of time the intervening beds of red sand, clay, and gravel represent. Whereas the Boulder clay is characterized by shells which flourish amid the rigours of an Arctic climate, the estuarine clay fauna presents, if anything, a rather more southern aspect than that now existing in local waters. In other words, while the species found in the local Boulder clays which do not now exist on our present shores are generally of northern types, the corresponding forms yielded by the estuarine clays have usually now their habitat further southward. But there is very little in the latter point; for the estuarine clay fauna differs to no material extent from that now existing within a short distance.

The changes of level shown by the series above described are instructive. Far back in Post-glacial times, but long after the grand era of depression and elevation which characterized the Great Ice Age, the land must have stood at least thirty feet higher than at present. Low swamps fringed the shores, with jungles of reeds and sedges, and copses of willows, alders, and hazels, among which roamed the red deer, the wild boar, and the great Irish elk.

A period of gradual depression ensued, and submergence of the land followed, with a slow accumulation of littoral mud, in which lived thousands of burrowing inter-tidal bivalves. A more rapid further depression followed, and in a depth of five or ten fathoms the

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[1] Report of British Association, 1872.

deposition of fine impalpable sediment continued, and at spots where tidal currents ran with force, or at the mouth of streams, sandbanks and gravel accumulations were formed. It is not easy to account for the presence of estuarine clay in certain spots. In the estuaries of rivers of some volume, such as the Loughs of Foyle and Belfast, and the estuary of the Quoile, and Dundalk Harbour, where the quantity of transported sediment is an appreciable factor, one is not surprised to find beds of silt; but river-borne mud will not account for such deposits as the estuarine clays of Magheramorne, Kilroot, and Newcastle, where, in the first-mentioned locality, thick beds have been formed where no streams of appreciable volume occur, and in the last-mentioned station a deposit of typical estuarine clay occurs in a wide exposed sandy bay. Probably Mr. Mac Adam is right when he suggests[1] that growths of wrack—in these cases *Zostera marina*—entangling and retaining the muddy particles, contributed to the formation of the clays. In order to test whether the deposits at present forming between tides in our estuaries resemble the Scrobicularia clays, a sample was carefully taken from two feet below the surface near Ballycarry on Larne Lough, where extensive mud-flats occur. On examination, it proved a bluish, very sandy mud, entirely without shells, and only containing a few starved specimens of three or four of the commonest Foraminifera, differing materially, therefore, from deposits of the estuarine clay series. The surface clays at the Alexandra Dock had more in common with the Scrobicularia zone; but were much less homogeneous in composition. A deposit more resembling the estuarine clays was discovered by Professor Dickie in his zoological exploration of Strangford Lough.[2] The entrance to this extensive sheet of water is much contracted, and through it the tides run with immense force. A series of dredgings taken in the Irish Sea opposite the entrance to the Lough showed that while coarse gravel formed the bottom at and near the bar, the material became finer as the distance from shore increased, and seven miles from the bar, in a depth of twenty-six fathoms, the deposit consisted of fine black tenaceous mud, in which *Scrobicularia nitida* lived. The colour of the estuarine clays is uniformly bluish, whereas the recent deposits which have been compared to them are black; but it may be remarked that a very black, unsavoury surface clay, full of *Hydrobia ulvæ*, encountered at the

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[1] Op. cit. p. 252.

[2] Report of British Association, 1857.

Alexandra Dock, turned light blue on the surface on twenty-four hours' exposure to the air; so that probably the blue colour of the estuarine clays is due to gradual oxidation.

Following this period of submergence, an era of elevation set in, which raised the surface to its present level. The deep-water clays emerged from the sea, or remained a few feet below its surface, and the sands and gravels were elevated, in places, to twenty or thirty feet above high-water mark. In some cases the Thracia clays may have been removed by marine denudation as the land rose, and the raised beaches [1] probably suffered considerably from the same cause. Since the upheaval, littoral clays and sands have been locally thrown down, forming the newest zone of the series. I shall not attempt to correlate the fluctuations of level which have been above described with those which have been or may be deduced from observations of the contemporaneous beds of the rest of Ireland, and of England and Scotland. I shall perform a more useful service, by accurately detailing that which has come directly under my own notice, than by entering into generalizations, which continuous and careful observation over an extended area alone would justify or make valuable; but I may remark that a succession of oscillations of level closely corresponding to those above described has been deduced by Rev. Maxwell H. Close from the observed levels of raised beaches and submerged peat in the Dublin district.[2]

The opportunities afforded for the study of the estuarine clays are few and far between, since the deposits lie almost without exception below tide-level, and are consequently inaccessible except when excavations or other artificial means permit their examination; such chances as are afforded by harbour works, and foundations of bridges and buildings, require to be promptly taken. Even then, the difficulties of the investigator are not at an end, for the clays are wet, soft, and tenacious, and the state of one's garments, hands, and feet, after a few hours of fossil-hunting, is not inviting. It is impossible to pick the smaller forms out of the clay in its natural condition, and a more or less troublesome process must be undergone before the small shells and microscopic forms can be examined. The method adopted in the present case is as follows:—The clay is slowly dried, by which process

[1] The term "raised beach" is used in a wide sense in the present Report; in many cases the term "beach" is not strictly applicable, the deposits being sea-beds, as proved by the molluscs *in situ* which they contain.

[2] Guide to the County of Dublin, 1878, p. 45.

it loses about one-third of its weight. When quite dry and hard it is thrown into cold water, and allowed to soak for from one to twenty-four hours; the more tenacious clays requiring a longer time than sandy clays. This produces pulverization of the clay, and entirely does away with its plastic character; but where vegetable matter is present, several successive dryings and soakings may be necessary. It is then washed through a sieve of 150 meshes to the square inch, which arrests the coarse matter and larger shells. A sieve of 900 meshes per square inch is next employed; it arrests the smaller shells, allowing microscopic forms to pass through. A sieve of very fine silk of 36,000 meshes per square inch is then used, which retains all Foraminifera, Ostracoda, &c., permitting the passage of only the impalpable sediment which composes the clay. When dried, the first siftings can be examined with the naked eye, the second by aid of a good lens, while for the Foraminifera, &c., the microscope is, of course, employed. For the purposes of the present report, over 300 lbs. of estuarine clay have been treated in this manner. The proportion of organic matter which the clays yield varies much. In some forty selected samples examined by the writer, the highest percentage of shells in the clay (dry) was ·1 at Eglinton, and the lowest ·001 at Newcastle, or from one-tenth to one-thousandth; but at Magheramorne some narrow zones of the clay consist of almost pure shells, and in others shells are entirely absent.

The exuberant growth and abundance of shells in the estuarine clays has been noticed by all the writers on the subject, and these points are made conspicuous by the beautiful state of preservation of the fossils in the majority of the deposits, the close and impervious nature of the clay protecting its embedded remains from the destroying effects of both air and water. The huge size which *Pholas crispata* attains has been a subject of frequent comment. Specimens obtained in the Pholad zone at Alexandra Dock were frequently $4\frac{1}{2}$ inches broad, with a girth of 8 inches.

Ostrea attains 6 inches long by 5 broad; *Pecten varius*, $2\frac{5}{8}$ inches by $2\frac{1}{4}$, at both Belfast and Magheramorne; a *P. maximus* from Magheramorne measured 6 inches by 7; specimens of *Tapes virgineus*, with a breadth of 2 to 3 inches, are abundant in the Magheramorne deposit; a single valve of Gastrana found at Downpatrick was $1\frac{1}{2}$ inches by $2\frac{1}{8}$; *Scrobicularia piperata* reaches in several deposits $1\frac{3}{4}$ inches by $2\frac{1}{4}$; specimens of *Thracia distorta* found at Magheramorne measured $\frac{7}{8}$ inches by $1\frac{1}{4}$; and Turritella of from $2\frac{1}{4}$ inches to $2\frac{3}{4}$ long occur in several beds.

The total fauna enumerated in the present report numbers 342 species, divided as follows :—

Foraminifera,	114	species.
Echinoidea,	3	,,
Polychæta,	4	,,
Ostracoda,	31	,,
Cirripedia,	3	,,
Decapoda,	3	,,
Gastropoda,	103	,,
Lamellibranchiata,	78	,,
Ungulata,	3	,,
Total,	342	,,

The Foraminifera have been most carefully scrutinized by Mr. Joseph Wright, F.G.S., and the table of distribution may be taken as exhaustive; the same cannot yet be said of the Ostracoda, which require further examination. The apparent complete absence of Polyzoa is noteworthy. Echinoderms are few, as would be expected on a muddy and rather shallow bottom. Gastropods number 103 species, and Lamellibranchs 78. The present molluscan fauna of the North of Ireland includes 173 Gastropods and 120 Lamellibranchs; the proportion of species of both univalves and bivalves of the estuarine clays, as compared with our present fauna, is therefore about two-thirds. Nine Gastropods and four Lamellibranchs occur in the estuarine deposits which are not known as recent species in the same area; if "recent species" were held to mean such species as had been dredged *alive* in the district, the above numbers would be very largely increased, particularly as regards the Gastropoda.

The proportion of marine Gastropoda to Lamellibranchs varies a good deal at the different stations. At Eglinton, Limavady Junction, and Alexandra Dock the ratio is exactly 1 to 1, there being respectively 27, 31, and 49 species of each order present. At the West Bank there are 36 univalves to 23 bivalves; at Magheramorne, 50 to 41; at Downpatrick, 32 to 14. In the Scrobicularia clays this ratio is reversed, Lamellibranchs being in a majority. Thus at the Bann there are 5 Gastropods to 14 Lamellibranchs; Albert Bridge, 7 to 16; and Newcastle, 6 to 12. In the total fauna the Gastropods are in a decided majority—103 to 78; but the Lamellibranchs are more generally distributed, so that the total number of occurrences of the various species of both orders in the different beds is much more equal; a number of the univalves appear at only one or two stations.

As regards the more important genera, Rissoæ are well represented in the estuarine clays, 15 out of the 20 recent North of Ireland species being present; of Odostomiæ, there are 15, out of 21 species taken in Ulster waters. The genus Trophon is absent from the clays, and Defranciæ and Pleurotomæ are rare. Of bivalves, we note that Venus and Tapes are over-represented, and that Astarte is completely absent. Compared with the fauna of the underlying Glacial beds, we observe that the genera Leda, Astarte, and Trophon, which (with the exception of one valve of *Leda minuta*) are entirely absent from the estuarine series, are abundantly represented in the Glacial beds, in which also Venus and Tapes are very rare.

The previous papers and references concerning the North-east of Ireland estuarine clays are mentioned under the head of the deposits to which they refer, but the more important may be enumerated here.

The papers describing any of the beds or their fauna in detail are:—

James Mac Adam—"Observations on the Neighbourhood of Belfast, with a description of the Cuttings on the Belfast and Co. Down Railway"; and Supplement to the same Paper. Journal of the Geological Society of Dublin, vol. iv., part ii., No. 2. Contains a list of estuarine clay species, supplied by Grainger.

J. Grainger—"On the Shells found in the Alluvial Deposits of Belfast." Brit. Assoc. Report, 1852.

J. Grainger—"On the Shells found in the Post-tertiary Deposits of Belfast." Nat. Hist. Review, 1859.

S. A. Stewart—"A List of the Fossils of the Estuarine Clays of the Counties of Down and Antrim." Eighth Annual Report, Belfast Nat. Field Club, 1871, Appendix. Contains lists of the species observed in the Estuarine Clays of Belfast, Magheramorne, and Newtownards.

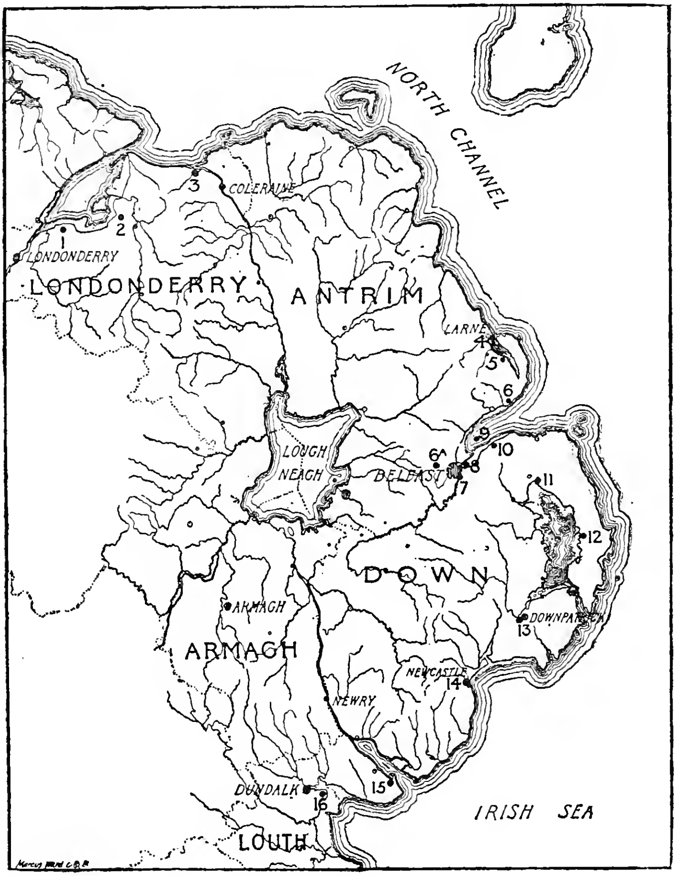
J. Wright—"The Post-tertiary Foraminifera of the North-east of Ireland." Proc. Belfast Nat. Field Club, 1879–80, Appendix. Contains list of Foraminifera found in the estuarine clays of Belfast, Magheramorne, Larne, Kircubbin, and Limavady Junction.

R. Ll. Praeger—"On the Estuarine Clays at the new Alexandra Dock, Belfast." Proc. Belfast Nat. Field Club, 1886–7, Appendix. Description of beds, and list of Foraminifera, Ostracoda, Mollusca, &c., observed in the excavations.

R. Ll. Praeger—"Report of the Larne Gravels Committee." Proc. Belfast Nat. Field Club, 1889–90. Describes beds and molluscan fauna of the estuarine series at Larne.

A. Bell—" Fourth and final Report of the Committee . . . appointed for the purpose of reporting upon the Manure Gravels of Wexford." Brit. Assoc. Report, 1890. Contains a general description of the Belfast and Magheramorne beds, and list of Mollusca, chiefly drawn from the papers above enumerated.

Other references to the beds under consideration will be mentioned in the later pages of the present Report.



The district to which the present Report refers extends from Londonderry on the north to Dundalk on the south, and comprises the coast line of the counties of Londonderry, Antrim, Down, and the northern half of Louth. In the tabular lists which follow, the distribution of fossils, in the various deposits, is shown by reference to seventeen stations, whose positions are laid down on the sketch-map on previous page, and which are thus distributed :—

I. Lough Foyle, . .	1. Eglinton. 2. Limavady Junction.
II. Mouth of River Bann, .	3. Bann.
III. Larne Lough, . .	4. Larne. 5. Magheramorne.
IV. Belfast Lough, . .	6. Kilroot. 6*a*. Broadway, Belfast. 7. Albert Bridge, Belfast. 8. Alexandra Dock, Belfast. 9. West Bank, Belfast Lough. 10. Holywood.
V. Strangford Lough, .	11. Newtownards. 12. Kircubbin. 13. Downpatrick.
VI. Dundrum Bay, . . .	14. Newcastle.
VII. Carlingford Lough, .	15. Greenore.
VIII. Dundalk Bay, . . .	16. Dundalk.

The following notes describe these deposits in detail :—

I.—Lough Foyle.

The Lough Foyle estuarine clays occupy an extensive area along the southern shore of the bay, stretching at least from the River Roe on the east to Culmore on the west, a distance of twelve miles, and attaining a known depth of twenty-five feet. The occurrence of these beds is mentioned by Portlock[1] and Stewart,[2] and their remarkably abundant Foraminifera catalogued by Wright[3] from an examination of a large quantity of material obtained near the surface at Limavady Junction. For the purposes of the present inquiry, the beds were examined at two points.

(1). *Eglinton.*—Rather sandy light blue clay, obtained from three feet below the surface (which is at about high-water mark), by the railway a mile east of Eglinton Station. Shells very abundant. Characteristic species—*Mactra subtruncata*, *Scrobicularia alba*, *Mya*

[1] Report on the Geology of the County of Londonderry, &c., pp. 161, 165.
[2] *Op. cit.* [3] *Op. cit.*

truncata, *Turritella terebra*, *Utriculus obtusus*, *U. mammillatus*. Three specimens occurred here of the beautiful *Odostomia nitidissima*—its only occurrence, so far as I am aware, as an Irish fossil. Foraminifera were plentiful.

(2). *Limavady Junction.*—The construction of a new railway bridge over the Burnfoot River supplied an excellent opportunity for the examination of the deposit. The iron caissons for the foundations were sunk through the clay to a depth of eighteen to twenty-five feet. The lowest third or fourth of this depth consisted of an estuarine clay of unusual character—a tough, firm, reddish brown clay, like a re-assorted Boulder clay, but full of *Scrobicularia alba* and *Montacuta bidentata*—characteristic estuarine species, which are absent from our Glacial beds. The rest of the deposit consisted of typical blue estuarine clay, its surface at about high-water mark, and containing many shells, of which *Nucula nucleus*, *Scrobicularia alba*, *Corbula gibba*, and *Turritella terebra* were especially abundant. The profusion of Turritella in the Lough Foyle estuarine clays is interesting in connexion with its profusion at an elevation of over 250 feet in Boulder clay at Bovevagh,[1] some eight miles southward, and its immense abundance on the shell-banks of Lough Foyle.[2] Foraminifera were very abundant at this station, the genera Bulimina, Bolivina, and Lagena being well represented.

II.—River Bann.

Portlock writes[3] "In Dunboe parish, on the boundary of Grange (More and Beg), is a bed of blue silt full of recent shells, Mytilus, Turbo, &c., in the banks of the stream, covered by 7 feet of fine sand (rabbit warren), the clay itself being 2 ft. 6 in. thick, and also resting on fine sand." This place is on the southern bank of the Bann, about a mile from its mouth, where the Articlave River, which here forms the boundary of the two townlands mentioned, winds sluggishly through a sandy alluvial tract to join the larger river. On examining the banks of the stream, I found the following section:—

	ft.
Stratified yellow sand, ...	7
Bluish clayey sand, without shells, but containing Foraminifera, ...	1
Yellow or gray sands (base not seen).	—
	8

[1] Portlock, *op. cit.*, pp. 157–159; and Stewart, "Mollusca of the Boulder Clay of the North-east of Ireland," Proc. Belfast Nat. Field Club, 1879–80, Appendix.
[2] Portlock, *op. cit.* p. 163. [3] *Op. cit.* p. 161.

The surface of the clayey layer is slightly above high-water mark. About three-quarters of a mile to the westward, in the banks of a streamlet which forms the eastern limit of the extensive range of sand-dunes that stretches to Castlerock, the same zone is found to have changed to regular estuarine clay. The section now is—

	ft.	in.
Blown sand, ...	6	0
Estuarine clay with Scrobicularia, &c., .	1	6
Blackish sand, ...	1	0
Estuarine clay, as before, ...	0	6
Blackish sand, ...	2	0
Pebbly layer (base not seen).		
	11	0

The surface of the clay is three feet above high-water mark. It is a typical Scrobicularia deposit, yielding *S. piperata*, *Mytilus edulis*, *Cardium edule*, *Tellina balthica*, Littorinæ, and Hydrobia. A single perfect example of *Tellina fabula*, very rare as an estuarine clay fossil, occurred. Foraminifera were rather plentiful; among the rare species which occurred were *Lagena distoma* and *L. pulchella*. Between the two points described the estuarine zone was again seen, more sandy in character and with fewer shells, and covered by twelve feet of stratified yellow and brown sands, destitute of marine forms, and evidently the creation of the river during the epoch of submergence which has already been shown to have followed the Scrobicularia period.

III.—Larne Lough.

The estuarine clays of Larne Lough could, until lately, be inspected at two points—at the old pottery at Larne; at the entrance to the lough, where building operations have now obscured them; and on the shore at Magheramorne, where good opportunities for their inspection still exist. The latter station is three miles above Larne, and the deposits probably extend continuously between, and still further up the lough. The character of the beds at the two spots indicated is widely different, but their relation to each other appears clear.

(4.) *Larne.*—The Curran at Larne is a narrow sickle-shaped promontory a mile in length, rising at its highest point some twenty-five feet above high-water mark, and composed of stratified gravels with recent marine shells, resting on estuarine clay, as first pointed out by Gray.[1] The clay was formerly used for the manufacture of pottery, and till lately could be seen in the excavations at the old factory,

[1] Jour. Royal Hist. and Arch. Assoc. of Ireland, 4th Series, vol. v., No. 39, p. 130.

whence samples examined by Wright[1] yielded nearly seventy species of Foraminifera. At that point the clay is blackish and sandy, becoming more sandy below, and at least three feet thick. Six feet of marine gravels overlie it, and its surface is some six feet above high-water mark. Foraminifera plentiful. Characteristic shells—*Tapes aureus*, *Tellina balthica*, *Scrobicularia piperata*, *Rissoa membranacea*, *Cerithium reticulatum*. It will be seen by this description that this bed is essentially a lower or Scrobicularia clay. In the construction of a sewer along the road which passes the pottery, a section was exposed ten feet in depth, running north-east from the pottery to the sea. It was there seen that the surface of the clay sloped towards the water, and the gravels thinned out, and a bed of yellow sand with many shells was interposed, so that close to the beach the section was—

	ft.
Gravels,	1
Yellow sand,	6
Do. with large pebbles,	2
Estuarine clay.	

The surface of the clay was now a few feet below high water mark.

With the co-operation of Mr. William Gray, who was also engaged in investigations under a grant from the Academy, and the Belfast Naturalists' Field Club, excavations were undertaken, and a careful examination made of the Curran deposits at another point where the gravel beds are thickest, the spot selected being the escarpment of gravel on the southern side of the railway, 400 yards from the edge of the wharf by the Curran railway station.[2] The section here was as follows:—

	ft.	in.	
Gravelly soil,	1	6	Raised Beach.
Coarse gravel,	4	6	
Sandy layers,	2	9	
Fine sand,	0	9	
Coarse gravel,	8	6	
Black muddy gravel,	2	6	
Black sand,	1	0	Estuarine Clays.
Estuarine clay,	3	0	
Black sand,	2	0	
Coarse black gravel,	2	6	
	29	0	

[1] Op. cit.

[2] A full account of this exploration, with plates and tabulated lists of fossils, will be found in Proc. Belfast Nat. Field Club, 1889-90, pp. 198-210.

The gravels contain burrowing bivalves still in the natural position, showing that they lived on the spot where they are now found, and that these deposits formed a sea-*bed* rather than a sea-*beach*. They are stratified throughout, the different beds having varying dips, and they contain shells and rude flint implements from top to base. The surface of the estuarine clay is here six inches above ordinary high-water mark. It will be seen that the Larne estuarine clay dips both north-east and south-east from the pottery, and I am inclined to think that the clay was originally deposited in this sloping position, since intertidal shells occur at the pottery much more abundantly than at the lower points. The clay obtained from the trial pit by the railway was blackish, with remains of Zostera and shells, among which *Cyamium minutum*, *Cardium exiguum*, *Trochus cinerarius*, *Rissoa striata*, and *Skenea planorbis* were conspicuously abundant. Foraminifera were plentiful in the clay, especially the genera Miliolina and Discorbina; *Polymorphina concava* and *Orbulina universa* were the most noteworthy forms. The underlying black sand yielded a similar fauna.

The black gravel, the lowest bed reached, contained large rounded boulders, covered with Spirorbis and corallines so fresh-looking that when cleaned they might easily have been supposed to have been just brought from the neighbouring beach. Patella, which, as would be expected, is very rare as an estuarine clay fossil, was abundant in this bed, which, like the overlying gravels, was evidently an accumulation formed by tidal currents in shallow water. On account of the quantity of water encountered, the base of the gravel could not be reached, but a short distance to the northward the Boulder clay crops out, and in all probability it directly underlies the last-mentioned bed.

(5) *Magheramorne.*—The bed at Magheramorne, on the western shore of the lough three miles above Larne, differs widely from the Larne clay, being essentially a Thracia or deep-water clay, and possessing a richer fauna than any other estuarine deposit that I know. The bed has probably a considerable area, and extends out into the sea, its surface slightly above low-water level. It would probably still lie concealed below its living mantle of Zostera were it not for the steady advance of a high spoil-bank from the adjoining chalk quarries, which, encroaching on the sea, has thrust the clay upward to a height of several feet above high-water mark all around its margin. The beds thus exposed are faulted and folded like old metamorphic rocks, and form an excellent object lesson on the effects of lateral pressure on plastic formations. This deposit was first described and its fossils enume-

rated by Stewart;[1] and Wright[2] has catalogued no less than seventy-two species of Foraminifera from it. Some additions to its fauna have been since published by the writer[3] and Alfred Bell.[4] Of its large and varied fauna, the following shells may be mentioned, which are characteristic species at Magheramorne, and either very rare in, or absent from any other estuarine clay in the district:—*Lima hians*, *Mytilus modiolus*, *Venus casina*, *Tapes virgineus*, *Pectunculus glycymeris*. The clay is typical in character—very fine, plastic, and blue in colour; owing to its disturbance, the relation of its various zones cannot be traced. Foraminifera are abundant, and the specimens usually of large size; the following rare species were met with:—*Lagena striato-punctata*, *Nodosaria obliqua*, *Miliolina seminuda*. Along the base of a second spoil-bank which lies to the west of Magheramorne railway station, the clay is exposed by the same agency, and is of different aspect. There are zones of bright blue clay full of *Cardium exiguum*, layers a foot thick almost composed of Zostera, thick beds of yellowish clay almost devoid of shells, and blackish gritty layers. *Scrobicularia piperata*, *Mytilus edulis*, *Tellina balthica*, and *Mactra subtruncata* occurred here, none of which I found at the east spoil-bank. This clay is decidedly littoral in character, but whether it underlies, overlies, or replaces the interesting clay further east, there is no opportunity of determining. Another zone is exposed at the extremity of the eastern out-crop, almost entirely made up of thousands upon thousands of oyster shells, the pairs of valves being still in juxtaposition. The shells are pear-shaped, and average five inches long by three broad. The thickness of this great old oyster-bed cannot be determined, but it was considerable, and generation must have succeeded generation hundreds of times. The variety and exuberant growth of the estuarine clay shells has already been commented upon, and this is especially noticeable at Magheramorne, when compared with the present paucity of molluscan life in Larne Lough. While the fauna of the Magheramorne estuarine clay numbers over ninety species of mollusks, dredgings by the Belfast Dredging Committee in 1858[5] in Larne Lough yielded but 26 species, 17 of them in a dead state. Six of these 26 shells are absent from the Magheramorne clay.

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[1] Op. cit.

[2] Op. cit.

[3] Proc. Belfast Nat. Field Club, 1889-90, pp. 215-7.

[4] Op. cit.

[5] Report of British Association, 1858.

IV.—Belfast Lough.

The estuarine clays in Belfast Lough have, on account of their proximity to local observers, and the excellent opportunities that extensive harbour works have afforded for their study, been examined on frequent occasions.

Probably the earliest explorer was Dr. William Magee, who, in 1830, collected a number of species, including the rare *Lima hians*, when Prince's Dock was in course of construction, and supplied a list of the estuarine clay fauna to James Bryce's "Tables of Simple Minerals, Rocks, and Shells" (Belfast, 1831); but they are included in the list of the recent shells of Down, Antrim, and Derry, without distinction. In the supplement to Mac Adam's Paper a list of seventy estuarine clay species is given, which was supplied by Grainger, who was then diligently exploring the deposits. A few species of mollusks obtained by William Thompson, in the clays about Belfast Harbour, are recorded in vol. iv. of his "Natural History of Ireland" (1856); and a collection of forty species, made by the same eminent naturalist at Belfast, is preserved in the museum of the Belfast Natural History and Philosophical Society. Hyndman, in the "First Report of the Belfast Dredging Committee,"[1] notes the occurrence of twenty-four species in the "alluvium." In 1858, Canon (then Mr.) Grainger contributed to the Dublin University Zoological and Botanical Association a valuable Paper, "On the Shells found in the Post-tertiary Deposits of Belfast," which was published in the *Natural History Review* for the following year. This author had previously contributed to Mac Adam's Paper, already mentioned, a list of the shells found in the Belfast bed, and had read at the meeting of the British Association at Belfast, in 1852, a Paper enumerating the species observed up to that date. This final Paper gives a list, with copious annotations, of 102 species, of which 96 are Mollusca. The shells were obtained from excavations made during the construction of the Victoria Channel, from the sand and mud raised for the railway embankments on either side of the bay, from sandy mud raised by steam dredges from the "bed of the present channel, near the lighthouse," and from raised beaches at Jordanstown and Holywood. The raised beaches do not belong to the estuarine clays. The geological position (if any) of the lighthouse-bed is indeterminable, but its fauna shows that it also does not belong to the series with which the present Paper

[1] Report of British Association, 1857.

is concerned. The species thus excluded from his list of the estuarine clay fauna are as follow:—*Pholas dactylus*, *P. parva* (probably recent), *Solen siliqua*, *Ceratisolen legumen*, *Tellina fabula*, *Donax vittatus*, *Venus exoleta*, *Cyprina islandica*, *Montacuta bidentata*, *M. ferruginosa*, *Mytilus modiolus*, *Pleurotoma rufa*, *Terebella conchilega*, *Serpula vermicularis*. It is probable that some of these were derived from the washing down of estuarine clay in the vicinity. In 1871, S. A. Stewart published his Paper, "A List of the Fossils of the Estuarine Clays of the Counties of Down and Antrim,"[1] which has been already referred to, and the same year read before the Belfast Naturalists' Field Club a communition on "The latest Fluctuations of the Sea-level on our own Coasts."[2] In the latter Paper the lessons that may be learned by study of the estuarine clay series are for the first time pointed out, and the conclusions of Mr. Stewart correspond very much with those at which the present writer has arrived, and which have been already set forth. The former Paper comprises annotated and tabular lists, showing the results of Canon Grainger's and the author's investigations; the latter having been conducted during the construction of Spencer Basin in Belfast Harbour, as well as at Magheramorne and Newtownards. In this Paper no less than 110 species and varieties of Mollusca are recorded from the Belfast beds, and a few Crustacea, Annelida, and Foraminifera. A list of 29 species of Ostracoda, found at various depths in estuarine clay obtained from excavations in Belfast Harbour, is given in the "Monograph of the Post-tertiary Entomostraca of Scotland," published by the Palæontographical Society in 1874, and is quoted on a subsequent page of the present Report. The Foraminifera of the Belfast beds were catalogued by Joseph Wright[3] in 1880, from clay obtained at Cooke's Statue, from a well at King-street, and from Mac Laine's Dock in Corporation-street. In 1887 the present writer took advantage of the fine sections exposed in the construction of the Alexandra Graving Dock, to make a careful examination of the beds and their fauna, and the results appear in the Proceedings of the Belfast Nat. Field Club, 1886–7, Appendix. Lately, Alfred Bell has added a few more species to the Belfast fauna.[4] From the above it will be seen that the Belfast beds have been thoroughly examined, and our knowledge of them is tolerably complete.

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[1] Eighth Annual Report Belfast Nat. Field Club, 1871, Appendix.

[2] Eighth Annual Report Belfast Nat. Field Club, 1871, pp. 55–7.

[3] Op. cit. [4] Op. cit.

The area covered by the Belfast Lough estuarine clays is considerable. They stretch up the banks of the River Lagan as far as the first lock on the canal, and down the shores of the lough as far as Holywood on the southern, and Whitehouse (at least) on the northern side, and they extend over an area of some ten square miles. In Belfast they underlie a considerable portion of the town; the old sea-cliff which formed their limit, and which is still distinctly traceable, is well described in Mac Adam's Paper. This escarpment consists of New Red Sandstone, capped by Boulder clay, and its abrupt slope, rising from the estuarine flat, can be seen with advantage extending from near the Northern Counties Railway terminus in a south-westerly direction, between York-street on the lower side and North Queen-street and Millfield on the upper, for nearly a mile, being especially conspicuous in the neighbourhood of Pepperhill-court, where the steepness of the escarpment has caused flights of steps to be used to surmount it. It is again conspicuous at Utility-street, beyond the Great Northern Railway terminus, where a high ridge of Boulder clay rises abruptly from the flats. A tongue of estuarine deposits extends up the valley of the Blackstaff; and Hyndman[1] has recorded *Scrobicularia piperata* as obtained eighteen feet below the surface at Linfield Mill, as well as thirty feet below the surface at Durham-street Mill, and the clay can be traced westward to Broadway factory, two and a-half miles distant from the present sea-margin. On the Co. Down side of the Lagan the Newtownards road probably forms the southern boundary of the deposits; but a tongue of clay runs up the valley of the Connswater nearly a quarter of a mile above the bridge which carries the Newtownards road across the stream, as shown by the following species obtained by the writer from excavations made on the river bank for the construction of a reservoir there:—*Ostrea edulis*, *Mytilus edulis*, *Cardium edule*, *Tapes decussatus*, *T. pullastra*, *Tellina balthica*, *Scrobicularia piperata*, *Littorina rudis*, *L. litorea*, *Corylus avellana*. The estuarine clays underlie all the upper end of the lough; but near Sydenham and Tillysburn the Boulder clay and overlying red sand and submerged peat rise to the surface; at Holywood the estuarine clay is again of considerable depth. An outlier of the Belfast beds occurs at Kilroot, on the Antrim shore, near the entrance to the lough, and twelve miles below Belfast; and narrow beds of this age underlie the gravels of Ballyholme Bay on the opposite shore. The submerged peat appears

[1] Report of British Association, 1857.

to underlie the clays throughout the greater part of the Belfast Lough area, as will be seen from the details which follow.

For the purposes of the present Report, the estuarine clays of Belfast Lough were examined at six points—at Kilroot, on the Antrim shore, where a small outlier of clay and peat occurs; at Broadway, by the river Blackstaff, and Albert Bridge, by the Lagan, both at the upper extremity of the estuarine area ; at Alexandra Dock, by the river, two miles below Albert Bridge ; at the West Bank, in the centre of the lough, two miles below Alexandra Dock; and at Holywood, the limit of the deposit on the County Down shore.

(6.) *Kilroot.*—A small patch of peat, underlying typical Scrobicularia clay, and resting on Boulder clay, occurs between tides on the shore close to Kilroot railway station, where it was first noticed by Stewart. The peat contains hazel nuts and stumps of Scotch fir *in situ.* The estuarine clay yields *S. piperata*, *Tellina balthica,* and a few other littoral shells, and rests directly on the peat. I am informed by Mr. Wm. Swanston, F.G.S., that before the existings ea-wall was built, the clay was seen cropping out on the beach from high-water mark to about half tide, and running in under the raised beach, containing flint implements and marine shells, which has been described by Professor Hull[1] and others, and which extends for some distance along the shore to the westward.

A continuation of the peat bed occurs at Carrickfergus, two miles west of Kilroot, on the shore between tides, where it underlies the sand and gravel of the beach. At this place hazel-nuts have been obtained, in which the kernel is replaced by crystalline carbonate of lime. Reference to these nuts may be found in the Minute Book of the Geological Society of London, under date 1810, February 2, and in their Transactions, Series I, vol. 4, p. 443 ; in M'Skimin's "History of Carrickfergus" (Belfast, 1811), p. 110 ; in Mantell's "Medals of Creation," vol. I., p. 71, and Plate III, figs. 6 and 7 ; and in Dickie's "Flora of Ulster," p. 117. Specimens of the nuts are preserved in the museum of the Geological Society of London, the museum of the Belfast Natural History and Philosophical Society, and in the Canon Grainger Collection at the Belfast Free Public Library. In the paragraphs above-mentioned the nuts are described as having the pericarp unchanged; but in some of the specimens in both of the Belfast museums, the shell of the nut is quite as hard as the interior. M'Skimin states that some of the willow and elder timber which

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[1] British Association Report, 1872.

accompanies the nuts is likewise petrified. I have not succeeded in obtaining these nuts *in situ*, nor do I know of their having been obtained recently.

In Bangor Bay and Ballyholme Bay, on the opposite shore of Belfast Lough, the submerged peat may be seen again, appearing on the beach near low-water mark. At Ballyholme, the peat is only four to six inches thick, but contains trunks and branches of large Scotch firs, and stumps of considerable size in an upright position. It rests on Boulder clay; above it is six inches of gray, unfossiliferous sand, which is capped by some twenty feet of stratified gravels containing marine shells.[1] The occurrence of the Ballyholme peat bed is mentioned by M'Skimin (p. 111).

(6*a*.) *Broadway*.—In the bed of the Blackstaff stream at Broadway damask factory, a deposit of blue sandy clay may be seen, which is several feet thick at least, and perhaps much more. Although no shells could be found there, a number of species of Foraminifera occurred, as detailed below, attesting the marine origin of the bed. Though this is the most western point to which I have traced the Belfast estuarine deposits, there can be little doubt that they extend further up the valley of this stream, and underlie the Bog meadows, which stretch in a level expanse south-westward for a further distance of over a mile.

(7.) *Albert Bridge*.—During the excavations for the County Antrim abutment of the new Albert Bridge, over the Lagan, in the winter of 1888, a good exposure of the bed occurred. The section was found to be as follows:—

	ft.
River mud and coarse sand, ...	10
Lower estuarine clay, ...	14
Gravelly bed, ...	1
New Red Sandstone.	—
	25

High-water mark is here thirteen feet above the surface of the estuarine clay. The upper clay, if ever present, has been washed away, and the bed that replaces it is the recent creation of the river. The estuarine clay was typical lower clay, brownish in colour, rather sandy in texture, and full of *Cardium edule*, *Tapes decussatus*, *Tellina*

[1] See R. Young, "Remarks on the Recent Changes of Coast Level at Ballyholme Bay, Co. Down," Proc. Belfast Nat. Hist. and Phil. Society, 1871, p. 39.

balthica, Scrobicularia piperata: hazel nuts and clytra of beetles were noticed in it; and the pelvic bone of a red deer occurred near its junction with the underlying gravels. Foraminifera were very rare in the clay, and the specimens poor.

(8). *Alexandra Dock.*—The construction of the Alexandra Graving Dock, in 1886–7, furnished the most complete sections of the local estuarine clay series of which there is any record. The excavations extended over an area of one thousand feet in length by about one hundred feet in breadth, and reached a maximum depth of fifty feet below high-water mark. Over the greater part of this area the section was as follows:—

	ft.	in.
Surface clays,	6	6
Yellow sand,	2	0
Upper estuarine clay,	6	0
Lower estuarine clay,	6	0
Gray sand,	2	0
Peat,	1	6
Gray sand,	2	0
Red sand,	4	0
Re-assorted Boulder clay (base not reached),	15	0
	45	0

The surface of the estuarine clay coincided with Ordnance Survey datum, or, in other words, was five feet below low-, and thirteen feet below high-water mark.

Towards the northern end of the excavations, the red sand rose up as a thick bank, the peat and gray sand thinned out, and the thickness of the estuarine clay was much reduced, the section at the dock entrance being:—

	ft.	in.
Surface clays,	5	6
Blackish sand,	2	0
Upper estuarine clay,	1	6
Lower estuarine clay,	0	6
Red sand,	19	6
Re-assorted Boulder clay.		
	29	0

It is worthy of remark that the surface of both the estuarine clay, and the re-assorted Boulder clay maintained an exactly uniform level over the whole of the excavations.

The surface clays consisted of blackish clayey and sandy layers, with abundance of *Mya arenaria*, *Cardium edule*, *Tellina balthica*, *Mytilus edulis*, and were still in course of deposition.

The yellow sand contained a large variety of species, some of them, such as Thracia, Lucinopsis, and Scrobicularia, evidently derived from the washing down of the older beds. The upper estuarine clay had all the characters already described—very fine, tough, and unctuous; it yielded abundance of *Pecten maximus*, *Cardium echinatum*, *Lucinopsis undata*, *Thracia convexa*, *Scrobicularia alba*, *Aporrhaïs pes-pelecani*, *Nassa pygmæa*, *Scalaria turtonæ*, all of fine size. Between the upper and lower clay was a zone characterized by Pholades, the occurrence of which was also noticed by Stewart in his investigations on the opposite side of the Lagan, and, as he points out, is the first indication of the subsidence which resulted in the deposition of the upper clay. Three species occur—*P. crispata*, *P. candida*, and *P. dactylus;* the shells all still in the natural vertical position. The enormous size which the first-named reached has been noticed by several writers, and is referred to on another page of the present Report. The lower clay is also typical, but contains a richer fauna than usual, as shown in the writer's Paper in Proc. B. N. F. C., but its most abundant fossils are still *Cardium edule*, *Tapes decussatus*, *Tellina balthica*, *Scrobicularia piperata*. The gray sands above and below the peat-bed are marine, as shown by the presence of Foraminifera. The peat is here twenty-eight feet below high-water mark; it yields the usual plants, and also bones of the red deer and wild boar. The red sand yielded a very few Foraminifera only.

(9). *West Bank.*—The West Bank lies in the middle of the lough, three miles below Queen's Bridge, Belfast. In the work of forming the new Victoria Channel, which has replaced the former tortuous approach to the harbour, this bank has been cut through for a length of over a half a mile, and to a depth of some 30 feet. Throughout this length and depth the material was solid estuarine clay of the Thracia zone. By the kindness of Mr. W. A. Currie, Secretary to the Belfast Harbour Commissioners, I was able to visit the works, and to select samples of clay from all depths, as brought up by the large steam dredgers engaged on the excavation. 15 lb. samples were taken from depths of 12, 17, 24, and 32 feet below the surface of the bank, which is four feet below high-water mark. From top to bottom the deposit was typical upper clay, and, as might be expected from its distance from land, was unusually fine and pure. Fossils were rarer than is usual in the Thracia clay, but were in large variety, and all the characteristic upper clay fossils were present. The clay from 12 feet below surface was of more littoral character than that from greater depths. In the 17 feet samples, *Pholas candida* occurred in great profusion. In the lower two samples, shells were few, and Foraminifera almost absent. *Nucula nucleus*, *Cardium exiguum*, *Lucinopsis undata*, *Scrobicularia alba*, *Turritella terebra*, all characteristic upper clay fossils, were present in every sample. The captain of the dredger informed me that at one point a browner clay, with more shells, was touched. This was probably the Scrobicularia or lower clay, which must here be some 35 feet below high-water mark. Foraminifera occurred but sparingly in all the samples obtained at West Bank.

(10). *Holywood.*—The flint implement-bearing gravels of the Kinnegar, at Holywood, rest on estuarine clay. Its depth is not known, but I am informed by Mr. W. Nimick, builder, of Holywood, that during the construction of the gas-works there in 1860, excavations 22 feet deep were made in the clay, large oyster-shells being found down to the bottom, and piles driven for the foundation of the chimney went down 38 feet before reaching firm ground. A little to the eastward, at the old pier, the New Red Sandstone was struck eight feet below the surface. Further eastward, at the mouth of a stream which passes Seapark-terrace, the submerged peat may be seen on the shore between tides, filling a shallow trough in the Boulder clay, which crops out all round. It is two feet in thickness, full of trunks and branches of Scotch fir especially, but also of willow, oak, and hazel, and marsh plants; one log of oak measured 25 feet in length by five feet in circumference; excellent impressions of willow leaves, apparently *Salix aurita*, were noticed, and hazel nuts. The peat rests on one foot of fine red sand, which rests in turn on Boulder clay. No estuarine clay was here observed; the peat may be seen also in the banks of the stream, where it is about 6 feet above high-water mark, and underlies some feet of stratified gravel (raised beach). On the beach, a couple of hundred yards further eastward, the Bunter sandstones crop out. The estuarine deposit continues westward of the Kinnegar, but at Tillysburn the underlying beds again rise to the surface. Large trunks of oak were formerly dug out of the shore near the latter place, and sawn up for use as timber; they evidently came from the submerged peat, since the red sand which underlies it appears on the shore a little further on. I took samples of estuarine clay at the Kinnegar from a depth of four feet below the surface. The deposit proved poor in fossils, and apparently is a surface clay containing some shells washed out of the Thracia zone, or else the upper surface of the deep-water clay with littoral shells lying on it. Foraminifera occur very sparingly.

A few other sections of the beds in the Belfast estuary have been described, and are available for comparison. At Spencer Basin the excavations, over 20 feet in depth, were through estuarine clay only, the surface beds, Thracia clay and Scrobicularia clay, being all well shown.[1]

In Smith's "Outlines of the Rocks of Antrim," p. 123 (Belfast, 1868), after a brief general description of the Belfast estuarine beds, four sections are given, the result of trial pits sunk into the dock bottom when the construction of Spencer Basin was in progress. The sections are from 38 to 54 feet in depth, and show a series of strata, closely resembling that at Alexandra Dock, already described. Underneath from 23 to 32 feet of blue clay, is a bed of peat, varying in thickness from 8 inches to 3 feet, a bed of gray sand being in some cases interposed, while where the peat was thinnest it underlay 8ft. 6in. of "vegetable loam, approximating to peat." Below the peat was a gray sand (0 to 2 feet); then dark red sand (4 to 6 feet); and under this, alternating layers of red clay and red sand, belonging to the Boulder clay series. At King-street, Belfast, the following succession of beds was passed through in sinking a well[2] :—

		Feet.
1.	Estuarine clay of the usual yellowish gray colour; Foraminifera rather common, ...	6
2.	Estuarine clay of brownish colour, and with offensive smell; Foraminifera very common, ...	22
3.	Fine sand; Foraminifera rare, ...	24
4.	Very fine Boulder clay; Foraminifera very rare, .	50
5.	Boulder clay, as it usually occurs in our neighbourhood; Foraminifera plentiful, ...	100
6.	New Red Sandstone.	
		202

The surface here was a few feet above high water.

A layer of twigs and hazel nuts at the base of bed No. 2 evidently represented the submerged peat.

[1] Stewart, Op. cit.

[2] Wright, Op. cit.

In sinking for a well at Police-square, Belfast, the beds met with were[1] :—

	Feet.
"Silt,"	33
Gravel charged with water, and containing a quantity of organic debris, ...	7
Very tenacious clay, "a thick deposit."	
	40

These gravels, lying between the estuarine clay and Boulder clay, probably correspond to the peat and gray sands of Alexandra Dock. The most interesting point about them was that they here yielded an inflammable gas, which, when an iron pipe was sunk, "flowed freely at the rate of 40 cubic inches per minute through the upper end of the pipe, and, when ignited, burned with a yellow flame, which could scarcely be distinguished from ordinary coal gas."

A careful analysis showed the following composition :—

Marsh gas (CH_4), ...	83·75
Carbonic acid gas, ...	2·44
Oxygen, ...	1·06
Nitrogen, ...	12·75
	100·00

"From this analysis," says Professor Andrews, "it is evident that the gas formed in this subterranean sheet of water is, in all respects, the same as that which is produced in stagnant pools containing leaves and other vegetable matters."

At Sydenham railway station, a mile east of Alexandra Dock, the Boulder clay has risen, and the section is :—

	Feet.
Littoral estuarine clay, ...	2
Yellow sand, with shells, ...	1
Red sand, gravel, or fine red clay, about, . . .	8
Boulder clay.	
	11

The surface of the estuarine clay here is three feet above high-water mark.

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[1] Prof. Andrews, in Proc. Belfast Nat. Hist. and Phil. Society, 1873–74, p. 93.

V.—Strangford Lough.

In Strangford Lough there is no large area of estuarine deposits as in Lough Foyle and Belfast Lough, but several isolated patches of some interest occur. The extensive flats which extend from Newtownards to the water, and the miles of Zostera banks which are laid bare at the upper extremity of the lough, and the low grounds fringing the estuary of the Comber River, have everywhere a substratum of the Post-glacial red sands before mentioned, or of Boulder clay, excepting one or two shallow patches of sandy estuarine clay laid down in the hollows which streams have formed. It is probable that estuarine clays of some depth underlie the slob lands that extend among the islands about Ardmillan and Killinchy, and clays there visible at low water look very like the surface of a deep deposit, but no sections are exposed.

(1). *Newtownards.*—Samples of sandy clay were obtained at about high-water mark near the sluice-gates on the Greyabbey road, a mile from Newtownards, and again on the eastern shore of the lough a mile below this place. The two samples were very similar in fauna, being rich in small shells, some of which, like *Montacuta bidentata, M. ferruginosa*, *Cæcum glabrum*, *Jeffreysia opalina*, *Rissoa albella* have not been taken in a recent state in the lough;[1] the last-named is present in the clay in the greatest abundance. The deposit yields shells characteristic of both the upper and lower zones, and like the neighbouring deposit at Kircubbin, to be next described, appears intermediate in character. Foraminifera were not abundant.

(12). *Kircubbin.*—The occurrence of estuarine clay at Blackstaff Bridge, two miles south of Kircubbin, on the eastern shore of Strangford Lough, was first observed by William Gray, as stated in Wright's Paper, in which forty-two species of Foraminifera are recorded from this bed—the only published notice of it. The clay occurs in a shallow basin among low hills of Boulder clay, near the margin of the lough, and is seen in the banks and bed of the Blackstaff, a small and sluggish stream. Under three or four feet of horizontal bands of brown, loamy, and gravelly strata—fresh-water beds—is a deposit of estuarine clay of the usual character. The upper surface is slightly above high-water mark, and the clay is at least three feet

[1] See Dickie, "Report on the Marine Zoology of Strangford Lough," Report of British Association, 1857.

thick. The surface layer is sandy, with great abundance of *Littorina litorea.* Below, it is fine and tough, and yields an abundant and interesting fauna, chiefly remarkable for the variety of shells of the Limpet section which occur, no less than five genera being represented—Patella, Helcion, Tectura, Emarginula, and Fissurella—all of which, as would be expected, are very sparingly distributed in the estuarine clays. *Gastrana fragilis* is an interesting species with a southern distribution, not now occurring in the north-east—one valve in the clay here, and another at Downpatrick show that it formerly inhabited Strangford Lough. The more abundant shells of the deposit give a rather mixed fauna as regards depth—*Lucina borealis*, *Tapes aureus*, *Cardium exiguum*, *Fissurella græca*, *Lacuna pallidula*, *Littorina litorea*, *Hydrobia ulvæ*, &c. Foraminifera are very rare in the clay at this station.

(13). *Downpatrick.*—One would hardly suspect that the extensive marshes which stretch around this ancient town covered a deep deposit of marine clays. Surrounded by hummocky hills, through which the River Quoile follows a narrow and tortuous course for several miles, till it joins the waters of Strangford Lough, these marshes more resemble the silted-up bed of a former lake than an old sea bed. The latter, however, is the case, and until the flood-gates, a mile below the town, were constructed in 1745, the marshes were slob lands covered at each tide. Piles driven in the construction of the railway bridge over the Quoile were sunk forty feet without reaching a solid bottom, and the excavations for the turntable at Downpatrick railway station, though almost on the limit of the swamp, were made through thirty feet of estuarine deposits. The surface here is about high-water mark; in the basal portion of the excavations quantities of oyster and mussel shells occurred, and below them was a bed of peat, with hazel nuts and fir cones. So that we have here upper and lower estuarine clay and submerged peat in the usual succession. That the greater depth of the clay belongs to the upper zone is shown by its fauna—*Turritella terebra*, *Nassa pygmæa*, *Nucula nucleus*, *Lucina borealis*, *Axinus flexuosus*, *Cardium exiguum*, *Scrobicularia alba* occurring plentifully in the deposit. The clay contains much vegetable matter, and many of the shells are of dwarf size. The abundance of long tubes of *Serpula vermicularis* is remarkable: Foraminifera are plentiful, the genera Miliolina and Bulimina being especially well represented. The turntable mentioned was constructed some years ago; but information kindly supplied to me by Mr. B. D. Wise, M. INST. C.E., then engineer of the railway, and an examination of the material from the excavations, which was happily still available, enable me to describe the bed, and catalogue its fossils.

VI.—Dundrum Bay.

Estuarine deposits might be expected on the shores of the sheltered Inner Bay of Dundrum, but hard sand only appears to prevail there. The outer bay is very open and exposed, with extensive sandy beaches.

(14). *Newcastle.*—At Newcastle, situated at the southern extremity of the outer bay, I was surprised to discover a bed of typical Scrobicularia clay. It occurs on the beach near low-water mark, a short distance north of the harbour, covered by an inch or two of sand, and was detected by the washed-out valves of *Scrobicularia piperata* on the shore in its vicinity. The clay is very pure, fine, and tough, crammed with Scrobicularia and Zostera roots: *Cardium edule, C. exiguum, Tellina balthica, Scrobicularia alba, Pholas candida, Littorina rudis, L. litoria, Hydrobia ulvæ, Skenea planorbis, Cerithium reticulatum,* and *Utriculus mammillatus,* complete the list of fossils—most of them occurring very sparingly. Foraminifera are rare; the deposit is of small extent; it is at least four feet thick; the lower portion becomes sandy, with greater abundance of Scrobicularia. Several mountain streams discharge into the bay at no great distance, and had probably something to do with the formation of this deposit, but the surroundings when it was laid down must have differed from the present shallow, sandy, storm-swept bay.

In a Paper read before the Belfast Natural History Society on February 24th, 1858, Dr. Dickie described a "recent deposit of wood, shells, &c., discovered by Dr. Rea at Newcastle, county Down. This deposit is Post-tertiary: it contains leaves and pieces of wood, oak, beech, and Scotch fir, also a number of Scotch fir cones. The shells belong to species chiefly littoral, but still existing on the neighbouring shores. They are *Scrobicularia piperata, Cardium edule, Tellina solidula, Littorina litorea, Rissoa ulvæ, Patella vulgata, Trochus umbilicatus.*" This description would correspond closely to the bed which I have described, with an underlying zone of submerged peat such as might be expected, but remains of the beech should not occur in any undisturbed Irish geological deposit, as that tree is a recent introduction to Ireland.

At Killough, on the county Down shore, north of Dundrum Bay, a narrow estuarine flat extends inland from the sea for about a mile, its surface slightly above high-water mark. Below a foot of sandy clay is a shell layer, full of *Scrobicularia piperata*, *Cardium edule*, *Tellina balthica*, and *Littorina litorea*. It rests on gray and pink fine laminated clays, apparently of fresh-water origin. In the muddy bay adjoining, I searched in vain for Scrobicularia, which has quite deserted its former haunt here, as elsewhere.

VII.—Carlingford Lough.

The Carlingford Lough estuarine clays may be seen close to Greenore. Similar deposits might be expected at Mill Bay, on the northern side of the lough, but sand only is seen there; and the low land that lies along the river from Narrow-water to Newry has probably a subsoil of estuarine clay, but no sections of sufficient depth are available.

(15). *Greenore.*—On the shore, at the railway junction between Carlingford and Greenore, the weight of the embankment has forced up the estuarine clay some five feet above its natural level, which is here two feet below high-water mark. The clay is rather sandy, and resembles the Newcastle bed, in containing Zostera and a profussion of a few littoral species, intermixed with shells pertaining to the five-fathom clay. Ostrea, Anomia, *Pecten varius*, *Tapes decussatus*, *Trochus cinerareus*, *Rissoa membranacea*, *Littorina litorea*, *Turritella terebra* are in abundance. *Pecten opercularis*, *P. maximus*, *Cardium exiguum*, *Scrobicularia alba* also occur, mixed with species which flourish between tides. Foraminifera occur but sparingly. The clay is at least five feet thick, and its base is not seen. Southward, it runs in under the raised beach at Greenore, and underlies gravels some fifteen feet in thickness, which, from base to top, contain shells similar to those of the clay.

VIII.—Dundalk Bay.

The bay is fringed with a wide and dreary extent of slob-land, which extends far out into the water. No sections were exposed; but it is possible that the beds are of considerable depth.

(16). *Dundalk.*—At Soldier's Point, at the entrance to Dundalk Harbour, the raised beach, resembling that at Greenore, rising some 15 feet above high water, and containing shells, overlies deposits of the estuarine clay series. Seaward of the gravels, the estuarine deposits extend, their surface a few feet above high-water mark. Small streams have cut through them to a depth of eight or ten feet, revealing horizontal beds of brownish littoral clay and gravel. The shells obtained are our commonest littoral species, and but little interest attaches to the deposit.

Deposits of the estuarine clay series probably occur at many points on the Irish coasts. The foregoing enumeration shows that they are to be found at almost every suitable locality in the district dealt with; and, although there are few records of their occurrence elsewhere in Ireland, there is no reason to suppose that they are almost from any part of the seaboard. A thorough knowledge of these deposits would probably throw much light on local later Post-tertiary geology. The Memoirs of the Geological Survey and other works contain mention of the submerged peat zone, but the estuarine clays, which probably in many cases overlie them, do not appear to have been considered worthy of notice. A bed of undoubted estuarine clay occurs at Clontarf, near Dublin, and has been mentioned by several writers. Turton[1] appears to have first noticed it, and records from it *Gastrana fragilis*, and also two varities of *Tapes aureus* (as *Venus ænea* and *V. nitens*). Thompson writes,[2] under *Petricola ochroleuca* (*Gastrana fragilis*)—"Not uncommon in a deposit of blue clay in Dublin Bay, where it was found many years ago by Mr. Furlong (O'Kelly, in Penn. Brit. Zool.). In 1840, I procured it there from the same material brought up from a depth of several feet." This bed is also mentioned in Canon Grainger's Paper, which author states that *Scrobicularia piperata* occurs in it abundantly. This deposit would be well worth working out. The occurrence of *Gastrana fragilis* is interesting, as the only other record of its occurrence on the east coast of Ireland is also from estuarine clays, in Strangford Lough, as cited in the present Paper.

In the annotated and tabular lists which follow, all records are on the authority of the writer except when otherwise stated. In both lists, species which have been recorded by other observers, but did not occur to the writer at any of the stations examined by him, are distinguished by the prefix of an asterisk. In the annotated list, any recorded stations for a species, which are additional to those at which it was observed by the writer, are mentioned.

I must here return my best thanks to those gentlemen who rendered me kind assistance in the preparation of the present Report. My thanks are especially due to Mr. Joseph Wright, F.G.S., of Belfast, who,

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[1] "Conchological Dictionary of the British Islands."

[2] "Natural History of Ireland," vol. iv.

as already stated, prepared the list of Foraminifera found in the deposits, a work involving much labour; to Mr. J. T. Marshall, of Torquay, who revised all my Rissoæ and Odostomiæ, and gave his valuable opinion on such other shells as were critical or doubtful; to Dr. R. F. Scharff, of Dublin, who went through the land-shells; and to Mr. S. A. Stewart, of Belfast, who gave me the benefit of his long experience and critical judgment in a number of ways.

ANNOTATED LIST OF SPECIES.

Foraminifera.

The Foraminifera found in the clays number 114 species. These are all shallow-water forms, and do not need to be separately dealt with. A tabulated list is given on a subsequent page showing their distribution in the various deposits.

Echinoidea.

Echinus miliaris, Leske. Spines and fragments of tests of this urchin occurred in most of the deposits; they were noted from the Lough Foyle and Belfast Lough beds, Magheramorne, Newtownards, Downpatrick, Newcastle, and Greenore. Stewart noticed closely packed layers in the clay at Spencer Basin; the same occurred to me at Alexandra Dock.

E. sphæra, Müller. Fragments of large tests at Alexandra Dock and Magheramorne.

Amphidotus cordatus, Pennant. Of frequent occurrence in the Belfast bed, as at Spencer Basin (Stewart), Alexandra Dock, West Bank; and in a fragmentary state, very rare, at Limavady Junction.

Polychœta.

**Pectinaria belgica*, Pall. Recorded by Grainger from the Belfast bed.

Serpula triquetra, Linn. Frequent on shells in the clay at Belfast, Magheramorne, and elsewhere.

S. vermicularis, Linn. Rare at Belfast; abundant in the Downpatrick deposit.

Spirorbis communis, Fleming. On shells at Belfast, Larne, Magheramorne, Downpatrick, and Eglinton. At least one other Spirorbis occurs, but I had no opportunity of determining the species.

Ostracoda.

Ostracoda were abundant in many of the beds; and I regret my inability to have them thoroughly worked out for the present Report. Mr. Joseph Wright kindly examined material from the various strata at Alexandra Dock, and obtained the following result:—

Abbreviations:—vr, very rare; r, rare; f, frequent; c, common; vc, very common.

		Blue Clay.	Grey Sand above Peat.	Grey Sand below Peat.	Red Sand.
1	Pontocypris mytiloides, Norman, ..	r	—	—	—
2	Cythere pellucida, Baird, ..	c	—	c	vr
3	—— crispata, Brady, ..	c	—	—	—
4	—— viridis, Müller, ..	vr	—	—	—
5	—— lutea, Müller, ..	r	—	—	—
6	—— convexa, Baird, ..	vr	—	—	—
7	—— villosa, G. O. Sars, ..	vr	vr	—	—
8	—— concinna, Jones, ..	c	—	—	—
9	—— tuberculata, G. O. Sars, ..	c	—	—	—
10	—— dunelmensis, Norman, ..	f	—	—	—
11	—— antiquata, Baird, ..	f	—	—	—
12	—— jonesii, Baird, ..	c	—	—	—
13	—— whiteii, Baird, ..	r	—	—	—
14	Loxoconcha guttata, Norman, ..	vc	r	r	vr
15	—— impressa, Baird, ..	f	—	—	—
16	Cytherura nigrescens, Baird, ..	c	—	—	—
17	—— striata, G. O. Sars, ..	r	—	—	—
18	—— undata, G. O. Sars, ..	vr	—	—	—
19	Paradoxostoma ensiforme, Brady, ..	f	—	—	—
20	—— fischeri, G. O. Sars, ..	r	—	—	—

Several of the species above-named are now very rare in our waters, and one, *Cythere whiteii*, has not yet been detected.[1]

In Stewart's Paper a single species, *Cythere albo-maculata*, is recorded as occurring in the clays both at Belfast and Magheramorne.

[1] See Malcomson, "Recent Ostracoda of Belfast Lough," Proc. Belfast Nat. Field Club, 1884–5, Appendix.

The only other note of Ostracoda from the estuarine clays that I know is in the "Monograph of the Post-tertiary Entomostraca of Scotland" by Messrs. Brady, Crosskey, and Robertson, published by the Palæontographical Society in 1874, in which (p. 102) a Table is given showing the distribution of these forms obtained at various depths in blue clay from excavations in Belfast Harbour, and which, in order to make my enumeration complete, I reproduce here :—

	3 to 4ft. below surface.	8ft. below surface.	12 to 14ft. below surface.	20 ft. below surface.
Pontocypris mytiloides, Norman, ..	×	×	—	—
Cythere pellucida, Baird, ..	×	×	—	×
—— viridis, Müller, ..	×	×	×	×
—— lutea, Müller, ..	×	×	—	×
—— albo-maculata, Baird, ..	×	—	—	—
—— convexa, Baird, ..	×	—	—	×
—— crispata, Brady, ..	×	×	×	×
—— pulchella, Brady, ..	×	—	—	—
—— villosa, G. O. Sars, ..	×	×	×	×
—— concinna, Jones, ..	—	—	—	×
—— tuberculata, G. O. Sars, ..	—	×	×	×
—— jonesii, Baird, ..	—	*var.* ×	×	×
—— antiquata, Baird, ..	×	×	×	×
—— whiteii, Baird, ..	—	×	—	—
—— dunelmensis, Norman, ..	—	—	×	—
Cytheridea elongata, Brady, ..	×	—	—	—
Loxoconcha impressa, Baird, ..	×	×	×	×
—— tamarindus, Jones, ..	×	—	—	×
Xestoleberis depressa, G. O. Sars, ..	—	×	—	—
—— aurantea, Baird, ..	—	—	×	—
Cytherura nigrescens, Baird, ..	×	×	×	×
—— similis, G. O. Sars, ..	—	—	—	×
—— affinis? G. O. Sars, ..	—	—	×	—
—— striata, G. O. Sars, ..	×	—	×	×
—— undata, G. O. Sars, ..	—	×	×	—
—— gibba, Müller, ..	—	—	—	×
—— acuticostata, G. O. Sars, ..	×	—	—	—
Paradoxostoma variabile, Baird, ..	—	—	×	—
—— ensiforme, Brady, ..	—	—	×	—

Cirripedia.

* *Balanus balanoides*, Linn. Examples of this species from the Belfast clay are in Canon Grainger's collection.

B. porcatus, Da Costa. On shells in a number of the deposits—of frequent occurrence at Belfast.

* *Verruca stromia*, Müller. Recorded by Grainger from the Belfast bed (*Creusia verruca*).

Decapoda.

Cancer pagurus, Linn. Portion of a large claw of this species was found at Alexandra Dock.

Portunus depurator, Leach. Claws, &c., at Alexandra Dock; rare.

Carcinus mœnas, Leach. Remains of this crab are somewhat common. They occurred at Alexandra Dock and West Bank, Kilroot, Magheramorne, and Larne.

Lamellibranchiata.

Anomia ephippium, Linn. Generally distributed, and characteristic of the upper clay, though absent from the Lough Foyle and Downpatrick beds. A beautiful Pecten-formed specimen from Alexandra Dock was four inches in breadth.

var. *aculeata* occurred at West Bank and Alexandra Dock; var. *squamula* was found occasionally.

A. patelliformis, Linn. Recorded from Belfast by Stewart on Grainger's authority. Bell has noted it from Magheramorne. Two valves occurred to me at Alexandra Dock.

var. *striata*. A single valve at Alexandra Dock.

Ostrea edulis, Linn. Occurred at almost every station, and generally of large size. At Alexandra Dock, and Spencer Basin (Stewart), thickly-packed layers of shells occurred; its immense profusion at Magheramorne has been referred to on a previous page.

var. *parasitica*. Grainger records fine specimens from the Belfast bed; and a shell obtained at Alexandra Dock is referable to this variety.

var. *hippopus*. Immense shells of this solitary deep-water variety characterize the Thracia clay at Belfast and Magheramorne. Some single valves at Alexandra Dock weighed from 1 lb. to 2 lbs. each; and a huge valve in the Belfast Museum, also from the Belfast clay (which, however, appears partially mineralised), weighs 5 lbs.

Pecten pusio, Linn. Two fine single valves at Alexandra Dock, one of which measured 1¾ inches in length.

P. varius, Linn. An abundant species, being present in all but the Scrobicularia clays. Generally of fine size; but the Downpatrick specimens, though mature, were very small. At Magheramorne pure white examples are frequent; but the number of ribs, which is invariably from 28 to 30, excludes them from belonging to the *P. niveus* of Macgillivray.

var. *purpurea*. Occurred at Alexandra Dock and Magheramorne; some specimens attaining a length of 2¾ inches.

P. opercularis, Linn. In the estuarine clays is less abundant than the last species; it occurred at Eglinton, Magheramorne, Belfast, and Greenore; being abundant in the Belfast bed. An example from Magheramorne has a breadth of 3 inches, and bears four Anomia plugs, two on each valve.

P. maximus, Linn. In the beds at Downpatrick and Greenore, fry only occurred. At Belfast and Magheramorne, full-sized examples were common. A fine specimen from the latter station measured 7¼ inches in breadth, and in the fine mud taken from between its closed valves over 45 species of Foraminifera, Ostracoda, and Mollusca were counted, including 18 species of the last-named division.

Lima loscombii, G. B. Sowerby. A single valve of this species occurred in clay from the Magheramorne bed, among a large number of its congener *L. hians*.

L. hians, Gmelin. Abundant in the Magheramorne deposit. Thompson, Hyndman, Grainger, and Stewart, successively, have recorded it as occurring very sparingly in the Belfast bed; but it did not occur to me there. It does not appear to now live on the North-east of Ireland coasts.

Mytilus edulis, Linn. Common in most of the deposits, and absent from none of them, except the Newcastle bed.

var. *pellucida* occurs occasionally.

M. modiolus, Linn. Abounds in the Magheramorne bed. Very rare at Eglinton, and occurred sparingly to Stewart and the writer at Belfast. At Magheramorne it does not share the exuberant growth of many of the bivalves there, being uniformly about 3½ inches long, whereas its normal length is 5 inches; full-grown specimens are common in our present waters.

M. adriaticus, Lamarck. Found sparingly at Magheramorne by Stewart and the writer, and at Belfast by Grainger in addition.

*var. *ovalis*. "Occurred in excavating a channel in Belfast Harbour, and may be considered a newer Pliocene fossil."—Jeffreys, Brit. Conch., vol. II., p. 117. "Some specimens dug out at the site of the new floating dock appear to belong to this variety."—Stewart.

Modiolaria marmorata, Forbes. Somewhat abundant at Magheramorne; very rare in the clays at Newtownards, Larne, and Limavady Junction. At Belfast, Stewart found it sparingly at Spencer Basin, and the writer at West Bank.

Crenella decussata, Montagu. This rare and beautiful little northern shell, characterized by Dr. Gwyn Jeffreys as an "exquisite gem of a mollusk," first occurred to me in the Magheramorne bed, where it is very rare. At Larne, in a bed of gray sand underlying the estuarine clay, a number of fine examples were obtained. Its presence at these two stations shows the persistency of species in certain limited areas, since this shell is one of the very few that Hyndman's dredging party obtained alive in Larne Lough.

Nucula sulcata, Bronn. Bell has recorded this species from Magheramorne. I did not find it there, but obtained a fine single valve at Alexandra Dock, and a smaller valve in the Downpatrick bed, and one or two at Larne. It is not recorded in a recent state from the North of Ireland.

N. nucleus, Linn. A characteristic shell of the Thracia clays, which usually yield it in abundance. Occurs in the deposits of the Loughs of Foyle, Larne, Belfast, and Strangford.

var. *radiata* occurred with the type at Belfast, Lough Foyle, and Magheramorne.

N. nitida, G. B. Sowerby. Sparingly distributed in the Lough Foyle beds. I obtained it at both Eglinton and Limavady Junction.

* *Leda minuta*, Müller. Grainger found a single valve of this species in the Belfast bed. This specimen was erroneously recorded in the supplement to Mac Adam's Paper as *Nucula oblonga* (*L. pernula*).

Pectunculus glycymeris, Linn. Is not uncommon in the Magheramorne clay.

* *Lepton nitidum*, Turton. A single complete specimen of this little shell is now recorded from the Belfast bed. It was found by Canon Grainger, during his explorations, but lay unnamed in his cabinet till after the publication of his Paper, when it was determined by Dr. Jeffreys. The shell has since been kindly examined and confirmed by Mr. J. T. Marshall.

[*Arca tetragona*, Poli, recorded from Alexandra Dock by the writer, was an error.]

Montacuta bidentata, Montagu. This little shell is one of the most characteristic species of the estuarine clays, being found, usually abundantly, at every station except those where the Scrobicularia zone only is present. The bathymetrical range is given by Jeffreys as 10 to 70 fathoms, but the depth in which it formerly abounded in local waters was presumably less than 10 fathoms. It appears to be now quite extinct on North of Ireland coasts, a few dead valves in one or two localities being the only recent records.

M. ferruginosa, Montagu. Occurs in the Thracia clays, but much more sparingly than the last. Limavady Junction was the only station where it was common. It also occurred at Larne, Alexandra Dock, West Bank, Holywood, Newtownards, and Kircubbin. Like the last, it is very rare locally in a recent state, and has not been taken alive.

Lasæa rubra, Montagu. A number of valves occurred in the black sand overlying the estuarine clay at the section in the railway cutting at Larne.

Kellia suborbicularis, Montagu. Has occurred to Bell and myself at Magheramorne; I also obtained one valve in the Kircubbin bed.

Lucina borealis, Linn. Is abundant in the deposits at Magheramorne, Kircubbin, and Downpatrick, and rarer at Belfast and Larne; very rare in the Lough Foyle and Greenore beds. The shells from almost all the beds are of small and uniform size, having a diameter of about ½ inch; but the Belfast specimens were full-grown, and at Magheramorne, among myriads of small examples of the size mentioned, a few tumid shells of 1¾ inch diameter occur.

Axinus flexuosus, Montagu. A characteristic upper clay shell, which is rare in our present waters. The deposits at Limavady Junction, Magheramorne, Alexandra Dock, and Downpatrick, yielded fine specimens in profusion, and it occurred in several other beds.

Cyamium minutum, Fabricius. Grainger and Stewart have both recorded this small shell as occurring sparingly at Belfast, and Stewart from Magheramorne also. To me it occurred at Larne, where it was locally abundant, and sparingly at Magheramorne, Kircubbin, Downpatrick, and Greenore.

Cardium echinatum, Linn. This fine and well-known shell is abundant in the Thracia clays at Belfast, as already testified by Grainger and Stewart. It occurs, but in less profusion, in the deposits of Lough Foyle and Magheramorne.

C. exiguum, Gmelin. Widely distributed, being present in almost every deposit examined, but is finer and more abundant in the Thracia than in the Scrobicularia zone. The clays at Magheramorne and Larne are replete with fine examples.

C. nodosum, Turton. Single valves occurred at Bann, Alexandra Dock, and West Bank. Stewart obtained a single specimen at Magheramorne only.

C. edule, Linn. This ubiquitous species is as abundant in the estuarine clays as it is at the present day. Though more plentiful in the littoral deposits, it also occurs throughout the deep-water clays. Few specimens were of more than average size.

var. *rustica* occurred at Alexandra Dock with the typical form.

C. norvegicum, Spengler. At Belfast only, where its occurrence has been noticed successively by Grainger, Stewart, and the writer. It is very sparingly diffused in the Thracia clay there. Two single valves, of fine size, were all that occurred to me.

Cyprina islandica, Linn. This large shell, abundant on our coasts at the present day, is conspicuously absent from the estuarine series. One complete specimen at Spencer Basin (Stewart) and another and two single valves at Alexandra Dock (Praeger) are the only indications of its existence. The conditions then obtaining would not, however, appear to have been unfavourable, for my specimens are of at least average size, and one of the single valves has a breadth of 5 inches.

Venus exoleta, Linn. Single valves only, at Alexandra Dock, Newtownards, and Magheramorne, sparingly.

V. lincta, Pulteney. Long recorded from the Belfast deposit, but in very sparing numbers. I obtained a few valves at Larne also.

V. fasciata, Da Costa. Occurs at Magheramorne, and a very few valves were obtained at Alexandra Dock.

V. casina, Linn. At Magheramorne only, where examples of fine size are somewhat abundant. Like some other estuarine clay species, while the habitat usually assigned to it is a sandy bottom, the clays show that it can flourish on a bottom entirely muddy.

V. ovata, Pennant. Noted by Stewart as frequent at Magheramorne. To me it occurred only very sparingly there, as also at Eglinton and Larne, but was more common at Kircubbin. In our present waters it is abundantly distributed, and its rarity and starved size in the estuarines show that a muddy bottom is unfavourable for its growth.

V. gallina, Linn. Widely distributed, but usually in sparing numbers and of small size. Was abundant at Alexandra Dock, attaining an average breadth of $\frac{7}{8}$ inch. In some localities on our coasts recent examples attain a breadth of $1\frac{1}{2}$ inch.

var. *laminosa* and var. *gibba* occur occasionally, with forms intermediate between them and the type.

Tapes aureus, Gmelin. Is present in all but the Scrobicularia clays. Apparently much rarer now in the same area.

var. *ovata*. Stewart records this variety from Belfast and Magheramorne, at both of which stations it also occurred to me.

T. virgineus, Linn. Noted in Hyndman's first Belfast Dredging. Report as "common in the alluvium"; but this must have been a mistake. Neither Grainger nor Stewart found a trace of it; and three single valves at Alexandra Dock is my only record of it from the Belfast deposits. At Magheramorne it occurs in great abundance, and of abnormal size, often attaining a breadth of 2½ inches. It was present in less numbers in the Lough Foyle deposits and at Larne.

T. pullastra, Montagu. More generally diffused than the last species, but absent from the strictly littoral deposits; also attains a very large size.

T. decussatus, Linn. Characteristic of the Scrobicularia clays, but of occasional occurrence in the Thracia zone also. At Alexandra Dock it was present in the lower clay in countless numbers, but of small size; while in the upper clay it was rare, but of large dimensions. It is absent from the Lough Foyle beds, and rare in those of Larne Lough; also occurred at Kircubbin, Downpatrick, Greenore, and Dundalk. Is now almost extinct in the district.

Lucinopsis undata, Pennant. Its abundance and large size in the Belfast deposits have been noticed by all the writers on the subject; it is one of the most characteristic species of the Thracia clays there. To me it occurred in profusion at Alexandra Dock and West Bank, and sparingly, also, at Limavady Junction and Magheramorne. This shell has now entirely deserted Belfast Lough, and appears very rare on North of Ireland shores.

Gastrana fragilis, Linn. This species has been already referred to on a previous page. One large valve was obtained at Downpatrick, and a small one at Kircubbin. In a recent state, Lough Swilly, in Donegal, appears to be its only station on the eastern or northern shores of Ireland. The European distribution of the species is essentially southern.

Tellina balthica, Linn. Was present in varying numbers at almost every station. At Alexandra Dock its distribution was very marked; it was present in the surface clays in large numbers, quite absent from the Thracia zone, and in the Scrobularia clays again appeared in profusion, many examples measuring over an inch in breadth.

T. tenuis, Da Costa. A very few examples at Larne and Alexandra Dock. Grainger and Stewart had both previously recorded it from Belfast.

T. fabula, Gronovius. Bell records it from the Belfast deposit. The writer obtained one perfect example in the estuarine clay of the Bann, and a single valve in the Limavady bed.

**T. squalida*, Pulteney. "The only specimens I have seen were single valves collected by the late William Thompson, Esq., and by Mr. Wm. Darragh"—Stewart. Darragh's specimens are in the Belfast Museum. One single valve and a fragment were found in the Belfast bed by Grainger, and recorded in the list supplied to Mac Adam's Paper (as *T. depressa*), but omitted from Grainger's subsequent Paper on account of a doubt as to the correctness of the determination; but the specimens, which I have examined, show that the record was correct.

Psammobia ferröensis, Chemnitz. Sparingly but widely distributed in the Belfast clays, having occurred successively to Hyndman, Grainger, Stewart, and the writer. A few valves at Limavady Junction is my only other note of the species.

P. vespertina, Chemnitz. Grainger records a single valve from the Belfast bed; two additional valves were subsequently found there by him, and are preserved in his cabinet. I obtained two valves in the Magheramorne clay.

Mactra solida, Linn. Very rare. Bell records it from the Belfast bed; and the writer obtained one valve at Magheramorne.

*var. *truncata* was noted by Stewart as rare in the Belfast clay; Bell marks it in his list as found at Magheramorne.

Mactra solida, Linn., var. *elliptica*. It is doubtful whether Grainger's note, "occurred pretty often in the sandy deposits," refers to the estuarine clay beds. Stewart omits the note in his enumeration; nor did this variety occur to him in his investigations. A single valve was found in the lower clay at Alexandra Dock, which is my only note of it.

M. subtruncata, Da Costa. Was present in most of the deposits, usually of small size.

Lutraria elliptica, Lamarck. Its occurrence in the Belfast bed has been noticed by Hyndman and all subsequent writers. At Alexandra Dock the specimens were in every stage of growth, and the rich, golden-brown epidermis beautifully preserved. At the north end of the works a large colony occurred, the shells all in the natural position, and occupying one zone of the clay in profusion. Magheramorne was the only other station at which it was found; there the specimens were small.

**L. oblonga*, Chemnitz. "Found in a recent deposit of blue clay excavated for a dock at Belfast, Dr. William M'Gee."—Thompson. The dock referred to is Prince's Dock. "A remarkably fine specimen of this now absent species occurred to the late James Lemon, Esq."—Grainger. It is rarer still in the district in a recent state.

Scrobicularia alba, Wood. A characteristic shell of the upper estuarine clay. In the deposits of Lough Foyle, Magheramorne, Belfast, and Downpatrick, it was present in great profusion. At Larne, Newtownards, Kircubbin, Newcastle, and Greenore, it occurred in sparing numbers. It inhabits the adjoining waters in 6 to 20 fathoms.

**S. tenuis*, Montagu. Is recorded by Bell from the Belfast deposit.

S. piperata, Bellonius. The typical shell of the lower or Scrobicularia clay, in which it is usually present in enormous numbers. At every point where this bed was examined in the Belfast estuarine area, by Hyndman, Grainger, Stewart, and the writer, it was present in the utmost profusion, from the first lock on the Lagan Canal to Kilroot, and from Millfield to Connswater. At

Newcastle, also, it is most abundant. Occurs in varying numbers in the Lough Foyle and Larne Lough beds, at the Bann, and at Greenore and Dundalk. It is absent from the Strangford Lough deposits, and from the Thracia clays of Belfast and Magheramorne. The specimens are often of large size; Grainger mentions specimens $1\frac{5}{8}$ by $2\frac{1}{8}$ inches; and I have before me one from Larne pottery measuring $1\frac{3}{4}$ by $2\frac{1}{4}$ inches. Like *Tapes decussatus*, which often rivals it in abundance in the lower clay, this mollusk has now completely deserted the habitat which it previously almost monopolised. Its nearest certain present stations are the same as those of Tapes—Lough Swilly on the north, and Carlingford Lough on the south. Southward of Carlingford Lough *S. piperata* still abounds.

**Solecurtus antiquatus*, Pulteney. "A single rather fine example of this scarce species was obtained in the (Belfast) clay by E. Aiken, Esq., of Dublin."—Grainger. It is marked in Bell's list as having occurred to him at Magheramorne.

**Ceratisolen legumen,* Linn. Noted by Bell from the Belfast bed. Very rare in the district at the present day.

Solen pellucidus, Pennant. Is of frequent occurrence in the Belfast Thracia clay, as noted by several writers. Limavady Junction was the only other station at which it occurred to me; there it was very rare. Stewart records it from Magheramorne.

S. ensis, Linn. Not common, but occurs at Eglinton, Larne, Magheramorne, and Belfast.

S. vagina, Linn. Noted in all the lists of the shells of the Belfast clays as of frequent occurrence. At Alexandra Dock fine and perfect specimens occurred, and I have it also noted from Eglinton, Magheramorne, and Holywood. This species is now extremely rare on the North of Ireland coasts, and has not been taken in a live state; while *S. siliqua*, which is absent from the estuarine deposits, flourishes abundantly in our waters.

Thracia papyracea, Poli. Frequent in the Belfast deep-water clays, and occurred sparingly at Limavady Junction, Bann, and Larne.

var. *villosiuscula* was noted by Stewart as frequent at Belfast. It occurred to me in the Larne clay.

T. pubescens, Pulteney. One specimen was obtained by Grainger in the Belfast bed. The writer found a full-sized valve in the Magheramorne deposit.

T. convexa, W. Wood. Selected by Stewart as the typical shell of the upper or deep-water clay. This applies excellently to Belfast, where fine specimens occur in that bed in profusion. Elsewhere it is rare; a few valves at Limavady Junction and Magheramorne being its only occurrence to me. A specimen in Canon Grainger's collection measures 3 inches in breadth.

T. distorta, Montagu. Several large valves at Magheramorne.

Corbula gibba, Olivi. Abundant in many of the deep-water clays, as the Lough Foyle beds, Magheramorne, Belfast, and Downpatrick. Specimens usually small and thin.

Mya arenaria, Linn. Rare, and conspicuously absent from the Scrobicularia clays, where it would naturally be expected to occur. In the surface clays at Alexandra Dock it was present in thousands, but can hardly be considered as fossil there. Of occasional occurrence in the Thracia clays. Very common at the present day.

M. truncata, Linn. More common than the last species, being abundant in the deep-water clays of Eglinton, Limavady Junction, and Alexandra Dock, and more rarely at Magheramorne, West Bank, and Holywood. The Belfast specimens were of fine dimensions, measuring up to $2\frac{1}{4}$ by $3\frac{1}{4}$ inches.

M. binghami, Turton. Noted by Stewart as at Magheramorne, very rare. To the writer it occurred frequently there, and a few valves were also found in the West Bank material.

**Panopea plicata*, Montagu. "Plentiful at Belfast in one narrow zone of the clay bed. Not yet found living on the Irish coasts"—Stewart. Jeffreys (Brit. Conch. Supplement) also notes it from Belfast, on Bell's authority, and Bell records it from Magheramorne also.

Saxicava rugosa, Linn. Frequent at Magheramorne. Rare at Alexandra Dock, West Bank, and Kircubbin. Specimens usually small.

var. *arctica*. A few valves are recorded by Grainger from the Belfast bed. One fine and complete specimen occurred to me at Alexandra Dock.

**Gastrochæna dubia*, Pennant. "Two portions of the curious flask-like tubes of this species were found in the deposits"—Grainger. Has not been found subsequently either at Belfast or elsewhere, and does not now inhabit the North of Ireland.

Pholas dactylus, Linn. One specimen at Alexandra Dock, and a fragment at Limavady Junction. A large single valve in the Belfast Museum is labelled as found in the Belfast estuarine clay by William Thompson.

P. candida, Linn. The most abundant Pholad of the estuarine clays. The occurrence in the Belfast deposits of a zone between the Thracia and Scrobicularia clays, characterized by an abundance of this and the following species, which did not occur in either the overlying or underlying bed, has been already alluded to. At Alexandra Dock this zone yielded the present species in profusion. At West Bank, at almost exactly the same level (21 feet below high-water mark), and there only, the clay was charged with this shell; but here the Thracia bed was very thick, and underlay the Pholad zone for a considerable depth. This species is common in the Lough Foyle beds, and a few valves were found in the Newcastle clay.

P. crispata, Linn. Long known from the Belfast deposit, where it attains extraordinary dimensions, as already stated. Stewart noted that it was found only in the Pholad zone, at the base of the Thracia clay. At Alexandra Dock, where alone it occurred to the writer, the same remark applies. The dimensions attained by these examples are often $4\frac{1}{2}$ inches in breadth by $2\frac{1}{4}$ inches in length, and 8 inches in girth. The specimens now obtained living in the lough, which burrow in sandstone, shale, and Boulder clay, near low-water mark, average $2\frac{1}{4}$ inches long by $1\frac{1}{4}$ in breadth; so the bulk of these estuarine clay giants was eight times that of the living examples. It should be noted, however, that single valves, almost as large as those of the clays, are washed up by the tide at both Cultra and Ballyholme, and probably in deep deposits of mud in the quiet waters below low-water mark, the species still flourishes as it did in the estuarine deposits.

Teredo norvegica, Spengler. Its occurrence in the Belfast deposits, in which it is widely but sparingly distributed, has been noticed by every observer since the time of Thompson. It did not occur in any of the other deposits examined by the writer.

Gastropoda.

Patella vulgata, Linn. Rare, as should be expected from the absence of stones or rocks, but occurs in the clays at Belfast, Magheramorne, Larne, Greenore, and Kircubbin. Specimens small.

var. *depressa* accompanied the typical form in the gravel underlying the clay at Larne.

Helcion pellucidum, Linn. Was frequent in the clay at Larne pottery, and a few examples were found at Alexandra Dock and Kircubbin.

var. *lævis* occurred sparingly in the Larne beds.

Tectura virginea, Müller. Stewart has recorded this species from Belfast. The writer found it frequently at Larne and Kircubbin, and very rarely at Downpatrick.

Ergmainula fissura, Linn. A single example in the Kircubbin clay.

Fissurella græca, Linn. Common, but very small in the Kircubbin bed; rare at Larne, Belfast, and Downpatrick.

Capulus hungaricus, Linn. One worn shell in the Thracia clay at Alexandra Dock.

Cyclostrema nitens, Philippi. This tiny shell was noted by Stewart as common at Magheramorne. To me it occurred only sparingly there, as also at Limavady Junction, Larne, and Downpatrick. Bell also notes it from Belfast.

* *Lacuna crassior*, Montagu. Recorded by Bell from Magheramorne.

L. divaricata, Fabricius. Occurred in almost every bed examined, often of fine size. An examination of Canon Grainger's specimens shows that this was the species recorded in each of his lists as *L. crassior*. The author concurs with me in this correction.

var. *quadrifasciata*. Frequent with the type at Alexandra Dock.

L. puteolus, Turton. Very rare, and of small size. A few examples at Larne, Newtownards, and Downpatrick. Stewart recorded it from the Magheramorne bed.

L. pallidula, Da Costa. Like the last, rare and small. Larne, Magheramorne, and Kircubbin were its only occurrences to me, but Stewart got it also at Belfast.

Littorina obtusata, Linn. Occurred in nearly every deposit.

var. *æstuarii*. Sparingly at Alexandra Dock and Downpatrick. Frequent in certain zones at Magheramorne, with a spire as high as *L. rudis*.

L. neritoïdes, Linn. Very sparingly in the Larne clay. Jeffreys records it from Belfast on Bell's authority.

L. rudis, Maton. Was found sparingly in almost every bed.

var. *tenebrosa*. In the Belfast bed Grainger met with it "rather frequently"; Stewart says "scarce." To the writer one example occurred in the upper clay at Alexandra Dock. Bell notes it from Magheramorne.

L. litorea, Linn. Present at every station, and usually in abundance.

* *Rissoa calathrus*, Forbes and Hanley. Recorded by Bell from Magheramorne.

R. reticulata, Montagu. As already recorded by me, this species occurs sparingly in the Magheramorne bed.

* *R. cimicoïdes*, Forbes. Magheramorne, Bell.

* *R. punctura*, Montagu. Noted by Bell from Magheramorne.

R. costata, Adams. Rather frequent in the clay at Kircubbin.

* var. *alderi* is noted by Bell from the Magheramorne bed.

Trochus helicinus, Fabricius. I found it frequently at Magheramorne, and sparingly at the West Bank.

T. magus, Linn. Of frequent occurrence at Magheramorne and Kircubbin; rare at Alexandra Dock, West Bank, Newtownards, and Greenore. The Magheramorne shells were very fine, measuring up to 1 inch in height by 1½ in breadth. The proportion of height to breadth in this species is variable. The specimens from the Newtownards clay were very flat.

T. cinerareus, Linn. The distribution of this variable species in the estuarine clays is irregular. While quite absent from the Lough Foyle clays, it occurs in immense numbers in the deposits of Larne Lough. It is diffused in varying abundance in the different zones of the Belfast clays; is abundant at Kircubbin, Newtownards, and Greenore, and occurs at Downpatrick.

T. umbilicatus, Montagu. Rarer than the last, but is found at Larne and Magheramorne, Belfast, Newtownards, Kircubbin, and Greenore.

T. millegranus, Philippi. A few examples of small size in the Downpatrick deposit.

Phasianella pulla, Linn. This pretty shell has been overlooked in previous lists of the estuarine clay shells, but is frequent in the clay at Magheramorne, and also at Larne, Kircubbin, and Downpatrick.

R. parva, Da Costa. Compared with its present profusion on our shores, this species is conspicuously rare in the estuarine clays. Though occurring at a number of stations, from Larne to Greenore, it was rare nearly everywhere.

var. *interrupta*. One example was obtained from the gravel underlying estuarine clay at Larne.

R. inconspicua, Alder. At Eglinton, Larne, and Magheramorne sparingly, and more frequent at Alexandra Dock. In Stewart's Paper, and in the writer's list of Alexandra Dock fossils, *R. albella* and *R. inconspicua* were confounded under the latter name; hence an erroneous estimate is there given of the abundance of the present species in the Belfast beds.

var. *sublævis*, Marsh. Specimens from West Bank have been so named by Mr. J. T. Marshall.

R. albella, Lovén. This rare shell, which, as a recent British species, is known from Bantry Bay only, is one of the most characteristic estuarine clay Rissoæ, occurring generally in profusion in almost every deposit. I have it noted from Limavady Junction, Eglinton, Larne, Magheramorne, Alexandra Dock, West Bank, Holywood, Newtownards, Kircubbin, Downpatrick and Greenore; in several of these beds it is the most abundant univalve. As an estuarine clay fossil it was first recorded by Bell, from Magheramorne.

var. *sarsii*. Occurs with the type at a number of stations, but is less abundant. Its recent distribution is directly the reverse of this.

R. membranacea, Adams. In almost every deposit, and generally abundant. Occurs in Thracia and Scrobicularia clays alike.

var. *venusta*. Frequent with the type at Greenore.

var. *elata*. Fine examples occurred in small numbers with the typical form at Limavady Junction, Larne, Newtownards, and Downpatrick.

R. violacea, Desmarets. Alexandra Dock, West Bank, and Magheramorne, in sparing numbers.

var. *ecostata*. A few specimens of the ribless form were obtained from the Magheramorne clay.

* *R. costulata*, Alder. Noted by Bell as found at Magheramorne.

R. striata, Adams. Generally distributed; rare in the Belfast Lough beds, but exceedingly abundant in the corresponding deposits in Larne Lough.

var. *arctica*. Occurs with the type at a number of stations, being often at least equally abundant. Mr. J. T. Marshall remarks that some of the *R. striata* which I sent him (from several stations) form a connecting link between that species and *R. proxima*, and in their extremely fine spiral striæ and other respects resemble the latter so closely as to excuse anyone for mistaking the species.

R. vitrea, Montagu. Sparingly distributed, but occurring at Eglinton, Larne, Alexandra Dock, West Bank, and Downpatrick. The specimens were often of fine size. One or two specimens obtained in Turbot Bank sand, by Hyndman, constitute its only recent record in the North of Ireland.

R. semistriata, Montagu. In the Newtownards clay, very rare.

R. cingillus, Montagu. In the lowest zone (black gravel) of the Larne estuarine series a number of examples were obtained.

Hydrobia ulvæ, Pennant. Common at almost every station, and occurred at all.

var. *barleei* was noticed in the Eglinton clay.

Jeffreysia opalina, Jeffreys. This pretty little shell, whose only Irish record, in either a recent or a fossil state, rests on two dead specimens from Roundstone Bay, county Galway, now in the collection of Mr. J. T. Marshall, occurred in the estuarine clay at a number of places. At Larne (two stations), Magheramorne, Newtownards, and Downpatrick, it was frequent, and a single specimen was obtained in clay from the West Bank.

Skenea planorbis, Fabricius. Abundant in the Larne Lough beds and at Downpatrick. Sparingly at Limavady Junction, Magheramorne, Kircubbin, Newtownards, Newcastle, and Greenore.

Homalogyra atomus, Philippi. Stewart, Bell, and myself have successively observed this minute shell in the Magheramorne deposit, where it is somewhat abundant. It is also diffused throughout the different zones of the Larne clays, and occurred sparingly at West Bank and Downpatrick.

H. rota, Forbes and Hanley. Sparingly with the last at Magheramorne and Downpatrick. A tiny species, the smallest of British shells.

Cæcum glabrum, Montagu. At Larne, Magheramorne, and Newtownards sparingly. Bell marks it in his list as found at Belfast also.

Turritella terebra, Linn. Was present in most of the deposits: its profusion in the Lough Foyle beds has already been commented on. Some examples are of unusual size. Grainger mentions a fine specimen from Belfast, $2\frac{3}{4}$ inches in length, which, alas! mysteriously disappeared when on exhibition in Section D at the British Association Meeting in 1852, and for the restoration of which to its rightful owner he issues a pathetic appeal. A large example obtained by the writer at Alexandra Dock was $2\frac{7}{8}$ inches long, and several Magheramorne examples attain $2\frac{1}{2}$ inches.

Scalaria turtonæ, Turton. Long recorded as common at Belfast, where it is a characteristic shell of the deep-water deposit; the specimens are of very small size, averaging only $\frac{3}{4}$ inch in length; $1\frac{3}{4}$ inches in the length given by Jeffreys. It is an inhabitant of the coralline zone (10–50 fathoms), but its occurrence in the deposit would show that it occasionally inhabits less depths. It also occurred sparingly at Limavady Junction. Grainger quotes it under *S. trevelyana*, Leach.

Aclis ascaris, Turton. One specimen was obtained at Limavady Junction.

A. supranitida, S. Wood. Stewart records it from Belfast in his annotated list, but, in the Table which follows, enters it in the Larne Lough (Magheramorne) column; the author informs me that the tabular list is to be taken in preference to the other. I obtained a few specimens at Alexandra Dock, West Bank, and Magheramorne.

Odostomia minima, Jeffreys. Stewart records a single specimen from Magheramorne, and Bell includes it in his Magheramorne list. But the remarkable abundance and comparatively gigantic size of this extremely rare and tiny species in the Magheramorne clay (where alone I met with it) deserves special mention. The only Irish record for it in a recent state rests on a few specimens from Birterbuy Bay (Jour. Conch., vol. vi., No. 7), and its only locality as an Irish fossil is that quoted above. From a packet of floatings of Magheramorne clay, one-fourth cubic inch in bulk, I picked out no less than sixty examples of *O. minima*, and the clay enclosed between the closed valves of a *Pecten maximus* from the same deposit yielded nineteen fine specimens. As regards its unusual size, Mr. J. T. Marshall writes to me: "Whereas recent examples never exceed half a line in length, and have four whorls only, yours are twice as long, four times the bulk, and possess six whorls. It looks as if the species were depauperating and dying out."

O. albella, Lovén. One specimen occurred in clay obtained on the West Bank in Belfast Lough, sixteen feet below the surface. New to Ireland.

**O. rissoides*, Hanley. Recorded by Bell from Magheramorne.

O. pallida, Montagu. Recorded by Grainger from the Belfast bed under the name *O. eulimoides*, Hanley. Stewart and Bell obtained it at Magheramorne. In addition to the station last-mentioned, where it is somewhat abundant, it occurred to me at Eglinton, Limavady Junction, Alexandra Dock, West Bank, and Newtownards. Bell makes a distinction between *O. eulimoides*, Hanley, and *O. pallida*, Montagu, and records both from Magheramorne.

O. conoïdea, Brocchi. One example obtained at West Bank. There is no previous record from the North of Ireland.

O. acuta, Jeffreys. Recorded by Stewart from Belfast and Magheramorne. To the writer, also, it occurred in both deposits, the Belfast station being West Bank.

O. unidentata, Montagu. A single specimen at Magheramorne was its only occurrence. At the present day it is one of our commonest local Odostomiæ.

**O. plicata*, Montagu. Is recorded by Bell from the Magheramorne clay.

O. insculpta, Montagu. West Bank, very rare.

O. indistincta, Montagu. Sparingly at Limavady Junction and Magheramorne. Stewart records it from Belfast.

O. interstincta, Montagu. A few examples at Limavady Junction. Stewart obtained it at Belfast.

O. lactea, Linn. This elegant little shell is the commonest Odostomia of the estuarine clays. In the Belfast and Magheramorne beds it is present in some numbers, and also occurs in the deposits of Lough Foyle, Larne, Newtownards, and Kircubbin.

O. pusilla, Philippi. Eglinton and Magheramorne, rare. I do not find any previous North of Ireland record.

O. acicula, Philippi. Occurred at Limavady Junction and West Bank very sparingly.

O. nitidissima, Montagu. I obtained three examples of this beautiful little shell in the clay at Eglinton.

Eulima bilineata, Alder. A specimen found by Grainger at Belfast, and doubtfully recorded as *E. subulata*, was, with his concurrence, transferred by Stewart to the present species. One or two examples occurred to me at Alexandra Dock.

**Natica grœnlandica*, Beck. "Belfast (A. Bell)!"—Jeffreys (Brit. Conch. Suppl.) Mr. Bell writes me that he received the specimen from Mr. Stewart, along with other Belfast estuarine shells. It is a northern form, not now inhabiting the North of Ireland; undoubtedly fossil examples have been dredged on the Turbot Bank at the entrance of Belfast Lough, and it is possible that this was a transported specimen.

N. catena, Da Costa. Belfast bed only, where it was found sparingly by Grainger, Stewart, and the writer.

N. alderi, Forbes. Abundant in the Belfast deep-water zone. Sparingly at Eglinton and Magheramorne.

Aporrhaïs pes-pelecani, Linn. The abundance of this well-known shell in the Belfast clay has been long noted: it appeared equally abundantly at the sections examined by Grainger, Stewart, and the writer (Alexandra Dock). On the West Bank excavations, however, its occurrence was rare; likewise at Limavady Junction and Magheramorne, its only additional stations. It is an inhabitant of the coralline zone.

Cerithium reticulatum, Da Costa. Present in myriads in most of the deposits.

Purpura lapillus, Linn. In the clays at many stations, but sparingly and of small size.

Buccinum undatum, Linn. Abundant at Alexandra Dock and Magheramorne. Rare at several other stations. Grainger found a specimen of the monstrosity *carinatum* at Belfast.

Murex erinaceus, Linn. Widely distributed in the district, but usually of small size. More frequent at Kircubbin than elsewhere, where the specimens were tiny.

Fusus antiquus, Linn. Rare in the deposits, being noted from only five stations, and sparingly at all of them. Belfast specimens attain four and a-half inches in length.

F. gracilis, Da Costa. One specimen at Alexandra Dock.

Nassa reticulata, Linn. Widely but sparingly distributed. Was abundant at Alexandra Dock only, but occurred in beds from north to south of the district. Bell records the form *N. nitida*, Jeffreys, from Belfast and Magheramorne.

N. pygmæa, Lamarck. This shell, extremely rare in our present waters, is characteristic of the Thracia zone of the estuarine clays. Its abundance in the Belfast bed has already been commented on by Grainger and Stewart. It is present also in the Lough Foyle beds, at Larne, and at Downpatrick, but conspicuously absent from the Magheramorne deposit. Grainger noted it as *N. incrassata*. The latter form has now locally replaced *N. pygmæa*, being a common shell on our shores.

**Defrancia gracilis*, Montagu. Stewart obtained one specimen at Belfast. Not now inhabiting the North of Ireland.

Pleurotoma attenuata, Montagu. Several specimens at West Bank. An unnamed specimen in Canon Grainger's collection, found in the Belfast clay, also belongs here.

P. costata, Donovan. Several examples occurred to the writer in the West Bank clay. This species is recorded from the Belfast bed by Grainger, but on examining the specimen Mr. J. T. Marshall refers it to the following species.

P. brachystoma, Philippi. Belfast bed. Stewart found it sparingly at Spencer Basin, and I at Alexandra Dock and West Bank. As mentioned above, Grainger's *P. costata* belongs here.

P. septangularis, Montagu. It has been found in the Belfast bed by Bell (Brit. Conch. Suppl.), Stewart, and myself, but is very rare there.

P. rufa, Montagu. "Belfast deposit," Jeffreys. The estuarine clays are probably intended. Bell notes it from Magheramorne. To the writer it occurred at Newtownards, Kircubbin, Larne, and Eglinton, being frequent at the station last named.

**P. turricula*, Montagu. Is noted from the Belfast bed by Grainger and Stewart; did not occur to me.

Cypræa europæa, Montagu. Sparingly but widely distributed in the Belfast bed and at Magheramorne.

**Cylichna nitidula*, Lovén. "In the Belfast bed I found one shell"—Stewart.

C. cylindracea, Pennant. A single fine example in the Thracia clay at Alexandra Dock.

Utriculus mammillatus, Philippi. Common at Eglinton and Limavady Junction, and frequent at Downpatrick. Sparingly also at Larne, Belfast, and Newcastle. Bell notes it from Magheramorne.

U. truncatulus, Bruguière. One specimen in the Downpatrick clay.

U. obtusus, Montagu. Sparingly at every station and in every zone of the Belfast clays. Abundant in the Lough Foyle beds. Rarer at Kircubbin and in the Larne Lough deposits.

var. *lajonkaireana* was found sparingly with the type at Limavady Junction. A curious monstrosity also occurred there, having a slender, tapered spire as long as the mouth.

U. hyalinus, Turton. Noted by Stewart as "plentiful in the Belfast and in the Larne beds." To me it occurred, but sparingly, at Magheramorne, Alexandra Dock, and Newtownards.

Acera bullata, Müller. The delicate shells of this species are always broken to fragments by the operation of washing the clay, but the flat angular-whorled top is easily recognizable. It is of rather general occurrence in the clays, being present in the beds of Lough Foyle, Bann, Larne Lough, Belfast Lough, and Lough Strangford.

var. *nana*. Dwarf examples, apparently this variety, were found at Magheramorne, where Stewart had previously noted them, and at Downpatrick.

Actæon tornatilis, Linn. Grainger records some shells of large size found in the Belfast bed. To me it occurred extremely sparingly at Alexandra Dock and Magheramorne, but the specimens were of very small size.

Scaphander lignarius, Linn. Grainger found one, Stewart three or four, and the writer one specimen, in the Belfast clay.

Philine scabra, Müller. One specimen only, at Alexandra Dock.

P. aperta, Linn. In the deposits of Lough Foyle, Larne and Belfast Loughs, and Downpatrick, in varying numbers.

Melampus bidentatus, Montagu. Stewart found it sparingly at Magheramorne. The writer obtained it there also, as well as at Larne and Alexandra Dock.

LAND AND FRESH-WATER SPECIES.

Zonites nitidulus, Draparnaud. Grainger records it from Belfast, and Bell from Magheramorne. One example occurred to me at Larne pottery.

Z. radiatulus, Alder. A single example at Larne pottery.

**Z. crystallinus*, Müller. Is included in Bell's list of the shells of the Belfast clays.

Helix nemoralis, Linn. To Grainger, Stewart, and myself, a few examples have occurred in the Belfast deposits. A specimen from Alexandra Dock is doubtfully referred to *H. hortensis*, Müller, by Dr. R. F. Scharff.

H. rotundata, Müller. Grainger found one at Belfast, and the writer several at Larne Pottery.

H. pulchella, Müller. One specimen in the clay at Larne Pottery.

Bythinia tentaculata, Linn. Several specimens occurred in the estuarine clay of the Bann.

Hydrobia ventrosa, Montagu. One specimen in the Downpatrick clay, a few at Holywood and the Bann, and a number at Eglinton. Appears to be rare in the North of Ireland; the only record I find is Larne Lough, in a recent state, on the authority of Dr. Jeffreys.

Limnæa palustris, Müller. In the blue clay examined in the railway cutting at Larne, a single fine example was found.

MAMMALIA.

Sus scrofa, Linn. Two portions of the lower jaw of a large wild boar, with teeth and both tusks, and at another spot a single tusk, were found at Alexandra Dock, on the upper surface of the submerged peat.

Cervus elaphus, Linn. A dorsal vertebra, right radius, and posterior right rib of the red deer, occurred at Alexandra Dock, in a position similar to the wild boar remains. I also obtained a pelvic bone of this species from the base of the clay in the county Antrim abutment of the new Albert Bridge, Belfast.

Cervus giganteus, Blum. A fragment of an antler, which has been referred by Professor Boyd Dawkins to this species, was obtained by Mr. William Gray, M.R.I.A., from excavations made for the county Down abutment of the new Albert Bridge, in 1890. I have failed to discover the exact position in which it was found, but it was probably on the upper surface of the Boulder clay. A more satisfactory record has recently occurred, when the greater portion of the skull of an Irish elk was found in the excavations made for the foundations of the east wall of the new branch floating dock, opening off Spencer Basin, Belfast. This skull was lying embedded in the submerged peat which, as previously stated, underlies the estuarine clay over the greater portion of the Belfast estuarine area. The peat at this point was three feet thick, and the skull was obtained in the middle of the deposit, at a depth of 26 feet below low-water mark. Above the peat was the usual thick deposit of estuarine clay.

In the following tabulated list of the Mollusca of the estuarine clays, the first sixteen columns show their distribution in the beds at the localities cited, as determined by the writer. A column (A) has been added showing the original recorder of each species as an estuarine clay fossil, and where it was first observed, points which possess some interest in a historical way; to the original finder belongs the credit of any discovery, not to the re-finder. The abbreviations used in this column are as follow:—B = Belfast; M = Magheramorne; L = Larne; Lv = Limavady Junction; E = Eglinton; Nt = Newtownards; K = Kircubbin; D = Downpatrick; N = Newcastle; *T* = Thompson (Nat. Hist. Ireland, vol. iv., 1856);

H = Hyndman (Brit. Assoc. Rep., 1857); *G* = Grainger (Nat. Hist. Review, 1859); *J* = Jeffreys (British Conchology, 1862–9); *S* = Stewart (8th Report, B.N.F.C., 1871, Appendix); *P* = Praeger (Proc. B.N.F.C., 1886–7, Appendix; *Ibid.*, 1889–90, pp. 207–208, 216–217); *B* = Bell (Brit. Assoc. Rep., 1890).

Columns B and C are added for comparison, and show the present distribution of the species enumerated, in the waters of the same district, viz. Londonderry to Dundalk. Where a shell has been taken alive, it is not entered also in the column of dead shells, unless its distribution in a dead state throws additional light on the relation of the present to the past. These columns are constructed from the writer's compilation[1] on the recent marine Mollusca of the province, corrected to date.

NOTE ADDED IN THE PRESS.

Since this Paper was read, a portion of the innominate bone of an Irish elk, and also a cannon-bone of the same species have been found in the excavations close to where the skull above-mentioned was obtained. They occurred at the base of the peat, between it and the underlying gray sand, and are by no means so fresh or well-preserved as the skull.

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[1] "The Marine Shells of the North of Ireland," Proc. Belfast Nat. Field Club, 1887–8, Appendix.

TABLE OF THE DISTRIBUTION OF MOLLUSCA IN THE ESTUARINE CLAYS OF THE NORTH-EAST OF IRELAND.

ABBREVIATIONS:—vr, very rare; r, rare; f, frequent; c, common; vc, very common.

	Species.	Eglinton.	Limavady Junction.	Bann Mouth.	Larne Curran.	Magheramorne.	Kilroot.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.	Dundalk.	Original Record.	Present Distribution on N.E. Ireland Coasts. Living.	Present Distribution on N.E. Ireland Coasts. Dead.
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	A	B	C
	Conchifera.																			
1	Anomia ephippium, Linn., ..	—	—	—	r	c	—	—	c	r	—	—	r	—	—	c	r	B–*G*	c	—
2	—— patelliformis, Linn., ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*S*	c	—
3	—— —— *var.* striata, ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	f	—
4	Ostrea edulis, Linn., ..	c	f	—	r	vc	f	—	vc	c	f	f	c	c	—	vc	c	B–*G*	c	—
5	—— —— *var.* parasitica, ..	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—	—	B–*G*	—	—
6	—— —— *var.* hippopus, ..	—	—	—	—	f	—	—	f	—	—	—	—	—	—	—	—	B–*S*	—	—
7	Pecten pusio, Linn., ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	f	—
8	—— varius, Linn., ..	f	f	—	r	vc	—	—	f	f	—	f	r	f	—	c	—	B–*G*	c	—
9	—— —— *var.* purpurea, ..	—	—	—	—	f	—	—	f	—	—	—	—	—	—	—	—	—	—	—
10	—— opercularis, Linn., ..	vr	—	—	—	f	—	—	c	r	—	—	—	—	—	vr	—	B–*G*	c	—

11	—— maximus, Linn., ..	—	—	—	—	f	—	—	c	r	r	—	—	vr	—	vr	—	B–*G*	c	—
12	Lima loscombii, G. B. Sowerby, ..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	M–*P*	f	—
13	—— hians, Gmelin, ..	—	—	—	—	vc	—	—	—	—	—	—	—	—	—	—	—	B–*T*	—	vr
14	Mytilus edulis, Linn., ..	c	c	c	r	vr	f	vr	c	f	f	r	r	c	—	r	f	B–*G*	vc	—
15	—— —— *var.* pellucida, ..	—	f	—	—	—	—	—	f	f	—	—	—	—	—	—	—	B–*P*	f	—
16	—— modiolus, Linn., ..	vr	—	—	—	c	—	—	r	—	—	—	—	—	—	—	—	B & M–*S*	c	—
17	—— adriaticus, Lamarck, ..	—	—	—	—	f	—	—	r	—	—	—	—	—	—	—	—	B–*G*	r	—
18	*—— —— *var.* ovalis, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*J*	—	—
19	Modiolaria marmorata, Forbes, ..	—	vr	—	vr	vc	—	—	—	vr	—	vr	—	—	—	—	—	B & M–*S*	c	—
20	Crenella decussata, Montagu, ..	—	—	—	r	r	—	—	—	—	—	—	—	—	—	—	—	L–*P*	r	—
21	Nucula sulcata, Bronn., ..	—	—	—	vr	—	—	—	vr	—	—	—	—	vr	—	—	—	D–*P*	—	—
22	—— nucleus, Linn., ..	c	c	—	vr	c	—	—	c	f	vr	vr	vr	c	—	—	—	B–*G*	c	—
23	—— —— *var.* radiata, ..	f	f	—	—	f	—	—	f	—	—	—	—	—	—	—	—	—	—	—
24	—— nitida, G. B. Sowerby, ..	r	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E–*P*	f	—
25	*Leda minuta, Müller, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*G*	r	f
26	Pectunculus glycymeris, Linn., ..	—	—	—	—	f	—	—	—	—	—	—	—	—	—	—	—	M–*P*	f	c
27	*Lepton nitidum, Turton, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B	r	r
28	Montacuta bidentata, Montagu, ..	c	c	—	r	c	—	—	c	c	c	f	—	f	—	vr	—	B & M–*S*	—	vr
29	—— ferruginosa, Montagu, ..	—	c	—	r	—	—	—	vr	r	r	r	vr	—	—	—	—	B–*S*	—	vr
30	Lasæa rubra, Montagu, ..	—	—	—	f	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—
31	Kellia suborbicularis, Montagu, ..	—	—	—	—	vr	—	—	—	—	—	—	vr	—	—	—	—	M–*P*	r	—
32	Lucina borealis, Linn., ..	—	r	—	r	vc	—	—	f	vr	—	—	c	vc	—	vr	—	B–*H*	f	c

	Species.	Eglinton.	Limavady Junction.	Bann Mouth.	Larne Curran.	Magheramorne.	Kilroot.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.	Dundalk.	Original Record.	Present Distribution on N.E. Ireland Coasts. Living.	Dead.
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	A	B	C
33	Axinus flexuosus, Montagu, ..	r	c	—	vr	c	—	—	c	vr	vr	r	—	vc	—	—	—	B–*H*	—	f
34	Cyamium minutum, Fabricius, ..	—	—	—	c	vr	—	—	—	—	—	—	vr	vr	—	vr	—	B–*G*	vc	—
35	Cardium echinatum, Linn., ..	f	f	—	—	f	—	—	vc	r	—	—	—	—	—	—	—	B–*G*	f	c
36	—— exiguum, Gmelin, ..	c	f	r	c	vc	—	r	r	f	r	c	f	f	vr	f	r	B–*G*	r	—
37	—— nodosum, Turton, ..	—	—	vr	—	—	—	—	vr	vr	—	—	—	—	—	—	—	M–*S*	f	—
38	—— edule, Linn., ..	f	f	f	c	f	—	vc	vc	vr	c	f	f	r	vr	r	c	B–*G*	vc	—
39	—— —— *var.* rustica, ..	—	—	—	—	—	—	—	f	—	—	—	—	—	—	—	—	—	—	—
40	—— norvegicum, Spengler, ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	vr	c
41	Cyprina islandica, Linn., ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*S*	c	—
42	Venus exoleta, Linn., ..	—	—	—	—	vr	—	—	vr	—	—	vr	—	—	—	—	—	B–*P*	vr	c
43	—— lincta, Pulteney, ..	—	—	—	vr	—	—	—	vr	—	—	—	—	—	—	—	—	B–*H*	r	c
44	—— fasciata, Da Costa, ..	—	—	—	—	f	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	f	—
45	—— casina, Linn., ..	—	—	—	—	c	—	—	—	—	—	—	—	—	—	—	—	M–*S*	f	—
46	—— ovata, Pennant, ..	vr	—	—	r	vr	—	—	—	—	—	—	f	—	—	—	—	M–*S*	vc	—

47	—— gallina, Linn.,	..	vr	vr	—	vr	f	—	—	c	f	—	—	—	vr	—	vr	—	B–*G*	c	—
48	—— —— *var.* laminosa,	..	r	f	—	—	f	—	—	f	—	—	—	—	—	—	—	—	B–*G*	—	—
49	—— —— *var.* gibba,	..	—	—	—	—	vr	—	—	r	—	—	—	—	—	—	—	—	B–*G*	—	—
50	Tapes aureus, Gmelin,	..	—	—	—	c	f	—	—	f	r	c	r	c	r	—	r	—	B–*H*	vr	c
51	—— —— *var.* ovata,	..	—	—	—	—	c	—	—	vr	—	—	—	—	—	—	—	—	B & M–*S*	—	—
52	—— virgineus, Linn.,	..	f	r	—	vr	vc	—	—	vr	—	—	—	—	—	—	—	—	B–*H*	vc	—
53	—— pullastra, Montagu,	..	f	r	—	vr	c	—	—	f	—	r	vr	f	vr	—	vr	r	B–*H*	vc	—
54	—— decussatus, Linn.,	..	—	—	—	r	r	—	vc	vc	—	—	—	f	vr	—	c	r	B–*H*	vr	vr
55	Lucinopsis undata, Pennant,	..	—	r	—	—	r	—	—	vc	c	—	—	—	—	—	—	—	B–*H*	vr	r
56	Gastrana fragilis, Linn.,	..	—	—	—	—	—	—	—	—	—	—	—	vr	vr	—	—	—	D–*P*	—	—
57	Tellina balthica, Linn.,	..	c	r	r	c	r	c	f	vc	—	f	—	r	—	r	vr	f	B–*G*	c	—
58	—— tenuis, Da Costa,	..	—	—	—	vr	—	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	c	—
59	—— fabula, Gronovius,	..	—	vr	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*B*	f	—
60	*—— squalida, Pulteney,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*G*	—	r
61	Psammobia ferröensis, Chemnitz,	..	—	vr	—	—	—	—	—	r	—	—	—	—	—	—	—	—	B–*H*	vr	c
62	—— vespertina, Chemnitz,	..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	B–*G*	—	r
63	Mactra solida, Linn.,	..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	M–*P*	—	c
64	*—— —— *var.* truncata,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*S*	f	—
65	—— —— *var.* elliptica,	..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	f	—
66	—— subtruncata, Da Costa,	..	c	c	—	vr	vr	—	—	c	r	c	f	vr	—	—	vr	—	B–*G*	f	—
67	Lutraria elliptica, Lamarck,	..	—	—	—	—	r	—	—	c	—	—	—	—	—	—	—	—	B–*H*	c	—
68	*—— oblonga, Chemnitz,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*T*	—	vr

	Species.	Eglinton.	Limavady Junction.	Bann Mouth.	Larne Curran.	Magheramorne.	Kilroot.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.	Dundalk.	Original Record.	Present Distribution on N.E. Ireland Coasts. Living.	Dead.
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	A	B	C
69	Scrobicularia alba, Wood, ..	vc	vc	—	r	c	—	—	vc	r	—	f	r	vc	vr	vr	—	B–*H*	f	—
70	*—— tenuis, Montagu, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*B*	—	vr
71	—— piperata, Bellonius, ..	f	vr	f	r	vr	vc	vc	vc	—	—	—	—	—	vc	vr	f	B–*H*	—	r
72	*Solecurtus antiquatus, Pulteney, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*G*	—	c
73	*Ceratisolen legumen, Linn., ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*B*	—	vr
74	Solen pellucidus, Pennant, ..	—	vr	—	—	—	—	—	f	—	—	—	—	—	—	—	—	B–*G*	c	—
75	—— ensis, Linn., ..	f	—	—	f	vr	—	—	r	—	—	—	—	—	—	—	—	B–*G*	c	—
76	—— vagina, Linn., ..	vr	—	—	—	vr	—	—	f	—	f	—	—	—	—	—	—	B–*H*	—	vr
77	Thracia papyracea, Poli, ..	—	vr	vr	vr	—	—	—	f	—	—	—	—	—	—	—	—	B–*G*	—	f
78	—— —— *var.* villosiuscula, ..	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	B–*S*	—	f
79	—— pubescens, Pulteney, ..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	B–*G*	—	vr
80	—— convexa, W. Wood, ..	—	vr	—	—	vr	—	—	c	f	—	—	—	—	—	—	—	B–*T*	—	r
81	—— distorta, Montagu, ..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	M–*P*	—	vr
82	Corbula gibba, Olivi, ..	c	c	—	f	f	—	—	c	c	—	r	f	c	—	—	—	B–*G*	c	—

83	Mya arenaria, Linn.,	..	r	—	—	—	r	—	—	c	—	vr	—	—	—	—	vr	f	B–*G*	vc	—
84	—— truncata, Linn.,	..	c	c	—	—	vr	—	—	c	vr	f	—	—	—	—	—	—	B–*H*	c	—
85	—— binghami, Turton,	..	—	—	—	—	f	—	—	—	vr	—	—	—	—	—	—	—	M–*S*	vr	r
86	*Panopea plicata, Montagu,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*J*	—	—
87	Saxicava rugosa, Linn.,	..	—	—	—	—	f	—	—	vr	vr	—	—	r	—	—	—	—	B & M–*S*	c	—
88	—— —— *var.* arctica,	..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	f	—
89	*Gastrochœna dubia, Pennant,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*G*	—	—
90	Pholas dactylus, Linn.,	..	—	vr	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	f	—
91	—— candida, Linn.,	..	c	f	—	—	—	—	—	c	c	—	—	—	—	vr	—	—	B–*G*	f	—
92	—— crispata, Linn.,	..	—	—	—	—	—	—	—	c	—	—	—	—	—	—	—	—	B–*H*	r	—
93	Teredo norvegica, Spengler,	..	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—	—	B–*T*	—	vr
	Gastropoda.																				
94	Patella vulgata, Linn.,	..	—	—	—	f	r	—	—	vr	—	—	—	f	—	—	vr	—	B–*G*	vc	—
95	—— —— *var.* depressa,	..	—	—	—	f	—	—	—	—	—	—	—	—	—	—	—	—	—	f	—
96	Helcion pellucidum, Linn.,	..	—	—	—	f	—	—	—	r	—	—	—	r	—	—	—	—	B–*P*	c	—
97	—— —— *var.* lævis,	..	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	L–*P*	c	—
98	Tectura virginea, Müller,	..	—	—	—	f	—	—	—	—	—	—	—	f	vr	—	—	—	B–*S*	c	—
99	Emarginula fissura, Linn.,	..	—	—	—	—	—	—	—	—	—	—	—	vr	—	—	—	—	—	c	—
100	Fissurella græca, Linn.,	..	—	—	—	vr	—	—	—	vr	—	—	—	c	r	—	—	—	B–*S*	r	—
101	Capulus hungaricus, Linn.,	..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	f	—
102	Cyclostrema nitens, Philippi,	..	—	vr	—	r	r	—	—	—	—	—	—	—	vr	—	—	—	M–*S*	—	vr
103	*—— —— *var.* alderi,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	—	—

	Species.	Eglinton.	Limavady Junction.	Bann Mouth.	Larne Curran.	Magheramorne.	Kilroot.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.	Dundalk.	Original Record.	Present Distribution on N.E. Ireland Coasts. Living.	Dead.
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**A**	**B**	**C**
104	Trochus helicinus, Fabricius, ..	—	—	—	—	f	—	—	—	vr	—	—	—	—	—	—	—	M–*P*	c	—
105	—— magus, Linn., ..	—	—	—	—	f	—	—	vr	vr	—	vr	f	—	—	vr	—	B–*G*	f	—
106	—— cinerareus, Linn., ..	—	—	—	vc	vc	—	—	c	r	—	c	c	f	—	c	—	B–*G*	vc	—
107	—— umbilicatus, Montagu, ..	—	—	—	vr	f	—	—	r	—	—	vr	r	—	—	vr	—	M–*S*	c	—
108	—— millegranus, Philippi, ..	—	—	—	—	—	—	—	—	—	—	—	—	vr	—	—	—	D–*P*	f	—
109	Phasianella pulla, Linn., ..	—	—	—	f	f	—	—	—	—	—	—	r	f	—	—	—	L–*P*	f	c
110	*Lacuna crassior, Montagu, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	f	—
111	—— divaricata, Fabricius, ..	vr	f	—	vr	f	—	r	c	f	vr	f	f	f	—	f	—	B & M–*S*	c	—
112	—— —— *var.* quadrifasciata, ..	—	—	—	—	—	—	—	f	—	—	—	—	—	—	—	—	—	c	—
113	—— puteolus, Turton, ..	—	—	—	r	—	—	—	—	—	—	vr	—	vr	—	—	—	M–*S*	—	r
114	—— pallidula, Da Costa, ..	—	—	—	r	r	—	—	—	—	—	—	f	—	—	—	—	B & M–*S*	c	—
115	Littorina obtusata, Linn., ..	vr	vr	—	vc	f	r	f	f	r	c	vr	c	f	—	f	r	B–*G*	vc	—
116	—— —— *var.* astuarii, ..	—	—	—	—	f	—	—	r	—	—	—	—	vr	—	—	—	B–*S*	—	—
117	—— neritoides, Linn., ..	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	B–*J*	c	—

118	—— rudis, Maton, ..	r	r	r	r	r	—	f	f	vr	r	vr	r	r	r	r	—	B–*G*	c	—
119	—— —— *var.* tenebrosa, ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	f	—
120	—— litorea, Linn., ..	r	f	c	c	r	—	vc	c	vr	c	vr	vc	r	r	c	c	B–*H*	vc	—
121	*Rissoa calathrus, Forbes & Hanley, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	—	vr
122	—— reticulata, Montagu, ..	—	—	—	—	r	—	—	—	—	—	—	—	—	—	—	—	M–*P*	—	c
123	*—— cimicöides, Forbes, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	—	vr
124	*—— punctura, Montagu, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	—	f
125	—— costata, Adams, ..	—	—	—	—	—	—	—	—	—	—	—	f	—	—	—	—	K–*P*	—	f
126	—— parva, Da Costa, ..	—	—	—	r	r	—	—	f	—	—	vr	vr	r	—	vr	—	M–*P*	vc	—
127	—— —— *var.* interrupta, ..	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—
128	—— inconspicua, Alder, ..	r	—	—	vr	r	—	—	f	—	—	—	—	—	—	—	—	B–*J*	—	r
129	—— —— *var.* sublævis, Marsh, ..	—	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
130	—— albella, Lovén, ..	c	f	—	r	vc	—	—	vc	c	f	vc	vr	f	—	r	—	M–*B*	—	—
131	—— —— *var.* sarsii, ..	c	f	—	r	c	—	—	c	c	—	c	—	—	—	—	—	M–*P*	—	—
132	—— membranacea, Adams, ..	c	c	c	c	c	—	vr	c	f	vr	r	f	c	—	vc	r	B–*G*	c	—
133	—— —— *var.* venusta, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	f	—	—	—	—
134	—— —— *var.* elata, ..	—	r	—	f	—	—	—	—	—	—	r	—	vr	—	—	—	L–*P*	—	—
135	—— violacea, Desmarets, ..	—	—	—	—	r	—	—	f	r	—	—	—	—	—	—	—	B & M–*S*	r	r
136	—— —— *var.* ecostata, ..	—	—	—	—	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—
137	*—— costulata, Alder, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	—	—
138	—— striata, Adams, ..	vr	vr	—	vc	vc	—	—	f	—	—	r	c	c	—	f	—	M–*S*	vc	—
139	—— —— *var.* arctica, ..	—	—	—	c	f	—	—	—	—	—	—	f	f	—	r	—	L–*P*	—	—

	Species.	Eglinton.	Limavady Junction.	Bann Mouth.	Larne Curran.	Magheramorne.	Kilroot.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.	Dundalk.	Original Record.	Present Distribution on N.E. Ireland Coasts. Living.	Dead.
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**A**	**B**	**C**
140	Rissoa vitrea, Montagu, ..	vr	—	—	vr	—	—	—	r	f	—	—	—	vr	—	—	—	B–*S*	—	vr
141	—— semistriata, Montagu, ..	—	—	—	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—	r
142	—— cingillus, Montagu, ..	—	—	—	r	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—
143	Hydrobia ulvæ, Pennant, ..	c	c	c	f	c	vr	vc	c	f	c	r	c	f	c	vr	c	B–*G*	vc	—
144	—— —— *var.* barleei, ..	f	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
145	Jeffreysia opalina, Jeffreys, ..	—	—	—	f	f	—	—	—	r	—	f	—	f	—	—	—	—	—	—
146	Skenea planorbis, Fabricius, ..	—	vr	—	c	c	—	—	—	—	—	vr	vr	c	vr	vr	—	L–*P*	vc	—
147	Homalogyra atomus, Philippi, ..	—	—	—	f	f	—	—	—	vr	—	—	—	vr	—	—	—	M–*S*	f	—
148	—— rota, Forbes & Hanley, ..	—	—	—	—	vr	—	—	—	—	—	—	—	vr	—	—	—	M–*S*	—	vr
149	Cœcum glabrum, Montagu, ..	—	—	—	vr	r	—	—	—	—	—	r	—	—	—	—	—	M–*S*	—	vr
150	Turritella terebra, Linn., ..	vc	vc	—	—	r	—	—	f	r	r	vr	vr	c	—	c	—	B–*H*	vc	—
151	Scalaria turtonæ, Turton, ..	—	vr	—	—	—	—	—	c	—	—	—	—	—	—	—	—	B–*H*	—	vr
152	Aclis ascaris, Turton, ..	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	vr
153	—— supranitida, S. Wood, ..	—	—	—	—	r	—	—	r	vr	—	—	—	—	—	—	—	M–*S*	—	r

154	Odostomia minima, Jeffreys,	..	—	—	—	—	f	—	—	—	—	—	—	—	—	—	—	—	M–*S*	—	—
155	—— albella, Lovén,	..	—	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
156	*—— rissoïdes, Hanley,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	—	r
157	—— pallida, Montagu,	..	r	r	—	—	f	—	—	vr	vr	—	r	—	—	—	—	—	B–*G*	f	—
158	—— conoïdea, Brocchi,	..	—	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
159	—— acuta, Jeffreys,	..	—	—	—	—	vr	—	—	—	vr	—	—	—	—	—	—	—	B & M–*S*	—	vr
160	—— unidentata, Montagu,	..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	f
161	—— plicata, Montagu,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	—	r
162	—— insculpta, Montagu,	..	—	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	r
163	—— indistincta, Montagu,	..	—	vr	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	B–*S*	—	r
164	—— interstincta, Montagu,	..	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*S*	—	f
165	—— lactea, Linn.,	..	vr	vr	—	vr	f	—	—	f	r	—	vr	r	—	—	—	—	B–*J*	—	c
166	—— pusilla, Philippi,	..	vr	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
167	—— acicula, Philippi,	..	—	r	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	vr
168	—— nitidissima, Montagu,	..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E–*P*	—	vr
169	Eulima bilineata, Alder,	..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*S*	vr	c
170	*Natica grœnlandica, Beck,	..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*J*	—	—
171	—— catena, Da Costa,	..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	c	—
172	—— alderi, Forbes,	..	vr	—	—	—	vr	—	—	c	—	—	—	—	—	—	—	—	B–*G*	c	—
173	Aporrhaïs pes-pelecani, Linn.,	..	—	vr	—	—	vr	—	—	vc	vr	—	—	—	—	—	—	—	B–*G*	c	—
174	Cerithium reticulatum, Da Costa,	..	vc	c	—	r	vc	—	—	vc	c	vc	vc	r	vc	vr	vc	—	B–*H*	vc	—
175	Purpura lapillus, Linn.,	..	f	vr	—	vr	r	—	—	r	—	vr	—	—	vr	—	—	—	B–*G*	vc	—

	Species.	Eglinton.	Limavady Junction.	Bann Mouth.	Larne Curran.	Magheramorne.	Kilroot.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.	Dundalk.	Original Record.	Present Distribution on N. E. Ireland Coasts. Living.	Dead.
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	A	B	C
176	Buccinum undatum, Linn., ..	vr	r	—	vr	c	—	—	vc	vr	—	vr	r	f	—	—	—	B–*H*	vc	—
177	Murex crinaceus, Linn., ..	vr	r	—	vr	f	—	—	r	—	—	—	f	—	—	vr	—	B–*G*	f	—
178	Fusus antiquus, Linn., ..	vr	vr	—	—	vr	—	—	r	—	—	vr	—	—	—	—	—	B–*G*	c	—
179	—— gracilis, Da Costa, ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	f	—
180	Nassa reticulata, Linn., ..	—	vr	—	vr	f	—	—	c	vr	—	—	r	r	—	vr	—	B–*G*	f	—
181	—— pygmæa, Lamarck, ..	r	c	—	vr	—	—	—	vc	f	vr	—	—	f	—	—	—	B–*S*	vr	—
182	*Defrancia gracilis, Montagu, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*S*	—	—
183	Pleurotoma attenuata, Montagu, ..	—	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
184	—— costata, Donovan, ..	—	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	f
185	—— brachystoma, Philippi, ..	—	—	—	—	—	—	—	vr	vr	—	—	—	—	—	—	—	B–*S*	—	vr
186	—— septangularis, Montagu, ..	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*J*	r	—
187	—— rufa, Montagu, ..	f	—	—	vr	—	—	—	—	—	—	vr	vr	—	—	—	—	B–*J*	r	—
188	*—— turricula, Montagu, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*G*	r	f
189	Cypræa europœa, Montagu, ..	—	—	—	—	vr	—	—	vr	vr	—	—	—	—	—	—	—	B–*G*	c	—
190	*Cylichna nitidula, Lovén, ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	B–*S*	—	vr

191	—— cylindracea, Pennant,	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	—	f
192	Utriculus mammillatus, Philippi,	c	c	—	r	—	—	—	vr	vr	—	—	—	f	vr	—	—	B–*P*	—	vr
193	—— truncatulus, Bruguière,	—	—	—	—	—	—	—	—	—	—	—	—	vr	—	—	—	D–*P*	—	f
194	—— obtusus, Montagu,	c	c	—	f	r	—	r	r	vr	f	—	r	—	—	—	—	M & Nt–*S*	—	f
195	—— —— *var.* Lajonkaireana,	—	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—	Lv–*P*	—	—
196	—— hyalinus, Turton,	—	—	—	—	f	—	—	vr	—	—	vr	—	—	—	—	—	B & M–*S*	—	r
197	Acera bullata, Müller,	r	f	r	r	f	—	—	c	r	—	f	—	r	—	—	—	B–*G*	c	—
198	—— —— *var.* nana,	—	—	—	—	f	—	—	—	—	—	—	—	f	—	—	—	M–*S*	—	—
199	Actæon tornatilis, Linn.,	—	—	—	—	vr	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	—	c
200	Scaphander lignarius, Linn.,	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*G*	c	—
201	Philine scabra, Müller,	—	—	—	—	—	—	—	vr	—	—	—	—	—	—	—	—	B–*P*	—	r
202	—— aperta, Linn.,	vr	r	—	—	r	—	—	c	f	—	—	—	vr	—	—	—	B–*G*	c	—
203	Melampus bidentatus, Montagu,	—	—	—	r	vr	—	—	vr	—	—	—	—	—	—	—	—	M–*S*	f	—
	Land and Freshwater Shells.																			
204	Zonites nitidulus, Draparnaud,	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	B–*G*	c	—
205	—— radiatulus, Alder,	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—
206	*—— crystallinus, Müller,	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	M–*B*	c	—
207	Helix nemoralis, Linn.,	—	—	—	—	—	—	—	r	—	—	—	—	—	—	—	—	B–*G*	c	—
208	—— rotundata, Müller,	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	B–*G*	c	—
209	—— pulchella, Müller,	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—
210	Bythinia tentaculata, Linn.,	—	—	f	—	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—
211	Hydrobia ventrosa, Montagu,	f	—	r	—	—	—	—	—	—	r	—	—	vr	—	—	—	—	vr	—
212	Linmæa palustris, Müller,	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	c	—

The following Table of the Foraminifera of the estuarine clays shows their distribution at a number of Stations, which Stations differ slightly from the Stations of the Mollusca list. This Table is the result of an examination of samples of clay obtained by the writer, specially undertaken by Mr. Joseph Wright, F.G.S., for the purposes of the present Report. An exception is the upper bed at Limavady Junction, which, having been exhaustively examined by Mr. Wright some years ago, was not re-examined, the list of Foraminifera then made being incorporated with that now prepared of the underlying beds at the same place, and entered in its proper column. In Wright's "Post-tertiary Foraminifera of the North-east of Ireland," previously referred to, no species are recorded which do not appear in the present Report, but additional Stations for some of the species will be found there:—

TABLE SHOWING THE DISTRIBUTION OF FORAMINIFERA IN THE ESTUARINE CLAYS OF THE NORTH-EAST OF IRELAND.

ABBREVIATIONS:—vr, very rare; r, rare; f, frequent; c, common; vc, very common.

SPECIES.		Limavady Junction.	Bann Mouth.	Larne—Pottery.	Larne—Railway Cutting.	Magheramorne.	Belfast—Broadway.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.
		2	3	4		5	6*a*	7	8	9	10	11	12	13	14	15
Nubecularia lucifuga, Defr.,	..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
Biloculina elongata, d'Orb.,	..	vr	—	—	—	vr	—	—	—	vr	—	—	vr	—	—	—
—— depressa, d'Orb.,	..	vr	vr	f	vr	—	—	—	vr	—	—	—	—	—	—	vr
Spiroloculina planulata, Lamk.,	..	vr	—	—	—	r	—	—	—	—	—	—	—	—	—	—
—— limbata, d'Orb.,	..	—	vr	—	—	f	—	—	—	—	—	—	—	—	—	—
—— canaliculata, d'Orb.,	..	—	—	—	vr	—	—	—	—	—	—	—	—	—	—	—
Miliolina trigonula, Lamk.,	..	r	—	r	r	c	vr	vr	—	vr	—	—	—	c	—	vr
—— tricarinata, d'Orb.,	..	c	vr	—	vr	f	—	—	—	—	—	—	—	—	—	—
—— oblonga, Mont.,	..	r	—	r	r	r	—	f	r	vr	—	vr	—	r	f	—
—— seminulum, Linn.,	..	c	f	f	c	c	f	r	f	f	vr	vc	—	f	f	r
—— auberiana, d'Orb.,	..	vr	—	r	f	f	vr	—	—	vr	vr	vr	—	f	r	—
—— sclerotica, Karrer,	..	f	vr	r	r	r	f	vr	f	vr	—	—	vr	r	—	—

Species.	Limavady Junction.	Bann Mouth.	Larne—Pottery.	Larne—Railway Cutting.	Magheramorne.	Belfast—Broadway.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.
	2	3	4	4	5	6*a*	7	8	9	10	11	12	13	14	15
Miliolina subrotunda, Mont., ..	c	f	f	f	c	c	r	f	r	—	c	r	c	r	r
—— seminuda, Rss., ..	—	—	—	r	c	—	—	—	vr	vr	r	—	f	—	—
—— ferussacii, d'Orb., ..	vr	—	—	vr	—	—	—	—	—	—	—	—	—	—	—
—— bicornis, W. & J., ..	vr	—	f	f	c	—	—	—	—	—	—	—	c	—	vr
—— fusca, Brady, ..	—	—	—	—	vr	—	—	—	vr	—	—	—	—	—	r
Sigmoilina secans, d'Orb., ..	—	—	r	—	vr	—	r	—	vr	—	vr	—	—	r	—
Cornuspira foliacea, Phil., ..	vr	—	—	—	—	—	—	—	—	—	—	—	vr	—	—
—— involvens, Rss., ..	c	r	vr	f	r	—	vr	f	vr	—	r	—	f	—	vr
Opthalmidium carinatum, B. & W.,	f	vr	—	vr	vr	—	—	—	—	—	—	—	—	—	—
Haplophragmium canariense, d'Orb.,	vr	—	—	—	vr	—	—	—	f	—	r	vr	r	—	—
Trochammina squamata, J. & P.,	vr	—	—	vr	—	—	—	vr	vr	—	—	—	—	—	—
—— inflata, Mont., ..	vr	—	—	vr	—	vr	vr	f	vr	vr	c	—	—	—	—
—— —— var. macrescens, Br., ..	vr	—	—	—	vr	—	—	vr	—	—	—	—	—	—	—
Textularia gramen, d'Orb., ..	—	r	f	r	—	—	—	—	vr	—	—	r	vr	—	r

Spiroplecta sagittula, Defr., ..	r	—	—	vr	—	—	—	—	—	—	—	—	—	—	—
Gaudryina filiformis, Berth., ..	—	—	—	—	vr	—	—	—	vr	—	—	—	vr	—	—
Verneuilina polystropha, Rss., ..	vr	—	—	—	r	—	—	—	f	—	—	—	c	—	—
Bulimina pupoides, d'Orb., ..	c	r	f	f	vr	—	vr	c	c	f	r	r	c	r	r
—— fusiformis, Will., ..	c	c	f	r	vr	—	vr	—	r	vr	—	—	f	r	—
—— marginata, d'Orb., ..	r	vr	r	r	r	—	vr	c	c	r	r	—	f	—	—
—— subteres, Br., ..	r	vr	vr	—	—	—	—	—	—	—	—	—	—	—	—
—— elegantissima, d'Orb., ..	c	r	f	r	—	—	—	c	r	r	f	—	f	r	—
Virgulina schreibersiana, Czjz., ..	f	r	vr	vr	vr	—	—	f	f	—	—	r	r	—	—
Bolivina punctata, d'Orb., ..	f	f	f	f	r	—	vr	f	r	vr	f	—	f	f	r
—— plicata, d'Orb., ..	f	r	f	r	c	r	—	f	r	vr	c	r	c	f	r
—— difformis, Will., ..	f	c	f	vr	—	—	—	r	vr	—	—	—	—	—	—
—— dilatata, Rss., ..	vr	—	—	—	vr	—	vr	—	vr	—	—	vr	r	r	—
—— lævigata, Will., ..	vc	r	—	—	—	—	—	—	vr	—	f	—	—	—	—
Cassidulina lævigata, d'Orb., ..	r	vr	—	—	—	—	—	—	—	—	vr	—	r	—	—
—— crassa, d'Orb., ..	c	f	f	vr	vr	—	—	—	—	—	—	—	vr	—	—
—— bradyi, Norman M.S., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lagena globosa, Mont., ..	r	—	—	—	vr	—	—	—	—	vr	—	—	—	—	—
—— lævis, Mont., ..	c	r	r	vr	r	vr	—	f	r	vr	f	—	r	f	r
—— —— *var.* clavata, d'Orb. ..	vr	vr	f	vr	f	—	—	f	r	—	r	—	f	r	r
—— gracillima, Seg., ..	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—— lineata, Will., ..	c	vr	vr	—	r	—	—	—	—	—	—	—	—	—	—

Species.	2 Limavady Junction.	3 Bann Mouth.	4 Larne—Pottery.	4 Larne—Railway Cutting.	5 Magheramorne.	6a Belfast—Broadway.	7 Belfast—Albert Bridge.	8 Belfast—Alexandra Dock.	9 Belfast—West Bank.	10 Holywood.	11 Newtownards.	12 Kircubbin.	13 Downpatrick.	14 Newcastle.	15 Greenore.
Lagena distoma, P. & J., ..	—	—	—	—	—	—	—	—	—	—	—	vr	—	—	—
— sulcata, W. & J., ..	r	r	r	vr	r	—	—	—	vr	vr	—	vr	r	r	—
— williamsoni, Alcock, ..	c	f	f	r	c	r	—	—	—	—	f	—	f	vr	—
— costata, Will., ..	r	—	vr	—	—	—	—	—	—	—	—	—	—	—	—
— striata, d'Orb., ..	c	r	—	vr	r	—	—	f	r	—	r	vr	r	r	—
— gracilis, Will., ..	r	—	—	—	—	—	—	vr	—	—	—	—	—	—	—
— semilineata, Wright, ..	vr	—	—	—	—	—	—	—	vr	—	—	—	—	—	—
— semistriata, Will., ..	r	vr	r	—	vr	—	—	r	vr	—	—	vr	r	—	—
Lagena aspera, Rss., ..	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— hispida, Rss., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
— striato-punctata, P. & J., ..	c	—	—	—	r	—	—	—	—	—	—	—	—	—	—
— squamosa, Mont., ..	c	r	f	vr	vr	—	—	—	vr	—	—	—	f	vr	vr
— hexagona, Will., ..	c	r	—	vr	f	—	vr	vr	vr	—	—	—	vr	vr	—
— lævigata, Rss., ..	—	—	r	vr	vr	—	—	vr	vr	vr	r	vr	r	r	—

—— —— *var.* lucida, Will., ..	c	r	f	r	vc	c	—	f	r	vr	vc	f	c	—	r
—— —— *var.* quadrata, Will., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—— marginata, W. & B., ..	c	f	—	vr	r	—	—	—	vr	—	—	—	vr	f	—
—— plano-convexa, Wright, ..	r	—	vr	—	—	—	—	—	—	—	—	—	—	—	—
—— lagenoides, Will., ..	c	r	vr	—	vr	—	—	—	—	—	—	—	—	—	—
—— bicarinata, Terq., ..	vr	vr	vr	—	—	—	—	—	—	—	—	—	vr	—	—
—— orbignyana, Seg., ..	c	c	f	r	r	—	vr	vr	vr	—	—	—	—	r	—
—— pulchella, Br., ..	vr	vr	—	—	—	—	—	—	—	—	—	—	—	—	—
Ramulina lævis, Jones, ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nodosaria pyrula, d'Orb., ..	r	vr	vr	vr	—	—	—	—	—	—	—	—	—	—	—
—— raphanus, Linn., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—— communis, d'Orb., ..	r	—	vr	vr	—	—	—	vr	—	—	—	—	vr	—	vr
—— radicula, Linn., ..	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—— scalaris, Batsch., ..	r	—	—	vr	—	—	—	vr	—	—	—	—	—	—	—
—— obliqua, Linn., ..	r	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
Lingulina carinata, d'Orb., ..	r	—	—	vr	vr	—	—	—	—	—	—	—	—	—	—
—— tenera, Born., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Vaginulina legumen, Linn., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Marginulina lituus, d'Orb., ..	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cristellaria crepidula, F. & M., ..	vr	vr	—	—	—	—	—	—	—	—	—	—	—	—	—
—— rotulata, Lamk., ..	vr	—	vr	vr	vr	—	—	vr	—	—	—	—	—	—	—
Polymorphina lactea, W. & J., ..	r	vr	r	vr	r	—	—	r	—	—	—	—	r	r	—

Species.	Limavady Junction.	Bann Mouth.	Larne—Pottery.	Larne—Railway Cutting.	Magheramorne.	Belfast—Broadway.	Belfast—Albert Bridge.	Belfast—Alexandra Dock.	Belfast—West Bank.	Holywood.	Newtownards.	Kircubbin.	Downpatrick.	Newcastle.	Greenore.
	2	3	4		5	6*a*	7	8	9	10	11	12	13	14	15
Polymorphina lactea, *var.* oblonga, W.,	r	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
—— gibba, d'Orb., ..	r	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—— compressa, d'Orb., ..	r	f	vr	vr	r	—	—	—	vr	—	—	r	r	c	—
—— rotundata, Born., ..	—	—	—	—	r	—	—	—	—	—	—	—	r	—	—
—— concava, Will., ..	r	—	—	vr	—	—	—	—	—	—	—	—	—	—	—
—— myristiformis, Will., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Uvigerina angulosa, Will., ..	r	r	vr	—	vr	—	—	r	vr	—	—	—	—	—	—
Globigerina bulloides, d'Orb., ..	f	f	f	r	vr	—	vr	—	vr	vr	—	—	r	—	—
—— inflata, d'Orb., ..	r	—	vr	vr	—	—	—	vr	—	—	—	—	—	—	—
Orbulina universa, d'Orb., ..	r	—	—	vr	—	—	—	—	—	—	—	—	—	—	—
Spirillina vivipara, Ehrn., ..	r	vr	—	vr	vr	—	—	—	vr	—	—	—	vr	—	—
Patellina corrugata, Will., ..	f	vr	f	f	vr	—	—	—	vr	—	vr	—	r	—	—
Discorbina rosacea, d'Orb., ..	r	—	f	—	—	—	—	—	—	—	—	—	—	—	—
—— globularis, d'Orb., ..	f	f	—	f	r	—	vr	f	r	—	vr	—	r	vr	r

Discorbina orbicularis, Terq., ..	—	—	f	r	vr	—	—	—	vr	—	—	—	vr	—	—
—— parisiensis, d'Orb., ..	r	—	—	r	vr	—	—	—	—	—	—	—	r	—	—
—— wrightii, Br., ..	vr	vr	vr	c	vr	—	—	—	vr	—	—	—	f	—	vr
—— bertheloti, d'Orb., ..	r	—	—	vr	—	—	—	—	—	—	—	—	—	—	—
—— nitida, Will., ..	c	r	r	r	r	—	—	—	—	—	—	—	r	—	—
Planorbulina mediterranensis, d'Orb.,	r	f	r	r	f	vr	—	f	vr	—	r	—	f	—	vr
Truncatulina refulgens, Mont., ..	—	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
—— lobatula, W. & J., ..	r	r	c	c	r	r	f	r	r	—	r	—	r	—	f
Tinoporus lævis, P. & J., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pulvinulina auricula, F. & M., ..	c	—	r	—	—	—	—	—	—	—	—	—	—	—	—
—— patagonica, d'Orb., ..	—	—	—	vr	—	—	—	—	—	vr	—	—	—	—	—
—— karsteni, Rss., ..	—	—	—	—	—	—	—	—	—	—	—	—	vr	—	—
Rotalia beccarii, Linn., ..	vc	vc	vc	c	c	c	c	c	vc	c	vc	c	vc	vc	vc
Gypsina inhærans, Schultze, ..	vr	—	vr	r	vr	—	—	—	—	—	—	—	—	—	—
Nonionina depressula, W. & J., ..	vc	vc	vc	vc	vc	c	vc	c	vc	vc	vc	c	vc	vc	vc
—— pauperata, Balkwill & Wright,	—	—	vr	—	—	—	—	—	—	—	—	—	—	—	—
—— turgida, Will., ..	c	vc	r	vr	vr	—	—	—	—	—	—	—	r	—	—
—— scapha, F. & M., ..	vr	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—— stelligera, d'Orb., ..	r	—	—	—	vr	—	—	—	—	—	—	—	—	—	—
Polystomella crispa, Linn., ..	c	r	c	vc	f	c	f	f	r	vr	f	c	c	vr	r
—— striato-punctata, F. & M., ..	vc	vc	vc	c	f	f	vc	c	vc	f	f	c	vc	vc	vc

XVIII.

ON A SHRINE LATELY FOUND IN LOUGH ERNE, NOW BELONGING TO THOMAS PLUNKETT, Esq, T.C., ENNISKILLEN. By REV. DENIS MURPHY, S.J.

[Read December 14, 1892.]

I beg leave to call the attention of the Academy to an important find lately made. In the late spring of this year, while some fishermen were plying their trade on Lough Erne one of them hooked a fish. The fish, to use a technical term that will be readily understood by disciples of Isaac Walton, if any are here, sulked, *i.e.* went to the bottom and remained there for some time. After a while, stirred by the gentle pressure of the hook, he began to move about, still on the bottom, and in his circumvolutions he somehow got the line entangled in what the fisherman thought was a stump. When he rose to the surface, the fisherman to his surprise found entangled in the line the shrine which you now see before you, and with a twofold motive for putting forward all his skill he succeeded in capturing his twofold prize. Mr. Plunkett, the Chairman of the Enniskillen Town Commissioners, hearing of the find, communicated immediately with the finder, and with the happy result to him, and I may add to the public—for Mr. Plunkett is well known to be a man who has the public interest deeply at heart, and devotes a great deal of his time to promote the welfare of his neighbours—he is now its happy possessor.

In his letter to me, stating that he had sent on the shrine for exhibition here this evening, Mr. Plunkett described the exact spot where it was found. There is a small bay on the western shore of Lower Lough Erne, about midway between Enniskillen and Belleek. On a projecting point close by, Mr. Plunkett says he found some remains of a stone structure, surrounded by a square fosse, one side of which runs along the top of the steep bank that bounds the shore of the lake. Tully Castle, built at the time of the Ulster Settlement, is quite near; possibly the stones of the abbey were used to build it. All tradition about the abbey, if such a building ever existed, has died out. The building would have been a small one, as the fosse encloses not more than twenty perches of ground.

To come to the shrine which is now exhibited—a visit to the Museum shows that these shrines vary in shape. Most of those in the collection are flat, being used to contain very possibly the writings or the Life of some saint, the founder of the church where the shrine was

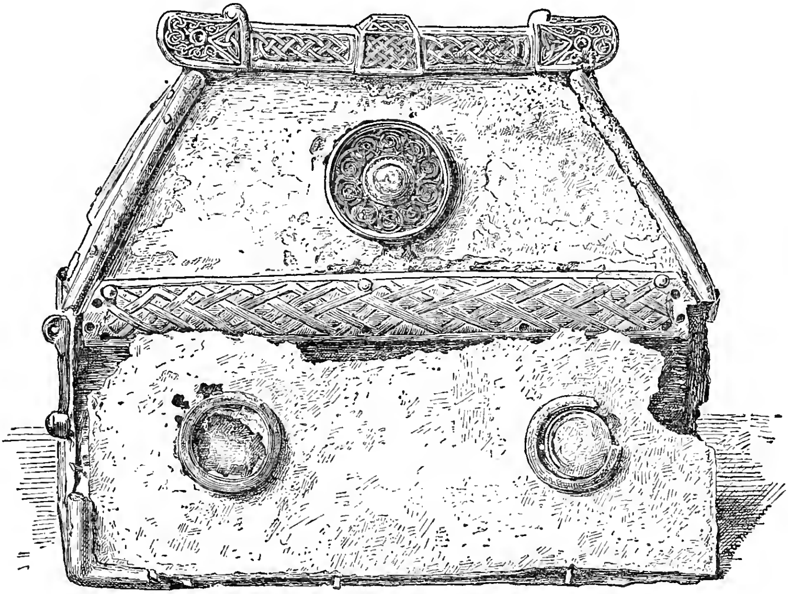


FIG. 1.—Reduced one-half.

kept; others are of the shape of a church, recalling somewhat the very ancient church of St. Benin, in the Island of Arran. A drawing closely resembling the outlines of this shrine will be found in the "Book of Kells." Miss Stokes gives it in vol. ii., p. 163, of her "Irish Inscriptions."

The measurement of the shrine (fig. 1) is—length 7 inches, width $3\frac{1}{3}$, height $5\frac{7}{8}$. It consists of two distinct parts, an inner shrine and an outer shell or double shell. The inner shrine is very simple; very possibly it is the more ancient part. The sides, roof, and the lower part of the two ends still remain. There seems to be no sign of ornament on any part of it, nor any opening to show that anything of the kind was ever attached to it. It has, however, at the end two ansæ, as the other one has, not unlike one portion of a hinge. The outer shrine has a lining of yew-wood in two distinct pieces, one in the upper part, another in the lower, each made of one solid piece scooped out roughly.

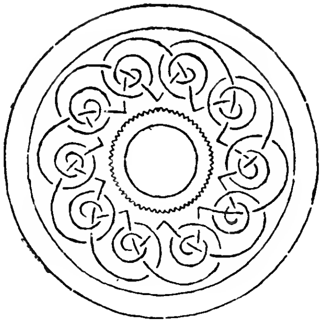


Fig. 2.

This wood serves as a support for the placques of metal forming the outer shell. The greater part of the exterior is plain and unorna-

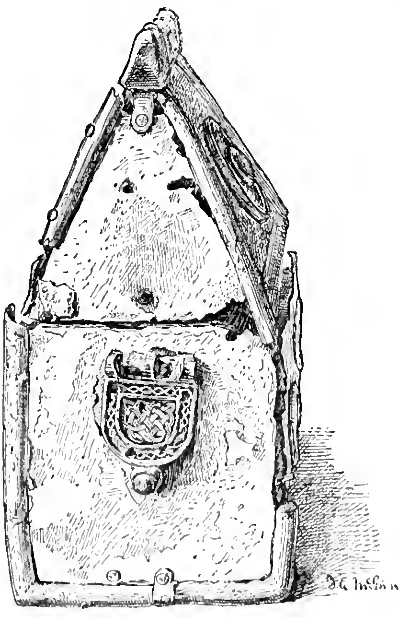


Fig. 3.—Reduced one-half.

mented; but clearly this was not its original state, for we have still remaining a highly ornamental boss (fig. 2), one of six very probably, seeing that on the corresponding part of the roof on the other side there is a hole through which such another boss would be fastened on. Then below on both sides we have evident remains of four other bosses, the circular traces still remaining of these bosses. The tracing running round the central knob is of the very highest type of Irish art, calling to mind the finest work of the "Book of Kells." Then there is another beautiful piece of work, the ansa; what its use was we shall see later on (fig. 3). On this we have two specimens of the *opus Hibernicum*, a larger pattern filling the central semicircle, and a smaller the edge round as a framework. On the top are three projections pierced through, somewhat like one part of a hinge, as on the inner shrine. Then there is a piece of metal, evidently meant to cover the joining of the side and roof. It has a pattern of a lozenge shape with interlacing lines. And lastly, there is the ridging, where we have several patterns of Irish work of a very finished and perfect type.

In connexion with this shrine, I would call your attention to another shrine very similar in shape and style of ornament to it, a description of which is given by Dr. Joseph Anderson, the Keeper of the Edinburgh Museum; it belongs to Sir Archibald Grant, of Moneymusk, and goes by the name of the Moneymusk Shrine. It is much smaller than that now exhibited, but its present state is far more complete. The side placques and the bosses are still remaining. Mr.

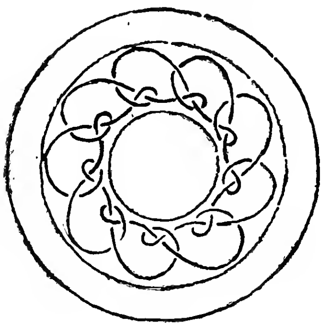


FIG. 4.

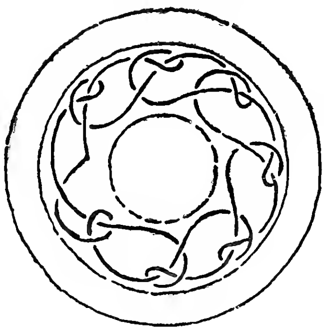


FIG. 5.

Longfield has kindly drawn for me, on an enlarged scale, the ornamental scrollwork on the boss of this shrine (fig. 4) and that on one of the bosses of the Moneymusk Shrine (fig. 5). These two figures will show at once how similar the shrines are, not merely in their general outline but in their ornamentation. In the Moneymusk Shrine we see the uses of the portion of the ansæ which still remains; a metal placque has its ends divided like the corresponding part of a hinge; a pin is passed through both; and from the ring at the top a cord of some kind would pass to a corresponding ring on the other end, by which it would be carried round the neck of the cleric or the lay custodian.

Mr. Longfield has called my attention to a shrine, described in Worsaae's "Catalogue of the Copenhagen Museum," very similar in shape to this which I now exhibit. It will be found at p. 110 of that work. The bosses are in the same positions. The roof is hipped, but, with this difference, that it is slightly curved. Where in our shrine there is a plate covering the joining of the sides and the roof, there are in the Copenhagen shrine two hinges, to allow it to be opened. The scroll-work both on the sides, roof, and bosses, shows distinctly that it is of Irish workmanship.

XIX.

ON A STONE WITH A GREEK INSCRIPTION (EARLY CHRISTIAN) FROM UPPER EGYPT. By CHARLES H. KEENE, M.A. (Plate XI.)

(COMMUNICATED BY REV. J. H. BERNARD.)

[Read February 8, 1892.]

The stone now exhibited (Plate XI.) I brought from Upper Egypt last spring. It was said to have been found at Erment, the ancient Hermonthis, a few miles above Luxor, and it was in the neighbourhood of that place I obtained it. The Rev. Maxwell Close has kindly examined the stone, and pronounces it to be chalk.

It is one foot nine inches long, eight inches high, and about three inches thick, with one side smoothed, so as to receive the inscription, and the other left in its rough state. It was evidently intended to close a niche in a columbarium similar to those still so common in Italian cemeteries.

The inscription, which I have not been able to find in any published collection, is as follows:—

ΠΡΙΝ CE ΛΕΓΕΙΝ Ω ΤΥΜΒΕ ΤΙC Η ΤΙΝΟC ΕΝΘΑΔΕ ΚΕΙΤΑΙ
Η CΤΗΛΗ ΒΟΑΑ ΠΑCΙ ΠΑΡΕΡΧΟΜΕΝΟΙC
CΩΜΑ ΜΕΝ ΕΝΘΑΔΕ ΚΕΙΤΑΙ ΑΕΙΜΝΗCΤΟΥ ΜΑΚΑ-ΡΕΙΗC
ΩC ΕΘΟC ΕΥCΕΒΕΩΝ ΓΕΥCΑΜΕΝΟΝ ΘΑΝΑΤΟΥ
ΑΥΤΗ Δ' ΟΥΡΑΝΙΗΝ ΑΓΙΩΝ ΠΟΛΙΝ ΑΜΦΙΠΟΛΕΥΕΙ
ΜΙCΘΟΝ ΕΧΟΥCΑ ΠΟΝΩΝ ΟΥΡΑΝΙΟΥC CΤΕ-ΦΑΝΟΥC

"Before thou canst say, O tomb, who or whose child lies here, the stele proclaims to all who pass, the body lies here of the ever-to-be-remembered Makareia, having tasted death, as is the wont of the pious, but she herself is a ministering spirit in the heavenly city of the saints, having a heavenly crown as a reward for her sufferings."

The phrase τίς ἢ τίνος, in the first line, occurs several times in the Anthology.

Αὐτή, "herself," in the fifth line, of course denotes the spirit, as distinguished from the body, and presents an interesting contrast to the Homeric point of view in the well-known passage at the beginning of the Iliad, where the same word denotes the body, as distinguished from the spirit.

The only word in the inscription that presents a difficulty is Μακαρείης. This we must suppose to stand, by poetic licence, for Μακαρίας, a variation the more natural, as ι and ει are often confounded by scribes, and, indeed, Cobet remarks that he never saw a MS. in which the confusion did not occur.

Μακαρία may be either an adjective or a proper name. The use of μακάριος in the same sense as μακαρίτης, *i.e.* the departed, in reference to the dead, is found in Plat. Legg. 947 D. If this be the sense here, however, the name of the deceased will not appear at all, and we cannot suppose it to have occurred in another part of the inscription, for the incised border by which it is surrounded shows that we have the entire epitaph.

It is best to suppose that Μακαρεί(ης)α stands for Μακαρία, a proper name. The name was borne by at least two martyrs mentioned in the martyrologies, and the festival of one of these was celebrated at Alexandria. It is hardly possible, however, to identify the lady referred to, though, doubtless, the reference to sufferings and a heavenly crown would be suitable on a martyr's tomb.

Below the inscription there is a remarkable combination of Greek and Egyptian symbols, for the monogram of Christus stands beside the *ankh*, or symbol of life, which, on Egyptian monuments, is so familiar as an emblem in the hands of gods and kings.

The familiar monogram of Christus occurs twice, the *ankh* once. There is a fourth symbol, which consists of a ρ with a transverse stroke across the stem, and which, at the first glance, might be supposed to be the unskilful attempt of a Greek stone-cutter to represent the Egyptian *ankh*. This view is to some extent favoured by the shape of the symbol and the symmetry of the design, for the archaically rounded head of the ρ is not unlike the loop of the *ankh*, and the position of the transverse line in both is identical; and as the monogram of Christus is twice repeated, once on the left extremity and once on the right, the design would be symmetrical if the Egyptian symbol of life were given twice in the centre. It seems pretty certain, however, that the symbol is what is known as the transverse monogram of Christus. This form of the monogram is somewhat later than the other. It is said to be for the most part used when it is desired to emphasize the mode of Christ's death on the Cross, and is therefore, as being the great Christian emblem, specially suitable in conjunction with the important religious symbol of Egypt, the *ankh*.

In attempting to assign a date to the inscription, we must take the form of the letters as the principal guide. From a comparison of the characters with the tables given by Gardthausen, in his Griechische Palaeographie, it appears that the letters in the inscription whose forms are sufficiently distinctive to furnish a criterion of date are α, β, γ, δ, ϵ, ι, λ, ρ, and perhaps ω. The forms of these letters correspond closely with the specimens given by Gardthausen from the Sinaitic MS., and we would thus be led to fix the date of the inscription in the fourth or fifth century A.D., though, of course, it is possible that the old forms of the letters were preserved longer in inscriptions than in MSS. This resemblance is very striking in the α, consisting of an acute-angled triangle applied to the middle of the lower or left-hand side of a line sloping upwards from right to left; in the β, with the upper loop considerably smaller than the lower; in the δ, the right-hand line of which is continued beyond the apex of the triangle, and in the λ, which has more resemblance to the ordinary small λ than to the usual uncial form. The ι is in several cases, though not in all, prolonged so as to rise above and descend below the line, thus corresponding with one of the forms of that letter in the Sinaitic MS. The resemblance in the form of the ρ is also very remarkable, and the ω has the same high centre stroke and inward curving sides that are found in the MS. The μ, though it does not depart widely from the Sinaitic type, is nearer to a form quoted by Gardthausen as belonging to the seventh century. It may, however, be referred to the sixth century, as it appears to be the regular form in Codex Z, in Trinity College Library, and in the Cyril Papyrus recently deciphered by Professor Bernard, both of which belong to that century.

Of the π, we find two distinct forms in the inscription. The older, which resembles the π of the Codex Sinaiticus, in the absence of projecting extremities to the transverse stroke, occurs only at the commencement of the first word, and is perhaps used much as we would use a capital at the beginning. The other form has projecting extremities to the horizontal stroke, as is the case in the Codex Alexandrinus, belonging to the fifth century.

The α, β, γ, δ, and κ correspond closely to those on the Rosetta stone (196 B.C.), and the inscription, as a whole, resembles that stone in the words not being divided from one another, in the absence of breathings, accents, and marks of punctuation, and in the square shape of the letters, which are as broad as they are high.

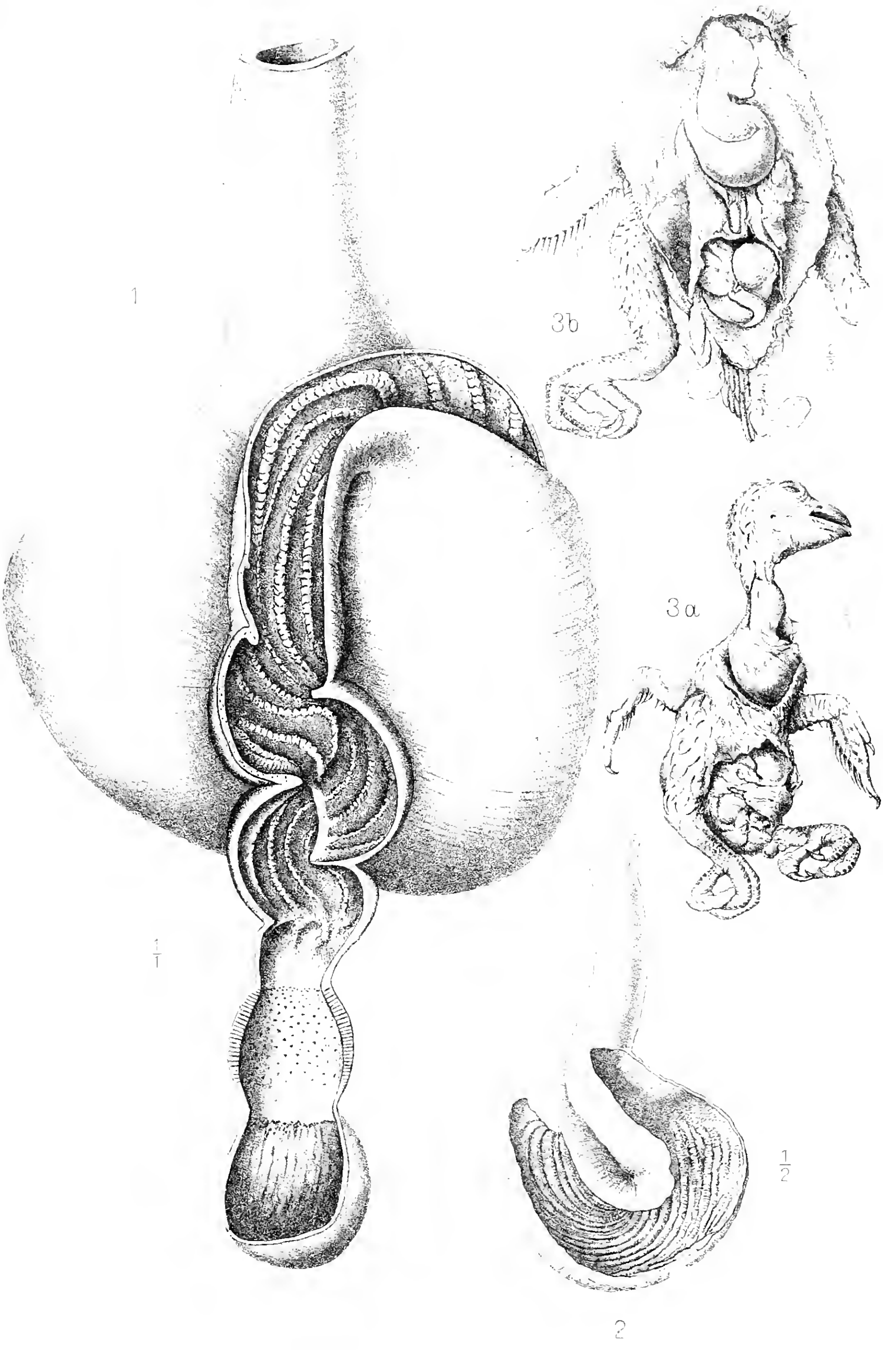
The only diacritic sign in the inscription is an apostrophe, to mark the elision of the ε of δὲ in the fifth line.

The letter τ, which in the Codex Sinaiticus has the horizontal line strengthened on the left side by a point or small knob, in the inscription agrees with the Rosetta stone, and is found in the oldest form, consisting of two straight lines of like thickness, the horizontal being bisected by the lower and vertical one.

It may be remarked, that the shapes of the α and μ are distinctively characteristic of Egyptian writing, being known as the Coptic α and μ.

On the whole, the form of the letters would seem to place the date of the inscription between the fourth and sixth centuries A.D.

The name Μακαρία may possibly point to the same period. As has been said above, it is hardly possible to identify the woman referred to under that name, but it is perhaps not unreasonable to conjecture that Μακαρία may have been a favourite name among female believers, owing to the fame of several Christians who, in the early centuries, bore the name of Macarius. It will suffice to mention two of these—Macarius Ægyptius, commonly called the Great, who lived in Scete, or Scetis, a part of the great Libyan desert, and Macarius of Alexandria, called πολιτικός, who was a victim of the persecution of Valens. Both of these men, who died at the ages of 90 and 100 years respectively, lived between 300 and 400 A.D.



OPISTHOCOMUS CRISTATUS

H.G. del

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4–8 OPISTHOCOMUS. 9 MELEAGRIS. 10. GOURA.

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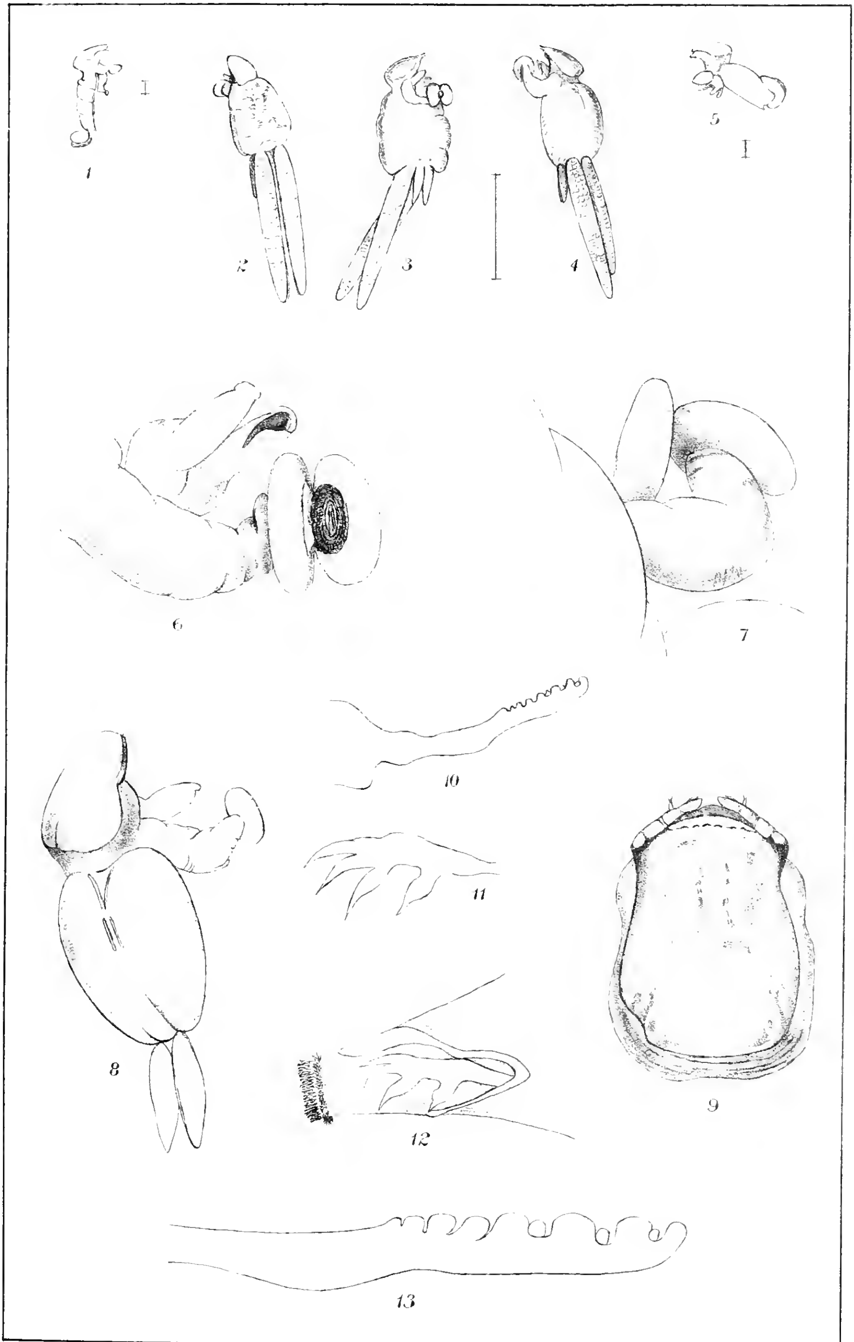

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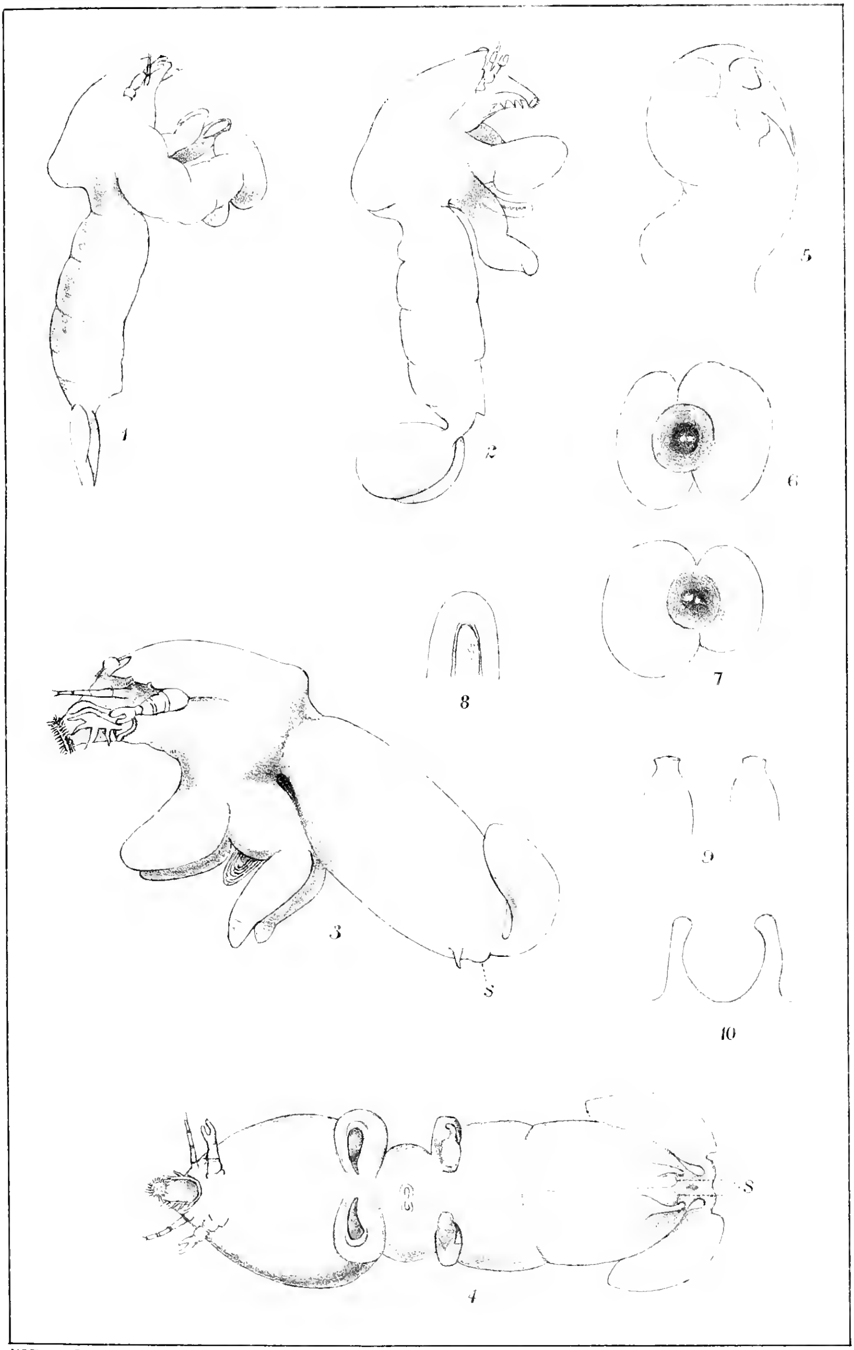

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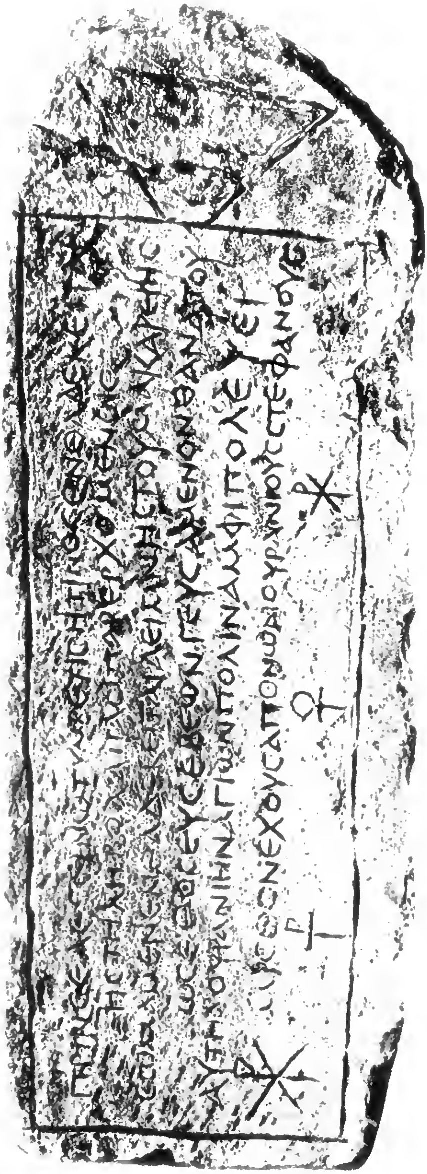

XX.

THE ABSORPTION OF HEAT IN THE SOLAR ATMOSPHERE.

By W. E. WILSON, M.R.I.A., and A. A. RAMBAUT, M.A., D.Sc.

[Read May 9, 1892.]

One of the most interesting questions in Solar Physics which awaits solution is—Does the quantity of heat received by the earth from the sun vary from year to year, or is it a constant? Assuming that the internal temperature of the sun remains constant, there are yet two factors, variations in which would cause the amount of solar heat received by the earth to vary. These are—the absorption of heat in the solar atmosphere, and the absorption in the earth's atmosphere. It is with the first of these that we propose to deal in this Paper. From the accompanying diagram (fig. 1) it will be seen that the amount of absorption at the edge of the disc of the sun must be much larger than at the centre. This fact has long been known as a matter of observation. Professor Henry of Princeton, in 1845, was the first to discover this, and it has since been confirmed by Secchi, Langley, and many others.

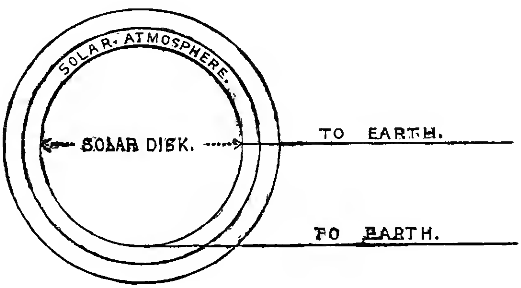

Fig. 1.

These observers all make the amount of heat coming from a point on the edge of the disc about half that coming from the centre. It is also an interesting subject of inquiry, how much of the sun's total heat is absorbed by his atmosphere. Laplace, making certain assumptions, found that the sun would be 12 times as bright if he was stripped of his atmosphere. Pickering, taking other data, says that the sun without his atmosphere would be $4\frac{2}{3}$ times as bright as it is. Langley and some others have investigated this difficult problem, and whatever the true amount may be, one thing is quite certain that the sun's radiation is stopped to a considerable extent by his atmosphere. If the solar atmosphere varies in depth it is plain from the diagram that the ratio of the absorptions at the centre and edge of the disc will vary, and if accurate measures were taken from time to time of these quantities, we could determine whether the depth of the solar atmosphere was constant or variable. It is with reference to the solution of this problem that we bring the following researches to your notice.

In 1884 Mr. Wilson had an apparatus made to carry out some experiments in this direction. It consisted of two small thermo-piles which were coupled up in such a way that as long as the corresponding faces of both continued at the same temperature the galvanometer remained at zero. At first, both piles were placed on the edge of the solar image formed by a large Cassagrain reflecting telescope. When the galvanometer was steady at zero one of the piles was moved into the centre of the disc. The deflection of the galvanometer was noted. The experiment was then repeated again and again, each time reversing the order of the piles. These experiments gave 0·52 as the heat from the limb, that from the centre being 1·00. Mr. Wilson soon came to the conclusion that some more accurate means would have to be devised before any final result could be reached. In 1888 Professor C. V. Boys invented his radio-micrometer. It is an instrument of extraordinary sensibility to radiant heat, and it occurred to Mr. Wilson that it would be an excellent instrument to use in these researches. In the first place it is so sensitive that we can use an enormously large image of the sun and still get plenty of heat to affect the instrument, and secondly it is very prompt and dead beat in its motion. The sensitive surface on which the heat is allowed to fall is only about 2 m.m. square, so that a very small portion of the solar surface can be examined at one time. Using an image of the sun of 80 c.m. in diameter, the instrument only covers the $\frac{1}{500000}$th part of the entire disc.

In 1888 Mr. Wilson fitted up a heliostat with silvered mirrors which reflected a small beam of sunlight into a dark room. It was received by a concave mirror of 10 feet focus, and a small convex mirror was placed inside of the focus: this formed a fine image of the sun 80 c.m. in diameter. In the plane of this image the radio-micrometer was set on a heavy slate shelf. A slice of limelight was allowed to fall on the mirror of the instrument and reflected from that to a scale. The relative position of the various parts of the apparatus is shown in fig. 2.

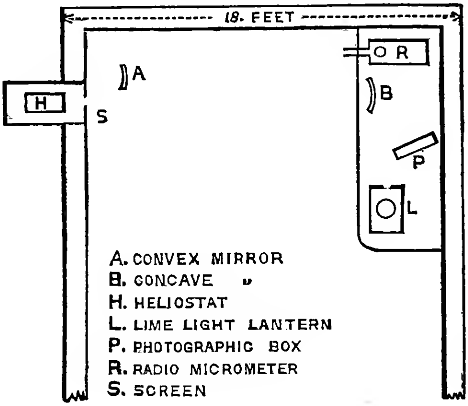

FIG. 2.

At first readings were taken with the edge of the sun and centre alternately on the instrument. On account of the very rapid fall in heat near the edge, this plan was not found to give satisfactory results; and at present the best results are got by allowing the image of the sun to transit across the instrument, and by recording the motion of the spot of limelight by means of a falling photographic plate.[1]

It became evident, from the first photographic curve obtained, that to translate its meaning, corrections would have to be applied for some disturbing causes, such as the damping effect of the air, and the variation in intensity of the source of heat to which the instrument was exposed. Dr. Rambaut has investigated these matters, and below will be found an exposition of the methods he has adopted to surmount the difficulties. What we now propose to do is to take frequent curves of absorption from time to time throughout a sun-spot cycle of 11 years, and thus try to solve the problem—Whether the sun's atmosphere varies in depth in that time. From a comparison of the photographs taken of it in maximum and minimum years, it would appear that the sun's corona varies in form, and also that the spots alter their characters in the same period. Is it not probable that changes are also taking place in the solar atmosphere? If we find that such changes are taking place, as will be shown by the alteration in the ratio of the heat from the limb

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[1] See British Assoc. Report, Cardiff, 1891; Trans. of Section A.

and centre of the disc, we think it will be quite possible, by an investigation of the co-ordinates of these curves, to determine the change in the value of the solar constant.

Examination of the Curves.

From the nature of the instrument it is clear that the only forces acting on the system are the directive force of the magnet, the force of torsion, and the resistance of the surrounding medium. If we denote the angle of torsion by ϕ, and the difference in temperature between the two ends of the couple by Θ, we obtain the following differential equation representing the motion:—

$$\frac{d^2\phi}{dt^2} + 2a\frac{d\phi}{dt} + b^2\phi = c\Theta, \qquad (1)$$

in which $2a\frac{d\phi}{dt}$ is the resistance of the medium, $b^2\phi$ the torsion, and $c\Theta$ the directive force of the magnet.

Also, if K denotes the intensity of the heat falling on the heated end of the couple, we have the equation

$$\frac{d\Theta}{dt} = kK - l\Theta. \qquad (2)$$

For the following method of obtaining this euqation we are indebted to Professor G. F. Fitzgerald:—

If we suppose θ_1 and θ_2 to be the elevation of temperature of the two ends of the couple above that of the surrounding medium, and if we suppose the couple divided into a number of segments ds, taking into account the resistance of the couple, a Peltier absorption of heat at the hotter, and emission of heat at the colder end, and a Thomson effect at other parts of the wire, we have, for any segment after the first, an equation of the form

$$d\theta = TC + c\frac{d\theta}{ds} - \rho\theta + rC^2,$$

in which TC is the Thomson effect, $c\frac{d\theta}{ds}$ the conduction, $\rho\theta$ the radiation, and rC^2 the heating by resistance. At the ends themselves we have a Peltier, instead of a Thomson, effect; and for the heated end the equation becomes

$$\frac{d\theta_1}{dt} = kK - P_1 C + c\,\frac{d\theta_1}{ds} - \rho\theta_1 + rC^2,$$

and for the other end

$$\frac{d\theta_2}{dt} = kK + P_2 C - c\,\frac{d\theta_2}{ds} - \rho\theta_2 + rC^2,$$

in which $P_1 C$ and $P_2 C$ represent the Peltier effects at the two ends of the couple.

We thus obtain

$$\frac{d\theta_1}{dt} - \frac{d\theta_2}{dt} = kK - (P_1 + P_2)\,C + c\left(\frac{d\theta_1}{ds} + \frac{d\theta_2}{ds}\right) - \rho\,(\theta_1 - \theta_2).$$

We may also assume that the terms $\frac{d\theta_1}{ds}$ and $\frac{d\theta_2}{ds}$ are each to a first approximation proportional to the difference of temperature, so that we obtain

$$\frac{d\Theta}{dt} = kK - l\Theta - (P_1 + P_2)\,C.$$

The last term here is so small that in an investigation like the present we may neglect it so that we reach the result given in equation (2).

If now we eliminate Θ between equations (1) and (2) we obtain the following linear differential equation of the third order

$$\frac{d^3\phi}{dt^3} + (2a + l)\frac{d^2\phi}{dt^2} + (b^2 + 2al)\frac{d\phi}{dt} + b^2 l\phi = ckK. \qquad (3)$$

In the method of observation described above the intensity K is a function of the time, so that we obtain the equation

$$\frac{d^3\phi}{dt^3} + (2a + l)\frac{d^2\phi}{dt^2} + (b^2 + 2al)\frac{d\phi}{dt} + b^2 l\phi = f(t). \qquad (4)$$

Denoting the roots of the equation $x^2 + 2ax + b^2 = 0$ by $-m$ and $-n$, and remarking that

$$e^{-xt}\int e^{xt} f(t)\,dt = \frac{f(t)}{x} - \frac{f'(t)}{x^2} + \frac{f''(t)}{x^3}\ \&c.,$$

we obtain the solution of equation (4) in the form

$$\phi = Ae^{-lt} + Be^{-mt} + Ce^{-nt} - \frac{1}{(m-n)(n-l)(l-m)}\left[f(t)\left\{\frac{m-n}{l} + \frac{n-l}{m} + \frac{l-m}{n}\right\}\right.$$
$$\left. - f'(t)\left\{\frac{m-n}{l^2} + \frac{n-l}{m^2} + \frac{l-m}{n^2}\right\} + f''(t)\left\{\frac{m-n}{l^3} + \frac{n-l}{m^3} + \frac{l-m}{n^3}\right\} - \&c.\right] \qquad (5)$$

The general term of this series may be written in the form

$$\frac{(-1)^r}{(m-n)(n-l)(l-m)} \times f^{(r-1)}(t) \times \begin{vmatrix} \frac{1}{l^r}, & \frac{1}{m^r}, & \frac{1}{n^r}, \\ l, & m, & n, \\ 1, & 1, & 1, \end{vmatrix},$$

which, being a symmetric function of the roots, can be expressed in terms of the coefficients of the equation. Hence, when the form of $f(t)$ is given, the motion of the couple is determined, and by means of this equation any assumption with regard to the law of variation of the sun's heat from point to point of its disc might be tested.

The question before us at present is, however, the inverse of this, namely, from the curve which represents this equation to determine the corresponding values of $f(t)$.

Now, it is obvious from equation (4) that if we can obtain the values of the constants a, b, and l, and the quantities

$$\frac{d^3\phi}{dt^3}, \quad \frac{d^2\phi}{dt^2}, \quad \frac{d\phi}{dt}, \text{ and } \phi$$

at any point along the curve, we can compute the corresponding value of $f(t)$.

In order to determine the constants, we have proceeded in the following manner:—If the couple be mechanically displaced from a position of equilibrium, its motion is represented by the equation

$$\frac{d^2\phi}{dt^2} + 2a\frac{d\phi}{dt} + b^2\phi = 0.$$

The solution of this equation gives us as the equation of the curve traced by the spot of light

$$\phi = Ae^{-mt} + Be^{-nt}, \qquad \text{if } a^2 \text{ is greater than } b^2;$$

or,

$$\phi = Ae^{-at}\cos(\delta t - \epsilon), \text{ if } a^2 \text{ is less than } b^2,$$

in which

$$\delta = \sqrt{b^2 - a^2}.$$

The first of these gives a continuously increasing value of ϕ—this ordinate only reaching its maximum value after an infinite time. The second equation gives a curve proceeding by a series of continually diminishing waves to the final position of equilibrium. From the form of the curve in fig. 5, which is a reduced copy of a photograph taken on 12th October, 1890, it is easily seen that it is an equation of the second form with which we have to deal in the case before us. In this case the period in which the oscillation takes place will give the value of $\frac{2\pi}{\delta}$, while the logarithmic decrement of the ordinates will give the value of $\frac{a\pi}{\delta}$. We shall thus be in a position to determine both a and δ from which we can immediately deduce the value of b.

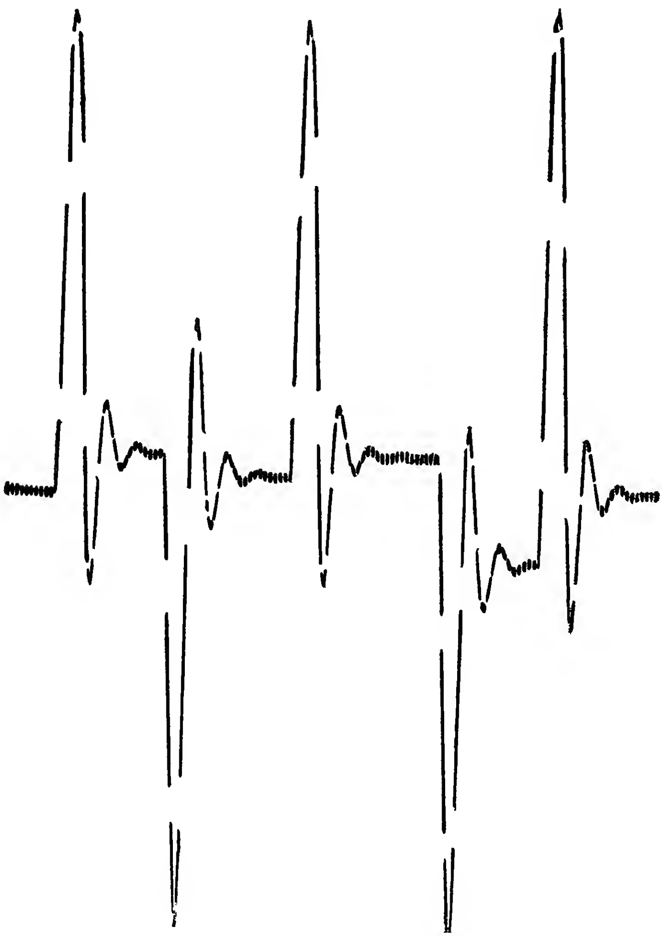

FIG. 3.

For this purpose the series of curves shown in fig. 3 were obtained by Mr. Wilson in the following manner:—To the head from which the fibre is suspended he attached a light arm movable between two stops through an angle of about 5°. When the instrument was in equilibrium he then moved the arm rapidly up to one of the stops and back, thus giving the couple an impulse, in consequence of which it continued to oscillate for some twenty seconds or so, while the spot of light traced out the left-hand curve in fig. 3. When equilibrium had been restored he moved the arm in a similar manner up to the other stop and set the couple swinging in the opposite direction, and thus obtained the second curve in the same figure. In this way, by giving alternately right-handed and left-handed impulses to the couple, the five curves in fig. 3 were obtained, from which it is possible to derive the constants a and b.

Now, if ϕ_1 and ϕ_3 are the first two maximum values of the ordinate, and ϕ_2 the first minimum value during the free motion of the couple after an impulse has been imparted to it as above described, and if $\bar{\phi}$ is the final value of ϕ when the position of equilibrium has been attained (which will be of the nature of an index correction to the readings of ϕ), we have clearly

$$\phi_1 = \quad A \cos \epsilon \qquad + \bar{\phi},$$

$$\phi_2 = - A \cos \epsilon \,.\, e^{-\frac{a\pi}{\delta}} + \bar{\phi},$$

$$\phi_3 = \quad A \cos \epsilon \,.\, e^{-\frac{2a\pi}{\delta}} + \bar{\phi};$$

whence

$$\phi_1 - \phi_2 = A \cos \epsilon \left(1 + e^{-\frac{a\pi}{\delta}}\right),$$

and

$$\phi_2 - \phi_3 = - A \cos \epsilon \,.\, e^{-\frac{a\pi}{\delta}} \left(1 + e^{-\frac{a\pi}{\delta}}\right);$$

therefore

$$\frac{\phi_3 - \phi_2}{\phi_1 - \phi_2} = e^{-\frac{a\pi}{\delta}}.$$

Reading the five curves in fig. 3,[1] we obtain the following values of ϕ_1, ϕ_2, and ϕ_3, expressed in millimetres :—

	Curve 1.	Curve 2.	Curve 3.	Curve 4.	Curve 5.
ϕ_1	− 33·1 m.m.	+ 41·0 m.m.	− 33·0 m.m.	− 11·5 m.m.	− 38·4m.m.
ϕ_2	+ 12·8	− 12·5	+ 12·0	− 33·9	+ 9·1
ϕ_3	− 3·6	+ 5·9	− 4·1	+ 18·2	− 8·1
Resulting value of $e^{-\frac{a\pi}{\delta}}$	0·357	0·344	0·358	0·346	0·362

The mean of these five determinations gives us 0·3534 as the value of $e^{-\frac{a\pi}{\delta}}$.

We have also determined half the period of a free oscillation from each of the five curves separately with the following results :—

Curve 1,	3^s·200
,, 2,	3 ·200
,, 3,	3 ·166
,, 4,	3 ·166
,, 5,	3 ·233
Mean,	3 ·193

We have thus obtained, from these five curves representing the free motion of the system, the following values :—

$$\left.\begin{aligned} \frac{\pi}{\delta} &= 3^s{\cdot}193 \\ \text{and } e^{-\frac{a\pi}{\delta}} &= 0\cdot3534 \end{aligned}\right\}.$$

In order to determine the value of the quantity $e^{-\frac{l\pi}{\delta}}$, the instrument was suddenly exposed to the radiation from a Leslie's cube filled with boiling water until it came to rest, and then the heat was as suddenly cut off, the instant at which the exposure began and ended being indicated by a flash of light which traced a line on the falling plate. The result of this procedure is shown in fig. 4.

[1] The curves in figures 3, 4, 5, and 7 are reduced copies of the original photographs.

Now, equation (5) shows that when the instrument is exposed to

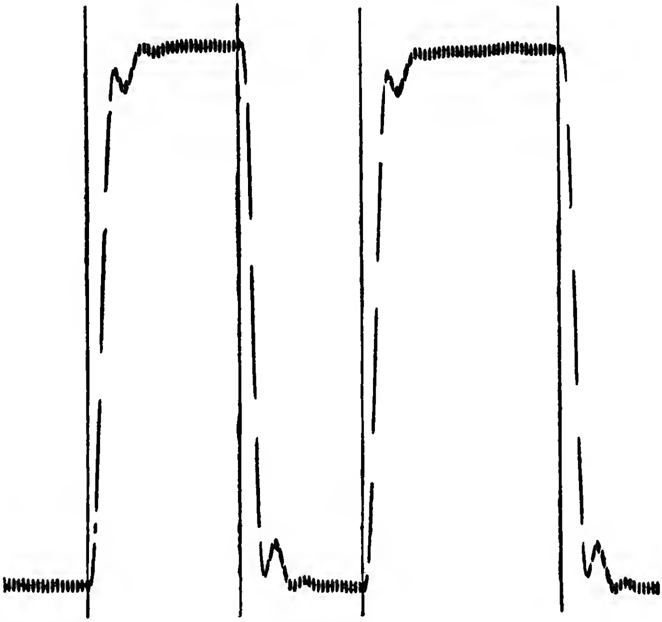

Fig. 4.

a constant source of heat the motion is represented by the equation

$$\phi = Ae^{-at}\cos(\delta t - \epsilon) + Ce^{-lt} + K.$$

When $t = \infty$, or when thermal equilibrium has been established, if $\overline{\phi}$ represent the final value of the ordinate, $\overline{\phi} = K$.

Hence if ϕ_0, ϕ_1, ϕ_2, &c., denote the values of the ordinates at the epochs $0, \frac{\pi}{\delta}, \frac{2\pi}{\delta}$, &c., we shall have

$$\phi_0 - \overline{\phi} = A\cos\epsilon + C = \psi_0, \text{ say;}$$

$$\phi_1 - \overline{\phi} = -A\cos\epsilon \,.\, e^{-\frac{a\pi}{\delta}} + C \,.\, e^{-\frac{l\pi}{\delta}} = \psi_1, \quad ,,$$

$$\phi_2 - \overline{\phi} = A\cos\epsilon \,.\, e^{-\frac{2a\pi}{\delta}} + C \,.\, e^{-\frac{2l\pi}{\delta}} = \psi_2, \quad ,,$$

$$\phi_3 - \overline{\phi} = -A\cos\epsilon \,.\, e^{-\frac{3a\pi}{\delta}} + C \,.\, e^{-\frac{3l\pi}{\delta}} = \psi_3, \quad ,,$$

$$\phi_4 - \overline{\phi} = A\cos\epsilon \,.\, e^{-\frac{4a\pi}{\delta}} + C \,.\, e^{-\frac{4l\pi}{\delta}} = \psi_4, \text{ \&c.}$$

Also, for the motion, when the heat is cut off we shall have an exactly similar series of equations, except that $\overline{\phi}$ will represent the final or zero reading of the ordinate.

In the case before us the values of ψ_4 are so small, in consequence of the rapid damping down of the oscillations, that we had better restrict ourselves to the first four of these equations. If we denote

$$e^{-\frac{a\pi}{\delta}} \text{ by } x, \text{ and } e^{-\frac{l\pi}{\delta}} \text{ by } y,$$

and if we eliminate $A \cos \epsilon$ and C, we obtain from each of the curves the two equations

$$x - y = \frac{\psi_1\psi_2 - \psi_0\psi_3}{\psi_0\psi_2 - \psi_1^2}$$

and

$$xy = \frac{\psi_2^2 - \psi_1\psi_3}{\psi_0\psi_2 - \psi_1^2}.$$

From the four curves in fig. 4 we find the following values of ψ_0, ψ_1, &c., with the resulting values of $x - y$ and xy :—

	ψ_0 m.m.	ψ_1 m.m.	ψ_2 m.m.	ψ_3 m.m.	$x - y$	xy
Curve 1, . .	142·6	55·4	8·8	5·5	0·1636	0·1252
,, 2, . .	142·4	65·4	5·6	6·4	0·1566	0·1113
,, 3, . .	142·0	54·1	8·5	5·7	0·2032	0·1373
,, 4, . .	142·4	68·0	5·8	6·7	0·1474	0·1111

The resulting values of x and y from each of the four curves are, accordingly,

	x	y
Curve 1, ...	0·4449	0·2813
,, 2, ...	·4210	·2644
,, 3, ...	·4858	·2826
,, 4, ...	·4151	·2677
Mean, ...	0·4417	0·2740

These figures seem to show two things :—Firstly, that the damping effect is less when the instrument is heated than when cold, since the value of x just found is greater than that found from the curves of free oscillation.

Secondly, it may be noticed that the values of both x and y are greater as derived from the 1st and 3rd curves than those deduced from the other two curves. The materials are, however, hardly sufficient to decide, whether this represents a real difference depending on the direction of the motion or is merely an accidental discrepancy.

We have thus the following results, taking for $e^{-\frac{a\pi}{\delta}}$ the value found from the heat curves (the system being then in circumstances more closely analogous to those which take place during a transit of the sun than when cold):—

$$\frac{\pi}{\delta} = 3^{s}\cdot193, \qquad e^{-\frac{a\pi}{\delta}} = 0^{s}\cdot4417, \qquad e^{-\frac{l\pi}{\delta}} = 0^{s}\cdot2740.$$

From these we find

$$\delta = 0\cdot9838 \text{ or } 56^{\circ}\cdot37, \qquad a = 0\cdot2558, \qquad l = 0\cdot4054;$$

whence $b^2 = 1\cdot0333$.

We thus find the coefficients of the differential equation on p. 303:—

$$2a + l = 0\cdot9170, \qquad 2al + b^2 = 1\cdot2407, \qquad b^2l = 0\cdot4189.$$

Whence $$\frac{d^3\phi}{dt^3} + 0\cdot9170\frac{d^2\phi}{dt^2} + 1\cdot2407\frac{d\phi}{dt} + 0\cdot4189\phi = f(t).$$

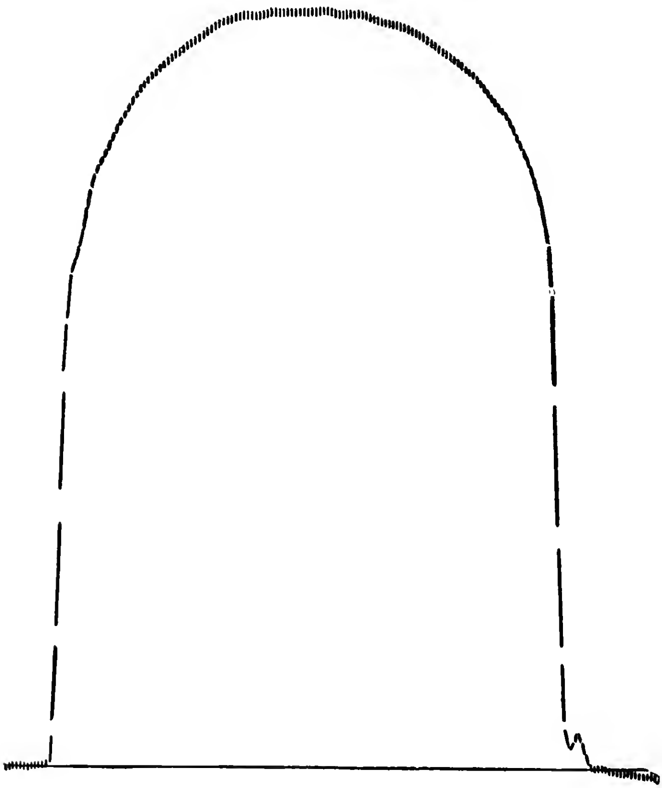

Fig. 5.

If the curve were a smooth curve without points of inflexion, it would be easy to compute the values of the differential coefficients from the differences of the readings of ϕ by means of the usual equation

$$\left(\frac{d}{dt}\right)^n = \{\log(1 + \Delta)\}^n.$$

Before applying this formula, however, it will be necessary to smooth the curve by removing the periodic part in the value of ϕ. The periodic terms are all contained in the expression $Ae^{-at}\cos(\delta t - \epsilon)$, and since this value for ϕ is a solution of the equation

$$\frac{d^3\phi}{dt^3} + (2a + l)\frac{d^2\phi}{dt^2} + (2al + b^2)\frac{d\phi}{dt} + b^2 l\phi = 0,$$

it is clear that the resulting curve is still a solution of the differential equation (4).

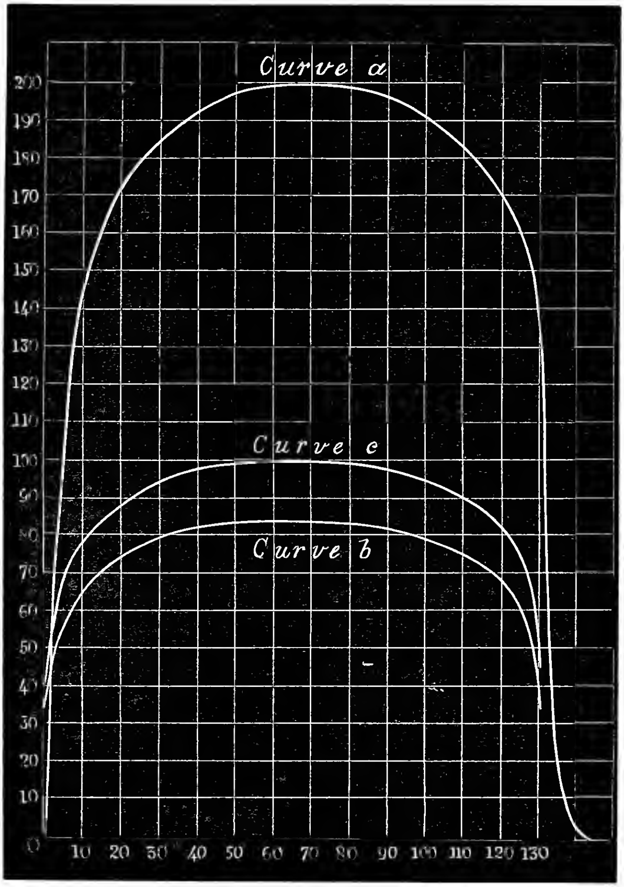

FIG. 6.

Curve *a* in fig. 6 represents the curve when the periodic terms have been removed. This has been done in a graphical manner, first with the eye, and then the curve was still further smoothed down by adjusting the differences in the way described by Sir John Herschel in the Memoirs of the Royal Astronomical Society, vol. v.

We thus obtain the following readings corresponding to each second of time from the beginning of the transit. The values of the successive differential coefficients have also been computed by means of the formula given above, which, when expanded, become

$$\frac{d\phi}{dt} = \Delta\phi - \tfrac{1}{2}\Delta^2\phi - \tfrac{1}{3}\Delta^3\phi - \tfrac{1}{4}\Delta^4\phi - \ldots$$

$$\frac{d^2\phi}{dt^2} = \Delta^2\phi - \Delta^3\phi - \tfrac{11}{12}\Delta^4\phi - \ldots$$

and

$$\frac{d^3\phi}{dt^3} = \Delta^3\phi - \tfrac{3}{2}\Delta^4\phi - \ldots$$

VALUES of ϕ, $\frac{d\phi}{dt}$, $\frac{d^2\phi}{dt^2}$, and $\frac{d^3\phi}{dt^3}$ from fig. 6.

t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.	t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.
s.	m.m.				s.	m.m.			
0	0·0	+ 31·8	− 6·5	+ 1·5	16	163·5	+ 2·1	− 0·1	—
1	28·8	26·0	5·1	1·1	17	165·5	1·9	—	—
2	52·5	21·5	3·8	0·7	18	167·4	1·8	—	—
3	72·2	18·0	3·2	0·5	19	169·2	1·7	—	—
4	88·7	15·1	2·6	0·3	20	170·9	1·6	—	—
5	102·5	12·6	2·2	0·2	21	172·5	1·6	—	—
6	114·0	10·4	1·8	0·1	22	174·1	1·6	—	—
7	123·5	8·3	1·2	—	23	175·7	1·6	—	—
8	131·2	7·0	1·0	—	24	177·3	1·5	—	—
9	137·7	5·9	0·8	—	25	178·8	1·5	—	—
10	143·2	5·0	0·7	—	26	180·3	1·2	—	—
11	147·9	4·3	0·5	—	27	181·5	1·1	—	—
12	151·9	3·7	0·4	—	28	182·6	1·0	—	—
13	155·4	3·3	0·4	—	29	183·6	1·0	—	—
14	158·5	2·9	0·4	—	30	184·6	1·0	—	—
15	161·2	+ 2·4	− 0·3	—	31	185·6	+ 1·0	—	—

$t.$	$\phi.$	$\frac{d\phi}{dt}.$	$\frac{d^2\phi}{dt^2}.$	$\frac{d^3\phi}{dt^3}.$	$t.$	$\phi.$	$\frac{d\phi}{dt}.$	$\frac{d^2\phi}{dt^2}.$	$\frac{d^3\phi}{dt^3}.$
s.	m.m.				s.	m.m.			
32	186·6	+ 1·1	—	—	61	199·0	− 0·1	—	—
33	187·5	0·9	—	—	62	199·1	0·0	—	—
34	188·4	0·9	—	—	63	199·1	0·0	—	—
35	189·3	0·8	—	—	64	199·2	0·0	—	—
36	190·1	0·7	—	—	65	199·2	0·1	—	—
37	190·8	0·7	—	—	66	199·3	0·1	—	—
38	191·5	0·7	—	—	67	199·4	0·0	—	—
39	192·2	0·6	—	—	68	199·4	0·1	—	—
40	192·8	0·6	—	—	69	199·5	+ 0·1	—	—
41	193·4	0·6	—	—	70	199·6	0·0	—	—
42	194·0	0·6	—	—	71	199·6	0·0	—	—
43	194·6	0·6	—	—	72	199·6	0·0	—	—
44	195·2	0·5	—	—	73	199·6	0·0	—	—
45	195·7	0·5	—	—	74	199·6	0·0	—	—
46	196·2	0·4	—	—	75	199·6	− 0·1	—	—
47	196·6	0·3	—	—	76	199·5	0·1	—	—
48	196·9	0·3	—	—	77	199·4	0·1	—	—
49	197·2	0·3	—	—	78	199·3	0·1	—	—
50	197·5	0·3	—	—	79	199·2	0·2	—	—
51	197·8	0·2	—	—	80	199·0	0·2	—	—
52	198·0	0·2	—	—	81	198·8	0·2	—	—
53	198·2	0·2	—	—	82	198·6	0·2	—	—
54	198·4	0·2	—	—	83	198·4	0·3	—	—
55	198·6	0·2	—	—	84	198·1	0·3	—	—
56	198·8	0·1	—	—	85	197·8	0·3	—	—
57	198·9	+ 0·1	—	—	86	197·5	0·3	—	—
58	199·0	0·0	—	—	87	197·2	0·3	—	—
59	199·0	0·0	—	—	88	196·9	0·4	—	—
60	199·0	0·0	—	—	89	196·5	− 0·4	—	—

t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.	t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.
s.	m.m.				s.	m.m.			
90	196·1	− 0·4	—	—	119	171·3	− 1·6	− 0·1	—
91	195·7	0·4	—	—	120	169·9	1·8	0·0	—
92	195·3	0·5	—	—	121	168·0	2·0	0·2	—
93	194·8	0·5	—	—	122	166·0	2·1	0·2	—
94	194·3	0·5	—	—	123	163·9	2·2	0·2	—
95	193·8	0·5	—	—	124	161·7	2·3	0·2	− 0·1
96	193·3	0·6	—	—	125	159·3	2·6	0·5	0·2
97	192·7	0·7	—	—	126	156·5	3·1	0·7	0·3
98	192·0	0·7	—	—	127	153·0	4·0	1·1	0·4
99	191·3	0·7	—	—	128	148·4	5·3	1·6	0·5
100	190·6	0·7	—	—	129	142·2	7·2	2·2	0·6
101	189·9	0·7	—	—	130	133·8	9·7	2·9	0·7
102	189·2	0·8	—	—	131	122·5	− 13 0	− 3·7	− 0·8
103	188·4	0·7	—	—	132	81·7	—	—	—
104	187·7	0·7	—	—	133	54·8	—	—	—
105	187·0	0·7	—	—	134	36·7	—	—	—
106	186·2	0·9	—	—	135	24·6	—	—	—
107	185·3	0·9	—	—	136	16·5	—	—	—
108	184·4	0·9	—	—	137	11·1	—	—	—
109	183·5	0·9	—	—	138	7·4	—	—	—
110	182·6	1·0	—	—	139	5·0	—	—	—
111	181·6	1·1	—	—	140	3·3	—	—	—
112	180·5	1·2	—	—	141	2·2	—	—	—
113	179·3	1·2	—	—	142	1·5	—	—	—
114	178·1	1·3	—	—	143	1·0	—	—	—
115	176·8	1·3	—	—	144	0·6	—	—	—
116	175·5	1·3	—	—	145	0·3	—	—	—
117	174·2	1·4	− 0·1	—	146	0·0	—	—	—
118	172·8	− 1·5	0·1	—					

It will be observed that from the 5th second to the 125th the values of $\frac{d^3\phi}{dt^3}$ become so small that we may reasonably reject them. Similarly from the 16th to the 116th second the values of $\frac{d^2\phi}{dt^2}$ become too small to be of importance. Between the 130th and 131st second the sun passes off the instrument, and there is near here a point of inflexion on the curve, in consequence of which the method of computing the values of the differential coefficients by means of the differences is inappropriate. This is, of course, of no importance from our present point of view, as this part of the curve merely shows the motion of the couple when in process of cooling.

If now we multiply the values of the differential coefficients given in the above Table by the corresponding coefficients of equation (4) already obtained (p. 310), we find the following quantities :—

t.	$\frac{d^3\phi}{dt^3}$.	$0{\cdot}917\frac{d^2\phi}{dt^2}$.	$1{\cdot}241\frac{d\phi}{dt}$.	$0{\cdot}419\ \phi$.	$f(t)$.	
s.						
0	+ 1·5	− 6·0	+ 39·5	0·0	35·0	41·9
1	1·1	4·7	32·3	12·1	40·8	48·8
2	0·7	3·5	26·7	22·0	45·9	54·9
3	0·5	2·9	22·3	30·3	50·2	60·0
4	0·3	2·4	18·7	37·2	53·8	64·4
5	0·2	2·0	15·6	42·9	56·7	67·8
6	+ 0·1	1·7	12·9	47·8	59·1	70·7
7	—	1·1	10·3	51·7	60·9	72·8
8	—	0·9	8·7	55·0	62·8	75·1
9	—	0·7	7·3	57·7	64·3	76·9
10	—	0·6	6·2	60·0	65·6	78·5
11	—	0·5	5·3	62·0	66·8	79·9
12	—	0·4	4·6	63·6	67·8	81·1
13	—	0·4	4·1	65·1	68·8	82·3
14	—	0·4	3·6	66·4	69·6	83·3
15	—	− 0·3	+ 3·0	67·5	70·2	84·0

t.	$\frac{d^3\phi}{dt^3}$.	$0{\cdot}917\,\frac{d^2\phi}{dt^2}$.	$1{\cdot}241\,\frac{d\phi}{dt}$.	$0{\cdot}419\,\phi$.	$f(t)$.	
s. 16	—	− 0·1	+ 2·6	68·5	71·0	84·9
17	—	—	2·4	69·3	71·7	85·8
18	—	—	2·2	70·1	72·3	86·5
19	—	—	2·1	70·9	73·0	87·3
20	—	—	2·0	71·6	73·6	88·0
21	—	—	2·0	72·3	74·3	88·9
22	—	—	2·0	72·9	74·9	89·6
23	—	—	2·0	73·6	75·6	90·4
24	—	—	1·9	74·3	76·2	91·1
25	—	—	1·9	74·9	76·8	91·9
26	—	—	1·5	75·5	77·0	92·1
27	—	—	1·4	76·0	77·4	92·6
28	—	—	1·2	76·5	77·7	92·9
29	—	—	1·2	76·9	78·1	93·4
30	—	—	1·2	77·3	78·5	93·9
31	—	—	1·2	77·8	79·0	94·5
32	—	—	1·4	78·2	79·6	95·2
33	—	—	1·1	78·6	79·7	95·3
34	—	—	1·1	78·9	80·0	95·7
35	—	—	1·0	79·3	80·3	96·1
36	—	—	0·9	79·7	80·6	96·4
37	—	—	0·9	79·9	80·8	96·7
38	—	—	0·9	80·2	81·1	97·0
39	—	—	0·7	80·5	81·2	97·1
40	—	—	0·7	80·8	81·5	97·5
41	—	—	0·7	81·0	81·7	97·7
42	—	—	0·7	81·3	82·0	98·1
43	—	—	0·7	81·5	82·2	98·3
44	—	—	+ 0·6	81·8	82·4	98·6

t.	$\frac{d^3\phi}{dt^3}$.	$0{\cdot}917\frac{d^2\phi}{dt^2}$.	$1{\cdot}241\frac{d\phi}{dt}$.	$0{\cdot}419\ \phi$.	$f(t)$.	
s. 45	—	—	+ 0·6	82·0	82·6	98·8
46	—	—	0·5	82·2	82·7	98·9
47	—	—	0·4	82·4	82·8	99·0
48	—	—	0·4	82·5	82·9	99·2
49	—	—	0·4	82·6	83·0	99·3
50	—	—	0·4	82·7	83·1	99·4
51	—	—	0·2	82·9	83·1	99·4
52	—	—	0·2	83·0	83·2	99·5
53	—	—	0·2	83·0	83·2	99·5
54	—	—	0·2	83·1	83·3	99·6
55	—	—	0·2	83·2	83·4	99·8
56	—	—	0·1	83·3	83·4	99·8
57	—	—	0·1	83·3	83·4	99·8
58	—	—	0·0	83·4	83·4	99·8
59	—	—	0·0	83·4	83·4	99·8
60	—	—	0·0	83·4	83·4	99·8
61	—	—	0·1	83·4	83·5	99·9
62	—	—	0·0	83·4	83·4	99·8
63	—	—	0·0	83·4	83·4	99·8
64	—	—	0·0	83·5	83·5	99·9
65	—	—	0·1	83·5	83·6	100·0
66	—	—	0·1	83·5	83·6	100·0
67	—	—	0·0	83·5	83·5	99·9
68	—	—	0·1	83·5	83·6	100·0
69	—	—	+ 0·1	83·6	83·7	100·1
70	—	—	0·0	83·6	83·6	100·0
71	—	—	0·0	83·6	83·6	100·0
72	—	—	0·0	83·6	83·6	100·0
73	—	—	0·0	83·6	83·6	100·0

t.	$\frac{d^3\phi}{dt^3}$.	$0·917\frac{d^2\phi}{dt^2}$.	$1·241\frac{d\phi}{dt}$.	$0·419\ \phi$.	$f(t)$.	
s. 74	—	—	0·0	83·6	83·6	100·0
75	—	—	− 0·1	83·6	83·5	99·9
76	—	—	0·1	83·6	83·5	99·9
77	—	—	0·1	83·5	83·4	99·8
78	—	—	0·1	83·5	83·4	99·8
79	—	—	0·2	83·5	83·3	99·7
80	—	—	0·2	83·3	83·1	99·4
81	—	—	0·2	83·3	83·1	99·4
82	—	—	0·2	83·2	83·0	99·2
83	—	—	0·4	83·1	82·7	98·9
84	—	—	0·4	83·0	82·6	98·8
85	—	—	0·4	82·9	82·5	98·7
86	—	—	0·4	82·8	82·4	98·6
87	—	—	0·4	82·6	82·2	98·3
88	—	—	0·5	82·5	82·0	98·1
89	—	—	0·5	82·3	81·8	97·9
90	—	—	0·5	82·2	81·7	97·7
91	—	—	0·5	82·0	81·5	97·5
92	—	—	0·6	81·8	81·2	97·1
93	—	—	0·6	81·6	81·0	96·9
94	—	—	0·6	81·4	80·8	96·7
95	—	—	0·6	81·2	80·6	96·4
96	—	—	0·7	81·0	80·3	96·1
97	—	—	0·9	80·7	79·8	95·5
98	—	—	0·9	80·4	79·5	95·1
99	—	—	0·9	80·2	79·3	94·9
100	—	—	0·9	79·9	79·0	94·5
101	—	—	0·9	79·6	78·7	94·1
102	—	—	− 1·0	79·3	78·3	93·7

t.	$\frac{d^3\phi}{dt^3}$.	$0{\cdot}917\frac{d^2\phi}{dt^2}$.	$1{\cdot}241\frac{d\phi}{dt}$.	$0{\cdot}419\ \phi$.	$f(t)$.	
s.						
103	—	—	– 0·9	78·9	78·0	93·3
104	—	—	0·9	78·6	77·7	92·9
105	—	—	0·9	78·3	77·4	92·6
106	—	—	1·1	78·0	76·9	92·0
107	—	—	1·1	77·6	76·5	91·5
108	—	—	1·1	77·3	76·2	91·1
109	—	—	1·1	76·9	75·8	90·8
110	—	—	1·2	76·5	75·3	90·1
111	—	—	1·4	76·1	74·7	89·4
112	—	—	1·5	75·6	74·1	88·6
113	—	—	1·5	75·1	73·6	88·0
114	—	—	1·6	74·6	73·0	87·3
115	—	—	1·6	74·1	72·5	86·7
116	—	—	1·6	73·5	71·9	86·0
117	—	– 0·1	1·7	73·0	71·2	85·2
118	—	0·1	1·9	72·4	70·4	84·2
119	—	0·1	2·0	71·8	69·7	83·4
120	—	0·1	2·2	71·2	68·9	82·4
121	—	0·2	2·5	70·4	67·7	81·0
122	—	0·2	2·6	69·6	66·8	79·9
123	—	0·2	2·7	68·7	65·8	78·7
124	– 0·1	0·2	2·9	67·8	64·6	77·3
125	0·2	0·5	3·2	66·7	62·8	75·1
126	0·3	0·6	3·8	65·6	60·9	72·8
127	0·4	1·0	5·0	64·1	57·7	69·0
128	0·5	1·5	6·6	62·2	53·6	64·1
129	0·6	2·0	8·9	59·6	48·1	57·5
130	0·7	2·7	12·0	56·1	40·7	48·7
131	– 0·8	– 3·4	– 16·1	51·3	31·0	37·1

The quantities in the sixth column of this Table represent the sums of those in the four preceding columns, and are taken as the ordinates in curve *b*, fig. 6, while those in the last column are the same quantities multiplied by 100/83·6 so as to express the intensity of the heat at each point in percentages of that at the centre, and are represented by curve *c* in the same figure. With these quantities as ordinates the curve *c* has been laid down. In this reduced curve the ordinates represent the relative intensities of the radiation of heat. The time which the sun's diameter took in transit on the 12th October, 1890, the day on which the photograph was taken, was 130 seconds, but as the sun's image was 800 mm. in diameter, and the diameter of the aperture of the radio-micrometer was 2 mm., the interval between the first and last contact with the limb is longer than this by $\frac{1}{400}$th of the time of transit. The whole time between the first and last contacts is, therefore, 130·3 seconds.

We thus obtain the following results:—

D.	*t*.	*H*.	$\frac{1}{2}(H+H')$.	*H'*.	*t*.	*D*.
	s.				s.	
0	65·15	100·0	100·0	100·0	65·15	0
10	58·65	99·8	99·9	100·0	71·65	10
20	52·15	99·5	99·6	99·8	78·15	20
25	48·90	99·3	99·3	99·3	81·40	25
30	45·65	98·9	98·8	98·7	84·65	30
40	39·15	97·2	97·3	97·4	91·15	40
50	32·65	95·3	95·3	95·3	97·65	50
60	26·15	92·2	92·5	92·8	104·15	60
70	19·65	87·8	88·7	89·6	110·65	70
75	16·40	85·3	86·3	87·4	113·90	75
80	13·15	82·5	83·9	85·3	117·15	80
90	6·65	72·0	74·9	77·8	123·65	90
95	3·40	61·8	65·6	69·4	126·90	95
98	1·45	51·5	55·0	58·5	128·85	98
100	0·15	42·9	45·1	47·3	130·15	100

In the first and last columns are given the distance of a point from the sun's centre taking its radius as 100. The second and sixth contain the values of *t*. In the third and fifth are given the corresponding values of the heat radiated, the mean of which will be found in the fourth column. These values, down to $D = 75$, agree in a remarkable manner with those obtained by Langley, using the bolometer, and beyond that are in as close agreement with this distinguished observer's results as could well be expected in view of the fact that they are based on a single photograph.

This close agreement seems to show that the method is a most reliable one, and the ease and rapidity with which the curve may be obtained especially adapt it to the purpose of keeping a constant watch on the sun, so that any variation in the heat-absorbing power of the sun's atmosphere may be detected. For this purpose a series of weekly photographs would probably supply all the material necessary. Or if it were found advisable to take photographs every day that the sun was seen, even this would not put too severe a strain on the observing resources of an observatory.

It will be of interest to find how far the above results are borne out by another photograph shown in fig. 7. In this photograph, which is on a smaller scale than the last, the sun did not pass centrally across the aperture, but we have the means of determining what chord of the sun was actually observed by the length of time occupied in transit.

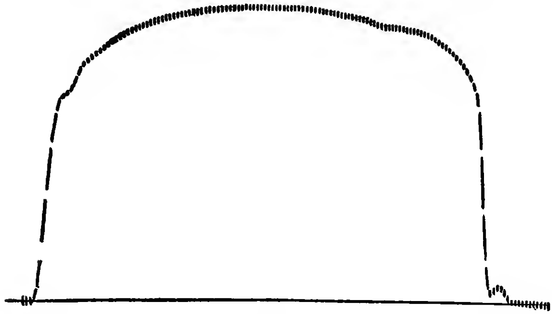

FIG. 7.

If we treat this curve similarly to the last, smoothing it down in the manner already explained, we obtain the following values of ϕ and its differential coefficients :—

VALUES of ϕ, $\frac{d\phi}{dt}$, &c., from curve *a*, fig. 8.

t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.	*t*.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$
s. 1	3·3	+15·4	−5·0	+3·0	s. 8	54·9	+ 3·3	−0·7	—
2	16·5	11·4	2·9	1·3	9	57·9	2·6	0·6	—
3	26·6	9·0	1·8	0·3	10	60·3	2·1	0·5	—
4	34·7	7·3	1·5	0·2	11	62·2	1·6	0·3	—
5	41·3	5·9	1·0	0·1	12	63·7	1·4	0·2	—
6	46·7	4·9	0·9	—	13	65·0	1·2	0·1	—
7	51·4	+ 4·0	−0·8	—	14	66·2	+ 1·1	−0·1	—

t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.	t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.
s. 15	67·3	+ 1·0	—	—	s. 44	79·5	+ 0·1	—	—
16	68·3	0·8	—	—	45	79·6	0·1	—	—
17	69·1	0·8	—	—	46	79·7	0·2	—	—
18	69·9	0·8	—	—	47	79·9	0·1	—	—
19	70·7	0·7	—	—	48	80·0	0·1	—	—
20	71·4	0·7	—	—	49	80·1	0·1	—	—
21	72·1	0·7	—	—	50	80·2	0·1	—	—
22	72·8	0·6	—	—	51	80·3	0·1	—	—
23	73·4	0·6	—	—	52	80·4	0·1	—	—
24	73·9	0·5	—	—	53	80·5	0·0	—	—
25	74·4	0·5	—	—	54	80·5	0·0	—	—
26	74·9	0·5	—	—	55	80·5	0·1	—	—
27	75·3	0·4	—	—	56	80·6	+ 0·1	—	—
28	75·7	0·4	—	—	57	80·7	0·0	—	—
29	76·0	0·3	—	—	58	80·7	0·0	—	—
30	76·3	0·3	—	—	59	80·7	0·0	—	—
31	76·7	0·4	—	—	60	80·7	0·0	—	—
32	77·0	0·3	—	—	61	80·7	0·0	—	—
33	77·3	0·3	—	—	62	80·7	0·0	—	—
34	77·6	0·3	—	—	63	80·7	− 0·1	—	—
35	77·9	0·3	—	—	64	80·6	0·1	—	—
36	78·2	0·2	—	—	65	80·5	0·0	—	—
37	78·4	0·2	—	—	66	80·5	0·1	—	—
38	78·6	0·2	—	—	67	80·4	0·0	—	—
39	78·8	0·1	—	—	68	80·4	0·1	—	—
40	78·9	0·1	—	—	69	80·3	0·1	—	—
41	79·0	0·2	—	—	70	80·2	0·1	—	—
42	79·2	0·1	—	—	71	80·1	0·1	—	—
43	79·3	+ 0·2	—	—	72	80·0	− 0·1	—	—

t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.	t.	ϕ.	$\frac{d\phi}{dt}$.	$\frac{d^2\phi}{dt^2}$.	$\frac{d^3\phi}{dt^3}$.
s. 73	79·9	– 0·1	—	—	s. 102	72·8	– 0·5	—	—
74	79·8	0·1	—	—	103	72·3	0·5	—	—
75	79·7	0·1	—	—	104	71·8	0·5	—	—
76	79·6	0·1	—	—	105	71·3	0·6	—	—
77	79·5	0·2	—	—	106	70·7	0·7	—	—
78	79·3	0·2	—	—	107	70·0	0·7	—	—
79	79·1	0·2	—	—	108	69·3	0·8	—	—
80	78·9	0·2	—	—	109	68·5	0·9	—	—
81	78·7	0·2	—	—	110	67·6	0·9	—	—
82	78·5	0·2	—	—	111	66·7	1·1	—	—
83	78·3	0·2	—	—	112	65·6	1·2	– 0·1	—
84	78·1	0·2	—	—	113	64·3	1·5	0·2	—
85	77·9	0·2	—	—	114	62·6	2·0	0·6	– 0·2
86	77·7	0·2	—	—	115	60·2	2·9	1·1	0·5
87	77·5	0·3	—	—	116	56·5	4·7	2·4	1·5
88	77·2	0·3	—	—	117	50·2	8·3	4·9	3·3
89	76·9	0·3	—	—	118	38·4	– 16·2	– 10·6	– 6·5
90	76·6	0·3	—	—	119	21·9	—	—	—
91	76·4	0·2	—	—	120	13·7	—	—	—
92	76·1	0·3	—	—	121	9·2	—	—	—
93	75·9	0·2	—	—	122	6·3	—	—	—
94	75·7	0·2	—	—	123	4·4	—	—	—
95	75·5	0·3	—	—	124	3·1	—	—	—
96	75·2	0·4	—	—	125	2·0	—	—	—
97	74·8	0·4	—	—	126	1·1	—	—	—
98	74·4	0·3	—	—	127	0·5	—	—	—
99	74·1	0·4	—	—	128	0·2	—	—	—
100	73·7	0·4	—	—	129	0·0	—	—	—
101	73·3	– 0·5	—	—					

We thus obtain the following Table :—

$t.$	$\frac{d^3\phi}{dt^3}$.	$0{\cdot}917\,\frac{d^2\phi}{dt^2}$.	$1{\cdot}241\,\frac{d\phi}{dt}$.	$0{\cdot}419\,\phi$.	$f(t)$.
s. 1	+ 3·0	− 4·6	+ 19·1	+ 1·4	18·9
2	1·3	2·7	14·1	6·9	19·6
3	0·3	1·7	11·2	11·1	20·9
4	0·2	1·4	9·1	14·5	22·4
5	− 0·1	0·9	7·3	17·3	23·8
6	—	0·8	6·1	19·6	24·9
7	—	0·8	5·0	21·5	25·7
8	—	0·6	4·1	23·0	26·5
9	—	0·6	3·2	24·3	26·9
10	—	0·5	2·6	25·3	27·4
11	—	0·3	2·0	26·1	27·8
12	—	0·2	1·7	26·7	28·2
13	—	0·1	1·5	27·2	28·6
14	—	− 0·1	1·4	27·7	29·0
15	—	—	1·2	28·2	29·4
16	—	—	1·0	28·6	29·6
17	—	—	1·0	29·0	30·0
18	—	—	1·0	29·3	30·3
19	—	—	0·9	29·6	30·5
20	—	—	0·9	29·9	30·8
21	—	—	0·9	30·2	31·1
22	—	—	0·7	30·5	31·2
23	—	—	0·7	30·8	31·5
24	—	—	0·6	31·1	31·7
25	—	—	0·6	31·2	31·8
26	—	—	0·6	31·4	32·0
27	—	—	0·5	31·6	32·1
28	—	—	+ 0·5	+ 31·7	32·2

t.	$\frac{d^3\phi}{dt^3}$.	$0·917 \frac{d^2\phi}{dt^2}$.	$1·241 \frac{d\phi}{dt}$.	$0·419\ \phi$.	$f(t)$.
s. 29	—	—	+ 0·4	+ 31·8	32·2
30	—	—	0·4	32·0	32·4
31	—	—	0·5	32·1	32·6
32	—	—	0·4	32·3	32·7
33	—	—	0·4	32·4	32·8
34	—	—	0·4	32·5	32·9
35	—	—	0·4	32·6	33·0
36	—	—	0·2	32·8	33·0
37	—	—	0·2	32·8	33·0
38	—	—	0·2	32·9	33·1
39	—	—	0·1	33·0	33·1
40	—	—	0·1	33·1	33·2
41	—	—	0·2	33·1	33·3
42	—	—	0·1	33·2	33·3
43	—	—	0·2	33·2	33·4
44	—	—	0·1	33·3	33·4
45	—	—	0·1	33·4	33·5
46	—	—	0·2	33·4	33·6
47	—	—	0·1	33·5	33·6
48	—	—	0·1	33·5	33·6
49	—	—	0·1	33·6	33·7
50	—	—	0·1	33·6	33·7
51	—	—	0·1	33·6	33·7
52	—	—	0·1	33·7	33·8
53	—	—	0·0	33·7	33·7
54	—	—	0·0	33·7	33·7
55	—	—	0·1	33·7	33·8
56	—	—	+ 0.1	33·8	33·9
57	—	—	0·0	+ 33·8	33·8

t.	$\frac{d^3\phi}{dt^3}$.	$0{\cdot}917\ \frac{d^2\phi}{dt^2}$.	$1{\cdot}241\ \frac{d\phi}{dt}$.	$0{\cdot}419\ \phi$.	$f(t)$.
s. 58	—	—	0·0	+ 33·8	33·8
59	—	—	0·0	33·8	33·8
60	—	—	0·0	33·8	33·8
61	—	—	0·0	33·8	33·8
62	—	—	0·0	33·8	33·8
63	—	—	− 0·1	33·8	33·7
64	—	—	0·1	33·8	33·7
65	—	—	0·0	33·7	33·7
66	—	—	0·1	33·7	33·6
67	—	—	0·0	33·7	33·7
68	—	—	0·1	33·7	33·6
69	—	—	0·1	33·6	33·5
70	—	—	0·1	33·6	33·5
71	—	—	0·1	33·6	33·5
72	—	—	0·1	33·5	33·4
73	—	—	0·1	33·5	33·4
74	—	—	0·1	33·4	33·3
75	—	—	0·1	33·4	33·3
76	—	—	0·1	33·4	33·3
77	—	—	0·2	33·3	33·1
78	—	—	0·2	33·2	33·0
79	—	—	0·2	33·1	32·9
80	—	—	0·2	33·1	32·9
81	—	—	0·2	33·0	32·8
82	—	—	0·2	32·9	32·7
83	—	—	0·2	32·8	32·6
84	—	—	0·2	32·7	32·5
85	—	—	0·2	32·6	32·4
86	—	—	− 0·2	+ 32·6	32·4

$t.$	$\frac{d^3\phi}{dt^3}$.	$0{\cdot}917\ \frac{d^2\phi}{dt^2}$.	$1{\cdot}241\ \frac{d\phi}{dt}$.	$0{\cdot}419\ \phi$.	$f(t)$.
s.					
87	—	—	− 0·4	+ 32·5	32·1
88	—	—	0·4	32·3	31·9
89	—	—	0·4	32·2	31·8
90	—	—	0·4	32·1	31·7
91	—	—	0·2	32·0	31·8
92	—	—	0·4	31·9	31·5
93	—	—	0·2	31·8	31·6
94	—	—	0·2	31·7	31·5
95	—	—	0·4	31·6	31·2
96	—	—	0·5	31·5	31·0
97	—	—	0·5	31·3	30·8
98	—	—	0·4	31·2	30·8
99	—	—	0·5	31·0	30·5
100	—	—	0·5	30·9	30·4
101	—	—	0·6	30·7	30·1
102	—	—	0·6	30·5	29·9
103	—	—	0·6	30·3	29·7
104	—	—	0·6	30·1	29·5
105	—	—	0·7	29·9	29·2
106	—	—	0·9	29·6	28·7
107	—	—	0·9	29·3	28·4
108	—	—	1·0	29·0	28·0
109	—	—	1·1	28·7	27·6
110	—	—	1·1	28·3	27·2
111	—	—	1·4	27·9	26·5
112	—	− 0·1	1·5	27·5	25·9
113	—	0·2	1·9	26·9	24·8
114	− 0·2	0·6	2·5	26·2	22·9
115	0·5	1·0	3·6	25·2	20·1
116	1·5	2·2	5·8	23·7	14·2
117	3·3	4·5	10·3	21·0	2·9
118	− 6·5	− 10·0	− 20·1	+ 16·1	—

These results are exhibited in the curve *b*, fig. 8.

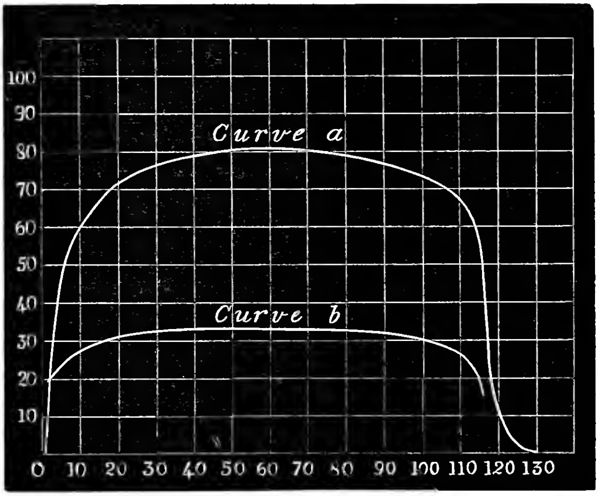

Fig. 8.

Now we see from the way the curve in fig. 7 begins to rise that the sun must have come on the instrument at $0^s{\cdot}7$ q. p., and comparing the curve with that obtained on 12th October, it appears to have left the instrument at $116^s{\cdot}1$ q.p. We have thus $115^s{\cdot}4$ as the time of transit of the chord observed. If d be the distance of the middle point of this chord from the centre of the sun, expressed in seconds, we have (since the sun's diameter was 128^s)

$$d = \sqrt{(64)^2 - (57{\cdot}7)^2} = 27^s{\cdot}69.$$

Also if D is as before the distance of any point on the chord from the centre of the sun expressed in percentages of the sun's radius, since the middle of the transit took place at $58^s{\cdot}4$, we have

$$t = 58{\cdot}4 \pm \sqrt{4096\,D^2 - 766{\cdot}74},$$

by means of which we can find the times corresponding to various values of D for comparison with the results previously obtained. We thus get the following results:—

D.	t_1.	t_2.	H_1.	H_2.	*H* Mean.	2·86 *H*.
50	42·4	74·4	33·3	33·3	33·3	95·3
60	31·8	85·0	32·7	32·4	32·5	92·9
70	23·2	93·6	31·5	31·5	31·5	90·1
75	19·2	97·6	30·6	30·8	30·7	87·8
80	15·3	101·5	29·5	30·3	29·9	85·5
90	7·9	108·9	26·4	27·6	27·0	77·2
95	4·3	112·5	22·8	24·3	23·5	67·2
98	2·1	114·7	19·7	20·9	20·3	58·1
100	0·7	116·1	[18·5]	[13·3]	[15·9]	[45·5]

These results are exhibited graphically in fig. 9, where they are represented by the dotted curve. The continuous curve in the same figure represents the results already obtained from the photograph of 12th October.

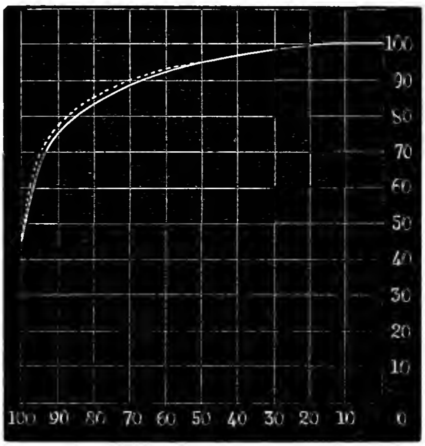

FIG. 9.

Considering the comparatively small scale on which the curve in fig. 7 was taken, and the degree of uncertainty attaching to the exact length of the chord observed, these results seem to agree fairly well.

The discrepancies that remain, however, show that it would be well to determine for each photograph the exact instant at which the sun enters and leaves the instrument, which can easily be done automatically by putting a reflector behind the couple so as to reflect a beam of sunlight on to the plate all the time the sun is in transit.

Absorption in the Sun's Atmosphere.

Although the results given on page 320 are of course only provisional, it will be of interest to calculate from them the amount of heat intercepted by the sun's atmosphere.

In the tenth book of the *Mécanique Céleste*, No. 12, Laplace shows that the law of extinction of the sun's rays in passing through an atmosphere is

$$\frac{dv}{v} = -\frac{Hd\theta}{\sin\theta},$$

where v is the intensity of the ray, $d\theta$ the element of the refraction, θ the zenith distance of the radiating body, and H a constant. Hence if V be the intensity of the beam before entering the atmosphere, we have

$$\log\frac{V}{v} = \frac{H\delta\theta}{\sin\theta},$$

where $\delta\theta$ is the whole refraction. This formula is also employed by Forbes in his Memoir "On the Extinction of the Solar Rays in passing through the Atmosphere," in the *Philosophical Transactions* of the Royal Society, 1842. In applying this to the absorption of heat in the sun's own atmosphere as Laplace has done in the next section to that referred to above, we assume that the absorption in its atmosphere obeys *a law similar to the terrestrial absorption differing only in the constant*. In this case θ will represent the angular distance from the sun's centre.

If v_0 is the intensity of the heat observed at the centre, since for small zenith distances we may put $\delta\theta = a\tan\theta$, we have

$$\log\frac{V}{v_0} = Ha,$$

and consequently

$$\log\frac{v}{v_0} = H\left(a - \frac{\delta\theta}{\sin\theta}\right),$$

and, therefore,

$$\log\frac{v}{v_0} = \left(1 - \frac{\delta\theta}{a\sin\theta}\right)\log\frac{V}{v_0}.$$

from which $\frac{V}{v_0}$ may be calculated.

In this we have assumed that V, the intensity of the heat before absorption, is the same at all points of the disc. Laplace, on the other hand, considers that if the sun's atmosphere were removed it would be found to radiate more heat from the regions near the limb than from the centre. He says: "Une portion du disque du soleil transportée, par la rotation de cet astre, du centre vers les bords du disque, doit y paraître avec une lumiere d'autant plus vive qu'elle est aperçue sous un plus petit angle; car il est naturel de penser que chaque point de la surface du soleil renvoie une lumiere égale dans tous les sens." He accordingly assumes that the intensity varies as sec θ. It is, however, more natural to suppose that the sun's surface would behave similarly to other radiating surfaces, in which the inclination of the surface will not increase the intensity, and this is borne out to some extent by the following Table in which we give the values of $\frac{V}{v_0}$ calculated from the observed values of $\frac{v}{v_0}$ on both hypothesis for every tenth degree of θ:—

θ.	$\frac{V}{v_0}$: $V = V_0 \sec \theta$.	$\frac{V}{v_0}$: $V = V_0$.	D.
10°	3·425	1·178	17·36
20	3·548	1·325	34·20
30	3·461	1·365	50·00
40	3·259	1·362	64·28
50	2·798	1·324	76·60
60	2·561	1·277	86·60
70	2·128	1·223	93·97
80	1·647	1·147	98·48
90	—	1·023	100·00

This Table shows that down to $D = 94$, or for the most reliable part of the curve, the different values obtained on the hypothesis of a uniform radiation agree fairly well together, while even beyond this they compare favourably with those in the second column of the Table. The gradual rise and fall in these values as θ increases seem to show that the law we have assumed does not exactly represent the radiation, and these results might be brought better together by assuming that, if V_0 is the intensity at the centre before absorption, $V = V_0(1 - b \sin 2\theta)^{\sec\theta - 1}$, in which $b = 0{\cdot}322$, or better still, if we take $V = V_0[1 - b \sin(2\theta + \alpha)]^{\sec\theta - 1}$ where $b = 0{\cdot}235$, and $\alpha = 20°$. Such a law as this would seem to indicate a radiating stratum of limited extent whose temperature increases towards the centre, so that the colder layers on the outside would absorb some of the intenser radiation coming from the interior. It would, however, be unsafe on such slender foundation to adopt such an artificial law of radiation as that represented by the equation just given, and we have preferred, for the present at least, to assume that $V = V_0$ all over the disc.

If we take the mean of the results in the third column of the Table, omitting the last, which rests on observations at the limb, we find $\frac{V}{v_0} = 1{\cdot}275$. We thus see that a vertical passage through the sun's atmosphere diminishes the intensity of the heat by about $\frac{1}{5}$th of its amount, while at the limb nearly $\frac{2}{3}$rds of it is lost.

In order to calculate how much the total heat is reduced we observe that on the assumption of uniform radiation

$$\frac{v}{v_0} = \left(\frac{V_0}{v_0}\right)^{1 - \frac{\delta\theta}{a \sin\theta}}.$$

Also the total radiation is, if we put the radius of the sun equal to unity,

$$2\pi \int_0^{\frac{\pi}{2}} \sin\theta \cos\theta \, d\theta \,.\, v.$$

We may also assume $\delta\theta = a \tan\theta$, which will represent the refraction very nearly except for values of θ corresponding to points very close to the limb from which but a very small proportion of the heat comes. If now we put $v_0 = 1$, $x = \cos\theta$, and $e^f = V$, this expression becomes

$$2\pi \int_0^1 e^{f\left(1 - \frac{1}{x}\right)} x\,dx = 2\pi e^f \int_0^1 e^{-\frac{f}{x}} x\,dx.$$

But since the total heat which we should receive if there were no absorption is πe^f, we find as the proportion (R) of the heat penetrating the atmosphere

$$R = 2\int_0^1 e^{-\frac{f}{x}}\, x dx.$$

The expression found by Laplace on the same assumption as before with regard to the local intensity before absorption is $\int_0^1 e^{-\frac{f}{x}}\, dx$, which he shows can be reduced to the continued fraction,

$$\cfrac{qe^{-f}}{1+2q\over \cfrac{}{1+q\over \cfrac{}{1+3q\over \cfrac{}{1+2q\over \cfrac{}{1+4q\over \cfrac{}{1+3q\over \cfrac{}{1+\&c.,}}}}}}}$$

in which $q = \frac{1}{f}$.

But integrating by parts we find

$$2\int e^{-\frac{f}{x}}\, x dx = e^{-\frac{f}{x}}\, x^2 - f\int e^{-\frac{f}{x}}\, dx.$$

Hence

$$R = e^{-f} - \cfrac{e^{-f}}{1+2q\over \cfrac{}{1+q\over \cfrac{}{1+3q\over \cfrac{}{1+2q\over \cfrac{}{1+\&c.}}}}}$$

We have already found $e^f = 1{\cdot}275$, whence we obtain $f = 0{\cdot}2429$, $q = 4{\cdot}1169$, and $e^{-f} = 0{\cdot}7843$, and substituting these values in the expression for R we find that it lies between 0·668 and 0·623, or that more than one-third of the sun's heat is intercepted by his atmosphere.

In conclusion, we may observe that if photographs are from time to time taken in the manner here described, and are all reduced in an exactly similar manner, even though the assumptions made with regard to the laws governing the radiation at the sun's surface do not *exactly* represent the real state of affairs [and that they are not in error to any great extent seems clear from the agreement found in the values of $\frac{V}{v_0}$ or e^f], still any variation in the resulting values of R would represent a real change in the absorbing power of the sun's atmosphere, and would thus enable us to detect an alteration in the state of the solar surface which would be wholly masked in direct observations by the varying conditions of the earth's atmosphere under which the observations would necessarily be conducted.

XXI.

REPORT ON THE BOTANY OF THE MOURNE MOUNTAINS, COUNTY DOWN. By SAMUEL ALEXANDER STEWART, F.B.S. Edinburgh; and R. LLOYD PRAEGER, B.E., M.R.I.A.

[Read February 22, 1892.]

The district to which the present Report refers forms the southern corner of the county of Down, and comprises the barony of Mourne, and a strip of the barony of Upper Iveagh. Its north-eastern and northern boundary line may be drawn from Narrow-water, at the upper extremity of the Lough of Carlingford (which separates Down from the adjoining counties of Louth and Armagh), in a north-easterly direction, along the base of the mountains, passing through the village of Hilltown, and by Lough Island Reavy to Castlewellan; thence it runs south-east to Newcastle, where it meets the waters of Dundrum Bay. In other directions a natural boundary is supplied by the Irish Sea, which stretches on the east and south-east, and by Carlingford Lough, which lies to the south-west. The greatest length north and south of the district thus enclosed is 13 miles, and its extreme breadth east and west 16 miles; its area is 180 square miles, or somewhat less than one-fifth of county Down, and about one-seventeenth of District 12 of the "Cybele Hibernica."

The Mourne Mountains, which form the highest and finest mountain-range in Ulster, and (excepting some of the lower hills of Antrim) the most easterly highlands of Ireland, occupy almost the whole of this area, stretching in a broad ellipse east-north-east and west-south-west, and at each extremity descending steeply into the sea. Southward, a tract of flattish cultivated land slopes gently from the mountains to the water, terminating in the low sand-dunes of Cranfield Point. On the northward, our boundary line keeps close to the base of the hills, rising from sea-level at each end to some 600 or 700 feet on the watershed east of Hilltown.

The highest peaks of the range, and all the more interesting mountains, lie towards the eastern extremity, the culminating points being Slieve Donard (2796 feet), Slieve Commedagh (2512), Slieve Bingian

(2449), and Slieve Bearnagh (2394). Westward, the hills are flatter, and less intersected by deep valleys. The mountains are drained by numerous streams, of which the following may be mentioned. The Shimna River flows eastward along the northern base of the range, and has on its lower course the woods of Tollymore Park, long noted as a botanical hunting-ground; southward, the Annalong and Kilkeel Rivers find their way through the two finest valleys in the district to the Irish Sea; while to the south-west, the White Water and Causeway Water, and further northward the Kilbroney, Ghann, and Moygannon Rivers descend into Carlingford Lough. The central northern slopes form the headwaters of the Bann, which flows through Hilltown on its long course of 97 miles to the northern ocean.

The lakes of the mountains are three in number, leaving out of account several ponds or marshes, which in winter alone assume any considerable size. Lough Shannagh is a sheet of water with an area of 36 acres, lying at an elevation of 1350 feet on a peculiar extensive shelf, which the officers of the Geological Survey consider an ancient sea-terrace. The Blue Lough is picturesquely situated in a deep hollow between Slieve Lamagan and Slieve Bingian, 1100 feet above sea-level; and the shallow Lough Bingian occupies a hollow on the adjoining mountain-side at an elevation of 1350 feet. On the northern lowlands, Altnadua Lough and Lough Island Reavy lie on our boundary-line; the latter has an area of over 250 acres, but on account of its now being used as a reservoir, and subject to fluctuations of 20 or 30 feet in level, it does not yield the store of aquatic species that might be expected in such an extensive sheet of water. Castlewellan Lake is, strictly speaking, outside our boundary, but was included in our exploration in order to try to confirm some old and unverified records.

The mountain-sides generally rise steeply, with deep valleys between, and occasional lofty cliff-ranges. These last, with the rocky banks of the streams, form the habitat of most of the rarer species. The lower grounds are well tilled, and usually offer little of botanical interest. The coast-line of the district is nearly 40 miles in extent: the shores are low and often stony, but extensive sandy beaches occur east and west of Cranfield Point, and again from Newcastle northwards; only the southern extremity of the Newcastle sandhills, from which many plants have been recorded, come within our district. Low sea-cliffs lie south of Newcastle, and offer a suitable habitat for several species which fail to find a congenial home elsewhere. The gravelly point of Killowen, in Carlingford Lough, and the fields adjoining, yield a peculiar group of plants, all rare in

District 12, and not found elsewhere in the Mourne area:—*Sinapis alba*, *Lepidium campestre*, *Thlaspi arvense*, *Malva rotundifolia*, *Carduus crispus*, *Linaria repens*, *Bromus sterilis*. The limit of cultivation varies from 200 feet on the steep eastern sea-slopes to 800 to 900 feet in sheltered valleys, and may be averaged at 600 feet. The rainfall in the district is higher than in any other portion of county Down.

The geological and petrological features of the area under consideration are by no means complicated. Rocks of Lower Silurian age once covered the district, as they now prevail over almost the entire county. Through these ancient grits and slates, now much indurated and contorted, eruptive granite has been forced in such a volume as to form the great bulk of the mountains. Thus the present aspect of the range shows the old stratified rocks lapping round the flanks of the granite hills, which rise in a noble series of dome-shaped masses, culminating in Slieve Donard, at the north-eastern extremity of the range. Vast as these granite masses now appear, they were, without doubt, originally much greater. These hills may, says Professor Hull, "undoubtedly be considered as the roots of volcanic mountains, the trunks and branches of which have been removed by denuding agents." The denudation during the glacial epoch has been very great, as the thick and extensive beds of glacial *débris*, unproductive alike to the botanist and geologist, which occupy the lower grounds, amply testify. Near the centre of the range the granite is almost divided into two sections by a spur of the sedimentary rocks, which ascends to a height of 2198 feet on Slieve Muck North. Although the Silurian rocks, as they occur in the North of Ireland, generally yield but a poor variety of plants, still, on account of the numerous weathered crevices they contain, and the moisture which continually oozes out of and trickles over them, the grits in the Mourne Mountains yield a richer flora than the dry and massive granites. The flora of the range can only be said to be modified, petrologically, by the two classes of rocks just referred to. Sandstone is absent. An outlier of Carboniferous limestone is seen on the shore of Carlingford Lough, near Greencastle, but its area is too limited to have any effect on the flora. Trap, for phytological effect the near ally of limestone, occurs only as occasional dykes penetrating the older rocks. True Boulder Clay seems scarcely to occur in the district, but extensive beds of granite *débris*, the result of glaciation, are frequent, and banks of this drift, thrown across many of the mountain valleys, indicate the latest pauses of the retreating glaciers. The mountain-sides have usually a covering of peat, sometimes of considerable depth, but peat bogs at low elevations, with their characteristic plants, are not met with.

Geologically, the Mourne Mountains form a distinctly defined area. The Slieve Croob range, which rises on the northward to a height of over 1700 feet, is cut off by some ten miles of Silurian rocks, a low-lying country diversified by rugged hummocky hillocks. The Slieve Croob granite, too, has been considered by the officers of the Geological Survey as having a different origin from that of the Mourne Mountains, and as being much more ancient. Therefore, neither geographically nor geologically does this mountain-group come within the limits of the Mourne district. The Carlingford Mountains, on the south, are cut off by a deep intervening inlet of the sea (Carlingford Lough), in itself a considerable barrier, but more especially are these mountains excluded by their petrological character. The basalts, hypersthenes, syenites, and porphyries of the Carlingford hills may represent the Mourne granites in time, but are very different in composition, and the replacement of slate by the pyroxenic group widely distinguishes these neighbouring ranges. The authors of the "Cybele Hibernica," therefore, were right in giving District 12 its present well-defined south-western boundary, which is true botanically as well as geologically.

As might be expected, the fine mountain-group of the Mournes has attracted the attention of botanists from an early date. Dr. Sherard made some explorations in the range at the end of the 17th century; John White examined the flora of the district, and of the Kilkeel neighbourhood especially, and supplied notes of the local plants to the "Irish Flora" (1833). John Templeton, Dr. Mackay, and Dr. Stokes, and later Wm. Thompson, G. C. Hyndman, and Professor Dickie, botanized among the hills and valleys. In recent years T. H. Corry, C. Dickson, and H. C. Hart, and in cryptogamic botany Rev. C. H. Waddell and Rev. H. W. Lett, have each added their quota of information to our botanical knowledge of the district. Mr. Hart's notice of the flora of the Mournes[1] is the result of a very few days well spent among the mountains. To certain statements of his, such as the extermination of *Cryptogamme crispa*, the unfavourability of the mountain-sides for the growth of plants, &c., we venture to take exception, and the majority of his upper limits of species we have raised; taking an average on all the species of which Mr. Hart and ourselves record upper limits, our upper limit is over 100 feet higher

[1] "Plants of some of the Mountain Ranges of Ireland," Proc. Royal Irish Academy, Ser. II., vol. iv., p. 238, 1884.

than his. Rev. H. W. Lett has given a voluminous Report on the Mosses, Hepatics, and Lichens (*Proc. R.I.A.*, Ser. III., vol. i., p. 265, 1889) of the Mourne Mountains and a large surrounding area.

From the above remarks it will be seen that the flora of this district has already been fairly well, though not exhaustively nor systematically, worked out by the botanists who have preceded us. The present exploration was undertaken, not in the expectation of adding many novelties to our north-eastern records, but with the object of ascertaining fully the extent and limits of this mountain flora, not only in respect of rare species, but also the more common forms, and of settling definitely some old records which stood in need of either confirmation or confutation. The opportunities for this revision have been considerable. Our visits to the mountains ranged from May till September, and extended over the seasons 1889 and 1890. During this time we spent, separately or together, forty days in the district, and traversed on foot over 850 miles of mountain, valley, or road; scarce a cliff or a stream of the least importance but has been visited and revisited; and it may be claimed that our examination of the flora has been reasonably complete.

The annotated list which follows contains 584 species and 31 varieties; an appendix is added in which are given such species or varieties, 35 in number, as have been recorded from the district, but were not found by us. The total flora of the district may be taken at 593 species, made up as follows:—Indigenous species, 566; escapes, colonists, or casuals, 18; species recorded from the district, which, though not found by us, no doubt still exist in the neighbourhood, 9; total, 593. Leaving the excluded species out of sight, the 575 species composing the indigenous flora equals 70 per cent. of the flora of District 12, or 57 per cent. of the flora of Ireland—a fairly large proportion for an area so limited. The flora of the Mourne Mountains is, however, chiefly remarkable by way of negative characters:—the rarity of alpine plants; Ireland is not rich in alpines, but the Mournes, despite their loftiness, can claim only a fourth of the Irish species; the poverty in species of Watson's Atlantic type, there being present only a third of the Irish representatives of that group; and the complete absence of plants of the Germanic and Hibernian types.

Comparing the proportion of the total Irish flora, District 12 flora, and Mourne flora, with that of some of the principal orders in the same areas, we find that Caryophyllaceæ and Umbelliferæ, which are in excess of their due number in District 12, are also in excess in the Mourne district. Compositæ, Scrophulariaceæ, Amentiferæ, and

Filices, which have a proportionate representation in District 12, are over-represented in our district. Ranunculaceæ, Leguminosæ, Labiatæ, and Orchidaceæ are under their proper ratio in District 12, and are similarly under the ratio in the Mournes. Rosaceæ and Cyperaceæ, though in excess of their due in District 12, are below the proportionate ratio in our district.

Out of a list of 88 species given in "Cybele Hibernica," as being the more remarkable plants of District 12 (Derry, Antrim, and Down), fifteen occur among the Mournes, being only 17 per cent. The fact that the essential feature of District 12 lies in its great basaltic plateau in the north-east, will no doubt account for this discrepancy.

The Mourne district is remarkably poor in poppies, as out of four species occurring in county Down, one only, our common *P. dubium* (aggregate), haunts the Mournes, and its colonies are few and far between. The Rubi of the district are not remarkable for variety, and mostly possess but small interest. One species, however, *R. ammobius*, a somewhat distinct form (*si sic omnes !*), only recently recognized as British, is new to the Irish flora. It is remarkable that of seven saxifrages found in District 12, one only, *S. stellaris*, inhabits the Mourne Mountains. To the Hieracia of the district we have paid particular attention, and during the period of our investigation gathered and dried some 250 specimens. We have to acknowledge with hearty thanks the kindness of Mr. F. J. Hanbury, F.L.S., who examined the greater part of this large series, and named them in accordance with the terminology of his splendid monograph of that critical genus, now in course of publication. The Hawkweed flora of the Mournes is exceptionally rich, no less than 14 forms occurring. Of these *H. auratum* has not previously been recorded from Ireland, and *H. argenteum* is new at least to District 12, the plant recorded under that name from the Mournes by Mr Hart being a widely different and most interesting form, which we hope will shortly be figured and described by Mr. Hanbury.[1] In Amentiferæ the willows are fairly represented, and all the other genera grow in the mountain glens and on the cliffs. Among Coniferæ, *Juniperus nana* alone occurs. Trunks and roots of the Scotch fir are dug out of the bogs up to 1000 feet elevation, far above the limit at which it will now grow. The name of the town of Newry shows that in former times the Yew flourished on the borders of our district. The scarcity of orchids is remarkable, considering the extent of upland pasture apparently well

[1] *H. hibernicum*, Hanb., *Jour. Bot.*, Sept. 1892, p. 258 (added in Press).

suited to their growth. Of 16 species occurring in District 12, 14 of which inhabit county Down, 8 only are found in the Mournes, and several of these are very rare. Of pondweeds we enumerate only four, but the rapidity of the mountain streams and scarcity of lowland waters account for this. A rich fern flora can be reported, all the 23 county Down species being found on the Mourne Mountains; the remainder of District 12 yields only four species additional.

The aquatic flora of the mountains is very limited, and in all three high-level lakes of the range is precisely the same, numbering just four species of plants: *Lobelia dortmanna*, *Littorella lacustris*, *Juncus supinus*, and *Isoetes lacustris*. The lakes were dragged with a specially-designed grappler, consisting of a three-inch diameter leaden disc fringed with fish-hooks, and fastened on an iron spindle passing through its centre, to one end of which a cord was attached. This implement worked admirably, but the results added little to shore observations. *L. dortmanna* grows in 0 to 3 ft. of water, at which latter depth it seldom if ever flowers. *Juncus supinus* flourishes in up to 4 feet of water, growing up to the surface with the habit of a pond-weed, having brown capillary leaves and lax flower-stems, of which the panicle alone rises above the water. *I. lacustris* grows in profusion in 2 to 8 feet of water, at which latter depth the grappler brought up very fine specimens with abundant fruit. The deeper water of the mountain lakes (a sounding of 17 feet was taken in the Blue Lough near the Slieve Lamagan shore) yields no plant life whatever, and the bottom consists of soft peat-mud. The plants enumerated flourish equally on peat and on granite sand.

The complete absence of maritime species on the mountains is worthy of note, considering the proximity of the range to the sea. Such plants as *Cochlearia officinalis*, *Silene maritima*, *Armeria maritima*, *Plantago coronopus*, and *P. maritima* (all of which range to 1000 feet or more in Antrim or Derry) are in these mountains conspicuous only by their absence.

The effect of the geological formation on the flora of the Mournes, when compared with the adjoining basaltic highlands of Antrim, is marked. Plants which are characteristic of, and often abundant on the Antrim hills, such as

Drosera anglica.	*Alchemilla vulgaris* var. *minor.*
Sisymbrium thalianum.	*Saxifraga hypnoides.*
Arenaria verna.	*Galium boreale.*
Geranium lucidum.	*Hieracium iricum.*
Trifolium medium.	*Orobanche rubra.*

are absent from the Mourne range, and most of them from county Down. The same remark applies to some characteristic Antrim lowland plants, such as—

Geranium pratense.
G. sylvaticum.
Geum rivale.
Parnassia palustris.
Pyrola media.
Melampyrum sylvaticum.
Gymnadenia conopsea.
Habenaria viridis.
Epipactis latifolia.

Against these, the only plants that we can claim for the Mourne district, which do not occur in county Antrim, are a few rare or critical species :—

Drosera intermedia.
Glaucium flavum.
Rubus ammobius.
R. nitidus.
Rosa involuta (type).
Saussurea alpina.
Hieracium argenteum.
Cynoglossum officinale.
Linaria repens.
Atriplex portulacoides.
Cladium mariscus.

Compared with county Louth, which adjoins on the south, a less difference is noticeable than in the case of Antrim, but the intervening waters of Carlingford Lough, which form the northern boundary of the great Carboniferous area, form also a northern limit, on the east coast, of several plants, which, more or less common to the southward, do not occur further north, or appear there only as rare and local members of the flora :—

Papaver rhœas.
Trifolium striatum.
Anthemis cotula.
Thrincia hirta.
Tragopogon pratensis.
Atriplex portulacoides.

The fact of the slate rocks affording more favourable conditions for plant life than the granites, has already been alluded to. The absolute difference of the floras of the two formations of the Mourne Mountains is, however, inappreciable. *Cryptogamme crispa* and *Saxifraga stellaris* were not observed growing on slate, nor was *Sedum rhodiola* seen on granite.

Of the plants which appear in the following list, seven are new to District 12 of *Cybele Hibernica*:—

Drosera intermedia.
Rubus ammobius.
R. nitidus.
Rosa involuta (type).
Saussurea alpina.
Hieracium argenteum.
H. auratum.

Of these, *R. ammobius* and *H. auratum* are now for the first time recorded from Ireland.

A few more plants in our list are new to county Down :—

Lepidium campestre.
Sagina ciliata.
(*Saponaria officinalis.*)
Spergularia rubra.
Rosa sabini.
Epilobium angustifolium.
Hieracium friesii.
Salix purpurea.
Populus tremula.

Carduus pratensis and *Equisetum hyemale* might be added to this list, the previous records being unsatisfactory and unconfirmed. Over 80 species are new to the Mourne Mountain district, and to the southern half of county Down.

To the names of many species in the following annotated list we have appended the upper, and occasionally the lower limit at which they were observed. The figure given for each plant is usually the maximum (or minimum) of a number of observations made at different spots on the mountains; the precise spot at which each maximum elevation was noted we have not thought it necessary to specify. This method, while for the commoner species, such as those of Ulex, Erica, Pinguicula, Pteris, it gives the true upper limit (anywhere below which the plant may be expected), for other species gives perhaps an exceptional elevation, as *Rubus saxatilis*, *Rosa spinosissima*, *Hedera helix*, *Lonicera periclymenum*, *Salix repens*, and *Lastrea oreopteris*, all at 2000 feet, the highest elevation yet recorded for any of these plants in Ireland, and in Great Britain for some of them. Crevices in slate rocks were the habitats in these cases. A plant ascends much higher when growing in the shelter of rocks than on a smooth peat-covered or stony mountain-side, and a patch of broken ground or a ridge of rocks on a mountain will immediately raise the limit by several hundreds of feet. In the subjoined list of species observed on the summits of the higher peaks, it will be noticed that the rock-crowned summits of Slieve Bingian and Slieve Bearnagh yield a number of plants which do not grow on the smooth and wind-shorn tops of some much lower mountains. Both mountains and species are arranged in descending order :—

Summit Plants of the Mourne Mountains.

SPECIES.	Slieve Donard (2796).	Slieve Commedagh (2512).	Slieve Bingian (2449).	Slieve Bearnagh (2394).	Slieve Meel Beg (2310).	Slieve Lamagan (2306).	Slieve Muck North (2198.)	Chimney Rock M. (2152).	Eagle Mountain (2084).	Slieve L. Shannagh (2000).	Slieve Maganmore (1837).	Totals.
Potentilla tormentilla, . .	×	×	×	×	..	×	..	×	×	×	×	9
Galium saxatile, . .	×	×	×	×	×	×	×	×	×	×	×	11
Vaccinium myrtillus, .	×	×	×	×	×	×	×	×	×	×	×	11
V. vitis-idæa, . .	×	×	×	×	..	×	×	..	..	..	..	6
Calluna erica, . .	×	×	×	×	×	×	×	×	×	×	×	11
Empetrum nigrum, .	×	×	×	×	..	×	×	×	×	×	×	10
Rumex acetosella, . .	×	×	..	..	..	..	..	..	..	..	..	2
Salix herbacea, . .	×	×	×	×	×	..	..	×	..	×	×	8
Carex pilulifera, . .	×	×	×	×	×	×	..	×	×	×	×	10
Festuca ovina, . .	×	×	×	×	×	×	×	×	×	×	×	11
Aira flexuosa, . .	×	..	×	×	..	×	..	×	×	..	×	7
Agrostis canina, . .	×	×	×	..	×	×	×	×	×	×	×	10
Lycopodium selago, .	×	..	..	×	..	..	..	×	..	..	..	3
L. alpinum, . .	×	×	..	×	×	..	..	×	..	..	..	5
Luzula maxima, . .	..	×	..	×	..	..	..	..	..	..	..	2
Juncus squarrosus, .	..	×	..	..	..	..	..	×	×	..	×	4
Scirpus cæspitosus, .	..	×	..	..	..	..	×	..	..	..	×	3
Viola sylvatica, . .	..	..	×	..	..	..	..	..	..	..	..	1
Solidago virgaurea, .	..	..	×	×	..	..	..	..	..	..	..	2
Erica cinerea, . .	..	..	×	..	..	×	..	×	×	×	×	6
Nardus stricta, . .	..	..	×	..	..	..	..	×	..	×	×	4
Molinia cærulea, . .	..	..	×	..	..	..	..	..	..	..	×	2
Athyrium filix-fœmina,	..	..	×	..	..	..	..	..	×	..	..	2
Lastrea dilatata, . .	..	..	×	×	×	×	..	×	×	×	..	7
Blechnum boreale, .	..	..	×	×	..	×	..	..	×	×	×	6
Polypodium vulgare, .	..	..	×	×	..	..	..	..	..	..	..	2
Polygala vulgaris, . .	..	..	..	×	..	..	..	..	..	..	×	2
Melampyrum pratense, var. montanum, .	..	..	..	×	..	..	..	..	..	..	..	1
Euphrasia officinalis, .	..	..	..	×	..	..	..	..	..	..	..	1
Carex binervis, . .	..	..	..	×	..	..	..	×	×	×	×	5
Anthoxanthum odoratum,	..	..	..	×	..	..	..	..	..	..	..	1
Carex glauca, . .	..	..	..	..	..	×	..	..	..	..	..	1
Eriophorum polystachion,	..	..	..	..	..	..	×	..	..	..	..	1
Festuca rubra, . .	..	..	..	..	..	..	×	..	..	..	..	1
Eriophorum vaginatum,	..	..	..	..	..	..	..	×	×	..	×	3
Erica tetralix, . .	..	..	..	..	..	..	..	..	×	..	×	2
Agrostis alba, . .	..	..	..	..	..	..	..	..	×	..	..	1
Juniperus nana, . .	..	..	..	..	..	..	..	..	..	×	..	1
Juncus supinus, . .	..	..	..	..	..	..	..	..	..	×	×	2
Carex echinata, . .	..	..	..	..	..	..	..	..	..	..	×	1
Juncus effusus, . .	..	..	..	..	..	..	..	..	..	..	×	1
Campanula rotundifolia,	..	..	..	..	..	..	..	..	..	..	×	1
Totals, .	14	15	20	22	9	14	10	18	18	16	24	

Plants usually occur at a lower elevation on a mountain summit than on the flanks of a higher mountain, the summits being, as a rule, more wind-swept and inhospitable.

The following is a descending list of the species of which we noted the upper limit on the Mourne Mountains: those species of which we have raised the recorded upper limit, or which are now for the first time assigned a definite place in the Mourne Mountain flora, being marked with an asterisk:—

List of Mourne Mountain Plants in descending order.

[*Alpine plants are printed in italics.*]

2796 feet.

Potentilla tormentilla.
Galium saxatile.
Calluna erica.
Vaccinium myrtillus.
V. vitis-idæa. *
Rumex acetosella.
Empetrum nigrum.
Salix herbacea.
Carex pilulifera.
Agrostis canina. *
Aira flexuosa.
Festuca ovina (viviparous).
Lycopodium alpinum.
L. selago. *

2510 feet.

Juncus squarrosus. *
Scirpus cæspitosus. *
Carex glauca. *

2500 feet.

Luzula maxima.

2450 feet.

Ranunculus acris. *
Viola sylvatica.
Stellaria uliginosa. *
Cerastium triviale. *
Montia fontana. *
Chrysosplenium oppositifolium. *
Solidago virgaurea. *
Erica cinerea. *
Nardus stricta. *
Molinia cærulea. *
Poa annua. *
Polypodium vulgare. *
Lastrea dilatata. *
Athyrium filix-fœmina. *
Blechnum boreale. *
Lycopodium clavatum. *

2394 feet.

Polygala vulgaris. *
Melampyrum pratense, *var.* montanum. *
Carex binervis. *
Anthoxanthum odoratum. *

2300 feet.

Euphrasia officinalis. *

2200 feet.

Eriophorum polystachion. *
Saxifraga stellaris.

2055 feet.

Erica tetralix. *
Eriophorum vaginatum. *
Agrostis alba. *

LIST OF MOURNE MOUNTAIN PLANTS—*continued.*

2000 feet.

Hypericum pulchrum. *
Oxalis acetosella.
Rubus saxatilis. *
Rosa spinosissima. *
Sedum rhodiola. *
Hedera helix. *
Lonicera periclymenum. *
Antennaria dioica. *
Saussurea alpina. *
Hieracium anglicum. *
Campanula rotundifolia.
Thymus serpyllum.
Pinguicula vulgaris. *
Salix repens. *
Juniperus nana.
Juncus supinus. *
Carex echinata. *
Polypodium phegopteris.
Lastrea oreopteris. *
Cystopteris fragilis. *
Selaginella spinulosa. *

1900 feet.

Scabiosa succisa. *
Tussilago farfara. *
Listera cordata.
Juncus acutiflorus. *

1837 feet.

J. effusus. *

1800 feet.

Pyrus aucuparia.
Schœnus nigricans. *

1720 feet.

Polygala vulgaris, *var.* serpyllacea. *

1700 feet.

Ranunculus flammula. *
Hieracium argenteum. *
Carex hornschuchiana. *
Cryptogamme crispa.
Equisetum hyemale (*Waddell*). *

1662 feet.

Aira præcox. *

1600 feet.

Menyanthes trifoliata. *
Pinguicula lusitanica. *
Anagallis tenella. *
Agrostis vulgaris, *var.* pumila. *
Festuca rubra. *
Asplenium adiantum-nigrum. *
A. trichomanes. *

1500 feet.

Thalictrum minus, *var.* montanum.
Ulex gallii.
Alchemilla vulgaris. *
Epilobium angustifolium. *
Hydrocotyle vulgaris. *
Sanicula europæa. *
Angelica sylvestris. *
Heracleum sphondylium. *
Valeriana officinalis, *var.* mikani. *
Hieracium auratum. *
Jasione montana. *
Melampyrum pratense.
Primula vulgaris (type). *
Salix aurita. *
Festuca ovina (normal).
Lastrea filix-mas. *
L. filix-mas, *var.* abbreviata. *
Hymenophyllum wilsoni.

LIST OF MOURNE MOUNTAIN PLANTS—*continued.*

1450 feet.

Drosera rotundifolia.

1400 feet.

Anemone nemorosa.
Rubus idæus. *
R. coryllifolius. *
Hieracium crocatum. *
Digitalis purpurea.
Teucrium scorodonia. *
Rumex acetosa.
Myrica gale. *
Betula glutinosa. *
Orchis maculata.
Narthecium ossifragum. *
Juncus conglomeratus.
Potamogeton polygonifolius.
Carex vulgaris.
C. flava. *
Lastrea æmula. *
Pteris aquilina.

1350 feet.

Viola palustris. *
Hypochæris radicata.
Leontodon autumnale.
Lobelia dortmanna.
Littorella lacustris.
Carex panicea.
Holcus lanatus. *
Poa pratensis.
Isoetes lacustris.

1300 feet.

Ranunculus repens. *
Meconopsis cambrica. *
Quercus robur. *

1225 feet.

Rhynchospora alba. *

1200 feet.

Draba verna.
Lotus corniculatus. *
Crepis paludosa. *
Hieracium lasiophyllum. *
Populus tremula. *

1150 feet.

Cardamine pratensis. *
Lotus pilosus. *
Alchemilla arvensis.
Peplis portula. *
Epilobium palustre.
Pedicularis palustris. *
Veronica officinalis. *
Plantago lanceolata. *
Callitriche hamulata. *
Carex rostrata.
Glyceria fluitans. *

1110 feet.

Eleocharis multicaulis.

1000 feet.

Ranunculus hederaceus. *
Lathyrus macrorrhizus. *
Prunus communis. *
Cratægus oxyacantha. *
Sedum anglicum. *
Cotyledon umbilicus.
Carduus palustris. *
Leontodon taraxacum. *
Fraxinus excelsior. *
Myosotis repens. *
Rhinanthus crista-galli. *
Veronica scutellata.

List of Mourne Mountain Plants—*continued.*

V. serpyllifolia. *
Corylus avellana. *
Arum maculatum. *
Aira caryophyllea.
Equisetum sylvaticum. *
E. limosum. *

950 feet.

Hieracium murorum. *
H. friesii. *

800 feet.

Hypericum humifusum. *
Ulex europæus.
Sarothamnus scoparius. *
Gnaphalium sylvaticum. *
Chrysanthemum segetum. *
Senecio sylvaticus. *
Hieracium flocculosum.
Ilex aquifolium.

700 feet.

Carduus pratensis. *

650 feet.

Hypericum elodes. *

500 feet.

Viola canina. *
Filago germanica. *
F. minima. *
Cynoglossum officinale. *

In the annotated list which follows, the lower limit of a number of mountain species will be also found; these are generally high, on account of the absence of sea-cliffs and rough ground at low elevations: for instance, *Meconopsis cambrica*, *Epilobium angustifolium*, *Sedum rhodiola*, and *Empetrum nigrum*, which in county Antrim descend to within a few feet of sea-level, in the Mournes find their limit at 950, 1250, 1000, and 1900 feet respectively.

In conclusion, we have to thankfully acknowledge kind assistance rendered by Mr. F. J. Hanbury, F.L.S., who, as already stated, examined our series of Hieracia; by Professor Babington, F.R.S., who determined the Rubi; by Mr. James Groves, F.L.S., who named our few Characeæ; and by Mr. Arthur Bennett, F.L.S., who favoured us with his critical judgment on a number of doubtful points.

LIST OF SPECIES.

RANUNCULACEÆ.

Thalictrum minus, Linn. Abundant on sandhills at Newcastle, close to the base of Slieve Donard. Var. *β. montanum*, Wallr., 300–1500 feet; rare. Rocks by Kilbroney River; slate rocks on east side of Pigeon Rock Mountain; cliff near the cave on Cove Mountain; by a waterfall on west side of Thomas Mountain, above the ice-house. Not seen on west side of Slieve Bingian (Templeton, 1808; *Flor. N.E.I.*).

Anemone nemorosa, Linn., 0–1400. At its upper limit flowers in July and August.

Ranunculus peltatus, Fries. Pools on the low ground, rare; Greencastle; Lough Island Reavy; Lisnacree. *R. hederaceus*, Linn., 0–1000. *R. sceleratus*, Linn. Salt marshes at Warrenpoint, Mill Bay, and Newcastle. *R. flammula*, Linn., 0–1700. Var. *pseudo-reptans*. This prostrate form occurs on the west margin of a mill-dam south-west of Hilltown. *R. ficaria*, Linn. *R. auricomus*, Linn. Wooded shore below Rostrevor Quay; very rare. *R. acris*, Linn., 0–2450. Var. *tomophyllus*, Jordan. Rocky banks of Moygannon River, and probably common in the district. *R. repens*, Linn., 1300. *R. bulbosus*, Linn.

Caltha palustris, Linn.

(*Aquilegia vulgaris*, Linn. Margin of Shimna River, north-west of Newcastle. Apparently well established.)

NYMPHÆACEÆ.

Castalia alba (Linn.), Salisb. Altnadua Lake, south-west of Castlewellan; very rare.

Nymphæa lutea, Linn. With the preceding species in Altnadua Lake; and in a lake N.W. of Milltown, near Warrenpoint.

PAPAVERACEÆ.

Papaver dubium, Linn. (aggregate). Not common. (*P. somniferum*, Linn. Abundant in a field by the road near Wood House, south of Rostrevor.)

Meconopsis cambrica, Vig., 950–1300. Along the banks of the stream above Rostrevor Waterworks; abundant in one spot; known here for almost 100 years.

Glaucium flavum, Crantz. Sandy and gravelly shores. At Mill Bay, in Carlingford Lough, and abundant in places from Greencastle Point to Nicholson's Point, and further north at Leestone and Glassdrumman Port.

Chelidonium majus, Linn. Roadsides; sparingly at several spots near Rostrevor and Killowen; and about a mile north of Annalong.

FUMARIACEÆ.

Fumaria capreolata, Linn. Var. *pallidiflora*, Jordan. Borders of fields about Warrenpoint, Killowen, Kilkeel, and Newcastle. Var. *confusa*, Jordan. Frequent.

CRUCIFERÆ.

Nasturtium officinale, R. Brown. *N. palustre* (Willd.), De Candolle. Wood at Rostrevor, and by lake at Narrow-water; rare.

Barbarea vulgaris, R. Brown. *B. intermedia*, Boreau. Sparingly in Moygannon Glen, and in cultivated fields at Rostrevor, Killowen, and Newcastle.

Cardamine flexuosa, Withering. *C. hirsuta*, Linn. *C. pratensis*, Linn., 1150.

Sisymbrium officinale, Linn. *S. alliaria*, Linn. Seashore south of Rostrevor; very rare.

Brassica campestris, Linn.

(*Sinapis alba*, Linn. Abundant in many fields about Killowen; apparently well naturalized.) *S. arvensis*, Linn.

Draba verna, Linn., 0–1200. Bare rocks near summit of Spelga, and on sandhills at Newcastle.

Cochlearia officinalis, Linn. *C. danica*, Linn. Plentiful by shores of Carlingford Lough, from Warrenpoint to Greencastle, and sparingly at Annalong.

Thlaspi arvense, Linn. Abundant in cultivated fields at Killowen, and thence for more than a mile eastward to Seafield. Not seen in Templeton's station south of Newcastle (*Flor. N.E.I.*)

Lepidium campestre (Linn.), Brown. Sparingly in fields at Killowen. No previous reliable record for the county. *L. smithii* (Linn.), Hooker.

Capsella bursa-pastoris (Linn.), Moench.

Coronopus ruellii, Gaertner. Rostrevor, Killowen, Kilkeel, Annalong, Newcastle; frequent in waste places by the sea.

Cakile maritima, Scop. Seashores at Newcastle and Cranfield Point.

Raphanus raphanistrum, Linn. Fields. *R. maritimus*, Smith. Sparingly on shore by Cranfield coastguard station; very rare.

RESEDACEÆ.

Reseda luteola, Linn. Sandy ground at Moygannon and Newcastle.

VIOLACEÆ.

Viola palustris, Linn., 1350. *V. sylvatica*, Fries, 2450. *V. canina*, Linn., 0–500. Shore of Lough Island Reavy; dry pastures north of Bryansford; rocky sea-shore at Bloody Bridge, and sandhills at Newcastle. *V. lutea*, var. *curtisii*, Forster. Sands at Cranfield and Newcastle, and on margin of Castlewellan Lake. *V. tricolor*, Linn. Sandy ground; frequent. Var. *arvensis*, Murr. Borders of fields.

DROSERACEÆ.

Drosera rotundifolia, Linn., 0–1450. *D. intermedia*, Heyne, 350–450. Wet, boggy ground by Colligan Bridge, on the Kilkeel River; also in a marsh among fields south-west of same place, and by peaty pools further up the river near the foot of Slieve Bingian. The vague record in *Irish Flora*, "Marshy places at the foot of the Mourne Mountains," is thus verified, and the plant is assigned a definite station in District 12.

POLYGALACEÆ.

Polygala vulgaris, Linn., 2394. Var. *serpyllacea*, Weihe. On dry heaths; not common; rises to 1720 feet.

CARYOPHYLLACEÆ.

(*Saponaria officinalis*, Linn. Roadside south of Bloody Bridge; not native.)

Silene anglica, Linn. In great profusion in fields by the course of the Causeway Water; fields at Kilkeel, Annalong, Bloody Bridge, Hilltown, and Bryansford, and on sandhills and in fields about Newcastle. Restricted *S. anglica* L. alone occurred. *S. inflata*, Smith. *S. maritima*, Smith. Seashores; ascends the course of the White Water and Causeway Water for two miles.

Lychnis flos-cuculi, Linn. Near Fofanny, and by the Burren River south-east of Castlewellan, and in a salt-marsh at Narrow-water; rare. *L. diurna*, Sibthorp. Sparingly in bushy places by Bloody Burn; rare. *L. githago*, Linn. Among corn crops at Killowen, Causeway Water, Annalong, and near "Maggie's Leap": not common.

Sagina procumbens, Linn. *S. apetala*, Linn. Rostrevor Quay, at Warrenpoint, and at Newcastle Railway Station; rare. *S. ciliata*, Fries. Sandhills at Newcastle; an addition to the county flora. *S. maritima*, Don. Shores at Warrenpoint, Killowen, mouth of Causeway Water, and at Newcastle; not common. *S. nodosa* (Linn.), E. Meyer. Shore at the mouth of the Causeway Water; very rare.

Arenaria peploides, Linn. *A. trinervia*, Linn. Rostrevor Wood, Tollymore Park, and roadside near Tollymore House. Not seen at Kilkeel (*Ir. Flor.*). *A. serpyllifolia*, Linn. Shores at Mill Bay in Carlingford Lough, and abundant on sandhills at Newcastle and Cranfield Point.

Stellaria media, Linn. *S. holostea*, Linn. *S. graminea*, Linn. *S. uliginosa*, Murr., 2450.

Cerastium glomeratum, Thuillier. *C. triviale*, Link, 2450. *C. tetrandrum*, Curtis. Rostrevor, Killowen, Newcastle; frequent.

Spergularia rubra (Linn.), Persoon. Abundant on shores of Lough Island Reavy. New to the county. *S. rupestris*, Lebel. Warrenpoint, Killowen, and Mill Bay. *S. media*, Persoon.

Spergula arvensis, Linn.

Scleranthus annuus, Linn.

MALVACEÆ.

Malva sylvestris, Linn. *M. rotundifolia*, Linn. Frequent by roadsides from Killowen to Seafield; not seen elsewhere.

(*Lavatera arborea*, Linn. By cottages—Annalong, Greencastle, &c.; probably originally native.)

HYPERICACEÆ.

Hypericum androsæmum, Linn. *H. tetrapterum*, Fries. *H. perforatum*, Linn. In great abundance on Newcastle sandhills; rare elsewhere. *H. humifusum*, Linn., 0–800. *H. pulchrum*, Linn., 2000. *H. elodes*, Hudson, 100–650. Abundant in marsh south-west of Colligan Bridge, on Kilkeel River; marshes by Altnadua Lake, Slievenabrock, Luke's Mountain, Shimna River above Tollymore Park, and in Castlewellan Park.

GERANIACEÆ.

Geranium perenne, Hudson. Sparingly on roadside near Newcastle Presbyterian Church; very rare. *G. molle*, Linn. *G. dissectum*, Linn. *G. robertianum*, Linn.

Erodium cicutarium (Linn.), Le Herit. A maritime plant that is common on the sandy coast line. It occurs, however, at two to four miles from the sea on banks and roadsides near Bryansford and Castlewellan. *E. moschatum* (Linn.), Le Herit. Roadside a half mile north of Annalong; not seen by us at Kilkeel, and the note in *Irish Flora* "abundant at Kilkeel Bay" probably refers to the preceding species. *E. maritimum*, Le Herit. Sandhills at Newcastle; very rare.

OXALIDACEÆ.

Oxalis acetosella, Linn., 2000.

LINACEÆ.

Linum catharticum, Linn.

Radiola linoides (Linn.), Gmelin. Abundant on drained site of Ballymartin Lake. Boggy spots by Causeway Water, and east of Dunny Water Bridge. Rocks by shore at Bloody Bridge, and sparingly among corn at "Maggie's Leap," and on an old road near Brackenagh Cross Water Bridge. Not seen at Kilkeel (Wade's *Plantæ Rariores* and *Ir. Flor.*) or Greencastle (S.A.S., *Flor. N.E.I.*).

CELASTRACEÆ.

Euonymus europæus, Linn. Thickets by Ghann River; by the shore south of Rostrevor; near Warrenpoint, Annalong, and Newcastle, and in Tollymore Park; not rare.

LEGUMINOSÆ.

Ulex europæus, Linn., 800. *U. gallii*, Planch., 0–1500.

Sarothamnus scoparius, Linn., 800.

Ononis repens, Linn. Plentiful on sands east of Cranfield Point, and on sandhills at Newcastle.

Medicago lupulina, Linn.

Trifolium pratense, Linn. *T. repens*, Hudson. *T. procumbens*, Linn. *T. dubium*, Sibthorp.

Lotus corniculatus, Linn., 1200. *L. pilosus*, Beeke, 1150. A small prostrate form is abundant in fields by the Yellow Water, near Slievenagore.

Anthyllus vulneraria, Linn. Abundant by Causeway Water and White Water; frequent at Hilltown; rare elsewhere; not seen at the eastern end of the mountains.

Vicia hirsuta (Linn.), Koch. *V. sylvatica*, Linn. In some quantity on steep banks by the sea north of Bloody Burn. Not found in the wood at Rostrevor (Templeton, 1793, *Flor. N. E. I.*). *V. cracca*, Linn. *V. sepium*, Linn. *V. angustifolia*, Roth.

Lathyrus pratensis, Linn. *L. macrorrhizus*, Wimm, 1000. Var. *tenuifolius*. Near Rostrevor.

ROSACEÆ.

Prunus communis, Hudson, 1000. *P. avium*, Linn. Doubtfully wild. *P. cerasus*, Linn. Hedges near Annalong and Ballymartin Lake. Perhaps introduced.

Spiræa ulmaria, Linn.

Agrimonia eupatoria, Linn. Killowen, roadside south of Bloody Bridge, and sandhills at Newcastle; rare.

Alchemilla vulgaris, Linn., 1500. *A. arvensis*, Lamk., 1150.

Potentilla anserina, Linn. *P. reptans*, Linn. Abundant at Warrenpoint; at Moygannon Glen; shore at Rostrevor, Killowen, and near Newcastle. *P. tormentilla*, Linn., 2796. Var. *procumbens*, Sibthorp. By Kilbroney River, and near Newcastle. *P. fragariastrum*, Linn.

Comarum palustre, Linn.

Fragaria vesca, Linn.

Rubus idæus, Linn., 1400.

R. ammobius, Focke. Sparingly by margin of Castlewellan Lake; new to the Irish flora. *R. nitidus*, W. & N., var. *hamulosus*, Mull. Margin of Altnadua Lake; rare. *R. rusticanus*, Mercier. Abundant by Causeway Water and Ghann River, but not general. *R. pyramidalis*, Kaltenberg. Tollymore Park and Donard Lodge, near Newcastle. (*R. colemanni*, Bloxam. Thickets by the Ghann River. "Probably, I am not quite certain about this," C.C.B.). *R. carpinifolius*, W. & N. Thickets and bushy places near Newcastle; plentiful in Moygannon Glen. *R. macrophyllus*, *W. & N.* White Water, margin of Altnadua Lake, and in Tollymore Park. Var. *umbrosus*, Arrhenius. Thickets by the White Water, and at Donard Lodge. Var. *glabratus*, Bab. Thickets by the Ghann River. [We have thought it best to keep the two latter forms, for the present, under *R. macrophyllus*, though Prof. Babington's present view (*in litt.*) is that *umbrosus* and *glabratus*, together with *R. maassii*, Focke, might be combined as an aggregate under *R. nemoralis*, Müll.] Var. *schlectendalii* W. & N. Moygannon Glen. Though *R. macrophyllus* has only been positively identified from the above limited number of localities, yet this in its various forms is one of the commonest brambles of the district. *R. mucronatus*, Bloxam? C.C.B. By mountain streams near Hilltown. *R. kœhleri*, Weihe. Frequent in some of its very variable, and not easily distinguished forms. Var. a *kœhleri*, Weihe. Newcastle. Var. *pallidus*, Bab, *non* Weihe. Tollymore Park. Var. *melanoxylon*, Mill. & Wirt? Damp thickets near Newcastle. Var. *plinthostylus*, Genevier? Tollymore Park. [These last two forms have been doubtfully determined by Prof. Babington. They have been placed by us under *kœhleri*, until better understood and correlated with continental brambles.] *R. corylifolius*, Smith. Frequent, but by no means common. On cliffs of Pigeon Rock Mountain at 1400 feet. *R. saxatilis*, Linn., 800–2000. By Kilbroney and Causeway Rivers, and frequent on the mountains, rising to 2000 feet on Slieve Muck.

Geum urbanum, Linn.

Rosa spinosissima, Linn., 2000. A curious form, with large urceolate fruit, occurs on the gravelly beach at Killowen. *R. involuta*, Smith. Frequent on the mountain roads about Hilltown. The type is new to District 12. Var. *sabini*, Woods. Not rare in the district above Hilltown. *R. mollissima*, Willd. By the Causeway Water; very rare. *R. tomentosa*, Smith. *R. canina*, Linn. *R. arvensis*, Hudson. Wooded shore south of Rostrevor, and sparingly by Kilkeel road half a mile south of Bloody Bridge. Not seen in Tollymore Park (Templeton, 1795, *Flor. N.E.I.*).

Cratægus oxyacantha, Linn., 1000.

Pyrus malus, Linn. Doubtfully native. *P. aucuparia* (Linn.), Gaertner, 1800.

LYTHRACEÆ.

Lythrum salicaria, Linn.

Peplis portula, Linn., 0–1150. Throughout the district. Abundant on the drained site of Ballymartin Lake, and about Hilltown, and Lough Island Reavy.

ONAGRACEÆ.

Circæa lutetiana, Linn. *C. alpina*, Linn., Tollymore Park.

Epilobium angustifolium, Linn. Cliffs of Eagle Mountain at 1500 feet, and cliffs south of Blue Lake at 1250 feet. The only stations in the county where the plant is undoubtedly native. *E. hirsutum*, Linn. *E. parviflorum*, Schreber. *E. montanum*, Linn. *E. obscurum*, Schreber. *E. palustre*, Linn., 1150.

HALORAGACEÆ.

Myriophyllum alterniflorum, De Candolle.

Hippuris vulgaris, Linn. By Altnadua Lake and lake at Narrow-water, and in bog-holes on site of Moneyscalp Lake; rare.

PORTULACEÆ.

Montia fontana, Linn., 2450.

CRASSULACEÆ.

Sedum rhodiola, De Candolle, 1000–2000. Rocks near summit of Slieve Muck North, and east and west slopes of Slieve Muck; sparingly on west side of Pigeon Rock Mountain; Black Stairs on Shanslieve, and north-east side of Slievenaglough; rare, and on slate rocks only. (*S. telephium*, Linn. Roadside near Bloody Bridge, and occasionally, but only as an escape from cultivation.) *S. anglicum*, Hudson, 1000. *S. acre*, Linn.

(*Sempervivum tectorum*, Linn. On walls, &c., occasionally; not native.)

Cotyledon umbilicus, Linn., 1000.

SAXIFRAGACEÆ.

Saxifraga stellaris, Linn., 1100–2200. Cliffs of Cove Mountain, Hare's Gap, and abundant on north-west slopes of Donard and Commedagh Mountains.

Chrysosplenium oppositifolium, Linn., 2450.

UMBELLIFERÆ.

Hydrocotyle vulgaris, Linn., 1500.

Sanicula europæa, Linn., 1500.

Eryngium maritimum, Linn. Abundant on sandy shores from Greencastle Point to Nicholson's Point. Not seen at Newcastle (Millen, *Flor. Ulst.*).

Apium nodiflorum (Linn.), Reich. *A. inundatum*, Reich. Lakes and ponds near Warrenpoint, and at Moore Lodge, near Kilkeel; also by the Shimna River, and pool in sandhills at Newcastle.

Ægopodium podagraria, Linn.

Bunium flexuosum, Withering.

Pimpinella saxifraga, Linn. Abundant, and very variable. Two or three different-looking forms occur.

Œnanthe lachenalii, Gmel. A single specimen by the roadside near Killowen, and a few plants by the mouth of Causeway Water. *Œ. crocata*, Linn.

Æthusa cynapium, Linn. Warrenpoint, Rostrevor, and abundant in fields at Killowen.

Angelica sylvestris, Linn., 1500.

Heracleum sphondylium, Linn., 1500.

Daucus carota, Linn.

Torilis anthriscus (Hudson), Gaert. *T. nodosa* (Hudson), Gaert. In great abundance in some stony fields above Killowen.

Scandix pecten-veneris, Linn. Common in fields at Killowen.

Chærophyllum sylvestre, Linn. *C. anthriscus*, Lamk. Sparingly by roadside south of Knockshee; very rare.

(*Myrrhis odorata*, Linn. Roadside south of Spelga, probably an escape.)

Conium maculatum, Linn.

Smyrnium olusatrum, Linn.

HEDERACEÆ.

Hedera helix, Linn., 2000.

CAPRIFOLIACEÆ.

Sambucus ebulus, Linn. Waste ground at Warrenpoint. *S. nigra*, Linn.

Viburnum opulus, Linn. Shore south of Rostrevor, margin of Altnadua Lake, and in Tollymore Park.

Lonicera periclymenum, Linn., 2000. Grows on cliffs at high elevations as an erect bushy shrub, with showy flowers.

RUBIACEÆ.

Sherardia arvensis, Linn.

Asperula odorata, Linn.

Galium aparine, Linn. *G. verum*, Linn. *G. saxatile*, Linn, 2796. *G. palustre*, Linn.

VALERIANACEÆ.

Valeriana officinalis, Linn. Common. What seems to be var. *mikani* Watson occurs at 1500 feet on Slieve Muck, and var. *sambucifolia* Mikan at Mourne Park and Tullybranagan, but the two forms appear doubtfully distinct.

Valerianella olitoria (Linn.), Moench. *V. dentata*, Willd. Abundant in dry cultivated fields about Killowen and Seafield; also seen by Causeway Water, at Lisnacree, and near "Maggie's Leap."

DIPSACACEÆ.

Dipsacus sylvestris, Hudson. Dry sandy bank at Cranfield Point; very rare.

Scabiosa succisa, Linn., 1900. *S. arvensis*, Linn.

COMPOSITÆ.

Eupatorium cannabinum, Linn. Steep banks on shore north of Bloody Bridge, and sea cliffs south of Newcastle; very rare.

Petasites vulgaris (Linn.), Desf. Near Warrenpoint; very rare. (*P. fragrans*, Presl. Warrenpoint, Rostrevor, Newcastle; spreading through the county).

Tussilago farfara, Linn., 1900.

Aster tripolium, Linn. Abundant on shores of Carlingford Lough, and on sea cliffs south of Newcastle, but not general.

Bellis perennis, Linn.

Solidago virgaurea, Linn., 0–2449. Var. *angustifolia*, Gaud. By the Bann above Hilltown, and abundant by the river in Tollymore Park.

(*Inula helenium*, Linn. Near a cottage behind Annalong, planted).

Pulicaria dysenterica (Linn.), Gaert. By White Water, and roadside south of Annalong; not common.

Filago germanica (Huds.), Linn., 500. *F. minima* (Huds.), Fries. 500.

Gnaphalium uliginosum, Linn. *G. sylvaticum*, Linn., 0–800. Frequent throughout the district; especially abundant at the south-western end.

Antennaria dioica (Linn.), Br., 200–2000. By Kilbroney River; slate rocks of Slieve Muck at 2000 feet, and on Slieve Meel Beg; rare.

Achillæa ptarmica, Linn. A. *millefolium*, Linn.

(*Anthemis arvensis*, Linn. Margin of field near Glassdrumman Cottage; a casual.)

Matricaria inodora, Linn. (*M. chamomilla*, Linn. A single plant on a dry bank by the north-east margin of Lough Island Reavy; probably a casual).

Chrysanthemum leucanthemum, Linn. *C. segetum*, Linn., 800.

Artemisia vulgaris, Linn.

Tanacetum vulgare, Linn. Moygannon Glen; near the cornmill on Kilbroney River, and near the source of the same river; by the sea at Mill Bay, and on dry banks one mile south of Bloody Bridge.

Senecio vulgaris, Linn. *S. sylvaticus*, Linn., 0–800. Abundant in stony places on Spelga Mountain; gravel bank at Mill Bay; fields at Kinnehalla Wood; at Annalong, Lough Island Reavy, and Newcastle. *S. jacobœa*, Linn. *S. aquaticus*, Hudson.

Bidens tripartita, Linn. By the Bann 1½ mile east of Hilltown; rare. *B. cernua*, Linn. Roadside near Killowen; marsh near Lisnacree; pool at Moore Lodge near Kilkeel, and by the Shimna River behind Newcastle; not common.

Saussurea alpina (Linn.), De Candolle. Sparingly in fissures of dripping vertical slate rocks at 2000 feet on Slieve Muck North. The plant is confined to one small spot, and is represented by little more than a dozen of roots, and seems condemned to sterility, as no flower stems were sent up during the summers of 1889 and 1890. New to District 12.

Arctium nemorosum, Lej. Moygannon, and several places thence to Newcastle. The prevailing, if not the only burdock of the district.

Centaurea nigra, Linn. *C. cyanus*, Linn. Cultivated fields.

Carduus crispus, var. *acanthoides*, Linn. Fields and waste ground at Killowen; very rare. *C. tenuiflorus*, Curtis. Sandy shores about Greencastle, Mill Bay, Kilkeel, Annalong, and Newcastle. *C. lanceolatus*, Linn. *C. arvensis*, Curtis. *C. palustris*, Linn., 1000. *C. pratensis*, Hudson. Throughout the valley of the Kilbroney River up to 700 feet; some specimens very luxuriant, with three heads on one stem; also sparingly by the Causeway Water, and by the Shimna near Newcastle.

Lapsana communis, Linn.

(*Cichorium intybus*, Linn. Cornfield north of Kilkeel).

Hypochæris radicata, Linn, 1350.

Leontodon autumnalis, Linn, 1350. *L. taraxacum*, Linn, 1000. Var. *palustre*, Smith, Rostrevor.

Sonchus oleraceus, Linn. *S. asper*, Hoffman. *S. arvensis*, Linn.

Crepis virens, Linn., 200–1200. *C. paludosa*, Moench. Frequent on the rocky banks of the mountain streams.

Hieracium pilosella, Linn.

H. anglicum, Fries, 200–2000. Cliffs of Eagle Mountain, and of Pigeon Rock Mountain; cliffs by the cave on Cove Mountain, and by the Mill River: granite cliffs at Hare's Gap, and on the "Eagle Rock" of Slieve Donard, also by the Shimna and Spinkwee Rivers in Tollymore Park and above it. The most abundant and most widely spread hawkweed in the mountains. Var. *acutifolium*, Backhouse. By stream on Luke's Mountain at about 1000 feet, and on slate rocks by the Shimna above Tollymore Park.

H. schmidtii, Tausch. On granite cliffs of Bencrom; quite rare.

H. cinerascens, Jordan. Very rare, and at one spot only. Slate rocks at 1200 feet near summit of Spelga, south-east of Rostrevor. Very fine examples were gathered, in full blossom, as late as the end of August.

H. argenteum, Fries. Abundant on granite cliffs at south end of "Eagle Rock" on Slieve Donard at 1700 feet ("beautifully typical," F.J.H.). Sparingly by the Shimna above the saw mill in Tollymore Park, at about 100 feet elevation. In some abundance on granite cliffs at and near the cave on Cove Mountain, and on cliffs of Bencrom at 1500 feet. The plant which grows at Broughnamaddy, near Rostrevor, and is recorded as *H. argenteum* (Hart, *Proc. R.I.A.*, 1884, and *Jour. Bot.*, 1886), is a very different, and as yet unnamed form.[1] Mr. Hanbury considers Mr. Hart's "*H. argenteum*," from Laghy, Co. Donegal, to be identical with the Broughnamaddy plant. In this case Muckanaght and Maam Turk, Co. Galway, are the only other known stations in Ireland for *H. argenteum*, Fries.

H. murorum, Linn. Very rare. On granite rocks by the Bann below Spelga Mountain, at about 950 feet. Not refound on Spelga, south-east of Rostrevor (S.A.S., *Flor. N.E.I.*).

[1] In *Jour. Bot.*, Sept. 1892, p. 258, added in Press, this species is named by Mr. Hanbury *H. hibernicum*, n.sp., and described from specimens obtained at the Broughnamaddy station, in company with S. A. S., in July, 1891.

H. flocculosum, Backhouse. Sparingly by the Spinkwee River at 800 feet (granite); not 1500 feet as stated in *Flor. N.E.I.* A few specimens only were seen, but we obtained it more abundantly on shady slate rocks by a waterfall in Tollymore Park, lower down the same stream. Unknown elsewhere in Ireland, save a few plants on basalt at Sallagh Braes in county Antrim, recently determined by Mr. Hanbury, and not hitherto recorded.

H. vulgatum, Fries. On granite cliffs south of Blue Lough, and at both sides of the Hare's Gap; on slate rocks at 2000 feet on Slieve Muck North. Without doubt there are some other of our specimens which must, ultimately, be referred to this species, but Mr. Hanbury having for the present hesitated to give an unqualified decision, we refrain from publishing them on our own authority.

H. friesii, Hartman. Rocks by the Bann River above Hilltown bridge (350 feet) and at its junction with Rocky River, and again in its steep descent below Spelga Mountain (950 feet). One clump on the north bank of the Shimna River in Tollymore Park. New to county Down, and the name is new to the Irish flora, as this plant was formerly recorded as *H. gothicum*, var. *latifolium*, Backh.

H. crocatum, Fries. Rare. By the Shimna River below Clonachullion Hill; sparingly by the Spinkwee River near the edge of Tollymore Park ("very beautiful and typical," F. J. H.); sparingly on cliffs of Pigeon Rock Mountain at 1400 feet, not flowering till near the end of August.

H. auratum, Fries. Rocky river banks at 150–1500 feet; the most abundant of the leafy-stemmed hawkweeds. Several spots by Kilbroney River; rocky sides of the pool called "The Black Chest" on the Bann below Spelga Mountain (1100 feet); by the Annalong River a quarter mile from the sea: glen at Fofanny; luxuriant by the Yellow Water below Crocknafeola; in a mountain gorge north of Slieve Maganmore; by the Bann above Hilltown bridge; throughout the course of the Shimna from Trassey Bridge to within a mile of Newcastle, being plentiful in the upper portion. The styles in the Mourne specimens are invariably bright yellow. Though wide-spread in District 12 this plant has only recently been distinguished as Irish by means of specimens sent to Mr. Hanbury from the Mourne Mountains.

H. commutatum, Beck. (*H. boreale*, Fries.) Abundant by the Shimna from Trassey Bridge to Tollymore Park. From *H. auratum*, which grows with it, the dark styles and crowded upper leaves with wavy margins distinguish it. Not seen on moist rocks near the middle bridge in Tollymore Park (Templeton, 1793, *Flor. N.E.I*), or at Slievenamaddy (Wade, *Plantæ Rariores*).

Three other interesting forms occur in the mountains, some of them at a number of stations; Mr. Hanbury has asked us to delay making a report on these, as they are still under investigation.

CAMPANULACEÆ.

Lobelia dortmanna, Linn., 330–1350. Abundant in pools by Kilkeel River below Slieve Bingian, in Lough Bingian, and in the Blue Lough; more sparingly in Lough Shannagh and Altnadua Lake; not seen by us at Castlewellan Lake (Thompson, *Flor. Ulst.*) but no doubt correct. It flourishes at the stations mentioned on peat, gravel, and sand, in 0 to 3 feet water; at the latter depth it rarely flowers.

Jasione montana, Linn., 0–1500.

(*Campanula rapunculoides*, Linn. In a field above the road at the Wood House, near Rostrevor, and in sandy fields by the railway near Newcastle station; known in the latter spot for twenty years.)

C. rotundifolia, Linn., 0–2000.

ERICACEÆ.

Calluna erica, DC., 0–2796.

Erica tetralix, Linn., 0–2055. *E. cinerea*, Linn., 0–2449.

Vaccinium myrtillus, Linn., 2796. *V. vitis-idæa*, Linn., 1500–2796. Shanlieve, Eagle Mountain, Slieve Muck (abundant at north end), Bencrom, Slieve Bearnagh, Slieve Bingian, Slieve Lamagan, Slieve Donard, Slieve Commedagh (the Castles), Shanslieve; stems sometimes a foot in length.

AQUIFOLIACEÆ.

Ilex aquifolium, Linn. Common on the mountains, and in woods up to 800 feet.

(*Ligustrum vulgare*, Linn. Plentiful in hedges where planted, and often growing spontaneously).

Fraxinus excelsior, Linn., 1000.

GENTIANACEÆ.

Erythræa centaurium, Persoon. Abundant at low levels, especially at the southern end of the mountains.

Gentiana campestris, Linn., 0–300. On Spelga Mountain, near Rostrevor; by Causeway Water; Bloody Bridge; road-side south of Newcastle, and on Newcastle links.

Menyanthes trifoliata, Linn., 0–1600. Shanlieve, Lisnacree, pool near Kilkeel, margin of Cove Lake, wet places near Newcastle.

CONVOLVULACEÆ.

Convolvulus arvensis, Linn. Railway banks at Warrenpoint, shore at Rostrevor, abundant in some fields at Killowen, near Kilkeel harbour, and roadside at Newcastle. *C. sepium*, Linn.

BORAGINACEÆ.

Cynoglossum officinale, Linn., 0–500. Sandhills at Greencastle; abundant on shore at Killowen, and ascending to 500 feet on the adjoining stony slopes of Spelga Mountain; also on sandhills at Newcastle.

Lycopsis arvensis, Linn. Dry sandy ground at low levels.

Symphytum officinale, Linn. Near Warrenpoint, Hilltown, and Newcastle.

Echium vulgare, Linn. Abundant in a gravelly field above the Wood House near Rostrevor, and on sandhills at Newcastle.

Mertensia maritima (Linn.), Don. Sparingly on shore near Greencastle; more plentiful on shore at Glassdrumman, north of Annalong, extending nearly a mile along the shingly beach.

Myosotis palustris, Withering. Sparingly near Rostrevor and Newcastle; rare. *M. repens*, Don, 0–1000. Abundant around the flanks of the mountains as well as on the low grounds, and quite replacing the preceding species. The sharply deflexed fruit stalk of this plant appears of an excellent critical character. *M. cæspitosa*, Schultze. Warrenpoint, Killowen, Mill Bay, Kilkeel, Hilltown, and Newcastle; much less abundant than the last species. *M. arvensis*, Hoff. *M. versicolor*, Reich. Margin of Castlewellan Lake.

SOLANACEÆ.

Solanum dulcamara, Linn. By stream at Glassdrumman port, north of Annalong; rare.

OROBANCHACEÆ.

Lathræa squamaria, Linn. Sparingly under trees in Tollymore Park.

SCROPHULARIACEÆ.

Verbascum thapsus, Linn. Stony beach north of Killowen, and sparingly on sandhills at Newcastle; rare.

Digitalis purpurea, Linn., 1400.

(*Linaria cymbalaria*, Mill.). *L. repens*, Ait. Occurs in abundance in fields, on banks, and by roadsides, and seashore about Killowen, and thence eastward to Seafield; rises to several hundred feet on stony ground, where Spelga slopes downward to the sea. First noticed here by R. Ll. P. in June, 1884. This plant is recorded, by inadvertence, as *L. minor* in *Flora N. E. I.* Some luxuriant specimens attain a height of three feet. This is its only station in district 12. *L. vulgaris*, Mill. Plentiful on railway line at Warrenpoint, and sparingly on roadside at Newcastle; rare. The Killowen record of *Flora N. E. I.* refers to the preceding species.

Scrophularia nodosa, Linn. *S. aquatica*, Linn. Roadside between Warrenpoint church and gasworks, and abundant by the lower course of Moygannon river. Not seen in Tollymore Park (Thompson, *Flor. Ulst.*).

Melampyrum pratense, Linn., 100–1500. Cliffs of Eagle Mountain at 1500 feet; very abundant in Tollymore Park. Var. γ *M. montanum*, Johnston, 1400–2394. Cliffs of Eagle Mountain, Slieve Beg, and Pigeon Rock Mountain; on Cove Mountain, Slieve Bingian, summit of Slieve Bearnagh, and north side of Donard; flowers very pale or white.

Pedicularis palustris, Linn., 1150. *P. sylvatica*, Linn.

Rhinanthus crista-galli, Linn., 1000.

Euphrasia officinalis, Linn., 2300. Var. *gracilis*, Fries. Rocky banks of Bloody Bridge river.

Bartsia odontites, Hudson.

Veronica scutellata, Linn., 0–1000. Site of Ballymartin Lake, and at 1000 feet on mountains near Rostrevor; by Causeway Water, and by the Bann above Hilltown; lower slopes of Bingian, margins of Lough Island Reavy and Altnadua Lake, and seashore at Dunmore Head south of Newcastle. *V. anagallis*, Linn. Marsh near Lisnacree, lake near Narrow-water, and frequent on the lower course of the White Water, but not general. *V. beccabunga*, Linn. *V. chamædrys*, Linn. *V. montana*, Linn. Plentiful in Tollymore Park; local. *V. officinalis*, Linn., 1150. *V. serpyllifolia*, Linn., 1000. *V. arvensis*, Linn. *V. agrestis*, Linn. *V. polita*, Fries. *V. buxbaumii*, Ten. Rostrevor, and common in fields at Killowen and Greencastle. *V. hederifolia*, Linn. Plentiful at Killowen, but a very local plant.

LABIATÆ.

(*Mentha rotundifolia*, Linn. Close to Dunny Water Bridge, an escape). *M. aquatica*, Linn. *M. sativa*, Linn. *M. arvensis*, Linn.

Lycopus europæus, Linn. Roadside inland from Annalong, and further north in wet places by the sea at Dunmore Head; by lake in Narrow-water demesne.

Thymus serpyllum, Linn., 2000.

Brunella vulgaris, Linn.

Nepeta glechoma, Benth.

Lamium amplexicaule, Linn. By Kilbroney River, and at Killowen, Knockshee, Greencastle, Kilkeel, Annalong, and Newcastle. *L. intermedium*, Fries. In a field at Greencastle, also at Newcastle; rare. *L. incisum*, Willd. Killowen, and fields at Glassdrumman north of Annalong; rare. *L. purpureum*, Linn. *L. album*, Linn. Roadside by the sea near Mourne Hotel at Rostrevor; rare; not seen in the Newcastle Station of *Flor. Ulst.*

Galeopsis tetrahit, Linn.

Stachys sylvatica, Linn. *S. palustris*, Linn.; common. Var. *β. ambigua*, Sm. Sparingly by the Causeway Water. *S. arvensis*, Linn. Rather common; in fields at Newcastle, and thence to Kilkeel, and abundant at Killowen.

Ballota alba, Linn. Near Warrenpoint; doubtfully native.

Teucrium scorodonia, Linn., 1400.

Ajuga reptans, Linn.

LENTIBULARIACEÆ.

Pinguicula vulgaris, Linn., 2000. *P. lusitanica*, Linn., 0–1600. At sea-level at Springwell Port, north of Annalong. Eastern slopes of Slieve-na-garragh and Slieve Bingian; marsh at base of Slieve-na-brock; by the Causeway Water; Hen Mountain, and banks of Rocky River above Hilltown; Dunnywater Bridge; pools by Kilkeel River under Slieve Bingian; by the Bann below Spelga; and at 1600 feet on Finlieve.

Utricularia vulgaris, Linn. Bog-holes at Altnadua Lake, and on the site of the now drained Moneyscalp Lake. *U. minor*, Linn. Bog-holes by the Kilkeel River under Slieve Bingian, and at Altnadua Lake.

PRIMULACEÆ.

Primula vulgaris, Hudson, 1500.

Lysimachia nemorum, Linn.

Glaux maritima, Linn.

Anagallis arvensis, Linn. *A. tenella*, Linn., 1600.

Centunculus minimus, Linn. Rocks by the sea north of Bloody Burn, and abundant on the drained site of Ballymartin Lake. Not seen on sandy shore three miles south of Newcastle (S.A.S., *Flor. N.E.I.*).

Samolus valerandi, Linn. Rocky shore south of Newcastle; mouth of White Water; abundant in a marsh near Narrow-water.

PLUMBAGINACEÆ.

Statice bahusiensis, Fries. From Warrenpoint to Narrow-water—abundant.

Armeria maritima, Wild.

PLANTAGINACEÆ.

Plantago coronopus, Linn. *P. maritima*, Linn. Seashore only. *P. lanceolata*, Linn., 1150. *P. major*, Linn.

Littorella lacustris, Linn., 50–1350. Blue Lough; Lough Bingian; Lough Shannagh. In several lakes near Warrenpoint and Narrow-water, and abundant in the Burren River. Pools by the Kilkeel River under Slieve Bingian.

CHENOPODIACEÆ.

Suæda maritima, Dum. Rare; along the Carlingford Lough shore only.

Salsola kali, Linn. Sandy shores at Newcastle, Kilkeel, Cranfield Point, and Greencastle.

Chenopodium album, Linn.

Salicornia herbacea, Linn. Muddy shores of Carlingford Lough.

Atriplex littoralis, Linn. Very rare. Newcastle Railway Station. *A. angustifolia*, Sm. *A. erecta*, Huds. Fields at Newcastle. *A. deltoidea*, Bab. Rostrevor. *A. hastata*, Linn. *A. babingtonii*, Woods. Sandy shores at Newcastle. *A. farinosa*, Dum. Sparingly on sandy shore at Greencastle.

Obione portulacoides, Moq. In profusion on muddy shore from Warrenpoint to Narrow-water. Its most northern limit on the eastern coast-line.

POLYGONACEÆ.

Rumex conglomeratus, Murr. *R. sanguineus*, Linn. Type absent; *var. R. viridis*, Sibth, rare, and only noted from Mourne Park. *R. obtusifolius*, Linn. *R. crispus*, Linn. *R. hydrolapathum*, Huds. Sparingly in marsh on site of Moneyscalp Lake. *R. acetosa*, Linn., 1400. *R. acetosella*, Linn., 2796.

Polygonum amphibium, Linn. *P. lapathifolium*, Linn. Abundant on the shores of Warrenpoint town reservoir. *P. persicaria*, Linn. *P. hydropiper*, Linn. *P. aviculare*, Linn. Common. Var. *β. littorale*, Link. Sandy shores at Newcastle and Mill Bay. *P. raii*, Bab. Sandy shores at Newcastle and Cranfield Point. *P. convolvulus*, Linn.

EMPITRACEÆ.

Empetrum nigrum, Linn., 1900–2796.

EUPHORBIACEÆ.

Euphorbia helioscopia, Linn. *E. paralias*, Linn. Abundant on sandy shore from Nicholson's Point to Greencastle Point. Not seen on shore at Newcastle (Thompson, *Flor. Ulst.*). *E. portlandica*, Linn. Sparingly on sandy shore near Cranfield Point. *E. peplus*, Linn. *E. exigua*, Linn. Fields north of Bryansford; among corn at "Maggie's Leap"; in fields at Killowen.

CALLITRICHACEÆ.

Callitriche verna, Linn. *C. stagnalis*, Scop. *C. hamulata*, Kutz., 1150. Common. Var. *β. pedunculata*, DC. By a mill-dam between Hilltown and Rocky Mountain.

URTICACEÆ.

Parietaria officinalis, Linn. Tullybranagan near Newcastle; common at Warrenpoint and Killowen.

Urtica urens, Linn. *U. dioica*, Linn.

ULMACEÆ.

Ulmus montana, With.

AMENTIFERÆ.

Salix pentandra, Linn. By the Yellow Water below Crocknafeola, and by the Kilbroney River; by the Kilkeel road south of Annalong. *S. alba*, Linn. *S. purpurea*, Linn. In a marsh east of Moneyscalp; roadside east of Crotlieve Mountain; marsh at Lisnacree east of Killowen. *S. viminalis*, Linn. *S. smithiana*, Willd. Castlewellan; Moneyscalp; near Leitrim Hill and Trasseybridge; by the Spinkwee River above Tollymore Park. *S. cinerea*. Linn. Common. Var. *β. aquatica*, Sm. Marsh near Lisnacree House. *S. aurita*, Linn., 1500. *S. caprea*, Linn. Shore of Carlingford Lough south of Rostrevor; by the Kilbroney and Ghann Rivers; sea-shore south of Newcastle. *S. repens*, Linn., 2000. *S. herbacea*, Linn., 1700–2796. Summits of Donard, Commedagh, Bingian, Bearnagh, Slieve Meel Beg, Chimney Rock, and Slieve Lough Shannagh. Eagle Rock of Slieve Donard (1700); Castles of Commedagh; rocks over the source of the Spinkwee River, and on Slieve Maganmore.

Populus tremula, Linn., 50–1200. Hedges behind Newcastle; granite cliffs south of the Blue Lough. Undoubtedly wild in at least the second station; new to county Down.

Myrica gale, Linn., 1400.

Betula glutinosa, Fries., 1400.

Alnus glutinosa, Gaert.

Quercus robur, Linn., 1300.

Corylus avellana, Linn., 1000.

CONIFERÆ.

Juniperus nana, Willd., 1000–2000. Locally and sparingly distributed, and only found among the higher mountains which lie to the east of the road from Hilltown to Kilkeel. In some quantity below, the Castles of Commedagh, on Slieve Bearnagh above Hare's Gap, and on the southern cliff-range of Cove Mountain; sparingly at seven other stations. Fruits very abundantly; on a portion of a flat branch 2½ inches long by 2 inches wide we counted 88 berries.

HYDROCHARIDACEÆ.

Elodea canadensis, Mich. Castlewellan Lake.

ORCHIDACEÆ.

Orchis mascula, Linn. *O. maculata*, Linn., 1400. *O. incarnata*, Linn. Very rare. By pool near Moore Lodge, Kilkeel; pools by the Kilkeel River under Slieve Bingian.

Habenaria viridis, R. Br. Wet places at Springwell Port north of Annalong, and in the Kilbroney valley. *H. bifolia*, R. Br. Rare. Near Springwell Port north of Annalong, and in the Kilbroney valley. *H. chlorantha*, Bab.

Listera ovata, R. Br. Very rare. Sparingly in woods at the parks of Mourne and Tollymore. *L. cordata*, R. Br., 1600–1900. On Slieve Bearnagh 200 feet above the Hare's Gap; N.E. face of Eagle Mountain (1600); east side of Carn Mountain (1650); near summit of Slieve Lough Shannagh (1900). Not seen on Slieve Donard (Dickie, *Flor. Ulst.*), nor on Slieve Commedagh (Hart, *Proc. R.I.A.*, 1884), but the plant is easily passed over, and is doubtless more common than would appear.

Neottia nidus-avis, Rich. In Tollymore Park by the lowest bridge; very rare.

IRIDACEÆ.

Iris pseud-acorus, Linn.

ALISMACEÆ.

Alisma plantago, Linn. *A. ranunculoides*, Linn. Wet places by river behind Newcastle; marshes at Lisnacree and Narrow-water; in lake near Milltown north of Warrenpoint, and abundant in Warrenpoint town reservoir.

Triglochin maritimum, Linn. By the sea at and south of Newcastle; muddy shores at Mill Bay, and from Warrenpoint to Narrow-water. *T. palustre*, Linn. Narrow-water; Killowen; Newcastle.

LILIACEAE.

Allium ursinum, Linn. Mourne Park; ruins of St. Mary's Church, near Bloody Bridge; abundant in Tollymore Park and Rostrevor Wood.

Endymion nutans, Dum.

MELANTHACEAÆ.

Narthecium ossifragum, Huds., 1400.

JUNCACEÆ.

Juncus maritimus, Sm. Newcastle, and shores of Carlingford Lough. *J. effusus*, Linn., 1837. *J. conglomeratus*, Linn., 1400. *J. acutiflorus*, Ehrh., 1900. *J. lamprocarpus*, Ehrh. *J. supinus*, Moench, 2000. A submersed very slender form, many feet in length, grows in the mountain lakes and slow-flowing streams, in up to four feet of water. *J. squarrosus*, Linn., 2510. *J. gerardi*, Lois. Shores about Newcastle and Carlingford Lough. *J. bufonius*, Linn.

Luzula maxima, DC., 2500. *L. vernalis*, DC. *L. campestris*, Willd. *L. erecta*, Desv.

TYPHACEÆ.

Typha latifolia, Linn. Rare. In marsh on site of Moneyscalp Lake; Warrenpoint town reservoir; abundant in lake in Narrow-water demesne.

Sparganium ramosum, Huds. *S. simplex*, Huds. Pool near Moore Lodge, Kilkeel; stream behind Newcastle; lake near Milltown north of Warrenpoint, and abundant in Warrenpoint town reservoir. *S. natans*, Linn. Altnadua Lough, sparingly. Not seen at Castlewellan Lake (Templeton, 1808, *Flor. N.E.I.*, and Whitla, *Flor. Ulst.*), but doubtless still there. *S. minimum*, Fr. Bog-holes at upper end of a lake N.W. of Milltown, near Warrenpoint.

ARACEÆ.

Arum maculatum, Linn., 1000.

LEMNACEÆ.

Lemna trisulca, Linn. With *Sparganium minimum* near Warrenpoint, very rare. *L. minor*, Linn.

POTAMOGETONACEÆ.

Potamogeton natans, Linn. *P. polygonifolius*, Pourr., 1400. *P. rufescens*, Schrad. Abundant in Burren River near Newcastle. *P. pusillus*, Linn. Burren River; bog-holes at Moneyscalp Lake; marsh near Lisnacree House.

NAIADACEÆ.

Zostera marina, Linn. Carlingford Lough.

CYPERACEÆ.

Schœnus nigricans, Linn., 1800.

Cladium mariscus, R. Br. Sparingly on northern margin of Altnadua Lake near Castlewellan. We have no doubt that this is Templeton's station for this plant (which is of extreme rarity in District 12, and was believed to be now extinct), although Mr. Templeton's note does not correspond with the actual station (see note in *Flor. N.E.I.*); Altnadua Lake is the first lake on the road from Castlewellan to Rathfriland, and is distant two miles from the former.

Rhynchospora alba, Vahl, 350–1225. Pools by the Kilkeel River under Slieve Bingian, and abundant in a marsh a quarter of a mile S.W. of Colligan Bridge; marshes at the base of Slieve-na-brock; in some abundance in boggy ground by the Annalong River S.E. of the cave on Cove Mountain.

Eleocharis palustris, R. Br. *E. multicaulis*, Sm., 1110.

Scirpus maritimus, Linn. Muddy shores at Mill Bay and above Warrenpoint. *S. sylvaticus*, Linn. Sparingly in Tollymore Park. *S. cæspitosus*, Linn., 2510. *S. fluitans*, Linn. Marshes at base of Slieve-na-brock; Rocky River near Hilltown; by Shimna River; lake in Narrow-water demesne. *S. setaceus*, Linn. Newcastle; Tollymore; "Maggie's Leap"; Kilkeel; Killowen; source of Kilbroney River. *S. savii*, S. and M., Newcastle; "Maggie's Leap"; Glassdrumman; Dunny Water Bridge; White Water; Narrow-water; Kilkeel.

Eriophorum vaginatum, Linn., 2055. *E. polystachion*, Linn., 2204.

Carex dioica, Linn. By the Causeway Yellow Water, Bloody Burn, and frequent on the mountain moors. *C. pulicaris*, Linn. *C. arenaria*, Linn. Sandy shores at Newcastle, Kilkeel, and Greencastle. *C. vulpina*, Linn. Salt marshes at Mill Bay and Narrow-water. *C. remota*, Linn. *C. echinata*, Murr., 2000. *C. leporina*, Linn. Sparingly on the lower grounds; in great abundance on the shores of Lough Island Reavy. *C. goodenovii*, Gay, 1400. *C. pallescens*, Linn. Tollymore Park. *C. panicea*, Linn., 1350. *C. præcox*, Jacq., Killowen, Spelga, Broughnamaddy. *C. pilulifera*, Linn., 2796. *C. glauca*, Scop., 2510. *C. flava*, Linn., 1400. *C. hornschuchiana*, Hoppe, 1700. *C. distans*, Linn. Shores near Newcastle, and south of Rostrevor. *C. binervis*, Sm., 2394. *C. lævigata*, Sm. Parks of Mourne and Tollymore. *C. sylvatica*, Huds. *C. hirta*, Linn. Rare; White Water, and near Newcastle. *C. rostrata*, Stokes, 1150.

GRAMINEÆ.

(*Phalaris canariensis*, Linn. Sands at Newcastle.) *P. arundinacea*, Linn.

Anthoxanthum odoratum, Linn., 2394.

Phleum arenarium, Linn. Common on sandhills at Newcastle. *P. pratense*, Linn.

Alopecurus geniculatus, Linn.

Nardus stricta, Linn., 2449.

Milium effusum, Linn. Wooded shore of lough south of Rostrevor. Not seen in Tollymore Park (Hart, *Proc. R.I.A.*, 1884).

Phragmites communis, Trin.

Psamma arenaria, R. & S. Sandy shores, Newcastle and Cranfield.

Agrostis canina, Linn., 2300. *A. vulgaris*, With. Common. Var. *β pumila*, Lightf. Sandhills at Newcastle; east side of Slieve Bingian at 1200 feet; N.E. slope of Eagle Mountain at 1600 feet, growing only one inch high. *A. alba*, Linn., 2055. Common; growing four feet high at White Water.

Aira cæspitosa, Linn. *A. flexuosa*, Linn., 2796. *A. caryophyllea*, Linn., 1000. *A. præcox*, Linn., 1662.

Holcus lanatus, Linn., 1350. *H. mollis*, Linn. Common. A tall (4 feet), slender form at White Water.

Arrhenatherum elatius, M. & K.

Triodia decumbens, Beauv.

Melica uniflora, Retz.

Molinia cærulea, Moench., 2449.

Poa annua, Linn., 2450. *P. trivialis*, Linn. *P. pratensis*, Linn., 1350.

Glyceria fluitans, R. Br., 1150.

Schlerochloa maritima, Lindl. Seashore south of Newcastle. *S. distans*, Bab. Warrenpoint. *S. loliacea*, Woods. By the White Water, and near Newcastle.

Briza media, Linn. Roadside between Warrenpoint and Narrow-water, and plentiful in a marsh near Narrow-water corn-mill.

Cynosurus cristatus, Linn.

Dactylus glomerata, Linn.

Festuca sciuroides, Roth. Near Newcastle and Warrenpoint; rare. *F. ovina*, Linn. Common; the viviparous form replaces the normal on the high grounds, and ascends to the highest point of the range (2796 feet). The type and variety were gathered together on Slieve Muck at 1500 feet; our lowest note of the variety is 200 feet. *F. rubra*, Linn., 0–1600. *F. sylvatica*, Vill. Abundant by the Shimna and Spinkwee Rivers in Tollymore Park, and very luxuriant, some specimens measuring 6 and 7 feet high. Not seen in woods at Rostrevor (Wade's *Plantæ Rariores*, 1804). *F. gigantea*, Vill. Moygannon Glen; Mourne Park; Tollymore Park. *F. arundinacea*, Schreb. Newcastle and Tollymore Park; rare. *F. pratensis*, Huds. Rare; meadows by the Ghann River.

Bromus asper, Murr. *B. sterilis*, Linn. Abundant on roadsides from Killowen to Seafield, and sparingly near Warrenpoint gas-works.

Serrafalcus mollis, Parl.

Brachypodium sylvaticum, R. & S.

Triticum caninum, Huds. Rocky shore a mile south of Newcastle. Pool near Moore Lodge, Kilkeel. *T. repens*, Linn. Near Kilkeel, Newcastle, and Rostrevor. *T. junceum*, Linn. Sandy shores at Newcastle, Kilkeel, and Greencastle.

Lolium perenne, Linn.

EQUISETACEÆ.

Equisetum arvense, Linn. *E. maximum*, Lamk. *E. sylvaticum*, Linn., 1000. *E. limosum*, Linn., 1000. Var. *β fluviatile*, Linn. Rare. *E. palustre*, Linn. *E. hyemale*, Linn. Sparingly by the Kilbroney River above Newtown Bridge, and on the banks of the Yellow Water S.E. of Crocknafeola; abundant on the banks of the stream below Rocky River Bridge near Hilltown, where also a curious sport occurred, the stems bearing several lateral alternate sessile fruit-spikes. By the Annalong River a quarter of a mile below Dunny Water Bridge. Rev. C. H. Waddell has sent us a fresh specimen gathered by him by the waterfall on Thomas Mountain, above the ice-house, at 1700 feet. The only previous county Down record was an unsatisfactory one from Dundrum.

FILICES.

Cryptogramme crispa, R. Br., 1200–1700. Very rare, and on granite only, mostly as single plants, and not fruiting. South side of Slieve Donard, and Eagle Rock on north side of Donard. Cliffs of Slieve Beg. Cliffs of Slieve Bingian south of Blue Lough. Not observed on Shanslieve or Slieve-na-brock (Lett, *Proc. B.N.F.C.*, 1885–86, app.), nor at Eagle Rock on Pigeon Rock Mountain (Barcroft, *ibid.*). The remarks of Mr. Hart (*Proc. R.I.A.*, 1884, p. 240) as to the extermination of the species on the Mourne range are incorrect. It still grows on Slieve Bingian and elsewhere, as shown above.

Polypodium vulgare, Linn., 2449. *P. phegopteris*, Linn. On granite and slate rocks, 800–2000 feet. Northern slopes of Slieve Donard; Castles of Commedagh; Black Stairs on Shanslieve; Luke's Mountain; Slieve-na-glough; cliffs south of Blue Lough; Hare's Gap; by the Bann below Spelga; on the eastern and western slopes of Slieve Muck, and at 2000 feet on Slieve Muck North; cliffs of Eagle Mountain; Slieve Magannmore; northern shoulder of Slieve Meel More, and east face of Slieve Meel Beg at 2000 feet; Slieve Lamagan; southern and eastern cliff-ranges of Cove Mountain; glen N.E. of Bencrom; and on Chimney Rock Mountain. Not seen at Rostrevor (Robinson, *Flor. N.E.I.*).

Lastrea oreopteris, Presl., 20–2000. In some abundance on the lower grounds along the northern slope of the range from Slieve Donard to Slieve-na-man; plentiful by a small stream east of Kinahalla; sparingly by the Annalong River near Dunny Water Bridge; glen at Fofanny, banks of Rocky River, and Mill River below Slieve Lamagan; single plants, mostly seedlings, on cliffs south of Blue Lough (1300), near Cove Mountain cave (1400), cliffs of Eagle Mountain (1600), and slate rocks on Slieve Muck North (2000). *L. filix-mas*, Presl., 1500. Var. δ *L. abbreviata* DC. 1300–1500. Abundant on cliffs of Eagle Mountain, and very distinct; new to district 12. *L. dilatata*, Presl., 2449. *L. æmula*, Brack. 100–1430; very local. Frequent throughout Tollymore Park; shady nook on cliffs on east face of Cove Mountain at 1400 feet.

Polystichum aculeatum, Roth. Very rare. Sparingly in Tollymore Park, and in Rostrevor Wood. *P. angulare*, Newman.

Cystopteris fragilis, Bernh., 800–2000. On dripping slate rocks, Black Stairs on Shanslieve; N. E. slope of Slieve-na-glough; Luke's Mountain; luxuriant on east face of Slieve Muck, and on Slieve Muck north at 2000 feet.

Athyrium filix-fœmina, Roth., 2449.

Asplenium adiantum-nigrum, Linn., 1600. *A trichomanes*, Linn., 1600. *A. marinum*, Linn. Abundant on slate rocks by the sea, south of Newcastle. *A. ruta-muraria*, Linn.

Scolopendrium vulgare, Sym. Rare.

Ceterach officinarum, Willd. Very sparingly on a wall at Tollymore House, near Newcastle. Not seen at Rostrevor (Crawford, *Flor. Ulst.*) or Bryansford (Thompson, *ibid.*).

Blechnum boreale, Sw., 2449.

Pteris aquilina, Linn., 1400.

Hymenophyllum wilsoni, Hook., 150–1500. On boulders in the Shimna and Spinkwee Rivers in Tollymore Park; N. E. shoulder of Slieve Meel More; abundant on cliffs of Eagle Mountain; cliffs south of Blue Lough; Hare's Gap; Slieve Beg; Luke's Mountain; in the cave on Cove Mountain (a variety with branched fronds). Templeton's station, "margin of Cove Lough" (*Flor. N. E. I.*), is a highly improbable one, the shores being low and swampy. Not observed on Slieve Maganmore (Hart, *Proc. R. I. A.*, 1884).

Osmunda regalis, Linn. On wet rocks only; very rare. Sea-cliffs south of Newcastle—well established here; very sparingly by the Bloody Burn; on the west side of Slieve Bingian; and by the Causeway Water. Not seen by the Glen River above Newcastle (Thompson, *Flor. Ulst.*, and Corry, *Flor. N. E. I.*) nor by the Kilbroney River (Turretin, *Proc. B. N. F. C.*, 1885-6, App.), but we have seen plants obtained at the latter place. Templeton's note, "Donard's Cave in the Mourne Mountains," refers to a sea-cave at our first-mentioned station; his record, "margin of a lake south-west of Castlewellan," probably refers to Altnadua Lake, where, however, the fern is not now to be found.

Botrychium lunaria, Sw. Sandhills at Newcastle Railway Station, and heathy pasture near Bloody Bridge.

Ophioglossum vulgatum, Linn. Very rare; shady spot behind Mourne Hotel at Rostrevor.

LYCOPODIACEÆ.

Isoetes lacustris, Linn, 1100–1350. Abundant in Blue Lough and Lough Shannagh, and sparingly in Bingian Lough, growing on sand and peat in three to eight feet of water. Very fine specimens were dredged in Blue Lough in five to eight feet of water.

Lycopodium clavatum, Linn. Extremely rare; a single plant on N. E. slope of Slieve Donard, at 2450 feet. Not seen in Tollymore Park (Dickson, *Flor. N. E. I.*). *L. alpinum*, Linn., 1900–2796. Summits of Slieve Donard, Slieve Commedagh, Slieve Bearnagh, Chimney Rock Mountain, Carn Mountain, and Shanslieve; abundant on the northern slope of Slieve Bearnagh down to 1900 feet. *L. selago*, Linn., 2796.

Selaginella spinulosa, A. Br., 0–2000.

CHARACEÆ.

Nitella opaca, Ag. Pond at saw-mill in Tollymore Park; mill-dam on Burren River; Lough Island Reavy, and in the stream that drains it; mill-race by the Bann above Hilltown.

Chara fragilis, Desc. In Warrenpoint town reservoir.

PLANTS RECORDED FROM THE MOURNE MOUNTAINS,

which were not found by S. A. S. and R. Ll. P. (This list does not include old records which have already, in *Flora N.E. Ireland*, been shown to be referable to mistakes, casuals, or escapes.)

Three species, noted as "common" in the *Flora of the North-east of Ireland*, do not occur in the district:—

Geum rivale, Linn.
Potamogeton perfoliatus, Linn.
P. crispus, Linn.

Papaver rhœas, Linn. Newcastle, S. A. S. (*Flor. N. E. I.*). A casual in South Down, and not established at any one spot.

Cerastium semidecandrum, Linn. Greencastle (*Ir. Flor.*). Not found.

C. arvense, Linn. About Greencastle (*Ir. Flor.*). Not seen.

Trifolium medium, Huds. Newcastle, R. Ll. P. (*Flor. N. E. I.*). We failed to re-find it in the district. In county Down it is known to grow only on the northern margin, adjoining its Antrim habitats.

Vicia orobus, DC. *Orobus sylvaticus nostras*, found near Rostrevor, Dr. Sherard (*Raii Synopsis*, Ed. II. 1696). Not seen anywhere, and in the north-east of Ireland known only in one station in county Antrim. The plant may have been *V. sylvatica.* The specimens in the Sherardian Herbarium at Oxford do not settle the question definitely.

Prunus insititia, Linn. Rostrevor Wood (*Ir. Flor.*). Not found; probably planted.

Rubus villicaulis, W. & N. By the Causeway Water, S.A.S. (*Flor. N.E.I.*). Not re-gathered, but the plant was right.

R. foliosus, Weihe. By stream in Tollymore Park, S. A. S. (*Flor. N.E.I.*). The remark on preceding species applies here also.

Pyrus aria, Sm. Brought from off the Mourne Mountains to Lord Clanbrassil; Templeton (*Flor. N.E.I.*). Does not now occur on the range, and appears to be almost extinct in northern Ireland.

Saxifraga aizoides, Linn. By the side of the cataract at Donard Lodge, Thompson and Hyndman (*Flor. Ulst.*). We have nothing to add to the note on this record in *Flor. N.E.I.* The plant is not there now, and was probably never there.

Apium nodiflorum, var. *β. repens*, R. In marshy places by the river side at Kilkeel (Wade, *Plantæ Rariores*). Not now known in District 12.

Solidago virgaurea, var. γ, *cambrica*, Huds. Banks of the river in Tollymore Park (Wade, *Plantæ Rariores*). Probably only a small form of *S. virgaurea;* var. *cambrica* is not now in Tollymore Park.

Anthemis nobilis, Linn. Foot of Tullybranagan Mountain, west of Newcastle, John White (Wade, *Plantæ Rariores*). Most likely a casual; our search for this was vain.

Hieracium corymbosum, Fr. Banks of Spinkwee River. River at upper end of Tollymore Park, S.A.S. (*Cybele Hibernica*, as *H. strictum*, and *Flor. N.E.I.*). Only typical *H. crocatum* could be found there, but the former record was based on the determination of a specimen by Mr. Backhouse.

H. umbellatum, Linn. Rocks, Tollymore Park, Templeton (*Flor. Ulst.*). Erroneous determination probably.

Arctostaphylos uva-ursi, Spr. Top of Slieve Donard, Dickie (*Flor. Ulst.*). *Vaccinium vitis-idæa*, which, though plentiful on the summit of Donard, is not included in Dr. Dickie's list of summit species, was evidently the plant intended.

Pyrola minor, Linn. Tollymore Park, Dickson (*Flor. N.E.I.*). May be right; no species of Pyrola occurred to us.

Convolvulus soldanella, Linn. Sandhills on the shore at Newcastle, Templeton, 1795 (*Flor. Ulst.* and *Flor. N.E.I.*). Not there now, but grows a few miles northward.

Hyoscyamus niger, Linn. About Greencastle, and the tower along the shore going to Kilkeel (*Ir. Flor.*). Not refound; it is a capricious and uncertain species.

Melampyrum sylvaticum, Linn. Tollymore Park, Thompson (*Flor. Ulst.*). Not seen by us in the district, and not known elsewhere in the county. Was no doubt a form of *M. pratense*.

Veronica officinalis, var. *β*, *glabra*, Bab. Mourne Mountains, near Warrenpoint, J. White; Templeton (*Flor. N.E.I.*). Not seen.

Mentha pulegium, Linn. Abundantly in wet pastures at the foot of Tullybranagan Mountain, county Down (*Ir. Flor.*). Not there now.

Galeopsis versicolor, Curt. Annalong (Hart, *Proc. R.I.A.*, 1884). Not seen anywhere, and not known elsewhere in county Down; possibly a casual.

Primula veris, Linn. Wood at Rostrevor, Gray (*Flor. N.E.I.*). Not refound. We doubt the plant being native here; all the District 12 stations are more than suspicious.

Beta maritima, Linn. Between Greencastle and Kilkeel, along the gravelly shore (*Ir. Flor.*). Not found, but quite probable.

Scirpus pauciflorus, Lightf. Shore four or five miles south of Newcastle, Templeton, 1797 (*Flor. N.E.I.*). Between Dunnywater Bridge and Annalong (Hart, *Proc. R.I.A.*, 1884). Not found by us.

Blysmus rufus, Linn. Warrenpoint, Robinson (*Flor. N.E.I.*). We suppose correct, but not seen by us.

Carex rigida, Good. Included by Dr. Dickie (*Flor. Ulst.*) in his list of plants growing on the summit of Slieve Donard. Certainly not there now, and must have been an error.

C. extensa, Good. Greencastle and Newcastle, S.A.S. (*Flor. N.E.I.*). Not gathered, but doubtless there still.

Avena pubescens, Linn. On rough banks south of Newcastle, Templeton, 1799 (*Flor. N.E.I.*). We searched for this unsuccessfully.

Koeleria cristata, Pers. High grassy banks above the rocks on the shore about one mile south of Newcastle, Templeton, 1799 (*Flor. N.E.I.*). The station is most explicitly defined, but we failed to find the grass.

Poa nemoralis, Linn. In a wood at the side of Knockchree Mountain, White (Wade, *Plantæ Rariores*). Donard Lodge, Thompson (*Flor. Ulst.*). Woods about Rostrevor, White (*Cyb. Hib.*). Not found anywhere, nor has the species been seen in District 12 for the last fifty years.

Lolium temulentum, Linn. Fields at Newcastle, Rea (*Flor. Ulst.*). Imported with seed, and has not remained.

Asplenium adiantum-nigrum, var. γ, *acutum*, Bory. In a dark cave among the mountains of Mourne (Sherard, *Herb. Oxon.*; also *Raii Synopsis* (*Filix minor longifolia*, &c.)). We are glad to be able to correct an error of long standing in regard to this fern. The plant which was collected by Sherard in the Mourne Mountains in 1694, and of which fronds are preserved in the *Herbarium Sloaneanum* in the British Museum, and the Sherardian herbarium at Oxford, was not an *Asplenium*, but a beautifully-divided plumose barren form of *Athyrium filix-fœmina*, closely resembling the form known to pteridologists as *Kalothrix*.

The frond in *Herb. Sloaneanum* (vol. 100, p. 52) is figured in Plukenet's *Phytographia* (p. 282, fig. 3), and described by Petiver in his *Almagestrum* (p. 250), the locality of West Indies, which is given on the page mentioned, being corrected in the *mantissa* (p. 78, para. 4) to "*ex Hibernia*." Ray (*Historia Plantarum*, vol. iii. p. 79, 1704) gives the mountains of Mourne, in county Down, as the place where the specimen above-mentioned was obtained, Plukenet's figure and description being quoted. In the third edition of Ray's *Synopsis* (1724) the editor, Dillenius, suggests (p. 127) that the fern may be a cave-grown form of *Asplenium adiantum-nigrum.* This view is endorsed by Newman, who says (*British Ferns*, ed. 1844, p. 259): "Sprengel, Willdenow, and Sadler all of them give an *Asplenium acutum*, which I think must be identical with Ray's *Filix minor longifolia*."

With regard to the specimen in the Sherardian herbarium at Oxford, Mr. G. C. Druce kindly informs us that it is labelled "gathered in ye mountains of Mourne in ye county of Down." On this label (? in Ray's handwriting) is written: "This is a very rare and elegant plant, and deserves a proper name." Accompanying it is a nature-printed sheet from the same specimen, and probably of nearly contemporaneous date. Sibthorpe, when professor at Oxford (1784–1795), labelled this specimen "*Asplenium adiantum-nigrum*, L."

The British Museum specimen, which R. Ll. P. has examined, is practically identical with the *Kalothrix* form of *Athyrium filix-fœmina*, and with the Oxford specimen. Professor Vines writes us: "I have compared the enclosed (a cultivated frond of *Kalothrix*) with the Sherardian specimen from the Mourne Mountains, and have no hesitation in saying that they are identical, excepting the differences that are to be referred to the fact that one plant is wild and the other cultivated. The Sherardian specimen is certainly '*Kalothrix*,' i.e. a barren plumose form of *Athyrium filix-fœmina*."

Hymenophyllum tunbridgense, Sm. Growing on trees in Tollymore Park, Ferguson; on Slieve Donard, above Donard Lodge, Dickie (*Flor. Ulst.*). *H. wilsoni* only appears to grow in the district now, and both the above records are believed to be erroneous.

XXII.

ON "SICKLES" (SO CALLED) OF BRONZE, FOUND IN IRELAND: WITH A LIST OF THOSE ALREADY DISCOVERED. By W. FRAZER, F.R.C.S.I., M.R.I.A. (Plates XII. and XIII.)

[Read June 27, 1892.]

A cutting implement of bronze (Pl. xiii., fig. 10) was placed in my hands by Rev. Mr. Lawrence, of Lawrencetown, Co. Galway, which had been obtained some years since in the deepening of the ford of Meelick, on the Shannon, a locality where numerous bronze weapons were discovered, and also stone celts of remarkably rude form as well as other specimens of fine polished workmanship. Similar weapons of bronze are usually described as "sickles" in our Museum collections, but the result of my investigations has led me to question this attribution. As they are seldom found in Ireland it is desirable to figure and place on record every example which occurs here, and especially to preserve the history of their discovery so far as it can be ascertained, for I regret to say, in many instances, we have no details of this description with reference to the majority of our specimens.

This specimen is composed of an oval socket, from one side of which springs a curved blade, measuring four and a-half inches from point to hilt, one inch in width at its broadest part where it joins the socket, and tapering to a rounded end similar to an ordinary dinner-knife, being about three-fourths of an inch across near its termination; the hollow socket measures one inch in width, by half an inch transversely; it is perforated by small apertures so placed that a single rivet passed through from side to side would secure the bronze blade firmly to a wooden handle. Both edges of the blade, and the rounded terminal part are sharpened in the same manner as the cutting edges of our bronze swords and daggers; and similar to what is observed in other bronze weapons, the cutting edges are made thinner than the rest of the blade. We notice in all varieties of these alleged sickles, no matter how much they vary in form, that they agree in having both edge and point of the weapon equally sharpened.

Implements of this class are always composed of true bronze, a definite alloy of copper and tin, and when discovered associated with other articles these are, without exception, also made of bronze; in fact they are as typical of the so-called "age of bronze" as celts, palstaves, spears, and leaf-shaped swords. Corresponding to what is noticed in several of these classes of weapons, whilst many "sickles" have no traces of decoration or ornamentation, a few display patterns varying from simple ribbing to more elaborate workmanship; of this latter there is a fine specimen preserved in the Museum of the Academy, which was discovered many years since in the county of Westmeath, and is figured in our published series of photographs (Pl. xii., fig. 1) Ornamental decoration is, however, exceptional, which would lead us to surmise that the greater number of such weapons ought to be referred to an early stage in the manufacture of bronze.

Sir J. Evans, in his classic work treating of Bronze Implements, divides the "sickles" into two principal varieties:—

1. Those possessing sockets closed above, similar to palstaves and spear-heads of bronze; he considers this shape peculiar to Britain and the North of France.

2. Implements having ring-shaped apertures to receive a handle, a form common over the greater part of Eastern and Western Europe, and found as far North as Scandinavia.

In Ireland both forms are met with.

In addition to these there remains a third variety to be described, which appears deserving of separate classification. In this class of implements, the blade springs from the upper portion of the socket, not from its side, and curving laterally resembles in shape a crook, or the curved end of a walking stick.

There is another difference to be noticed in the shape of these weapons, which seems of some importance for classifying them, namely, that certain examples are distinguished by having sharp-pointed terminations, whilst in others the ends of the blades are rounded, and comparatively blunted. For, when discriminating between other forms of bronze cutting implements, a marked variation in this direction is recognised, and alleged to depend on their having belonged to different races in legendary times. Thus, O'Curry, in his treatise upon the weapons in use in former ages (and in this respect his views have been adopted by our principal authorities), differentiates cutting implements such as daggers and spears into groups, those which possess broad or bluntish terminations being ascribed to an earlier age, and constituting the offensive arms of that primitive race termed Firbolg, whilst the class of weapons distinguished by more graceful outlines, having acuminated terminations, are traditionally believed to be of later origin, and introduced subsequent to the blunted weapons by invading Danaan tribes.

An examination of our bronze collection of weapons places beyond question the fact that well-marked differences can be recognised in their configurations, and that they admit being placed under separate classifications, whatever explanation we may accept as to the source of this difference, or whether it originated in their being employed by distinct races as tradition reports. This being admitted, it becomes difficult to understand why an exception is made with reference to these so-called "sickles," some of which, like the Danaan weapons, terminate in acuminated points, and others have rounded ends similar to Firbolg spears or daggers. In both forms, whether blunt or sharp-pointed, the edges are sharpened alike on their convex and concave borders, a useless proceeding, it seems to me, if they were intended for cutting down ears of corn, but perfectly intelligible if designed for purposes of warfare.

True sickles composed of bronze are obtained in considerable abundance on the Continent, especially from the sites of Swiss and French lake dwellings. They appear to fulfil in a satisfactory manner the indications that might be expected in instruments designed for such a special purpose; but are altogether different from the weapons at present engaging our attention, which are far from common in the British Isles, compared with our other bronze articles. Typical illustrations of these Continental sickles are given in Sir J. Evans's work; they consist of short detached blades without continuous sockets; to these blades special shaped handles were adapted, into which they were fastened. Nothing similar to either the blades or handles belonging to such sickles have yet been found in Ireland.

Sickles composed of iron are occasionally discovered here; they resemble in shape those still employed for farm work. I possess one that appears to belong to a remote age, found at Clonmacnois, but it is comparatively modern when compared with the bronze weapons I am describing. When perfect it measured about eight inches or so, the portion still preserved being about six inches in length by three quarters of an inch across the blade; it consists of a thin flat strip of metal, of which the inner concave edge alone is sharpened as might be expected, and was intended to be fastened to a convenient wooden handle by its projecting spike.

The earliest form of sickle used in Egypt was composed of a curved stick or branch having sharp flakes of thin flint fastened along its concave edge; there are representations of such sickles seen on Egyptian tombs, and some examples are preserved in Museums. They bear no relation whatever to our so-called bronze sickles. Upon a seal of Hæmatite which I obtained from Syria, a reaper is represented cutting down ears of corn; the implement he employs is curved into a hook. We might possibly consider there was some resemblance between the curved bronze blades shaped like a crozier top and the reaping-hook of this Syrian reaper; but beyond question the dagger-shaped blades, whether with blunt or sharp terminations, must be referred to some very different use instead of cutting down corn.

In seeking a possible solution of this problem, as to the purpose for which they were intended to be employed, we are bound to give due consideration to the stores of information contained in O'Curry's Lectures when treating of the weapons of bronze known to the Ancient Irish, and described in Bardic tales. He mentions, amongst others, certain "Firlanna" or curved blades which are traditionally ascribed to a date so remote as the early battle of Magh Tuireadh. I venture to suggest the "sickles" now under our notice would fulfil the requirements of such a weapon, and furthermore our museums, rich in varied forms of bronze, present us with nothing but these deserving the name of curved blades. If also we place upon a stout ashen staff one of these bronze blades, with a perforated socket, and above this fasten a sharp pointed spear, they would form an efficient and reliable weapon similar to a mediæval halbert. O'Curry likewise refers to a "double spear" which he does not attempt to identify with any implement at present known. There is much to induce us to accept as a reasonable solution of such a compound weapon the halbert now suggested; its terminal and lateral sharp spikes or blades would answer in all respects to the idea of a "double spear," and the fact that both edges of these alleged "sickles" are sharpened similar to our bronze spears and daggers, strengthens the supposition that they were designed for purposes of warfare and not for peaceful corn reaping.

When investigating all possible uses to which implements such as these might be applied, it occurred to me, amongst other practical purposes, they would be found of material advantage for cutting down acorns, hazel nuts, and small branches of trees, similar to our bill-hooks; also for grappling objects, aiding in the capture of game or salmon, and perhaps also for the uses for which boat hooks are required. The latter suggestion originated from my possessing two implements made of iron which were discovered at Ballinderry crannog some years ago that were probably employed in this manner (see Pl. XIII., figs. 8 and 9). These iron-hooked implements appear to a certain extent to represent their bronze prototypes, allowing for differences in the material employed for their construction, and their restricted application for a special purpose. Whether this be so or not, it appears desirable to preserve some record of these iron implements which are alluded to in the *Transactions* of this Academy, as they are the only examples yet discovered in Ireland of similar shaped articles.

I obtained from Sweden, through the kindness of Professor Soderberg, one of the flint-blades which Northern antiquarians consider were formerly used for reaping. It is an admirable specimen of flint manufacture, and perhaps the only example that has yet reached Ireland. Whether intended for reaping or not, it affords a remarkable proof of skilled workmanship in flint, and might be employed for many purposes like an ordinary knife.

Independent of the conjecture that all these forms of bronze curved implements were intended for warfare, and not for the peaceful reaping of grain, it will, I hope, be admitted they may be classified into at least three forms deserving of separate description. It would have added to the force of these remarks if I were able to adduce satisfactory evidence that the culture of grain was unknown in the earlier bronze ages in Ireland. I believe the primitive bronze using races were hunters and owners of herds of cattle. The climate of this country, its dense woods, bogs, and lakes, its cold and prolonged winters and damp summers, were all unfavourable to agriculture, and it is not until the introduction of Christianity that we have clear proof of local settlements, and the practice of growing grain in connexion with these centres of civilization. At present it must be remembered our island is not favourable for the growth of grain, which in Norway and Sweden matures far north of our latitude, but as I cannot obtain conclusive facts to elucidate this interesting question, I must content myself with simple reference to the so-called sickles, and the classification of them now proposed.

There are at least three well-marked varieties of the so-called sickles which deserve separate arrangement:—

1. The implement springing laterally from an open socket of which the specimen found at Meelick Ford is a good example.

2. A somewhat similar shaped weapon springing from the side of a closed socket.

3. The comparatively rare curved weapon, shaped like the handle of a walking-stick or end of a crozier; this is usually larger in size than the other forms, and bears a certain external resemblance to a sickle, but has both sides equally sharpened.

In both Nos. 2 and 3 there are found examples with rounded terminations to the blade, like ordinary dinner knives, and also some with acute points. Whether this difference demands their separation into distinct classes must be left undecided at present. Such difference is considered important in the case of other bronze implements, and alleged to depend on their belonging to distinct Irish races.

I append a list of all the examples at present known to me in this country and in Great Britain.

LIST OF DIFFERENT FORMS OF BRONZE IMPLEMENTS USUALLY CLASSED AS "SICKLES."

I.—*Those distinguished by having perforated sockets.*

1. Found at Ford of Meelick, on the Shannon: socket, upwards of one inch deep; blade, 4¼ inches in length; point rounded (Dr. Frazer). (Pl. XIII., fig. 10.)

2. Royal Irish Academy Museum (No. 83): socket, 1½ inch; blade, 3½ inches; point rounded. (Pl. XIII., fig. 7.)

3. Royal Irish Academy Museum (No. 84): socket, 1½ inch; blade, 3½ inches; point rounded.

4. Royal Irish Academy (No. 85): socket, 1½ inch; blade, 3¼ inches; point rounded.

5. Museum of Cambridge Antiquarian Society: obtained from Streatham Fen; measurement given by Sir J. Evans, 5½ inches.

6. From Downham Fen, 5¾ inches.

7. In vol. i., p. 108, "Dublin Penny Journal," there is a woodcut representing an instrument of this class with five bands upon the sockets and two ribbings on the blade, the socket about 1½ inch deep, and the blade 5½ inches long, point acuminated. No history is given; it prefaces a paper on the Antiquity of Corn in Ireland after the Christian Era, about which no doubts exist, but there

appears no connexion between this bronze implement and the author's remarks. I do not know where it is at present.

8. Socket, $1\frac{3}{4}$ inch long; blade $4\frac{1}{2}$ inches with raised central ribbing along blade. Found in the Thames, near Windsor, and engraved in Proc. Soc. Antiqs. London, 2 ser. vol. 5, p. 95.

II.—*Socket closed above; blade springing from side of socket.*

1. Royal Irish Academy Museum (No. 77); length of socket, $1\frac{1}{8}$ inch; length of blade, $3\frac{1}{4}$ inches; point rounded.

2. Royal Irish Academy Museum (No. 79); length of socket, 2 inches; of blade, $3\frac{1}{4}$ inches; point rather acuminated.

3. Royal Irish Academy Museum (No. 78); length of socket, almost 3 inches; blade broken across two inches from socket; the sides decorated in a cord-like pattern along centre of blade; point was probably acuminated.

4. Royal Irish Academy Museum (No. 80); length of socket, 2 inches; length of blade, 3 inches; point rounded.

5. Royal Irish Academy Museum (No. 76); length of socket, $2\frac{1}{4}$ inches, above which the blade extends for another quarter of an inch; it is broken transversely across, two inches from side of socket, and ornamented with a series of parallel flutings; the point appears to have been acuminated; found in county Cavan.

6. Royal Irish Academy Museum (No. 82); length of socket, 2 inches; from this the blade springs in an oblique line, passing from top of socket in a continuous curve, and forming an intermediate form with the next described class of implements; length of blade, $3\frac{1}{2}$ inches; found in county Tipperary. (Pl. XII., fig. 2.)

7. Royal Irish Academy Museum: a highly decorated implement, of which a woodcut is given in Sir W. Wilde's Catalogue; length of socket, $2\frac{1}{2}$ inches, above which the blade rises for half an inch; length of blade about $4\frac{3}{4}$ inches; found in county Westmeath. (Plate XII., fig. 1.)

8. In Canon Grainger's Collection, Belfast; length of socket, $1\frac{1}{2}$ inch, above which the blade rises for about one eighth of an inch; length of blade, $3\frac{1}{2}$ inches; end broken off; it appears to have been much rounded. (Pl. XIII., fig. 11.)

9. Canon Greenwell, Durham (fig. 1)[1]; length of socket above 1½ inch; of blade, 3¼ inches, with three ribbings on sides of blade; end sharp pointed; got at Garvagh, county Derry; figure 237 in Evans on "Bronze Implements."

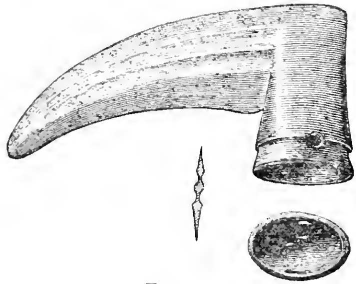

Fig. 1.

10. Perth Museum; length to top of socket, 2 inches, above which the blade rises for about one-fourth of an inch; length of blade, 5 inches; there are five flutings on sides of blade; point well rounded; dredged from the Tay, near Errol, in 1840; figure 236 in Evans on "Bronze Implements."

11. British Museum; length of socket, 2 inches; the blade extends obliquely from upper part of socket across its sides to a point about one inch above the aperture, and measures 3½ inches; point acuminated; found at a depth of 6 feet in a bog, county Tyrone; figured in Archæol. Journal, vol. ii., p. 186.

12. Mr. Carruthers; length to top of socket, 1¾ inch, from which the blade springs continuously, so that no distinct demarcation is preserved; length of blade, nearly 6 inches; point sharply acuminated; found near Belfast in 1849. (Pl. xii., fig. 3.)

13. Length to top of socket 2½ inches; length of blade, 3 inches springing from side of socket similar to No. 12; a cord-like decoration runs along the sides of blade to its point, which is acuminated; found in Aberdeenshire, and figured in Proc. Soc. Antiq., Scotland, vol. vii., p. 376.

14. R. Day, Esq., Cork; length to top of socket, 2 inches, from which the blade springs without marked demarcation; blade, curved considerably, with rounded end projecting four inches from the socket, so that its curved convex edge measures six inches; found in county Antrim. (Plate xiii., fig. 12.)

[1] I have to acknowledge the kindness of Sir J. Evans, D.C.L., late President of the Society of Antiquaries, in lending the woodcuts used to illustrate this paper.

15. A broken blade with sharp point 3 inches in length; sides ornamented with three narrow bands; found at Ballon, Co. Carlow, several years since, it is said, with urns, but I am not aware of the circumstances; communicated by Rev. J. M. ffrench, of Clonegal.

16. In Sir J. Evans' Collection; length of socket, 2 inches; of blade, $4\frac{1}{2}$ inches; dredged from the Thames in 1859; figure 234 in his work on "Bronze Implements."

III.—*The blade much curved, springing from the top of a closed socket.*

1. Royal Irish Academy Museum (No. 86); length of socket, $1\frac{3}{4}$ inch; blade measured along its upper edge to expanded top of socket, $7\frac{1}{2}$ inches; apex of blades broken; acuminated. (Pl. XII., fig. 4.)

2. Royal Irish Academy Museum (No. 87); length of socket, nearly $2\frac{1}{2}$ inches, expanding like last where the blade originates; this measures along its upper convex edge $8\frac{1}{2}$ inches, and ends in a pointed extremity. (Pl. XII., fig. 5.)

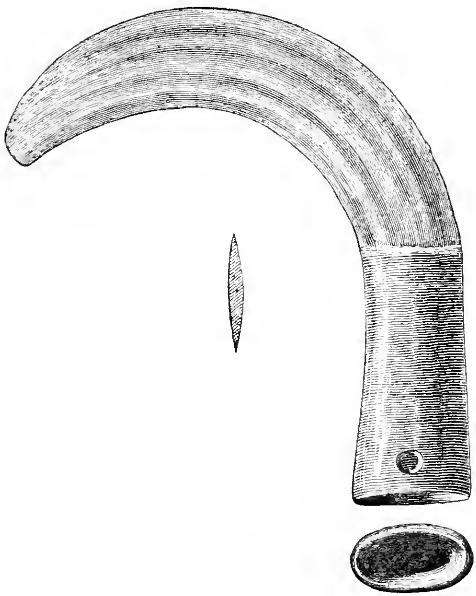

FIG. 2.

3. British Museum (fig. 2); length of socket, $2\frac{1}{4}$ inches; blade, broad, with rounded ending, having three ribbings on its sides; it

measures along its convex edge from top of socket nearly 8 inches; found near Athlone; figure 238 in Evans' "Bronze Implements."

4. Portion of a similar implement from Crofton Croker's Collection.

5. Belfast Museum; length of socket, nearly 2 inches; blade with broad rounded end and central ribbing, measuring along convex edge from top of socket, $6\frac{1}{2}$ inches; found at Drumlane, county Antrim. (Pl. XIII., fig. 6.)

6. Leeds Museum (Collection of J. Holmes, Esq.); no distinction between socket and blade, which is sharp on both edges; it measures from opening of socket to broad rounded end 10 inches; side of blade with central ridge.

7. Norwich Museum; no distinction between socket and blade, which is sharp on both edges, and has one rivet-hole; socket opening $\frac{11}{16}$ by $\frac{7}{16}$ of inch; measured from opening of socket to end of blade, along convex edge, about $7\frac{1}{2}$ inches; figure 235 in Evans' "Bronze Implements."

XXIII.

REPORT ON SOME SPECIES OF THE GENERA *BUCCINUM*, *BUCCINOPSIS*, AND *FUSUS*, DREDGED OFF THE SOUTH-WEST OF IRELAND. By HENRY K. JORDAN, F.G.S.

(COMMUNICATED BY DR. SCHARFF.)

[Read May 23, 1892.]

The specimens submitted for the purpose of this Report were contained in six jars and bottles and in seven boxes. For facility of reference, the former will be lettered A to F, and the boxes numbered 1 to 7.

Their contents were :—

Jar A. *Fusus islandicus*, Chemn.: one live example.
Fusus gracilis, Da Costa: two dead examples.
Buccinopsis dalei, J. Sowerby: two dead examples.
Buccinum humphreysianum, Bennett: one live example.
Fusus propinquus, var.: one dead (enclosed in a glass tube).

Jar B. *Fusus antiquus*, Linn.: one specimen.
Fusus jeffreysianus, Fischer: one specimen, dead.
Fusus fenestratus, Turton: three specimens, dead.
Buccinum humphreysianum: one live specimen in a tube, and one dead.

Jar C. *Fusus berniciensis*, King: two dead examples.
Fusus gracilis: three dead examples.
Buccinum humphreysianum, var.: one dead example.
Buccinopsis dalei: one dead example.
Fusus antiquus: one live and one dead.

Jar D. *Fusus gracilis*: one specimen.
Fusus jeffreysianus: one dead example.

Jar E. *Buccinum undatum*, Linn.: one live and one dead specimen.

Jar F. *Fusus gracilis*: one example.
Fusus propinquus, Alder.: one dead specimen.

Box 1. Marked "Warren Collection, loc. : ?"
Fusus gracilis: a series of five specimens.
Fusus antiquus: three young examples mixed with above.

Box 2. *Fusus propinquus:* one live and three dead specimens.

Box 3. *Fusus propinquus:* two specimens.
Buccinum undatum, fry: in two tubes.

Box 4. *Fusus despectus*, Linn.: a dead and fragmentary specimen.

Box 5. *Fusus jeffreysianus:* in a tube, marked "*F. propinquus* (?)."

Box 6. *Fusus jeffreysianus:* a series of live shells in bad condition.

Box 7. *Fusus propinquus*, var.: one specimen.

The specimens above mentioned will now be described in detail. Those in the jars have been retained in spirits, as desired, for the preservation of organisms adhering to some of them.

Genus, **Buccinum**, Linn.

1. *B. undatum*, Linn. It is remarkable that of this widely distributed and prolific species there are only two small examples, one live and one dead, and a few of the fry. These are of a form approaching the type and call for no special comment.

2. *B. humphreysianum*, Bennett. Of this much rarer species there are three live and one dead of the type, and one dead specimen of the following variety in Jar C:—

   B. humphreysianum, var., *ventricosum*, Kiener.

   This is an interesting and remarkable form, and undoubtedly new to the British fauna. It is the *B. ventricosum* of Kiener, and occurs on the coast of Provence.

   According to the Marquis di Monterosato, Kiener's shell is the *B. striatum*, Phil., a Sicilian fossil.

I have compared the specimen under notice with *B. ventricosum* from Provence. The two shells agree in size, contour, and texture; but the spiral striæ of the Provence shell, which are clearly visible to the naked eye on the upper and lower part of the whorls, disappear at the periphery; whereas on the Irish specimen the striæ are stronger and occur regularly over each convolution. The fineness, or coarseness, of striation is merely a question of degree, and in this respect some univalves vary greatly, as will be noticed when describing *Fusus gracilis*. *B. ventricosum* and *B. humphreysianum* have hitherto been regarded as distinct species, but Jeffreys in describing the latter species says :—" *B. ventricosum* of Kiener (from the coast of Provence) is closely allied to our shell" (*British Conchology*, vol. iv., p. 294). The specimen under notice clearly connects the two species; it is 2·1 inches in length, and 1·2 inch in breadth.

GENUS, **Buccinopsis,** Jeffreys.

Buccinopsis dalei, J. Sowerby. Of this rare species there are two dead examples in Jar A, the smaller specimen having a semi-fossilized appearance, and a dead example in Jar C. This species has recently been taken near St. Kilda, and is found around the Shetland Isles, and off Aberdeen, and the Yorkshire coast.

GENUS, **Fusus,** Bruguiere.

This generic appellation will be used in this Report in the broad sense in which it was employed in "British Conchology."

Modern opinion probably leans to the view that the learned author of that work merged into this genus species which should be grouped in two or more genera.

Until a new standard work upon the British Marine Molluscan Fauna appears, it will be wise to conform to Jeffreys' arrangement.

1. *Fusus antiquus*, Linn. This common species, which is found all around the British Isles, is represented by a solitary living example in Jar B, and this specimen is intermediate in form between *antiquus* and *despectus* of Linné.

In a Paper published by me on *Fusus* (*Journal of Conchology*, July, 1890), in describing the var. *striata*, the following statement occurs :—" This variety also occurs on the opposite side of the Channel, off the Waterford Coast, and some examples are so strongly ridged as to approach in form *Fusus despectus*, Linné. I entertain the opinion that, if a sufficient number of specimens were obtained, the fact would be established that *F. antiquus* and *F. despectus* are one and the same species."

Since then other specimens from the same district have occurred, and which are still more strongly carinated. Of one of these Canon A. M. Norman says :—" I refer it to *despectus* rather than to *antiquus*." The specimen in Jar B may be regarded as an extreme form of *F. antiquus*, var. *striata*, or as *F. despectus* with equal propriety.

2. *F. despectus*, Linn. A dead specimen in Box 4, marked "Station 3, 1885," would be referred to this species by any conchologist who was in ignorance of the locality from which it was obtained. This species is recorded in the *Porcupine Report* as occurring off the West Coast of Ireland, Stations 10 to 17. The fragmentary specimens obtained in the *Porcupine* expedition in the locality mentioned are in the Natural History Museum, South Kensington, and I cannot distinguish those specimens from the one under notice.

3. *F. islandicus*, Chemnitz. One fine live specimen in Jar A, 5·02 inches in length. It is only within the last seven years that this species has been found in the living state in the British Seas, the three specimens found in earlier times—two from Shetland and one from the Wexford Coast—being dead, as recorded in *British Conchology*, and a doubt existed as to whether they were recent or glacial fossils. During the past seven years some eight or nine living examples have been trawled between the Waterford and Pembrokeshire Coasts, most of which were secured by the writer. The specimen in Jar A, although it has unfortunately lost its embryonic whorls, is the finest example of *F. islandicus* that I have seen from the British seas.

4. *F. gracilis*, Da Costa. There are of this common species only seven specimens in the jars, and five of these are dead. In Box 1 there are two distinct forms—one being the type, and the others with strong spiral striæ are varietal. The difference in the sculpture of these two forms is as great as that spoken of in describing *Buccinum humphreysianum*, var. *ventricosum;* other species, notably *Buccinum undatum*, vary in the same way.

5. *F. propinquus*, Alder. There are, in all, nine specimens, of which four may be referred to the type (three dead specimens in Box 2, and one dead example in Jar F). The remainder furnish, at least, two new varieties which will now be named and described:—

F. propinquus, var. *intermedia*, Jordan. The immature specimen in Box 7, "Exp., 1886, log. 44, 108 fms.," is intermediate in form between *F. propinquus* and *F. jeffreysianus*, partaking slightly more of the facies of the former. It is an interesting specimen, as it appears to connect these two species. L. 1. B. 0·44 inch.

F. propinquus, var. *nana*, Jordan. A dwarf, solid form. The first five whorls increase more rapidly, and the others less rapidly, than in the type; thus the shell has a sub-cylindrical shape. The penultimate and ante-penultimate whorls are longer, and the body whorl is much shorter than usual. L. 0·94; b. 0·40. This curious little specimen, out of Jar A, was almost entirely invested by an anemone, the end of the canal alone been visible. It was inhabited by a hermit crab, and is returned *in a box* with this Report.

In Box 2 there is a remarkably thick and solid specimen, and in Tube B, Box 3, a similar form. To these might be assigned the varietal appellation of *incrassata.* This variety also occurs near Aberdeen.

6. *F. jeffreysianus*, Fischer. The two dead specimens in Jars B and D, and the examples in Boxes 5 and 6, call for no special comment.

7. *F. berniciensis*, King. Two dead specimens in Jar C—one measuring 4·34, and the other 1·63 inch in length. These are the first specimens which have been recorded from the Irish coasts, so far as I can ascertain, and this fact imparts a special interest to the specimens notwithstanding their bad condition. This species has been taken in the North Atlantic, midway between the Irish and Labrador coasts, 690 fms.; in the Bay of Biscay, *Le Travailleur* Expedition; and in the slopes of the Channel, 257–539 fms.

8. *F. fenestratus*, Turton. Three dead specimens in Jar C—two of them measuring 2·12, and the other 1·95 inches in length. During the past twelve months a dead but fresh specimen was trawled between the Waterford and Pembrokeshire coasts, 40–60 fms.

Having described the specimens in detail, it may be well to take a brief survey of them in general.

The first impression is one of disappointment at their small number and generally bad condition; nevertheless there is considerable interest attached to them. In the first place the *Buccinum ventricosum* of Kiener—a Lusitanian and Mediteranean form—is new to the British fauna, and its connexion with *B. humphreysianum* is established. Again, it is in company with *F. islandicus*—a boreal and Arctic species—and thus affords another illustration of the "interdigitation of faunæ," which has been noticed by former Reporters. (*Proc. R.I.A.*, Ser. 3, Vol. I. p. 42.

Then, again, *F. berniciensis* is new to the Irish coasts, and there are at least two new varieties of *F. propinquus.*

Of the nine species of *Fusus* described in *British Conchology*, seven are represented; the two non-occurring species being *F. turtoni* and *F. norvegicus*.

The former occurs off the Yorkshire coast, and northwards, but it has not been recorded from the west coasts of the British Isles. The latter has been taken off the Butt of Lewes, and will probably be found off the west coast of Ireland.

In the "*Porcupine*" expedition a new species of *Fusus* was dredged off the S.W. of Ireland. It was named *Fusus attenuatus*, Jeffr. It has not been described or figured, but a specimen of it is in the Natural History Museum, South Kensington. In the Report of the same expedition mention is made of "an undescribed species of *Fusus*, allied to *F. sabini*," having been taken off Valentia (Stations 2–9), 88–808 fms.

In drawing attention to these rare and almost unknown species, I would suggest that if another expedition is fitted out—which, let us hope, may be the case—efforts be directed to the re-discovery of them.

That a further expedition would enrich our knowledge of the marine fauna of the British Isles, and add new species to our lists, there can be little doubt, and, with the exception of the Faroe Channel, there are no localities around our coasts possessing greater attractions than those areas from which the specimens herein described were obtained.

XXIV.

SOME NEW ANTHROPOMETRICAL INSTRUMENTS.

By C. R. BROWNE, M.B.

[COMMUNICATED BY PROFESSOR D. CUNNINGHAM, M.D.]

[Read December 4, 1891.]

Very soon after the regular work of the Anthropometrical Laboratory of Trinity College, Dublin, was started, it became evident that there was need for some slight improvement both in our methods and instruments.

The first change made was the abolition of the measurement from tip of mid-finger to centre of patella, as this was found to be difficult,

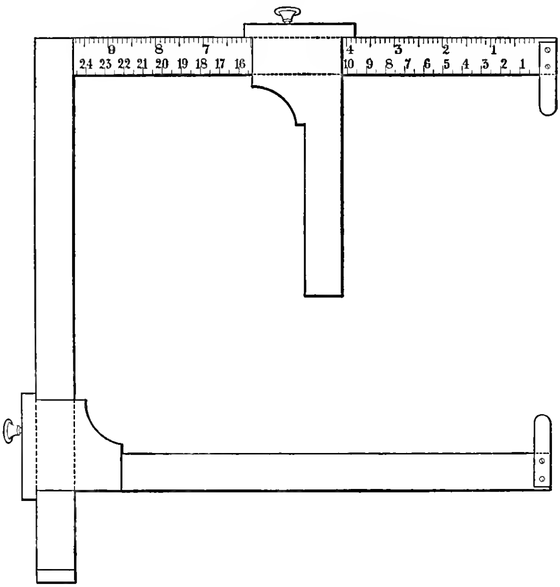

Fig. 1.

I may say practically impossible, to get correctly, owing to the very great discrepancies made by slight differences in the attitude of persons being measured.

The next was the introduction of a reliable instrument for taking radial measurements of the head, such as the auriculo-cranial height and the auriculo-alveolar, and auriculo-nasal lengths. To take these, Professor Cunningham introduced a modification of Busk's craniometer. (See fig. 1.) It consists of an L-shaped portion, each limb twenty-five centimetres in length, one arm of which is terminated by a conical ear-piece of ivory, and is graduated on two scales, millimetres and tenths of an inch from below upwards—the zero of the scale corresponding to the centre of the ear-piece. This limb carries a short sliding bar, moving freely up and down by means of a collar. The other limb is plain and ungraduated, and carries, by means of a long collar, a bar equal in length to the graduated limb, parallel to it, and like it terminated by an ear-piece. The mode of action is as follows:—The person to be measured being seated in a chair, the operator stands behind, and, having introduced the ear-piece on the fixed limb into one ear, he slowly moves the sliding bar until the plug it carries is well situated in the other, and then, getting the person to hold the extremities of the bars, he still further steadies the instrument by grasping the horizontal limb with one hand while with the other he moves the sliding indicator down upon the vertex, which done, he reads off the measurement from the scale. This instrument has been in use in the Laboratory for some time, and has given very satisfactory results.

The instrument which was first employed in the Laboratory for testing keenness of eyesight was the very excellent apparatus introduced by Mr. Galton. Experience showed, however, that a slight modification of this was advisable, and the instrument which I have devised for the purpose of taking its place may be described as follows:—It consists of a square bar, about forty-two inches long (on which is a scale graduated in centimetres and half centimetres), mounted horizontally on a stand; on this bar, and sliding freely along it, is a collar, which carries at its anterior extremity a clip in which is held the test-card printed with numerals of standard type (brilliant), and also holds, by means of a fixed arm, the carriage lamp which provides the light. At one end is the eye-piece, a tube like the end of a telescope, but without lenses, four centimetres in length, and one in diameter at the orifice, set in the centre of a blackened metal disc, which is so large as to cut off all view of the test-tablet except that through the tube. Care is taken to have the light as constant as possible by having the lamp fixed in its position with respect to the test-card, and by cutting off direct daylight by means of a large blackened shield. This shield is movable, and can be attached to whichever side of the instrument the window giving the direct light may be situated on.

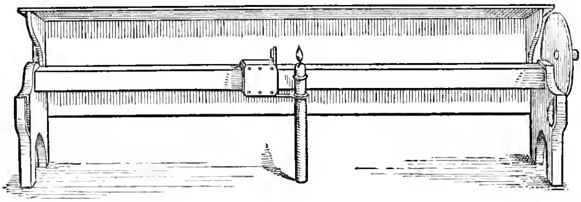

FIG. 2.

The main points in which this instrument differs from Mr. Galton's are—1st, Instead of several fixed test-tablets there is only one which is movable along the graduated bar; 2nd, The distance of the lamp from the test-card is fixed and constant; 3rd, The disc and tubular eye-piece 4th, The shield to cut off direct daylight.

It is in contemplation soon to begin to take a series of records of the curvatures of the cranium by means of leaden strips, such as were used by Professor Cunningham in his investigations upon the lumbar curve.

XXV.

NOTE ON SOME CINERARY URNS FOUND AT TALLAGHT, COUNTY OF DUBLIN. By T. H. LONGFIELD, F.S.A.

(Plate XIV.)

[Read May 23, 1892.]

Some months ago I purchased from Mr. Halbert, of High-street, two fragments of an ancient cinerary urn which he informed me had been found "on the east side of a hill between Tymon Castle and the Green Hills, County Dublin Mountains." These fragments had been brought to him for purchase, and a few days after he went to the locality mentioned by the vendor and secured some more portions of the same urn and a few fragments of a smaller urn and two flint scrapers, which I also obtained from him.

The number of fragments of the larger urn (exclusive of scraps) was 130. I have been able to join several of the pieces together and to make a drawing of the urn in its original form. (See Plate XIV.) The height of the urn was 1 ft. $\frac{1}{2}$ in., its greatest diameter $10\frac{1}{2}$ in., the diameter at mouth $8\frac{3}{4}$ in., and the diameter at base $4\frac{1}{2}$ in.; at its greatest diameter was a band $\frac{3}{8}$ in. wide, with chevron ornament in high relief. With the exception of a band about an inch wide near the bottom, the entire surface was richly decorated, as also the top edge of rim, and for a distance of $2\frac{3}{4}$ inches down the inner side of mouth.

The smaller urn or food vessel which was found with the large one was $3\frac{5}{8}$ in. high, and its greatest diameter $5\frac{3}{8}$ in.; its outer surface and rim was also entirely covered with decoration; but while there are about 15 bands of chevron work on the large urn none occur on the food vessel.

The description Mr. Halbert gave me as to the manner in which the interment was constructed is as follows:—

The urn was about 10 feet under the surface, placed, mouth downwards on a flag, over the calcined bones; the top soil containing partly-burned clays and black clay with an oily smell. For some distance round the urn a rough wall of large stones had been built, outside which was heavy blue sand and loam, and the space inside and over the urn was filled with small stones, about the size of walnuts, stained with white (which white stain I also found on some of the fragments of the larger urn).

The fragmentary state of the bottom of the urn, compared with the very perfect state of the mouth, would, I think, be accounted for by the fact of moisture lying on the bottom for such a lengthened period. So far as I have been able to discover, the larger urn is one of the most beautifully and richly decorated urns that has been found in Ireland. With the urns were found a large human skull and arm bones.

XXVI.

ON A NEW SPECIES OF EARTH-WORM. By the REV. HILDERIC FRIEND, F.L.S.

[COMMUNICATED BY DR. SCHARFF.]

[Read NOVEMBER 14, 1892.]

THROUGH the courtesy of Dr. Scharff I received in the middle of June, 1892, a consignment of earth-worms collected in his garden in Dublin, which included, in addition to several species already well known to occur in Britain, one which is new to science. I have pleasure in submitting the following account of the new species under what seems to be its most fitting designation, the Irish worm (*Allolobophora hibernica*). I shall first deal with the general characters of the species, then give a detailed account of the specimens studied, and finally determine its position and relationships.

I.—GENERAL CHARACTERS.

A. hibernica, sp. nov.

When living and extended in the act of crawling the worm (fig. 1) is about 2 inches or 50 mm. in length. In spirits it is from 1 to 1⅓

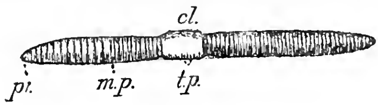

Fig 1.

inches, or 25 to 35 mm. long, and thus ranks in size with three or four of our British dendrobænic worms, such as the tree-worm (*A. arborea*, Eisen), or the Celtic worm (*A. celtica*, Rosa). Unlike these, however, its colour is fleeting, so that immediately upon being placed in alcohol the small quantity of colouring matter which is present in the living worm evanesces, leaving the preserved animal without the least indication of its pretty appearance in a state of nature. The anterior portion of the worm when alive is of a rosy hue closely approaching flesh-colour; the girdle is a dull yellow, while the rest of the body, excepting the caudal extremity, is a greyish hue, appearing brown along the line of the dorsal vessel. The last half dozen segments are yellow, just as in the gilt-tail or cockspur of the angler (*A. subrubicunda*, Eisen). The presence of a pigment which is exuded from the dorsal pores accounts for this yellow tinge, which in the most adult specimens may be found pervading other portions of the body to a slight degree.

As regards the colour, therefore, this worm most closely resembles the mucous worm (*A. mucosa*, Eisen). The disposition of the setæ, however, settles the point of specific difference in a moment; for while the setæ of the mucous worm are arranged in four couples, the individuals of which are pretty close together, those of the Irish worm are in eight rows (fig. 8), more or less equidistant, as in the gilt-tail or the dendrobænic group.

With a worm so short as this it is rather unexpected to find so many segments, but the average is 90–100, so that they are very narrow, and closely arranged side by side. In this respect they come very near the constricted worm (*A. constricta*, Rosa).

The worm is a true Allolopobhora in the sense in which all modern writers, following the classification of Eisen, understand the term. In the genus Lumbricus the lip or prostomium (*pr.*) so completely cuts the first segment or peristomium (*per.*) as to form with it a perfect mortise and tenon. (See fig. 3.) The setæ, also, in Lumbricus, are always in four pairs (fig. 7), the individuals of which very closely approximate, and the colour is a warm ruddy brown with an iridescent colour-play under the action of light. There are other characters, both external and internal, which might be stated; but Allolobophora differs chiefly in the following points. The lip only cuts the peristomium partially, if at all (fig. 2); the setæ may be in pairs or scattered, while the colour is exceedingly variable. So far as British species go we find that in Lumbricus there are invariably six girdle segments, the inner four of which are (fig. 4) spanned by the puberty band (*tubercula pubertatis*), whereas in Allolobophora the girdle covers from five to eight or ten segments, and has the tubercula, if present at all, either on consecutive or alternate segments, in the shape of a band or as pores (see fig. 5), and varying in number from two upwards.

In the light of this brief statement of generic differences it will clearly be seen, when I state the distinguishing features, that the new worm belongs to the genus Allolobophora, and not to Lumbricus. The lip or prostomium is very small and pallid, not perceptibly cutting the first segment. When fully extended, however, the prolongation backwards into the peristomium may be distinguished for a short distance, owing to the extreme delicacy and whiteness of the lip, and its attachment. When retracted the lip is quite closed by the peristomium, and lies in the buccal cavity unperceived from above. The setæ are scattered, and the colour, as already stated, is not of that permanent character which pertains to the Lumbrici. The latter genus is not represented by a single species which exudes a coloured or turbid secretion, whereas this animal, like the mucous and gilt-tail worms is wont to throw out a small quantity of fluid of a yellowish

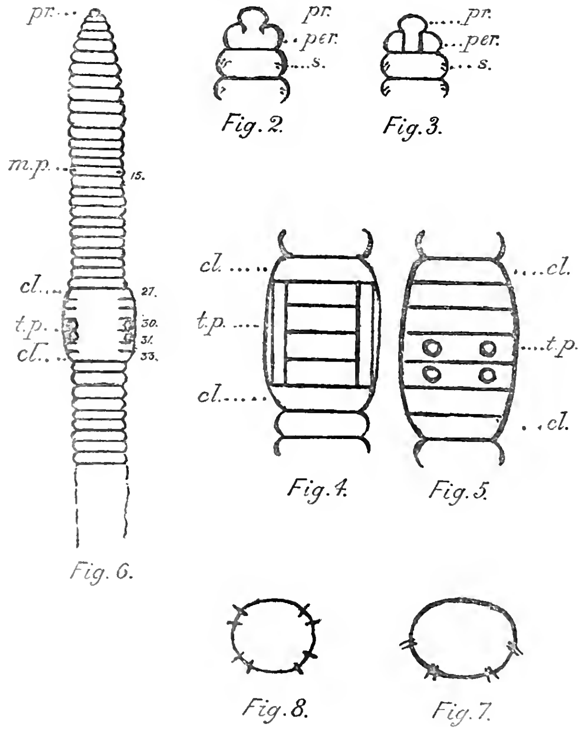

Fig. 2. Fig. 3. Fig. 4. Fig. 5. Fig. 6. Fig. 8. Fig. 7.

colour. Many other species belonging to this genus possess a similar property, and as the quantity of fluid discharged from the dorsal pores seems to vary with the maturity of the worm I am disposed to hold that it has something to do with the most important functions of nature. The position of the first dorsal pore has yet to be determined. In the mucous worm it can be readily seen, not so here.

The male pores are found on each side of the fifteenth segment (fig. 5 *m.p.*), being easily recognised in adult specimens by the small papillæ upon which they are seated. In some worms bearing a close relationship to this species the papillæ are so large as to affect the two adjoining segments (14–16), but, in this case, no such prominent position is held by them. The girdle is conspicuous, dense, and closely fused on the dorsal surface, but each segment is clearly defined beneath. It covers six to eight segments, two only of which bear the *tubercula pubertatis*. The general outline of the girdle ventrally closely resembles that of the nearly allied mucous worm (*A. mucosa*, Eisen), as it is truthfully pourtrayed by Eisen in the plate which accompanies his original description. We shall the better understand this after studying the details supplied in the next section.

One rather striking peculiarity may here be emphasized. In several species of worms, such as the brandling (*A. fœtida*, Sav.), the long worm (*A. longa*, Ude), and the common earthworm (*Lumbricus terrestris*, L.), we find a tendency on the part of those segments which contain the sexual organs to become tumid and pale on the ventral side. In this case, however, it is the dorsal surface which is so affected, especially in segments 10 and 11, and on the worm being dissected the cause of this unusual appearance is at once discovered. Whereas in most species of worms the spermathecæ are ventrally or laterally placed, in the Irish worm they are disposed on the back.

II.—SYSTEMATIC ACCOUNT OF SPECIMENS.

I was fortunate enough to find eight specimens of this worm in the batch consigned to me, and had recognised the novelty of the worm as soon as the first specimen or two had been transferred to alcohol, so that I was able deliberately to study the whole series, first in a living state, and afterwards in spirits. I have since received two large series of the same worm from Dr. Scharff, by means of which I have been able to confirm and extend my earliest observations. As the characters by which the species is distinguished in a living condition have now been generally set forth, I will proceed to specify some details respecting the individual specimens as they appear when preserved in alcohol. Not one of the specimens carried spermatophores, but six out of the eight were sexually mature, and the other two were in a specially good condition for external diagnosis. One of the most important points in relation to the classification of worms is that which concerns the number and position of the *tubercula pubertatis* and it frequently happens that the exact solution of the difficulty is accomplished with the greatest ease when the worms are in a state of puberty. Earlier in life there is absolutely nothing to differentiate one segment from another, while the fully developed girdle of later life sometimes obscures these organs, as for example very notably in the turgid worm (*A. turgida*, Eisen). There was not the least difficulty in the present instance, owing to the fact that the two immature worms had reached the period of pubescence, and showed the glandular prominences known (fig. 6.) as the *tubercula pubertatis* most distinctly on segments 30 and 31. There are, therefore, a pair on each side, and as the segments bearing them thicken, and develope the girdle, this portion of the body attains the greatest diameter.

A bird's-eye view of the whole will be best obtained by means of a chart in which the points of importance may be tabulated in detail. The measurements were all made after the animals had been placed in alcohol.

TABULAR VIEW OF THE SPECIMENS.

No.	Segments occupied by		Length in mm.	Total No. of Segments.	REMARKS.
	Tubercula	Girdle.			
1	30 : 31	0	23	94	Immature. Greatest diameter, 3 mm.
2	30 : 31	0	26	98	Pubescence further advanced than in No. 1.
3	30 : 31	27–33	25	92	Fully mature. Male pore well developed.
4	30 : 31	28–33	27	98	Segments 10 : 11 tumid on dorsal surface.
5	30 : 31	27–32	28	86	Smallest number of segments: diameter greater.
6	30 : 31	28–33	30	100	Last four segments rapidly tapering.
7	30 : 31	27–33	32	104	Papillæ developing under segment 24.
8	30 : 31	27–33	34	108	Girdle 4 mm, curved as in *A. mucosa*.

It will be seen that the number of segments ranges between 86 and 108, so that the average is about 100. The length when contracted does not exceed 1⅜ inch or 34 mm., while the youngest specimen falls just short of an inch. The range is more limited than in some of the larger species, and there is much greater uniformity in other particulars as well. There was not the least trace of an exception with regard to the tubercula, and with reference to the girdle the divergences are very small. Three specimens had seven (figs. 5, 6) segments (27–33) involved, and three had six (27–32 or 28–33), showing what I believe to be a tendency towards reducing the girdle to the limits reached by the genus Lumbricus.

While the worms are perfectly cylindrical in alcohol, with the tail rapidly coming to a point, as in the green worm (*A. chlorotica*, Sav.), yet, when in motion, the hinder part frequently appears flattened and somewhat spatulate. The anal segment is large, while the first ten or dozen segments are about double the diameter of the rest, with the exception of the segments which form the girdle in the mature worm. The setae are disposed somewhat as in the gilt-tail (*A. subrubicunda*, Eisen), but are not placed on pale gland-like sacs as they usually are in the finest forms of that species. In the gilt-tail also the segment behind that which carries the male pores is tumid ventrally, frequently forming a conspicuous ridge along the under-surface of the body, whereas no such tumidity is seen in any of the specimens of the Irish worm submitted to me. On one of the specimens (No. 7) there were glandular prominences or papillæ developing under the 24th segment. Such papillæ are a striking feature in many earth-worms, and are concerned with the sexual relationships of the animals carrying them. It may be observed also with reference to another specimen (No. 5) that though it has the smallest number of segments, it is exactly midway between the two extremes in point of length. Having studied some hundreds of abnormal worms, I find that whenever the number of segments in an adult worm falls below the average there is a tendency for the segments to increase their longitudinal diameter. This inclines one to the opinion that there is a normal length which it is desirable for each worm to attain if it is to discharge the functions of life in the fullest and best possible manner.

Important as external characters are, and readily as the great bulk of worms may be assigned to their true genus and species without the least study of internal organs, it is nevertheless of the utmost importance that the sexual organs of each species should be carefully examined, and their number and position defined. Rosa, the eminent Italian biologist, has clearly pointed out on more than one occasion how necessary it is, not merely to examine the spermathecæ, but especially to notice the position of the opening by which their contents are capable of being passed from within outwards. We shall have in the next section to reiterate this fact; for the present, then, we will be content to examine the species in hand.

Opening a specimen of the Irish worm by a latero-dorsal incision extending from the girdle tothe lip, we are able to display every organ of the body-intestine, gizzard, nephridia, seminal vesicles, spermathecæ, &c. (fig. 9.) Instantly we perceive the reason for the dorsal tumidity of segments 10 : 11. Two pairs of spermathecæ are exposed to view, lying in the 9th and 10th segments. The posterior pair is about twice the size of the anterior, and thus tends to fill up the segment immediately behind that in which it properly lies.[1] A cord or duct connects each of these important bodies with the integument, and they are clearly seen to open into the median-dorsal line near to the place usually occupied by the dorsal pores. They are attached to the anterior face of the septum, and thus connect themselves with the 9/10th and 10/11th intersegment. This is the crucial point so far as internal anatomy is concerned; and while much might be written about the other organs, the neglect of this point might result in very erroneous conclusions.

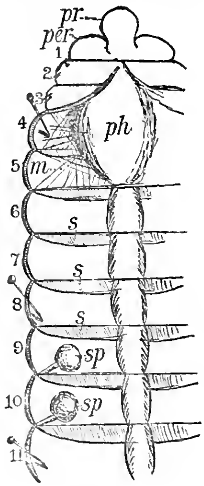

Fig. 9.

III. Affinities.

The specimens under examination were found associated with three species of Lumbricus, together with the green worm, brandling, and gilt-tail. It was evident at first sight that its direct affinities were not very strongly with either of these species. Michaelsen, however, described a form two years ago which seemed at once referable to that under discussion. In an article on Die Lumbriciden Norddeutschlands (*Jahrb. der Hamburg. wiss. Anstalten*, vii.) he speaks of a worm which was supposed to be a variety of the gilt-tail, but differed from the type (*A. subrubicunda*, Eisen) in having the *tubercula pubertatis* on segments 30 and 31, instead of on segments 28, 29, 30. Besides this there was a difference in the disposition of the setæ. Michaelsen, however, failed to examine the structural details of the worm's internal anatomy, or he would have found at once, what the external facts indeed pretty clearly indicated, that the two worms were not in the least intimately related.

It remained for Dr. Rosa to assign to the worm described by Michaelsen as "*Allolobophora subrubicunda*, Eisen, forma nov. *hortensis*" its true position. In the "*Atti del R. Inst. Venet.*" iv. (1885–6), p. 674, Rosa gives an account of the earth-worms of Venice, and

[1] This difference in size is not a permanent character, but depends on the maturity of the organs.

among others makes mention of a new species, which he designated the Venice worm (*A. veneta*, Rosa). As this worm corresponds in some particulars exactly with the Irish worm (*A. hibernica*, Fr.) I think it necessary to transcribe the principal portion of Rosa's description, taken both from his original memoir, and from the synopsis of the same published in the "*Boll. Mus. Zoolog. Anat. Comp. Torino*," vol. i., No. 3 (Ap. 15, 1886).

DESCRIPTION OF *A. veneta*, ROSA.

Length in alcohol from 50 to 70 mm., or an average of 60 mm.; diameter immediately *behind* the girdle, 5 mm. Segments averaging 140, or ranging from 120 to 150. In form and colour exactly like the brandling (*A. fœtida*, Sav.). Cylindrical in alcohol, but with the hinder part polyhedric, owing to the disposition of the setæ. Very large from the head up to the girdle, then rapidly attenuated towards the anal extremity. Segments occupied dorsally by a band of reddish pigment, with other points of resemblance to the brandling. Prostomium pale, the prolongation occupying one-third of the first segment or peristomium. Instead of the pallid spot found on the brandling under segments 9 : 10 : 11, one here usually finds a white aureole on segment 12 at the base of the 3rd and 4th setæ. The male pore is as usual on segment 15, with very small papillæ, the setæ near the apertures being affected. The girdle occupies segments 27–33 (= 7), rarely 27–32 (= 6), or 26–33 (= 8). The tubercula are in two pairs on segments 30 : 31, and are well seen in young examples, in which the girdle is not yet developed. Setæ in pairs, but not closely approximated. The spermathecæ are disposed exactly as in the brandling, viz. a pair in segment 9, and another in the 10th segment against the posterior dissepiment, and opening into the intersegments 9/10, 10/11 in the neighbourhood of the mid-dorsal line. The seminal vesicles also correspond with those of the brandling. The worms are very active, and emit abundance of yellow fluid from the dorsal pores. At first sight, and especially in the matter of colour, it is impossible to distinguish this species from the brandling, although the wide pairing of the setæ rather suggests association with the Alpine worm (*A. alpina*, Rosa). The tubercula, however, serve at once to distinguish these three species.

In 1889 Dr. Rosa published a note on a worm found in the Botanical Gardens of Coimbra, in Portugal, as well as in Liguria, the characters of which showed it to be a variety of the foregoing. From what we learn respecting it we may judge that it approaches the form described in this Paper more nearly than the Irish form approaches the Venetian type. The Portuguese variety differs from the type, both in the matter of size and in the more closely approximating setæ. The examples preserved in alcohol are 40 to 50 mm. in length, with a maximum diameter of 3 mm. For the rest, the colour, position of girdle, tubercula, and spermathecæ, it is exactly like the type. This variety, says Dr. Rosa, in a recent bulletin which he has courteously forwarded to me, is precisely the same as Michaelsen's forma *hortensis,* which Rosa, through the kindness of Michaelsen, has carefully examined.

It is true that, so far as the tubercula and spermathecæ are concerned, the Irish and Venetian worms are alike, and it may be possible, when our knowledge is wider, to decide whether or not the foregoing are distinct species, sub-species, forms or varieties of one another. In the meantime the differences in size, colour, shape, disposition of setæ, and the like must not be overlooked. The Irish worm is, in general appearance, closely allied to the mucous worm (*A. mucosa*, Eisen), while the Venetian is identical with the brandling. Rosa has recently described a new Tunisian worm (*A. bestæ*, Rosa) which in some points touches our Irish worm, and links it with the Venetian species. Its length is 30 to 35 mm., and its diameter 2 mm. in alcohol. The form is cylindrical, the prostomium extremely small, and often entirely retracted into the buccal cavity. The tubercula are on 29 : 30 : 31, as in the mucous worm (*A. mucosa*, Eisen), and the spermathecæ are in two pairs, opening dorsally in segments 12 and 13. Rosa would have taken it for a form of the mucous worm if he had not examined the latter character, and rightly insists upon the absolute necessity of observing the number, position, and direction of the duct of the sperm-sacs.

Postscript.—A few weeks after the discovery of the worm described in the foregoing communication, an account of which I sent to Dr. Rosa of Turin, I learned from that distinguished savant that he had simultaneously discovered a new worm in Italy which exactly corresponded with my account of *A. hibernica.* To this animal he at first assigned the position of a variety merely, and proposed for it the name of *Allolobophora veneta*, Rosa, var. *decolor.* He has since suggested that it be known as *A. cantibrica,* Rosa, but I do not know whether he has published any account of the worm under that name or not. We have exchanged specimens, and I have every reason to believe the worm found in Geneva to be identical with that discovered in Dublin.

XXVII.

NOTES ON NEWTONIAN CHEMISTRY. By REV. SAMUEL HAUGHTON, M.D., S.F.T.C.D.

[Read April 11, 1892.]

Note II.—Ternary Compounds.

(*Water Type.*)

In my first note on compounds of the hydrochloric acid type (HCl), I showed that the properties of the Halogen group, when combined with hydrogen, could be explained on Newtonian principles, viz.,

$$\text{attraction} = \mu \frac{mm'}{r^2},$$

where μ is the coefficient of attraction, varying with the chemical nature of the compounds, m, m' the atomic weights, and r the distance of the bodies.

At all sensible[1] distances the coefficient of attraction (μ) is constant; but at insensible distances such as those contemplated in Chemical Science, μ ceases to be a constant, and varies with the chemical nature of the element, and varies also from other causes, as I shall demonstrate in this note.

By equating the centrifugal force to the attraction in any molecule the radius of whose orbit is unity, we found

$$\mu = \frac{4\omega^2}{\beta} = \frac{4}{\beta m^2}$$

where ω is the angular velocity, m the reciprocal of ω, and β the atomic weight.

---

[1] In sensible distances I include the smallest distances made known by the microscope.

Using the values found in Note I. we construct the following Table :—

Coefficients of Attraction.

	β	m	μ
HH	1	1	1,000,000·0000
FF	19	9	649·7700
Cl Cl	35·5	17	97·4700
Br Br	80	39	8·2182
II	127	63	1·9838

This Table shows how enormously the coefficient of attraction of hydrogen exceeds those of the halogens.

In the case of hydrogen combined with one of the halogens, by equating the centrifugal force to the attraction, we obtain

$$\mu'\beta = \left(\frac{m + \beta}{m}\right)^2,$$

where β is the atomic weight, and m the reciprocal of the angular velocity of the halogen molecule, and μ' the coefficient of attraction between hydrogen and the halogen.

Using the values found in Note I. we construct the following Table, remembering that the values of m must be negative : —

Coefficients of Attraction.

	β	m	μ'
HF	19	− 9	16244
HCl	35·5	− 17	8339
HBr	80	− 39	3454
H I	127	− 63	2031

1. *Case of Water* (H_2O). In the case of water, two atoms of hydrogen are united to one atom of oxygen to form a molecule, and we must suppose that two molecules of hydrogen unite with one molecule of oxygen, with the result that the oxygen molecule is bisected, and that we have two molecules of water.[1] The molecular volume of oxygen is the same as that of hydrogen, and (as is well known) the volumes of hydrogen and oxygen in becoming steam are reduced to two-thirds of the bulk of the original volumes.

The volume of the water (steam) molecule is the same as that of the hydrogen, fluorine, chlorine, bromine, iodine, and oxygen molecules, for

$$\text{molecular volume} = \frac{\text{weight}}{\text{specific gravity}} = \frac{18}{0{\cdot}622} = 28{\cdot}94,$$

a result strictly comparable with those already given for the moleculai volumes of the elements named.

Before discussing the ternary compound of one atom of oxygen united with two atoms of hydrogen, let us consider the binary compound of one atom of oxygen with one atom of hydrogen. This binary compound is not known to exist separately, but is recognized in combination in complex bodies and is called *hydroxyl*.[2] The reason why it is not formed separately is, that it is less stable than water,

$$H_2O > HO,$$

[1] *Vide* Appendix.

[2] *Hydroxyl.* As a matter of fact, OH is not known in the free state, but is recognized by chemists as existent in numerous chemical compounds. All oxyacids are supposed to contain one or more OH groups, and the caustic alkalies, potash, soda, &c., contain OH also; while peroxide of hydrogen (H_2O_2) is regarded as an unstable compouud of two OH groups which are tacitly assumed to be more or less opposed in properties.

This, as I shall show, is in entire accordance with the principles of Newtonian Chemistry.

An investigation of the properties of HO similar to that of the properties of HCl, in Note I., would give the rotations and stabilities of these two hydroxyls, viz.,

positive hydroxyl, . $\omega' = +\ 0{\cdot}97017$,
negative hydroxyl, . $\omega' = -\ 1{\cdot}10406$,

revolving in opposite directions, and having stabilities,

positive hydroxyl, . $\omega'^2 = 0{\cdot}94123$,
negative hydroxyl, . $\omega'^2 = 1{\cdot}2189$;

not far from the proportion of 7 to 9.

and is thus prevented from making its appearance as a separate compound.

If we look back to the dynamical equations on which hydrochloric acid depends we have

Areas $$(\beta + 1)\,\omega' = \beta\,(1 + \beta\omega_1). \tag{4}$$

Energy $$(1 + \beta\omega_1^2) - \frac{\beta + 1}{\beta}\,\omega'^2 = 0. \tag{5}$$

If we substitute in these equations for β the atomic weight of oxygen we have the conditions necessary to account for the production of hydroxyl.

In equations (4) and (5) I have supposed the atoms to be infinitely hard, elastic, and without rotation, so that they cannot undergo any change of energy during collision, and that the whole change of energy takes place in the orbital changes of the molecules.

If we suppose this to be no longer the case, and that $\pm\,\epsilon_1$ denotes the atomic loss or gain of energy in forming one molecule of hydroxyl, we have, instead of equation (5),

$$2\epsilon_1 + (1 + \beta\omega_1^2) - \frac{\beta + 1}{\beta}\,\omega'^2 = 0. \qquad (5)\ bis.$$

Eliminating ω' between (4) and (5) *bis*, we find, after some reductions, and making $\omega_1 = \dfrac{1}{m}$

$$\{2(\beta + 1)\,\epsilon_1 + 1\}\,m^2 - 2\beta^2 m - \{\beta^3 - \beta^2 - \beta\} = 0. \qquad (7)\ bis.$$

Substituting for β the atomic weight of oxygen, we have

$$(34\epsilon_1 + 1)\,m^2 - 512m - 3824 = 0.$$

If the atoms of oxygen and hydrogen have no rotation, and be infinitely hard and elastic, $\epsilon_1 = 0$, and the value of m becomes

$$m = -\,7{\cdot}3625.$$

If we take (as in Note I.) the nearest whole number and make

$$m = -\,7,$$

we find,[1] as the most probable solution,

$$\omega'^2 = 1{\cdot}2564, \quad a_1 = 1{\cdot}50, \quad \epsilon_1 = +\,0{\cdot}0042,$$

where ϵ_1 represents the atomic loss of energy, per atom of hydrogen, during the formation of hydroxyl, and ω'^2 represents the stability of hydroxyl.

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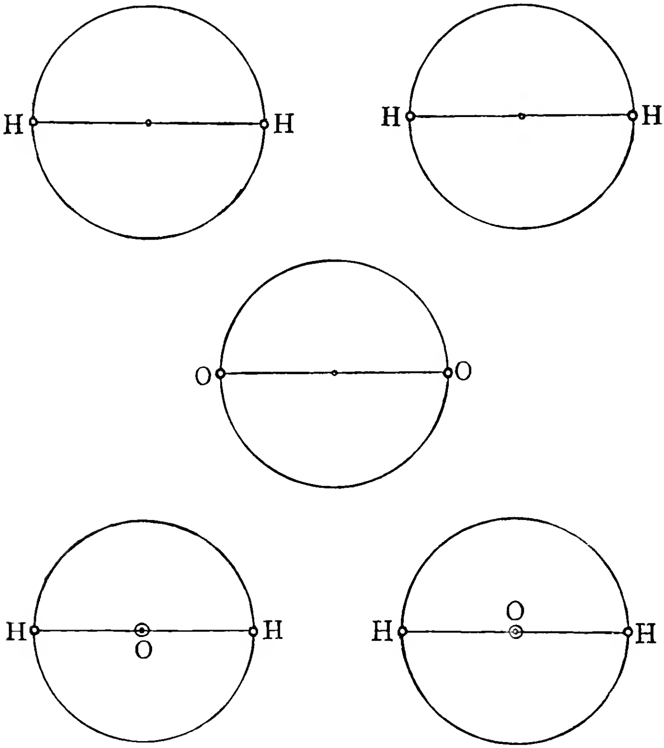
[1] See Note A, p. 430.

In the case of water (H_2O) we have two molecules of hydrogen and one of oxygen converted into two molecules of water.



There are four possible cases to be considered depending on the direction of rotation of the several molecules.

	H	H	O
CASE I., .	+	+	+
CASE II., .	+	+	−
CASE III., .	+	−	+
CASE IV., .	+	−	−

The *equation of Areas* becomes for these cases,

$$\left.\begin{array}{l}\text{Case I.}\\ \text{Case II.}\end{array}\right\rangle \omega'' = 1 \pm \frac{8}{m}.$$

(A)

$$\left.\begin{array}{l}\text{Case III.}\\ \text{Case IV.}\end{array}\right\rangle \omega'' = \pm \frac{8}{m}.$$

The *equation of Configuration* is

$$\omega''^2 = 1 + \left(\frac{m+16}{m}\right)^2. \qquad \text{(B)}$$

The *equation of Energy* is thus found—

Energy before collision $= 2 + \frac{16}{m^2}$.

Energy after collision $= 4 + 4\left(\frac{m+16}{m}\right)^2 - 2\omega''^2$.

Energy lost during collision

$$\frac{16}{m^2} - 2 - 4\left(\frac{m+16}{m}\right)^2 + 2\omega''^2.$$

Hence, if $4\epsilon_2$ be the atomic energy lost during collision,

$$4\epsilon_2 + 2\omega''^2 + \frac{16}{m^2} - 2 - 4\left(\frac{m+16}{m}\right)^2 = 0,$$

or, making

$$\omega''^2 = 1 + \left(\frac{m+16}{m}\right)$$

and reducing, we find, finally—

Equation of Energy,

$$2\epsilon_2 + \frac{8}{m_1^{\,2}} - \left(\frac{m+16}{m}\right)^2 = 0. \qquad \text{(C)}$$

From (A) and (B) we find, by eliminating ω'', and leaving the sign of m to be determined by the resulting equation,

$$\left.\begin{array}{l}\text{Case I.}\\ \text{Case II.}\end{array}\right\rangle m^2 + 16m + 192 = 0.$$

The roots of this equation are imaginary, and, therefore, these cases impossible.

$$\left.\begin{array}{l}\text{Case III.}\\ \text{Case IV.}\end{array}\right\rangle m^2 + 16m + 96 = 0.$$

The roots of this equation also are imaginary, and these cases impossible.[1]

It is evident, from the foregoing, that it is impossible to satisfy equations (A) and (B) so long as the value of m is the same in both.

This impossibility of hydrogen and oxygen combining together of themselves to form water is entirely in accordance with chemical facts. If a mixture of two volumes of hydrogen and one volume of oxygen be made, they will not combine unless aided from without by a lighted match or an electric spark; when this aid is given, water is at once formed with an explosion, which corresponds to a "catastrophe" in a planetary system.

We must now modify equations (A) and (B) so as to suit the condition of aid from without, and give a real value of m.

Equation (B) which depends solely on geometrical configuration does not admit of modification; but equation (A) which represents the conservation of areas can be easily modified; let us suppose that the effect of the lighted match or electric spark is to add a quantity α to the right-hand side of the equation of areas.

We now have

$$\left.\begin{array}{l}\text{Case I.}\\ \text{Case II.}\end{array}\right\rangle \omega'' = 1 \pm \frac{8}{m_1} + \alpha,$$

$$\left.\begin{array}{l}\text{Case III.}\\ \text{Case IV.}\end{array}\right\rangle \omega'' = \pm \frac{8}{m_1} + \alpha',$$

where α and α' are the areas necessary to be added; from which we see that

$$\alpha' = 1 + \alpha.$$

Cases I. and II. are therefore to be preferred to Cases III. and IV., because they require a less amount of external aid.

We now have

$$(A) \quad \omega'' = \frac{m_1 + 8}{m_1} + \alpha.$$

$$(B) \quad \omega''^2 = 1 + \left(\frac{m + 16}{m}\right)^2.$$

---

[1] ω'' = angular velocity of water molecule.

ω_1 = angular velocity of oxygen molecule.

$$m = \frac{1}{\omega_1}.$$

I have already shown that in the case of hydroxyl the most probable value of m_1 is $m_1 = -7$, from which I found

$$\omega'^2 = 1 \cdot 2564 \qquad a_1 = 1 \cdot 50.$$

Now, since $H_2O > HO$, we have

$$\omega''^2 > 1 \cdot 2564.$$

If $\qquad m = -10, \qquad \omega''^2 = +1 \cdot 3600,$

$\qquad a_2 = \quad 1 \cdot 3090, \qquad \epsilon_2 \quad = +0 \cdot 0984.$

If $\qquad m = -11, \qquad \omega''^2 = \quad 1 \cdot 2066,$

$\qquad a_2 = \quad 1 \cdot 2412, \qquad \epsilon_2 \quad = -0 \cdot 0217.$

The last of these must be rejected, for ϵ_2 must be positive. The first fulfils the essential conditions

$$\omega''^2 > \omega'^2, \quad a_2 < a_1.$$

Therefore select $m = -10$.

As this differs from $\qquad m_1 = -7$

the most probable value of m in forming hydroxyl, it follows that the attraction of oxygen upon hydrogen is different in hydroxyl and water, in other words, the attraction of oxygen upon hydrogen depends upon its having one or two satellites of hydrogen to deal with.

In fact, we find

$$\mu' = 25829,$$

$$\mu'' = 5625,$$

where μ' is the coefficient of attraction of oxygen upon hydrogen in hydroxyl, and μ'' the coefficient of attraction of oxygen upon hydrogen in water.

2. *Sulphuretted Hydrogen.* Sulphur, selenium, and tellurium, behave towards hydrogen in the same manner as oxygen; and chemists recognize HS analogous to hydroxyl, and H_2S (sulphuretted hydrogen) analogous to water.

Like hydroxyl, HS is not known to exist as a separate compound, but it may exist in combination in higher compounds.

Introducing $\beta = 32$ in the general equation (7) *bis*, we find

$$(66\epsilon_1 + 1)\,m^2 - 2048m - 31712 = 0.$$

If $\epsilon_1 = 0$, we find $m_1 = -15$, the nearest whole number to the negative root.

From this we find

$$\omega' = \frac{32}{33} \times \frac{17}{15} = -1{\cdot}0524,$$

$$\omega'^2 = 1{\cdot}1076, \qquad \alpha_1 = 0{\cdot}7687.$$

It is easy to show, as in the case of oxygen, that no dyad atom can enter into combination with two hydrogen atoms without external aid; for, if β be the atomic weight of any dyad, we have

Conservation of areas

$$\left\langle \begin{array}{l}\text{Case I.}\\ \text{Case II.}\end{array}\right. \qquad \omega'' = 1 \pm \frac{\beta}{2m}$$

$$\left\langle \begin{array}{l}\text{Case III.}\\ \text{Case IV.}\end{array}\right. \qquad \omega'' = \pm \frac{\beta}{2m}.$$

Configuration

$$\omega''^2 = 1 + \left(\frac{m+\beta}{m}\right)^2.$$

Eliminating ω'', we have

$$m^2 + \beta m + \frac{3}{4}\beta^2 = 0 \qquad \left\langle \begin{array}{l}\text{Case I.}\\ \text{Case II.}\end{array}\right.$$

and

$$m^2 + \beta m + \frac{3}{8}\beta^2 = 0 \qquad \left\langle \begin{array}{l}\text{Case III.}\\ \text{Case IV.}\end{array}\right.$$

Both equations give imaginary values of m for real values of β. We must therefore suppose, as in the case of water, that an addition α is made to the right-hand side of the equation of conservation of areas.

This gives us,

$$\textit{Areas}, \quad . \quad . \quad \omega'' = \left(\frac{2m_1+\beta}{2m_1}\right) + \alpha.$$

$$\textit{Configuration}, \quad . \quad \omega''^2 = 1 + \left(\frac{m+\beta}{m}\right)^2.$$

Now, since $\qquad H_2S > HS$, or $\omega''^2 > \omega'^2$

we have $\qquad \omega''^2 > 1{\cdot}1076.$

If $\beta = 32$, and

$$m = -22, \qquad \omega''^2 = 1{\cdot}2066,$$

$$\epsilon_2 = 0{\cdot}0677, \qquad a = 0{\cdot}8257,$$

$$m = -23, \qquad \omega''^2 = 1{\cdot}0153.$$

The last of these, $m = -22$, fails to satisfy the condition

$$H_2S > HS,$$

and we therefore assume $m = -22$, which just satisfies that condition.

Chemical facts, as before, require this result, for the direct union of sulphur and hydrogen occurs when hydrogen and sulphur vapour are passed over pumice heated to 400° C., or when hydrogen is passed over boiling sulphur or is burned in sulphur vapour, or by passing electric sparks through a mixture of hydrogen and sulphur vapour.

The *equation of energy* in the case of H_2S becomes

$$2\epsilon_2 + \frac{16}{m_1^2} - \left(\frac{m + 32}{m}\right)^2 = 0, \qquad \text{(C)}$$

where $m_1 = -15$.

It is easy to calculate from the foregoing that a sulphur atom in the presence of one or two atoms of hydrogen has the following coefficients of attraction :—

$$\mu' = 10035,$$

$$\mu'' = 1614.$$

3. *Selenuretted Hydrogen.* Discussing this case in the same way as water and sulphuretted hydrogen, we find, since $\beta = 79$ for HSe,

$$(158\epsilon_1 + 1)\,m^2 - 12482m - 486719 = 0, \qquad \text{(7) } bis.$$

from which it appears that the most probable value of m_1 is

$$m_1 = -38.$$

For H_2Se we find

Areas, . . $\omega'' = \left(\dfrac{2m_1 + 79}{2m_1}\right) + a.$ (A)

Configuration, . $\omega''^2 = 1 + \left(\dfrac{m + 79}{m}\right)^2.$ (B)

Energy, . . $2\epsilon_2 + \dfrac{79}{2m_1^2} - \left(\dfrac{m + 79}{m}\right)^2 = 0.$ (C)

The stability of HSe is represented by

$$\omega'^2 = 1{\cdot}1190, \qquad a_1 = 0{\cdot}3052,$$

We now find

$$m = -\,59, \qquad \omega''^2 = 1{\cdot}1490,$$

$$m = -\,60, \qquad \omega''^2 = 1{\cdot}0277.$$

The second of these fails to satisfy the condition

$$\omega''^2 > 1{\cdot}1190.$$

Therefore

$$m_1 = -\,59, \qquad \omega''^2 = 1{\cdot}1490,$$

$$\mu' = 3684,$$

$$\mu'' = 363.$$

4. *Telluretted Hydrogen.* Tellurium has the same relations to hydrogen as oxygen, sulphur, and selenium. Its atomic weight being 125, we find for HTe

$$(252\epsilon_1 + 1)\,m^2 - 31250m - 1937375 = 0. \qquad (7)\ bis.$$

This equation is very nearly satisfied with the values

$$m_1 = -\,62, \quad \epsilon_1 = 0.$$

The following are the conditions to determine H_2Te :—

$$\omega'' = \left(\frac{2m_1 + 125}{2m_1}\right) + a. \qquad (A)$$

$$\omega''^2 = 1 + \left(\frac{m + 125}{m}\right)^2. \qquad (B)$$

$$2\epsilon_2 + \frac{125}{2m_1^{\,2}} - \left(\frac{m + 125}{m}\right)^2 = 0. \qquad (C)$$

We have also

$$\omega'^2 = \left(\frac{125}{126} \times \frac{63}{62}\right)^2 = 1{\cdot}01609.$$

$$\omega''^2 > 1{\cdot}01609.$$

Hence we have

if $$m = -\,110, \qquad \omega''^2 = 1{\cdot}018595,$$

$$\epsilon_2 = 0{\cdot}001668, \qquad a = 1{\cdot}0170,$$

if $$m = -\,111, \qquad \omega''^2 = 1{\cdot}013472.$$

The last value of m does not fulfil the condition

$$\omega''^2 > \omega'^2.$$

Therefore $$m = -\,110.$$

Hence we find the coefficient of attraction of tellurium for hydrogen is

$$\mu' = 2065, \qquad HTe.$$

$$\mu'' = 103, \qquad H_2Te.$$

Collecting together the preceding results, we find

Coefficients of Attraction.

	β	m	μ
OO	16	9	1275·50
SS	32	15	138·88
Se Se	79	38	8·76
Te Te	125	62	2·08

Coefficients of Attraction.

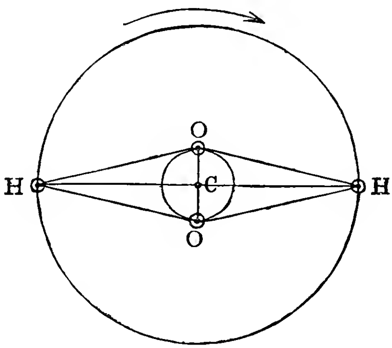
	β	m	μ'	μ''
HO	16	− 7	25829	—
H_2O	—	− $9\frac{1}{2}$	—	5625
HS	32	− 15	10035	—
H_2S	—	− 21	—	1614
HSe	79	− $38\frac{1}{2}$	3684	—
H_2Se	—	− 68	—	363
HTe	125	− 62	2065	—
H_2Te	—	− 110	—	103

5. *Peroxide of Hydrogen* (H_2O_2). From the chemical statement made in the note to p. 413 (for which I am indebted to Dr. J. Emerson Reynolds), it is natural to suppose that peroxide of hydrogen is formed by the union of the left-handed and right-handed hydroxyl molecules, whose angular velocities are

$$\omega_1 = -\ 1\cdot10406,$$

$$\omega_2 = +\ 0\cdot97017\ ;$$

and combined into a molecule of a rhombic form, as here shown.[1]



The equations of condition required by this configuration are two in number, one for the angles HH, and the other for the angles OO;

$$\frac{\mu}{4} + 2\mu'\beta\cos^3\theta = \omega''^2, \qquad (B)_1$$

$$\frac{\mu_1\beta^2}{4\tan^2\theta} + 2\mu'\beta\cos^2\theta\sin\theta = \beta\tan\theta\omega''^2, \qquad (B)_2$$

where

μ = 4 = coeff. of attraction (HH) in the hydrogen molecule.

μ' = coeff. of attraction (HO) in the rhombic molecule.

$\mu_1 = \dfrac{4}{\beta m_1^2}$ = coeff. of attraction (OO) in the oxygen molecule.

θ = semiangle of the acute angle of the rhombus.

β = atomic weight of the dyad element.

ω'' = angular velocity of rhombus.

HC = 1.

[1] This rhombic molecule is drawn to scale to represent peroxide of hydrogen.

We also have
$$\mu'\beta = \left(\frac{m+\beta}{m}\right)^2 = \phi^2,$$

where m is to be found from the chemical conditions of the problem, and is not necessarily the same as m_1, which belongs to the oxygen molecule.

The foregoing equations become, therefore, after some reductions,

$$\omega''^2 = 2\cos^3\theta\phi^2 + 1. \qquad (B)_1$$

$$\omega''^2 = \frac{2}{\beta}\cos^3\theta\phi^2 + \frac{1}{m_1^2\tan^3\theta}. \qquad (B)_2$$

Eliminating ϕ^2, we find

$$(\beta - 1)\,\omega''^2 = \frac{\beta}{m_1^2\tan^3\theta} - 1, \qquad (a)$$

giving *the form of the rhombic molecule in terms of its stability.*

Eliminating ω''^2, we find

$$2\frac{\beta - 1}{\beta}\sin^3\theta\phi^2 + \tan^3\theta = \frac{1}{m_1^2}, \qquad (b)$$

giving *the form of the rhombic molecule in terms of the attraction of oxygen upon hydrogen in the molecule;* for

$$\mu'\beta = \left(\frac{m+\beta}{m}\right)^2 = \phi^2.$$

In considering the problem of water where an atom of oxygen attracts two atoms of hydrogen, we found

$$m = -10.$$

If we assume this to be the value of m in the peroxide of hydrogen molecule, we find from (B_1) and (B_2),

$$\begin{aligned} m &= -10, \\ \phi^2 &= 0{\cdot}3600, \\ \theta &= 13^\circ \\ \omega''^2 &= 1{\cdot}6660. \end{aligned}$$

Comparing this result with what has been found respecting hydroxyl and water, we find the stabilities of all three as measured by the squares of their angular velocities.

Stabilities.

HH, . .	1·0000
HO, . .	1·2596
H_2O, . .	1·3600
H_2O_2, . .	1·6660

It would appear at first sight as if peroxide of hydrogen would be formed in preference to either hydroxyl or water, which is contrary to the chemical facts which prove that water is formed to the exclusion of both hydroxyl and peroxide of hydrogen. The explanation of this is to be sought in the equations of area and energy which require to be satisfied as well as the equations of configuration.

The equation of areas is

$$\frac{\beta+1}{\beta}(\omega_1+\omega_2)+2\alpha_2=2(1+\beta\tan^2\theta)\,\omega'', \qquad \text{(A)}$$

or, substituting the numerical values already given,

$$(1+16\tan^2\theta)\,\omega''=\frac{17}{32}(\omega_1+\omega_2)+\alpha_2,$$

$$\alpha_2=2{\cdot}3843,$$

which is greater than α_2 found for water 1·3090. Therefore, so far as areas are concerned H_2O_2 is more expensive than H_2O.

The equation of energy is easily found from the foregoing.

Energy before shock—

$$1+\frac{\beta}{m_1^2}.$$

Energy after shock—

$$2+\frac{2\beta\cot\theta}{m_1^2}+4\cos\theta\left(\frac{m+\beta}{m}\right)^2-(1+\beta\tan^2\theta)\,\omega''^2.$$

Loss of Energy during shock—

$$2\epsilon_2+(1+\beta\tan^2\theta)\,\omega''^2-\frac{\beta(2\cot\theta-1)}{m_1^2}-4\cos\theta\left(\frac{m+\beta}{m}\right)^2-1=0. \qquad \text{(C)}$$

Substituting in this equation the values already found, and making $\beta=16$, we find $\epsilon_2=+\,0{\cdot}9090.$

The corresponding loss of atomic energy in the formation of water was only

$$\epsilon_2=+\,0{\cdot}0984,$$

showing that peroxide of hydrogen is a *much more* expensive molecule to produce than water.

APPENDIX.

The Laplacian Triangle.

General Lemma.—Let there be three chemical atoms, α, β, γ, placed at the angles of a certain triangle ABC, and let the coefficients of attraction be

$$\begin{array}{lcl} \lambda & \text{between} & \beta, \gamma, \\ \mu & ,, & \gamma, \alpha, \\ \nu & ,, & \alpha, \beta. \end{array}$$

If the triangle revolve in steady motion, in its own plane, round the common centre of gravity of α, β, γ, you are required to show that the species of the triangle is given by the proportions,

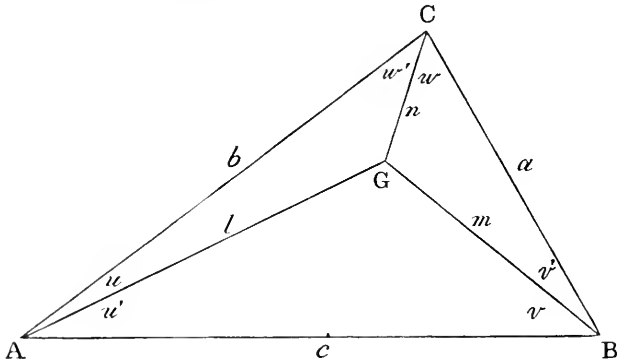
$$a^3 : b^3 : c^3 :: \lambda : \mu : \nu,$$

and to find the other conditions of steady motion.[1]

The accompanying figure shows the general construction where

a, b, c, are the sides of the triangle,

l, m, n, are the lines drawn from the angles to the centre of gravity,



and these lines divide the angle A into u and u', the angle B into

[1] Laplace has solved a particular case of this problem for the sun, earth, and moon, and his triangle is, of course, equilateral, because the gravitation coefficients are equal.—*Mécanique Céleste*, Book X., ch. VI.

v and v', and the angle C into w and w'. Each atom is attracted by the other two and must fulfil the following mechanical conditions:—

1°. The tangential components must be equal.

2°. The radial components must equal centrifugal force.

From the first condition we find, at once,

$$\frac{\nu}{\mu}\,\frac{\beta}{\gamma}\,\frac{b^2}{c^2} = \frac{\sin u}{\sin u'}, \qquad (a)$$

$$\frac{\lambda}{\nu}\,\frac{\gamma}{\alpha}\,\frac{c^2}{a^2} = \frac{\sin v}{\sin v'}, \qquad (b)$$

$$\frac{\mu}{\lambda}\,\frac{\alpha}{\beta}\,\frac{a^2}{b^2} = \frac{\sin w}{\sin w'}. \qquad (c)$$

From the second condition we find

$$\frac{\mu\gamma}{b^2}\cos u + \frac{\nu\beta}{c^2}\cos u' = \Omega^2 l, \qquad (d)$$

$$\frac{\nu\alpha}{c^2}\cos v + \frac{\lambda\gamma}{a^2}\cos v' = \Omega^2 m, \qquad (e)$$

$$\frac{\lambda\beta}{a^2}\cos w + \frac{\mu\alpha}{b^2}\cos w' = \Omega^2 n, \qquad (f)$$

Ω denoting the common rotation of all three.

We have also from the geometrical properties of the centre of gravity,

$$\frac{\sin u}{\sin C} = \frac{a}{l}\,\frac{\beta}{\alpha+\beta+\gamma}, \qquad (g)$$

$$\frac{\sin v}{\sin A} = \frac{b}{m}\,\frac{\gamma}{\alpha+\beta+\gamma}, \qquad (h)$$

$$\frac{\sin w}{\sin B} = \frac{c}{n}\,\frac{\alpha}{\alpha+\beta+\gamma}, \qquad (i)$$

and

$$\frac{\sin u'}{\sin B} = \frac{a}{l}\,\frac{\gamma}{\alpha+\beta+\gamma}, \qquad (g)'$$

$$\frac{\sin v'}{\sin C} = \frac{b}{m}\,\frac{\alpha}{\alpha+\beta+\gamma}, \qquad (h)'$$

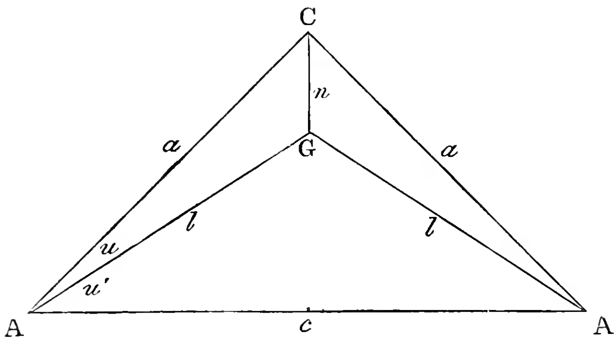
$$\frac{\sin w'}{\sin A} = \frac{c}{n}\,\frac{\beta}{\alpha+\beta+\gamma}. \qquad (i)'$$

From this we find at once,

$$\frac{\nu}{\mu}\,\frac{b^2}{c^2} = \frac{\sin C}{\sin B}, \quad \&c., \quad \&c.,$$

and finally, $\lambda : \mu : \nu :: a^3 : b^3 : c^3.$ Q. E. D.

The Laplacian triangle becomes isosceles in the case of water, the oxygen atom being placed at the vertex C, and the hydrogen atoms at



the extremities of the base A, A. If n be made equal to CG, where G is the common centre of gravity, it is easy to see, since GA is unity,

$$a^2 \quad = 17n^2 + 1,$$

$$\sin A = \frac{9n}{a},$$

$$\sin u' = 8n.$$

We find, from the dynamical principles already laid down,

$$\frac{\mu}{c^2}\cos u' + \frac{\mu''\beta}{c^2}\cos u = \omega''^2, \tag{1}$$

$$\frac{\mu}{c^2}\sin u' = \frac{\mu''\beta}{c^2}\cos u, \tag{2}$$

where μ is the coefficient of attraction between hydrogen and hydrogen, μ'' the coefficients of attraction between oxygen and hydrogen in the combination H_2O,[1] and β the atomic weight of oxygen.

---

[1] The coefficient of attraction between oxygen and hydrogen in water (H_2O) is different from the coefficient in hydroxyl (HO).

Eliminating $\frac{\mu}{c^2}$ between the two equations we find

$$\omega''^2 = \frac{\mu''\beta}{a^2}\,\frac{\sin A}{\sin u'},$$

or

$$\omega''^2 = \frac{9}{8}\,\frac{\mu''\beta}{(17n^2 + 1)^{\frac{3}{2}}}.$$

Hence, for a given coefficient of attraction, ω''^2 (which measures the stability of the molecule) will be a maximum when $n^2 = 0$; or, in other words, the dumb-bell form of molecule, when the vertex of the triangle falls upon the base (or when the two sides of the triangle become equal to, or less than, the third), is the most economical configuration for producing a given stability of molecule.

The condition for a real triangle is, of course,

$$2\mu''^{\frac{1}{3}} > \mu^{\frac{1}{3}},$$

or

$$\mu'' > \frac{1}{2},$$

or

$$\mu''\beta > 8.$$

When $\mu''\beta = 8$ the triangle begins to degenerate into the dumb-bell, and

$$\omega''^2 = \frac{9}{8}(\mu''\beta) = 9.$$

I have shown in the text that this amount of stability is much greater than we want, and that therefore the sum of the two sides of the Laplacian triangle is much less than the base.

Note A, Page 414.

The most general form of the equations would be

$$(\beta + 1)\,\omega' = \beta\left(\frac{m+\beta}{m}\right) + \alpha_1, \qquad \text{(A)}$$

$$2\epsilon_1 + \left(1 + \frac{\beta}{m^2}\right) = \frac{\beta + 1}{\beta}\,\omega'^2. \qquad \text{(C)}$$

We have, therefore, two equations between four unknowns, viz.,

$$m/\omega'/\alpha_1/\epsilon_1,$$

or, periodic time of oxygen molecule,

stability of hydroxyl,

addition to areas from without,

loss of atomic energy by shock.

First Solution—No addition of areas.

$$m = -7, \qquad \alpha_1 = 0,$$

$$\omega'^2 = 1{\cdot}4619, \qquad \epsilon_1 = +\,0{\cdot}1134.$$

Second Solution—If we suppose the atoms of oxygen and hydrogen to be infinitely hard and elastic, we find

$$m = -7, \qquad \alpha_1 = +\,1{\cdot}4764,$$

$$\omega'^2 = 1{\cdot}2596, \qquad \epsilon_1 = 0.$$

The first solution supposes that the addition of areas from without is *nil*, but the necessity of the stimulus of light to make chlorine and hydrogen unite renders this supposition improbable.

The second solution supposes that no energy is lost in the collision of atoms, but this is improbable from the constitution of matter.

A solution between these two would be more probable than either, and we may find it by means of the following Table :—

a_1	ω'^2	$2\epsilon_1$
0·0	1·4619	+ 0·2268
1·0	1·4058	+ 0·1672
1·5	1·2564	+ 0·0084
1·6	1·2432	− 0·0056
1·7	1·2301	− 0·0195
2·0	1·1913	− 0·0608

The most probable solution is

$$m_1 = -7, \qquad \omega'^2 = 1{\cdot}2564,$$

$$a_1 = 1{\cdot}5, \qquad 2\epsilon_1 = +\,0{\cdot}0084.$$

XXVIII.

NOTES ON NEWTONIAN CHEMISTRY. By REV. SAMUEL HAUGHTON, M.D., S.F.T.C.D.

[Read April 11, 1892.]

Note III.—Quaternary Compounds.

(*Ammonia Type.*)

1. *Ammonia.*—We have now reached the third of Mendelejeff's four typical compounds, viz. that in which a triad molecule combines with three hydrogen molecules, of which the most perfect example is ammonia.

We have seen that the monad molecules combine together in binary groups, like hydrochloric acid, and in doing so, satisfy the two most important conditions for catastrophe in a planetary system, viz.:

1°. The motions of the combining molecules in the same plane are in opposite directions.

2°. The periodic times of the combining molecules have a small common multiple.

In the case of the dyad molecule combining with two monad molecules, the same conditions for catastrophe are fulfilled; and in addition it was found that the molecules could not combine unless assisted from without by electricity or heat appearing in the dynamical equations in the form of a *bonâ fide* addition to the sum of the areas (*moments of momenta*).

The volume of the nitrogen molecule is the same as that of the elements already discussed, for

$$\text{Molecular volume} = \frac{\text{weight}}{\text{sp. gr.}} = \frac{28}{0{\cdot}9713} = 28{\cdot}826.$$

The molecular volume of ammonia is also very nearly the same as that of nitrogen, for

$$\text{Molecular volume} = \frac{17}{0{\cdot}6234} = 27{\cdot}27.$$

In the present case, of which ammonia is the type, we have a molecule of a triad element combining with three molecules of hydrogen, and we shall show that similar conclusions hold. There are three combinations of nitrogen with hydrogen whose properties can be calculated on Newtonian principles ; and although one only of the three is known in a separate form, the existence of the others in a combination in higher compounds is probable, and their non-appearance in a separate form can be explained by the greater facilities which exist for the production of ammonia, which precludes them from appearing.

These three compounds are—

(*a*). NH.
(*b*). NH_2.
(*c*). NH_3 ammonia.

(*a*). *Nitride of Hydrogen in which nitrogen behaves as a monad* (NH).

The general equations belonging to this case are—

Areas

$$(\beta + 1)\,\omega' = \beta\left(\frac{m+\beta}{m}\right) + \alpha_1. \qquad \text{(A)}$$

Configuration

$$\mu'\beta = \left(\frac{m+\beta}{m}\right)^2. \qquad \text{(B)}$$

Energy

$$2\epsilon_1 + \left(1 + \frac{\beta}{m^2}\right) = \frac{\beta + 1}{\beta}\,\omega'^2, \qquad \text{(C)}$$

where $\beta = 14$ in the case of nitrogen.

We therefore have to deal with the case of three equations containing five unknowns,

$$\omega'/m/\alpha_1/\mu'/\epsilon_1,$$

where

ω'^2 represents the stability of NH.
m the periodic time of the nitrogen molecule.
α_1 the addition made from without (if any) to the equation of areas per atom of hydrogen employed.
μ' the coefficient of attraction of nitrogen for hydrogen in NH.
ϵ_1 the loss of atomic energy (if any) per atom of hydrogen employed.

We know also that ω'^2 is greater than unity, and that μ', α_1, and ϵ_1 are positive.

As a first approximation to the solution of the three equations, suppose

$$\alpha_1 = 0, \quad \epsilon_1 = 0.$$

Eliminating m between (A) and (C) we find

$$(\beta^2 - \beta - 1)\,\omega'^2 + 2\beta\omega' - \beta^2 = 0. \qquad (6)$$

This gives for nitrogen

$$181\omega'^2 + 28\omega' - 196 = 0,$$

$$\omega' \begin{cases} +\ 0{\cdot}96613, \\ -\ 1{\cdot}1208\,; \end{cases}$$

but since ω'^2 is greater than unity, we must choose the negative value of ω'; and since it follows that m must be negative when ω' is negative, for

$$m = \frac{\beta^2}{(\beta + 1)\,\omega' - \beta};$$

the molecules of nitrogen and hydrogen must, therefore, revolve in opposite directions, thus fulfilling the first condition for a catastrophe.

The second condition for a catastrophe is that m should be, if possible, a whole number.

$$m^2 - 2\beta^2 m - (\beta^3 - \beta^2 - \beta) = 0.$$

When $\beta = 14$, this becomes

$$m^2 - 392m - 2534 = 0.$$

The roots of this equation are real.

$$m \begin{cases} +\ 398{\cdot}361 \\ -\quad 6{\cdot}361 \end{cases}$$

Our concern is with the negative root, which, however, does not fulfil the second condition essential to a catastrophe. Let us then assume $m = -6$ the nearest integer, and find values of α_1 and ϵ_1 to suit our supposition.

$$m = -6, \text{ gives } \omega' = -\frac{112}{90},$$

and

$$m = -7, \text{ gives } \omega' = -\frac{98}{105},$$

which, being less than unity, must be rejected.

We find, therefore,

First solution[1] $\alpha_1 = 0$ (one extreme),

$$m = -6, \qquad \alpha_1 = 0,$$

$$\omega'^2 = 1{\cdot}5486, \qquad \epsilon_1 = +0{\cdot}1351.$$

Second solution (other extreme).[2]

$$m = -6, \qquad \epsilon_1 = 0,$$

$$\omega'^2 = 1{\cdot}2962, \qquad \alpha_1 = 1{\cdot}5891.$$

An intermediate solution, more probable than either, may be thus found.

If $\alpha_1 = 1{\cdot}55, \qquad m_1 = -6,$

$$\omega'^2 = 1{\cdot}3021, \qquad 2\epsilon_1 = +0{\cdot}0063.$$

If $\alpha_1 = 1{\cdot}6, \qquad m_1 = -6,$

$$\omega'^2 = 1{\cdot}2944, \qquad 2\epsilon_1 = -0{\cdot}0020.$$

The second case is impossible, because ϵ_1 must be positive; and the first case may be adopted, because it gives

$$\frac{2\epsilon_1}{E} = 0{\cdot}2637 \text{ per cent.},$$

which may be easily admitted.

From the value $m_1 = -6$ we find the attraction of nitrogen for hydrogen in NH to be

$$\mu' = 31746.$$

---

[1] This solution is improbable, because it throws the whole strain of the transformation upon ϵ, the loss of energy incurred by the atoms, independent of the orbital motion, and it is easy to see that this loss of atomic energy is much too great to be admitted.

In fact, the total energy of the two molecules of nitrogen and hydrogen before the shock is

$$E = 1 + \frac{14}{m_1^2} = 1{\cdot}3889.$$

The atomic loss of energy during the shock is

$$2\epsilon_1 = 0{\cdot}2702.$$

This makes the percentage of atomic loss to orbital energy to be 19·454 per cent., or nearly *one-fifth*, which would be enormously greater than anything known among our planetary experiences.

[2] This solution supposes the atoms of nitrogen and hydrogen to be without rotation, and infinitely hard and elastic, which is improbable.

(*b*). *Nitride of Hydrogen in which nitrogen behaves as a dyad* (NH_2).

The general equations belonging to this case are—

$$\omega'' = \frac{m_1 + 7}{m_1} + a_2, \qquad \text{(A)}$$

$$\omega''^2 = 1 + \left(\frac{m + 14}{m}\right)^2, \qquad \text{(B)}$$

$$2\epsilon_2 + \frac{7}{m_1^2} - \left(\frac{m + 14}{m}\right)^2 = 0, \qquad \text{(C)}$$

where $m_1 = -6$, as found from the discussion of NH, and m is the corresponding quantity in NH_2.

We have now a more definite case to deal with than NH, for we have three equations between four unknowns,

$$\omega''/m/a_2/\epsilon_2,$$

instead of three equations among five unknowns.

The three equations may be written as follows:—

$$a_2 = \omega'' + 0{\cdot}1666, \qquad \text{(A)}$$

$$\omega''^2 = 1 + \left(\frac{m + 14}{m}\right)^2, \qquad \text{(B)}$$

$$2\epsilon_2 = \left(\frac{m + 14}{m}\right)^2 - 0{\cdot}1944. \qquad \text{(C)}$$

If $m = -9$, $\omega''^2 = 1{\cdot}3086$,

$a_2 = 1{\cdot}3106$, $4\epsilon_2 = +\,0{\cdot}2284$.

If $m = 10$, $\omega''^2 = 1{\cdot}1600$,

$a_2 = 1{\cdot}2437$, $4\epsilon_2 = -\,0{\cdot}1376$.

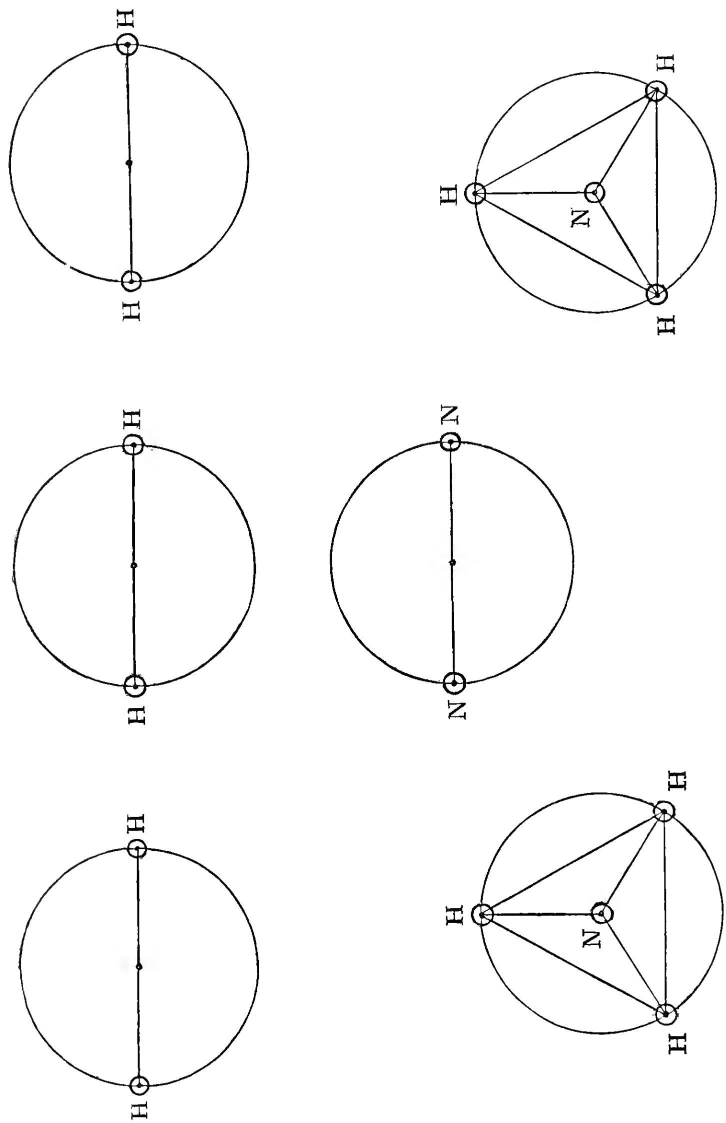
The last of these is inadmissible, because ϵ_2 must be positive.

The coefficient of attraction between nitrogen and hydrogen in NH_2 (if it exists) would be

$$\mu'' = 5511.$$

(*c*). *Nitride of Hydrogen in which nitrogen behaves as a triad* (NH_3).

In this case a molecule of nitrogen combines with three molecules of hydrogen to form two molecules of ammonia.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The general equations are—

Areas

$$\omega''' = \frac{3m_1 + 14}{3m_1} + a_3. \qquad (A)$$

Configuration

$$\omega'''^2 = 2 \sec\theta + \left(\frac{m + 14}{m}\right)^2. \qquad (B)$$

Energy.

This is thus found—

Energy before shock $3 + \dfrac{14}{m_1^2}$.

Energy after shock $12 \sec\theta + 6\left(\dfrac{m + 14}{m}\right)^2 - 3\omega'''^2$.

Hence, after some reductions, we find—

Energy

$$2\epsilon_3 + \frac{3m_1^2 + 14}{3m_1^2} - 2\sec\theta - \left(\frac{m + 14}{m}\right)^2 = 0. \qquad (C)$$

Substituting $m_1 = -6$, $\theta = 30°$, we obtain finally

$$a_3 = \omega''' - 0{\cdot}2222. \qquad (A)[1]$$

$$\omega'''^2 = 2{\cdot}3094 + \left(\frac{m + 14}{m}\right)^2. \qquad (B)$$

$$2\epsilon_3 - \left(\frac{m + 14}{m}\right)^2 - 1{\cdot}1798 = 0. \qquad (C)$$

Equation (B) may be written

$$\omega'''^2 = 2{\cdot}3094 + \phi_3^2,$$

in which 2·3094 represents the stability of the molecule of ammonia due to the hydrogen triangle, and

$$\phi_3^2 = \left(\frac{m_3 + 14}{m_3}\right)^2 = \mu'\beta$$

represents the stability due to the action of nitrogen upon hydrogen.

---

[1] The corresponding equation to find a_2 in NH_2 was

$$a_2 = \omega'' + 0{\cdot}1666.$$

If therefore we suppose $\omega''' = \omega''$ (or NH_2 and NH_3 of equal stability), we find

$$a_2 = a_3 + 0{\cdot}3888\ ;$$

showing that ammonia is a cheaper article than NH_2, and will be produced in reference.

If the action of nitrogen upon hydrogen in ammonia be attractive, the least possible value of ω'''^2 would be 2·3094, a quantity much greater than what is necessary to make ω'''^2 greater than either ω''^2 or ω'^2 which we found to be

$$\omega''^2 = 1{\cdot}3086,$$

$$\omega'^2 = 1{\cdot}3021.$$

If we suppose that the action of nitrogen upon hydrogen in ammonia is repulsive, and that $\phi_3^2 = -1$, we find

$$\phi_3^2 = -1, \qquad \omega'''^2 = 1{\cdot}3094,$$

$$\alpha_3 = 0{\cdot}9207, \qquad 6\epsilon_3 = +0{\cdot}5394.$$

If we assume $\phi_3^2 = 0$, we have

$$\phi_3^2 = 0, \qquad \omega'''^2 = 2{\cdot}3094,$$

$$\alpha_3 = 1{\cdot}3974, \qquad 6\epsilon_3 = 3{\cdot}5394.$$

On comparing the values of α_3 and ϵ_3 with those found for the supposition $\phi_3^2 = -1$, we are forced to the conclusion that the action of nitrogen upon hydrogen in ammonia is repulsive, and that

$$\mu''' = -17857.$$

Hence, finally,

Coefficients of Attraction.

	β	m	ϕ^2	μ
NN	14	− 6	—	+ 1979·56
NH	—	− 6	$+\left(\frac{4}{3}\right)^2$	+ 31746
NH_2	—	− 9	$+\left(\frac{5}{9}\right)^2$	+ 5511
NH_3	—	Imaginary.	− 1	− 17857

2. *Phosphuretted Hydrogen* (PH_3).

In this case, like ammonia, we have to consider three combinations of phosphorus and hydrogen—

(*a*). PH.
(*b*). PH_2.
(*c*). PH_3 (phosphuretted hydrogen).

(*a*) (PH).

Assuming $\alpha_1 = 0$, $\epsilon_1 = 0$, as a first approximation, we find

$$m^2 - 2\beta^2 m - (\beta^3 - \beta^2 - \beta) = 0. \qquad (7\ bis.)$$

Making $\beta = 31$, the atomic weight of phosphorus, we find

$$m = -14{\cdot}87,$$

or taking the nearest whole number $m_1 = -15$.

If $\omega' = -1{\cdot}04$, $\omega'^2 = 1{\cdot}0816$,
$\alpha_1 = 0{\cdot}2123$, $\epsilon_1 = -0{\cdot}0107$.

If $\omega' = -1{\cdot}05$, $\omega'^2 = 1{\cdot}1025$,
$\alpha_1 = 0{\cdot}6677$, $\epsilon_1 = +0{\cdot}0001$.

The first solution must be rejected, for ϵ_1 cannot be negative. Hence we find for (PH),

$$m_1 = -15, \qquad \omega'^2 = 1{\cdot}1025,$$

$$\alpha_1 = 0{\cdot}6677, \qquad \epsilon_1 = +0{\cdot}0001,$$

$$\mu' = 9175{\cdot}6.$$

(*b*) (PH_2). The fundamental equations are—

$$\omega'' = \frac{2m_1 + \beta}{2m_1} + \alpha_2. \qquad (A)$$

$$\omega''^2 = 1 + \left(\frac{m+\beta}{m}\right)^2. \qquad (B)$$

$$2\epsilon_2 + \frac{\beta}{2m_1^2} = \left(\frac{m+\beta}{m}\right)^2. \qquad (C)$$

Substituting

$$\beta = 31, \qquad m_1 = -15,$$

these become

$$\omega'' = \alpha_2 - 0{\cdot}0333. \qquad (A)$$

$$2\epsilon_2 + 0{\cdot}06889 = \left(\frac{m+\beta}{m}\right)^2. \qquad (C)$$

Hence we find

If $m = -23$, $\omega''^2 = 1{\cdot}12098$,

$a_2 = 1{\cdot}0921$, $\epsilon_2 = +0{\cdot}02605$,

$$\mu' = 975{\cdot}6.$$

If $m = -24$, $\omega''^2 = 1{\cdot}0830$,

$a_1 = 1{\cdot}0741$, $\epsilon_2 = +0{\cdot}00707$.

If $m = -25$, $\omega''^2 = 1{\cdot}0576$,

$a_1 = 1{\cdot}0617$, $\epsilon_2 = -0{\cdot}00564$.

Of these solutions the third must be rejected, because ϵ_1 is negative, and also because ω''^2 should be greater than

$$\omega'^2 = 1{\cdot}1025.$$

The second solution is to be rejected for one of these reasons.

(*c*) (PH_3). *Phosphuretted Hydrogen.*

The fundamental equations are—

$$\omega''' = \frac{3m_1 + \beta}{3m_1} + a_3. \qquad \text{(A)}$$

$$\omega'''^2 = 2{\cdot}3094 + \left(\frac{m + \beta}{m}\right)^2. \qquad \text{(B)}$$

$$2\epsilon_3 = \frac{3m_1^2 + \beta}{3m_1^2} - 2{\cdot}3094 - \left(\frac{m + \beta}{m}\right)^2 \qquad \text{(C)}$$

Two of these become, when we make $m_1 = -15$, $\beta = 31$.

$$\omega''' = 0{\cdot}3111 + a_3. \qquad \text{(A)}$$

$$2\epsilon_3 = 1{\cdot}2635 + \phi_3^2. \qquad \text{(C)}$$

From these equations it follows that the action of phosphorus upon hydrogen in phosphuretted hydrogen is repulsive, and that ϕ_3^2 lies between -1.2 and -1.3; for

If $\phi_3^2 = -1{\cdot}2$, $\omega'''^2 = 1{\cdot}1094$,

$a_3 = 0{\cdot}7421$, $\epsilon_3 = +0{\cdot}03175$.

If $\phi_3^2 = -1{\cdot}3$, $\omega'''^2 = 1{\cdot}0094$,

$a = 0{\cdot}6936$, $\epsilon_3 = -0{\cdot}01825$.

The second solution must be rejected, because ϵ_3 is negative, and because ω'''^2 is too small; and the first may be accepted, for although ω'''^2 is somewhat less than ω''^2, a_3 is much less than a_2, so that PH_3 is less expensive than PH_2.

Collecting together the constants which show the relations of phosphorus to hydrogen, we find $\beta = 31$.

	m	ϕ^2	μ
PP	—	—	+ 143·36
PH	− 15	$+\left(\frac{16}{15}\right)^2$	+ 9175·6
PH_2	− 23	$+\left(\frac{8}{23}\right)^2$	+ 975·6
PH_3	Imaginary.	− 1·2	− 9677·4

(seniuretted Hydrogen.

Arsenic resembles nitrogen and phosphorus, one atom combining with three atoms of hydrogen, producing arseniuretted hydrogen. I give the results of my calculations without the details, which are necessarily tedious.

(AsH). In this case arsenic behaves as a monad, and I find

$$m_1 = -36, \qquad \omega'^2 = 1·08619,$$

$$a_1 = 1, \qquad \epsilon_1 = +0·0201,$$

$$\beta = 75, \qquad \mu' = +3912.$$

(AsH_2). In this case arsenic behaves as a dyad, with the following results:—

$$m_2 = -58, \qquad \omega''^2 = 1·0859,$$

$$a_2 = 1·0837, \qquad \epsilon_2 = +0·0222,$$

$$\mu'' = +286·3.$$

(AsH_3). *Arseniuretted Hydrogen.*

$$\phi_3^2 = \left(\frac{m + 75}{m}\right)^2 = -1·22, \qquad \omega'''^2 = 1·0894,$$

$$a_3 = 0·7382, \qquad \epsilon_3 = +0·03313.$$

Coefficients of Attraction.

$\beta = 75.$

	m	ϕ^2	μ
AsAs	—	—	+ 102·88
AsH	− 36	$+\left(\frac{39}{36}\right)^2$	+ 3912
AsH_2	− 58	$+\left(\frac{17}{58}\right)^2$	+ 286·3
AsH_3	Imaginary.	− 1·22	− 4066

(6). *Antimoniuretted Hydrogen.*

The last of this group of triads is antimony whose constants I find as follows :—

(SbH). Antimony as a monad—

$$m_1 = -60, \qquad \omega'^2 = 1{\cdot}02919,$$

$$a_1 = 1, \qquad \epsilon_1 = +0{\cdot}001885,$$

$$\beta = 122, \qquad \mu' = 2188.$$

(SbH_2). Antimony as a dyad—

$$m_2 = -104, \qquad \omega''^2 = 1{\cdot}029955,$$

$$a_2 = 1{\cdot}03178, \qquad \epsilon_2 = +0{\cdot}06505,$$

$$\mu'' = 61{\cdot}38.$$

(SbH_3). *Antimoniuretted Hydrogen.*

$$\phi_3^2 = \left(\frac{m+\beta}{m}\right)^2 = -1{\cdot}2794, \qquad \omega'''^2 = 1{\cdot}0300,$$

$$a_3 = 0{\cdot}6927, \qquad \epsilon_3 = +0{\cdot}00935,$$

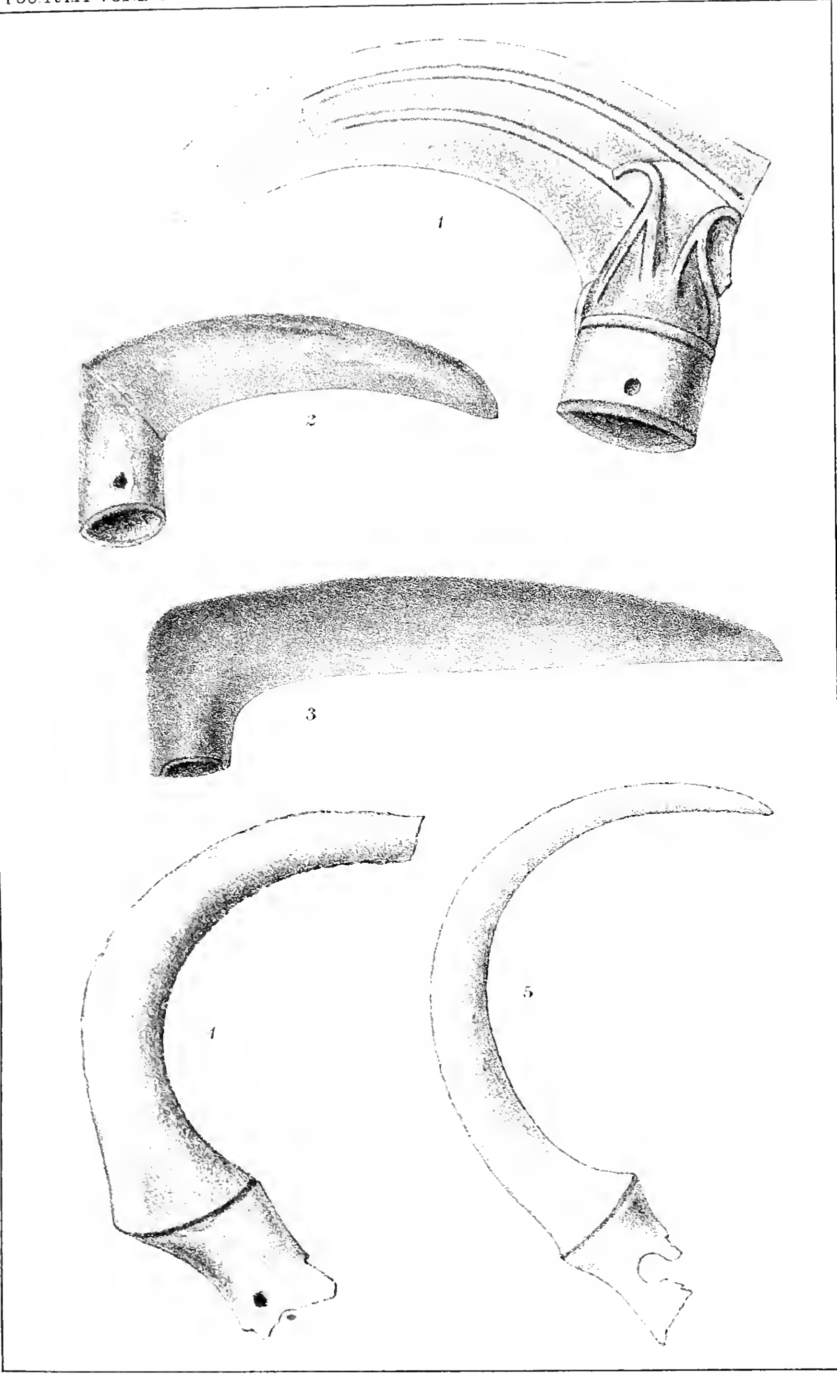
$$\mu''' = -2621.$$

Coefficients of Attraction.

$\beta = 122.$

	m	ϕ^2	μ
SbSb	—	—	+ 2·2768
SbH	− 60	$+\left(\frac{62}{122}\right)^2$	+ 2188
SbH_2	− 104	$+\left(\frac{18}{122}\right)^2$	+ 61·38
SbH_3	Imaginary.	− 1·2794	− 2621

END OF NOTE III.



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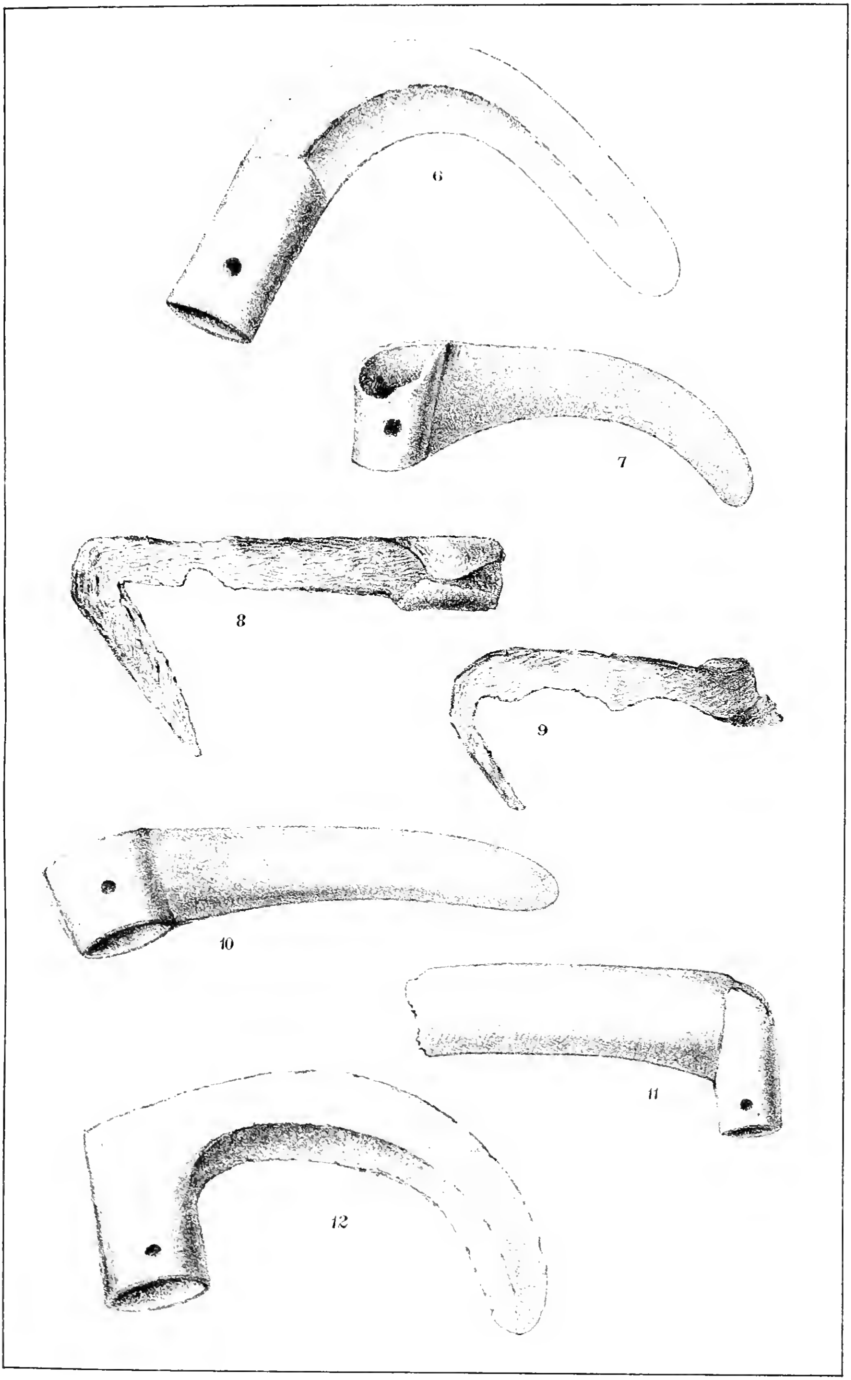

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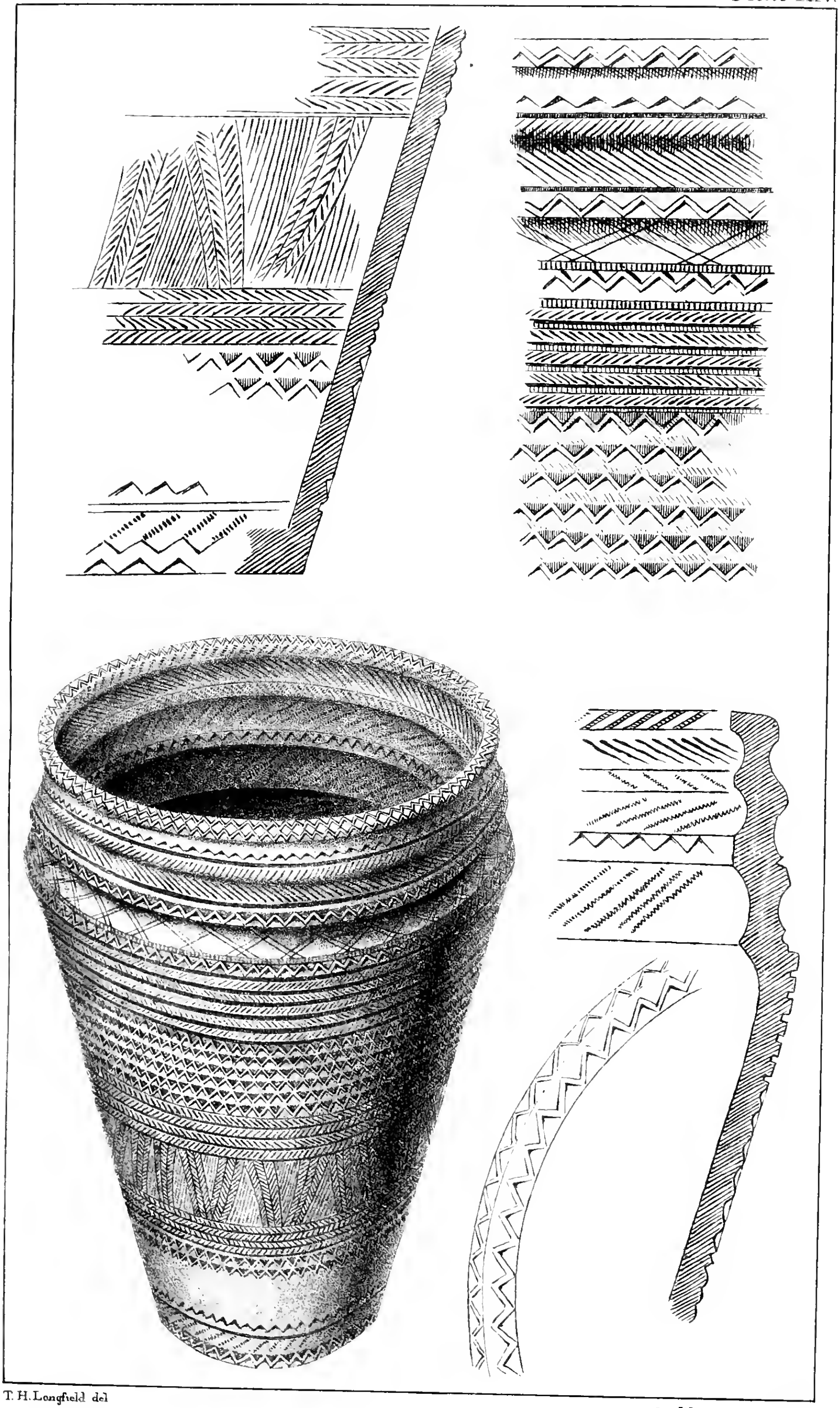

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XXIX.

NOTES ON NEWTONIAN CHEMISTRY. By REV. SAMUEL HAUGHTON, M.D.

[Read April 11, 1892.]

Note IV.—Quinary Compounds.

(Marsh Gas Type.)

1. *Marsh Gas.*—The last of Mendelejeff's typical compounds is marsh gas, in which an atom of the element carbon combines with four atoms of hydrogen.

I commence my discussion by recapitulating the essential mechanical equations which regulate the compounds of all classes, monads, dyads, triads, tetrads.

Let X be any element whose atomic weight is β.

(*a*) *Monad* (XH).

Areas

$$(\beta + 1)\,\omega' = \beta\left(\frac{m_1 + \beta}{m_1}\right) + a_1. \tag{A}$$

Configuration

$$\mu'\beta = \left(\frac{m_1 + \beta}{m_1}\right)^2. \tag{B}$$

Energy

$$2\epsilon_1 + \frac{m_1^2 + \beta}{m_1^2} = \frac{\beta + 1}{\beta}\,\omega'^2. \tag{C}$$

(*b*) *Dyad* (XH_2).

Areas

$$\omega'' = \frac{2m_1 + \beta}{2m_1} + a_2. \tag{A}$$

Configuration

$$\omega''^2 = 1 + \left(\frac{m_2 + \beta}{m_2}\right)^2. \tag{B}$$

Energy

$$2\epsilon_2 + \frac{\beta}{2m_1^2} = \left(\frac{m_2 + \beta}{m_2}\right)^2. \tag{C}$$

(*c*) *Triad* (XH_3),

Areas.

$$\omega''' = \frac{3m_1 + \beta}{3m_1} + \alpha_3. \qquad \text{(A)}$$

Configuration

$$\omega'''^2 = 2 \sec(30^\circ) + \left(\frac{m_3 + \beta}{m_3}\right)^2. \qquad \text{(B)}$$

Energy

$$2\epsilon_3 + \frac{3m_1^2 + \beta}{3m_1^2} - 2 \sec(30^\circ) - \left(\frac{m_3 + \beta}{m_3}\right)^2. \qquad \text{(C)}$$

(*d*) *Tetrad* (XH_4).

Areas

$$\omega'''' = \frac{4m_1 + \beta}{4m_1} + \alpha_4. \qquad \text{(A)}$$

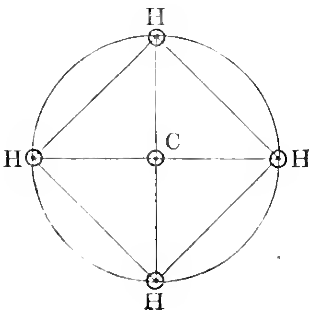
Configuration

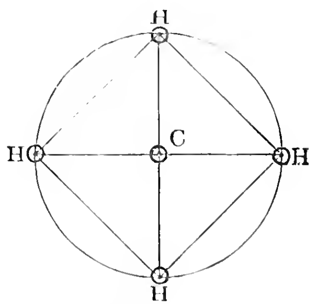
$$\omega''''^2 = (1 + 2 \sec(45^\circ)) + \left(\frac{m_4 + \beta}{m_4}\right)^2. \qquad \text{(B)}$$

Energy

$$8\epsilon_4 + \frac{4m_1^2 + \beta}{m_1^2} - 4(1 + 2 \sec(45^\circ)) - 4\left(\frac{m_4 + \beta}{m_4}\right)^2 = 0. \qquad \text{(C)}$$

These last equations result from the combination of four molecules of hydrogen uniting with one molecule of carbon, producing two molecules of the shape





1°. *Compounds of Carbon with Hydrogen.*

Using $\beta = 12$, the atomic weight of carbon, I find, following the methods already described.

(*a*) *Carbon as a monad* (CH).

$$m_1 = -5, \qquad \omega'^2 = 1{\cdot}37,$$

$$\alpha_1 = 1{\cdot}1839, \qquad \epsilon_1 = +0{\cdot}002085,$$

$$\mu' = +40833.$$

(*b*) *Carbon as a dyad* (CH_2).

$$m_2 = -8, \qquad \omega''^2 = 1{\cdot}2500,$$

$$\alpha_2 = 0{\cdot}9180, \qquad \epsilon_2 = +0{\cdot}0050,$$

$$\mu'' = +5208.$$

(*c*) *Carbon as a triad* (CH_3).

$$\phi_3^2 = \left(\frac{m_3 + 12}{m_3}\right)^2 = -1, \qquad \omega'''^2 = 1{\cdot}3094,$$

$$\alpha_3 = 0{\cdot}9442, \qquad \epsilon_3 = +0{\cdot}0747,$$

$$\mu'' = -20833\tfrac{1}{3}.$$

(*d*) *Carbon as a tetrad* (CH_4).

$$\phi_4^2 = \left(\frac{m_4 + 12}{m_4}\right)^2 = -2{\cdot}6, \qquad \omega''''^2 = 1{\cdot}2284,$$

$$\alpha_4 = 0{\cdot}7083, \qquad \epsilon_4 = +0{\cdot}0542,$$

$$\mu'''' = -54166.$$

Hence we find

Constants of Carbon.

$\beta = 12.$

	m	ϕ^2	μ
CC	—	—	$+3333\frac{1}{3}$
CH	-5	$+\left(\frac{7}{5}\right)^2$	$+40833$
CH_2	-8	$+\left(\frac{4}{8}\right)^2$	$+5208$
CH_3	Imaginary.	-1	$-20833\frac{1}{3}$
CH_4	Imaginary.	$-2{\cdot}6$	-54166

2°. *Compounds of Silicon with Hydrogen.*

It is well-known that silicon, like carbon, forms various compounds with hydrogen, one of which SiH_4 is gaseous and analogous to CH_4 (*marsh gas*).

But SiH_4 resembles, in some respects, the triad compounds, such as phosphuretted hydrogen more closely than marsh gas.

(*a*) *Silicon as a Monad* (SiH). Here I find, following the methods described for carbon, since $\beta = 28$,

$$m_1 = -13, \qquad \omega'^2 = 1{\cdot}1342,$$
$$a_1 = 1{\cdot}4, \qquad \epsilon_1 = +0{\cdot}00305,$$
$$\mu' = +11887.$$

(*b*) *Silicon as a dyad* (SiH_2).

$$m_2 = -20, \qquad \omega''^2 = 1{\cdot}1600,$$
$$a_2 = 0{\cdot}777, \qquad \epsilon_2 = +0{\cdot}0386,$$
$$\mu'' = +1428{\cdot}5.$$

(*c*) *Silicon as a triad* (SiH_3).

$$\phi_3^2 = -1{\cdot}1694. \qquad \omega'''^2 = 1{\cdot}1400.$$
$$a_3 = 0{\cdot}786, \qquad \epsilon_3 = +0{\cdot}0980,$$
$$\mu''' = -10441.$$

(*d*) *Silicon as a tetrad* (SiH_4),

$$\phi_4^2 = -2{\cdot}6, \qquad \omega''''^2 = 1{\cdot}2284,$$
$$a_4 = 0{\cdot}646, \qquad \epsilon_4 = +0{\cdot}0935,$$
$$\mu'''' = -23214.$$

Constants of Silicon.

$\beta = 28.$

	m	ϕ^2	μ
SiSi	—	—	211·32
SiH	− 13	$+\left(\frac{15}{28}\right)^2$	+ 11887
SiH_2	− 20	$+\left(\frac{8}{28}\right)^2$	+ 1428
SiH_3	Imaginary.	− 1·1694	− 10441
SiH_4	Imaginary.	− 2·6	− 23214

SUMMARY.

I have now completed the discussion of the problem proposed by Mendelejeff in his lecture at the Royal Institution, on the 31st May, 1889.

He proposed the problem, to discuss the chemical properties of four typical bodies,

Hydrofluoric acid (HF),

Water (H_2O),

Ammonia (NH_3),

Marsh gas (CH_4),

on the supposition that the chemical atoms act upon each other by laws similar to those of gravitation, viz.,

$$A = \mu \frac{mm'}{r^2}$$

where A is the action of two bodies upon each other in the line joining them; m, m' are the masses of the bodies; r is the distance between them; and μ is the coefficient of action of two units of mass separated by a distance of one unit.

In the discussion of this problem I have extended it beyond his proposal to consider the action of hydrogen upon four elements, viz., fluorine, oxygen, nitrogen, and carbon, and have discussed the action of hydrogen upon fourteen elements, including the four proposed by Mendelejeff, viz.,

Hydrogen.	Fluorine.	Oxygen.	Nitrogen.	Carbon Silicon.
	Chlorine.	Sulphur.	Phosphorus.	
	Bromine.	Selenium.	Arsenic.	
	Iodine.	Tellurium.	Antimony.	

The general results of my discussion are the following :—

1°. The chemical facts show that the laws of gravitation apply, so far as the product of the masses and inverse square of the distance are concerned, to all these bodies.

2°. The chemical facts show that the coefficient of action (μ) ceases to be constant at insensible (*chemical*) distances, and varies (*a*) with the nature of the element, and (*b*) with the number of atoms of hydrogen acted upon.

(*a*) *Action depending on the nature of the element.*

The following values of μ prove this statement in the clearest way :—

Coefficients of Attraction of Fifteen Elements.

	Atomic Weight.	μ
1. Hydrogen upon Hydrogen, ..	1	1000000
2. Carbon upon Carbon, ...	12	3333
3. Nitrogen upon Nitrogen, ..	14	1979
4. Oxygen upon Oxygen, ...	16	1275
5. Fluorine upon Fluorine, ..	19	649
6. Silicon upon Silicon, ...	28	211
7. Phosphorus upon Phosphorus, ..	31	143
8. Sulphur upon Sulphur, ...	32	138
9. Chlorine upon Chlorine, ..	35·5	97
10. Arsenic upon Arsenic, ...	75	10·28
11. Selenium upon Selenium, ..	79	8·76
12. Bromine upon Bromine, ..	80	8·21
13. Antimony upon Antimony, ..	121	2·27
14. Tellurium upon Tellurium, ..	125	2·08
15. Iodine upon Iodine, ...	127	1·98

(*b*) *Action depending on the number of hydrogen atoms engaged.*

The following Table shows the action (either attraction or repulsion) of the several elements when combined with one, two, three, or four atoms of hydrogen.

	Atomic Weight.	H.	H_2.	H_3.	H_4.
1. Hydrogen, ..	1	1000000	—	—	—
2. Carbon, ..	12	+ 40833	+ 5208	– 20833	– 54166
3. Nitrogen, ..	14	+ 31746	+ 5511	– 17857	—
4. Oxygen, ..	16	+ 25829	+ 5625	—	—
5. Fluorine, ..	19	+ 16244	—	—	—
6. Silicon, ..	28	+ 11887	+ 1428	– 10441	– 23214
7. Phosphorus, ..	31	+ 9175	+ 975	– 9677	—
8. Sulphur, ..	32	+ 10035	+ 1614	—	—
9. Chlorine, ..	35·5	+ 8339	—	—	—
10. Arsenic, ..	75	+ 3912	+ 286	– 4066	—
11. Selenium, ..	79	+ 3684	+ 363	—	—
12. Bromine, ..	80	+ 3454	—	—	—
13. Antimony, ..	122	+ 2188	+ 61	– 2621	—
14. Tellurium, ..	125	+ 2065	+ 103	—	—
15. Iodine, ..	127	+ 2031	—	—	—

The foregoing Table proves conclusively, on Newtonian principles,

Firstly—That the action of an element upon *one* atom of hydrogen is always an attraction.

Secondly—That the action of an element upon *two* atoms of hydrogen is always an attraction, but much less than the former attraction.

Thirdly—That the action of an element upon *three* atoms of hydrogen is always a repulsion.

Fourthly—That the action of an element upon *four* atoms of hydrogen is always a repulsion, but much greater than the former repulsion.

It can easily be shown that if pentad, hexad, or heptad elements exist, the repulsion between them and the increasing number of hydrogen atoms must also increase with the more complex configuration of the molecule; and perhaps this is the reason why we are doubtful of the existence of higher elements than tetrads. Why some elements should have the power of acting upon only one atom of hydrogen while others are capable of acting upon one, two, three, or four atoms of hydrogen is an ultimate fact, of which science can, at present offer no explanation.

3°. The methods employed by me in this discussion are the following:—

(*a*) The law of conservation of areas gives me a dynamical equation (A), involving an addition of area (α) during the change of state, which addition is required to be as small as possible.

(*b*) The equation of configuration (B) is dynamo-geometrical, and determines the stability of the compound molecule by the square of its angular velocity.

(*c*) The third equation (C) is dynamical like the first, and is the equation of energy (or *vis viva*), and involves the loss of energy (ϵ) depending upon the collision of the atoms during the change of state. This loss must be positive and very small. The first and third equations (A) and (C) are easily dealt with, as they depend on well ascertained dynamical principles.

The second equation (B) is controlled by the chemical facts which state in each case what compound is produced and what compounds (although possible) are suppressed; and it is chiefly by means of the equation (B) that the facts expressed in the preceding Tables have been ascertained.

4°. By these methods I have been able to show that a chemical change of state is equivalent to a planetary catastrophe, and that it fulfils the two primary conditions of such a catastrophe, for—

(*a*) In each case all the molecules of hydrogen revolve in the direction *opposite* to that of the molecule of the element.

(*b*) In each case the periodic times of the molecules of hydrogen and the element have a small common multiple.

XXX.

ON SOME NEW IRISH EARTH-WORMS.

By the REV. HILDERIC FRIEND, F.L.S.

[COMMUNICATED BY DR. SCHARFF.]

[Read December 12, 1892.]

I.—A New Species of Lumbricus.

On the 16th June, 1892, I received from Dr. Scharff a series of earth-worms collected in Dublin, which contained not only a fine set of the Hibernian worm (*Allolobophora hibernica*, Friend), recently described, but also a good specimen of a Lumbricus which presented a number of striking characters. I was not prepared at the time to decide whether it was simply an abnormal form of the common earth-worm (*Lumbricus terrestris*, L.), or whether it belonged to a distinct species. I therefore made a note of its peculiarities, and awaited an opportunity for coming to a decision on sufficient evidence. In due course the much-wished for data were at hand, for on November 16th

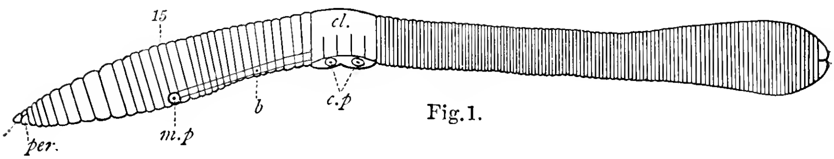


Fig. 1.

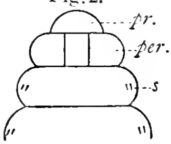
I received from Mr. Redding, L.R.C.S., a second specimen taken at Glasnevin, exactly corresponding in every detail to the one already observed. Careful and repeated examination of these specimens, and of others more recently received from different parts of Ireland, both internally and externally, and detailed comparison with the type of the genus, have enabled me to decide that we have here an earth-worm which is new to Great Britain, and as far as I can ascertain, new to science as well.

It seems very fitting that the first scientific description of this species should issue from the city whence the worm itself originally came. I have pleasure therefore in submitting the following account of the species, and adding particulars of the other species of the genus so far as I have been able to acquaint myself with its Irish representatives.

I may in the first place give a plain account of the worm in English, following it with a brief diagnosis corresponding with that supplied of the Ruddy Worm (*Lumbricus rubescens*, Friend), as described by me last year in a communication to the Linnean Society.[1]

The adult worm is 4 inches or 10 cm. in length when well preserved in alcohol. It is 8 mm. across the girdle and sexual organs, while the tail is spathulate or flattened so as to measure nearly a centimetre in diameter. In colour it is ruddy brown, but lighter than the common earth-worm usually is, though in size and other parti-

Fig. 2.



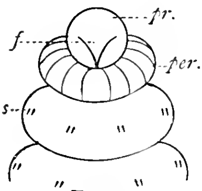


Fig. 3.

Fig. 4.

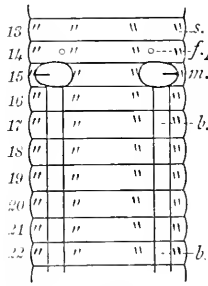
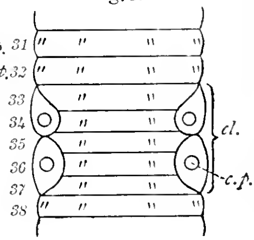


Fig. 5.



culars it closely resembles that species (*L. terrestris*, L.), which we may regard as the type of the genus. The lip or prostomium forms with the peristomium (fig. 2) a perfect mortise and tenon, while the under side of the lip is marked by a forked groove (fig. 3). This is undoubtedly of service to those species which possess it, as it enables the worm to grasp its food more firmly than it could otherwise do. The under surface of the peristomium is deeply ribbed or indented. On the 15th segment we find a pair of prominent pale papillæ on which the male pores are situated. In front of these, on the preceding segment, the female apertures can be discerned (fig. 5), while running backwards and closely connecting the male pores with the girdle we

[1] "Journal Linn. Soc. Zoology," vol. xxiv., p. 305.

find a band or ridge (fig. 1 b) similar to that which is often seen very distinctly in the red worm (*L. rubellus*, Hoffm.). The girdle occupies five segments only (33-37). Every species of Lumbricus previously found in Great Britain possesses six girdle segments, but we find an analogous instance on the Continent where one species (*L. melibæus*, Rosa), is described as having a girdle of five segments. Along these segments there runs on either side a prominent band (*tubercula pubertatis*) which appears to cover and connect the whole girdle. In reality, however, the band occupies segments 34–37. The most remarkable feature about the girdle is the large clitellar papillæ (figs. 1, 4 *p.*) on the 34th and 36th segments. We have no other species of Lumbricus which regularly exhibits these organs. In the allied genus, Allolobophora, they are frequent. I once observed them in a specimen of the red worm (*L. rubellus*, Hoffm.), received from Dublin, but no other example has hitherto come under my notice.

The position of the band (*tubercula pubertatis*) is of extreme interest, as we are able by the discovery of this species to fill a curious gap. Dr. Rosa some years ago drew up a chart in which he displays the arrangement of the clitellar band in the different species of Lumbricus. We are now able to modify and improve the table.

L. rubellus, Hoffm.,	28	29	30	31							
L. purpureus, Eisen,		29	30	31	32						
L. melibæus, Rosa,			30	31	32	33					
L. tyrtæus, Savigny,[1]				31	32	33	34				
L. forma No. 5, Rosa,[2]					32	33	34	35			
L. terrestris, Linn.,						33	34	35	36		
L. papillosus, Friend,							34	35	36	37	
L. rubescens, Friend,[3]								35	36	37	38

A similar chart might be prepared to enable us to see at a glance

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[1] I strongly suspect this is the same as *Allo. profuga*, Rosa.

[2] A form described by Rosa in "I Lumb. del Piemonte," p. 22.

[3] Rosa places here *L. festivus*, Savigny; but the description is too brief to enable us to decide whether they are synonymous.

the position of the first dorsal pore. I give the Irish forms herewith in order that it may be perfected as our knowledge grows.

L. rubescens, Friend,	5	6				
L. purpureus, Eisen,		6	7			
L. rubellus, Hoffm.,			7	8		
L. terrestris, Linn.,				8	9	
L. papillosus, Friend,					9	10

How far this character is constant remains yet to be demonstrated, though Ude has made elaborate investigations which seem to indicate that its value is not to be despised in diagnosis. It will be seen, if the foregoing chart is reliable, that there is at present no apparent relationship between the position of the first dorsal pore and the first clitellar papilla.

The setæ are in four couples on each segment, and are slightly wider apart than in the other species. On account of the presence of clitellar papillæ in this species and no other I have named it *L. papillosus*, a designation which I think well calculated to express the principal feature.

Following the diagnosis of the Ruddy Worm (*L. rubescens*, Fr.), and that of the other species found in Eisen's memoir, I now give a brief description of the new species.

Lumbricus papillosus, sp. nov.

Corpus elongatum aut crassum, antice cylindricum, postice spatulatum.

Lobus cephalicus (sive *prostomium*) magnus, antice rotundatus, postice segmentum buccale (id est *peristomium*) in duas partes dividens; infra pallidus, sulco longitudinali furcato.

Tubercula ventralia plerumque conspicua in segmento 15.

Cingulum e quinque segmentis (33-37) confectum; infra duobus parallelis tuberculis in segm. 34, 35, 36, 37, cum duabus papillis in utroque latere infra segmenta 34 et 36.

Setæ ubique binæ approximatæ.

Segmenta circa 130.

Longitudo circa 10 cm. Max. diam. 8 mm.

Prima foramen dorsi inter segmenta 9-10.

Internally the Papillose Worm has the typical number and arrangement of essential organs—the gizzard in segments 17–18, two pairs of spermathecæ in 9 and 10, and three pairs of sperm sacs.[1]

At the present moment the species of Lumbricus known to occur in Ireland are five in number, and as they do not appear to have been described or recorded by any of my predecessors, I submit herewith a brief account of the four remaining species. I have carefully studied specimens of each which have been received from different parts of the island, and find that they are typical in character, and widely distributed.

The common earth-worm (*L. terrestris*, Linn.), though formerly very vaguely defined and constantly confused with a number of other species, especially the Long Worm (*A. longa*, Ude), is now easily recognized by the constancy of its girdle and band. It is the largest of our native terrestrial annelids, often reaching a length of six or eight inches, when living undisturbed in rich vegetable mould. It is of a warm brown colour, usually iridescent on the back, and flesh-coloured beneath. On the fifteenth segment it carries pale-coloured papillæ, on which are situated the male pores. These papillæ are a good starting point when the segments have to be counted backwards to ascertain the position of the girdle. I have examined many hundreds of specimens at all seasons of the year, and have, without a single exception, found the girdle in the mature worm covering the 32nd to the 37th segments, the four innermost of which have the *tubercula pubertatis* on the ventral surface. The setæ are arranged on the underside of the body in four double rows, whereas in the tree worms they form eight single rows nearly equidistant all over the body. When irritated, the worm exudes a clear colourless slime, but we never find a liquid substance poured from the dorsal pores. In the case of the tree worms, and several species of Allolobophora this is the case, while a few instances occur in which an odour of garlic or some other vegetable is emitted.

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[1] NOTE IN PRESS.—Since this communication was presented to the Academy I have received further supplies of the Papillose Worm from Ireland, and in one instance I discovered spermatophores on the ventral surface of the animal's body, between segments $\frac{27}{28}$ and $\frac{28}{29}$. The Ruddy Worm is the only other British Lumbricus upon which I have thus far observed these peculiar appendages.

The distribution of the Papillose Worm, so far as at present known, is as follows:—Ireland—Dublin (Dr. Scharff, June 16, 1892); Glasnevin (Mr. Redding, November 16, 1892); Cork (Miss Abbott, January 13, 1893); Valencia, Kerry (Miss Delap, January 13, 1893).

The ruddy worm (*L. rubescens*, Friend) is identical in point of size and colour with the new species described above. It was first discovered by me in Yorkshire a couple of years ago, and described in detail in the Linnean Society's "Journal of Zoology," vol. xxiv., p. 305 seq. The Irish specimens which I have examined in no way differ from the type, which is about four inches in length, and has an average number of 120 segments. It has probably been mistaken by earlier investigators for one or other of the worms which it closely resembles, though Savigny may have intended this species when he wrote his brief account of *L. festivus*. The curious point about the matter is that no one on the Continent has ever found a worm answering to the description of Savigny, though he wrote more than half a century ago. In the ruddy worm we have the male pores again conspicuously situated on papillæ, while in the two remaining species they are wanting altogether. The girdle extends from the 34th to the 39th segment, and as usual the band stretches across the four innermost. The discovery of the new worm bridges over the gap between the common earth-worm and the ruddy worm, and they begin their girdle respectively on segments 32, 33, and 34. This fact is suggestive. I have observed spermatophores on the ventral surface of the body of this worm between the male pores and the clitellum; but hitherto I have failed to discover them on any other species of Lumbricus save the newly-described Papillose Worm. They are minute sacs of a delicate structure, balloon-shaped, filled with spermatozoa.

The red worm (*L. rubellus*, Hoffm.) differs from all the foregoing in the forward position of its girdle, and the absence of papillæ on the 15th segment. It is therefore impossible as a rule to know where the male pores are situated in this species and the next without counting the segments carefully from the head backwards. When the worm is adult, however, a band is often to be seen running along each side of the body from the girdle forwards to the 15th or 14th segment, similar to that found in the papillose worm. The girdle commences on the 27th segment and reaches to the 32nd, the 28th to 31st carrying the *tubercula pubertatis*. This worm appears to be liable to variation, but what the cause may be is not yet known. I have shown in a paper on Hybridity among Worms that the red worm may sometimes be found in association with other species. Among the variations which have come under my notice the following are the most important. One specimen received from Dublin had two pairs of papillæ under the girdle exactly after the manner of the papillose worm. What Eisen remarked of the species as found in Scandinavia I have found to be true here, viz. that the girdle sometimes begins and ends one segment in advance of the normal position. Then in certain localities the hinder extremity is found to be curtailed, while one specimen received from Bangor recently had the girdle exactly in the position which it occupies in the Continental species (*L. melibœus*, R.). In the latter, however, there are papillæ on segment 15, which did not occur on this abnormal specimen, or we might at once have added another species to our list.

The purple worm (*L. purpureus*, Eisen) is the smallest indigenous species. When in its finest form one can scarcely distinguish it from the last, but the girdle always occurs one segment further back, extending from the 28th to the 33rd. It is specially fond of burrowing among droppings in pastures, and usually has a tumid ridge on the ventral surface of the 10th segment. The male pores cannot be detected owing to the absence of papillæ. There is good reason to believe that this is the species which Savigny named *Enterion castaneum* in 1829, but the early naturalists had not a sufficient knowledge of the most important characters to make their diagnoses of permanent value. The main points may be best presented in the form of a chart, which I give on page 460.

I beg to point out the great value to the true earth-worms of the flattened or spathulate extremity. So far as I am aware it has never been observed by any other helminthologist that the habitat of the species and the shape of the posterior part have a direct relationship to each other. It is only among those species which expose a portion of their body when in search of food, while the other remains in the burrow, that the distinctly flattened tail is found in our native species. Oriental species are as a rule as round as a straw, while our tree haunting species are usually octangular. I shall have some curious facts to present on this point in another paper on *Variation among Annelids*, resulting from my study of Irish earth and tree worms, should such a communication be acceptable. Meanwhile I am content to observe that the shape of the tail in the genus which we have been studying is of immense value, since it enables the worm to grip its burrow most tenaciously and so retain its hold if an attempt be made to drag it forth.

[A TABULAR VIEW OF THE IRISH LUMBRICI.

A TABULAR VIEW OF THE IRISH LUMBRICI.

LUMBRICUS.	Segments occupied by			Average.		Papillæ.	
	Girdle.	Band.	First Dorsal Pore.	Length.	No. of Segments.	Male Pore.	Elsewhere.
1. TERRESTRIS, Linnæus, 1757.	32–37	33–36	$\frac{8}{9}$	5 inches.	150–200	15	26
2. PAPILLOSUS, Friend, 1892.	33–37	34–37	$\frac{9}{10}$	4 inches.	130–150	15	34, 36
3. RUBESCENS, Friend, 1892.	34–39	35–38	$\frac{5}{6}$	4 inches.	100–130	15	28
4. RUBELLUS, Hoffmeister, 1845.	27–32	28–31	$\frac{7}{8}$	3 inches.	100–120	0	0
5. PURPUREUS, Eisen, 1870.	28–33	29–32	$\frac{6}{7}$	2 inches.	80–100	0	10

II.—A NEW SPECIES OF ALLURUS.

Among a very valuable series of worms sent to me by J. Trumbull, Esq., L.R.C.S., from Malahide on November 22nd, 1892, I found a single specimen of an Allurus which is totally different from any other British species yet described; and as it is also, so far as I am able at present to determine, distinct from every other species known to science, I send this preliminary note respecting it. Fuller details must be reserved till a further supply of materials can be obtained.

The Long-tailed Allurus (*A. macrurus*, Friend), when preserved in alcohol is 3 cm. or nearly an inch and a-half in length, and 5 mm. in diameter across the girdle. In this brief space we find no fewer than 160 segments, those behind the girdle being the narrowest I have ever seen in any earth-worm at home or abroad. Like its nearest ally (*A. tetragonurus*, Friend) it has the girdle in a very advanced position; apparently covering segments 15 to 22.

The clitellar papillæ (*tubercula pubertatis*) are on the underside of the girdle segments 20, 21. On segments 13 and 22 we find ventral papillæ of a peculiar character, arranged in pairs.

The head is fleshy pink, the body of a peculiar greenish hue, quite different from any other species known to me. The girdle is yellowish, and retains a somewhat yellow-green hue in spirits. The setæ are wide apart, and the anus is peculiar in shape, size, and general appearance. The enormous number of segments behind the girdle (viz. 140), has suggested the name *macrurus* or the Long-tailed worm, and the presence of the male pores on segment 13 determines its position in the family.

I have recently forwarded to the Linnean Society an account of the different species of Allurus already known to occur in Great Britain. The worm now under review being added, we shall have five indigenous[1] species of Allurus; each one of which, however, merits a good deal of further investigation. Of the life-history, distribution, affinities, varietal forms, range of habitat, and other matters we at present know very little, and I shall welcome any assistance from collectors in Ireland

[1] It yet remains to be seen whether this species is indigenous, or merely a foreign importation. If the latter, whence came it, and how?

which will make this subject better known. The species of Allurus now on record for Great Britain are:—

1. Allurus tetraedrus, Savigny.
2. Allurus amphisbæna, Dugès.
3. Allurus flavus, Friend.
4. Allurus tetragonurus, Friend.
5. Allurus macrurus, Friend.

We have also at least two varieties of No. 1, named by Eisen var. *obscurus*, and var. *luteus*. I believe the West of Ireland would yield one or two more species if carefully worked.

XXXI.

A STUDY OF THE LANGUAGES OF TORRES STRAITS, WITH VOCABULARIES AND GRAMMATICAL NOTES. (Part I.) By SIDNEY H. RAY, Member of the Anthropological Institute, and ALFRED C. HADDON, M.A., Royal College of Science, Dublin.

[Read June 22, 1891.]

CONTENTS OF PART I.

PART I.

I.—Introduction.

Apart from the general interest which is attached to Papuan languages, those of the south-west of New Guinea possess a special value; for it is here, and here only, that the undoubted Papuans come into contact with the Australians, and a study of the languages in the neighbourhood of Torres Straits should throw some light on the relations between the two races; a subject upon which, up to the present time, there has been much conjecture and but little evidence. One of us is preparing a Monograph on the Torres Straits' Islanders, in which this question will be discussed at length.

With a view of throwing further light upon this problem, we have collected all the vocabularies and literature we could discover, whether in print or in manuscript, and have done our best to elucidate the syntax and construction of the languages.

The present Memoir deals with the three Papuan languages of this district. These are :—

(1) The Miriam.
(2) The Saibai.
(3) The Daudai.

We have not yet been able to collect sufficient information respecting the languages of the Cape York peninsula to enable us to say anything about the North Queensland languages. We are, however, making inquiries which we hope may lead to some definite knowledge being obtained from this practically unknown region.

The Miriam language is spoken on the Murray Islands (Mer, Waier, and Dauar), Erub (Darnley Island), and Ugar (Stephen's Island), in the Eastern portion of the Straits. The language is substantially the same throughout, and no differences of dialect have been noted.

The Saibai (here adopted as a convenient general term for the language of the Western Tribe) is spoken in the numerous islands extending from Cape York in Australia to within a mile or two of the mainland of New Guinea. The chief divisions of the tribe are as follows* :—

1. Kauralaig (the Kowrarega of Macgillivray) inhabiting Muralŭg (Prince of Wales' Island) and the neighbouring islands, and the large island of Moa (Banks' Island).

2. Gumulaig, occupying Bădu (Mulgrave Island) and Mabuiăg (Jervis Island).

3. Saibailaig, living on Saibai, Dauan (Mount Cornwallis) and Boigu (Talbot Island).

4. Kulkalaig, inhabiting Năgir (Mount Ernest), Tud (Warrior Island), Măsig (York Island, the Massied of Jukes and Machik of Stone), and the neighbouring islets.

On comparing the speech of the natives from, say, Muralŭg, Mabuiăg,

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* Cf. "The Ethnography of the Western Tribe of Torres Straits."—*Journ.* Anthrop. Institute, vol. xix., 1890, pp. 297–440.

Saibai, and Tud, it is evident that although there is only one language, yet dialectic differences can be discerned. The Kauralaig tongue is more distinctively Australian in its character, while the Saibai and, to a less extent, the Gumulaig use several Daudai words. The pronunciation and enunciation also vary, and it is partly owing to this cause that the same word is spelt in different ways by various travellers. The natives are quite aware of this difference, and the Gumulaig compare their enunciation with that of the Kauralaig, not to the advantage of the latter. Speaking in general terms, the Kauralaig not only often pronounce words differently from the other divisions of the tribe, but their enunciation is slurred; cf. *barit*, *bait*, *mari*, *mai*, *&c.*, in Saibai vocabulary.

Although the islands of Moa and Bădu are separated by a narrow channel only a little over a mile in width, yet in passing from the one to the other the traveller is at once struck by certain dialectic differences in the speech of the inhabitants. The reason for this is to be found in the fact that each belongs to a different intermarrying group, the former being Kauralaig and the latter Gumulaig (cf. *Journ.* Anth. Inst., xix., pp. 356–357). There is also a relation between trade routes and the affinities of languages (cf. *Journ.* Anth. Inst., pp. 341–342).

The Daudai is spoken on the mainland of New Guinea, opposite the Straits; the word "Daudai" itself being applied by the islanders to the mainland. Australia is sometimes called Koi Daudai, and New Guinea Mŭgi Daudai.

"The Kowraregas speak of New Guinea under the name of Muggi (little) Dowdai, while to New Holland they apply the term of Kei (large) Dowdai" (Macgillivray, vol. ii., p. 4). The apparent reason for this nomenclature is owing to the fact that a considerable stretch of high land can be seen from Muralug, and the natives in their little voyages would see yet more of the coast. It is doubtful whether Muralug natives ever went to New Guinea fifty years ago, but reports would certainly reach them that the land was all low-lying, and even the Saibailaig were acquainted with only a small portion of the neighbouring coast.

According to Macgregor, the Kiwai people speak of the mainland on the west side of the delta of the Fly River "from Sui up past Odagositia" as Dudi; but the sea-coast beyond is Daudai.

The specimens of the Daudai language have been obtained from three localities :—

1. Mowat, Mouatta (or Moatta) at the mouth of the Binature River (Kătau or "Katow River").
2. Parama, Perem (or Bampton Island) near the coast and east of Mowat.
3. Kiwai, a large island in the delta of the Fly River.

There is a considerable variation of dialect in the three localities. This consists not only in changed pronunciation as, for example, the loss of the sibilant in Perem and Mowat, but also extends to the use of different words; cf. *sun*, in the vocabulary. The dialects of both Daudai and Sabai will be more fully discussed in the Grammatical Notices.

Our thanks are due to the Rev. Dr. Macfarlane, Rev. E. B. Savage, and Rev. A. E. Hunt for the use of their manuscript vocabularies; to the Hon. John Douglas for the Saibai vocabulary of Mr. James Sharon, and to the Rev. James Sleigh, for notes on Lifu and Samoan words introduced into the Straits.[1] To the Rev. Dr. Codrington, whose standard works on the "Melanesians" and the "Melanesian Languages" form a veritable thesaurus of facts and suggestions for the student of the Oceanic Races and Languages, we are indebted for valuable hints and explanations.

We have adopted the following vowel pronunciations :—*a* as in "father"; ă as in "at"; *e* as a in "date"; *ĕ* as in "debt"; *i* as ee in "feet"; *ĭ* as in "it"; *o* as in "own"; *ŏ* as in "on"; *ö* as German ö in "schön"; *u* as oo in "soon"; *ŭ* as in "up"; *ai* as in "aisle"; *au* as ow in "cow." The consonants are sounded as in English; *ng* as in "sing."

[II.—Bibliography.

[1] The Lifuan teachers mentioned in these articles were trained by Mr. Sleigh at Lifu, and proceeded to the Straits from that island with the Rev. S. Macfarlane when the New Guinea Mission was started in 1871.

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(3) 1852. CRAWFURD, JOHN, F.R.S.—"A Grammar and Dictionary of the Malay Language, with a Preliminary Dissertation." London: Smith, Elder, & Co. Vol. I., Dissertation and Grammar; Vol. II., Dictionary.

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Eleven hymns in the language of Daudai. Translated and printed by Rev. E. B. Savage.

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(MS. 5). HUNT, REV. A. E.—Vocabulary, English and Murray Island (1888).

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(MS. 9). SAVAGE, REV. E. B.—Vocabulary of Murray Island and English (1886 ?).

(MS. 10). SCOTT, REV. H.—Notes on Murray Island Language (1885 ?).

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* Mr. Sharon was a schoolmaster, appointed by the Queensland Government to teach English to the natives; unfortunately he did not remain long in the Straits. Mr. Robert Bruce, of Mer, had a copy of Mr. Sharon's valuable vocabulary; if he had not preserved it Mr. Sharon's labours would have been lost to Science. The Hon. John Douglas, the Government Resident, gave me permission to make what use I pleased of the Sharon MS.—A. C. H.

III.—A Comparative Vocabulary.

(*English, Miriam, Saibai, and Daudai.*)

In this list the words are mostly given as they appear in the various mss. Thus, the Miriam words sometimes have the prefix *d*, and the Saibai the verbal endings *n*, *z* (*s*), or *ipa*.

Miriam words marked (J), (L), appear only in Jukes, the latter being Lewis' Murray Island. Saibai marked (M) are only in Macgillivray. In the Saibai and Daudai lists words in italics are from Macgregor's Vocabularies. The dialects of Mowat, Perem, and Kiwai are distinguished by the letters (M), (P), and (K), respectively.

This vocabulary does not contain all the words of the three languages. For many others, and for fuller explanations of those here given, the separate lists should be consulted.

VOCABULARY.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
A,	abĕle, netat,	senabi, urapon,	*nao*, goina.
abandon,	dekaer, adem-dikri,	adataĕan,	otoi, ëmēra.
abhor,	derar,	ngulamoin,	atatiai.
abide,	emri,	apatanu,	omiei.
able,	umele,	ngulaigö,	umoro.
abode,	utĕb,	lagö,	mauro.
abominable,	wit,	wati, ipidadö,	gumasa.
abortion,	{ deg-werem { kirer, werem pez }	umakazi,	
above,	kotor,	gimal,	ou.
absent,	nole-ike,	mata-launga,	
accede,	iakaida,	kuduman,	
accept,	egared,	toridiz,	omogu.
accompany,	bakeam-kĕmĕm,	kalmel-uzar,	
accuse,	atrumda,	imulizilamizö,	korutia.
accustom,	luzaple,	mina-asizinga.	
acknowledge,	ataut,	wa,	
across,	bogbog,	kakuru-pataean,	
act,	ikĕli,	nidaipa,	auagati.
add,	i-isir,		adabuti.
admit (*allow*),	ataut,	kuduman,	
advance,	kekem-bakeamu,	kulaitai,	

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
advise,	mer-atagere (*take counsel*),	gudö-nitun,	
adze,	(*stone*) inigob (?) panigob (?),	*walgan*,	*ota* (*wood*).
afraid,	geum,	akanö,	tore.
after,	keubu,	wagel, muasin,	uapurëto.
afternoon,	kiem,	kuta (M) *kutapa*,	*adimo*.
again,	ko, iako,	laka (M)	mina.
agree,	netate-mer-detager,	uraponia,	
air,	ner,	gubö,	sera (K) era (P).
alike,	mokakalam,	matangadagid,	gedagebi.
alive,	eded, ageg,	igelilönga,	kigiro, iopu.
all,	gair, gaire, uridili,	mura.	ipipu, aue.
allow,	amari,	getwani,	
alone,	tĕbtĕb,	kusaig,	naturai.
also,	pako, iako, a,	a,	e.
always,	niai-karem,	mata, ngaru,	mina.
among,	eipu,		turiat.
ancestor,	kaied,	kaied (*grandmother*),	
anchor,	par,	iadi, koiad,	*seneniti*, aga (M).
ancient,	ĕmeret,	kulba,	
and,	a, pako,	a, ia (M)	e.
*angel,	angela (*Eng.*),	angela,	
anger,	wekuge, urker,	tabukir, iaragi,	*worowοro*, doa.
animal,	ebur,	urui,	wowogo, uōōg.
ankle,	teter-kebi kok,	dana-koko,	ima.
anklet,	teter mŭkamuk,	dunakukur, brua.	
anoint,	asauem,	pinin,	adiriti.
another,	nerutĕ,	wara,	*naturaimi*, ata, *natura*.
answer,	etkat,	modobia, *muli*,	*gibo*, iarabuti.
ant,	iserŭm, soni (?) (J)	mugu, *taumi*,	*eneene*, *omo*, aparatara.
argue,	basared,	patöridizö,	korotoi.
arise,	ekwe,	kadai tanuriz,	totoboa.
arm,	tag,	getö, udu, zugu,	tuo, *tūpi*.
armlet,	put,	musur,	*tusase; piuri, gaumabu*, tutai (M).
do. (*shell*),	wauri,	waiwai,	*mabuo*.
around,	deraueli,	lunuranö,	uagediai.
arrive,	tabarki,	mangizö,	abarkai.
arrow,	kĕp,	taeak, taiek, terig (M), kimus.	*tere*, were (M).
artery,	kĕrar,	kirer,	*esume*.
as,	mokakalam,	keda,	gedagebi.
ascend,	ogi,	walizö,	ioro.
ashamed,	sirip,	azir,	*siripo ia*.
ashes,	pi, tibi,	kunur,	*tuo*.
ask,	amos,	iapopoibi,	*arogo*, uaratai.
asleep,	uteid,	utui,	utuo.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
assemble,	netat-gedim,	garöweidamoin,	
assist,	upinati,	ibupoidan,	uarabai.
astonished, be,	amer,	lupaliz,	uadow.
at,	ge (*suffix*),	nia (*suffix*),	-ato (*suffix*).
attack,	arĕs,	pazilamiz,	
attempt,	mirem,		kodoboa.
aunt,	au (*wife's side only*),	rebata, apu, ăma (M), naiubat.	*aberaburu.*
authority,	sirdam,		kauarubi.
avenge,	bodomalam,		uia (P) wisa (K).
awake,	itiri,	danpaliz,	amutia.
away,	adem,	adapa,	eberiai.
axe,	deumer-tulik, sapăra,	aga, turik,	kabi, *warikabi, daunomu, ema-aiopu.*
Babe,	kebi-bebi (*Eng*) sursur-werem,	mabetö, kazi	*osiomere, osiobesere.*
back,	sor, kur	kalö, kibu	*gimini-poa.*
backbone,	sor-kokelid,	göruridö,	*gimini-soro.*
bad,	adud, wit	wati, ipida d	*karakarai*, uba, gu-masa.
bag,	epei,	iana,	*baika*, abea (M).
bald,	ped,	guai,	
ball,	kai,	kokam,	
bamboo,	marĕp,	marapö,	*gagari* (?), *marabo.*
banana,	kaba,	katamö, dauai	*obīra*, tsime, dubari (M). (*Varieties*).
band (*company*),	nosik,	iatial,	dumeke.
bark (*of tree*)	gegur,	pia, pura	*ota tama.*
barter,	erap		
basin,	ezer,		*wedere*, nuku.
basis,	giz,		mabu.
basket,	epei,	iana, li, boi,	*titi, sito*, ito (M).
bat (*flying-fox*),	saper,	sapor, sapura.	soge.
bathe,	araiger,	urupugan,	*uāā.*
bay,	ukes, awak, kop,	kupadö,	*kubira.*
beach,	tawer, dodomer,	butu,	dodo, *wio.*
bead (seed),	kus,	kusa,	*kusa.*
beak,	kik,	gudö, piti,	*muba.*
bear (*v*),	bakuar (*carry*), kodrom bakuar (*on shoulders*), egaret (*suffer*),	töridiz,	aragotai (*on shoulders*).
beard,	imus,	iata, gudop,	*mubamūso*, baga-muo (M).
beat,	ipit,	mataman,	*ododa*, opio.
beautiful,	debĕle,	kapu,	*wade, titi.*
because,	abĕlelam,	siaizi, kedazöngu,	goinagaut.
become,	akai,	azipa (M),	oritorai.
bed,	sik,	dögam,	dodo.
bee,	ganiapu,	töda, ped, mosu,	

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
beetle,	isiri,	idara,	*kaiara, ibaba, pitu-pitu.*
before,	opem, kĕkem,	paru, kulai,	ororo.
beg,	damos,	ieudepa, amaizö,	uaratai.
begin,	ditimeda,	kuikaiman,	mabuedea.
behead,	kerem-derapei,	kuikö-patan,	
behind,	sor-ge,	kalapa,	*wabutu, iritoedea,* ururudo.
behold !	dasmer !	ngapanagi,	
believe,	oituli,	kapuakasin,	sibomuguruti.
bell,	amulu (M) pat (*Lifu*),	pati,	pate.
belly,	gĕm, kĕm,	maita,	*niro.*
below,	lokod,	apalö,	magumo.
belt,	wak,	wakau,	*bagebata, potobata,* bata, bagi (M).
bend,	egiami (J),	balbaitilan,	
berry,	kĕp,	kusa,	iopu.
best,	au-debele,	kapuminar,	
betel,	(*not known*),	(*not eaten*) wau	*gore.*
between,	eipu,	dadan,	turiat.
beware,	mamor-dasmer (*carefully-look*),	iman,	
beyond,	apĕk, apeik, ma-zepkor.	adapudiz,	apuo.
*bible,	zogo-jiauwali,	tusi-mina,	
big,	au,	köi, kai,	auo.
bind,	sopem,	dörödimoin,	kauaaupu.
bird (=*animal*),	ebur,	urui,	wowogo, uōōg.
birth,	aosos,	mainguzi, *mani,*	*rorota.*
bit (*n*),	mog,	tapi,	ipi.
bite,	areg,	töidiz, *taidisa,*	*tōabūti,* irio.
bitter,	kurabkurab,	tera (M),	
black,	golegole, kig,	kubikubinga,	uibuuibu.
bladder,	usi,	ubalö,	*susu.*
blade,	tulik,	turik,	*bari.*
blame,	emaideretili,	guratöridan,	
blaze,	be,	buia,	dogo.
bleed,	babuser,	kulka-ieudiz,	orouoduti.
*blessed,	werkab,	uuabo,	uada.
blind,	pone-asamasam, sadmer,	imaiginga	*idamari duduo, pai auri dubu.*
blood,	mam,	kulka,	arima.
blossom,	sik,	kukuam, kowsur (M),	*mu,*
blow (*v*),	diper, wami,	puian,	*orio* (*trumpet*), *susua epuro* (*with mouth*).
blow (*n*),	ipit,		opio.
blue	(suseri ?),	tanabadö, *maluda,*	*ipuaipua, uibuna.*
blunt,	kibor, kibkib (J),	dugunga,	

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
blush,	bamosa,	azir,	
board,			dodo.
boast,	bauspili,	ngada-palepa,	samo.
boat,	nar,	gul,	pe.
body,	gĕm,	gamu,	durupi.
bog,	sĕbdirki,	sai, *pupu*,	*bobo*.
bone,	lid,	ridö,	*soro* (K), *oro* (P).
*book,	jauali,	tusi,	*peba* (*Eng. paper*).
bore (*a hole*),	seker (J),	tarte-paleipa (M),	
born,	osmer, aosos,	mani,	araigiri.
bosom,	marmot,		bodoro.
both,	neis,	sepal,	netoa.
bottom,	giz,	apal,	mabu.
bow (*weapon*),	sarik,	gagai, gagal, gagari,	gagari.
bow (*v*),	esorgiru,		oroguriato.
bowels,	teibur,	görzö,	*niro*, tuburu.
bowl (*of bamboo pipe*),	tarkŏk,	turkŭ, terku,	
boy,	werem, kebile,	gara kazi, magitiom,	mere.
brain,	idoni,	tigi,	*tigiro*.
branch,	tam,	tam,	*koumiri*, kago.
bread,	areto (*Greek*),	areto,	*kono*, areto.
bread-fruit,	tamad,	*ti*,	*toma*.
break,	erap, atoat,	papalamiz, patidan	*buru*, ebia, ototoro.
breast,	nano,	*da*, susu, dŭra,	bodoro, amu (M).
breath,	ner,	ngana,	sera (K) era (P).
breathe,	ner-bataueret,		era (*breathing*)(M).
bridegroom,	aspidar-le,	mabaeg-kain-ipigasaman,	
bridge,	eseger,	do,	*waratoto*.
bright,	zoromzorom,	meakata,	*adipiru dureru*, airima heruo.
bring,	ais, ekau	mani, ngapa, angan,	*iāpo*, *auogu*, omidai, uagori.
broad,	au-kes,	atadonga	*patura* (breadth).
brood,	omăsker,	apukazi,	mere.
brother,	(*man's*) keimer, (*woman's*) berbet,	kutaig (*man's younger*), kuikuiga (*man's elder*), ngaubatö (*woman's*), tokiŭp, babŭd.	*namu*, *niragerema*, miradu, kiradubu (M).
brow,	mat,	si, paru	guri (M).
bud,	lusik.	gudpaliz,	
build,	{ meta-emor (*house*) ikĕli. }	*lagö-aiman* (*house*)	*moto-ididi* (*house*).
bullroarer,	bigo,	wainis, wanĕs, bigu,	
bunch,	eme,	köimagu, katam	
burial,	atkobei,	marama-toiaipa	

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
burn,	urem,	iaiame, gamuidiz	*iripuadoi*, eragu-mito.
burst,	erperida,	papalamiz,	ararupo.
bury,	atkobei,	marama-toiaipa,	*gubiri*, *edea*.
bush,	sumez,	darpa, darubo	*tumu*, urto.
but,	epe, a	matakazupa,	a.
butterfly,	kap,	paekau,	*maupo*.
buy,	arap, erap,	{ baropudeipa. zabudamoin, }	*uōsa*, *nimidai*, emadi.
by,	de (*suffix*).	mani, madi (*suffix*),	ro.
Calico,	wali,	dumawaku,	*kariko* (*Eng.*), oborotama.
call,	abger,	walmizin, turan,	oromai, *wiroro*, *koromāi gĭdō*.
calm,	metalu,	mataro,	*mataro*, matarou (M).
can,	umele,	ngulaig,	umoro.
cannibal,	le-ergi,	mabaeg-purutan,	
canoe,	nar,	gulö,	pe.
cap,	aper,		*ado*, epurkod.
cape,	pit-ged,	gizu,	*muba*.
care for,	asesere,		uagoria.
careful,	mamoro,		uaito.
cargo,	titirda,	gulngu-rugal,	
carry,	erpei,	angeipa, toridiz,	{ *raguta*, orobai arategere (K), erabai (P).
cassowary,	sam,	samu,	diware, samo (M).
cast out,	imu,	nguroweidan,	araribia,
catch,	erpei,	gasamanö,	orobai (K), erabai (P).
cause,	giz,		mabu.
cave,	kur,	sakai,	*ganopa*.
centre,	eipu,	dadalö,	*turube*, turiat.
centipede,	isi,	saga,	*sarusaru*, *bano*.
chain,	malil-lager,	mapil-urukam, mitinit,	
*chair,	bao, bau,	niaiza,	
change,	depegem,		uarui.
charcoal,	keg,	burker (M), kubi,	*uibu*.
charm (*n*),	madub,		
chase,	darakesa,	wakaean,	*orŏbai* (*kangaroos*), *iriwoto* (*men*).
cheek,	bag,	dak, bagö,	*ogomu*, agamu (M).
chest,	marmot,	bero,	bodoro.
chew,	erusĕr,	nadamai,	*orūso*.
chief,	opole, mamus,[1] tarim-le,	kuikulnga,	buaraigo.

[1] *Cf.* Miriam-English Vocabulary.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
child,	werem,	kazi,	mere.
children,	omăsker,	măgina-kaziöl,	mere.
chin,	imur, iba,	ibu, bagö,	*tatamu*, baga (M).
choose,	depeger,	poidan, taiamoin,	
*church,	zogo-meta,	sabi-lagö,	
circle,	gogob,	bokadongö,	
clam,	mi,	akul,	*ipa*.
clap,	tag-mut,	get-matamizö,	
claw,	imi,	*awaro*, tar (M).	*igiri*.
clay,	sep,	parma,	*were*, sopu (K), opu (P).
clean,	okak, kerekar,	tuginga,	
clear,	zoromzorom,		aiima-heruo.
climb,	ogi,	walizö,	ioro.
close,	dimi,	tamudan,	opai, uroro (*partly*).
cloth,	wali,	sakö, *dumawaku*,	oboro tama.
clothe (*v*),	ami,		arauai.
clothes (*n*),	am-wali,	dumawaku,	karanaina.
cloud,	baz,	zia, bĕge, amal,	*bubuere*, toboro.
club (*stone*),	gabagaba,	gabagaba,	*gabagaba*.
coast,	dodomer,	balbadö, *taiwa*,	*dodoro*, *tuturuo*, dodo.
cockatoo,		wem (dri?)	*ga*.
coconut,	u, uĕ,	urabö,	oi.
cold (*adj*),	gebĕgebĕ,	gabunga,	gabugabu.
cold (*n*),	ziru,	sumai,	*gubadora*, gabu.
collect,	ais, etaker,	garweidamoin,	uagori.
coloured,	warwar,	lönga (*suffix*), go-molu.	
comb,	kĕrĕm-seker,	ialpat,	*ipogi*, iaprupat (M).
come,	tabarki,	mangiz, aic, boie,	*taro*, ogu, ogunita.
come down,	abu,	pagan,	ororua.
comfort,	upiatidar, baimilei, baimida,		uarabai, emiserai.
commence,	ditimeda,	kuikaiman,	mabuedea.
company,	kĕme,	kaimil,	paa.
compel,	člĕle,	puzarizo, tuma-waean,	aue.
conceal,	ispilu,	utizi, gumi,	epuruo.
conceive,	batagem,		
conch-shell,	maber,	bu,	*tuture*,
condemn,	mer-barditug,	kudu mamain,	emĕuti.
conduct,	tonar,		tanar.
cone shell and shell armlet,	wauri,	waiwi,	*mabuo*.
confess,	etomer abei,	iadupalgan, minai-pataman,	arapoi.
connect,	atkap,	kalmel-manamoin,	amahiri.
console,	baimilei,		emiserai.
cook,	ikas,		
coral,	weswes,	gaet, mat, *pagaru*, prak,	noŏra.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
corner,	serer,	köru,	
corpse,	eud-le,	gamu,	
cough,	kobek,	kobaki,	kashu (M) *koseă.*
country,	ged,	laig, kawa,	*namira*, dirimoro.
cover,	batkam (*v*),	abeipa (*v*), *supo*,	aidomai, aradimai,
crab,	guriz,	gitulai, kanturi (M),	*kŏkŏwā.*
crack,	erap (*v*) mir (*n*),	nurö (*n*) pis.,	ebia.
crawl,	esapem,	kurtur, *amaianö*,	*ogirio.*
crayfish,	kaier,	kaier,	*sikara.*
creep,	iskĕli, esapem,	amaean,	*ogirio* (*crawl*).
crocodile,	kadal,	ibara, kodal, kadalö,	*sibara.*
crooked,	barbar,	balbai,	kauikaui.
cross,	satauro, zerem,	taldan,	
crow,	erertikri,	poibizi,	uri.
cry,	ezoli, erertikri,	walmizin,	idobi, oroto.
cup,[1]	tanelu, sor-tulik,	binibini,	nuku.
cure,	idigiri,	luwaiz,	dodiai.
curse,	kupei,	ipidad-pugan,	
cuscus,	barit,	bait, barit (M),	*padi*, parima (M) măgi (M).
custom,	tonar,	minasizinga,	tanar.
cut,	{ isimi, esakei, eragi,	labeipa, patan,	{ *asio*, *itouti*, otoai (M) agaba (M).
cuttlefish,	kĕrĭgĕr,	sŭgu (M),	
cymbium (melon shell).	ezer,	alup,	ipa.
Dagger (*of cassowary bone*),	sok,	soki, zorki,	*uriosoro*, zoke.
dale,	awak,	wakadar,	
dance,	kab, ginar,	kap, girar, gamudiwapa,	*madio.*
dark,	kupikupi, ki,	kubilö, inur (M),	durugi, duo.
dash,	eremeli,	taean,	
daughter,	werem, neur,	ngawakazi, ipiegokazi,	besere (K) buere (P).
dawn,	bane,	arö, moigi,	bani.
day,	gerĕger,	göiga,	sai (K) inio (P) duo (M).
daybreak,	bane,	arö,	bani.
dead,	eud,	umanga,	*pāara*, uparu (M) para (P).
deaf,	nole asor kak,	karengaigigö,	*garetato.*
death,	eud,	uma,	*uparu.*
decayed,	buzibuz,		boroboro.
deceive,	okardar,	{ paruidizö, *ngalakipa*, }	matigi,

[1] An introduced object; shells were previously employed.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
declare,	etomer,	iakaman,	arapoi,
decorate,	teir,	sasan-mepa,	
deep,	berderge, muimui,	köi-malu (*deep sea*),	*auo-obo* (*deep water*.
defeat,	degmori,	gagadinga,	
*deity,	ad,	augadö,	oradubu.
defile,	dedkoli,	getölangan,	ubagouaidumo.
deliver,	emarik,	getö-wani,	emeriai.
*demon,	lamar,	markai,	oboro.
deny,	asaret, agem,	gudo-tadiz, patre-diz,	kolotoi.
depart,	bakeamulu,	adapa-mizin, uzar,	
descend,	eupumar,	pagan, mulupa,	*eregetei* (*down-wards*.
desire,	lagelag,	ubinemepa,	diriuo.
destroy,	atkirua,	idimoin,	
detain,	mameri-dari,	wadan,	
detest,	derar,	ngulamoin,	atatiai.
dew,	tsi,	dibagö, urma (M),	
die,	eud, eumi,	uma,	*irorisiai*, *uparu*, *utua*.
differ,	nole-mokakalam,	keda-aiginga,	*naturaimi*, *ata*, *na-tŭra*.
dig,	daiwi, dakeilu,	paman, *gatapogai*, *poidanö*, gugus,	*agurubai*.
dip,	akmei, iter,	töidan,	
dirt,	og,	baradar, *uduma*, tumit (M),	*ipua*.
dirty,	arubkak, ogog,	tulainga,	ipuipu.
disappear,	badmirida,	uotiz,	
disease,	gim,	kikiri,	*temeteme*, koropa.
disgust,	derar,	ngulamoin,	atatiai.
dish,[1]	ezer, kobar,	dibedib,	nuku.
dislike,	obogai,	ubigasin,	inaitato.
dismiss,	emarida,	gudowodian,	emeriai.
disperse,	kepu-bamarida,	adapa-waean,	
display,	etomer,	paiwanö-pagan,	arapoi.
dispute,	basared,	pataraidizo,	korotoi.
ditch,	irkes,	babu-iabu, goua,	*parigōŭa*.
dive,	araiger,	pëneipa,	orodobi.
divide,	eragi,	dadömamain,	*otăāŭti*.
do,	ikĕli, akĕre,	nidaipa, aimaipa,	*wogati*, auagati, odio (M)?
dog,	omai,	umai,	*sīo*, umo (M).
door,	pau, te (*mouth or opening*),	*tamudara* (*closing part*), pasa (*open-ing*),	*episuromorōă*.
doubt,	karomkarom,	siböpapilamiz,	
down,	lokod-ge,	apalö,	magumoato.

[1] An introduced object; shells were previously employed.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
draw,	eguatumur, edomer,	pardan,	agiriti,
dream,	pem,	*piki* (*n*) pigintaean (*v*),	*woito*, koka.
dress (*n*),	am-wali,	dumawaku,	karanaina.
drink,	ere,	wanipa,	*obo odio, tuto odio*, odio.
drive out,	imuda,	ziziman,	araribia.
drop,	kĕpi-abuli (*v*),	suliz,	
drown,	baiteri,	dudupizö,	*iroruodiro*.
drum, (*large, with jaws*,)	warup,	warup,	*gama*.
do (*small, cylindrical*),	bŏrobŏro,	buruburu,	
dry,	esperi (*v*) uatuet (*a*),	palealnga, wata,	otapara.
dugong,	dĕger, dăger,	dangal, dungal,	maumora.
dumb,	te-dabim,	iagasin, *iaginga*,	*karatai auera*.
dung,	le,	kuma,	
dust,	puipi,	tu, poi,	
dwell,	emri,	apatanor,	*warōmi*, omiei (K) oromiado (P).
Ear,	laip, gĕrip, pĕl,	kaura, kursai,	*gare*, sepate (K) epate (P) (M).
earring,	godegode, mai leb,	gagi, muti,	gagi (M).
earth,	sep, seb,	baradar, apa,	sopu (K) opu (P).
east,	naiger, sager pek (ESE),	waradogam, *palagis* (*arising*),	*dibiri-duba*.
eat,	aro, ero,	purutaipa,	*iriso, odio*.
ebb,	megomarida,	gato,	
echo,	baremda,	nurö,	
eclipse,	dimdi,	wardan,	
edge,	serer, deg,	gizu, dang,	*eresa*.
eel,	kamsam,		
egg,	wer,	kakur,	*iopu*.
egret,	sir,	kabai,	
elbow,	tag-au-kok,	kudru, kudu,	*tupoa*.
empty,	nosor,	zaginga, aiginga,	buru.
end,	mop,	kutö,	bari.
enemy,	keubu-le,	kobu (?) ridau,	*irisai wada*.
enter,	balu, barot, badari,	muia-utiz, kami,	odoro.
entire,	netat, kemer-kemer,	mura,	umumue.
envy,	kurab,	imulizilamiz.	
equal,	okakes, mokakalam,	matangadagidö,	paa, pope.
erase,	adem-itkir, desak,	idimoin,	
erect,	eskedi,	nanitan,	
err,	didmirki,	rimarim,	uararai.
escape,	badmirida,	adapatamöin, katpalagiz,	

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
eternal,	niaikarem, aseamurkak,	ngaru,	nanito, iporigaitato.
even,	pe, ăbkorĕb,	matangadagido,	midobo.
evening,	kikem,	kutapa,	adimo, *erasugumai*, duo.
evil,	adud, wit,	watipaua,	gamasa, uba.
example,		minaman,	
excrement,	le,		
exhort,	okadeskeda,	dantaean,	iaroguti.
explain,	darborki,	balbaigpalan,	
eye,	ponĕ,	dan,	damari.
eye-ball,	poni-wer, irkĕp,	dun, puuka,	*damari*.
eye-brow,	irkemus, baibaimus,	beibăsa, babasum,	*damari-muso*.
eye-lash,	pone-mus,	samudung,	damari-muo (M).
eye-lid,	poni-pau, irke, irau,	pura, *dunasamu*,	*damari-tama*.
Face,	op,	paru,	*ipiriti*, ororo, guri (M).
faint,	suskak,	umuwalepa,	
faith,	oituli,	kapuakasin,	sibomuguruti.
fall,	ekesmer, abi,	ipiap, putizo,	eregeti.
false,	bes,	ngölkai,	naramai.
far,	muriz-ge,	koisigal,	mureso.
fast (*a*),	dudum, wamenwamen,	matadobura,	siö (K), iö (P).
fat (*a*),	toirtoir, dobdob,	buzar, gam,	*gadi*, gudogudo.
father,	baba, aba (*voc*),	tati, baba (*voc*),	abera, baba.
fathom,	kaz,		
fear,	geum,	aka,	tore.
feast,	wetpur,	ta,	*samo*.
feather,	lub,	baba, kaikai, plis,	muso (K) muo (P) waro (M).
feed,	epie, web, desiri,	aidupoiban,	nagorai.
feel,	itpe (J),	karengemin,	
fence,	kar, karu,	pa, ara,	*kara*, ia, ara (M).
fern,	karakar,	niki,	epe, atio, agareba (M).
fetch,	ais, ekau,	mani,	omidai, nagori,
fight,	arĕs,	kwir, silamai,	*boso*, araberumo, boo (M).
fill,	osmer,	gudia-iaudiz,	*atămiāī*, dibi, orooti.
fin,	lĕb,	mēt, togoru,	
find,	erdalu,	imaipa,	*omidai*, nouea,
finger,	ke,	dimur, getal,	*giri*, tuiopo (M) turi (M).
finish,	eseamuda,	ipataman, muasin,	iporigai, tau, sigai (M).
fire,	ur,	mui,	era.

English.	Miriam.	Saibai.	Daudai.
fire-sticks,	goigoi,	salgai, guigui,	
(*vertical stick*)	werĕm,	ini,	
(*horizontal* ,,)	apu,	sagai,	
(*rotary movement*),	drim,		
first,	kikiam,	kulai,	taugo.
fish (*n*),	lar,	wapi,	*arimina* (P) *irisina* (K).
fish-hook,	mĕkĕk, kek,	tudi,	tudi.
flame,	be,	buia,	dogo.
flat,	diadi,	zeinga,	
flea,	titig,	tikat,	*nimu*.
flee,	koreder,	ariz, pupariz,	iu,
flesh,	med,	madu,	*gadi*, *sirĭgo*.
float,	sap,	moinitun,	
flower,	sik,	kowsur (M), *kukuam*,	*mu*, ura (M) sura (M).
fly (*n*),	narger,	buli,	*susuomi*.
fly, *blue bottle*,	persok (? *locust*),	tădar,	
fly (*v*),	eperda,	palagiz,	*iarubo*, arubia, uarubia.
flying fox (*pteropus*),	saper,	sapura,	*soge*.
fold,	sopsop,	tupaltaean,	kauaaupu.
follow,	irmili,	puzipa, kaimi,	ougi, augaruaruru.
food,	lewer,	ai-purutan,	iriso, *topo* (K) iriona (P).
fool,	paim,	rimarim,	*dadara dubu*.
foot,	teter,	koko, san,	*sairo*, irigiri (M).
forehead,	mat, mŏrop,	si, paru, *pautö*,	guri (M).
forget,	okataprik,	iakanoriz,	{ *dodo-gonĭmata*, dodonamatigi, dododenamarti (M).
forgive,	atwe, akri,	guduaiz,	
*fork,	lugu,	patö,	
fowl,	kalkal, toka,	kalakala,	*kakaba*, kŭrakŭra.
friend,	boai, tĕbud, marale,	tökoiap, igalaig, kaime,	*moronamiradubu*.
frightened,	geum,	akan,	tore.
frog (*tree*),	goai,	kaet, *kateko*,	*kĕau*.
from,	lam (*suffix*),	ngu (suffix),	gaut (*suffix*).
fruit,	turum,	keusa, *kausa*,	*iōpu*, miruiao.
fuel,	urarap,	zazuman, watar,	*era-ota*.
full,	mitkar, osmer,	irum, gude-udiz,	orooti.
Game,	sĕgur,	sagulö,	korīo.
garden,	gedub,	apö, daraba,	pari.
garment,	am-wali,	dumawaku,	karauaina.
gate,	gab-te,	pasa, *buta*,	*gābo*.
gather,	etkemet,	palan (?), poidan,	ihehea.
gauntlet (*armguard*),	kadik,	kadig,	adigo.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
generation,	nosik,	markuikö,	*nogerebu*, dumeke.
ghost,	lamar,	mari,	*urio*, oboro.
girdle,	wak,	wakau,	*bata*, *bagi*.
girl,	neur,	ipikazi,	busēre (K) buere (P).
give,	ikwar,	poibanö,	*agiwai*, *noosa* (K), uosa (P),
glad,	sererge,	ika, igaligal,	amadi ?
glance,	keikei,	dana-muktaean,	etauaito.
go,	bakeam,	uzar, ladun, ute-man,	*gogu*, *turo*, *ai*, gui-togu.
*God,[1]	Ade,	Augadö,	Oradubu, *aramo-rubi*.
good,	dĕbĕ,	kapu,	*wade*, geso, waderi (M) adina (M).
grandfather,	kaied, porpa (?),	bobata (M),	
grandmother,		kaieda (M),	
grasp,	erpei,		orobai (K) erabai (P).
grass,	soge, sogi,	burdö, bai, *eripö*, *imusö*,	*suagŏ*.
grave,	ao,	iutan, maramö,	*edea bobua*.
great,	au, aule,	köi,	aũo.
grief,	okasosok,	wakaeasin,	oiuo.
groin-shell,	alida, ĕbĕneop,	lorda, ălidan,	
ground,	seb, sep,	apa, baradar,	sopu (K) opu (P).
grow,	omeida,	malegui, sirisor,	*rorootoi*, opito.
guard,	asesere, gab diri,	danalpataipa,	uagoria.
guess,	mirem-abei,	luman,	
guest,	wi, sub-le,	tokoiap, azazi-ma-baeg,	apararubi.
guide,	datkimuar,	{ sestaman, *ngingaibia* (?).	uabugoi.
gum,	sus,	susu, *wukö*,	*ota-arima* (*tree-blood*).
Habit,	tonar,	pana,	tanar,
hair,	mus,	ialbupö, ial,	*muso* (K), muo (P),
halt,	mena,		dogo.
hand,	tag,	apopauna, getö,	*tuigiri*, tuo, tupata (M).
hang,	emerered,	puidan, dordimoin,	*eregedioti*.
hard,	kĕlarkĕlar,	ridanga,	uaiuai.
hasten,	bakeam sobkak,	kikimizi,	*samoito*.
hat,	aper,	walap, göuga,	epurkod.
hatchet,	{ deumer-tulik, sapăra,	turik, aga,	{ kabi, *warikabi*, *daunomu*, *emauiiopu*.
hate,	derar,	tabukiri, ngula-moin,	atatiai.

[1] *Cf.* Miriam-English Vocabulary.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
have,	nagri,	aidai, munia,	airerea, iriuia.
hawk,	waridub,	ngagalaig, kausi,	*wariu.*
haul,	edomer, eguatumur,	puzariz,	agiriti.
head,	kĕrĕm,	kuikö, kwig,	epuru.
he,	e,	noi, nöido,	nōŭ.
heal,	idigiri,	pupumiz,	dodiai.
hear,	asor,	karengemin,	*iroidiro*, erauidiro (K), mitidiro (P).
heart,	nerkĕp,	ngönakap,	*tusuopu*, *otakapuki*, girop.
heat,	urweri,	*kuamö*,	eraera, arahia (M).
*heaven,	kotor, arem,	dapar,	*osua* (K), ou (P), aromo (M).
heavy,	beber,	mapunga,	*mibomibo.*
heel,	in,	pökuk, korul,	*ebonupōe.*
height,	perepere,	kuisimi,	tuturu.
help,	upinati,	ibupoidan,	uarabai.
*herd,	isir (?),	töbud (?),	
here,	ike,	ina,	*nai tawa tawa*, *noboi rom*, noboi.
hew,	ismi,	pönizi,	otoai.
hide,	ispida,	utizo, arizö,	epuruo.
high,	kotor,	kutalenga,	tuturu.
high water,	meg-ogi,	*urö-waisa*,	*auo-obo-omio.*
hill,	paser,	pada,	*podo*, pasaro.
hip,		lurug,	*doto.*
hiss,	simer,	sipoibi,	
hit,	ipit, iski,	mataman,	opio.
hog,	borom,	burum,	baroma.
hold,	erpei,	angeipa,	orobai (K), erabai (P).
hole,	neb,	*arkatö*, guago, tarte (M,),	*sia.*
hole (*in ground*),	ao,		*bobo* (*water hole*).
holy,[1]	zogo.	mamalenga,	muguru, zugu.
home,	utĕb,	lagö,	mauro.
honest,	ageakar,	mina,	nanike.
honey,	isau (?)	utu,	
honour,	espili,	awidizo,	uadoro.
hook,	kĕk, mĕkĕk,	pordaiza.	*tutuopu.*
hoop-iron,	gegur-tulik,	elap-turik,	
hope,	oituli,	kapuakasin,	sibomuguruti.
hot,	urweri,	kuamalnga,	eraera.
house,	meta,	lagö, mautu, mudö,	moto, mautu (M).
how ?	nalugelam ?	midöpa ?	
howl,	ezoli.		*ororimawa*, oroto.
how many ?	nakĕt ?	mido ?	bedamota ?
humble,	gebgeb,		kobokobo.
humid,	beber,	urainga,	

[1] *Cf.* Miriam-English Vocabulary.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
hungry,	werer-ge,	maita-iginga, weragi (M.),	durugere.
hunt,	araimer, darakesa,	luman, gasamanö,	ora.
hurl,	bataueret,	taean, pagan,	eberiai.
husband,	kimiar,	alae, *imi*,	*uramu*, dubu.
hush !	bamer !	iagiasin,	mure.
husk (*n*),	mes, muti,		*mosore*.
hut,	meta,	laga (M), mautu.	moto.
*hymn,	wed,	na,	*wasare*, poo.
hypocrisy,	okardar,		matigi.
I,	ka, kaka,	ngai,	mo.
idiot,	paim,		*sobu*, daradari.
if,	ese,	sike,	numada.
ignite,	diseri,	gamuidan,	
ill,	gimgim,	kikiri,	temeteme, koropa.
illumine,	datki,		emeriuidiro.
image,	roai-roai, ise,	ngadalga, uroi,	nouororo.
imitate,	wanarminale,	puzida,	ougi, augaruaruru.
immediately,	sobkak,	matadöbura,	samuito.
immerse,	akmei, iter,		
impossible,	umer-kak,	korawaig,	umorotato.
impudent,	lid-agem,		
impure,	adud,	moaizinga,	uba.
in,	ge (*suffix*),	nu (*suffix*),	ato (*suffix*).
incline (*slant*),	gorgor,	ioipa,	
increase,	bataili,	sirisiri,	
infant,	sursur wĕrĕm,	mapeta,	*osiomere, osiobesere.*
iniquity,	wit,	ipidadö, wati,	gamasa.
inland,	sumez-em,	darba-nu,	*amedēi*, tumu.
inquire,	damos, itmer,	iapopoibi,	uaratai, aratoro.
insane,	paimpaim,		daradari.
insect,	(?) pem, (?) ebur,	urui, *baibuli*,	*irao*.
inside,	mui,	mui,	niro.
inter,	atkobei,	marama-toiaipa,	*gubiri*, *edea*.
interpret,	(?) depegeli,	inngu-ngulaigö,	*atamudiro*.
intestines,	teibur,	akur (M),	tuburu.
invite,	damos,		uaratai.
iron,	tulik, turi, malil,	turik,	*kerĕre*, turika (M).
island,	iser (?) kaur, kebi-ged,	kawa, kaura,	*mămŏkō*, ura.
it,	(*nom*) e (*acc*) abi,	noi,	noŭ.
itch,	kap,	kurtumiz,	
Jaw,	iba,	bagö,	*tatamu*.
jew's-harp,	darobĕri,	darubi,	
join,	atkap,	utömoin,	amahiri.
joint,	kok,	worām, woiam,	popu, *reresebo*.
joy,	sererge,		amadi.
judge,	barditug,		emeuti.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
juice,	sus, serure,	sulizö,	
jump,	eupumar,	katapulgipa (M),	*irobouai*, ereberiai.
just,	barkak,	balbaiginga,	kauitato.
Kangaroo,	usar,	usa,	usaro,
keep,	erpei,	angeipa,	orobai (K) erabai (P),
kernel,	këp,		iopu,
kick,	teter-itur,	kukuna - mapeipa (M)	neragiuai,
kidney,		*pokiridö*,	*oisusuopa*.
kill,	ipit-eumida,	uma-mataman,	opio-para.
kin,	boai,	igalaig,	gu.
kind,	maman,	dalnga, ngalnga,	
kindle,	diseri,		
*king,	opole,	kuikulunga,	buaraigo.
kinsman,	boai,	igalaig,	gu.
kiss,	ěskŏs,	gudo-tapaman,	*osomiai*.
knee,	kok-ne,	kolo, kulu,	popu.
kneel,	kok-mamu,	*kulu-idamanu*,	poputomiei.
knife, (*iron*),	tulĭk, kor-tulĭk,	gi-turik,	giri.
,, (*bamboo*),	kwoier,	upï,	wěri.
knock,	ipit,		opio.
knot,	mukub,		mopo.
know,	umele,	{ ngulaig, ngurupan, kakal, }	umoro.
Lad,	kěbi-le,		sobo mere.
lad (*young*),	nokŏrot,	zungri,	
lad (*adolescent*),	makerěm,	kaukwik,	
lad (*during initiation*),	kersi,	karingi, kěrnge, kirger,	
lagoon,	keper,	gawata,	bobo.
lame,	patara, parapa,	rapepa,	
lament,	ezoli,		oroto.
land,	geseb, seb,	kawa, lagö,	*dodo*, sopu (K), opu (P).
language,	giz-mer, kodo-mer,	ia,	*auera*, ouera.
large,	au,	köi,	auo.
lash (*n.*),	mukub,		mopo.
lash (*to fasten*),	audbar,	*mukuboidan*, *dirdimöinö*,	otoirai, itoiriti.
last,	mop,	wagel,	bari.
laugh,	neg,	gio, napoidan,	*kiri*, wari.
law,	gelar,	sabi,	sabi.
lawful,	barkak,	matangadagidö,	kauitato.
lay,	ikedi,	kabutan,	edea.
lazy,	baudili (*idle*),	*gamakawasina*,	{ *wasi-nakobokobo*, *oiwoi*. }
lea (*v.*),	eguatumur,	ieutizi, turan,	agiriti.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
leader,	opole,		buaraigo.
leaf,	lam,	*nisö*,	pasa.
leak,	egobli,	burkui, pisalinga, goagalnga (*a*),	*aberuti*.
lean (*adj.*),	gem-kak, lidelid,	mörimal, muri-mari,	
leap,	eupúmar,	kat-palagiz,	ereberiai.
learn,	ĕrĕwerĕm,	ngurapipa,	kitamodiro, atamuai.
*leather,	kaura-paur (*cow's skin*),	pauna,	
leave (*v.*),	ekai, dekaer,	wanan,	otoi, emera.
leave off!	sina!	wan-nur (M),	*berseai*.
leech,	ouzi,		
left-side,	ber,	böda-dögam, badanga,	pere.
left-hand,	ber-tag,	böda-get,	pere-tuo.
leg,	teter,	tira (M) ngara, *tete*,	*sairo*, airo (M).
leglets,	mŭkamŭk,	makamak, duna-kukur, brua,	makamak (M), *sogeri* (*of twine*).
lend,	bes-ikwar,	kasa,	
length,	pĕripĕri,	kutal,	tuturu.
let (*allow*),	amari,		
*letter,	jauali,	tusi (*Samoan*),	jauali (*introduced from Mir*).
level,	diadi,	zeinga,	
liar,	bes-le,	*ngoolăkai*,	*warame dubu*.
lick,	esomed,	neipoiz,	osomĕāi.
lie (*n.*),	bes-mer,	lalkai (M), ngolkai (M),	mapuwara.
lie down (*v.*),	uteid,	utui, uneipa (M),	utūa.
life,	eded,	igili,	kigīro.
lift,	ages,	kadaitaran, toridiz,	
light (*s.*),	be, atki,	buia,	*era, dogo*.
light (*v.*),	diseri, datki,		emereuidiro, wăteir (M).
light (*easy*),	norgor,	tauanga, turong (M),	torutoru.
lightning,	peripēr, girgir,	ponipan, bagumö (M),	poniponi (M.), *emaserue*, airimerua.
like (*adj.*),	mokakalam, abkoreb,	kedangadal,	gedagebi, midobo.
like (*v.*),	lagĕlag,	ubinmepa,	
likeness,	roairoai, ise,		nouororo.
lime,	giaud (?),	*kunarö*, kulau-amai, uari,	*eka*.
line, fishing,	ked, arĭag, me-kek-gam, muti mĕkĕk,	aring, wali, arĭga,	ariaga,
lip,	mit,	iragud,	*ipusu* (K) ipu (P.M.).

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
listen,	asoli,	karengemin,	erauidiro (K) mitidiro (P).
little,	kĕbĕ,	măgina,	*ekebūri*, *eke*, sobo.
live,	eded,	igili,	kigiro.
liver,		sibu (M),	*bēu.*
lizard (*species*),	panpan, mornan,	karum, gnaru,	*wabi*, *gugurta*, &c.
load (*n*),	(lu-gaire ?)	*garuidamainö*,	*warŭbaĭ.*
loaf,	areto (*Greek*),	areto,	areto.
loathe,	derar,	ngulamoin,	atatiai.
lobster,	keiar, kedked (?),		
lofty,	kotor-ge,	kutalenga,	ouato.
log (*felled tree*),	sap,	köi-pui (*big-wood*),	
loins,	wakei ?	kibu,	*bigi.*
lonely,	tĕbtĕb,	kusaig,	naturai.
long (*a*),	pĕripĕri,	kutalnga,	tuturu.
long (*v*),	lagĕlag,	mokene (?)	diriuo.
look,	asmer,	nagepa, iman,	damari (K) euri (P).
looking-glass,	pĕrepēr,	maridan,	*mari.*
loose (*v*),	atwe, norgor,	mukmepa,	epuruo.
*lord,	opole,	kuikulnga,	buaraigo.
lose,	abi,	getowani,	eregetidi.
loud,	ĕlĕle,	köi-ia,	aue.
love,	omare, nasge,	ubinmizi, sibuwanan,	moini, nirimogari.
louse,	nem,	ari, supa,	*nimo.*
low,	teupai,	apai,	omo (P) sopuimi (K).
lungs,	ber, pereg,	iapaladö, saka (M),	*sibo*, *torutoru*, parapara (M).
lust,	erkepagan,		
Mad,	paimpaim,	rimarim,	daradari.
maid,	neur,	paka,	beseri (K) bueri (P).
*maize,			*kunu* (*? introduced. The Papuans have no cereals.*)
make,	atagem, ikĕli,	aimaipa, nidiz,	*wăŭpō*, atauti, auagati, odio (M).
malady,	gim,		koropa.
male,	kimiar,	garakazi, inile (M),	dubu.
man,	le,	mabaeg.	didiri (K) auana (P) dubu (*pl.* M).
mango,	waiwai,	waiwi,	uĭūĭ, *koko*, &c.
mangrove,	zi,	taga, kuiyur, biiu,	
manner,	tonar,	pawa,	tanar.
many,	gaire, dordor, lamlam,	koima, köigorsar, mura,	sirio, ipipu, aue.
margin,	serer,	gizu,	eresa.
mark (*n*),	user, atamelam, war, nener,	tonar-tidanö, minar,	karadabutigaut, omu.
marry,	ispili, faiboibo (*introd.*),	maipaielpan, garoweidamoin,	adabuai.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
marvel,	amer,		uadow.
mast,	sesĕri,	raba (M) *rangadö*,	*sawa ota*.
master,	sirdam, kole,		kauarubi.
mat,	moder,	waku, sobera, kai, tobai,	*tabaro*, tiro.
measure,	autare-lu,	minaman,	auwa,
medicine,	lukup,	lokop, göuga,	rukupo.
meet,	obapit,	dadamangizö,	orodai.
melt,	edegi,	idumiz,	
mend,	dimer,	butupataipa,	
men's quarters,	siriăm,	kwod,	
mercy,	omare,		nirimogari.
merry,	sererge,	igaligal,	amadi.
metal,	malil,	malil,	
midday,	eipu-gerĕger,	dada-göiga,	iui-ipa.
middle,	eipu,	dadal,	*turi*, turiat.
midnight,	eip-ki,		
midst,	eipu,	dada, dadal,	turiat.
might (*n.*),	adigir,		iriveitorai (?).
milk,	sus,	susu, ikai (M),	*amo*.
mind,	nerkĕp,	körkak, ngönakap,	girop.
mine,	kara,	ngau,	moro.
mirth,	sererge,		amadi.
mistake,	didmirki (*v*),	rimarim,	uararai.
mix,	etaperet,	garweidamoin,	
moist,	beber, sibeb,	urainga,	
month,	meb,		
moon,	meb,	mŭlpal, kizai,	*sagana*, gamuno (M).
more,	ko,	lakö,	
morning,	kĕbĕ-gerĕgere,	batainga,	*duduaere*.
morrow,	abgerĕgere,	bangal, batainga,	duduo.
mosquito,	sŭni, lag,	iwi, imi,	nati.
moss,	peumer,		
moth,	sapok,	narminamis,	
mother,	apu, amau!	apu, ida, ama (*voc.*),	aida (P) māū (K) *maramu*.
mould,	sep,		
mountain,	paser,	pada,	pasaro, *podo*.[1]
mourn,	okabatageli,	wakaiasamoin, mai,	oiuono-nagoria.
mouse,	makus, mokeis,	makasö,	
mouth,	te,	gudö,	magata.
mud,	usurusur,	baradar, sai,	*gato*.
multitude,	lakub,	mudö,	pae.
murder,	ipit-eumida,	{ poimanak-palan, uma-mataman,	*didiri-opia*.
murmur,	gumik-mer-atager,	dubidubia,	

[1] As there is only one small hill, Mabudauan, in the whole of Daudai, it would appear that these are loan words from Miriam and Saibai respectively.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
mussel,	tig,		*tepere.*
musket,	sarik,	tarika (M),	'*trigger*' gagari.
mute,	te-dabim,	iagasin,	
my,	kara,	ngau,	moro.
myself,	karababu,	ngai-kusaig,	moimarai.
nail (*toe, &c.*).	tarpot, pot,	tal, tar,	*pitu*, igiri (M).
nail (*iron*),	sok-tulik,	magina-malil,	*toto.*
naked,	nogem, aole,	kasa-kupal,	tanuauana.
name,	nei (*n*) atker (*v*),	nel (*n*),	paina (*n*) mapoi (*v*).
narrow,	etkoperida.	katamiz,	
native,	kem-le.		mutudubu.
navel,	kopor,	kupur,	*gupuru*, upuro (M).
nay!	nolea!		
near,	maike,	amadan, logi (M),	tatari.
neck,	pereg,	katö, modul, kut,	mao.
necklace,	sĕserig (*of dog's teeth*), tabo-kaukau (*beads*),	*kamadö*, soger (*cord*),	dapurkup (M) *nese orogori.* genaio (M. *of dog's teeth*).
needle,	kuskus, atkĕtelu nidel (*introd.*)	sabu-kemus,	
neighbour,	boai,	töridan,	gu.
nest,	pĕk,	pakadö, fad, pad,	*wowogo toto.*
net (*not made in Torres Straits*),	net (*Eng.*) wĕrĕs, terag. (*See list of introduced words*,	api, törpi, pingi,	*di, parani, băsa-băsa.*
new,	kerekar,	kain,	orio.
next,	keubu,	amadan,	uapureto.
night,	ki,	kubilö, inur (M),	hanuaboi (*Motu*), uo (M).
nipple,	nano,	susu-gud,	
no,	nole, kak,	launga, ginga (*suffix*),	pai, puai, pukai.
nobody,	nole-le-kak,	mabaegöginga,	
nod,	opoitimeda,	kuik-taean,	
noise,	mut, sasmi,	ugauganpagaip,	*geboso*, pako.
none,	nole-le-kak,	aiginga,	
noon,	eipu-geregere,	dada-göiga,	*sai-epi*, iui-ipa.
north,	sab,	naidai dögam,	*suroma.*
north-west.	koki,	kuki,	*suroma*, uramo (M).
nose,	pit,	piti, bipi (?),	wōdi.
nose-stick,	kirku, gogoneb,	gub, gigub,	
nostril,	nonor,	nursak,	*sarugosio.*
nothing,	nole-lu-kak,	maigi-wara-za,	
now,	peirdi, irdi,	kaibö,	abara.
nurse,	asesered, egared,	kamatauradiz,	uagoria.
nut,	kĕp,	kusa,	*sia.*
Oar,	uzer,	kaba,	*aibi.*
obey,	asoli,	karengemin,	erauidiro (K), mitidiro (P).

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
obscene,	kogmer,	ngulamaia,	
ocean,	au-gur,		*oromo-damo.*
octopus,	gole, arti,	ati,	
of,	ra (*suffix*),	-nö (*suffix*),	na (*suffix*).
often,	no, mena,	köigörsar,	dogo.
oil,	ide,	idi,	
old,	buzibuz,	kulpa, döbu, *möroigö*,	*tagara*, boroboro.
on,	ge (*suffix*),	gimal,	ato (*suffix*).
once,	netat,		
one,	netat,	wara, urapon,	nau.
only,	tĕbtĕb,	mata,	naturai,
ooze,	babuser,	iatiz,	orouoduti.
open,	diski,	adan, pudan,	uareuo.
opossum (*cuscus*),	barit,	bait, barit,	padi (?), parima (M).
oppose,	dedkoli,	ridau,	ubagouaidumo.
or,	a,		*nuairomi.*
order,		iautumiz, iamuitaean,	
orifice,	neb,	guago, tarte (M),	sia.
origin,	giz,		mabu.
other,	nerutĕ,	wara,	ata.
our,	meriba (*inc.*), keriba (*exc.*),	ngalpan (*inc.*), ngoimun (*exc.*),	nimoibina (*inc.*), nimona (*exc.*).
ourselves,	meribabu (*inc.*), keribabu (*exc.*),	ngöingöi (*exc.*),	
outside,	adi,	kala, ada-dögam,	sito (K), sugu (P).
outrigger,	serep,	saima, sarima (*float*), togo (*pole*),	*sarima* (*float*), tugu (*poles*).
oven (*earth*),	ame,	ămai, palagus,	*wedere.*
over,	tumem,	gimia, gimal,	ouato.
ovulum shell,	bubuam,	boboam, boboum,	*buama.*
owner,	kem-le,		mutudubu.
oyster,	gen,	ita, itro, *awidö*,	*gōīrĭ.*
Paddle (*n.*),	uzer,	kaba, karaba,	*aibi.*
paddle (*v.*),	ireb,	puban, *kabanitunö*,	*abidiro.*
pain,	ăsi,	kikir,	tema.
paint,	lukup,	auei, bud,	*eka*, rukupo.
pair,	neisi,	sepal, palae,	netoa.
paling,	kar,	pa, ara,	ia.
palm of hand,	tag-gab,		
palsy,	ibibi,	umuwalepa (*v.*),	togiri.
pandanus,	abal, inau, ineu,	kasa, gara,	*duboro.*
papaw,			*maniapu.*
paradise bird,	degem,	dăgam,	kakaium, kokaiām (M), amura (K).
pardon,	atwe, detwe,	getö-waniz,	epuruo.
part (*n.*),	tam, mog, kaierpeik,	ködu,	ipi, kago.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
pass,	digmi,	pasia,	
past,	ĕmĕrĕt,	adapadan,	tagara.
path,	gab,	iabu, iabuguda,	gābo.
pay,	bodom,	modobia,	*wisaōosa* (K) uia(P).
peace,	paud, mapodan,	pautö,	*miro.*
pearlshell,	mai,	mai,	*nese.*
pelican,		awai, auwai,	*awaia*, doburu(M).
penis,	eb,	ini,	arumo (M).
people,	lakub-le,	mabaegal,	*arubi.*
petticoat,	nesur,	zazi, gagi, jaji,	wapa, maiwas, maidek.
physic,	lukup,	göugu,	rukupo.
physician,	lukub-le,		
piece,	mog,	*musi*,	*kopo*, ipi.
pig,	borom,	burum,	baroma.
pigeon (*white*),	daumer,	gainau, gaino,	*gimai.*
pillow,	amaz,	guzi,	
pinch,	tapot,	dimunupagan,	
pipe (*tobacco*),	zub, sokop-marĕp,	suguba marapi, sukuba morapi,	*waduru.*
pith,	teibur,	tabu,	tuburu.
place (*s.*),	utĕb,	dögam, lagö,	mauro, drimŏl(M).
place (*v.*),	ikĕdi,	ieutiz,	edea.
plague,	gim,	kikiri,	koropa.
plait,	diadi, ewer (*v.*),	zeinga,	
plank,	tag, laulau (*Samoan*),		kauta.
plant (*v.*),	emor,	sowagai, *utuna*,	{ *cpōo*, *ibăūti*, aru, iboriti.
plantain (*banana*),	kaba,	katamö,	tsime(K) obira(P).
plantation,	gedub,	daraba, apö,	pāri.
platform of canoe,	tam-ge (I.),	tamu (M), natara,	patara.
play,	segur,	sagul,	korio.
plenty,	gaire, dordor,	köi-gorsar,	*sirio*, ipipu, aue.
point (*of arrow*),	kek, kik,	gizu,	*io.*
point (*of land*),	pit-ged,		*muba.*
poison,	kŏmer (L), sumez-lukup,	*upiri*,	*giwari.*
pole,	seseri,	surö,	*tiwa.*
poor,	nole-lu-kak,	zagigal,	
post,	paier,	pasi-kaig,	saui.
pour,	epaiter,	paieudan, sulan,	auodoi, auoduti.
*powder (*gun*),	pi,	pöi,	pāūoro.
power,	adigir,	parpar,	irveitorai (?).
praise,	espili,	ieso,	uadoro.
*pray,[1]	esorapa,	toitu-pagiz,	erudomoti.

[1] Esorapa, to sit with bended head; esorgiru, to bow the head in worship; kokmamu, to bend the knee. *Cf.* Miriam-English Vocabulary.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
preach,	marau,	maumizin,	totomo.
prepare,	derser, dersem,	butupataipa, moidemin,	orosiodiro.
present (*adj.*),	peirdi,	nabi,	abara.
press,	atkap,	panudiz,	amahiri.
prick,	ekos,		aurai.
proceed! go on!	mase!		
proud,	perorge (*a.*) bauspili (*v.*),	ngada-palepa (*v.*),	samo.
pull,	egnatumur,	{ pudan, *pusarisö*, *nitunö*, *dirdimai*,	agiriti.
punish,	dulam,	modabia,	
purple,	mamam,	kulukal,	
push,	esaperi,	geto-oidan,	
put,	ikëdi,	wanan, ieutiz,	edea.
Quarrel,	ataparet,	tabukiri,	karamarogo.
*queen,	opole-kosker,	kuiku-ipi,	
quench,	asam,	usimoin,	
question,	itmer,	iapupoibiz,	aratoro.
quick,	dudum, wamen-wamen,	kikimizi, wamen = *walk quick*,	*samoito*, siö (K) iö (P).
quiet,	mirkok, bamer,	kasa-iagiasin, nuragi (M),	mure.
Rafter,	pek, lemlem (?)	sau,	*kararuso.*
rage,	wekuge,	tabukir,	doa, *woroworo.*
rain,	irmer,	ari,	{ *moburo*, *arumo*, nisai (K), uiai (P), niëri (M).
rainbow,	suseri,	oripara (M),	*susuruwia.*
raise,	ages,	toridiz,	
rat,	mökeis, makus,	makasö,	*kaiani.*
rattle, (*n*),	lolo,	pădătrong,	
*read,	etage,	getötitai, getidiz,	oputi.
receive,	egared,	töridiz,	omogu.
red,	mair, mamam,	kulka, parma, parama,	*dogodogo*, kopōr (M).
reed,	pater, sem,	buzö,	*dudu.*
reef,	nor,	mazan, *maja*,	*wanogoro*, maja, nora (*coral*).
refuge,		muiariz (*run inside*),	
refuse,	ditwaki,	laungaman,	
rejoice,	serer-ge,	ikatiaiba, *diwanami*,	amadi.
remain,	mena, emri, ĕpki,	apatanor, umaizö,	dogo, omiei, oromiado.
remember,	akiapor,	ngonanama,	meragidiro.
rend,	atoat,	sigataean,	ototoro.

English.	Miriam.	Saibai.	Daudai.
repair (*v.*),	ewer, wademer,	butupataipa,	auoto.
repent,	obazgeda,	garötöitaean,	enbumuguruti.
reply,	etkat,	kuduman, *muli*,	iarabuti, *gibo*, *waratai*.
rest,	ner-ezi,	ngöna,	eranapar.
*resurrection,	ededem-obakiam, eded-akaida,	lakö-igililenga,	
return,	iako-tabakeam,	kunia tidiz, *laköboi*,	*nitara wămĕaī ioritŏrōi*.
rib,	bilid,	bero, beara,	*barasoro*, baraoro (M).
rich,	lu-giz-ra-apu,	zapul,	*borguborgu-sirio* (*wealth*).
ridge,	serer,	töra,	*eresa*.
right side,	tuter,	gëta-dogam,	tumodi.
rim,	serer,		*eresa*.
ring,	gogob,	pitu,	
ripe,	agëg, neo,	buru-gamul, kunamin,	*gumi*.
rise up,	ekwe, ekiam,	kadai-tariz,	totoboa, oribo.
river,	dodo,	kösa, böbu,	gou, *oromo*.
road,	gab,	iabu, iabugudö,	gabo.
roast,	igi,		*era itai*.
rob,	eruam, gatkam,	puru,	*imadi*, piro.
rock,	baker,	mukö, kula,	nora (*coral*).
roll,	erask,	taean, nupadö-taean,	*etebuti*.
root,	sip,	kuik,	*miti*, tibi.
rope,	lager,	amu, uru, *wali*,	{ *kari*, *pou-bari*, *isisira*, iwi (M), waro (M).
rotten,	buzibuz,	döbunga,	boroboro.
rough,	sekerseker,	wasalolnga,	
round,	gogob, zurkagem,	tubal, kokam,	*dogobe*.
row (*v.*),	ireb, erĕb,	kaba-nitun.	*abidīro*.
rub,	etatmili,	tadin, iban, nudan,	*titi*.
rudder (*steering board*),	pĕs, korizer (?),	walunga,	
run,	koreder,	zilamiz, nanitan,	ui,
rust,	tulik-le,		
Sago palm,	bisi,	bisi (M),	dou, *siahu*.
sail (*n*).	moder,	gul-waku, amori,	*sawatiro*, *tiro*, aua (M).
salt,	watwet-gur,	usabutu,	*karakara*.
salt water,	gur,	adabu (M), adabadu,	*karakara-obo*, *oromoboa*.
same,	mokakalam,	urapa, matangagid,	gedagebi.
sand,	we,	bukö, surum,	*wio*.
sap,	nini, sus (?),	ikai,	
sawfish,	botoger,	waiitutu,	

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
say,	atager,	muliz, iamuliz,	arogo, aroguti.
scalp,	gegur,	göngau,	
sear,	dub,	babur,	nato, bugomu.
*school,	ĕrĕwerĕm-meta,		
scold,	ataparet,	silamai, ideipa (M),	biroro (M).
scrape,	ikris, ĕkupĭmar (J),	iban,	*arigiti* (*scratch*).
scratch,	ikris, kapkap,	kurtumiz,	*arigiti.*
scream,	sasmi,	makiam,	
*scriptures,	zogo-jauali,	tusi (*Samoan*),	
sea,	gur, karem (J),	malu, ur, bau,	*uro*, oro.
seashore,	tauer,	tawala,	dodo.
search,	araimer,	luman,	ora.
seat,	bau,	niailagö,	
seaweed,	mau (J),	damu,	
secret,	gumik,	kumi,	menae.
see,	asmer, ardar,	imaipa, nagepa,	damāri (K) euri (P).
seed,	kĕp, kus, neg,	kousa, kapu,	iopu.
seek,	araimer,	luman,	ora.
seize,	erpei,	gasaman,	orobai (K) erabai (P).
select,	depeger,		uarui.
self,	-bu (*suffix*),	kusaig,	marai.
sell,	erap,	zapudamoin,	emadi.
send,	emarida, emark,	wasan, zapawaean,	emeriai.
separate,	ditakeamur,	dadömamain, komakoma,	
*sepulchre,	ao (*pit*),	maram-gudö,	
*sermon,	giz-mer,		
serpent (*species*),	tabo,	tabu, elma,	arua, *ede*, *topo*, *etc.*
*servant,	memeg-le,	niai-kazi,	
serve (*v.*),	memeg,		momogo.
set,	ikedi (*put*),	putizö,	edea.
sew,	itkët, ikĕdi,	pagamöin, widan,	auaruo.
shade,	igiredi (?),	iradu-aban,	
shadow,	mar,	rimö,	
shake,	durdur, demare,	galupan,	
sham,	besbes,	ngolkai,	uaramai.
shame,	sirip,	asir,	*siripo.*
shape,	nog,		
share,	peik,	kupai,	
shark,	bezam,	baidamö, baidam,	*bidu.*
shark (*hammer-headed*),	iruapap,	korsi,	
sharp,	garger,	köigizu, gizule (M),	
shave,	imus-itu,	luwaean, *iatapatizo*,	*arigiti.*
she,	e, abi,	na,	noŭ.
sheep,	mamoe (*Samoan*),	mamoe,	
shelf,		zaungalaig,	
shell,	sorsor, lid (M),	*waipa* (*land shell*),	
shelter (*n.*),	mud,		
shield,	etirida (*v.*),	akamaiza, *bada*, arepa (*v.*) gaidesa,	*gope*, kes (*n.*).

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
shin,		tara, bru-rida (*bone*),	*sairidoro.*
shine,	zorom,	pönipan, meketu,	airima-eruo.
ship,	au nar,	arawi-gul,	auope.
*shoe,	teter-gab,	azazi-san,	*otosairo.*
shoot,	itimeda, iprik,	tadin,	pedua.
shore,	tawer, dodomer,	tawala, taman,	dodo.
short,	teupai,	taupainga,	ropuimi (K) omo (P) *kopo, kopume.*
shoulder,	tugar, map,	tabai,	*orosidiro*, tigiri (M).
shout,	ererekrier,		ui.
shove,		taean,	
show,	etomer,	iakaman, sesitaman,	arapoi.
shrimp,	meg-apu,	*gagi*,	*kadami.*
shut,	dimi,	tamudan,	opai.
sick,	gimgim,	kikiri,	temeteme, koropa.
side,	kepilid,	buadia, kam, uiu,	*sapua.*
sigh,	ner-batauered,	körkak-öbado,	
sign,	atamelam,	tonar,	*irŭmaī*, karadabu-tigaut.
silence,	bamer,	iaga, iagiasin, aragi (M),	oroomai, mure (?)
sin,	wit, adud,	ipidadö, watipawa,	gamasa, uba.
sinew,	peris,	kirer,	
sing,	wed-akiriare,	napoidan,	po-ābo, ări (M).
sink,	baragida,	dudupiz,	orodobi.
sister,	(*man's*) berbet, (*woman's*) keimer,	babŭd, babad, tokiŭp, tokiap,	kolodĭrĭ, *mabīa*, bramgerima (M).
sit,	emri,	apatanor, patiz, nia.	*susi*, oromiado (P), omiei.
skin (*human*),	gegur,	gönau, gam, *gun-gau.*	*tama.*
skin (*animal*),	paur,	pura,	pauna.
skull,	kerem-lid,	*kuikö*,	*epuru.*
sky,	arem, kotor,	dapar, je (M),	aromo (M).
slanting,	gorgor,		
sleep,	uteid,	utui,	*uo*, utūo.
sling (*n*),	dau, serg.	kubai,	
sling for carrying heads,	serg,	sungi, zinge,	sungei (M), adiga.
slip,	pertar (*v*),	paget-wanizö,	
slit,	isimi,		otoai.
slow,	wapum,	gabudan, sobaidiz,	besi.
small,	kĕbĕ,	magina,	*eke*, sobo, mabi (M),
smart,	saserim,	sobaginga,	erapo.
smash,		palga-palan,	*oropio.*
smear,			*gato, titi.*
smell (*n*),	gemelag (*perfume*), semelag (*stink*),	ganu, pulman,	nibo.
smile,		*masiatödımisö*,	uari.
smoke (*n*),	kemur,	tu,	tema.
smooth,	zurkak, pertarper-tar,	zeinga,	

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
snake (*species*),	tabo,	tabu, elma,	*ede, topo etc.* arua.
snatch,	itkir,		iperiti.
sneeze,	siau,	asarö,	asīo.
snore,	gegermer,	paran-matapa,	gărŏroă.
snout,		kaigutalpiti,	*tamari muba.*
so,	kega,	keda,	gebo.
sob,	udili,	koingöna poidan,	
soft,	gubingubin	piranga,	
soil,	sep, seb.	baradar, apa,	sopu (K) opu (P).
some,	wader,	durai,	arua.
son,	werem,	kazi,	mere.
song,	wed,	na, na-poidanö,	*abodo, wasare,* poo.
soon,	keubu, menaba,	kaibö,	uapurĕto.
sorcerer,	maidkĕmĕle,	maidĕlăg,	
sorcery,	maid,	maiĭd,	*suagai.*
sore,	ăsiăsi (*a*) băd (*n*)	kikir (*a*) badale (*a*) bada (*n*)	tematema.
sorrow,	okasosok,	ikan-pungaipa,	oiuo.
*soul,	nĕrkĕp, lamar,	mari,	*urio, manukai.*
sound,	mut, bumer,	nurai,	pako.
sour,	kurabkurab,	mitaiginga, teral-nga,	*isisira.*
south,	garĕd, jiai pek, (s. s. w).	zadögam, nangap, *je,*	*sie rarogoro.*
south-east,	sager,	aibu, *waura,*	uroa (M).
south-west,	ziai, logab (?),		
sow (*n*),		*ipukaja-burumö,*	*upi-baroma.*
sow (*v*),	emor,	utuipa,	aru.
spade,			*ea.*
spark,	kakaper,	kökaper,	
speak,	atager,	mulai, iamuliz,	*geboiara,* arogo, aroguti.
spear,	dab, kalak, baur, zab,	bau, kalak, bager, *kubai, malila.*	*tete.*
speech	mer,	*mauinisinö,*	*auera.*
spew,	megi,	magiz,	*mamaru.*
spider,	seber,	enti (M), *ma,*	*apisăū, gaira,* &c.
spine,	sorkoklid,	göru-rid,	*giminí*-soro, gimi-ni-kako (M).
spirit,[1]	lamar, mar,	mari,	oboro.
spit,	itu, mos-ekeilu,	mos-aladiz	*geradu.*
spittle,	mos,	mos,	orobere.
split,	isimi,	palamöin,	otoai.
spoil,	dedkoli, itkam,	idimoin,	ubagouaidumo.
sponge,	sap,	diadi, pazara,	
spot,	kutaire,	badö,	
spread,	esawi (*v*),	poidamoin, tapi,	ogurumo.
spring (*v*),	eupumar,	palagiz, kuki,	ereberiai.
square,		muiilinga,	*oagoberaĭ.*

[1] *Cf.* Miriam-English Vocabulary.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
squeeze,	igmĕsi, atkap,	sasiman,	*tusoro*, amairi, piperiti.
stab,	ekos,	banitan,	aurai.
stalk,		malegui,	*durupi*.
stand,	ekwe,	kadai-tariz,	totoboa, oriboa(M).
star,	wer,	titui, tituri,	*gugi*, oroi (M).
starfish,	aber,		
start (*of fear*),	basik, aziznaret, esigmada,	madupaman,	
stay,	emri,	*ngöna-pudis*,	*monobainomi*, omiei, oromiado.
steal,	eruam,	puru,	piro.
steer,	korizer,	kuli-töidiz,	*waopo aibi*.
step over,	datupida,		adagauri.
stick, staff,	kokĕt,	bogi,	soki.
sting-ray,	at(?), gwar, tapim,	tapimula, aona (M),	*guere*.
stink,	semelag,	watiganu,	*gamăsa nibo*.
stomach,	kĕm,	maita, wera (M),	*tuburu*, dopi.
stone,	baker,	kula,	*kuraĕre*, nora.
stoop,	eparsili, esorgiru,	apasin,	orogurio.
stop,	emri, ekwe,	seautari,	omiei.
storm,	ras,	köi-gubö,	
straight,	barkak,	balbaiginga,	kawitato.
stranger,	sub-le,		apararubi.
stream,	dodo, kemur,	kasa, böbu,	gou, bobo (*water-hole*).
strength,	kelar,		uai.
strike,	ipit, detapi, damerik,	mataman, *urimanö*,	opio, *araberŭmo*, *korodio*
string,	lager,	yadal, *urukamö*,	*isisira*.
strong,	kĕlarkĕlar,	magas, kunakunanga, *kaibibiri-linga*,	*erapotato*, uaiuai.
stump,	giz,		mabu (?).
suck,	esomed,	suzu, puiman,	*amoisi*.
suffer,	ăsiăsi (*pain*), di-megeroa (*allow*),	kikir (*pain*),	tematema (*pain*).
sugar-cane,	neru,	geru,	*magai*.
summit,	tum,	gimalö,	*dawane*.
sun,	lem,	göiga,	sai (K), iuio (P), ibiu (M).
sunrise,	bane, gerger-osa-keida,	göiga-palagizö,	
sunset,	lem-baraigida,	göiga-putizö,	uorogomai.
swallow,	irmi,	angemin,	*tau ima godio*.
swear,	adud-mer,	gudo-tadiz,	
sweat (*v*),	mereg,	magö, murug,	*orosa*, eraera (*hot*).
sweep,	puipi-drup,		*osuderuti*.
sweet,	debe-laglag,	mitalnga,	durupi nibo.
sweet-potato (*varieties*),	kak, irou, orgăb, nuri,	urugabau, rugăbu,	miruu (M).
swim,	bareb,[1]	tapeipa, waeapa,	*dămedame*.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
*Table,	laulau (*Samoan*), bau-lu,	biraig, laulau,	kauta.
tabu,	gelar, zogozogo,	sabi, azar (M),	*sabi*.
tail,	upi,	köuba, kob, babun,	*nupu*, nopo (M).
take,	ais, ekau, egaret, erpei,	mani, meipa,	*omidai*, uagori.
tale,			*totoma*.
talk,	atager,	muliz,	arogo, aroguti.
tall,	kotor,	köikutalnga,	tuturu.
tame,	markak,	kuibur-törödiz,	
taro,	aneg,	göen,	*saso*, anega (M).
taste,	tepasker,	nutan (*v*), mita (*n*),	aratiaiado.
teach,	ĕrĕwerĕm,	ngurapipa,	kitamodiro, atamuai.
tear (*s*),	ebeb, e,	ngudi,	*idobisuo*.
tear (*v*),	etoat, lama (J),	ladeipa (M),	ototoro.
tell,	atager,	iakaman, iadupalgan,	arogo, aroguti.
tempt,	mirem,	nutan,	kodoboa.
tender,	gebgeb,	körpusönga,	kobokobo.
termination,	mop,	kutö,	bari.
terrible,			
terror,	geum,	aka,	tore.
thank,	esoao,	īeso,	eso.
that,	abĕle,	siëi, sena, senabi,	*gidi naro*, goina.
thee,	mare,	ngi,	ro.
their,	wiaba,	tanamun, palamun,	neinai.
them,	wiabi,	tana, pala,	nei.
there,	peike, dali, darali,	siëi, sena, senabi,	nono, noboi, gonou, *gido*, *nebetaromi*.
therefore,	abelelam,	kedazinga, senaoki,	goinagaut.
they,	wiaba, wi,	tana (*pl.*), palae (*du.*),	nei.
thick,	dobdob,	badalenga,	*bata*.
thief,	eruam-le,	puru-mabaeg,	
thigh,	wakei, pat,	madu, drakapi,	wagi.
thin,	lerkar, lidlid,	pepenga,	*isisira*, tamatama.
thine,	mara,	nginu,	roro.
thing,	lu,	za, pawa,	numabu, *nuna*.
think,	akiapor,	wakaintamamiz,	emaragidiro.
thirst,	ni-ap,	muk-ĕnei (M),	*obo-durugere*.
this,	abĕle, pe,	ina, inabi, ita,	goina, goinoina.
thorny,	zigerziger,	pui-patalai,	*oroor*o, siuia, kikop
thou,	ma, mama,	ngi,	ro.
though,	ese,		numada.
throat,	pĕrĕg,	ia, karta (M),	*turuturuoa*.
through,	eipu,	adakado,	
throw,	batauered,	taean, pagan,	eberiai.
throw away,	dikri,	taean,	*berseai*, *isiro*, eberiti.
throwing-stick,		kogwoi, kobai,	
thrust,	aziriklu,		

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
thumb,	au ke,	kuikudim, kabageta.	oto.
thunder,	gīrigiri,	gigi, duyuma (M),	gurŭru.
thus,	mokakalam, kega,	keda,	gebo.
thy,	mara,	nginu,	roro.
tide,	meg,	bubu,	obo (*water*).
tie,	mukub, audbar,	kunumeipa (M),	mopo, otoirai, itoiriti.
till,	mop-ge,	kurusipa,	bari-ato.
time,	kerker, taim (*Eng*).		tagu.
tired,		gamu-doidima,	
to (*prep.*),	-em (*suffix*),	-pa,-mulpa (*suffixes*),	-to (*suffix*).
to (*infinitive*),	ko,		
tobacco,	sokop, sukub,	suguba, sukub,	*sūkŭbá.*
to-day,	abĕle-gerĕger,	nabi-göiga, *kaiba*,	*abrăsai*, *doguaimi.*
together,	kĕmem,	kaimil,	
toil,	dorge,	zagetö	kerigedio (K), erigedio (P).
*tomb,	ao,	umau-lagö,	
tongue,	werut,	nöia, nöitai, *löia*,	odotorupi, watatöropi (M).
to-night,	abĕle ki,		*abraduo.*
tooth,	tereg (*sing.*), warem (*pl.*),	dang (*sing.*),	*iăwa*, ibonora (M).
top,	tum,	gimal,	ou.
torch,	be,	buia,	*pida.*
toss,	dikri,		eberiti.
totem,	agud,	augŭd,	
touch,	itut,	tadiz, nidemin,	odiodoi.
tree,	lu (?),	*pui*, prue,	*ota.*
tremble,		galupan, *sumainuwedan.*	*komo gurti.*
trench,	awak,		
true,	ageakar, kar,	mina,	nanike.
trumpet (*shell*),	maber,	bu,	*tuture.*
trunk (*tree*),	gĕm,		*durupi.*
trust,	oituli,	kapuakasin,	sibomuguruti.
try,	mirem,	nutan,	kodoboa.
tune,	kodo,	na,	poho,
turmeric,			*soworc.*
turn,	depegili, egeremalu.	kidotaean, tarteipa.	uarui, eremeterai.
turtle,	nam,	waru,	gamu, *tumanua.*
turtle-shell.	kaisu,	wanawa, kărar, krar,	*gamosoro.*
twine,		wali,	*isisira.*
twist,	dipit,	nureipa,	*ameduti*, *garamaduti.*
two,	neis,	uka, okŏsa, ukasar,	netoa.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
Ulcer,	begur,	bada, bagur (M),	*ioto.*
uncle,		kenba-tati, waduam, adoama (M), *igalaigu*,	*nogereburo*,
unclean,	ogog,	tulainga,	ipuipu.
under,	lokod-ge, mud-ge,	apa, apal,	magumo-ato, iri-ato.
understand,	umele, akmer,	ngulaig, wakaitamain,	umoro.
undo,	detwe,	gudöwaiz,	epuruo.
undress,	igi,	pudiz,	obiriodoi.
unripe,	(pez ?)	kobaris (M),	*karokaro.*
until,	mop-ge,	kurusipa,	bari-ato.
up,	kotor-em, armem,	gimal, kadai,	*osua.*
upon,	kotorge, tumem,	worogi,	ou-ato.
urine,	ěspi,	nguki-tuidan,	
us,	meribi (*inc.*) keribi (*exc.*),	ngalpa (*incl.*) ngöi (*excl.*),	nimo.
Vain, in,	sagim,		garigari.
valley,	awak, pat,		
vanish,		idumai,	
vein,	kěrar,	kirer,	tuai (M).
verses,	wed,	kudu,	*wasare*, poo.
very,	au,	köi	auo.
village,	utěb, ged,	apnu, *mudö*,	*maura.*
voice,	kodomer, kodo,	ngurö, böie, nurö,	kudu, ouera-kudu.
vomit,	megi,	magiz,	
Wail,	ezoli,	kuik-gasamiz,	oroto.
waist,		ka,	
wait,	emri, mena,	nganö, *tuma*,	dogo.
wake,			*oribōo.*
walk,	ekas,	uzar,	*ogu*, airogu.
walking-stick,	kokět,	bogi,	soki.
want,	lagělag,	möken, ubinmepa,	dirino.
war,	arěsem,	kouba, kobu,	bōō (M), *boso.*
warm,	urweri (*a*), bauger (*v*),	kamanale (*a*) (M.)	*erairagido itai*, gabu.
warn,		*iedawaiano*,	*waia.*
warrior,	arěsle,	koupapa, *murawardan*,	*boso didiri.*
wash,	arub,	garöwalgaipa,	*waroti*, umiriti.
watch (*v.*),	derser (*prepare*), asesere (*look after*),	danalpataipa, poipiam,	orosiodiro.
water,	ni (*fresh*), gur (*salt*),	wěr, nguki (*fresh*), adabu (M) (*salt*),	*obo* (*fresh*), oro (*salt*), topobo (*fresh*) (M).
wave,	zauber,	bau,	
wax,	isau,	iěrka, isau,	*moromoro* (*knobs on drum*).
way,	gab,	iabu,	gab.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
we,	mi, ki (*du.*), meriba (*incl. pl.*), keriba (*excl. pl.*),	ngalabe (*du*), ngalpa (*incl. pl.*), ngoi (*ex. pl.*),	nimo.
weak,	gebgeb, beber,	gogainga, dagö,	kobokobo.
weapon,	arĕs-lu,		
weep,	ezoli,	maiadan,	*idobi*, oroto.
well (*n*),	ni-pat,	wĕr-nuriz, mai,	*bobo*.
west,	koki ziai, beli (?)	kuki-dogam, *gaiga-puliso* (*sundown*),	*irărasukumai*, *sie*.
wet,	bebeb,	urainga,	
whale,	galbol,	matu,	
what?	nalu?	midö? miei?	*bedara?* ebeta?
when?	nageregere?	migöiga? namoit.	
whence?	nadelam?	nalagazi?	
where?	nadĕ?	nagö? milagnu?	boro?
which?	nete? niti?	nalagi? miza?	*bedana?* botur?
while,	mena,	közi,	dogo.
whistle,	komelag,	upiuz, wadu,	musi-boo (M), wasare boso.
white,	kakekake, zarazer, giaud,	gamulenga, uru (M), saradönga, meik,	keakea.
whither?	nagedim?		
who?	niti?	nga? *mimabaigö?*	*beturo? botur?*
whole,	kemerkemer,	mura,	umumue.
why?	nalugelam?	mipa? mingu?	
wicked,	adud, wit,	ipidadö, wati,	uba, gamasa.
wide,	aukes,	atadonga,	
widow,	mai-kosker,	*maikö*,	
wife,	kosker,	ipi, ipikazi,	orobo (*sing.*), upi (*pl.*).
wig,	weraki,	adŭdzeolai, pakomari.	yaprumu.
wild,	markak,	gamungazilamiz,	*serao*.
wind,	wag,	gubö,	*susua* (K), uo (P), u'ua (M).
wing,	peo, pao,	böta, buta,	*tama*.
wipe,	itkir,	garowalgan,	iperiti.
wish (*v*),	lagĕlag,	ubinmepa, eka,	diriuo.
with,	-dog (*suffix*), kĕmem,	-ia (*suffix*), kaimil,	-gomoa (*suffix*).
withered,	euselu,	raji (M),	oruria.
within,	muige,	muinu,	niroato.
without,	adem, adge,	ada-dögam,	sugu (P), sito (K).
witness,	ageakarem,		
woman,	kosker (*married*) neur (*unmarried*),	ipi, ipökazi,	(*married*) orobo (*sing.*), upi (*pl.*); (*unmarried*) besere (K), buere (P).
womb,	kĕm,		

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
wonder,	dame,	lupaliz,	
wood,	atwa,	wata, pui,	ota, *peere*, *soro*.
word,	mer,	ia,	onera.
work,	dorge,	zageta,	kerigedio (K), erigedio (P), *serao*, *namabu owaigati*.
world,	geseb,	apalapal, *imana*,	*tawatawa tuturu* sopu (K), opu (P).
worm,	gegedar,	kuparö, sagad,	
worship,	esorerapare,	toitupagiz,	erudomoti.
wound,	asilam,	*dubiruna*,	*osĭo*.
wrestle,	bakatu,		
wrist,	kĕbĕ kok,	weiam, tiapi,	*tumaho*.
*write,	detar, autare,	minarpalan,	*titi*, titi-rosidiro.
wrong, to be,	didmirki,	balbainga,	uararai.
Yam (*varieties*),	ketai, wĕskip, lewer,	gabau, bumat, bua,	*umamu*, miruu, opuo (M).
ye,	waba,	ngita,	nigo.
year,	urut,	watö, saziwaur,	urato.
yellow,	tirtir (M ?), (*ochre*) siu,	uru, *murdaga-mulnga*,	*sowora*, *agoago*, *madira*.
yes,	wao, eko, peike,	wa,	iō.
yesterday,	ab-gerĕgere,	ngulö,	duduo, *duduata*, *duduatăsāī*.
you,	ma (*sing.*), uaba (*pl.*),	ngi (*sing.*), ngita (*pl.*),	ro(*sing.*), nigo(*pl.*).
young,	kerekar,	kawakuik,	*ekĕburi*.
young child,	kĕbili,		sobo mere.
young man,	makeriam,	kawakuiko,	osio (K), oio (P).
your,	mara (*sing.*), uaba (*pl.*),	nginu (*sing.*), ngitamun (*pl.*),	roro (*sing.*), nigonai (*pl.*).
youth,	kebili (*masc.*), neur (*fem.*),		osĭo (K), oio (P)

* An asterisk has been placed against those words which are certainly foreign to the natives in their English meaning. They have been translated by the Missionaries into what was considered to be their nearest native equivalents, or new compound words were coined for them. Possibly this list might be increased. In addition to these several loan-words will be found in this Vocabulary.

IV.—THE MUTUAL RELATIONS OF THE TORRES STRAITS' LANGUAGES, AND THEIR PAPUAN, MELANESIAN AND AUSTRALIAN AFFINITIES.

1. The three languages of Miriam, Saibai, and Daudai are decidedly distinct. The elements of Grammar, the formative particles, the pronouns and numerals, show little evidence of a common origin. Yet, as might be expected in the languages of three tribes of the same race, two of which are in constant intercourse with the third, a certain amount of likeness is found, both in grammatical structure and vocabulary.

The following points of agreement in grammar may be noted:—

1. Nouns and pronouns are declined by means of suffixed particles. These suffixes are however distinct in the three languages.
2 Adjectives are usually formed by reduplication of verbs or nouns. Negation of a quality is expressed by a suffix.
3. The pronouns have inclusive and exclusive forms for the first person plural, and are declined as nouns.
4. There is extraordinary complexity and variety in verbal expressions. No strict sense of time. Modifications in meaning are made by prefixes as well as suffixes.

The following list exhibits the agreement in vocabulary between the three languages.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
and,	a,	a,	e.
armguard,	kadik,	kadig,	adigo.
bamboo,	marep,	marap,	marabo.
bead (*Job's tears*),	kus,	kusa,	kusa.
belt,	wak,	wakau,	bagi.
calm,	metalu,	mataro,	mataro.
cassowary,	sam,	samu,	samo.
cheek,	bag,	bag,	baga (*jaw*).
club (*stone*)	gabagab,	gabagab,	gabagaba.
cold,	gebgeb,	gabu,	gabugabu,
dagger (*bone*),	sok,	soki,	zoke,
dog,	omai,	umai,	umo (*Mowat*).
ear.	gerip,	kaura,	gare.
father,	baba,	baba (*Tud*)	aba.
fence,	kara,	ara,	kara, ara.
fishing-line,	ariag,	arius,	ariaga.
fowl,	kalkal,	kalakala,	kŭrakŭra.
ground, soil,	sep,	apa,	sopu, opu.
hill,	paser,	pada,	podo, pasaro.
house,	meta,	mautu (*Tud*)	moto
iron,	tulik,	turik,	turika (*Mowat*).
island,	kaur,	kaura,	ura.
kangaroo,	usar,	usa,	usaro.
left side,	ber,	boda,	pere.
leglets,	mŭkamŭk,	makamak,	makamak.
mango,	waiwi.	waiwi.	wiwi.
navel.	kopor,	kupur,	gupuru, upuro.
opossum (*cuscus*)	barit,	barit, bait,	padi.

ENGLISH.	MIRIAM.	SAIBAI.	DAUDAI.
ovulum,	bubuam,	boboam,	buama.
paint,	lukup,	lokop,	rukupo.
path,	gab,	iabu,	gabo.
pig,	borom,	burum,	boromo.
pith,	teibur,	tabu,	tuburu.
rain,	irmer,	ari,	wieri, aromo.
rib,	bir-lid,	bero,	bara-soro.
sea,	gur,	ur,	oro, uro.
seed,	kep,	kapu,	iopu.
shame,	sirip,	azir,	siripo.
sleep,	uteid.	utui,	utuo.
snake (*a species*),	tabo,	tabu,	topo.
thunder,	girgir,	gigi,	gururu.
tobacco,	sokop,	suguba,	sukuba.
year,	urut,	wato,	urato.
yes,	wao, eko.	wa,	io.

The two following lists show the connexion of the Saibai with the Miriam and Daudai :—

ENGLISH.	MIRIAM.	SAIBAI.	ENGLISH.	MIRIAM.	SAIBAI.
ancestor,	kaied,	kaied.	lime,	kiaur,	kulau.
artery,	kerar,	kirar.	milk, gum,	sus,	susu.
away,	ade,	ada.	moon,	meb,	malpal.
bad,	wit,	wati.	mother,	apu,	apu.
bat, *Pteropus*,	saper,	sapor.	name,	neì,	nel.
blaze,	be,	buia.	nest,	pëk,	pakado.
body,	gëm,	gamu.	nose,	pit,	piti.
bone,	lid,	rid.	nose-stick,	kirku,	gigu.
bowl (*of pipe*),	tarkok,	turku.	oil,	ide,	idi.
brother,	berbet,	babat.	paradise, bird of,	degem,	dagam.
cheek,	bag,	bago.			
cough,	kobek,	kobaki.	peace,	paud,	pautö.
crayfish,	kēr,	kaier.	pearl shell,	mai,	mai.
crocodile,	kadal,	kadal.	perspire,	mereg,	murug.
crooked,	barbar,	balbai.	platform of canoe,	tam,	tamu.
dance,	ginar, kap,	ginar, kap.			
day, sun,	gerger,	göiga.	powder,	pi,	pöi.
die,	eumi,	uma.	quick,	wamenwamen,	wamen.
dislike,	obogai,	ubigasin.	rat,	mokeis,	makas.
ditch,	auak,	wakadar.	sago,	bisi,	bisi.
drum,	warup,	warup.	shore,	tauer,	tawala.
dugong,	degaer,	dangal.	short,	teupai,	taupai.
enemy,	keubu,	kobu.	skin (*human*),	gegur,	göngau.
flea,	titig,	tikat.	,, (*animal*),	paur,	pura.
flesh,	med,	madu.	sorcery,	maid,	maiid.
game,	segur,	sagul.	spark,	kakaper,	kökaper.
girl,	neur,	ngaua.	spear,	kalak,	kalak.
gunpowder,	pi,	pöi.	spittle,	mos,	mos.
heart, mind,	nerkep,	ngönakap.	sugar-cane,	neru,	geru.
inside,	mui,	mui.	sweet potato,	orgab,	urugabau.
jaw,	iba,	ibu.	ulcer,	begur,	bagur.
jew's-harp,	daroberi,	darubi.	vomit,	megi,	magiz.
juice,	serur,	suliz.	wood,	atwa,	wata.
lame,	parapa,	rapepa.			

ENGLISH.	SAIBAI.	DAUDAI.	ENGLISH.	SAIBAI.	DAUDAI.
black,	kubikubi,	uibuuibu.	mother,	ida,	aida.
bow,	gagari,	gagari.	outrigger-float,	sarima, saima	sarima.
brain,	tigi,	tigi-ro.	,, pole,	togo,	tugu.
crocodile,	ibara,	sibara.	rain,	ari,	wiĕri.
ditch,	goua,	goua.	reef,	mazan,	maja.
ear-ring,	gagi,	gagi.	rob,	puru,	piro.
easy,	turo,	torutoru.	sad,	mapu,	mibomibo.
fish-hook,	tudi,	tudi.	sling (*n*),	sungi,	sungei.
he,	noi,	noŭ.	sneeze,	asoro,	asio.
law,	sabi,	sabi.	stone,	kula,	kuraēre.
lightning,	ponipan,	poniponi.	thick,	bada,	bata.
live,	igili,	kigiri.	woman,	ipi,	upi (*plur.*).
louse,	neme,	nimu.			

Agreements between the Miriam and Daudai are more prominent than those between the Miriam and Saibai, or Saibai and Daudai. The presence of *s* in Miriam shows a closer connexion with the Kiwai dialect than with Mowat or Perem. In common words in the two last dialects the sibilant is lost, or replaced by *h*. Many of the Daudai words drop a medial guttural which is present in Miriam. These agreements seem to indicate a former connexion between the Miriam and the tribes in the Delta of the Fly River. The following list is supplementary to that given in the three languages:—

ENGLISH.	MIRIAM.	DAUDAI.	ENGLISH.	MIRIAM.	DAUDAI.
abide,	emri,	omiei.	louse,	nem,	nimo.
bag,	epei,	abea.	morning,	idim,	adimo (*evening*).
beat,	ipit,	opio.			
beyond,	apeik,	apuo.	put,	ikedi,	edea.
bread-fruit,	tamad,	toma.	rend,	atoat,	ototoro.
brother,	kaimeg,	kaimi.	ridge,	serer,	eresa.
carry,	erpei,	erabai, orobai.	sacred,	zogo,	zugu.
chew,	erusĕr,	orūso.	sand,	we, ve,	wio.
coconut,	ne,	oi.	sea,	gur,	uro.
custom,	tonar,	tanar.	serve,	memeg,	momogo.
dawn,	bane,	bani.	shoulder,	tugar,	tigiri.
deliver,	emarik,	emeriai.	sky, above,	arem,	aromo.
dove,	dibadiba,	dibadiba.	snore,	geger,	gărŏroa.
eat,	aro, ero,	irio.	sting-ray,	gwar,	guere.
far,	muriz,	mureso.	taro,	aneg,	anega.
fire,	ur,	era.	thank,	esoao,	eso.
frog,	goai,	keau.	thigh,	wakei,	wagi.
give,	ikuar,	agiwai.	turtle,	nam,	gamu.
grass,	soge,	suago.	voice,	kodo,	kudu.
hair,	mus,	muso, muo.	warm,	gebauger,	gabu.
hand,	tag,	tuo.	weak,	gebgeb,	kobokobo.
hide,	ispilu,	epuruo.	white,	kakekag,	keakea.
hot,	urueri,	eraera.	whole,	kemerkemer,	umumue.
knot, tie,	mukub,	mopo.	wind,	wag,	uo.
know,	umele,	umoro.	wound,	asi (*sore*),	osio.
large,	au,	auo.			

In the foregoing vocabularies many of the words which are similar in the three languages refer to objects which are common articles of trade. The trade routes are (1) Muralug, Moa, Badu, Mabuiag, Saibai, Mowat; (2) (Muralug?), Nagir, Tud, Mowat; (3) Mer, Erub, Parama. As the Daudai language with only slight dialectic differences extends from Kiwai to Mowat, it is clear that certain words, at least, should be common to the three languages. As a matter of fact a much greater agreement would be expected, at all events between the two Island languages; but it appears that these two tribes practically never came into contact with each other, excepting perhaps an occasional meeting of two or three individuals in Masig and other neighbouring islets.

Both of the island tribes import from Daudai, canoes, drums, cassowary feathers, the bone "daggers" or implements made from the cassowary's leg-bone, plumes of the paradise bird (*P. raggiana*), dogs' teeth necklaces, boars' tusks (natural and deformed), stone-clubs, bamboo knife and head-sling, arrows, often bows and probably the gauntlets, sago, etc.

The cuscus and the kangaroo are known to the islanders, the cassowary, the paradise bird, and the large bat (flying fox), are natives of Daudai, and do not occur in the islands.

None of these words imply any community of race between the tribes in question, any more than do the words for the exports into Daudai, such as pearl-shell, shell armlet, dĭbidĭbi ornament, turtle-shell, ovulum-shell, occasionally dugong meat, etc.

All the above exports and imports, together with other articles, were also articles of intra-insular trade within the limits of each tribe.

The javelin ("spear") and the throwing-stick were probably the only imports from Cape York, and these were confined to the Western Tribe. An account of the trade of the latter will be found in the Journ. Anthrop. Inst. xix, 1890, pp. 338–342.

From their names it is evident that the pig, the dog (dingo), tobacco, and probably the coconut, arrived in the Straits from Daudai.

According to the legends of the "cultūre-heroes," Gelam, Malu and Yawar, higher culture was taught to the Eastern Tribe by the Western.[1]

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[1] "Legends from Torres Straits," in Folk-lore, vol. i., pp. 47–81, 172–196.

2. *Connexion with other Papuan Languages.*

The Papuan[1] languages of the mainland of British New Guinea seem to belong to numerous distinct stocks, with very slight connexion in vocabulary. Hardly anything is known of their structure, except that it differs greatly from the Motu, Kerepunu, and other Melanesian tribes east of Cape Possession. Only one translation is known to the writers. This is a small schoolbook in the language of Elema or Motumotu at Cape Possession. In this the pronouns and numerals show a similar construction to the Torres Straits tongues.

I,	*ara*;	my,	*ara-ve.*	We,	*ero*;	ours,	*ero-ve.*
Thou,	*ao*;	thy,	*a-ve.*	You,	*eo*;	yours,	*e-ve.*
He,	*areo*;	his,	*are-ve.*	They,	*ere*;	theirs,	*ele-ve.*

One, *farakeka*; two, *oraokaria*; three, *oroisoria*; four, *orokaoroka* (2 + 2); five, *orokaoroka me farakeka* (2 + 2 + 1).

The following is the Elema or Motumotu Paternoster:—

Ero Oa kauri avai. Ave rare ovariave. Ave basileia mau
Our father sky dwelling. Thy name be holy Thy kingdom (Greek) beside

forerai. Ave hahea roi karikara e pisosia, kauri mafeare.
Thy village be done sky thus

Rariaetau ao ero aumiarai. Ao ero maroro savuteai, ero mafaere
food thou us Thou us bad we thus

ereo maroro ero au savuteai. Rohorai muteai revi rariovi maroro
them bad us Deceive lead bad

ao ero raivo makuri roi. Ave *basileia*, eata kerorikerori, avai
thou us life Thy and dwell

peapea. Amen.

This shows the adjective preceding the noun, and object preceding the verb as in Miriam.

The only other Papuan tongues for which we have any specimens are those of the Koiari and Koita tribes of the district inland from Port Moresby. A few sentences in Macgregor show a similar construction to the Elema.

[1] The term Papuan is here restricted to the black frizzly-haired tribes. In this notice the Motu, Kerepunu, and lighter-coloured natives of the mainland are called Melanesians.

KOIARI.

I,	*da*;	my,	*da-iero.*	We,	*noikoa*;	our,	*ni-ero.*
Thou,	*a*;	thy,	*a-iero.*	You,	*yane*;	their,	*ya-iero.*
He,	*eke*;	his,	*eke-ero.*	They,	*yabuia*;	your,	*yabu-iero.*

KOITA.

I,	*da*;	my,	*da-iaraki.*	We,	*no-kaki*;	our,	*no-iaraki.*
Thou,	*ana*;	thy,	*a-ieraki.*	You,	*yana*;	your,	*ya-iaraki.*
He,	*au*;	his,	*au-ieraki.*	They,	*eau-kaki*;	their,	*eau-eraki.*

In Koiari the name of the object possessed is infixed in the possessive pronoun. Hand, *ada* and banana *ufe* appear thus :—

My hand,	*di-ada-kero.*	My banana,	*a-ufe-ro.*
Thy hand,	*ai-ada-kero.*	Thy banana,	*a-ufe-ro.*
His hand,	*eke-ada-kero.*	His banana,	*af-ufe-ro.*

In the Koiari and Koita, as well as in Elema, the verbal forms seem to be very complex. This is a characteristic of the Miriam and Daudai.

In vocabulary the Papuan tongues seem to have little in common with those of the Straits. The following apparent agreements may upon closer investigation be found accidental.

Two vocabularies by Bevan,[1] from the villages of Tumu[2] and Evorra[3] represent the nearest mainland languages to the Daudai.

Soil, Kiwai *sopu*, Miriam *seb*, *sep*, Tumu *sappu*. Water, Kiwai *obo*, Tumu *ōō*. Tobacco, Kiwai *suguba*, Miriam *sokop*, Tumu *shugōō*. Boat, Kiwai *pe*, Tumu *vi*, Evorra *pi*. Coconut, Kiwai *oi*, Miriam *ue*, Tumu *ōō*. Bow, Daudai *gagari*, Saibai *gagari*, Tumu *kăkări*-biai. Arrow, Kiwai *tere*, Mowat *were*, Evorra *ĕre*.

With the Elema or Motumotu of Cape Possession[4] are found the following apparent agreements.

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[1] Toil, Travel, and Adventure in British New Guinea by Theodore F. Bevan. London, 1890.

[2] Tumu is on the Douglas river, about 25 miles N.W. of the Aird Hills in Long. 144° E. and Lat. 7° 12′ S.

[3] Evorra is on the Queen's Jubilee River, about 15 miles N.W. of Bald Head in Long. 144° 57′ E. and Lat. 7° 34′ S.

[4] Grammar and Vocabulary of the language spoken by Motu Tribe (New Guinea) by Rev. W. G. Lawes, F.R.G.S. Second edition, Sydney, 1888.

A Few Months in New Guinea by O. E. Stone. London, 1880.

British New Guinea Vocabularies. London, 1889.

Laugh, Daudai *wari*, Elema *area*. Girl, Kiwai, *besere*, Perem *buere*, Elema *bori*. Bird, Saibai *urui*, Elema *ori*. Fire, Miriam *ur*, Daudai *era*, Elema *ahari*. Sun, Daudai *sai*, Elema *sare*. Die, Daudai *uparu*, Elema *opai*.

The other distinctly Papuan dialects of British New Guinea are the Koiari, Kabana, and Manukoliu.

The Koiari, with its dialects, Koita (or Koitabu), Meroka, Favere, Maiari, Eikiri, and Kupele, is spoken by tribes in the hill district inland from Port Moresby. Vocabularies of the two first are given by Macgregor[1] and Stone[2]. Some words of the last five will be found in the British New Guinea vocabularies.[3] All are substantially the same language.

The Kabana is spoken in the neighbourhood of Mount Owen Stanley, and the Manukolu on the coast west of Round Head. Lists of words from these are in the British New Guinea vocabularies. The Kabana list contains many Melanesian words, but the numerals agree with the Koiari. The pronouns are distinct.

With the Torres Straits languages the following resemblances are found :—

arrow,	Mir. *kep*, Koiari *giba*.
bird,	Daud. *wowogo*, Koi, *uku*, *ugu*.
black,	Daud. *uibu*, Koi. *dubu*.
bone,	Daud. *soro*, Koi. *tori*.
father,	Daud., Mir., Saib. *baba*, Kabana *babe*.
fence,	Mir., Saib., Daud. *kara*, *ara*, Koi. *gara*.
house,	Saib. *lagö*, Koi. *yaga*.
large,	Mir. *au*, Daud. *auo*, Manukolu *vau ua*.
louse,	Daud. *nimo*, Koi. *umu*.
milk,	Daud. *amo*, Koi. *amu*.
mother,	Daud. *mau*, Kabana *mah'*.
red,	Daud. *dogodogo*, Koi. *tago*, *tao*, *aghove*, blood.
wood,	Mir. *atua*, Daud. *ota*, Kab. *ora*.

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[1] Queensland—Annual Report on New Guinea, 1890.

[2] A Few Months in New Guinea.

[3] British New Guinea Vocabularies. London, S.P.C.K. In quoting this work we have used the original MS. of Part I. (due to the kindness of Dr. R. N. Cust), and have not referred to the printed copy, as the latter has numerous errors. There has been no occasion to quote the Torres Straits vocabularies in Part II. of the collection which were printed with the wrong equivalents. See Bibliography, No. 21.

With the imperfectly known languages of Netherlands New Guinea, those of Torres Straits appear to have little agreement.

The following may, however, be noted:—

Ground, soil, Daud. *sopu*, Mir. *seb*, Mefoor *sap*. Stranger, foreigner, (? bush-man) Mir. *sub le*, Mef. *sup*, bush, country. House, Mir, etc. *meta*, Mef. *menu*, village. Leaf, Mir. *lam*, Mef. *raïm*, *ram*. Hill, Daudai *podo*, Saibai *pada*, Mefoor *bon*. Climb, Miriam *ogi*, Mefoor *ek*, *ejek*. Fire, Miriam *ur*, Daudai *era*, Mefoor *fôr*. Milk, Miriam, Saibai *sus*, Mefoor *sus*. Wind, Miriam *wag*, Mefoor *wam*. Food, Miriam, *lever*, Mefoor *robean*. Mango, Mir. Saib. *waiwai*, Daud. *wiwi*, Mef. *awa*.

The Mefoor words *sap*, *sup*, *menu*, *ram*, *bon*, *ēk*, *fôr*, *sus*, *wam* are, however, stated by Dr. Kern to be Malayo-Polynesian.[1]

With Tidor the following agreements appear:—Mir. *ue*, *re*, sand, Kiwai *wio*, Tidor *ui*, Daud. *ota*, tree, Mir. *atua*, wood, Tidor *hate*. Mir. *gur*, sea, Daud. *uro*, Tidor *ngolo*. Mir. etc., *girigiri*, *gururu*, thunder, Tidor *doturu*, Kapauer *wongru*. Tidor *baba*, father, Mir., etc., *baba*.

With other languages of the Moluccas may be noted:—Saib. *nguki*, Galela *akke*, Daud. *ota*, tree, Galela *gotta*, Daud. *odio*, eat, Galela *oddo*, Daud. Saib. Mir. *uteid*, *utui*, *utuo*, sleep, Ternate *hotu* (*hotoe*).

The languages of German New Guinea (Kaiser Wilhelm's Land), may, perhaps, be found to contain some Papuan elements. At present they are regarded as connected with the island languages further east. In this notice they are referred to as Melanesian.[2]

3. *Affinities with the Melanesian Languages.*

Along the coast of British New Guinea, eastward of Cape Possession, are found numerous settlements of a race lighter in colour, and

[1] Over de verhouding van het Mafoorsche tot de Maleisch-Polynesische Talen. Leiden. 1884.

[2] Dr. Schnorr von Carolsfeld writes:—"Hinsichtlich der Sprachen von Kaiser Wilhelm's Land erlaube ich mir mitzutheilen, dass sie meiner Ansicht nach *sicherlich* mit denen von Melanesien und den Malayischen verwandt sind; aber gewiss bestehen Unterschiede zwischen dem Festlande einerseits und dem Archipel (Neu Britanien, etc.), andererseits. Die Ansicht, dass erstere (die Sprachen des Festlandes) Papuanische Sprache mit Fremdwörtern von den Inseln seien, wird sich nicht vertheidigen lassen, da selbst die Stämme welche weit im *Innern* von Deutch Neu Guinea wohnen, die gemeinsamen Wörter besitzen."—Letter to S. H. R., Sept. 9, 1891.

differing in physical features, customs, and language from the Papuans of the west and interior of the island. Native tradition assigns the origin of these coast tribes to the sea,[1] and an examination of their language proves the correctness of the tradition. The language of the Motu tribe of Port Moresby is in every detail of grammar, and largely in vocabulary, as much Melanesian as the languages of the Solomon Islands and the New Hebrides. The same may be said of the dialects related to the Motu. In these the pronouns, numerals, and a large number of words, as well as the syntax, are Melanesian. The dialects known are as follows:—

1. Motu, Port Moresby.
2. Kerepunu, Hula, Hood Point and Bay.
3. Aroma, east of Hood Bay.
4. Dahuni or Suau, South Cape.
5. Kabadi, Redscar Bay.
6. Maiva, west of Hall Sound.
7. Mekeo, Upper St. Joseph district.
8. Sariba, Hayter Island and neighbourhood.
9. Tarova, Taroa or Sinaugolo, central coast districts.
10. Doura, Redscar Bay.

Vocabularies of 1–6 are in the 2nd edition of Rev. W. G. Lawes' Motu Grammar; 7–8, in Macgregor; 8–10 in British New Guinea Vocabularies.

In comparing the Torres Straits languages with the Melanesian of the south-east coast, and through them with the island languages generally, it is necessary to take into account a modern introduction of Melanesian words into the Straits by the Loyalty Island teachers settled on the islands by the London Missionary Society. The list of introduced words, which will be given in Part II., will show many Lifu words, and a few Samoan, which have come into the Straits since the establishment of the Mission in 1871. Most of the English and Greek terms also appear in their Lifu form.

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[1] "Work and Adventure in New Guinea," by Rev. J. Chalmers, p. 14. Also on p. 84:—"The inhabitants of the inland villages are probably the aborigines who have been driven back to the hills by the robuster race now occupying their plantations on the coast.

Torres Straits words which may probably be shown to have a connexion with the Melanesian or Polynesian are the following:—

anger, Daud. *woroworo*, Aroma. *paruparu*, Kerep. *baru*, Motu *badu*.

back, Mir. *sor*, Motu *doru*. (Motu *d* represents a common Melanesian *s*.)

*banana, Saib. *daui*, Motu *dui*.

biceps-muscle, Mir. *pŭgas*, Motu *pāga*, shoulder.

by and by, Daudai *dogo*, Motu *doko*, the end, New Hebrides, *toko*, *toga*, *doga*, etc., to remain, stay.

daybreak, Saib. *arö*, Malay *ari*. Common in New Heb. *alo*, sun.

*dog, Daud. *sio*, Motu *sisia*.

east, Daud. *wara*, Motu *walau*.

*face, Saib. *paru*, Motu *vaira*, Kerep., Maiva *waira*, Banks Islands *warea*, forehead. Apparently the same word is in Koiari *vari*, forehead.

forehead, Mir. *mat*, Motu *mata*, eye. Du. York Island, Solomon Islands, etc., *mata*, eye, face, or front. *Cf.* preceding word.

fence, Mir., Daud. *kara*, Saib. *ara*, *pa*, Motu *ara*, Florida, Solomon Islands *peo*, Fiji *ba*, *bai*, Sta. Cruz. *pa*. The word *gara* is also fence in Papuan Koiari.

fly (v.), Daud. *iarubo*, *arubia*, Kerep., Maiv. *roro*, Kabadi, *rova*, Aroma *lobo*, Motu *roho*, New Brit. *rowo*, Banks Islands *rowo*.

gum, milk, Saib. *susu*, Mir. *sus*, nipple, South C. *susu*, breast. See Kern. Over de verhouding, p. 50.)

house, Mir. *meta*, Saibai *mudö*, village, Maiva *marea*, Fiji *maliwa*, an open space, Samoan *malae*, open space in village.

hold of canoe, Daud. *urouro*, Hayter Island *karo*.

laugh, Daud. *kiri*, Motu *kiri*.

little, Daud. *eke*, New Hebrides, etc., *riki*, *liki*, Du. York Is. *lik*, Maori *iti*, etc.

lungs, Mir. *pereg*, Motu *baraki*.

*Malay apple (*Eugenia*), Saibai *apiga*, Fiji *karika*, Banks Islands *gariga*, etc.

mango, Mir., &c., *waiwai*, *wiwi*, Mekeo *veivei*, Hayter Island *waiwai*, Wango, Solomon Is. *wawai*.

mangrove, Saib. *taga*, Motu *togo*, Fiji *ndogo*, Samoan *togo*.

mat, Saib. *waku*, Kabadi *eka*, Savo, Solomon Islands *ragu*.

mother, Saib. *ida*, Perem *aida*, Kabadi *aida*, Ysabel, Solomon Islands *ido*.

mouth, Saib. *gudö*, Motu *udu*, nose or mouth, Fiji *udhu*, nose, *gusu*, mouth, Efate, New Hebrides *ngusu*. A common root, meaning nose or mouth.

neck, Saib. *kato*, South C. *gado*, Hayter Island *gado*.

nose, Daud. *wodi*, Motu *udu*, Fiji *udhu*. See word for mouth.

nose-stick, Saib. *gub*, Mekeo *angibo*.

*paddle, Mir. *uzer*, South C. *vose*, Motu *hode*, Kabadi *ode*. A word common in Melanesia and Polynesia.

pain, Mir. *asiasi*, Motu *hisihisi*.

penis, Mir. *eb*, Motu *apo*, scrotum.

*pig, Mir., Saib., Daud. *borom*, *burum*, *baroma*, Motu, Kabadi, &c., *baroma*.

rain, Kiwai *uisai*, Perem. *uiai*, Solomon Islands *usa*, Fiji *udha*. A common root. Mir. *irmer* is perhaps Mekeo *imu*.

*outrigger float, Daud. *sarima*, Saib. *saima*, Hayter Island *sarime*, Solomon Islands, New Hebrides, &c. *sama*, Duke of York Islands *ama*. A very widely spread word.

platform of canoe, Saib. *natara*, Daud. *patara*, Hayter Island *patapatara*.

rock, Saib. *mukö*, Samoan *ma'a*,

rudder, Saib. *kuli*, Mir. *kor-izer*, to steer, Fiji *uli*, helm, Samoan *uli*, to steer (a steering board or paddle).

self, Saib. *kusaig*, Banks Islands and New Hebrides *gese*, *kese*.

shield, Daud. *gope*, *kes*, Motu *kesi*, Maiva *kehi*, Kerep. *gehi*, South Cape *opea*, Hayter Island *yesi*.

short, Mir. *teupai*, Saib. *taupai*, Daud. *kopo*, Kerepunu (no *t*) *upa*, Aroma *upa*, Kabadi *opeope*, Sta. Cruz. *topa*, little, Hayter Island *kubakuba*.

skin, Mir. *gegur*, Florida, Solomon Islands *guiguli*, Fiji *kuli*, Malay *kulit*. A very common Oceanic word.

*sugar-cane, Saibai *geru*, South C. *garu*, Hayter Island *garu*.
tide, Mir. *mek*, South C. *magu*.
water, Saib. *wēr*, Hayter Island *waira*. Perhaps the common Oceanic *wai*.
wave, Saib. *baau*, Fiji *mbiau*, Samoan, &c. *peau*.
wind, Mir. *wag*, Motu *lai*, Kerep., Aroma *agi*. The common Oceanic word *lagi*. (See Kern. Over der Verhouding, p. 53.)
wind, Saib. *gubö*, Motu *guba*, sky, heavens, wind, Kerep. *gupa*, Aroma *kupa*, Kabadi *upa*, rain.

In this and the following list missionaries' words have been excluded, and we have marked with an asterisk (*) several words which are probably loan words. These no doubt migrated along with the objects. The edible (not the wild) banana can only be propagated artificially; this and the sugar-cane are necessarily immigrants. The coconut also accompanies human migrations. One of its names, *niu* and its variants, is widely spread in the Pacific (*cf.* Codrington, "The Melanesian Languages," pp. 41–64), and it possibly appears in Torres Straits in the abbreviation *u*. Tobacco is another example. The dog (dingo) and pig have been introduced by man into Australasia and Melanesia, and the name for the latter is very widely spread. It is not surprising that there is considerable uniformity in names connected with canoes such as paddle and the float of the outrigger.

The languages of the south-eastern extremity of New Guinea and the Louisiade Archipelago are so very imperfectly known that their relations to the neighbouring tongues cannot be definitely decided. As, however, much of the vocabulary, the pronouns, and numerals are generally the same as in the island languages east and south of them, they are here regarded as Melanesian. Those of which specimens[1] are known are —

1. Awaiama, East Cape and neighbourhood.
2. Murua, Woodlark Island, Louisiades.
3. Misima, St. Aignan Island, Louisiades.
4. Tagula, Sud Est Island, Louisiades.
5. Duba, Rossel Island, Louisiades.

[1] All these are from Macgregor's Report.

The following from these languages resemble Torres Straits words:

belly,	Awaiama *koiba*, Mir. *kopor*, navel, Saib. *kupor*, etc.
butterfly,	Awai. *kapeu*, Mir. *kap*.
head,	Awai. *kare*, Mir. *kerem*.
neck,	Awai. *gadau*, Saib. *kato*, etc. (See previous list.)
*Outrigger,	Awai. *harima*, Daud. *sarima*, Saib. *saima*. (See previous list.)
arrow,	Murua. *gipoi*, Mir. *kep*.
fence,	Murua. *kari*, Mir., Daud., Saib. *kara*, *ara*. (See previous list.)
salt.	Tagula, *jiur*, Mir, *gul*, sea, Saib. *ur*, &c.

With the (so-called) Melanesian languages of German New Guinea we find little agreement.[1]

mother,	Bongu, *ama*, Saibai *ama*, Mir. *amau*, Kiwai *mau*.
path,	Bongu, *gom*, Bokadschim *gam*, Mir. *gab*, Daud. *gabo*.
*pig,	Kelana, *borre*, Mir. *borom*, &c.
spear,	Bongu, *kadja*, Mannikam *kadjak*, Mir., Saib. *kalak*.
water,	Jabim, *bu*, Kei dialects *obo*, *oboa*, *opa*, Daud. *obo*.
sea,	Bongu, *ual*, Dschongu, Bokadschim *jual*, Mir. *gur*, Daud. *uro*, Saib. *ur*.

4.—*Australian Affinities.*

In grammatical structure the languages of Torres Straits closely resemble those of Australia, and are found to contain all the elements which are regarded as distinctively Australian. These have been thus summed up by Ridley[2] :—

1. Nouns are declined by suffixes.
2. There are two nominative cases, the first simply naming the object of attention, the second indicating the agent of the act described in a verb.
3. Often however the agent suffix is omitted: even before the active verb.
4. Pronouns are declined in some respects like nouns. They have distinct dual and plural forms.

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[1] See Vocabularies in Petermann's "Mitteilungen," 36 Band. 1890, V., p. 127. "Untersuchungen über 24 Sprachen aus dem Schutzgebiet der Neuguinea Compagnie," von Hugo Zöller.

[2] Curr. The Australian Race, Vol. I., p. 20.

The chief exception to the above is to be found in the Miriam, where the dual and plural may be the same in form, though the proper plural is usually shown by the suffixing of a word meaning "all."

Unfortunately for the proper comparison of grammar we have no examples of the languages of Northern Australia beyond very scanty vocabularies. The longest list is that of the Gudang language of Cape York, given by Macgillivray.

Of the three Torres Straits languages that of Saibai alone presents any considerable agreement with Australian languages in the actual grammatical elements. In that language the personal pronouns are as follows:—

Sing. 1. *ngai*; 2. *ngi*; 3. *noi*, *na*.
Dual 1. (inclusive)—, (exclusive) *ngalbe*; 2. *ngi-pel*; 3. *palae*.
Plural 1. (inclusive) *ngalpa*; (exclusive) *ngoi*; 2. *ngi-ta*; 3. *tana*.

These have been fully discussed by Latham,[1] who shows:—

1. That *nga* is a common Australian root to express the 1st person.
2. That *ngi* for the second person is also common.
3. That *pel*, *palae* of the dual is found not only as the numeral "two" but also as the dual pronoun in Australian languages.

To these elements may be added:—

1. The Saibai suffix of the agent *du*, in Miriam *de*, is found in many Australian languages. Lake Macquarie *to*, Turrubul *du*, W. Austr. *dju*, S. Austr. *to* (with pron.)
2. The Saibai *mi*, what? may be compared with Narrinyeri *minya*? (root *mi* or *me*) L. Macquarie *min*?
3. The Possessive suffix *nö* (Saibai) *na*, *ro* (Daudai) *ra* (Miriam) may perhaps be the Kabi (Queensland) *ro* or *no* "an affix indicating possession."[2]

The Miriam *bu*, self, in *karbabu*, *mabu*, etc., is parallel to the L. Macquarie *bo*, which forms the reciprocal noun or pronoun equivalent to self, only. The same may appear in the Miriam prefix *ba*, to intransitive and reflexive verbs.

5. The absence of words for the numerals above two or three.

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[1] Remarks on the Vocabularies of the Rattlesnake, and Opuscula, p. 223.

[2] On the Kabi dialect of Queensland, by J. Matthew, Jour. Anthrop. Inst., Vol. IX., p. 315.

6. In Saibai pronouns distinguish the sexes *Noi*, he, *na*, she. Miriam and Daudai do not. Mir. *E*, he or she, Daudai *noŭ*.

The Gudang vocabulary of Macgillivray shows numerous identities between the Gudang and Saibai. These, however, must be regarded as due to the close intercourse of the Muralug (Prince of Wales Is.) people with the mainland of Cape York. Macgillivray states positively and emphatically[1] that the Gudang tribe are of Australian race, and describes the Muralug as Papuanized Australians, inferior to all the other islanders in culture, though in advance of the Australians proper. This statement is confirmed by Professor Haddon's own observations.[2] Hardly anything is known of Gudang grammar, but in Macgillivray's list the pronouns and numerals, as well as most of the verbs and adjectives, are different to the Saibai. Yet the general resemblance of the Saibai grammar and vocabulary to those of Australia seems to require investigation. That the superior Papuan race should have adopted the language of their inferior Australian neighbours seems improbable, but not impossible. The great difference between the Eastern and Western Tribes of the Straits leads to the supposition that the islanders of the West may have originally been of Australian descent, but that continual conquest and occupation of the islands by Papuans from New Guinea have gradually brought about a change in the physical features of the people, without materially affecting their language. A very similar change has taken place in the New Hebrides, where on the islands of Aniwa and Fotuna, a population which is in physical features and customs entirely Melanesian, is yet found to speak a Polynesian language quite different from the Melanesian dialects of the nearest islands.

The likeness between the Miriam language and that of the tribes in the Delta of the Fly River has been already pointed out. It may thus probably be safely regarded as a true Papuan language. The proper solution of this interesting problem can only be brought about by an accurate knowledge of native customs and languages on both sides of the Straits, a knowledge which at the present time we do not possess.

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[1] Voyage of H.M.S. Rattlesnake, Vol. II., p. 4.

[2] In The Legend of Malu ("Legends from Torres Straits, II." Folklore, Vol. I., pp. 193–4), he says: "In this particular legend it is to me a matter for great surprise that Muralug should be the reputed home of the culture-heroes, for as I have elsewhere shown, the natives of that island, or Kauralaig, are lower in culture than the other islanders in some respects, and approach the Australians."

Many of the Australian affinities of the Torres Straits tongues have been adduced by Dr. Schnorr von Carolsfeld.[1] We would like to point out that in this, as in other comparative vocabularies, resemblances in names for animals and cultivated plants may occur which should be used with great caution; for instance, travellers ask the name of an animal, and get the natives' name for that particular form or species; as likely as not, it is recorded as the name for the group to which that form belongs. Such doubtful words are bird, fish, fly, etc., or banana, yam, sweet potato, etc.

A summary of Carolsfeld's notes may be made as follows:—

Mir. *nĕtat*, one. Austr. words, *ngitya*, *nidda*, *neecha*, *itcha*, etc.

Saib. *urapon*, *warapon*, one. Austr. *werba*, *wirba*, *warpa*, *warpur*, etc.

Mir. *wer*, star. Austr. *waro*, sun.

Mir. *gur*, sea. Austr. *korkora*, karokor.

Mir. *ur*, fire. Austr. *oorra*, *poori*, *burri*, *boorde*, *boode*, etc.

Mir. *tup*, a fish. Saib. *tabu*, snake. Austr. *taboo*.

Saib. Mir. *wapi*, fish. Austr. *web*, *wappie*, *webing*.

Mir. *werem*, child. Kamilaroi, *wurume*.

Mir. *kerem*, head. Austr. *kurria*, *kur*, *gar*, *karm*, *kaam*.

Saib. *kwikö*, head. Austr. *koka*, *kaka*, *gigi*.

Mir. Daud. *mus*, *muso*, hair. Austr. *moder*.

Mir. *irkep*, eye-ball. Austr. *iragoo*.

Mir. *te*, mouth. Austr. *ta*, *taa*, *tha*, *da*, *daw*, etc., etc.

Mir. *tep* (*te ip*), lip. Austr. *tai-appa*, *dabara*.

Mir. *imur*, chin. Austr. *merrung*.

Mir. *tĕrĕg*, tooth. Austr. *tirra*, *thirra*, *teera*, *dera*, *dara*, *tarakin*, *drirk*, *dirrung*, *tirrung*, etc., etc.

Mir. *nonor*, nostril. Austr. *nunder*.

Mir. *tag*, hand. Austr. *tungun*.

Saib. *ngar*, leg. Austr. *akooroo*, *karraku*, *kero*, *kaar*, etc.

Mir. *teter*, foot. Austr. *tarra*, *tharra*, *tara*, *durra*.

Mir. *mĕk*, mark or foot-print ("foot" in Carolsfeld). Austr. words for "foot," *macka*, *makuru*, etc.

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[1] Beiträge zur Sprachenkunde Ozeaniens, Das Australische Festland. München, 1890.

Mir, *gegur*, skin. Austr. *kooloo.*
Mir. *paur*, skin. Austr. *poodla*, *pulta*, *epoola*.
Mir. *gole* (Carolsfeld, *gūli*), black. Austr. *kolli*[1].

These correspondences were based on the vocabularies of Macgillivray and Jukes, compared with the Australian vocabularies in Curr's "Australian Race."[2]

A few others are added from the present notice and Curr, chiefly from North and West Australia and North Queensland.

Mir. *wer*, egg. W. Austr. *wolo*, *wala*, etc.
Saib. *wapi*, fish. N. Austr. *yap*, *geeab*. W. Austr. *wappie*, etc.
Saib. *buli*, fly. N. Queens. *bulbul*, mosquito.
Saib. *kaura*, ear, Mir. *gerip*, Daud. *gare*. Nickol B. *koorulka*, *koolga*.
Mir. Saib. Daud. *baba*, father. N. Austr. *peppel*. Woolna, *bipie*.
Mir. *lar*, fish. Woolna *lieya*, *liyer*.
Mir. *pel*, ear. Woolna *wal*, *wol*.
Mir. *narger*, fly. Austr. *nin*, *nunga*, *nenga*, &c.
Saib. *san*, foot. W. Austr. *chiena*, *jenna*. Common Australian *chena*, *jena*, *ena*, *tin*.
Mir. *kopor*, Saib. *kupur*, Daud. *gupuru*, navel. W. Austr. *gabbel*, *gobble*, etc. N. Queens. *kippa*, *gippa*.
Mir. *teibur*, bowels, pith, Saib. *tabu*, Daud. *tuburu*. Austr. *tepar*, *juppa*.
Mir. Saib. *kalak*, spear. N. Queens. *kulka*, *kalge*, *gulka*, &c.
Mir. *gerger*, day, Saib. *göiga*. Austr. *ungar*, *unga*, *woonga*.
Mir. *irmer*, rain. N. Austr. *walmat*.
Mir. *paur*, skin. Saibai. *pura*. N. Queens. *purra*.
Mir. Saib. Daud. *meta*, *mautu*, *moto*, hut. W. Austr. *minda*, *maie*.

The foregoing is the result of a very imperfect and fragmentary comparison. A closer inspection would probably show many more coincidences. The whole subject of the affinity of the Torres Straits Languages to the Australian is one which is well worthy of further investigation.

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[1] The Mir. word *gur*, salt water, is also compared by Von Carolsfeld with Australian words for "water" and rain, *gūr* being taken to mean "fresh water." The Warrior Island *boule* a fly, said to be probably an error for *boute* is correctly *buli*, and does not compare with Australian *perti*, *beti*.

[2] "The Australian Race" by E. M. Curr, London, 1886-7.

5.—*Miscellaneous Affinities.*

1. A certain amount of likeness between the Dravidian tongues and the Australian has been pointed out by Bleek[1] and Caldwell.[2] This for the most part also applies to the Saibai.

The following resemblances appear:—

Lu, plural suffix in Telugu. Saibai *l*. The Dhimal *galai*, a word denoting the plural, (Caldwell p. 140). Miriam *gaire*. A common plural suffix in Dravidian is *gal*, or *kal*.

Mir. *ni*, water. Tamil *nir*. Saib. *kura*, stone. Tamil *kal*.

Mir. *neg*, laugh. Tamil *nagei*. Mir. Saib. *baba*, father. Tamil *apa*.

Mir. Saib. *pada*, mountain. Canarese *betta*.

Daud. *mere*, child. Canarese *mari*.

Saib. *ngi*, thou. Dravid *nî*.

Saib. *ina*, here. Rajmahal *ino*.

These correspondences are probably of little value.

2. Some agreements between the Australian and the Andaman and Nicobar languages have been pointed out by Von Carolsfeld. Between the latter and the Straits' languages we have noted only the following:—

Mir. Saib. Daud. *uteid*, *utui*, *utuo*, sleep. Gt. Nicobar *etaja*. Mir. Daud. *mus*, *muso*, hair. Andam. *māūde*. Daud. *arumo*, rain. Car Nicob. *kumra*. Mir. *irmer*, rain. Gt. Nicob. *hame*.

3. The following from the Malay Archipelago are in addition to the words already shown to resemble the Melanesian and common Oceanic roots:—

Malay, Matabello, Teor. &c., *rusa*, Tagala *usa*, deer. Mir. Sai. Daud. *usar*, kangaroo. Malay, Javan, *kupukupu*, *kupu*. Teor *kokop*. Mir. *kap* butterfly. Javan. *er*, water. Saib *wer*. Ende *ora* salt. Daud. *oro*. Mir. *gur*. sea. Mysol *tun*. Saib. *dan*, eye. Tidor. Gani *baba*, *lapa*. Malay *baba*. Saibai, Mir. Daud. *baba*, father. Mysol. *mame*, red. Mir. *mam*, blood. Matabello, Teor *gălagăla*, spear. Mir. Saib. *kalak*. Mangarei dial. of Flores *appi*, Saib. *wapi*, fish.

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[1] On the position of the Australian Languages, by W. H. Bleek. Jour. Anthrop. Inst., Vol. I., 1872, p. 89.

[2] Comparative Grammar of the Dravidian Languages by R. Caldwell. London, 1875, Introd., p. 78.

It is necessary to point out that many of the resemblances here noted may have to be corrected in the light of future information. We do not wish to found on them any theory, but merely present them as facts worthy the consideration of the student. To those who believe in the fundamental unity of the Australian, Papuan and Malayo-Polynesian languages they will perhaps afford examples of words widely spread throughout the Oceanic region. The true relations of the Ocean languages, however, are not to be determined by isolated correspondences between words in far distant places, though these as possible survivors of the original speech have their value. The islands need to be joined by linguistic threads one to the other, forming an ever-extending network, of which the twisted strands are not necessarily of the same extent or of the same material. If the Melanesian, Australian, and Papuan Sprachstoff be really distinct, the Torres Straits languages, from their position, may supply threads missing from the net. Till, however, the languages of Western New Guinea and Northern Australia are accurately known we have only a detached portion of the net, and the surrounding threads have yet to be sought.

V.—Sketch of Miriam Grammar.

Considerable difficulty has been experienced in determining the grammatical structure of the Torres Straits languages. Nearly all the translations made have been based on the work of natives of the Loyalty Islands, Melanesians whose native idioms differ widely from those of the islanders of the Straits. Hence it is certain that the Gospels and other translations do not fully represent the language, and contain many mistakes. White men who have lived on the islands, have for the most part been satisfied with vocabularies, in which the equivalent of an English word is often given in a variety of forms, with no clue to the exact meaning of the terms.[1] In the

[1] I much regret that I, too, only collected vocabularies; it would not have been difficult for me to have framed some sentences which would have given a clue to the construction of the two Torres Straits languages, but seeing the translations of the Gospels and the service books in constant use I not unnaturally concluded that a study of these would reveal their syntax. Unfortunately, my confidence was misplaced.—A. C. H.

Rev. A. E. Hunt's Vocabulary (MSS. 5), for instance, "*to be born*" is rendered *eosmeda*, *aosos*, *aosmer*, *osmeda*. "*To ask*" is *itmer*, *eutumer*, *bautumer*, *itimdare*. "*To hear*," *asoli*, *asereda*. In the Rev. E. B. Savage's list, "*to be born*" is *osmelu*, *teosmelu*, *teosmeda*. "*To ask*, *eutumer*, *nautmer*. "To hear," *asor*, *aserei*, *aserare*. It is evident that the words given contain the true roots, "*osmer*," "*itmer*," *asor*," equivalent to the English "be born," "ask," "hear," but no explanation is given of the meanings of the prefixes and suffixes used. These have to be gathered from the Translations.

The Bibliography shows four texts (8, 12, 13, 17) which ought to have provided ample material for a grammar of the Miriam language. To the first of these we have been able to make no reference. The notice which follows is based chiefly upon the Gospels and prayer books (12). None of the missionaries have recorded details of the grammar, and in their reading books the verbal prefixes, especially, seem to have been either ignored or used indiscriminately with little regard to their signification. So far as the printed or manuscript evidence goes, no white man or coloured teacher has ever understood the construction of a Torres Straits language.[1] The results which are here set forth have been arrived at after careful comparisons of the forms found in the gospels. Though viewed from every possible standpoint they leave much to be desired for the elucidation of the verbal forms, and in the notice of the verb an interpretation is here given which, though supported to some extent by the Gospels, may at a future period, be proved inaccurate. The sections relating to the pronouns, nouns, and adjectives may be regarded as correct. All uncertain portions of this sketch are enclosed within square brackets [ ].

The Gospel translations were no doubt made from the Lifu Testament of 1873. Evidence of this appears in the Miriam version as follows:—

1. English and Greek words introduced have the same form in both Lifu and Miriam. Many of these introduced words could have been easily pronounced by Torres Strait natives in their original form

[1] This is no doubt owing to the great difficulty experienced by Europeans in understanding the Australian verb. In Threlkeld's Grammar of the Lake Macquarie dialect, and Hale's notice in the Philology of the U.S. Exploring Expedition are found the most detailed accounts of the Australian verb which exist.

(See note at end of List of Introduced Words), but in using foreign words in Lifu "it is convenient and usual to end with a vowel; a vowel must be inserted between two consonants, and a final consonant is dispensed with. Thus αρτος becomes *areto*, Joseph, *Josefa*."[1]

2. The Miriam word for "twice" in Mk. xiv. 72 is *neisi-em*, the numeral "two" and the causative suffix. This is an obvious imitation of the Lifu *a-lue-ne*, twice, in which *a* is the causative prefix, *lue* the numeral, *ne* the transitive suffix.

3. In Jno. xix. 18, the Lifu causative *a* appears as well as the Miriam *em*. The Lifu has *a-satauro*, to crucify. The Miriam Gospel has *a-satauro-em*. (Satauro = Greek, σταυρος).

4. In Jno. xiv. 18, "comfortless" is translated *ab kak a apu kak* (lit. no father and no mother). The Lifu is *pë keme me thin* (lit. no father and no mother).

5. In Jno. v. 18, the Miriam has: epe E iako detauti, kega, Ade abara Ab kar, pako kaka a Ade abkoreb, which is a translation of the Lifu: ngo ngöne fe la hnei nyidëti hua qaja, ka hape, Akötesieti la sipu keme i nyidë, kola a acei tu nyidë me Akötesie. Both phrases are literally: but also said, thus, God his true father, and I and God are alike. The Miriam kar, abkoreb = the Lifu sipu, acei tu, "true" and "like," which do not appear in the English version.

6. Another evidence of Lifu influence appears in the orthography, the characters *ö* and *ë* being used in the Lifu version.

An example of the wide difference of idiom between the two languages will be found in the following extract (Jno. iv. 28, 29):—

LIFU: Ame hnei föe hna amë pe la ge i nyido, me
Then by woman was left the calabash of her me

tro kowe la hnalapa, me qaja kowe la nöjei ate, ka hape, ange trojë
go to the town and told to the (pl) men saying ye go

fe, ma troa wange la ate cengöne qaja koi ni la nöjei
also so that shall (going to) see a man completely told to me the (pl)

ewëke asëjëihë lo hnenge hna kuca.
things all which by me were-done.

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[1] Rev. J. Sleigh.

MIRIAM: Koskeret tabara nisor ekëdilu, a utëbem bakeamulu,
woman her water-bottle left and to-the-town went-away

a gaire le daratagerare, kega, Tabakeuare, dasmerare abele le
and many men told thus come (go there) see that man

kare natageri gaire lu kaka ekëli.
me told many things I did.

§ I.—*Alphabet.*

1. VOWELS.—*a* as in *father*; *ă* as in *at*; *e* as a in *date*; *ĕ* as in *let*; *i* as *ee* in *feet*; *ĭ* as in *it*; *o* as in *own*; *ŏ* as in *on*; *u* as *oo* in *soon*; *ŭ* as in *up*.

In the Gospels and service books the Lifu *ë* = French *e* in *le*, is also found; we write it *ĕ*.

The short vowels are often confounded, *ătager*, *ĕtager*, to say; *ăro*, *ĕro*, to eat.

A vowel between two consonants is frequently dropped, *karbara* for *karăbara*; *abgrī* for *abgĕri*; *damsare* for *damŏsare*, *trum* for *tŭrum*, *treg* for *tĕreg*.

2. DIPHTHONGS:—*ai* as in *aisle*; *au* as *ow* in *cow*; *ei* as *ay* in *May*; *oa* as *o* in *forty*.

3. CONSONANTS.—*k*, *g*; *t*, *d*; *p*, *b*; *v*, *w*; *j*; *s*, *z*; *r*, *l*; *m*, *n*. These are sounded as in English.

As in the languages of the New Guinea mainland, there is some confusion between *t* and *d*, *p* and *b*, *r* and *l*.

J only appears in the words *jiai*, west, and *jawali*, paper. These are more correctly written *ziai* and *ziauwali*. Jukes notes that there is "a rather peculiar pronunciation of the 'd' or the 'dz,' in which a kind of aspirate is sometimes heard. This sound might sometimes be represented by 'dh,' sometimes by 'dz,' and sometimes by 'th,' or even by the English 'j' in John, where there is also a dental sound" (ii. p. 276). *J* in introduced words is represented by *I*. As a medial and final consonant *r* is common, but it is rarely found as an initial, and is lost before *l*. Lewis sometimes has *d* where others have *r*; *gaide* = *gaire*, *woodwey* = *urwer*. The sounds of *f* and *h* are not found in native words, but occur in words introduced from English. Lewis gives *faiek* = peikĕ, now, of which Jukes remarks that it could not be pronounced at Erub. Lewis also has *sh* for *s*; *maash* for *mas*, *moosh* for *mus*. Both Lewis and Jukes have *th* for *d*; *athega* for *adige*, *ithpay* for *itpe*. In the Gospels *v* and *w* are absent except in (12). Their place is taken by *u*. Dr. Macfarlane's and Professor Haddon's lists have *w*. The Rev. J. T. Scott, whose book (12) was written for Erub, puts *v* where *w* is used for Mer. We cannot say whether this indicates an insular variation, or is merely Mr. Scott's interpretation of the sound for which others have written *w* or *u*. In the vocabulary we have used *w* before vowels, and *u* before consonants.

The absence of the nasal *ng* as in singing is worthy of note. It is also absent in Daudai, and in the Melanesian languages of the South East Coast of New Guinea (Motu, Kerepunu, and South Cape). In Saibai, however, *ng* is a common sound.

The combinations of consonants met with are *dr*, *gw*, *kw*, *sk*. A syllable is often closed by a consonant.

§ II.—*Pronouns.*

1. PERSONAL.—These are declined as nouns by means of suffixes. The forms are as follows:—

(*a.*) *Nominative.*—Singular, 1. *Ka*, I; 2. *ma*, thou; 3. *E*, he, she, it.

Dual. 1. inclusive of person addressed, *mi*, thou and I; *Ki*, exclusive of person addressed, he and I; 2. *wa*, you two; 3. *wi*, they two.

Plur. 1. (inclus.) *Mĕriba*, you all and I; (exclus.) *Kĕriba*, they all and I; *waba*, you all; *wiaba*, they all.

In the Gospels and Mr. Hunt's Reader, *ua*, *ui*, *uaba*, and *uiaba* are written for the Dual and Plur. 2nd and 3rd Pers.

Ka and *ma* are usually reduplicated *kaka*, *mama*. In the plural *ba* probably stands for *aba*, all. (Cf. *naba*, all present.) No distinction seems to be made between the simple nominative and the nominative of the agent. In some cases the simple forms *mi*, *ki*, *ua*, *ui*, are used in the plural (probably when few persons are indicated).

The Miriam pronouns are very different to the forms usual in the Australian languages. The 1st and 2nd Sing. may be compared with the Melanesian suffixed pronouns *ku*, my, *mu*, thy, but the resemblance is probably accidental. By adding *bu* to these pronouns they become emphatic with the signification of myself, thyself, &c.

Sing. 1. *karbabu*; 2. *mabu*; 3. *ababu* or *tababu*.
Plur. *meribabu, keribibu, uabu, uiabu.*

This *bu* = the *bo* of Lake Macquarie, a reciprocal noun or pronoun (Threlkeld. Austral. Gram., p. 25), and is analogous to *-ndi* suffixed to pronouns in South Australia.

(*b.*) *Objective.*—The pronouns, when directly governed by the verb, take the following forms:—

Sing. 1. *kare*; 2. *mare*; 3. *abi.*
Plur. 1. (inclus.) *meribi*; (exclus.) *keribi*; 2. *uabi*; 3. *uiabi.*

In the Reading-book, Rev. A E. Hunt writes *kari* and *mari* for the 1st and 2nd Pers. Sing. The Rev. H. Scott gives ending *e* or *i* in 1st Pers. Sing. and Plur.; *i* only in 2nd and 3rd Pers.

The suffix *bu*, self, may be added to these forms.

(*c.*) *The Possessive* is formed, as with nouns, by the suffix *ra*, 'of.'

Sing. 1. *kara*, my; 2. *mara*, thy; 2. *abara*, his, her, its.

In the plural, the nominative form is used.

Ex. *kara baba*, my father, *keriba baba*, our father, *mara teter*, thy foot, *uaba baba*, your father, *abara tag*, his arm, *uiaba boai*, their kinsman.

My own, thy own, are expressed by inserting *ba* before the suffix, *karbara, mabara.* In the third person *t-* is prefixed, *tabara.* With another possessive *taba, mabe, etc.*, alone are used. *Taba gëme ra meta*, his own body's house.

(*d.*) The Dative is expressed by *-m*, "to" or "for" suffixed to the objective.

Sing. 1. *karim*; 2. *marim*; 3. *abim.*
Plur. 1. (inclus.) *mĕribim*; (exclus.) *kĕribim*; 2. *wabim*; 3. *wiabim.*

If the following word begin with a consonant *m* is dropped (Rev. H. Scott). This is not the use in the Gospels.

(*e.*) The ablative is shown by suffix *-elam*, "from" or "through."

Sing. 1. *karielam*; 2. *marielam*; 3. *abielam*.
Plur. 1. (inclus.) *meribielam*; (exclus.) *keribielam*; 2. *uabielam*; 3. *uiabielam*.

(*f.*) The Ergative, expressing the performance of an action *with* another, is formed by the suffix *-dog*.

In the translations *dog* is usually written as a separate word.

(*g.*) The Instrumental Suffix *de*, is not found with Pronouns. The Locative *ge* is only occasionally found.

Examples of Pronouns:—*E kara aba*, he (is) my father; *uiaba abi asoli*, they hear him; *Ad meriba aba, E au omare meribim, a meribi ikuar gaire debe lu*, God (is) our father, he (has) great love for us and gives us many good things; *nole abkoreb marim ko ekau mabara sik*, (it is) not proper for thee to take up thy bed; *karbabu karim ageakarem*, I bear witness for myself; *E uiabim detaut*, he said to them; *Ade nole abi dog*, God (is) not with him; *E emri kari dog*, he lives with me, *i.e.*, I live and he lives.

Future Pronouns:—For *kai* and *mai*, future forms of *ka* and *ma*, see Verbs (14).

2. INTERROGATIVE.—The Personal interrogative is *Niti* or *Nete*, who? declined as the other personal pronouns. *Mama nete?* who (art) thou? *Nete mari ikuar abele debe gem-uali?* who gave thee this good garment? *Nitira neur mama?* whose daughter art thou? *Nitim keriba bakeam?* to whom shall we go.

Niti, unlike the other personal pronouns, is found with the instrumental suffix *de*. *Nitide sirdam mama ikëli abele gair lu*, by whose authority (dost) thou do these things.

The word *na* is used prefixed to nouns as an interrogative adjective with the meaning "what"? what sort?

Keribi detager, na le E detaut? Tell us what man he speaks of? *Na dorge-lam uaba kare bakeru natimeda?* Through what work do you cast stones at me? *Nalu mara apura nei?* What (lit. what thing is) thy mother's name? *E nade?* Where is he? (For further examples of the use of *na*, see interrogative verbs and adverbs.)

3. DEMONSTRATIVE PRONOUNS AND ADJECTIVES.—The exact use of these is difficult to define.

Pe is used to call attention to some object, *Baba pe Ad*, the Father, that is God ; *Abara berbet gimgim pe Lasaro*, her brother that was sick was Lazarus. *Ab*, this, or that. *Ab gedelam*, from that country. *Abele*, this. *Abele Ad-ra gelar*, this is God's law. *Ia*, this. *Ike*, this. *Kara mam ike*, this is my blood ; *soge pur ike*, this is a desert. *Koreb*, of such a kind. *Ade-ra baselaia uiaba koreb*, God's kingdom (is) such as they ; *ma ko omare le maredog emeri mabi koreb*, you shall love your neighbour as yourself. *Dali*, *E dali*, that, he there ; plural, *darali*, those there ; *Adera areto dali*, that is God's bread ; *Nete le la uerem dali?* Who is this son of man : *Ui darali dudum net dekaelei*, those two quickly left their nets. *Nali*, this here. *Kakanali*, this is I ; *mamanali*, you here. *Naba*, all here.

These words, *dali*, *darali*, *nali*, *naba* suggest a signification of the verbal prefixes *de*, *na*, *dara*, *naba*. (Cf. verbs 6.) *Pe* and *ia* are sometimes combined with *dali* and *ike*. *Abele gemlam osmeda*, *gem pedali*, that from flesh born, flesh that is ; *nerute uiaba iadali*, this is one of them ; *Jesu pedali*, *Josefa ra uerem*, that is Jesus, Joseph's son, *Ab kesem peik*, this is the heir. Dr. Macfarlane gives *geedag*, these ; *geetedag*, those.

4. Indefinite Pronouns and Adjectives.—One, the other, a certain, *nerute* ; some, *uader* ; all, *narid*, *uridili* ; both, *neis* ; each, *nerute a nerute* ; any, *nerute* ; many, *gaire*. These all precede the noun.

§ III.—*Nouns.*

Noun Forms.—A verb may be used as a noun without change of form : *kaka nagri eded*, I have life ; *kaka eded*, I live.

The ablative suffix *lam* seems, in some cases, to form a noun from a verb or adjective. *Asilam* a wound, from *asi*, sore, pain. *Atamelam* a sign, from *etomer*, to show. *Lam* in these cases, no doubt, retains its proper meaning of origin. *Asilam*, that from which the pain proceeds ; *Atamelam* that which results from the showing.

The words *le*, man, or *kosker*, woman, following a verb denote the person doing the action, *eruam le*, a thief, thieving man ; *ares le*, a warrior, fighting man ; *Le* following the name of a place expresses a person belonging to that place ; *Nazareta le*, a Nazarene, *Saibairum le*, Saibai man. *Lu* (thing) following a verb denotes the object with which the action is done, *ares lu*, a weapon, fighting thing; *amere lu*, a seat, from *emri*, to sit; *atketelu*, a needle, from *itkědi*, to sew.

A few nouns (and verbs) appear in two forms, one with, the other without the initial *g* (or *ge*). The meaning of this variation cannot be ascertained. See in vocabulary *garap*, *arap*; *gatkam*, *itkam*, *itkir*; *gebaugare*, *bauger*; *gĕbo*, *eb*; *geseb*, *seb*; *gope*, *op*.

2. Number.—The dual is shown by the numeral *neisi*, two, before the noun; *neisi le*, two men; *neisi lar*, two fishes. The plural is usually expressed by the word *giz* following the noun; *keimer giz*, brothers; *kosker giz*, women; *ged giz*, lands; *tabo giz*, snakes.

The primary meaning of *giz* seems to be that of a lump or mass. As a separate noun it means the beginning, origin, foundation of anything, *e.g.* the stump or base of the trunk of a tree. The plural idea may possibly have arisen from observing the numerous sprouts arising from the stump of a tree when cut down.

The plural is also expressed by the adjective *gaire*, many, preceding the noun, usually with names of things. *Gaire lu*, things; *gair baz*, clouds; *gaire ebur*, animals. *Gaire* becomes *gai* before *le*, person. *Gai le lakub*, many people. The number may be shown by the verbal ending, *abara kaimeg nakuare*, his men gave. When it is clear from the context that the plural is intended, no sign is used. *Uiaba pao nagri*, they have wings; *gaire ebur gem nagri*, animals have bodies; *uiaba nole gesep le*, they are not men of the world. Totality is expressed by *uridili* following the noun; *E umele gaire lu uridili*, he knows everything, all things.

Gab, path, seems to have a plural, *u-gab* (Mk. i. 3; vi. 56). Cf. *uader*, some, and *u-ridili*, all.

3. Gender.—The sex can only be expressed by the use of the words *kimiar*, male, or *neur*, *kosker*, maid, female, following the noun. *Kimiar kau*, a bull; *memeg kimiar*, manservant; *memeg neur*, maid-servant.

4. Case.—The noun is declined by means of suffixes. There are nine cases, Nominative, Instrumental or Nominative of the agent, Accusative, Genitive, Dative, Ablative, Locative, Ergative, and Vocative.

(*a.*) *Nominative and Instrumental*:—

The Nominative is the bare root. The Instrumental is shown by the suffix *de*.[1] The distinction in the use of these two forms does not appear so clearly as in the Australian languages,[2] or in Saibai. In some cases the bare root is used with a verb. *Lazaro uteid*, Lazarus sleeps; *Kodomer uatabu kotolam*, a voice fell from heaven. Usually, however, the agent is expressed by the suffix. *Jesu-de detaut taba gëmera meta*, Jesus spake of his own body's house; *babede kare mer tigri*, the father gave me orders; *gaire le uridili ko alase urde*, all men shall be salted by fire; *Uiaba abara kerem paterde ipit*, they smote his head with a reed; *ese nerute le nole osmeda nide a Lamarde*, if a man be not born by water and by spirit.

(*b.*) The Accusative form does not differ from the Nominative in Rev. A. E. Hunt's reader, and only appears in a few instances in the Gospels. In these cases it is formed by changing the final *a* of the root to *e* (or *i*). *Baba*, father; *Kaka Babe lag*, I love the father. *E Pilatoi damos*, he asked Pilate; *E Jesu i op-ge ekësmer*, he fell in front of Jesus (accus. used for possessive, see *k*).

(*c.*) The GENITIVE or POSSESSIVE case is shown by the suffix *-ra*. *Ade-ra gelar* God's law; *uetpur-ra opole*, feast's chief; *le ispidara kodomer*, the bridegroom's voice; *Mariara uerem*, Mary's son. In some cases *ra* becomes *la* or *r*, *Nerute le la kaimer*, a man's brother, *aber nei*, father's name. *Ra* may be compared with the Daudai *ro*, of; the North Queensland *ro*; Andaman *lia*.

(*d.*) The DATIVE, denoting motion towards, or purpose for which a thing is intended is shown by the suffix *-em*, or *-ïm*. *Galilaiem*, to Galilee; *paserem*, to a mountain; *Adim*, to God; *tagem*, to a hand; *metaem*, to a house; *nerute neur abkoreb kosker Isakaim*, a girl suitable as a wife for Isaac; *Ko nerut lu ikëli abem a apuem*, to do anything for father or mother. Verbs of asking, believing, saying, giving, are often found with a dative object. *E Adim itmer*, he asked God; *Ad Evaim detager*, God said to Eve.

(*e.*) The Ablative, denoting direction from, or origin, is shown by

[1] *Du* is found as a suffix denoting the agent in Saibai and Kamilaroi, and corresponds to the *to* of Lake Macquarie.

[2] Australian nouns have two nominative cases :—" The first nominative is simply declarative, wherein the subject is inactive, as, this is a bird, *unni ta tib-bin*. The second nominative is when the subject is an agent causative of action: as *tib-bin-to ta-tân*, the bird eats. (Threlkeld, Australian Grammar, p. 10.)

the suffix *-lam*, or *elam*. *Meta-lam*, from a house; *Judaialam*, from Judea; *Kaka bakeam abi itiri uteidelam*, I go to awake him from sleep; *eudelam ededem*, from death to life; *gesep eded abielam*, the world (is) alive through him. A final *r* is lost before *lam*; *uzer*, a paddle, *uzelam*; *neur*, a girl, *neulam*; *nar*, a ship, *nalam*; *mer*, word, *melam*; *kotor*, sky, *kotolam*.

(*f.*) The Locative, denoting position in, or at, a place, is shown by the suffix *-ge*. *Zogo meta-ge*, in the holy house; *nerkep-ge*, in the heart; *kupkupi-ge*, in darkness; *E gesep-ge*, he (was) in the world; *tauer-ge*, on the shore.

(*g.*) The Ergative, denoting one doing the action with another, is shown by the suffix *-dog*. *E Ade-dog emrilu*, he abode with God: *nerute uabielam kare keserkeser, abele le kare-dog eroli*, one from you betrays me, the man eating with me.

The Rev. A. E. Hunt adds *dog* to the Dative form of nouns. In the Gospels it is added to the accusative. Thus Rev. A. E Hunt has: *E emri Adim-dog kotorge*, he abides with God in heaven; *Uiabi leuer eroli Josefaim-dog*, they eat food with Joseph. "With" meaning "in the company of" is translated by *kem-em*. *Ki ko nabakeuare mare kem-ëm*, we all will go for your company; *gaire lamepa këm*, with lamps; *gaire be këm*, with torches. *Dog* is often equivalent to the English "have." *Arëto naket uabidog?* How many loaves have ye? *Nagelam mare dog eded ni?* From where do you have the living water? *Demoni mare dog*, you have a demon.

(*h.*) The Vocative does not differ from the nominative except in the words, *Baba!* my father! *Amau!* my mother! used instead of the common *aba* and *apu*.

(*i.*) There is the appearance of a case ending in *u* (Instrumental). *Sopem irpi ualiu, sopem irpi tauelu*, bound with a napkin, bound with a towel (Jno. xi. 44); *uaba kare bakeru natimeda*, you throw-at me with stones (Jno. x. 32); *sebge detali tagu*, wrote on the ground with (his) hand (Jno. viii. 6).

(*j*) In some cases *t* is found as a noun termination. *Abele le kare naorar, E kare abet naorarti*, he that hates me hates the father also (Jno. xv. 23); *Opole, keribi abet detomereta*, Lord show us the father; *mabi abet a mabi apuet naospili*, honour thy father and thy mother. In these *t* would appear to mark the accusative were it not that in John iv. 15, 17, 19 we find, *koskeret detaut, koskeret abi detager*, the woman said, the woman told him, and in Jno. iii. 35, *abet uerem omare*, the father loves the son. In these *t* is used with the nominative. (Cf. Jno. iv. 25, 28; xiv. 9, 13; xvii. 1.)

The Rev. J. T. Scott (11) used *t* with the word *abet* both as an objective and nominative. *E abi abet itikaretili*, he asked his father; *abet abi detager*, the father said to him.

There is a possibility that this use of *t* may have arisen from a Lifu teacher's imitation of expressions in his own language. In Lifu it is usual to add *ti* to words when used in a respectful manner. The first of the sentences given above, is in Lifu: *Ame la ate methinë ni, kolo kö a methinë kakati fe*, he that hates me hates the father also. Here *kakati* is the respectful form of *kaka*, father. In the next example (Jno. xiv. 8), the Lifu has *tetetro*, a very respectful word for father, taken from the chief's language. Though the termination *ti* is not used in the Lifu in all cases where the Miriam has *t*, it is worth notice that the idea of honour or respect is present in nearly every case. The words as given in a modified form by the Lifuan interpreter may have been taken by the English missionaries as correct Miriam.[1] Cf. § xi. Numerals, 2.

(*k*) When a word in any case except the nominative or accusative is used with the possessive case of the pronoun or noun, the latter loses the possessive suffix. *Kara nei*, my name; *kare neilam*, through my name; *kare ab taglam*, from my father's hand; *karba abem*, to my father, *mabe gimlam*, from thy sickness; *abi tumge*, on him, on his top; *taba ged ge*, in his own country; *le kemge*, in a man's body.

§ IV.—*Adjectives.*

1. A few simple adjectives are found. *Au*, large; *kebe*, small; *nit*, bad; *debe*, good. Many of these have the words *le* (person) or *lu* (thing) added, according to whether a person or thing is qualified.

2. Most adjectives are formed from nouns by reduplication, e.g., *muimui*, deep, from *mui*, the inside; *mamam*, red, from *mam*, blood; *eudeud*, deadly, from *eud*, death; *lamlam*, many, from *lam*, a leaf;

[1] "I always thought, and do still, that the ending "et" principally to be found in John is an affectation of one of the pundits of the occasion and in my estimation would have been best ignored for the sake of simplicity.—Rev. H. Scott.

turum turum, fruitful, from *turum*, a fruit; *nini*, filled with water, from *ni*, water.[1]

In other instances the reduplicated form occurs, but the root is not separately found, *golegole*, black; *gebigebi*, cold; *eded*, living.

A vowel is sometimes weakened in reduplication, *garger*, sharp; *kerekar*, clean.

A few adjectives are formed by adding *kak*, not, to the root of another adjective. *Barkak*, crooked from *barbar*, straight, *zurkak*, smooth, from *seksek*, rough. This formation is a regular one in the language of the Western Tribe, and occurs also in Daudai.

3. Comparison is usually made by two positive statements. *Debele ma ededem barot netat teter, a adud neisi teter genaim batauerde*, Good (that) thou enter into life one foot, and bad (that) two feet enter into hell.

Comparison may also be made by means of the noun *tum*, top, usually in the dative (*tum-em*) or locative (*tum-ge*). *Ma aule tumem keriba aba Jakobo*, Thou (art) greater than our father Jacob; *kara aba aule kare tumge*, my father is greater than I.

4. The Superlative is expressed by means of the dative tumem, of the noun *tum*, top. *Sinapi këp kebikeb tumen gair këp uridili geseb-ge emor: emetu emor, E omeida, a aule tumem gair lu ekekeri*, mustard-seed, little above all seeds in the earth sown; after sowing it grows and great above all trees becomes.

5. A "great many" is expressed by emphasising and prolonging the *ai* of *gaire*, *g-āī-re*. A similar intensitive is given to analogous adjectives by emphasising and prolonging the middle syllable. Peculiar expressions used as adjectives are *lukak*, poor (no thing); *nogem*, naked (only flesh); *lu gizra apu*, rich (mother of things or property). In Jno. viii., 44, *E besbes, a aba bësapu*, he is false and father of lying.

§ V.—*Verbs*.

1. Verbal roots apparently always to commence with a vowel. *Asmer*, see; *atager*, say; *emri*, stay; *ezoli*, cry; *imo*, put out; *ikuar*,

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[1] Adjectives in Daudai are formed in the same way. *Tamatama*, thin, from *tama* skin; *ipuipu* dirty from *ipua, opu*, soil. A few examples are also found in Saibai.

give; *irmir*, follow; *itmer*, ask; *osmer*, come out; *umare*, love; *oituli*, believe; *umer*, know.

This initial vowel constantly varies without any change of meaning[1]; e. g., *aro*, *ero*, eat; *atager*, *etager*, say; *agared*, *egared*, receive; *akuar*, *ekuar*, *ikuar*, give; *akere*, *ekëli*, *ikeli*, do; *esmeda*, *osmeda*, *aosmer*, be born; *oatur*, *uatur*, believe. The verbal roots appear to end in almost any consonant or vowel, but the most common endings are *r*, *t*, and *m*.

2. *Verbal Forms.*—(*a.*) *Causative.* This is shown by the suffix *em*. *Barkakem*, to make straight, from *barkak*; *satauro-em* to crucify, from *satauro* (Gr. σταυρος) cross; *akmerem*, to inform; *akmer*, to know; *kurab*, savour; *kurabem*, to flavour. When added to a verb, *em* often appears to denote purpose, (*cf.*) the dative suffix. *Kare ni nakuar ko areem*, give me water to drink, for drinking; *ko leuer arapem*, to buy food, for food buying.

(*b.*) *Negative.* The *Negative* is shown by *nole* preceding the verbal root with, or without, *kak* following. *Uiaba nole uteidi*, *a nole bazoli*, *a nole asi kak*, *a nole gim kak*, *abelelam uiaba lamar*, they (do) not sleep, and (do) not cry, and not (have) pain, and not (have) sickness, because they (are) spirits.

(*c.*) *Interrogative.* The word *Nako* introduces an interrogative sentence. *Nako ma dasmer lem peike?* Do you see the sun there? *Nako ma Esau kar?* Are you Esau really? *Nako kotorlam!* Was it from heaven? The interrogative force lies in *na* (see Interrogative Pronouns and Adverbs). *Ao* is also found as an interrogative particle. *Ma Elia ao? Ma perofeta ao?* Are you Elias? are you a prophet?

(*d.*) *Quotations.* These are introduced by *kega* (in Saibai *keda*). *Gaire le batagereda, kega, E eumida.* Many men said "He (is) dead."

(*e.*) There is no substantive verb. *Kaka Abarahama ra Ad*, I (am) Abraham's God; *Kaka mamoe giz ra te*, I am the sheep's gate; *Ade lamar*, God (is) Spirit. Owing to this absence of the substantive in Miriam, words which are not in verbal form appear as verbs: e. g. *netat gedim*, to assemble, *i. e.* (to go to or be in) one place; *nole mokakalam*, to differ, *i. e.* (to be) not alike.

3. In the translation of the Rev. A. E. Hunt (17) a very sparing

[1] I think the variation of initial vowel is only due to the influence of individual choice.—Rev. H. Scott.

use is made of suffixes and prefixes. In the Gospels and prayer-books they are very generally used, and what follows is the result of a close comparison of the forms there found. In doubtful cases the note is placed within square brackets, thus [ ].

The verbal root is modified by prefixes and suffixes to express variations of mood, time, [place] and number.

4. *Mood* :—

(*a.*) *Imperative.* The suffix *-am* is used to form the imperative mood, but only to express an order to two persons. *Ua tabarkam, dasmeram*, you two come, see! *Bakeamulam*, you two go! *Ua detautam*, you two say.

In the plural *-em* is sometimes found with the same meaning. *Uaba aserauem*, Listen ye! Usually, however, the ordinary form of the verb is used in the imperative. *Uaba mamor dasmer, derser, a esorerapare*, you carefully look, prepare and watch, and pray! *Tekue, mabara sik ekau, a mabara meta bakeamu*, Stand, thy bed take, and go—to thy house.

A mild form of imperative is shown by *mase* (come) or *debele* (it is good that) placed at the beginning of the sentence. *Mase keribi upinati*, do help us! *Debele meriba mamoro asoli Jesura debe mer*, let us carefully hear Jesu's good word! *Debele meriba nerezi*, let us rest!

The prohibitive does not differ from the ordinary negative. *Ma nole geum kak*, do not fear! *Ma nole eruam kak*, do not steal!

"Must" is translated by a noun *dorge*, work. *Meriba dorge ko ikerare*, we must do, lit. our work to do. This idiom is adopted in the jargon English now spoken—if anything they have to do is referred to—they say "work belong we fellow."

(*b.*) *Infinitive.*—A verb in the infinitive is preceded by *ko*. *Uaba nole mare namos ko uiabi egaret geseplam*, I do not ask thee to take them from the world.

(*c.*) *Desiderative.*—A wish is expressed by *lag*, usually reduplicated *laglag*. *Ma laglag ko kari ipit*, you wish to strike me; *Josefa laglag ko dasmer Benjamin*, Joseph wished to see Benjamin. Disinclination is shown by *nole la kak* (*la* for *lag*). *E nerut meta badari a nolé la kak nerut le abi dasmer*, he entered another house, and did not wish any man to see him.

(*d.*) *Potential.*—A kind of potential is expressed by *umele* (lit.

know how); in the negative *umer kak*. *Nete umele asoli?* Who can hear it? *Gaire le umele badari*, all men can enter; *uiaba umer kak leuer aroare*, they cannot eat food.

(*c.*) *Subjunctive and conditional.*—These apparently do not differ in form from the indicative, but are expressed by means of the conjunctions *ese*, if, and *ueakai*, then, so that. *Maiem, ueakai kaka mari itut a umele ese mama Esau kar* (come) to the place-near, so that I (may) touch thee and know whether thou (art) true Esau; *mabara tag abi-tumge dikmerik ueakai abi digiri*, lay thy hand on her and then she lives; *ese kaka bakeam, kaka ko abi emarida uabim*, if I go, I will send him to you.

5. *Time.*—[The Rev. H. Scott names two tenses "Imperfect (including also Present and Future), and Perfect (including Pluperfect and Future perfect)," but gives no explanation or illustrations. A careful comparison of the texts does not make the distinction clear, and it is possible that the reference may be to what (in the present sketch) are called the distinctions of place.]

In the Gospels the verbal forms are apparently indefinite and time is expressed by an accompanying adverb.

(*a.*) *Past.*—A definite past is expressed by *emetu* (after, finished) preceding the word. *Kaka emetu uabim detaut abele gaire mer*, I have told you all these words; *Mara keimer emetu tabakeam a kari okardar* your brother came and deceived me; *E emetu meribi detagem*, he has made us.

(*b.*) *Future.*—The future is shown by *ko* preceding the verb. *Kara Aba ko kari itut*, my father will touch me; *ua ko damsare*, ye shall ask.

The pronouns *kaka* and *mama* take the forms *kai* and *mai* in the future, *ko* is then omitted. *Kai iako uabi dasmer*, I will see you again; *mai nagedim bakeam?* you will go to-what-land? *Kai ezagili kara meta-neg*, I will pull down my barn.

(*c.*) *Continuance.*—[The prefix *ua* (*wa*) seems to express the idea of continuance], which is, however, more commonly shown by the use of the adverb *mena* (still, continuously). *Gair le uatupili*, many were coming and going; *uaba ko dasmerare kotor uanakesmur, a gair Adera angela uatabatuer iako uabog tumem le la uerem*, ye shall see the sky opening and God's angels descending and ascending upon the son of man; *kaka mena uiabi dog gesebge, kaka uiabi nasesereda*, while I remain with them in the world, I take care of them; *kerker ia uatabaruk*, the time is now coming; *ma tabakeam, kara uerem ue eumi*, come down, ere my child die (? my child is dying).

[There is a verbal ending *eda* which in many cases appears to have a reference to past (imperfect) time. As we have quite failed to obtain an explanation from any of the translators we append a few exa nples from the various texts.]

(No. 12.) *E wiabim detagereda*, he said to them; *wiaba asereda*, when they have heard; *nole arbum kak; iuëakai* wheat *ko darbumda okakes*, don't pull up, lest (you) pull up the wheat also; *e abi* 100 pence *dekarida*, he owed him 100 pence.

(No. 13.) *Iesu teosmeda zogo metalam*, Jesus went out of the temple; *uerem giz tekue obapit uiaba aba a apu, a ui emarida ko eumida*, children rise up against their father and mother and shall cause (allow) them to be killed. *E Barabasa uiabim namarida*, he released Barabbas unto them.

(No. 17.) *Iakobo nole la kak ko namarida Benjamina*, Jacob did not wish to send Benjamin; *Emetu Josefa eumida*, after Joseph was dead; *Mose mamoe asesered*, Moses was minding sheep; *gaire Israela le odarateda Mose ra mer*, the Israelites believed Moses' word; *Ad namarida gaire dordor narger*, God sent many many flies; *Uaba obazgeda*, they repented.

6. [*Place.*—Four verbal prefixes are in use which seem to denote the place in which the action is performed. These are *ba*, *na*, *de*, and *dara*.]

(*a.*) The prefix *ba* shows the continuance of the action in the same place as the agent.[1] In most cases it takes the place of the initial vowel of the verb, but in a few instances combines with the initial in the form *bau*.

There appear to be three ways in which *ba* is used:

1. As a prefix to intransitive verbs. *Bakeam*, go; *balu*, enter; *bazeguar*, be quiet; *babuser*, to ooze; *uaba bazik bakeuare, a sebge bakësmer*, they backwards went and on the ground fell.

2. *Ba* prefixed to a transitive verb causes it to become reflexive, e.g. *bauspili*, to boast, praise oneself, from *espili*, to praise; *lem baraigida*, the sun's setting, from *araiger*, to dip; *mabu bakeli Ad*, you

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[1] Compare *bu*, *ba*, self, own, in pronouns.

make yourself God, from *ikeli*, to make, do; *batagem*, to conceive, from *atagem*, make; *barot*, to enter, from *arot*, to put in, etc.

3. With plural agent *ba* forms a reciprocal; *basared*, to argue, hear one another, from *asered*, hear; *bares*, to fight one another, from *ares*, to fight; *bataparet*, to quarrel, from *ataparet*, scold; *Nako uaba mer batagereda abele nole leur kak?* Why do you say to one another (there is) no bread.

There are a few words which present some difficulty if this view of the meaning of *ba* be correct. An example, adduced by Rev. H. Scott, is *bataueret*, to throw, especially in the phrase *ner bataueret*, to throw out one's breath, to breathe, where the sense is almost intransitive. To throw a stone at any one is *bakeru itimed*. *Na dorgelam uaba kare bakeru natimeda?* Why do you throw stones at me? (Jno. x. 32.)]

(*b.*) [The prefix *na*, appears to denote the performance of the action in the same place as the relater or describer of the action.] It rarely appears in the third person, but is very common in the first and second. The adverb "here" may in almost every case be understood, chiefly with reference to the object of the verb. This view of *na* receives some support from the vocabularies. The Rev. E. B. Savage (MS. 7), gives *na ua?* you stay! *naba*, all here, all present; *ma na mi!* you sit down here. In the Rev. A. E. Hunt's Reader (15) we find *Nako! ma Esau kar?* What! you (are) real Esau? The answer is *Kakanali*, I am. In the Gospels *kakanali* is found equivalent to "It is I" (who am here) in allaying doubts or fears; *uaba kare nabei Ereuere le a Opole, uaba debe detaut, kaka nali*, you call me teacher and Lord, you speak good, so I am. Other examples are *kai te nali*, I am the door; *kai nali*, I am he.]

In the third person the corresponding expression to *kakanali mamanali* is always *E dali*, he there.

Examples of *na* may be classified as follows:—

1. With first and second persons in imperatives and requests. With third person, only when object is present. *Kare narmili*, follow me; *mi nabakeuare gair mai ged*, let us go to the next place; *kare n nakuar*, give me water; *kaisarara lu kaisaraim nakuar*, give Cæsar's thing (present) to Cæsar; *uaba ge nameri*, abide ye here.

2. In conversations. *Uaba pone nagri a nole asmer kak*, you have eyes and do not see; *ese mama laglag mama umale kare nadigiri*, if you

wish you can cure me; *ki ko nabakeuare mare kemem*, we will go with you; *kaka mare namos*, I ask thee; *uiaba ko mare nasmereda ad kar netat, Jesu Keriso mama namarida*, they shall know thee, the only true God, and Jesus Christ (whom) thou hast sent; *kaka nabue Babealam*, I came from my father; *abele uiaba ma kare nakuar*, those (whom) thou hast given me; *ki nabaume*, we are perishing.

(*c*) [The prefix *de* (of which *te* appears to be only another form), refers to an object in a place removed from the speaker], and corresponds in sense to the demonstrative *E dali*, he there. It is the usual form with the third person, singular object, but is sometimes found with the first and second. Examples from the Rev. E. B. Savage's vocabulary are *desisi*, to feed one; *tegaret*, to bring, if one man. The use in the Gospels appears to correspond. *De* becomes *d* before verbs commencing with *i* or *a*.

Examples:—*E dasmer nerute ged*, he saw a country; *keriba abara zorom dasmerare*, we saw his glory; *Ad detagem gaire lu*, God made all things; *ua ko damsare* ye shall ask; *ma dekaer mabara ged*, you leave your own country; *dasmer! kara apu*, look! my mother; *uiaba abi derar*, they hated him; *uiaba tabaos*, they came; *ui Filipoim tabakeuare*, they came to Philip.

(*d*) [The prefix *dara* (or *tara*) is used with an object in the first or second person dual], and corresponds to the demonstrative *darali*, they two there. In the vocabulary of Rev. E. B. Savage *taragaret* is "bring, if two men;" "*derasisi*, to feed two." This is the use found in the Gospels, but in a few cases it appears as though *dara*, refers to a small number of objects, not necessarily two only.

Examples:—*Iesu ui darali daratager*, Jesus told them two; *Iesu egreemalu a darasmer ui darali abi irmilei*, Jesus turned round and saw them two, they followed him; *E uiabi darabgerare a uiabi daratagerare*, he called them and told them.

(*e*) *Dara* used with the plural suffix *are* is given by Rev. E. B. Savage (but rather vaguely) as the plural form corresponding to *de* and *dara*. "*Taraisare*, bring, if plenty men; *derasisiare*, to feed plenty." He also gives a trial form "*tararaisideri*, to feed if three men." Of similar form to the latter we find in the Gospels no examples.

Examples of *dara* with suffix *are*: *Iesu gair le lakub derabgerare abim*, Jesus called the multitude to him; *E gaire mamoe darakaertare*, he leaves the sheep; *E uiabi darabgerare a uiabi darategerare*, he called them and told them.

(*f*) The prefixes are very frequently omitted, and even when used are often used only with one verb in the sentence.

7. *Number.*—The number of persons concerned in an action is expressed by means of suffixes to the verbs.

(*a*) *Singular*—A verb is used without a suffix in the singular, but more commonly takes the suffix *r* or *er*, which seems in many cases to give a distinctively verbal character to the word. *Niabge* (water want) is thirst, *ni abger*, to ask for water. Examples.—*E abi detager*, He told them, *E no lam dasmer*, he saw only leaves.

(*b*) *Dual.*—When two persons are referred to as performing the action, the verb takes the suffix *-ei*.

Examples.—*Abele neisi kaimeg abara mer aserei, ui darali Iesu irmilei*, the two disciples heard his word and followed Jesus; *ui darali bakeamulei a dasmerei abara uteb*, they two went and saw his dwelling; *Ma mamoro mara aba a apu naospereie*, honour thy father and mother. (In this example the object and not the subject is dual).

(*c*) [*Trial*—The Rev. H. Scott gives *iei* as "verb ending for the action of three," but gives no example.] The use of *iei* in the Gospels does not make the meaning clear. In Jno. 1. 38, we have "*Iesu egreemalu, a darasmer ui darali abi irmilei, a ui darali detagerei, kega, nalu ua deraimeriei?*" Jesus turned and saw them two follow, and said to them two, thus, what do you two seek. Here *iei* is used of two, and *ei* (the ordinary dual) is used of one speaking to two. In Jno. xx. 10, *bakeamudariei* is used for "two went," but in Mar. i. 20 we have *E sobkak ui darali ererekiriei*, he directly called them two. Possibly *iei* denotes three persons *concerned* in the action, not necessarily performing it.

(*d*) The plural is shown by the suffix *are*, *Uiaba bakeuare*, they went; *uiaba nautmerare*, they asked; *keriba abara zorom dasmerare*, we saw his glory; *uaba kare nasmerare*, you see me.

8. Other verbal prefixes are *ob*, *oka*, *it*, *esa*, *erkep*.

(*a*) The prefix *ob* apparently implies opposition, and may be connected in meaning with the noun *op*, the face or front of anything. Examples are *obapit*, meet, from *ipit*, strike; *obatutulei*, two persons come together again, from *itut*, touch; *opaseseret*, detect, take knowledge of, from *aseser*, to look after; *obazgeda*, repent, from *basik* (?), to go back. *Gaire le nolam ko asoli abara kodomer a ko obakiam*, men from the grave shall hear his voice and come back.

(*b*) There seems to be a prefix *oka* with intensive force. *Okabatageli*, grieve; *okadeskeda*, preach; *okadiridili*, accuse; *ok-ardare*, hypocrisy; *okataprik*, to forget.

(*c*) Many verbs denoting movement begin with the syllable *it*. This may probably be analogous to the *ngapa* of Saibai (See Macgillivray II. p. 307).

(*d*) The meaning of *esa* is doubtful. It is seen in *esakri*, outside (Mk. xi. 14), *esaimelu*, *esaimeda*, pass by or over; *esakeilu*, cut (Mk. v. 5). Cf. *akri*, cast out or away, *digmi*, pass, *dikeam*, cut off. *Esameida* to be darkened is from *asam*.

(*e*) A few verbs have *erkep* prefixed. *Erkep-agan*, to lust; *erkep-akos*, to spy; *erkep-asam*, to shut the eyes. Here *erkep* is the same as *irkep*, the eye-ball, and *agan* = *akai*, make; *akos* = *ekos*, put forth; *asam*, to darken. These seem to be the only examples in Miriam of a practice which is common in Saibai, that of prefixing to the verb the name of the part of the body concerned in the action. Cf. Saibai Grammar in Part II.

9. *Directives.*—Certain suffixes are apparently used as directives. Those in which the directive force is most evident are *mu*, *muda*, *ik* *ulu* and *os*.

(*a*) *Mu*, *muda*, denotes motion forth, or outward (as Polynesian *atu*), perhaps connected with verb *imuda* from *imo*, *imu*, to put forth. Ex. *itirimuda*, to put forth the hand, *itiri*, to stretch out the hand; *bakeamuda*, to depart, *bakeam*, to go.

(*b*) *Ik* shows motion away, perhaps connected with the verb *ekai*, to leave. Ex. *emarik*, to give up, deliver (allow to go), *amari*, to allow; *dituaki*, reject, *detue*, to loose; *erask*, to roll away, *erparik*, to remove away, *erpei*, to grasp, *basik*, to start back, fall away from, *tabaruk*, to come away, *desak*, to erase, etc.

(*c*) [*ulu*, motion towards, inwards (perhaps connected with *balu*, to enter)]. Ex. *bakeamulu*, come in, *egeremalu*, look towards, *ekuelu*, to rise up, *egimulu*, to settle upon, etc.

(*d*) [*os*, forth]. Ex. *ekos*, to put forth; *tabaos*, went out. Cf. *osmer*, to come out, be born.

10. Other verbal suffixes occur, but their use is not clear. We give some examples of sentences containing them.

(*a*) *auem*. *Gair le tabarkauem abgedelam*, people came to him, from everywhere; *Meriba nole dasmerauem tonar mokakalam*, We never saw it like this fashion; *E uiaba nadgirauem*, he healed them; *uiaba aule ra tonar irmirauem*, they follow the traditions of the elders; *Uader gaire le ge tekue, nole eud kak, kekëm adera baselaia dasmerauem tabarki këmem adgiri*, some that stand here, not die, till they see God's kingdom come with power.

(*b*) *erti*, *arti*. *Abara mam diruruarti*, her blood dried up, *E kotor dimiruarti*, he looked up to heaven; *Iesu a abara kaimeg giz nar ge ekauererti*, Jesus and his disciples took a ship; *Ese nerute le meta dekaerti*, if a man leave his house.

(*c*) *oa*. *Uaina apaiteredoa*, wine is spilled; *Abele le ma dasmer Lamar zogo uëeperoa abi kerem ge egimurua*, the man you see the Holy Spirit descending and settling on his head.

(*d*) *i*. This is a very common termination of the verb, and mostly occurs with *l* or *r* as *li* or *ri*. The meaning is obscure. Sentences in which these are found do not differ in sense from those in which *r* (see 7*a*.) is the termination

(*e*) *le* and *lu* as verb endings are also found. They may possibly be compared with the adjective terminations *le*, *lu*, and the nouns *le*, man, *lu*, thing.

(*f*) In Mk. i. 19, *Abele ge-lam E Kebikeb ekasereder*, when he had gone a little farther from that place; and in Jno. ii. 14, *gaire le mani eraplare emereder*, money changers sitting there seems to be a suffix *eder*. Cf. *ekas*, *emri*.

It is evident that these notes on the Miriam verb leave much to be desired for the accurate understanding of the language. The faulty material and printers' errors have no doubt led to many misunderst ndings. If what is here stated leads to a future correction, the p1 1pose of the writers will be fully served.

§ VI.—*Adverbs.*

1. *Interrogative.*—Interrogative adverbs are formed by means of the word *na*, what? prefixed to nouns or case particles.

(*a*) *Place.*—*Nade?* where? *Nade mara aba?* where's your father? *Nagedim?* (lit. to what place) whither? *Mai nagedim bakeam?* whither wilt thou go? *Nadelam?* (from where) *nagelam?* (from what place) whence? *Ki umer kak nagelam E dali*, we know not where he (is) from.

(*b*) *Time.—na gerger ge?* (lit. at what day) when? *Ma ge tabarki na-gerger-ge?* when did you come here? *Naket gerger?* (how many days) how long?

(*c*) *Cause.—Nalugem?* (for what thing?) why? *Nalugem ma kare nautumer?* why do you ask me? *Nalugelam?* (through what) why? how? *Nalugelam ua nole aro kak abele debe turum?* why don't you eat this good fruit? *Na-dorgelam?* through what work? *Nalu tonalam?* through what sort of thing, how?

(*d*) *Number.—Naket?* how many? *Ad naket?* how many Gods; *Ma keribi bamsili naket gerger?* how many days will you keep us waiting?

2. *Place.*—These are mostly nouns or demonstratives, usually with the case particles suffixed. Distinction of place seems sufficiently expressed by the verb. *Ge*, *abele-ge*, in this, here; *ma ge*, there or here (lit. at you) *ese ma ge emri*, if thou hadst been here; *maike*, in the neighbourhood, near; *maiem*, to the neighbourhood, near; *tauerge*, on the shore, etc. In the Gospels *idali*, *peike*, there; *iama*, *ike*, here. In the vocabularies, *moko*, there at a distance; *eipu*, in the middle; *keubu*, next; *mop-ge*, at last, at end. The Rev. A. E. Hunt writes *abele taim* (English, *time*) for "then."

3. *Time.—Kige*, in the night; *banege*, at dawn; *peirdi*, now; *menaba*, in little while; *niai*, *niaiem*, for a long while; *iuaokaer*, *abgeregere*, to-morrow; *mopkak* (lit. no end), never; *iobaru*, on next day; *nur*, at pruning time; *penoka*, now, while; *inoka dali*, in the meanwhile, then.

4. *Manner.—Elele*, strongly, emphatically; *mamoro*, carefully; *abkoreb*, such as that, just so, accordingly, suitably; *mokakalam*, like; *kem*, likewise; *nosik*, one after the other; *ageakar*, truly; *au* (lit. large), very; *sagim*, in vain; *dudum*, *dudumge*, quickly; *iako*, again.

The word *no* (the root of *no-le*, nothing, not) is used in a restrictive sense equivalent to "only," "just," and often translates the conjunction "but." *E nogëm*, he was body only (naked); *Uiaba no kare naorarti*, ye hate me for no reason; *Iesu nole utëbge tabarki, E no emri abele utëb Maretha abi obapit*, Jesus was not come to the town, but stayed where Martha met him.

§ VII.—*Postpositions.*

These take the place of the English prepositions.

1. The simple postpositions used as suffixes to nouns and pronouns are *ra*, of; *em*, *im*, to or for; *ge*, at, in; *lam*, *elam*, through, from, off,

out of; *de*, by means of; *dog*, with. Their use is illustrated in the sections on pronouns and nouns.

2. Some nouns are used with postpositions to denote relations of place. These are: *op*, face; *tum*, top; *mui*, inside; *sor*, back; *adi*, outside; *mop*, end; *lokod*, the bottom, under part; *mai*, the place near; *pek*, *deg*, side. They appear as *opem*, before; *tumge*, above; *tumem*, over; *muige*, inside; *sorge*, after, behind; *adem*, to the outside, away from, out of; *adige*, on the outside; *adelam*, from without; *mopge*, at the end, last, till, until; *lokod ge*, at the bottom; *lokotlam*, from below; *mudge*, under; *dege*, beside; *maige*, *maiem*, near, near to. *Këmem*, used for "with," is doubtless a word of the same kind, *këm* meaning company.

The word *kes* is used for "for," "for the sake of." *Kaka ko ekuar kara eded mara kes*, I will give my life for thy sake; *ab gede ra kes*, for the people's sake.

3. Many Miriam verbs express ideas which in English require a verb and preposition.

§ VIII.—*Conjunctions.*

1. And, *pako*, *ko*; also, *ko* (used only with nouns); *a*, and (with verbs). But, *epe*; or, *a*; if, *ese*. That, so that, in order that, *ueakai*; than, *tumem*; thus, *kega*; for this, because, therefore, *abelelam*.

§ IX.—*Exclamations.*

1. *Nole!* no, nay! *Eko! uao!* yea, yes! *Waiai!* Oh (of admiration); *Weu!* alas! An interrogative exclamation is *nako*, (see verbs, 2*c*).

2. The Salutations are *Bakeam!* (Sing.), *Bakeamulum!* (Dual), and *Bakeawara!* (Trial or Plural). These are forms of the verb "to go" and said on meeting. The words *Nawa* (Sing.), *Dawa* (Dual), *Uridwa* (Plur.), are used in the same way.

3. Similar exclamations are *Dawam!* you two stop; *Mase*, go on! proceed! *Warem!* wait a bit! hold on! stay! *Mena!* stop! *Sina!* leave off! enough!

§ X.—*Syntax.*

The following are the chief syntactical rules:—

1. The Subject precedes the verb. *Kaka natager*, I say.

2. The Object follows the Subject, and precedes the verb. *E abi omare, a tag itirimuda, a abi itut*, he pitied him and stretched out his hand and touched him.

3. Adjectives and possessives precede the noun. *Debe gem wali*, good body cloth; *kara werem*, my child; *le la werem*, a man's child.

4. The adverb precedes the verb and the object (if any). *Iesu emetu uiabim daratagereda, iako abim bakuarda kotorem*, Jesus after to them he had spoken again to him (i.e. God) went up to heaven; *uiaba sobkak teosmeda*, they immediately came forth.

5. For other examples, see the preceding sections, and the specimens.

§ XI.—*Numerals and Measures.*

One, *netat;* two, *neis*; three, *neis a netat;* four, *neis a neis;* five, *neis a neis a netat.*

2. Numerals adopted from the English are in use for numbers above two. These are *thri*, *foa*, *faif*, *siks*, *seven*, *eit*, *nain*, *ten*, *elefen*, *tuelf*, etc., *wan handed*, *tu handed*, *thausan.*

2. There are properly no ordinals or multiplicatives. In Mark, xii., 31, xiv., 72, however, we find *neisiem*, for second time. Here *em* is the causative suffix, and the word is a literal rendering of the Lifu *alue*, twice (*a*, causative prefix, *lue*, two). *Neisiem* cannot be regarded as a true Miriam word.

The following note on the Miriam numerals is extracted from the Journal of the Anthropological Institute, Vol. xix., 1890, p. 303.

"Jukes says (ii., p. 302), 'They rarely count beyond six, but for higher numbers collect bits of sticks in bundles, and "nʌesa" [*sic.*] repeated three or four times rapidly, means an indefinite large number; twice only means "a few," as we should say "three or four." In a MS. memorandum Dr. S. Macfarlane says "They have only words for one and two, except they count the fingers on one hand, then the wrist joined above and below; the same with the elbow, shoulder, across the breast, and the other arm, beginning and ending with the little finger. In this way they count up to twenty-five. For anything beyond that they use bundles of small sticks about the thickness of a match." I have already referred to these bundles of sticks. At Erub I saw an old man count as follows, beginning with the little finger of the left hand:—5th digit, *kebike* [little finger]; 4th and 3rd digits, *epke* [middle fingers]; index finger, *bauke* [spear finger]; thumb, *auke* [big finger]; wrist, *kĕbĕkokĕne*; elbow joint, *aukokĕne* (*owkokni*, Macfarlane MS.); armpit, *kĕnani*; shoulder, *tuga*; pit above clavicle, *gĕlid*; pit of neck, *nĕrkĕp*; and then passing in the reverse order on to the right side, ending with the little finger, with the same names. This gives a total of twenty-one.'"

Seasons.

The year, *urut*, is divided into the following seasons:—

koki, north-west monsoon, or rainy season.

gaibar, all things spring up (*gair*, all; *bar*, spring).

1. *usiam*, turtle season and early food (*usiam*, the name of a constellation).
2. *neur wer*, do. do. (*neur*, girl; *wer*, star).

mag, sprouting of new leaves of yam.

umi, swelling of the yam tubers.

giznur, leaf of yam dies, beginning of the yam harvest (*giz*, beginning).

nur, yam harvest (*nur*, harvest).

egĕb, cut down the scrub.

itara, carry away and clear the scrub.

emor, yams planted.

siruar, turtle season.

These seasons are defined by the rising of certain stars, or constellations. Thus, the constellation of *usiam* is *mĕk*, or sign for the season which bears its name.

Bar and *nur* are, respectively, spring and harvest.

The months, *meb*, are not counted. There are no weeks, nor are the days, *gerĕger*, reckoned.

Weights and Measures.

There is no system of weights and measures among the Miriam. The only unit of length is the fathom, *kaz*, which is measured from tip to tip of the fingers of the outstretched hands.

Points of the Compass.

Error may easily arise in recording what are taken to be native names for the cardinal points of the Compass, it being too frequently forgotten by compilers of vocabularies that without a magnetic compass natives can scarcely be expected to have directions in space which correspond with ours. For seven months in the year (April to October) the trade-wind blows steadily from the south-east, and during the other months intermittently from the north-west.

The following identifications may be taken as being as accurate as possible :—N.-W., *koki ;* N., *sab ;* N.-E. to E., *naiger ;* S.-E., *sager ;* S., *garĕd ;* S.-S.-W. to S.-W., *ziai.*

Sab is, perhaps, more accurately northerly, rather than due north; *sab koki* appears to be N.-N.-W.; *naiger* and *naiger pek* are easterly, perhaps the latter is more north-easterly ; *sager pek,* or *sagiar pek*, apparently corresponds to our E. or E.-S.-E., and *ziai pek* to our S.-S.-W. ; *logab* is down in one vocabulary for S.-W., and *beli* for W., *kokiziai* is also given for the latter. *Pek* here means "by the side of," or "towards."

VI.—Specimens of the Miriam Language.

The Paternoster and Decalogue.

(*From the Gospels and Service-Book. No.* 13.)

Keriba Aba kotor-ge. Zogoem mara nei. Mamoro mara *baselaia* sepem uatabu. Ikeroa mabara lag abele geseb ge mokakalam kotor. Keribi ikuar lever nerute gerger a nerute gerger keriba abkoreb. Adem dikri keriba uit mokakalam keriba dikri ui uridili keribi did-koeda. Nole keribi amari kak adud tonar ikëli, mamoro keribi dit-kedarare uitelam. Abelelam mare dog *baselaia*, a adigir, a eded, niai karem. *Amen*.

Ade-ra Gelar.

1.

Mara nole nagri nerut Ade kare tumge.

2.

Ma nole le op atua kak, a roairoai nerute lu kotor-ge a nerute lu geseb-ge, a gur-ge, a nole esorgiru abele a nole erkëpsam uiabim abelelam kaka *Iehoua* mara Ad, kaka Ad teptëb a bodomalam ikuar uerem giz ab giz adud tonarlam bakedida nosik le *thri* a *foa* karim obogai, a omare etormerti gair *thausanim* kare laglag, a kara gelar giz erpei.

3.

Ma nole didmirki ataut kak *Iehoua*-ra nei mara Ad, abelelam *Iehoua* ko bodomalam ikuar uiabim gaire le didmirki ataut abara nei.

4.

Ma dikiapor mamor zogoem abele : *sikes* gair gerger mara lu uridili ikëli, abele gerger *sefen Iehoua*-ra gerger *sabath*, mara Ad ; ma nole lu akerare abele gerger, mara kimiar uerem, a mara neur, a mara memeg kimiar, a mara memeg neur, a gair mara ebur, a sub le mare utëb ge, abelelam *sikes* gerger *Iehoua* detagem kotor-ge, a geseb-ge a gur, a gair lu uridili nerezi abele gerger *sefen* abelelam *Iehoua* mamor egali *sabath* a zogoem.

5.

Ma mamoro asoli mabi abera a apuera, ueakai mara gerger perepere abele gede-ge Ad mare ikuar.

6.

Ma nole ipit eud kak.

7.

Ma nole ko kak.

8.

Ma nole eruam kak.

9.

Ma nole bes mer nerute le ataut kak.

10.

Ma nole dikëli nerute le la meta, ma nole dikëli nerute le la kosker a abara memeg le kimiar, a abara memeg le kosker, a abara *kau*, a abara *asina*, a abara nerute lu.

THE PARABLE OF THE SOWER (*Mark*, iv. 3-9).

3. Uaba aserauem ; Dasmer, nerut amorda le bakeamu ko emor:

4. E dikri, a uader këp gab dege abi, epe ebur giz kotolam tabakeuda abele eroare.

5. Uader këp tumem neidge abi, kebi seb-ge ; sob-kak omeili abelelam lerkar seb-ge.

6. Gerger eupamada, a eueri a eumili, abelelam nole sip kak.

7. Uader këp lu eipu daradara-ge omeili, a detarapi abelelam nole turum kak.

8. Uader këp debe seb-ge abi, a omeili, a esali, a turumturum ; a turum *therte* nagri, a *sikeste;* a *uan handed.*

9. E uiabim detagereda, kega, Le la grip nagri ko asoli, debele E asoli.

THE WICKED HUSBANDMEN.

(*Mark*, xii. 1–9.)

1. Iesu ko ditimeda uiabim detager gair mer abkoreb, kega, Nerute le *uine* gedub akerare, a karu derumeda, auak dakeili ko *uine* igmësi, a eskare emoarare, a gedub le nakuarare, a muriz ged bakeamuda.

2. Nur-ge E nerute memeg-le namarida uiabim gair gedub le, ko *uine* turum taisare uiabielam.

3. Uiaba abi terpei, a abi damrik, a abi dituaki, nole lu kak.

4. E iako uiabim nerute memeg le namarida ; a ui bakeru abi erborare, abara kerem nakesmuare a emetu dedkoare uiaba abi dituaki.

5. E iako nerut namarida ; a uiaba abi ipit eumida, a uader gair ; a uader damrik, a uader ipit eumida.

6. E nagri netat uerem nasge, E keubu abi namarida uiabim, kega, Uiaba ko kare uerem geum-ge.

7. Uiaba gair gedub le mer atagere, kega, Ab kesem peik, mi abi apite, a gair abara lu, meriba lu.

8. Uiaba abi terpei, a ipit eumida, a adige batauerem *uine* gedublam.

9. *Uine* gedub-ra opole ualu ko ikëli? E ko tabarki a uiabi gedub le atkirua, a *uine* gedub uader le nakuarare.

The Story of Lazarus.

(*John*, xi. 1–45.)

1. Nerute le gimgim, Lazaro Bethania le, Maria pako Maretha abi narbete-ra utëb.

2. Abele Maria Kole basao *muro*-de, a tabara neisi teter itkir musede abara berbet gimgim pe Lazaro.

3. Neisi abara berbet abim namarida, a detager, kega, Kole, ma dasmer E mama abi nasge E gimgim.

4. Iesu asoli, a detager, kega, Nole niai eud abele gim, epe ko Ade despereda iaueakai Ade-ra Uerem despereda.

5. Iesu Maretha omare, a tabara keimer a Lazaro.

6. E asoli E gimgim, E iako emeri abele utëb neisi gerger.

7. Abele iobaru, E abara kaimeg giz detager, kega, Meriba iako bakeauare Iudaia-em.

8. Ege kaimeg giz abi detager, kega, *Rabi*, emeret-ge Iudaia le giz mare deraimer ko bakeru mare natimdare; nako ma iako bakeamu abele?

9. Iesu detaut, kega, Nako, nole *tuelf* gaire *haua* gerger-ge? Ese nerute le gerger-ge ekas; E nole teter itur, abelelam E geseb datki dasmer.

10. Ese nerute le ki-ge ekas, E ko teter itur, abelelam datki nole abi-dog.

11. Abele gaire lu E detaut: keubu abele E uiabim detager, kega, Lazaro uteid: meriba boai: kaka bakeam abi itiri uteidelam.

12. Abara kaimeg giz abi detaut, kega, Opole, ese E uteid, E iako eded.

13. Iesu abara eud detaut; uiaba dikiapor, kega, E detaut uteid a nerezi.

14. Iesu paret-kak detaut uiabim, kega, Lazaro eumida.

15. Uiabim kaka serer-ge, abelelam kaka nole nali, iaueakai uaba oituli; mi nabakeauare abim.

16. Toma (nei atker Didumo), tabara këme kaimeg giz detaut, kega, Mi ko nabakeauare, abi këmem eumilu.

17. Iesu tabarki, E dasmer *foa* gerger E ao-ge.

18. Bethania maike Ierusalema, mokakalam *fiftin* gaire *setadia*.

19. Dordor Iudaia le tabakeauare Maretha-em a Maria-em, ui ko baimilei, ui berbet-lam.

20. Maretha asoli, kega, Iesu tabarki, E bakeam abim obapit: Maria penoka mui-ge meta.

21. Maretha Iesu detager, kega, kole, ese ma-ge emri, kara berbet nole eud kak.

22. Peirdi kaka umele, gaire lu uridili ma damos Adi-elam, E ko mare ekuar.

23. Iesu abi detaut, kega, Mara berbet ko eded akaida.

24. Maretha abi detager, kega, Kaka umele E ko eded akaida abele keub gerger.

25. Iesu abi detaut, kega, Kaka abele eded akaida, pako eded: abele le kare oituli, ese eud, E ko eded.

26. Abele le eded karielam pako kare oituli, E nole eude kak niaiem niai karem. Nako, ma egaret abele mer?

27. E abi detaut, kega, Eko, Opole: kaka dikiapor mama Keriso Ade-ra Uerem, gesep-em tarabu.

28. E emetu abele mer detaut, E bakeamulu, a Maria abara keimer gumik dabger, a detager, kega, Opole emetu tabarki, E mare dabgeri.

29. E abele asoli, E sobkak tekue, a abim bakeam.

30. Iesu nole utëb-ge tabarki, E uo emri abele utëb Maretha abi obapit.

31. Iudaia le giz abi dog meta-ge abi baimida, uiaba dasmer Maria sobkak tekue, a adem bakeam, uiaba abi irmili, a detager, kega, E ao-em bakeam ko ezoli abele.

32. Maria tabarki Iesu-dog, a abi dasmer, E ekësmer abi teter-ge, a abi detager, kega, Opole, ese ma ge emri, kara berbet nole eud kak.

33. Iesu abi dasmer ezoli, a Iudaia giz abi këmem bakeam, ko ezoli, E kem-ge nerezi, a okasosok.

34. A detager, kega, Nade uaba abi ikëdarare? Uiaba abi detager, kega, Opole, tabakeam dasmer.

35. Iesu ezoli.

36. Iudaia giz detaut, kega, Dasmer, E abim au omare.

37. Uader uiaba detaut, kega, Nako, abele le sadmer le-la neisi pone diski, E umer kak daisumda a nole eud kak abele le?

38. Iesu iako taba nerkëp-ge nerezi, a ao-em tabarki. Kur peik baker te-ge dimilu.

39. Iesu detager, kega, Baker, adem. Maretha abara berbet eumida, detaut, kega, Opole, E semelag: ege *foa* abara gerger.

40. Iesu abi detaut, kega, Nako, kaka nole mare natagere, ese mama oituli, ma ko dasmer Ade-ra adigir?

41. Uiaba baker adem utëb-lam eud le uteid. Iesu kotor-em etilu, a detaut, kega, Baba, kaka marim esoao, abelelam ma kare asoli.

42. Kaka umele, mama mena kare asoli : kaka emetu detager, abelelam gai le lakub derumada, iaueakai uiaba ko egaret ma kare namrik.

43. E emetu detaut abele, E elele erertikri, kega Lazaro, teosmeda.

44. Epe eud le osmeda, abara teter pako abara tag emetu sopem irpi ualiu, a abara op sopem irpi *tauelu*. Iesu uiabim detaut, kega, Abi ditui, a abi emariklu ko bakeam.

45. Iudaia giz Maria-em tabaruda, dasmerare gaire lu Iesu-de ekerer, uader abi oituli.

Dives and Lazarus.

(*Luke*, xvi. 19–31).

(*From the Rev. J. Tait Scott's Book of Parables.* No. 12).

19. Nerut luglugle debe wali ameli, a gaire lever kar eroli nerut gerger a nerut gerger.

20. A nerut lukak le abi nei Lazarus, e emri abara gabtege, abi gem keskak badbad.

21. E lagalag eroli puipi lever lugluglera *laulau*lam abi ; a abele umai giz tabakeuare abi badbad desomet.

22. Kerkerge abele lukak le eumeda, a *angela* giz abi egaret Abrahamra marmot ; a abele luglug le eumida ; a wiaba abi itikobe.

23. A muige *Hades* e egremada ; e au asiasi ; e Abraham murizge dasmer a Lazarus abara marmotge.

24. E erertikri, a detager kega, Baba Abraham karim omare, a Lazarus karim emarida ko abara tag nige akme ko kara verut gebgeb ; abelelam kaka urvere abele urge.

25. Abelu Abraham detager kega, Kara verem mamoro dikiapor ma mara debe lu giz nagiri mara ededge, a ko Lazarus abara adud lu giz ; aka peirde e verkable a ma au asiasi.

26. A nole abele tebteb, ni ai karem keribim au kes wabim ; abelelam wiaba lagalag ko bakeuare umerekak keribi gedlam bakeuare wabim ; a wiaba ko lagalag tabarki keribim umerekak.

27. Iako e detager kega, kaka marim bali, Baba, ma ko abi namarida kare babera meta; abelelam kaka 5 keimer giz nagiri.

28. E wiabim ageakar etomeret. Iueakai wiaba ko tabakeuare abele adud uteb, au asiasi uteb.

29. Abraham abi detager kega, wiaba nagiri Mose a gaire profeta, wi wiaba mer mamoro asoli.

30. E detager, nolea, Baba Abraham, ese nerut le eudelam wiabim bakeam, wiaba ko obasgeda.

31. Abraham abi detager kega, ese wiaba asor kak Mose a gaire *profeta* wiaba ko obogai ese nerut le eudelam bakeam.

Tonar Iakobo a Esau.

(*From the Reading Book of the Rev. A. E. Hunt. No.* 17.)

Abele	taim	Isaka	aule,	a	abara	pone	tik	nakuareder	
That	*time*		*old man*	*and*	*his*	*eyes*	*dim*	*gave*	
E	dabgri	Esau,	a	abi	detager,	kega,	kara	eud	maike,
He	*called*		*and*	*him*	*told*	*thus*	*my*	*death*	*near*
debele	ma	nani	deraimer,	a	derser,	ueakai	kaka	eroli	
good-that	*thou*	*goat*	*seek*	*and*	*prepare*	*so-that*	*I*	*eat*	
a	debe	mer	atager	marim.	Abelelam,	Esau	bakeam	nani	
and	*good*	*word*	*say*	*to thee*	*Through-that*		*went*	*goat*	
deraimer,	abkoreb	Isakara	leuer.						
seek	*suitable*	*Isaac's*	*food.*						

Epe	Rebeka	asoli	Isakara	mer,	a	E	dabgri	Iakobo		
Then		*heard*	*Isaac's*	*word*	*and*	*she*	*called*			
a	abi	detager,	kega,	Ma	dudum	bakeam	a	neis	nani	
and	*him*	*told*	*thus*	*Thou*	*quick*	*go*	*and*	*two*	*goat*	
tais,	a	emetu	derser,	ma	ais	abele	leuer	Isakaim	a	
take	*and*	*finish*	*prepare*	*thou*	*bring*	*that*	*food*	*to-Isaac*	*and*	
E	ko	dikiapor	mama	Esau	a	debe	mer	atager	marim.	
he	*shall*	*think*	*thou*		*and*	*good*	*word*	*say*	*to thee.*	
Epe	Iakobo	detaut,	kega,	Nolea,	umer kak,	abelelam	Esau			
Then		*said*	*thus*	*no*	*cannot*	*through-this*				
au	gemus,	a	kaka	gemus	kak.	Kara	aba	ko	kari	
very	*hairy*	*and*	*I*	*hairy*	*not*	*My*	*father*	*will*	*me*	
itut,	a	umele	kaka	okardar	le.					
touch	*and*	*know*	*I*	*cheating*	*man.*					

Epe Rebeka tikalu nerute Esaura debe uali a dami
Then took out one Esau's good dress and put-on

abele Iakoboim, a didbari kebi mog nanira paur abara
that for Jacob and bound little piece goat's skin his

tag-ge, pako tabo-ge. Emetu abele, Iakobo ais abele *nani*
hand-on and on-neck. After that brought that goat

Rebeka emetu derser a bakeam abara aba-ra utebem. A
finished prepare and went his father's abode-to. And

Isaka abi itmer, kega, Ma nete, a Iakobo detaut, kega,
him asked thus Thou who and said thus

Kaka emetu asoli mara mer a nani tais: ma ekiam a eroli.
I finish hear thy word and goat took thou rise-up and eat.

Isaka detager, kega, Ma emetu sobkak erdali abele! Iakobo
spake thus Thou finish quick seek this

detaut, Uao Jehova mara Ad emetu kari upinati. Epe
said yes thy God has me helped. But

Isaka abi detager, kega. Maiem, ueakai kaka mari itut
him told thus. Come here so that I thee touch

a umele ese mama Esau kar. A Iakobo maiem abim
and know if thou truly. And came near to him

a Isaka abi itut a detager, Abele Iakobora kodo, epe
and him touched and said this Jacob's voice but

abele tag Esaura tag. E umer kak E Iakobo dali abele
this hand Esau's hand. He knew not He-there was Jacob this

nanira paurlam abara tag ge. A E ko itmer abim, kega,
goat's skin-through his hand on. And he again asked to him this

Nako, ma Esau kar? A Iakobo detaut, Uao, kakanali.
What thou true And said Yes I (am) here

A Isaka lener eroli a debe mer atager Iakoboim, kega,
And food eat and good word says to Jacob thus

Debele Jehova mari upinati a mari ikuar gaire debe lu
Let thee help and thee give many good things

niaiem; gaire gede le mara memeg le giz, a gaire mara
always many country men thy serving men and many thy

apu ra uerem mara memeg le giz niaiem.
mother's children thy serving man pl always.

Uaiai abele le mari desauersili, a uerkab abele le
Woe that man thee reviles and blessed the man

mari upinati.
thee helps.

VII.—MIRIAM AND ENGLISH VOCABULARY.

This Vocabulary, of over 2000 words, is compiled chiefly from the Gospels and Service Books (13), and the MS. Vocabularies of the Rev. A. E. Hunt (MS. 5), Rev. E. B. Savage (MS. 7), and Professor Haddon (MS. 4). To these are added a few words from the other lists. Words marked (M), (J), or (L), are found only in the Vocabularies of Rev. S. Macfarlane (MS. 6), Jukes' Voyage of the Fly (1), and Lewis' list given by Jukes. Those marked (S) occur only in the Rev. J. T. Scott's translation (12).

A difficulty has been experienced in entering the verbs. For the most part these have been entered according to the initial vowel, unless the simple form with initial vowel has not been found. In the latter case the verb must be sought under *d* or *n*. All the verbal expressions met with are given with the simplest word.

A few words have no meaning annexed. These have been inserted in the hope that their signification may be hereafter ascertained.

VII.—*A Miriam-English Vocabulary.*

a, *conj.* and, but, or also.

ab, *a.* this, that. ab gereger, yesterday (M).

aba, *n.* father.

ababeis (S) *conj.* if. ababeis E kige tabarki, if he shall come in the night.

ababu, *pron.* himself, herself, itself.

ababur, ababurge, *ad.* Mark, xv. 8. ko uiabim ikëli mokakalam ababur ge ikëli, to do as he had ever done unto them.

abal, *n.* the pandanus or screw pine, "kŏpa" tree, cf. inau.

abara, *pron.* his, her, its.

abei, *v.* to confess, speak about; mirem abei, *v.* to guess. [abeida, abeilu, babei, babeida, nabei.]

abĕle, *a.* this, that. abĕle gereger, to-day.

abĕlelam, *conj.* through this or that, because, on account of, for, therefore.

abĕlugem, *a.* this, that.

aber, *n.* starfish (J), bêche de mer (M).

abgedelam, *ad.* from this place.

abger, *v.* to call [dabgerare, dabgeri, darabgerare, darabgereda].

abger, *n.* high tide (M).

abgeregere, *ad.* yesterday, to-morrow.

abi, *pron.* him, her, it.

abi, *v.* to lose.

abi, *v.* to fall = abu.

abibu, *pron.* himself.

abielam, *pron.* from him.

abim, *pron.* to him.

ăbkorĕb, *a.* suitable, according to, like, equal to, sufficient; nole ăbkorĕb, insufficient; mer ăbkorĕb (s) *n.* a parable.

absaimarsaimar, *ad.* so much.

abu, *v.* to come down, to fall. [nabue, nabuda, tabi, tabu, tarabu, didbida (s), wadarabuerare.]

abuli, *v.* to drop, cf. eb.

Ad, *n.* "God." (I believe this word really signifies something which is ancient and sacred, and that it was the term employed for a legend or myth. The idea of God or Gods is an entirely foreign one, A. C. H.).

ad, *n.* the outside; adem, to the outside, away; adige, on the outside; adem-dikri, *v.* to abandon (M); adem-itkir, *v.* to erase.

adigir, adgiri, *n.* power, strength; *v.* to heal, save. [nadgir, nadigiri, nadgirda, nadgirare, nadgirauem.]

adile, *n.* an outside man, a stranger.

adket = itkedi.

adud, *a.* bad, evil, nasty, cf. wit; adud lag (L) *a.* sour; adud nesur, catamenia.

apite = ipit.

agared, agaret, *v.* to take, receive, believe. [egared, egardare, agaretelu, egaredelu, nagaret, tegared, tegaret, tegardare, tegaredilu, wanagared.]

ageakai = ageakar.

ageakar, *n.* truth, *a.* true.

ageakarem, *v.* to be true, to bear witness.

agĕg (J), *a.* alive, applied to shells. (? ripe, Mark, iv. 29.)

agem, *v.* to deny; agemkak, *v.* to acknowledge.

ăger (J), *n.* name of a shell, *Turbo.*

ages, *v.* to lift, to raise, to stretch out the hand. [agisilu, nagisi, tagis.]

agimur = egimurua.
agud, *n.* the initiation ceremony or the masks used on this occasion, possibly also a totem, cf. augŭd of Saibai.
ais, *v.* to bring, to take, collect; dis adem, to take away. [aisis, aisare, aisuer, daisare, dis, naisuare, naisuerare, tais, taisare, taraisare, taraisideri.]
aisumdar, *v.* to desist, leave off, stop. [daisumda, daisumdalu, daisumdarare, deraisumdarda.]
aiswer, *n.* a kind of feast (probably derived from ais, and werer, to be hungry).
aka (s), *conj.* but, and, = ako.
akar (?) nole akar pedali, he was not there.
akai, *v.* to become, to do. [akaida, ekaida, ekairare, nak ai.
akaoreli (s) = ekau. Mara lamar marielam akaoreli, Thy soul shall be required of thee.
akĕre = ikĕli.
akeris = ikris.
akesmulam, *n.* a fall, from ekesmer.
akesmur = ekesmer.
akëulam ?
akiapor, *v.* to consider, think. [dikiapor, dikïaporare, dikiaporauem, dikiaporeda.]
akmei, *v.* to dip. [akmeilu, bakmeida.]
akmer, *v.* to understand, apprehend, know.
akmerem, *v.* to cause to know, to reprove, to make ashamed. [akmelam.]
ako, *conj.* but.
akomeda, *v.* to return (retreat, M). [akomeret, akomelam, takomeda.]
akoselam, see ekos.
akri, *v.* to throw, cast away, forgive. [dikri.]
akur, *v.* to stand = ekwe.
akur, *v.* to thatch (M).
akwar = ikuar.
akwe, *v.* to stand = ekwe.
ali, *v.* to wonder.
alida, *n.* a shield-shaped piece of shell worn over the groin when fighting and sometimes when dancing, cf. etirida.
ălun (J), *v.* to sail.

amale das, *inter.* behold! (M).
aman, *n.* mother.
amari, *v.* to allow = emari.
amariklu = emarik.
amarkarem,
amaz, *n.* a pillow.
ame, *n.* an oven of earth; the loan word "kŏpamauri" is now in general use in the Straits.
amer, *v.* to wonder. [dameri, dameare, damesili, damreda.]
amer, *v.* to clothe.
amerelu (s), *n.* a seat, from emri.
ami, *v.* to clothe, *n.* clothes; am-wali, *n.* dress, clothes. [ameare, dameare, darame.]
amile, *n.* the young men whose duty it was to prepare the corpse for desiccation.
amor = emor.
amos, *v.* to ask. [bamos, bamereda, damos, damseda, namos, namsi.]
amu = imu. [amulam.]
amulu, *n.* bell (M).
aneg, *n.* taro.
ao, *n.* a pit or hole, a grave. (Winepress ao daevi (s) digged a winepress.)
ao, an interrog. particle.
aokaerem (s), *v.* to wait for, see naokaili.
aole, *a.* naked, aole barseie.
aosmer = osmer.
aosperera, *v.* to bless = espili. [aospilam.]
aosos, *a.* born, *v.* to be born.
aotale, *n.* a scribe.
aotar, *v.* to write.
ap = ab.
apaiter, *v.* to spill. [epaiteredelu, apaiteredoa, darapaitare.]
apeir = arpeir = erpei, *v.* to take hold of.
apĕk = apeik, *prep.* beyond, on the other side of. cf. pek, peik.
aper, *n.* a hat (?).
apgeregere = abgeregere.
apit = ipit, *n.* a blow, *v.* to strike.
apu, *n.* mother; the horizontal fire-stick; meg-apu, shrimp, (the Cape York throwing stick (J)).

apuera, *n.* mother.
araiger, *v.* to dive, dip; araiger-le, diver; lem baraigida, sunset.
araimer, *v.* to seek. [deraimer, deraimerare, deraimereiei, deraimeli, deraimerer, naraimeli, naraimereda, naraimerare.]
arap, *v.* to buy, sell, barter; arap-le, merchant. [arapem] see garap, erap.
araparap, (s), *a.* maimed, tagaraparap.
arapeir = erpei.
arbor, *v.* to tear. [arborare, darbor.]
arbum (s), *v.* to pluck up by roots. [darbum, darbumda.]
ardar, ardali, *v.* to see, find, know. [erdarda, nardarare, nardalu.] cf. erdali.
areĕ, *v.* to drink = ere; hence paim arelam (M) to get drunk.
areg, *v.* to bite. cf. tĕrĕg, teeth.
arem, *n.* sky, heaven; the top of anything; high.
arĕs, *v.* to fight; arĕs-le, a soldier; arĕs-lu, a weapon; aresem (M) *n.* war. [baresa, barili, barseda.]
arĭag, *n.* fishing line.
armem = aremem; *ad*, upward (lit. to the sky).
armi, armir = irmili.
armir = ami.
aro = ero.
arot, *v.* to put in. [barot, barte, tabarot.]
arpeir = erpei, *v.* to seize.
arperiklam, burst (?).
arub, *v.* to wash; arubkak, *a.* dirty, unwashed; puipi drup, *v.* to sweep (s.) [dirup, dirub.] cf. ogarup, ogdirup.
artare = *v.* many put in? cf. arot.
arti, *n.* octopus.
as, *n.* various shells, *Murex*, *Auricula*, *Cassis*.
asam, *v.* to quench, put out, darken. [esameida, darasamare.]
asamasam, *a.* quenched, put out, pone asamasam, blind.
asaperem, *v.* to catch fish.
asaret, asared, to deny. [basared, basaret, nasared.]
asauem, *v.* to anoint. [basao, desauem.]
aseamur, *v.* to finish, aseamur kak, eternal. [eseamuda, esēëmula, oseëmulu, uësëemur.]
asesere, *v.* to guard, care for, tend; hence, le gab te asesere, porter, mamoe asesered le, shepherd. [darasisiere, darasisieda, naseseredare, nasesereda, naseseredili, asisiem.]

ăsi, *n.* pain, *v.* to hurt.

ăsiăsi, *a.* painful, sore; (M) *v.* to suffer. nerkep ăsiăsi, sorrow.

ăsilam, *n.* wound.

asisiem, *v.* to rear, bring up, feed. [darasisiare, darasisieda, derasisi, derasisiare, desisi.] cf. asesere.

asmer, *v.* to see. [dasmer, dasmeram, dasmerare, dasmerauem, das, merdare, dasmereda, dasmerei, dasmerer, darasmer, darasmerare-nasmer, nasmerare, nasmereda, nasmeli.]

asodalam, Jno. xiii. 5, mog uali-de abi asodalam, with the towel wherewith he was girded. cf. eso.

asoli = asor, *v.* to hear, obey.

asor, *n.* the spider shell, *Pteroceras.*

asor, *v.* to hear; nole asor kak, to disobey. [asaredelam, aserare, aserauem, asereda, aserei, asoli.]

asoroa, *v.* to listen (M).

aspas, *v.* to rend.

aspidar le, *n.* bridegroom, from ispili.

aspirem, *v.* to make a marriage, see ispili.

at, *n.* a fish; the sting-ray (?). cf. arti.

atagem, *v.* to make. [detagem], hence create, cf. ikĕli.

atager, *v.* to speak, to say to; mer atagere, to take counsel. [atagerem, batagereda, daratager, daratagerare, daratagelare, daratagereda, detager, detageram, detagerare, detagereda, detagerei, detageri, ditagi, natager, natageri, detageroa (s).]

atamelam, *n.* a sign, a mark, a proof, from etomer.

ataparet, *v.* to scold, quarrel (words only), rebuke. [bataparet.]

ataparetlam, *n.* uproar, tumult.

atapetem = etaperet.

atarat = itarat.

atatkeamur.

atatkoem, *v.* to draw up (water). [atatkolam.]

ataut, *v.* to speak, acknowledge, admit. [atautelam, detaut, detautam, detautare, detauter, detautili, nataut, natautere, natauti, tada-tautare.]

atiëm (?) *v.* to voyage, to go into a boat, to pass over the sea.

atkap, *v.* to squeeze, press, join together. [atkaplam, daratkapared, ditkabda, natkabda.]

atkĕtelu, *n.* a sewing thing, a needle, *v.* itkëdi.

atki, *n.* a light, *v.* to light up. [daratkeare, daratkeda, datki, natkar, natkeri.]

atkir, atker, *v.* to name.

atkirua, *v.* to destroy, wipe out.

atkobei, *v.* to lay the head on the ground, to bury (in native manner). [etkobei, detakobei, etkobeilu, natkaba, natkobei.]

atkolam, *n.* an abomination, from dedkoli.

atoat, *v.* to break, tear. [batoat, batoatare.]

atoatoat *a.* torn.

atomeret = etomeret.

atrumda, *v.* to accuse. [daraturumda.]

atwa, *n.* wood.

atwe, *v.* to cast out, forgive, take away. [detwe, daradwelare, daradweare.]

atut = itut.

atuter, *v.* to touch = itut.

au, *a.* large, great; au ke, thumb; au-kale, bigger than; au-nar, ship; au-gur, ocean; au buzibuz, very old; au-le, old man, infirm; au-kok (J), elbow; au kosker, old woman; au-kes (M), *a.* broad.

au, *ad.* very.

au, *n.* an aunt, on wife's side.

aud (J) aun (L) dead, cf. awem, eud.

audager (s) edag.

audbar, *v.* to bind; audbar-meta, prison. [didbar, didbarare, didbarda.]

augar (M), *v.* to cook.

augwat, *v.* to clasp; tag augwat, to shake hands (the native method was to scrape hands. Now they shake hands European fashion which they call "talopa," a loan word). cf. deiwat.

aukes, *a.* broad, wide (M).

ausk (J), *v.* to crouch down.

autare, *v.* to write; autare lu, to measure; aotale, scribe. [detar detali, detarda, detarer, naotali.]

awak, *v.* a dale valley, trench, a bay. (cf. kop); awak kes (M), a port, harbour. (cf. pat).

awem = ao-em (to the) grave (M).

azer, *v.* to refuse, not grant (a request), to draw back.

azeriklu, *v.* to put in, to lay in, cf. aziri.
azigmaret = ezigmada, esigmada.
aziri, *v.* to be cast in.

Ba, a prefix to verbs.
baba, bab (J), *n.* father.
babisdari mer, *n.* proverbs, parable.
babuser, *v.* to ooze, exude, bleed; [babusdari, babusdare.]
băd, *n.* a sore, fester, abscess, venereal disease; nerute le uit lamar bada abim obapiti, a man with an unclean spirit met him.
badari, *v.* to enter, go in.
badmirida, *v.* to lose sight of, disappear, escape.
bag, *n.* the cheek.
bagem,
bager, *v.* to look round; uiaba kok bagagarare, they doubted.
bager, *n.* a long spear.
bagiali (S), *v.* to be looked at, respected.
baidö, *v.* to sit.
baibai mus, *n.* the eyebrow.
baili, *v.* to fast, go without food.
baimilei, *v.* to console one another (of two persons). [baimida.]
baiteri (M), *v.* to drown.
bak,
bakaerti, *v.* to receive sight (?); to be awake (M).
bakatu, *v.* to wrestle.
bakeam, *v.* to go; bakeamulu, to depart; bakeam sobkak, to hasten; kekem bakeamu, to advance. [bakeamuda, bakeamudariei, bakeamuelam, bakeamulei, bakeaware, nabakeam, nabakeamulu, nabakeaware, obakiam, tabakeam, tabakeamu, tabakeware, tabakewarem, tabakeuda, tabakeamulu.]
bakedida, *v.* to finish, complete.
baker, bakir, *n.* a stone, rock.
bakesmeri, *v*, to fall down (ekesmer).
bakesmulu.
bako, *v.* to rise up, stand (ekue).
bakwar, *v.* to carry, to bear. [bakwarare.]
bali (S), *v.* to ask, beseech,
balu, *v.* to enter, go in. [tabalu.]

bamer (M), *v.* to be silent, quiet; *inter.* peace! hush! [baimilu.]
bameri, *v.* to stay, dwell (emri).
bamerik, *v.* to go away.
bamisili, *v.* to keep one waiting when another has sent him.
bamos, *v.* to ask (amos, damos, etc.).
bamosa (M), *v.* to blush.
bamsili = bamisili.
bane, *n.* daybreak; *ad.* banege, in the early morning.
bao = bau, *n.* a seat, a chair; kot bau, judgment-seat.
bao, *v.* to go in, enter.
bar, *n.* spring (in opposition to nur, harvest).
baraigida, *v.* to sink, dive down (araiger), lem-baraigida, sunset.
barapare, (?) Jno. iv. 6.
baratug, (?) mer baratug, *v.* to take counsel.
barbar, *a.* crooked.
barditug, *v.* to make straight, judge. [barditugili, mer-barditug, condemn.]
bareb, *v.* to swim. [barebli.]
baremda (M), *v.* to echo.
bares, *v.* to fight (ares). baresei, *n.* (M), war.
barit, *n.* cuscus or phalanger ("opossum").
barkak, *a.* straight, not crooked; hence just, lawful.
barkakem, *v.* to make straight, to make good, hence, in Gospels, sanctify.
barkare, *v.* many depart. [tabarki, tabarkare, tarabarakua.]
băroma, (J), *n.* red branched coral.
barot, barti, *v.* to enter (arot). [tabarot.]
bartiri, *v.* to constrain, cf. itiri.
baru, *v.* to proceed, go on.
baruk (?), abele baruk, after this. Jno. ii. 12.
basao, to anoint, cf. asauem.
basaret = basared, *v.* to argue, dispute. [basardare, basaredelare.]
basik, *v.* to fall back; to be startled, cf. azigmaret, esigmada.
baskare (?), ërkepu baskare, many look on each other. Jno. xiii. 22.
batagem, *v.* to conceive (atagem).
batager, cf. atager.
bataili, *v.* to grow, get larger. cf. esali.
batapili (?), grip batapili, deaf.

batauret, *v.* to throw away; ner bataueret, to breathe, to sigh. [bataueredа, batauerem, bataueredilu, bataurdi.]
bateri, batiri, *v.* to go in. cf. aziri.
batkam, *v.* to cover over (as with a sheet), to excuse. [batkamda, natkamda.]
batkitie.
batoamerdi, *a.* shining (?), see etoamerdare,
batoat, *v.* to tear (atoat).
batrimu (J), *v.* to open the arms. cf. itiri.
batueri, *v.* to go down. [batueli, uatabatuer.]
bau = bao (bau-lu, table).
baudaredelu, *v.* to wail. [baudaredelare.]
baudili (S), *a.* idle.
bauger, *v.* to warm one's self.
bauger, *n.* the booby-bird.
baumer, *v.* to die (eumi).
baur, *n.* a turtle spear (J), a fish spear, a carved plank used in certain turtle ceremonies in Dauer.
baur-ke, *n.* the forefinger.
bauspili, *v.* to boast, *n.* pride, *a.* proud (espili).
bautumer *v.* to enquire (eutumer).
baz, *n.* a cloud; kupkup baz, a cloudy sky.
bazere,
basigmaret, *v.* to start back (ezigmada).
bazeguar, *v.* to hold one's peace, be quiet.
bazik, *v.* to fall backwards.
bazoli, *v.* to weep, cry (ezoli).
be, *n.* light, flame, the cause of light, a torch. Jno. xviii. 3.
bebeb, *a.* wet. cf, ebeb.
beber, *a.* difficult, moist, heavy (of the eyes), slow, weak.
begur, *n.* an ulcer; bĕgun (L).
beli, *n.* west (?).
ber, *a.* the left; ber tag, the left hand.
ber = bir, *n.* the lungs, the side of the body.
berber, *a.* sad.
berbet, *n.* a man's sister or woman's brother, cf. keimer.
berderge (M), *a.* deep.
bĕrĕg, *n.* a shed, a porch.

bĕriber kar, *n.* a rope fence (?)
bes, *a.* false; *v.* to pretend; bes le, a liar; bes mer, a lie; hence bes ad, idol.
besapu, *n.* lying (person). Jno. viii. 44. (lit. false mother. cf. lu giz ra apu.)
bes-ekwar, bes ikwar, *v.* to lend (lit. false-give).
beskak, *a.* true (lit. not false).
bezam, besam or beizum (J), *n.* a shark; bezam le, the shark clan.
bi,
bid, *n.* a porpoise.
bigo, *n.* a bull roarer.
bilid (bir-lid), *n.* ribs, lit. side-bone.
bir, *n.* side of the chest.
bĭrobĭro, *n.* a stone image of a bird; (this may be a totem).
bisi, *n.* sago, sago palm.
boai, *n.* members of a clan having the same totem, hence a kinsman, friend, neighbour.
bodom, *v.* to pay; *n.* a payment.
bodomala (S) *a.* owing. lu bodomala, *n.* debt.
bodomalam, *v.* to recompense, avenge.
bogbog, *a.* across.
borobŏro, *n.* a small cylindrical drum.
borom, *n.* a pig.
botoger, *n.* a sawfish.
buber, *n.* the fold of skin on the inside of the finger.
buber (J), *n.* the barb of an arrow.
bubu-barsi (J), *v.* to sit cross-legged.
bubuam, *n.* a shell, Amphiperas [Ovulum] ovum.
bud, *n.* mourning; cf. buth (probably this is not mourning, but the grey mud which was plastered over the body during mourning, and which is called "bud" in Saibai).
bukani (S), *n.* a scorpion.
buli (J), *n.* a kind of cuckoo.
bumer, *n.* a sound, buzzing of a bee (? bu mer, the speech or sound of the shell trumpet (maber), the bu of Saibai).
burar (J), *n.* a clay pipe.
buromar (J), *n.* a red branching coral. *Gorgonia*
bŭsor (J), *n.* a shell, the white *Natica.*

buth (L), mourning. cf. bud.
buzibuz, *a.* rotten, decayed, old.

Dab, *n.* a spear, a war spear (? throwing stick).
dabim (?), te dabim, *a.* dumb.
dad, *n.* the Milky way, cf. wertik.
dager (s), *v.* to gather, cf. edag.
daiu, *v.* to dig; daivi (s).
daismuda, *v.* to stop (any one from fighting). [daisumda.]
daivi (s) = daiu.
dakeili, *v.* to dig. [dakeilu.]
dali, *pron. demons.* he there, there.
dam, *v.* to subtract.
dame, damer, *v.* to astonish, wonder; *a.* wonderful. [dameri, damreda, dameare, damesili.]
damerik (damrik), *v.* to strike, to scourge.
damos, *v.* to ask, beg, to subtract (amos). [damsare, damseda, namos, namsi.]
danako (s), *n.* a ring, finger ring (probably an anklet), cf. gogob.
dara, a prefix to verbs.
daradara (s), *a.* thorny, prickly.
daradweare (atwe).
darakesa (M), *v.* to chase.
darali, *pron. demons.* they there.
darborki (M), *v.* to explain.
dari (M), *v.* mameri dari, to detain.
darobĕri, darubiri (J), *n.* a bamboo jew's harp.
dasiri, *v.* to sheath. cf.
dasur.
datere (M), beams of a house.
datki, *v.* to light, shine (atki). [daratkeda, daratkeare.]
datkimuar, *v.* to guide, lead. [datkimuartare, datkimoartare.]
datupida, *v.* to step over. [datuparare.]
datuperti, Jno. vi. 17.
dau (M), *n.* a sling; *v.* to sling.
daugatare (M), *v.* tag daugatare, to marry.
daumer, *n.* The Torres Strait pigeon, *Carpophaga luctuosa*; daumer le, the daumer clan.

dawam, *interj.* a form of salutation.
de, a suffix, by, by means of.
de, a prefix to verbs.
dĕbĕ, dĕbĕlĕ, *a.* good; debe-laglag, sweet; hence debe-merkem, gospel.
dedered, *v.* to anoint, to pour on.
dedkoli, *v.* to spoil, corrupt, oppress, oppose. [dedkoeda, dedkoare, natkoli.]
dedkomet? sealed, Jno. iii. 33. ? answered, cf. etkat.
dedomeri, *v.* to draw, see edomer.
deg, *n.* a border, edge, deg-werem, *n.* abortion.
dĕgĕm, *n.* The Bird of Paradise.
dĕger (or dăger), *n.* the dugong.
degmori, *v.* to conquer.
degraret, *v.* to begin (degraretelu, degerati, s).
dei, Jno. vi. 8.
deib, deb, *n.* elephantiasis of the leg, any swelling.
deibdeib (s), *a.* puffed up, swollen, like deib. Adera baselaia mokakalam leaven nerut kosker abele flour ge ikedi; iako akaida dëibdëib flour uridili leaven lam (s).
deidei, *n.* a shell, the *Turbo*, deidei pot, the operculum of turbo, it has eye-like markings.
deiwat, tag deiwat, *v.* to scratch the palm in shaking hands (J). cf augwat and ewatumur.
dekaer, *v.* to leave, cf. ekai.
dekas (M), *v.* to boil.
dekekeli (M), *v.* to peep.
demali, *v.* to shake, (M) demare, (s) demari.
demar, *v.* to praise, glorify. [demali, demare.]
demer = dimer.
demir = dimer.
depaup (M), *v.* to bale, to lave.
depegem, *v.* to turn over or up, alter. [depegili, depegemelu.]
depeger, *v.* to choose, appoint, to change into. [depegereda, depegelam, depegerare.]
depumeda (s), *v.* to fill. Ko kara meta depumeda, to fill my house.
deragada (?), chosen?
derali, *pron. demons.* they there, there.

derar, *v.* to hate, dislike. [derarti, derarteda, derareti, naorar, naorti, naorarti.]
deraueli, *v.* to surround; *a.* around. [deraueida.]
dereb (M), *v.* to pick.
dereg, *v.* to put out the tongue, weret-dereg. cf. areg, těrěg.
děrěs, *n.* a pool or lagoon in a reef.
dergeda (M), *n.* fat. dergederge (s), *a.* fatted.
dergëiri, *v.* to burst. Mark, v. 4.
derku (J), *n.* a wild grape.
derser, dersem, *v.* to prepare; (M), to watch. [dersemrare, dersemer.]
derumeda, *v.* to stand round.
desak, *v.* to erase.
desauersili, *v.* to revile, abuse. [nasauersili.]
deskemrare, *v.* many persecute.
deskerdi, *v.* to shake.
detai = detali. cf. detar.
detapi, *v.* to strike. [detapiare.]
detar, *v.* to write (autare).
detaserik (M), korizer detaserik, *v.* to steer.
detoamered (M), *v.* to blow the nose.
detroki (M), *v.* to pierce.
detwe, *v.* to take away, unloose, unfasten (atwe).
deumer (M), *n.* hatchet; deumer tulik, hatchet, axe.
diadi, *a.* flat, level; (M) *n.* a flap, plait; *v.* to flap.
dibadiba, *n.* a dove.
diber-kap, *n.* the name of a dance.
dĭbidĭbi, *n.* a circular shell ornament made from the flat end of the *Conus millepunctatus* (Wauri).
didmirki, *v.* to cast away, lose, to err; *a.* thoughtless, mistaken.
didwi (M), *v.* to unite.
digmi (M), v. to pass.
digmiri, Mark, xiii. 20. shortened?
dikaer = dekaer, from ekai.
dikas, *v.* to cook.
dikëtilu, *v.* to stoop down.
diketida, *v.* to arise.
dikiam, *v.* to cut off. [dikiemur (s)].
dikomer (J), *v.* to twist.

dikmerik, *v.* to send away. [dikmeriklu, dikimerkeda.]
dikri, *v.* to throw away, hurt, (M) to forgive, = akri.
dilik (?) dilik barge, in winter, Jno. x. 22.
dilikili (S), *n.* a feast.
dimdi, *n.* an eclipse.
dimegeroa, *v.* to allow.
dimer, *v.* to mend.
dimi, *v.* to shut; wali deměd, a curtain. [demare, demdare, dimilu.]
dimiri (S), *v.* to put on clothes, cf. ami.
dimirualu, *v.* to look up. [dimiruarti.]
diper, *v.* to blow (as a trumpet).
dipumeda (?) *n.* toll, Mark, ii. 14.
dirili (?) kerem dirili, *v.* to wag the head.
dirser (M) = derser.
diseri, *v.* to light (as a lamp), to ignite, to burn up. [diserida.]
dĭsĕlis (J), *n.* a twig.
disirik, *v.* to burn.
diski, *v.* to open [diskilu, darauskilu] (isăk (L) an opening).
ditagi = detager.
ditakeamur (M), *v.* to separate.
ditarida, *v.* to choose, appoint = itili.
ditimeda, *v.* to begin. [natimeda.]
ditpurdare (M), *v.* to delve.
dituaki, *v.* to expel; (M) to refuse. [dituagda, detuakili, natuaki.]
ditwi (M) = detue.
doakri (?). uader kebi uar abi doakri, other little ships were also with him, Mk. iv. 36.
dobdob, *a.* fat, corpulent, (M) thick.
dodo, *n.* a stream, brook, river.
dodomer (M), *n.* a coast.
dog, *postpos*, with, along with, belonging to.
do͡iom, *n.* a rain charm.
dopek (M), *n.* to have a nightmare.
dordor, *a.* numerous, many; often (M); nole dordor (M) seldom.
dorge, *n.* labour, *v.* to work.
dorsumda, *v.* to prohibit.
dri (or dĕri) *n.* a white feather headdress.
drim, *n.* the revolving movement of the fire-stick in making fire.

dub, *n.* a scar or cicatrix ; nem (or nano) dub, a cicatrix formerly cut on the breast.

dudum, quick, fast.

dulam (M) *v.* to punish ; *n.* judgment.

durdur, *a.* shaking, trembling ; (M) *n.* the shivering stage of the malarial fever.

E, *pron.* he, she, it.

e, *n.* tears.

eakai = akar. [eakarida.]

ebazoli = bazoli, ezoli.

ĕb, *n.* the penis ; ĕbĕneop, cf. alida = ĕb, op. [= ebunau (J).] cf. gebo.

ebeb, *n.* tears, weeping.

ebegri, *v.* to scatter.

ĕbĕneop. See under ĕb.

ebisi, (M) *v.* to heal. [ebisida.]

ebisker, (L) *n.* a cure.

ebunau (J), *n.* a shield-shaped shell worn over the groin. cf. ĕbĕneop.

ebur, *n.* an animal, a bird ; ebur-edarem, *n.* an insect ; ebur meta, *n.* birds' nest.

ĕd, *n.* hair twisted into long ringlets and usually plastered with mud.

edag, *v.* to reap, collect, save up. [edagili, edagare.]

edarem (?) ebur-edarem, *n.* an insect.

eded, *n.* life, *a.* living, alive ; *v.* to live.

ededem, *v.* to save, to make live.

edegi (M), *v.* to melt.

eder,

ĕdoak, *n.* the shell of the smooth *Turbo.*

edomer, *v.* to drag in ; to guide, to draw, to pull (as of a bow). [dedomur, nadomer.]

egared, *v.* to take in, receive, accept, nurse = agared.

egaret, *v.* to suffer, to bear.

egali, *v.* to speak. [degali, degarere, nagali.]

ege, *conj.* and, then.

egĕb, *n.* the season when the bush is cut down.

egemedi (M), *n.* a pool.

egremalu, *v.* to turn round. [tegeremalu.]

ĕgĕli, *v.* to look round.

egiameidö (m), *n.* the past.
egiami, *v.* to bend.
egimer, *v.* to save.
egimulu, *v.* to settle on, rest on. [wë-egimurua.]
egobli (m), *v.* to leak.
eguatumur, *v.* to haul, drag ; pull in; lead, guide.
egur (j) = gegur.
eipu, *n.* the middle, midst; *prep.* through, between, among; eipu-gerĕger, noon; eip-ki, midnight.
ekaerti (m), *n.* a burn ; karbabu ekaerti, *v.* to burn myself.
ekai, *v.* to ask. [ekailu.]
ekai, *v.* to leave. [dekaer, dekaeda, dekaelei, dekaelu, dekaereta, dekaererti, darakaertare, nakaerti.]
ekaida, *v.* to become. [ekairare] see akai.
ekao = ekau. [tekao.]
ekarida,
ekas, *v.* to walk. [ekasereder, ekaseredi, nakas, nakasir, nakaseredi, tekas.]
ekasmai (l), *v.* to fall down, to slit, to split (as wood), cf. ekesmer.
ekau, *v.* to carry, take up, bear, bring. [ekada, ekadare, ekadarare, ekalu, ekauerelu, ekauerertare, ekauererti, tekadare, tekaderare, tekalu, tekau.]
ekeam, *v.* to rise, as from sleep. [ekeamda, ekeamulu, nakiamda, ĕkiam.]
ekekeli, *v.* to decrease, get smaller. [nakekeri.]
ekëli = ikeli, aker.
ekesmer, *v.* to fall; mer akesmer, *n.* oath. [bakĕsmeri, nakesmulu, uanakesmur.] (nakesimu, to split (as wood) (j).
eko, *ad.* yes.
ekos, *v.* to put forth, set up as a post, stab, prick, begin, institute. [akoselam.]
ekoseli, *v.* to spread abroad.
ekosili (?), le umele a ekosili, an honourable man and a counsellor. Mark, xv. 43.
ĕkupĭmar (j), *v.* to scrape. cf. ikris.
ekwar = ikwar ; bes-ekwar (m), to lend (lit. false-give).
ekwe, *v.* to stand up, arise, stop. [akuelam, ekueda, ekueili, ekueilu, ekueirare, tekue, tekueilu.]

ĕkwe, *n.* a kingfisher (?).

ĕlĕle, *a.* tight, fast, firm (M), loud; *v.* to hold tight, compel.

em. *Suffix*, to, for, towards.

emaideretili (M), *v.* to blame.

emarida, *v.* to send, dismiss; kepu bamarida, many are scattered. [bamarida, demarida, namarida, taramarida, tedemarida, temarida.]

emarik, emark, *v.* to give up, deliver; (M), let go. [amariklu, bamerik, damrik, emariklu, namrik, namariklam, namarkare, taramarkare, temariklu.]

emarmuli, *v.* to spill.

eme (M), *n.* a bunch.

emeli, *v.* to give suck.

emetu, *v.* to finish, complete; *adv.* after.

emerered, *v.* to hang.

ĕmĕrĕt, ĕmĕrit, *adv.* a long time ago, formerly; *v.* to send away; emeretlu, *n.* an old or ancient object (with an emphasis on the first syllable if of great age).

emo, *v.* to pile up, to build. emorare.

emor, *v.* to sow, plant; *n.* the season for planting yams; le emor, amorda le, sower; meta emor, to build a house.

emor (M), *n.* a palm.

emri, *v.* to stay, stop, dwell, sit, wait; koreder emrilei, two run together. [bameri, bameli, emereder, emerered, emeredi, emrilei, emrilu, namer, nameri.]

eogerdi, *v.* to destroy, pull down.

eosmeda, *v.* to come out, to fill (*i.e.* come over, overflow) = osmer.

epaiter = apaiter.

epars (M), *v.* to hatch.

eparsili, *v.* to stoop.

epe, *conj.* and, but, then (consequence), though, nor (with negative verb), Ma nole geum kak, epe oituli, be not afraid, only believe.

ĕpei, ĕpe, *n.* a basket, bag.

eperekili, *v.* to put out leaves.

eperda, *v.* to fly.

ĕpie (M), *v.* to feed.

ĕpitili (M), *v.* to graze, to lie in, to wallow.

ep ke, *n.* the middle finger, the ring finger (eipu-ke).

ĕpki, *v.* to stay, abide, cf. emri.
ĕpoa (M), *v.* to keep.
epule, *n.* an intermediary in purchasing, a "middleman." cf. eipu, le.
ĕpuli, *v.* to divide. cf. eipu.
equatumor (M) = eguatumur.
eragi, *v.* to divide. [eragili, uëirag (s).]
erap = *v.* to buy or sell, to barter; ĕraple or araple, a buyer, merchant. [arapem, eraplare, terapei, terapare.]
erap, *v.* to break, crack, divide, cut off; kerem derapeida, to behead. [erapei, arapeir, derapeida, derapeir, tederapeida, uaderapei.]
erarem (s), I will not.
erask, *v.* to roll away, to overthrow. [eraskida, dararaskilare.]
erbor = arbor.
erdali = ardar, *v.* to see, espy. [erdalu, erdarda, nardarare.]
ere, *v.* to drink. [areëm, arcë, areli, dere, eri, ereli, ereare, erili.]
erĕb, *v.* to row or paddle.
eregili, *v.* to catch. [eregilu.]
erek (?), *a.* a colour, pale yellow.
eremeli (M), *v.* to dash.
ĕrĕmlu, *n.* a long wooden bodkin used for thatching.
ere-meta, *n.* a school.
ererekrier, *v.* to shout to, cry out to, hail. [ererakri, ererekireiei.]
ererkak (s), *a.* faint.
erertikri, *v.* to shout to, to call, to crow. [erertikrili.]
erewere, *n.* teaching, instruction, doctrine; *n.* erewer le, teacher.
ĕrĕwerĕm, *v.* to teach, to learn. [nerewereda] (ereverem ereuerem).
ergi (M), *v.* to eat; le ergi (M), *n.* a cannibal. cf. areg.
ĕriura (J) = ere ur, cf. ĕrurwer (J).
erkepagau, *v.* to lust, look with an evil eye on a woman.
erkepakos (M), *v.* to spy.
erkepe-irmi, *v.* to lie unwittingly, to judge wrongly.
erkepasam, *v.* to shut the eyes, cf. irkĕp, asam.
ĕro, *v.* to eat. [aro, aroem, eroarare, eroarem, eroeda, erolare, eroli, naroli, tero.]
erom (M) = eruam.
erparik, *v.* to remove, send away. [erparkei.]
erpei, *v.* to grasp, seize, hold, catch, carry. [erpeilu, terpei, terpeirare.]

erperida (M), *v.* to burst.
eruam, *v.* to steal; to ravish, rape; eruam le, *n.* thief.
eruar, *v.* to throw away.
eruer = ereuere.
erusĕr, *v.* to chew.
ĕrurwer (J), *v.* to smoke tobacco (descriptive of the Papuan method of smoking, and lit. ere to drink, urweri heat.)
esa.
esaimelu, *v.* to outrun, to pass by. [esaimeda.]
esakei (M), *v.* to cut. [esakeilu, isaker.]
esakri, outside. Mark xi. 4. cf. akri.
esali, *v.* to increase.
esani, *v.* to multiply, multiplication.
esapem, *v.* to crawl, creep.
esaperi, *v.* to push.
esawi, *v.* to spread; see basao, asawem.
ese, *v.* to suppose; *conj.* if, though.
ese nole, *conj.* unless, except.
eseamuda, *v.* to finish. [eseëmuda, oseëmulu, uëseëmur.]
esegemelu, *n.* pavement. Jno. xix. 13.
eseger, *v.* to furnish, prepare, make ready. [esegarare.]
eseger, *n.* a bridge.
esigmada, *v.* to start back; be frightened.
esipili = ispilu.
eskare, tower? Mk. xii. 1.
eskedi, *v.* to erect, as a post.
eski = ekos, *v.* to put forth.
ĕskŏs, *v.* to kiss.
esmelu, esmilu, *v.* to go out, to be born. See osmer.
eso, *v.* to gird, to put on girdle. [asodalam, uanaso.]
ĕso ao, *v.* to thank.
esolu, *v.* to gird, put on clothes.
esomed, *v.* to suck, to lick.
esorapa, *v.* to sit with bended head; to sit quiet. (This has come to be the attitude of prayer, and the word has been adopted by the missionaries to mean prayer. The true word for prayer should have been ekai, to ask, beg.) [esorerapare, esorerapem, esoreraparem, esorerapeida, esorerapeilu.]

esorarapa = esorapa.
esorgiru, *v.* to bow the head, to stoop.
esperi, *v.* to dry.
ĕspi, *n.* urine.
espili, *v.* to praise, to honour. [baospili, despereda, despili, naospereda, naospili.]
etage, *v.* to count, read.
etaker, *v.* to take up, gather up, collect. [etakerare, itakemarare, ditkeda.] cf. edag.
etali, (M), *v.* to swing.
etalu, *v.* to find.
etami, *v.* to meet together in one place, to collect.
etaperet (M), *v.* to mix.
etarapi, *v.* to choke. [detarapi, ditarapi.]
etatkoi, *v.* to beat into (of waves).
etatmili (M), *v.* to rub.
etauem (M), *n.* a span.
etauriklu, *v.* to smite.
etaute, *v.* to speak, tell, = ataut.
ëti, *v.* to look up, lift up the eyes. [etilu.]
etirida, itirida, *n.* a shield; *v.* to shield, cf. alida.
etkat, *v.* to speak, answer. [etkarti, etkalu, itkalu, natkalei, natkartare, natkarti.]
etkemet, *v.* to gather, cut off.
etkobei = atkobei, *v.* to lay on the ground, to bury (native fashion).
etkoperida (M), *a.* narrow.
etoamerdare, *v.* many kindle a fire; ur etoamered (M), to light a fire.
etoat, *v.* to break, to tear. [batoat, batoadare.]
etomer, *v.* to show, confess, make plain. [atomeret, detomereta, detomertare, etomeret, etomerti, natomelu, uatomertare, natomertauem.]
etut, *v.* to point, see itut.
euatumur (s) *v.* to draw, pull, see eguatumur.
eud, *n.* death: *a.* dead; *n.* to die; eud le, *n.* a corpse. [eudilu.]
eudeud, *a.* deadly.
eumi, *v.* to die; ipit eumilu, to kill. [eumida, eumilu, naumilu, teumida.]
eupamada, *v.* to rise, as the sun; lem eupumada, sun-rise.

eupimar, *v.* to leap.
eupimada = eupamada.
eupumar, *v.* to descend, to leap.
euselu, *a.* blighted, withered.
eutumer = itmer, *v.* to ask, inquire. [bautumer, nautumer, nautumerare.]
ewa, *n.* natural "cloth" of the spathe of leaf of coco palm.
ewatumur, see eguatumur.
ewe (s) = ewer. Dodo abele meta elel demari, au kilar kilar ewe. Luke, vi. 48.
ewer, *v.* to plait, hence weave; mend, repair. [ewelei, ewerare.]
ezageri, *v.* to tear, destroy. [esakri, ezagarare.]
ezagili (s) = ezageri.
ezer, *n.* the melon shell (*Cymbium*); this is used as a pan, cooking-vessel, etc.; hence a dish, etc.
ezigmada, *v.* to start back = esigmada.
ezoli, *v.* to weep, cry. [bazoli, ebazoli.]
ezubamëli, *v.* to rail at, abuse.

Gab, *n.* a flat clear surface, a path, road; gab diri, *v.* to guard; teter gab, *n.* the sole of the foot, a shoe; tag gab, *n.* the palm of the hand; gab te, *n.* a gate; ogar gab, *n.* the red sweet potato.
gabagaba, *n.* disc-shaped stone club.
gabor, *n.* the outer skin of the nostril.
gai = gaire, many, before le.
gaibar, *n.* early spring = many things spring up (cf. list of seasons).
gainau-tulik (M) *n.* a hatchet.
gaino, *n.* the Torres Strait pigeon (daumer is the more general name, gaino is the Saibai name).
gair, gaire, *a.* many, all, a sign of the plural; hence gaire war, the alphabet.
gako, *conj.* that. Jno. iii. 16.
gako kikem, *ad.* towards evening, Jno. i. 39.
galbol, *n.* a whale.
gam (gem-M), *n.* fishing line.
gani apu, *n.* a bee.
garap, *n.* merchandise, *v.* to barter, buy, or sell, cf. arap. Jno. ii. 16, Iu garap meta, house of merchandise.

garĕd, *n.* the south.
garger, *a.* sharp.
gas, *n.* *Periophthalmus*, a hopping fish.
gatkam, *v.* to snatch away with intent to steal, gatkame le, *n.* a thief.
ge, *ad.* here, now.
ge, *post-pos*, on, at, in.
geasgeas wĕrĕm (M), *n.* a newly-born infant.
gebaugare, *v.* many warm themselves. [bauger, gebaugeli.]
gebgeb, *a.* gentle, meek, weak; ripe (M).
gebigebi, *a.* cold.
gĕbo (gebu), *n.* scrotum, testicles, cf. ĕb.
ged, *n.* land, country, village, Mark, ii. 2, ged kem le, *n.* proprietor, owner of land, pit ged, *n.* cape, headland (lit. nose land); kebi ged, *n.* island (little land); netat gedim, *a.* in one place, *v.* to assemble.
gĕdub, *n.* a garden, plantation.
geedag (M), *pron.* these.
geetedag (M), *pron.* those.
gegedar, *n.* a worm.
gegërmer (M), *v.* to groan, moan, snore.
gegi, *n.* king-fish.
gegur, *n.* skin, bark (M), scalp; ome gegur, bast, or inner bark of the ome tree; gegur tulik, *n.* hoop-iron.
gelar = găla (J), tabu, prohibition; *v.* to place under restriction, hence law, command.
gĕm, *n.* the body, abdomen; gĕm-kak, *a.* lean, ? skeleton (lit. no body); kĕbĕ gĕmgĕm, lean (lit. small body); gĕm wali, *n.* shirt, chemise (lit. body-cloth); gĕm urueri, *n.* fever (lit. body hot); gĕm lidelid, *a.* lean (lit. body bony); gem amuamu, *v.* to press; gĕm kakikak, *n.* leprosy (lit. white body).
gĕm, *n.* the trunk of a tree.
gemelag, *n.* a sweet smell, perfume.
gen, *n.* an oyster, *Pecten*, *Anomia*.
ger (J), *n.* the walnut [?] tree.
gerĕger, *n.* day, daylight; gaire geregere, *ad.* daily; gereger osakeida, *n.* near sunrise; kĕbĕ gereger, *n.* early morning; eipu geregere, *n.* mid-day; abgeregere, *n.* to-morrow, yesterday; abĕle gerĕgere, *n.* to-day.

gĕrĕgĕrĕ, *n.* a parrot (?).

gerar (M), *n.* a rock at sea.

gerer modĕra (J), *n.* a small square of plaited grass fastened to a necklace (? gelar, moder).

gĕrĕs, *n.* sea anemone.

gerger = gerĕger.

gĕrip (grip), *n.* the ear-hole.

geseb, gesep, *n.* land; hence the earth, world; geseb-ge, *ad.* on land, ashore, cf. seb.

geum, *n.* fear, terror; *a.* afraid; *v.* to be afraid, to dread.

geur, *n.* a large marine eel.

giai, *n.* the west wind. cf. ziai.

giau = ziau.

giaud (T), *n.* a white pigment, lime?

gie (M), *n.* a root. (? giz.)

gĭlid (J), the shoulder blade = glid.

gim, *n.* a disease, illness, plague (in Gospels); gim akai, to get ill.

gimgim, *a.* sick, ill; gimgim-le, *n.* invalid.

ginar, *n.* a dance; ginar-diger (?), *v.* to dance.

gir, *n.* a boar's tusk.

girgile (M), *a.* pleasant.

girgir, *n.* thunder.

girkupi, *a.* tender; *v.* to become tender.

giz, *n.* the base of a tree trunk, notably the swollen base of the stem of a coco-palm; the origin, basis, foundation, bottom; sign of plural.

giz nur, the season when the yam leaf withers; *n.* the beginning of harvest; tereg-giz, *n.* gums, base of teeth; hence giz mer, *n.* language, sermon, speech.

gĭz, *n.* a scar.

glid, *n.* the clavicles and hollows above.

goai, *n.* a tree frog (*Hyla cœrulea*).

goar (gwar), *n.* a fish, a kind of skate, sting-ray.

gobar, *a.* adopted; gobarem-tais, *v.* to adopt; gobarawerem, *n.* adopted son.

godegode, *n.* a shell ear-ornament.

gogob, *n.* a ring, a circle, a rope or cane, ring or gromet.

gogonĕb, *n.* the nostril. cf. nĕb.

goigoi, *n.* fire drill (? also a boring drill).
gole, *n.* octopus.
golegole, *a.* black. (green. Mark, vi. 39.)
golegole wer, *n.* pupil of the eye.
gope (M), *n.* head of canoe; cf. mĕkĕtop, op.
goram; pereg-goram, *n.* the front of the neck.
gorgor, *v.* to slant, incline; *n.* a steep place, precipice.
gorgor-paser, *n.* the slanting surface of a hill.
gotat, *n.* sea current, tide, tideway.
grip = gerip.
gub (M), *n.* a water spout.
gubingubin, *a.* soft.
gumik, *a.* secret; *n.* fornication; *ad.* secretly; hence gumik-mer-atager, to murmur.
gune = gur-ge. Mark, v. 13.
gur, *n.* sea, salt water; gur araiger, *v.* to dive; au gur, *n.* ocean.
gur ebur (M), *n.* a seagull.
guriz, *n.* a crab.
gwar, *n.* a sting-ray, cf. goar.
gwĭs, *n.* a stone fish charm—in the form of a fish.

Ia, *a.* this, now.
iakaida, *v.* to accede.
iako, *ad.* again, also.
iama, *ad.* here.
iamdali, *a.* that.
iawataba, *v.* = it is coming.
iawaeakai, *conj.* then.
iba, *n.* the jaw; keu-ib, *n.* the lower jaw.
ibibi, *a.* shaking; *n.* palsy.
id, *a.* good.
idaid, *n.* the *Nautilus* shell.
idali, *ad.* there.
idĕ, *n.* oil.
idid, baker, *n.* a stone used as a hammer and for crushing, hence a millstone. Mark, ix. 42.
idigiri, *v.* to make good; rub off, heal, save, = adigir.
idim, *n.* morning; *ad.* idimge, in the morning.

idimirki (L), *a.* thoughtless; *v.* not to be aware of. [didmirki.]
idisor, *n.* a small variety of coconut water-bottle, cf. nisor.
idmer = irmer.
idŏ, *a.* precious; hence idolu, money.
idoni, idoli (M), *n.* the brain.
ielam, *pron.* from him.
ĭger (J), *n.* the name of a tree.
igi, *v.* to strip off, undress. [igilu, igida] (to bake or roast, cf. ikas).
igiredi, *v.* to shelter (?) to shade.
igmĕsi, *v.* to squeeze.
ikap, *n.* the temples; ikap ăsi, *n.* headache.
ikas = ekas, *v.* to walk, go, or come.
ikas, *v.* to cook.
ike, *ad.* here; *a.* this; *a.* nole ike, absent, not here (? i-ge, at this, cf. ia).
ikeaga, *v.* to say, speak, cf. kega.
ikedi, *v.* to place, put, lay, set. [akedir, ekedarare, ekĕdilu, ekidilu, ikĕdarare, uaikedeua.]
ikĕli, *v.* to do, make, act, build. [aker, akerare, bakĕli, ekĕrere, ikelare, ikereda, ikerer, ikeroa, nakeli.] cf. atagem, emor.
ikid, *v.* to reap, to cut; le ikid, *n.* reaper.
ikip, *v.* to reap.
ikris, *v.* to scrape, scratch.
ikupmaretili, ikubamaretili (S), *v.* to grind the teeth.
ikwar, ekwar, *v.* to give; bes ikwar, *v.* to lend. [bakwar, dakwarare, dekwarare, dekwarda, nakwar, nakwarare.]
ilket,
im, *n.* *Chiloscyllium*, a kind of dogfish (Itar of Saibai).
imada (M), *v.* to drive.
imer (J), *n.* rain, cf. irmer.
imi, *n.* a claw.
imirida.
imo, imu, *v.* to put out, cast out. [imoare, imuare, imuda, namuare.]
imur, *n.* the chin.
imus, *n.* the beard (*i.e.* ip-mus, jaw-hair), the moustache, all the hair on face; imus-itu, *v.* to shave.
in, *n.* the heel.
inau (J), ineu (M), *n.* the Pandamus tree and fruit, cf. abal.

inigob, *n.* a stone adze (?).
inoka, *a.* this.
iobaru, *ad.* after, afterwards.
ipe (M), *v.* to lie down for a thing, cf. uteid (for a person).
ipe, *ad.* there, Jno. xii. 24.
ipit, *v.* to strike, to beat, twist; *n.* a blow; ipit-eumida, *v.* to kill; pat ipit, *v.* to ring a bell. [depit, ipitare, napit, uanapitare.]
iprik, *v.* to shoot; *n.* a shoot (M).
irado (S), *v.* to take service with.
iram (L), *v.* to dig.
irau, *n.* eyelid.
irdi, *ad.* now, cf. peirdi.
ireb (J), *v.* to paddle.
ĭrei (L), *n.* a cockroach.
irgi, *v.* to rebuke.
irimi = irmi.
irke, *n.* the eyelid; irke-mus, *n.* the eyebrow; irke-amarik, *v.* to wink (M).
irkĕp, *n.* the eyeball.
irkes (M), *n.* a ditch.
irmautur (M), *v.* to rave; hence, drunken.
irmer, *n.* rain; irmerpi, *n.* mist; irmerkok (L), *a.* dry.
irmi (M), *v.* to swallow. [ermeda.]
irmili, *v.* to follow, to set the heart on, to believe, to imitate. [armi, armir, ermilei, irmilam, irmilei, irmireda, irmirauem, narmili.]
irou (J), *n.* the purple sweet potato.
irpi = erpei.
iruam, *n.* a kind of bogey or strange beast whom legends say lived in a water hole.
iruapap, *n.* the hammer-headed shark.
irukili (S), *v.* kar irukili, to make a hedge or fence.
irwi (M), *v.* to ravish, rape (probably same as eruam).
isăk (L), *n.* an opening, cf. diski.
isau, *n.* wax, honey.
ise, *n.* image, likeness, *a.* like.
iseda, *v.* to draw out. [iselu.]
iser, *n.* an island (?), cf. kaur, kebĭged.
iserum, *n.* an ant.

isi, *n.* a centipede.
isimi, *v.* to split, cut, divide (with downward motion). [dismilu, nasmilu.]
ismi = isimi ; adem ismi, *v.* to cut away.
isir (?), *n.* a crowd, herd of animals.
isir (?) *a.* sorry, Mark, iii. 5.
isiri, *n.* a beetle.
isisir, *v.* to add, spell, to get larger, to shoot out branches.
iskapsir ? (Jno. ii. 15) (? = atkap).
iskemada (M), *v.* to be victorious.
iski (M), *v.* to hit, to sting ; *n.* a wound ; karbabu bask (M), to wound myself
iskĕli, *v.* to creep.
isorge, *ad.* behind (lit. at the back).
ispi (L), *a.* hidden.
ispili, *v.* to marry ; *n.* marriage.
ispilu, *v.* to hide, conceal. [ispida.]
itara, *n.* the season for clearing the bush, after egeb.
itara, *v.* to divide.
itarat (M), *v.* to fold.
iter (M), *v.* to dip. [itili.]
itiagi, *a.* complete.
itikaretili (S), *v.* to answer. [natikaretili.]
itikobe (S.) = atkobei.
itili, *v.* to be named, be called. [iterare, ditarida, ditararda, natarare.]
itimed, *v.* to shoot, to throw, cast stones ; opu batimeda, *v.* to beckon. [batimeda, batimedilu, itimdare, natimeda.]
itiri, *v.* to put out the hand or foot ; to awake, to rouse, to hold back, constrain. [daratrieda, ditirieda, itirimuda, natiri.]
itkalu = etkalu
itkam, *v.* to divide, to spoil. [itkamer, itkamri, itkamare, naditkamare], cf. itkir, gatkam.
itke = itkir.
itkĕt, itkĕdi (M), *v.* to mend, sew.
itkir, *v.* to snatch, take away. [etkemet, itke, itker, natkedarare.]
itkiri (M), *v.* to wipe ; tag itkir (J), *v.* to wash hands.
itkur.

itmer, *v.* to ask, enquire, answer. [eutumer, nautumer, nautumereda.]
itparare (M), *v.* to join.
itpe (J), *v.* to feel.
itu, *v.* to spit (M); *v.* to shave. (probably = to foam, make foam.)
itur, *v.* to stumble; to break (food). [daraturumda.] teter itur, to kick.
itut, *v.* to touch. [itutilu.]
iwaokaer, iwaokai (M), *ad.* to-morrow. (cf. iawaeakai, *adv.* then.)

Jawali or jianwali = ziau-wali.
jiai = ziai.

Ka, kaka, *pron.* I.
kab, *n.* a dance.
kaba, *n.* banana (plant, leaf, and fruit); sopsop kaba, cf. sopsop; sumes kaba, wild banana.
kabigili, *v.* to be quick.
kabor, *n.* a bottle, cf. tarpor.
kadal, *n.* crocodile.
kadik or kadig, *n.* a gauntlet worn to protect the left arm from the bow-string.
kai, *n.* ball.
kaied, *n.* a grandfather, ancestor.
kaier, *n.* the other, remainder, a part.
kaier, kaia, *n.* crayfish.
kaimeg, *n.* cousin; follower, comrade; hence disciple.
kaip, *n.* the name of several species of bivalve shell; these are often used as spoons and ladles, hence kaip, a spoon, and kaip tulik (L), a spoon.
kaimer, keimer, *n.* a man's brother or woman's sister.
kaise, *a.* like in features, cf. ise.
kaiser, *v.* to be like.
kaisu, *n.* turtle shell ("tortoise shell"); a ridge of hair left on women's heads (J).
kak (J), *n.*, purple sweet potato.
kak, *ad.* none, nothing. gem kak, no body, lean, skeleton (?).
kaka, *pron.* I.

kakanali, *pron.* I here, I am he.
kakaper, *n.* a spark.
kakekake, *a.* white (kakekag).
kalak (J), *n.* a spear.
kalam = kar-lam.
kale (kali), *a.* bigger, a word added to adjectives to intensify the meaning; netat debe kali mai treg (S), one pearl of great price.
kalkal, *n.* a fowl.
kamsam, *n.* eel.
kamut, *n.* a game played with a string, cat's cradle.
kănai, *n.* the mitre shell, *Mitra.*
kap, *n.* butterfly.
kap (J), *n.* the itch.
kapkap, *v.* to scratch; kapŭto, kapăkrĭs (J).
kar, *a.* true; Ade abara Ab kar, God was actually his father, Jno. v. 18.
kar, *n.* a fence, an enclosure; nole abele kalam, not from this fold. Jno. x. 16.
kara, *pron.* my, mine.
karababu, *pron.* myself.
karakar, *n.* a fern.
karba, *prep.* unto.
karbabim, *pron.* to myself.
karbarseri, *n.* a redoubt = kar bares, fighting fence. (? a native term.)
kare, *pron.* me.
karem, *n.* time; *ad.* niai karem, always.
karem, *n.* sea.
karim, *pron.* to me, for me.
karker, *n.* name of a bird; a crab (J).
karokarom, *v.* to stammer.
karomkarom, *a.* doubtful.
karu, *n.* a fence; a curlew (J).
karudirumdi, *v.* to enclose, put within a fence.
kase, *ad.* exceedingly; au kase, beyond measure.
kataur (?), *n.* a cockatoo.
kauaisu (J), *n.* grass.
kaubkaub, *n.* a ball, sphere; hence a European bead. See tabo kaubkaub.
kaur, *n.* island; cf. kebĭged, iser.

kausor, *n.* a hermit crab.
kaz, *n.* fathom, the unit of measure, from tip to tip of finger of outstretched arms.
ke, *n.* finger; ep-ke, middle finger; baur-ke, forefinger; au ke, big finger, *i. e.* thumb; kebe-ke, little finger.
ke au mit, *n.* the lower lip.
keaub keaub meta, *n.* a round or bee-hive house, cf. kaubkaub.
kĕbĕ, *a.* small; kebĭ ged, *n.* island; kebi le, *n.* boy.
kĕbĕ gereger, *n.* morning; lit. little day.
kebe ke, *n.* the little finger.
kebe kok, *n.* wrist.
kĕber, *n.* the man dressed up at the death dance, to represent the spirit of the man (kimiar kĕber) or woman (kosker kĕber) who is deceased; kĕber op, leafy mask worn by kĕber.
kĕbi = kĕbĕ.
kĕbikes (M), *a.* narrow.
kĕbili, *n.* lad, boy.
kebitab, *v.* to fine; *n.* a fine.
kĕd or kĕd lager, *n.* strips of coconut husk tied together so as to form a rope; kĕdĕlup, the string or handle which suspends two coconut water-vessels.
kĕdakĕda, *n.* kingfisher.
kedked, *n.* lobster.
kĕf, *n.* a wooden skewer used for joining mats to make sails.
keg (?), ablu keg (L), take away.
kega, *ad.* sign of quotation, saying, thus.
kei = ke.
kei, *ad.* forth (?).
keiar, *n.* spiny lobster (*Palinurus*).
keikei, *v.* to glance.
keimer, kaimer, *n.* a man's brother or woman's sister, cf. berbet.
kĕk, *n.* the front; mĕta-kek, *n.* the front of a house; kekëm, *ad.* to the front, before, first.
kek, *n.* a fish hook = mĕkĕk, kik.
kĕkem bakeamu, *v.* to go before, to precede.
kekiam = kekem, before.
kekmir, *n.* mucus of nose.
kelar, *n.* force, strength.

kĕlarkĕlar, *a.* strong, hard.

kĕm, *ad.* likewise, also.

kĕm, *n.* the belly, the womb; kĕmkĕm, *a.* pregnant; kemge nerezi, *v.* to groan; kem osmeda, *a.* filled (with food), cf. gĕm.

kĕme, *n.* the same company; keme kaimeg giz, his fellow disciples. Jno. xi. 16.

kĕmem, *a.* accompanying, along with, in the midst.

kĕmer, *a.* young, small; the youngest child.

kemerkemer, *a.* fulfilled, whole, entire.

kem-le, *n.* chief, master, owner; hence ged kemle, *n.* owner of country.

kemle, *a.* native.

kemur, kămur, *n.* smoke; a stream, *v.* to stream.

kĕnan, *n.* the arm-pit; kĕnan mus, *n.* hair of arm-pit.

kĕp, *n.* an arrow.

kĕp, *n.* kernel, seed.

keper, *n.* a lagoon, a pool; gur keper, a sea pool.

kĕp abuli, *v.* to drop.

kepilid, *n.* side (M).

kepkep (S), *a.* few, not many.

kepu, *v.* to separate, kepu bamarida, *v.* to be scattered.

ker (M), *n.* the walls of a house, cf. kar.

kĕrakĕra, *n.* a pungent bulb. ("This root, when fresh, looked like and tasted like ginger, but when dried it lost all flavour" (J).)

kĕrar, *n.* vein, artery, sinew, Mar. ix. 18, gëm kerar, pines away, *i.e.* body becomes veins.

kerase (L), *n.* the mainmast.

kerekar, *a.* new, clean, fresh; young.

kĕrĕm, *n.* the head; kĕrĕm lid, *n.* skull; kĕrĕm sĕker, *n.* a comb.

kĕrĕm derapeida, *v.* to cut off the head, behead.

keret (J), *n.* a kind of shell, *Strombus.*

keriba, *pron.* we, exclusive of person addressed, our.

keribibu, *pron.* ourselves, exclusive.

kĕrĭgĕr (J), *n.* the cuttle-fish.

keris lar (M), *n.* raw fish.

kerker, *n*, a crab.

kerker, *n.* time; kerker peik, *ad.* then.

kersi, *n.* the initiation period.

keru (J), *n.* a kind of curlew.

kes (s), *n.* a gulf channel, an open place; au-kes (m), *a.* broad, cf. ukes, kop.

kĕs, *n.* sake; *prep.* on account of, for; kara kĕs, mara kĕs, my, thy sake; ab gedera kĕs, for the land's sake.

kĕs (l), *n.* day.

kesem, *n.* heir, successor; (*v.* to raise up heirs).

keserkeser, *a.* false; *v.* to betray, cheat.

keskak (s), *a.* full; abi gem keskak badbad, his body full of sores.

kĕtai, *n.* a variety of yam.

kĕtkĕt or kĕdkĕd, *n.* ? a shrimp or lobster.

keuba, *v.* to attack; keubu le, *n.* enemy.

keubu, *a.* next; *ad.* afterwards, last. kewu (l).

keu-ib, *n.* lower jaw.

keu nerkep, *n.* pit of the stomach.

ki, *pron.* he and I.

ki, *n.* night; *a.* dark; kiem (l), *n.* afternoon (cf. kikem); eip-ki, *n.* midnight.

kiaur, *n.* lime, cf. giaud.

kibkib (j), *a.* blunt.

kibor, *a.* blunt.

kig (j), *n.* black pigment or charcoal.

kik = kek, hook, point, a bird's beak.

kikem, *n.* evening; twilight.

kikiam, *ad.* in the front, first.

kikiem, *ad.* in the evening.

kimiar, *n.* male, a husband; (sometimes kosker kosker le, that is, a woman's man.

kimiar kau, *n.* = male cow, *i.e.* bull, a new word for an introduced animal.

kimiar kĕber, *n.* the representative of a man's spirit at death dance.

kip, *n.* nates or buttocks, kip lid = kip bone or vertical column of sacrum.

kirir, *n.* abortion.

kirkub, *n.* a nose stick.

ko, sign of the future tense and infinitive mood.

ko, *ad.* that, so that; again, like, more.

koba = kaba, *n.* banana; koba sermer, earwig.

kobar, *n.* a dish, a cup, a vessel.

kobek, *n.* cough; *v.* to have a cold (m).

kober or kobĭl, *n.* the bush people (of New Guinea) ; countrymen.
kodo, *n.* voice, tune.
kod, *n.* occiput, back of the head.
kodomer, *n.* language.
kitoto, *n.* a stridulating insect.
kodrom, *v.* to place on the shoulders; kodrom bakuar, to carry on shoulders.
kogem, *n.* adultery ; kogem-le, *n.* adulterer, cf. koko.
kogim (L), *n.* courtship.
kogiz, *n.* polygamy.
kogmer, *a.* obscene, cf. og.
koima (koemau J), *n.* an oval scar on the shoulder.
koiop, *n.* dragon-fly.
kok (?), below.
kok, *n.* a joint ; kok-ne, knee, elbow ; kĕbĕ-kok, wrist; teter-kok, knee ; kok mamu, *v.* to kneel ; kok bagagarare, many doubted. Jno. xiii. 22.
kok, *n.* (a bow ?)
kokĕt, *n.* stick, staff.
koki, *n.* the north-west monsoon ; the rainy season ; north-west ; koki ziai, west.
koko, *n.* marital intercourse.
kolap, *n.* stone teetotum or top.
kŏlber kŏlber, *n.* a tuft of cassowary feathers worn as a "tail" when dancing.
kole, *n.* master, chief, cf. opole.
kolelut, *n.* a chief, a nobleman. Jno. iv. 49.
komelag, *n.* a whistle.
kŏmer, *n.* poison (L).
kop, *n.* a bay, opening of the sea, cf. awak, kes, ukes.
koparsor (J), *Helix* and *Solarium* shells. (Probably this is kopor sor or navel shell, a very appropriate name for shells with an open umbilicus.)
kopeitemed (s), *v.* to condemn.
kopkop, *a.* deep.
kopor, *n.* navel.
kor, *n.* the back.
kŏr, *n.* the groin ; kŏr-mus, hair of the groin.

koreb, *ad.* such; *v.* to need.
koreder, *v.* to run, flee; koreder bameri, to run along with.
kŏrizer, *v.* to steer.
korot, *m.* the fold of skin in the groin.
kosker, *n.* a married woman, wife; mai-kosker, widow.
kotor, *n.* sky, *a.* high; kotorge, above, in the sky (hence in heaven); kotorem, up.
krupkar (s), *a.* wicked.
kub, *a.* many.
kuk (J), *n.* name of a shell, *Nerita.*
kuki = koki (J).
kukuli.
kupe, *n.* a number of sticks tied on to a piece of string and used as a tally for recording certain events, such as the number of dugong or turtle killed, also "belong eruam," *i. e.* "steal woman."
kupei, *v.* to curse; *n.* a curse, oath.
kuper, *n.* whelk; also maggots (?)
kupikupi, *a.* dark.
kur (L), *n.* back, afterpart; *ad.* behind, cf. kor, sor.
kur, *n.* cave; kur-te, mouth of a cave.
kurab, kurap, *a.* bitter; hence *n.* envy, bitterness of heart.
kurabem, *v.* to give saltness or bitterness to, to flavour.
kurabkurab, *a.* bitter, sour.
kus, *n.* seed, but more particularly *Coix lachrymæ,* Job's tears; kus lĕb, an ear ornament made of "kus."
kuskus, *n.* a needle.
kutaire, *n.* a spot.
kutikuti, *v.* to dive.
kwir, *n.* dart of dugong harpoon.
kwoier, *n.* bamboo knife.
kwarwei, *n.* a wild-fowl smaller than Surka.
kriskris, a kind of bird.

La *post-pos* = ra.
lag, *n.* mosquito.
la gĕlag, *v.* to desire, wish, love, like.
lager, *n.* rope, line; malil lager, *n.* a chain; zigerziger lager euer aperem, to plait a rope of thorns for a hat. Mark, xv. 17.

laip, *n.* the outer ear; laip nĕb, hole in lobe of the ear; gĕrip, the ear hole; laip tute, an ear ornament; idaid laip, ear ornament made of nautilus shell.

lakak, *v.* not to wish, be unwilling, *cf.* lag, kak.

lakup, *a.* many, plenty, a great number.

lam, a suffix to nouns, from, through, out of.

lam, *n.* a leaf.

lama (J), *v.* to tear.

lamar, *n.* a spirit, ghost, white man; hence Lamar zogo, Holy Spirit. (probably = le mar, lela mar, man's spirit), cf. mar.

lamlam, *a.* many, numerous.

lar, *n.* a fish.

laulau, *n.* a board, table. (Introduced from Samoa *viâ* Lifu.)

laup, *n.* a mask (le op).

le, *n.* a human being; le-aud, a desiccated corpse, mummy; cf. eud le; le op, mask, image (le atua, a carpenter).

le, *n.* fæces, excrement; hence, rust.

lĕb, *n.* a fin = lib, a pectoral fin (J).

lĕb, *n.* the rim of the ear; kus-leb, ear ornament made of kus seeds; mai leb, ear ornament made of pearl shell.

led.

leise, *a.* like a man.

lem, *n.* the sun; lem baraigida, sunset.

lemlem, *a.* a lath.

lerkar, *a.* thin.

leserur (M), *n.* diarrhœa, cf. le, serur.

lĕt, *n.* a bowstring.

lever (S), = lewer.

lewer, *n.* food, yam.

li, *v.* to evacuate; *n.* fæces = le.

lib (J), *n.* the pectoral fin of a fish.

liber le (S.), *n.* enemy.

lid, *n.* bone, skeleton, joist of roof, shell; kerem lid, skull; map lid, shoulder blade; kip lid, vertical column of sacrum; bi lid = side bone, ribs; lidlid le (M), a warrior.

lidelid, *a.* bony, thin; gem lidlid, lean.

lid agem, *a.* insolent.

lid-asmer, *v.* to stare (lit. to look at the bone).

liga (J), *n.* a shell, *Conus;* liga lĕr (J), *n.* the *Conus geographicus.*
lislis, *n.* a twig, leaf (?).
logab, *n.* south-west (?).
lokod, lokot, *n.* the bottom of a thing; lokod-ge, under, beneath, down; lokotlam, from below.
lokok, *ad.* under (M).
lola (J), cf. nole.
lolo, *n.* a bamboo flick or whip; the crack is made by recoil of handle when the string is pulled. (pĕpedu of Saibai.)
lu, *n.* a thing, tree (?). Ad abi detager lulam, Mk. xii. 26, God spake to him through the bush.
lub, *n.* a feather.
lugaide (L), *a.* loaded (lit. lu-gaire, many things).
lugelam, *v.* to give in return, pay back.
lugem, *v*, to do work.
lu gizra apu, *a.* rich (lit. mother of things). Mark, x. 23.
luglug (S), *a.* rich.
lugu, *n.* a fork (introduced).
lugulug, *v.* to cast out.
lu-ismi, *v.* to fell a tree.
lukak (S), *a.* poor (lit. nothing).
lukem-le, *n.* the master of the ceremonies at a tama feast.
lukluk mer, *n.* an impediment in the speech.
lukup, *n.* medicine (perhaps from lu, thing, and Saibai kupe, a medicinal plant), paint. (antidote, L.)
lukup kem-le, *n.* doctor, physician (introduced combination).
lusik, *n.* a bud, lit. a blossom-thing.
luzap-le (?), *v.* to accustom, *a.* careful.

Ma, mama, *pron.* thou, you (sing).
mab (S), *n.* the shoulder = map.
mabara, *pron.* thy, thine own.
mabĕk, *n.* evening. Mark, vi. 47.
maber, *n.* a conch shell, *Pyrula, Fusus, Triton;* a shell trumpet, which is here usually a *Fusus proboscidiferus.*
mabu, *pron.* yourself.
mabus, *v.* to put up with, to suffer.
madă (J), *n.* a woman [doubtful, cf. mada in Saibai voc.]

madu (J), *n.* a shell, a kind of *Arca.*

madub, *n.* a charm; neur madub, a wooden image of a girl, used for sorcery or as a charm; sugob madub, a tobacco charm; a simpleton or mad (L), this probably means one who has been acted upon by sorcery.

mag, *n.* the season when the new leaves of the yam are sprouting.

mai, *n.* pearl shell, the crescentic breast ornament made of pearl shell; mai lĕb, ear ornament made of pearl shell; mai-tĕrĕg, a pearl, lit. pearl-shell tooth.

mai, *pron.* thou.

maid, *n.* sorcery, magic, perhaps more particularly that which produces sickness, etc.; maidkĕmĕle, *n.* a sorcerer; maidimbli (L), a murderer.

maiem, *inter.* a form of greeting.

maik, *n.* mourning; maik nagar, mourning costume; maikosker, a widow, lit. a wife in mourning.

maike, *ad.* near, close by, beside.

maisu, *n.* porch, verandah (introduced).

makamak, mukămuk, *n.* a leglet; tag makamak, a finger ring.

makerem, makeriam, makreĕm, *n.* a young man.

makus, *n.* mouse, cf. mokeis.

malil, *n.* a sheet of metal, iron; malil tanelu, *n.* a tin plate; malil lager, *n.* a chain (probably introduced), cf. tulik.

mam, *n.* blood.

mama, *pron.* = ma, thou, you.

mamam, mamamam, *a.* blood colour, red, purple.

mamam (M), *a.* kind; mamam le.

mamamali, *pron.* thou here.

mameri dari, *v.* to detain.

mamoro, *ad.* carefully; mamor-dasmer, *v.* to look carefully, beware, take heed.

mamuar, *v.* to drive away.

mamus, *n.* the name now used to signify a chief; originally it appears to have been merely a man's name (probably mam mus, red hair), the chiefs recognized by the Queensland Government are all called "Mammoose"; formerly there were no chiefs at all.

mair, mairme, *n.* red ochre; red, cf. mer.

map, *n.* the shoulder (mab); map lid, shoulder blade.

mapodăn, *n.* quiet, easygoing (used erroneously in Gospels for peace, cf. paud).
mar, *n.* cf. lamar, a shadow, spirit, soul, ghost; marasmer, *n.* reflection of face in a mirror or in water; lit. to see a shadow.
mara, *pron.* thy, thine.
marale (L), *n.* a friend (lit. your man), cf. tĕbud.
marasmer, see mar.
marau, *v.* to exhort, preach.
mare, *pron.* thee, you (sing.).
marĕp, *n.* the bamboo.
mari, *pron.* thee, you (sing.) = mare.
markak, *a.* tame, wild (both in M).
markaream, *ad.* always.
marmar, *a.* wild, not tame.
marmot, *n.* the breast or chest, bosom.
mash (L), *a.* below [Mark xii. 36. mara teter mas, thy footstool].
mase, *exclam.* go on! proceed!
mat, *n.* a frondose coral.
mat, *n.* forehead; mat pas, *n.* wrinkles, cf. pas; mata lagări (J) *n.* a fillet for the forehead.
matalager, *n.* forehead band, plain or made of "kus" seeds, etc; piau (or idaid) matalagir, forehead band made of nautilus shell, "idaid."
mau, *n.* seaweed (J); termite (white ant).
māūd, *n.* the *Pinna* shell = māūb.
mazepkor (J), *prep.* beyond.
me, an interrog. particle, Mark, xv. 2. Ma Iudaia giz Opole, me?
meb = mep, *n.* moon, month; mebpeak (M), first quarter of moon (? peak = pek, the side of the moon); meb zizimi (M), last quarter of the moon (? zizimi = ismi, the cut moon); giz meb (M), full moon.
mebgerib, *v.* to shine, of the moon.
med, *n.* flesh.
medu, *n.* the "nipa" palm, which occasionally floats down from the Fly River.
meg (J), *n.* the tide.
megi, *v.* to vomit.
megogĕri, *n.* flood tide (? meg ogi).
megomarida, *v.* to ebb (of the tide), megirap (L).

megtauerge, *n.* on the beach.

mĕk, *n.* sign or mark; ex. the rising of the constellation Usiam is the mĕk for the harvest of new yams; tetermĕk, footprint.

mĕkĕk, *n.* a fish-hook; mekek-gam (J), *n.* a fishing-line (gem. M).

mĕkĕtop, *n.* the figure-head of a canoe, cf. gope.

mekik = mekek.

mem, *n.* louse.

meme, *v.* to have dealings with; gaire Iudaia le a Samaria le nole meme kak, Jno. iv. 9.

meme, *a.* weary, tired; memelam, Jno. iv. 6, weariness.

memeg, *v.* to serve; memeg le, servant.

memegem (S), *v.* to serve.

memekru (S), *n.* a famine.

mena, *ad.* continually, often, yet; *v.* wait! stop! *conj.* while.

menaba, *ad.* in a short time, in a little while, soon.

meput (J), *n.* a cane or reed.

mer, *n.* word, speech, language; merkak, *a.* dumb; geger mer, *n.* a snore; mer akĕsmu, *n.* an oath (lit. fall-down word); merakesmer, *v.* to condemn; mer atager, *v.* to take counsel; mer tigri, *v.* to command.

mer (J), *n.* a paint made of red ochre, cf. mair.

mer (J), *n.* the windpipe.

mereg, *v.* to perspire; *n.* sweat.

meriba, *pron.* we, our, inclusive of the person addressed.

meribabu, *pron.* ourselves.

merkem, *n.* a message, a messenger, hence Mar. i. 1, debe merkem for Lifu maca ka loi, good message, gospel; and karba merkem, Mar. ii. 2, for Lifu macange, my messenger.

mermer,

mĕrod, *n.* the calf of the leg; mĕrod user, a scar cut on the calf of the leg.

merume le, *n.* a witness. Mark, xiv. 63.

mes (J), *n.* coconut husk.

meskep, *n.* low tide (M).

mĕskus, *n.* muscles, or meat of the back.

meta, *n.* dwelling-place, house (meta-neg (S), a barn).

meta kĕk, *n.* front of the house.

metalu, *a.* calm.

mi, *n.* small kind of *Tridacna*; a clam-shell with yellow lips.
mi, *pron.* we two, thou and I.
mielam = mitelam, by or with the lips.
miga (J), *n.* pudendum muliebre, cf. mone.
mimim, *a.* on foot, walking.
mir, *n.* a crack, a noise; mirkok, *a.* quiet (not noise).
mirem, *v.* to tempt, try, attempt; mirem abei, *v.* to guess.
miskor (J), *n.* a shell, *Tridacna* (mi sor).
misma (S) = mase (?) misma ma kare nataut tonar kara lu ma asisered, give an account of thy stewardship.
mit, *n.* lip; op mit, upper lip; keau mit, lower lip; mit lid (J), gums.
mitkar, *a.* full, complete.
mizmiz, *n.* a piece; hence chapter.
mo (J), *n.* a shell, *Bulla.*
moa (J), *n.* a shell, *Cypraea.*
moder, *n.* a mat, a sail.
mog, *ad.* apart, *n.* a lump, bit, piece (moguali, *n.* a towel).
mogmog, *a.* in pieces, broken.
moiaini, *n.* a coco palm leaf plaited on itself, so as to form a kind of fan, used in connexion with doiom.
mokakalam, *a.* the same way, like, similar to, as, so.
mokăp (J), *n.* shell, *Cypraea argus.*
mŏkeis, makus, mokus, *n.* a rat, mouse.
momoro, *ad.* howbeit, cf. mamoro.
mone, *n.* vulva, cf. miga.
mop, *n.* the end; head of a tree; mop-ge, at the last, until.
mopert, *n.* a *Cowrie* with a broad brown edge.
mornăn, *n.* a lizard.
mŏrop, *n.* the forehead.
mos, *n.* saliva; mos ekei (M), mos ekeida, mos ekeilu, mos itu, *v.* to spit, expectorate.
motŏp, *n.* the middle line of the buttocks (mo- or moa-op).
mu (L), *n.* a piece, seaweed.
mu, *see* mui.
mud, *n.* the underside; mudge, *ad.* under, underneath, in secret.
muda, *n.* shelter (J).
mudu (J), *n.* a species of *Arca* shell.

mui, *n.* the inside; mui-ge, *prep.* in the inside, within; mur (L), inside, gaire mu tonar, mysteries. Mar. iv. 11.
muimui, *a.* deep.
mukub, *a.* fastened, fixed; *n.* a knot (L); hence, a shoelace.
muriz, *n.* a distant place; muriz-ge, *ad.* far off.
muro, *n.* ointment.
mus, *n.* hair.
mut, *v.* to clap; *n.* a sound; tag mut, *v.* to clap the hands.
muti (J) *n.* coconut husk.

Na, a prefix to verbs.
na, *ad.* when? what? a prefix of interrogation.
nab, *v.* cannot; kaka nab, I cannot do it.
naba, *pron.* all, all here, all present.
nabazier = nerbazi, see nerezi.
nabue, *v.* to come out.
nadelam? *ad.* whence.
nadi, *ad.* where?
nagar, *n.* the costume or dress of a widow.
nagĕd, *n.* kind of fish.
nagedim, *ad.* whither? (lit. to what place?).
nagelam, nadelam, *ad.* whence? (lit. from what place?).
nagi.
năger (J), *n.* a fly, cf. narger.
nagri, *v.* to have, get, obtain, possess.
naig (L), *n.* seeds, cf. neg.
naiger, *a.* north-east, or N.E. to E.; naiger pek, the N.E. side.
naiwet, *n.* a father in law.
nakĕt, *ad. interr.* how many? how much?
nako, an interrog. particle.
nali, *pron. demons.*, here used with kaka and mama.
nalu, *pron. interrog.*, what?
nalugelam, *ad. interrog.*, how? why? through or from what thing?
nam, *n.* the turtle.
na mi, *v.* stay here! ma na mi, you sit down here.
nano, *n.* the breasts, the nipples; nano user, a scar-device cut on the breasts; nanō dub, a scar on the breast, cf. dub, nem dub.
naokaili, *v.* to leave waiting.

nar, *n.* a canoe, hence a boat; au nar, a ship.
narat, *n.* a light wooden platform, from which dugong were harpooned, probably merely the Saibai name neët or nat.
narbĕt, *n.* the oldest child.
narger, *n.* a fly.
narid, *a.* all, cf. uridili.
naridili, *v.* to accuse. [okadiridili.]
naru (J), neru (L), *n.* sugar cane.
nas, *n.* pity, sorrow.
nasge, *v.* to love, to pity.
nasi, *n.* the *Turbo* shell; nasi sauad, an ornament made from the shell of a *Turbo* in the form of a boar's tusk.
naskaili, *v.* to wait for, to wait on.
nasnas, *a.* pitiful, compassionate.
natar, *v.* to choose.
natkedar, *v.* to pluck, cf. itkir.
nawa, *v.* stay here! you stay!
nauwarĕb zogo, *n.* the zogo or fetish of a certain garden.
nawar (S), *ad.* when? at what hour? war, English hour, and na the interrog. prefix.
nazirkeda.
ne (M), *n.* a torch; neigi, *v.* to fish by torch-light.
neabgir, *n.* a short bamboo whistle.
nĕb, *n.* a hole; laip nĕb, the hole in the lobe of the ear pit nĕb, the hole in the septum of the nose.
neegirnunu, *v.* to do and stay.
neeperoa, *v.* to descend.
neg, *v.* to deride, laugh at; neg degerere, *v.* to laugh.
neg, *n.* seeds; hence the introduced words meta-neg (S), a barn, storehouse; le neg (S), reapers.
negeneg, *a.* laughing.
neg-aiguthi (L), *v.* to laugh.
negarit (L), *a.* low.
nei, *n.* a name.
neid, *n.* stony ground (a cliff, J).
neigi, *v.* *see* ne.
neis, neisi, *a.* two; *pron.* both.
neisorarare (S), *v.* to bow to, see esorarapa.

nem, the breast; nĕm dub, or nano dub, the cicatrix formerly cut on the breast.

nem, *n.* lice.

nemkod (J), *n.* a shell, *Cerithium.*

nener, *n.* a boundary, border.

nener (M), *n.* hiccough.

neo (M), *a.* ripe.

ne-peg (J), *n.* a calabash (? coconut shell) for water; cf. ni, epei.

ner, *n.* the breath; air; ner bataueret, to breathe, to sigh.

nerazi = nerezi, Jno. vii. 2. nerazi meta netpur, rest-house feast, feast of tabernacles.

nerezi, *v.* to sigh, take a long breath; to rest, leave off work for a time. [ner-bazi, na-bazier.]

nerkak, *a.* continuous.

nĕrkĕp, *n.* the heart; the mind; op. nerkep, the pit of the neck; keu nerkep, the pit of the stomach.

neru (L), *n.* sugar cane.

nerutĕ, *a.* another, other; each.

nerzĭsu (J), a coral, *Fungia.*

nesor = nisor.

nesur, *n.* a petticoat; ome nesur, made of beaten bast of ome root; kaba nesur, made of banana leaf; tĕger nesur, made of tĕger leaf. su nesur, dance petticoat worn by the men, made of young leaves of the coco-palm.

net, *n.* a *Chiton.*

netat, *a.* one, alike, corresponding.

nete, *pron. inter.* who?

netkak (L), *a.* stiff; lu-nethkak, perpendicular.

neur, *n.* a girl, unmarried woman; neur wer, *n.* a constellation, a season.

ni (ne, J), *n.* fresh water; ni padi, a well; ni ab, thirst; ni purapura (M), a duck.

niai, *ad.* always (in the future); hereafter, for a long time; niai karem, always, even.

nĭkĕrim (J), *n.* an *Echinus.*

nini, *a.* filled with water; *n.* sap (M).

nisor, *n.* a coconut shell used as a water bottle; a diminutive variety is called idisor (= ni, fresh water, sor, shell).

niti. *pron. interrog.* = nete.

no, *a.* bare, naked, *ad.* only, for no cause; no-gem, naked (lit. bare body).

no (M), *ad.* often.

nog, *n.* the outside of a place; hence nog-le, heathen; nog uteb, a solitary place; abara nog uaba asmer kak, you have not seen his shape.

noge, Mark, xvi., 10. uiaba noge okasosok, as they mourned.

nokŏrot, *n.* a young boy "without kormus" (lit. no, bare, naked; kor, groin).

nole, *a.* no, not, none; *v.* nole la kak, unwilling; *pron.* nole le kak, nobody, no one; nole lu kak, nothing; *a.* nole ike, absent; nole mokakalam, *a.* unlike (M), *v.* to differ.

nolea, *interj.* nay!

nonor, *n.* the nostril.

nonu (J), *n.* the nipple = nano.

nor, *n.* a coral reef.

norgor, *a.* easy. Mark, x., 15.

nosik, *n.* a long row of men, one behind the other; a generation.

nosor, *a.* empty. (? no sor, only a shell, *i.e.* a shell with nothing in it).

nug, *n.* the roof of the mouth.

nug utĕb-ge, in the place where it ought not. Mark, xiii. 14.

nunur, *a.* white for harvest (prob. adjective from nur). Jno. iv. 35.

nur, *n.* the season of harvest.

nuri, *n.* the white sweet potato (? ogar nuri).

Oatur, *v.* to believe = oituli. [natur.]

obaiter, *v.* to perish.

obakiam, *v.* to come forth, from bakiam.

obapiti, *v.* to meet, see apit.

obaruk.

obasgeda, (M), obazgeda, } *v.* to repent, be sorry for.

obgai = obogai, *v.* to dislike, hate.

odaratare, *v.* to think, believe. [onatareda, odarateda, odaratarare.]

og, *n.* dirt.

ogarub, *v.* to wash.

ogarup, *v.* to wash; le ogarup, washerman.

ogar-gab, *n.* red sweet potato, cf. orgab.
ogdirup, *v.* to wash, cf. og-arup.
ogi, *v.* to ascend, climb. [nogi, uabog.]
ogog, *a.* defiled, unclean, dirty.
oituli, *v.* to believe, give the heart to a thing; *n.* faith, hope. [uatur, natur.]
oka batageli, *v.* to be grieved, vexed. [okabatagereda.]
oka deskeda, *v.* to preach, exhort. [okadaraskeda.]
oka diridili, okadiridiri, *v.* to accuse. [naridili.]
okak, *a.* clean; not dirty = og, kak.
okakes, okakise, *a.* along with, equal, uniform, like; nole okakes, unlike.
okaikës, *ad.* from that day forth.
okardar, *v.* to deceive, to be false. [okardarem].
okasosok, *v.* to be troubled, *n.* grief.
okataprik, okatiprik, *v.* to forget.
omabar, *n.* name of a small bird; a love charm.
omai, *n.* a dog; omaile, the dog clan.
omaiter (or wap omaiter), *n.* a dugong-harpoon (wap) used in sorcery (maid).
omare, *v.* to pity, love; *n.* love, pity; omare lu, *n.* a present.
omăsker, *n.* children; (M), a brood.
ome, *n.* name of a tree, the bark of which when beaten was used for making petticoats (nesur).
omeida, *v.* to spring up, to grow [tomeili, omeili].
ŏmŏba (J), *n.* a shell *Dolium.*
omosk (M) = omasker.
onatareda; see odaratare.
op, *n.* the face, the front; opem, in front, before; le op, an image, mask; op-meta, door; op nerkep, pit of the neck; hence op sik, the front seat; op etarer, *v.* to look about.
opas (M), *n.* a cold in the head, cf. asi.
opaserceret, *v.* to take knowledge of, detect, find out, cf. asesere [opaserertem].
opauzi (M), *v.* to sneer.
opele = opole.
opelid, *n.* wantonness.
opisu (J), *n.* a cane or reed.

op-oitimeda (M), *v.* to nod.
opole, *n.* a chief (lit. front man).
orida, *v.* were amazed. Mark, xvi. 8.
orgăb (J), *n.* a kind of sweet potato, cf. ogar gab.
osakeidi (gereger), the day is breaking (M); cf. esakei, to cut. (In Melanesia also the morning "cuts," Codrington, "Melanesians," p. 157).
osëemulu = eseëmulu.
osmer, *v.* to be born, go out; to fill so as to overflow. [eosmeda, esmeda, esmelu, osmeda, osmelei, osmelu, tabaos, teosmeda, teosmelu.]
ouzi, *n.* leech.

Pad, padi, *n.*, cf. pat.
pagi, *n.* a sea snake, sometimes carved in wood as a sign of gĕlar, *i.e.* tabu.
paier, *n.* a post, the supports of the frame on which corpses are dried; a graveyard.
paikai, *n.* the extreme end of anything; a cape or point of land; the point of a spear; cf. pek.
paim, *n.* a fool, idiot; paim arelam (M), *v.* to get drunk (an introduced custom).
paimpaim, *a.* foolish, silly, crazy; *n.* folly.
pako, *conj.* also, and.
pălis (J), *n.* a feather (?).
palopalo, *n.* a segment of a circle.
pam, (?) pamukup, the knot known as the clove hitch; pam kukub, *n.* a noose.
panpan (J), *n.* a lizard; cf. punepun.
pănigob, *n.* shell axe.
pao, peo, *n.* a wing (of bird).
par, *n.* a stone used as an anchor, hence an anchor; par batawared, *v.* to come to anchor (M).
parapa, *a.* lame.
pardali, *v.* to know a great deal; le pardali, *n.* a wise man, (s) a judge.
paret, *v.* to thin out, prune, clear; paret le, husbandman.
paret kak, *a.* open, plain (?).
pas, *n.* a crease, fold; mat pas, wrinkles.

pas (J), *n.* the peppermint tree.
paser, *n.* hill, mountain.
pat, *n.* a hollow, valley; ni pat, a water hole; hence a well.
pat, *n.* the thigh.
patara = parapa, *a.* lame.
pater, *n.* a reed.
pau, *n.* door.
paud, *n.* peace, friendship, cf. mapodan.
paupa (M), *n.* grandfather.
paur, *n.* skin (of an animal).
pe, *ad.* even, just like.
ped, *a.* bald.
pedali, *pron.* he there, him there = dali.
peik, *n.* a part, share.
peikĕ, *ad.* there; *a.* this.
peim = pem.
peirdi, *ad.* now, at present time.
pek, *n.* a rafter, the side of anything.
pĕk, *n.* a nest.
pĕl, *n.* the ear.
pĕlak, *n.* the sacred house in which the masks used in the initiation ceremonies were kept.
pĕm, *n.* a dream; *v.* to dream.
pem, *n.* a locust.
penoka, *ad.* far away.
peo, *n.* wing = pao.
pereg, *n.* lungs (M), cf. ber.
pĕrĕg, *n.* the neck, throat; pĕrĕg gorom, front of neck; pĕrĕg tabo, back of the neck; Mark, xii. 33, the understanding.
pĕrĕpĕrĕ = pĕripĕri.
pĕripēr, *n.* lightning, a mirror (which flashes like lightning).
pĕripĕri, *a.* long; *n.* length.
peris, *n.* a sinew.
peritar, *a.* slippery; *v.* to slip. [peritida.]
peritida, *v.* to slip, slide.
pĕror, *a.* conceited, gaily dressed (in Colonial slang "flash"); (*n.* fever (M).
perorge, *a.* proud.

perper, *a.* light, bright.
pertarpertar, *a.* slippery.
pes, *n.* a steering board or rudder, handle of the panigob or club; candlestick (introduced); pestle (M).
pĕtă (J), *n.* a shell, small species of *Cypraea.*
peumer, *n.* moss.
(pez, *a.* this possibly means unripe, cf. upez, green coconut; werempez, abortion).
pi, *n.* wood ashes; hence gunpowder, cf. tibi.
piau, *n.* mother-of-pearl, nacre (? only from the Nautilus).
pirsok, persok, *n.* the blue-bottle fly, the locust (?), name of a con stellation.
pit, *n.* nose, point of land or cape; pit mop, septum = nose end; pit lĕd, septum (J); pit nĕb, hole in septum = nose hole; pit ged, a point of land, cape.
pitar (L), *n.* cramp.
piupiu, *n.* name of an ornament.
poipi, Mark, v. 16. mer poipi detaut, told the things done; Lifu, hna qeje pengöne la hna kuca.
poipum (S), a watching.
pone, poni, *n.* the eye; poni wer = irkep, eyeball; pone mus, eyelash; poni-pau (J), the eyelid (lit. eye-door).
pokopok tebur, *n.* stomach (M).
porpa, *n.* a grandfather? cf. paupa.
pot, *n.* nail of finger or toe, bird's claw; deidei pot, operculum of turbo (lit. nail of deidei shell; hence detapot (M), a button (? deideipot).
pŭgas, *n.* the biceps.
puipi, *n.* dust; lewer puipi, crumbs; puipi drup (S), *v.* to sweep.
punepun (L), *n.* a lizard.
pupuag, *n.* jelly-fish.
pur (?) soge pur, *n.* a grassy place, desert.
put, *n.* a plaited armlet (musur of Saibai).

Ra, *post-pos* of, sign of genitive.
ras, *n.* a storm.
ris (M), *n.* fishing bait.
roairoai, *a.* like; *n.* a likeness, image.

Sab, *n.* the north; a sponge; a particular kind of tabu.
sabagorar, *n.* a turtleshell ornament worn by girls during their betrothal.
sab koki, *n.* north, north-west.
sabide (s), *n.* oil.
sademe = sadmer.
sadmer, *a.* blind; rotten (J).
sager, *n.* the south-east; sager pek = the east, or E.S.E.
sagerop, *a.* out of sight, beyond.
sagiar (sager) pek, *n.* the east, or E. S. E.
sagim, *ad.* vainly, fruitlessly, with difficulty; *v.* to labour.
sak, *n.* the lobe of the ear when pendant.
salgar, *v.* to boast.
sam, *n.* the cassowary, feathers of the cassowary or headdress made of them.
sap, *v.* to float; *n.* a log or felled tree (probably a water-borne tree trunk), flotsam and jetsam.
sap = sab, *n.* a sponge.
sapăra (J), a hatchet, old name for knife, cf. tulĭk (? introduced, modification of chopper).
saper, *n.* the flying fox (*Pteropus*, a large fruit-eating bat).
sapok, *n.* moth.
saprukup (M), *n.* abortion (? sap lukup or log physic; this is a doubtful word).
sarĕk pas, *n.* a scented plant, similar to an onion.
sarik or sarĕk, *n.* bow and arrow, a musket, a bow.
sasarem, *v.* to make an ado, to be noisy.
saserim, *n.* smart; *v.* to smart; saserim, *a.* strong, well.
sasmi, *n.* noise.
satauro, *n.* cross (introduced from Greek *viâ* Lifu).
satauroem, *v.* to crucify.
sauad, *n.* an artificially deformed boar's tusk used as an ornament.
saurisauri, *n.* a star-shaped stone club (?), a blue star-fish.
se, *n.* the flying-fish.
sĕb = sĕp, *n.* land, soil, earth; sĕb dirki, *n.* a bog; sĕbge, *ad.* on ground, lowland (M), cf. geseb.
sĕbae, seber (or sebbea (L)), *n.* a spider.
sedemer, *ad.* (L), rotten, cf. sadmer.

seg, *n.* the belt and sword in the constellation of Orion.
segise (M), *v.* to row; *n.* a row.
sĕgur (sagur), *n.* play, game, fun, pleasing.
sĕker, *n.* a comb, more frequently kĕrĕm sĕker.
seker (J), *v.* to bore a hole.
sekerseker, *a.* rough.
sem, *n.* a reed.
semelag, *v.* to stink.
sep = seb, *n.* land, ground (sepem, to the world).
sĕpir sĕpir (J), *n.* the *Haliotis* shell.
sĕrar, *n.* name of a seabird = sirar.
sered, *n.* the shin.
serep (M), *n.* the outrigger of a canoe.
serer, *n.* a ridge, corner, edge; the dorsal fin of a fish (J).
sererge, *v.* to rejoice, love, long for; *a.* glad, happy.
serg, *n.* the cane sling on which heads are carried home after a fight.
sermer (?) koba sermer, *n.* earwig.
serpa, *n.* a bracelet of "*Arca*" shells.
serur, *n.* watery saliva; foam.
serure, *n.* juice.
ses, *n.* day (J).
sesĕri, *n.* the mast of a canoe; the pillars of a house (M).
sĕserĭg, *n.* a necklace of dogs' teeth.
sĕskip (J) *n.* a shell, kind of *Turbo*.
siau, *v.* to sneeze.
sibeb, *a.* moist.
sik, *n.* a bed, couch; table; hydrocele of the scrotum; a blossom, flower (hence ear of corn).
simer (M), *v.* to hiss.
sina, *ad*, enough, sufficient; last; *v.* leave off; *n.* the end; *v.* to suffice.
sip, *n.* root.
sir, *n.* the egret (kabai of Saibai.)
sirar, *n.* name of a seabird = sĕrar.
sirdam, *n.* authority, ruler, master (doubtful).
siriăm, *n.* the house set apart for men (the kwod of the Saibai).
sirip, *n.* shame; *a.* ashamed.
sirisiri, *a.* lame.
sirkak (S), *a.* covetous.

siruar, *n.* the green turtle, name of the season for turtle fishing.
siu, *n.* yellow ochre.
sobkak, *a.* quick; *ad.* immediately.
soge, sogi, *n.* grass.
soge purge, *n.* in the wilderness, desert (introduced idea).
sok, *n.* an implement made from the leg-bone of a cassowary; a dagger, a spike; sok tulik, an iron nail.
soka (M), *n.* a chicken.
sokop, sukub (J), *n.* tobacco; sukub marĕb (L), a bamboo tobacco pipe.
soni (J), *n.* an ant.
sopem (J), *n.* a bird, the blue heron.
sopem, *v.* to bind; *v.* to cook in an earth oven (M).
sopsop, *v.* to fold; sopsop kaba, banana fruit which has been wrapped up while growing so as to make it sweet.
sor, *n.* a shell, the shell of a nut, cf. koparsor, nesor, nisor, etc.; hence the outside.
sor tulik, *n.* a cup (lit. an iron shell).
sor, *n.* the back; sor korb, middle part of back, cf. kor, kur.
sorge, *ad.* at the back, behind.
sorkob, *n.* a hump.
sor kokelid, *n.* the backbone, spine.
sŏroi, *n.* a marine *siluroid* fish.
sorsor, *n.* a shell.
su, *n.* the sprouting leaf of the coco-palm which has a pale yellow colour; su nesur; su wakokop; cf. siu.
sub le, *n.* a stranger; sub le uteb, guest-chamber, Mark, xiv. 14.
sugu, *n.* the octopus, cf. arti.
sumez, *n.* the bush, uncultivated land; sumez-em, inland (lit. to the bush).
sumasuma, *v.* to tie or fasten.
sunasuna, *a.* half-bred; *n.* a half-caste.
sŭni, *n.* a mosquito.
surka, *n.* a kind of wild fowl.
sursur, *n.* a baby.
sus, *n.* milk, gum, juice.
suseri, *n.* rainbow (M): meb suseri, moon's halo (M) (blue?).
suskak, *v.* to faint; *a.* faint.

Taarim = tarim.

taba, *prep.* from (?).

taba, *a.* his own; taba ged ge, in his own country; taba neige, in his own name.

tababielam, *ad.* concerning his own.

tababu, *pron.* he himself.

tabamirge.

tabaos, *v.* to go out. See osmer.

tabara, *pron.* his own, his.

tabarki = tabaruk, *v.* to come, when the person is not seen. [tabarkam, tarabarakue, tabarkare, tabarkauem, tabarkeda, tabaruda, uatabaruk.]

tabe (L), alone.

tabo, *n.* the neck.

tabo kaukau, *n.* a necklace (probably the name given to a European necklace; lit. balls for the neck; cf. tabo, kaubkaub).

tabu, *n.* a species of snake.

tag, *n.* the hand, forearm; tag-gab, the palm of the hand; tag au kok (J), elbow; tag kebi kok (J), wrist; tarpot = tag-pot finger nail; tag augwat, *v.* to shake hands (which see); tag deiwat (J), "to scratch the palm in shaking hands," cf. ewatumur; tagmut, to clasp the hands; tag-pim, finger, hand (s).

tagai, *n.* a large constellation representing a man (cf. Legends, "Folklore," I. p. 184).

tagilu, *n.* the ornament worn in the kadig.

taibi, *n.* the leaf of the croton.

taimar (M.), *n.* a rasp or file; taimar tulik, *n.* a saw.

tak.

tam, *n.* a branch, something broken off; hence a division in a sermon.

tama, *n.* a kind of native exchange of food, etc.

tamad, *n.* breadfruit.

tamilĕb, *n.* the assistants to the three zogole at the initiation ceremonies.

tauelu, *n.* dish, cup. Perhaps introduced. Cf. list of introduced words.

tap (J), *n.* a plank (M), a table.

tapim, *n.* the sting-ray.

tapot = tag-pot = tarpot (M), *v.* to pinch.

taputu (?). Mark, viii. 32. Peteru abi taputu irgi, Peter took him.
tara, a prefix to verbs.
tarageri, *v.* to abide, stay.
tare, *n.* a measure.
tarim, *n.* the front; the bow of a canoe; tarim le, a front man, the "captain" or "forehead man" of a canoe; hence a chief.
tarkok (J), *n.* the bowl of a bamboo pipe.
taupere, *a.* short.
tarpor, *n.* a bottle, box; cf. kabor.
tarpot, *n.* the finger nail.
tatuei (M), *n.* a ray.
tawer, *n.* the shore, beach.
te, *n.* the mouth, a door; gab-te, *n.* a gate; kur te, the mouth of a cave; te dabim, dumb.
tĕbtĕb, *a.* only, alone; by one's self.
tĕbud, *n.* a friend.
tedaraskeusarare, *v.* many fill (?).
tedegemili.
tĕger, *n.* a plant with bulbous root, the leaf of the tĕger.
teibur, *n.* the inside, the belly, the stomach, bowels, pith; teibur tulik, a sword.
teir (M), *v.* to decorate.
tep, *n.* the lips (prob. = te-ip, opening or door of jaws).
tepaskir, tepdesker, *v.* to taste. [tepdeskerare.]
tepamer (M), *a.* acid.
tepelu.
ter, *n.* tortoiseshell (turtleshell) bodkin used for piercing the nasal septum of infants and for shredding the leaves of which the petticoats were made.
tĕrag, (J.), *n.* a narrow fish basket.
tĕrĕg, *n* the teeth; maitĕrĕg, a pearl; tĕrĕg ăsi (J), toothache.
tereiem, *v.* to purify.
terpa, *n.* a corrugated clam-shell.
teter, *n.* the foot; teter au kok (J), the knee; teter kebi kok (J), the ankle; teter gab, *n.* sole of foot, shoe; teter mĕk, *n.* footprint; teter itur, *v.* to kick.
teubai = teupai.
teupai, *a.* short; *ad.* a little while (tauper, topai.)

tibi, (*n.*) ashes, cf. pi.
tig (J), a shell, *Lithodoma.*
tigri, *v.* to pour out; mer tigri, to command, to speak.
tigur, *v.* to draw water. [tigrari.]
tik (?), pone tik, dim, of eyes.
tikau, *v.* to fetch.
titida.
titig, titi (M), *n.* a flea.
tirtir (M), *a.* yellow.
tirtirda (M), *n.* a cargo.
toabuki, *v.* to assist, aid.
toar (J), *n.* a pandanus leaf.
toiatoia, *a.* = toirtoir.
toirtoir, *a.* fat, corpulent.
tom, *n.* a covenant, testament. Mark, xiv. 24.
tonar, *n.* custom, habit, character, quality, nature, fashion.
torob wag (M), *n.* storm, tempest.
tot (M), *n.* a roof.
totoam, *n.* a kind of fish which follows floating seaweed.
totoam (M), *v.* to fall.
tsi (M), *n.* dew.
tuab (J), *ad.* here.
tugar, *n.* the shoulder.
tuk, *n.* a boil.
tulĭk, iron knife (probably introduced); tulik-le, rust; cf. turi, malil.
tum, *n.* the top; tumge, *ad.* on the top; tumem, *prep.* to the top, over, than.
tumtum, *a.* on the top, superficial, shallow; not inside; uiaba tumtum nerkĕp, their hard hearts.
tup, *n.* a small fish which comes in-shore in large shoals.
tuprik, *v.* to shorten.
turi, turik, tori, cf. tulik.
turum, *n.* fruit.
turumturum, *a.* fruitful.
tut (M), *n.* a hammer; cf. itut.
tute (?), laip tute, *n.* an ear ornament.
tuter, *a.* right, right-hand side.

U, uĕ, *n.* coconut, palm and fruit. Macfarlane gives the following:— ugem, coconut palm [gem = trunk]; u gebgeb, ripe coconut: upez, green coconut; u sor, empty coconut; ip sor, dry coconut; u ai, germinated coconut. Jukes gives—bunari ("boonārri") for the fruit (cf. list of introduced words); u, mes, muti, for the husk, and lid for the shell; su, young leaf of the coconut palm.

uatur = watur.

udili (M), *v.* to sob.

ugab, *n. plur.* Cf. gab, Mar. i. 3.

ukes, *n.* a bay, cf. kes, kop, awak.

umai, (J) = omai.

umele, *v.* to know how, be able, can.

umen (M), *n.* an eel.

umer-kak, *v.* to be unable, cannot, not to know how.

umi, *n.* the season when the yam tubers begin to swell.

upi, *n.* the tail of an animal.

upiatidar, *v.* to comfort; *n.* a comforter.

upinati, *v.* to help; *n.* a helper.

upole = opole.

upuna (M), *n.* small-pox.

ur, *n.* fire; ur kup, firewood; ur etoamered (M), *v.* to light a fire; ura tuam (J), *v.* to blow a fire (ur, urami).

urarap (M), *n.* fuel (lit. buy-fire).

urem, *v.* to burn (lit. make fire).

uret (J), *a.* contrary, of the wind.

uridili, *pro. demons.* they all.

urim = urem.

urker, *n.* anger; urkerem, *a.* angry (lit. in anger).

urweri, *a.* hot, warm; *n.* heat; gem urweri, *n.* a fever.

urut, *n.* a year.

us, *n.* a thin sharp shell used for carving.

usar, *n.* kangaroo.

user, *n.* a mark or cicatrix.

usi, *n.* the bladder; *v.* to pass urine.

usi.

usiam, *n.* the Pleiades, a constellation, the season for early food.

usurusur, (M), *a.* muddy, mud.

utapit, *v.* to doze; utab (L), *n.* a bed.

utĕb, *n.* a dwelling, abode, a place, a village, Mark, vi. 36; etkobei utĕb, burying-place; Satanara utĕb, hell (introduced).

uted.

uteid, *v.* to lie down, to sleep; *n.* sleep. [uteidi, uteidilu, utirdelu, ut, uta.]

uzer, *n.* paddle, oar.

Wa, *pron.* you two.

waba, *pron.* you, your.

wabog, *v.* to go up, ascend, go back, cf. ogi.

wabu, *pron.* yourselves.

wada, *n.* a large bean of a deep red colour.

wadali (uadali), *pron.* they two.

wademer (M), *v.* to mend, repair.

wader, *a.* some, a few.

waeakai = weakai.

wag, *n.* wind, air.

wăgăb (J) *n.* a bivalve shell (*Cyrena*).

wai (uai), *n.* blade of grass (?), Mar. iv. 28; uai kekëm, sik keubu, the blade first, the ear after.

waiai, *interj.* an exclamation of wonder or surprise; sometimes, wai! waiwaiwai (J), often accompanied by flipping the thumb nail against the teeth.

waiker (?), Jno. xv. 8, ia uabim uaiker kara kaimeg gig, so shall ye be my disciples.

waimari, *v.* to stretch out, cf. imo, imu.

wairapare (M), *n.* religion (probably a word compounded from wai and esorapa).

waiwai, *n.* the wild mango and its fruit; waiwai lid, the pomum Adami (lit. bone or stone of the wild mango).

wak = wag, wind.

wak, *n.* a belt, girdle; hence purse.

wakei, *n.* the inner side of the thigh.

waki, *n.* the hornbill (*Buceros*).

wakokop, *n.* the crossed shoulder-belt made of the young leaf of the coco palm (M).

waku (L), *a.* sulky.

wali, *n.* cloth, clothes, a bandage; am wali, clothing; gem wali, shirt, chemise (jacket, L); wali lino, linen; mog wali, a towel; ziau wali, paper, cf. ewa, ewer.

wamen, wamenwamen, *a.* quick, fast.

wami, *v,* to blow (of the wind).

wanarminale (M), *v.* to imitate.

wao, wau, *ad.* yes.

wap, *n.* a dugong harpoon; wap omaiter, *n.* a wap used in sorcery.

wapi (J), *n.* a fish; this is the Saibai name, cf. lar.

wapu (S), *v.* to delay.

wapum, *a.* slow, taking a long time; nole wapum kak, not long after.

war, *n.* a figure, a numeral, a letter of the alphabet (probably original meaning is a mark).

waraz, *n.* a kind of *Oliva*; a necklace made of olive shells; a shell ear ornament (J).

warem, *interj.* wait-a-bit! hold on! stay! mop warem, the end shall not be yet.

warem (M), *n.* teeth (plural).

waridub, *n.* the eagle, a large hawk.

warŏwĕr (M), *n.* a colour; *a.* coloured; *n.* writing (L), cf. war.

warup, *n.* a large drum, constricted in the middle, with a jaw-like orifice at one end; warup le, the drum clan (?), probably hereditary musicians.

wate detager (M), *v.* to accuse, inform.

watupili, *v.* to be coming and going. [watupilu.]

watur = oitulu.

watwet, *a.* dried up, withered; watwet gur (M), *n.* salt.

wauri, *n.* *Conus millepunctatus*; the shell-armlet made from the cone-shell.

we, *n.* sand.

weapu, *n.* the larva of the ant-lion which makes pitfalls in the sand, cf. abu or apu.

weakai, *conj.* then, so that.

web (M), *v.* to feed.

wed, *n.* a song; wedakiriar, wedekiri, *v.* to sing a song (wed, ikĕli) wederakodo (S), *n.* music and dancing.

wĕegimurua, *v.* to settle on, to stay on, cf. egimulu.

weirag (S), *v.* to separate.

wekuge, *v.* to murmur, cf. wiker.
wer, *n.* a star; egg (? a ball); golegole wer, the pupil of the eye.
wer, *n.* appetite, cf. werer.
weraki (J), *n.* a wig worn by men.
wĕrĕm, *n.* child, children, family; the vertical fire-stick; sursur wĕrĕm, a baby; deg werem (Hunt), abortion; werem pez (M), to have an abortion; we do not know what deg means, pez may be unripe (cf. upez, green coconut).
werer, *v.* to be hungry; werer udili (M), *v.* to starve.
wererge, *a.* hungry (lit. in hunger).
wĕrĕs, *n.* a conical basket used in catching tup.
werir, *n.* the poles used for frightening the tup in order to catch them.
werkab, *a.* blessed. Mark, xi. 9, John, xx. 29.
wertik (M), *n.* the Milky Way, cf. dad.
werut, *n.* the tongue.
wĕsĕemur, see eseamuda.
wĕser (J), *v.* to eat; *n.* a glutton (L).
wĕskip (J), *n.* a kind of yam.
wĕsor (L), *n.* turtle eggs.
weswes, *n.* a branching coral (*Madrepore*).
wĕtpur, *n.* a feast.
weu, an exclamation of sorrow.
wez, *n.* the croton.
wez, *n.* grass or leaf tail, inserted in the belt when dancing.
wi (M), *n.* a guest.
wi, *pron.* they two.
wiaba, *pron.* they, their.
wiabielam, *pron.* through them.
wiabim, *pron.* to them.
wid (M) = wit, *a.* bad.
wiker (S), *v.* to murmur, cf. wekuge.
wit, *a.* bad, *v.* to do bad, cf. adud.
witha (J), *n.* a bivalve shell, a kind of *Tellina.*
wiu (J), *n.* a shell, a kind of *Triton.*
wiwar, *n.* a stone used in sorcery for producing sickness.
wonwon, *n.* a sea-urchin, *Echinus.*
wonpĭs (J), *n.* a mask.

Zab (J), *n.* a war spear.
zauber, *n.* a wave, breakers.
zazer, zarazer, zager, *a.* white.
zerem (M), *n.* a cross.
zewar, *n.* a land crab.
zi (J), *n.* the mangrove.
ziai, *n.* the south west; ziai pek, S.S.W.
ziau, *n.* the dura-mater. Paper is called ziau-wali or jiauwali, "jauali" of service book, etc. (wali = calico, cloth), as it is the wali which resembles the dura-mater. Owing to their familiarity with corpses (making mummies, etc.), the natives were well acquainted with the parchment-like character of the outer membranous covering of the brain.
zigerziger, *a.* thorny, prickly.
ziru, *a.* cold.
ziz, *n.* a wound.
zogo, *n.* a fetish, charm, an oracle (possibly also a totem, cf. agud); hence, sacred, holy; zogo jiauali, Bible; zogo meta, a church.
zogoem, *v.* to sanctify.
zogole, *n.* the temporary sacred men who divine with any particular zogo, or the three chief men of the initiation ceremonies (used in the Gospels for "priest").
zogozogo, *a.* tabu, sacred, hence holy.
zole, *n.* a fire-charm in the shape of a roughly fashioned, crouching, pregnant woman in stone.
zor (J), dead coral.
zorom, *a.* bright, shining, like reflection of sun on water; hence, glory.
zoromzorom, *a.* shining.
zup, *n.* a bamboo tobacco pipe.
zug.
zurkagem (M), *a.* round.

Part II. of this 'Study' will be published in the next Volume of the *Proceedings*, and will contain: VIII. Sketch of Saibai Grammar: IX. Specimens of the Saibai Language: X. Saibai-English Vocabulary: XI. Sketch of the Daudai Grammar: XII. Specimens of the Daudai Language: XIII. Daudai-English Vocabulary: XIV. Native Names of people and places in Torres Straits: XV. A List of Introduced and Adapted Words: XVI. Concluding Remarks.

XXXII.

ON A PROBLEM IN VORTEX MOTION. By FRANCIS ALEXANDER TARLETON, Sc.D., LL.D., F.T.C.D.

[Read December 12, 1892.]

If a perfect liquid, extending in all directions to infinity, be in motion under the influence of two parallel rectilinear vortices of small section and infinite length whose strengths are equal and opposite, the motion will take place in planes perpendicular to the axes of the vortices; and the lines of flow in one of these planes will (as is well known) be a system of coaxal circles having as their limiting points the intersections of the plane with the vortex axes. From hence it has been concluded that, if a single rectilinear vortex of small section exist in a liquid bounded by a parallel circular cylinder, the motion of the liquid will be that due to the given vortex A, together with another parallel vortex of equal and opposite strength, passing through the point which is the inverse with respect to the circular section of the cylinder of the intersection of A with the plane of this section.

When the liquid whose motion is under consideration is contained *within* the rigid cylinder, the inference above is correct; but it seems to have hitherto escaped the attention of mathematicians that, in the case of a liquid extending to infinity, and bounded internally by a rigid cylinder, the conditions of the problem are not satisfied by a motion such as has been described. In order to see this, let us suppose that, at first, a single rectilinear vortex exists in an infinite liquid unbounded in every direction. The current function due to the vortex will then be given by the equation $\psi = -m \log r$, where πm is the strength of the vortex, and r the distance of any point in the plane of motion from the point A in which it is met by the vortex axis. Let us now suppose that a circular cylinder of liquid parallel to the vortex becomes rigidified, and let us inquire how the motion of the remaining liquid is thereby affected. In the first place, the current function in the new state of motion must be constant at all points of the circle S bounding the section of the cylinder in the plane of motion. This condition is fulfilled by supposing the motion to be the same as that due to the effect of the given vortex along with another of strength $-\pi m$ situated at the point B, which is the inverse or electrical image of A in the circle S. The current function at any point P is then

$$m \log \frac{BP}{AP},$$

and this is constant when P is on the circle.

Up to the present time it seems to have been supposed that the condition above is sufficient. This, however, is not the case; for we have no warrant for asserting that there can be only one function of the co-ordinates which differs by a constant from $m \log AP$ at each point of S, is constant at infinity, and satisfies Laplace's equation throughout the field of motion. On the other hand, there is another condition which the motion must satisfy, which apparently has been hitherto overlooked.

When a cylinder of liquid is rigidified, the only immediate effect on the surrounding liquid is an impulsive pressure at each point of the cylindrical boundary. Such a pressure will produce an additional velocity potential in the moving liquid; and the essential character of a velocity potential so produced is that it should have only one value at each point of the field—in other words, be *acyclic* throughout the field, though not necessarily a single valued function. Hence it follows that the circulation in every circuit throughout the field outside the cylinder must remain unaltered by its rigidification.

The function $m \log \frac{BP}{AP}$, when taken as the current function, does not satisfy the condition now mentioned, and hence cannot be the current function. In fact, in order to get the motion of the liquid outside the cylinder, we must suppose this motion to be that due to the original vortex at A, along with a vortex of equal and opposite strength at B, and a third vortex, of the same strength as that of the original one, placed at the centre C of the circle S.

The current function is then given by the equation

$$\psi = m \log \frac{BP}{AP} - m \log CP,$$

and all the conditions of the question are satisfied.

It is easy to see now that we have obtained the only possible correct solution of the problem.

In fact, we know by Green's theorem that, disregarding a constant, there can be only one function of the co-ordinates which satisfies the equation $\nabla^2\phi = 0$ and is acyclic throughout the field, and whose differential coefficient along the normal is given at each point of the circle S, and also at infinity. Now the velocity potential corresponding to the current function $m \log \frac{BP}{CP}$ satisfies all the specified conditions, and is therefore the only function which does. Hence the state of motion supposed is the only possible state of motion satisfying the conditions of the problem.

The case of a circular cylinder has been considered at length; but it is obvious that whatever be the form of the curve bounding the section of the cylinder in the plane of motion, the current function must be constant along this curve, and such that the corresponding circulation in every circuit throughout the field of motion is the same as that due to the actually existing vortex which causes the motion.

By these two conditions the motion of the liquid is determined in all cases in which it is due to a rectilinear vortex of infinite length and small section, situated in a liquid extending to infinity, and containing a fixed rigid cylinder of infinite length parallel to the vortex axis.

XXXIII.

NOTES ON THE CORRELATION OF THE LATER AND POST-PLIOCENE TERTIARIES ON EITHER SIDE OF THE IRISH SEA, WITH A REFERENCE TO THE FAUNA OF THE ST. ERTH VALLEY, CORNWALL. By ALFRED BELL.

[COMMUNICATED BY DR. SCHARFF.]

[Read November 14, 1892.]

With the exception of the country bordering the western end of the Caledonian canal crossing Scotland, there is very little possibility of the discovery of fresh deposits of later Tertiary age in the United Kingdom. So many specialists having taken part in the investigation of the faunas of the different members of this group, a fairly comprehensive view of the whole is now available for study; and a comparison and correlation of the various organic assemblages may suggest some lines of research as to the course of events that have led to the delimitation and configuration of this portion of the earth's surface.

The fauna of the Post-Pliocenes is larger than is generally supposed, a brief summary of a catalogue compiled during some years past from all available sources presenting tho following results:—

Marine.		Non-Marine.	
Mammalia,	23	Mammalia,	124
Pisces,	18	Aves,	48
Crustacea,	12	Reptilia,	8
Cirripedia,	14	Pisces,	8
Entomostraca (about),	125	Crustacea,	1
Annelida,	15	Cladocera, &c.,	9
Radiata,	15	Entomostraca (about),	40
Mollusca,	600	Insecta and Annelida,	39
Polyzoa,	63	Mollusca,	140
Actinozoa, &c.,	14	Other groups,	8
Rhizopoda,	130	Plantæ (including musci),	326
Alga,	20	Diatomacea,	460
	1049		1211

For present purposes the marine division of the fauna, and primarily the molluscan element will be mainly referred to, as affording the most ready means for collating the synchronism of the different horizons in the limits of the Post-Pliocene stage, and the least persistent in time if compared with the land and freshwater equivalents of the same epoch.

Mollusca.	Still present.	Exotic.	Unknown.		
Land and freshwater,	121	9	10	=	140.
Marine Gastropoda,	282	68	24	=	595.
,, Pelecypoda,	157	59	5		
,, Brachiopoda,	3	1	1	=	5.

Practically speaking one out of seven of the land and freshwater species are either exotic, or the habitats are unknown, or, excluding some half dozen chiefly from the Norfolk Forest bed as being doubtful species, are as few as one out of ten, the marine forms having more than one-fourth part under the same categories.

In compiling a catalogue of Tertiary fossils, I found that with very few exceptions, such as that of the Turbot bank, Co. Antrim, the various deposits of the Post-Pliocene age fall under the ensuing headings.

1. *Pre-Glacial.*—The Norfolk beds in the Bure Valley, and the Weybourne Sands—the marine or "shelly" Wexford sands and gravel, and the forest bed, and overlying laminated clays—in the Norfolk Cliffs, the marine deposits being characterised by the abundance of *Tellina balthica*, a hitherto unknown form in the British area.

2. *Arctic*, or the sands and clays at Bridlington, East Scotland, and in a few western localities which yield almost a purely northern, or Arctic fauna, such as now lives within the Arctic circle.

3. *Mid- or Inter-Glacial*, including most of the valley gravels, and the marine deposits at Selsey in Sussex, and Killiney Bay, and those deposits which indicate by the southern elements in their contents the influence of a much increased temperature, probably exceeding that of the present day.

4. *Late Glacial*, embracing many of the cave deposits, the Lancashire and other N. W. of England drifts, the clays and sands of Balbriggan Bay, Ballygeary, Ballyrudder, Howth, and the most elevated gravels on the Dublin Mountains, Moel Tryfaen in N. Wales, and elsewhere in Shropshire, Cheshire, and Lancashire, indicative of deep submergence, Palæolithic man first appearing in

the lowest beds of Kent Hole towards the close of the Arctic stage, and more fully developed in the Inter-Glacial period. The Later Glacial representing the more advanced or reindeer stage.

5. *Post-glacial or Neolithic.*—Most of the Scottish beaches and other deposits yielding a few boreal forms still doubtfully existing on the northern coasts, and later the Estuarine clays in Ireland, the Carse clays of Scotland, the Buttery clays of the Fen lands, and the marine accumulation of Portrush, Largo Bay in Fife, and elsewhere.

6. *Recent.*—Blown sands, Scrobicularia beds, submerged forests, &c.

Acting upon these lines, I purpose endeavouring to trace the sequence of the different horizons, and to synchronize the deposits on either side of the channel by means of their geological surroundings, and the similarity or differences in the faunas they have preserved as far as possible.

The terms Upper, Middle, and Lower have caused great confusion, the Irish drifts so qualified, having nothing in common with the N. W. English Boulder clays, and neither of them with the Upper, Middle, and Glacial beds of East Britain, except in a very limited way.

It would serve no useful purpose to enter into minute details, it will be sufficient to notice the more salient points, the more important deposits, and the general *facies* of the contained faunas.

The oldest deposit in the channel area is unquestionably the shelly sands of Wexford, which, prior to the forcing of the barrier of Ordovician rocks by the Slaney River, near Fitzstephen's Castle (Ferry Carig), extended, as I have tried to point out in some British Association Reports, 1887-1890, from the landward side of the Wexford range, near Rathaspick and Little Clonard, without break to Arklow, where it thins out by the Wicklow Mountains intersected by the Ovoca River. As I there noticed, the sands are exceedingly clean, with few pebbles, and exhibited in places decided lamination. This was very well seen in a pit near St. Peter's College, Wexford, where an angular mass of rock had pressed into and deflected the lines on either side. The sand passes upwards into a comminuted shelly sand with occasional perfect specimens, but only at considerable heights, the pits at Clonard and Pulregan being many feet above the sea level, and the whole is capped by gravel and calcareous clay, except where these have been obviously denuded.

The whole rests directly upon Palæozoic rocks, and is remarkably free from signs of glaciation.

About 100 species of molluscs have been obtained from these sands (see Reports), embracing a number of forms of Pliocene age, and others of a northern type, the relative proportions suggesting that the northern fauna was gradually superseding the decaying southern and Pliocene one. Such a mixture of Pliocene survivals and Boreal species is only equalled in some of the very late East Anglian Pliocenes, the Pre-Glacial Weybourne and Bure Valley sands, and a deposit now being worked by Mr. Kendall, F.G.S., near Ramsey, in the Isle of Man.

Wexford Species—Exotic or habitat unknown.

Pliocene.	Boreal.
*Melampus pyramidalis.	Scalaria grænlandica.
Turritella incrassata.	Meyeria pusilla.
Cypræa lurida ?	Pleurotoma pyramidalis.
*Nassa recticosta.	,, lævis, n. sp.
* ,, semistriata.	,, harpularia.
Purpura incrassata.	Volumitra ———.
Fusus contrarius.	Natica affinis.
,, rostratus.	Trophon latericeus.
Leda pusio ?	,, craticulatus.
Nucula cobboldiæ.	,, clathratus.
* ,, proxima	Fusus islandicus.
	,, menapii, n. sp.
	,, sabinii.
	Astarte borealis.
	Leda hyperborea (? oblongoides).
	,, pernula.

Of these Pliocene species, *Melampus pyramidalis*, *Nassa recticosta*, *N. semistriata*, *Turritella incrassata*, *Nucula cobboldiæ*, and *Fusus contrarius* are thoroughly characteristic crag-shells, and the remainder southern or Mediterranean. An interesting question arises here—How came these forms usually known as only Crag or Pliocene into the Irish area? Till lately, no very satisfactory answer could be given to the query, but the discovery of a fossiliferous deposit in the St. Erth Valley, near the extremity of Cornwall, to the south or S. S. E. of the Wexford coast, throws some light upon the subject. Upon the death of the late Mr. S. Wood, and my brother, R. G.

* Also found at St. Erth. (See pp. 624, *et sqq.*)

Bell, it fell to my lot to take up the thread of their palæontological work, and having had the majority of the specimens extant in the few museums through my hands, and others obtained in a personal examination of the section, I venture to offer a list of all the species recognised, and those described by Mr. Etheridge, F.R.S., and myself in preparing a monograph upon these fossils, the present list being as yet unpublished.

St. Erth Fossils.

Ostrea edulis, *L.*, *var.* sinuosa, *E. and B.*

Flat, almost circular, with concentric lines of growth.

,, edulis, *var.* semilævis, *E. and B.*

A triangular shell, with pointed apex; ribbed on the bottom, and partly so on the upper valves.

,, plicatula, *Gmel.*

,, ungulata, *Goldf.*

Pecten brocchii, *E. and B.*

,, plebeius, *Broc.* non *Lam.*

Perhaps a variety of P. opercularis, finely costated, but not imbricated.

,, opercularis, *L.*

,, ,, *var.* audouinii, *Payr.*

,, pusio, *L.*

,, curvistriata, *E. and B.*

The ribs are straight; moderately close; the whole crossed by thin curved erect squamæ.

,, divigata, *E. and B.*

Ribs made up of 3–5 close-set, smaller riblets; interspaces rather wide, with shallow curving imbrications, projecting forward; the whole covered with fine perpendicular lines, diverging on the costæ.

,, striatus, *Müll.*

Like the two preceding species, this is only known by a fragment, but the sculpture corresponds with Müller's species in the finely divergent lines between the ribs. If not this species, it is new, and may be called "intertextilis."

Pectunculus glycimeris, *L.*

Limopsis minutus, *Phil.*

Nucula nucleus, *L.*

Nucula sulcatus, *Born.*
,, proxima, *Say.*
Cardium tuberculatum, *L.*
,, semituberculatum, *E. and B.*

This seems intermediate between tuberculatum and aculeatum; it may be a thick variety of the latter species. It has the outline but not the sculpture of a large C. edule (the angular forms).

,, echinatum, *L.*
,, deshayesii, *Poli.*
,, hornesianum, *Grat.*
,, papillosum, *Poli.*
,, minimum, *Phil.*
,, strigilliferum, *S. O. Wood.*
Lucina borealis, *L.*
Axinus flexuosus, *Mont.*
Cyamium minutum, *Fabr.*
Cardita aculeata, *Lam.*
,, corbis, *Phil.*
,, striatula, *E. and B.*

A small semicircular acute pointed shell, with concentric striæ; broader than Corbis.

Astarte parvula, *S. V. Wood.*
,, macandrewi, *Smith.*
Woodia digitaria, *L.*
Montacuta truncata, *S. Wood.*
,, bidentata, *Mont.*
,, ellipsoides, *E. and B.*

A shell rather larger than M. bidentata, with the umbones nearly central, sides elliptic.

,, pusilla, *E. and B.*

A minute semicircular shell, more rounded than M. bidentata, very near to the M. ovata of Jeffreys.

,, ovata, *Jeffr.*
Lasæa rubra, *Mont.*
,, pumila, *S. V. Wood.*
Kellia orbicularis, *S. V. Wood.*
Lepton nitidum, *Turt.*
Artemis exoleta, *L.*
Venus ovata, *Penn.*

Tapes aureus, *Gmel.*
,, virgineus, *L.*
,, pullastra, *W. Wood.*
Venus multilamella, *Lam.*
Erycina longicallis, *Phil.*

A very small shell that possibly belongs to this species: the hinge does not quite correspond.

Abra trigonula, *E. and B.*

Has the look and build of a medium-sized Mactra, but differs in the ligamental process.

Mactra solida, *L.*
,, subtruncata, *Da C.*
Thracia villosiuscula, *M'Gill.*
Mya arenaria, *L.*
Saxicava rugosa, *L.*
Solen ensis, *L.*
Lutraria elliptica, *L.*
Cypræa avellana, *Sow.*
,, affinis, *Duj.*
,, europæa, *Mont.*
,, dubia, *E. and B.*

This may be an aberrant variety of the preceding, but differs in the arrangement of the encircling ridges.

Voluta St. Erthensis, *E. and B.*

Differs from V. lamberti in the disposition of the columellar folds; a fragment only known.

Columbella erythrostoma, *Bon.*
Nassa serrata, *Broc.*
,, emiliana, *Beyr.*
,, granifera, *Duj.*
,, granulata, *Sow.*
,, touerneri, *May.*
,, semistriata, *Broc.*
,, recticosta, *Bellardi.*
,, perrieriæ, *Bellardi.*
,, dertonensis, *Bellardi.*
,, mutabilis, *L.*
,, var. St. Erthensis, *S. V. Wood.*
,, var. gigantea, *R. G. Bell.*

Nassa solida, *S. V. Wood.*
,, warburtoni, *E. and B.*
A Nassa of the same type as N. semistriata, but quite smooth.
Buccinum jani, *May.*
,, aquitanicum, *May.*
Lachesis multilineata, *E. and B.*
A long slender shell, densely crowded with fine spiral revolving lines, very distinct.
Nesæa candidissima, *Phil.*
Murex funiculosus, *Born.*
Fusus tentativus, *E. and B.*
A very minute, strongly knobbed shell.
Euthria cornea, *L.*
Pleurotoma herndsii, *Mayer.*
,, costatostriata, *S. V. W.*
,, costata, *Don.*
,, brachystoma, *Phil.*
,, parvula, *E. and B.*
,, tenuicosta, *E. and B.*
The last two species and Fusus tentativus require a larger series than we have seen; they are very well defined and sculptured, but may be the fry of larger shells.

Defrancia linearis, *Mont.*
Cerithium tricinctum, *Broc.*
,, reticulatum, *Da C.*
,, pseudoreticulatum, *S. V. W.*
,, crassicostata, *E. and B.*
A very strongly defined shell, with 4–5 stout squarish ribs, nearly continuous from apex to base.

Ceritheopsis minimum, *E. and B.*
Triforis adversum, *Mont.*
,, perversum, *L.*
Menestho basistriata, *E. and B.*
Turritella triplicata, *Broc.*
,, planispira, *Nyst.*
Natica catenoides, *S. V. Wood.*
,, varians, *Duj.*
,, sordida, *Phil.*
,, millepunctata, *Lam.*

Natica multipunctata, *S. V. Wood.*
,, consors, *S. V. Wood.*
,, proxima, *S. V. Wood.*
,, beyrichii, *V. Koenen.*

The last four chiefly differ in the size and position of the umbilical ridge.

,, montacuti, *Jeffr.*
,, burtoni, *E. and B.*

Odostomia albella, *Lor.*
,, obliqua, *Ald.*
,, acuta, *Jeffr.*
,, unidentata, *Mont.*
,, rissoides, *Hanl.*
,, pallida, *Mont.*
,, turrita, *Hanl.*
,, plicata, *Mont.*
,, warrenii? *Jeffr.*
,, conspicua, *Ald.*
,, insculpta, *Mont.*
,, striolata, *Alderc.*
,, magna, *E. and B.*

A slender, graceful species, one of the largest of the genus; tooth almost hidden.

Chemnitzia clathrata, *Jeffr.*
,, eximia, *Jeffr.*
,, euterpe, *Semp.*
,, plicatula, *Broc.*
,, costellata, *Grat.*
,, interstincta, *Mont.*
,, warringtoni, *E. and B.*

Turbonella culimæformis, *E. and B.*

A smooth shell with four whorls; aperture much like that of Eulima.

Aclis elongata, *E. and B.*

Much like Aclis (Pherusa) gulsonæ, but has a stiliform apex.

Eulima intermedia, *Cant.*
,, subulata, *Don.*
,, polita, *L.*
,, stalioi, *Cant.*
,, gracilis, *Jeffr.*

Eulima stenostoma, *Jeffr.*
Eulimene pendula, *S. V. Wood.*
,, var. turgida, *E. and B.*
,, terebellata, *Nyst.*
,, var. conica, *E. and B.*
,, var. acuminata, *E. and B.*
,, bythinæformis, *E. and B.*

These merge the one into the other, but the trivial names will easily distinguish them; the last closely resembles the freshwater Bythinia.

Hydrobia ventrosa, *Mont.*
,, ulvæ, *Penn.*
Jeffreysia diaphana, *Ald.*
,, globularis, *Jeffr.*
Rissoa ehrenbergii, *Phil.*
,, montagui, *Payr.*
,, partim cancellata, *Wood.*

Cancellated on the lower part of the whorl.

,, reticulata, *Mont.*
,, substriata, *Phil.*
,, intusstriata, *E. and B.*

A very massive, thick-ribbed, solid shell, striated between the ribs.

,, semistriata, *Mont.*
,, fenestrata, *E. and B.*

A turbinated form, with 3–4 strong striæ, producing a a coarse fenestration to the shell.

,, pulcherimma, *E. and B.*

A small species with convex whorls, the fine striæ crossed by delicate curved ribs.

,, gracilicosta, *E. and B.*

Smaller than the last; finely marked with curved ribs; no striæ.

,, densecosta, *E. and B.*

Ribs closely packed; fine curved.

,, ovalis, *R. G. Bell.*

Moderately large, regularly ovate, smooth.

,, parva, *Da Costa.*

Rissoa pentadonta, *S. V. Wood.*
,, var. picta, *E. and B.*
Painted with irregular red streaks.
,, var. rigida, *E. and B.*
Has a thin coloured line on periphery.
,, membranacea, *A. Ad.*
,, var. elata, *Phil.*
,, soluta, *Phil.*
,, cingillus, *Mont.*
,, whitleyi, *E. and B.*
A strongly costated and angulated shell.
,, milletii, *E. and B.*
In shape like R. soluta, but crowded with close-set spiral lines.
,, truncata, *E. and B.*
Comes near to R. striata, but is stouter, shorter, and has a very oblique mouth.
,, conuloidea, *E. and B.*
Similar to the above, but broader and more conical.
Lacuna suboperta, *S. V. Wood.*
Littorina cincta, *E. and B.*
Small, well marked by strong revolving ridges, but unlike a similar variety of L. rudis.
,, gibbosa, *E. and B.*
A dark brown gibbous shell with small acute spire.
Cithuia tenellæformis, *E. and B.*
Somewhat resembles Hela (Cithua) tenella, *Jeffreys.*
,, fusca, *E. and B.*
A short littorina-like shell, but with the umbilical line and perforation of Cithua.
Adeorbis obliquata, *E. and B.*
A small flat, smooth species, distinguished by its large umbilicus.
,, naticoides, *S. V. Wood.*
More elevated and globular, smooth canaliculated section umbilicus, moderate.
Solarium conulus, *Weink.*
Clanculus newtoni, *E. and B.*
Resembling a small Trochus (Gibbula) magus in outline, but encircled with projecting striæ intersected by curved mural plates in place of ribs.

Trococochlea St. Erthensis, *E. and B.*

May be known by the coarse muricated sculpture.

,, turbinatus, *Born.*
,, littoralis, *E. and B.*

Allied to the preceding shell, but differing in the aperture and position of the columella.

Trochus multistriatus, *S. V. Wood.*
,, umbilicatus, *Mont.*
,, zizyphinus, *L.*
,, elenchoides, *Jessel.*
,, adriaticus (?), *Phil.*
,, adansoni (?), *Payr.*
,, noduliferens, *S. V. W.*
,, miliaris, *Phil.*
,, granosus, *S. V. W.*
Cyclostrema nitens, *Phil.*
,, basistriata, *Jeffr.*
,, lævis, *Phil.*
,, spheroidea, *S. V. W.*
Homalogyra atomus, *Phil.*
Skenea planorbis, *Fabr.*
Calyptrea chinensis, *L.*
Capulus hungaricus, *L.*
Parmophorus minutus, *E. and B.*
Dentalium minimum, *E. and B.*

This and the preceding may be known by their size; there are no special marks by which they can be described.

Chiton discrepans, *Brown.*
,, fascicularis, *L.*
Utriculus mammillatus, *Phil.*
,, truncatulus, *Brug.*
Amphisphyra hyalina, *Turt.*
Scaphander punctato striata, *Mighels.*
Tornatina exilis, *E. and B.*
Melampus bidentatus, *Mont.*
,, pyramidalis, *Sow.*
Ringicula acuta? *Phil,*
,, striata.
,, ovalis, *E. and B.*

Of the 200 forms (more or less) listed, about 90 are common to the East Anglican Pliocenes, especially to that portion of the Red Crag which lies at the base, immediately upon the London Clay at Walton-on-the-Naze, and elsewhere. Some of these still live in our seas, but 40 or 45 are only known in the Crags or in other waters. It may be noticed that not one of the species quoted in the list are northern types, and as the passage or basal beds at Walton are similarly free, the presumption is that the two deposits were laid down under like conditions.

Of the 11 species of Pliocene shells given from the Wexford gravels, only 5 have been obtained at St. Erth; but considering the smallness of the patch of fossiliferous Clay, less than 100 feet square in extent, and from 1 to 4 feet thick, of which only a small portion has been examined, this is as much as could be expected. Compared with the Crag, 8 out of the 11 are common to both. The association of northern species with the decaying Pliocene fauna sufficiently demonstrates that various phenomena, involving great geographical alterations, had intervened between the deposition of the St. Erth and the Wexford beds.

The clay overlying the Wexford sands are largely derived from the decomposition of the metamorphic Cambro-Silurians, and are totally unlike the Boulder clay of the north, or the Scottish "till." I may notice, as showing the nature of the pebbly drift, that out of 60 stones picked up indiscriminately, 48 were Ordovician rock and intrusive quartz, 7 black limestone, 3 flints, and 2 granite.

Whether the peat and land surfaces noticed by Mr. Kinahan in Queen's County; Gort, Co. Galway; and Nenagh, in Tipperary (Geol. Mag. II., p. 92), beneath the superincumbent Limestone clay are coeval with the Wexford Gravels does not seem quite certain; but as the cones of a northern fir (*Pinus abies*) occur, they probably are so, considering the Arctic character of many of the Wexford shells. Assuming that the position of the Gravels beneath the Calcareous clay is definite, and that the fauna contains a certain number of Pliocene elements, I see no other course open, although I believe Prof. Hull does not agree in this, that the Gravels are immediately Pre-Glacial, and have no counterpart elsewhere in Ireland, the only English representatives of the period occurring in the group of sands and clays characterized by the abundance of *Tellina balthica* immediately underlying the Arctic deposits of the Norfolk Cliffs already mentioned.

In my examination of the Wexford coast, I found reason to believe that Captain James and Prof. Forbes had grouped the fossils of the marls in Rosslare Bay and Wexford Harbour with those of the sands, which in reality they overlap and are of much later date, the facies of the fauna as I saw near the summits of the cliffs by the pier beyond Ballygeary being of an entirely different character.

The next stage is one familiar to most Irish geologists, viz. the age of the Limestone gravels and clays, and the glaciation of the greater part of Ireland, of which I need only remark that the utter absence of either marine or terrestrial life in the Limestone clays may, perhaps, be accounted for, in the first place, by supposing that the whole surface was enveloped in ice, and the thermal conditions never so relaxed as to permit the growth of peat, and the deposition of stratified sands full of terrestrial animal and plant life, such as is not infrequent in the Scottish till or Boulder clay.

Coincident with the glaciation of the west, the eastern coast of Britain appears to have been open to the sea, the basement clays of the Yorkshire cliffs, containing a highly Arctic fauna not very dissimilar to that which obtained at a later period in the red laminated Clays and Gravels of East Scotland and the Clyde Valley, the bivalves with interlocked valves and well preserved epidermis.

Of this northern fauna, very few members are found in Ireland; and the conclusion appears to be inevitable, that while these Arctic species were abounding in the district mentioned above, Ireland was practically closed to marine influences, till the submergence, which had already set in, and the disappearance of the ice brought it once more within their reach.

The laminated Clays referred to are closely related to the adjacent till, and may be the marine equivalents of the same; in some places they overlie it, in others they inosculate therewith. At King Edward, in Banffshire, the shells occur in a clean sand deposited in a trough cut in the Boulder clay; and at Gravel Park, near Greenock, the shell-bearing laminated Clays have been scooped out for some 300 feet, and a totally different fauna introduced.

The following lists exhibit a large series of northern forms, some being published for the first time, especially those from King Edward, in Banff, which, with few exceptions, have all been through my hands. Messrs. Lamplugh and Wood are chiefly responsible for the Bridlington column; Mr. Jamieson, F.G.S., for the East Coast; and Messrs. Scott, Steele, and myself, for the West, or Gravel Park series. Only Arctic and exotic species are quoted, otherwise the lists would be much extended.

	Bridlington.	E. C. Scotland.	King Edward.	W. Scotland.
MAMMALIA.				
Phoca fœtidens, ...	—	×	—	—
AVES.				
Molleria somatissima, *L.*, ...	—	×	—	—
Oidemia nigra, *L.*, ...	—	×	—	—
STARFISH.				
Ophiolepis (Hoplaster) gracilis, *Allman*, ..	—	×	—	—
ECHINODERMATA.				
Amaura sulcosa, *Lecke*, ...	×	—	×	—
*Buccinum groenlandicum, *Ch.*, ...	×	—	—	×
Buccinofusus kroyeri, *Müll.*, ...	×	—	—	—
Cancellaria (Admete) viridula, *Fabr.*, ...	×	—	—	—
,, *var.* conthonyi, ...	×	—	—	—
*Columbella rosacea, *Gould*, Fort William ..	×	—	—	—
Dentalium striolatum, *Stimps.*, ...	×	×	?	—
Fusus curtus, *Jeffs*, ...	×	—	—	—
,, *L.*, despectus, ...	×	—	×	—
,, leckenbyi, *S. V. W.*, ...	×	—	—	—
,, sabinii, *Hanc.*, ...	×	—	—	—
,, sarsii, *Jeffr.*, ...	×	—	—	—
,, spitzbergensis, *Reeve*, ...	×	—	—	—
,, ventricosus, *Gray*, ...	×	—	—	—
Littorina globosa, *Jeffr.*, ...	×	—	—	—
,, squalida. *B. & S.*, Fort William, ..	—	×	?	—
Menestho albula, *Fabr.*, ...	×	—	—	×
Molleria costulata, *Möll.*, ...	—	—	—	×
*Natica affinis, *Gm.*, ...	×	×	×	×
* ,, grœnlandica, *Beck.*, ...	×	×	×	×
,, occlusa, *Wood*, ...	×	—	—	—
,, islandica, *Gm.*, ...	×	×	×	×
Pleurotoma bicarinata, *Conth.*, ...	×	—	×	—
,, cylindracea, *Möll.*, ...	×	—	—	—
,, cinerea, *Möll.*, ...	×	—	×	—
* ,, decussata, *Conth.*, ...	×	—	—	—
,, elegans, *Möll.*, ...	×	—	×	—
,, dawsoni, *S. V. W.*, ...	×	—	—	—
,, harpularia, *Conth.*, .. .	×	—	×	—
,, elegantior, *S. V. W.*, ...	×	—	—	—
* ,, exarata, *Möll.*, ...	×	—	×	—
,, multistriata, *Jeffr.*	×	—	—	—
* ,, pyramidalis, *Strom.*, ...	×	×	×	×

* Only those so marked (17 species) are found in Ireland, chiefly in the Later Gravels and Clays of Balbriggan and Ballyruddery.

	Bridlington.	E. C. Scotland.	King Edward.	W. Scotland.
Pleurotoma nobilis, *Möll.*, ...	—	—	×	—
,, robusta, *S. V. W.*, ...	×	—	×	—
,, scalaris, *Möll.*, ...	×	—	×	—
,, ,, *var.* abyssicola, *Friell.*, ..	—	—	×	—
,, ,, *var.* ecatenata, *Sars.*, ..	—	—	×	—
,, scalaroides, *Sars.*, ...	—	—	×	—
,, simplex, *Midd.*, ...	×	—	×	—
,, violacea, *Migh.*, ...	×	—	×	×
,, viridula, *Migh.*, ...	—	—	×	—
Rissoa drenaria, *Migh.*, ...	—	—	—	×
,, subperforata, *Jeffr.*, ...	×	—	—	—
,, Wyville-Thomsoni, *Jeffr.*, ...	×	—	—	—
*Scalaria grœnlandica, *Ch.*, ...	×	—	×	—
Trochus cinereus, *Conth.*, ...	×	×	—	—
,, elegantissimus, *Bean.*, ...	×	—	—	—
(Margarita) grœnlandicus, *Ch.*, ...	×	×	×	×
(Margarita) vahlii, *Beck.*, ...	—	×	—	×
,, varicosus, *Migh.*, ...	×	—	—	—
*Trophon clathratus, *L.*, ...	×	×	×	×
,, ,, *var.* gunneri, *Lor.*, ..	×	×	×	×
* ,, latericeus, *Müll.*, ...	×	—	—	—
,, fabricii, *Beck.*, ...	×	—	—	—
*Turritella erosa, *Conth.*, ...	×	×	×	—
,, reticulata, *Migh.*, ...	—	—	×	—
Trichotropis insignis, *Midd.*, ...	×	—	—	—
Velutina undata, *Br.*, ...	—	—	—	×
,, zonata, *Gould*, ...	—	—	—	×
Cylichna alba, *Br.*, ...	×	×	—	×
,, scalpta, *Lecke*, ...	×	—	—	—
Bulla crebristriata, *Jeffr.*, ...	×	—	—	—
Philine lima, *Br.*, ...	—	—	—	×
Utriculus constrictus, *Jeffr.*, ...	×	—	—	—
*Rhynchonella psittacea, *Ch.*, ...	×	×	—	×
*Astarte borealis, *Ch.*, ...	×	×	×	×
Axinopsis orbiculata, *Sars.*, ...	×	—	—	×
Cardium grœnlandicum, *Ch.*, ...	×	×	×	—
,, islandicum, *L.*, ...	×	—	×	—
Cardita borealis, *Conrad*, ...	×	—	—	—
Corbula pusilla, *Phil.*, ...	×	—	—	—
Crenella faba, *Müll.*, ...	×	×	—	—
Dacrydium vitreum, *Möll.*, ...	—	×	—	×
*Leda arctica, *Gray*, ...	—	×	—	×
,, buccata, *Stimps.*, ...	×	—	—	×
,, frigida, *Tor.*, ...	—	—	—	×
,, intermedia, *Sars.*, ...	×	—	—	—
,, lenticula, *Möll.*, ...	×	—	—	×

* Only those so marked (17 species) are found in Ireland, chiefly in the Later Gravels and Clays of Balbriggan and Ballyruddery.

	Bridlington.	E. C. Scotland.	King Edward.	W. Scotland.
Leda limata, *Say.*, ...	—	—	×	—
,, limatula, *Say.*, ...	×	—	×	—
,, lucida, *Lov.*, ...	—	—	×	×
* ,, pernula, *Müll.*, ...	×	—	—	×
,, tenuis, *Phil.*, ...	×	—	—	—
,, thraciæformis, *Stimps.*, ...	—	×	—	—
Lyonsia arenosa, *Möll.*, ...	—	—	—	×
Modiolaria lævigata, *Gray*, ...	—	×	—	×
Montacuta dawsoni, *Jeffr.*, ...	×	—	—	×
,, elevata, *Stimps.*, ...	—	—	—	×
*Nucula cobboldiæ, *Leathes*, ...	×	—	—	—
,, inflata, *Hanc.*, ...	×	—	—	×
Neæra subtorta, *Sars.*, ...	—	—	—	×
Pecten grœnlandicus, *Sow.*, ...	—	×	—	×
,, islandicus, *Müll.*, ...	×	×	—	×
Saxicava norvegica, *Spery*, ...	×	×	—	×
*Tellina calcarea, *Ch.*, ...	×	×	×	×
,, obliqua, *Sow.*, ...	×	—	—	—
,, pusilla, *Phil.*, ...	×	—	—	—
Thracia myopsis, *Beck.*, ...	—	×	—	×
,, truncata, *Brown*, ...	—	—	—	×
Venus fluctuosa, *Gould*, ...	×	—	—	—

From such a fauna as the above to that found in Ballybrack or Killiney Bay is a long step, involving an enormous lapse of time. Out of the 64 species obtained, three are eminently southern and five northern, or rather boreal in their habitat.

Southern.	Boreal.
Nassa granulata, *Sow.*	Pleurotoma pyramidalis, *Strom.*
Pecten glaber.	Astarte borealis, *Ch.*
Woodia digitaria, *L.*	Leda buccata, *Stimps.*
	,, pernula, *Müll.*
	Tellina calcarea, *Ch.*

This indicates a return to more genial conditions, and accordingly not only here but in England the fauna follows the climate, especially in the South, East, and Midlands, where it is largely reinforced by southern elements; as at Leden, near Colchester, where the peat contained Transpyrenean insects exclusively; and at Selsey in Sussex, where out of at least 200 species of shells, there is not one that is not

* Only those so marked (17 species) are found in Ireland, chiefly in the Later Graves and Clays of Balbriggan and Ballyruddery.

a denizen of Atlantic or Mediterranean waters, about 40 being unknown to British seas.

In the line of the Severn Straits, from Worcester, and thence north to Lancashire, there are traces of such influences; *Cytherea chione, Mactra glauca*, *Cardium aculeatum*, and other shells of southern types, being not all uncommon.

Between the deposition of the laminated Scottish Clays and those just described, fossiliferous details are very few and scanty. None are known in Ireland, and the principal representatives occur in Bute, about Paisley, and possibly the Hebrides, where the older fossiliferous Boulder clays contain a northern fauna, but wanting in nearly all the characteristic species of the preceding lists.

The southern element disappears after the Killiney stage, the fauna of the Gravels in Balbriggan and Ballyrudder beneath the superincumbent Clays exhibiting a large increase of northern species. Whether the true fossils of the Turbot Bank, Fort William, and Lochabar on the Caledonian canal, and a submarine bed off Cruden, Aberdeenshire, are also contemporaneous is doubtful, but a very similar *facies* pervades the fauna.

	Balbriggan.	Ballyrudder.	Cruden.	Fort William.	Turbot Bank.
Astarte borealis, ...	×	×	×	—	—
Leda abyssicola, ...	×	—	—	—	—
,, arctica, ...	×	—	—	—	—
,, pernula, ...	×	×	—	×	—
Pecten islandicus, ...	—	—	×	×	—
Rhynchonella psittacea, ...	—	×	×	—	—
Tellina calcarea, ...	×	×	×	×	—
Acirsa borealis, ...	—	—	×	—	×
Buccinum groenlandicum, ...	—	×	—	—	×
Columbella holböllii, ...	×	—	×	—	×
Margarita cinerea, ...	—	—	×	—	×
Natica affinis, ...	—	×	×	—	—
Molleria costulata, ...	—	—	×	—	×
Pleurotoma decussata, ...	—	×	—	—	—
,, exarata, ...	—	×	—	—	—
,, pyramidalis, ...	—	×	—	—	—
Trophon clathratus, ...	—	×	×	—	×
,, gunneri, ...	—	×	×	—	—
,, latericeus, ...	—	×	—	—	—
Turritella erosa, ...	—	×	—	—	—
Piliscus commodus, ...	—	—	×	—	—

The group of clays, marls, and interbedded sands on the Wexford coast, and at intervals between Greystones and Howth, should be, if the general aspect of the fauna is any criterion, of about the same age, and may be compared with the main mass of the Lancashire and Cheshire drifts or fossiliferous sands and gravels other than those containing southern forms, and similar deposits in the Isle of Man. In all these places the shells are co-equal to the deposit they are in, and are either *in situ*, or but washed in from a very short distance away. The fragmentary condition many of the shells are in is not necessarily indicative of far travel, for in the St. Erth deposit perfect bivalves are exceedingly rare (except oysters), yet there is no question that these are in their original home.

To this stage also may be referred the clays of the Nar Valley in Norfolk, the sands and gravels of the eastern counties and Lincolnshire, and the raised beaches and sea beds of Torbay, Portland, and the south coast of Britain, generally, west of Beachy Head.

The elevated shelly gravels, near Dublin, 1240 feet; Gloppa, near Oswestry, Shropshire, 1130 feet; Macclesfield, 1200 feet; and those on Moel Tryfaen, 1360 feet, may be collated together, and exhibit signs of stratification. In the least fossiliferous Gravels, those on the Three Rock Mountain are described as being arranged in layers, varying in thickness; at Gloppa, where they are better seen, and the contents frequently well preserved, the shingle and loam is current-bedded. On Moel Tryfaen the beds consist of incoherent sand and gravel, 35 feet in thickness, deposited in thin irregular layers, bearing every mark of gradual and successive accumulation; and Professor Ramsey declared his inability to distinguish these Moel Tryfaen drifts from others near Snowdon and elsewhere, nearly 1000 feet higher.

It is a disputed question as to whether these accumulations are due to ice or water action. It is difficult to imagine that ice could have sorted the gravels and sands in the intervening space between the low grounds and those at the heights mentioned above. The intercolated sands frequently contain many delicate molluscs intermingled with broken debris. The fact that Mount Mangerton, in Kerry, is glaciated to the top, 2700 feet above sea level, does not affect the hypothesis that the shell-bearing deposits have been water-sorted, and the erratics associated with them to be ice-borne, the glaciation of the mountains being the work of land-ice in the earlier phases of glacial history, and the other of berg or floating ice in a deep sea at a later time when the Irish Eskers and Scottish Kaims were in course of formation.

This submergence which, in extent, affected, to speak broadly, the whole area of N. England, Scotland, and Ireland, west of a line extending from the British Channel to the Humber; land glaciation, on a very minor scale, operating in the rest of England at the same time. This period may be taken as the close of the Palæolithic stage in Britain.

During the re-emergence many of the newly deposited strata must have been removed; and it is not till the land arrived to within some 40 or 50 feet of its present level that we obtain the richly fossiliferous Clays of the Clyde, Belfast and its vicinity, and Ardnamaree on Lough Swilly; the Belfast and Ballyrudder Clays being the oldest. In all these localities many of the bivalves are paired and in exquisite preservation. A few of the species of this horizon are at present confined to certain localities, *Fusus contrarius*, *Trophon latericeus*, *Arca pectunculoides*, and *Pectunculus glycimeris* have only been found in the Antrim Clays, and *Pecten islandicus* in the Clydian area. The absence of this fine shell in the Irish deposits is very remarkable.

The beautiful series of Estuarine Clays on the Irish shores, lately described in detail by Mr. Lloyd Praeger in these *Proceedings* (*antea*, p. 212), are very poorly represented on the opposite side of the Channel, either as regards the richness of the fauna, the state of preservation, or the size of so many individual examples.

Some of the more recent low-lying Clays fringing the shores of the Clyde estuary and the adjacent coast lines, the marine silts with relics of early Neolithic man, the Carse Clays of the Forth and the Tay, the Buttey Clays of the English Fen-lands may all have been laid down about the same time, but the fauna is excessively poor and confined to few species. A shore Clay occurred near Edinburgh some years since to Hugh Miller, containing very characteristic Estuarine Clay shell, *Thracia convexa*, and this deposit is one of the few remaining marine equivalents of the Irish series. The constant waste of land going on round the Scotch and English coasts is probably the cause of this, the many submerged forests all down the English and Welsh side of the Channel showing that, at one time comparatively recent in Geological history, the land had its coast line much farther out to sea than it is now; otherwise the low levels upon which so many of the coast towns are built should show traces of the marine inhabitants, such as are found in the Clays upon which so many of the Irish and Scotch towns are built, but they do not.

It is certain that a very considerable interval elapsed between the latest of the Gravels or Clays, containing as parts of their constituent faunas the northern Tellen *T. calcarea, Pecten islandicus*, *Trophon* *clathratus*, and *Leda pernula*, and the large and varied faunas in the Estuarine Clays (almost amounting to a new creation) where they are no longer present, and from the absence in the neighbouring seas of a number of the shells quoted by Mr. Praeger, and the depauperation of many others, we may faintly shadow the time passed since they were living.

The only similar instance I can remember or that has come under my notice is a large shell-bearing sand-bank situated on the shores of Largo Bay in Fife, which from personal examination I concluded was originally a portion of an old sea showing current bedding. But out of about 120 species of shells collected from this place, some are only known living in the south-west of the English Channel, and others in the Shetlands and the Hebrides: altogether about one-sixth of the whole series are not known within many miles of the Bay.

In the south of Ireland, the eminence known as Clay Castle near Youghal, and the Estuarine Clays in Tramore Bay, Co. Waterford, in which the late Professor Hardman told us he had found a number of recent species, may also be of this age. From a small patch of clay on the shore of Rosslare Bay I collected a few species, rather more coloured than usual, but excessively fragile and badly preserved.

The low raised beaches, the Curran Gravels, the marine accumulations at Portrush and elsewhere do not call for special notice here For further particulars I may refer to the British Association Report already mentioned.

It will be seen from the foregoing notes that while, on the other hand, the non-marine fauna has a percentage of from 10 to 14 of exotic species, the purely marine is as high as 26 per cent.; and it may be further noticed that the non-marine fauna, less the exotic forms, has continued with hardly a break from the newer Pliocene epoch to the present day; whereas the marine series is only presented, as I have shown, in detached and fragmentary portions, the contents of each portion differing very considerably.

Professor Forbes contended that the plant distribution of the south of Ireland—and he might have strengthened his case by including the Scilly Islands and the south of England—was due to a Miocene connexion between the Asturias and Ireland. Heer and Ettinghausen go much further, presuming that the area of the Atlantic was mainly dry land. In any case the centre and South of Europe was then largely sea, having communication with the Indian Ocean, the faunas of the ancient seas and modern ocean possessing much in common; and it is to this Miocene sea and its subsequent outgrowths that we must look for those causes that render the same species in the later deposits on either side of Britain and in Wexford. On the eastern side of England the encroachment of the sea northwards over N. W. Germany and Flanders proceeded without cessation, as we get an unbroken sequence of deposits till we reach the passage beds at Walton-on-the-Naze, the fauna up till then being absolutely free from northern species. On the western side, Messrs. Viellard and Dolfuss have worked out the deposits in the Dep. de la Manche; and the examination of their lists of fossils indicates that the Miocene sea had expanded in this direction as a narrow inlet, the older and newer deposits having their equivalents in the Diestien sands, the oldest English Pliocene bed, and the succeeding Coralline Crag.

A further projection of this sea-inlet northward is present in the St. Erth Valley, Cornwall, where, as already stated, no northern species are present. The next move upwards in time shows that very considerable alterations took place shortly after, both the eastern and western areas being opened up to the northern. In East Anglia the period of unrest typified in the older sea crag full of derived remains from older rocks gradually passed away till, in the Pre-Glacial deposits in Norfolk, the marine Ante-Glacial fauna came to an end. Corresponding changes took place on the other side, but being further removed from the area of disturbance was probably less violent, no such remanie' products having been noticed, and the first stage in the delimitation of Ireland is visible in the Wexford sands, where, as described, a northern fauna is also present. When the basaltic plateau between the Causeway and Staffa was as yet displaced does not appear, but there are two other routes by which northern waters could have travelled, if this, as I think, was still existent, one by the line of the Caledonian Canal, and another *via* the Clyde and Forth estuaries, containing high Arctic species, this route being the most likely one. The presence of northern forms in the later Sicilian Tertiaries, into which area they could only have found their way in the line of the Garonne, across France from Bordeaux to the Mediterranean, would further indicate a more southerly channel than that of St. Erth-Wexford, now probably closed or shut off.

Following close upon the foregoing stages, comes in the period of the greater or major glaciation; and it is not till the climatial conditions were so far modified by the disappearance of the ice, and the reopening of the sea channels that traces of organic life again reappear in Ireland, as we have seen in the drifts of Killiney Bay.

The finding of West Indian shells in the Worcester gravels is valuable evidence, as showing that the southern coast of Ireland had been exposed, and washed by western current, which still brings into the S. W. of England, and to the Irish coast so many exotic forms. Whether all these exotics were thus brought is questionable; some may have been introduced by ships in ballast, and others accidently introduced, but it is to say the least curious that nearly all are West Indian, or South American species, and a Terebratula, Bulla, and Tellina (*Sporsella carnaria*) which I picked out of some of Mr. Hyndman's dredgings off the Turbot Bank, were not surreptiously introduced.

Proofs of submergence are not confined to fossiliferous evidence. In his book, "Ancient Sea Margins," the late Mr. Chambers refers to many of these shelves, at different levels, as high as 1400 feet or more, and the presence of stratified gravels even higher still seems to militate against the conclusion of many glacialists that land ice, and that alone, is responsible for the presence of marine shells in such exalted deposits as occur in Ireland and the English localities mentioned.

The oscillation, consequent upon the depression and re-elevation of the north western area, will probably account for the disruption of the basaltic Antrim-Staffa plateau; the strain upon the jointing of the pillars must have been enormous, and disintegration greatly facilitated thereby.

It may not be much value as evidence, but it is worth remarking how little the accumulation at Portrush, to the west of the Causeway, has in common with the fauna of the Scottish coasts so little removed even at the present day.

It is the fashion in some quarters to decry these later Tertiary deposits as but of little geological importance, and chronologically as hardly worth mentioning, but the constant and long sustained movements, the frequent breaks in the chain of life, and the isolation and variation of each faunal group, especially when we know how slow a fauna changes when left alone, seems to demand time of which we have no conception since the United Kingdoms first began to be separated from the mainland of Europe.

One little fact as to the appearance of a species in a new locality may be referred to. Both Forbes and Hanley and Jeffreys do not give an English locality for the shell *Pandora inæquivalvis*, only Channel Islands. I found some very fine examples at Weymouth, and some dead ones in Bracklesham Bay in Sussex, where afterwards some living specimens were obtained, and are still to be got. This has occurred since Dr. Gwyn Jeffreys died, and I knew the coast ten years before then.

XXXIV.

ON A SKULL FROM LINCOLN, AND ON IRISH CRANIA.

By WILLIAM FRAZER, F.R.C.S.I., M.R.I.A.

[Read January 23, 1893.]

The present contribution to Anthropology is a careful measurement of the three skulls now exhibited. They include, in the first instance, that of a Roman lady, discovered at Lincoln; second, a more recent Irish cranium, a male, obtained from the vicinity of the ancient Danish Assembly Mount, or Thingmote, of Dublin, that formerly stood near St. Andrew's Church, Suffolk-street; and, lastly, the skull of Ryan Puck, who was executed upwards of fifty years ago at Limerick. He admitted, I believe, having slain six persons, but was credited with double the number—the outcome of agrarian outrages.

The measurements of these crania were made with all possible accuracy by Dr. C. R. Browne and myself, and from these data he has calculated the various indices, and furnished me with the tabulated results appended to this Paper.

I am indebted to the kindness of Dr. O'Neill, of Lincoln, for the cranium of the Roman lady, which reached me in a very perfect condition, along with the lower maxilla, after an interment of near 1800 years. The body was discovered lying within a coffin of stone, of which Dr. O'Neill has sent me a coloured drawing, made by his niece. The coffin measured only five feet ten inches in length; it was two feet two inches wide, outside measurement. At the upper, or head part, it was one foot ten inches high, decreasing gradually towards the lower end to a height of one foot five inches. This stone coffin became uncovered, with three others, at a depth of twelve feet, during the progress of some excavations at the back of the School of Art, in Monks-road, close to the boundary wall of a new wing intended to be erected for a parochial school, the opposite side of the plot being bounded by the Lindum-road, in which Dr. O'Neill resides. Three of the skeletons were found interred with their faces downwards, and one lying on its side. A black substance filled up half of the interior of the coffin, which is conjectured to have been charcoal. The sites of these discoveries are marked out upon a small plan of the locality, and several urns have, from time to time, been also obtained here, usually in a broken condition.

The Roman Lindum, now Lincoln, was colonized about the year 70 A.D., and must have formed a settlement of considerable importance. In the year 1884, the remains of a Roman villa were unearthed, sunk about two or three feet beneath the present surface of the soil, in the Greetwell fields. The discovery was made when sinking shafts for the extraction of iron ore, which revealed portions of old walls, and of rooms with tesselated pavements. This was about half a mile east of the present city. An account of this villa was published in the "Archæological Journal," vol. XII., p. 321, by Dr. O'Neill, and in greater detail by Rev. E. Venables, M.A., Precentor of Lincoln, describing additional explorations.

In June, 1884, while digging out the foundations of an old house at the Bailgate, which occupies the situation of the old Roman entrance to the main street running north and south, there was discovered a crematory furnace, five feet in length, one foot nine inches wide, and the same in height, built of long thin bricks, the furnace at its north end, and near it lay a quantity of charcoal ready for use. About three feet below the crematorium was a chamber formed of large stones, with concrete bottom, and at top a covering of large rough stone slabs; on it, imbedded in a layer of lime, lay ten vases of different sizes, covered by a layer of fourteen inches of fine sand. Hence we find, as in other Roman settlements, both cremation and coffin interments were employed by their inhabitants simultaneously.

This is the first "Roman" cranium submitted to scientific measurement in Ireland, and it appears to me a fair example of the race. They may have come here as accidental visitors, and, during the decline of the Roman power in Britain, as slaves captured by invading bands of Irish warriors, for such was the fate of St. Patrick; but we have, as yet, no recognized specimens of Roman skulls found in this country.

The lady was young: her wisdom teeth have not made their appearance; her skull was mesaticephalic, the cephalic index being 75·4; the outline of the cranial arch is graceful, with slight depression behind the bregma, and there is some want of symmetry apparent on viewing it from the upper part; the cranial sutures are simple, and there is a small Wormian bone in the lambdoidal suture.

The orbital space was megaseme, and the eyes, consequently, full and large; the nose somewhat broader than would be supposed from the appearance of the bony nares; the mouth, probably, small and delicately shaped, as the palate bones are decidedly of small size. The cranial cavity, on measurement, was found referable to the mesocephalic type, its capacity being 1400. For more complete details I refer to the tabular lists.

No. 2. The old hill where the Danish colonists of Dublin held their Thingmote Assemblies has long disappeared; its materials were removed to form the elevated portion of Nassau-street, above the level of the College Park, about the year 1685. It was a conical hill, about 240 feet in circumference, and 40 feet high, in the parish of St. Andrew's, near Hoggin Green, its precise situation being the angle, formed by Church-lane and Suffolk-street, nearly opposite the present Church of St. Andrew's, and about 40 perches east of the old edifice.

The skull now shown was obtained when some excavations were made in Suffolk-street, upwards of forty years ago, within the limits of the old graveyard of St. Andrew's, which extended up to the Thingmote, across the present street. As to its age I can offer no conjecture—it must be upwards of 200 years, at least, for the locality it was found in has ceased to be used for a burying ground for a long time.

The points for attachment of the different muscles are strongly marked; the glabella and supercilary ridges well developed. This cranium belonged to a man rather advanced in life, as its sagittal suture is half obliterated. When the cranial sutures are examined, they will be found waved and complex—a marked contrast to the simpler lines of suture seen on the cranium of the Roman lady.

This skull is dolichocephalic, its index being 73·1; the nose is classed as mesorhine, therefore smaller in size, comparatively, than the last, and the cerebral capacity is considerable, 1480; it hence falls decidedly under the class of megacephalic. The orbits are small, the index being 744, and the eyes were, therefore, not a conspicuous feature. Many of the indications found on this skull point to racial affinities with our earlier dolichocephalic Irish race, though it could not be considered a typical example. It is probable that the individual had straight black hair and a swarthy complexion. For further measurements see the tabular statement.

No. 3. The Limerick man had a cranium of rounder shape, the measurements of which place it amongst the mesaticephalic skulls, its index being 76·2. It is an unusually massive specimen, the cranial walls very thick and dense, almost of ivory hardness, such as would prove of exceptional advantage to a person of pugnacious propensities; its external surface presents evidences of conflicts, in two depressed fractures of long standing, one situated on the os frontis, of small extent, the other of larger size, apparent upon the left parietal bone. The lines of suture are much waved and complex, and there is a single small Wormian bone situated on the right limb of lambdoidal suture. The fossæ, especially the occipital, are strongly marked off from each other, and the internal surface of the cranial vault is deeply channelled over by ramifications of the meningeal arteries. The facial bones being broken, several desirable measurements were unattainable, and the lower maxilla also is deficient. The cranial capacity was of average bulk, or mesocephalic, measuring 1420, being larger than that of the Roman lady, though decidedly inferior to the size of the Dublin skull.

This is a cranium that might have belonged to a man of considerable ability, capable of obtaining distinction as a combatant, or perhaps excelling in diplomacy. It affords a good illustration of the anthropological statement, that even to secure pre-eminence in Evil, a capacious, well-formed skull may be considered as bringing to its possessor power and capabilities, the exercise of which are determined by other factors not measurable by indices, or the amount of cubic capacity in centimetres of the cranial cavity.

Measurements of Indices.

INDICES.	ROMAN LADY.	DUBLIN SKULL.	LIMERICK SKULL.
Cephalic, ..	75·4	73·1	76·2
Alveolar, ..	91·8	102·0	—
Auriculo-gnathic, ..	101·1	91·3	—
Altitudinal, ..	73·2	73·7	73·4
Auriculo vertical, ..	64·5	67·7	63·8
Upper facial, ..	50·8	55·5	—
Total facial, ..	83·5	—	—
Foraminal, ..	85·7	89·2	89·5
Nasal, ..	543	500	—
Orbital, ..	949	744	—
Frontozygomatic, ..	81·5	85·9	—
Palatal. ..	120	105·0	—
Cerebral Capacity, ..	1400	1480	1420

Measurements of Skull.

CRANIAL.	ROMAN LADY.	DUBLIN SKULL.	LIMERICK SKULL.
Glabello occipital length, ..	183	186	188
Ophryo occipital length, ..	182	186	188
Maximum breadth, ..	138	136	144
Basi-bregmatic height, ..	134	137	138
Auriculo cranial height, ..	118	126	120
Minimum frontal width, ..	94	99	96
Stephanic width, ..	101	110	113
Asterionic width, ..	111	107	117
Horizontal circumference,	518	516	532
Vertical transverse arc, ..	294	307	510
Frontal longitudinal arc, ..	133	132	129
Parietal longitudinal arc, ..	123	135	116
Occipital longitudinal arc,	119	113	129
Total longitudinal arc, ..	375	380	374
Foramen magnum length,	35	37	38
Foramen magnum breadth,	30	33	34

Measurements of Facial Bones.

FACIAL.	ROMAN LADY.	DUBLIN SKULL.
Basi nasal, ...	98	103
Basi alveolar length, ...	90	101
Auriculo nasal length, ...	89	95
Auriculo alveolar length, ...	90	104
Bizygomatic breadth, ...	124	128
Bimalar breadth, ...	100	107
Internal ethmoid width, ...	23	25
Naso alveolar length, ...	63	71
Naso mental length, ...	104	—
Nasal height, ...	46	50
Nasal width, ...	25	25
Orbital width, ...	37	39
Orbital height, ...	39	29
Palato maxillary length, ...	46	59
Palato maxillary breadth, ...	56	62
Symphysial height, ...	28	—
Coronoid height, ...	63	—
Genio symphysial length, ...	74	—
Bigonial width, ...	94	—
Bicondyloid width, ...	119	—

[*Correction, April* 10, 1893.]

ON THE RELATIVE POSITIONS OF 223 STARS IN THE CLUSTER χ PERSEI AS DETERMINED PHOTOGRAPHICALLY. By SIR ROBERT S. BALL, LL.D., F.R.S., AND ARTHUR A. RAMBAUT, M.A., D.Sc.

WE wish to correct an erroneous statement which occurs in our Memoir on the Relative Positions of 223 Stars in the Cluster χ Persei "Transactions," vol. xxx., pt. iv., pp. 231, 276; January, 1893.

On p. 263 of this communication, in reference to Mr. Harold Jacoby's article in the "Astronomical Journal," No. 233, we have stated that he confines his attention to terms of the 2nd degree, whereas the fact is that he considers the 3rd degree terms, except in the case of one formula, in which these terms can never become sensible. Since the statement as it stands would seem to attribute a want of accuracy to Mr. Jacoby's work, we here beg to tender our apologies for the mistake.

XXXV.

ON SOME CRANIA FROM TIPPERARY.

By C. R. BROWNE, M.D.

[Read February 27, 1893.]

The crania forming the subject of the present notice come from one of the nearly untouched spots in the wide and little-worked field of Irish craniology; for there is not a single specimen from this district figured or described in the "Crania Brittanica," the "Crania Ethnica," or the "Thesauros Craniorum"—no Paper on any has been brought before this Academy, or, as far as I can ascertain, any other society in this country, and with the exception of a Paper by Professor Welcker (which I have not been able to obtain) no description of any crania from this county has as yet been published.

The fact of this region being unworked, together with the size of the series as coming from one locality, has induced me to bring the matter before you.

Though the county is one in which the population is known to be very much mixed, yet—as if craniological investigation of Irish districts was to be confined to localities where the strain was pure, the field would become excessively limited—a consideration of these crania may not be without interest.

The collection, a fairly large one, consists of thirteen specimens—seven skulls, four crania, and two calvaria: most of them very brittle, and more or less extensively damaged—a fault unfortunately only too common in collections of Irish crania, which are, as a rule, only obtained after long interment or exposure. In several cases the facial bones are very much broken, and one skull is so shattered, that very few measurements could be got from it.

The zygomatic arches are broken in seven specimens, so that the bizygomatic width could not be measured; and, in nine instances, the lachrymals and the orbital plates of the ethmoid bones are broken away. The lower jaw has suffered most severely, being perfect enough to give the total face length in only three cases.

Norma-verticalis.—The specimens, though coming from a mixed district, have many features in common. They are cryptozygous and, with the exception of one which is asymmetrical, are a regular oval in outline. The frontal and parietal eminences are well marked, and the vertex is evenly curved from side to side, except in one case, where the sagittal suture lies in an elevated ridge.

Viewed in *norma lateralis*, the glabella and supracillary ridges are seen to be prominent, the forehead is upright or but slightly receding, and the profile passes from it to the inion in an even curve.

The occipital region presents the appearance of being flattened below the superior curved line. This flattening is in part real, but is rendered more apparent by the large, and, in some cases, hook-like inion, and the strong development of the superior curved line. The mastoid processes are generally large. The denticulations of the cranial sutures present much variety, but in most cases are rather complex, being very complex in seven cases, complex in three, and simple in three.

The face is orthognathous, long, and narrow; the nose mesorhine, inclining towards leptorhine, with high and projecting nasal bones. The orbits are microseme or mesoseme.

In those cases in which the mandible remains, the mental process has been well marked, and the angles everted.

All the subjects had reached adult life, and, with one exception, were males.

Peculiarities.—In five cases (Nos. 1, 7, 8, 9, and 11) wormian bones are found; in one, the metopic suture is persistent (No. 8), and in three, the dentes sapientiæ were not erupted. In six cases, the parietal longitudinal arc exceeded the frontal. In one case, the parietal and occipital arcs are equal; and in one, the occipital exceeded the parietal. In every case the frontal arc was greater than the occipital. The stephanic breadth is greater than the asterionic in all cases but two.

Indices.—The mean cephalic index of the twelve crania is 76·2; or, if the one brachycephalic specimen be excluded, 75·7. The highest index is 81·2, the lowest, 72·5; but eight out of the twelve are mesaticephalic. In eight out of ten cases they are tapeinocephalic, the mean vertical index being 70, the maximum 74·4, the minimum 67·7.

The mean facial index is 53·8; the highest index, 57; the lowest, 51·9. Owing to the zygomata being broken, this index could only be taken in six cases, and injury to the mandibles only allowed the total face index to be obtained in two instances. The gnathic index showed orthognathism; the mean gnathic index being 96·4, with maximum of 103·1, and minimum 87·4.

The mean nasal index is 48·3, being mesorhine, but nearly approaching the leptorhine; the two forms occur in an equal number of cases, but there is one platyrhine. The maximum nasal index is 54·3, the minimum 36·7.

The orbital index is megaseme in one instance, mesoseme in three, and microseme in four. The mean index is 84·5, with a maximum of 94·7, and a minimum of 78·0.

The palato-maxillary index is only obtainable in five cases; of this, one (No. 3) is brachyuranic, one mesuranic (No. 6), and three dolicho-uranic. The mean index is 109·6, with a maximum of 124 and minimum of 102.

The measurements and indices, which are given in full in the accompanying Tables, have been obtained after the methods in use in the Anthropological Laboratory. It may be mentioned that, owing to the fragile state of most of the specimens, the cranial capacity was measured with millet instead of shot.

These crania form part of the Irish series in the Anatomical Museum, Trinity College.

TIPPERARY CRANIA.—*Measurements.*

Collection Number,	1	2	3	4	5	6	7	8	9	10	11	12	13
Sex,	M.	M.	M.	M.	M.	M.	M.	F.	M.	M.	M.	M.	M.
Age,	AD.	AD.	AD.	AD.	AD.	AD.	AD.	AD.	AD.	AD.	AD.	AD.	AD.
Cranial capacity,	1785	1490	1615	1630	1535	1445	1600	1550	1625	w	1620	1330	w
Glabello-occipital length,	201	182	185	194	189	184	186	186	186	184	191	180	w
Ophryo-occipital length,	199	181	182	193	186	181	184	184	184	182	192	178	w
Maximum breadth,	155	143	147	145	137	138	151	140	140	136	146	135	142
Basi-bregmatic height,	w	126	132	136	128	128	128	130	135	w	130	134	w
Auriculo-bregmatic height,	w	w	120	121	121	112	123	120	w	w	116	115	w
Minimum frontal width,	99	104	103	103	92	101	90	104	100	90	103	97	w
Stephanic width,	125	108	115	119	118	120	119	122	114	106	115	111	112
Asterionic width,	124	111	119	114	107	112	114	103	112	w	116	104	w
Horizontal circumference,	564	518	529	541	528	512	530	523	524	510	540	503	w
Vertical transverse arc,	335	304	317	316	303	294	318	308	310	w	300	299	w
Frontal longitudinal arc,	149	123	133	140	129	120	138	130	128	113	132	119	125
Parietal longitudinal arc,	130	125	123	126	135	118	132	120	140	115	125	120	128
Total longitudinal arc,	409	361	356	399	380	357	376	367	379	w	380	351	w
Foramen magnum length,	w	38	38	37	37	34	32	39	39	w	38	39	w
Foramen magnum breadth,	w	32	34	35	32	31	28	32	35	w	31	31	w
FACE.													
Basi-nasal length,	w	95	98	w	99	105	98	103	97	w	102	103	w

Auriculo-alveolar length,	w	w	96	w	w	96	100	106	w	w	104	103	w
Bizygomatic breadth,	w	w	135	w	w	129	130	128	w	w	131	133	w
Bimalar breadth,	w	113	114	w	w	109	108	111	w	w	120	109	w
Internal ethmoid width,	w	w	w	w	24	29	25	29	w	w	w	24	w
Naso-alveolar length,	67	75	75	w	w	67	68	73	w	w	68	79	67
Naso-mental length,	w	w	w	w	w	123	117	w	w	w	w	w	119
Nasal height,	w	47	60	w	w	46	52	50	w	w	46	50	44
Nasal width,	w	22	22	w	w	25	24	26	w	w	24	24	w
Orbital width,	41	w	38	w	38	41	40	41	w	w	41	38	w
Orbital height,	36	w	36	w	30	34	33	32	w	w	33	33	w
Palato-maxillary length,	w	w	49	54	w	51	61	w	w	w	59	58	w
Palato-maxillary breadth,	w	w	61	55	w	57	62	w	w	w	64	62	w
Mandible.													
Symphyseal height,	w	Cranium only.	Cranium only.	36	Cranium only.	38	29	w	Calvaria only.	Calvaria.	—	Cranium only.	32
Coronoid height,	w			69		64	72	59			—		64
Condyloid height,	w			w		67	67	52			—		61
Gonio-symphyseal length,	w			93		86	79	69			—		84
Bigonial width,	w			w		99	99	93			—		96
Bicondyloid width,	w			w		110	121	w			—		109
Breadth of ramus,	w			30		30	34	34			—		38

TIPPERARY CRANIA.—*Indices.*

Collection Number,	1	2	3	4	5	6	7	8	9	10	11	12
Cephalic index,	77·1	78·6	79·5	74·7	72·5	75·0	81·2	75·3	75·3	73·9	76·4	75·0
Altitudinal,	w	69·2	71·1	70·1	67·7	69·6	68·8	69·9	72·6	w	68·1	74·4
Auriculo-vertical,	w	w	64·9	62·4	64·0	60·0	66·1	64·5	w	w	60·7	63·9
Foraminal,	w	84·2	91·9	91·5	86·5	91·2	52·3	82·0	89·7	w	81·6	79·5
Fronto-zygomatic,	89·7	w	85·1	w	w	93·0	91·5	95·3	w	w	87·8	84·0
Alveolar,	w	87·4	92·9	w	w	92·4	103·1	102·9	w	w	99·0	97·1
Auriculo-gnathic,	w	w	101·1	w	w	101·1	105·3	109·3	w	w	92·3	109·6
Upper facial,	w	w	55·5	w	w	51·9	52·3	57	w	w	52·5	59·4
Total facial,	w	w	w	w	w	95·3	90·0	w	w	w	w	w
Nasal,	w	46·8	36·7	w	w	54·3	46·0	52·0	w	w	52·2	48·0
Orbital,	87·8	w	94·7	w	78·9	85·4	82·5	78·0	w	w	80·5	84·6
Palato-maxillary,	w	w	124	102	w	112	102	w	w	w	108	107

XXXVI.

ON THE BURIAL-PLACE OF ST. PATRICK.

By REV. T. OLDEN.

[Read February 27, 1893.]

The honour of possessing the remains of St. Patrick has been claimed for several places, but nothing decisive on the subject has been brought forward, and his actual burial-place has always been more or less doubtful. "Discrepancies and doubts," Bishop Reeves says, "have for a succession of ages attended the consideration of the subject." The difficulty of arriving at the truth has arisen in some degree from the want of correct texts of the documents used in the inquiry. This, however, no longer exists, for we have now the learned edition of the portion of the Book of Armagh relating to him by Rev. E. Hogan in the Analecta Bollandiana, and a later edition of the same documents in the work of Mr. Whitley Stokes—"The Tripartite Life of St. Patrick." The time seems therefore to have come for a fresh examination of the whole question, and I propose to consider the different accounts of his burial, and to indicate what I venture to think is the true solution of the problem.

The earliest authority is Tirechán, whose treatise, though compiled at the close of the seventh century, is only known to us in a manuscript of the ninth. His account is—that on St. Patrick's death, two hosts (*hostes*) or parties, disputed the possession of his body, but ultimately separated without an actual conflict, because each saw or seemed to see the bier and corpse in its own company. The rival claims thus described, he goes on to say, were maintained long after, until Colum Cillé, by divine inspiration, pointed out his grave at Sabhall or Saul, in the present county of Down, and thus, as it seemed, decided the matter.

The next reference to his burial at Saul is in the Fourth Life in Colgan, where it is related that a boy playing in the churchyard there lost his hoop in a chink of St. Patrick's grave, and having put down his hand to recover his plaything was unable to withdraw it. Upon this, Bishop Loarn of Bright, a place near at hand, was sent for, and on his arrival he addressed the saint in the following words :—"Why, O Elder, dost thou hold the child's hand?"

Passing on to the year 1293, the "Annals of the Four Masters" describe Nicholas Mac Maelisa, Primate of Armagh, as having discovered the remains of St. Patrick at Saul, together with those of SS. Brigit and Colum Cillé. He had them taken up, and many miracles were wrought by them. Such is the evidence for his burial at Saul; yet the fact that there is little or no mention of this place afterwards in the Annals suggests doubts whether so famous a saint could have been buried there.

We have now to consider the narrative of Muirchu maccu Machtheni, in his Life of St. Patrick in the "Book of Armagh." An angel announced to St. Patrick his approaching death, and commanded him to go to Armagh, "which he loved above all the earth." He set out, accordingly, but on his way came to a bush that burned but was not consumed. In this was the angel Victor, who sent another angel to countermand the previous order, and direct him to return to Saul whence he had come. An angel then gave instructions as to his burial. Two untamed oxen were to be harnessed to his bier, and wherever they stopped was to be his burial-place. They arrived at Down, which was only two miles off, but went no farther, and therefore his remains were interred there. It was divinely ordered that his grave should be deep, and that his remains should not be disturbed. In evidence of this, when the ground was excavated for the erection of the church of Down, flames burst forth and drove the workmen away. Muirchu has the same story as Tirechán, of the two hosts contending for his remains, and he gives the additional information—that they were the people of Orior and Ulaidh, or, in other words, of Armagh and Down. They were about to engage in battle when the arm of the sea which lay between them arose in mighty waves and prevented a conflict. But the dispute continued, and the people of Armagh made an armed inroad into Down, and succeeded, as they thought, in carrying off his body; but it was a divine illusion, for when they reached a certain river, both oxen and waggon disappeared. They were deceived, the writer says, as the Syrians were by Elisha (2 Kings vi. 18–20), a narrative on which we may presume he founded his story, as that of the waggon and oxen is founded on 1 Sam. vi. 7–12.

The next mention of Down in connexion with St. Patrick occurs in 1183. When John De Courcey conquered and took possession of the town he found the church dedicated to the Holy Trinity, but recognizing the importance of engaging the religious feelings of the Irish on his side, he changed the dedication to St. Patrick. In pursuance of this design, he removed the emblem of the Trinity from its place of honour in the church and substituted for it a statue of St. Patrick.[1]

Two years afterwards, his friend Malachi, Bishop of Down, had a vision, in which St. Patrick made known the part of the church in which he was buried. He was in due course disinterred, and De Courcey, having invited Cardinal Vivian from Rome for the occasion, his remains, with those of SS. Brigit and Colum Cillé, were translated with much pomp to another part of the church.[2] This discovery was not recognized by the Irish, and no notice of it occurs in the Annals. They had their own view of the discovery of the remains at Saul, as already mentioned. In the present case, as in that of Saul, it is a suspicious circumstance that there is no mention of Down in connexion with St. Patrick from 807, the date of the "Book of Armagh," until the appearance of Jocelyn's "Life of St. Patrick," in 1183, which prepared the way for the invention of his remains. It is also worthy of notice that the name Downpatrick only dates from De Courcey's time, and is due to the dedication of the church to St. Patrick by him.

A third burial-place assigned to St. Patrick was Glastonbury, famous for its connexion with the Irish. The monks there denied that he was buried at Down, and a poet, or a poetaster—as Ussher calls him—of their community has left a verse on the subject, which may be thus translated :—

"Patrick, Brigit, Colum Cillé,
Raves Chester,[3] in his book most silly,
Are buried in the church of Down,
Conferring honour on the town."

Here, also, an angel pointed out his grave, and fire burst forth as at Down, and alarmed the spectators.

These three conflicting accounts are about on the same level as to credibility, and when we have examined and discussed them, we find ourselves as far as ever from knowing where the remains of St. Patrick lie.

Is it, then, quite hopeless to pursue the inquiry, and must we accept

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[1] Pembridge's Annals, in Reeves' Antiq. Down, &c., p. 229.

[2] Lanigan, Ecc. Hist., vol. iv., p. 274, &c.

[3] Ralph Higden, known as Ranulphus Castrensis, or Ralph of Chester.

it as a fact that his grave, like that of Moses, is to remain unknown? On the contrary, I believe satisfactory evidence on the subject is attainable; but before proceeding to consider it I must refer to the theories proposed regarding St. Patrick. At one time it seemed necessary to assume the existence of five of the name: a later view reduces them to three. These are Palladius, who, in a passage of the "Book of Armagh," is said to have been also called Patrick, Sen Patrick, or the elder Patrick, and Patrick the Apostle. Palladius may be omitted from our discussion, as no one assigns a burial-place in Ireland to him, if, indeed, he ever came at all, of which there is no sufficient proof. There remain then Sen Patrick, and the Apostle. Dr. Lanigan held that these were really one and the same person; but, unfortunately, he burthened his theory with irrelevant matter, and therefore it has been neglected by succeeding writers. Nevertheless, I believe it is the only theory which meets the difficulties of the question, and I have endeavoured to support it with additional proofs in my "History of the Church of Ireland." The only writer of recent times who approached the true solution of the question was the late W. M. Hennessy, in his Notes to the first volume of the "Annals of Ulster." His view was, that the Acts of Sen Patrick were blended with those of the Apostle. "They are so interwoven," he says, "that it is very difficult to resolve them."[1] One step more would have brought him to the conclusion that the reason they could not be resolved was that the two Patricks were really one and the same person. Having discussed the matter elsewhere, as already mentioned, I shall assume for the present that they are identical. If this is so, the burial-place of St. Patrick is no longer doubtful, as we have distinct reference to his tomb at Armagh. For in the "Calendar of Cashel" the following entry occurs:—"The relics of the Elder Patrick repose at Armagh, in the place called the Monument of the Elder Patrick" (*Reliquiæ Patricii senioris requiescunt Ardmachæ in lipsanis Patricii senioris appellatis*).[2] Lipsana, literally "relics," is also the receptacle in which they were contained, and may be rendered "*monumentum*," according to Du Cange. Hence it appears, that in the eleventh century when this Calendar was compiled, there was a place at Armagh known as "The Monument or Tomb of Sen Patrick," in which his relics were preserved. In the following century, Marian Gorman[3] or his scholiast makes a similar statement, using the same expression—

[1] Annals of Ulster, A.D. 457, p. 17.

[2] Trias Thaumaturga, Appendix V., p. 262. [3] *Ibid.*

"Lipsana Patricii senioris," as if it was well known. Again, the Lebar Brecc, in the fifteenth century, has a corresponding entry in Irish—"The relics of Sen Patrick are in the stone tomb (*Uladh*) of Sen Patrick at Armagh."[1] Thus, from the eleventh to the fifteenth century, inclusive, there is continuous evidence of the existence of this tomb.

But the proofs of the identity of the two Patricks are not so generally known and accepted that an argument founded on it can be relied on to carry conviction in the present case. I will therefore turn to another line of reasoning which leads to the same conclusion, and has the advantage of being independent of any theory as to St. Patrick. Returning for this purpose to the "Book of Armagh," we find that Muirchu and Tirechán, much as they differ, agree in stating that at the time of his death Armagh claimed to possess his remains; for, as we have seen, one of the hosts mentioned were the people of Armagh. They agree, also, that the claim continued to be made long after. Eleven years later than the date of the "Book of Armagh," Artri, Abbot of Armagh, went to Connaught with the shrine of St. Patrick.[2] Twenty-three years after this the shrine was still in the custody of the Abbots or Coarbs of Armagh; for in 841, Forannán, Chief Coarb of St. Patrick, fled from Armagh to the county of Limerick, carrying it with him.[3] Two hundred years later, we have the testimony of St. Bernard that it was still at Armagh. "As St. Patrick," he says, "presided at Armagh in his lifetime, so in death his remains repose there"[4]: evidence of the greatest weight, when we remember that St. Bernard was the intimate friend and biographer of the famous Malachi, Archbishop of Armagh, and must have had the best information as to Irish opinion on the subject. Lastly, William of Newbridge, who compiled his work in the reign of Richard I., that is, between 1189–1199, says:—"The Primacy was bestowed on Armagh, in honour of St. Patrick and other indigenous saints whose remains rest there."[5] But others, Ussher says, refer this to St. Patrick alone. Now, the Patrick to whom these passages relate is not termed Sen Patrick, and therefore must be the St. Patrick of popular belief. The question then arises:—Were there two St. Patricks buried at Armagh, for we have already seen that Sen Patrick's tomb was there? No one asserts this. Nevertheless, if they were different persons, this would follow from the facts mentioned.

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[1] *Facsimile*, p. 94.
[2] Chronicon Scotorum, A.D. 818.
[3] Wars of the Gaedhill, &c., p. xlii.
[4] Ussher (Works), vi. 420.
[5] Ussher, vi 419.

But, it may be said, if St. Patrick was buried at Armagh, some reference, direct or indirect, to his tomb should appear in the "Book of Armagh." It must have been well known, and it would be most strange if it were unnoticed there. I believe there is a distinct reference to it in the curious collection of legends, termed the "Book of the Angel"—a reference which has hitherto escaped notice, owing to a mistake as to the meaning of an old Irish word. The following passage is evidently historical, though found embedded in legendary matter:—"The foundation of prayer every Lord's Day at Armagh going to and returning from the Sargifagum Martyrum is Psalms (Vulgate) lxxxvii., lxxiii., and cxviii. to the end of the Benediction, together with twelve Psalms of Degrees."[1] The Psalms of Degrees are cxix.–cxxxiii., inclusive. Sargifagum is merely a barbarous spelling of Sarcophagum, and the expression "ad Sargifagum Martyrum" is glossed in Irish by the words "*du ferti martur*," that is, "to the tomb of the relics." The special ritual for the use of those going to and returning from this place was apparently for pilgrims who visited it. Such observances are mentioned in the Apostolic Constitutions (third century), where the following direction is given:—"Assemble in the cemetery, reading the sacred books, and singing psalms, on account of the martyrs who have fallen asleep, and of all saints from the beginning, and of our brethren who have fallen asleep in the Lord."

The Irish gloss on the name of the place is of the highest importance in this inquiry, for the word *ferti* is the dative of *ferta*, a grave or tomb. Now the place called the Ferta at Armagh was well known. In the interesting account of the interview between Daire, the Chieftain of Armagh, and St. Patrick, when he sought a place to settle in, as related in the "Book of Armagh" and the "Tripartite Life," the chieftain said, "What place dost thou desire?" St. Patrick replied, "On this great hill above"—"the place," adds the writer, "whereon Armagh stands to-day." "I will not give it," saith Daire; "howbeit I will give thee a site for the church in this strong rath below"—the place, as the writer explains, "where is the Ferta to-day."[2] If we endeavour to put ourselves in the position of St. Patrick and his small band of missionaries, nothing is more natural than his request for a site on the hill. They were about to settle among the fierce and warlike Oirghialla, of whom it was believed that when taken captive in

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[1] Tripartite, ii. 356. [2] Trip. i. 229.

battle they were entitled to be manacled with golden fetters. In such a state of things they had to consult for their security, and the summit of the hill appeared to them to be the most desirable place.

Daire, however, refused to place them in this strong position; but when granting a site on the low ground re-assured them by pointing out that he was giving them a strong rath (*Rath cobsaid*) where they would be safe. St. Patrick accepted the offer, and proceeded to erect his *congbail*, or monastic buildings. They are thus described in the "Tripartite"[1]:—"In this wise Patrick measured the Ferta, viz. 140 feet in the enclosure, and 27 feet in the great house, 17 in the kitchen, and 7 in the oratory." This description, as Dr. Todd says, is expressed in very archaic language, most of the terms being obsolete and unintelligible, but for the explanations of them in ancient glossaries. The place was small,[2] and the buildings described were of a very primitive character, and appear to have been of circular form, as the diameter only is given. Here he and his followers dwelt "for a long time" (*re cianai*), and here Sechnall or Secundinus visited him, and held converse with his community about his merits.[3] It seems also to have been during St. Patrick's stay here that Secundinus composed the hymn in his praise, which is described in the "Lebar Brecc" as on "Patrick of Macha." In course of time the zeal of St. Patrick and his clergy produced a deep impression on Daire. He saw the benefits conferred on himself and his people by the introduction of Christianity amongst them, and he came forward and offered the high ground originally asked for. How long after the former grant this was we cannot tell, as the narrative is entirely wanting in historical perspective; but it evidently was many years, and there can be no doubt that, as Bishop Reeves says, "In the brief story, as told in the 'Book of Armagh,' there is probably condensed a long train of political and religious events." Having at length obtained the desired site, the "Tripartite" describes how St. Patrick went forth in solemn procession "with his elders (*sruithe*) and Daire, and the magnates of Orior with them to the hill to mark it out, and to bless it, and to consecrate it."[4]

Now here we have clear evidence of two settlements of St. Patrick at Armagh: an early and humble one on the low ground, and a more important one subsequently on the hill. There has been much confusion on this subject, and Colgan, as Dr. Todd shows, transferred the description of the building of the Ferta to this later foundation on the

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[1] Tripartite, 237. [2] Locus angustus secus Ardmachiam situs.—Jocelyn.
[3] Trip. i. 241, 243. [4] Tripartite i. 231.

hill.[1] But it is necessary to keep in view the fact that they were quite distinct in point of time as well as in character; the first was the unpretentious settlement of a Christian mission amongst a heathen population; the second, the recognition by king and people of the debt they owed to them when the success of their labours had become evident.

The name of the Ferta, which the site on the lower ground bore when the "Book of Armagh" was written, was not its original appellation, but was given it, according to Jocelyn, in comparatively recent times, that is, before the twelfth century: *tempore moderno*, is his expression. The name appears to date from the time that it became the receptacle of the relics. What its former designation may have been there is no positive information; but a consideration of the names Macha and Ardmacha leads to a probable conclusion. Ardmacha means "the height of Macha," and Macha has been supposed to be the name of a prehistoric queen; but the place seems to have borne the name before the date assigned to this mythical personage, "Macha of the auburn hair," and the expression "Patrick of Macha," which frequently occurs, is altogether inconsistent with the word being a personal name. It has been generally taken as equivalent to "Patrick of Ardmacha"; but this seems to be a mistake. The names represent different periods in his career; he was Patrick of Macha when inhabiting the lower settlement, and afterwards Patrick of Ard Macha. *Macha*, a plain or field, is a primitive Irish word cognate with *machaire*, a plain, and distinct from *Magh*, which has the same meaning, and resembles it. Magh has superseded Macha in the present instance, and Ard Macha has become Armagh in popular usage; but it is quite modern, and the primitive form is invariably found in the "Book of Armagh" and the "Irish Annals," as well as in the "Tripartite." Macha, as Bishop Reeves points out, is of frequent occurrence as a local name, but the existence of such a combination as Magh Macha, to which Dr. O'Donovan refers, appears to have led that scholar to conclude that Macha was a personal name, as otherwise it would seem to be tautology. But the prefixing of a modern synonym to an ancient term which had become obsolete is of frequent occurrence. We speak of the River Avon, though *avon* means a river; and the island in the Clyde, Ailsa Craig, offers a similar combination—the modern Gaelic *craig*, a rock, being added to the old Irish *ail*, also a rock, but long obsolete. The expression Magh Macha, then, is merely

[1] St. Patrick, 479, Note 4.

the plain of Macha, and I hold that Macha was the name of the plain at Armagh in which was situated the strong rath bestowed on St. Patrick, and in which he erected his early settlement. Afterwards, when the spot became his last resting-place, it acquired the name of the *Ferta*.

To sum up these observations, we find that immediately after his death the people of Armagh claimed to be in possession of his remains: that they continued to make this claim in spite of opposition: that St. Bernard's testimony confirms it. Further, that there was at Armagh a sacred place known as The Tomb, that special psalms were appointed to be recited by pilgrims to it; and, lastly, that this had been the early and favourite residence of St. Patrick. From these facts, it is difficult to avoid the conclusion that the Sargifagum martyrum was the tomb of St. Patrick.

Bishop Reeves, more than forty years ago, discussed the question of St. Patrick's burial-place in his "Antiquities of Down and Connor and Dromore;" but eminent ability and learning are of no avail when the documents relied on betray the student. So it was in his case; for, when referring to the Ferta, he quoted from a manuscript[1] of the "Tripartite," which read *Inde ferta*—the *e* of *inde* being a scribal error. Unaware of this, and regarding ferta as a plural noun, he divided *inde*, and read the passage as three words, *In de ferta*. *In* being the article "the," and "*de ferta*" taken as the name of the church. The error is an old one: it is found in Colgan,[2] who writes "Ecclesiam *De fearta* vocatam."

Ussher, again, has it as *Deæ-fert*,[3] as though *Deæ* was the genitive of *Dea*, a goddess or female saint. They do not appear to have made any attempt to translate it; but Bishop Reeves[4] did, rendering it "the *two* graves," and thus going quite off the track. Dr. Todd has the same translation, but he corrected the Irish by writing *da ferta*, which would have been grammatical, if *ferta* were a plural as he thought. But *ferta*, as appears from Mr. Stokes' "Tripartite," is a singular, and the true reading of the passage is *Ind ferta*,[5] which means, not "two graves," but "The Grave." It is highly probable that others were afterwards laid in this sacred spot, hallowed by the memory of the National Saint; but that it was originally simply his tomb seems clear

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1 Probably Egerton, 93. Brit. Museum M.S.

2 Trias Thaum, p. 162; Ussher's Works, vi. 419.

3 Works, vi. 419.

4 Ancient Churches of Armagh, Appendix, p. 47.

5 Trip. i. 228.

from what has been said. It has been already mentioned that in the tenth and following centuries this place was well known as the Tomb of Sen Patrick. Why, then, is the "Book of Armagh," which dates from the ninth, silent as to his connexion with it? The explanation is, that that work was compiled "with a purpose," according to Dr. Petrie.[1] It evidently favours the new view of St. Patrick, then growing in popularity, and his mysterious burial in some unknown spot. It was therefore politic, when referring to the Ferta, to avoid directly indicating it as his burial-place. Hence it is treated as a kind of mortuary chapel, the Tomb of the Relics, and his individuality is merged in that of the many saints whose remains were believed to rest there.

In a matter with which legend has been so busy for many centuries, it is not to be supposed that all difficulties can be removed merely by the recovery of the true reading of the name of St. Patrick's burial-place, and the argument however successful founded on it. It will be asked, perhaps, why should Down set up a claim against Armagh if there was no ground for it? The account in the "Book of Armagh" of his burial at Down, and its unhistorical character, has already been referred to. The modern connexion of Down with St. Patrick's name only dates from John De Courcey's time, the close of the twelfth century, and is therefore purely legendary. But when once the story was put in circulation, the local pride of the people of Down would be enlisted in its favour. A legend, however, must have some foundation in popular feeling in order to acquire currency, and in this case there was first of all the jealousy of Armagh, arising from the long-continued feud between the two populations of Orior and Ulaidh. In the year 332 Emania, near Armagh, the palace of the Orior kings, was taken and destroyed, and the Ulidians were driven into Down and Antrim. Hostilities between the two territories continued for many centuries, and in 754 a great battle took place, in which the Ulidians were victorious. In such a state of things, the people of Down would naturally listen with eagerness when told on high authority that they and not their rivals were in possession of the remains of the national saint.

Again, the story derived an appearance of probability from the fact that it was in their territory St. Patrick first landed in the north, there he made his first convert Dichu, and set up his first church, that of Saul. Hence it is that Jocelyn brings the Angel Victor on the scene,

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[1] Essay on the History and Antiquities of Tara Hill, p. 111.

and makes him say "The Lord has promised that you shall die in the territory of Ulaidh, which you first converted in Ireland, and that you shall be honourably interred in the City of Down." The people of Down were evidently not concerned to sift this story too closely.

But why, it may be asked again, did the Armagh clergy allow the claim of another place, and refrain from asserting their own? It seems certain that, in the eleventh century, when St. Bernard wrote, they did not allow it. Opinion seems to have been in an unsettled state as regards the new and the old view of St. Patrick. Muirchu's "Memoir" is an attempt to reconcile them, and, according to Rev. E. Hogan, Probus' Life, in the following century is a revised version of Muirchu's. Eventually the attempt was given up, as the two accounts of him became more and more divergent, and then it became the popular belief that there were two St. Patricks—Patrick the Apostle and Sen Patrick an earlier saint. This change had not fully taken place when the "Book of Armagh" was written, and therefore the name of Sen Patrick does not occur in it, nor did it probably come into existence until the following century, when it is found, for the first time, in the Calendar of Œngus. The Apostle was the popular favourite, and the marvels with which Jocelyn crowds his pages were devoured like a sensational novel of the present day. The difficulty was as to his burial-place, Armagh being already in possession of the elder saint. This was got over by saying he was like Moses,[1] inasmuch as "no one knew where he was buried." Thus the Armagh people had not to yield possession of him to Down or any other site. If we inquire how his grave could be unknown when such a concourse of "people and clergy" is said to have attended his funeral, the explanation given by Jocelyn[2] and others is that a heavy sleep fell on them by divine appointment, and meanwhile the angels buried him darkly by dead of night. When the people awoke in the morning all was over, and no one knew where he was laid. Under these circumstances, if Down, Saul, or Glastonbury, or people on their behalf chose to make a claim, there was nothing to prevent them. The matter was of little importance to the Armagh clergy.

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[1] Tirechân, Tripartite, 332.

[2] In omnes qui convenerant sopor Domini irruit et donec angelicæ explerentur exequiæ usque mane consopitos detinuit.—Jocelyn, cap. xix. 169.

He seems to have taken the hint from the Hymn of Fiacc:—

"Ireland's Clerics went by every road to wake Patrick. The sound of the chanting cast them down, so that each of them slept on the way."—(Verses 31, 32.)

The old St. Patrick gradually faded from view, and came to be regarded as an obscure early saint, of whom little was known, and finally was wholly forgotten; the new St. Patrick was buried—no one knew where; but all the privileges and immunities connected with the burial-place of a famous saint were admittedly theirs. In the Hymn of Fiacc it is said—"Victor cried from the flaming bush, Primacy is appointed to Armagh, give thanks to Christ." Its termon or sanctuary was of great extent: *vastissimus*, it is termed in the Book of the Angel. Its eastern boundary being Slemish, in Antrim, and Dromma Breg, in Meath, the western Mons Berbicis, and Bri Erigi, which are not identified. Moreover, at Armagh were preserved the *Minna* of St. Patrick, *i.e.* the *Canóin Patraic*, supposed to be his copy of the New Testament: his bell, the *Clog an edachta*, and his crozier, the *Bachall Isa*, which were the title-deeds of the Coarbs.

It will be difficult to find an instance in Ireland where all the associations connected with the memory of a saint are attached to a particular church, while his remains repose elsewhere, and are almost unnoticed. On the contrary, in Irish usage such memorials of a saint are always associated with the presence of his relics; and therefore we have here an additional and conclusive proof that the burial-place of St. Patrick was Armagh.

XXXVII.

ON THE GENERA CALOPHYLLUM AND CAMPOPHYLLUM.

By JAMES THOMSON, F.G.S., Honorary Member of the Royal Ducal Society of Jena; Corresponding Member of the Royal Society of Science, Liége, Belgium. (Plates XV.-XXI.).

[communicated by g. h. kinahan.]

[Read April 13, 1891.]

Introduction.

Eight years ago, when reviewing the generic relations of the corals of the Carboniferous system,[1] I asserted that the genus Campophyllum must include *Cyathophyllum parricida*, McCoy, as suggested by Edwards and Haime.[2] Subsequent investigations have further shown that there must also be included a large series of forms which have been defined as belonging to other, though closely allied, genera. If such an enlargement of the genus be accepted, it will include compound, as well as simple, coralla; and it will further include, a series of forms, the distinguishing characters of which are that the septa never reach the centre of the calicular fossa, and therefore leave exposed a more or less circumscribed flat floor in the calice.

When the communication alluded to was made, while I was satisfied that such an enlargement was necessary, I had not completed the examination of the series, in detail, of the forms that will now be included; and I therefore considered that it would be well to defer their re-arrangement till my inquiry was more complete.

The examination of the forms, described by Edwards and Haime, and placed in the genera "Campophyllum," "Zaphrentis," and "Cyathophyllum," and of allied forms, has occupied much of my time

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[1] Trans. Phil. Soc. of Glasgow, vol. xiv., p. 375, 1883.

[2] Trans. Palæon. Soc., p. 182, 1852.

during many years, and I have been able to accumulate a number of interesting new facts. But so numerous are the varieties in the series, and so minute are the differences of the structural details, that in spite of having a series, consisting of several hundreds of specimens, I, for a time, felt considerable hesitation in arriving at a satisfactory conclusion.

In the interval I had several parcels of specimens belonging to these groups, forwarded from different parts of Britain, for identification; and judging from the diverse guesses as to their identity, and, in several instances, the divergence from the definitions given by the original authors, it seemed desirable that the unmistakable evidence I possessed should be placed on record.

The examination of the generic and specific relations of the remarkably varied series of those forms which it is now proposed to include in the Campophyllidæ, and in the allied genus Calophyllum on the one hand, and of Cyathophyllum on the other, shows that a number of the forms that have been classified as belonging to the latter genus exhibits structural details of a different character. While the larger and central series of "Campophyllum" pass by minute gradations of structural details into "Calophyllum" on the one hand, and, on the other, merge into Cyathophyllum, yet the types of each exhibit their generic distinctions throughout. Several species of "Calophyllum," if examined in their uncut condition, cannot be separated from some of the smaller and simpler species of "Campophyllum." When sections are made, however, the former exhibit a very important difference from the latter. The different species of "Calophyllum" are found to possess minute secondary septa; there are, moreover, no interseptal dissepiments in the peripheral zone, and the tabulæ extend to the wall. While in all the species of "Campophyllum" there are both primary and secondary septa, interseptal dissepiments are more or less developed, and the tabulæ never reach the wall. In some of the forms I propose including in the genus "Campophoyllum," the septa are more or less intercepted by vesiculæ, and never reach the wall. In "Cyathophyllum," as defined by Goldfuss,[1] "the septa extend to the centre of the calice," and therefore have no generic relation to "Campophyllum."

It is scarcely necessary to point out the important bearing of the presence of secondary septa; and especially in conjunction with interseptal dissepiments. In those, in which interseptal dissepiments are

[1] Peterf. Germ., vol. i., p. 54, 1826.

sparse, the lip of the calice is more or less thin, and the septa descend sharply down, and rest upon the tabulæ, and the calice always presents a more or less broad, flat floor; while, on the other hand, those forms in which the secondary septa and interseptal dissepiments are numerous, the lip of the calice is more or less rounded, and frequently everted; and in proportion to their number, and consequent extension inwards, is the floor of the calice more or less circumscribed.

That the plan of structure found in the type of Campophyllum bears a striking resemblance to that of species which have been defined as belonging to other genera, has been conceded by Edwards and Haime. But it is not generally understood that, not only in this, but in other groups, these divergent opinions have arisen from a morphological examination, for if the structural characters had been observed, there would have been found a great dissimilarity. If we inquire what are the distinguishing characters of the genus defined by Edwards and Haime as "Campophyllum,"—corallum, simple, tall, and protected by an epitheca; septa well developed; tabulæ very large, and smooth towards the centre; interseptal loculi filled with small vesiculæ—it will be apparent that they rested the generic distinction (1) upon the corallum being simple and tall; (2) the septa well developed; (3) the tabulæ very large; and (4) the interseptal loculi being filled with small vesiculæ.[1] If, however, the peculiarities of the group are taken into consideration, it will at once appear that one of these characters is sufficient in itself to enable us to determine generic identity. Indeed, all the structural details referred to are found in that form designated as *Zaphrentis cylindrica*, and in other species of Cyathophyllidæ, by the same authors. The corallum, being simple and tall, is a cosmopolitan character. The septa, being well developed, more or less characterizes many of the groups of fossil corals. The large tabulæ is certainly an important element, yet not all-important, as in the genera Amplexus and Calophyllum, and others, the tabulæ are invariably large. The interseptal loculi, being filled with vesicular tissue, is a characteristic observed in a large number of genera. The question therefore turns upon the relative proportion of these parts, and the relationship they bear to those genera which are more or less closely related. If we take a comprehensive view of the series that are more or less related, we will find that a large number of forms are so closely allied that it becomes difficult to define the boundary line. And

[1] Introduction to the British Fossil Corals, p. 68, 1849.

although the type of the genus is defined as simple in character, it will be found that the series must include forms that have not only been produced from ova, but will necessitate the introduction into the generic diagnosis of forms increasing by gemmation and by fission.

Indeed, it will be shown that the three modes of development have taken place in one species, *Campophyllum* (*Cyathophyllum*) *parricida*, M'Coy (Plate XIX., figs. 6 and 7). And if we extend the comparison throughout the entire series we will find this conclusively sustained by the fact that, while the original mode of development was ovular in the individual, in several species the further reproduction was calicular gemmation, enlarging and expanding from a simple corallum into masses of gigantic dimensions. The chief difference, then, between the definition of Edwards and Haime, and that which we now propose, arises from an increased knowledge of a series, and rests upon the discovery of other closely allied species, enabling us to more fully define their varied characteristics.

"Campophyllum" proper presents an intermediate group, separated on the one side from "Calophyllum," by the presence of a zone of vesicular tissue around the periphery, and the tabulæ never reaching the wall, and from "Cyathophyllum" on the other side by the circumscribed extension of the septa and the correspondingly enlarged tabulate area.

An objection to this explanation might be made on the grounds that the tabulate area varies in all the species of the group. No doubt this is variable; but that does not alter the homologies any more than the fact that, in the septal system, there is a constant and persistent variation in their extension inwards in their form, and also in the interseptal dissepiments that unite them.

A comparison of *Campophyllum murchisoni* (Pl. XV., fig. 13), or any other species of the group, cannot fail to remove any doubts respecting the close structural resemblance of the series which may linger in the minds of those who have become accustomed to consider them as belonging to different types. All goes to prove that, amongst the group, the distinction adopted upon the ground of the presence or absence of a broad tabula loses its importance with every step of our progress in the knowledge of their structure.

If, however, type-forms are sectioned in a series at different parts, then it will be seen how extensive is the range of variation amongst groups. Reference to the present series will amply demonstrate that correct descriptions of species can hardly be defined from isolated specimens. I have examined hundreds of specimens belonging to the group, amongst which there are not two alike, which is well exemplified in Pl. XVI., figs. 1, 2, 4, and 6; Pl. XVII., figs. 1, 2, 3, 4, 7, and 8; and Pl. XVIII., figs. 1, 4, and 8, all of which have been named as *Zaphrentis cylindrica*. The extent of this variability constitutes one of the most important phenomena of the group.

Indeed, it never will be possible to give an intelligent definition of either the genera or species unless the characteristics of a large series of specimens are observed. While the varieties of one species, if seen isolated, or obtained from different parts of the country, might be described as different, yet when we increase the field of observation and include an extensive series, it will at once be apparent how minute are the distinctions.

GENERIC RELATIONS.

I hope that a more or less detailed reference to the series I have selected to illustrate their relationship with the type will clearly show that the genus Campophyllum has a distinction that not only justified the eminent French authors in establishing the genus, but also to warrant us in associating the forms I have chosen as being generically related.

To trace their relationship through an extended series is all the more necessary from the fact that Michelin associated *Caninia gigantea* with *Zaphrentis patula*. And more recently Edwards and Haime placed the same with *Zaphrentis cylindrica*, for which Scouler had suggested the generic name of "Syphonophyllia." Why should the latter authors group some of the more complex and compound forms with the genus "Cyathophyllum?" A number of these we regard as belonging to the genus "Campophyllum." The characters which distinguish the latter from "Cyathophyllum" and "Zaphrentis" are pronounced; the individualization of the structural details obliterates the impression of similarity, inducing us to believe that the association of these as belonging to one genus could only arise from the examination of external aspects and unsectioned specimens. Had any of those authors sectioned their specimens, and compared their relative parts with the structural details of the type, it would have aided them considerably towards a consistent nomenclature.

It is true there are minute modifications in each. We at present cannot tell how far the environment may have induced modification in some; while in others the inherent tendency to variation and subsequent fission may have multiplied the division of parts, inducing a more or less connected series in varied directions from causes beyond our knowledge.

But so soon as we realize that, in "Campophyllum" proper, the septa never reaches the centre of the calicular fossa—whereas, in "Cyathophyllum" and "Zaphrentis," the septa converge, and more or less unite, in the centre; and the absence of vesicular tissue around the periphery in the latter is a generic distinction—then the only source of mistake that may arise will be with those forms in which the septa all but unite in the centre of the fossa. Such an error, however, can only arise from the examination of uncut or imperfectly preserved forms: specimens imperfectly preserved are of frequent occurrence, and in the majority of cases their imperfections are only observed after being carefully sectioned. In all such cases it has been an invariable rule with me to lay them aside, and rather wait till I procured better preserved forms, which, in the case of one group, caused a delay of over twenty-six years.

As is shown by an examination of the more complex forms, differentiation to such a high degree is eminently liable to vary, not only in number, but also in form; consequently the multiplicity of structural details would naturally afford the materials for adaptation of the most diverse conditions. Yet the species might retain, through the force of inheritance, traces of their original and fundamental generic characters. The corallites, in the earlier stages being more or less alike, and subject to the same conditions in the environment, whether more or less modified, would be serially homogeneous. And I further regard these modifications as being due to the plasticity of the soft tissue of the polyp's body during life.

In the homologies, in the different forms of closely allied species, nothing is more common or more useful, in order to fully understand the relations of the different parts, than the discovery of the aborted septa that are so frequently present. In some forms enlarged vesiculæ are found irregularly dispersed throughout the dissepimental zone as in Pl. xx., fig. 1. Whereas, in other forms, we have only found them near the wall (Pl. xvii., fig. 1). In others they are found in limited areas around the periphery, and thus locally intercepting the septa from reaching the wall (Pl. xvii., fig. 4). In others the zone of inverted vesiculæ is more largely developed, and in some cases intercepts the septa on one side; while on the other side of the corallum the septa are in no way interfered with, and extend uninterruptedly to the wall (Pl. xx., fig. 3); whereas in other species the periphery is environed by a zone of inverted vesiculæ, and the septa are thereby fully intercepted and never reach the wall (Pl. XVIII., fig. 7), inducing the inquiry, how do these enlarged vesicles influence the further development of the corallum? We have found that the larger and irregular vesiculæ are usually found in those deposits which, from the gritty conditions, indicate that the bathymetrical range was limited, and that indiscriminate impingement of drifted matter had, in all probability, influenced the partial withdrawal of the tentacles corresponding to the aborted septa, and the consequent non-secretion of the sclerodermic matter.

If such a suggestion is permissible, and the soft tissue of the polyp be further differentiated, so as ultimately to merge into other conditions, in which the tentacles are restricted to the median zone, there would thus be presented a more or less circumferential zone of mammilæ around the lips of the corallum. There are breaks in the continuity, not in nature, but rather from our imperfect knowledge of the continuity of the palæontological record; yet we have been able to trace this transformation sufficiently far as to warrant us in believing that other forms will yet be discovered which will bridge and unite the genus "Campophyllum" on the one side, with the genus "Thysanophyllum" and with "Cyathophyllum" on the other. Both of the former genera are similarly developed in the central area; and in each there is a morphological departure from the normal conditions in the central area observed. In each, radial plates are more or less developed in some varieties along the superior face of the tabulæ. These we have found, in one species, bisecting a portion of the tabulæ (Pl. XIX., fig. 5*a*). We discovered a similar departure in the interruption of the columellarian rod in the genus "Konincko-phyllum" (Trans. Phil. Soc. of Glasgow, vol. x., p. 122, 1876), in which we found the columellar rod more or less aborted in some species.

EMBRYOLOGY.

It must be borne in mind that a knowledge of the embryonic development of Palæozoic corals can only be gained by analogy. We can never hope to trace the changes that have taken place in the embryos of fossil corals; we can only cull from the studies of those who have investigated the development of recent corals. The investigations of Duthiers and others upon the embryos of recent corals enable us to extend these comparisons and aid us in arriving at an approximate conception of the embryological conditions of the fossil corals. From such we learn that the young polyps, when ejected, are simple, independent animals; that, under suitable conditions, these soon absorb the mineral ingredients of the sea-water, and thus produce a counterpart of the organization of the animal's body; that with increased growth, it is afterwards incased in a cup and surrounded by the theca, or, as Professor James Dana has defined it, "foot secretion"; and with increased growth the corallum is gradually widened and enlarged until it reaches that stage when the process of reproduction begins, which may either be by ova or by calicular gemmation and fission: all of these modes of reproduction are exemplified in one species of the present group (Pl. xix., fig. 6), which is dimorphic; consequently we cannot rest generic or specific identity on the mode of reproduction, as has been done by some authors. There is, however, one point which I wish to notice, *i. e.* the dissimilarity of the secreted matter in the initial conditions both of many genera and species, all of which end, of course, in reproducing their typical peculiarities. In the series before us we have the clearest evidence that the development of the corallum in the initial stage after ejection is more or less dependent upon the nature of the environment.

Reproduction and Development.

This is one of the most interesting departments of our inquiry, rendered all the more interesting from the fact that the evidence we seek is not only obscured by the lapse of time, but is also so from various causes, principally our ignorance of the geological record, and the persistent fragmentary condition of the evidence of these forms in the commingled wreckage of the past. Yet the evidence we have pointedly implies that the development of the series under consideration was brought about by minute stages of variation: the influence of parasites, as is shown in Pl. xx., figs. 1, 6, 14, and 15, and the solution of the exposed parts by the long-continued action of chemical influences, and their exposure to the abrading action of drifted matter, and the minute metamorphoses that have been induced by inherent modifications, rendering their identification problematical. Recent discoveries in this, as in all the other groups that have been examined by me, show what wonderfully minute changes in structure have been brought about in the development of the coral remains of the Carboniferous system. It is, for example, a remarkable addition to our knowledge that, in several genera, and more particularly in the group we are presently considering, a number of these should have originally been developed from ova, and for a time remain simple and free, and then, by calicular, latero-calicular gemmation, and by fission, become compound groups; and these should again produce ova, which should for a time be free, and becoming attached to rocks and other marine structures, are developed into diverse forms, to again and again differentiate, and develop into simple and compound communities, and so on in endless cycles, and thus produce reefs of gigantic proportions, as well as simple forms, scattered about the sea bottom in great numbers.

The belief in the essential and restricted reproduction of genera and species by either of those modes can no longer be entertained. My recent discoveries of the different modes of development in a group of forms belonging to one species (Pl. XIX., figs. 6 and 7) render it imperative that we must enlarge the field of observation. The principle of the great discovery by the late eminent Louis Agassiz, of the "Polymorphic development of the Acalephæ," is also demonstrated in the Rugose Corals of the Carboniferous system. As long as the inquiry was conducted, and largely demonstrated, by the examination of unsectioned forms, no evidence of other conditions was forthcoming.

From amongst the thousands of sections made,[1] this, and other equally interesting discoveries, have been made. As has already been stated, in the embryonic condition of the secreted scleroderm, some species, may be exactly alike, and yet may become widely different during development to the adult condition. I have, however, been unable to define with any degree of certainty the relative proportions of the septal system, in the earlier condition of segmentation. In this stage, some of them differ so much that I am induced to regard it as a necessary result of the nature and condition of the bodies to which the embryos became attached. A reference to the accompanying plates shows that many of these species, when mature, differ in so extraordinary a manner, in the form and arrangement of the structural details, that, if examined as isolated forms, they would be ranked as distinct genera. But when such a series as now lies before me is examined, many of them can barely be distinguished. The proportional differences in the structural details are incomparably less than we had hitherto supposed. Some characteristic points of

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[1] My thanks are due to the British Association for several grants of money to aid me in making sections of corals in a way unknown in the past.

difference in the form and arrangement of the interseptal dissepiments, and inverted vesiculæ around the periphery could not be distinguished in the uncut condition. The central area, however, must be regarded as an exception to this rule, as in all, the tabulæ are more or less exposed in nearly all conditions. The spasmodically formed radii, in the centre of the calicular fossa, may be regarded as exceptional. This, however, can only be regarded as temporary, induced by causes that at best can only be regarded as problematical. The constancy of the tabulæ, from the initial stages to the adult forms, proves that, although at times more or less aborted, their presence is an important generic condition, and must have been inherited. Nor does the evidence warrant us in assuming that the suggested causes are sufficient of themselves to bring about those morphologically changed conditions. A reference to the accompanying plates will show that the many slight variations in the structural details are only shown in the more or less mature forms; and the fact that there is but little modification in the initial conditions, in the central area, induces us to regard the latter as inherent, and the former as having been variously induced.

In some species the basal extremity is conical, and the calice is stout, and enveloped by the theca; the calice in turn becomes segmented, and divisional segments become subdivided, and ultimately become bilaminate septa (Plate xvi., figs. 1 to 1*h*); while in other forms they are concave, and the septa in the initial condition are stout, and the interseptal divisional spaces are scarcely recognisable (Plate xvii., fig. 6). In other forms the plastic embryo had become attached, folding round, clasped foreign bodies, and thus not only modifying its external appearance, but also inducing variation in the structural details (at least for a time). In order that these different conditions may be fully understood, I will notice in detail a few forms, in which we can trace the initial conditions, and ultimate development. As I have shown in a former contribution[1] the changes which take place after ejection of the ova from the parent, I need not here refer to the different stages of ovular development, but rather trace the different aspects of the secreted sclerodermic matter. For our present purpose, I shall first trace the stages of growth in *Campophyllum* (*Zaphrentis*) *cylindrica*, E. and H., in which, if we section the basal extremity, we find that there is no segmentation in the stout calice; it is simply a homogeneous mass enveloped by the theca, Plate xvi., fig. 1*h*, which in fig. 1*g* is segmented around the margin, and the

[1] Trans. Phil. Soc. of Glasgow, Vol. xiv., p. 304, 1883.

rudimentary septa are indicated extending to the theca. In fig. 1*f*, great change in the form and arrangement of the septa is apparent: the stout theca that enveloped the central space is no longer present; the central area is now occupied by tabulæ which form the floor, and the septa are bilaminate and converge further into the centre of the corallum; and secondary septa are indicated on one side, and a rudimentary fossula is present. Fig. 1*e*.—The septa are considerably enlarged. There is, however, a marked difference of the two sides of the septal system. Those on the convex or dorsal side are considerably stouter; and secondary septa and interseptal dissepiments are observable around the periphery. Fig. 1*d*.—A still greater change is visible: there is a more decided difference of the septa on each side of the corallum; there is an increase in the number of the interseptal dissepiments; the fossula is more pronounced; and there is a considerable extension of the septa. Fig. 1*c*.—The septa are stouter on the dorsal side, and are extended further inwards. The fossula is more pronounced, and the interseptal dissepiments fill up the interseptal spaces around the periphery. Fig. 1*b*.—This section is made where the curvature of the corallum terminates, and introduces that part where the changes in the character of the septa are exceedingly abrupt; so much so, that a section made a little higher exposes where the septa are found to have lost their stout development, and to assume the normal condition of an older and fully developed corallum. Fig. 1*a*.—The septa are shown to have lost their stoutness; and the section, as here exhibited, may be regarded as representing the condition upon which the specific identity may be defined; the inner ends of the septa rest upon the lateral margins of the downwardly inclined tabulæ; and their ends are exposed, in cut sections, as irregular and sparse interlocular dissepiments near the inner ends of the septa; and the fossula is distinct and easily diagnosed.

Fig. 1 represents a longitudinal section near the superior extremity of the corallum. The deep calice is shown, and the broad tabulæ of the central area are seen extending, and occupying two-thirds of the entire width of the corallum. At their lateral margins, they curve downwards, and extend a short distance into the interseptal loculæ. The zone of vesicular tissue is irregular, and moderately broad, and, as in all species of the genus, intercepts the tabulæ from reaching the wall. Such may be regarded as a brief explanation of the development of the structural details of this species. There are, however, other and more complex forms which are worthy of examination. For that purpose I have delineated a series of sections, nearly all taken from the same slab representing the structural details in the different stages of development. From which it will be apparent that in the earlier stages, the structural characters in the inferior part of the corallum may be regarded as the prototype of the more mature or adult forms. Pl. xx., figs. 1 to 14.—In carefully comparing these in the different stages, we will realize how great is their identity in development, and how little there is in nature to justify the separation of this most natural series of coral remains. If there is any doubt regarding the forms about to be noticed not having generic identity, a comparison of the earlier stages of development will go far to show that the difference in the structural details from the earlier stages of growth, will, I hope, show how great is their generic relationship; and that, at most, their divergent characters can only be regarded as showing specific distinction, and that some of them being placed amongst the "Cyathophyllums" proper, can only be accounted for from the examination of unsectioned specimens. I regret that in none of the latter have I been able to exhibit the initial stages of growth; there is, however, a specimen lying before me, one of many which is so much crushed and distorted as to render its structural details unreliable, but the base is preserved, in which the thecal covering is shown exactly similar to what we found in the base of *Campophyllum cylindrica.* I have taken the following sections all from one mass, with several exceptions, which will be noticed as we pass in review each section in their order. Those from the same slab can be traced as the progeny of a primary simple corallum at the base of the mass, which by their latero-calicular mode of development and rapid expansion, had increased to fully two feet and a-half in diameter, and a little under three feet in height. This mass I got cut into thin slices, and thus exposed a large series of sections, and am able to show the different stages of their development; and therefore the relationship may be recognised by their structural details as being the ultimate of one species. It is true there are slight differences in the structural details, a condition which can be readily accounted for, from the innate tendency to variation in this as in all the groups that have been examined by me.

As I have formerly stated[1] the basal ectoderm secretes the stout thecal covering at the base of the corallum. Segmentation takes place, and the septa arise from the inner surface of the basal portion of the theca, which, with their growth and increase,

[1] Trans. Phil. Soc. of Glasgow, vol. xiv., p. 306, 1883.

extend from the base to the superior extremity, partitioning the corallum, near the periphery, into interseptal spaces. Pl. XVI., fig. 1 *h*, represents the initial stage. I wish again to refer to fig. 1 *g*, in which there is represented a succeeding stage in this species.

In Plate XX., fig. 11, we have a section from near the base of a young corallum, which shows the extension of the septa, and the development of interseptal dissepiments, and on the ventral side, the septa are considerably larger than are observable on the dorsal side, and one of their number is seen to extend inwards to the centre, indicating a tendency to vary even in the earlier stages of development. This is one of the sections that does not belong to the series taken from the large mass. In Pl. XX., fig. 10, a difference in the size and arrangement of the septa and interseptal dissepiments is evident: the normal spherical form is not preserved; the incurved portion of of the latero-ventral side of the corallum has been affected during growth by being crushed, or rather has grown against some hard substance, and thus the altered aspect is due to the environment. Fig. 9.—There is a considerable increase in the size and arrangement of the various parts; and the influence of environment is impressed on the dorsal side, where some of the septa are more or less laterally deflected and the corallum is irregular in outline. Fig. 8 represents a slightly larger form in which there is a corresponding increase in the different parts; this section does not belong to those taken from the large slab. Pl. XX., fig. 7, does not belong to the community in the large slab, but it is the same species, and exhibits a corresponding increase in the size, form, and arrangement of the different parts. The tabulæ are a little broader in proportion to the size of the corallum, which can only be regarded as showing the varietal tendencies exhibited throughout the series; it is also from a more gritty matrix of strata; the section it was found in is fully twenty feet higher in the series, and exposed on the banks of the Ponneil Water, near Lesmahago. The interseptal dissepiments are not so numerous, a condition frequently accompanying gritty detrital conditions.

Plate XX., fig. 5, represents a section of a larger specimen than I could have wished. I have not an example between it and the preceding. The tabulate area is somewhat broader in proportion to its size; and there is a modification in the form of the interseptal dissepiments. They are more irregular in the median area of the loculi, and may be regarded as an example showing the tendency of endemic modification. The curved plate exposed on the latero-dorsal side represents the cut end of a down-curved tabula. Fig 4. represents a section in which the septa extend considerably further inwards, thus circumscribing the central area. The interseptal dissepiments are more or less rectangular, similar to what is found in the earlier stages of development. The fossula is somewhat different and more pronounced, conditions which have been regarded as sufficient to warrant specific distinction, but which I can only accept as showing their innate tendency to variation. Fig. 2.—The septa and interseptal dissepiments are in all essential respects similar to the preceding. The increase of the septa represents the proportional increase of the growth of the corallum, and demonstrates that we cannot rest specific distinction on their increased number (as has been done) unless we take into account the relative proportionate diameter of the corallum. Fig. 1 represents one of the largest coralla on the slab. The interseptal dissepiments are less regular in their size and form. Here and there the extensions of the septa are interrupted, and do not reach the periphery in consequence of the increased size of a portion of the interseptal dissepiments. A similar break in the continuity of the septa is found more or less in many of the species of the genus. Indeed, that condition may be regarded as one of the most conclusive evidences of induced modification and tendency to merge into an allied genus,[1] in which the septa never reach the wall. This section is further characterized by a zone of minute vesicles around the periphery on the dorsal side of the corallum, which also intercept the septa from reaching the wall, indicating further that modification is inherent, and shows clearly that there is no finality in the structural details.

The foregoing may be regarded as a fair representation of the reproduction of this group of fossil corals, including ovular, calicular gemmation and fission. We are not, however, to suppose that all the species which I propose to include in the genus "Campophyllum" are similar in the initial stages of development. In this, as well as in many other forms belonging to other genera, there are departures from what are regarded as the normal conditions. In a former communication[2] I stated that in consequence of some of the ova having

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[1] It will be observed that the structural details are in several places replaced by a foreign body; such replacement and displacement in this and other species have not been formerly recorded; it is of sufficient importance to require special attention, which will be given further on.

[2] "The Generic Relations of the Corals of the Carboniferous System," Trans. Phil. Soc. of Glasgow, vol. xiv., p. 308, 1883.

become attached to rocks or other foreign bodies the lower portion of the embryo was infolded, or, in other words, the ectoderm folded over and partly around the foreign body, and thereby, instead of retaining its normal pyriform aspect, the ectoderm became more or less concave, in which case the ectoderm was infolded at both extremities, the infolding at the superior extremity being the normal morphological change through which the embryos pass. Therefore, the infolding of the ectoderm at both extremities would nearly meet internally, the septa being developed in the latero-divisional folds, followed by the secretion of the tabulæ at the base of the supra-infolded ectoderm, thus giving rise to the base of the corallum being more or less concave, instead of, as in the preceding, being conical, a condition I have found more frequently represented in this than in any other group I have examined. I now briefly refer to a few examples demonstrating that condition which I have not seen otherwise recorded.

Plate xv., fig. 15*a*, represents the concave tabulæ and projecting septa and interseptal dissepiments at the base of the corallum, which are greatly more developed on the ventral side of the corallum than on the dorsal side. This, however, is more apparent than real, from the fact that the ventral side had been imbedded in the soft ooze at the bottom of the sea, and a small portion had been dissolved away from the peripheral area on the dorsal side.

Plate xvii., fig. 6, represents the stout septa just preceding the development of tabulæ, which demonstrates that stage when the stout septa are more or less segmented, and the interlamellar spaces are first exhibited.

Plate xix., fig. 1*a*, exhibits the outline of a longitudinal section, showing the irregular growth constriction, the convex tabulæ at and for fully half-an-inch above the concave base of the corallum, while here and there are exposed locally-developed longitudinal lines united by concave tabulæ. These represent a longitudinal section of the occasionally-developed radial plates on the superior face of the tabulæ; while fig. 3*a* shows the tabulæ less concave, and the limited development of the septa preceding the secretion of the tabulæ.

Plate xv., figs. 1*a*, 5*a*, 6*a*, and 9*a*, all show the concave base, and the development of septa and theca in the genus "Calophyllum," demonstrating that the secretion of the sclerodermic matter by the incurved base of the ectoderm is not confined to "Campophyllum" proper, but is more or less represented in allied genera. Indeed, I might have given similar representations from many other forms. I hope those given will suffice for our present purpose. To include similar conditions from other genera would extend the present communication beyond my limits.

These divergent characteristics will be better understood when we notice in detail the structural differences. In short, the type of the genus can at all times be distinguished by the broad, shallow calice, and the limitation of the septa; and it is equally interesting to record the discovery of allied groups whose septa are even more limited, "Calophyllum" on the one side (Pl. xv., fig. 5); and on the other, to varieties in which the development of the septa and interseptal dissepiments approach nearly to the type of the genus "Cyathophyllum" (Pl. xvi., fig. 3). Indeed, the variations are so constant and so universal that there is not a single form that agrees wholly either with the more highly developed or with those of less complex organization.

We may readily enough understand, on these grounds, why forms described by different authors, and from external appearance, have been regarded as belonging to other closely-allied genera. Still, I am satisfied that we do not yet know the precise links of connexion; there is a sharp and clear hiatus between many of the forms, not only in the external features but also in the structural details. With the modern system of investigation there is no difficulty in relegating many of those variable forms to their natural divisions. Thus, each diversified form discovered widens the field of our inquiry, and more or less abolishes the broad lines of demarcation which formerly separated one genus from another. While all the different forms can be shown to start in their development from a common basis, and agree in their initial stages, all start from a common morphological type, and for a time retain traces of their primitive similarity; while, in their adult condition, they present only a slight resemblance to each other. If we extend our investigations into allied groups, the types may be readily enough appreciated. If we examine fully developed forms of such groups as "Amplexus," "Calophyllum," "Zaphrentis," or "Cyathophyllum," we discover that each possesses conspicuous structural details, enabling us to distinguish them from all other groups. Yet, if we examine either or all of them in their earliest stages, we discover a similarity, until they merge into absolute identity, inducing us to regard dimorphism as the outcome of the inherent tendency to evolve from and to merge into closely allied forms.

The chief characteristics of these genera consist in the form and arrangement of the septa, interseptal dissepiments, and tabulæ in the central area. Thus, the foregoing genera constitute collectively the larger forms of the tabulata; whilst other and still more minute groups are distinguished by the tabulæ extending across the corallites from wall to wall. We, however, cannot overlook the fact that in many of these there is shown a departure, divergent from the generic types; while in several of the more complex forms of "Campophyllum" there are occasional radial plates developed along the "superior" face of the tabulæ, indicating an induced tendency to vary from the parent type, and to merge into other, more or less closely allied genera, distinguished by the more complex structural details, and the stiliform columella (Pl. XIX., figs. 1 *a*, 5 *a*; Pl. XXI., fig. 1). In another variety there are occasionally developed a series of irregularly disposed radial plates, which more or less approach each other near the centre of the fossa (Pl. XXI., figs. 5, 7, and 10). Such radial plates, however, really never pierce or bisect the tabulæ, but are localized, and are usually developed on the superior face of a portion of the tabulæ, as seen in Pl. XXI., figs. 2 *a*, *d*, and Pl. XIX., fig. 1 *a*, near the base of the corallum.

In Pl. XXI., fig. 2, a series of irregular plates are exposed; these, however, are the cut edges of the irregular convex tabulæ, and can only be regarded as showing a tendency to merge from and to pass into other structural conditions.

In the examination of the series it will be apparent that in the septa and interseptal dissepiments, there is even a greater variation in their form, size, and arrangement. Indeed, these variations characterize almost every section that has been examined by me. The irregular extension of many of the septa inwards is apparent in a large number of forms, not only in this group, but in many of the other genera. In Pl. XXI., fig. 7, one of the septa extends inwards to the centre. In Pl. XXI., fig. 13, several of the septa extend to near the centre on the large half of the ventral side of the corallum. In fig. 14 a portion of the septa is shown to unite into fascicules, and the central septum of each fascicula converges to the centre, and there unite, foreshadowing their mergence into the genus "Cyathophyllum;" while in Pl. XX., fig. 15, the irregularity of the inner ends of the septa is of a very marked character. In fig. 14 a portion extends inwards; and there are lateral plates which might be regarded as the origin of the interlamellar dissepiments of the lamella in the central area. I am, however, inclined to regard those as the cut ends of the irregular tabulæ, at their lateral margins. Indeed, in several of the sections there is more or less irregularity near the inner ends of many of the septa. In none of them, however, have I observed them piercing and bisecting the tabulæ.

Many of these varieties are so distinct that had they been examined by themselves they would have been classified as distinct species, and not a few as sub-genera. Thus, we are induced to believe that, if the geological record was more complete, and each variety sectioned, and arranged in their progressive stages, we would be able to group them into divergent lines, each varying more and more from the parent form. Each group would exhibit a series of minute stages of divergence, with here and there central forms more pronounced in their structural details, and thus forming central specific types around which varieties diverge in all directions.

Whilst many of the connecting links are wanting, and in all probability have left no residue from causes beyond our knowledge, such breaks in the continuity may be regarded as a probable explanation of the sudden disappearance of both genera and species in the stratified rocks of the Carboniferous system.

Fossula.

The form and arrangement of the structural details of the fossula have been accepted as the basis of specific diagnosis by Edwards and Haime, Pal. Soc. Trans., Part III., p. 169, 1852. And more recently Nicholson subdivided the genus "Heilophyllum," and raised to the rank of a genus one of the species of that genus on the ground that a semicircular plate united the inner ends of the septa that formed the walls of the fossula, and from the presence of the V-shaped termination. He created the genus "Crepidophyllum," Proceedings of Royal Society of Edinburgh, vol. IX., No. 95, p. 149, a form which Billings designated as *Diphyphyllum archaici*. In my investigation of thousands of sections I find that there is no part of a corallum which it is more delusive to found either genera or species upon than the character of the fossula, a description of which, in conjunction with other details, is necessary for systematic definition. But to establish either specific or generic identity upon its structural details alone is misleading in a high degree, and more especially in the tabulated forms of the "Cyathophyllidæ." Had I accepted similar evidence in a large number of the group under consideration as of generic importance, a reference to the accompanying plates will show that we might have raised to the rank of genera a large series of forms. Had Nicholson sectioned with care his specimens, I have reason to believe that he would have found that the curved plate around the inner margin of the fossula was alone due to the section exposing the cut margin of a more or less convex part of the tabulæ. I have hundreds of sections exposing similar curved plates, the same forms sectioned at right angles to the plain of the perpendicular; and where the tabulæ were not convex, it would be found that the walls of the fossula were not so united, but were open and free. The form and structure of the fossula, in conjunction with the structural details of other parts of the corallum, aid and guide diagnostic designations, but nothing more.

STRATIGRAPHICAL DISTRIBUTION.

A large portion of the species we propose including as belonging to the genera "Calophyllum" and "Campophyllum" is found imbedded in a series of thin beds of impure limestone and shale that occurs near the base of the Lower Limestone series of the Carboniferous system, and more especially that species and its varieties that were defined by Edwards and Haime, and by M'Coy, as *Zaphrentis cylindrica* (Pl. XVI., fig. 1). While occasionally this and other species have been found imbedded in pure limestone, yet the great majority are found in that zone, not only throughout Scotland, but also in all the localities throughout England, Wales, and Ireland which we have examined. And as to many of the localities the coralline remains abundantly testify that these had been exposed to shallow-water conditions. In many cases the ventral side of the calice is wholly broken or dissolved away, and in others the structure is crushed and frequently rendered useless; and not unfrequently it is only that portion of the corallum which had been submerged in the soft ooze which can be used for determination; while a few feet higher in the series the larger species of "Campophyllum" are frequently found, and are traced as extending into a zone from eight to twenty feet above the former, usually about two feet thick, largely composed of coralline remains. In the latter horizon we have found numerous examples of the more complex forms. Some of these have been defined by Edwards and Haime as belonging to the genus "Cyathophyllum." The latter and a number of other genera are got more or less associated in that zone throughout the central valley of Scotland. There are exceptions. At Auchinskeoch, Dalry, Ayrshire, we have alone found the smaller species of "Amplexus" (Pl. XV., fig. 16), associated with several species of "Calophyllum," and some of the simpler species of "Campophyllum." In this locality the higher zone in which the more complex species are found, is wanting. At Hillhead, near Beith, Ayrshire, the upper beds are wanting; and in the lower we have alone found "Amplexus," "Calophyllum," and one or two species of "Campophyllum" represented. At Cunningham-badland, Dalry, Ayrshire, the larger and more complex species are found in the upper zone. At Brockley, Lesmahgow, Lanarkshire, both the upper and the lower zones are exposed on the banks of the Ponneil water, in which we find the simpler forms in the lower, and the more complex in the higher, zone. At Charlestown, Fifeshire, in the lower zone, "Calophyllum" is found associated with all the species of "Heterophyllum" known to me, "Lophophyllum," "Centrophyllum," "Densophyllum," and others yet to be defined; whilst in the upper zone, a series of the more complex species of the most variable character is found abundant. Similar conditions are represented in the sections exposed along the coast line at Cat-Craig, near Dunbar, Haddingtonshire, while in the southern portion of Ayrshire, and in several localities in Dumfrieshire we have only discovered a few of the more complex forms.

From the foregoing, regarding not only the stratigraphical distritribution, but also the close alliance of the genus "Calophyllum" to that of the genus "Campophyllum," it seems desirable that we should associate a description of both genera. This is the more desirable from the fact that Edwards and Haime expressed some doubts regarding the validity of the genus "Calophyllum" (Dana). There is, however, another and a more potent reason why I should include this genus. In my communication on the "Generic Relations of the Corals of the Carboniferous System," Trans. Phil. Soc. of Glasgow, vol. xiv., p. 296, 1883, I referred to interseptal dissepiments occurring in the interseptal loculi. Subsequent investigations have satisfied me that the "seeming" interseptal dissepiments are the cut ends of the down-curved tabulæ at their lateral margins; and I therefore feel called upon to state that in no instance have I found interseptal dissepiments proper in "Calophyllum." I will now define the genus and species, giving structural details which characterize the group.

Genus **Calophyllum** (Dana).

The corallum is simple, cylindro-conical, and curved. The epitheca is well developed; in some forms it is stout, while in others it is thin, with encircling striæ and accretions of growth. The calice is circular and moderately shallow. The septa are of two orders, and of variable length; the primary invariably fall short of the centre, and the tabulæ are more or less exposed over the median area. The secondary septa are rudimentary, and there is a proportionate increase in those species in which the primary septa are more fully developed. In some species there are seeming interseptal dissepiments; these, however, are the cut ends of the down-curved tabulæ. The septa rest upon the superior face of the tabulæ. A septal fossula is present. The tabulæ are irregular in form and arrangement, comparatively remote, and in all cases extend to the wall, and form the floor of the calicular fossa.

The genus "Calophyllum" was established by Prof. James Dana for the reception of a group of tabulate corals, which form a natural and intermediate series between the genus "Amplexus" on the one hand, and the genus "Campophyllum" on the other; and some of the species indicate a near affinity to some of the smaller species of "Zaphrentis." In a former communication[1] I expressed doubts as to whether the more highly developed forms could be regarded as having more than specific value from some of the simple species of "Campophyllum." Subsequent and more extensive examination, of not only the species then referred to, but also others, have revealed that the genus "Calophyllum" is distinct in its generic character, and can at all times be recognized by the extension of the tabulæ, which form the floor of the calice from wall to wall, and further, by the total absence of vesicular tissue around the periphery. Externally, they present a close resemblance to the simpler forms of "Campophyllum," but they are nevertheless separated by characters sufficiently distinct, and easily recognized by the structural details, as exposed in cut sections, to warrant them being retained as an intermediate genus, as Professor James Dana showed; and like all that that able observer has recorded regarding coral remains, the new facts announced by him have stood subsequent investigations, and his determinations are amply verified, and therefore enduring.

Calophyllum danai, sp. nov.

[Pl. xv., figs. 1 and 1*a*.]

Corallum simple, cylindro-conical, and curved. The epitheca is unusually stout; there are crenulate encircling lines, and broad, shallow annulations of growth. The calice is shallow, and exposes its flat floor. The primary septa are variable at their inward extensions, and the secondary septa are 1 mm. long. There are thirty-three primary and a similar number of secondaries. The septa are bilaminate, and

[1] Trans. Phil. Soc. of Glasgow, p. 358, 1883.

inclined stereoplasm occupies the interlamellar spaces. The fossula is small, and one primary septum of shorter length than the others extends into it. The tabulæ, as exposed in the longitudinal section, are sparse, and are inclined downwards at their lateral margins. The corallum is concave at the base, arising from the ovum having been located on a convex body, and that the plastic embryo had folded over, and conformed to the outline of the body it had been attached to, exemplifying that variation had been more or less induced by external conditions.

The corallum is 45 mm. long, and the diameter of the calice is 19 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Roughwood, Beith, Ayrshire, about 8 feet above the lowest bed of marine limestone. This species I intended dedicating in honour of Prof. James Dana, LL.D., in my Memoir on the generic relations of the Corals of the Carboniferous System, but by mistake it was misplaced, and overlooked in the appended errata. It now gives me pleasure to correct the error, and give myself the pleasure of naming it in honour of that distinguished American author, the founder of the genus.

Calophyllum spinosum, sp. nov.

[Pl. xv., fig. 2.]

Corallum simple, cylindrical, slightly conical, and concave at the base. The epitheca is thin, and marked with crenulate lines, shallow annulations of growth, and sparsely-dispersed spines. The calice is shallow, and the septa extend over the superior face of the tabulæ, the section being cut along the under face of a convex tabulæ, thus exposing a free space for about a fourth of the total diameter, showing that the septa are only developed along the superior face of the tabulæ. The septa are bilaminate, and stereoplasm occupies the interlamellar spaces. The primary septa extend inwards from the theca for 5 mm., and the secondaries are fully a centimetre long. There are twenty-nine primary and an equal number of secondary septa ; and the cut ends of the concave tabulæ are present in the interlocular spaces, and present the appearance of interseptal dissepiments. The fossula is small, and a primary septum of shorter length extends into it.

Height of corallum, 19 mm.; diameter of calice, 18 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Auchinskeoch, Dalry, Ayrshire, in the shale which overlies the lowest bed of limestone.

This species is distinguished by the extension of the septa to near the centre of the calicular fossa, and by the system of spines which are here and there dispersed over the theca.

Calophyllum tuberculatum, sp. nov.

[Pl. xv., figs. 3, 3*a*, and 4, 4*a*.]

Corallum, simple, cylindro-conical, conical, and curved ; the base is broad and concave in fig. 3 ; while fig. 4 is conical at the base, and the epitheca envelopes the terminal point. The epitheca is moderately stout, and marked with irregular encircling lines, and the annulations of growth are varied. The calice is moderately deep ; the tabulæ are smooth, and extend to the wall, and the septa rest upon their superior face. The septa are bilaminate; and stereoplasm occupies the interlamellar spaces. The primary septa extend inwards from the theca for fully $1\frac{1}{2}$ mm., and the secondary septa are minute, and hardly recognizable. There are twenty-four primary and an equal number of secondary septa; here and there the cut margins of the down-curved tabulæ are exposed in the interlocular spaces. The fossula is indistinct, and a primary septum of shorter length than the others extends into it.

Length of corallum, and diameter, various.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the shale which overlies the Productus limestone.

This species can at all times be distinguished by the limitation of the septa. Indeed, if not carefully examined, it might be, and has been, regarded as belonging to the genus "Amplexus." It is, however, distinguished from that genus by the presence of minute secondary septa, and may be regarded as one of the allies to the latter genus.

Calophyllum irregularum, sp. nov.

[Pl. xv., fig. 5. and 5 *a*.]

Corallum simple, cylindrical, and curved. The epitheca is moderately stout, and marked with delicate longitudinal ridges, crenulate encircling lines, and irregular annulations of growth. The calice is shallow, and the tabulæ form its floor, and extend from wall to wall. There are primary and secondary septa. The primary extend inwards for 2 mm., and the secondary septa are minute, and are about ⅓rd of a mm. long. The septa are bilaminate, and inclined stereoplasm occupies the interlamellar spaces. The fossula is obscure, and scarcely recognisable. The tabulæ, as shown in the longitudinal sections, are irregularly disposed, and inclined at their lateral margins. The corallum is concave at the base. There are 31 primary and an equal number of minute secondary septa.

Tho corallum is 39 mm. long, and the calice is 14 mm. in diameter.

Formation.—Lower Carboniferous.

Locality.—Formed at Auchinskeoch, Dalry, Ayrshire, in the bed of shale which immediately overlies the lowest bed of marine limestone.

This species may be regarded as an intermediate form between *Caloph. danai*, and that of *Caloph. cuspidum.* From the former it differs by the limitation of the septa, and from the latter by the thin epitheca, its cylindrical form, and the septa are considerably shorter.

Calophyllum (Zaphrentis) le Honiana (Koninck.)

[Pl. xv., figs. 6 and 6 *a*.]

Corallum simple, cono-cylindrical, and curved. The epitheca is stout, and marked with crenulate encircling lines, and broad, shallow annulations of growth, The calice is deep, and the tabulæ form its floor. The primary septa extend inwards fully a third of the total diameter of the corallum, and the secondary septa are cuspidate, and one mm. long. They are bilaminate, and stereoplasm occupies the interlamellar spaces which are inclined inwards. There are 26 primary alternating with an equal number of secondary septa. The tabulæ are irregular, and curve down to the theca at their lateral margins; and the septa extend inwards over their superior face; the base is concave; the fossula is moderately large, and a primary septum of shorter length than the others extends into it.

The corallum is 32 mm. long; the diameter of the calice is 18 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Auchinskeoch in the shale which is interstratified with the thin beds of limestone about 8 feet above the lowest bed of marine limestone.

This species is distinguished from all the preceding by the greater extension of the septa; and was placed amongst the "Zaphrentidæ" by the late eminent palæontologist, Professor de Koninck. After comparing the type with this form, and sectioning a form sent me by that distinguished author, I was induced to place it with the "Calophyllidæ," from the fact that the septa do not conform to the conditions of the "Zaphrentidæ," as defined by Rafinesque and Clifford, the founders of the genus; by the total absence of a portion of the septa, extending inwards to near the centre of the corallum, and their folding round and forming the walls of the fossula, that being the distinguishing character of the "Zaphrentidæ."

Calophyllum cuspidum, sp. nov.

[Pl. xv., fig. 7.]

Corallum simple, cylindri-conical, slightly curved, and concave at the base. The epitheca is stout, and marked with crenulate lines, and irregular annulations of growth. The calice is moderately deep, and the flat tabulæ form its floor. The septa are bilaminate, and stereoplasm occupies the interlamellar spaces, which are inclined inwards and downwards. The primary septa extend inwards about 3 mm. The secondary septa are cuspidate, about one centimetre long, and formed by the laminæ of the primary septa, recurving near the wall, and extending inwards and forming the laminæ of the secondary septa, presenting an alternate deep and shallow-scolloped inner wall. The septa do not extend to the wall, but stop short; and the space between the outer ends of the septa and the theca is about one centimetre; and around the inner face of the theca there is a series of minute incurved cells. The tabulæ extend from wall to wall, and are curved downwards at the lateral margins, which in transverse sections are occasionally seen to extend into the interseptal spaces, and thus might be mistaken for interseptal dissepiments. The fossula is broad, and a primary septum of shorter length extends into it. There are 30 primary septa, and these alternate with an equal number of secondary septa. This species is concave at the base, indicating that the ovum had become attached to a convex body; the soft plastic embryo had folded over, and the basal extremity conformed in accordance with the outline of the body it was attached to, exemplifying that this variation was induced by external conditions, which I regard as an explanation of all those forms that are concave at the base of the corallum.

Height of corallum, 25 mm.; diameter of calice, 15 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the bed of shale that overlies the Productus limestone near the base of the marine series.

This species is distinguished from *Camp. danai*, its nearest ally, by the scolloped aspect of the septa, the minute incurved cells that are developed around the inner margin of the theca, and the denticulate secondary septa.

Calophyllum nodosum, sp. nov.

[Pl. xv., fig. 8, 8*a*, 8*b*.]

Corallum simple, conical, and curved. The epitheca is stout; there are encircling lines, delicate ribs, and irregular growth accretions, and nodes are frequently dispersed near the base. The calice is moderately deep, the tabula is exposed in the centre, and the septa rest upon the superior face of the tabulæ. The tabulæ are irregular and convex, and present a more or less lax cellular aspect. The septa are bilaminate, and stereoplasm occupies the interlameller spaces. The primary septa extend inwards from the theca fully a third of the total diameter, the secondary septa are three-fourths of a mm. long. There are 28 primary, and an equal number of secondary septa, and the cut ends of the curved tabula are more or less exposed in the interlocular spaces. The fossula is small and a primary septum of shorter length than the others extends into it.

Length of corallum, 20 mm.; diameter of calice, 17 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the shale that is interstratified with the thin beds of limestone, about 50 feet above the base marine limestone of the system.

This species is distinguished from *Cal. tuberculatum* by the greater extension of the septa, and the consequent limited tabulæ in the centre of the calicular chamber, and the unusual arrangement of the tabulæ. Until this species was sectioned, I regarded it as a variety of *Cal. tuberculatum*; its structural details being so pronounced warrants its specific distinction.

Calophyllum angularum, sp. nov.

[Pl. xv., fig. 9 and 9*a*.]

Corallum simple, cono-cylindrical, and slightly curved. The epitheca is ribbed; there are crenulate encircling lines and irregular shallow annulations of growth. The calice is shallow, and the tabulæ are sharply inclined to the dorsal side of the corallum. The primary septa are irregularly disposed; they are about 1 mm. on the ventral, and fully double that length on the dorsal side. The secondary septa are about three-fourths of a mm. long. The septa are bilaminate, and stereoplasm occurs in the interlamellar spaces. There are 30 primary, and an equal number of secondary septa. The fossula is broad and shallow, and one primary septum of shorter length than the others extends into it.

The corallum is 26 mm. long, and the diameter of the calice is 14 mms.; the corallum is, however, considerably contracted near the superior extremity.

Formation.—Lower Carboniferous.

Locality.—Found at Auchinskeoch, Dalry, Ayrshire, in the bed of shale that immediately overlies the lowest bed of limestone.

This species is distinguished from all others by the irregular septa, and by the tabulæ being inclined at a sharp angle to the dorsal side of the corallum, and by the ribbed condition of the theca.

Calophyllum denticulatum, sp. nov.

[Pl. xv., figs. 10 and 10 *a.*]

Corallum simple, cono-cylindrical, and curved. The epitheca is moderately stout, smooth, and marked with broad and shallow annulations of growth. The calice is shallow, and a small portion of the tabulæ are exposed in the centre. The primary septa are irregular in their inward extension; a portion of them converges to near the centre of the calicular fossa, while others are considerably shorter; the secondary septa are minute, and not more than a centimetre long; they are bilaminate, and stereoplasm occurs in the interlamellar spaces, which extend inwards and downwards; there are 26 primary, and these alternate with an equal number of minute denticulate secondary septa; the fossula is large, and a primary septum of shorter length extends into it; the longitudinal section shows the irregularly disposed tabulæ and down-curved margins.

The corallum is 32 mm. long; the diameter of the calice is 14 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in a bed of gritty shale that is interstratified with the beds of limestone, about six feet above the Productus limestone.

This species differs from the preceding by the greater extension of the primary and by the minute denticulate secondary septa; the septa are not so numerous in proportion to the diameter of the corallum.

Calophyllum robustum, sp. nov.

[Pl. xv., figs. 11 and 11 *a*.]

Corallum simple, cylindro-conical, and curved. The epitheca is thin, and the outer ends of the septa are exposed through the thin theca, and thus form longitudinal ribs; the calice is deep, but imperfect, and I am thus not able to define its details; the septa are robust and numerous in proportion to the diameter of the corallum. There are 32 primary alternating with an equal number of secondary septa; the former are 3 mm., and the latter are full one centimetre long; the septa are bilaminate, and stereoplasm occupies the interlamellar spaces which are inclined inwards; a fossula is present, and a primary septum half the length of the others extends into it; the longitudinal section shows the irregular tabulæ, their inclination to the dorsal side of the corallum, their down-curved margins, and their attachment to the theca.

Length of corallum, 33 mm.; diameter of section, 11 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Roughwood, Beith, Ayrshire, in the shale that overlies the lowest bed of limestone.

This species differs from all the others of the genus by its robust septa, and the greater number in proportion to the diameter of the corallum, and may be regarded as an intermediate variety between *Caloph. danai* and that of *Caloph. denticulatum.* The corallum is much contracted near the upper extremity; hence the greater diameter of the longitudinal section.

Calophyllum approximatum, sp. nov.

[Pl. xv., figs. 12 and 12 *a*.]

Corallum simple, conical, and curved. The epitheca is thin and marked with encircling lines, and irregular shallow annulations of growth; the calice is shallow, and the septa rest upon the superior face of the tabulæ, and extend inwards to near the centre of the fossa; there are 28 primary, and these alternate with an equal number of secondary septa; the latter are fully a millimetre long; the septa are bilaminate, and stereoplasm occupies the interlamellar spaces which are inclined inward (12 *a*, *b*). The fossula is large, and a primary septum of shorter length than the others extends into it; the septa that forms the walls of the fossula are united at their inner ends by curved plates, and in this respect approximate closely to some species of Zaphrentis. Indeed, I long regarded it as a species of that genus. The near union of a portion of the septa near the centre, and their not being folded round and forming the walls of the fossula, preclude its being placed in the latter genus. The longitudinal section shows the extension of the tabulæ over the total width of the corallum, and their inclination at the lateral margins and attachment to the wall.

Length of corallum, 36 mm. The calice is imperfect; diameter of section, 15 mm.

Formation.—Lower Carboniferous.

Locality.—Formed at Roughwood, Beith, Ayrshire, in the interbedded shale between the thin beds of limestone, which in this locality is about eight feet above the lowest bed of limestone.[1] This species is readily recognised by the greater extension of the septa and by the form of the fossula, which in these respects differs from all the other species of the genus, and thus shows its near alliance to some of the species of the genus "Zaphrentis."

The structural details of the genus "Calophyllum" are so characteristic that there is no difficulty in distinguishing it from that of other and closely related genera: the total absence of vesicular tissue around the periphery, in conjunction with the extension of the tabulæ over the total diameter of the corallum, and the manner they bend down at the lateral margins and become attached to the wall, while the latter condition is indicated in some of the species of the genus "Amplexus," but is a persistent character in the genus "Calophyllum." The possession of secondary septa, as observed in their varied extension from minute pointed granules, and their increase in the different species from a third of a millimetre to fully a millimetre long, contribute further to distinguish the group from all other genera. If to these characters we add the prominent shallow fossa and radiating septa, and their limited extension along

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[1] I wish it to be understood that the beds of limestone referred to throughout this paper as the lowest are the equivalents of the basement limestone throughout Great Britain.

the superior face of the tabulæ, and the fact that in no instance have we observed the septa piercing or bisecting the tabulæ, we have thus a combination of structural characters not found in any other group of coralline remains from the Carboniferous system, and which justly entitles the group to be considered as a distinct genus. They differ from the "Campophyllidæ," not only by the more extended tabulate area in the centre of the corallum, but also by the total absence of the vesicular tissue that is abundantly represented around the periphery in a number of the species of "Campophyllum." While in the latter the reproduction is variable, and may be either "ovular," "calicular," or by "fission," the latter two modes giving rise to compound masses, the consequence being that while, in "Campophyllum," there are both compound and simple species, in "Calophyllum" we have not yet discovered variations that indicate a departure from the single and simple conditions in any of the species. The "Calophyllidæ" resemble the "Zaphrentidæ" in the development of the tabulæ, and their extension across the total diameter of the corallum, and by the fact that there is no vesicular tissue in the peripheral region; while in the "Calophyllidæ" there is, as in the "Zaphrentidæ," the extension of the septa along the superior face of the tabulæ; but in the former they are limited in their extension, and never reach the centre of the fossa, and thus leave the more or less broad tabulæ exposed to view in the centre. While in the "Zaphrentidæ" their extension is in some forms to the centre, in others, a portion only reaches the centre, but in all cases a portion converges inwards, coalesces, and forms the walls of the fossula. Upon the whole the "Calophyllidæ" and the "Zaphrentidæ" bear the greatest resemblance to one another; but I do not believe that I have exaggerated the importance of their difference in considering them as distinct. It is true, in the "Calophyllidæ" the floor of the calice extends to the periphery in the form of irregular plains; but in the "Zaphrentidæ" the tabulæ are more or less concealed by the extension of the septa near (in most cases) to the centre; and the calice is uniformly deep, and presents an inverted conical appearance; and the long septa project and converge to the centre, and thus present a pronounced structural distinction, generic in its character. Some of the simpler forms may be regarded as related, on the one side, to the genus "Amplexus," and on the other, to indicate a near relation to "Zaphrentis," and to merge into the "Campophyllidæ" on the other, and are thus polymorphic.

GENUS **Campophyllum** (Edwards and Haime).

Corallum simple or compound. The calice is variable in depth. The tabulæ extend over the central area, and never reach the theca. Outside the tabulæ there is present a zone of vesicular tissue of variable width, environing the tabulæ and united to the periphery. There are primary and secondary septa; these are variable in their extensions inward and at their inner ends, the former rests upon the lateral margins of the tabulæ. The tabulæ are more or less exposed to view in the centre of the calicular fossa. The septa are bilaminate, in some species are inclined inward, while in others they extend outward and downward; the interlameller spaces are occupied by stereoplasm. The interseptal loculi are occupied by interseptal dissepiments, which, in the longitudinal section, are exposed as irregular convex cellular tissues, convexity inward, and pointing upwards. A fossula is present. Edwards and Haime thus describes the type:—

"Corallum simple, very tall, and protected by an epitheca. Septa well developed. Tabulæ very large, and smooth towards the centre. Interseptal loculi filled with small vesiculæ."

It will thus be apparent that the type is distinguished by the large tabulæ forming the floor of the calicular fossa, and the presence of a zone of vesiculæ around the periphery, characters which include a large and varied series of both simple and compound forms found in the Carboniferous system.

The simple varieties are characterized by the sparse vesicular tissue around the periphery, and the broad tabulæ forming the floor of the calicular fossa, which in this respect approximates so closely to the more highly developed varieties of the genus "Calophyllum" (Dana) as to be readily mistaken for the latter. If, however, transverse or longitudinal sections are made, they are found to differ from the latter by the possession of vesiculæ around the periphery, and the tabulæ are thus intercepted, and never reach the wall; while in "Calophyllum" the tabulæ extends to the theca, and there are no circumambient vesiculæ. While in the more complex forms of "Campophyllum" they are distinguished by the possession of a more or less broad zone of vesiculæ, and the variable extension of the septa towards the centre, which in some forms merge into and all but unite the more highly developed forms to Cyathophyllum. From the latter they differ by the more or less exposed tabulæ; while in "Cyathophyllum" the septa extend inwards to the centre of the corallum, and there unite from opposite sides, and form a "pseudo-columella."

These distinctions may be summarized as follows:—

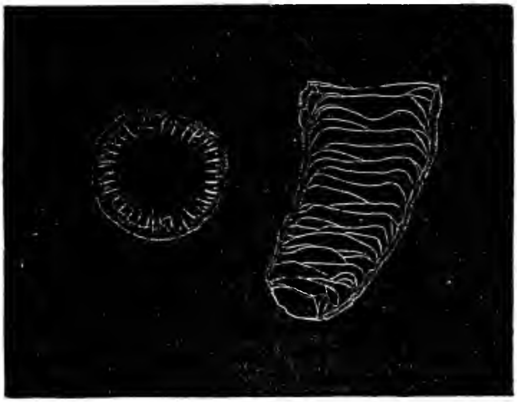

Fig. 1.

1st. "Calophyllum" (fig. 1) is distinguished by the absence of vesiculæ around the periphery, and the extension of the tabulæ across the corallum trom wall to wall.

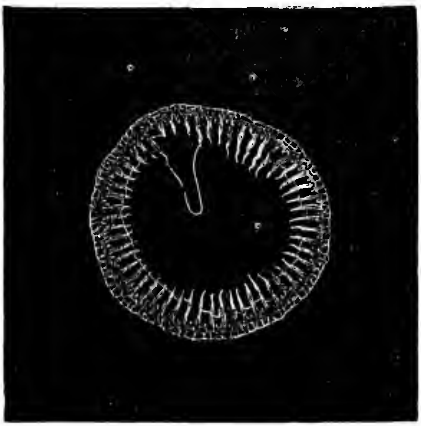

Fig. 2.

2nd. "Campophyllum" (fig. 2) is at all times recognised by the possession of a more or less dense zone of vesiculæ around the periphery, which, as shown in section, are convex, the convexity pointing inwards and upwards; and the tabulæ are intercepted by vesiculæ, and never reach the wall; and the septa at their inner ends more or less rest upon the superior face of the tabulæ.

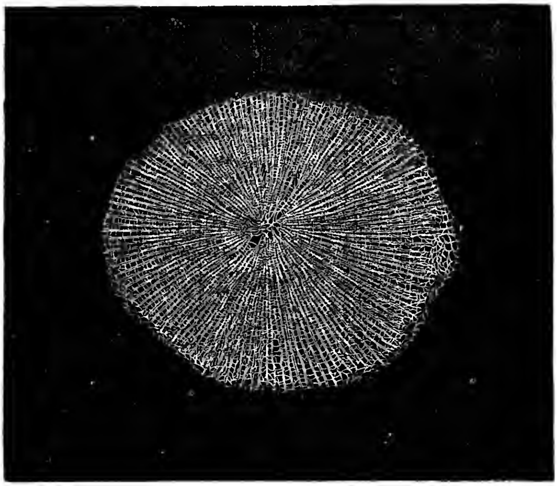

FIG. 3.

3rd. And "Cyathophyllum" (fig. 3) may at all times be distinguished by the extension of the septa from the wall inwards to the centre, where they unite and are slightly raised, and present the aspect of a "pseudo-columella."

The varieties of those forms which I now propose including as belonging to the genus "Campophyllum," are so varied in their structural details, and the names they have been distinguished by, induce me to notice briefly a few of the more important definitions, so that we may show good grounds for placing them as belonging to one genus.

As formerly stated, the genus "Campophyllum" was founded by M. Edwards and J. Haime to include one species, *Camp. murchisoni* (Pl. xv., fig. 13), which stands as the type of the genus. These authors subsequently described another form as *Zaphrentis cylindrica*, which can only be distinguished from *Camp. murchisoni* by a slight increase in the extension of the septa, and the vesicular tissue in the peripheral zone is more dense, a distinction which I hope to show can only be regarded as specific; and further these authors regarded the latter as being analogous to that corallum which Michelin, in "Icon. Zooph.," p. 81, pl. vi., fig. 1, 1843, described as *Caninia* *gigantea*, and which Dr. Scouler defined as *Syphonophyllia cylindrica*, in M'Coy, "Syn. of Carbon. Fossils of Ireland," p. 187, pl. xxvii., fig. 5, 1844; and D. Orbigny, "Prodr. de pal. stratig.", vol. i. (pl. 158, 1850), defined as *Caninia gigantea*. This name M'Coy adopted in 1851. In the same year M'Coy described another form in the "Ann. Nat. Hist.," 2nd series, vol. VII., p. 167, as *Caninia subibicina*. M'Coy ("Pal. Foss.," p. 85) describes a form as *Cyathophyllum dianthoides*, and (l. c. p. 86) includes two other forms as *Cyath. parricida* and *Cyath. pseudo-vermiculare*. Subsequently M. Edwards and J. Haime ("Polyp. Foss. des Terr. Pal.," p. 365) suggested that *Cyath. parricida* ought to be placed amongst the "Campophyllidæ." Their reasons for erasing this species from the "Cyathophyllidæ," and placing it in the "Campophyllidæ," were suggested by the fact that the septa never reach the centre of the calicular fossa; consequently always leave the flat tabulæ open to view. If such conditions be regarded as valid for this species being grouped with the Campophyllidæ, then the fact that *Cyathophyllum dianthoides* (M'Coy), and *Cyath. wrighti.* (E. & H.) and a large number of undescribed forms being similar to their structural details, these must also be transferred to the "Campophyllidæ." *Cyathophyllum pseudo-vermiculare* (M'Coy), as defined by that author, is readily distinguished by the fact that the septa are intercepted by a zone of vesicular tissue, and never reach the theca, characters which have been regarded as of generic importance, and defined as "Thysanophyllum" (Nich. and Thom.), and therefore must be excluded from the "Campophyllidæ."

The classification of M'Coy ("Syn. of the Carboniferous Fossils of Ireland," p. 187, 1844) was evidently based upona general appreciation of external aspects. It would seem that none of these authors had undertaken the arduous and expensive task of preparing sections of these coral remains; as had the specimens been sectioned they certainly would have found that those species we now propose removing from the "Cyathophyllidæ" to the "Campophyllidæ" were in no way related to the former, and that that part of the corallum which suggested the designation of "Syphonophyllia" to Dr. Scouler, *i.e.* the inclined margin of the tabulæ curving down and folding round, and thus forming the walls of the fossula, is more or less a characteristic of the great majority of the species of "Campophyllidæ." The union of *Campophyllum* (*Caninia*) *gigantea* and *Campophyllum cylindrica* with the "Zaphrentidæ," by Edwards and Haime, Tran. Pal. Soc., p. 171, 1852, was undoubtedly an equally great exaggeration, as had either of those authors compared the structural details, such would have freed them from the impression that either of those species had the most remote relationship to the latter genus. If they had understood that the distinguishing characters of the "Zaphrentidæ," as defined by Rafinesque and Clifford, were "the extension of the septa into the ventro-central side of the corallum, their curving and folding round, and thus forming the walls of the fossula, and the total absence of vesiculæ around the periphery," such would have prevented them from placing them in the "Zaphrentidæ."

There are, however, other structural details which clearly separate them into distinct genera, and which I wish specially to refer to. I have been long convinced that *Caninia gigantea* (Michelin) could not be referred to the "Zaphrentidæ." This species was removed from Canina to Zaphrentis by Edwards and Haime, and designated as *Zaph. cylindrica.* I am, however, persuaded that the structural characters of *Caninia gigantea* and *Zaphrentis cylindrica*, not only clearly precludes both of these species from being grouped with the "Zaphrentidæ" as defined by "Rafinesque and Clifford," but also debars them being regarded as belonging to one and the same species. In "Zaphrentidæ," "the usual deep calice and the conspicuous septa extending inward to the latero-ventral side of the visceral chamber, and a portion of them curving and folding round, thus forming the walls of the fossula," are characters which clearly separate them into different genera, while in *Campophyllum* (*Caninia*) *gigantea* and *Campo.* (*Zaphrentis*) *cylindrica*, the broad, flat tabulæ forming the floor of the shallow calice, and the vesiculæ around the periphery are structural distinctions that it will be evident removes them out of the "Zaphrentidæ." Indeed, Michelin placing *C. gigantea* along with *Zaphrentis patula* is of itself sufficient evidence that there is not only no generic relationship, but that he had not examined the structural details in sectioned specimens.

In adopting this rearrangement, "Campophyllum" will thus include a large series of compound as well as simple forms, all of which differ from the type of "Cyathophyllum," by the fact "that the septa never extend to the centre of the calicular fossa," and always leave a more or less flat tabula exposed in the centre. If these changes are accepted, and I see no valid reason why they should not, we will thus have presented to us an organic bond that is natural, which includes species not only like each other, but also varieties which are nearly alike; and those forms that are more or less dissimilar indicate that modification is not only inherent, but is also more or less affected by the surrounding physical conditions, and that variation is to a considerable extent influenced by the organisms having been brought into new relationships.

Upon the whole the genus "Campophyllum" may be regarded as an intermediate group between "Calophyllum" on the one hand and "Cyathophyllum" on the other.

The group, however, includes a series of forms of an extremely varied character. The septa vary in their extension inwards. The secondary septa can be traced from minute points less than a centimetre in length, while in other forms they extend inwards to near the inner ends of the primary septa. In some forms the septa are here and there interrupted and do not reach the wall, indicating and foreshadowing a mergence into the near allied genus Thysanophyllum (Nich. and Thom.). The dissepiments that close in the interseptal loculi are of an extremely diverse character, and their number is regulated by the form of the calice and the extension inwards of the secondary septa; indeed, many of these are so dissimilar, yet their structural characters approach so close to their nearest allies, that it becomes difficult to define specific distinctions. In fact, unless there is a large series of carefully sectioned specimens examined, such divergent deductions might be expected; yea, some of the species that have been grouped with other genera are so unlike the groups they are classified amongst that we are disposed to believe that such an error could only have arisen from the examination either of external aspects or from imperfect specimens. To discover the minute divergent characters and to indicate the varied modifications which could be represented, it would be necessary to include a more extensive series than is permissible. Those delineated represent a number of the important characters, and as far as possible exemplify type forms from the earlier stages of growth through the varied modifications up to the more or less complete corallum. The difficulties which surrounds specific definition are minute, and all but debars recognition. What I have deemed expedient is to note the extension of the septa and their character, accompanied with the width of the tabulæ; these, I believe, are the only data we can rest specific distinction upon. Further, a few of the included forms have been described in former communications; but there are several structural details which I have since discovered: I therefore considered that it would be more satisfactory to notice in order the structural distinctions of each, including the recently discovered details.

Campophyllum murchisoni (Edwards and Haime).

[Pl. xv., fig. 13.]

Corallum simple, tall, cylindro-conical, and curved; the epitheca is thin, and marked with encircling lines and shallow annulations of growth; the calice is shallow, and its floor is occupied with broad, flat tabulæ; the septa are bilaminate; and stereoplasm occupies the interlamellar spaces. There are 54 primary alternatin gwith an equal number of secondary septa; the primary converge inwards $5\frac{1}{2}$ mm. from the theca, and at their inner ends rest upon the tabula; the secondary septa are 2 mm. long; they are delicate around the periphery, and are stout and united by a stout circumferential band in the centre; they are then thin and pointed at their inner ends; the diameter of the tabula between the inner ends of the septa is $21\frac{1}{2}$ mm., or fully more than two-thirds of the total diameter of the corallum. Around the periphery vesiculæ occupy the interseptal loculi, which, in the longitudinal section, are convex; convexity inwards and pointing upwards, and arranged in oblique rows; the fossula is large, and extends to near the centre of the visceral chamber, showing the cut margins of the down-curved tabulæ; the development is by ova, and is therefore simple.

Length of corallum, $5\frac{1}{2}$ inches; diameter of calice, 1 inch.

Formation.—Lower Carboniferous.

Locality.—Found at Durnish, County Limerick, Ireland. The specimen is in the Geological Survey of Ireland Collection.

Pl. XVIII., fig. 9, is a young specimen of the same found at Brockley, Lesmahagow, Lanarkshire.

When this species was defined in my communication on the generic relations of the Corals of the Carboniferous System (Trans. Phil. Soc. of Glasgow, 1883), I had not discovered the interlamellar plates in the septa (stereoplasm), which I now record as occurring in this group.

Campophyllum brockleyences, sp. nov.

[Pl. xv., fig. 14.]

Corallum simple, cylindrical, and slightly tapering; the base is broad; the epitheca is thin, and marked with encircling lines and irregularly disposed shallow annulations of growth; the calice is imperfect; the septa are delicate and bilaminate; and stereoplasm occupies the interlamellar spaces; they are irregular in their inward extension; the intermediate are about 6 mm.; and these alternate with an equal number of secondary septa, which are fully a half mm. long.; the section is 23 mm. in diameter; there are 36 primary, alternating with an equal number of secondary septa; the interseptal loculi are occupied by irregular dissepiments, and the free ends of the down-curved tabulæ are exposed around the inner margins of the loculi. The diameter of the tabula between the inner ends of the septa is about 12 mm., and is thus fully a-half of the total diameter. The fossula is abnormally large, and the free ends of the tabulæ are exposed in semicircular plates around its inner margin. I have not a longitudinal section, and therefore am unable to refer to the arrangement of the tabulæ. The development is by ova, and therefore simple.

Length of corallum, 1¼ inch; diameter, 1 inch.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the upper portion of the thin beds of limestone, or about fifty feet above the lowest bed of marine Carboniferous limestone, associated with "*Lithostrotion junceum*" and "*Diphyphyllum blackwoodii*," &c. This remarkable species is distinguished from the preceding by the unusual dimensions of the fossula: the greater proportion of the septa extending a little further inward, and the interseptal dissepiments are more numerous; externally it much resembles the genus "Amplexus," to which I did think it belonged, but when sectioned the structure of "Campophyllidæ" is pronounced.

Campophyllum simplicum, sp. nov.

[Pl. xv., figs. 15 and 15 *a*.]

Corallum simple, cylindrical, curved, and concave at the inferior extremity. The epitheca is thin, and marked with encircling lines, and broad, shallow annulations of growth; the calice is shallow, and the broad, flat tabulæ form its floor; the septa are bilaminate, and stereoplasm occupies the interlamellar spaces, which are inclined inwards and downwards; the corallum is 20 mm. in diameter; there are 36 primary septa, which are more or less clavate near their inner ends; these extend inwards 3 mm., and rest upon the lateral margins of the down-curved tabulæ. There are an equal number of minute secondary septa one centimetre long, and the interseptal loculi are occupied by dissepiments, which, in the longitudinal section (15 *a*), are shown as elongate and slightly convex; convexity inwards, and slightly inclined upwards; the section is fully 20 mm. in diameter, and the tabulæ are 15 mm. between the inner ends of the septa, and thus occupy three-fourths of the total diameter. A fossula is present, and two primary septa, half the length of the others, extend into it.

The development is by ova, and is therefore simple.

Length of corallum, $2\frac{3}{8}$ inches; diameter of calice, 1 inch.

Formation.—Lower Carboniferous.

Locality.—Found at Auchinskeoch, Dalry, Ayrshire; associated with the genus "Calophyllum," in the shale that overlies the lowest beds of marine limestone of the system.

This species approximates so near the "Calophyllidæ" that I long regarded it as such; when sectioned longitudinally, the narrow zone of vesiculæ was exposed at the periphery, intercepting the tabulæ from reaching the wall; such being the structural distinction of the "Campophyllidæ," therefore, I regard it as one of the simpler forms of that genus.

Campophyllum (Zaphrentis) cylindrica, Scouler.

[Pl. XVI., figs. 1, 1 *a* to 1 *h*.]

Corallum simple, tall, cylindro-conical, and curved. The calice is deep, and the broad tabulæ form its floor; the epitheca is moderately stout; there are crenulate encircling lines, and deep, broad annulations of growth; and the septa project through the theca, which is therefore more or less ribbed; the septa are bilaminate (stereoplasm occupies the interlamellar spaces); they are thin and sinuous near the wall, and stout towards their inner extremities; there are 48 primary, which at their inner ends extend for a third of their total length over the superior face of the tabulæ; these alternate with an equal number of secondary septa; the latter extend inwards for 5 mm.; the interseptal spaces are occupied by dense angular tissue near the inner endothecal ring; less dense, and not quite so angular, near the periphery. The diameter of the section is $39\frac{1}{2}$ mm.; the primary septa are 10 mm. long; and the tabulæ are 19 mm. between the inner ends of the primary septa, or about the half of the total diameter; the fossula is moderately large, and the cut margins of 4 of the tabulæ encircle and unite its walls; this section represents the adult condition of the corallum, while the sections (1 *b* to 1 *h*) represent this species in the different stages of development, showing where the secondary septa and the interseptal dissepiments are first developed; and the variable condition of the septa during the earlier stages of growth, and their variable stoutness on the dorsal side (1 *b*), till the corallum loses the acute curved form (1 *a*), show the structural details of the same about half-an-inch higher from that part of the corallum upwards where alone have I found indications of ovular reproduction. Fig. 1 shows the form and arrangement of the longitudinal section, the interseptal dissepiments (vesiculæ), and their relation to the periphery, and the interception of the tabulæ from reaching the wall, which has been accepted as of generic significance.

The tabulæ are broad, irregularly disposed, and bend slightly down at their margins, and rest upon the inner margin of the vesicular tissue ; the vesiculæ are irregular in size, and convex, the convexity pointing upwards and inwards, and arranged in oblique rows.

The series of sections from 1 *a* to 1 *h* demonstrates the form and arrangement of the structural details from the superior extremity to the thecal covering that surrounds the base or first secreted sclerodermic matter; the frequent crushed and distorted condition that a large proportion of the specimens are found in debars me from representing a continual series from the same corallum ; those given are, however, from the same species ; and I hope will thus aid in the determination of the generic character from the earlier stages of development to the mature corallum, and further show where specific definition car alone be determined from.

Length of corallum—I have this species 10 inches long ; diameter of calice fully 39 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Peter's-hill, Bathgate, Linlithgowshire, embedded in the shale that overlies the basement marine limestone ; and at Auchinskeoch, Dalry, Ayrshire, in the same zone.

Campophyllum recurvatum, sp. nov.

Pl. xvi., fig. 2.

Corallum simple, imperfect; a large portion of the lower extremity is wanting. The calice is shallow, and everted, and the septa extend over the tabulæ to near the centre of the visceral chamber; the epitheca is thin; there are minute encircling lines and irregular shallow annulations of growth ; the septa are delicate near the wall, and bilaminate; and stereoplasm occupies the interlamellar spaces; the section is 32½ mm. in diameter. There are 44 primary, alternating with an equal number of secondary septa ; the extensions of the septa are greatly interrupted by the lateral enlargement of a large portion of the vesicular tissue: and in some parts the septa are so interrupted that they do not reach the wall at all; the secondary septa (where not interfered with) extend inwards 2½ mm.; the endothecal tissue is very irregularly disposed. The fossula is large, and four primary septa of shorter length extend into it; and the septa that form its walls near the inner margin, recurve on either side, and are united to a central mucronate plate which points outwards, and extend to the vesiculæ that unite the two central septa of the fossula; the tabulæ are 3 mm. in diameter.

Length of corallum imperfect; diameter of calice, fully 1¼ inch.

Formation.—Lower Carboniferous.

Locality.—Found in the bed of shale that overlies the basement marine limestone at Brockley, Lesmahagow, Lanarkshire.

This species is distinguished by the remarkably irregular endothecal tissue, the singular structural details of the inner extremity of the fossula, and the extension of the septa to near the centre of the visceral chamber.

Campophyllum dicuspidophyllum, Thomson.

[Pl. XVI., fig. 3.]

Corallum simple, tall, and curved. The epitheca is moderately stout; there are encircling lines and irregular annulations of growth; the calice is shallow, and thin at the margin; the septa are thin, and more or less flexuous near the wall; bilaminate in the intermediate area, delicate and cuspidate inwards; the interlamellar spaces are occupied by stereoplasm. The section is oval in outline, and is 32 mm. on the narrowest, and 35 mm. at the longest diameter; there are 30 primary, alternating with an equal number of secondary septa; the latter extend inwards to near the inner ends of the primary septa; there they unite, and the primary extend in, and all but meet in the centre of the visceral chamber. The interseptal spaces are occupied by rectangular dissepiments. The tabulæ are 2 mm. in diameter; the fossula is large, and extends into the centre of the corallum, and four septa of shorter length than the others extend into it.

I am unable to give the length of this species; the specimen was imperfect; it is in the Geological Survey of Ireland Collection, Dublin.

Formation.—Lower Carboniferous.

Locality.—West of Ireland, the precise locality was not given.

From the description of details, and reference to the figured section, it will be apparent that this is one of the passage forms that all but unites "Campophyllidæ" with the "Cyathophyllidæ" proper. Indeed, in a former communication, I placed it in "Cyathophyllidæ." On, however, taking a general review of the series, and the fact that Goldfuss rested his definition of the genus "Cyathophyllum" upon the extension of the septa to the centre, there uniting and forming a pseudo-columella, clearly preclude us from placing this species in the latter genus, and this species can only be regarded as an intermediate form, and thus all but bridging and uniting the two genera; yet the septa stopping short, and not uniting in the centre, can only be regarded as demonstrating that when the evidence is more complete, then we will be better able to realize how difficult it will be to define where the one genus ends and the other begins.

Campophyllum breviseptum, sp. nov.

[Pl. xvi., fig. 4.]

Corallum simple, cono-cylindrical. The epitheca is thin, and marked with delicate crenulate encircling lines, and broad, shallow annulations of growth. The calice is shallow, and the broad tabulæ are conspicuous in the floor. The septa are sinuous, delicate near the wall, and moderately stout, and bilaminate in the centre; and stereoplasm occupies the interlamellar spaces. The corallum is slightly oval. There are forty-three primary, and these alternate with an equal number of secondary septa; the extension of the primary are varied; they are 8 mm. on the dorsal, and a little shorter on the ventral side; the secondary septa are about two-thirds of a mm. long. The interseptal dissepiments are irregularly disposed. The tabulæ are 21½ mm. broad inside the septa, and are fully more than a-half of the total diameter of the corallum. The fossula is moderately large, and a primary septum of shorter length than the others extends into it.

Length of corallum, 4 inches; diameter of calice, a little under 1½ inch.

Formation.—Lower Carboniferous.

Locality.—Found at Nettlehurst, Beith, Ayrshire, in a bed of shale about six feet above the basement marine limestone of the system.

This species is distinguished from all the preceding by the broad tabulæ, the limited extension of the primary septa, and the minute secondary septa.

[Pl. XVI., fig. 5.]

This is a section of a young specimen, which is not sufficiently developed to warrant specific distinction. The section is cut at a slight angle, and a little below where the septa assume their normal specific condition, exposing them, extending to near the centre of the visceral chamber on the one side, where they are considerably stouter, their limited extension and incorporation with the tabula on the other; the latter condition is one formerly referred to, and may be regarded as being one of the distinctive characters of the genus, and clearly demonstrates that the septa, at their inner extremities, are alone developed along the superior face of the tabulæ.

This corallum is $2\frac{3}{4}$ inches long.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the interbedded shale, with the thin bands of limestone, about 50 feet above the basement marine limestone of the system.

Campophyllum gigantea.

[Pl. XVII., fig. 1.]

Cyathophyllum fungites, Portlock, Rep. on the Geol. of Londonderry, p. 332, 1843.

Caninia gigantea, Michelin, Icon. Zooph. p. 81, Pl. XVI., fig. 1, 1843.

Syphonophyllia cylindrica, Scouler, in M'Coy's Syn. of Carb. Foss. of Ireland, p. 187, Pl. XXVII., fig. 5, 1844.

Caninia gigantea and *Syphonophyllia cylindrica*, D. Orbigny, Prod. de. Pal. Stratig., vol. i., p. 158, 1850.

Zaphrentis cylindrica, M. Edwards and J. Haime, Polyp.; Foss. des Terr. Palæoz., p. 339, 1851.

Caninia gigantea, M'Coy, Brit. Palæoz. Foss., p. 89, 1850.

Corallum simple, tall, cylindrical. The epitheca is stout, with encircling lines, and broad, shallow annulations of growth. The calice is moderately deep, and the broad tabulæ form its floor. The corallum is 63 mm. in diameter. There are 78 primary, alternating with an equal number of minute secondary septa. The primary converge inwards from the wall $22\frac{1}{2}$ mm., and the secondary 1 mm., and denticulate. The septa are frequently interrupted by the lateral extension of a portion of the vesicula, and do not reach the wall. They are bilaminate, and stereoplasm occupies the interlamellar spaces, which are inclined inwards. The endothecal tissue is broad, elongate, and moderately convex; convexity inclined inwards and upwards. The tabulæ are numerous, broad, and inclined near their lateral margins; recurve and rest upon the inner extremity of the vesicular tissue. The fossula is large, extending to near the centre of the visceral chamber; the semicircular plates around the inner margin are the cut ends of the down-curved tabulæ, and form a more or less V-shaped termination, which, while alone due to the section exposing the cut margins of the depressed tabulæ, in the present communication will be shown to be of frequent occurrence;[1] a primary septum of shorter length extends into it. A portion of the septa are interrupted by two hemispherical cells. The tabulæ are less than a third of the total diameter in this species.

Development by ova, and therefore simple.

Length of corallum—it is frequently found from 12 to 15 inches in Ireland.

Formation.—Lower Carboniferous.

Locality.—Found in many localities in Ireland; the figured specimen had no locality indicated.

Plate XVI., fig. 6, agrees in all the essential details with the above; it differs by the slight modification of the fossula and the non-interruption of the septa, and by the enlarged vesiculæ; in other respects the structural details are so nearly alike that it can only be regarded as belonging to the same species, and that the slight difference in the structural details may be regarded as due to the environment of the shale; the latter was found embedded in the residuum of a fine impalpable mud, and more or less free from gritty matter, demonstrating that the environment did more or less influence modification.

Formation.—Lower Carboniferous.

Locality.—Peter's Hill, Bathgate, Linlithgowshire.

This is the only specimen I have found in Scotland that so closely agrees with the type that is so abundant in Ireland.

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[1] Although a similar termination to the fossula has been rashly accepted as of generic importance, such being simply due either to the local elevation or depression of the tabula, we cannot regard such alone as even of specific importance.

Campophyllum subfurcillatum, sp. nov.

[Pl. XVII., fig. 2.]

Corallum simple, cylindrical. The epitheca is thin, and there are irregular, shallow annulations of growth, and the septa are indicated through the thin epitheca. The calice is imperfect, one side being crushed in, and concealing the floor. The primary septa are delicate, and crenulate near the wall, and stout and bilaminate, and the interlamellar spaces are occupied by stereoplasm. The section is 39 mm. in diameter. There are 44 primary, alternating with an equal number of secondary septa; the former converge inwards 12 mm., and the secondary 5 mm.; thus the septa extend over—a little under two-thirds of the total diameter. The interseptal dissepiments are more or less rectangular on the dorsal, while on the ventral side they are somewhat angular, and subfurcate at their union with the periphery; at the inner endothecal ring they curve outward, and present a more or less scolloped aspect. The fossula is of moderate dimensions; one primary septum of shorter length than the others extends into it; the inner end of the septum is clasped on either side by bilaminate plates giving a somewhat cordiform aspect. The tabula in the central area is 12½ mm. between the inner ends of the septa.

Length of corallum (imperfect), 3½ inches; diameter fully 1½ inch.

Formation.—Lower Carboniferous.

Locality.—Found at Charlestown, Fifeshire, in the coralline band that is frequently found throughout the central valley of Scotland, which varies from eight to twenty feet above the basement marine limestone.

This species is readily distinguished by the greater extension of the secondary septa; the subfurcate interseptal dissepiments, at their union with the theca on the one side, and their rectangular condition on the other; the cordiform termination of the primary septum in the fossula; and the thin epitheca, through which the septa are indicated.

Campophyllum juddi, sp. nov.

[Pl. XVII., fig. 3.]

Corallum simple, cylindrical. The epitheca is thin; there are delicate, encircling lines, and irregular, broad, shallow annulations of growth. The calice is imperfect, deep, and thin around the lip. The septa are sinuous and thin near the wall, bilamellar and stout towards their inner extensions, and stereoplasm occupies their interlameller spaces. The diameter of the section is 60 mm. There are 54 primary, alternating with an equal number of secondary septa. The former converge inward 16 mm. and the latter 2 mm.; and the tabula between the inner ends of the primary septa is 30½ mm. in diameter, and is, therefore, fully a half of the total diameter of the corallum. The interseptal dissepiments are angular, and more or less festooned around the inner endotheeal ring, and lax towards the periphery. The fossula is small, and the cut margins of two of the tabulæ unite its walls, and a primary septum of shorter length than the others extends into it. The inner ends of the primary septa extend over, and rest upon the superior face of the tabulæ. The base of the corallum is concave.

Length of corallum, 3¼ inches.

Formation.—Lower Carboniferous.

Locality.—Found at Harelaw, Haddingtonshire, embedded in the thin beds of limestone, about 3 feet above the basement marine limestone of the system.

This species is distinguished by the limited number of the septa in proportion to its diameter, by their irregular stout form near the inner endothecal rings, and the secondary septa are longer in proportion than is found in the preceding. Upon the whole, the structural distinctions are of a very marked character, but which, if it had been defined by external aspect would have been classed as belonging to *Camp. gigantea.*

It gives me great pleasure to name it in honour of Prof. J. W. Judd, F.R.S., who has done so much to elucidate the characteristics of the igneous rocks of the west Highlands of Scotland.

Campophyllum laxicum, Thomson.

[Pl. XVII., fig. 4.]

Corallum simple, cylindrical, and oblong in outline; it is 41 mm. at the long, and 33 mm. at the narrow, axis. The epitheca is thin, and there are shallow annulations of growth. The septa are diffusiform, and bilaminate at their union with the inner endothecal ring, and stereoplasm occupies the interlamellar spaces. The primary septa converge inward 9½ mm., and the secondary septa are 1 mm. long. The interseptal dissepiments are sparse and lax, and the extension of the septa are interrupted by several enlarged vesicles on the one side, which do not reach the wall. The tabulæ between the inner ends of the septa are 21 mm. in the long, and 15 mm. in the narrow, axis, and thus the septa converge inwards fully less than a half of the total diameter. The fossula is moderately large, and a semicircular plate (the cut margin of a tabula) unites the septa that form its walls, and a primary septum of shorter length extends into it.

Length of specimen, imperfect.

Formation.—Carboniferous.

Locality.—There was no locality given with this specimen. The specimen is in the Collection of the Geological Survey of Ireland, Dublin.

This species differs from all the other species of the genus by the delicate difusiform primary septa, the minute secondary septa, and the lax interseptal vesiculæ.

Campophyllum dissimilis, sp. nov.

[Pl. XVII., fig. 5.]

Corallum simple, conical, and curved. The calice is shallow and everted round the margin. The tabulæ are slightly dome-formed in the centre, and a portion of the septa extended inwards to near the centre, whilst others stop short at various distances from the central area. The epitheca is thin, and there are broad annulations of growth. There are 44 primary, alternating with an equal number of secondary septa. The former are dissimilar in their inward extension, and the latter are 1 centimetre long. They are bilaminate, and stereoplasm occupies the interlamellar spaces. The secondary septa are only observed in a small part of the section on the dorsal side, in consequence of the decayed condition of the corallum. The fossula is large, and three of the primary septa of shorter length extend into it. The septa that form its walls are united near their inner ends by a series of convex plates inclined inwards. The interseptal dissepiments are angular, and near the periphery point outwards.

Length of corallum, 1½ inch; diameter of calice, 1 inch.

Formation.— Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in rotten shale, associated with *Lithostrotion junceum* and a large series of simple corals, about 50 feet above the basement marine limestone of the system.

This species is readily recognised by the dissimilar extension of the septa, the acute outwardly-angled interseptal dissepiments, and the broad zone of vesiculæ.

Campophyllum heteroseptum, sp. nov.

[Pl. xvii., fig. 7.]

Corallum simple, cylindro-conical, and curved. The calice is shallow, and thin around the periphery, and the tabulæ that form its floor are inclined down to the ventral side. The epitheca is thin; the septa are indicated through it; there are delicate crenulate encircling lines, and shallow annulations of growth. The primary septa are unusually irregular in their prolongation; they are 14 mm. long on the dorsal, and 5 mm. on the ventral side of the corallum. The section is 43 mm. in diameter. There are 46 primary, alternating with an equal number of secondary septa; the former are thin and sinuous near the wall, and bilaminate to near their inner extension; there they rest upon the tabulæ, and stereoplasm occupies the interlamellar spaces. The secondary septa extend inwards 3 mm., thus the total extension of the septa is 19 mm., leaving the tabulæ for 24 mm. open to view, or fully more than the half of the total diameter. The narrow zone of endothecal tissue is dense, and more or less furcate at the periphery on the ventral, and lax and somewhat rectangular on the dorsal side. The fossula is of moderate dimensions, and the septa that form its walls are united by three semicircular plates, which are the cut margins of three of the inclined tabulæ; a clavate primary septum of shorter length extends into the cut margin of the lower tabula.

Length of corallum, $3\frac{3}{4}$ inches; diameter of calice, $1\frac{3}{4}$ inch.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, in the gritty shale that overlies the Productus limestone.

This species is distinguished by the irregular extension of the septa, which induced me to cut the specimen at four different parts; in all the irregular prolongation was exposed, by which it can readily be distinguished.

Campophyllum furcatum, sp. nov.

[Pl. xvii., fig. 8.]

Corallum simple, cono-cylindrical, and slightly curved. The calice is broad, but imperfect. The epitheca is thin, and the outer end of the septa are indicated as ribs through the thin theca. The septa are delicate near the wall, sinuous, and bilaminate. The interlamellar spaces are occupied by stereoplasm, which extends inwards and downwards. The section is 56 mm. broad. There are 50 primary septa; these alternate with an equal number of secondary septa—the former are irregular in their extension; the intermediate are about 20 mm., and extend over fully two-thirds of the corallum; the latter are 2½ mm. The interseptal spaces are occupied by convex dissepiments till near the theca, where they are more or less dicotomose, and pointing outwards. The endothecal tissue is considerably broader on the dorsal side than it is upon the ventral side of the corallum. The fossula is moderately large, and two primary septa of shorter length than the others extend into it. The semicircular plates that unite its walls are the cut margins of the down-curved tabulæ. The tabulæ are irregular in width in consequence of the variable extension of the septa.

Length of corallum, 3 inches; diameter of calice, 2½ inches.

Formation.—Lower Carboniferous.

Locality.—Found at Cunningham-badland, Dalry, Ayrshire, in the shale that is interstratified with the thin beds of limestone, about 15 feet above the basement marine limestone of the system.

This elegant species is distinguished by characters of an unusually well-defined nature—the long sinuous and unequally prolonged septa, the broad zone of convex interseptal dissepiments, and the minute outwardly inclined dissepiments around the periphery separate it from all the other species of the genus; until sectioned, I regarded it as *Camp. gigantea*, but from the form and density of the interseptal dissepiments, and the absence of the laterally enlarged vesiculæ, it is precluded from being associated with that species.

Campophyllum rectangularum, sp. nov.

[Pl. XVIII., figs. 1 and 1*a*.]

Corallum simple, cylindrical, curved, and conical. The calice is moderately deep on the dorsal, and shallow on the ventral side, and the broad tabulæ form its floor. The epitheca is thin; there are delicate encircling lines, and shallow annulations of growth. The diameter of the corallum is 39 mm. There are 54 primary, alternating with an equal number of secondary septa. The former converge inward 12 mm., which at their inner ends, and for fully half of their total length, extend over the superior face of the tabulæ. The secondary septa are 3½ mm. long, and the interseptal spaces are occupied by rectangular dissepiments near the wall, and are more or less angular around the inner cycle of the endothecal tissue. The septa extend over two-thirds of the total diameter, and the tabulæ are sparse, and 30 mm. broad, between the peripheral vesiculæ, and there are occasional plates that unite the tabulæ and vesiculæ. The fossula is large, and semi-encircled by a series of the cut margins of the irregular disposed tabulæ; the inner two are sections of those that are wide apart, and those that enclose and unite the inner septa are the cut margins of those that are more dense. Fig. 1*a* shows the broad tabulæ, and their inclined margins. The vesicular tissue is variable in width, consisting of irregular convex cells, convexity pointing upwards and inwards, and arranged in oblique rows which are narrow on the ventral, and considerably broader on the dorsal side.

Length of corallum, 3¾ inches, diameter of section, 25 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the bed of shale that is interstratified with the thin beds of limestone, which are about 50 feet above the basement marine limestone of the system.

This species is distinguished by the rectangular dissepiments, the broad and irregularly disposed tabulæ, the occasional interposed plates, uniting the lateral margins of the tabulæ to the vesiculæ—thus indicating the development of the triareal arrangements of the structural details. The large fossula, fig. 9, I regard as a young specimen of the same species.

Campophyllum dendriformum, sp. nov.

[Pl. xviii., figs. 3 and 3*a*.]

Corallum simple, and curved. The calice is shallow and slightly everted, and the tabulæ form its floor. The epitheca is thin; there are crenulate encircling lines and deep annulations of growth. The diameter of the section is 24 mm. There are 37 primary and an equal number of secondary septa. The former converge inward 7½ mm., and the latter are fully 2 mm. long. Thus the septa extend over nearly three-fifths of the total diameter. The tabulæ between the inner ends of the septa are 10 mm., or a little less than the half of the total diameter. The septa are bilaminate, and stereoplasm occupies the interlamellar spaces, which are inclined inwards and downwards. The interseptal spaces are occupied by dissepiments, which, near the inner endothecal ring, are more or less bifurcate, giving the outer area of the septa a more or less dendriform aspect. The fossula is obscure, and one septum, slightly shorter than the others, extends into it. Fig. 3*a* shows the irregularly disposed tabulæ and the interlocular plates that unite the tabulæ and the vesicular tissue; the latter are more fully developed than I have found in any other species of the genus. These interlocular plates are always present in the more highly developed forms, and thus indicating clearly the inherent tendency to evolve from the simple to the more highly developed groups. The zone of vesiculæ is narrow, lax, and convex; convexity pointing upwards and arranged in oblique rows.

Length of corallum, 26 mm.; diameter of calice, 21 mm.

Formation.—Lower Carboniferous.

Locality.—Found in the coralline zone, about 50 feet above the basement marine limestone, at Brockley, Lesmahagow, Lanarkshire.

This species is distinguished by the interrupted extension of the tabulæ, by the zone of interlocular plates, uniting the tabulæ and vesiculæ in the peripheral zone, the dendriform aspect of the septa near the wall, and the narrow zone of vesiculæ.

Figs. 5 and 5*a* I regard as the young of this species, showing the development of structural details from near the base of the corallum.

Campophyllum amplexicum, sp. nov.

[Pl. XVIII., fig. 4.]

Corallum simple, cylindro-conical, and twisted. The calice is shallow, and contracted from external influences. The epitheca is thin; there are delicate, crenulate encircling lines, and broad, shallow annulations of growth. The base is concave. The corallum is 38½ mm. in diameter. There are 46 primary septa, and an equal number of secondary septa; the former are delicate near the wall, and moderately stout towards their inner extension. They are bilaminate, and stereoplasm occupies the interlamellar spaces. The septa extend inward, 17 mm. on the dorsal, and 8½ mm. on the ventral side, and the secondary septa are 1½ mm. long; thus the former extend over fully a-half of the total diameter; and the tabulæ are 22½ mm. at the broadest and 17 mm. at the narrowest diameter. The interseptal spaces are occupied by angular endothecal tissue. The fossula is small, and one septum of shorter length extends into it, which at its inner extremity is enlarged and bipartite, and embraced by a semicircular plate, giving the termination an amplexical aspect.

Length of corallum, 5 inches; diameter of section, fully 1½ inch.

Formation.—Lower Carboniferous.

Locality.—Found at Charlestown, Fifeshire, in the coralline band. which is about 10 feet above the basement marine limestone.

This species is distinguished by the broad, dense vesiculæ, the minute secondary septa, and the amplexical termination of the septum in the fossula, and, upon the whole, the structural details are intermediate between figs. 2 and 7 of Plate XVII.

Campophyllum subclavaformis, sp. nov.

[Pl. XVIII., fig. 6.]

Corallum simple, cylindro-conical. The epitheca is thin; there are encircling lines, and irregular, broad, shallow annulations of growth. The calice is imperfect, moderately deep, and the floor is occupied by the tabulæ. The corallum is 28 mm. in diameter. There are 39 primary, and an equal number of minute secondary septa; the former are 7 mm. long, and the latter 1 centimetre; thus the septa extend over about half of the total diameter, and the tabulæ are 13 mm. between the inner ends of the septa. The septa are bilaminate, and stereoplasm occupies the interlamellar spaces. The interseptal spaces are occupied by irregularly disposed dissepiments. The fossula is small, and a septum slightly shorter than the others extends into it.

Length of corallum, 3 inches; diameter of calice, $\frac{3}{4}$ inch; diameter of section, $1\frac{1}{8}$ inch. The superior extremity has been exposed during growth to a hard foreign body; it is crushed to the one side.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in a coralline band, about a hundred feet above the basement marine limestone.

This species is readily distinguished from all the preceding by the diminutive fossula, the subclavate septa, and the broad zone of lax vesiculæ.

Campophyllum mammilatum, sp. nov.

[Pl. XVIII., fig. 7.]

Corallum simple, cylindro-conical, and curved. The calice is imperfect. The epitheca is thin; there are crenulate encircling lines, and irregular, shallow annulations of growth. The septa are delicate for fully a third of their total length from the theca, and bilamellar inwards; and the interlamellar spaces are occupied by stereoplasm. The section is 36 mms. in diameter. There are 56 primary alternating with an equal number of secondary septa; the former, converge inwards $11\frac{1}{2}$ mm., and the latter 6 mm., and stop short 4 mm. from the inner endothecal ring. The septa are nearly all intercepted by a zone of the cut edges of a system of mammiliform tissue that environs the periphery, resembling the mammillæ that environ the lip of the calices of the genus "Thysanophyllum" (Nich. & Thom.). The endothecal tissue is irregularly disposed, and more limited in width and number than is developed in the majority of allied species found in the same locality. Here and there the septa are temporarily intercepted in the median zone by enlarged vesiculæ. The tabulæ are broad, and the septa impinge upon their superior face for fully a third of their total length. The fossula is of moderate dimensions, and two of the primary septa of shorter length than the others pass into it; and the two septa that form its walls are united by a triangular plate.

Length of corallum, $4\frac{3}{4}$ inches; diameter of calice, $1\frac{1}{2}$ inch.

Formation.—Lower Carboniferous.

Locality.—Found in the coralline band, about 10 feet above the basement marine limestone, Charlestown, Fifeshire.

This interesting and elegant species is recognised by the zone of of mammiliform tissue that environs the periphery, the broad tabulæ, and limited interseptal dissepiments, and indicates that the tentacular crown of the polyp was circumscribed to the median area, with mammillæ around the periphery.

Campophyllum supraphyllum, sp. nov.

[Pl. XVIII., figs. 8 and 8*a*.]

Corallum simple, cylindrical, and curved. The calice is deep. The epitheca is thin. There are delicate encircling lines, and broad, deep annulations of growth. The delicate theca bend round, and thus expose the septa as longitudinal ribs. The septa are considerably raised above the lateral margins of the deep curved tabulæ; they then bend down and become incorporated with the tabulæ at their inner extremities. The primary septa are moderately long and bilaminate, and the interlamellar spaces are occupied by stereoplasm, which is inclined downwards and inwards (fig. 8*a*, *b*). There are forty-two primary, alternating with an equal number of secondary septa; the former extend inwards 10 mm., and the latter $3\frac{1}{2}$ mm. The diameter of the corallum is 41 mm.; thus the septa extend inwards a little under the half of the total diameter. The interseptal dissepiments are more or less rectangular around the periphery, and irregular and angular near the inner endothecal ring. The fossula is large, and extends to near the centre of the visceral cavity; and three of the cut edges of irregular exposed tabulæ curve round and form its inner margin. In the longitudinal section (fig. 8*a*), the tabulæ are irregularly disposed, and curve down at the lateral margins. A system of plates is shown to extend from the inner ends of the interseptal loculi, and thus unite the vesiculæ to the tabulæ. The endothecal tissue is moderately broad, and exposed in irregular elongated convex cells, convexity inwards and upwards, and arranged in oblique rows.

Length of corallum, 4½ inches; diameter of calice, 42 mm.

Formation.—Lower Carboniferous.

Locality.—Found at Peter's Hill, Bathgate, Linlithgowshire, imbedded in the bed of shale that overlies the basement marine limestone.

This species shows a distinctly marked difference from the preceding species; the vesiculæ are less dense; and by the form and arrangement of the tabulæ, and further by the presence of a system of plates extending from the inner margin of the interloculæ, and to rest upon the tabulæ; thus showing the earlier condition of the triareal structural character found in more highly organized forms. Fig. 8*a*, *b* show a small portion of the stereoplasm that occupies the interlamellar spaces of the septa.

Campophyllum turbinatum, sp. nov.

[Pl. XVIII., fig. 10.]

Corallum simple, short, and acutely turbinate. The calice is imperfect. The epitheca is thin. There are encircling lines and shallow annulations of growth. The diameter of this corallum is 41 mm. There are fifty-three primary alternating with an equal number of secondary septa. The former are thin and sinuous near the theca, and bilamellar inwards, and stereoplasm occupies the interlamellar spaces. The primary septa converge inwards 15½ mm., and the secondary 8 mm. The extension of the septa are interrupted, and do not reach the theca by a zone of minute vesicles. These are the cut edges of a system of mammilations that environ the periphery; and here and there on the dorsal side the septa are interrupted in the intermediate area by enlarged vesiculæ. The interseptal dissepiments are dense on the ventral, and irregular and less dense on the dorsal side, and more or less angular and festooned around the inner endothecal ring. There are several curved plates which are shown extending from the inner ends of the septa and impinging upon the tabulæ. These we believe to be the cut edges of irregularly disposed tabulæ. The fossula is moderately large, and two of the primary septa of shorter length than the others pass into it. The primary septa which form its walls are united at their inner ends by a concave plate. The tabulæ are circumscribed in the central area, and the inner ends of the primary septa rest upon them.

Length of corallum, 1½ inch ; diameter of calice, 2¼ inches.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire.

This elegant species is distinguished by the limited tabulæ in the centre of the visceral chamber, and by the zone of vesiculæ that intercepts the extension of the septa to the periphery, and by the form and arrangement of the interseptal dissepiment.

Campophyllum concaveum, sp. nov.

[Pl. xix., figs. 1 and 14.]

Corallum simple, conical, and curved. The calice is imperfect, and the corallum is much contracted near the superior extremity, and deeply concave at the inferior extremity. The epitheca is thin. There are delicate encircling lines, and deep, irregular annulations of growth. The septa are thin near the wall, and bilaminate inwards ; and stereoplasm occupies the interlamellar spaces. Where sectioned, the corallum is 36 mm. in diameter, as will be observed in the longitudinal section. It is considerably broader a little nearer the base, and the annular growth rings are shown in the arrangement of vesiculæ. There are seventy-seven primary septa, alternating with an equal number of secondary septa. The former are withered and melted away on the ventral side. When complete these are 10 mm., and the latter are 4 mm. long. Thus the septa extend over nearly two-thirds of the total diameter. The interseptal spaces are occupied by rectangular dissepiments, which are dense near the wall and inwards to the endothecal ring. There, and inwards, they are less dense and irregularly disposed. Those near the inner ends of the septa are the cut margins of the system of plates that unite the vesiculæ with the tabulæ. The tabulæ are irregular, and near the base are deeply convex. Here and there are shown minute longitudinal plates which interrupt the extension of the tabulæ ; these in no instance have we observed bisecting the broad tabulæ. The vesiculæ are here and there unusually broad, while in other parts they are considerably less developed, corresponding with the deep, irregular growth rings. The fossula is small, and a V-shaped plate unites its walls. This unusual termination of the fossula I conceive is due to the cut margins of two of the intermediate plates that unite the vesiculæ with the tabulæ.

Length of corallum imperfect; the specimen is $2\frac{3}{4}$ inches; the diameter is $1\frac{3}{16}$ inch.

Formation.—Lower Carboniferous.

Locality.—Found at Broadstone, Beith, Ayrshire, imbedded in a band of fine soft shale, about 8 feet above the basement marine limestone.

This specimen being curved and twisted, and the longitudinal section being cut along the plain of curvature, and thus exposing the bilamellar septa and the interlamellar stereoplasm in a number of the septa which are shown more or less bisecting the vesiculæ, renders this specimen unusually interesting. The irregularly developed vesiculæ, the irregular growth ring, and the deep concave base indicate the interrupting influences of the environment. The frequent occurrence of the minute longitudinal plates and the occurrence of the system of plates that connect the vesiculæ with the tabulæ, indicate the inherent tendency to variation. Upon the whole this species is not only distinct in specific detail, but presents structural variation of an exceedingly instructive character.

Campophyllum marginatum, sp. nov.

[Pl. XIX., figs. 4, 3, and 3*a*.]

Corallum imperfect, compound; the lower extremity is wanting, and I am therefore unable to define its external aspect. Reproduction by ova and fission; and the earlier stage of fission is shown where the corallum is incurved; there, two of the larger septa are shown converging toward the centre from opposite sides, which, when further developed, would ultimately unite at the axes, when septa are formed on either side, and thus the divisional ridge separates the corallum into two portions, and each grows as individual corallites and so forms a compound community. The epitheca is stout; there are crenulate lines and shallow annulations of growth. The calice is deep, and the tabulæ extended to near the wall. The septa are variable, and limited in their inward extension; the intermediate are 5 mm. long; these are delicate near the wall, and bilamellar towards the inner ends, and the interlamellar spaces are occupied by stereoplasm. The secondary septa extend inwards 2 mm. at the broad, and 1 mm. where the endothecal tissue is narrowest. The interseptal dissepiments are sparse and rectangular. A fossula is present, and three of the primary septa, of shorter length, extend into it.

Length of corallum, imperfect.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, embedded in the gritty shale that overlies the Productus limestone.

I believe figs. 3 and 3*a* belong to the same species. The marginal character of the septa and endothecal tissue are shown both in the transverse and longitudinal sections, and the broad tabulæ are exposed extending to near the theca. In 3, the extension of the septa are interrupted by enlarged vesiculæ, and 3*a* shows the concave base. Upon the whole, while there is a seeming difference in the structural details of this and fig. 4, yet I am inclined to regard the slightly different character of the details as being due to the environment.

Campophyllum interruptum, Thom. and Nich.

[Pl. XIX., figs. 5, 5*a*.]

Corallum simple and turbinate. The epitheca is thin; there are encircling lines and broad shallow annulations of growth. The calice is imperfect. The primary septa are delicate in the outer zone, and stout and bilaminate near the inner ends; and the interlamellar spaces are occupied by stereoplasm, which are inclined inwards and downwards. The section is 28 mm. in diameter. There are 44 primary; these alternate with an equal number of secondary septa; the former converge inwards 9 mm. and the latter 4½ mm.; thus, the septa extend over about two-thirds of the total diameter, and the interseptal spaces are occupied by irregularly-disposed interseptal dissepiments; there are frequently enlarged vesicles that intercept the septa. In the longitudinal section the tabulæ are interrupted by an irregular discontinuous columella near the centre, which is absent at the base, and near the superior extremity, indicating not only the inherent tendency to variation, but also modification induced by the condition of the environment. The vesiculæ are numerous near the superior, and sparse towards the lower extremity; these intercept the tabulæ from reaching the wall. The fossula is small, and one primary septum of shorter length extends into it.

Length of corallum, 1½ inch; diameter of imperfect calice, 1¼ inch.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, near Lesmahagow, Lanarkshire, in a dark calcareous shale, about 50 feet above the Productus limestone.

This remarkable species was described by Professor Nicholson and Thomson, in the "Proceedings of the Phil. Soc. of Glasgow," as *Koninckophyllum interruptum*, from the presence of the discontinuous columella. When that communication was published we had not satisfied ourselves of the diversified character of the "Campophyllidæ." Subsequent investigations have shown the close alliance of the two genera, and although this species shows a near affinity to the "Koninckophyllidæ," yet the "Campophyllidæ" characters predominate, and I therefore believe that, while it may be regarded as belonging to the latter, its polymorphic character places it as an intermediate form.

Campophyllum parricida, M'Coy.

[Pl. xix., figs. 6 and 7.]

Corallum compound, cylindri-conical, and curved. The reproduction is by ova in the initial stage, and may also be by calicular, latero-calicular gemmation, and by fission. In the group, fig. 6, there are shown the three modes of development in the one slab, all of which originated from a simple corallum. Fig. 6 *d* shows in transverse section latero-calicular gemmation; 7 *a* shows the same in longitudinal section; it and 6 *b*, and 6 *d*, show calicular gemmation in different stages, and 7 *a* shows the same in a longitudinal section; while fig. 7 shows the external aspect of a corallum crowned with nine young corallites, demonstrating that the life of the young is fatal to that of the parent. Fig. 6 *c* shows the different stages of fissiparous gemmation. The calice is deep, and its floor is occupied by more or less rectangular tabulæ. The epitheca is thin; there are encircling lines and shallow annulations of growth. The septa are delicate near the theca, and bilamellar inwards; and stereoplasm occupies the interlamellar spaces, which extend inwards and downwards. In a corallum 15½ mm. in diameter there are 43 primary, alternating with an equal number of secondary septa; the former converge inwards 5 mm. and the latter 2½ mm. The interseptal dissepiments are rectangular and dense. A system of irregularly disposed plates unites the vesiculæ with the tabulæ. In this species these are developed from the inferior to the superior extremity of the corallum; thus the initial condition of the triareal structural details is more or less continuous. In the longitudinal section 7*a* the tabulæ are shown to occupy fully a third of the total diameter of the corallum, and their union with the plates that extend from the vesiculæ is shown. The vesiculæ around the periphery are dense and convex, inwards and upwards. The fossula is large, and one septum of shorter length extends into it.

Length of corallum variable. I have single specimens 3 inches long. The diameter is 8 lines, while in some localities they are found not only single, but also in dense compound communities.

Formation.—Lower Carboniferous.

Localities.—Found at Brockley, Lesmahagow, Lanarkshire; Broadstone, Beith, Asheyburn, Muirkirk, Ayrshire, and many other localities throughout Scotland.

From the above it will be apparent that Edwards and Haime's belief that this species could not be retained as belonging to the genus "Cyathophyllum" is well founded; that its classificatory position proper is in the "Campophyllidæ." It will also be seen that all the different modes of development are represented in one group, demonstrating that neither generic nor specific distinction can alone be defined upon calicular, latero-calicular, or fissiparous gemmation, and further show that external aspects cannot be relied upon for diagnostic purposes.

Campophyllum echinatum, Thomson.

[Pl. XIX., figs. 8 and 8*a*.]

Corallum simple and compound, cylindro-conical and slightly curved. The epitheca is thin; there are delicate encircling lines and shallow annulations of growth. The calice is moderately deep, and the tabulæ are slightly raised in the central area, and curve downwards at the lateral margins. The septa are numerous, and bilamellar in the centre; and the interlamellar spaces are occupied by stereoplasm, which are inclined downwards and outwards in the outer area, and at their inner ends they are delicate and single. The corallum is 14 mm. in diameter, and there are 40 primary and an equal number of secondary septa; the former converge inwards $4\frac{1}{2}$ mm. and the latter 3 mm.; thus the septa extend over about two-thirds of the total diameter, and the interseptal spaces are occupied by rectangular dissepiments, which are dense in the outer zone and sparse in the inner area. Along the lateral margin of each septum there are a series of minute spines, from which I take the specific name. In the longitudinal section the central area exposes the cut edges of the tabulæ, while in the intermediate (interlocular) area are developed a series of concave plates; these unite the dense vesiculæ of the outer interseptal area to the tabulæ, and are therefore triareal. The peripheral vesiculæ are convex, convexity pointing inwards and upwards, and arranged in oblique rows. The fossula is small, and one of the primary septa of shorter length than the others passes into it.

Length of corallum, 1 inch 9 lines; diameter of calice, 8 lines.

Formation.—Lower Carboniferous.

Locality.—Found in the upper reaches of the Ponneil water, at Brockley, Lesmahagow, Lanarkshire, in a bed of cream-coloured concretionary limestone, the position of which varies much throughout Scotland, but always below the bed of calcareous shale that underlies the basement bed of economic limestone, and has been frequently recorded as the passage beds, between the Lower Carboniferous and the upper Old Red Sandstone series. This is the only instance in which I have found organic remains in this cream-coloured concretionary limestone. The species is also found at Gatesid, near Beith, Ayrshire.

This species I separated from *Camp. parricida* (fig. 7, Trans. Phil. Soc. of Glasgow, 1880), from the presence of the minute spines along the lateral margins of the septa, and by the interlamellar plates (stereoplasm) extending downwards and outwards, whilst in *Camp. parricida* the septa are not echinophorus, and the interlamellar plates are inclined downwards and inwards; and by the triareal arrangement of the structural details, characters which separate the species by a minute, but of an extremely interesting morphological significance. Indeed, the difference being so marked induced a suggestion of there being a generic distinction. Such, however, I could not accept, and can only regard such as being specifically distinct.

Campophyllum asheyburnensi, sp. nov.

[Pl. xx., fig. 1.]

This, and a portion of the following sections, are selected from a large mass I had cut into thin slices, in order to trace, in the different sections, how far I could identify specific distinction in the different stages of growth. Those figured from the same mass are the progeny of a simple corallum, which by calicular gemmation increased into a mass of gigantic dimensions. I am, therefore, unable to define the character of the calice, theca, or external aspects. I can only note the number and character of the septa, the endothecal tissue, and see how far each differ in their relative proportions.

Fig. 1 is a section of one of the largest forms in the compound community. It is 42 mm. at the narrowest, and 46 mm. at the broadest. There are 55 primary, alternating with an equal number of secondary septa; the former converge inwards 15½ mm. and the latter 12 mm.; these curve, and unite with the primary septa at the inner endothecal ring. The endothecal tissue is irregularly disposed, and a portion of it is frequently of larger dimensions; these intercept the continuity of the septa. Here and there the septa do not reach the wall, in consequence of the development of an occasional zone of the cut edges of peripheral mammillar tissue. The septa are bilamellar, and the interlamellar spaces are occupied with stereoplasm. The fossula is of moderate dimensions, and three primary septa, of shorter length than the others, extend into it. Here and there a portion of the septa are absorbed by a parasite (*b*), which I believe to be a Nullipore; there is also a space in which there is a sponge-like body (*a*). The obliteration of the sclerodermic matter by such parasites has been long known to me, and I now record their presence. These will have my attention by-and-by.

Formation.—Lower Carboniferous.

Locality.—Found at Asheyburn, Muirkirk, Ayrshire, in a bed of shale that overlies the lowest bed of economic limestone. The mass was pyriform, about four feet deep and about three feet broad.

Fig. 2 represents another section from the same mass; it is 39 mm. in diameter; there are 51 primary septa alternating with an equal number of secondary septa; the former are bilamellar; the interlamellar spaces are occupied with stereoplasm; the former septa converge inwards from the theca 15½ mm., and the latter 10 mm., and extend over four-fifths of the total diameter; the endothecal tissue is more dense, and the septa are more numerous in the proportionate diameter than the preceding; the fossula is narrower, but extends further inwards; there is only one primary septum, of shorter length than the others, extending into it, and five of the cut margins of the down-curved tabulæ unite its walls.

Fig. 4 is another section from the same slab; the diameter is 31 mm.; the septa are slightly sinuous and thin for fully half their length; stout and bilamellar inward, and stereoplasm occupies the interlamellar spaces; there are 43 primary alternating with an equal number of secondary septa; the former converge inwards from the theca 12 mm., and the latter 8½ mm., and unite with the primary at the inner endothecal ring. The endothecal tissue is less dense than the preceding, and a portion of the septa are interrupted; the fossula is large, and a primary septum of shorter length than the others extends into it. The structural details are slightly dissimilar from either of the preceding. Figs. 7, 8, 9, 10, and 11 represent a series of young corallites imprinted from the calices of contiguous corallites in the same slab; in all, the secondary septa extend to the inner endothecal ring as in the preceding. The endothecal tissue is more or less rectangular; and in each there are various modifications in the structural details, some of which are more marked than others.

Fig. 12 is a variety of the same; it is, however, from a section of strata of a more gritty character, and from a horizon a little higher in the system.

Fig. 13 shows the development of the septa and the endothecal tissue in the initial stage of secretion, and shows the character and relation of these to the broad tabulæ in those forms that are concave at the inferior extremity of the corallum. In order that we may further trace these modifications we shall notice other and more complex variations, and hope to show how varied are the modifications that are found in the offspring of a primary simple corallum as demonstrated in this series.

Campophyllum (?), sp. nov.

[Pl. xx., fig. 3.]

Corallum simple, cylindro-conical, curved, and irregular in outline; the calice is shallow and imperfect; the epitheca is stout; there are delicate encircling lines, and irregular, deep annulations of growth. The section is 37 mm. at its greatest width; there are 56 primary alternating with an equal number of secondary septa; the former converge inwards 13 mm. on the ventral, and 7 mm. on the dorsal side; and the latter are 3 mm. on the dorsal, and 8 mm. on the ventral side; thus the septa extend a little over two-thirds of the total diameter; they are irregular at their inner extremities, and bilamellar; stereoplasm occupies the interlamellar spaces. The interseptal dissepiments are more or less angular, and inclined outwards; there are breaks in the continuity of a few of the septa by the lateral extension of some of the dissepiments. The tabulæ are dense, and are 13 mm. broad between the inner ends of the primary septa; the fossula is moderate in size, and two primary septa of shorter length than the others extend into it, and the septa that form its walls are united by the cut margins of five of the dense tabulæ.

Length of corallum, 3 inches; diameter of calice, 1½ inch.

Formation—Lower Carboniferous.

Locality—Found at Charlestown, Fifeshire, in the coralline band of impure limestone, which is about 18 inches thick and about 10 feet above the basement marine limestone of the series. This species is distinguished from the preceding by the septa being more limited, by the tabulæ being more dense, and considerably broader in the centre of the visceral chamber, and the prolongation of a portion of the primary septa at their inner extremities, thus indicating an inherent tendency to modification. These distinctions seem not sufficiently pronounced to warrant a specific distinction.

Campophyllum submammillatum, sp. nov.

[Pl. xx., fig. 5.]

Corallum simple, cylindro-conical, and curved; the calice is moderately deep and thin around the lip; the epitheca is stout; there are minute encircling lines and irregular and shallow annulations of growth. The corallum is 27 mm. in diameter; there are 43 primary and an equal number of secondary septa; these are thin and flexuous for a third of their total length inwards from the periphery, and bilamellar inward. The interlamellar spaces are occupied with stereoplasm; the former converge inwards 10½ mm. on the dorsal and 6½ mm. on the ventral side, and the latter extend inwards 6 mm. on the dorsal and 3 mm. on the ventral side; here and there a portion of the primary septa are prolonged further inwards than the others. The tabulæ are broad and open to view in the centre, and the primary septa are considerably prolonged over the superior face; the interseptal dissepiments are sparse, and more or less rectangular on the dorsal; dense and angular, and near the theca point outwards on the ventral side of the corallum; a portion of the septa are interrupted in the median area on the dorsal side by enlarged vesiculæ; the fossula is broad and shallow, and two of the primary septa of shorter length pass into it; several of the cut margins of the tabulæ form a semicircle, uniting its walls at its inner extremity.

Length of corallum, 2½ inches; diameter of calice, 1¼ inch.

Formation—Lower Carboniferous.

Locality—Found in a band of coral remains fully 18 inches thick, about 10 feet above the basement marine limestone at Charlestown, Fifeshire.

This species is distinguished by the broad tabulæ and the prolonged extension of the primary septa over the face of the tabulæ by the extension of the septa to the wall on the dorsal side, and the interception of the septa on the ventral side, which shows a semi-mammilated aspect around the lips of the calice, and the prolongation of a portion of the septa over the tabulæ.

Campophyllum radiolarum, sp. nov.

[Pl. xx., fig. 6.]

Corallum compound. This species is one of the sections from the large mass; the section is 25 mm. in diameter; there are 40 primary alternating with an equal number of secondary septa; the former are variable in their inward extension; the intermediate converge inwards $9\frac{1}{2}$ mm. and the secondary 7 mm., and unite with the primary septa at the inner endothecal ring; a few of the septa are interrupted by enlarged vesiculæ; they are bilaminate for two-thirds of their length, and stereoplasm occupies the interlamellar spaces; the interseptal dissepiments are dense, and variously angled for a third of the diameter, and less dense, and rectangular around the remaining portion of the section. A portion of the septa converge along the superior face of the tabulæ to the centre, and there unite with radia from the opposite side, inducing us to regard that variation from the type condition as being due to the inherent tendency to modification, and to indicate a tendency to merge into other generic conditions. The fossula is small, and one septum of shorter length than the others passes into it.

It will be observed that at *b* a portion of the sclerodermic matter is absorbed by a parasite which we believe to be a Nullipore that, as formerly stated, is under consideration.

Formation—Lower Carboniferous.

Locality—Asheyburn, Muirkirk, Ayrshire, and one of the sections selected from the pyriform mass of limestone found imbedded in and at the base of the compact shale which overlies the basement marine limestone of the system.

Campophyllum dendriformum, sp. nov.

[Pl. xx., figs. 14 and 14 *a*.]

Corallum simple, cylindro-conical, and curved. The calice is shallow, and oval in outline; the epitheca is delicate; there are crenulate encircling lines and irregular annulations of growth; the septa are irregular in their extension inwards; they are dendriform, and of shorter length on the ventral side, and of much greater length on the dorsal side; they are thin, bifurcate, and crenulate near the wall, and stout, and bilamellar inwards; the interlamellar spaces are occupied by stereoplasm, which converges inwards and downwards. The section is 32 mm. at the narrowest, and 37 mm. at the broadest part; there are 51 primary, alternating with an equal number of secondary septa; the former are 8 mm. on the ventral, and 14 mm. long on the dorsal side, and the latter converge inwards $3\frac{1}{2}$ mm. on the dorsal, and 9 mm. on the ventral side, and unite with the primary at the inner endothecal ring; thus the septa extend over fully two-thirds of the total diameter. The interseptal dissepiments are lax on the dorsal, and dense on the ventral side, and the extension of the septa are frequently interrupted by enlarged vesiculæ. In the inner interseptal spaces there are numerous transverse plates; these are the cut margins of the sharply down-curved tabulæ; a portion of the septa extends further inwards than the others, and are laterally united by irregularly-disposed plates. The fossula is large, and extends considerably inwards towards the centre of the visceral chamber; and the septa that form its walls are united by a conical plate which indicates a sharply-inclined depression in the centre, and the elongated semi-encircling plate is the cut margin of the deeply inclined tabulæ. The tabulæ are irregularly disposed, and curve sharply down at their lateral margins, recurve, and pass to the peripheral vesiculæ, and thus form a broad groove round the inner ends of the septa. There are several indications of the inherent tendency to modification: first, fig. 14, the prolongation of a portion of the septa; and, as shown in fig. 14 *a*, *b*, they bisect the lateral margins of the tabulæ, and only impinge on the superior face of the tabulæ at their termination; by this modification the bilamellar septa, with the interlamellar stereoplasm, are exposed in consequence of the curvature of the corallum, and thus the longitudinal section being slightly oblique, the above modifications and the interlamellar stereoplasm are shown. Upon the whole, this species exemplifies that there is no finality in the form and arrangement of the structural details;

that there is a constant and persistent modification in all the different parts of the corallum, which has not been recorded before. Fig. 14*b* is a small portion of the parasite formerly referred to.

Length of corallum, 2½ inches.

Formation.—Lower Carboniferous.

Locality.—Found at Howret, Dalry, Ayrshire, in the bed of shale, about 8 feet above the basement marine limestone.

Campophyllum eleganteum, sp. nov.

[Pl. xx., fig. 15.]

Corallum simple, turbinate, and concave at the base. The epitheca is nodo-crenulate, and there are broad and shallow annulations of growth; the calice is deep, and everted for a fourth of the total diameter; and the septa at their inner ends are sharply inclined into the deep calice; the septa are bilamellar, and the interlamellar spaces are occupied by stereoplasm which is inclined inwards and downwards; the corallum is 50 mm. in diameter; there are 59 primary, alternating with an equal number of secondary septa; the former converge inwards 17½ mm., and the latter 13 mm.; thus the septa extend over the corallum fully five-eighths of the total diameter. The interseptal dissepiments are variable in their form and size; some are acutely angular, and unite in the centre of the loculi, and are thus connate; others are rectangular, slightly curved, and inclined inwards and downwards. The tabulæ are slightly elevated towards the centre of the visceral chamber, and a number of the septa recurve at their inner ends, and impinge upon the tabulæ. The fossula is large, and extends to near the centre, and three of the primary septa, of shorter length than the others, pass into it. Near its inner margin there are a series of irregularly disposed semicircular plates which unite the septa that form its walls; these are the cut margins of the upwardly inclined tabulæ.

Length of corallum, 1½ inch; diameter of calice, 2⅜ inches.

Formation.—Lower Carboniferous.

Locality.—The precise locality I am unable to give, but from the colour and matrix I am disposed to believe that it is from Corrieburn, near Kilsyth, Dunbartonshire.

This elegant and unique species is readily distinguished by structural details of an unusual character; in it there is demonstrated a tendency to variation in a marked degree. Indeed so much so that genera have been founded on structural differences of a less marked character; meanwhile I can only regard it as a distinct species with an extensive series of variable forms, for which I am indebted to Mrs. James Smith, Lugar, Ayrshire, a careful naturalist: to her I offer my cordial thanks for allowing me to add so remarkable a species to the fauna of the Carboniferous system.

At letter *b* it will be observed that a large portion of the septa and interseptal dissepiments have been absorbed, and replaced by a parasite which I conceive to be a Nullipore, probably *Null. carbonarius*; and at *a* there is represented a sponge-like body. As before stated the investigation of these and other parasitic bodies will have my early attention.

Campophyllum agassizi, sp. nov.

[Pl. xxi., fig. 1.]

This elegant species is exposed in several sections, near the base of the large mass of limestone, formerly referred to. It is one of the corallites developed from the parent corallum of the group, and is therefore compound; it is irregular and elongate in outline; it is 52 mm. at the longest, and 22 mm. at the narrowest diameter. At the latter the septa are deflected, and the endothecal tissue is considerably more minute than is shown in any other part of the section. The septa are stout, and rest upon the tabulæ near their inner ends, and more or less crenulate outwards to the periphery. They are bilamellar for three-fourths of their total length, and delicate outwards, and stereoplasm occupies the interlamellar spaces. There are 60 primary, alternating with an equal number of secondary septa; the former converge 19 mm. at the broadest, and 7 mm, at the narrowest; and the latter are 14 mm. long, and 6 mm., alternating with the primary. For seven-eighths of the total circumference the septa are intercepted by minute outwardly inclined vesicles *b*; these are the cut margins of a zone of mammilar tissue that environ the periphery, which is more dense on one side, and at *a* septa they extend to the periphery. There are a small series of irregularly disposed plates, developed in the superior face of the tabulæ, in the centre of the visceral chamber. The fossula is large, and two of the primary septa of shorter length than the others extend into it. In consequence of this corallum being embedded in the mass of limestone, I am unable to define its external aspects.

Formation.—Lower Carboniferous.

Locality.—Found at Asheyburn, Muirkirk, Ayrshire, embedded in compact shale, which overlies the basement marine limestone of the system.

This species is distinguished by characters of an unusually pronounced nature: the interception of the septa from reaching the periphery by the zone of mammilæ for seven-eighths of the total diameter; the irregular form and deflected septa; the development of the irregular plates in the centre of the visceral chamber; the increased length of the secondary septa; and the enlarged zone of vesiculæ. It gives me great pleasure in naming it in honour of Prof. Alex. Agassiz, the distinguished American naturalist, who has contributed so largely to our knowledge of the coral reefs of Florida, and other kindred departments of Natural History.

Campophyllum domiformum, sp. nov.

[Pl. xxi., figs. 2 and 2a.]

Corallum, simple, conical, and curved. The calice is imperfect. The epitheca is thin; there are encircling lines, and broad, shallow annulations of growth. The septa are thin and crenulate for half their total length from the wall, and bilamellar inward. The interlamellar spaces are occupied by stereoplasm. The corallum is 24 mm. in diameter. There are 44 primary septa alternating with an equal number of secondary septa—the former converge inwards 8 mm., and the latter 4 mm., thus the septa extend over two-thirds of the total diameter. The interseptal dissepiments are dense. The prolongation of the septa are intersepted (2 *b*) by a zone of vesiculæ; these point outward; these are the cut margins of mammillæ that surround the periphery on the dorsal side of the corallum, while on the ventral side (2 *a*) the septa are not interrupted, and therefore reach the wall. The interception of the septa on the one side of the corallum, and not on the other, indicates clearly the inherent tendency to merge from the normal condition of the type, and to pass into other generic structures. The fossula is small, and a primary septum of slightly shorter length than the others passes into it. The tabulæ are exposed in the longitudinal section (fig. 2 *a*, *d*) are here dome-shaped, and their minute vertical plates are shown between a portion of the tabulæ, which, if the transverse section had cut through, would have exposed a system of radial plates developed along the superior face of the tabulæ, The blank parts of the tabulæ are due to the presence of a thin section of sclerenchyma, or to the section exposing a portion of the lamina of the septa, which is of frequent occurrence in those sections of coralla, which are curved. The endotheeal tissue is variable in breadth in the peripheral area, convex—convexity pointing inwards and upwards, and arranged in oblique rows. The base of the corallum is concave, and the endotheeal tissue is wanting.

Length of corallum, $1\frac{3}{4}$ inch; diameter, $\frac{7}{8}$ of an inch.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the coralline band of impure limestone, about 50 feet above the basement marine limestone.

This elegant and variable species differs from all the other species I have yet discovered, by the dome-shaped tabulæ exposed in the transverse section as convex plates, the limitation of the secondary septa and the endotheeal tissue, and is thereby separated from No. 3 of Plate XXI., which I regarded as belonging to the same species, when, however carefully examined, it exhibits characters widely different.

Campophyllum tuberculatum, sp. nov.

[Pl. XXI., fig. 3.]

Corallum compound. This is one of the sections selected from the superior extremity of the mass formerly referred to. I am, therefore, neither able to define the character of the calice nor epitheca. The two nodes indicated on the margin of the section indicate that there were tubercles developed externally. The section is $21\frac{1}{2}$ mm. in diameter. There are 40 primary alternating with an equal number of secondary septa. The former converge inwards from the theca $7\frac{1}{2}$ mm. on the dorsal, and $4\frac{1}{2}$ mm. on the ventral side, and the latter 6 mm. on the dorsal, and 3 mm. on the ventral side of the corallum. The septa are thin near the wall, and bilamellar for fully two-thirds of their total length inward, and the interlamellar spaces are occupied with stereoplasm. The interseptal dissepiments are delicate and numerous to the inner endotheeal ring. There the secondary septa bend and unite with the primary, the inner termination of the latter are more or less sinuous and irregularly disposed. The fossula is small, and a primary septum of shorter length than the others extends into it. The tabulæ are more rectangular and more exposed between the inner ends of the primary septa, and the interseptal dissepiments are considerably more developed inwards, and the septa extend over fully two-thirds of the total diameter of the corallum.

Formation.—Lower Carboniferous.

Locality.—Asheyburn, Muirkirk, Ayrshire.

Campophyllum subpalmatum, sp. nov.

[Pl. xxi., fig. 4.]

Corallum simple, cylindro-conical, and curved. The calice is shallow, and everted from the inner endothecal ring. The epitheca is stout; there are delicate crenulate encircling lines, and shallow annulations of growth. The section is 26 mm. in diameter. There are 48 primary and an equal number of secondary septa—the former converge inwards 9 mm. on the dorsal, and 6 mm. on the ventral side, and the latter 3 mm.; thus the septa extend over the corallum about two-thirds of the total diameter. A number of the primary septa are considerably longer than the others, indicating the initial tendency to variation. The interseptal dissepiments are irregularly disposed, lax in the median, and somewhat dense and angled outwards from each side of the septa, and present a dense palmate aspect around the periphery on the ventral side of the corallum; and a portion of the dense vesiculæ are concave, and intersept the septa from reaching the theca; these are the cut edges of the mammiform tissue on the everted side of the calice, while on the dorsal side the septa are not interrupted, and therefore reach the wall. The fossula is large, and two primary septa slightly shorter than the others pass into it.

Length of corallum, $1\frac{1}{2}$ inch; diameter of calice, $1\frac{3}{8}$ inch.

Formation.—Lower Carboniferous.

Locality.—Found at Charlestown, Fifeshire, in the coralline band of impure limestone, about 10 feet above the basement marine limestone.

This species demonstrates clearly the inherent tendency to variation by the vesiculæ around the periphery. It is rectangular on the dorsal, palmate on one side of the ventral, and mammilliform on the other, thus presenting a combination of structural details of a marked character.

Campophyllum radiolarium, sp. nov.

[Pl. xxi., fig. 5.]

Corallum, simple and turbinate. The calice is imperfect and everted. The epitheca is thin; there are delicate encircling lines and deep, irregular annulations of growth. The septa are delicate and more or less crenulate. There are minute elongated cells developed along their lateral margins, presenting a cellulose aspect in the outer third of their length. They are bilamellar inwards, and the interlamellar spaces are occupied with stereoplasm. The corallum is 35 mm. in diameter. There are 47 primary, alternating with an equal number of secondary septa; the former converge inwards from the theca from 10 to 13 mm., and the latter are 9 mm. in length. The septa and vesiculæ are melted away on the ventral side. The secondary septa unite with the primary at the inner endothecal ring. The interseptal dissepiments are dense, and are inclined, and unite in the centre of the interseptal spaces, and present a dense zone of vesiculæ near the periphery. The septa do not reach the theca, being intercepted by a zone of minute vesiculæ; these are the cut margins of a zone of peripheral mammilar tissue that are developed between the outer ends of the septa and the theca. A portion of the septa extends inwards to the centre of the visceral chamber, and there unites with a series of radial plates, which are developed along the superior face of the tabulæ, and thus demonstrates a tendency to pass from the "Campophyllidæ" into the "Cyathophyllidæ." The fossula is moderately large, and one primary septum of shorter length than the others extends into it.

Length of corallum, 2 inches; diameter of section, 1 inch 3½ lines.

Formation.—Lower Carboniferous.

Locality.—Found at Charlestown, Fifeshire, in the coralline zone, about 10 feet above the basement marine limestone.

This elegant species is distinguished from all the species I have yet discovered by the delicate and cellulose condition of the septa, by the zone of dense vesiculæ around the periphery, thus intercepting the septa from reaching the theca, and indicating a tendency to merge into "Cyathophyllidæ" by the prolongation of the septa on the one side, and to that of "Thysanophyllidæ" (Nich. & Thom.) on the other, by the development of mammilar tissue around the periphery.

Campophyllum taylori, sp. nov.

[Pl. XXI., fig. 6.]

Corallum compound, conical, and slightly curved. The epitheca is moderately stout; there are encircling lines and broad annulations of growth. The calice is deep and thin around the lip, and its floor is formed of broad, flat tabulæ. The septa are variable in their inward extension, thin and sinuous near the theca, and bilamellar for two-thirds of their total length inwards, and the interlamellar spaces are occupied with stereoplasm. The transverse section is 36 mm. in diameter. There are 57 primary, and an equal number of secondary, septa, which terminate at the inner endothecal tissue. The corallum is irregular in outline, probably due to its having grown against some hard body, and where so affected, the endothecal tissue is more dense. The extension of the septa are variable, those on the dorsal side average about 14 mm., while on the ventral side they are 8 mm.; and the secondary are 8 mm. on the former, and 6 mm. on the latter. The fossula is large, and two of the primary septa of shorter length than the others extend into it; and the septa that form its walls are united by semicircular plates, which we regard as the cut margins of the tabulæ, inside of these there are others, which I regard as the cut margins of a portion of the system of plates which extend from the tabulæ, and unite with interseptal dissepiments.

Length of corallum—The figured specimen is incomplete. I have, however, a complete form, which is 4 inches long.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in a bed of coralline remains, about 50 feet above the basement marine limestone of the system.

This species was the first corallum that I discovered in April, 1856. In order to know its name, I showed it to Dr. John Taylor, Prof. of Natural Philosophy, Anderson's College, at the termination of one of his lectures on Geology in the beginning of 1857. He named it "Cyathophyllum," the designation it was then known by, and it gives me great pleasure to name it in grateful remembrance of that eminent and kindly teacher.

Campophyllum intercellulosum, sp. nov.

[Pl. xxi., fig. 7.]

Corallum simple and turbinate; the calice is imperfect, and oblong in outline; the epitheca is moderately stout; there are encircling lines, and broad, shallow annulations of growth. The corallum is 32 mm. at the narrow, and 44 mm. at the long axis. The septa are delicate near the wall, and bilamellar for two-thirds of their total length inwards; and near the outer extremity of the lamellæ the interlamellar plates (stereoplasm) are elongate, instead of rectangular, as is in the case in all the forms I have yet examined, thus giving the interlamellar spaces a longitudinal cellular aspect, while towards the inner ends they are rectangular. There are 52 primary, and these alternate with an equal number of secondary septa. The former converge inwards from the theca 9 mm. on the ventral, and 15 mm. on the dorsal side; and the latter are 6 mm. on the ventral, and 9 mm. long on the dorsal side. The interseptal dissepiments are irregular, somewhat less dense on the one side than they are on the other. A small portion of the septa are intercepted, and do not reach the theca by outward inclined vesiculæ, which are the cut margins of a small zone of mammillæ that environs a portion of the periphery. Here and there the septa are interrupted by enlarged vesiculæ. A portion of the septa extends inwards over the superior face of the tabulæ, and unite with irregularly disposed plates in the centre of the visceral chamber; a few converged over the face of the tabulæ were depressed, and were only exposed in the depression, demonstrating clearly that these radial plates, and the inner ends of the septa, do not bisect the tabulæ; the laterally compressed form, and the prolonged septa, and central radial plates are to be noted.

Length of corallum, 3 inches; diameter of calice, 2½ inches.

Formation.—Lower Carboniferous.

Locality.—Found at Broadstone, Beith, Ayrshire, in a bed of shale about 10 feet above the basement marine limestone.

Campophyllum subclavatum, sp. nov.

[Plate XXI., figs. 8 and 8*a*.]

Corallum compound, cono-cylindrical, and curved. The calice is obovate, deep, and thin on the dorsal side, and everted on the ventral side. The epitheca is stout; there are encircling lines, and broad, shallow annulations of growth. The section is 26 mm. on the narrow, and 38 mm. on the long diameter. The septa are thin and sinuous for half their total length from the theca; they are then bilamellar, and stout to their inner extremities, presenting a subclavate aspect, and stereoplasm occupies the interlamellar spaces, which converge downwards and outwards. There are 45 primary, alternating with an equal number of secondary septa; these would have been increased in number had the corallum been cut nearer the calice. In this species I cut about half the length of the corallum, in order to show the proportionate width of the tabulæ, their relation to the endothecal tissue, the width and arrangement of the vesiculæ outwards to the wall. The primary septa converge inwards from the theca 8 mm. at the narrow, and 12 mm. at the long axis of the section; the secondary septa converge inwards 6 mm. at the long, and 4 mm. at the narrow axis; thus the septa extend a little under two-thirds of the total diameter of the corallum. The extension of the septa are frequently interrupted by enlarged vesiculæ. The fossula is small, and four primary septa, of variable lengths, and of slightly shorter length than the others, pass into it.

The longitudinal section (fig. 8*a*) shows the broad vesicular tissue, arranged in oblique rows; the irregularly disposed tabulæ, which are downwardly inclined at their lateral margins; here and there, are developed an intermediate plate, between the tabulæ and the vesiculæ, indicating their inherent tendency to merge into the triareal arrangement of the endotheeal structure. The longitudinal section being cut along the plain of the axis, and in consequence of the corallum being curved, the section exposes a portion of the interlamellar spaces of the bilamellar septa, and show the interlamellar plates (stereoplasm) inclined downwards and outwards (*b*), a condition I have only found in one other species; in all the others this delicate structure is inclined downwards and inwards.

Length of corallum, 3 inches; diameter of calice, $1\frac{7}{8}$ of an inch.

Formation.—Lower Carboniferous.

Locality.—Found at Howret, Dalry, Ayrshire, about 8 feet above the basement marine limestone.

Campophyllum crenulatum, sp. nov.

[Pl. xxi., fig. 9.]

Corallum compound, and elongate in outline, arising from lateral pressure. The section is taken from the compound slab; consequently I cannot define the form of the calice, nor the external aspect. The septa are crenulate; they are thin near the theca, and bilamellar for fully half their total length inward; and the interlamellar spaces are occupied with stereoplasm. The section is fully 18 mm. at the narrow, and 38 mm. at the broad diameter. There are 48 primary; these alternate with an equal number of secondary septa. The former extend inwards from the wall $6\frac{1}{2}$ mm. at the incurved part of the section, and 12 mm. at each end of the long axis, and the secondary septa converge inwards $2\frac{1}{2}$ mm. at the narrow, and 7 mm. at each end of the long axis. The endotheeal tissue is semi-rectangular. The fossula is small, and circumflexed at the inner margin by three of the cut margins of the tabulæ. In a section of the same mass, $1\frac{1}{4}$ inches higher, there is a section of the same corallum, in which the septa are crushed and broken.

Length of corallum—This being one of the compound community in the larger mass formerly referred to, I am unable to define the external aspects.

Formation.—Lower Carboniferous.

Locality.—Found at Asheyburn, Muirkirk, Ayrshire.

Camphophyllum clavatum, sp. nov.

[Pl. XXI., figs. 10, 11, and 12.]

Corallum simple, obovate in outline, conical, and moderately curved. The calice is imperfect; the epitheca is wanting; the septa are thin near the theca, and bilamellar inwards; and at their inner ends they are stout, and clavate, and stereoplasm occupies the interlamellar spaces. The section is 24½ mm. in diameter at the narrow, and 29½ mm. broad at the long axis. There are 50 primary, alternating with an equal number of secondary septa; the former converge inwards from the theca 10 mm., and the latter 5½ mm.; thus the septa extend over fully two-thirds of the total diameter. The endothecal dissepiments are more or less rectangular, and extend inwards to the stout clavate portion of the septa. A portion of the septa and endothecal tissue is interrupted by an elongated amorphous mass, in the centre of which there is a spherical body (fig. 10*a*) which resembles the cut end of a Serpula, or one of the simple species of Lithostrotion,[1] which has been enveloped in the soft tissue of the polyp's body. Whichever it is, it is an interesting fact, and showing clearly the adaptability of either the embryo to clasp round, and envelop the foreign body, or at a subsequent stage the tubular body had got accidentally embedded in the polyp, on the superior face of the tabulæ. In the centre of the visceral chamber there is developed a series of radially-disposed plates, which are more or less arranged in fascicles; and the central plates of several of the fasciculæ extend and unite in the centre, thus indicating a tendency to merge into other generic characters. The fossula is minute and hardly recognisable; a septum of shorter length extends into it. Figs. 12 and 13 I regard as young forms of the same species; these are found in the shale above the Productus limestone at Brockley, Lesmahagow, Lanarkshire.

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[1] I have several specimens of cup corals, from the Rotten limestone at Cunningham-badland, Dalry, Ayrshire, in which corallites of *Lithostrotion junceum*, and in others the spines of Productus had been surrounded by the coral embryo, and the latter had grown around the Lithostrotion; yet the growth of the latter was not interrupted. In one specimen the cylindrical Lithostrotion protrudes about a half of an inch above the floor or tabula of the simple corallum, and on the crown of the latter there is exemplified calicular gemmation, by the presence of the earlier stages of four young corallites, showing clearly that the corallite had been surrounded during the life of the former.

Length of corallum, 1½ inch; diameter of section, 1⅛ inch.

Formation.—Lower Carboniferous.

Locality.—Found on the banks of the Marnock water, near Fenwick, Ayrshire, in the coralline band of impure limestone, a few feet above the basement marine limestone of the system.

Campophyllum fasiculatum, sp. nov.

[Pl. xxi., figs. 13 and 14.]

Fig. 14.—The corallum is simple and cylindrical; the calice is deep; the epitheca is thin and ribbed; there are encircling lines and shallow annulations of growth; the septa are bilamellar, and the interlamellar spaces are occupied with stereoplasm; the section is 13 mm. in diameter; there are 36 primary, alternating with an equal number of secondary septa; the former are variable in their inward extension; a portion unites, and four of them converge to the centre of the visceral chamber, and present a quadripart fasciculate aspect; the majority converge inwards from the theca 5 mm., and the secondary septa are 2½ mm. long and unite with the primary at the inner endothecal ring, and each are united by rectangular interseptal dissepiments. The fossula is small and indistinct, and a septum of shorter length than the others passes into it.

Fig. 13 is a younger specimen of the same species; the section is cut slightly angular, therefore the extended septa are only exposed on one side of the section.

Length of corallum, ¾ of an inch; diameter fully ½ an inch.

Formation.—Lower Carboniferous.

Locality.—Found at Brockley, Lesmahagow, Lanarkshire, in the gritty shale about 10 feet above the Productus limestone. I regarded this species as belonging to the genus Fasiculatum, discovering that the septa that converge to the centre were only developed along the superior face of the tabula, and not present on the lower section, satisfied me that the quadrupart fasicular arrangement of a portion of the septa was not continuous in the centre of the visceral chamber.

In this genus, as defined by Edwards and Haime, the central area is occupied by flat tabulæ, and the septal system is limited in its extension inwards, and is united by a zone of interseptal dissepiments, which in the longitudinal section exposes a system of convex cellular tissue around the periphery. Their definition, while it only included one species, *Campophyllum murchisoni*, is characterized by the limitation of the septa and vesicular tissue around the periphery and the necessarily corresponding enlarged tabulate area; such, however, while it has been regarded as of generic import, can only be regarded in a corporate community as exhibiting a simple specific position. In order that we may trace how far specific distinction may be recognized, and variation may be due to the initial condition of the corallum and subsequent modification induced by the environment, let us briefly examine the elementary conditions of those forms we have been able to represent, and how far modification may be traced through the varied stages of development during the different stages of growth. Be it remembered I do not profess to give a complete history.

In my examination of the septa I found that the form and arrangement of the septa form an important element for diagnostic purposes, and that the development and extension of the septa to a large extent guide specific definition. There is, however, an important fact that cannot be overlooked. In a number of forms the septa are more or less arrested in their outward extension; in such forms the vesicular tissue is laterally enlarged; in some cases intercepting one, and in others two, and even three septa; this may be temporary (as in Pl. XVII., fig. 4), and confined to a limited area; while in others (as in Pl. XVII., fig. 1) the lateral enlarged vesicles frequently intercept the septa from reaching the wall; in others, again, there is a zone of vesicular tissue round the periphery (Pl. XVIII., fig. 7, and Pl. XXI., fig. 5, and more partially in Pl. XX. fig. 14), which is remarkable; these are the cut edges of a system of marginal mammilations which are developed around the lip of the calice, and thus intercept the septa from reaching the wall, an important structural modification induced by causes of which we have no knowledge; exhibiting a modification and transitional tendency to merge into those genera, in which the septa never reach the wall, as in the genus "Thysanophyllum" (N. and T.), in which genus the calicular fossa are exposed as a margiual zone of mammilations. There are, however, other species in which these mammilations are not continuous round the periphery (Pl. XX., fig. 1, Pl. XXI., fig. 1), and in these forms the septa here and there reach the wall (Pl. XXI., fig. 1 *a* and fig. 2 *a*); while in other parts of the same section (fig. 1 *b* and fig. 2 *b*) the septa are intercepted and do not reach the wall, thus clearly indicating a modificatiou of a marked character; the development of these becomes more and more modified until the peripheral zone of mammilations are more or less developed around the calicular fossa, as in the genus "Lonsdalia," and approach the genus "Thysanophyllum."

From amongst the hundreds of specimens which I have examined of the forms I now propose to include in the genus "Campophyllum," I have found the septa to vary much in their extension inwards. Indeed so much so, that if not examined in a connected series, they might give, and have given, rise to different generic definitions. If, however, they are examined, and compared collectively, they will be found to show variability in a connected series. The type of the genus (Pl. xv., fig. 13) is readily distinguished from all the other species by the broad tabulæ, the form and arrangement of the septa, and the limited zone of vesicular tissue around the periphery. Inducing us to regard all forms whose structural details are more or less similar in character, although differing in their relative proportions, to be included in the same group, and to regard forms whose structural characters are similarly arranged, but differ in their relative proportions as modifications, as those to which we can only assign specific identity. The flat tabulæ in the centre of the calicular fossa are more or less a characteristic of a large series of forms. We have found that in proportion to the limitation of the width of the floor of the calice there is a proportionate increase in the inward extension of the septa; and with the extension of the septa there is a proportionate increase in the number and arrangement of the interseptal dissepiments forming the vesiculæ around the periphery. There is, however, another important distinction which cannot be overlooked, *i. e.* the presence and extension of secondary septa, the latter being a distinguishing character of the genus. There is another point which calls for special attention—the fossula—which although it has been regarded as of generic importance,[1] yet from its variability I cannot accept as of specific value, from the fact that in this group of tabulate corals, the sections, if cut at different parts of the same corallum will vary, arising from the fact that the tabulæ are extremely variable and irregular horizontally, and if sectioned along the plane of the convex part of the tabulæ, will expose a more or less semicircular plate around the inner end of the fossula, which has been accepted as of both generic and of specific importance. I will briefly summarize these points of distinction and see how far we can accept of the varied structural details as guides for generic and specific identification.

I am well aware that to attempt to define species acceptable to every specialist in any department of Palæontology is a difficult

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[1] Nicholson on the new genus Crepidophyllum, Proc. of the Royal Society of Edinburgh, vol. ix., No. 95, p. 149.

task. At best, we can only take central types, around which specific variation diverge in all directions, each exhibiting structural details, more or less alike in all essential characters. It should, however, .be borne in mind that any intermediate variety which might be found would be ranked, unless the whole chain could be perfectly restored, as a new and distinct species; for it is not pretended that we have any criterion by which species and varieties can be discriminated. While the series resemble each other in all essential characters, differing, however, in their relative proportions, many are distinguished by minute structural differences. The more minute may have been induced by the impingement of particles of drifted matter; and the more pronounced modifications in form and structural characters may have been due to the conditions of the environment. From whatever causes modification has been brought about, whether from the influences of external conditions acting upon the soft tissues of the polyp, or from an inherent tendency to modification, an almost indefinable series of variations are represented throughout the group, rendering specific distinction most difficult. Yet, I venture to assert that, however minute these modifications are, the fact that the series possess the tabulæ, forming the floor of the calicular fossa, surrounded by the septa, and with the zone of vesiculæ around the periphery, renders their determination quite easy. While all vary in degree, yet being persistent in the uniformity of the generic characters, the generic identity is placed beyond the region of doubt, but the individual differences in such minute details render the definition of species a matter of difficulty. The polymorphic character of the series implies a large amount of variation; regarding many of the species a divergence of opinion may be expected. In this, as in all polymorphic genera, some of the specific distinctions are indisputable; their specific characters are as distinct in their homologies, as are the species of "Cyathophyllum," their near allies. The periphery as an encircling wall, partitioned by variable, radiating, septa, converging more or less to the central cavity, is polymorphous. The central area may be circumscribed by the radiating primary septa, as in Pl. XVI., fig. 3; or it may be open and broad, as in Pl. XV., fig. 13, and the radiating septa circumscribed to the peripheral zone; or, as in the former, the secondary septa may extend inwards to near the inner extremity of the primary septa, or they may be represented by minute denticles, as in Pl. XVII., fig. 6. The primary septa may be sinuous and limited in their prolongation; and the secondary septa somewhat enlarged, as in Pl. XVI., fig. 3; or they may be equally sinuous, more numerous, and considerably more prolonged, and a still further increase in the length of the secondary septa, as in Pl. xvii., fig. 2. The interseptal dissepiments may be more or less rectangular and sparse, as in Pl. xvi., fig. 3; or they may be variously angular and sparse, as in Pl. xvii., fig. 4, whereas they may be curvilinear to near the wall, and angular outward round the periphery, as in Pl. xvii., fig. 8. The primary septa may be delicate, and spiniform, with a still further prolongation of the secondary septa, and united by rectangular interseptal dissepiments, as in Pl. xvi., fig. 3; or the primary septa may be more or less stout and crenulate; and the secondary septa converge considerably more inwards, and the interseptal dissepiments angular, and more dense, as in Pl. xvi., fig. 1*a*. Further, the primary septa may be irregularly disposed, as in Pl. xvii., fig. 4. The secondary septa may be minute, and the dissepiments sparse as in Pl. xvii., fig, 4, whereas the septa may be considerably larger, and the dissepiments dense and angular on the one side of the corallum, and on the other less dense and more or less rectangular on the other side, as in Pl. xx., fig. 14. Further, the septa and interseptal dissepiments may be sparse, and the secondary septa may be minute, as in Pl. xvii., fig. 4; or the primary septa may be more numerous, and a further extension of the secondary septa, and the interseptal dissepiments may be largely increased in number, as in Plate xviii., fig. 4. There may be a still further increase in the number and extension of the septa, and dissepiments, as in Pl. xvii., fig. 7. And a still further prolongation of the secondary septa and the dissepiments greatly increased in number and variously angled, as in Pl. xvi., fig. 1*a*. A further modification is shown in the prolongation of the primary septa, the irregularly developed dissepiments, and the frequent interruption of the septa, as in Pl. xix., fig. 5. It is immaterial whether the radiating primary septa are limited to the peripheral zone or extend to near the centre of the calicular fossa, or whether the secondary septa are minute, and only developed around the inner margin of the theca, or converge to near the inner extension of the primary septa.

Whether the interseptal dissepiments are limited and rectangular, or largely increased and more or less angular, or whether they are dense and continuous to the inner endothecal ring, or are largely increased in form and more or less angular, or whether they are dense and continuous, or less numerous and more or less enlarged, and thereby intercept the extension of the septal system all in their generic relations, are facts of primary importance. These varied structural differences constitute the specific features of the varieties of the genus, and in no way interfere with their homologies.

Many of the preceding species are so nearly related that, unless sectioned and compared, they might be, and have been, associated with *Campophyllum cylindrica.* A comparison of any of these with the type is most likely to strengthen the impression of specific distinction. The forms, however, which I have grouped in Pls. XVIII., XIX., and XX., while they are more varied and their structural details more complex, are therefore more likely to be associated with other generic groups, but as soon as we can free ourselves of preconceived beliefs, and give due consideration to the structural relationship, and allow due weight to homological evidence, the near affinities of the series become self-evident. This once settled, the specific homologies of the series I now further propose grouping under the "Campophyllidæ" are easily traced. As formerly stated, M. Edwards and J. Haime regarded *Campophyllum* (*Cyathophyllum*) *parricida*, M'Coy, Pl. XIX., figs. 6 and 7, as belonging to "Campophyllum," E. and H.; but in consequence of the imperfect preservation of the specimens examined they were unable to define its classificatory position (Trans. Pal. Soc., p. 182, 1852). This, however, will be better understood when we cursorily review this, and a number of allied forms, even some forms more complex in their structural details, but which I conceive to merely have specific distinction. As formerly stated, what prominently distinguishes "Campophyllum" as a genus is the flat tabulæ in the centre of the calicular fossa, the environment of the periphery by a septal system, and the presence of a zone of vesicular tissue around the inner margin of the theca. In comparing the structural details of Pl. XIX., figs. 6 and 7, with those referred to above, it will be found that while these are of smaller size, yet the septa are analogous in form and arrangement. The tabulæ in this group are somewhat more limited, and usually are about a third of the total diameter, while the forms represented in Pl. XIX., figs. 4 and 5, are similar in all the essential details of the type, but more limited in the extension of the septa, and therefore marginal.

Fig. 8 is essentially similar to fig. 7 in the length of the septa and arrangement of the dissepiments; there is, however, a system of denticles developed along the lateral margins of the septa, and therefore specific. Fig. 8*a*: The tabulæ are somewhat more regular in their arrangement, and the system of concave plates that unite the tabulæ and dissepiments are continuous, from the inferior to the superior extremity of the corallum, and therefore the initial condition of the triareal arrangement of the structural details is more or less complete. Pl. xviii., fig. 7: The septa and interseptal dissepiments are somewhat similar in their extension and arrangement; and the tabulæ are similar in proportion. There is this difference: the corallum is greatly larger, and the septa at these inner margins are somewhat more irregular. Pl. xix., fig. 1*a*: The tabulæ are less regular, and the longitudinal sections of the interlamellar plates, or the cut edges of the semiradial plates, that are occasionally developed along the superior face of the tabulæ, although indicated in fig. 8*a*, are in this species of more frequent occurrence, and more pronounced towards the base of the corallum; the tabulæ are of somewhat similar proportions to the preceding species. Pl. xviii., fig. 10: There is a marked dissimilarity in the structural details, and in the presence of a zone of inverted vesicular tissue, intercepting the extension of the septa to the wall on one side of the corallum; the tabulæ are considerably restricted in dimensions, and there is a further development of irregular plates at the inner ends of the septa. Pl. xx., figs. 1, 2, and 3, are all from one mass; these, and figs. 8, 9, 10, and 11, are selected from amongst 150 corallites in one slab, all originating from a single corallum that formed the base of the group. In fig. 1, the dissepiments are here and there irregular and sparse; the diameter of the tabulæ is somewhat greater in proportion, and the fossula are in all varied in their form and arrangement, yet upon the whole I can only regard these variations as not due to specific distinction, but rather brought about by slightly changed conditions. Figs. 8, 9, 10, and 11 might be regarded as varieties of Pl. xviii., fig. 1. These, however, I imprinted from the calices of the above species, and this precludes them being regarded as other than the young and immature forms of the species. Pl. xx., fig. 3: The septa are more numerous in proportion to the size, and the dissepiments are slightly more angular, the diameter of the tabula is considerably more, and the septa are proportionately more limited in their inward extension, and irregular in length at their inner ends. Several of the septa are intercepted in the median area. Pl. xx., fig. 5: In this species, the septa around the periphery are bifurcated for a considerable portion of the total circumference of the corallum, and somewhat palmate; there is, however, a small space in the centre of this zone, in which the dissepiments are inverted, and therefore the septa do not reach the wall, whereas on the opposite side the extension of the septa is in no way interrupted, and therefore extend to the theca. The tabulæ are somewhat similar in proportion to the preceding. Pl. xx., fig. 6: In this species a portion of the interseptal dissepiments are unusually dense and angular, and at the margin of the dense vesiculæ a small space of single inverted dissepiments cut off the septa from reaching the wall, whereas on the opposite side of the corallum the dissepiments are rectangular, and considerably less dense. The tabulate area is irregular, and a portion of the septa are prolonged, and are more or less fasiculate, and converge to the centre. A portion of the radial plates are alone developed near the centre, and therefore are not united with the septa. Similar central radial plates are present in a section of the same corallum, 2½ inches lower than the section figured. These, however, may not be continuous, but occasional. I have numerous illustrations of similar conditions in other coralla, which I have, in another communication, designated as spasmodic. Pl. xxi., fig. 7: In this species three of the septa are prolonged a short space over the tabula. The theca, and a portion of the outer margin of the septa and vesicular tissue are dissolved away. Where preserved, which is for considerably more than half of the circumference, there is a zone of inverted vesiculæ, which environs the periphery and intercepts the septa from reaching the wall. The septa are numerous, and the tabulæ are about a third of the total diameter. Pl. xx., fig. 14: In this species the septa are limited in length and dendriform, and the dissepiments are minute and dense on the one side, and greatly prolonged and less dense, and here and there a portion of them are laterally enlarged, and thus there is a temporary interception of the septa on the one side of the corallum. A considerable number of the septa are prolonged inwards, and are more or less laterally united by irregularly disposed plates, which are the cut margins of the upward inclined tabulæ. The diameter of the tabulæ is under a third of the total diameter of the section. Fig. 14 *a* shows the upwardly inclined tabulæ at the lateral margins, and the dense vesiculæ on the one side, which are broad and less dense on the other. Pl. xx., fig. 15: This remarkable species is so distinct in its structural character that no further reference is required to point out its specific identity. Pl. xxi., fig. 1: It will be observed that there is a zone of inverted vesiculæ in each of the contracted sides of the corallum; these intercept the septa from reaching the wall, whereas at each extremity of the long axis the inverted vesiculæ are wanting, and therefore the septa are not interrupted, and extend to the wall. The interseptal dissepiments are minute and dense in the incurved side, and the septa are laterally deflected, as I believe, by external pressure. The minute irregularly disposed plates on the superior face of the tabulæ, and the dense structural details, render this species totally unlike any of the other species of the genus. Pl. XXI., fig. 2: In this species the zone of inverted vesiculæ all but completely surrounds the periphery. Several of the septa do reach the wall, and therefore the inverted vesicles nearly environ the corallum, showing a further development of the mammilliform structure around the periphery of the calicular cavity. Figs. 2*a*, *c*, and *d* show the cut edges of the periodically-developed radia along the crown of the tabulæ. Fig. 3: In this section there are exposed the walls of two of the tubercles that are here and there dispersed over the theca, which, in conjunction with the total extension of the septa to the wall, and its delicate structural details, render this species distinct from all other species of the genus. Fig. 4: In this species the irregular prolongation of the septa is shown. The inner margin of the vesicular ring is pronounced, and a series of the cut margins of the tabulæ unites and environs the inner interseptal spaces. There are several enlarged vesiculæ; these locally intercept the septa. The secondary septa are prolonged to the inner endothecal ring, and on one side of the section the interseptal dissepiments are angular, and extend outwards to the theca, whereas on the other side they are sparse and rectangular. The fossula is semi-environed at the inner margin by the cut margins of several of the tabulæ. Fig. 5: This species is characterized by the dense series of radial plates in the centre of the calicular fossa; by the prolongation of a portion of the septa to the centre of the visceral chamber, and there unites and forms irregular fascicles, by the dense and delicate vesicular tissue, and by the zone of inverted vesicular tissue that surrounds two-thirds of the periphery. The walls of the fossula are united by the cut margins of two of the tabulæ.

Fig. 6: This species is distinguished by the semi-dendriform aspect of the septa, the minute cellular tissue around the periphery on one side of the corallum, the more or less rectangular and sparse dissepiments on the other, and by the broad tabulæ, and the irregular prolongation of the septa. The fossula is large, and half surrounded by the cut margins of two of the tabulæ. The irregular outline I believe to be due to the influence of the environment. Fig. 7: This species is recognized by the dense vesiculæ that environ fully three-fourths of the corallum and the lax dissepiments on the opposite side; there are several enlarged vesicles that temporarily intercept the prolongation of the septa. The septa are irregular in their prolongation inwards; and the radial plates, in the centre of the visceral

chamber, are irregularly disposed. The fossula is semi-environed by several plates; these are the cut margins of several tabulæ. On the whole, the structural characters are sufficiently pronounced to warrant the specific distinction. Fig. 8 : This species is distinguished by characters of a pronounced nature; its obovate form and irregularly-disposed vesicular tissue, the laterally elongate vesicles that intercept the septa; on the dorsal side by the broad tabulæ, and the extension downwards and outwards of the interlamellar plates of the septa (stereoplasm). Figs. 8 *a*, *b* : Whereas these plates usually pass downwards and outwards. Fig. 9: This species is readily recognized by the crenulate septa, the more or less rectangular interseptal dissepiments, and indications of the distribution of obtuse tubercles on the theca, as exposed in the irregular margin of the transverse section. The fossula is semi-environed by the cut margins of three tabulæ. Fig. 10: The radial plates in the centre of the visceral chamber are more numerous than I have found in any of the preceding species; and the claviform termination of the septa, and rectangular interseptal dissepiments, render this species pronounced in its specific distinction, characters all indicated in figs. 11 and 12, which I conceive to be young forms of the same species. Figs. 13 and 14 are distinguished by the prolongation of a portion of the septa, and their fasciculate arrangement and union in the centre of the visceral chamber—a distinction I once regarded as of generic importance—but after satisfying myself that the tabulæ were not bisected by the prolonged septa, I was satisfied that these structural differences were merely of specific value.

The conditions of life vary in proportion to the extension of the area, and hence there will be a tendency to individual variation. Suggestions as to the reasons for some of these variations can only be made by extending the field of observation, and noting the varied conditions of the matrix the forms are found in, and comparing their structural differences. I venture to suggest that in small isolated areas, where the conditions are more or less uniform, the modifications would be incipient in character, and thus the variations of species less pronounced; whereas large areas, including dissimilar conditions, are more favourable to greater diversity in the structural details, and thus more favourable to the production of new species, and thus the change in modification would be more rapid, and consequently more varied, and would so give rise to a greater number of new varieties and species, which by minute stages of variation would ultimately merge into new generic characters.

In accordance with this view we are introduced to some facts that will be apparent in comparing the distribution of the larger species of "Campophyllum." And with our present knowledge, the limitations of such forms as *Camp. gigantea*, and *Camp. cylindrica*, to the shales near the base of the Carboniferous system, and also the diversified characters of closely-allied species, where the matrix is more variable in character, such as at Brockley, Lesmahagow, are remarkable. And further, how minute and delicate are the modifications that are present in those forms that are found imbedded in deposits that indicate tranquil and more isolated conditions, such as at Charlestown, Fifeshire, in the zone a few feet above the lower marine limestone, where the simpler forms of "Campophyllum" are frequently found associated with the larger varieties of "Calophyllum."

The inherent tendency to variation offers an explanation of the minute details of structure, but it is less easy to account for the presence of the enlarged vesicles that frequently interrupt the exten sion of the septa, rendering them temporarily aborted.

EXPLANATION OF PLATES XV.-XXI.

PLATE XV.

Fig.			
1.	Calophyllum	danai, sp. nov.	
1 *a*.	,,	,,	a longitudinal section of the same.
2.	,,	spinosum, sp. nov.	
3.	,,	tuberculatum, sp. nov.	
3 *a*.	,,	,,	external aspect with a concave base.
4.	,,	,,	a variety of the same.
4 *a*.	,,	,,	showing external aspect and conical base.
5.	,,	irregularum, sp. nov.	
5 *a*.	,,	,,	a longitudinal section of the same.
6.	,,	(Zaphrentis) le honiana, Koninck.	
6 *a*.	,,	,,	a longitudinal section of the same.
7.	,,	cuspidum, sp. nov.	
8.	,,	nodosum, sp. nov.	
8 *a*.	,,	,,	a transverse section of the same.
8 *b*.	,,	,,	a longitudinal section of the same.
9.	,,	angularum, sp. nov.	
9 *a*.	,,	,,	a longitudinal section of the same.
10.	,,	denticulatum, sp. nov.	
10 *a*.	,,	,,	a longitudinal section of the same.
11.	,,	robustum, sp. nov.	
11 *a*.	,,	,,	a longitudinal section of the same.
12.	,,	approximatum, sp. nov.	
12 *a*.	,,	,,	a longitudinal section of the same.
13.	Campophyllum	murchisoni, E. and H.	
14.	,,	brockleyensis, sp. nov.	
15.	,,	simplicum.	
15 *a*.	,,	,,	a longitudinal section of the same.

Plate XVI.

Fig.

1. Campophyllum (Zaphrentis) cylindrica, Scouler: a longitudinal section.

1 *a*. ,, ,, a transverse section.

1 *b* to 1 *h*. ,, ,, showing the different aspects of the structural details, from the epitheca at the base to 1 *b*, where the corallum becomes less tapering.

2. ,, recurvatum. sp nov.

3. ,, dicuspidophyllum, Thomson.

4. ,, breviseptum.

5. ,, ,, is a young specimen, sp. (?). This specimen being cut at a slight angle, exposes the inner ends of the primary septa extending over the superior face of the tabulæ, while, on the other half, the septa are absorbed by the tabulæ.

6. ,, cylindrica (var. denticulatum).

Plate XVII.

Fig.

1. Campophyllum (Canina) gigantea, Michelin.

2. ,, subfurcillatum, sp. nov.

3. ,, juddi, sp. nov.

4. ,, laxicum, Thomson.

5. ,, dissimilis, sp. nov.

6. ,, ,, a young specimen showing the condition of the septa, near the concave base of the corallum.

7. ,, heteroseptum, sp. nov.

8. ,, furcillatum, sp. nov.

PLATE XVIII.

FIG.

1. Campophyllum rectangularum, sp. nov.

1 *a* ,, ,, a longitudinal section of the same.

2. ,, ,, a young specimen of the same, showing the condition of the septa near the conical base of the corallum.

3. ,, dendriformum, sp. nov.

3 *a*. ,, ,, a longitudinal section of the same, in which are shown the inner interseptal dissepiments, extending from the peripheral zone of vesiculæ and uniting with the tabulæ, and showing a further development of the triareal structural details.

4. ,, amplexicum, sp. nov.

5 & 5 *a*. ,, ,, young specimens of the same.

6. ,, subclaviformis, sp. nov.

7. ,, mammillatum, sp. nov.

8. ,, supraphyllum, sp. nov.

8 *a*, ,, ,, a longitudinal section of the same, showing a small portion of stereoplasm at *b*.

9. ,, ,, a young specimen of C. rectangularum.

10. ,, turbinatum, sp. nov.

Plate XIX.

Fig.

1. Campophyllum concavum, sp. nov.

1 *a*. ,, ,, a longitudinal section of the same, the corallum being curved, the lamellæ of the primary septa are shown, and the interlamellar stereoplasm, *b*. The interrupted and convex tabulæ are shown near the base of the corallum.

2. ,, marginatum, sp. nov. 2 *c*, showing fissiparity.

3. ,, ,, a variety of the same.

3 *a*. ,, ,, a longitudinal section of the same, showing the broad tabulæ, the inner interseptal plates, uniting the tabulæ and peripheral zone of vesiculæ, and the narrow zone of peripheral vesicular tissue.

4. ,, ,, sp. nov. 2 *c*, showing fissiparity.

5. ,, interruptum, Thom. & Nichol.

5 *a*. ,, ,, a longitudinal section of the same, showing the subcolumellar rod interrupting the tabulæ, near the lower extremity of the corallum.

6, 7. ,, parricida, McCoy.

7 *a*. ,, ,, two longitudinal sections, showing calicular gemmation, and a further development of the inner interseptal plates that unite the peripheral zone of vesicula and the tabulæ.

7 *c*. ,, ,, showing latero-calicular gemmation.

7 *c*. ,, ,, showing calicular gemmation.

8. ,, echinatum, Thoms.

8 *a*. ,, ,, a longitudinal section of the same, *bb*, showing stereoplasm extending outwards and downwards.

PLATE XX.

FIG.			
1.	Campophyllum asheyburnensis, sp. nov., from large slab.		
2.	,,	,,	from same slab.
4.	,,	,,	,,
7–11.	,,	,,	young forms of the same.
12.	,,	,,	from the same slab, a young form.
13.	,,	,,	a young form of the same, showing the primary condition of the septa in those forms that are concave at the base.
3.	,,	? sp. nov.	
5.	,,	submammillatum, sp. nov.	
6.	,,	radiolarum, sp. nov.	
14.	,,	dendriformum, sp. nov.	
14 *a*.	,,	,,	a longitudinal section of the same, *b*, showing the inner interseptal plates, indicating the triareal arrangement of the structural details.
15.	,,	eleganteum, sp. nov.	

Plate XXI.

Fig.

1. Campophyllum agassizi sp. nov. section taken out of slab.
2. ,, domiformum, sp. nov., *a*, showing the septa extending to the theca; *b*, the septa are interrupted by a zone of mammilæ.

2 *a*. ,, ,, a longitudinal section of the same; *c* shows a blank space, or a longitudinal section of the lamella of the septa; at *d* are shown sections of the radial plates, that are occasionally developed along the superior face of the tabulæ, while at *b* are exposed the interrupted tabulæ.

3. ,, tuberculatum, sp. nov.
4. ,, subpalmatum, sp. nov.
5. ,, radiolarium, sp. nov., showing the fasiculate radia along the superior face of the tabulæ.
6. ,, taylori, sp. nov.
7. ,, intercellulosum, sp. nov.
8. ,, subclavatum, sp. nov.

8 *a*. ,, ,, a longitudinal section of the same, showing the broad, vesicular arrangement of the tabulæ, the inner interseptal plates, the interlamellar plates (stereoplasm) of the septa, inclined downwards and outwards.

9. ,, crenulatum, sp. nov.
10. ,, clavatum, sp. nov., showing the supra-radial plates of the tabulæ.

11 & 12. ,, ,, young forms of the same.

13 & 14. ,, fasiculatum, sp. nov.

XXXVIII.

STUDIES IN IRISH CRANIOLOGY: THE ARAN ISLANDS, CO. GALWAY. By PROFESSOR A. C. HADDON.

[Read DECEMBER 12, 1892.]

THE following is the first of a series of communications which I propose to make to the Academy on Irish Craniology. It is a remarkable fact that there is scarcely an obscure people on the face of the globe about whom we have less anthropographical information than we have of the Irish.

Three skulls from Ireland are described by Davis and Thurnam in the "Crania Britannica" (1856–65); six by J. Aitken Meigs in his "Catalogue of Human Crania in the Collection of the Academy of Natural Sciences of Philadelphia" (1857); two by J. Van der Hoeven in his "Catalogus craniorum diversarum gentium" (1860); thirty-eight (more or less fragmentary), and five casts by J. Barnard Davis in the "Thesaurus craniorum" (1867), besides a few others which I shall refer to on a future occasion.

Quite recently Dr. W. Frazer has measured a number of Irish skulls. "A Contribution to Irish Anthropology," Jour. Roy. Soc. Antiquarians of Ireland, I. (5), 1891, p. 391. In addition to three skulls from Derry, Dundalk, and Mary's Abbey, Dublin, Dr. Frazer gives measurements of fifty more or less broken crania from Donnybrook, Co. Dublin, which were the best preserved of the skulls of over 600 human beings who were there massacred about the year 800 A.D.[1]

Strangely enough the pioneer investigator of the craniology of

[1] Since the present Paper was written, Dr. Frazer has read before the Academy a short Paper entitled "On Irish Crania;" read January 23, 1893 (*antea*, p. 643). And still later, February 27, 1893, Dr. C. R. Browne read a Paper "On some Crania from Tipperary," in which he describes the crania of individuals (*antea*, p. 643).

Ireland was a man whose labours appear to have been almost entirely overlooked, and who, for careful work and ingenuity in devising apparatus, was second to none of his contemporaries. I refer to the late John Grattan, of Belfast. Thanks to the kindness of his sisters the Misses Grattan, of Belfast, I have had access to all Grattan's unpublished MSS., and these, as well as his published papers, prove that had he been spared there would have been little occasion for reproach on the score of neglect in Irish anthropology. The following is a list of the papers which I can trace to him :—

GRATTAN, JOHN.—"On the importance to the Archæologist and Ethnologist of an accurate mode of measuring Human Crania, and of recording the results: with the description of a new Craniometer."—*Ulster Journal of Archæology*, I., 1853, pp. 198–208, 5 pls.

"Notes on the Human Remains discovered within the Round Towers of Ulster, with some additional contributions towards a 'Crania Hibernica.'"—*Ibid.*, VI., 1858, pp. 27–39, 3 pls.; pp. 221–246, 2 pls.

Two of the skulls I am about to describe form part of the "Grattan Collection" which was bequeathed by him to the Belfast Natural History and Philosophical Society in 1873. (Cf. "Descriptive Catalogue of Skulls and Casts of Skulls from various Irish sources, collected by the late John Grattan, Esq., now the property of the Belfast Natural History and Philosophical Society," *Proc. Belfast N. H. and Ph. Soc.* for 1873–74 (1874), p. 121.) I would also like to express my thanks to the Council of this Society for having entrusted the whole of this collection to me for description.

Mr. Grattan gives the following measurements (*l.c.* Table 2, p. 246) of these two crania:—Cubic capac. in inches and tenths—max. 92, min. 84, av. 88; length—max. 7·4, min. 7·3, av. 7·3; breadth—max. 5·5, min. 5·5, av. 5·5; circumf.—max. 20·6, min. 20·6, av. 20·6; occipito-frontal arch—max. 14·9, min. 14·7, av. 14·8; mastoidal arch (from the point of one mastoid process to the other)—max. 15·1, min. 14·5, av. 14·8. Proportional breadth in decimal sub-divisions of length—max. ·75, min. ·74, av. ·75. These two crania agree in almost every average with the averages of the twenty-five crania which comprise Grattan's "Group 4—Modern Celtic." All of these measurements are in inches and tenths. These crania were subsequently remeasured by Mr. Grattan in millimetres as well as in inches and tenths, and a few minor corrections were made. These, with some drawings, are among the MSS. referred to.

In the following Paper a fairly complete account has been given from an ethnographical point of view of the natives of the Aran

Islands. The present communication deals solely with what information is available as to their craniology. The material consists of two skulls from Innishmaan (Nos. 49 and 50) in the Grattan Collection, and of another (T.C.D.) from Aranmore which I have presented to the Anthropological Museum in Trinity College. Three fragmentary crania (A, B, and C) were measured by Dr. Browne and myself in Tempul Brecain, Onaght ('Seven Churches'), Aranmore, and Dr. Beddoe gives some measurements of four skulls which "were found in the dry sand which has gathered within the small and ancient church of St. Eneay, Aranmore" (*l.c.* p. 229). He gives the total measurements in a table on p. 227, as follows:—"Glab.—max. length, 7·53; max. breadth, 5·59; basio-bregm. height, ? 5·27; latit. index, 74·25; altit. index, 70?."

Dr. Beddoe has very kindly permitted me to extract the following details from his MS. notes made on the occasion of his visit to Aranmore in 1861. I have reduced these measurements to millimetres, and have added their cephalic indices within brackets.

"No. 1. L., $7\frac{1}{4}$; B., $5\frac{1}{2}$; forehead breadth, $3\frac{3}{4}$; height, 5 inches (internal from level of mastoid). [L., 183 mm.; B., 140 mm.; C. I., 76·1.]

"No. 2. L., $7\frac{5}{8}$; B., $5\frac{5}{8}$; height as before, $5\frac{1}{4}$. [L., 194 mm.; B., 143 mm.; C. I., 73·7.]

"No. 3. L., $7\frac{1}{4}$; B., $5\frac{1}{2}$. [L., 183 mm.; B., 140 mm.; C. I., 76·1.]

"No. 4. L., $7\frac{3}{4}$; B., $5\frac{3}{4}$; height, $5\frac{5}{8}$. [L., 197 mm.; B., 146 mm.; C. I., 74·1.]

"Another imperfect one is 6 inches broad, length not ascertainable."

A sketch by Beddoe of the *norma verticalis* is very similar to that of the T.C.D. specimen.

Two skulls were collected by Dr. Beddoe on this occasion and presented by him to Dr. Barnard Davis, and they are described as follows in the 'Thesaurus Craniorum.' Probably neither of these two were included among the preceding four measurements:—

"208.—842; Irish ♀, æt. c. 30. Imperf. calv. Has a frontal suture. From Teampull Brecain, Aara Mor or Great Aran Isle."

"209.—843, Irish ♂ of advanced age. Imperf. calv. The sutures are almost wholly obliterated in this heavy calvarium. From Killeany or St. Eney's Church, Aranmore. These graveyards of the Aran Isles are regarded by Sir W. R. Wilde, the distinguished Irish antiquary, as 'very early,' and the crania derived from them 'as very ancient skulls.'"

To save space I have put the measurements given by Dr. Davis of these two calvariæ side by side; those of skull 209 are printed in heavy type.

Intl. capac. **63·5**; circ. **20·7**; fronto-occip. arch 14, **15**; frontal 4·8; parietal 4·9; occip. 4·3; longit. diam. 7·1, **7·4**; trans. diam. 5·5 par., **5·5** par.; widest frontal breadth at coronal suture 4·7, **4·6**; most divergent par. breadth 4·9, **5·2**; occipital [asterionic] 4·4, **4·3**; height 4·9, **5·1**; intermastoid arch **15**; Busk's frontal radius **4·6**; parietal do. **4·8**; occip. do. **4·3**. Length-breadth, index 77, **74**; length-height, index, 69, **69**.

Owing to the courtesy of Professor C. Stewart I have been able to measure these two specimens, and they will subsequently be referred to under the numbers 208 and 209 respectively, which are their catalogue numbers in the museum of the Royal College of Surgeons, London.

Methods.

It is unfortunate that, even at the present time, it should be necessary to indicate what method of taking any given measurement has been employed. It is true we have a so-called "Frankfort Agreement," but what is required is a Franco-German agreement.

In the majority of the measurements I have adopted, the name given sufficiently indicates the points of measurement. In all cases, except where otherwise stated, I have made direct measurements, and not according to the German recommendation, viz. that, wherever possible, the measurements of the skull should be taken in relation with the horizontal plane adopted by the Frankfort Congress. With regard to the latter point I can only endorse the criticism made by Dr. Garson in his Paper on "The Frankfort Craniometric Agreement, with Critical Remarks thereon" (Journ. Anthrop. Inst. xiv., 1884, p. 64).

The auriculo-bregmatic arc and the bi-auricular breadth I take as he suggests, "where the auriculo-bregmatic lines cross the prolongation ridges backwards of the zygomatic arches" (*Ibid.*, p. 76). The auriculo-cranial, auriculo-nasial, and auriculo-alveolar radii are taken with Cunningham's modification of Busk's instrument (cf. C. R. Browne, these Proceedings, *antea*, p. 397). The palato-maxillary length and breadth were taken from the points advocated by Sir W. H. Flower, and for these I find the *compas glissière* very convenient.

DESCRIPTION AND MEASUREMENTS OF EIGHT ARAN CRANIA.

T. C. D.—Cranium, ♀, adult, from Tempul Brecain, Onaght ("Seven Churches"), Aranmore, August, 1890, Trinity College, Dublin. Symmetrical, well-formed cranium, in a fair state of preservation; the left jugal arch is broken. All the teeth are present except the two left and the first right incisors. The teeth are free from disease, and not unduly worn.

The condition of the sutures and the presence of wormian bones in this and the succeeding crania will be noticed subsequently.

49.—Cranium, ♀, old. "Ennismain, Islands of Arran, Galway Bay, September, 1857." Grattan collection, Belfast. Symmetrical, well-preserved cranium, except that the greater portion of the cranial floor is absent. Only the second pre-molar of the right side remains; it is much worn but free from disease. This is a ponderous and massive cranium; at the ophryon (above the frontal sinus) the frontal bone is 14 mm. thick, and the parietal is in places from 10 to 11 mm. in thickness.

50.—Cranium ♂, old. "Ennismain, Islands of Arran, Galway Bay, September, 1857." Grattan collection, Belfast. Symmetrical, well-preserved cranium; the face has been mended; the left jugal arch is broken; only the left orbit is complete; the upper portion of the maxillary bone on the right side is entirely wanting, and part of that on the left side also; the nasals and deeper bones of the face are absent, and the orbital cavities much broken. No teeth are present. The supra-orbital crests are only slightly developed, as also are the rugosities for the attachment of muscles to the cranium. The inion is not specially prominent.

In 49 and 50 the left half of the roof of the cranium has been sectioned by Mr. Grattan, and each of these has been cut into five radii according to the plan adopted by him. They were evidently collected by him on the excursion of the Ethnological section of the British Association, Dublin Meeting, September, 1857.

208.—Calvarium, ♀, adult, from Tempul Brecain, Aranmore, 1861, Royal College of Surgeons, London.

Imperfect metopic calvarium, with the left squamosal, temporal, and zygomatic arch absent.

209.—Calvarium, ♂, adult, from Teglach Enda, Killeany, Aranmore, 1861 Royal College of Surgeons, London.

This is an imperfect calvarium of a very old man, and is remarkably heavy and dense; all the sutures are nearly entirely obliterated; the inion is prominent.

A.—Broken calvarium, probably male; the glabella not prominent; large inion; sutures simple.

B.—Broken calvarium, probably female; sutures extremely complex.

C.—Broken calvarium, undoubtedly male, with a prominent glabella and medium inion; sutures very complex and greatly obliterated.

These three fragmentary specimens were measured, and left upon the altar of Tempul Brecain, Aranmore, in September, 1892.

Sutures.—A frontal suture is present in 208.

The parietal sagittal suture is simple in 49, 50, 208, and in A; but complex in T. C. D., B, and in C; it is obliterated in 209.

The lambda suture is simple in 49, 50 and 208, but in T. C. D. there are four epactal bones, two on each side of the sagittal suture.

In 208 there is a wormian bone in the sagittal suture a short distance above the lambda suture; and along the parieto-occipital suture there are four large wormian bones on each side, and another on the right side at the junction of the suture with the squamosal; this also occurs in 49.

Pterion.—The variations in the pterion suture are of interest.

T. C. D., *right side.*—Pterion in H of Broca, with three small wormian bones at angle of the parietal, squamosal, and sphenoid bones.

T. C. D., *left side.*—Pterion in H; a small wormian bone in the parieto-fronto-sphenoid angle, and a larger triangular one at the parieto-squamoso-sphenoid angle.

49. *Right side.*—Pterion apparently in H; the lower part of the parieto-frontal suture is all but obliterated.

Left side.—Pterion in H. According to a drawing made by Mr. Grattan, there are two small wormian bones in the parieto-squamoso-sphenoid angle, but, as the skull has been sawn in this region, these bones are not now present.

50. *Right side.*—Pterion primarily in H, but with a large wormian bone, by the squamosal, which almost cuts off the parietal from the sphenoid; this condition almost precisely resembles that figured by Topinard (Eléments d'Anth. Générale, fig. 127, viii.).

Left side.—Pterion in H, with a large rhomboidal wormian bone, which completely cuts off the parietal from the sphenoid, corresponding to Topinard's (*l.c.*), fig. 127, vi.

208. *Right side.*—Pterion in H.

	♀ T. C. D.	♀ 49	♂ 50	♀ 208	♂ 209	♂ ? A.	♀ ? B.	♂ C.
Cranial Measurements.								
Glabello-occipital length,	188	187	188	181	186	194	—	205
Ophyro-occipital length,	191	186	187	180	187	—	—	—
Maximum breadth, ..	137	140·5	139	138	140	153	140	152
Basio-bregmatic height,	136·5	—	130	116	—	—	—	—
Auriculo-cranial radius,	119	120	115	—	—	—	—	—
Minimum frontal breadth,	94	96	101	105	98	100	160	—
Stephanic breadth, ..	110	114	116	119	110 ?	135	118	—
Asterionic breadth, ..	113	109	107	106 ?	108 ?	131	—	—
Frontal longitudinal arc,	134	125	126	119	—	131	123	148
Parietal longitudinal arc,	136	114	134	126	—	139	111	129
Occipital longitudinal arc,	110	134	119	107	—	122	—	130
Fronto-occipital arc (nasion to opisthion),	380	373	379	352	374	392	—	407
Foramen magnum length,	38	—	35	48	—	—	—	—
Basio-nasial length, ..	101	—	99	94·5	—	—	—	—
Auriculo-nasial radius, ..	94	95	88	—	—	—	—	—
Total longitudinal circumference,	519	—	513	—	—	—	—	—
Auriculo-bregmatic arc,	295	303	300	—	—	332	—	—
Bi-auricular breadth, ..	117	123	114·5	—	—	124	—	—
Horizontal circumference,	524	—	525	510	522	548	—	—
Facial Measurements.								
Basio-alveolar length, ..	96	—	93	—	—	—	—	—
Auriculo-alveolar radius,	99·5	97·5	95	—	—	—	—	
Bi-zygomatic breadth, ..	124 ap.	129	127 ?	—	—	—	—	—
Maximum bi-maxillary breadth,	90	92	90	—	—	—	—	—
Bi-dacryal breadth, ..	21	22	—	25 ?	—	—	—	—
Nasio-alveolar length, ..	63	65	64	59	—	—	—	—
Nasal height, ...	46	45	47	44	—	—	—	—
Nasal width, ...	23	23·5	—	21	—	—	—	—
Orbital width, ...	39 r	39 ?	—	44 r	—	—	—	—
	38 l	38 l	40? l	—	—	—	—	—
Orbital height, ...	33 r	31 r	—	34 r	—	—	—	—
	34 l	30 l	33 l	—	—	—	—	—
Palato-maxillary length,	53	51 ?	50	49	—	—	—	—
Palato-maxillary breadth,	62	59·5	63	59	—	—	—	—
Indices.								
Cephalic, ...	72·9	75·1	73·9	76·2	75·3	78·9	—	74·1
Height (basial), ...	72·3	—	69·1	64·1	—	—	—	—
,, (auricular), ..	63·3	64·2	61·2	—	—	—	—	—
Upper facial or maxillary,	50·8 ?	50·4	50·4 ?	—	—	—	—	—
,, (Virchow),	70	70·6	71·1	—	—	—	—	—
Stephano-zygomatic, ..	88·7 ?	88·4	91·3 ?	—	—	—	—	—
Gnathic, ...	95	—	93·9	—	—	—	—	—
,, (auricular,) ..	105·8	102·6	108·8	—	—	—	—	—
Palatal, ...	117	116·6 ?	126	124	—	—	—	—
Nasal, ...	500	510	—	477	—	—	—	—
Orbital (Broca), ...	84·6 r	79·5 r	—	75 r	—	—	—	—
	89·5 l	78·9 l	82·5 l	—	—	—	—	—
,, (German), ..	80·5	75·5	76·7	—	—	—	—	—

Cephalic Index $\frac{B. \times 100}{L\,(G\,.\,O)}$:—From these measurements we find that specimen T. C. D., 50, C and Dr. Beddoe's Nos. 2 and 4 (see p. 761) are Dolichocephalic. 49, 208, 209, Dr. Beddoe's 1 and 3, and A, are Mesaticephalic, the first being just within this division. The mean of the seven indices I have calculated is 75·2, and the mean of Dr. Beddoe's four calvaria is 75. (The latter measurements are admittedly rough and ready, and cannot be relied on implicitly.)

Height Index $\frac{H\,(B\,.\,B) \times 100}{L\,(G\,.\,O)}$:—T. C. D. is just within the Metriocephalic group, or well within the Orthocephalic of the Germans, whereas 50 and 208 are Tapeinocephalic, or Chamæocephalic.

The auriculo-cranial height has not yet been reduced to a system.

Upper Facial, or *Maxillary Index* :—T. C. D., 49, and 50, are all barely Leptoprosopic, taking Kollmann's stardard, $\frac{H\,(N\,.\,A) \times 100,}{B\,(B\,.\,Z)}$, and by Virchow's measurements, $\frac{H\,(N\,.\,A) \times 100}{B\,(B\,.\,M)\,x}$, they would be "narrow upper face."

Stephano-zygomatic Index.—The two female crania have practically the same index. They are all Phænozygous.

Gnathic Index $\frac{B\,.\,A \times 100}{B\,.\,N}$:—T. C. D. and 50 are Orthognathous.

No comparative terms have as yet been determined upon for the Auriculo-gnathic Index.

Palatal Index $\frac{Pb \times 100}{Pl}$:—T. C. D., 49, 50, and 208, are Brachyuranic, according to Turner's nomenclature; but so far as I can make out, 49 is Lepto-, T. C. D. is Meso-, and 50 (and, probably, 208) are Brachy-staphyline, according to the measurements adopted by Virchow.[1]

Nasal Index $\frac{Nw \times 100}{Nh}$:—208 is Leptorhine, but T. C. D. and 49 are Mesorhine.

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[1] According to the German method (*cf.* the "Frankfort Agreement"), the palatal measurement are as follows for—

	T. C. D.	49.	50.
Palatal length, ...	47,	48,	46
,, breadth, ...	38,	35,	40
,, index, ...	808,	729,	870

Naso-malar Index:—For this index I have adopted Oldfield Thomas' system (*cf.* Journ. Anthrop. Inst., xiv., 1884, p. 332). As might be expected, T. C. D., 49, and 50, are Pro-opic, *i. e.* with an index above 110, being 112 and 111·4, respectively.

Orbital Index $\frac{\text{Oh.} \times 100}{\text{Ow.}}$:—According to width measurements, taken from the dacryon,[1] 49, 50, and 208 are Microseme, while T. C. D. is just Mesoseme in the right orbit, and barely Megaseme in the left.

According to the German style (*cf.* the "Frankfort Agreement"), 49 and 50 (and, consequently, 208 also), are Chamækonch, and T. C. D. Mesokonch.

On reviewing the above facts, it will be seen, that taking them as a whole, the Aran crania may be said to come just within Kollmann's dolicho-leptoprosops; but they are by no means typical, and appear to exhibit signs of belonging to a mixed race.

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[1] The Broca-Flower method of excluding the lachrymal groove from the measurement of the orbital width fails in many ancient, or imperfectly preserved skulls. As the ascending process of the maxilla is very often intact, the dacryon would appear to be a more suitable point for measurement.

XXXIX.

THE ETHNOGRAPHY OF THE ARAN ISLANDS, COUNTY GALWAY. By A. C. HADDON, M.A. (Cantab.), M.R.I.A., Professor of Zoology, Royal College of Science, Dublin; and C. R. BROWNE, B.A., M.D., M.R.I.A.

[Read December 12, 1892.]

CONTENTS.

I.—Introduction.

When the Anthropometric Committee was first constituted, it was decided that the main portion of its work should fall into two categories:—1, the routine observations made in the Anthropometric Laboratory; and 2, researches in country districts.

An account of the work done in the Laboratory will shortly be presented to the Academy. The present communication is the first of what we hope to be a series of studies in Irish Ethnography. It is the first-fruits of the Anthropometric Laboratory in its peripatetic aspect.

It will, however, be noticed that we have in the present study far exceeded the lines of research which the Committee at first proposed for itself. We have done so in the belief that the ethnical characteristics of a people are to be found in their arts, habits, language, and beliefs as well as in their physical characters. For various reasons we do not now propose to enter into all these considerations; but we hope that the following account will give a fairly accurate, though somewhat imperfect, presentment of the anthropography and mode of life of the inhabitants of the most interesting group of islands round the Irish coast.

II.—PHYSIOGRAPHY OF THE ARAN ISLANDS.

With the exception of Achill Island, which is virtually part of the mainland, the Aran Islands in Galway Bay are the largest and most important of the western isles of Ireland. The three Aran Islands lie N.W. to S.E. in the mouth of Galway Bay in lat. 53° 10′ N., long. 9° 50′ W. They are about twenty-eight miles west of Galway Harbour.

The largest, Aranmore, sometimes, as in the Admiralty Charts, called Inishmore, or the Great Island, is about nine miles long and averages a mile and a-half in breadth. It contains 7635 acres and has a population of 1996 (census of 1891).

Inishmaan, the Middle Island, is about one-third of the size of the North Island, having 2252 acres, and a population of 456.

Inisheer, the South Island, which is two and a-half miles long by one and a-half broad at its widest portion, contains only 1400 acres, and also supports a population of 455.

The geological formation of the islands is the Upper Carboniferous Limestone. The conformation of the land is such, that towards the Atlantic there are vertical, and in places overhanging, cliffs which range up to 208 feet in height. The hills decrease by numerous terraces towards the north-east where the shore line is low. By far the greater portion of the islands is covered with bare rock, intersected in all directions by deep crevasses, sometimes a dozen or more feet in depth, which are choked with maiden-hair (*Adiantum capillus-veneris*) and other ferns, sweet grass, and various plants. In places the naked rock forms large slabs, and in others it is so fissured as to present a series of vertical ridges. Scattered all over the North Island, especially, are large, ice-borne, erratic boulders of granite and sandstone from the Connemara mountains, locally they are known as "Connemara stones."

Owing to the natural drainage of the rocks and the shallow depth of the soil a wet season is the best for the Aran farmers. If the weather is very dry a water famine may ensue, and the cattle have to be deported to the mainland.

There are a few short streams in the North Island, but a good deal of the drinking water is obtained from dripping springs.

The climate of the Aran Islands is mild and uniform; it rarely freezes, and when snow falls it does not lie. There is, fortunately for the inhabitants a heavy rain-fall which is fairly evenly distributed throughout the year. It is usually windy.

The following description of O'Flaherty's (1684) is worth quoting:—"The soile is almost paved over with stones, soe as, in some places, nothing is to be seen but large stones with wide openings between them, where cattle break their legs. Scarce any other stones there but limestones, and marble fit for tomb-stones, chymney mantle trees, and high crosses. Among these stones is very sweet pasture, so that beefe, veal, mutton are better and earlyer in season here, then elsewhere; and of late there is plenty of cheese, and tillage mucking, and corn is the same with the seaside tract [*i.e.* South Connemara]. In some places the plow goes. On the shore grows samphire in plenty, ring-root or sea-holy, and sea-cabbage. Here are Cornish choughs, with red legs and bills. Here are ayries of hawkes, and birds which never fly but over the sea; and, therefore, are used to be eaten on fasting-days: to catch which, people goe down with ropes tyed about them, into the caves of cliffts by night and with a candle light kill abundance of them. Here are severall wells and pooles, yet in extraordinary dry weather, people must turn their cattell out of the islands, and the corn failes. They have noe fuell but cow-dung dryed with the sun, unless they bring turf in from the western continent" (pp. 66-68 of Hardiman's edition, 1846). The mode of tillage in vogue on the north shore of Galway Bay, "the sea-side tract" is described on pp. 57-59; the corn grown was "wheat, barley, ry, or oats." Hardiman adds, in a footnote to p. 68: "The privations which these poor and honest islanders sometimes undergo, part of which are above alluded to by our author, are very severe; and yet you will not find any of them willing to exchange the 'bare flags' of Aran, for the comparative comforts of the inland country. . . . It is believed that the greatest human punishment that could be inflicted on an Aranite would be to sentence him never to return home."

Trees now only grow in two sheltered spots, one in Mr. Johnson's farm, the other in the Rectory garden.

According to Mr. Barry, wood, at one time, appears to have been abundant, the last trees on Gort-a-oonan quarter, Oghill townland, were cut early in the eighteenth century.

"The islands were anciently covered with wood" (according to J. T. O'Flaherty, 1824, p. 133), "as is evident from the numerous trunks of fir, pine, oak, &c., found in the peat bottoms and marshes. Wild ash and hazel grow in several places, among the rocks and cliffs. With the exception of these and a few solitary shrubs, the whole surface is quite denuded." On p. 97, in referring to the "remains of Druidism," which "abound" in the Isles of Aran, he speaks of "evident vestiges of oak groves." "They were," says Mr. Hardiman,[1] "anciently overshadowed with wood, of which there are still very evident remains."

Burke (*loc. cit.* p. 75) quotes a letter from the Rev. W. Kilbride, Rector of Aran, to the following effect:—"My little grove was planted by myself. I find the greatest difficulty in preserving it, seven trees having been destroyed this year [Dec. 11, 1886]. Then I planted every nook and cranny with evergreens; but they were plucked up three several times. I get sick of this thing. Many places in the island were covered with trees. In fact, fifty years ago or so, I have been informed that a large portion of the island grew trees, especially hazel, from twenty to twenty-six feet in height."

For the botany of the islands the papers given on p. 829 may be consulted:—J. T. O'Flaherty (*loc. cit.* p. 133) gives a short list of plants and concludes with the following:—"They have a plant, in Irish 'rineen,' in English 'fairy flax' [*Linum catharticum*], and in this they greatly confide, for its medicinal virtues, almost in all cases. The tormentil root [*Icosandria polygyhia*] serves them in the place of bark for tanning leather. . . . The kitchen-gardens are well supplied with every necessary vegetable."

III.—ANTHROPOGRAPHY.

1. METHODS.

The following is an account of the observations and measurements we made, and our method of doing so:—

(A) *Hair and Eye Colour.*—The anthropological data most readily obtainable are the colour of the hair and eyes: and they appear to

[1] "History of Galway," p. 319.

possess very considerable importance. For these observations we followed the methods suggested by Dr. Beddoe,[1] and which are the result of the very considerable experience of the veteran English anthropologist.

The marking cards introduced by Dr. Beddoe are in every way admirably adapted for field work, since they are small enough to fit in a waistcoat pocket. As the noting of an individual can be made by a single pencil mark, they admit of rapid and accurate use in situations where writing would be difficult. Each card is divided vertically into three main divisions for eye colour: light, medium, and dark, respectively. The three spaces thus formed are further sub-divided vertically into five columns for the five hair colours: red, fair, brown, dark, and black. These are indicated by the letters R. F. B. D. and N. at the heads of the columns. The card is sub-divided by a horizontal line into two equal parts—the upper for the males, the lower for the females. It is convenient to leave a space at the end of the card for the name of the locality. The back of the card can be utilized for the date and further particulars. The initialing of the card by the observer indicates that the record is completed for that card (*cf.* p. 792).

The eyes are classed as follows:—

Light.—"All blue, bluish grey, and light grey eyes."

Medium.—"Dark grey, brownish grey, very light hazel or yellow, hazel grey (formed by streaks of orange radiating into a bluish grey field), and most shades of green."

Dark.—"The so-called black eyes, and those usually called brown and dark hazel."

The following hair colours are adopted:—

Red.—"All shades which approach more nearly to red than to brown, yellow, or flaxen."

Fair.—"Flaxen, yellow, golden, some of the lightest shades of our brown, and some pale auburns in which the red hue is not very conspicuous."

Brown.—"Numerous shades of brown, answering nearly to the French *chatain* and *chatain-clair*, but perhaps less extensive on the dark side."

Dark.—"Corresponds nearly with the French *brun*, most of their

[1] The Races of Briain, a Contribution to the Anthropology of Western Europe, by John Beddoe, M.D., F.R.S., 1885.

brun-foncés, and the darkest *chatains*, and includes the remaining shades of our brown up to—

"*Black* (*Niger*).—Which includes not only the jet black, which has retained the same colour from childhood and is generally very coarse and hard, but also that very intense brown which occurs in people who in childhood have had dark brown (or in some cases deep red) hair, but which in the adult cannot be distinguished from coal-black, except in a very good light." Personally we think it would be advantageous to discriminate in some way (say by making a different mark in the N. column) between the jet-black and the black-brown.

In the present instance the hair colours were taken as nearly as possible on Dr. Beddoe's plan, there being a difficulty only on one point, and that the case of the brown hair, much of which is of a light shade, and in many cases accompanied by a light yellowish or reddish beard; and might by some have been classed as fair. Care was taken to note only such cases as could be seen fully at close quarters, and in a good light, so that there could be no mistake about the colour—a precaution very necessary for the estimation of doubtful tints, especially of the eyes. Cases in which the hair had begun to turn grey were excluded altogether; and, as far as possible, all who were not natives also: this was rendered an easy matter in most cases by the distinctive dress. It may be mentioned here that one of the most valuable means of obtaining the colours was the getting together of groups to be photographed or measured, and the noting both of them and of the members of the knot of spectators which was sure to assemble; another way was to engage in conversation with some group by the roadside or on the seashore, and note them carefully while speaking. Children (*i. e.* all apparently under eighteen) were noted on separate cards, and had a separate index and nigrescence table made out for them. The apparent difference between them and the adults, both as to index of nigrescence and the presence of black hair, is due to the progressive darkening with age of the "very dark" hair, which has been counted as black in the adults, as being only distinguishable from it in some lights, and on very close examination. In fact, from the absence of true black among the children, it is doubtful whether there is any among the adults we observed.

The Index of Nigrescence and its use are best explained in Dr. Beddoe's own words:—

"A ready means of comparing the colours of two peoples or localities is found in the Index of Nigrescence. The gross index is gotten by subtracting the number of red- and fair-haired persons from that of the dark-haired, together with twice the black-haired. I double the black in order to give its proper value to the greater tendency to melanosity shown thereby; while brown (chestnut) hair is regarded as neutral, though in truth most of the persons placed in B. are fair-skinned, and approach more nearly in aspect to the xanthous than to the melanous variety:—

$$D + 2N - R - F = \text{Index.}$$

From the gross index the net or percentage index is of course readily obtained."

Though it is not specifically mentioned in Dr. Beddoe's book which index he uses, yet, as it is evident from a glance at the tables given by him that he has used the percentage index there, the same has been employed here in all cases.

The tables given here are not formed on Dr. Beddoe's plan, but on one somewhat more minute. All the actual observations are given in their classes, as well as the percentages; and separate tables are given for males and females. To facilitate reference, however, a table on his plan is given, showing his Aran observations along with those of this expedition.

The difference apparent between the two indices must evidently be due to the smaller number (90) in the first series.

(B). *Head, Face, and Body Measurements*:—

1. *Head length.*—Taken from the glabella to the greatest diameter behind, in the middle line.

2. *Head breadth.*—The greatest breadth obtainable, the callipers being held at right angles to the middle longitudinal line. In this and in the former measurement, the points of the callipers were placed in as close contact to the skin of the scalp as was possible.

3. *Head height.*—The radius of the top of the head vertical to the ear-opening, and from its centre.

4. *Head circumference.*—The greatest horizontal circumference obtainable above the eyebrows. The tape was passed under the hair of the back of the head, and brought as close to the skin of the scalp as possible.

5. *Face length.*—From the naso-frontal suture (nasion) to the point of the chin.

6. *Face breadth.*—The greatest breadth obtainable on the zygomatic arches.

7. *Bigonial breadth.*—The distance between the angle of the lower jaw on one side and that on the other.

8. *Auriculo-nasial radius.*—The radius from the centre of the ear-hole to the nasion.

9. *Auriculo-alveolar radius.*—A similar radius to the lower border of the gums of the upper front teeth, the lips being drawn back.

10. *Nose length.*—From the nasion to the angle between the septum and the upper lip.

11. *Nose breadth.*—The greatest breadth of the nostrils, care being taken not to compress them.

12. *Internal bi-ocular or inter-caruncular breadth.*—The distance between the internal angle of both eyes.

13. *External bi-ocular breadth.*—The distance between the external angle of both eyes.

14. *Height.*—The subject stood upright on the box of the anthropometer with his back and head against the graduated rod, and with his eyes looking straight in front. Allowance was made for the pampooties which most of the men wore; or if boots were worn, the height of the heel was measured and deducted from the reading on the scale.

15. *Span.*—The measuring rod was placed along the back and the arms stretched to their fullest extent, the measurement was taken from the tip of one mid-finger to that of the other.

16. Tip of mid-finger to styloid of the right arm, the hand being held straight.

17. Styloid to epicondyle of the right arm.

The indices were calculated as follows (the numbers within the brackets refer to measurements in the foregoing list) :—

Cephalic Index, . . $\frac{\text{HB (2)} \times 100}{\text{HL (1)}} = \text{I (Index)}.$

The subtraction of two units from the ordinary formula for obtaining the cranial index, when this is employed for the living head, was proposed by Broca (Bull. Soc. d'Anthrop. (2) III. 1868), cf. Topinard, "Anthropology" (Eng. transl. 1890, p. 326). In our first column of indices we give the figures resulting from the ordinary formula, but we add a corrected list, the figures in which, are placed in arithmetical order. In discussing the Cephalic Index we make use solely of the corrected series.

Height Index, . . $\frac{HH (3) \times 100}{HL (1)} = I.$

Facial Index, . . $\frac{FB (6) \times 100}{FL (5)} = I.$

Bigonial Index, . $\frac{BB (7) \times 100}{FL (5)} = I.$

Alveolar Index, . . $\frac{AA (9) \times 100}{AN (8)} = I.$

Nasal Index, . . $\frac{NB (11) \times 100}{NL (10)} = I.$

It is hardly necessary to warn our readers that none of the above measurements or indices accurately correspond with analogous measurements made on skulls, or with the indices calculated therefrom the sole exception being in the case of the correction made for the Cephalic Index.

(c). *Instruments used.*—We took with us "The Traveller's Anthropometer," a very compact and useful instrument designed by Dr. J. G. Garson, and manufactured by Messrs. Aston & Mander, 25, Old Compton-street, London. This instrument is described in "Notes and Queries on Anthropology," Second Edition (1892), published by the Anthropological Institute. It is possible to take all the requisite measurements with this instrument, except the cranial circumference, but we preferred to use other instruments for the head measurements.

We also had with us Flower's Craniometer (made by Stanley, Great Turnstile, Holborn, London), which is a very convenient instrument for this class of measurements; a compas d'épaisseur and a compas glissière (both made by Mathieu, 113, Boulevard Saint-Germain, Paris. The former is very useful for face measurements as the rounded points of the callipers reduce any danger from accidents to a minimum. The sole objection to our instrument is that it is graduated in two millimetres, and not in single millimetres. The compas glissière is a very handy and delicate little instrument, but it can be dispensed with when a Flower's Craniometer is used.

A sliding rule, such as was first used in Galton's Anthropometrical

Laboratory, for measuring the span, was usually carried with our other apparatus. It is a little more convenient than adapting Garson's Anthropometer. Chesterman's steel tape was used for taking the horizontal circumference of the head.

Lastly, we measured the cranial height, and auriculo-nasal and alveolar radii, with Dr. Cunningham's modification of Busk's Craniometer, made by Robinson, Grafton-street, Dublin, an instrument which has been used in our Laboratory since its inception.[1]

All measurements were taken in millimetres.

(D). *General Remarks on the Methods Employed.*—The height of the head would best be taken from the ear-hole to the bregma, but in the vast majority of living subjects it is impossible to determine this spot. The measurement we took is convenient, and sufficiently definite.

The horizontal circumference was not taken round the eyebrows, but above them; it is very difficult to take a satisfactory measurement by the former method, owing to the tape slipping, and the variable development of the eyebrows.

The auriculo-radii were found to be readily taken in field-work; and none of the subjects measured absolutely objected to having the plugs of the instrument inserted into their ear-holes, although some demurred at first. Of 293 persons who have been measured in the Dublin Anthropometric Laboratory none have objected to the instrument being used. We thus already have a large series of the three measurements for which this instrument is employed. It is necessary in using this instrument to feel that it is actually pressing against the bony wall of the external auditory meatus.

The internal bi-ocular breadth we consider to be a valuable measurement, as giving the distance between the eyes. The external bi-ocular breadth was taken so as to give some idea as to the size of the eyes, but we did not find this of much practical value, and we consider it preferable to measure from the middle of the outer border of the one orbit to the corresponding point of the other.

The span, or fathom, is an interesting measurement and one readily made. We do not propose to discontinue this measurement, but it is worth bearing in mind that it is of little real scientific value, as it is a composite one, being the addition of four variables, viz. the hand, fore-arm, upper-arm, and the width of the body across the shoulders. In the laboratory, and in this expedition, we measure the

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[1] *Cf.* Proc. Roy. Irish Acad. (3), II., 1892, p. 397.

lengths of the right hand (tip of mid-finger to styloid (and of the right fore-arm (styloid to epicondyle). It is also the custom in the laboratory to measure the right upper-arm (epicondyle to acromion), but this was found to be impossible in the case of the Aran islanders on account of the thickness of their flannel sleeves. In the laboratory, also, there is great difficulty, and sometimes it is impossible, to take this measurement. When these three upper-limb measurements can be taken, the span measurement is of considerable value. These measurements, however, can only be taken by an observer who has had some anatomical instruction, and often they are very difficult to take even by a skilled observer.

(E) *Photography.*—A considerable number of photographs were obtained of the people. In some cases groups were taken, but full-face and side-view portraits were secured of thirteen of the subjects we measured. We found that the promise of a copy of their photograph was usually a sufficient reward for undergoing the trouble of being measured and photographed.

2. Physical Characters.

(A) The general physical character of the people is as follows:—

Height.—The men are mostly of a slight but athletic build; and though tall men occasionally are to be met with among them, they are, as a rule, considerably below the average Irish stature. The Aran average is 1645 mm. or about 5 feet 4¾ inches, that of 277 Irishmen is 1740 mm. or 5 feet 8½ inches.[1]

Limbs.—The span is less than the stature in a quarter of the cases measured, a rather unusual feature in adult males. The hands are rather small, but the forearm is often unusually long.

Head.—The head is well shapen, rather long and narrow; but viewed from above the sides are not parallel, there being a slight parietal bulging.

The mean Cephalic Index, when reduced to the cranial standard, is 75·1, consequently the average head is, to a slight extent, mesaticephalic; although, as a matter of fact, the number measured is nearly evenly divided between mesaticephalic and dolichocephalic. The top of the head is well vaulted, so that the height above the ears is considerable.

The forehead is broad, upright, and very rarely receding; not very high in most cases. The superciliary ridges are not prominent.

Face.—The face is long and oval, with well-marked features.

[1] *Cf.* Final Report of the Anthropometric Committee, Table III., p. 263. British Association Report, 1883.

The eyes are rather small, close together; they are marked at the outer corners by transverse wrinkles. The irises are in the great majority of cases blue or blue-gray in colour.

The nose is sharp, narrow at the base, and slightly sinuous or aquiline in profile.

The lower lip is, in many cases, rather large and full.

The chin is well developed.

The cheek-bones are not prominent.

In quite a large proportion of cases the ears, though not large, stand well out from the head.

In many men, the length between the nose and the chin has the appearance of being decidedly great.

The complexion is clear and ruddy, and but seldom freckled. On the whole, the people are decidedly good-looking.

Hair.—The hair is brown in colour; in most cases of a light shade and accompanied by a light and often reddish beard. As a rule, the hair on the face is moderately well developed.

Sight and Hearing.—The sight and hearing of the people are, as a rule, exceedingly keen, especially the former. The range and distinctness of the vision is astonishing, as we have had occasion to know; and we are informed by Dr. Kean, that on a clear day, any of the men whose eyesight is average can, with the naked eye, make out a small sailing boat at Black Head, 20 miles away, before he can see it with a good binocular.

For further details the reader is referred to the appended tables.

Certain characteristics appear to be somewhat local. For example, the hair appears to be darker in the neighbourhood of Killeany, at the south-eastern end of Aranmore; and the large, aquiline nose seems to be most common at Oghil and Oat-quarter in the middle of the same island.

Repeated inquiries tended to show that the natives of the Middle and South Islands are considered by those of the North Island to be somewhat more burly in build, and darker in colour, than those of the North Island, and they certainly are better fishermen. Our statistics, however, tend to show that the Inishmaan men are somewhat lighter than the Aranmore men. One of us, a couple of years ago, had the opportunity of seeing most of the men from the three islands collected together at Kilronan, on the North Island, as well as a fair sprinkling of Connemara men. The latter were distinguishable at a glance by their dress, and certainly they had a different build from the Aranites, and were darker in colour. The men from the Middle and South

Islands appeared, as stated above, to be distinguishable from the Inishmore men. The occasion of the gathering was a regatta in which the crews from the Middle and South Islands beat those from the North Island in the Curragh races. One Aranmore man was heard to say in extenuation of the defeat:—"It was only to be expected that them islanders would beat, as they have to go about in canoes so much"!

Dr. Beddoe paid a visit to Aranmore in 1861, and his observations are embodied in his valuable work, "The Races of Britain," from which we extract the following remarks:—"The people of the Aran Isles, in Galway Bay, have their own very strongly marked type, in some respects an exaggeration of the ordinary Gaelic one: the face being remarkably long, the chin very long and narrow, but not angular; the nose long, straight, and pointed; the brows straight, or rising obliquely outwards; the eyes light, with very few exceptions; the hair of various colours, but usually dark brown. We might be disposed, trusting to Irish traditions respecting the islands, to accept these people as representatives of the Firbolgs, had not Cromwell, that upsetter of all things Hibernian, left in Aranmore a small English garrison, who subsequently apostatised to Catholicism, intermarried with the natives, and so vitiated the Firbolgian pedigree" (p. 267); and on p. 25 he says:—"They have nearly the same long-featured, long-headed type already spoken of as common in the Belgic region of Northern France." In his third plate of types of British faces (p. 258), Dr. Beddoe gives a portrait of an Aranmore man.

Dr. Beddoe very kindly lent us the notes he took on this visit, and he has permitted us to make the following quotations therefrom:—"The inhabitants of Aranmore very much resemble each other. They are generally of good stature, with square shoulders, not very broad. Head inclining to be long and narrow; convexity above not great. Forehead rather narrow; looks square from the front, but is gently rounded from other points of view; brows straight or rising obliquely outwards, rather low. Eyes rather narrow, blue-grey, greyish blue, or dark grey. Hair in women abundant, in men not notably so; of various colours, generally dark brown. Nose of good length, straight, pointed. Mouth of good size; often open, as in Irish generally. Chin very long, narrow, but not angular at extremity; great length of jaw with remarkably little curve. Cheek-bones somewhat prominent in front."

Mr. John McElheran says (p. 161):—"I could remark about one Dane or Saxon in fifty of the population [of Co. Galway], especially in those who come from the island of Arran—a very peculiar people. . . . I give some accurate portraits of the Claddagh men, and two fishermen from the South Arran isles." At the end of the Paper, in the explanation of the Plates, we read:—"13. Arran man (Danish type). 14. Do. (Celtic type)." We are indebted to Dr. E. P. Wright for this last reference.

J. G. Barry, in the Paper we have already quoted, thus describes the people:—"The inhabitants appear to be of a mixed race; they are fair, tall, and comely."

The South Island was visited in 1852 by a late President of the Academy, Sir Samuel Ferguson. In his interesting sketch of the island (1853) he says (p. 90):—"The patches of vegetable soil which occur here and there over this rugged tract, are carefully enclosed, and generally planted with potatoes. The soil is light and sandy, but, owing to the absorption of heat by the rock, peculiarly warm and kindly; and the islanders here have had the singular good fortune never to have been visited by the potato blight; never to have had a death from destitution; and never to have sent a pauper to the poorhouse. They are a handsome, courteous, and amiable people. Whatever may be said of the advantages of a mixture of races, I cannot discern anything save what makes in favour of these people of the pure ancient stock, when I compare them with the mixed populations of districts on the mainland. The most refined gentleman might live among them in familiar intercourse, and never be offended by a gross or sordid sentiment. This delicacy of feeling is reflected in their figures, the hands and feet being small in proportion to the stature, and the gesture erect and graceful. The population consists principally of the three families or tribes of O'Flaherty, Joyce, and Conneely. . . . 'Our island is clean—there are no worms here,' were the repeated expressions of my companion. . . . To see the careful way in which the most has been made of every spot available for the growth of produce, might correct the impression so generally entertained and so studiously encouraged, that the native Irish are a thriftless people. Here, where they have been left to themselves, notwithstanding the natural sterility of their islands, they are certainly a very superior population—physically, morally, and even economically—to those of many of the mixed and planted districts.

"This practice of forming artificial fields by the transport of earth recalls the old tradition of the Fir-Volgic origin of the early inhabitants of Aran. . . . These Fir-Volg, according to their own account, were Thracians, who had been enslaved in Greece, and there employed in carrying earth in leather bags to form the artificial terrace-gardens of Bœotia. If any portion of the existing population of Ireland can with propriety be termed Celts, they are this race" (p. 91).

(B). *Statistics of Hair and Eye Colour.*

Children.—I. Boys.

Hair.	Eyes.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	3	0	0	3	2·86
Fair, ..	4	0	0	4	3·81
Brown, ..	78	1	2	81	77·14
Dark, ..	11	6	0	17	16·19
Black, ..	0	0	0	0	0·00
Totals, ..	96	7	2	105	100·00
Percentage, Eye Colours,	91·43	6·66	1·91	100	—

Index of Nigrescence, . . 9·52.

II. Girls.

Hair.	Eyes.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	3	2	0	5	4·03
Fair, ..	13	0	0	13	10·48
Brown, ..	74	2	2	78	62·91
Dark, ..	16	8	4	28	22·58
Black, ..	0	0	0	0	0·00
Totals, ..	106	12	6	124	100·00
Percentage, Eye Colours,	85·48	9·68	4·84	100·00	—

Index of Nigrescence, ... 8·07.

Combined Index (both sexes), . . 8·79.

ADULTS.—I. MALES.

HAIR.	EYES.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	4	1	—	5	3·73
Fair, ..	8	—	—	8	5·97
Brown, ..	80	3	2	85	63·43
Dark, ..	27	6	1	34	25·37
Black, ..	—	1	1	2	1·50
Totals, ..	119	11	4	134	100·00
Percentage, Eye Colours,	88·80	8·21	2·99	100·00	—

Index of Nigrescence, . . 18·57.

II. FEMALES.

HAIR.	EYES.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	1	—	—	1	1·37
Fair, ..	4	—	—	4	5·48
Brown, ..	44	1	1	46	63·01
Dark, ..	15	6	—	21	28·77
Black, ..	1	—	—	1	1·37
Totals, ..	65	7	1	73	100·00
Percentage, Eye colours,	89·04	9·59	1·37	100·00	—

Index of Nigrescence, . . 24·66.

Total, Aran Islands.—I. Males.

Hair.	Eyes.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	7	1	—	8	3·34
Fair, ..	12	—	—	12	5·02
Brown, ..	158	4	4	166	69·45
Dark, ..	38	12	1	51	21·34
Black, ..	—	1	1	2	0·85
Totals, ..	215	18	6	239	100·00
Percentage, Eye Colours,	89·96	7·53	2·51	100·00	—

Index of Nigrescence, . . 14·68.

II. Females.

Hair.	Eyes.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	4	2	—	6	3·05
Fair, ..	17	—	—	17	8·63
Brown, ..	118	3	3	124	62·94
Dark, ..	31	14	4	49	24·87
Black, ..	1	—	—	1	0·51
Totals, ..	171	19	7	197	100·00
Percentage, Eye Colours,	86·81	9·64	3·55	100·00	—

Index of Nigrescence, . . 14·22.

TABLE OF NIGRESCENCE.—INISHMAAN MEN.

HAIR.	EYES.			Totals.	Percentage Hair Colours.
	Light.	Medium.	Dark.		
Red, ..	1	1	—	2	7·41
Fair, ..	2	—	—	2	7·41
Brown, ..	14	2	1	17	62·96
Dark, ..	4	2	—	6	22·22
Black, ..	—	—	—	—	—
Totals, ..	21	5	1	27	100·00
Percentage, Eye Colours,	77·78	18·52	3·71	100·00	—

Index of Nigrescence (percentage), . . 7·40.

The women observed, 10 in number, all had brown hair and light eyes.

Age.	Number.	Sex.	Light Eyes.					Eyes Light.	Medium Eyes.					Eyes Neuter.	Dark Eyes.					Eyes Dark.	Index of Nigrescence.
			Red.	Fair.	Brown.	Dark.	Black.		Red.	Fair.	Brown.	Dark.	Black.		Red.	Fair.	Brown.	Dark.	Black.		
* Adult, .	90	both.	3·9	11·1	25·6	30·6	4·4	75·6	—	—	3·3	10	3·3	16·6	—	—	—	5	2·8	7·8	51·6
† Adult, .	207	both.	2·4	5·8	59·9	20·3	·5	88·9	·5	—	1·9	5·8	·5	8·7	—	—	1·4	·5	·5	2·4	22·6
† Children,	229	both.	2·6	7·4	66·4	11·8	—	88·2	·9	—	1·3	6·1	—	8·3	—	—	1·7	1·7	—	3·4	8·8

* Dr. Beddoe. † Anthropological Laboratory.

(c). *Detailed List of Measurements.*

No.	Name.	Village.	Age.	Eye Colour.	Hair Colour.	REMARKS.
1	Dirrane, Michael, ...	Oghil, ..	18	blue-grey,	brown, ..	curved nose. Plate XXIV.
2	,, Roger, ...	,, ..	25	,,	,, ..	brother to former. ,,
3	,, Anthony, ...	,, ..	50+	,,	,, ..	aquiline nose. ,,
4	,, John, ...	Oat Quarter,	38	,,	dark brown.	
5	Gangly, Patrick, ...	Kilronan,	40	,,	brown.	
6	Faherty, John, ...	Inishmaan,	45	,,	,,	
7	Folan, Barton, ...	,,	30?	,,	light brown.	
8	Magher, Thomas, ...	,,	74	,,	brown, ..	sagittal depression; acrocephalic.
9	Mulkerrin, Thomas, ..	,,	17?	blue, ..	,,	
10	Connelly, Michael, ...	,,	65	grey, ..	,,	Fig. 5, Plate XXIII.
11	Faherty, Martin, ...	,,	65	blue, ..	grey.	
12	Folan, Roger, ...	,,	30	grey, ..	dark brown.	
13	O'Flaherty, Michael, ..	Killeany, ..	40?	,, ..	brown.	
14	Joyce, William, ...	Eararna, ..	47	,, ..	,, ..	reddish beard.
15	,, Patrick, ...	,,	36	blue, ..	dark brown,	brown beard.
16	Connelly, Bartley, ...	,,	27	blue-grey,	brown.	
17	O'Donnell, John, ...	,,	47	blue, ..	dark brown,	beard, dark brown.
18	Hernon, Tom, ...	Kilronan,	50?	grey, ..	,,	
19	Cook, Michael, ...	,,	25	,, ..	,,	nose straight; slightly scaphoceph.
20	Gill, John, ...	,,	36	blue, ..	brown.	
21	Hernon, Michael, ...	,,	17	blue-grey,	dark brown,	son to Tom (18).
22	Dillane, Patrick, ...	,,	45	,,	,,	
23	Connelly, Tom, ...	,,	75	grey, ..	grey, ..	brown, when younger.
24	Folan, Peter, ...	,,	63	,, ..	,,	dark brown, when younger.
25	O'Donnell (John), Michael,	Oghil, ..	53	blue-grey,	,,	dark brown, when younger. Pl. XXII.
26	Flaherty, Thomas, ...	Cowragh,	40	grey, ..	light brown,	red whiskers.
27	Mullin, Michael, ...	Kilronan,	21	blue, ..	brown, ..	reddish beard. Figs. 3, 4; Pl. XXII.

No.	Cephalic. Length.	Cephalic. Breadth.	Cephalic. Height.	Cephalic. Circ.	Facial. Length.	Facial. Breadth.	Facial. Bigonial.	Facial. Sub-nasal.	Auriculo. Nasal.	Auriculo. Alveolar.	Nasal. Length.	Nasal. Breadth.	Ocular. Int.	Ocular. Ext.	Body Height.	Fore-limb. Span.	Fore-limb. Hand.	Fore-limb. Forearm.
1	192	154	128	—	134	136	109	68	99	95	66	34	32	92	1812	—	—	—
2	196	155	132	—	129	138	112	68	98	94	61	33	28	90	1718	—	—	—
3	194	152	139	—	122	133	110	63	97	95	59	35	30	89	1629	—	—	—
4	202	156	131	—	137	137	112	82	94	100	55	31	28	89	1641	1740	—	—
5	202	151	125	578	122	140	116	68	102	105	54	36	30	92	1695	1666	189	236
6	204	155	134	590	126	148	130	58	106	107	68	34	30	90	1751	1810	195	265
7	206	153	136	590	143	148	126	83	104	106	60	40	32	96	1875	1890	210	315
8	174	148	120	532	130	128	104	74	94	92	56	34	29	86	1642	—	182	260
9	194	145	127	545	126	132	112	68	101	99	58	34	34	94	1716	1770	197	257
10	198	163	132	590	148	148	124	92	99	98	56	34	38	98	1727	1882	208	260
11	194	150	118	561	120	139	116	66	97	98	54	34	29	89	1565	1540	177	245
12	199	148	133	572	121	133	109	67	95	100	54	37	31	88	1679	1640	184	240
13	201	157	130	578	133	134	110	75	92	95	58	31	27	91	1707	—	191	295
14	196	150	133	568	136	144	114	77	109	99	59	32	30	84	1762	1762	192	280
15	200	148	138	577	133	144	118	75	103	105	58	37	30	96	1787	1820	203	281
16	189	154	132	550	126	133	113	73	97	97	53	33	36	89	1708	1718	191	253
17	196	151	132	574	138	138	118	78	99	94	60	32	31	91	1660	1587	1884	250
18	207	155	134	590	122	139	109	64	104	102	58	32	29	89	1706	1702	196	248
19	196	145	129	561	133	137	110	76	90	100	57	33	29	89	1759	1825	209	270
20	199	157	130	580	132	139	105	74	98	106	58	33	27	90	1676	1703	187	245
21	201	153	137	574	129	135	108	75	102	102	54	34	32	90	1780	1835	199	254
22	204	146	128	573	125	137	106	69	100	100	56	35	33	91	1735	1830	193	266
23	202	152	128	573	133	135	105	73	95	103	60	35	34	90	1660	1742	201	255
24	192	153	133	560	119	130	112	64	96	104	55	36	32	89	1697	1781	189	280
25	206	160	133	589	138	148	112	78	105	103	60	31	32	89	1717	1755	192	248
26	203	156	130	580	126	140	110	70	96	98	56	32	30	84	1650	1608	183	232
27	192	148	132	563	127	131	114	69	95	96	58	33	28	85	1652	1625	187	235

No.	Indices.						Proportions to Stature. Height = 100.				
	Cephalic.	Height.	Facial.	Bigonial.	Alveolar.	Nasal.	Hand.	Forearm.	Span.	Face.	Nose.
1	80·2	66·7	101·4	81·3	96	51·5	—	—	—	7·39	3·64
2	79·1	67·3	106·9	86·8	95·9	54·1	—	—	—	7·50	3·55
3	78·4	71·6	109	90·1	97·9	59·3	—	—	—	7·48	3·62
4	77·2	64·9	100	81·7	106·4	56·4	—	—	106·03	8·34	3·35
5	74·8	61·9	114·7	95	102·9	66·7	11·15	13·92	98·23	7·19	3·18
6	76	65·7	117·5	103·1	100·9	50	11·14	15·14	103·36	7·19	3·88
7	74·3	66	103·5	81·1	101·9	66·6	11·20	16·80	100·80	7·62	3·20
8	85·1	69	98·4	80	97·9	60·7	11·08	15·77	—	7·91	3·47
9	74·7	65·5	104·7	88·8	98	58·6	11·40	14·97	103·14	7·34	3·38
10	82·3	66·7	100	83·7	99	60·7	12·04	15·05	108·91	8·56	3·24
11	77·3	60·8	115·8	96·6	101	63	11·30	15·65	98·33	7·66	3·45
12	74·4	66·8	109·9	90·1	105·3	68·5	10·96	14·35	97·01	7·26	3·21
13	78·1	64·7	100·7	82·7	103·3	53·4	11·13	17·28	—	7·79	3·45
14	76·5	67·9	105·8	83·8	90·8	54·4	10·90	15·87	100·28	7·71	3·34
15	74	69	108·2	88·7	101·9	63·8	11·30	15·72	101·84	7·44	3·24
16	81·5	69·8	105·5	89·6	100	62·3	11·10	14·81	100·58	7·37	3·10
17	77	67·3	100	85·5	94·9	53·3	11·08	15·06	95·60	8·31	3·61
18	74·8	64·7	113·9	89·4	98·1	55·2	11·43	14·53	99·76	7·15	3·40
19	74	65·8	103	82·7	111·1	57·8	11·31	15·34	103·75	7·56	3·24
20	78·9	65·3	105·3	79·5	108·2	56·9	11·09	14·67	101·67	7·87	3·46
21	76·1	68·2	104·6	83·7	100	63·0	11·18	14·29	103·09	7·24	3·03
22	71·6	62·7	109·6	84·8	100	62·5	11·01	15·33	105·47	7·20	3·22
23	75·2	63·4	101·5	78·9	108·4	58·3	12·16	15.36	104·93	8·04	3·61
24	79·7	69·3	109·2	94·1	108·3	65·4	11·13	16·49	104·83	7·01	3·24
25	77·7	64.6	107·2	81·1	98·1	51·7	11·18	14·44	105·47	8·09	3·49
26	76·8	64	111·1	87·3	102·1	57·1	11·09	14·06	102·21	7·63	3·39
27	77·1	68·8	103·1	89·7	101·1	56·9	11·32	14·22	97·57	7·69	3·51
Mean	77·1 (75·1)	66·2	106·3	86·9	101·1	58·5	11·24	15·18	101·94	7·61	3·38

Cephalic Index, Corrected for Comparision with Skulls.

		A. Corrected Indices.	B. Actual Indices.
8	83·1	2 Brachycephalic.	4 Brachycephals.
10	80·3		
16	79·5	11 Mesaticephalic.	
1	78·2		
24	77·7		14 Mesaticephals.
2	77·1		
20	76·9		
3	76·4		
13	76·1		
11	75·3		
4	75·2		
27	75·1		
17	75·0		
26	74·8	13 Dolichocephalic.	
14	74·5		
21	74·1		
6	74·0		
23	73·2		
5	72·8		9 Dolichocephals.
18	72·8		
9	72·7		
12	72·4		
7	72·3		
15	72·0		
19	72·0		
25	70·8		
22	69·6	1 Hyper-Dolichocephalic.	

(D). *Analysis of the Statistical Tables.*—An analysis of some of these indices and figures brings out some interesting points.

It is generally agreed that the natives of the Middle Island (Inishmaan) and the South Island (Inisheer) have been less subject to foreign influence than those of the North Island (Aranmore); consequently we should expect to find them more uniform in their characters.

Unfortunately the weather prevented us from visiting the South Island; and in the Middle Island we obtained but seven measurements.

In order to test the difference between the men of the Middle Island and those of the North Island we have drawn up the following tables. We have placed the Middle Island men first, and the North Island districts in succession from the south-east to the middle of the island:—

Locality.	Brachy.	Mesati.	Dolicho.	Hyper-dol.
Inishmaan, . .	2	1	4	—
Earnarna, . . .	—	2	2	—
Killeany, . . .	—	1	—	—
Kilronan, . . .	—	3	5	1
Oghil, etc., . .	—	5	1	—

The arithmetical mean cephalic index (corrected) of the three classes of Inishmaan men is as follows:—Brachy, 81·7; mesati, 75·3; dolicho, 74·8; the total mean being 75·8, which would make them mesaticephalic, but with the wide range of from 83·1 to 72·3. The mean head-height index is 65·8.

We have also calculated the arithmetical mean of the face-indices of the Inishmaan men, but in these we have omitted Thomas Magher, No. 8, as his age (74) would affect the normal average.

The following figures may be compared with the total Aran means:—Facial Index, 108·5; Bigonial Index, 90·6; Alveolar Index, 101; Nasal Index, 61·3.

The arithmetical mean height of the seven Inishmaan men is 1708 mm. (5ft. 7in.), but one of these is 74 years of age and much bent; if he be excluded the height is raised to 1718 mm., or 5ft. 7½in. The average height of the twenty Aranmore men is 1621 mm., or

5ft. $3\frac{3}{4}$in., and the mean of sixteen spans is 1731 mm., or 5ft. 8in. The average of six spans is 1722 mm., or 5ft. $7\frac{3}{4}$in., but this is probably too low a figure.

To complete our comparison we add the statistics of the eye and hair colours of Inishmaan.

R	F	B	D	N	R	F	B	D	N	R	F	B	D	N	
1	2	8	4	—	1	1	2	—	—	—	—	1	—	—	Inishmaan.
—	—	10	—	—	—	—	—	—	—	—	—	—	—	—	

The Nigrescence of this island is, as may be seen from the table, 7·40, as against the Aran index for adult males of 18·57, thus showing a lighter pigmentation.

We think this includes all the more important distinctions between the men of Inishmaan and those of Aranmore. This analysis was made out after the general remarks on the physical features were written and the statistics support the conclusions there stated.

Finally, we would like to draw attention to certain proportional measurements which have some interest.

These are worth notice in that they in many respects differ from the accepted artistic canons, and also from the European proportions of Quetelet and Gould, in some cases to a considerable extent (Topinard, pp. 329–334; and Windle, "Proportions of the Human Body, p. 39)." The ethnological value of proportional measurements is well established. The stature is taken as the standard and as equaling 100.

Face.

Face.—The proportion borne by the face-length to stature is interesting, the whole face being evidently very long, as the average is 7·56 instead of 6·60 as given by Topinard, and 6·90 the proportion found by Quetelet in his observations on adult male Belgians. It is fairly constant, but varies between 8·56 and 7·01.

Nose.—This is very constant in its proportion and subject to but slight variation On the average it bears the exact French artistic mean of 3·38.

N.B.—From this it is evident that the variations in face proportion must be due to irregularities in the length of the sub-nasal portion.

FORELIMB.

Span.—This is as decidedly short on the whole, the average being only 101·9, as compared with 104·6, the figure obtained by Gould from the measurement of 827 Irish soldiers, and 104·5 by Quetelet on Belgians. It varies considerably, however, the extremes being 97·01 and 106·03. In six cases out of the twenty-two it is less than the stature, a very high proportion.

Hand.—This is a rule decidedly short, giving the mean of 11·24 to the 11·5 of the canon (French) and of Quetelet's observations. It ranges between 12·16 and 10·9, though it is only above 11·40 in two cases and below 11 in two.

Forearm.—This is often unusually long and bears only an eccentric relation to stature. On the average it is 15·18, but varies between 17·28 and 14·06.

3. VITAL STATISTICS (GENERAL AND ECONOMIC).

(A.) *Population.*—The population of these islands like that of Ireland in general is a decreasing one, the rate of decrease having been much larger during the last decade than what it was before that period. The falling off in population and number of houses occupied in the whole period since 1841 amounts to 17·44 and 9·50 per cent. respectively, of which a loss in population of 7·27 per cent., and in houses of 4·79 per cent., has occurred in the decennial period, 1881–1891.

The following table shows the population at each census since 1841, with the number of houses occupied, the average number of inhabitants per house, and the number of acres per head at each decennial period. The two latter we give to illustrate the density of the population :—

Census.	Population.	Houses.	Inhabitants. per house.	Acres per head.
1841	3521	621	5·67	3·20
1851	3339	633	5·27	3·38
1861	3299	656	5·02	3·42
1871	3049	592	5·15	3·70
1881	3163	593	5·33	3·56
1891	2907	562	5·17	3·88

That the decrease shown here is solely due to emigration is evidenced by the return of births and deaths, which in the period 1881 to 1890 amounted to—births, 848, and deaths, 517, or an excess of births over deaths of 331, or 39·03 per cent. The population in 1821, however, was 3079 (cf. Hardiman's note on p. 5 of O'Flaherty's H. Iar Connaught); and in 1815 it was 2400.

When one of us was in Aran a couple of years ago he noticed that the old village of Killeany was remarkable for the number of extremely old people and children, large numbers of the young and middle-aged people having emigrated to America.

In St. Eany's graveyard, Killeany, is a grave with the following inscription :—"Michael Dirrane, who departed this life in the 119th year of his age—1817."

The total area of the islands is 11,288 acres, and the present population (census 1891) 2907; males, 1542; and females, 1365, distributed as follows:—

Island.	Acres.	Population.			Houses.
		Total.	Males.	Females.	
Inishmore, .	7635	1996	1048	948	397
Inishmaan, .	2252	456	240	216	84
Inisheer, . .	1400	455	254	201	81

In 1871 there were 27 more males than females, and in 1891 the number of males exceeded that of the females by 177.

(B) *Acreage and Rental.*—The rental of Aranmore is £1433 18*s.* 1*d.*, that of Inishmaan is £423 18*s.* 5*d.*, and that of Inisheer £227 14*s.*, the gross total being £2085 10*s.* 6*d.*

It will be seen from these statistics that taking the number of houses at 562, there is an average acreage of 20 A. 0 R. 13½ P. to each house of five persons, and the corresponding average rental is £3 14*s.* 2½*d.*

The density of the population to the square mile is 171, that of county Galway is 87 and for the whole of Ireland 146. It should be borne in mind that much of the land in the Aran Islands is unprofitable, but how much is not easily estimated, and this naturally raises the density of the population in proportion to the profitable area.

According to Mr. J. G. Barry "the rents were fixed some ninety years ago at rates varying from £4 3*s.* to £2 10*s.* per cannogarra on the supposition that a cannogarra or holding could feed a cow with her calf, a horse, and some sheep for their wool and give sufficient potatoes to support one family." The north island is divided into four townlands, Onagh, Kilmurvey and Killeany, each townland is divided into 6 carrows and each of these again into 4 cartrons, which are themselves further sub-divided into 4 cannogarras. Thus each townland contains 96 cannogarras. The cannogarras of Aranmore average from about eleven to over thirteen acres, those of Inishmaan average eleven acres, while the cannogarra of Inisheer has over fourteen acres.

According to Barry (1885, p. 488) early in the eighteenth century Simon Digby, Bishop of Elphin, purchased for £8200, the interests of Sir Stephen Fox and John Richard Fitzpatrick in these islands. The present owner is the Hon. K. Digby St. Lawrence.

John T. O'Flaherty (1824) states:—" These several islands are the estate of Mr. Digby (John William Digby of Landenstown in the county of Kildare). This gentleman is considered one of the best of landlords. He allows annually 20 guineas to schoolhouses for the instruction of orphans; and £20 annually for clothing the poor, with other pecuniary donations. His annual rental, on the islands, is £2700. Mr. Thomson, his agent, visits them twice a-year, not only to receive rents, but to adjust all differences. The quit and crown rents of the isles is £14 17*s.* 0¾*d.*" (p. 137). On p. 93 we find the following:—

"On 9th September [1662], 21st, Charles II. the King, by patent under the Act of Settlement, granted unto Richard Earl of Aran the great island, containing as followeth:—viz. 6 quarters of Killeny 153 acres profitable, 211 A. 2 R. unprofitable. Oghill 6 quarters, 227 acres profitable, 620 acres unprofitable. Killmoacre alias Kilmurry 6 quarters, 308 acres profitable, 504 A. 2 R. unprofitable. Ogheught 6 quarters, 214 acres profitable, 512 acres unprofitable. The island of Inishmaine containing the four quarters of Kilcannon, 258 A. 2. R. 20 P. Lorke 4 quarters, 177 A. 2 R. profitable, 257 A. 3 R. unprofitable. In the small island 4 quarters 123 acres profitable. Total, 2376 A. 1 R. 7 P. statute measure, all situate in the half barony of Aran and county of Galway, at the annual rent of £14 7*s.* 0½*d.* payable to the King, his heirs, and successors."

From the foregoing quotation it appears that 200 years ago 1461 A. 0 R. 20 P. were profitable and 2105 A. 3 R. were unprofitable, these totals do not agree with the reputed "total, 2376 A. 1 R. 7P. statute measure"; but the proportion shows that a considerable ratio of the land was useless. It would be interesting to know, if it could be determined, what portion of the land is actually of no value.

Burke (1887, pp. 66-70) quotes from the Report of the Land Commission of June, 1885, that Michael O'Donel's holding contained twenty-two acres, five of which were nothing but rocks and stones, without one blade of grass in them, so that it was seventeen acres of productive land he had, at an annual rental of £3 18*s.* 6*d.* The Court reduced it to £2 7*s.* 6*d.*, being 39·75 per cent. reduction. This is stated to be a typical case.

Wilde (1857) says:—" Of the entire area of the Aran Isles, amounting to 11,288 acres, only 742 were under crops, of which 692 were sown with potatoes in 1855." This, probably, is what Martin Haverty (1859, p. 7) refers to when he says:—" Little more than 700 [acres, in the Aran Isles] are productive."

(c) *Language and Illiteracy:—Language.*—2572 persons or 88·47 per cent. of the population are returned at the last census as speaking Irish, of whom 772 persons, 390 males and 382 females, speak Irish only; and 1800, 963 males and 837 females, both Irish and English. The return does not state the numbers on each island but the proportion speaking Irish only must be least on Aranmore, and is probably greatest on Inishmaan.

" *Illiteracy.*"—The population above five years of age amounts to 2552 of whom 1128 or 44·20 per cent. are returned as illiterate. These are distributed as follows:—

	Inishmore.			Inishmaan.			Inisheer.		
	Total.	Male.	Female	Total.	Male.	Female	Total.	Male.	Female
Number above 5 years, ..	1758	918	840	408	217	191	386	212	174
Illiterates, ..	799	415	384	189	84	105	140	75	55
Proportion per cent, ..	45·4	45·2	45·7	46·3	38·7	55·0	36·3	35·4	32·0

These figures show, as might have been expected, a much lower rate of illiteracy among the males than among the females.

Of the three islands it will be observed that there is least illiteracy on Inisheer, while Inishmore and Inishmaan have exactly the same proportion, the former having a higher rate among the males than the latter.

POPULATION TABLE, O'Flaherty (1824), p. 140.

DENOMINATIONS.	HOUSES.				PERSONS.			OCCUPATIONS.				SCHOOLS.		
												Pupils.		
	Inhabited.	Families.	Uninhabited.	Building.	Males.	Females.	Total of Persons.	No. of Persons chiefly employed in Agriculture,	No. of Persons chiefly employed in Trades, Manufactures, or Handicrafts.	No. of all other Persons occupied.	Total Number of Persons occupied.	Males.	Females.	Total.
Inisheer, ..	59	61	5	1	218	199	417	71	48	68	187	31	9	40
Inishmaan, ..	62	65	—	1	198	188	386	105	83	37	225	19	1	20
Killeany, ..	178	185	6	—	545	518	1063	123	160	191	474	46	12	58
Oaghill, ..	66	68	3	—	211	176	387	82	38	39	159	46	23	69
Kilmurvay, ..	68	72	—	—	231	200	431	104	46	29	179	—	—	—
Onought, ..	65	66	1	—	209	186	395	118	78	16	212	19	8	27
	498	517	15	2	1612	1467	3079	603	453	380	1436	161	53	214

(D) *Health.*—We regret to be unable to give any figures of the prevailing diseases especially the causes of death, but the following information has been kindly afforded us by Dr. Kean, the medical officer of the islands :—

The inhabitants of one island do not as a rule intermarry with those of another, and as, owing to their insolated position marriages between the natives and the people of the mainland are not common, but little fresh blood can have been introduced for generations. The people of each locality are more or less inter-related, even though marriages between those of close degrees of relationship may not be usual.

For these reasons it might be expected that this homogeneity of strain would produce some of the effects usually attributed to consanguineous unions, but with the exception of the great similarity in personal appearance which is observed among them, there seems to be no appreciable result from the in-breeding.

The population seems on the whole to be an unusally healthy one. *Idiocy and imbecility* are not common, there being but two cases on the islands, both imbeciles, but possessed of a certain amount of shrewdness.

Epilepsy is said to be rare.

Insanity is not very common. In September, 1892, there were seven cases, four males and three females, or one in 415 of the population. All these were in Ballinasloe Asylum. There is no reason for assigning alcoholism as an exciting cause in any of these cases, nor was consanguinity of parents alleged as a cause.

There is one case of deaf mutism: both parents and grand-parents said to have been relatives.

The condition of the islanders, as regards the most easily ascertainable infirmities, idiocy, insanity, deaf mutism and blindness, is best shown by comparison of the proportions borne to population by the same in county Galway and in Ireland at large, as given in Report on Census, 1891, Part II. :—

	Blind.	Insane.	Idiotic.	Deaf and dumb.
Aran, 1 person in every ..	1453[1]	415	1453	2907
Galway, ,, ,, ..	902	408	789	1248
Ireland, ,, ,, ..	881	315	754	1398

[1] None congenital.

Hare-lip.—Of this there are four cases (all young people), double in each instance, and accompanied by cleft palate. Two of these are in one family in Aranmore, both very bad cases.

"*Constitutional*" *Diseases.*—Cases of phthisis are very few, and there is but little struma. Malignant disease not seen. Rheumatism very rarely met with.

Dietetic Diseases.—Dyspepsia and dilatation of the stomach are extremely common, due, no doubt, to the large proportion of vegetable food in their dietary, and aggravated by the tea which has come greatly into use of late years; it is drunk very hot and strong, and without milk: a habit which often gives rise to severe gastralgia.

Respiratory Diseases.—Cases are not very numerous.

Local.—These cannot be said to be either common or many. *Eye:* There are two or three cases of cataract; and conjunctivitis, especially the granular form, is pretty common among children, and aggravated by the peat smoke of the cabins. *Teeth:* Though the incisors are even and white, in young people and women give much trouble: the molars and bicuspids being very subject to caries, and abscess of the alveolus being extremely common.

Venereal affections may be said to be practically unknown.

Naturally, owing to the mode of life, fractures and other injuries are fairly common.

The following account given by J. T. O'Flaherty, 1825 (p. 132), is interesting in this connexion:—"The general longevity of the inhabitants proves the excellent temperature of the air. There is a late instance of an Aranite having died at, or about, the age of one hundred and fifty. It was this excellence of climate that gave rise to the fable of incorruptibility, in these islands, of all dead and uninterred bodies, such as Cambrensis and others have foolishly related. This quality of the air, together with sobriety and industrious habits, accounts for the hardiness, strength, and activity of the inhabitants. Here nothing is known of the gout, rheumatism, &c., nor of any of those artificial diseases which idleness and intemperance engender among the more opulent and self-called civilized classes."

4. Psychology.

We believe the following to be a fair and unbiassed description of their psychology. This is a very difficult and delicate subject, but it must not be ignored in an investigation of this nature. Our remarks apply to Inishmore.

Naturally to the casual visitor the inhabitants show to their best advantage, and to such they appear as a kindly, courteous, and decidedly pleasing people. Though begging is becoming more prevalent than formerly, owing to the opening up of the island to tourists, a pleasant independence is often exhibited. We believe them to be "good Catholics." They have had the character of being exceptionally honest, straightforward, and upright. On the other hand, we have been told that the men have no unity or organisation, that they are cunning, untrustworthy, and they certainly are very boastful when in liquor. They rarely fight, but will throw stones at one another. Occasionally the old people are badly treated; and when an old man has made over his farm to his married son, the young people have been known to half-starve him, and give him the small potatoes reserved for the pigs. The men do not appear to have strong sexual passions, and any irregularity of conduct is excessively rare: only five cases of illegitimacy having been registered within the past ten years. There is no courtship or love-making, marriages being suddenly arranged for, mainly for unsentimental reasons. The marriages appear to be as happy as elsewhere; and the women can quite hold their own with the men.

There are no indications that the æsthetic sense is well developed among the people. They appear to be distinctly non-musical, as is evidenced by the fact that there is no piper, fiddler, or musician of any sort on the islands. Miss Banim remarks that the art of music "is almost unknown there. Rarely I heard a song, and then but a curious, wild 'croonaun,' like the moaning of the wind at sea; but I never heard a musical instrument. Yet in speaking, the voices of the natives are very soft and low. Occasionally at a wedding or some such festival songs are sung" (p. 146). The children, so far as we could see, do not appear to play games. The men and lads occasionally play at "fives."

Sir Samuel Ferguson says of the people:—"The people themselves, so fine-natured, genial, and intelligent, are more worthy of regard than all their monuments from the fifth century downwards.

. . . The same obliging disposition that characterizes the people of the less frequented islands, shows itself in equally amiable ways among the inhabitants of Arran More" (*loc. cit.* p. 496).

Dr. Petrie gives a pleasing picture[1] of the native character:—"They are a brave and hardy race, industrious and enterprising. . . . They are simple and innocent, but also thoughtful and intelligent; credulous, and, in matters of faith, what persons of a different creed would call superstitious. Lying and drinking, the vices which Arthur Young considers as appertaining to the Irish character, form at least no part of it in Aran, for happily their common poverty holds out less temptation to the one or opportunity for the other. I do not mean to say they are rigidly temperate, or that instances of excess, followed by the usual Irish consequences of broken heads, do not occasionally occur; such could not be expected, when their convivial temperament and dangerous and laborious occupations are remembered. They never swear, and they have a high sense of decency and propriety, honour and justice. In appearance they are healthy, comely, and prepossessing; in their dress (with few exceptions), clean and comfortable; in manner serious yet cheerful, and easily excited to gaiety; frank and familiar in conversation, and to strangers polite and respectful; but, at the same time, free from servile adulation. They are communicative, but not too loquacious; inquisitive after information, but delicate in seeking it, and grateful for its communication." Dr. Petrie then continues with several charming and sympathetic descriptions of the character of a few individuals.

Dr. Petrie also writes:—"The result of much inquiry and attentive observation was a conviction, that though from recent circumstances the brightness of this picture [primitive simplicity, ingenuous manners, and their singular hospitality] should now be somewhat lessened, and that the Araners can no longer be considered the simple race unacquainted with crime, such as they were generally depicted, yet that enough still remains of their former virtues to show that the representations of them were but little, if anything, exaggerated.

"The introduction, a few years since, of a number of persons into Aranmore for the purpose of erecting a lighthouse, has had an injurious effect on the character of the native inhabitants of the island. Their unsuspicious confidence and ready hospitality were frequently taken advantage of and abused, and their interesting

[1] Stokes' Life of Dr. Petrie, pp. 49, 50.

qualities have consequently been in some degree diminished. Till that time robbery of any kind was wholly unknown in the island. 'Such was their honesty,' said one who has passed his life amongst them, 'that had a purse of gold been dropped in any part of the island there would have been no uneasiness felt respecting its safety, as assuredly it would be found at the chapel on the Sunday or holiday following, no instance having ever occurred of anything lost not being restored in that manner.' There is some reason to doubt that this would be so now. Several petty thefts have occurred, and though they have uniformly been attributed by the islanders to the strangers lately settled among them, it would perhaps be rash to conclude that they themselves have hitherto wholly escaped the vicious contagion . . . . . . (p. 50). Much of their superiority must be attributed to their remote, insular situation, which has hitherto precluded an acquaintance with the vices of the distant region, ... they are to be considered, not as a fair specimen of the wild Irish of the present day. ['The wild Irish are at this day known to be some of the veriest savages in the globe!!!'—*Pinkerton's History*], but rather as a striking example of what that race might generally be under circumstances more happy."

Since Dr. Petrie's visits (1821 and 1857) the Aranites have come still more under the influence of foreigners, and even politics are not unknown.

Dr. Stokes (1868, p. 48) says:—"For the last ten years, out of a population of 3300, and with only one magistrate, the committals to prison have not annually averaged one per thousand of the people, and not one has been sent for trial at assizes or quarter sessions."

The following quotation from a letter from Philip Lyster, Esq., Barrister-at-Law, Resident Magistrate of the district in which Aran is situated, to Mr. Burke (cf. "The South Isles of Aran," p. 59) is of considerable interest:—

"The Aran islanders, as a body, are an extremely well-behaved and industrious people. There are sometimes assaults on each other, which invariably arise out of some dispute in connexion with the land, and are generally between members of the same family. There are very few cases of drunkenness. I have known two months to elapse without a single case being brought up. I should say that for four years, speaking from memory, I have not sent more than six or seven persons to jail without the option of a fine. There is no jail on the islands. We hardly ever have a case of petty larceny. I remember only one case of potato stealing; when the defendant was sent for trial and punished. There are often cases of alleged stealing of seaweed in some *bonâ fide* dispute as to the ownership, which we then leave to arbitration by mutual consent. I know very little of the history of the islands. In the last century justice used to be administered by one of the O'Flaherty family, the father of the late James O'Flaherty, of Kilmurvy House, Esq., J.P. He was the only magistrate in the islands, but ruled as a king. He issued his summon for 'the first fine day,' and presided at a table in the open air. If any case deserved punishment, he would say to the defendant, speaking in Irish: 'I must transport you to Galway jail for a month.' The defendant would beg hard not to be transported to Galway, promising good behaviour in future. If, however, his worship thought the case serious, he would draw his committal warrant, hand it to the defendant, who would, without the intervention of police or anyone else, take the warrant, travel at his own expense to Galway, and deliver himself up, warrant in hand, at the county jail. I am afraid things are very much changed since those days."

For a comparison of the character of the natives of the three islands with one another, we are obliged to again quote from Dr. Petrie:—

"The proximity of the island of Innisheer to the Clare coast, rendering an intercourse with the parent country easy, has long given to the inhabitants of that island a somewhat distinctive character, not more remarkable in the Munster dialect of the Irish which they speak, than in the superior shrewdness, marked with occasional want of principle, which causes them to be dreaded in their dealings, and in some degree disliked by the other islanders. Of the existence of this peculiar sharpness as well as desire for gain, not at all observable in the other islanders, I had myself sufficient opportunity of judging.

"In the island of Innishmain alone, then, the character of the Aran islander has hitherto wholly escaped contamination, and there it still retains all its delightful pristine purity" (p. 49).

5. Language.

An ethnographical description of a people is not complete without their language being taken into account. We are not competent to say anything on this subject, but merely give one or two abstracts from previous writers. Writing in 1824, O'Flaherty says:—"The Irish is the only language in the islands, where it is full of primitive words, not intelligible even on the neighbouring continent" (p. 138). More recently, Barry (1886, p. 490) found, as is at present the case, that Irish is most generally spoken by the people to one another: one woman informed us that she had never spoken in English to her husband; the majority, however, can understand and speak English, but their "vocabulary is very simple and limited, and in their idiomatic expressions they rather resemble the Highlanders of Scotland."

Folk Names.

In reply to our request, Sergeant Wm. Law, of the Royal Irish Constabulary, has kindly made a list of the names which occur among the Aran islanders. In his letter he writes:—

"I forward a list of the surnames of the people of these islands. The frequency of the names as shown on the list is strictly accurate.

"I have omitted a few names such as those of Johnston, Chard, Kilbride and a few others of more ancient appearance on the islands.

"I carefully went over the Christian names of above 250 families with the result as shown on No. 2 list. I give all the Christian names used here, so that you might see if we have any pagan ones amongst us."

These lists contain 61 surnames belonging to 458 individuals and 61 christian names, of which 37 are those of males and 24 those of females. The christian names are those of 1314 individuals.

We cordially thank Sergeant Law for the trouble he has taken in so carefully compiling these interesting lists.

1.—LIST OF SURNAMES OF THE INHABITANTS OF ARAN ISLANDS, GALWAY BAY.

Surname.	Approximate frequency.	Surname.	Approximate frequency.
Beaty, ...	1	Joyce, ...	17
Brabson, ...	1	Kean, ...	5
Burke, ...	5	Kelly, ...	4
Concannon, ..	5	Kilmartin,[8] ..	1
Conneely,[1] ..	61	Kennedy, ...	1
Cooke, ...	5	Kenny, ...	1
Curlin, ...	8	King, ...	1
Coleman, ...	1	Keilly, ...	1
Costello, ...	8	Kyne, ...	2
Crampton, ...	1	Lee, ...	2
Davoran, ...	1	Leonard, ...	3
Derrane,[2] ..	57	Maher, ...	7
Dillane, ...	4	M'Donagh, ..	27
Donohoe, ...	11	Millane, ...	6
Duignan, ...	3	M'Nally, ...	1
Faherty,[3] ..	78	Mulkerrin, ...	4
Fallon, ...	3	Mullin, ...	20
Fahy, ...	1	Murray, ...	2
Flaherty,[4]	80	Naughton, ...	3
Fitzpatrick,[5] ..	5	O'Brien, ...	5
Flanagan, ...	1	O'Donnell, ...	20
Folan, ...	18	O'Rourke, ...	2
Gauly,[6]	1	Powel, ...	14
Garvey, ...	1	Quinn, ...	2
Gillan,[7]	3	Ryder,[9]	1
Gill, ...	6	Scofield, ...	1
Gould, ...	1	Sharry,[10]	2
Griffin, ...	9	Toole, ...	4
Hardy, ...	1	Wallace, ...	3
Hernon, ...	11	Walsh, ...	4
Hogan, ...	1		

[1] This name is found over the three islands.
[2] This name is confined (with exception of two families) to the large island
[3] Distributed over the three islands.
[4] Distributed over the three islands.
[5] Originally from the King's County.
[6] Originally from Dublin.
[7] Originally from the North.
[8] From County Clare.
[9] Originally from Boffin Isle.
[10] Originally from County Clare.

2.—A List of Christian Names of People on Aran Islands, Showing the Frequency with which the Names Occur.

(*a*) Males.

Christian Names.	Frequency of occurrence.	Christian Names.	Frequency of occurrence.
Andrew, ...	3	Matthew, ...	1
Ambros, ...	1	Martin, ...	48
Anthony, ...	4	M'Dara, ...	8
Bartly, ...	34	Michael, ...	105
Bryan, ...	4	Morgan, ...	8
Coleman, ...	24	Myles, ...	1
Daniel, ...	1	Patrick, ...	113
Denis, ...	2	Peter, ...	31
Edward, ...	19	Philip, ...	1
Edmond, ...	1	Roger, ...	2
Francis, ...	2	Robert, ...	1
George, ...	1	Simon, ...	5
Hugh, ...	1	Stephen, ...	11
Hubard, ...	1	Thady, ...	1
James, ...	7	Thomas, ...	61
John, ...	101	Timothy, ...	1
Joseph, ...	18	Walter, . ..	1
Lawrence, ...	2	William, ...	9
Mark, ...	1		

(*b*) Females.

Christian Names.	Frequency of occurrence.	Christian Names.	Frequency of occurrence.
Agnes, ...	6	Hannah, ...	3
Alice, ...	1	Judith, ...	2
Anne, ...	51	Julia, ...	10
Barbara, ...	28	Margaret, ...	62
Bridget, ...	95	Maria, ...	6
Catherine, ...	62	Mary, ...	165
Celia, ...	1	Norah, ...	3
Debby, ...	1	Nappy, ...	2
Delia, ...	12	Sally, ...	1
Ellen, ...	16	Sarah, ...	6
Elizabeth, ...	1	Sabina, ...	1
Honor, ...	27	Winifred, ...	8

The following is an approximately complete list of the names of the people to whom the remarkable and unique road-side monuments were erected. It is evident that this fashion was started by the Fitzpatricks, and it has now practically died out.

Name.	Age.	Date of death.	Locality of Monument.
Patrick Fitzpatrick, ..	—	1754	Near Killeany House.
Margrett ,, (wife), ..	—	—	,, ,,
John ,, ..	25	1754	,, ,,
Dennis ,, ..	23	1753	,, ,,
Peter ,, ..	17	1854	,, ,,
Sara M. Swein (?) wife to Hn. Fitzpatrick, ..	—	1709	,, ,,
Rickard ,, ..	—	1701	,, ,,
John ,, ..	—	1709	,, ,,
Florence ,, ..	—	1709	,, ,,
Edmd. Dirrane, ..	80	1827	Killeany.
Joh. Wiggan, ...	—	1837	,,
Mich. Dirrane, ...	119	1817	,,
Petr Wiggins, ...	66	1826	,,
Simon Wiggins, erected by Anne Flaherty, wife,	34	1845	,,
Margt. O'Flaherty, als. Dirrane, ..	52	1830	,,
Martin O'Flaherty, ..	38	1848	,,
John Flaherty, ...	60	1858	,,
Barthw. O'Donnell, ..	18	—	,,
Mary ,, ..	24	—	,,
Denis ,, ..	48	1834	,,
Ann ,, (wife), ..	63	—	,,
Catherine Gill, also Flaherty, ..	37	1846	,,
Hugh Gill, ...	66	1840	,,
James Fitzpatrick, John (son), Bridget (daughter), ..	26	1828	,,
Mich. McDohog[n], ..	38	1820	,,
James Naughten, ..	30	1817	,,
Anthony O'Flaherty, ..	56	1822	,,
Patrick O'Donnell, ..	50	1863	Between Kilronan and Oghil.
Wife of do., ...	6 (?)	1849	,, ,,
Roger Conelly, ...	83	1853	,, ,,
Anne ,, (wife), ..	56	1859	,, ,,
Michael ,, (son), ..	24	1872	,, ,,
Julia Derrane, ...	26	1855	,, ,,
Bridget ,, *alias* O'Brien, ..	48	1811	,, ,,
Thomas Mullin, ..	19	1875	,, ,,
Ann Durane, ...	—	1846	Oatquarter.
Bartholomon Hernan, ..	50	1863	Kilmurvy.
Mary (daughter), ..	—	1871	,,
Michael Dirrane, ..	26	1828	,,
Honora ,, ..	50	1822	,,

IV.—Sociology.

1. *Occupations.*—All the men are land-holders to a greater or less extent. According to J. G. Barry (1885) "the rents were fixed some ninety years ago at rates varying from £4 3*s.* to £2 10*s.* per cannogarra, on the supposition that a cannogarra or holding could feed a cow with its calf, a horse, and some sheep for their wool, and give sufficient potatoes to support one family."

It appears that at the present time rents vary from about £2 to £7 per holding, according to the quantity of land, the average being about £3 10*s.*

Most of the fields are very small in size, and the tendency is to further divide up the large fields by walls in order to more completely protect the crops from the wind. These walls are composed of stones piled loosely one on the top of another; there are no gates or permanent gaps through the walls; entrance for cattle being made by pulling a portion of the wall down, and then piling up the stones again. In some places the walls are of a considerable height.

Owing to the way the land is apportioned to the members of a family, a man usually owns a number of isolated fields scattered all over the island. This necessitates a great loss of time in going from one field to another to see that no trespassing of cattle or sheep is occurring.

The subletting of land on the con-acre system also tends to further subdivision.

Only a fraction of the land is naturally fit for anything, and probably a considerable portion of the existing soil has been made by the natives bringing up sea-sand and sea-weed in baskets, on their own or on donkeys' backs, and strewing them on the naked rock after they have removed the loose stones. Clay scooped from the interstices of the rock may also be added. Farmyard manure is little used in the fields. Only spade labour is employed in the fields.

Potatoes are grown in this artificial soil, after a few crops of these, grass is sown, and later rye. The latter is cultivated for the straw which is used for thatching; the rye-corn is not now employed for eating purposes.

"The prevailing crops are potatoes, rye, and a small kind of black oats, all which ripen early, and are of good quality and sufficiently productive. The islanders sow some small quantities of barley and wheat, and in that operation employ an increased quantity of manure. They have also small crops of flax. On the whole, their harvest seldom exceeds domestic consumption; agriculture, however, is daily improving. Their pasture land is appropriated to sheep, goats, and a few small cows and horses, for which latter they reserve some meadows; the mutton is considered delicious, but their most profitable stock consists of calves, which are reputed to be the best in Ireland" (J. T. O'Flaherty, p. 132).

Burke states (p. 7):— "The tillage of the islands comprises potatoes, mangold wurzel, vetches, rape, clover, oats, and barley. The potatoes almost exclusively planted [1887] are the Protestants . . . the crops are greatly devastated by caterpillars and grubs. The abundance of these pernicious insects is attributed to the great scarcity of sparrows and other small birds."

Sweet grass grows in the crevices of the rocks, and this forms, in addition to the meadows, the usual pasturage for the sheep.

The farm will usually keep a family in potatoes, milk, and wool. Flour and meal are imported from Galway along with tea and other foreign produce.

For fuel the Aranites employ peat and dried cow-dung. All the former is imported from Connemara. The latter is collected in the early months of the year when it is sodden, it is then tramped on and worked with the hands, the cakes thus prepared are heaped up against a wall and when dry are carried home for fuel.

The natives eat very little meat of any description, save fish, nor butter, nor cheese, and but very few eggs. Tea is being increasingly drunk.

The women do not work much in the fields, but they help to weed the potatoes; they are very industrious, and, in addition to the house-work, most of them card and spin the wool, gather Carrigeen moss (*Sphærococcus crispus*) off the rocks, and help in drying and stacking kelp.

Most families make a certain amount of money every year by kelp-burning. The weed is mainly collected by the men, who also attend to the kilns. According to J. T. O'Flaherty in 1824:—"The annual average of kelp made in the islands is computed at from 150 to 200 tons; it is considered to be of a very superior quality" (p. 134). Burke states (pp. 69, 70):—"In 1866 the kelp made on the islands realised £2577, being £5 a ton. There is no kelp now [1887], owing to the fall in prices." This particularly variable industry has again revived. Many families make from 3 to 7 tons of kelp in the year, others as much as 10 or 14 tons, the present price for the best quality is £4 10*s.* per ton. We understand that the seaweed belongs to the owner of the foreshore.

Every well-to-do man owns a curragh and does a little fishing. The value of a canoe (curragh) is from £4 to £4 10*s*. The men of Aranmore cannot as a rule be described as fishermen. What fishing industry there was in the past centred itself in Killeany. The Inishmaan and Inisheer men are said to be much better fishermen and sailors. In the Middle Island every farmer fishes and makes kelp, and the men are on the whole better off than those on the North Island and do not drink so much.

During the past year, the Rev. W. S. Green, one of H. M. Inspectors of Irish Fisheries, has been instrumental in developing what promises to be a thriving fishing industry in Aranmore. We merely allude to this in passing, as it is entirely due to foreign capital and energy and is not a local development. Mr. Johnson, the son-in-law of, and successor to, the late Mr. O'Flaherty, is the only considerable farmer in the island, and latterly he has been successfully turning his attention to the fishing.

J. T. O'Flaherty informs us that, early in this century (1824, p. 134):—"Fish, kelp, and yearling calves (these generally brought, before the late fall of prices, from £7 to £8 a-piece) are almost the only articles of traffic; Galway, and the surrounding country, the chief mart. There are belonging to the three islands about 120 boats, 30 or 40 of which have sails, and are from five to ten tons burden; the rest are row boats. The spring and beginning of summer are employed in the Spillard fishery; here are taken immense quantities of cod, ling, haddock, turbot, gurnet, mackerel, bream, etc., and, in the season, abundance of lobsters, oysters, crabs, scollops, cockles, muscles, etc. They look much to the herring fishery, which sometimes disappoints, but generally gratifies their best expectations. In May the pursuit of the sun-fish [*Selache maxima*, the Great basking shark] gives employment to many. This rich supply of sustenance seems perfectly providential, when we consider the scanty soil and dense population of the islands. After high tides, the water, lodging in the caverns and cliffs exposed to the sun, soon evaporates, and leaves a residuum of good strong salt with which the Aranites, I understand, cure their ling; it also serves them for culinary purposes."

"The numerous and lofty cliffs of Aran are well stocked with puffins [*Mormon fratercula*], which are sought for by the agent, Mr. Thomson, chiefly for the sake of the feathers. He employs cragmen, or clifters, to procure these birds, allowing sixpence for every score they bring. The operations of these cragmen are not less perilous than curious. They provide themselves with a large cable, long enough to reach the bottom of the cliff; one of them ties an end of this rope about his middle, holding it fast with both his hands; the other end is held by four or five men, standing one after the other, who are warned by the cragman, when arrived at the haunts of the puffins to hold fast. Here the cragman gets rid of the rope, and falls on the game with a pole, fastened to which is a snare he easily claps on the bird's neck, all being done at night; such as he kills he ties on a string. His comrades return early the next morning, let down the rope, and haul him up. In this way he kills from fifteen to thirty score per night. Quantities of large eggs are also taken out of these deep cliffs" (p. 135). Martin Haverty gives (pp. 18, 19) a graphic account of the manner in which men are let down and pulled up the cliffs.

The bulk of the men on the North Island may be described as small farmers who do a little fishing. There are besides two or three weavers, tailors, and curragh builders; this about exhausts the occupation or trades so far as the natives are concerned. The butcher, baker, and other allied tradesmen are mainly related to the small population, which may fairly be termed foreign, such as the representatives of the Government, and the spiritual and secular instructors. There are two or three small shops on Aranmore where a few imported goods, hardware, crockery, clothing, and the like can be obtained, and there are about as many houses licensed to sell alcoholic liquor. The kelp is usually sold to a native, who is the accredited agent of the wholesale buyers.

The Rev. W. Kilbride, in a letter to Mr. Burke (1887, p. 74), states that:—"Men's wages vary. There is no constant work whatever. Spring and the seaweed gathering for kelp are the chief harvests for the labourer. A labourer has seldom more than four months' labour in the year, so that it is a necessity on his part to get gardens on hire. Until last year or the year before [the letter is dated December 11, 1886] he got from 1*s.* to 1*s.* 6*d.* in spring, with his diet, at harvest, about 1*s.* with his diet, three meals in the day, bread and tea for breakfast, etc. When there is a hurry in seaweeding time he used to get 2*s.* 6*d.* and diet, but this lasts only a week twice in the year."

2. *Family-life and Customs.*—The family usually consists of six or seven children; they go to school as soon as they can walk, and about four or five years of age they attend regularly. The children now attend better than formerly, as the priests enforce attendance. We understand that the children are intelligent, and make fair progress.

They stay at school till they are fourteen or fifteen, and till seventeen if they get monitorships.

The children very early help their parents in various ways, such as weeding potato fields, helping in putting the kelp out to dry, and carrying water for the house and for the cattle.

If a girl is not married by the time she is twenty years of age she will probably emigrate to America, but the boys are generally much older than the girls when they emigrate.

There is no courting or love-making, nor do the young people ever walk together. The marriages are arranged for ; as a rule the lad has his father's consent and may be accompanied by him when he goes to ask for the girl. It seems that most, if not all, the marriages take place immediately before Lent. Sometimes a young man may suddenly, a day or two before the beginning of Lent, decide upon marrying, and, after seeing what his father will do for him, he goes to the house where there is a suitable girl and asks her to marry him. If she refuses he might go straight on to another ; and a man has been known to ask a third girl in the same evening before he was accepted. The marriage might take place immediately, and the couple would live happy ever after. Girls marry quite young, seventeen is a common age and some are married at fifteen.

The eldest son generally inherits the house and the bulk of the property, and he lives with his parents when he is married. Often, however, when the latter get old the property is made over to the young people, and the old folks stay on in the house.

According to Miss Banim :—"A strange custom prevails upon a marriage here: the bride's fortune goes to portion off the old couple—the husband's father and mother—in lieu of their giving over the little plot of land to the son and his wife, or perhaps they again portion off a daughter with the same money" (p. 147).

The dead are "waked" on the night before the funeral, and this is an occasion for the consumption of a considerable amount of whiskey.

There are certain spots where the procession stops on the road to the cemetery, and there it is usual to raise a small memorial heap of stones or even only a single stone. In the North Island there are quite a number (about two dozen) of unique road-side monuments erected at these resting-places. The oldest of these were erected by the Fitzpatrick family in 1709, and the most recent is dated 1875.

There is no keening while going to the burial ground, but only when the latter is reached.

Wakes are held, not only upon those who die on the islands, but also on the absent dead in America or elsewhere. The neighbours gather at the house, candles are lighted, and everything proceeds as if the corpse were present.

3. *Clothing.*—The dress of both sexes is for the most part home-made, being largely composed of homespun, either uncoloured or of a speckled brown, or blue grey, or bright red colour. The people appear not only to be warmly clad, but as a rule to be over-clothed.

As previously mentioned the girls and women card and spin the wool, the wool is worth eightpence per pound. The cards are bough in Galway, and the spinning wheel is of the pattern which is common throughout the west coast. A large fly-wheel is supported on a form, at the other end of which is an upright board which supports the spindle. The wheel is turned by hand. The whole machine is of rough workmanship and is home-made. Some women will hire other other women to come to their houses to do their spinning for them at the rate of eightpence per pound. All the yarn is woven on the islands by professional weavers who charge fourpence per yard for the plain and fivepence for the coloured flannel. The flannel or yarn is dyed by the women. Dr. Kean informs us that formerly the wool used to be dyed a black of a very fast nature by steeping it in a decoction made from some plants which he has never been able to identify and, then boiling it in an "ink," as they used to term it, composed of the black liquid from bog holes, which was imported from Connemara for the purpose. This method has been given up for some years since the introduction of the dyes of commerce. Those most in use now are madder and indigo. O'Flaherty writes (1824), p. 133 :—"There is a native vegetable, the name of which I now forget, which gives a fine blue dye, much used in colouring the wool which the islanders manufacture for their wearing."

The men wear a shirt of dark flannel procured from Galway, and over this a jacket or sleeved waistcoat (bawneen) of white homespun nearly as thick as a blanket; outside of which is worn a waistcoat made of grey-blue or brown flannel, in many cases it is bound with a dark braid. Of this waistcoat there are two patterns, one with large collar flaps buttoned back on the shoulders, and the other buttoned up to the neck with a simple turnback collar without flaps. The latter pattern, though sometimes worn by the men, is for the most part worn by boys. The trousers are of white or grey homespun and are worn loose and rather short, ending well above the ankles, and are slit down the outer side of the calf for the lower four inches. The feet are clothed in blue woollen stockings with white upper bands and toes.

These are knitted by the women. They also wear a homemade broad blue bonnet of the "Tam o'Shanter" type with a chequered head-band, or a broad-brimmed soft hat which is imported. Up to the age of about twelve the boys wear a long frock of red homespun coming well below the knees and buttoned up the back (see vignette on p. 826), otherwise they are clothed like the men.

The women wear only one cotton undergarment, a bodice, and several heavy petticoats; the outermost is usually of a bright red colour. They often wear a white jacket like a man's. Frequently a woman will be seen wearing a petticoat over her head as a shawl; but more usually an imported tartan shawl is worn, the red patterns, as Stuart, Grant, and M'Nab, being the favourites. In many cases a red kerchief is worn on the head, but caps, hats, or bonnets are not worn. O'Flaherty (1824 p. 138) says:—"The female headdress is completely the old *Baraid* of the Irish."

Both sexes wear sandals made of raw cowhide, the hair being outside. The edges of the piece of hide are caught up with string, with which they are tied on over the instep. They are admirably adapted for climbing and running over the rocks and loose stones. Some of the men, however, are now taking to wearing leather boots. These sandals are precisely similar to the "rivlins" of the western and northern islands of Scotland. In Aran they are now called "pampooties"; the origin of this term is obscure (cf. Wilde, 1861, p. 281). A curious point about them is, that they have to be wetted with water before being put on, and that while in wear they must be kept damp in order to preserve their flexibility.

In a footnote on p. 96 of O'Flaherty's "H. Iar Connaught," Hardiman says:—"It is observed that the people of Aran, who wear seal-skin pumps, or 'pampooties,' are never afflicted with gout. They affirm that a piece of the skin worn on the person cures and keeps away the cholic." A pair of pampooties will last about three months, and the cost of the skin is from 6*d.* to about 1*s.* 2*d.* per pair.

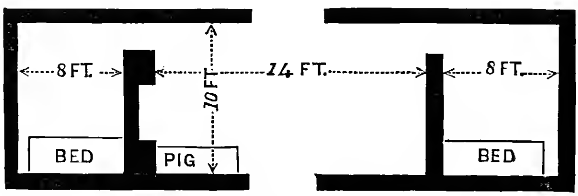
4. *Dwellings.*—The houses of the better class consist of three rooms, a central kitchen, and a bedroom at each end; but many houses have only a single bedroom. The following description applies to a typical Aran house:—The walls are built of irregular stones and may be placed together with or without mortar, sometimes the whole is whitewashed. There are always two outside doors opposite one another in the kitchen. At a funeral the corpse is always carried out through the back-door. The fireplace may be in the right- or left-hand side-wall of the kitchen; it is a large recess, in the centre of

which there is always a peat fire burning; and there is often a seat on each side of this, within the fireplace. A hook (" crook ") hangs down over the fire for the suspension of the cooking-pot. Very often there is a small pen by the side of the fire, this is the pigstye, it is circumscribed by long, low slabs of limestone, and the entrance is closed by a board. The pigs are very clean both in their bodies and habits. The kitchen floor may be the bare rock, or clay, or it is very rarely boarded.

The doors into the bedrooms are at the front door-end of the party-walls. The bed is a "tent-bed," that is, with boarded ends and a pitched roof. It lies along the back wall of the bedroom, the head of the bed usually being towards the party wall. The bedrooms are sometimes boarded.

The peat is often stored on boards above the beams (" couples"). Sometimes there is a loft over a bedroom and opening into the kitchen, in which the peat is stored, or the boys of the house may sleep in a loft.

The houses vary in size; a kitchen would be about 14 ft. long by 10 ft. deep, and a bedroom about 8 or 9 ft. wide, and as long as the breadth of the house.



The roof is thatched with rye-straw; scraw (or sheets of grass-turf) are first laid on the rafters; the thatch is not fastened on to this with rods, or scallops as they are called in some parts of Ireland, but it is tied on by straw ropes, which are formed into a kind of net, and the ends are pegged into the walls of the house and over the edges of the gables. The latter may be made with straight edges, but very often they are left as a series of steps, in which case the horizontal straw-ropes are carried round in the angles of the stones. The houses are lightly thatched every year—or at least every two years—the new thatch being laid over the old. Nearly every house has a small out-house or shed, in which the potatoes are stored. Horses and cattle are never put under shelter.

5. *Transport.*—The means of transport are important in an economic survey of a people. There are no roads worthy of the name in the Middle or South Islands, and till lately there were not many in Aranmore. Now there are several good roads. Twenty years ago there was not a wheel vehicle in the North Island, and there is not one at present in the other islands. Carts are still very rare, and the carrying is done by human porterage, or by donkeys and horses. All the well-to-do men own a mare, which is generally followed by a foal wherever she goes. Some of the men have a donkey as well. A poor or con-acre man (*i. e.* one who hires a small piece of land) will have only a donkey.

A great many men own curraghs, which are used more for fishing than transport. At present only a few own sailing-boats; but we learn that some twenty years or so ago there were twenty decked vessels belonging to Aranmore.

V. Folk-Lore.

Concerning this important branch of inquiry, we regret that our information is so scanty. It was from lack of opportunity, and not from lack of interest, that we collected so little on this subject; and we would here like to call attention to its ethnological importance, and to remind our readers that the lore is fast disappearing from the folk, and that no time should be lost in recording the vanishing customs and beliefs of old times.

According to J. T. O'Flaherty :—"The people retain in language, habits, and customs, beyond comparison, more of the primitive Celtic character than any of the cotemporary tribes of that stock, at least in this kingdom [p. 137] . . . Here you have, on every lip, the exploits of *Cuchullan*, of *Conal Cearnach*, of *Gol* son of *Morna*, of *Fionn* son of *Cumhal*, of *Oisin*, and of *Oscar;* here they enthusiastically point out the very places which their *Invincibles* had honoured with their presence; and here, they tell us, their spirits rest as in Elysian Isles! Here, too, no bad memory is retained of the sacred fires, and of the priests of the sun : so constantly refreshed is tradition by the numerous and unequivocal memorials of the Celtic ritual, still preserved in Aran. But the Aranites have preserved a far better recollection—that of Christian holiness, which had so pre-eminently distinguished their 'Isle of Saints.' [p. 138] . . . The people of Aran, with characteristic enthusiasm, fancy that at certain periods they see *Hy-Brasail*, elevated far to the west in their watery horizon. This had been the universal tradition of the ancient Irish, who supposed that a great part of Ireland had been swallowed by the sea, and that the sunken part often rose and was seen hanging in the horizon: such was the popular notion. . . . But it is only to an unmixed, aboriginal people that such a tradition as this could descend unimpaired, through the long and tedious stream of ages" (p. 139).

Sir Samuel Ferguson says:—"No distinct traditions of the Fir-Volgs remain in the islands. . . . The traditions of the people of Aran are either hagiological, or have reference to the exploits of such personages as Croohore-na-Suidine O'Brien, Emun Laidie O'Flaherty, or Oliver Cromwell. The saints or their miracles supply the great historical topics of these simple people."

O'Flaherty also says (p. 98):—"The Aranites, in their simplicity, consider these remains of Druidism [open temples, altars, stone pillars, sacred mounts of fire worship, miraculous fountains, and evident vestiges of oak groves (p. 97), numerous fire-temples (p. 127)] still sacred and inviolable; being, they imagine, the inchanted haunts and property of aerial beings, whose power of doing mischief they greatly dread and studiously propitiate. For entertaining this kind of religious respect, they have another powerful motive: they believe that the cairns, or circular mounts, are the selpulchres, as some of them really are, of native chiefs and warriors of antiquity, of whose military fame and wondrous achievements they have abundance of legendary stories. The well-attended, winter-evening tales of the *Scealuidhe*, or story-tellers, are the only *historical* entertainments of this primitive, simple, and sequestered people. In this credulous and superstitious propensity, they exactly resemble their brethren, the Scots of the Highlands and Isles. Indeed, the solitude and romantic wildness of their 'seagirt' abode, and the venerable memorials of Christian piety and Celtic worship so numerously scattered over the surface of the Aran Isles, fairly account for the enthusiasm, credulity, and second-sight of these islanders." On p. 102 he states that:—"No portion of the Irish population has preserved the primitive manners, language, and recollections, with more fidelity than the secluded inhabitants of Aran."

The following is from Burke (*loc. cit.* p. 91):—

"The Irish of the 'oak' is Dara, and many an Aranite bears that name. Now, there was a blessed saint, 'Mac Dara,' who lived in those islands ages ago, and there was a renowned statue of him made of oak, which the people venerated with an idolatrous veneration. It was in vain that the Catholic clergy called on them to desist from kneeling before that graven image, and from swearing on it rather than on the Book of the Gospels, on which all men swore. Malachy O'Queely, Roman Catholic Archbishop of Tuam, was, however, resolved to put down an exhibition which he considered a scandal to the Catholic Church, and so, coming to the islands in 1645, he tore down the statue, and flung it into the sea; but ill-luck awaited him." The same year he was cut to pieces by the Parliamentary forces at Sligo.

In common with the west coast Irish the Aranites believe in fairies, banshees, ghosts, &c. Whirlwinds contain small men who gather up the weeds out of the people's way.

Mr. W. Lane Joynt informs us of a tradition of a black dog that comes up out of the sea and kills eels.

A thirteenth child is a piper, *toul gorés pebud*; but Colman Faherty Thomas (cf. Pl. xxii. figs. 1, 2) is a thirteenth child, but cannot play the bagpipes.

There do not appear to be many superstitions relating to fishing; the sight of a cat brings ill-luck to the fishing, as does also the meeting of a red-haired woman.

When a funeral is passing down the road the front door of a house is always closed. The corpse is carried out through the back door.

The following is said to be common to both Aran and Co. Galway. If anyone at a marriage repeats the benediction after the priest, and ties a knot at the mention of each of the three sacred names on a handkerchief, or a piece of string, the marriage will be childless for fifteen years, unless the knotted string is burnt in the meantime.

Boulders are peculiarly numerous south-east of Eararna, and folk say that once upon a time a local giant was passing the time of day with his Connemara brother, then they came to abuse, and ended by throwing stones at one another, these boulders being the missiles thrown by the latter. It is true that boulders from Connemara are plentifully scattered all over Aranmore through ice-action, but unfortunately for this story these particular stones are local in origin.

There is a sacred well at Kilmurvey called Tuber Carna, the water of which is reputed to be unboilable, and if dead fish are put into it they will come to life again. The sick too will be cured if any one prays at the well for their recovery. The water of one well curdles milk.

Rags are attached to sprays of the bramble or ivy at most of the holy wells; an elder bush over a well close by Tempul Brecain is similarly decorated. Offerings are placed at some of the blessed places, as, for instance, on the altar of St. Columb Kill at Killeany, and buttons, fish-hooks, iron nails, shells, pieces of crockery, &c., are deposited in the holy well at Tempul-an-Cheathruir-aluinn, or

"The Church of the Four Comely Ones." Numerous rounded pebbles are placed by the well and on the altar of St. Columb Kill.

Women pray at St. Eany's Well, by the Angels' Walk,[1] when they desire children, and the men pray at the rag-well by the Church of the Four Comely Ones at Onaght. Women are also said to resort to St. Brecain's bed for the same object.

On the night before going to America the people will sleep in the open, beside one of the holy wells, in order that they may have good fortune.

When any member of a family falls sick, another member makes a promise that if the sick one recovers, the person promising will sleep one, two, or three nights in one of the saint's beds. One bed at the Seven Churches (probably St. Brecain's bed) is said to be occupied pretty regularly.

Suspended priests are considered capable of working cures by touch of the hand.

We have already alluded (p. 814) to the reputed therapeutic effect of wearing a piece of the skin of a seal.

The senior author is indebted to Mr. David O'Callaghan, the National school-master, for the following notes on Folk-lore, which were given him more than a year ago:—

"*An droc ryl*, or *The Evil Eye.*—The 'Evil Eye' is very much dreaded in Aran, hence you had better not praise any Aranite, or any of his live stock, in his presence without saying 'God bless him or them.' Otherwise, if any accident afterwards occurred to either one or the other, it would be due to your having an Evil Eye. Anyone affected by the Evil Eye is cured by the person possessed of it spitting on the patient, and at the same time saying ó ᴅıa opᴛ, ('God bless you'). Numberless are the tales told of the Evil Eye and of those who have succumbed to it, and of those who have been cured. Among the latter is one which was related to me lately as happening to the narrator himself:—

"'Well, master,' he says, 'and you don't think there is such a thing as the Evil Eye?' 'No, Pat,' said I; 'I don't think there is.' 'You don't think there is? Well! I tell you there is, and I am the man that can tell it to you. You see me now,' he says; 'I suppose you don't think much of me to-day; yet, thirty or forty years ago, I was one of the best men in Aran. I was one night at a dance, and

[1] "'An' it's here the Guardian Angels of Aran come, of a summer's night, to take their diversion.'" (*Cf.* Miss Banim, *l. c.* p. 133.)

though you would not believe me now, I was then a fine dancer. I was praised by all in the house while I was dancing, but just in the midst of the dance I fell down dead on the floor.' 'Dead, Pat?' said I. 'Yes, dead,' said he; 'for I had not a kick in me then, nor for two days after. Well, my friends, knowing what was the matter with me, got every person in the house to throw a spit on me, saying at the same time, 'God bless you,' but to no purpose. I remained dead, thrown in a bed in the corner near the fire, for two days, when a young woman comes in and spits on me, saying 'God bless you, Patrick, you are very ill;' when I went of one jump from the corner to the middle of the floor, and began to dance; and I was well from that out.' 'Of course, Pat,' I said, 'you married that girl?' 'God bless you,' said Pat, 'I thought you had sense till now. I did not, nor would I not, if there was not another girl in Aran.' This is as close a translation, as possible, of Pat's story as told to me in Irish.

"Some days are considered here unlucky upon which to begin any work of importance, to get married, or even to bury the dead. Monday is one of those days, and la crois na bladna, or the cross day of the year, is another, and so is lá crois na bliadna, the feast of the Holy Innocents. Whatever day of the week this festival falls on is considered an unlucky day in every week throughout the year following. No person will be buried on that day in any week throughout the following year, nor on Mondays. If they have occasion to bury a corpse on these days, they turn a sod on the grave the previous day, and by this means they think to avoid the misfortune attached to a burial on an unlucky day."

Burke (*loc. cit.* p. 101) says:—"The spinning-wheel in Aran, the old crones say, should never spin on a Saturday." He also says (p. 99) that the belief also occurs here that "fern-seed" renders a person invisible.

Dr. John Lynch ("Gratianus Lucius") was the first to refute ("Cambrensus Eversus," 1662; pp. 125–129 of Kelly's edition: Celtic Society, 1848) "the tissue of flagrant blunders" given by Giraldus de Barry—Giraldus Cambrensis—that in Aran "human bodies are never buried and never rot, but lie exposed under the air, proof against corruption. . . . No rat is found in that island." "My own opinion is," writes Dr. Lynch, "that Giraldus bungled his narrative by applying to Aran what is told of Inisgluair, an island off the coast of Erris, in the county of Mayo: for the bodies buried in that island do not decay, but even the hair and nails grow, so that one could recognise his grandfather."

VI. ARCHÆOLOGY.

An ethnographical study of a people would be incomplete without a reference to its archæology. In the present instance the amount of material is so great as to preclude an adequate treatment. The antiquities of the Aran Islands have never been systematically described and published; and yet nowhere else in the British Islands are there so many and so varied remains associated within a like limited area. The islands may not inaptly be described as an unique museum of antiquities.

1. *Survivals.*—It is worth while recording some of the survivals from olden time which characterize these islands.

Certain details in the costume of the people are ancient, but none more so than the persistence of the raw-hide sandals or brogues.

The curraghs are similar, in general character, to those common along the west coast; the simple oars are pivotted on thole pins.

Stone anchors are still used; more frequently in the Middle and South islands.

Querns are not used at present, but it is not long since they were employed.

2. *Christian Antiquities.*—Although of supreme interest and value in other branches of knowledge, the Christian antiquities have but little bearing on ethnological inquiries, as the religion, art, and largely also, the architecture, are alien; and a colony of monks and nuns does not affect the population from a racial point of view.

3. *Pagan Antiquities.*—The most impressive of the pre-Christian antiquities are the great duns or forts for which these islands are famous. At the present time there are four forts in a good state of preservation in Aranmore: Dun Ængus, Dun Eoganacht, Dun Eochla, and Dubh Cathair, the "black fort." Hardiman says (p. 76):—"At the village of Eochoill, about half-a-mile south-east of Dun Eochla, there are strongly marked traces of another dun or fort. Its original name [like those of Dun Eoganacht and Dun Eochla] is also lost; but the people relate that it was the strongest fort on the island. . . . About half-a-mile south-west of the village of Kilronan are the remains of another dun, but entirely in ruins." In Inishmaan there are Dun Conchobhair (Dun Connor), and Mothair Dun. Hardiman states that "Cathair nam-ban—*civitas mulierum*—on the South Island is now entirely in ruins. There is not at this day extant any tradition concerning it, or even its name."

No one who has written on the Aran Islands has failed to refer to some or most of these forts. The date of Dun Ængus is popularly supposed to be about 100 B.C. Dubh Cathair is locally reputed to be the oldest of all. We were informed that when it was captured, all the prisoners were thrown into the sea over the cliff on which it stands, with the sole exception of one man, who was spared on the condition of his showing the conquerors how to build a similar fort, and Dun Ængus was accordingly erected. This story, however, does not appear to have any historic value.

Cloghans, or bee-hive stone huts, appear to have been common. The largest and most perfect of these is the Clochan-na-carraige, near Kilmurvy. There is another not far from Killeany; and Kinahan discovered and described quite a town of ruined cloghans and other stone buildings.—(G. H. Kinahan, 1867).

In the Middle Island there is a nearly perfect cloghan in the village of Kinbally.

In the neighbourhood of the village of Cowragh in Aranmore is a Cromlech, or *Leabha Diarmuda agus Grainne*, which is built of slabs of limestone. There is another one in Inishmaan.

Also near Cowragh are several pillar stones, some of which have fallen down.

There are two holed-stones on Aranmore; one is well-known; it stands in the enclosure of Mainistir Connaughtagh, close by Tempul Chiarain; an early form of cross is incised on the slab; the latter may perhaps be regarded as a symbol of Christian annexation of a pagan sacred stone. The second holed-stone, so far as we have been able to discover, has not hitherto been recorded in print. It is a small stone without any inscription or decoration, which lies close to the small font of St. Sourney; the latter is reputed never to be empty of water, although it is not fed by any spring.

The virtues ascribed to most of the numerous holy wells may be regarded more as pagan legacies than as distinctly of Christian origin, notwithstanding that many of them are associated with some saint or another.

We feel that we cannot conclude without drawing the attention of the Academy to the desirability of its undertaking a careful and detailed survey of the antiquities of the Aran Islands. It is true that several distinguished archæologists have visited these islands, and some have published fragmentary accounts of certain of the remains, but not even a complete list has yet been printed, of the pagan and Christian antiquities. Unfortunately several of the priceless ruins have been tampered with on various occasions; and it is full time that every object of interest should be acurately surveyed, measured, and photographed under the direction of competent archæologists. If the results were published, with a sufficient number of illustrations, archæologists would possess a memoir, the value and interest of which it would be almost impossible to exaggerate.

VII.—HISTORY.

We cannot pretend to give a history of the Aran Islands; several authors who have written on these islands have given imperfect sketches of their supposed history (amongst whom may be mentioned J. T. O'Flaherty, Barry, Burke), and our account is mainly to remind the reader that there are traditions of changes of race, and we know that there have been changes in the government of these islands from time to time.

According to the Book of Conquests, some of the Firbolgs fled to these and other of the western islands after they were defeated at Muireadh or Moytura by the Tuatha de Danan (Damnorians or Dedannans).

Here they remained until the period of their expulsion by the Cruithnigh or Picts of Ireland, not long after the division of the whole country into provinces; how long these Picts were in possession of Aran does not appear to be clearly ascertained.

The Picts were succeeded by a Damnorian [? Firbolg] tribe, patronimically called Clan-Huamoir, who retained possession down to the middle of the third century of our era. "It further appears from our annals" (writes O'Flaherty, and from whom the above account is taken, 1825, p. 85), that two chiefs, Aengus and Concovar of the Huamor Sept, possessed the Isles of Aran in the time of Maud, Queen of Connaught, whose reign was not long anterior to the Christian era. Of these chiefs there are still unequivocal memorials; one in the Great Isle of Aran called Dun Aenguis, "the fortification of Angus"; the other in the Middle Isle, traditionally called Dun Concovair, "the fortification of Concovar."

O'Flaherty adds:—"Among the early tribes who had fixed in Aran we meet mention of Soil Gangain; and Ptolemy clearly places his Gangani in or about these isles. It is more than presumable that these are the Concani whom Orosius traces in Cantabria, calling them, as Camden remarks, Scyths or Scots. . . . . The early inhabitants of Aran were, it is true, of the Belgic and Damnorian stock; but, so late as the middle of the second century, Ptolemy's time, it is by no means improbable, that a Scottish clan had also settled there. The Scots had possession of Ireland many centuries before that period."

"Archbishop Usher affirms that Ængus, the first Christian King of Desmond or South Munster had bestowed the Isles of Aran on St. Einca, called also Endeus; and it does not appear that the learned Primate's opinion has been contradicted." Ængus died about 490.

"In 546, it was agreed between the Kings of Munster and Connaught that the islands of Aran were to acknowledge no superior or pay chief rent to any but their native princes.

"In 1081, the Great Island was destroyed by the Danes, as the annalists of Inisfallen record. 'Arain na Naoimh do lusgadh le Lochlannaibh.'

"The old records of Galway attest that the inhabitants of that town were, from a remote period, on terms of close friendship and alliance with the Sept of Mac Teige O'Brien, hereditary lords of Aran; both parties being bound to give mutual aid in all cases of emergency. This league, however, did not save the islanders from the violence of the Lord Justice, Sir John D'Arcy, by plunder, fire, and sword in 1334.

"Late in the sixteenth century [1586] the O'Briens were expelled from the islands by the O'Flaherties of Iar Connaught. Upon information of this transaction having been received by Queen Elizabeth, a commission issued, which declared that the islands belonged to her Majesty in right of her crown. She accordingly by letters-patent, dated 13th January, 1587, granted the entire to John Rawson, of Athlone, gentleman, and his heirs, on condition of his retaining constantly on the islands, twenty foot soldiers of the English nation." The Corporation of Galway, ineffectually addressed the Queen on behalf of the Sept Mac Teige O'Brien of Aran as the temporal captains or lords of the islands of Aran "time out of man's memory."

Sir Robuck Lynch of Galway next became proprietor of the islands.

"In 1651, when the royal authority was fast declining, the Marquis of Clanricarde resolved to fortify these islands; where he placed 200 musketeers, with officers and a gunner, under command of Sir Robert Lynch. The fort of Arkyn, in the great island, was soon after repaired and furnished with cannon, and by this means held out against the parliamentary forces near a year after the surrender of Galway. In December, 1651, the Irish routed in every other quarter, landed 700 men here in boats from Iar-Connaught and Inis-Bophin. On the 9th of the following January 1300 foot, with a battering piece, were shipped from the bay of Galway to attack them. On the 13th the islands surrendered . . . The parliamentary forces, on taking possession of the fortifications found seven large pieces of cannon, with a considerable quantity of arms and ammunition; they seized also a French shallop of 28 oars, and several large boats.

"The late proprietor of the islands, Sir Robert Lynch, was declared a forfeiting traitor, and his right made over to Erasmus Smith, Esq., one of the most considerable of the London adventurers. This gentleman's interest having been purchased by Richard Butler, created Earl of Aran in 1662, the title of the latter was confirmed by the Act of Settlement (cf. p. 795).

"On the surrender of Galway to King William's forces in 1691, Aran was garrisoned, and a barrack built, in which soldiers had been quartered for many years after.

"In 1762 Arthur Gore was created Earl of Aran. At this time [1852] the ownership of the islands is in the Digby family, to a member of which they are said to have been mortgaged by a Mr. Fitzpatrick of Galway for £4000. On failure of payment, the mortgage was foreclosed.

During the documentary period of its history these islands have changed hands more frequently than is mentioned in the foregoing sketch, but there is nothing to show that fresh blood was introduced into the population. It is mainly owing to their lying at the mouth of Galway Bay that the Aran islands have had such a chequered history.

VIII.—ETHNOLOGY.

Several authors regard the existing Aranites as descendants of the Firbolgs. This belief is doubtless due to the reputed Firbolg origin of the forts. The latter may be true, but even so, it does not afford proof for the former statement.

If the foregoing sketch of the pre-Christian history of the Aran Islands be only approximately correct, we have grounds for believing that the Firbolgs did not remain undisputed owners of the islands.

Sir Samuel Ferguson says (*loc. cit.*, p. 496):—"These islands when Enda first obtained his alleged grant of them from Aengus, King of Cashel, had no population to instruct, all the souls to be cured were on the mainland" . . . and on p. 497 he adds, after mentioning that Enda according to tradition returned from Rome with a hundred and fifty monks about the year 580 and established himself at Kill-any. "The island at this time appears to have been wholly depopulated of its Fir-Volg colony. We read of no occupants besides the religious and occasional, "gentile" visitants from the adjoining district of Corcomroe. The captain of these pagans was one Corban; and Enda, after some negotiations, so far won his respect as to be allowed the undisturbed possession of his desert. A single dun cow, a relict probably of the Fir-Volgic herds, afforded the chief supply of aliment for the first recluses. Enda's *Laura* soon increased to a considerable community."

In the Christian period we find it a stronghold of the Clan Mac Teige O'Brien. By the sandy cove of Port Murvey in Aranmore, at the spot still called "Farran-na-Cann," "the field of skulls," the O'Briens are said at some remote period to have slaughtered each other almost to extermination.

Later the O'Briens were expulsed from their territory by "ye ferocious O'Flaherties of Iar-Connaught."

It is not probable that the O'Briens or the O'Flaherties were Firbolgs.

We know that garrisons were several times quartered on the islands, more particularly on Aranmore, and it is not improbable that owing to wrecks and to possible occasional immigrants from Galway of "foreigners," that mixture of blood may have occurred during the lapse of the last 500 years.

To what race or races the Aranites belong, we do not pretend to say, but it is pretty evident that they cannot be Firbolgs, if the latter are correctly described as "small, dark-haired, and swarthy."

Group of three Aran Boys. We have been informed that the reason why the small boys are so dressed is to deceive the devil as to their sex. (The negative was kindly lent to us by Mr. N. Colgan.)

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EXPLANATION OF PLATES XXII., XXIII., XXIV.

(*The Photographs were taken by Prof. Haddon.*)

Plate XXII.

Figs. 1, 2.—Colman Faherty, Thomas, aged about sixty years, Oghil. Michael O'Donnell, John, No. 25, Oghil.

When there is more than one man of the same name in the Aran Islands, the individuals are distinguished by the addition of their father's christian name, as in the foregoing cases. Faherty, who is a thirteenth child, is a very typical Aranite. O'Donnel's ancestor came from Ulster. They are standing in front of St. Sournick's thorn.

Figs. 3, 4.—Michael Mullin, No. 27, Kilronan. A typical Aranite.

Plate XXIII.

Fig. 5.—Michael Connelly, No. 10, Inishmaan.

A burly man, with the largest head measured in the Middle Island.

Fig. 6.—A characteristic group of the young men of Aranmore.

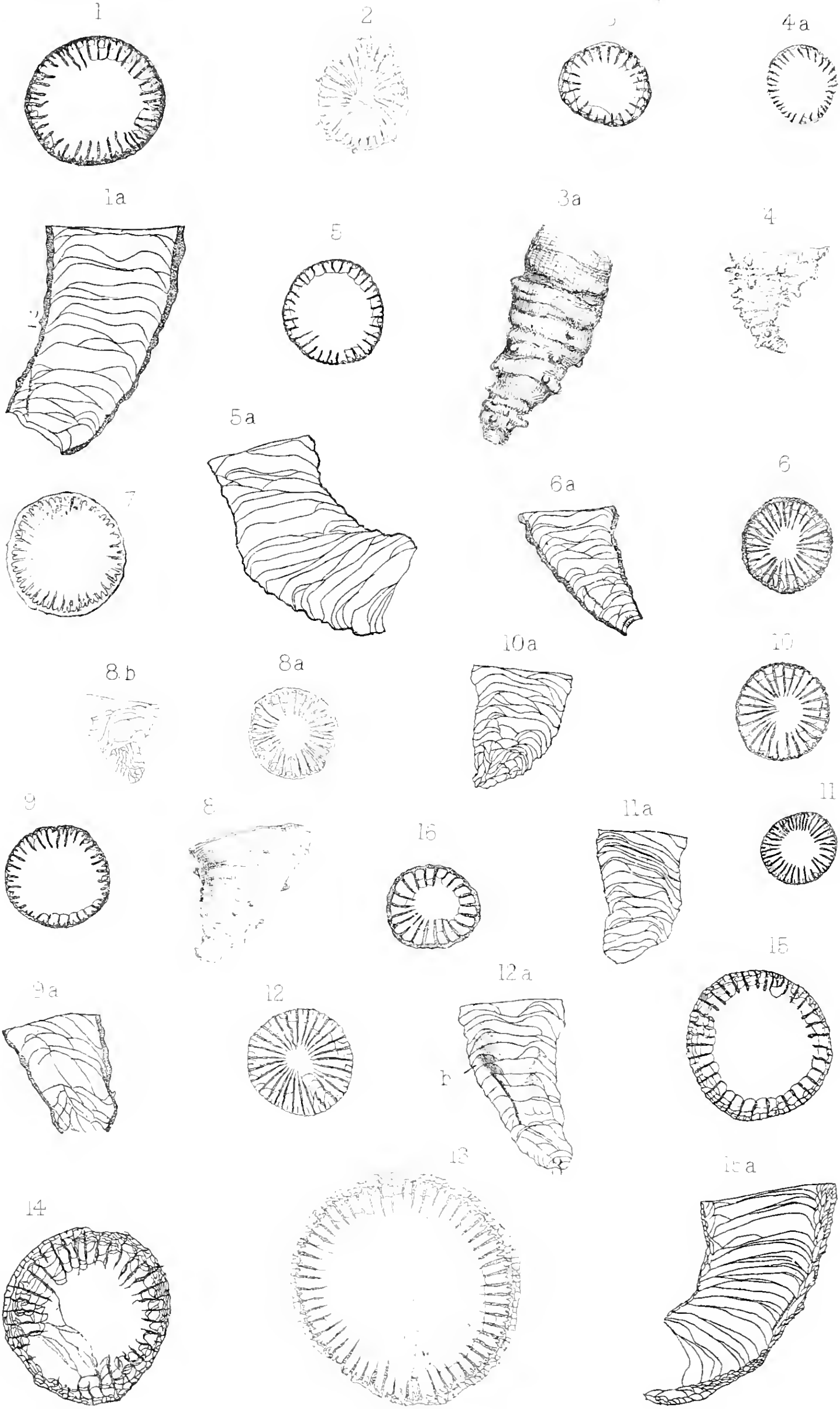
Fig. 7.—Michael Faherty, and two women, Inishmaan.

Faherty refused to be measured, and the women would not even tell us their names.

Plate XXIV.

Figs. 8, 9.—Michael Dirrane, No. 1; Roger Dirrane, No. 2; Anthony Dirrane, No. 3: all from Oghil.

Michael and Roger are brothers, and are by no means typical Aranites. There is an acknowledged foreign strain (? French) in their blood. Their relative Anthony is, on the other hand, quite typical.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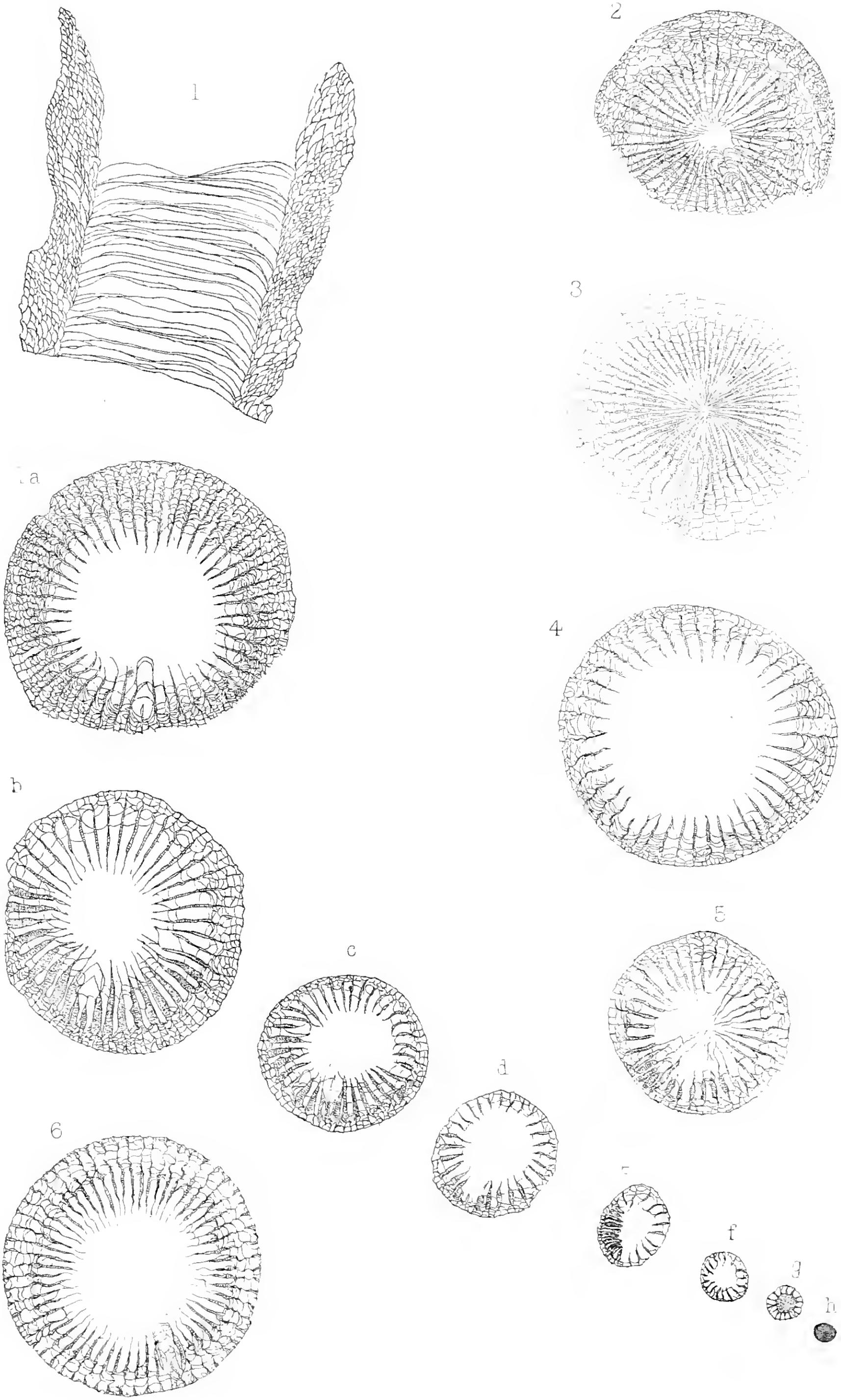

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Plate XVII

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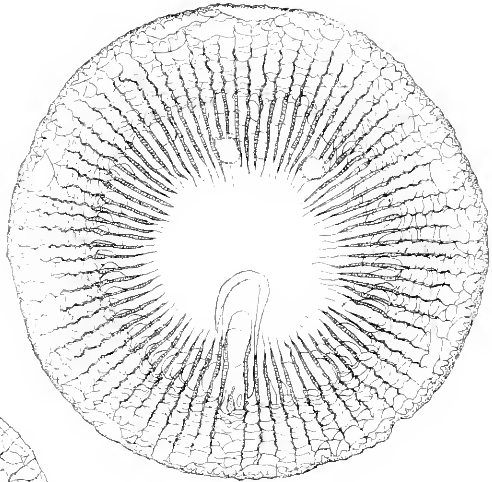

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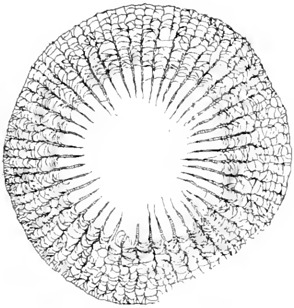

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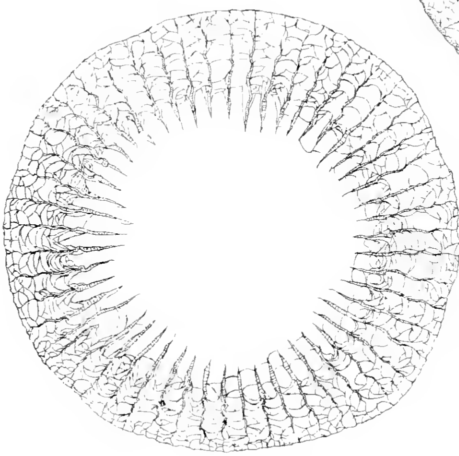

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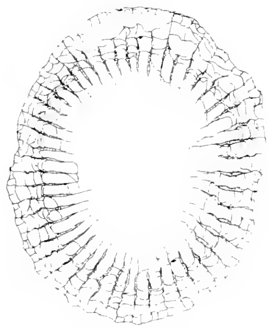

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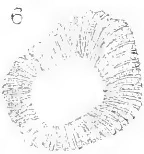

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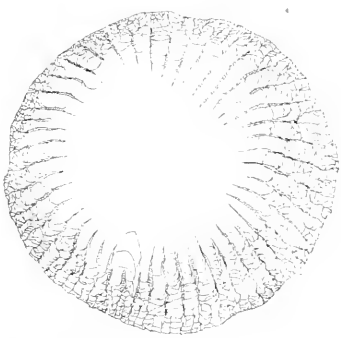

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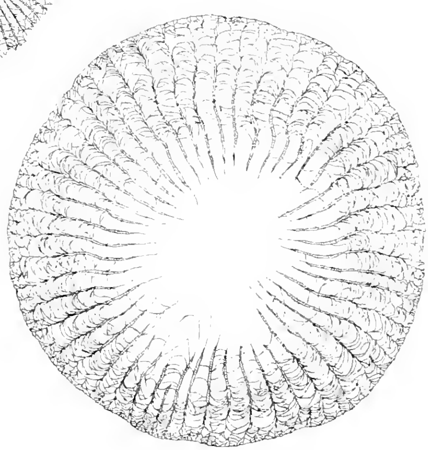

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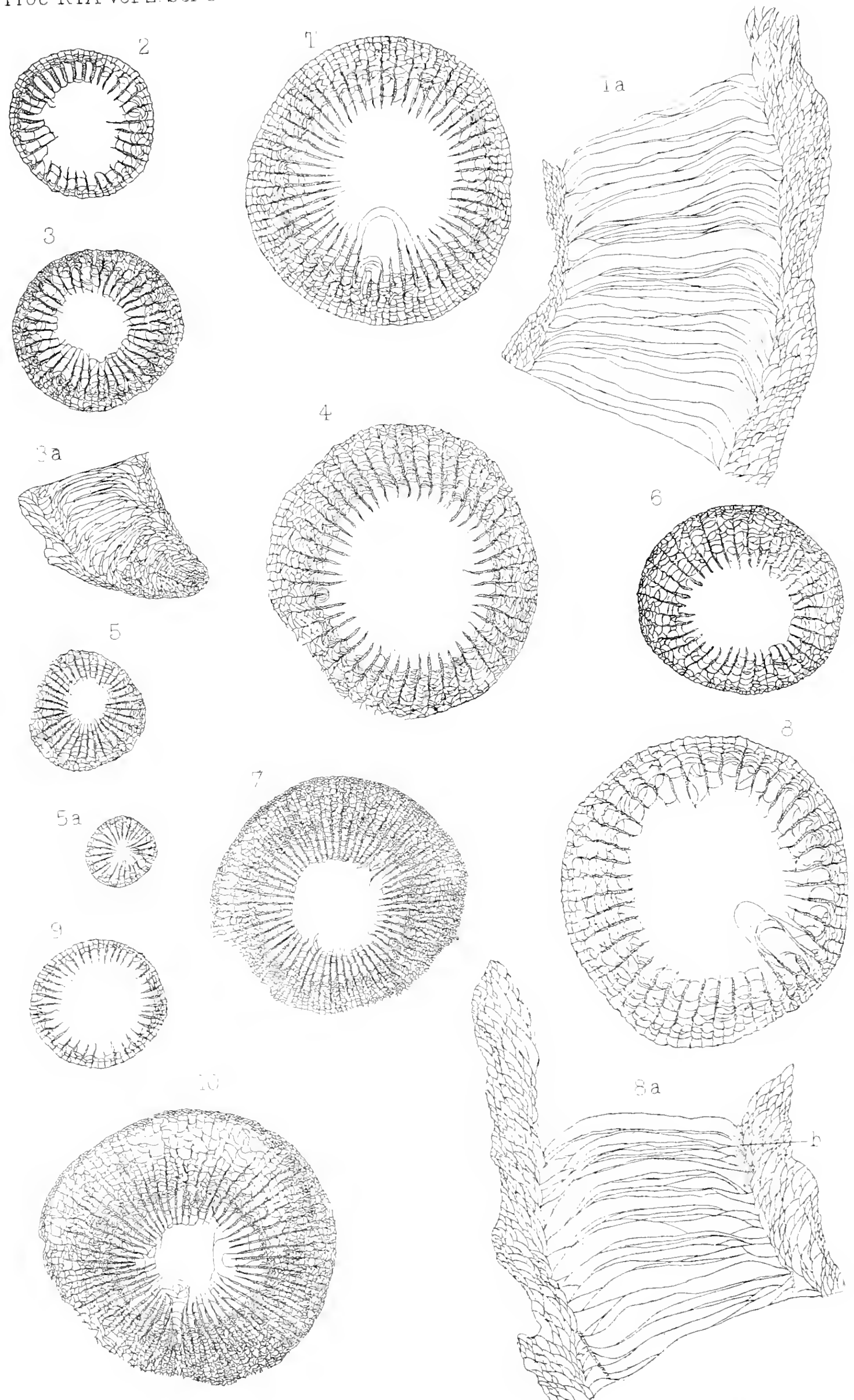

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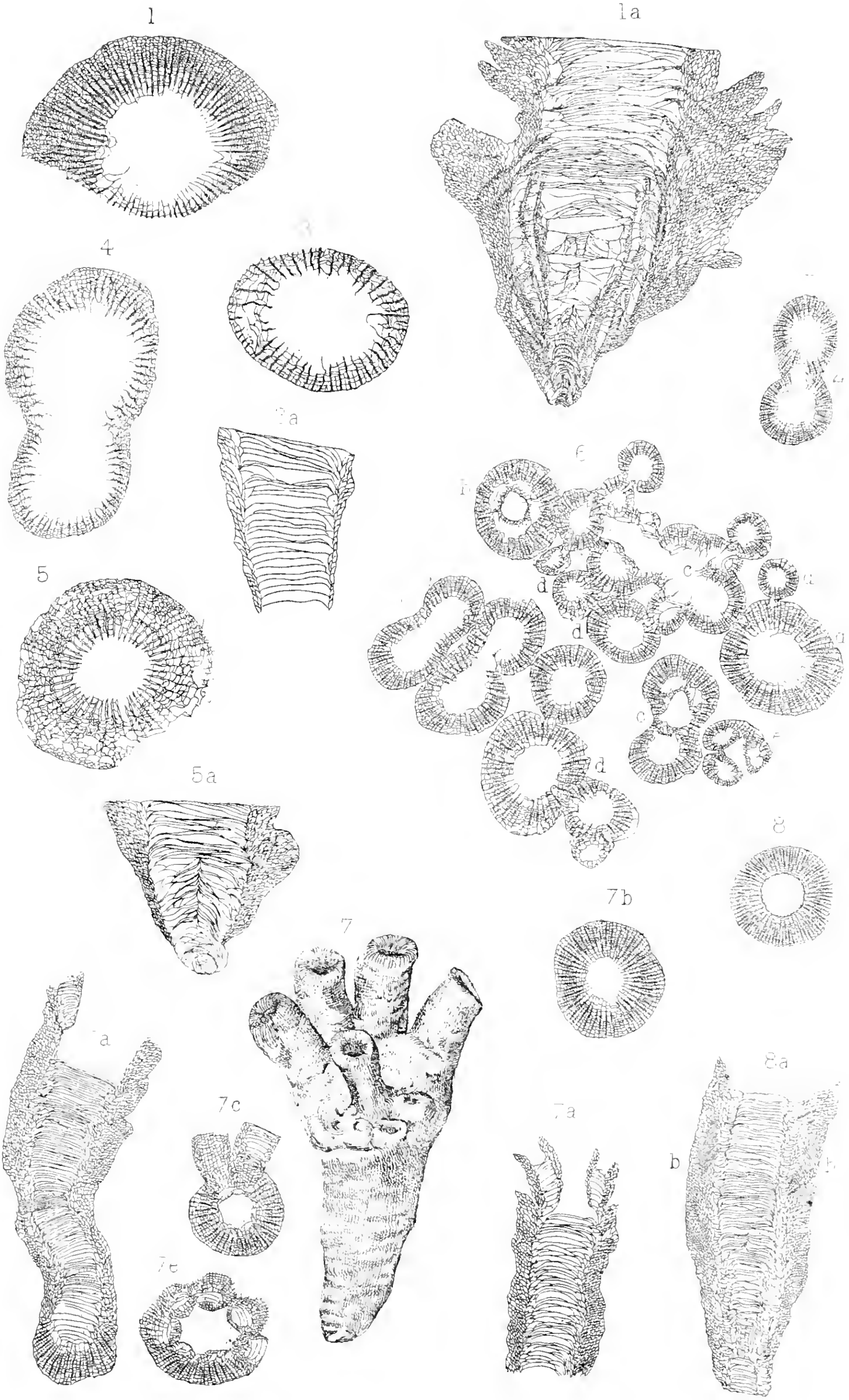

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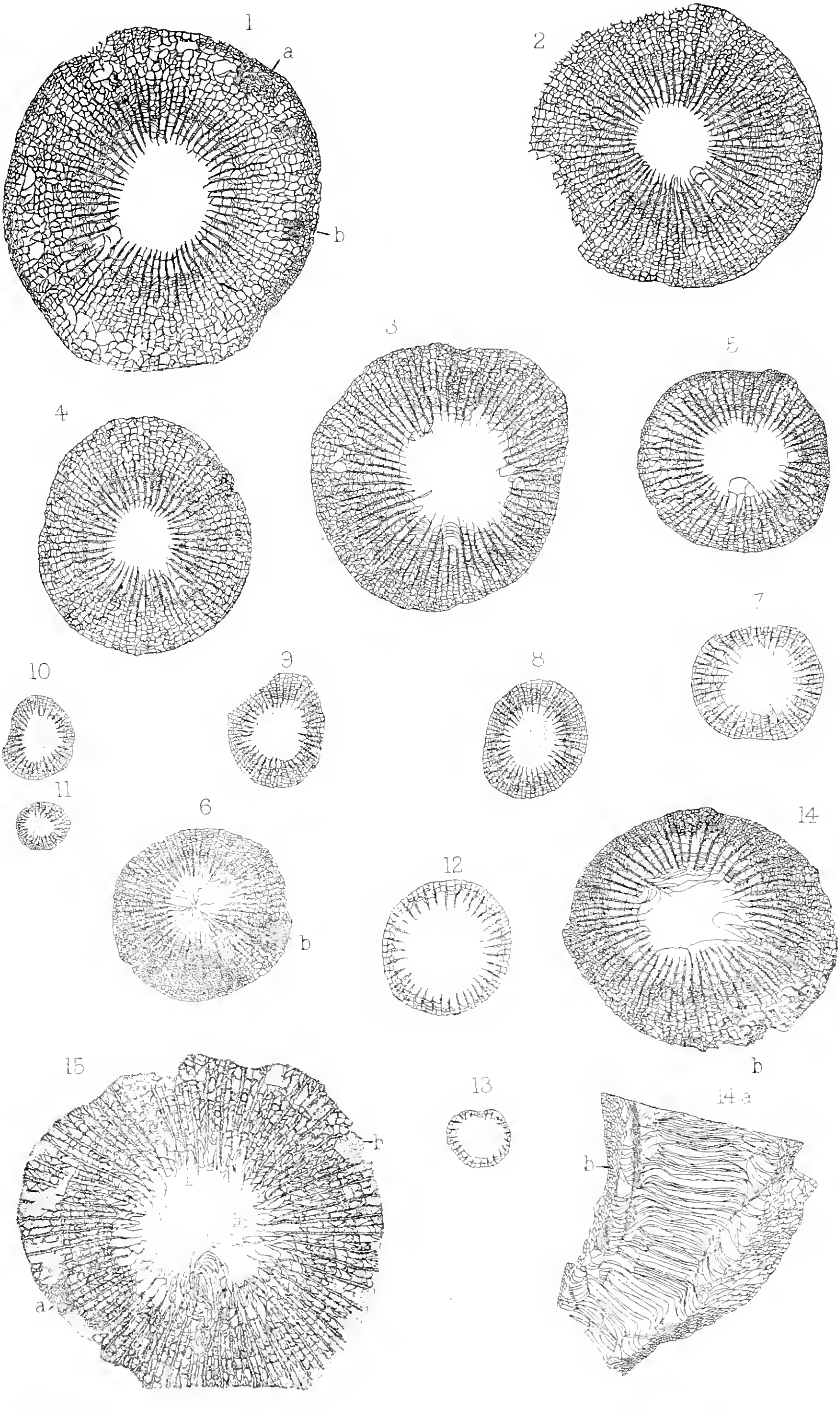
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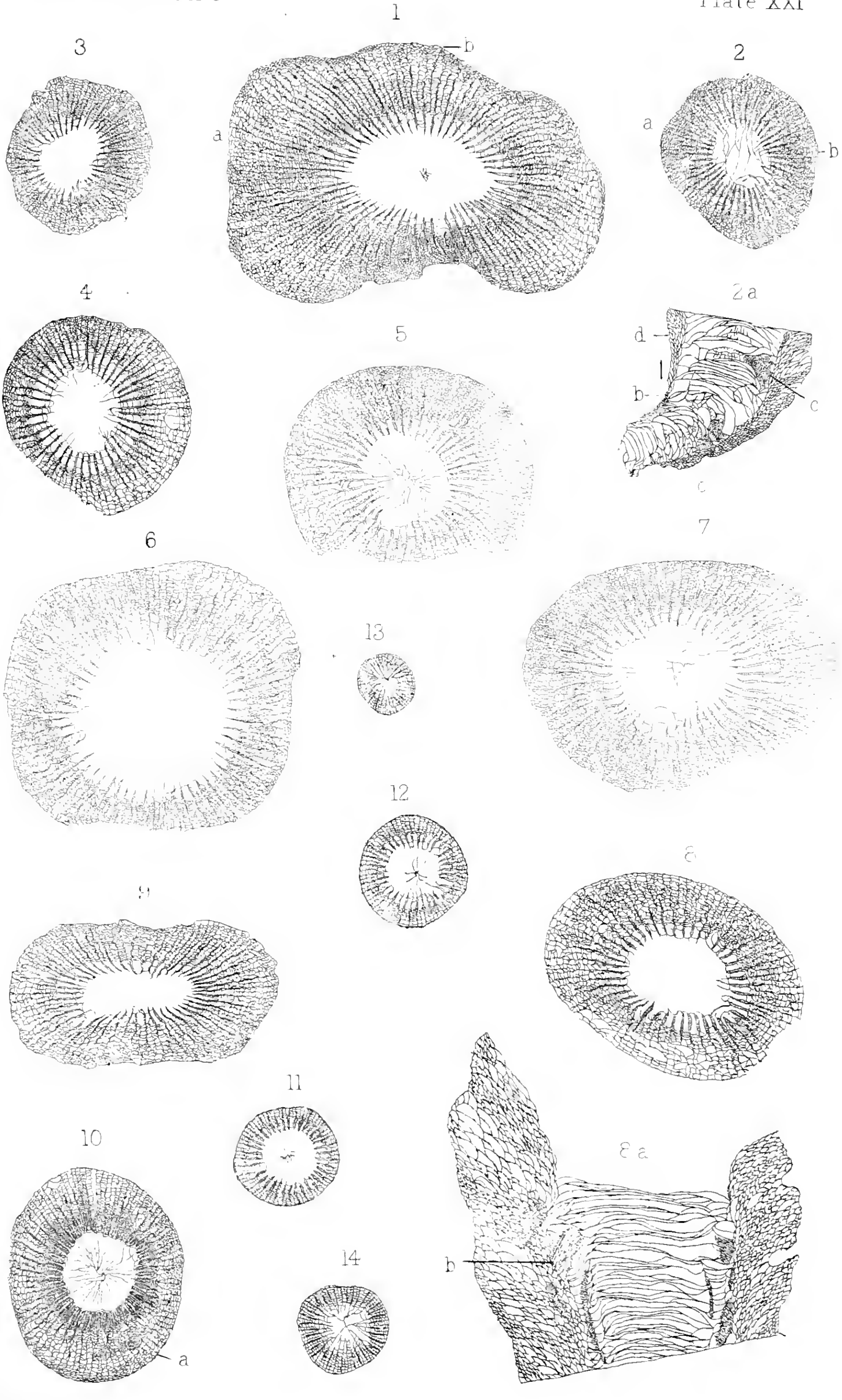

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APPENDIX.

MINUTES OF PROCEEDINGS

OF THE

Royal Irish Academy.

Royal Irish Academy.

MINUTES OF PROCEEDINGS.

Monday, April 25, 1887.

Rev. Dr. Haughton, f.r.s., President, in the Chair.

Rev. John Gwynn, d.d., and Mr. George Coffey, b.e., signed the Roll, and were admitted Members of the Academy.

The Right Rev. Dr. Graves, Bishop of Limerick, read a Paper "On the Reading and Interpretation of an Ogam Inscription found at Maumanorig, in the County of Kerry."

The Secretary read Notes by Professor Morgan W. Crofton, f.r.s., "On the Application of the Symbolical Methods to the Solution of certain Functional Equations."

Donations to the Library were announced, and thanks were voted to the Donors.

Monday, May 9, 1887.

Sir Robert Ball, f.r.s., Vice-President, in the Chair.

Mr. Albert R. Nichols, b.a.; Mr. James C. S. Green, m.b.; and Rev. Patrick A. Yorke, were elected Members of the Academy.

Hon. Mr. Justice O'Hagan, Vice-President, took the Chair while Sir Robert Ball, f.r.s., read a Paper "On the Plane Sections of the Cylindroid, being the Seventh Memoir on the Theory of Screws."

Sir Robert Ball having resumed the Chair—

Dr. W. Frazer read a Paper "On Counterfeited Irish Antiquities."

Donations to the Library were announced, and thanks were voted to the Donors.

The following Recommendation from the Council was adopted by the Academy:—

That instead of By-Laws 2 and 8, in Chapter III., as they now stand, the following be substituted:

2. "Every Member (save as provided for in Rules 5 and 8 of this Chapter) shall, besides his Entrance Fee, pay in every year to the Treasurer the sum of Two Guineas as an Annual Subscription. This sum becomes due on the 16th of March next after the Election of such Member, unless his Election has taken place between the 1st of January and the 16th of March, in which case his first Annual Subscription shall not become due until the 16th of March in the year following."

8. "In the case of non-compounding Members resident out of the United Kingdom, the Annual Subscription shall be One Guinea for every clear Academic Year spent abroad."

A Committee appointed by the Academy to draw up an Address of Congratulation to Her Majesty the Queen, Patron of the Academy, on the completion of the Fiftieth Year of Her Reign, brought up the following:—

"To HER MOST GRACIOUS MAJESTY QUEEN VICTORIA.

"MAY IT PLEASE YOUR MAJESTY,

"We, the President and Members of the Royal Irish Academy, beg permission to present to you our most loyal and hearty congratulations on the completion of the Fiftieth Year of your Reign.

"Our Academy was founded by Royal Charter in 1786, and since then the reigning Sovereign of these realms has been our Patron.

"Founded for the promotion of the study of Science, Polite Literature, and Antiquities in Ireland, we hope that the record of our published work, and the large Museum of Antiquities that we have collected, will prove us not to have been unfaithful to our trust.

"We recall with pride and gratification, that on the occasion of celebrating our centenary, in May, 1886, we were honoured by the congratulations and best wishes of Your Most Gracious Majesty.

"And we pray that Your Majesty may be long spared to occupy your exalted position.

"Signed on behalf of the Royal Irish Academy,

"SAMUEL HAUGHTON, CLK., M.D., *President.*
"E. PERCEVAL WRIGHT, M.D., *Secretary.*

It was moved by Sir Robert Kane, seconded by Mr. Justice O'Hagan, and passed :—

"That the Address to Her Majesty the Queen, just read, be adopted, and that the President and Secretary of the Academy (accompanied by the Mace) do present the same, on behalf of the Academy, at whatever time and place shall be appointed."

MONDAY, MAY 23, 1887.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. Albert R. Nichols, Mr. James C. S. Green, and Rev. Patrick A. Yorke, signed the Roll, and were admitted Members of the Academy.

Mr. V. Ball, M.A., F.R.S., read a Paper "On the Identification of the Animals and Plants of India which were known to the Ancient Greeks."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JUNE 13, 1887.

RIGHT HON. SIR PATRICK J. KEENAN, C.B., K.C.M.G., Vice-President, in the Chair.

Mr. James C. Semple was elected a Member of the Academy.

The Secretary read a Paper by Mr. J. E. Gore, F.R.A.S., "A Revised Catalogue of Variable Stars, with Notes and Observations."

The Secretary read a Paper by Mr. Philip Burton "On the Reflection of Light from Below the Horizon."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JUNE 27, 1887.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. James C. Semple signed the Roll, and was admitted a Member of the Academy.

Mr. Richard A. Gray and Mr. Hugh Robinson were elected Members of the Academy.

Professor D. J. Cunningham, M.D., read a Paper by Dr. St. John Brooks and himself "On the Peroneus Quinti Digiti Muscle."

Professor D. J. Cunningham, M.D., read a Paper by Professor E. H. Bennett, M.D., and himself, "On the Brain and Eyeball of a Cyclopian Embryo."

Donations to the Library and Museum were announced, and thanks were voted to the Donors.

The following Science Grants, recommended by the Council, were confirmed :—

£10 to the Rev. T. E. Espin, to assist him in his revision of Birmingham's Red Star Catalogue.

£10 to Mr. Richard P. Vowell, for a Report on the Flora of the Shores and Neighbourhood of Loughs Corrib and Mask.

£25 to Professor J. P. O'Reilly, as an additional grant for a Report on the Constitution of certain Cambrian Rocks.

The Secretary laid on the table Cunningham Memoir, No. IV. (Sir Robert Ball "On Dynamics and Modern Geometry"), and a circular relating to the forwarding of the 4to publications of the Academy to the Members.

MONDAY, NOVEMBER 14, 1887.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. Richard A. Gray, and Mr. Robert Cochrane signed the Roll, and were admitted Members of the Academy.

Mr. John Mulhall was elected a Member of the Academy.

Rev. P. A. Yorke, read a Paper "On Ancient Irish Architecture."

Professor H. Hennessy, F.R.S., read a Paper "On the Hot Air Bath in Central Europe and in Ireland."

Dr. Tarleton, F.T.C.D., read a Paper "On a New Method of finding the Conditions fulfilled when the Roots of the Harmonic Determinant Equation are Equal."

Dr. W. Frazer read a Paper "On a Bell Shrine recently purchased for the Museum."

Donations to the Museum and Library were announced, and thanks were voted to the Donors.

The following Letters, relative to the Academy's Address to the Queen, were read:—

"WHITEHALL, 25*th June*, 1887.

"SIR,

"With reference to your letter of the 20th ultimo, I am directed by Mr. Secretary Matthews to inform you that he has been commanded by the Queen to express to you Her Majesty's regret that she has been unable to arrange to receive in person the Address of Congratulation of the Royal Irish Academy on the occasion of Her Majesty's Jubilee.

"If, therefore, you will be so good as to forward the Address to this Office, Mr. Matthews will be happy to take an early opportunity of laying the same before Her Majesty.

"I am, Sir,
"Your obedient Servant,
"E. LEIGH PEMBERTON.

"THE REV. THE PRESIDENT,
"Royal Irish Academy,
"Dawson-street, Dublin."

"WHITEHALL, 23*rd July*, 1887.

"SIR,

"I have had the honour to lay before the Queen the loyal and dutiful Address of the Members of the Royal Irish Academy on the occasion of Her Majesty attaining the Fiftieth Year of Her Reign; and I have to inform you that Her Majesty was pleased to receive the same very graciously.

"I have the honour to be, Sir,
"Your obedient Servant,
"HENRY MATTHEWS.

"THE REVEREND THE PRESIDENT
"Of the Royal Irish Academy,
"19, Dawson-street, Dublin."

The Todd Lecture Series, Vol. II. (Dr. R. Atkinson "On the Passions and Homilies from *Leabhar Breac*"), was laid on the table.

WEDNESDAY, NOVEMBER 30, 1887.

(Stated Meeting.)

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. Edmond Barry signed the Roll, and was admitted a Member of the Academy.

The Secretary of Council brought down from the Council the following Recommendation :—

The Council recommend to the Academy that the following By-Law, Chapter XI., Section 1 (*Manuscripts*)—

"No MS. shall, under any circumstances, be lent out of the Library without such pecuniary guarantee for its safe return as the Council shall require"

—be amended, by striking out the words subsequent to the word "Library."

The following Amendment was moved by Mr. J. T. Gilbert and seconded by the Rev. D. Murphy :—

"That the Recommendation of the Council relating to the alteration of By-Law, Chapter XI., Section 1, be referred back to the Council for reconsideration."

The Amendment was carried by the casting vote of the President, there being ten for and ten against.

Dr. Tarleton, F.T.C.D., read a Paper "On the Determination of the Numerical Factors in the Expansion of Laplace's Co-efficients."

The Secretary read a Paper by Mr. J. E. Gore, F.R.A.S., "On the Double Star, Struve, 2120."

The Librarian (Dr. Frazer) exhibited a series of Letters, purchased for the Academy, from Bishop Barnard to Sir Joseph Banks relating to the Foundation of the Royal Irish Academy.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, DECEMBER 12, 1887.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. Francis O'Brien, P.P., and Mr. Seaton Forest Milligan were elected Members of the Academy.

The Secretary read a Paper by Sir Robert Ball, F.R.S., "Researches on the Theory of Distance."

The Secretary read a Paper by Mr. J. E. Gore, F.R.A.S., "On the Double Star, 45, Geminorum."

Professor Haddon, M.A., read a Second Report "On Deep-Sea Dredging off the South-West Coast of Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

An Index to the Papers published in the *Transactions*, *Cunningham Memoirs* and *Irish Manuscript Series* (4to), between the years 1786 and 1886, with an Appendix giving the names of the Officers of the Academy from 1785 to 1887, and of those to whom the Academy's Cunningham Gold Medals have been awarded, was laid on the table.

The following Notice of Motion was handed in by Mr. J. T. Gilbert:—

"Notice of Recommendation to Council to be proposed at the next Meeting of the Academy.

"That, as the Four Volumes in the Irish Language, issued by the Academy, are not accompanied by English versions, and as their contents are consequently unavailable to the public, the Council be recommended to consider the matter, and report to the Academy, at its next Meeting, on the practicability of procuring and publishing translations of these books by means of the £400 voted annually to the Academy by the House of Commons for works on Irish MSS.; and also whether, for this object, allocations could be made from the interest of the Cunningham Fund, now at the disposal of the Academy."

MONDAY, JANUARY 23, 1888.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. Dr. Gwynn read a Paper "On a Syriac MS. of the New Testament in the Library of the Earl of Crawford."

Donations to the Library were announced, and thanks were voted to the Donors.

The following Science Grants, recommended by the Council, were confirmed:—

£10 to Mr. R. Lloyd Praeger, for the investigation of the Post-tertiary Estuarine Deposits of the North of Ireland.

£20 to Mr. W. J. Knowles, to investigate the Prehistoric Remains of the Sand Hills of the Coast of the Northern Counties.

£15 (additional) to Professor O'Reilly, for investigating the Chemical Constitution of the Cambrian Rocks of Bray.

Read Letter from the Rector of the University of Bologna, asking the Academy to send a Representative to be present at the celebration of the completion of the Eighth Century of the University's existence.

It was proposed by the Rev. J. H. Jellett, D.D., Provost of Trinity College, Dublin, seconded by Mr. J. T. Gilbert, and resolved—

"That the President be requested to act as Representative of the Royal Irish Academy at the celebration of the completion of the Eighth Century of the existence of the University of Bologna."

Mr. J. T. Gilbert moved and Mr. W. J. Doherty seconded the following, which was passed:—

"That, as the Four Volumes in the Irish Language, issued by the Academy, are not accompanied by English versions, and as their contents are consequently unavailable to the public, the Council be recommended to consider the matter, and report to the Academy, at its next Stated Meeting, on the practicability of procuring and publishing translations of these books by means of the £400 voted annually to the Academy by the House of Commons for works on Irish MSS.; and also whether, for this object, allocations could be made from the interest of the Cunningham Fund, now at the disposal of the Academy."

MONDAY, FEBRUARY 13, 1888.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. John Mulhall signed the Roll, and was admitted a Member of the Academy.

The Most Rev. Bishop John Healy, D.D., LL.D.; Richard C. W. Hill; Rev. David B. Mulcahy, P.P.; Robert F. Scharff, B.SC., PH.D.; and George Walpole, were elected Members of the Academy.

Donations to the Library were announced, and thanks were voted to the Donors.

The following Science grant, recommended by the Council, was confirmed:—

£50 to Professor Haddon, to assist him in the investigation of Coral Reefs.

MONDAY, FEBRUARY 27, 1888.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. Richard C. W. Hill signed the Roll, and was admitted a Member of the Academy.

The following Science grants, recommended by the Council, were confirmed:—

£10 to Colonel W. G. Wood-Martin, in aid of the Exploration of the newly-discovered Crannog Site in the County of Meath.

£60 to a Committee consisting of Rev. W. S. Green, Mr. J. Wright, Dr. C. B. Ball, and Dr. E. P. Wright, to continue the Deep Sea Investigations to the 1000 fathom depth off the South Coast of Ireland.

On the Motion of Viscount Gough, seconded by Mr. Justice O'Hagan, it was resolved that

"The Academy desires to place on record its deep sense of the great loss which it has sustained by the decease of the Rev. Dr. J. H. Jellett, Provost of Trinity College, who had been for nearly forty-seven years one of its Members, and during which period he had taken a very active part in the direction of its affairs, as Member and Secretary of its Council, and for more than four years as its President.

"By his death Science has lost one who took a foremost position in its ranks, and who had therein achieved a very high reputation.

"The Academy tenders to Mrs. Jellett and the members of her family its sincerest sympathy in their bereavement."

The Academy, as a mark of respect, then adjourned.

Friday, March 16, 1888.

Rev. Dr. Haughton, f.r.s., President, in the Chair.

Dr. Robert Scharff signed the Roll, and was admitted a Member of the Academy.

The President declared the Ballot open for the Election of the President and Council for the year 1888–9, and appointed Mr. J. R. Garstin and Mr. J. F. Lombard Scrutineers.

The President declared the Ballot open for the Election of an Honorary Member, and appointed the Treasurer and Secretary Scrutineers.

The Secretary of Council read the following

Report of the Council for the Year 1887–88.

Since the date of the last Report of the Council the following parts of the *Transactions* have been published:—

Vol. xxix.

Part 1. "On the Plane Sections of the Cylindroid, being the Seventh Memoir on the Theory of Screws." By Sir Robert S. Ball, ll.d., f.r.s., Royal Astronomer of Ireland.

Part 2. "On the Ogam Monument at Kilcolman." By the Right Rev. Charles Graves, d.d., Bishop of Limerick.

Cunningham Memoirs.

No. iv. "Dynamics and Modern Geometry, a New Chapter in the Theory of Screws." By Sir Robert S. Ball, LL.D., F.R.S., Royal Astronomer of Ireland.

Also "A List of the Papers published in the *Transactions*, *Cunningham Memoirs*, and *Irish Manuscript Series* (4to) between the Years 1786 and 1886; with an Appendix giving the Names of the Officers of the Academy from 1785 to 1887, and of those to whom the Academy's Cunningham Gold Medals have been awarded."

Of the *Proceedings*, Part 6 of vol. iv. (Second Series), containing Papers on Science, and Part 8 of vol. ii. (Second Series), containing Papers on Polite Literature and Antiquities, were published in January, 1888.

In the *Todd Lecture Series*, vol. ii., "The Passions and Homilies from the *Leabhar Breac*: Text, Translation, and Glossary." By Robert Atkinson, M.A., LL.D.

In the Department of Science the Contributors are:—Mr. Morgan W. Crofton; Sir Robert Ball; Mr. V. Ball; Dr. Cunningham; Dr. Brooks; Mr. Gore; Mr. Burton; Dr. Bennett; Mr. H. Hennessy; Dr. Tarleton; Mr. Haddon; Mr. Alexander; and Mr. Thomson.

In the Department of Polite Literature and Antiquities:—The Bishop of Limerick; Dr. Frazer; Rev. P. A. Yorke; Rev. Dr. Gwynn.

The following Grants in aid of the Preparation of Scientific Reports have been sanctioned by the Academy:—

£10 to the Rev. T. E. Espin, to assist him in his revision of Birmingham's Red Star Catalogue.

£10 to Mr. Richard P. Vowell, for a Report on the Flora of the Shores and Neighbourhood of Loughs Corrib and Mask.

£25 to Professor J. P. O'Reilly, as an additional grant for a Report on the Constitution of certain Cambrian Rocks.

£10 to Mr. R. Lloyd Praeger, for the investigation of the Post-tertiary Estuarine Deposits of the North of Ireland.

£20 to Mr. W. J. Knowles, to investigate the Prehistoric Remains of the Sand Hills of the Coast of the Northern Counties of Ireland.

£15 (additional) to Professor O'Reilly, for investigating the Chemical Constitution of the Cambrian Rocks of Bray.

£50 to Professor Haddon, to assist him in the investigation of Coral Reefs.

£10 to Colonel W. G. Wood-Martin, in aid of the Exploration of the newly-discovered Crannog Site in the county of Meath.

£60 to a Committee consisting of Rev. W. S. Green, Mr. J. Wright, Dr. C. B. Ball, and Dr. E. P. Wright, to continue the Deep Sea investigations to the 1000 fathom depth off the South Coast of Ireland.

In the past year the study of Celtic has been advanced by the publication of the Lectures of the Todd Professor, during his tenure of office in the years 1885–1887. As his successor in this office, the Rev. Dr. M'Carthy has been appointed, and he will, it is hoped, deliver his first series of Lectures during the incoming Academic year.

The Council have to regret that more progress has not been made with the *Annals of Ulster*, of which the first volume, however, is now available to the public, having been issued by the Stationery Office.

On a motion of Mr. Gilbert, it was referred to the Council to prepare a Report in expression of their opinion as to the practicability of attempting to obtain translations of the Facsimiles of Irish MSS., already published by the Academy; but the Council, after considering the subject, felt that it was too important to be hurried over in the end of the Council session, and therefore recommend the completion of the inquiry to the incoming Council.

Amongst the numerous additions to the Library made during the past year are—a large series of publications presented by the trustees of the British Museum; a number of volumes from the Natural History Department of the British Museum, South Kensington; Catalogue of the Medusæ of the Australian Seas, &c., presented by the trustees of the Australian Museum, &c.

During the past year several objects, some of considerable antiquarian interest, have been added to the collection of the Museum. They comprise implements of bronze, wood, stone; portion of a bell shrine with leather case; a unique gilt bronze ornament, found in the Co. Antrim; an ancient bottle and leather purse, Co. Mayo; and an iron cauldron of remarkable workmanship, found near a crannog in the Co. Cavan.

The following Ordinary Members have been elected since the 16th March, 1887:—

1. Richard A. Gray, C.E.
2. James C. S. Green, M.B.
3. Most Rev. Bishop Healy, D.D., LL.D.
4. Richard C. W. Hill.
5. Seaton F. Milligan.
6. Rev. David B. Mulcahy, P.P.
7. John Mulhall.
8. A. R. Nichols, B.A.
9. Rev. Francis O'Brien, P.P.
10. Hugh Robinson.
11. Robert F. Scharff, B.SC., PH.D.
12. James C. Semple.
13. George Walpole.
14. Rev. Patrick A. Yorke.

We have lost by death, within the year, twelve Members:—

1. Thomas Baldwin, elected June 24, 1872.
2. Sir John Barrington, D.L., elected May 14, 1866.
3. John A. Blake, M.P., elected January 10, 1876.
4. Very Rev. Canon Ulick J. Bourke, P.P., elected January 9, 1871.
5. Right Hon. Lord Clermont, D.L., elected January 11, 1841.
6. Denis Crofton, B.A., elected August 24th, 1857.
7. Rev. John Hewitt Jellett, D.D., Provost of Trinity College, Dublin, elected April 12, 1841.
8. Charles Croker King, M.D., elected June 8, 1845.
9. Right Hon. James Anthony Lawson, LL.D., D.C.L., elected May 11, 1857.
10. George Woods Maunsell, M.A., D.L., elected January 9, 1871.
11. Very Rev. Canon John O'Rorke, P.P., elected June 11, 1866.
12. Lieutenant-General William J. Smythe, F.R.S., elected April 14, 1873.

We have also lost, by death, one Honorary Member in the Section of Polite Literature and Antiquities:—

Sir Henry James Sumner Maine, LL.D., K.C.S.I., F.R.S.

Among the foregoing, Mr. D. Crofton published in our *Transactions* and *Proceedings* several Papers, the titles of which (given below) sufficiently indicate the nature of his studies, though they suggest rather than display his power of grappling with the difficulties of Oriental writings, leaving it to be regretted that more continuous efforts in a similar direction should not have afforded better opportunities of fully judging his manifold attainments.

The following is a list of the Papers by Mr. D. Crofton:—

"On the Collation of a MS. of the Bhagavad-Gîtâ."

"On Vestiges of Ancient Human Habitations in Poole's Cavern, Derbyshire."

"On a Coincidence between a Babylonian Cuneiform Inscription of Nebuchadnezzar and a Passage in the Book of Daniel."

"On the Brick Inscribed in Archaic Characters in the Museum of Trinity College, Dublin."

"Upon a Sculptured Slab from Nineveh, with a Cuneiform Inscription, at Trinity College, Dublin."

The Academy has sustained a very deep loss in the death of the Rev. Dr. Jellett, the late Provost of Trinity College. His name was a household word among us. In how honourable an estimation he was held by the Academy, his election as President during the years 1869–1874 will show. The Academy also appreciated his sterling worth by conferring on him its Cunningham Gold Medal in 1851. And Dr. Jellett reciprocated the esteem of the Academy by a loyal adhesion to it throughout his career. It is worth note that all his Papers, not published in book form, were read before the Academy, and appeared in its *Proceedings*.

His principal mathematical work was a treatise on the *Calculus of Variations*, published in 1850. This valuable treatise furnished a lucid account of the researches of Continental mathematicians on the subject, and removed many of the difficulties and obscurities connected with this branch of science, especially those attaching to it in the writings of its great inventor, Lagrange. The treatise on the *Calculus of Variations* exhibits, in a remarkable manner, the extreme clearness of thought which was the most striking characteristic of the intellect of Dr. Jellett. Among his other mathematical publications may be especially mentioned those relating to inextensible surfaces, as of great interest and value; as also his book on *Friction,* which was published in 1872; but probably a surer foundation for his scientific reputation will be found in his invention of the beautiful and delicate instrument called the Double-plane Analyser, and in his application, by means of this instrument, of the properties of polarized light to the investigation of the difficult and unsolved problem of the nature of chemical union. The science of chemistry, viewed from the standpoint of mathematical physics, is yet in its infancy, and to trace the connexion between the chemical properties of matter and its primary qualities must be the work of some Newton of the future; but of those who have striven to clear the way for the final discovery, there is probably none who has made a more original and successful attempt than Dr. Jellett. The investigations described in his Paper on Chemical Optics, in which the properties of polarized light are employed to discover the nature and laws of chemical equilibrium, exhibit a remarkable union of theoretical and experimental skill.

It does not come within the scope of this notice to treat of Dr. Jellett's theological writings, which, of course, could not be left out of consideration in any complete estimation of the labours of the late Provost. As a speaker, however, it may be said that he never addressed an audience without making a deep impression by his lucid statement and logical enchainment of the reasons that guided him to a decision on any disputed point; his earnest manner, outspoken without bitterness, his quiet, yet forcible oratory, always rivetted the attention of his hearers; but it was, above all, his transparent truthfulness that was his highest charm; nor can greater praise be given to a man placed in a position of responsibility and authority than this—which can assuredly be said of Dr. Jellett—that, alike, his supporters and his opponents felt and acknowledged him to be always and in all things a man of absolute integrity.

Appended is a list of Dr. Jellett's Papers in the Academy.

Papers published in the *Transactions*:—

"On the Equilibrium and Motion of an Elastic Solid."

"On the Properties of Inextensible Surfaces."

"Researches in Chemical Optics."

Papers published in the *Proceedings*:—

"A Note on Some New Properties of Surfaces of the Second Order."
"On the Equilibrium or Motion of a Molecular System."
"On the Properties of Inextensible Surfaces."
"On the Effect of the Internal Fluidity of the Earth on the Length of the Day."
"On the Reflexion and Refraction of Polarized Light."
"On a New Analysing Prism."
"On a New Optical Saccharometer."
"On a Fluid possessing Opposite Rotatory Powers for Rays at Opposite Ends of the Spectrum."
"On an Optical Method, by means of which the Formation of Definite Chemical Compounds may be in certain cases Determined."
"On Optical Saccharometry, with special reference to an Examination of some Specimens of Sugar Beet grown in Ireland."
"A further Communication on Optical Saccharometry, with special reference to the Sugar Beets grown in Ireland in the year 1872."
"On the question of Chemical Equilibrium."
"On the Chemical Changes which take place in the Potato during the Progress of the Disease."

The Report was adopted.

On the motion of the Secretary of the Academy, seconded by Dr. J. T. Banks, By-Law 6 of Chapter IX. was suspended (for the purpose of the reading of Papers and the admission of Visitors).

Professor Cunningham, M.D., read a Paper "On the Growth of the Brain during Childhood and Adolescence; with some Observations upon Cranio-cerebral Topography. Illustrated by a Series of Models of the Human Brain *in situ*."

By permission of the Academy, Professor Alexander read a Paper by Mr. A. W. Thomson and himself "On Two-nosed Catenaries, and their Application to the Design of Segmental Arches."

The following letter was read:—

"Provost's House,
"*2nd March*, 1888.

"Dear Dr. Wright,

"I write on behalf of my mother and myself to return our sincere thanks to the Royal Irish Academy for the kind resolution passed by them on the 27th ult. Kind and generous as the resolution is, it is doubly valuable and comforting to us when coming from the

Royal Irish Academy, with whom my dear father was so long and so intimately connected.

"I beg to return our heartfelt thanks.

"Very truly yours,

"W. M. Jellett.

"E. P. Wright, M.D.,
"*Secretary, Royal Irish Academy.*"

The President, on the Report of the Scrutineers, declared the following duly elected as President and Council for the ensuing year:—

President.

Rev. Samuel Haughton, M.D., F.R.S., S.F.T.C.D.

Council.

Committee of Science.

J. P. O'Reilly, C.E.
John Casey, LL.D., F.R.U.I., F.R.S.
George Sigerson, M.D., F.R.U.I.
Charles R. C. Tichborne, LL.D.
Sir Robert Kane, LL.D., F.R.S.
Edward Perceval Wright, M.D.
Sir Robert. S. Ball, LL.D., F.R.S.
V. Ball, M.A., F.R.S.
F. A. Tarleton, LL.D., F.T.C.D.
Daniel J. Cunningham, M.D.
Benjamin Williamson, M.A., F.R.S., F.T.C.D.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
John Kells Ingram, LL.D., S.F.T.C.D.
William Frazer, F.R.C.S.I.
David R. Pigot, M.A.
Right Hon. Sir Patrick J. Keenan, C.B., K.C.M.G.
P. W. Joyce, LL.D.
John R. Garstin, M.A., F.S.A.
Hon. Mr. Justice O'Hagan, M.A.
John T. Gilbert, F.S.A.

The President, on the report of the Scrutineers, declared Dr. Joseph Anderson duly elected an Honorary Member of the Academy, in the section of Polite Literature and Antiquities.

The President then declared the Ballot open for the election of Officers, and appointed Dr. La Touche and Dr. Sigerson Scrutineers.

Donations to the Library were announced, and thanks were voted to the Donors.

A portrait of the late Dr. R. R. Madden was presented to the Academy by his son, Dr. Thomas More Madden.

It was moved by Dr. W. Frazer, seconded by Dr. J. K. Ingram, and Resolved—

"That the special thanks of the Academy are hereby given to Dr. T. M. Madden for his donation of the portrait of his father, the late Dr. R. R. Madden."

The President, on the Report of the Scrutineers, declared the following duly elected Officers for the ensuing year:—

Treasurer—Rev. M. H. Close, M.A.

Secretary—Ed. Perceval Wright, M.D.

Secretary of the Council—Robert Atkinson, LL.D.

Secretary of Foreign Correspondence—Joseph P. O'Reilly, C.E.

Librarian—John T. Gilbert, F.S.A.

Clerk of the Academy—Robert Macalister, LL.B.

The President, under his hand and seal, appointed the following Vice-Presidents for the ensuing year:—

Professor J. P. O'Reilly, C.E.

Right Hon. Sir Patrick J. Keenan, C.B., K.C.M.G.

Hon. Mr. Justice O'Hagan, M.A.

Professor B. Williamson, M.A., F.R.S., F.T.C.D.

The Academy then adjourned.

Special Meeting.

Wednesday, March 28, 1888.

Rev. Dr. Haughton, F.R.S., President, in the Chair.

The following Recommendation was brought down from the Council, in reference to the funded property of the Academy:—

"Resolved, that it be recommended to the Academy to assent to the proposal of the Chancellor of the Exchequer, relative to the transfer of the funds of the Academy (£4005), now in the New Three per Cents., to the Two-and-three-quarters per Cents., and to give assent to the proposal to transfer the funds (£3290) now in Consols likewise."

The Recommendation was approved and adopted.

MONDAY, APRIL 9, 1888.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. George Walpole signed the Roll, and was admitted a Member of the Academy.

Mr. George D. Burtchaell, M.A., LL.B., and Mr. Edward M. Sellors, M.A., were elected Members of the Academy.

The Secretary read a Paper by Mr. J. E. Gore, F.R.A.S., "On the Variable Star μ Cephei."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, APRIL 23, 1888.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. G. D. Burtchaell and Mr. E. M. Sellors signed the Roll, and were admitted Members of the Academy.

Sir Patrick Keenan, Vice-President, took the Chair while the President read a Paper "On Geometrical Illustrations of Newlands' and Mendelejeff's Periodic Law of the Atomic Weights of the Chemical Elements. Part I. Hydrogen, and the First and Second Periods following it—1. The Carbon Period; 2. The Silicon Period."

The President having resumed the Chair,

Professor Haddon, M.A., read a Paper entitled "Contributions towards a Revision of the British Actiniæ." Part I.

Donations to the Library were announced, and thanks were voted to the Donors.

The Rev. Dr. Haughton, F.R.S., President, was elected a Representative of the Royal Irish Academy on the Board of Visitors of the Museum of Science and Art, Dublin, in the room of the late Rev. Dr. Jellett.

MONDAY, MAY 14, 1888.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. James A. Mahony was elected a Member of the Academy.

Dr. Atkinson, on behalf of the Subscribers, presented to the Academy a Portrait, by Miss Sarah Purser, of the late Sir Samuel Ferguson, President of the Academy. The President, on behalf of the Academy, accepted the same.

Dr. Tarleton took the Chair while the President read a Paper "On Geometrical Illustrations of Newlands' and Mendelejeff's Periodic Law of the Atomic Weights of the Chemical Elements. Part II. The Third and Fourth Periods—3. The Titanium Period; 4. The Germanium Period."

The President having resumed the Chair—

The Secretary read a Paper by Dr. C. G. Young "On the Habits and Anatomy of *Opisthocomus cristatus*."

Dr. Frazer read some Notes on Testoons of Henry VIII., with details of an undescribed Testoon of the Bristol mint, coined by Thomas Sharington.

Dr. Frazer read some Notes on a Powder Flask referable to the time of James I., with Celtic ornamentation.

Professor Cunningham, M.D., exhibited some additional Models illustrative of Brain Growth.

Donations to the Library were announced, and thanks were voted to the Donors.

The following letter was read:—

"ROYAL INSTITUTION, EDINBURGH,
"*April 26th*, 1888.

"DEAR SIR,

"In acknowledging receipt of your letter accompanying the Diploma of Membership, permit me to express my sense of the very high honour the Royal Irish Academy has done me in electing me one of its Honorary Members in the Department of Polite Literature and Antiquities—an honour which I appreciate the more highly as coming from the Academy which has done, and is doing, so much to revive and foster the widening interest in Celtic Literature and Celtic Antiquities.

"I am, dear Sir,
"Yours very truly,
"JOSEPH ANDERSON.

"E. PERCEVAL WRIGHT,
"*Secretary, Royal Irish Academy.*"

MONDAY, MAY 28, 1888.

RIGHT HON. SIR PATRICK J. KEENAN, C.B., K.C.M.G., Vice-President, in the Chair.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JUNE 11, 1888.

PROFESSOR J. P. O'REILLY, Vice-President, in the Chair.

The Secretary read for the Rev. T. E. Espin "A New Edition of Birmingham's Red Star Catalogue."

By permission of the Academy, Mr. W. F. Wakeman read a Paper "On the 'Bullan,' or Rock Basin in Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

The following Science Grants, recommended by the Council, were confirmed:—

£20 to Mr. Joly, for an investigation of the Melting Points and Thermal Expansions of Minerals.

£10 to a Committee, consisting of Prof. G. F. Fitz Gerald, F.R.S.; Prof. W. J. Sollas, and Mr. Smeeth, for the purposes of investigating the Electrical Resistance of Crystals.

The Treasurer read, in accordance with By-Law 3, Chapter III., the List of Members in arrear.

MONDAY, JUNE 25, 1888.

PROFESSOR J. P. O'REILLY, Vice-President, in the Chair.

Sir George Porter, M.D.; Rev. Leonard G. Hassé; and Dr. John Lentaigne signed the Roll, and were admitted Members of the Academy.

Mr. Edward H. Earl, Mr. Wesley W. Wilson, and Mr. William E. Wilson were elected Members of the Academy.

Dr. Frazer called attention to the manufacture of Spurious Antiquities in the City of Dublin.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, NOVEMBER 12, 1888.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

The Secretary read a Paper by Sir Robert S. Ball, LL.D., F.R.S., "Eighth Memoir on the Theory of Screws, showing how Plane Geometry Illustrates General Problems in the Dynamics of a Rigid Body, with Three Degrees of Freedom."

The Secretary read a Paper by Lieutenant-Colonel W. G. Wood-Martin, "Report on an Exploration of a Crannog Site in Meath."

The following were exhibited:—

Two Casts of Scottish Antiquities, presented by D. W. Kemp, Esq., Edinburgh.

Gold Torque, recently added to the Museum of the Academy.

Silver Coins, Hiberno-Danish, presented by the Hon. Robert Marsham.

Donations to the Library were announced, and thanks were voted to the Donors.

Letter read from the University of Bologna, thanking the Academy for sending a deputation to take part in the Eighth Centenary celebration of the University.

FRIDAY, NOVEMBER 30, 1888.

SIR ROBERT KANE, LL.D., F.R.S., in the Chair.

Mr. W. W. Wilson and Mr. L. W. King signed the Roll, and were admitted Members of the Academy.

Donations to the Library were announced, and thanks were voted to the Donors.

The following Science Grant, recommended by the Council, was confirmed:—

£30 to Professor Cunningham, M.D., to aid him in his researches on "Cranio-Cerebral Topography."

Monday, December 10, 1888.

Rev. Dr. Haughton, f.r.s., President, in the Chair.

Mr. William Edward Wilson signed the Roll, and was admitted a Member of the Academy.

The Very Rev. William (Canon) Hutch, d.d., and Brigade-Surgeon Charles Sibthorpe, f.k.q.c.p., were elected Members of the Academy.

The Todd Professor (Rev. Bartholomew MacCarthy, d.d.), delivered the First Todd Memorial Lecture, Series III. "On the Codex Palatino-Vaticanus. No. 830."

Sir Robert Ball, ll.d., f.r.s., read a Paper on "The Harmonic Tidal Constituents of the Port of Dublin."

Donations to the Library were announced, and thanks were voted to the Donors.

Monday, January 14, 1889.

Rev. Dr. Haughton, f.r.s., President, in the Chair.

Mr. Edward H. Earl signed the Roll, and was admitted a Member of the Academy.

Mr. Charles Grove Young, m.d., was elected a Member of the Academy.

The Todd Professor (Rev. Bartholomew MacCarthy, d.d.) delivered the Second Todd Memorial Lecture, Series III. Subject:—"The Codex Palatino-Vaticanus. No. 830." (Successions and Synchronisms from Books of Leinster and Ballymote.)

Mr. W. J. Knowles read his "Report on the Flint Implements of the North-East of Ireland."

Mr. W. J. Knowles read his "Report on the Prehistoric Remains from the Sand-hills of the Coast of Ireland."

Mr. W. J. Knowles read a "Note on an old Iron brazed Bell from Cullybackey, Co. Antrim."

Rev. B. MacCarthy, d.d., read a "Note on the Tripartite Life of St. Patrick. New Textual Readings."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JANUARY 28, 1889.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Professor J. P. O'Reilly, C.E., read a Paper on "The Directions of Jointings in the Neighbourhood of Bray."

The Secretary read for Brigade-Surgeon C. Sibthorpe, F.K.Q.C.P., "Notes on Filaria sanguinis hominis."

The President called attention to an Ancient Tombstone, found in the Graveyard of All Hallows Monastery, near Rathdrum, Co. Wicklow, which had been presented to the Academy by W. F. Littledale, Esq.

Donations to the Library were announced, and thanks were voted to the Donors.

Mr. W. J. Doherty moved and Mr. George Coffey seconded the following:—

"That the Council of the Academy be recommended to prepare and print, for the use of the Members and the public, a descriptive list of all articles in the Museum of the Academy that are not enumerated in Sir William Wilde's Catalogue; and to have a complete record made and printed, for similar use, of all Irish Antiquities and other articles that are to be transferred to the Museum of Science and Art, Dublin.

Which was adopted.

MONDAY, FEBRUARY 11, 1889.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. Justice O'Hagan, Vice-President, took the Chair while the President read a Paper on "Geometrical Illustrations of Newlands' and Mendelejeff's Periodic Law of the Atomic Weights of the Chemical Elements. Part III. The Fifth and Sixth Periods of Seven Elements following Hydrogen; or the Zirconium and Tin double period. Part IV. The Ninth and Tenth Periods of Seven Elements following Hydrogen; including Gold, Mercury, Bismuth, and Wolfram."

Professor Bartholomew MacCarthy, D.D., read the Third Todd Memorial Lecture, Series III. Subject—"Synchronisms from the Book of Ballymote."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, FEBRUARY 25, 1889.

HON. MR. JUSTICE O'HAGAN, Vice-President, in the Chair.

Rev. David B. Mulcahy, P.P., signed the Roll, and was admitted a Member of the Academy.

Professor Bartholomew Mac Carthy, D.D., read the Fourth Todd Memorial Lecture, Series III. Subject—"Synchronisms from the Book of Ballymote."

Donations to the Library were announced, and thanks were voted to the Donors.

SATURDAY, MARCH 16, 1889.

(Stated Meeting.)

RIGHT HON. SIR PATRICK J. KEENAN, C.B., K.C.M.G., Vice-President, in the Chair.

The Vice-President, in the Chair, declared the Ballot open for President and Council for the ensuing year, and appointed Deputy-Surgeon-General King and Dr. Mac Swiney Scrutineers.

The Ballot was also opened for the election of Honorary Members, the Treasurer and Secretary of the Academy being appointed Scrutineers.

The Secretary of Council read the following

REPORT OF THE COUNCIL FOR THE YEAR 1888–9.

Since the date of the last Report of the Council the following Parts of the *Transactions* have been published:—

Vol. xxix.

Part 3. "On Two-nosed Catenaries and their Application to the Design of Segmental Arches." By T. Alexander, C.E., Professor of Engineering, Trinity College, Dublin; and A. W. Thomson, B.SC., Assoc. Mem. Inst., C. E., Lecturer in the Glasgow and West of Scotland Technical College.

Part 4. "The Brain and Eyeball of a Human Cyclopian Monster." By D. J. Cunningham, M.D. (Edin. and Dubl.), Professor of Anatomy, Trinity College, Dublin; and E. H. Bennett, M.D., Professor of Surgery in Trinity College, Dublin.

Part 5. "On the Theory of the Content." By Sir Robert Stawell Ball, LL.D., F.R.S., Andrews Professor of Astronomy in the University of Dublin, and Royal Astronomer of Ireland.

The following is in the Press, and will be published immediately:

Part 6. "The Tripartite Life of St. Patrick: New Textual Studies." By the Rev. B. Mac Carthy, D.D., M.R.I.A., &c.

Of the *Proceedings*, Part 1 of the first volume of Series iii. was published in December, 1888, containing Papers in the various Departments of the Academy's work, the Council having determined in the Third Series to revert to the original method of publishing Papers consecutively, instead of in separate sections of Science, Polite Literature, and Antiquities, respectively.

The contributors of Papers during the year were:—Rev. Dr. Haughton, F.R.S., President of the Academy; Professor J. Alexander, M.A.I.; Sir R. S. Ball, F.R.S.; Professor D. J. Cunningham, M.D.; Rev. T. E. Espin, M.A.; W. Frazer, F.R.C.S.I.; J. E. Gore, F.R.A.S.; Professor A. C. Haddon, M.A.; W. J. Knowles; Professor J. P. O'Reilly, C.E.; Brigade-Surgeon C. Sibthorpe; A. W. Thomson, B.SC.; W. F. Wakeman; Lieutenant-Colonel W. G. Wood-Martin; C. G. Young, M.D.; and the Todd Professor, Rev. Bartholomew Mac Carthy, D.D.

The following Grants in aid of the Preparation of Scientific Reports have been sanctioned by the Academy:—

£20 to Mr. Joly, for an investigation of the Melting Points and Thermal Expansions of Minerals.

£10 to a Committee, consisting of Prof. G. F. FitzGerald, F.R.S., Prof. W. J. Sollas, and Mr. Smeeth, for the purposes of investigating the Electrical Resistance of Crystals.

£30 to Professor Cunningham, to aid him in his researches on "Cranio-Cerebral Topography."

And the following will be submitted to the Academy at this Meeting:—

£20 to Mr. W. J. Knowles, to enable him to continue his investigation into the Prehistoric Remains of the Sand-hills of the Coast of Ireland.

£50 to Professor W. J. Sollas, to assist him in completing his Report on the Igneous Rocks of Carlingford and County Down.

£50 to Professor D. J. Cunningham, to assist him in completing his Report on Brain and Cranial Growth.

£20 to Professor O'Reilly to assist him in completing his investigations into the Chemical Constitution of the Cambrian Rocks of Bray Head.

The following are amongst the objects added to the collection in the Museum since the publication of last Annual Report:—

Gold neck torque, found in a bog-drain in Lissadrom, Co. Mayo.
Bronze axe-head and rude stone implements, from Scariff, Co. Clare.
Bronze penannular circlet, recently found in Co. Tyrone.
Bronze bracelet, *bronze fibula* (known as the *Cunningham Brooch*), and *bracelets of silver*, from the Londesborough collection.
Bronze leaf-shaped sword, from Lough-Gurr, Co. Limerick.
Ancient leather shoe, from Dromore.
Slab of wood, with intaglio designs.
Ancient and rare silver coins.
Casts from ancient Scottish sculptured stones.
Inscribed tombstone from graveyard of All-Hallow's Monastery, Rathdrum, Co. Wicklow.

In the Library a considerable amount of work has been done in continuation of the Catalogue of pamphlets and broadsides. A valuable Irish language manuscript, on vellum, has during the past year been obtained for the Library.

The Yellow Book of Lecan, the last of the great Irish MSS. which the Council propose to reproduce in *facsimile*, is now in hands; and it is hoped that a large proportion of the work will be completed in the summer of the present year.

During the present session the Rev. Dr. MacCarthy delivered the first series of his lectures as the Academy's Todd Professor.

In compliance with the request of the University of Bologna, the Academy appointed the President as Representative at the celebration of the Octo-Centenary of that University, which was held in May, 1888, and at which the President presented to the Rector of the University the Academy's Congratulatory Address.

The following Members have been elected since the 16th March, 1888:—

1. George D. Burtchaell, M.A., LL.B.
2. Edward H. Earl.
3. Very Rev. William (Canon) Hutch, D.D.
4. James A. Mahony.
5. Edward M. Sellors, M.A.
6. Brigade-Surgeon Charles Sibthorpe, F.K.Q.C.P.
7. Wesley W. Wilson, C.E.
8. William E. Wilson.
9. Charles G. Young, M.D.

We have lost by death, within the year, seven Members:—

1. William Hellier Baily, F.G.S., elected April 8, 1872.
2. Robert Clayton Browne, M.A., D.L., elected January 13, 1851.
3. Sir Benjamin J. Chapman, Bart., elected June 13, 1842.
4. Henry Freke, M.D., F.K.Q.C.P.I., elected May 10, 1847.
5. William Maunsell Hennessy, elected February 13, 1865.
6. Henry Hudson, M.D., F.K.Q.C.P.I., elected February 28, 1824.
7. John Herbert Orpen, LL.D., elected December 10, 1838.

We have also lost by death, within the year, three Honorary Members:—

In the Section of Science:—

1. Rudolf Julius Emmanuel Clausius, elected March 16, 1866.
2. Asa Gray, elected March 16, 1875.

In the Section of Polite Literature and Antiquities:—

1. James Orchard Halliwell-Phillipps, elected March 16, 1841.

William Hellier Baily was attached to the Geological Survey of Great Britain from 1844 to 1857, in which year he was appointed

Acting Palæontologist to the Irish branch of the Geological Survey, and in 1868 Demonstrator in Palæontology to the Royal College of Science for Ireland, which offices he continued to hold until his death.

He was the author of numerous Papers on subjects in his department of Natural History, the value of which was enhanced by their being illustrated so admirably by his skilful and accurate pencil.

The number of labourers in the field of Irish antiquities is so limited as to make the loss of any student of the Irish language a matter of deep regret; and in the case of Mr. Hennessy the loss is the more sensibly felt, because he was specially familiar with the early history and geography of Ireland. His knowledge was, unfortunately, not worked up permanently into a connected whole, such as would adequately represent his learning: Celtic scholars would have been grateful indeed for the heritage of an Irish Encyclopædia of archæology and geography, such as perhaps he alone could have written. But though no monumental work remains, enough is left to show clearly the range and accuracy of his scholarship.

In his publication of the "Annals of Loch Cé," and the "Chronicon Scotorum," in the Master of the Rolls' Series, he has given proofs of consummate ability and unsparing diligence, in the solution of many a knotty problem whose difficulty can only be appreciated by fellow-students: often, too, the printed work giving no adequate idea of the labour expended in attaining the desired solution.

Perhaps his most admirable piece of work, as it certainly is the most interesting, was his translation of the famous Irish Tale in the "Leabhar Breac," the Vision of Mac Conglinny, published in "Fraser's Magazine," September, 1873. It is not an exaggeration to say that this translation would of itself have placed him in the first rank of Irish scholars of the day: though wonderfully literal, it yet enables a reader to recognize the attractiveness of the original. As almost the only tale remaining to us from olden time of genuine Irish humour, it was well that it should receive admittance into the general current of literature through the excellent translation of so capable a scholar.

Other works, which need not here be mentioned, exhibit equally clearly the deep interest he took in all questions of Ireland's history and archæology; but it would be hard indeed to estimate the influence he has indirectly exerted in Celtic studies by his advice and assistance.

It cannot be doubted that, in the general estimation of scholars, the reputation of Mr. Hennessy stood very high for the breadth and accuracy of his knowledge; but perhaps even a better claim to their kindly memory is the liberality with which he responded to requests for aid of any kind: loans of MSS., verifications of text, explanations of words or phrases, identifications of persons or localities, everything was granted with instant readiness. Perhaps there is hardly a single work on Irish literature or archæology published for a generation that does not contain a grateful acknowledgment of his generously accorded help.

It will scarcely be disputed that the removal from us of his familiar figure has taken away one of the land-marks in the history of the studies pursued in this Academy. Mr. Hennessy was, probably, the last of the older school of students who, by patient application to the blurred pages of MSS., have won their way to a knowledge of the real contents of Irish literature. His name in the future will form no unworthy pendant to those of O'Curry and O'Donovan.

Donations to the Library were announced, and thanks were voted to the Donors.

The Secretary of Council then moved the adoption of the following Recommendations from the Council:—

£20 to Mr. W. J. Knowles, to enable him to continue his Investigation into the Prehistoric Remains of the Sand-hills of the Coast of Ireland.

£50 to Professor W. J. Sollas, to assist him in completing his Report on the Igneous Rocks of Carlingford and County Down.

£50 to Professor D. J. Cunningham, to assist him in completing his Report on Brain and Cranial growth.

£20 to Professor O'Reilly, to assist him in completing his Investigations into the Chemical Constitution of the Cambrian Rocks of Bray Head.

The Recommendations were adopted.

On the Report of the Scrutineers, the Vice-President declared the following duly elected as President and Council for the ensuing year:—

PRESIDENT.

REV. SAMUEL HAUGHTON, M.D., F.R.S., S.F.T.C.D.

COUNCIL.

Committee of Science.

J. P. O'Reilly, C.E.
John Casey, LL.D., F.R.U.I., F.R.S.,
George Sigerson, M.D., F.R.U.I.
Charles R. C. Tichborne, LL.D.
Sir Robert Kane, LL.D., F.R.S.
Edward Perceval Wright, M.D.
Sir Robert S. Ball, LL.D., F.R.S.
V. Ball, M.A., F.R.S.
F. A. Tarleton, LL.D., F.T.C.D.
Daniel J. Cunningham, M.D.
Benjamin Williamson, M.A., F.R.S., F.T.C.D.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
John Kells Ingram, LL.D., S.F.T.C.D.
William Frazer, F.R.C.S.I.
David R. Pigot, M.A.
Right Hon. Sir Patrick J. Keenan, C.B., K.C.M.G.
P. W. Joyce, LL.D.
John R. Garstin, M.A., F.S.A.
Hon. Mr. Justice O'Hagan, M.A.
John T. Gilbert, F.S.A.

On the report of the Scrutineers, the Vice-President declared the following elected Honorary Members of the Academy:—

In the Section of Science.

Dimitri Ivanovitch Mendelejeff, St. Petersburg.
Julius Sachs, Strasburg.

In the Section of Polite Literature and Antiquities.

C. F. Herbst, Copenhagen.
Edward Maunde Thompson, London.

The Ballot was then opened for the election of Officers, and on the report of the Scrutineers, the following were declared duly elected :—

Treasurer—Rev. M. H. Close, M.A.
Secretary—Edward Perceval Wright, M.D.
Secretary of the Council—Robert Atkinson, LL.D.
Secretary of Foreign Correspondence—Joseph P. O'Reilly, C.E.
Librarian—John T. Gilbert, F.S.A.
Clerk of the Academy—Robert Macalister, LL.B.

The Academy then adjourned.

Monday, April 8, 1889.

Hon. Mr. Justice O'Hagan, Vice-President, in the Chair.

Rev. John Henry Bernard, B.D., F.T.C.D., was elected a Member of the Academy.

The Secretary read a Report by Messrs. G. F. Fitz Gerald, F.R.S., and J. E. Cullum, "On the Magnetic Observations at Valentia."

A notice from Professor A. Milne Edwards was read, announcing that an International Congress of Zoologists would be held in Paris between the 5th and 10th August, 1889.

Donations to the Library were announced, and thanks were voted to the Donors.

Monday, May 13, 1889.

Rev. Dr. Haughton, F.R.S., President, in the Chair.

Rev. J. H. Bernard, F.T.C.D., signed the Roll, and was admitted a Member of the Academy.

The Secretary read the Report of the Committee on the Deep-sea Dredging off the South West of Ireland.

The Secretary read a Paper by Dr. Bertram C. A. Windle, "On the Pectoral Group of Muscles."

Dr. Frazer read a Paper "On a Crozier with early Celtic Ornamentation."

The Secretary read a Report by Rev. H. W. Lett, "On the Mosses —Hepaticæ and Lichens—of the Mourne Mountain Range."

The President exhibited a number of Stone Implements from Demerara, presented to the Academy by Dr. C. G. Young, M.R.I.A.

The President, under his hand and seal, nominated the following as Vice-Presidents for 1889–90:—

The Right Hon. Sir Patrick Keenan, C.B., K.C.M.G.
The Hon. Mr. Justice O'Hagan, M.A.
Mr. Benjamin Williamson, M.A., F.R.S.
Sir Robert Stawell Ball, LL.D., F.R.S.

Dr. E. Perceval Wright was deputed to represent the Academy at the International Congress of Zoologists, to be held in Paris in August, 1889.

The following Letters were read:—

"Rosenborg Castle, Copenhagen,
"*5th May*, 1889.

"My Dear Sir,

"I have just received from you, as Secretary, the notification of the compliment which has been paid me by the Royal Irish Academy, in their having nominated me an Honorary Member.

"There are many points of contact, Antiquarian and Historic, between my country and Ireland, and I am proud to accept the honour thus so kindly given to me.

"With thanks and compliments,

"Very respectfully yours,

"C. F. Herbst.

"Ed. Perceval Wright, M.D.,
"*Secretary of the Royal Irish Academy.*"

"British Museum,
"*7th May*, 1889.

"Sir,

"I beg to thank you for your letter of the 30th April, informing me that the Royal Irish Academy has been pleased to elect me one of its Honorary Members, and forwarding the Certificate of election.

"I am most sensible of the distinction which has been conferred upon me, and would ask you to convey to your Academy the expression of my sincere thanks for this honour.

"I am, Sir,

"Your faithful servant,

"E. Maunde Thompson.

"E. Perceval Wright, Esq., m.d.,
"&c. &c. &c."

Donations to the Library and Museum were announced and thanks were voted to the Donors.

The following letter was read:—

"1, Winton-road, Dublin,
"*10th May*, 1889.

"Dear Dr. Wright,

"I request you, as Secretary of the Royal Irish Academy, to ask, in my name, the Academy's acceptance of the accompanying Biography, now completed by me, in three volumes, of their former distinguished President, Sir William Rowan Hamilton.

"I am very faithfully yours,

"R. P. Graves."

Part 6 of Vol. XXIX. of the *Transactions* ("The Tripartite Life of St. Patrick: New Textual Studies," by Rev. B. Mac Carthy, d.d.) was laid on the table.

MONDAY, MAY 27, 1889.

RIGHT HON. SIR PATRICK J. KEENAN, C.B., K.C.M.G., Vice-President, in the Chair.

Dr. Frazer read a Paper "On an Unusual form of Polished Stone Implement, with Sculptured Decorations."

The Secretary read a Report by Mr. S. A. Stewart "On the Botany of the Shannon Estuary and South Clare."

Dr. S. M. Mac Swiney exhibited a series of Drawings of Dublin Ornamental Marble Work of the last century which were presented to the Academy by Mr. Stirling Ballantine.

A special vote of thanks was passed to Mr. Stirling Ballantine for his Donation.

Donations to the Library were announced, and thanks were voted to the Donors.

The following grants, recommended by the Council, were confirmed:

£40 to Prof. G. F. Fitz Gerald, F.R.S., and Mr. E. Cullum, to assist them in carrying on a series of Magnetic Observations at Valentia.

£15 to Mr. S. A. Stewart and Mr. R. L. Praeger for an Investigation of the Flowering Plants and Characeae of the Mourne Mountain Range.

The following Letter was read:—

"ST. PETERSBURG, $\frac{30th\ April}{12th\ May}$, 1889.

"DEAR SIR,

"I beg to acknowledge the receipt of your letter, dated the 30th of April, with the Diploma accompanying it.

"Please to convey to your Society my gratitude and thanks for the honour they have conferred upon me.

"I am, dear Sir,

"Yours faithfully,

"D. MENDELEJEFF.

"ED. PERCEVAL WRIGHT, ESQ., M.D."

The Treasurer, in compliance with Section 3, Chapter III., of the By-Laws, read the List of Members in arrear.

MONDAY, JUNE 24, 1889.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. Robert Barklie, F.C.S.; Mr. James Brenan, R.H.A.; and Rev. George Raphael Buick, M.A., were elected Members of the Academy.

The Secretary read a Paper by Mr. Thomas Preston, M.A., "On the Motion of a Particle and the Equilibrium of Strings on a Spherical Surface."

The Secretary read a Paper by the Lord Bishop of Limerick "On the Focal Circles of Spherical Conics."

The Secretary read a Paper by the Lord Bishop of Limerick "On an Ogham inscribed on a Tine of an Antler of an Elk or Stag found in the Crannog at Moynagh, Co. Meath."

By permission of the Academy, The Rev. Dr. Mahaffy, F.T.C.D., read a Paper "On a Relic of St. Cataldus."

By permission of the Academy, Mr. William S. M'Cay, M.A., F.T.C.D., read a Paper "On Three Similar Figures, with an Extension of Feuerbach's Theorem."

The Rev. The President read a Paper, "Prediction of the Atomic Weight of the Missing Element between Molybdenum and Silver, founded on the known Atomic Weights of the Rhodium, Ruthenium, and Palladium Groups."

The Secretary read a Paper by Dr. W. Doberck, "Observations of Double Stars made at Markree."

Donations to the Library were announced, and thanks were voted to the Donors.

A vote of thanks was passed to Mr. Owen Smith of Nobber, Co. Meath, for his donation of a Tine of an Antler of a Deer with an Ogham inscription.

The following letter was read:—

"WÜRZBURG, 30 *Mai*, 1889.

"SEHR GEEHRTER HERR!

"Die Royal Irish Academy hat mir die hohe Auszeichnung erwiesen, mich zu ihrem Ehrenmitglied zu erwählen. Ich bin durch diese Ernennung freudig überrascht und bitte Sie, dem Verehrten

Herrn Presidenten so wie der Kgl. Akademie meinen herzlichen Dank dafür aussprechen zu wollen.

"Ich ergreife diese angenehme Gelegenheit, Ihnen, Verehrter Herr College, meine besondere Hochachtung zu bezeugen.

"SACHS."

The following grant, recommended by the Council, was confirmed:

£10 to Mr. V. Ball, F.R.S., to assist him in completing his Report on the Mineral and Vegetable Substances used as drugs in India during the Middle of the 16th century.

Transactions, Vol. XXIX., Part 7 ("Geometrical Illustrations of Newlands' and Mendelejeff's Periodic Law of the Atomic Weights of the Chemical Elements," by Rev. Dr. Haughton), and Part 8 ("The Eighth Memoir on the Theory of Screws," by Sir Robert Ball), were laid on the table.

MONDAY, NOVEMBER 11, 1889.

RIGHT HON. SIR PATRICK J. KEENAN, C.B., K.C.M.G., Vice-President, in the Chair.

Mr. James Brenan, R.H.A., signed the Roll, and was admitted a Member of the Academy.

Mr. J. Casimir O'Meagher read a Paper "On St. Patrice de Rouen."

Donations to the Library were announced, and thanks were voted to the Donors.

SATURDAY, NOVEMBER 30, 1889.

(STATED MEETING.)

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

On the motion of the Secretary, seconded by the Treasurer, By-law 6, Chapter IX., was suspended (to permit the reading of Papers and the Admission of Visitors).

Dr. E. Perceval Wright reported that he had, as Representative of the Academy, attended the International Congress of Zoologists, held in Paris in the month of August.

Prof. G. F. Fitz Gerald, F.R.S., F.T.C.D., read a Paper, by Sir William Thomson, F.R.S., "On the Stability and Small Oscillation of a Perfect Liquid full of nearly Straight Coreless Vortices."

Prof. W. J. Sollas, F.R.S., read "Contributions to a Knowledge of the Granites of Leinster."

The President then presented to the Academy an Oil Portrait (by Miss Purser) of himself.

Donations to the Library and Museum were announced, and thanks were voted to the Donors.

MONDAY, DECEMBER 9, 1889.

HON. MR. JUSTICE O'HAGAN, Vice-President, in the Chair.

Mr. Mac Carthy Conner was elected a Member of the Academy.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JANUARY 13, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. William S. M'Cay, M.A., F.T.C.D.; Mr. Frederick Purser, M.A., F.T.C.D.; and Mr. Douglas Hyde, LL.D.; were elected Members of the Academy.

Professor O'Reilly read a "Note bearing on the History of the Irish Wolf Dog."

The Secretary read for Sir Robert Ball, F.R.S., a "Note on a Determinant in the Theory of Screws."

Dr. V. Ball, F.R.S., read as a Report "A Commentary on the Colloquies of Garcia de Orta on the Simples and Drugs of India."

Mr. G. H. Kinahan read "Notes on some Specimens of North American Indian Pottery, with Models of Bone Implements, presented to the Academy by the Hon. Edward Murphy of Montreal.

The President read a note by the Right Rev. Dr. Graves, Bishop of Limerick, "On the Theory of Surfaces of the Second Order."

Donations to the Library were announced, and thanks were voted to the Donors.

On the motion of Mr. G. H. Kinahan, seconded by Rev. Denis Murphy, S.J., a special vote of thanks was passed to the Hon. Edward Murphy for his donation of Specimens of North American Indian Pottery.

The following Science Grants, recommended by the Council, were confirmed by the Academy:—

£15 to Prof. Hartog to enable him to carry on his researches into the Physical Structure of Protoplasm.

£15 to Mr. G. Y. Dixon and Mr. A. F. Dixon to enable them to investigate the Marine Invertebrate Fauna of the neighbourhood of Dublin.

On the motion of Mr. G. H. Kinahan, seconded by Professor O'Reilly, it was resolved "That an Address of Welcome be presented to his Excellency the Lord Lieutenant, and that the Officers be requested to prepare a draft address for the approval of the Academy."

The Officers subsequently brought up the following Address, which was adopted :—

"To His Excellency Laurence, Earl of Zetland,

"*Lord Lieutenant-General and General Governor of Ireland.*

"May it please your Excellency,

"We, the President and Members of the Royal Irish Academy, desire to offer to your Excellency our respectful congratulations on your assuming the high office of Viceroy of Her Most Gracious Majesty the Queen.

"The Royal Irish Academy was incorporated by Royal Charter, more than a hundred years ago, for the purpose of promoting the study of Science, Polite Literature, and Antiquities.

"It has discharged, during that period, in Ireland, functions similar to those of the Royal Society in England, and of the Royal Society of Edinburgh in Scotland; and also to those of the Societies of Antiquaries of London and of Scotland.

"The results of the labours of the Academy in the various branches of knowledge are known through its publications, which are to be found in the chief scientific and literary centres of Europe and America.

"Your Excellency, as Viceroy, is Visitor of the Royal Irish Academy, and we trust that in the exercise of this office you will continue that protection of its interests which the Academy has received from your predecessors, and that you will, if possible, make yourself practically acquainted with the details of its work and methods."

MONDAY, JANUARY 27, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. Frederick Purser, M.A., F.T.C.D., and Mr. William S. M'Cay, M.A., F.T.C.D., signed the Roll, and were admitted Members of the Academy.

Donations to the Museum and Library were announced, and thanks were voted to the Donors.

MONDAY, FEBRUARY 10, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Mr. Blayney Reynell Townley Balfour, D.L., and Rev. Edmund Hogan, S.J., were elected Members of the Academy.

Sir Robert Ball read his "Ninth Memoir on the Theory of Screws, showing a remarkable transformation of the general differential equations of Motion and other applications in the theory of Abstract Dynamics.

Professor Haddon read a Paper by Mr. W. Kitchen Parker, F.R.S, "On the Osteology of the *Alcidæ* and the *Anatidæ*.

Donations were announced, and thanks were voted to the Donors.

WEDNESDAY, FEBRUARY 12, 1890.

(SPECIAL MEETING.)

A Special Meeting of the Academy was held for the purpose of receiving His Excellency the Lord Lieutenant, Visitor of the Academy.

Their Excellencies the Lord Lieutenant and the Countess of Zetland, having been received by the Rev. Dr. Haughton, President, and the Members of the Council, were conducted to the Library, where the Address, adopted at the Meeting on 13th January, was presented.

His Excellency replied as follows :—

"Dr. Haughton and Gentlemen—I am fully sensible of the honour that has been done me by the Members of the Royal Irish Academy, and desire to convey to them my cordial thanks for their Loyal welcome.

"I am very pleased indeed to have this opportunity of meeting so many distinguished Members of your Academy, and of inspecting your admirable collection of ancient manuscripts and Irish antiquities, of which you have such good reason to be proud.

"It would be difficult, I think, to overrate the obligations we owe this Institution for having gathered together so many splendid specimens of the ancient art of Ireland, and for the valuable contributions it has made to the early history of this country.

"The record of the original work of your Members in the fields of Literature and Science cannot fail to be most gratifying to all who have the interests of the Academy at heart, and who desire, as I cordially do, to see it continue to advance in its career of usefulness. I assure you that you may at all times count on my willingness to extend to the Academy the same support as my predecessor, and that I wish all success may attend its labours in the future."

Their Excellencies then inspected many of the Ancient Manuscripts in the Library and the Antiquities in the Museum.

MONDAY, FEBRUARY 24, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. Edmund Hogan and Mr. Blayney R. T. Balfour signed the Roll, and were admitted Members of the Academy.

The following Science Grants, recommended by the Council, were confirmed:—

£85 to Sir Robert Ball, F.R.S., for a Star Photograph Measuring Apparatus.

£5 to Professor M. Hartog, PH.D., to assist him in his Researches into the Physical Structure of Protoplasm. (Additional grant.)

£15 to a Committee consisting of the President and Mr. Robert Russell, F.T.C.D., towards making Mechanical Appliances for the Graphic Construction of Quadratic, Cubic, and Quartic Curves.

The following Resolution was moved by the Right Rev. Dr. Reeves, Bishop of Down and Connor, seconded by Mr. David R. Pigot, and adopted :—

"That the Academy desires to place on record its deep sense of the great loss which it has sustained by the decease of Sir Robert Kane, LL.D., F.R.S., who had been for over fifty-eight years one of its Members, during which he had taken a very active part in the direction of its affairs as Member and Secretary of its Council, and for five years as its President."

" The Academy tenders to the members of his family its sincerest sympathy in their bereavement."

It was moved by Sir Robert Ball and seconded by Dr. Frazer—

"That the Academy, as a mark of respect to the memory of Sir Robert Kane, now adjourn ;"

which being carried, the Academy then adjourned.

SATURDAY, MARCH 15, 1890.

(Stated Meeting.)

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. Robert Conlan signed the Roll, and was admitted a Member of the Academy.

The Ballot was then opened for the Election of President and Council for the ensuing year.

Mr. J. R. Garstin and Mr. J. F. Lombard were appointed Scrutineers.

The Ballot was also opened for the Election of an Honorary Member.

Dr. Davy and Professor O'Reilly were appointed Scrutineers.

The Secretary of Council then read the following:—

Report of the Council for the Year 1889–90.

Since the date of the last Report of the Council the following parts of the *Transactions*, vol. xxix., have been published:—

Part 7. "Geometrical Illustrations of Newlands and Mendelejeff's Periodic Law of the Atomic Weights of the Chemical Elements." By the Rev. Samuel Haughton, M.D. (Dubl. et Bonon.), D.C.L. (Oxon.) LL.D. (Cantab. et Edin.), F.R.S.

Part 8. "The Eighth Memoir on the Theory of Screws, showing how Plane Geometry illustrates General Problems in the Dynamics of a Rigid Body with Three Degrees of Freedom." By Sir Robert S. Ball, LL.D., F.R.S. Plate VI.

Part 9. "The Focal Circles of Spherical Conics." By the Right Rev. Dr. Graves, Lord Bishop of Limerick, F.R.S.

Part 10. "On Three Similar Figures, with an Extension of Feuerbach's Theorem." By William S. M'Cay, M.A., F.T.C.D.

Part 11. "On the Motion of a Particle, and the Equilibrium of Flexible Strings on a Spherical Surface." By T. Preston, M.A.

Part 12. "The Pectoral Group of Muscles." By Bertram C. A. Windle, M.A., M.D.

Part 13. "Observations of Double Stars made at Markree." By W. Doberck, PH.D.

The following is in the press and will shortly be published:—

"Cunningham Memoirs." (No. V.). The Red Stars: Observations and Catalogue, by J. Birmingham. New Edition by Rev. T. E. Espin.

Of the *Proceedings*, Part 2 of the first volume of Series iii. was published in December, 1889, containing Papers in various branches of Science and Archæology, and Part 3 it is hoped will be published in May next, containing the Papers ordered for publication up to the date of the last Meeting.

The Contributors of Papers during the year were:—Rev. Dr. Haughton, F.R.S., President; Sir R. S. Ball, F.R.S.; V. Ball, F.R.S.; J. E. Cullum; W. Doberck, PH.D.; G. F. FitzGerald, F.R.S.; W. Frazer, F.R.C.S.I.; Right Rev. Dr. Graves, F.R.S.; G. H. Kinahan, F.R.G.S.I.; Rev. H. W. Lett, M.A.; W. S. M'Cay, F.T.C.D.; Rev. Dr. Mahaffy, F.T.C.D.; J. C. O'Meagher; J. P. O'Reilly, C.E.; W. Kitchen Parker, F.R.S.; T. Preston, M.A.; W. J. Sollas, F.R.S.; S. A. Stewart; Sir W. Thomson, F.R.S.; B. C. A. Windle, M.D.; E. Perceval Wright, M.D.; C. G. Young, M.D.

The following Grants in aid of the Preparation of Scientific Reports have been sanctioned by the Academy:—

£40 to Professor G. F. FitzGerald, F.R.S., and Mr. E. Cullum, to assist them in carrying on a Series of Magnetic Observations at Valentia.

£15 to Mr. S. A. Stewart and Mr. R. L. Praeger, for an Investigation of the Flowering Plants and Characeæ of the Mourne Mountain Range.

£10 to Mr. V. Ball, F.R.S., to assist him in completing his Report on the Mineral and Vegetable Substances used as Drugs in India during the Middle of the 16th Century.

£20 to Professor M. Hartog, PH.D., to enable him to carry on his researches into the Physical Structure of Protoplasm.

£15 to Mr. G. Y. Dixon, M.A., and Mr. A. F. Dixon, to enable them to investigate the Marine Invertebrate Fauna of the neighbourhood of Dublin.

£85 to Sir Robert Ball, F.R.S., for a Star Photograph Measuring Apparatus.

£15 to a committee consisting of the President and Mr. Robert Russell, F.T.C.D., towards making mechanical appliances for the Graphic Construction of Quadratic, Cubic, and Quartic Curves.

[Appended to this Report is given a list of the Grants in aid of Scientific Research voted by the Academy from June, 1879, up to the present date.]

In the Library we have received by donation an interesting set of drawings of Irish marble work of the last century. A valuable and unique series of delineations of ancient edifices in Ireland has also been acquired, together with several important additions to the Academy's collection of tracts and pamphlets. The Government has deposited with the Academy the remainder of the collections made by the late topographical department of the Ordnance Survey of Ireland, and these will now be accessible in the Library of the Academy, with the volumes of the same collections which we received many years since.

With respect to the Irish department of the Academy's work, there have been printed off fifty-two pages of the Yellow Book of Lecan, in photography, and a large number of pages have been photographed, and are shortly to be printed off.

Dr. Atkinson has finished his edition of Keating's Trí Bior-ġaoite an Báis, vol. i., text, glossary, and appendix, and it will be laid before the Academy at the next Meeting.

A correspondence has taken place between His Excellency the Lord Lieutenant, Her Majesty's Treasury, and the Council, in reference to the future Housing of the Academy, after the transfer of its Museum to the New Museum of Science and Art, Dublin. The Council feel that the best thanks of the Academy are due to His Excellency for so promptly and effectually intervening as to secure to the Academy the continued occupancy of their present house.

The Council trust that the further question of the future relations of the Academy to their Museum Collections will shortly receive definite solution, upon which the transfer may be speedily effected, to the suitable apartments prepared for the Collections in the New Museum Building.

The following Members have been elected since the 16th March, 1889:—

Blayney R. T. Balfour, D.L.
Robert Barklie, F.C.S.
Rev. John H. Bernard, B.D., F.T.C.D.
James Brenan, R.H.A.
Rev. George Raphael Buick, M.A.
MacCarthy Conner.
Rev. Edmund Hogan, S.J.
Douglas Hyde, LL.D.
William S. M'Cay, M.A., F.T.C.D.
Frederick Purser, M.A., F.T.C.D.

The following Honorary Members were elected on the 16th March of last year :—

In the Section of Science.

Dimitri Ivanovitch Mendelejeff.
Julius Sachs.

In the Section of Polite Literature and Antiquities.

Christian Frederick Herbst.
Edward Maunde Thompson.

We have lost by death within the year nine Members :—

John Ball, M.A., F.R.S., elected April 13, 1840.
Matthew P. D'Arcy, M.A., D.L., elected April 13, 1846.
Right Hon. the Earl of Granard, K.P., elected April 13, 1863.
Sir Robert Kane, M.D., LL.D., F.R.S., elected November 30, 1831
Robert Edwin Lyne, elected January 13, 1868.
Robert M'Donnell, M.D., F.R.S., elected February 9, 1857.
Walter Myers, elected April 10, 1876.
John Neville, C.E., F.R.G.S.I., elected June 8, 1844.
Thomas Williams, elected January 9, 1837.

We have also lost by death within the year one Honorary Member in the Section of Science.

Elias Loomis, elected March 16, 1880.

Among the ordinary Members removed by death we may specially mention, although not a contributor to the *Transactions* of the Academy, Mr. John Ball, F.R.S., who represented the Academy for many years on the Government Grant Committee of the Royal Society. The results of his distinguished botanical, geographical, and physical investigations are published elsewhere.

Dr. Robert M'Donnell was born on the 15th March, 1828, in Dublin. He entered Trinity College, Dublin, in 1844, graduating as B.A. in 1849; M.B. in 1851; and M.D. in 1857. He also studied in the Schools of Paris and Vienna. He was elected a Member of this Academy in 1857, and served for several years on its Council. In

1865 he was made a Fellow of the Royal Society, and has served on several Royal Commissions, such as those appointed to inquire into the Medical Acts, into the Prisons in Ireland, and on the Education and Employment of the Blind.

Well known and highly respected by his professional colleagues, he was President of the Royal College of Surgeons in Ireland in 1877; and was President of the Academy of Medicine in Ireland in 1885.

During the Crimean War he served as a Volunteer, being first attached to the British Hospital at Smyrna, and then at Sebastopol, receiving for his services the British Medal and clasps and the Turkish Medal.

His contributions to Surgical literature were very numerous, but in his early days, before the responsibilities and cares of a large practice were upon him, he devoted all his leisure to Physiological and Biological studies: many papers on such subjects will be found in the *Journal de la Physiologie*, and in the *Proceedings* of the Royal Dublin Society. To our *Transactions* he contributed in 1862 a Memoir on the "Lateral Line in Fishes."

Sir Robert Kane, almost from his boyhood, exhibited a very strong taste and aptitude for chemical research, and in 1828, at the early age of eighteen, published his first paper, "Observations on the Existence of Chlorine in the Native Peroxide of Manganese." This was soon followed by a number of essays on various chemical subjects. For his investigations into the chemical history of Archil and Litmus, printed in the *Philosophical Transactions*, he obtained in 1841 a Royal Medal from the Royal Society of London.

For his researches on the nature and constitution of the compounds of Ammonia he was awarded, in 1843, the Cunningham Gold Medal of this Academy. It may be mentioned in connection with his labours on those compounds, that in the opinion of Berzelius, Kane has assisted in an important degree, to establish the actual existence in nature of *amide* (or, as Kane preferred to call it, *amidogene*, from its analogy with oxygen, &c.), *i.e.* H_2N, which had been before only inferred by Dumas.

In addition to these classical researches, he made many others of considerable scientific value, amongst which may be mentioned those on Pyroxylic spirit, or Acetone; on the composition of certain essential oils; on the constitution of the Ethers; and on several new Salts, or compounds, which he discovered, of Copper, Mercury, Platinum, and other metals. In addition to his labours in the fields of original research he published, in 1842, his "Elements of Chemistry."

Having been appointed Professor of Natural Philosophy to the Royal Dublin Society in 1843, he delivered before the Society, in that year, a series of lectures on the natural sources of wealth in this country. These constituted the basis of his well-known book published in the following year, "The Industrial Resources of Ireland," which, even in these days, notwithstanding the change of circumstances in various respects and the subsequent advancement of science, continues to be a work of great interest and importance.

In 1849 Sir R. Kane was elected a Fellow of the Royal Society.

Having been for a short time Director of the Museum of Irish Industry, Dublin, he was appointed, in 1849, the first President of Queen's College, Cork; the duties of which post he zealously and efficiently discharged until he resigned it in 1873, when he came to live in Dublin. In 1875 he was appointed Commissioner of National Education, and a Member of the Academic Council of the University of Dublin, and, in 1880, a Member of the Senate of the Royal University.

To us of the Academy his loss is great; he was emphatically one of our land-marks, his Membership of the Academy having begun so far back as 1831. He was elected on the Council in 1841; he was Secretary of the Council from 1842 to 1846, and President of the Academy from 1877 to 1882.

Along with his rare ability and scientific attainments, Sir R. Kane was endowed with qualities which made association with him very pleasant; his excellent judgment and unruffled temper made him an admirable adviser on any point on which his opinion was asked, or when he felt it his duty to set forth his views. And in consequence of his habitual moderation he was able to hold and express perfectly definite opinions without forfeiting either the friendship or the respect of those from whom he differed. Perhaps few men of his position have preserved so steadily to the end so large a circle of friends; and there are still fewer whom even opponents would name with such unfeigned esteem and respect.

It should not be forgotten that his work was in various ways pre-eminently of a national character; the result of his labours tended directly to benefit and to ameliorate the condition of his fellow-countrymen. A thoroughly practical man, he has left an admirable example of the manner in which skilled knowledge may be made to yield valuable results for the better development of the condition and resources of a country.

The following is a list of the Papers by Sir Robert Kane in the *Transactions* and *Proceedings* of the Academy :—

Papers published in the "Transactions."

1835. "Researches on the Action of Ammonia on the Chlorides and Oxides of Mercury."
1837. "On a Series of Combinations derived from Pyro-acetic Spirit."
1837. "On the Composition of certain Essential Oils."
1838. "Researches on the Nature and Constitution of the Compounds of Ammonia."

Papers published in the "Proceedings."

1836. "Contributions to the History of Pyroxylic Spirit, and the derived Combinations."
1836. "Xanthomethilic Acid."
1836. "On the Composition of Thebaine."
1837. "Researches on the Combinations derived from Pyro-acetic Spirit."
1837. "On Dumasine, a new Fluid Substance isometric with Camphor."
1837. "On the Composition of certain Essential Oils."
1838. "On the Sulphates and Nitrates of Mercury, particularly the basic salts formed by Ammonia."
1838. "On the Theory of Ammoniacal Compounds."
1838. "On the Ammoniacal and other Basic Compounds of the Copper and Silver Families."
1838. "On the Action of Arseniuretted Hydrogen on Sulphate of Copper, and on the Manganese Alum analysed by Dr. Apjohn."
1838. "On the Theory of the Ethers."
1839. "On a Substance intermediate between White Precipitate and Sal-ammoniac."
1840. "On the Production of Audible Sounds."

1842. "On the Colouring Matter of the Persian Berries."
1842. "On the Tannin of Catechu and the Chemical Substances derived from it."
1843. "On the Chemical Composition of the different plants of Flax and Hemp."
1844. "On the Chemical Composition of the different kinds of Fuel found in Ireland."
1847. "On the Composition of the Essential Oil of *Laurus sassafras*, and of certain compounds derived from it."
1848. "Maps illustrative of the distribution of the values of land in Ireland."
1849. "On the Manufacture of Iron in this country."

APPENDIX:

PARLIAMENTARY GRANT FOR THE PREPARATION OF SCIENTIFIC REPORTS.

[*Vide* also Appendix B, Minutes of *Proceedings* for 1875, p. lxvii., and Appendix A, Minutes of *Proceedings* for 1880, p. 134.

From June, 1879, to Feb., 1890, the following Grants in aid of Scientific Research recommended by the Council have been approved of by the Academy :—

No.	Date.	Name and Subject.	Amount of Award. £ s. d.
	1879.		
76	June 23.	G. H. Kinahan, R. J. Ussher, and Leith Adams, for the exploration of the Cappagh Caves near Dungarvan, ...	50 0 0
77	,, ,,	J. E. Reynolds, for the purchase of a considerable quantity of Sulpho-urea, to make experiments on the Comparative Actions of the Isomeric Bodies, Sulphocyanate of Ammonium, and Sulpho-urea, on the growth of certain plants, ...	15 0 0
78	,, ,,	G. H. Kinahan and W. H. Baily, for the investigation of the fossils and igneous rocks of the Curlew and Fintona Beds, ...	50 0 0

PARLIAMENTARY GRANT—*continued.*

No.	Date.	Name and Subject.	Amount of Award. £	s.	d.
	1880.		£	*s.*	*d.*
79	Jan. 26.	R. M. Barrington, for the investigation of the Flora of the Blaskett Islands, ...	10	0	0
80	,, ,,	H. C. Hart, for the investigation of the Flora of the Galtee Mountains, ...	10	0	0
81	,, ,,	P. S. Abraham, to assist him in the Microscopic Study of the Marsupial Tissues, ...	20	0	0
82	Mar. 16.	S. A. Stewart, for the exploration of the Botany of the portion of the County Fermanagh west of Lough Erne, including what is called the Highlands of Fermanagh, ...	10	0	0
83	,, ,,	J. E. Reynolds and Rev. S. Haughton, for Microscopic Slide Sections of a large collection of Sandwich Island Lavas, already analysed by Dr. Haughton, .	20	0	0
84	,, ,,	H. W. Mackintosh, for the further investigation of the Structure of Echinoderms, ...	30	16	6
85	,, ,,	F. Hodges, for researches on the action of various Bleaching Agents, ...	25	0	0
86	,, ,,	I. Carroll, for the exploration of the Botany of the district in the County Cork lying to the westward of a line drawn from Skibbereen to Bantry, ...	10	0	0
87	,, ,,	G. Sigerson, for the Construction of an Electric Apparatus for Physiological investigations, ...	20	0	0
88	,, ,,	B. C. A. Windle, for researches on the embryology of the Muscular System, ...	25	0	0
89	June 14.	E. T. Hardman, to make Soundings in Lough Gill, with a view to throwing light on the Geological Formation of the locality, ...	15	0	0
	1881.				
90	Feb. 14.	F. P. Blackwill and J. Wright, for the examination of the Foraminifera of Dublin Bay, ...	20	0	0
91	,, ,,	Gerrard Kinahan, in aid of his researches on the Chemical Impurities of River Waters, ...	30	0	0
92	,, 28.	Rev. S. Haughton, to aid in completing his researches in Sun Heat, ...	50	0	0
93	,, ,,	R. A. Hayes, to aid him in Microphotography by Electric Light, ...	10	0	0
94	,, ,,	R. M. Barrington, for the Botanical Exploration of the Islands of Lough Erne, . . , ...	15	0	0
95	,, ,,	S. A. Stewart, to complete the investigation of the Botany of the Mountains of Fermanagh and Cavan, ...	10	0	0
96	Mar. 16.	H. C. Hart, to aid him in the Exploration of the Botany of the Killarney Mountains, ...	20	0	0
97	,, ,,	A. G. More and A. C. Haddon, for Dredging in Dublin Bay, ...	25	6	6
98	May 23.	E. W. Davy, for further researches on the Organic Nitro-prussides, ...	20	0	0

PARLIAMENTARY GRANT—*continued.*

No.	Date.	Name and Subject.	Amount of Award.
	1882.		
99	Jan. 23.	T. H. Corry, for an examination of the Botany of Ben Bulben, ...	15 0 0
100	,, ,,	J. L. E. Dreyer, for Calculations to determine the exact Value of the Constant of Precession, . .	20 0 0
101	,, ,,	Rev. W. Green, towards Exploring the New Zealand Glaciers, ...	30 0 0
102	,, ,,	W. F. De Vismes Kane, for an examination of the Entomological Fauna of the wooded districts of Ulster, ...	25 0 0
103	Feb. 13.	H. W. Mackintosh, to aid in Exploring the Zoophytes of the Irish Coast, ...	20 0 0
104	,, ,,	A. G. More, to aid in the Exploration of the Botany of St. Kilda, ...	15 0 0
105	Mar. 16.	H. C. Hart, for a Botanical exploration of the Mountain Ranges of Ireland, ...	25 0 0
106	,, ,,	R. M. Barrington, to complete his Botanical exploration of the Shores and Islands of Lough Erne, .	15 0 0
107	,, ,,	S. A. Stewart, for a Botanical exploration of Rathlin,	15 0 0
108	,, ,,	Rev. W. Green, towards exploring the New Zealand Glaciers (in addition to £30 already voted), . .	17 10 11
109	June 12.	Gerrard A. Kinahan, in aid of researches in the Minerals of Ireland by means of washing, . .	25 0 0
110	,, ,,	E. W. Davy, in aid of researches in the Physical and Chemical Properties of the Alkaloids, . . .	25 0 0
111	Dec. 11.	H. C. Hart, for exploration of the Botany of the Coast-line of Ireland, ...	15 0 0
112	,, ,,	F. P. Balkwill and J. Wright in aid of further researches in the Foraminifera of Dublin Bay, . .	20 0 0
	1883.		
113	Dec. 11.	A. Macalister, to purchase Skulls of the Peninsular and Insular Races of Western Europe, for comparison with Irish Crania, ...	25 0 0
114	Feb. 26.	W. Doberck, for a Magnetic Survey of Ireland, .	50 0 0
115	,, ,,	C. A. Cameron, for researches on the Iodates and Bromates of the Alkaloids, ...	10 0 0
116	,, ,,	H. C. Hart, for the continued Botanical Examination of the Mountains of Ireland, ...	30 0 0
117	May 28.	T. H. Corry, to continue the Botanical Survey of Ben Bulben, ...	10 0 0
118	,, ,,	S. A. Stewart, for a Botanical Survey of Lough Allen and the Slievanierin Mountains, ...	15 0 0
119	,, ,,	W. F. de V. Kane, to investigate the Entomological Fauna of the South and South-west Coasts of Ireland,	25 0 0
120	,, ,,	J. Wright and F. P. Balkwill for further researches on the Foraminifera of Dublin Bay and neighbourhood,	10 0 0
121	,, ,,	Greenwood Pim, to investigate the Irish Fungi, especially those of Killarney, ...	15 0 0

Parliamentary Grant—*continued.*

No.	Date.	Name and Subject.	Amount of Award. £	s.	d.
	1883.				
122	May 28.	Rev. H. W. Lett, for an examination of the Mosses and Lichens of the Mourne Mountains, . . .	10	0	0
123	Nov. 12	R. M. Barrington, for the exploration of the Flora of the Shannon Lakes, ...	15	0	0
124	,, ,,	R. S. Ball, for the Construction of a Model of a Cylindroid, ...	15	0	0
125	,, ,,	H. C. Hart, for a Botanical Report in connection with the Palestine Exploration Expedition, . . .	50	0	0
	1884.				
126	Feb. 11.	W. M. Coates, for a Magnetic Survey of Ireland. [A grant of £50 was made to Dr. Doberck for this purpose in February, 1883, but, being unable to proceed with the survey, in consequence of his departure to Hong Kong, he returned the amount of the grant.], ...	50	0	0
127	,, ,,	Rev. S. Haughton, to assist in defraying the expenses of Calculations of Sun-heat and Radiation, . .	35	0	0
128	,, ,,	R. M. Barrington and R. P. Vowell, to complete the Botanical Survey of the Ben Bulben Range, . .	15	0	0
129	Nov. 10.	Rev. S. Haughton, in supplement of a grant of £35, to defray the expenses of Calculation of Sun-heat Co-efficients and Radiation, ...	15	0	0
130	,, ,,	W. Adeney, for a Chemical and Spectroscopical Investigation of the rarer Elements in some of the Crystalline Rocks of Donegal, ...	25	0	0
131	,, ,,	A. C. Haddon, for researches on the Morphology of the Mollusca, ...	30	0	0
132	,, ,,	H. C. Hart, for the investigation of the Flora of Southern Donegal, ...	15	0	0
133	,, ,,	S. A. Stewart, for the investigation of the Flora of the Southern portion of the County Clare and the Shannon Estuary, ...	15	0	0
134	Dec. 8.	J. P. O'Reilly, to aid in researches regarding the Distribution of Earthquakes in Great Britain and Ireland, ...	15	0	0
135	,, ,,	W. Frazer, for the purchase of the Standard Instruments for the correct measurement of Crania, ...	10	0	0
	1885.				
136	Feb. 9.	E. P. Wright, A. C. Haddon, W. J. Sollas, H. W. Mackintosh, P. Sladen, J. Wright, and R. Malcolmson. for a report on the Deep-Sea Dredging off the Entrance to Bantry Bay, ...	50	0	0
137	,, ,,	W. J. Sollas, to aid in researches on the Metamorphic and Igneous Rocks of the Western Highlands of Ireland, ...	40	0	0

PARLIAMENTARY GRANT—*continued.*

No.	Date.	Name and Subject.	Amount of Award. £	s.	d.
	1885.				
138	Feb. 9.	J. Wright, to aid in researches on the Foraminifera of Dublin Bay,	20	0	0
139	,, ,,	R. M. Barrington, to aid in researches as to the Migration of Birds in Ireland,	15	0	0
140	June 8.	R. M. Barrington and R. P. Vowell, for a report on the Flora of the Shores and Islands of Lough Ree,	10	0	0
141	,, ,,	H. C. Hart, for a further report on the Flora of the County of Donegal,	10	0	0
142	,, ,,	W. F. de V. Kane, for a report on the Distribution of the Lepidoptera of the South of Ireland,	10	0	0
143	,, ,,	W. Gray, for a report on the Worked Flints of the North-east of Ireland,	10	0	0
144	,, ,,	S. A. Stewart, for a report on the Flora of the Southern Shores of the Shannon,	10	0	0
145	,, ,,	A. M'Henry, for a report on the Animal and other Remains found in the Sand-hills of Ballintoy and the Crannog of Lough-na-Crannagh,	20	0	0
146	,, ,,	A. G. More, for a report on the Geographical Distribution of Plants in Ireland,	50	0	0
147	Nov. 9.	W. J. Knowles, to investigate the Flint Implements of the North-east of Ireland,	10	0	0
148	,, ,,	D. J. Cunningham, for a report on the Anatomy of the Chimpanzee,	60	0	0
	1886.				
149	Feb. 22.	E. P. Wright, W. J. Sollas, and A. C. Haddon, to assist in the preparation of the Record of Zoological Literature for 1885,	10	0	0
150	June 28.	H. C. Hart, towards the continuance of the Botanical Exploration of Southern and Central Donegal,	15	0	0
151	,, ,,	A. C. Haddon, Rev. W. S. Green, J. Wright, and E. P. Wright, for a further report on the Dredging in Deep Water off the South-west Coast of Ireland,	40	0	0
	1887.				
152	Feb. 28.	G. F. FitzGerald, to aid in making Magnetic Observations at Valentia,	40	0	0
153	,, ,,	J. P. O'Reilly, to aid in a Chemical Study of certain Rock Formations about Dublin,	15	0	0
154	,, ,,	Rev. S. Haughton and G. F. FitzGerald, to aid in ascertaining the Amounts of Evaporation of Water and other Liquids, when the same Total Amount of Heat is applied in different times,	40	0	0
155	,, ,,	W. J. Sollas, to aid in the Study of the Structures and Relations of the Igneous Rocks of the Carlingford and Mourne Mountain Districts,	25	0	0

Parliamentary Grant—*continued.*

No.	Date.	Name and Subject.	Amount of Award. £	s.	d.
	Feb. 28.		£	s.	d.
156	,, ,,	V. Ball, to prepare a report on the Mineral and Vegetable Substances used as Drugs in India in the middle of the sixteenth century,	25	0	0
157	June 27.	Rev. T. E. Espin, to assist him in the revision of Birmingham's Red Star Catalogue,	10	0	0
158	,, ,,	R. P. Vowell, for the investigation of the Flora of the Shores and Neighbourhood of Loughs Corrib and Mask,	10	0	0
159	,, ,,	J. P. O'Reilly, as an additional grant for the investigation of the Constitution of certain Cambrian Rocks,	25	0	0
	1888.				
160	Jan. 23.	R. L. Praeger, for the investigation of the Post-tertiary Estuarine Deposits of the North of Ireland,	10	0	0
161	,, ,,	W. J. Knowles, for the investigation of the Pre-historic Remains of the Sand-hills of the Coast of the Northern Counties,	20	0	0
162	,, ,,	J. P. O'Reilly, as an additional grant for the investigation of the Chemical Constitution of the Cambrian Rocks of Bray,	15	0	0
163	Feb. 13.	A. C. Haddon, to assist him in the investigation of the Coral Reefs of Torres Straits,	50	0	0
164	Feb. 27.	W. G. Wood-Martin, for the Exploration of the newly-discovered Crannog Site in the County of Meath,	10	0	0
165	,, ,,	Rev. W. S. Green, J. Wright, C. B. Ball, and E. P. Wright, to continue the Deep-sea Investigations to the one thousand fathom depth off the South Coast of Ireland,	60	0	0
166	June 11.	J. Joly, for the investigation of the Melting Points and Thermal Expansion of Minerals,	20	0	0
167	,, ,,	G. F. FitzGerald, W. J. Sollas, and R. Smeeth, for the investigation of the Electrical Resistance of Crystals,	10	0	0
168	Nov. 30.	D. J. Cunningham, for researches on Cranio-Cerebral Topography,	30	0	0
	1889.				
169	Mar. 16.	W. J. Knowles, as an additional grant for the investigation of the Pre-historic Remains of the Sand-hills of the Coast of Ireland,	20	0	0
170	,, ,,	W. J. Sollas, as an additional grant for the investigation of the Igneous Rocks of Carlingford and County Down,	50	0	0
171	,, ,,	D. J. Cunningham, as an additional grant for researches on Brain and Cranial Growth,	50	0	0

PARLIAMENTARY GRANT—*continued.*

No.	Date.	Name and Subject.	Amount of Award. £ s. d.
	1889.		
172	Mar. 16.	J. P. O'Reilly, as an additional grant for the investigation of the Chemical Constitution of the Cambrian Rocks of Bray Head, ...	20 0 0
173	May 27.	G. F. FitzGerald and E. Cullum, to carry on a series of Magnetic Observations at Valentia, ...	40 0 0
174	,, ,,	S. A. Stewart and R. L. Praeger, for an investigation of the Flowering Plants and Characeæ of the Mourne Mountain Range, ...	15 0 0
175	June 24.	V. Ball, as an additional grant for the investigation of the Mineral and Vegetable Substances used as Drugs in India during the middle of the sixteenth Century, ...	10 0 0
	1890.		
176	Jan. 13.	M. Hartog, to enable him to carry on his researches into the Physical Structure of Protoplasm, . .	15 0 0
177	,, ,,	G. Y. Dixon and A. F. Dixon, to enable them to investigate the Marine Invertebrate Fauna of the neighbourhood of Dublin, ...	15 0 0
178	Feb. 24.	Sir Robert Ball, for a Star Photograph Measuring Apparatus, ...	85 0 0
179	,, ,,	M. Hartog, as an additional grant to assist him in his Researches into the Physical Structure of Protoplasm,	5 0 0
180	,, ,,	Rev. Dr. Haughton and Mr. R. Russell, towards making mechanical appliances for the Graphic Construction of Quadratic, Cubic, and Quartic Curves .	15 0 0

The Report was adopted.

Read the following letter from Mr. R. R. Kane :—

"DUNGIVEN, AILESBURY ROAD,
"*March 2nd*, 1890.

"DEAR DR. WRIGHT,

"On behalf of the family of Sir Robert Kane, I desire to express our deep sense of the honour done to his memory by the resolution of the Royal Irish Academy, a copy of which you sent to me in yours of the 24th February.

"Yours very faithfully,

"ROBERT ROMNEY KANE.

"E. P. Wright, Esq., M.D."

By-Law 6, chapter ix., having been suspended, Visitors were admitted.

Professor R. Atkinson, LL.D., read a Paper on—"The use of Two Inflexional Forms of the Verb in Irish."

The Secretary read for Professor Sollas, LL.D., F.R.S., a Paper on—"The occurrence of Zinnwaldite in the Granite of the Mourne Mountains."

On the report of the Scrutineers, the President declared the following duly elected as President and Council for the ensuing year:—

PRESIDENT:

REV. SAMUEL HAUGHTON, M.D., F.R.S., S.F.T.C.D.

COUNCIL.

Committee of Science.

John Casey, LL.D., F.R.U.I., F.R.S.
Charles R. C. Tichborne, LL.D.
Edward Perceval Wright, M.D.
Sir Robert S. Ball, LL.D., F.R.S.
V. Ball, LL.D., F.R.S.
F. A. Tarleton, LL.D., F.T.C.D.
Daniel J. Cunningham, M.D.
Benjamin Williamson, M.A., F.R.S., F.T.C.D.
J. P. O'Reilly, C.E.
George L. Cathcart, M.A., F.T.C.D.
Rev. Joseph A. Galbraith, M.A., S.F.T.C.D.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
David R. Pigot, M.A.
Right Hon. Sir Patrick J. Keenan, C.B., K.C.M.G.
P. W. Joyce, LL.D.
John R. Garstin, M.A., F.S.A.
Hon. Mr. Justice O'Hagan, M.A.
John T. Gilbert, F.S.A.
John Kells Ingram, LL.D., S.F.T.C.D.
Right Rev. William Reeves, D.D., *Bishop of Down and Connor.*

The ballot was then opened for the election of Officers. Mr. Lombard and Mr. Garstin were appointed Scrutineers.

On the motion of Deputy Surgeon-General King, seconded by Professor Atkinson, Professor E. Perceval Wright, M.D., was elected a Visitor of the Museum of Science and Art, Dublin.

On the Report of the Scrutineers, the President declared the following duly elected:—

TREASURER—Rev. M. H. Close, M.A.

SECRETARY—Edward Perceval Wright, M.D.

SECRETARY OF THE COUNCIL—Robert Atkinson, LL.D.

SECRETARY OF FOREIGN CORRESPONDENCE—Joseph P. O'Reilly, C.E.

LIBRARIAN—John T. Gilbert, F.S.A.

CLERK OF THE ACADEMY—Robert Macalister, LL.B.

On the Report of the Scrutineers, the President declared that

Sir William Turner, F.R.S.,

had been elected an Honorary Member in the Section of Science.

Donations to the Library were announced, and thanks were voted to the Donors.

The President under his hand and Seal appointed the following as Vice-Presidents for the ensuing year:—

Hon. John O'Hagan, Mr. Benjamin Williamson, Sir Robert Ball, Dr. John K. Ingram.

The Academy then adjourned.

MONDAY, APRIL 14, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Douglas Hyde, LL.D., signed the Roll, and was admitted a Member of the Academy.

Lord Walter Fitzgerald and Rev. Rowland Scriven, M.A., were elected Members of the Academy.

Professor Cunningham, M.D., read a Paper on "A Stage in the Growth of the Brain of the Order Primates."

The following letter from Sir William Turner was read:—

"6, ETON-TERRACE, EDINBURGH,
"*20th March*, 1890.

"SIR,

"I had the honour to receive this day your letter of the 18th March, with accompanying Diploma, in which you inform me that at the Stated Meeting on the 15th instant I was elected an Honorary Member of the Royal Irish Academy in the Section of Science.

"Permit me to express my most cordial thanks to the Academy for the distinction conferred upon me in enrolling me on the list of their Honorary Members.

"It is a most unexpected honour, and is consequently the more appreciated.

"Believe me to remain

"Your obedient Servant,

"WILLIAM TURNER.

"DR. E. PERCEVAL WRIGHT,
"Secretary Royal Irish Academy."

Donations to the Library were announced and thanks were voted to the Donors.

Mr. J. Y. Robertson presented to the Academy some tracings from frescoes on the walls of St. Canice's Cathedral, Kilkenny.

A special vote of thanks was passed for this Donation.

MONDAY, APRIL 28, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

The Secretary read for Mr. Joseph Wright a Report on the Foraminifera of the South of Ireland.

Professor O'Reilly read a "Note on the Occurrence of Idocrase in the County of Monaghan."

Dr. Frazer read a "Note on two Medals of St. Vergil and St. Rudbert, Irish Missionary Saints of the Seventh Century, struck at Salzburg.

Dr. Frazer read a "Note on the Irish Remains at Lough Crew," and exhibited a series of Illustrations by the late G. V. Du Noyer of the Scribed Stones found at Lough Crew.

Donations to the Library were announced, and thanks were voted to the Donors.

A letter was read from Dr. John M'Donnell, M.R.I.A., presenting a Copy of the *Lilium Medecinae* to the Library.

A special vote of thanks was accorded to Dr. M'Donnell for this Donation.

MONDAY, MAY 12, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. George Raphael Buick, M.A., signed the Roll, and was admitted a Member of the Academy.

Dixon C. O'Keefe, M.A., and Robert Lloyd Woollcombe, LL.D., were elected Members of the Academy.

Mr. Justice O'Hagan took the Chair while the President read a Paper "On the Newtonian Chemistry—1. General Principles; 2. Binary Compounds; 3. Ternary Compounds."

The Secretary read a Paper by Dr. Scharff "On some New or Rare Fishes from the South-West Coast of Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JUNE 9, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Robert Lloyd Woollcombe, LL.D., signed the Roll and was admitted a Member of the Academy.

The Secretary read a Paper by Mr. H. C. Hart, B.A., "On the Range of Flowering Plants and Ferns on the Mountains of Ireland."

The Secretary read a Paper by Mr. J. E. Gore, F.R.A.S.—"A Catalogue of Binary Stars for which Orbits have been computed."

The Treasurer laid on the table the Audited Accounts for 1889–90, and the Estimate for 1890–91.

The Treasurer read the list of Members in arrear, as ordered by By-Law 3, chapter iii.

MONDAY, JUNE 23, 1890.

J. K. INGRAM, LL.D., S.F.T.C.D., Vice-President, in the Chair.

Rev. Rowland Scriven, M.A., signed the Roll, and was admitted a Member of the Academy.

Professor J. P. O'Reilly read a Paper "On the Occurrence of Serpentine in the Rocks of Bray Head."

Professor B. Williamson, F.R.S., F.T.C.D., read a Paper "On Curvilinear Co-ordinates."

The Secretary read for Mr. W. Percy Sladen a Report "On some Echinoderms from the South-West Coast of Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

The following grants, recommended by the Council, were approved of by the Academy :—

£20 to Messrs. R. Patterson and R. Lloyd Praeger to assist them in their Researches into the Vertebrate Portion of the Fauna of Ulster.

£10 to Mr. J. F. X. King to assist him in his Investigations into the Neuropterous Fauna of the North of Ireland.

£100 to a Committee, consisting of Prof. Cunningham, M.D., Rev. Dr. Haughton, F.R.S., and Prof. Haddon, M.A., to assist in the purchase of Anthropometrical Instruments.

Read Letter to the Council from Sir West Ridgeway, June 13, 1890, enclosing a Draft Agreement for transferring the Museum of the Academy to the Museum of Science and Art, Dublin, which Agreement had been approved of by the Council.

"We the Royal Irish Academy, incorporated by Royal Charter, considering that it has been deemed advisable for increasing the utility of the Museum, and securing both its future preservation and enlargement as a National Collection, to transfer and convey to the

Lords of the Committee of Council on Education on behalf of the public, the entire collection of antiquities, coins, and medals, together with the cabinets and glass cases in which the same are contained, if said latter be required, all belonging to the said Royal Irish Academy, with all such additions as may be hereafter received; and the said Lords of the Committee of Council on Education, having agreed to accept of this transfer on the terms and under the conditions specified below, all of which have been agreed to and approved of by the said Royal Irish Academy: Therefore, We, the said Royal Irish Academy, do now by these presents, but under the conditions and regulations after expressed and referred to, give, grant, assign, transfer, convey, and make over to and in favour of the said Lords of the Committee of Council on Education, for behoof of the public, all and whole the collection of antiquities, coins, and medals, belonging to the said Royal Irish Academy, with all such additions as may be hereafter made thereto, together with the cabinets and glass cases in which the same are contained, if such latter be required; and it is hereby expressly conditioned and declared, that the said Lords of the Committee of Council on Education shall, by acceptance hereof, be bound and obliged to retain the said collection in Ireland, in suitable apartments provided in the Science and Art Museum in Dublin, and at all times thereafter shall provide for the preservation and exhibition to the public of the collection of antiquities, coins, and medals hereby conveyed: and also it is hereby expressly conditioned and declared that the charge and custody of the said collection of antiquities, coins, and medals above transferred, shall remain with the said Royal Irish Academy, subject to such regulations and directions as may from time to time be prescribed by the said Lords of the Committee of Council on Education, but so as to leave the Royal Irish Academy as unfettered in the charge and management of the Museum as circumstances will allow: and also that the funds required to furnish the requisite means for the preservation and exhibition thereof, and to pay the salaries of the present officers of the Museum, who are to become officers of the Science and Art Department, and for the purchase of Irish Antiquities as at present voted under the existing Treasure Trove Regulations, Ireland, are to be provided by an estimate to be submitted to Parliament each year.

"In witness whereof," &c.

Whereupon it was moved by Master Pigot, seconded by the Right Rev. Dr. Reeves, Bishop of Down and Connor, and unanimously

Resolved—"That the President and Treasurer be authorized to affix the Corporate Seal of the Academy to the Instrument, the draft of which is now submitted, transferring the Museum of the Academy to the Lords of the Committee of Council on Education."

Monday, November 10, 1890.

Rev. Dr. Haughton, f.r.s., President, in the Chair.

The President mentioned that the Instrument conveying the Museum of the Academy to the Science and Art Department had been sealed and signed by the President and Treasurer of the Academy on behalf of the Academy, and had also been sealed and signed on behalf of the Science and Art Department; and that the Museum had been transferred to the Science and Art Museum, Dublin.

The Rev. G. Salmon, d.d., Provost of Trinity College, Dublin, moved, and the Very Rev. John O'Hanlon, p.p., seconded the following resolution:—

"That the Royal Irish Academy desires to place on record its deep sense of the great loss which it has sustained by the decease of the Rev. J. A. Galbraith, m.a., s.f.t.c.d., who had been over forty-five years one of its Members, during which period he had served several times on its Council, and had been a frequent contributor of scientific papers to its Meetings.

"The Academy tenders its sincerest sympathy to the members of his family in their bereavement."

The Secretary read for Professor Morgan W. Crofton, f.r.s., a Paper "On Applications of Operative Symbols."

The President exhibited and made some remarks on Two Meteoric Stones that fell in Winnabayo County, Iowa, on the 2nd May, 1890.

Donations to the Library were announced, and thanks were voted to the Donors.

SATURDAY, NOVEMBER 29, 1890.

(STATED MEETING.)

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

The Ballot was opened for the election of Two Members of Council, and Mr. B. Williamson, F.R.S., and Mr. W. R. Molloy were appointed Scrutineers.

The following letter from Miss Galbraith was read :—

"46, LANSDOWNE-ROAD.

"Sir,—Will you kindly offer to the Royal Irish Academy the grateful thanks of my brothers, sisters, and myself, for the Resolution passed by them on the 10th inst.

"We shall cherish it among the memorials of our dear father.

"Yours faithfully,

"HANNAH GALBRAITH.

"*Nov. 15th.*"

The following Resolution was proposed by Mr. J. R. Garstin, D.L., seconded by Dr. F. A. Tarleton, F.T.C.D., and unanimously adopted :—

"That the Royal Irish Academy desires to place on record its sense of the loss it has sustained by the death of the Hon. John O'Hagan, M.A., who was a Member of the Academy since 1866, served on its Council, and at the time of his decease was the senior Vice-President of the Academy.

"That a copy of this Resolution be sent to the Members of his family, with an expression of the sympathy of the Academy with their sorrow."

By-Law 6, chapter ix., having been suspended, visitors were admitted.

Mr. George Coffey, B.E., read a Paper "On the Decorative Treatment of the Inscribed Figures in the Chamber of the Tumulus at New Grange, illustrated by a series of twenty photographs thereof."

Cunningham Memoir, No. VI., "On the Morphology of the Duck and the Auk Tribe," by W. Kitchen Parker, F.R.S., was laid on the table.

Donations to the Library were announced, and thanks were voted to the Donors.

On the report of the Scrutineers, the President declared Mr. George H. Kinahan and Dr. William Frazer duly elected Members of Council.

The President under his hand and seal appointed the Right Rev. Dr. Reeves, Bishop of Down, Connor, and Dromore, a Vice-President of the Academy, a vacancy having been caused by the death of the Hon. John O'Hagan.

MONDAY, DECEMBER 8, 1890.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

By the permission of the Academy the Rev. J. P. Mahaffy, D.D., F.T.C.D., read a Paper "On a Series of Greek Manuscripts, dating from the Third Century before Christ, found by Mr. Flinders Petrie."

The following letter was read :—

"GLENAVEENA, HOWTH,
"*6th December*, 1890.

"Dear Sir,—Mrs. O'Hagan has asked me to write to you and thank you, in the first instance, for your letter and most kind message of condolence. She wishes me also to beg of you that you will convey to the Royal Irish Academy her grateful acknowledgments of the Resolution passed by that body, which you have had the kindness to send her. She knows how sincere is the expression of regret it contains for the loss of her dear husband: for she knows how attached he was to the Royal Irish Academy, and how many personal friends he counted among its Members, and she feels very thankful for its words of sympathy with herself.

"Believe me,
"Your faithful Servant,
"GEORGE TEELING."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JANUARY 12, 1891.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Lavens Mathewson Ewart and the Rev. James F. M. ffrench were elected Members of the Academy.

Dr. V. Ball, C.B., F.R.S. read "A Commentary on the Colloquies of Garcia de Orta. Part 2."

The Secretary read for Mr. W. J. Knowles a Second Report "On the Prehistoric Remains from the Sandhills of the Coast of Antrim."

Mr. G. H. Kinahan read a Paper "On the Silurian Basics of Killary and the Metamorphic Rocks of Connemara."

By the permission of the Academy, the Rev. James F. M. ffrench read a Paper "On a Manner of Lighting Houses in old Times," illustrated by a series of rushlight candlesticks.

Donations to the Library and Museum were announced, and thanks were voted to the Donors.

The following Resolution was moved by Dr. E. P. Wright, Secretary of the Academy, seconded by Professor O'Looney, and unanimously adopted :—

"That the Academy has heard with great regret of the death of Dr. John Casey, F.R.S., who had been for nearly twenty-five years a Member of the Academy, and at the time of his death was the Senior Member of the Science Committee of the Council.

"Dr. Casey had contributed many Papers to the Academy, which are published in the *Transactions*, *Cunningham Memoirs*, and *Proceedings*; and the Academy deeply feels the loss which it has sustained by his death.

"That a copy of this Resolution be forwarded to the Members of his family."

The following Science Grants recommended by the Council were confirmed by the Academy :—

£10 to Mr. J. F. X. King, to assist him in his Investigations into the Neuropterous Fauna of Ireland.

£25 to Professor J. P. O'Reilly, to enable him to complete his Analysis of the Rocks of Bray Head.

£20 to a Committee, consisting of Rev. Dr. Haughton, F.R.S., Professor T. Alexander, and R. Russell, F.T.C.D., to enable them to complete an Instrument for the Graphic Construction of Quartic Curves.

It was moved that £25 be granted to a Committee, consisting of G. H. Kinahan, Professor A. C. Haddon, and J. Thomson, to assist Mr. J. Thomson in publishing an Illustrated Report on Irish Carboniferous Corals.

The Secretary of the Academy stated that he had received a note from Professor A. C. Haddon requiring his name to be removed from the Committee, whereupon

Professor Cunningham moved, and Dr. La Touche seconded,

"That under these circumstances the Recommendation be referred back to the Council for their reconsideration," which was adopted.

The following Recommendation of Council, having been moved, was adopted:—

That it be recommended to the Academy that the Treasurer be authorized to sell out a sum of £75 10*s.* 10*d.* now standing in the name of the Academy in Bank of Ireland Stock, the same to be placed to the credit of the Council for Publication Purposes.

Monday, January 26, 1891.

Rev. Dr. Haughton, f.r.s., President, in the Chair.

Lord Walter FitzGerald signed the Roll, and was admitted a Member of the Academy.

Professor D. J. Cunningham, m.d., read a Paper "On the Skeleton of the Irish Giant (Cornelius Magrath), a case of so-called Acromegale."

The Secretary read a Paper by Mr. J. E. Gore, f.r.a.s., "Observations of the Variable Star μ Cephei."

Professor Alexander, m.a.i., exhibited an Apparatus for constructing the ellipse and its pedal, and a Rocker for detecting periodic oscillations.

Donations to the Library were announced, and thanks were voted to the Donors.

The following letter was read:—

"India Office, Whitehall, S.W.,
15*th January*, 1891.

"Sir,—I am directed by the Secretary of State for India in Council to acknowledge the receipt of your letter of the 12th ultimo, submitting on behalf of the Council a request for the presentation to the Academy Library of a copy of each of the Reports on the Archæological Survey of Western India.

"In reply, I am to inform you that Vols. 1 and 2 of this Series are quite out of print, and there are, consequently, no copies available for presentation; but His Lordship has much pleasure in placing at the disposal of the Council a copy of the remaining Volumes [3 to 5], and these have accordingly been forwarded to your address.

"I am, Sir,

"Your obedient Servant,

"A. GODLEY.

"THE LIBRARIAN,

"Royal Irish Academy,

"19, Dawson-street, Dublin."

RESOLVED—"That the marked thanks of the Academy be given to the Secretary of State for India for the Donation."

The following letter was read:—

"86, SOUTH CIRCULAR-ROAD,

"*20th January*, 1891.

"Sir,—I beg to acknowledge having received from you by this morning's post the Resolution of Sympathy passed by the Academy concerning the death of my dear father, Dr. Casey, and to express to you and to the Academy my most grateful thanks for it.

"Believe me, Sir,

"Very sincerely yours,

"KATIE DOWLING.

"E. PERCEVAL WRIGHT, M.D."

Part 14 of Vol. XXIX. *Transactions.*—"Contributions to a Knowledge of the Granites of Leinster." By W. J. SOLLAS, LL.D., D.SC., F.R.S., was laid on the table.

MONDAY, FEBRUARY 9, 1891.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. George Thomas Stokes, D.D., and Joseph Smith were elected Members of the Academy.

Mr. W. J. Doherty, C.E., read a Paper "On some Ancient Crosses and other Antiquities of Inishowen, Co. Donegal."

Donations to the Library were announced, and thanks were voted to the Donors.

The following Recommendation from the Council was adopted:—

"That the Corporate Seal of the Academy be affixed to a power of Attorney in favour of the Treasurer, Rev. Maxwell H. Close, for the sale of £75 10*s.* 10*d.*, Bank of Ireland Stock."

MONDAY, FEBRUARY 23, 1891.

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

Rev. George T. Stokes, D.D. signed the Roll, and was admitted a Member of the Academy.

Professor A. C. Haddon, M.A., read a Report by himself and Professor D. J. Cunningham, M.D., "On the Dublin Anthropometric Laboratory."

Donations to the Library were announced, and thanks were voted to the Donors.

The following Science Grants, recommended by the Council, were confirmed by the Academy:—

£15 to Mr. George Coffey, to enable him to complete the Photographing, Surveying, &c., of the Tumuli at New Grange, Dowth, and Knowth.

£10 to Mr. W. J. Knowles, to enable him to continue his Report on the Prehistoric Remains from the Sandhills of the North and North-West Coasts of Ireland.

MONDAY, MARCH 16, 1891.

(STATED MEETING.)

REV. DR. HAUGHTON, F.R.S., President, in the Chair.

The President announced that he did not wish that his name should be voted for as President for the coming year. Dr. J. K. Ingram, S.F.T.C.D., then proposed and Sir Robert Ball, F.R.S., seconded that the Right Rev. William Reeves, D.D., Bishop of Down and Connor and Dromore, should be elected President.

The Ballot was then opened for the Election of President and Council.

Surgeon-General King and Rev. Rowland Scriven were appointed Scrutineers.

A Ballot was also opened for the Election of Honorary Members.

The Treasurer and Secretary of the Academy were appointed Scrutineers.

The Secretary of Council then read the following :—

REPORT OF THE COUNCIL FOR THE YEAR 1890–91.

Since the date of the last Report of the Council the following Parts of the *Transactions* have been published :—

VOL. XXIX.

Part 14. "Contributions to a Knowledge of the Granites of Leinster." By W. J. Sollas, LL.D., D.SC., F.R.S., Professor of Geology and Mineralogy, University of Dublin.

"Cunningham Memoirs."

No. V. "The Red Stars: Observations and Catalogue." By J. Birmingham. New Edition, by Rev. T. E. Espin.

No. VI. "On the Morphology of the Duck and the Auk Tribes." By W. Kitchen Parker, F.R.S.

The following is laid on the Table to-day :—

VOL. XXIX.

Part 15. "Curvilinear Coordinates." By Benjamin Williamson, M.A., F.R.S., F.T.C.D.

The following are in the Press:—

"Cunningham Memoirs."

No. VII. "On the Growth of the Human Brain." By D. J. Cunningham, M.D., Professor of Anatomy in the University of Dublin.

No. VIII. "On the Petrie Papyri, lately discovered in the Fayyum District in Egypt." By the Rev. J. P. Mahaffy, D.D., F.T.C.D.

Of the *Proceedings*, Parts 3 and 4 of the first volume of Series iii. were published in June, 1890, and January, 1891, containing Papers in various branches of Science and Archæology; and Part 5 will be published in April next, and will complete the first volume of the current Series.

The Contributors of Papers during the year were:—Rev. Dr. Haughton, F.R.S., President; T. Alexander, M.A.I.; R. Atkinson, LL.D.; V. Ball, C.B., F.R.S.; G. Coffey, B.A.I.; M. Crofton, F.R.S.; D. J. Cunningham, M.D.; W. J. Doherty, C.E.; Rev. J. F. M. ffrench; W. Frazer, F.R.C.S.I.; J. E. Gore, F.R.A.S.; A. C. Haddon, M.A.; H. C. Hart, F.L.S.; G. H. Kinahan; W. J. Knowles; Rev. J. P. Mahaffy, D.D., F.T.C.D.; J. P. O'Reilly, C.E.; R. F. Scharff, B.SC., PH.D.; P. Sladen; W. J. Sollas, LL.D., F.R.S.; B. Williamson, F.R.S., F.T.C.D.; J. Wright.

The following Grants in aid of the preparation of Scientific Reports have been sanctioned by the Academy:—

£20 to Messrs. R. Patterson and R. Lloyd Praeger, B.E., to assist them in their Researches into the Vertebrate Portion of the Fauna of Ulster.

£10 to Mr. J. F. X. King to assist him in his investigations into the Neuropterous Fauna of the North of Ireland.

£100 to a Committee consisting of Professor Cunningham, M.D., Rev. Dr. Haughton, F.R.S., and Professor Haddon, M.A., to assist in the purchase of Anthropometrical Instruments.

£25 to Professor J. P. O'Reilly, C.E., to enable him to complete his Analysis of the Rocks of Bray Head.

£20 to a Committee consisting of Rev. Dr. Haughton, F.R.S., Professor T. Alexander, M.A.I., and Mr. R. Russell, F.T.C.D., to enable them to complete an Instrument for the Graphic Construction of Quartic Curves.

£15 to Mr. George Coffey, to enable him to complete the Photographing, Surveying, &c., of the Tumuli at New Grange, Dowth, and Knowth.

£10 to Mr. W. J. Knowles, to enable him to continue his Report on the Prehistoric remains from the Sandhills of the North and North-West Coasts of Ireland.

Some valuable manuscripts have been acquired for our Library during the year by presentation and purchase.

The important collections of the late topographical department of the Ordnance Survey of Ireland, recently presented by H. M. Government, have, under the supervision of the Librarian, been arranged and catalogued, and are now accessible to those who desire to consult them.

The apartments hitherto occupied by the Museum of Antiquities are now being adapted for the reception of books and manuscripts, for which this additional accommodation was urgently required for some time past.

With a view of facilitating access to the Academy's Library Collections, the Council have made arrangements for an extension of the hours at which the Library is open to readers.

The new Building for the Museum of Science and Art having been completed during the past year, an Agreement between the Academy and the Lords of the Committee of Council on Education for the transfer of the Collections to the Science and Art Department was duly executed on August 18, 1890, and the Collections were transferred in the month of October to the new Building in Kildare-street. The terms of the Agreement will be found in the Minutes of the meeting of the Academy on 23rd June, 1890.

Of the "Yellow Book of Lecan," two hundred and fifteen pages have now been printed off, and forty more are just ready for printing.

The following Members have been elected since the 16th March, 1890 :—

Lavens Matthewson Ewart.
Rev. James F. M. ffrench.
Lord Walter Fitz Gerald.
Dixon C. O'Keefe, M.A.
Rev. Rowland Scriven, M.A.
Joseph Smith.
Rev. George Thomas Stokes, D.D.
Robert Lloyd Woollcombe, M.A., LL.D.

At the Stated Meeting, on the 15th March of last year,

Sir William Turner, LL.D., F.R.S.,

was elected an Honorary Member of the Academy in the Section of Science.

We have lost by death within the year twelve Members :—

John Casey, LL.D., F.R.S., elected May 14, 1866.
Rev. Benjamin Dickson, D.D., elected January 9, 1860.
Rev. Orlando Dobbin, B.D., LL.D., elected January 13, 1851.
Alexander Ferrier, M.A., elected January 10, 1842.
Rev. Joseph A. Galbraith, M.A., S.F.T.C.D., elected April 14, 1845.
Sir Andrew Hart, LL.D., Vice-Provost of Trinity College, elected February 13, 1837.
His Grace The Duke of Manchester, K.P., elected January 10, 1859.
Hon. John O'Hagan, M.A., elected June 25, 1866.
Hugh Robinson, elected June 27, 1887.
Aquilla Smith, M.D., elected February 23, 1835.
James Stewart, M.A., elected December 14, 1874.
William Kirby Sullivan, PH.D., LL.D., elected August 24, 1857.

And the following Honorary Members :—

His Eminence John Henry, Cardinal Newman, D.D., elected March 16, 1886.
Heinrich Schliemann, D.C.L., elected March 16, 1886.

By the deaths of Sir Andrew Hart and Dr. Casey, Ireland has lost within the year two of the most distinguished geometers that the country has produced.

The name of the former will always be known among mathematicians by his discoveries in the geometry of Curves and Surfaces; and indeed Dr. Salmon in his great standard works fully acknowledges the importance of many of the theorems contributed to mathematical science by Sir A. Hart. His published works are not, indeed, numerous; they include the following three Papers, published by the Academy:—In 1849, "On the Form of Geodesic Lines through the Umbilic of an Ellipsoid"; in 1875, an important Paper on "Nine-point contact of Cubic Curves"; and another, in 1878, "On the Intersection of Plane Curves of the Third Order." The esteem in which Sir A. Hart was held by his fellow-workers, in respect of his knowledge and ability, was yet more deeply felt by all in respect of his disinterestedness and courtesy.

Dr. Casey's remarkable capacity as a Mathematician was of the kind that amply justified the opinion expressed by capable judges that he has left a valuable legacy to future Mathematicians of a vast store of new theorems. Among his early works may be mentioned his remarkable Paper "On the Equations of Circles," *Proceedings*, R. I. A., 1866; and his great Memoir "On Bicircular Quartics," *Transactions*, R.I.A., 1867. After his appointment to a Mathematical Chair in the Catholic University he continued his scientific labours by the publication of many valuable contributions to Mathematical Science, chief among which may be mentioned "On a new Form of Tangential Equations," *Philosophical Transactions*, 1877; "On the Equations of Circles (Second Memoir)," *Transactions*, R. I. A., 1878, and a voluminous and valuable memoir on Cubic Transformations, read before the Royal Irish Academy in 1879, and subsequently published as one of the "Cunningham Memoirs." In 1878 the Academy bestowed on him its Cunningham Medal. The difficulties he himself had had to encounter in early life prevented him from devoting himself to the study of the higher branches of Mathematics till he had nearly reached middle age; and when the force of his own natural talents and industry had secured for him the high reputation in which his name is universally held, his recollections of his early difficulties prompted him to apply his singularly clear and methodic capacity to smoothing the path of those who were to come after him. His long experience as teacher had given him great skill in the removal of difficulties: in these introductory treatises the lucidity of his explanation is only paralleled by the orderliness and method of his exposition. There have been few men of simpler heart and kindlier spirit than Dr. Casey; and in spite of the absorbing nature of his mathematical studies, he constantly exhibited a deep interest in the history and traditions of Ireland.

The Rev. J. A. Galbraith was another of our Members for whom there was felt a strong personal liking by all who knew him. It may be a matter of regret that his early bent to independent scientific work was diverted to practical duties; for it is admitted by the most eminent of his contemporaries that he had given promise of great capacity in scientific investigation. But the value of his practical labours was so high, that even those who would have rejoiced at seeing his talents directed to independent research, were eager to receive his co-operation in the complicated affairs of public business, where a clear brain and an absolutely independent spirit are indispensable.

Mr. Justice O'Hagan's literary talents were too well known and appreciated among us to need any particular mention of them here: the fine taste and careful execution exhibited in his work made it the object of as sincere an admiration to competent judges, as the charm of his personal character won for him the unqualified respect and affection of all who had the honour of his acquaintance.

In Dr. A. Smith the Academy has lost not only one of its oldest Members, but a man whose special knowledge made him peculiarly valuable. He was elected a Member in 1835, and he held for a time the office of Treasurer of the Academy. His numismatic skill was so marked, that in 1884 the Council of the Numismatic Society conferred on him the highest distinction in their power by awarding him their Medal in acknowledgment of his distinguished services to the Science of Numismatics. It was the more natural that the Academy should have already honoured Dr. Smith with its Cunningham Medal, for it was especially in reference to the coinage of Ireland that the eminence of his position as Numismatist was then publicly acknowledged. On the occasion of the presentation of the Medal, Sir R. Kane succinctly stated the scope of Dr. Smith's inquiries, and expressed only the general feeling felt among us as to the substantial merits of the execution of the work, and as to the public spirit and liberality with which he aided the Academy's desire to secure a Numismatic collection worthy of the name on the occasion of its purchase of his particularly fine collection of Irish coins and tokens from Dr. Smith. Full of years, and with an abundant record of hard and successful work, he has left to the Academy an ever-honoured name, a link with the older generation of students in this field, in many respects a model of the type of the Antiquarian now too rare.

Of his Papers the following were published by the Academy :—

Transactions.

1839. "On the Irish Coins of Edward IV."

1841. "On the Irish Coins of Henry VII."

Proceedings.

1839. "On the Irish Coins of Edward IV."

1840. "On an unpublished Irish Coin of Edward IV."

1841. "On the Irish Coins of Henry VII."

1849. "A Catalogue of the Tradesmen's Tokens current in Ireland between the years 1637 and 1639."

1852. "On Scotch Coins and Counterfeits found in Ireland."

1853. "Supplement to a Catalogue of Tradesmen's Tokens current in Ireland in the Seventeenth Century."

The branch of science in which Dr. Sullivan was specially distinguished was that of chemistry. He first studied this under Liebig in the University of Giessen, where his marked ability displayed itself early, and attracted the special notice of his eminent teacher. During his career of chemical investigation he had laboured not only at the abstract principles but also at the practical application of his science; hence, with his power of organization and active zeal, he was peculiarly well qualified to take a prominent part in the working of the Industrial Exhibition in Dublin in 1853. He was subsequently appointed Professor of Chemistry in the Catholic University, a post which he filled with remarkable success. He succeeded Sir Robert Kane as President of Queen's College, Cork, in 1873, and threw into his discharge of the onerous duties of that office all his energy and knowledge, as well as his remarkable administrative ability, by which he was enabled to effect various important improvements in the working of that Institution. Dr. Sullivan held the office of Secretary of the Royal Irish Academy, from 1867 to 1874.

Subjoined is a list of the Papers published by Dr. Sullivan in the Academy; but it would not be right to omit mention also of another important side of human learning, in which he felt deep sympathy and had made no little progress. In the study of the Irish language he had followed the course of investigation which the labours of Zeuss had inaugurated; and Dr. Sullivan did good service in this field by translating into English several important articles on Celtic philology, written by H. Ebel. A larger work, in which Dr. Sullivan edited a number of the Lectures on Irish Literary History by Professor O'Curry, was further noteworthy for the Introductory Volume, in which the Editor set forth an interesting *résumé* of the numerous matters treated in the two volumes that he edited, with many an illustration from the parallel customs of other nations in early Europe. This work, on the "Manners and Customs of the Ancient Irish," exhibited another side of Dr. Sullivan's capacity, which of itself would have been sufficient to render his name a household word in the literary world. With his intellectual qualities he combined great geniality of disposition, so that his death is not only a serious loss to the cause of education and of science, but also one to be lamented on personal grounds by a numerous circle of friends.

Of his Papers contributed to the Academy the following are the titles:—

Proceedings.

1849. "On the Chemical History of Pollen in Plants."

1861. (With Prof. J. P. O'Reilly.) "On the Hydrocarbonates and Silicates of Zinc of the Province of Santander, Spain."

"On some curious Molecular changes produced in Silicate of Zinc by the application of Heat."

1861. "On a new Hydrated Silicate of Potash and on some of the conditions under which the Reniform Structure in Minerals may be developed."

1868. "On the occurrence of Mammalian Bones, Brown Coal, and Pebbles in Mineral Veins."

1871. "Note on the great Dolomite Bed of the North of Spain in connexion with the Tithonic stage of Herr Opel."

The Report was adopted.

Mr. J. R. Garstin, D.L., F.S.A., by leave of the President, exhibited and described a rare Dublin printed Book of Common Prayer of 1637, and pointed out that the name of "S. Patricke" appeared in the Calendar, being the only known instance of its occurrence in an Anglican Book of Common Prayer.

On the report of the Scrutineers, the following were declared elected President and Council for the ensuing year:—

PRESIDENT.

RIGHT REV. WILLIAM REEVES, D.D., M.B., LL.D.,
Bishop of Down and Connor and Dromore.

COUNCIL.

Committee of Science.

Charles R. C. Tichborne, LL.D.
Edward Perceval Wright, M.D.
Sir Robert S. Ball, LL.D., F.R.S.
V. Ball, C.B., LL.D., F.R.S.
F. A. Tarleton, LL.D., F.T.C.D.
Daniel J. Cunningham, M.D.
Benjamin Williamson, M.A., F.R.S., F.T.C.D.
J. P. O'Reilly, C.E.
George L. Cathcart, M.A., F.T.C.D.
George Henry Kinahan.
Rev. Samuel Haughton, M.D., F.R.S., S.F.T.C.D.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
David R. Pigot, M.A.
Right Hon. Sir Patrick J. Keenan, C.B., K.C.M.G.
P. W. Joyce, LL.D.
John R. Garstin, M.A., F.S.A.
John T. Gilbert, F.S.A.
John Kells Ingram, LL.D., S.F.T.C.D.
William Frazer, F.R.C.S.I.
Rev. Denis Murphy, S.J.

On the Report of the Scrutineers the following were declared elected as Honorary Members of the Academy :—

In the Section of Polite Literature and Antiquities.

Léopold Delisle, Paris.
Rev. Archibald Henry Sayce, Oxford.

The outgoing President then left the Chair and it was taken by the newly-elected President.

Mr. J. R. Garstin, D.L., F.S.A. moved a resolution of thanks to the Rev. Dr. Haughton for his distinguished services as President of the Academy for the last four and a-half years. This was passed by acclamation.

The President then declared the Ballot opened for the election of Officers, and the Rev. L. Hassé and Dr. J. J. Digges La Touche were appointed Scrutineers, on whose subsequent report the President declared the following duly elected :—

TREASURER—Rev. M. H. Close, M.A.

SECRETARY—Ed. Perceval Wright, M.D.

SECRETARY OF THE COUNCIL—Robert Atkinson, LL.D.

SECRETARY OF FOREIGN CORRESPONDENCE—Joseph P. O'Reilly, C.E.

LIBRARIAN—John T. Gilbert, F.S.A.

CLERK OF THE ACADEMY—Robert Macalister, LL.B.

The President under his hand and Seal nominated the following as Vice-Presidents for the year 1891–2 :—

Sir Robert Ball, LL.D., F.R.S.
John Kells Ingram, LL.D., S.F.T.C.D.
Rev. Samuel Haughton, M.D., S.F.T.C.D.
John Ribton Garstin, M.A., F.S.A.

MONDAY, APRIL 13, 1891.

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

James Mills and Robert Lloyd Praeger, B.E., were elected Members of the Academy.

By permission of the Academy Mr. James Mills read a Paper "On a Middle English Poem (an early Moral Play) found in the Record Office."

The Secretary read a Paper by James Thomson "On the Species of the Genera Campophyllum and Calophyllum."

Professor D. J. Cunningham, M.D., exhibited a line engraving of Cornelius Magrath, the Irish Giant. This engraving had been presented by Mr. J. Chaloner Smith to the Library of Trinity College, Dublin.

Donations to the Library were announced, and thanks were voted to the Donors.

The following letter from M. Léopold Delisle was read:—

"PARIS, *le* 28 *Mars*, 1891.

"Monsieur le Secrétaire,—Je m'empresse de vous remercier de l'avis que vous avez bien voulu me donner de ma nomination de membre honoraire de l'Académie royale d'Irlande. Moins j'avais de titres à une aussi flatteuse distinction, plus je suis reconnaissant du grand honneur qui m'a été fait.

"Soyez assez bon, je vous prie, pour être l'interprète de mes sentiments auprès de vos savants confrères et pour leur offrir deux volumes dans lesquels sont quelques indications pouvant se rattacher à l'étude de la paléographie irlandaise.

"Veuillez agréer, je vous prie, Monsieur le Secrétaire, l'assurance de ma haute considération et de mon entier dévouement.

"L. DELISLE.

"Monsieur le Secrétaire de l'Académie
royale d'Irlande."

A special vote of thanks was voted to M. Delisle for his Donation.

MONDAY, APRIL 27, 1891.

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

Mr. James Mills signed the Roll, and was admitted a Member of the Academy.

Rev. J. H. Bernard, B.D., F.T.C.D., read a Memoir "On some recently discovered Fragments of a Seventh-Century Manuscript of S. Cyril of Alexandria."

Dr. Ingram, V.P., took the Chair, while the President read a Paper "On the History and Contents of the Book of Armagh."

By permission of the Academy Mr. George Y. Dixon, M.A., read a Report by himself and A. F. Dixon, B.A., "On the Marine Invertebrate Fauna of Dublin."

The Secretary read a Paper "On the Structure of Tmesipteris," by A. Vaughan Jennings, F.L.S., and Kate Hall.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, MAY 11, 1891.

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

Mr. Dixon C. O'Keefe and the Rev. James F. M. ffrench signed the Roll, and were admitted Members of the Academy.

By permission of the Academy, Mr. J. Joly, M.A., read a Report "On the Determination of the Melting Points of Minerals."

Dr. Ingram, V.P., took the Chair, while the President read the continuation of his Paper "On the History and Contents of the Book of Armagh."

Donations to the Library were announced, and thanks were voted to the Donors."

MONDAY, MAY 25, 1891.

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

Dr. Ingram took the Chair, while the President read a Paper "On the Cistercian House of Killfothuir."

Professor R. Atkinson, LL.D., read a Paper "On the Function of the Subjunctive Mood in Irish."

The Secretary read a Paper by J. E. Gore, F.R.A.S., "On the Orbit of the Binary Star 35 Comae Berenices (Struve, 1687)."

Donations to the Library were announced, and thanks were voted to the Donors.

The list of Members in arrear was, in accordance with By-law 3, Chapter III., read out by the Treasurer.

MONDAY, JUNE 8, 1891.

REV. DR. HAUGHTON, F.R.S., Vice-President, in the Chair.

The Very Rev. Dr. O'Rorke, P.P., signed the Roll, and was admitted a Member of the Academy.

Rev. Francis Mac Enerny was elected a Member of the Academy.

Rev. M. H. Close, M.A., read a Paper "On the Moon's Variation and Parallactic Inequality."

The Treasurer laid the Accounts for 1890–91, as audited, on the Table.

MONDAY, JUNE 22, 1891.

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

Rev. Francis Mac Enerny signed the Roll, and was admitted a Member of the Academy.

Professor Haddon, M.A., read a Paper by Sidney H. Ray, "A study of the Languages of Torres Straits, with Vocabularies and Grammatical Notes."

The Secretary read a Paper by J. E. Gore, F.R.A.S., "On the Orbit of the Binary Star ι Leonis (Struve, 1536)."

The Secretary read a Paper by Hans Gadow, PH. D., M.A., "On the Crop and Sternum of *Opisthocomus cristatus*."

Professor Cunningham, M.D., F.R.S., exhibited a life-size Model of a Female Chimpanzee, Models of the Limbs of a Male Orang-Utan, and Models of the Hands and Feet of a Female Gorilla.

Dr. Frazer exhibited a MS. Poem on Human Life, written in the year 1638.

Dr. Frazer exhibited also a piece of Bees' Wax of historic interest, and gave an account of its discovery.

Donations were announced, and thanks were voted to the Donors.

The following Science Grants recommended by the Council were approved by the Academy:—

£15 to Rev. T. E. Espin, to assist him in preparing his supplementary Report on the Red Stars.

£30 to a Committee consisting of Messrs. A. G. More, R. J. Ussher, and Robert Warren, to assist them in reporting on the Birds of Ireland.

£26 to a Committee, consisting of Dr. E. P. Wright and Mr. James Thomson, to assist the latter in the preparation of a Report on the Species of the Genera Campophyllum and Calophyllum.

£50 to Prof. A. C. Haddon, to assist him in preparing a Report on Savage Art.

The following letter from Professor Sayce, LL.D., was read:—

"QUEEN'S COLLEGE, OXFORD,
"*June* 10, 1891.

"SIR,—Will you kindly express to the Royal Irish Academy my thanks for the honour they have conferred upon me in electing me an Honorary Member. I know of no distinction which I could have coveted more or have appreciated more highly.

"That the Academy have judged me worthy of filling the place of Dr. Schliemann makes the distinction conferred on me even more gratifying.

"Your obedient servant,
"A. H. SAYCE.

"The Secretary, R. I. A."

MONDAY, NOVEMBER 9, 1891.

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

Mr. J. Casimir O'Meagher read "Some notes on St. Fiacre de la Brie."

Dr. J. K. Ingram, S.F.T.C.D., exhibited the Abbatial Seal of the Exempt Jurisdiction of Newry and Morne, which was presented to the Museum of the Academy.

Mr. George Coffey, B.A.I., read "Some further Notes on the Tumulus and Inscribed Stones of New Grange."

Donations to the Library and Museum were announced, and thanks were voted to the Donors.

Part 17, Vol. XXIX., of the *Transactions*, "The Theory of Permanent Screws; being the Ninth Memoir on the Theory of Screws," by Sir Robert Stawell Ball, LL.D., F.R.S., Royal Astronomer of Ireland, was laid on the Table.

MONDAY, NOVEMBER 30, 1891.

(STATED MEETING.)

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

Mr. Richard Paul Carton, Q.C., signed the Roll, and was admitted a Member of the Academy.

The Right Rev. the Lord Bishop of Down and Connor and Dromore, D.D., LL.D., M.B., then delivered his Presidential Address.

His Excellency the Lord Lieutenant (the Earl of Zetland), Visitor of the Academy, proposed, and the Most Rev. the Lord Bishop of Canea (Dr. Donnelly), seconded:—

"That the marked thanks of this Academy be given to the President for his Address," which was carried by acclamation.

MONDAY, DECEMBER 14, 1891.

RIGHT REV. DR. REEVES, Lord Bishop of Down and Connor and Dromore, President, in the Chair.

Patrick Doyle, C.E., F.G.S., and Robert Magill Young, B.A., C.E., were elected Members of the Academy.

Professor Cunningham, M.D., F.R.S., read a Paper by A. E. Wright, M.D., "A Study of the Intravascular Coagulation produced by the Injection of Wooldridge's Tissue-fibrinogen."

By permission of the Academy, Dr. Charles R. Browne read "Notes on some New Instruments devised in the Anthropometrical Laboratory of Trinity College, Dublin."

Rev. Denis Murphy, S.J., exhibited and read "Notes on a Shrine lately found in Lough Erne."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JANUARY 11, 1892.

DR. J. K. INGRAM, S.F.T.C.D., Vice-President, in the Chair.

Dr. V. Ball, C.B., F.R.S., read a Paper "On a Block of Red Enamel found at Tara Hill."

Rev. J. H. Bernard. B.D., F.T.C.D., read a Paper "On some recently discovered Fragments of an Ante-Hieronymian Version of Holy Scripture."

By permission of the Academy, Rev. J. P. Mahaffy, D.D., F.T.C.D., read a Paper "On the Flinders Petrie Papyri, No. II."

Donations to the Library were announced and thanks were voted to the Donors.

MONDAY, JANUARY 25, 1892.

DR. J. K. INGRAM, S.F.T.C.D., Vice-President, in the Chair.

The Secretary announced that he had forwarded to Her Majesty the Queen and to the Prince and Princess of Wales, letters expressing the deep sympathy of the Academy on the occasion of the death of H. R. H. the Duke of Clarence."

Her Majesty the Queen had replied as follows:—

"OSBORNE,
"*January* 20, 1892.

"Sir Henry Ponsonby is commanded by the Queen to request Dr. Wright to thank the Members of the Royal Irish Academy for their expression of condolence on the death of the Duke of Clarence.

"The Queen learned with regret the news of the death of the Bishop of Down, President of the Academy."

The Rev. Dr. Salmon, Provost of Trinity College, moved and the Very Rev. Dr. Delany, S.J., seconded the following Resolution:—

"That the Academy desires, at this its first Meeting since the decease of its lamented President, the Right Rev. the Lord Bishop of Down and Connor and Dromore, to express its deep sense of the loss it has sustained in his death, and to convey to Mrs. Reeves and the members of his family its earnest sympathy and condolence."

The resolution was unanimously adopted, and the Academy then adjourned.

MONDAY, FEBRUARY 8, 1892.

REV. DR HAUGHTON, F.R.S., Vice-President, in the Chair,

Read the following letter from Mrs. Reeves:—

"DUBLIN, *Jan. 27th*, 1892.

"EDWARD PERCEVAL WRIGHT, M.D.

"DEAR SIR,—Will you please convey to the Members of the Royal Irish Academy for myself and every member of my dear husband's family, our deep appreciation of their kind resolution of the 25th instant, and our sincere thanks for their sympathy with us in our great sorrow.

"I remain, most faithfully yours,

"C. A. K. Reeves."

Mr. James Brenan and Mr. Greenwood Pim, at the request of the Vice-President, acted as scrutineers of the ballot which was opened for the election of a President.

Sir John Banks, M.D., K.C.B., proposed, and the Most Rev. Dr. Donnelly, Lord Bishop of Canea, seconded, that Dr. Ingram should be elected President.

Mr. W. F. de V. Kane, M.A., read a Paper "On a new species of Lernæopoda and some Notes on the Morphology of the Lernæopodidæ."

Professor D. J. Cunningham, M.D., F.R.S., read "Some further Notes on the Primate Cerebrum," by himself and Dr. Victor Horsley, F.R.S.

Sir Robert Ball, F.R.S., Vice-President, then took the Chair.

By permission of the Academy, Mr. Charles H. Keene, M.A., read a Paper "On a Stone with a Greek Inscription (early Christian) from Upper Egypt."

Mr. J. R. Garstin, F.S.A., Vice-President, took the Chair.

Rev. G. T. Stokes, D.D., read a Paper "On the Knowledge of Greek in Gaul and Western Europe down to A.D. 700."

Dr. Frazer exhibited a drawing of a stone from Slieve-na-Calliagh, presented to the Museum by E. Crofton Rotheram, Esq.

The Vice-President in the Chair, on the report of the scrutineers, declared that John Kells Ingram, LL.D., S.F.T.C.D., had been elected President of the Academy.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, FEBRUARY 22, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. Robert Lloyd Praeger, B.A.I., signed the Roll, and was admitted a member of the Academy.

Rev. G. T. Stokes, D.D., read a Paper "On the Knowledge of Greek in Ireland between A.D. 500 and 900."

Mr. R. Lloyd Praeger, B.A.I., read a "Report on the Estuarine Clays of the North-East of Ireland."

Mr. R. Lloyd Praeger, B.A.I., read also a Report by himself and Mr. S. A. Stewart "On the Botany of the Mourne Mountains, County Down."

Part 18, Vol. XXIX., of the *Transactions*, "On some Fragments of an Uncial MS. of S. Cyril of Alexandria, written on Papyrus," by the Rev. J. H. Bernard, B.D., Fellow of Trinity College, Dublin, was laid on the table.

Donations to the Library were announced, and thanks were voted to the Donors.

WEDNESDAY, MARCH 16, 1892.

(STATED MEETING.)

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

The President declared the Ballot open for the election of President and Council for the ensuing year, and appointed Surgeon-General King and Mr. G. Coffey to act as scrutineers.

The Secretary of Council then read the following :—

REPORT OF THE COUNCIL FOR THE YEAR 1891–92.

Since the date of the last Report of the Council the following Parts of the *Transactions* have been published :—

Vol. XXIX.

Part 16. "The Skeleton of the Irish Giant, Cornelius Magrath." By D. J. Cunningham, M.D., LL.D., F.R.S., Professor of Anatomy in the University of Dublin.

Part 17. "The Theory of Permanent Screws; being the Ninth Memoir on the Theory of Screws." By Sir Robert Stawell Ball, LL.D., F.R.S., Royal Astronomer of Ireland.

Part 18. "On some Fragments of an Uncial MS. of S. Cyril of Alexandria, written on Papyrus." By the Rev. John Henry Bernard, B.D., Fellow of Trinity College, Dublin.

Part 19. "On Elliptographs." By Thomas Alexander, M.A.I., Professor of Civil Engineering in the University of Dublin. Completing volume XXIX.

Cunningham Memoirs.

No. VIII. "On the Flinders Petrie Papyri, with Autotypes, Transcriptions, Commentaries, and Index." By the Rev. John P. Mahaffy, D.D., Fellow of Trinity College, Dublin.

Of the *Proceedings*, Part 5 of the first volume of the current Series was published in June, 1891, completing that volume; Part 1 of the second volume was published in August, 1891, and Part 2 will be published in April next.

The contributors of Papers during the year were:—J. K. Ingram, LL.D., President; the late Right Rev. the Bishop of Down and Connor, D.D.; R. Atkinson, LL.D.; V. Ball, C.B., F.R.S.; Rev. J. H. Bernard, B.D.; C. R. Browne, M.D.; Rev. M. H. Close, M.A.; G. Coffey, B.A.I.; D. J. Cunningham, M.D., F.R.S.; A. F. Dixon, B.A.; G. Y. Dixon, M.A.; W. Frazer, F.R.C.S.I.; H. Gadow, PH. D.; J. E. Gore, F.R.A.S.; Kate Hall; V. Horsley, F.R.S.; A. V. Jennings, F.L.S.; J. Joly, M.A.; W. F. de V. Kane, M.A.; C. H. Keene, M.A.; Rev. J. P. Mahaffy, D.D.; J. Mills; Rev. D. Murphy, S.J.; J. C. O'Meagher; R. L. Praeger, B.A.I.; S. H. Ray; Rev. G. T. Stokes, D.D.; J. Thomson; A. E. Wright, M.D.

The Rev. Edmund Hogan, S.J., has been appointed to the Academy's Todd Professorship of the Celtic Languages, and it is hoped that his first series of Lectures will be delivered shortly.

Of the Photolithography of the Yellow Book of Lecan, the Council have to report that one hundred and nine pages have been printed off during the year.

The fund for the purchase of Treasure Trove has been, as heretofore, administered by the Committee of Polite Literature and Antiquities; and the articles purchased by means of that fund, as well as several objects of antiquarian interest presented to the Academy during the year, have been added to the Academy's Collections in the New Museum of Science and Art, Dublin.

The following Grants in aid of the preparation of Scientific Reports have been sanctioned by the Academy:—

£15 to Rev. T. E. Espin, to assist him in preparing his Supplementary Report on the Red Stars.

£30 to a Committee consisting of Messrs. A. G. More, R. J. Ussher, and Robert Warren, to assist them in reporting on the Birds of Ireland.

£26 to a Committee, consisting of Dr. E. P. Wright and Mr. James Thomson, to assist the latter in the preparation of a Report on the Species of the Genera Campophyllum and Calophyllum.

£50 to Prof. A. C. Haddon, to assist him in preparing a Report on Savage Art.

And the following will be submitted to the Academy at this meeting:—

£22 to Prof. D. J. Cunningham, M.D., F.R.S., to assist him in illustrating his Report on the Primate Cerebrum.

The following Members have been elected since 16th March, 1891:—

Patrick Doyle, C.E.
Rev. Francis MacEnerny, C.C.
James Mills.
Robert Lloyd Praeger, B.E.
Robert Magill Young, B.A., C.E.

At the Stated Meeting on the 16th March last year,

Léopold Delisle, and
Rev. Archibald H. Sayce, LL.D.,

were elected Honorary Members of the Academy in the Section of Polite Literature and Antiquities.

We have lost by death within the year seven Members:—

Right Rev. William Reeves, D.D., M.B., LL.D., Lord Bishop of Down and Connor and Dromore, President of the Academy, elected December 14, 1846.

John Browne, elected May 13, 1878.

Richard G. Butcher, M.D., elected January 8, 1855.

Right Hon. the Earl of Charlemont, K.P., elected Jan. 11, 1864.

Rev. John Grainger, D.D., elected April 10, 1876.

Sir Edward Hudson Hudson-Kinahan, Bart., elected April 9, 1866.

John M'Donnell, M.D., elected March 16, 1827.

We have also lost by death two Honorary Members in the Section of Science:—

Sir George Biddell Airy, K.C.B., D.C.L., LL.D., elected November 30, 1832.

John Couch Adams, LL.D., F.R.S., elected March 15, 1873.

In the death of our late President, Dr. Reeves, Lord Bishop of Down and Connor and Dromore, the Academy has to deplore the loss of one of its most eminent scholars, one of the most capable students of antiquity that Ireland has produced. Taken from us in the fulness of years, though still with abundant promise of admirable work for which none was more fitted, he has left an honourable record in publications, whose value can hardly be overrated, and is likely to increase with time. This is, of course, not the place to enter into detail respecting the various works with which his name is indissolubly connected: the mere enumeration of their titles affords but a very limited notion of the extent of his labours in the branches of study to which he devoted himself, and of which he was admittedly a master; but it is only by long familiarity with some one of his numerous writings that one can attain to any just appreciation of their characteristic quality, viz. their accuracy. In this respect it may be safely affirmed that few writers have surpassed him; the attention he devoted to his self-imposed duty was never relaxed; no document bearing on any point under discussion escaped his notice, no authority was ignored, and what is perhaps more significant, no quotation or reference was left unverified. His keen eye in the review of masses of fact, his sagacity in the discovery of sources of information, the scholarly habits that made him dwell lovingly on all the minutiæ, till the whole subject under study was irradiated with the fullest light of positive knowledge, give to his writings a powerful attraction, and promise for them a lasting place in the memory of scholars, a continued claim to the gratitude of all who are interested in the study of the Antiquities of Ireland.

A list of Dr. Reeves' Works, supplied by himself, will be found in the Supplementary Volume of Cotton's *Fasti Ecclesiæ Hibernicæ.*

The following Papers by him were published in the Academy's Transactions and Proceedings:—

Transactions.

1860. "On the Céle-dé, commonly called the Culdees."
1863. "On the Bell of St. Patrick, called the Clog an Edachta."

Proceedings.

1851. "On the Codex Maelbrighde."
1851. "On an Ulster Memorial preserved in the Chapter House, Westminster."
1852. "On a Scotch Charter."
1857. "On the Early System of Abbatial Succession in the Irish Monasteries."
1857. "On the Irish Abbey of Honau on the Rhine."

1858. "On Hymnus S. Aidi."

1859. "On the Church of St. Duilech."

1859. "On certain Crannoges in Ulster."

1859. "An Account of the Crannoge of Inishrush and its Ancient Occupants.

1860. "On Marianus Scotus of Ratisbon."

1861. "On the Townland Distribution of Ireland."

1861. "On Augustin, an Irish Writer of the Seventh Century."

1861. "Memoir of Stephen White."

1862. "On the Island of Sanda."

1863. "On SS. Marinus and Anianus, two Irish Missionaries of the Seventh Century."

1863. "On certain Irish Ecclesiastical Bells."

1864. "On a Bull of Pope Innocent IV."

1875. "On a MS. Volume of Lives of Saints—chiefly Irish—now in Primate Marsh's Library, Dublin; commonly called the 'Codex Kilkenniensis.'"

1879. "Observations upon a Letter from the late John Forster, presented to the Academy by the Lord Bishop of Killaloe."

1891. "The Cistercian Abbey of Killfothuir."

1891. "On the Book of Armagh."

The Report was adopted.

The following Science grant, recommended by the Council, was passed:—

£22 to Prof. D. J. Cunningham, M.D., F.R.S., to assist him in illustrating his Report on the Primate Cerebrum.

Dr. Frazer and Mr. Garstin, by leave of the President, made short statements in reference to a Dublin-printed Anglican Prayer Book, 1637, with the name of S. Patrick in the Calendar, and exhibited a Laudian Prayer Book printed in 1637, in Edinburgh, in which the name of S. Patrick also occurred in the Calendar.

On the report of the Scrutineers, the President declared the following elected as President and Council for the year 1892–3:—

PRESIDENT.

John Kells Ingram, LL.D.

COUNCIL.

Committee of Science.

Edward Perceval Wright, M.D.
Sir Robert S. Ball, LL.D., F.R.S.
V. Ball, LL.D., F.R.S., C.B.
F. A. Tarleton, LL.D.
Daniel J. Cunningham, M.D., F.R.S.
Benjamin Williamson, D. SC., F.R.S.
J. P. O'Reilly, C.E.
George L. Cathcart, M.A.
George Henry Kinahan.
Rev. Samuel Haughton, M.D., F.R.S.
W. J. Sollas, D. SC., F.R.S.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
David R. Pigot, M.A.
Right Hon. Sir Patrick J. Keenan, C.B., K.C.M.G.
P. W. Joyce, LL.D.
John R. Garstin, M.A., F.S.A.
John T. Gilbert, F.S.A.
William Frazer, F.R.C.S.I.
Rev. Denis Murphy, S.J.
Louis C. Purser, LITT. D.

The Ballot was then opened for the election of Officers. Dr. Frazer and Mr. Cathcart were appointed Scrutineers, on whose subsequent report the President declared the result as follows:—

TREASURER.—Rev. M. H. Close, M.A.

SECRETARY.—Ed. Perceval Wright, M.D.

SECRETARY OF THE COUNCIL.—Robert Atkinson, LL.D.

SECRETARY OF FOREIGN CORRESPONDENCE.—Joseph P. O'Reilly, C.E.

LIBRARIAN.—John T. Gilbert, F.S.A.

CLERK OF THE ACADEMY.—Robert Macalister, LL.B.

The President under his hand and seal appointed the following as Vice-Presidents.

Sir Robert S. Ball, LL.D.
Rev. Samuel Haughton, M.D., D.C.L., LL.D.
John Ribton Garstin, M.A., LL.B.
David R. Pigot, M.A.

The Academy then adjourned.

MONDAY, APRIL 11, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Rev. Philip O'Doherty, C.C.; Bryan Lewis O'Donnell, William Patrick O'Neill, William Joseph Myles Starkie, M.A., F.T.C.D.; Ven. Andrew Tait, D.D., LL.D., F.R.S.E., and Laurence A. Waldron, were elected Members of the Academy.

Rev. Dr. Haughton, F.R.S., read a Paper on "Newtonian Chemistry. Note 2—Ternary Compounds of the Type of Water."

Rev. Dr. Haughton, F.R.S., also read—"A Simple Account of 'Chemical Valency' on Newtonian Principles."

The Secretary read, for Dr. Parker, a Paper "On the Anatomy and Physiology of *Protopterus annectens*."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, APRIL 25, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

The Secretary read a Paper by the Right Rev. Charles Graves, D.D., Lord Bishop of Limerick, "On an Ogam Inscription supposed to bear an Anglo-Saxon Name."

Dr. Frazer read a Paper on "The Bronze Instruments usually described as Sickles."

Sir Robert Ball, LL.D., F.R.S., read a Paper by himself and Arthur Rambaut, D.SC.—"Report on the Relative Positions of 223 Stars in the Cluster χ Persei, as obtained by Photographic Observations at Dunsink."

Donations to the Library and Museum were announced, and thanks were voted to the Donors.

MONDAY, MAY 9, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. W. E. Wilson and Dr. A. A. Rambaut read a Paper "On the Absorption of Heat in the Solar Atmosphere."

Rev. Edmund Hogan, S.J., read the first of a series of Todd Memorial Lectures. Subject:—"The *Cath Ruis na Rig*, from the Book of Leinster."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, MAY 23, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. Bryan Lewis O'Donnell signed the Roll, and was admitted a Member of the Academy.

Rev. Edmund Hogan, S.J., read his Second Todd Memorial Lecture. Subject—"The *Cath Ruis na Rig*," from two Manuscripts of the Royal Irish Academy, and one of the British Museum.

The Secretary read a Paper by Miss Margaret Stokes, HON. M.R.I.A., on "The Cross of Cong."

Mr. T. H. Longfield, F.S.A., read "A Note on some Cinerary Urns found at Tallaght, Co. Dublin."

The Secretary read a Report by Mr. Henry K. Jordan, F.G.S., on "The Genera Buccinum, Fusus, &c., dredged off the S. W. of Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

The following Science Grants recommended by the Council were approved of:—

£15 to Mr. Joly to aid him in his Researches on the Volume-change of Rocks in passing from the solid to the liquid state.

£20 to Dr. Scharff, to enable him to continue his Researches into the Origin and Geographical Distribution of the Irish Land and Fresh-water Fauna.

£25 to Dr. W. H. Thompson, to aid him in determining the Course and Cerebral Connexions of certain Cranial Nerves, especially of the Auditory and Vagus.

The Treasurer read (in accordance with By-law 3, Chapter III.) the list of Members in arrear.

The Treasurer laid the Audited Accounts for the past year and the Estimates for the coming year on the table.

MONDAY, JUNE 13, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Charles R. Browne, M.B., and Thomas R. J. Polson were elected Members of the Academy.

Rev. Edmund Hogan, S.J., read his Third Todd Memorial Lecture. Subject—"The Linguistic value of the Texts which formed the Subjects of the preceding Lectures."

Mr. John Ribton Garstin, M.A., F.S.A., read a Paper on "Some Unpublished Mediæval Inscriptions in Ireland."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, JUNE 27, 1892.

DR. J. K. INGRAM, S.F.T.C.D, President, in the Chair.

Arthur Alcock Rambaut, M.A., D.SC., was elected a Member of the Academy.

Rev. Edmund Hogan, S.J., read his Fourth Todd Memorial Lecture. Subject—"Irish Neuters."

Professors A. C. Haddon; W. J. Sollas, F.R.S.; and G. Cole, read a Paper on "Some Volcanic Islands in Torres Straits."

Mr. B. O'Looney exhibited a MS. Collection of the Writings of Dr. Geoffrey Keating, and gave a descriptive account of same.

Donations to the Library were announced, and thanks were voted to the Donors. A special Vote of thanks was given to Dr. Thomas

More Madden for a Donation of Thirteen bound Volumes of the Correspondence, some unpublished Essays and literary fragments of his father, the late Dr. R. R. Madden.

The following Science Grants were approved of by the Council:—

£10 to Mr. R. Lloyd Praeger, to assist him in his Investigations concerning the Raised Beaches of the North Coast of Ireland.

£20 to a Committee consisting of Dr. G. F. Fitz Gerald, F.R.S., and Mr. J. E. Cullum, to assist them in their Magnetical Observations at Cahirciveen.

£25 to a Committee consisting of Dr. E. P. Wright, and Dr. W. K. Parker, to assist the latter in his Researches into the Anatomy of *Protopterus annectens.*

£15 to a Committee consisting of Mr. G. Coffey and Mr. J. H. Pentland, for the purpose of enabling them to investigate the Loughcrew Cairns.

No. VII. of the Cunningham Memoirs.—" Contribution to the Surface Anatomy of the Cerebral Hemispheres. By D. J. Cunningham, M.D., D.SC., F.R.S.; with " A Chapter upon Cranio-Cerebral Topography," by Victor Horsley, M.B., F.R.S., was laid on the Table.

MONDAY, NOVEMBER 14, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Mr. Laurence A. Waldron, Mr. Charles R. Browne, M.B., and Dr. Arthur A. Rambaut, signed the Roll, and were admitted Members of the Academy.

Rev. B. Mac Carthy, D.D., read a Paper " On the A.D. misdating in the Annals of Ulster.

Mr. J. Casimir O'Meagher read Notes " On the Irish Marching Bagpipe."

Dr. Frazer read " Some Notes on the *Corp Naomh*, bought for the Royal Irish Academy some years since; its Antiquarian History."

Dr. Scharff communicated a Paper by Rev. H. Friend, M.A., " On a New Species of the Genus Lumbricus found in Ireland."

Dr. Scharff also communicated, for Mr. Alfred Bell—"Notes on the Correlation of the Later and Postpliocene Tertiaries on either side of the Irish Sea, with a reference to St. Erth Valley, Cornwall."

The following Resolution was adopted—That an Address of Welcome be presented to His Excellency the Lord Lieutenant, and that the Officers of the Academy be requested to prepare a draft Address for the approval of the Academy. The following Address having been submitted, was agreed to:—

To His Excellency, Robert Offley Ashburton, Baron Houghton, Lord Lieutenant General, and General Governor of Ireland.

May it please Your Excellency,

We, the President and Members of the Royal Irish Academy, beg leave to congratulate you on your appointment to the high office of representative in Ireland of Her Most Gracious Majesty, Queen Victoria.

The Queen is Patron of our Academy, which was founded by Royal Charter, in the year 1785, for the purpose of promoting in this country the study of Science, Polite Literature, and Antiquities.

Our records will prove that we have not been unfaithful to the trust thus committed to us.

We have numbered amongst our Members the most eminent men of Science whom this country can boast, and many of the most important products of their genius were announced at our meetings, and appear in our Transactions.

We have devoted much study to Literature in general, and especially to the Celtic Literature of Ireland. We have published the most valuable of our ancient Irish Manuscripts, so as to make them accessible to Scholars abroad, as well as at home. In carrying out this important National object, we have been aided by the liberality of Parliament, which we desire gratefully to acknowledge.

We have also made—in a large measure by the contributions of our Members—what is universally admitted to be a noble collection of the extant specimens of the ancient art of Ireland, which is still in our charge and custody, though now displayed for the benefit of all in the Dublin Museum of Science and Art.

In virtue of your high office, your Excellency becomes Visitor of the Academy. We hope that you will be pleased to honour us with your presence on some early occasion, and that we may reckon on your sympathy and support in labours which you are so well qualified to understand and appreciate.

Donations to the Library were announced and thanks were voted to the Donors.

Stated Meeting.

Wednesday, November 30, 1892.

Dr. J. K. Ingram, s.f.t.c.d., President, in the chair.

The President announced that the Address adopted at the previous Meeting of the Academy had been duly presented to His Excellency the Lord Lieutenant, and that His Excellency had replied as follows :—

Dr. Ingram and Members of the Royal Irish Academy, I have received with much gratification your loyal address presented to me on my coming here as Representative of Her Majesty the Queen, who, as you remind me, is Patron of your Academy. In your Address you claim to have successfully promoted in this country the study of Science, Polite Literature, and Antiquities, and I can well believe that your claim to have done so is a well-founded one. I have had an opportunity of seeing some of the volumes in which the transactions of your Academy are embodied, and I have been greatly struck with the variety and interesting character of the subjects dealt with and the manner in which the works have been prepared and got up—a manner which will bear favourable comparison with the publications of any similar society in the United Kingdom. You have, as we must all feel, done the country a real service by preserving the records of its ancient history and literature—a service perhaps not enough appreciated by everybody in this practical and utilitarian age. I was told the other day of a political gentleman who, on being appealed to to support the bringing out of some ancient records said that, as far as he was concerned, all the records of his country might perish and disappear. We shall be disposed, I think, to agree that he was entirely wrong, for all of us have much to learn from the study of ancient records, if it only brings us to the conclusion that there is nothing new under the sun. I have had an opportunity of visiting your interesting collection of Irish Antiquities at the Science and Art Museum, and I am not surprised to hear that it brings visitors from all parts of the world to see such a unique and splendid exhibition. It is with pleasure that I take up the office of your Visitor, and I hope to have the privilege of visiting the Academy shortly, and, in doing so, I shall regard it as a pleasure not less than as a duty.

Visitors were admitted.

The President then delivered the following Address :—

In addressing you on this occasion in accordance with the practice of Presidents of the Academy, my first duty is to return my cordial thanks for the high honour which has been done me in placing me in this Chair. It has been occupied before me by many distinguished men, of whom Ireland is justly proud. I have little claim to succeed them beyond what is founded on my labours for many years in the service of the Academy, and my known zeal for its interests and its honour. I rely on the kindness of its members, which I have already so often experienced, to support me in the efforts I shall make by every means in my power to maintain the position and extend the usefulness of a body which has so greatly contributed in the past to promote the culture and raise the character of our country.

In referring to those who have gone before me, it is impossible not to think especially of my immediate predecessor. It is but a short time since he delivered his Inaugural Address, and there was no apparent indication of any decline in his activity and energy when he was suddenly and unexpectedly taken from us. He needs no formal eulogy, and I have already expressed in the Academy my deep sense of his eminent merits and services. He was a man of extensive general learning, and, as I ventured to say on a former occasion, no one, since the days of Ussher and Colgan, has shown a wider or more accurate knowledge of the Ecclesiastical History of this country. His mind was a book written within and without with all the memorabilia of Ireland's early annals. And never was anyone, possessed of such intellectual stores, more willing to communicate from his wealth to other labourers in the same field. When I was Librarian of Trinity

College, I not unfrequently had occasion to consult him, and he always gave me in reply much more than I had asked. Of the charm of his personal character—the frankness, kindness, and geniality of his address—I need say nothing amongst so many who were his intimate friends or habitual associates. I rejoice to know that we shall soon possess in this Academy a portrait by an able artist, which will transmit to our successors an image of the noble head and the expressive countenance which those who knew him never can forget.

When I had the honour of addressing you on the occasion of the Centenary of the Academy in 1886, I offered a slight sketch of the history of our body. I then remarked that it would be profitable to take a complete survey of what it had already done and of the work which seemed to lie before it in the future. But, I added, the task was one exceeding my powers, and would, besides, be better suited to a special *séance* of the Academy than to a festive meeting like that which celebrated our Centenary. I therefore restricted myself to a brief notice of a few particular points of interest in the story of our past.

If I endeavour now to fill up the slight outline which I then traced, it is not because I have more confidence in my ability to execute the task in a manner entirely satisfactory to you or to myself. But it is better that it should be performed imperfectly than not performed at all. I think that by some of our members, and still more by the general public, the nature and extent of the work of the Academy are indistinctly conceived, and therefore inadequately appreciated. And yet so large a part of the intellectual history of our country is bound up with the records of this institution, that Ireland cannot neglect those records without incurring the reproach, more than once brought against her, of being *incuriosa suorum.*

There was in the more advanced countries of Europe in the seventeenth century a marked movement towards the creation of national societies for the promotion of science and literature. The Royal Irish Academy was one of the products of that movement. It was not, however, an immediate product. Its formal establishment was preceded for upwards of a century by more or less successful efforts on the part of Irish savants and scholars to form private associations for mutual aid and encouragement in their intellectual pursuits. As early as 1683, by the exertions of the celebrated William Molyneux, author of "The Case of Ireland Stated," the Dublin

Philosophical Association was founded, with Sir William Petty for its President and Molyneux himself for its Secretary. The date will suggest the difficulties which the maintenance of such an Association must have encountered; and, in fact, in consequence of the distracted state of the kingdom, we are told, it was dispersed in 1688. About the beginning of the eighteenth century the Earl of Pembroke, then Lord Lieutenant, presided over a Philosophical Society established in Trinity College. In 1740 the Physico-Chemical Society was instituted, and lasted long enough to publish two volumes of minutes. In the otherwise memorable year 1782 was founded the Society out of which our Academy arose; the members of this Society belonged, for the most part, to the University, and read essays in turn at weekly meetings. In 1786, the Royal Irish Academy was incorporated, and the first volume of its *Transactions* appeared in 1788.

A characteristic feature of the Academy from its first foundation was the union within it of distinct Committees of Science, Polite Literature, and Antiquities (the two latter of which have since been fused together), and the reading of papers belonging to these different departments at the same meetings of the body. It was the belief of the founders, in borrowing this plan from several learned societies in Continental Europe, that it was desirable to enlist the interest of students of science in literary and antiquarian research, and of literary and archæological students in science, or, at least, by giving these classes the opportunity of frequent social contacts, to cultivate in each a spirit of respect for the other's pursuits. Some have questioned the wisdom of such a combination, and have wished to separate the several departments of the Academy's work, and assign them to different institutions. This policy has not unfrequently been prompted by what I must call a narrow spirit which shows itself, in what is happily only a small minority of men of science, in the contempt which they habitually feel and express for the study of antiquities. It is possible, indeed, to pursue that study in a trivial and peddling way, with little regard to the large aims it ought to have in view, and without maintaining the due proportion between different sorts of knowledge. Ancient ornaments and implements, and the contents of museums generally, which are usually contemplated when we speak of antiquities, are most valuable; but it is as means to an end. Along with architectural monuments, with language, with popular tales and traditions, all of which belong to the domain of archæology, they supplement such literary documents as we possess, they help us to reanimate the past, and thus aid us in one of the noblest of intellectual pursuits, the study of the progress of civilization and the development of human societies.

But though the proposal to distribute the different branches of our work among several institutions has been more than once put forward, the sentiment of the great majority of our members has always been opposed—and, I believe, justly opposed—to such projects, and has favoured the maintenance of what Sir Samuel Ferguson called the encyclopædic character of our studies. In a country such as this, in which several institutions of a really high order could with difficulty be sustained, there seem to be particularly strong reasons for the combination of which I have been speaking. And its continuance is eminently seasonable at the present time, when a general revolt is in progress against the dispersive specialism which has from obvious causes been hitherto dominant, and when there is a growing demand for a synthetic education, in which all the essential elements of culture shall be represented in due proportion, and co-ordinated into a harmonious whole.

The history of the Academy, as I observed in my Centenary Address, falls naturally into three periods. The first of these extends to the close of the first quarter of the present century. During this period many remarkable men took part in the labours of our body. Among those most worthy of special mention was the first President, Lord Charlemont, at that time prominent in Irish politics, an earnest student of literature, and in particular of Italian literature. The second President was Richard Kirwan, well known as a chemist and mineralogist. His reputation has suffered from his having for some time maintained the old doctrine of Phlogiston in opposition to the new theory of Combustion; but so much importance did the school of Lavoisier attach to the arguments or the scientific influence of Kirwan, that, his book having been translated into French by Mme. Lavoisier, its refutation was made the task of five of the most illustrious Frenchmen of the day, Lavoisier himself, Monge, Berthollet, Morveau, and Fourcroy.[1] It is honourable to Kirwan's rectitude and candour that he owned himself convinced, and adopted the new doctrine. Matthew

[1] See Mr. Donovan's Biographical Account of Kirwan, *Proceedings R. I. A.*, vol. ii., p. lxxxi.

Young, Fellow of Trinity College and Professor of Natural Philosophy in the University, afterwards Bishop of Clonfert, was an active member; he was possessed of the most varied learning and accomplishments, and is described as a man of noble character. Hugh Hamilton, author of a well-known treatise on Conic Sections, and Henry Ussher, Andrews Professor of Astronomy, also contributed to the *Transactions*. At a somewhat later period, the eminent Dr. John Brinkley, an Englishman and a graduate of Cambridge, who was Ussher's successor at the Dunsink Observatory, wrote largely and ably on Mathematics in the eighteen years during which, as Sir Robert Ball tells us,[1] he was waiting for the telescope which Ramsden had undertaken to construct for him. In the literary and antiquarian departments papers were read by the Rev. John Barrett, Editor of the Palimpsest of the Gospel of St. Matthew, now known as Codex Z; by Dr. Thomas Leland, the historian of Ireland; by William Preston, author of a Version of Apollonius Rhodius, and other poetical writings; by Joseph Cooper Walker, author of Historical Memoirs of the Irish Bards; by Richard Lovell Edgeworth, father of the eminent novelist; and by General Vallancey, whom I shall have occasion to mention again by-and-by.

Besides the names of those who wrote in the *Transactions*, there occur in the early lists of members those of many persons prominent at the time in political life, such as Grattan, Flood, Foster, Barry Yelverton (afterwards Lord Avonmore), and Robert Stewart (afterwards Lord Castlereagh). In such a list in the third volume of the *Transactions*, out of a total of 174, there are no fewer than 33 who either by right of birth or of public office were entitled to the prefix of "Right Honourable." This is striking evidence of the interest then taken by Irishmen of the higher classes in the cultivation of Science and Literature.

The period with which I have hitherto dealt may best be regarded as preparatory to that which succeeded, and which I call "the great period" of the Academy. It is true that a survey of these early years of the existence of our body does not quite bear out the idea, often propounded, of an intellectual torpor having fallen upon our country during the first quarter of the nineteenth century. But there is no doubt that

[1] See "The Book of Trinity College, Dublin," p. 137.

after that time a remarkable development of the mental energies of the nation took place; a new spirit of hopeful and progressive activity was everywhere apparent, sounder methods of research were introduced, and epoch-making work was done in Science and Archæology. Without unduly depreciating the preceding generation, we may yet justly speak of this great period as that of an Irish Renaissance. Its greatness on the Scientific side was in a large measure the result of an impulse, memorable in the intellectual history of the country, which is associated with the name of Bartholomew Lloyd.

Ireland does not yet, I think, understand the magnitude of the debt she owes to this truly eminent man. It is well known that English Mathematicians, influenced by the partiality of Sir Isaac Newton for the methods of the Ancient Geometry, adhered to those methods long after their brethren on the Continent had developed the modern analysis, and had applied it in particular to the study of Physical Astronomy as founded by Newton himself. Ireland in this respect followed the English lead, and so lagged behind in the scientific race. When Lloyd, still a Junior Fellow of Trinity College, was elected Professor of Mathematics, he at once set himself to the task of bringing the University of Dublin in this branch of study up to the most advanced standard of the time. "Singly and unassisted," says a competent witness, "he conceived and executed the most important and rapid revolution ever effected in the details of a great public institution." By his teachings from the chair, and by his Treatise on Analytical Geometry, he naturalized amongst us the French Mathematics, as they were then called; and when afterwards elected Professor of Natural Philosophy, he carried the reform into this department also, and produced what the Quarterly Review of the day pronounced to be the most valuable Treatise on the Theory of Mechanics which had yet appeared in the English language. As Provost of Trinity College, he carried out within a few years, it has been said, "greater improvements than had been wrought during the whole of the previous century." Under the renovated system of studies thus introduced were formed three men who must always be regarded as among the chief glories of our Academy—Sir William Rowan Hamilton, James Mac Cullagh, and Humphrey Lloyd.

Hamilton's large and prolific genius, and his frank and generous nature, are admirably depicted in Dr. Robert Perceval Graves's biography of him—a book which contains much of the intellectual history of his period. He was a loyal and devoted friend of the Academy, and it was at our meetings that his most important discoveries were announced —the only exception as to his productions of the first order being his General Dynamical Method, which was presented to the Royal Society. It was here that his Paper on Systems of Rays was read, which contained the celebrated scientific prophecy of conical refraction in biaxal crystals; and it was here that he first announced his Theory of Quaternions, and afterwards, in a long series of communications, developed the new Calculus and exhibited its various applications. Mac Cullagh's peculiar pre-eminence lay in the power with which he used the instrument of pure geometry, and the remarkable elegance and symmetry of his methods and theorems. He worked out the construction of surfaces of the second degree corresponding to the modular method in the conic sections—a mode of treating those surfaces which was afterwards completed by a supplementary conception of Dr. Salmon. Mac Cullagh applied the geometry of the ellipsoid with great ability to the study of Fresnel's Wave-surface, and only by an oversight missed the discovery of conical refraction, which was an obvious consequence of his construction of a tangent plane to that surface. It cannot be said, I believe, that his attempt to supply a mechanical theory as to the nature of the luminous ether has been more satisfactory to men of science than those of Fresnel, Cauchy, Green, and others who have applied themselves to the same problem. But it is interesting to observe that when that problem was studied, fifty years after, by Sir William Thomson (now Lord Kelvin), he unconsciously wrote down the same equations which had been given by Mac Cullagh.[1] Humphrey Lloyd was by nature rather an observer than a deductive reasoner or *à priori* speculator. He had a greater capacity for experimental investigation than either of his eminent contemporaries. He verified by actual trial the phenomenon of conical refraction which Hamilton had theoretically predicted. He rendered most valuable services in terrestrial magnetism. The Magnetic Observatory of Trinity College, founded under his father's auspices, was placed under his direction and furnished with instruments devised by himself; and when the Government, urged by the Royal Society and the British Association, established similar observatories throughout the United Kingdom and India, the preparation of instructions for

[1] "L. E. and D. Philosophical Magazine" for November, 1888.

the conduct of the observations was confided to Lloyd. A great number of memoirs on this branch of research was communicated by him to our *Transactions.*[1]

Chiefly through the mathematical labours I have mentioned, the Academy won a reputation which is acknowledged wherever science is held in esteem. In Physics and Chemistry, within the same period, it had distinguished names—those of Apjohn, Andrews, and Kane—and in biology, of Harvey and Allman. We see, then, that this was a memorable epoch in science; and, if we turn to the other side of the Academy, we shall find its efforts in that sphere no less vital and progressive.

Up to this time, Irish Archæology had been in the pre-scientific stage. Arbitrary hypothesis, fanciful speculation, possessed the field, and the tendency was to exaggerate the antiquity and the splendour of our early civilization in the temper described by the words—*Omne ignotum pro magnifico.* In this region we had, in the great period of the Academy, what may be called an *Aufklärung* on a small scale. And the leader of this beneficent reform was George Petrie. For the old random guesses, the wild theories, the misapplied learning which had prevailed in this domain, he introduced the sober and sceptical spirit of science, accurate observation and patient study of fact. The new principles and the old methods first came into decisive conflict on the question of the Round Towers. Vallancey and others had propounded the most different, but equally baseless theories respecting them. They were Persian fire towers, Phallic temples—certainly Pagan structures, and probably of extreme antiquity. The Academy proposed as a subject for a Prize Essay, the question of the origin and destination of these buildings. The successful Essay was written by Petrie, and it opened a new era. It is still a model for Archæological investigators. The author begins by refuting, one by one, in the most satisfactory manner, the vague and inconclusive arguments urged in favour of the visionary theories I have mentioned; and then, adopting his characteristic process of using combinedly the evidence of the existing monuments, and the records in the national Annals, he proves that the Towers were of Christian origin, and invariably connected with Churches—that they

[1] It is much to be desired that a collected edition of Hamilton's Mathematical writings should be published. Mac Cullagh's works were edited (1880) by Mr. (afterwards Provost) Jellett and Dr. Haughton. A number of Humphrey Lloyd's papers on Physical Science were collected by himself in 1880.

served the double purpose of belfries and of places of protection for ecclesiastical persons and property against sudden assault, and that they belong to a period ranging from the sixth to the thirteenth century. (It is now believed that he ought to have said—from the ninth to the thirteenth; their use as keeps, which was certainly the primary one, having arisen from the Danish invasions.) Petrie then proceeded with the larger inquiry into the whole history of Ecclesiastical Architecture in Ireland, and this he was the first to place on a sound basis. I will add, though somewhat anticipating the order of time, that his work, which was left unfinished, was followed up by Edwin, third Earl of Dunraven, to whose labours Ireland is deeply indebted. He personally examined and photographed almost every ancient Church in the country. The results of Lord Dunraven's researches were given to the world after his death in two noble volumes, edited by Miss Margaret Stokes, an Honorary Member of our Academy. This accomplished lady added valuable Essays of her own, which have since been separately published,[1] and which give the most comprehensive and accurate treatment of the whole subject which is anywhere to be found. By these inquiries we are enabled to trace the progress of Ecclesiastical Architecture in Ireland from the uncemented oratories of the primitive Christian period through the earlier Churches, small, without semicircular apse, and never exhibiting a true arch, to the decorated work of the eleventh and twelfth centuries, when a genuine Irish Romanesque appears, which was arrested in its development and supplanted by the introduction of the Anglo-Norman.

So much for the reform of Irish Archæology which was initiated by Petrie. Our linguistic studies, also, at this time gained much in sanity and solidity. They had suffered even more than Archæology from unscientific guesswork and wild conjecture, and confusion reigned throughout this whole province of thought. Not to speak of the extraordinary aberrations of Kirwan, when he ventured on the field of language, Vallancey, and after him Betham, fell into errors of which no intelligent undergraduate of our days, who reads his Max Müller, could be guilty. They were profoundly in the dark as to the affinities of the Irish, making it to be cognate with the Phœnician. We know,

[1] "Early Christian Architecture in Ireland" (Bell & Sons, 1878). See also Miss Stokes' "Early Christian Art in Ireland" (Chapman & Hall, 1887), Part ii.

thanks to Bopp and his followers, that this is impossible—the one being an Indo-European, the other a Semitic tongue. But it is curious to what a recent period similar delusions have lingered in some quarters. I have pointed out elsewhere how Victor Hugo, in his "L'homme qui rit," tells us that an Irishman and a Basque understand one another, because they both speak the old Punic jargon, showing at once that he misconceives the position of the Basque language, and that he regards as a "jargon" belonging to one great linguistic family what is really a well-authenticated and respectable member of another.

When the relations of the other Indo-European languages had been sufficiently studied by the new school of philologists, attention was turned to a closer examination of the Celtic; and Zeuss ascertained its ancient forms, and compared the several dialects of its Gaelic and Kymric varieties. Irish scholars were not yet ripe to take part in the researches of the higher philology; indeed, the Irish language had long been neglected in its own home.

Eminent men had often protested against this neglect. Leibnitz, from the point of view of the philosopher, and Boyle and Bedell, in a religious interest, had urged the study of Irish. Samuel Johnson had been particularly earnest in pressing it. Edmund Burke had taken a practical step towards the object; a valuable collection of Irish MSS., which had belonged to the well-known Welsh antiquary and philologist, Edward Llwyd, had, at his death, passed into the possession of the Seabright family, and at Burke's request they were presented by Sir John Seabright to Trinity College in 1786.[1] But this gift for a long time bore no fruit. Occasional efforts were made by isolated scholars to call attention to the language, and the literature it embodied, and societies were formed—such as the Gaelic Society in 1807—for the publication of some of the old Celtic tales and poems. But the first really effective movement in this study must always be connected with the names of O'Donovan and O'Curry. Neither of these scholars was trained in the new Philology, though O'Donovan in his later life saw the importance of its principles,

[1] The celebrated Henry Flood bequeathed to Trinity College an estate said to be of the value of £5000 a-year, in trust—1, to maintain a Professorship of Irish; 2, to give prizes for compositions in the Irish language, and 3, to purchase all obtainable books and MSS. in Irish or the cognate languages. His intention was defeated by a decision of the Courts of Law.

and endeavoured to acquire some knowledge of them. But both were masters of the modern language, and had a wonderfully extensive acquaintance with all the extant manuscript materials. The Irish Archæological Society, which was an offshoot of our Academy, and the Celtic Society gave these scholars the opportunity of editing and illustrating unpublished Gaelic texts, and a Professorship in the Catholic University supplied a fitting sphere for the labours of O'Curry. It may be truly said that scarcely any book was published, or memoir written, in Ireland, requiring the use of Celtic learning, to which one or other of these two men was not invited to lend assistance. Meanwhile Todd and others went on examining and describing Irish MSS. in home and foreign libraries, or publishing and elucidating ancient texts.

Outside the Celtic field a great philological investigator was at work amongst us in this period—I mean the Rev. Edward Hincks. In his earlier papers, he applied himself to the study of the Egyptian hieroglyphics, and Brugsch, a competent judge, has said that he was the first to employ the true method in their decipherment. He afterwards enriched our *Transactions* with many learned memoirs on the Cuneiform Inscriptions; and this solitary Irish scholar, working in a country parish in Ulster, was able to keep pace—and more than keep pace—with the discoveries of Rawlinson at Bagdad.

I cannot retrace this brilliant period of our Academy's history without a shade of melancholy feeling clouding the retrospect. MacCullagh, Hamilton, Lloyd, Todd, Petrie, Wilde, Stokes, Kane, Jellett, Ferguson, and Reeves—all were known to me, and some of them were my beloved friends—I have seen them one by one pass away. Of our habitual contributors, there now remain, I think, but two who continue amongst us the traditions of the great period—Graves, who was a worthy fellow-worker with the foremost amongst those whom I have named, and who in both sides of the Academy's labours exhibited a power and a fertility which are yet unexhausted—and my contemporary, Haughton, who having won distinction at an unusually early age in this body and elsewhere, and having afterwards done some of the best and most original work which appears in our *Transactions*, retains all the versatility and keenness of research that marked him from the first.

When we arrive at the years which, beginning about the middle of the century, and continued to the present, form the third period in the life of the Academy, though I can truly say that they have been filled with excellent work, it becomes less fitting to enumerate and characterize the contributions of individuals. Selection would often be invidious, and it would be presumption in me to criticise labours on which Time has not yet pronounced its verdict. But there are a few names of members who have been removed by death, or transferred to other spheres of activity, which, on account of their memorable services to the Academy, I cannot omit. I refer to Casey, Hennessy, Macalister, and Ball—the first one of our ablest geometers, the second an excellent and thoroughly trained Irish scholar, the third a distinguished biologist, whom Cambridge, to her great gain, took from us some years since, and the last a mathematician and astronomer of the highest rank, who, quite recently leaving this country for the same University, has divided our minds between regret for his loss and gratification at his attaining a position of wider influence and usefulness.

But though I cannot dwell on the work of individuals, I must speak of what has been done by the Academy in its collective or corporate capacity during this third period of its existence—going back earlier when necessary, to explain the nature of the several enterprises it has undertaken.

And first I will mention the formation of its Museum. This object the Academy had proposed to itself almost from its beginning, and donations of antiquities occur in our very early records. But the collection remained in a rudimentary state till the 24th June, 1839. On that day Professor Mac Cullagh presented the beautiful ecclesiastical relic known as the Cross of Cong, which he had acquired at the cost of £100. At the same meeting there were also presented two fine gold torques which had been discovered at Tara thirty years before, had afterwards gone to England, and, having travelled back, were purchased by subscription. It is plain, from the words of Mac Cullagh on the occasion, that the effective commencement of our collection may be dated from those gifts, for he expressed the hope that they would form the nucleus of the *future* National Museum. Since then, many valuable collections, brought together by private persons, have been obtained, sometimes by grants from the funds of the Academy, or special subscriptions amongst the members, and sometimes by the liberality of the Government.

The Underwood, Sirr, Murray, and Ray collections were bought by the Academy, which also made frequent grants for the purchase of special objects, as, for example £500 for the bell and bell-shrine of St. Patrick. The precious Dawson collection was acquired by public subscription. The Shannon Commissioners presented a number of bronze and iron weapons and utensils discovered in their operations; the Government purchased for us the Petrie and the Aquila Smith collections; and by the privilege conferred upon us of administering the Treasure Trove Fund, we obtained the beautiful chalice and other objects found at Ardagh. The Museum thus formed is generally admitted to be amongst the foremost national collections in the world. It has been, as you are aware, given over to the keeping of Government for public exhibition, but remains, according to the terms of transfer, in the care and management of the Academy.

The value of our Museum for purposes of study was greatly increased by Sir William Wilde's Catalogue, which it is much to be regretted he left unfinished. It is to be hoped that the Government will take early steps for its completion, entrusting its several portions to the most competent hands.

The ultimate fruit of this collection ought to be a well supported history of the progress of Irish art, especially in the department of metal-work, from the remains of what is called the late Celtic period to the highest examples of Christian art in the 10th and 11th centuries, after which its native character is found very much to disappear. No doubt, the fact that many of our art objects are undated presents a difficulty; but I believe that the study of the characteristic ornament of each epoch, compared with the continental types, will ultimately enable such a history to be constructed.

It was natural that a body which had studied the architectural monuments of the country should be anxious for their preservation. How grievously they were not merely neglected, but violated, in past times is too well known. Petrie used to relate that, when he first visited Clonmacnois, he found the stile that led into the cemetery made up of inscribed stones. And when he saw the prehistoric structures in Aran in 1857, he wrote—"Alas, that from the want of a protecting hand, these singularly interesting remains should be doomed to utter ruin. The Duns or Cahers are now only vestiges of the monuments which astonished me by their barbaric grandeur on my visit to those islands in 1822, and it made me melancholy to see the devastation which unthinking men, and not the elements, had made in a few years."[1] The Academy, desirous of providing for our ancient buildings the protection they so much needed, when the Irish Church Act of 1869 afforded an opportunity, urged on the Government, through their then President, Lord Talbot de Malahide, the propriety of taking steps for the purpose, and made suggestions as to the work to be done. These representations were carried into effect, so far as the nature of the Act permitted. Again, in 1882, when Sir John Lubbock brought in his bill for the preservation of national monuments, the Academy strongly supported him, and furnished a list of the monuments which ought to be protected; and further lists have been supplied on more than one occasion since. So far as I have been able to learn, the Board of Public Works has rightly interpreted its duty under these enactments, and its architect, Sir Thomas Deane, has followed the sound practice of doing only what is necessary for the preservation of the monuments, without aiming at their so-called restoration.

By a similar combination of public grants with private action, to that which took place in the case of the Museum, our Library was formed. Not later than 1788 the "Book of Ballymote" was presented by the Chevalier O'Gorman, and other donations were made by individuals from time to time. The Hodges and Smith collection was acquired through a grant of £600 from the Government of Sir Robert Peel, given on condition of the amount necessary for the purchase being made up by the Academy. The collection of Sir William Betham was acquired by public subscription. The Hudson collection was bequeathed by its owner. The poet Moore's Library was given by his widow, and the vast collection of pamphlets and books relating to Irish history, made by Mr. Charles Haliday, was, after his decease, in fulfilment of his known wish, presented by Mrs. Haliday. The Lords of the Treasury, when the Ashburnham MSS. became the property of the nation, agreed to deposit in our custody such of them as related to Ireland. The volumes containing the topographical, statistical, and antiquarian materials collected in the course of the Ordnance Survey, but not published, were, on a memorial being addressed to the Lord Lieutenant, transferred into the keeping of the Academy, and every facility, so far as is consistent with their safety, is afforded here to

[1] Stokes' "Life of Petrie," pp vii. and 381.

persons desirous of consulting them. Our Library is further increased by exchanges of our *Transactions* for those of more than 320 other learned bodies, and we are thus kept in touch with Scientific progress throughout the civilized world.

It was felt that the important Gaelic MSS. which are among the treasures of the Library, ought not merely to be preserved in the Academy, but that in the interests of Irish philology they ought to be published, so as to make them accessible for purposes of study, not merely to home, but also to English and foreign, scholars. And accordingly, by the patient and faithful labour of Joseph O'Longan, a worthy successor of the celebrated ancient scribes of Ireland, accurate transcripts were made and were printed in fac-simile. We began with what is called the Leabhar-na-hUidhre, or Book of the Dun Cow, the oldest volume now known which is entirely in the Irish Language; we then similarly issued the Leabhar Breac, or Speckled Book; and afterwards the "Book of Leinster" (Trinity College, to which this last belongs, placing it at our disposal, and bearing half the cost of its publication). The death of Mr. O'Longan made it necessary to relinquish the method of transcription, and in bringing out the "Book of Ballymote," we resorted to photo-lithography, which has also been employed in the case of the "Yellow Book of Lecan," which is nearly ready for issue. These books contain the great bulk of the most important existing materials for the study of ancient Irish legend and history. They do not indeed exhibit the oldest form of the Irish language of which we have any knowledge—*that* is represented in the ancient glosses in Continental Libraries, which were used by Zeuss, and have been edited by Stokes, Ascoli, and Nigra. The books of which I have spoken are of dates varying from the twelfth to the fifteenth century, and are in what is called Middle Irish. But it is certain that much of the matter contained in them is of far earlier date, though the copyists have altered the words and forms of the language so as to adapt them to the usage of their own time.

These books, it will be understood, are not continuous treatises—they each include a great number of pieces, historical, poetical, genealogical, medical, grammatical; and many portions of them, through the reproductions which the Academy has published, have been studied, critically edited, and translated, by Dr. Whitley Stokes, Windisch, Zimmer, Kuno Meyer, and others. The successive holders of the

Irish Professorship which we have founded in our body in commemoration of our former President, Dr. Todd, have already taken part in this work, and we may expect that they and their successors will gradually edit and translate a large part of the literature which our manuscripts contain.

That literature, besides much poetry, which is on all hands admitted to have been singularly ingenious and elaborate in its metrical structure, comprised a very large number of prose tales relating warlike adventures, voyages, tragic events, visions, and the like; many of these are still extant, and a considerable number have been translated or paraphrased, so that, though the renderings are sometimes unfortunate in point of style, an English reader can form a tolerable idea of their merit as works of imagination. As to this merit, the most opposite opinions have been expressed. Some have represented them as devoid of all value or interest; others have spoken of them as a literature of the first order, and have almost implied that the Irish intellect of the present day would find its best possible culture in their study. The truth, as usual, lies between these extreme views. We possess in Irish no work of genius comparable to the Nibelungen Lied, or the Song of Roland. To speak of the Táin Bó Cuailnge as a Gaelic Iliad seems to me—to say the least—an imprudent comparison. But, without any great continuous composition, there are in the remains which have come down to us passages of much beauty and tenderness; some of the tales are impressively and touchingly told, and there is one singular relic—the Vision of Mac Conglinne,[1] which is instinct with genuine humour of the Rabelaisian type. But, apart from the literary merit of these pieces, they are highly important from two different points of view: 1, as specimens of the language in its flourishing period; and 2, as documents throwing light on the institutions, customs, and modes of thought of the Irish race.

When translated, they have an additional value which we must not overlook, as supplying subjects or hints for the poet or imaginative writer of our own time. However interesting to scholars in their

[1] Translated by W. M. Hennessy in *Frazer's Magazine* for September, 1873. The Gaelic text has been edited, with a translation based on Hennessy's, and much illustrative matter, by Kuno Meyer (D. Nutt, 1892).

original form, I do not think these tales will ever win their way to general esteem among cultivated readers, except as transmuted into shapes better adapted to our ideas, and with a certain breath of modern thought and feeling subtly mingled with their substance. We all know the admirable use which Tennyson has made of Malory's Morte Arthur, and of Lady Charlotte Guest's translation of the Mabinogion; and there are many instances of a similar happy employment of narratives in the old Irish literature by Aubrey de Vere, Clarence Mangan, Denis Florence Mac Carthy, and, above all, by Sir Samuel Ferguson. His Epic of Congal is founded on the story of the Battle of Magh Rath, his noble poem of Conary on the tale of the Bruidin da Derga, his Deirdre on that of the Sons of Usnach; and many of his shorter poems were suggested by notices in the Annals, as for example his Burial of Cormac, his Aideen's Grave, and his splendid version of the barbaric legend of the Welshmen of Tirawley. Tennyson himself found in one of our Irish originals the materials from which, by skilful selection, elaboration, and development he constructed his Voyage of Maildune.

And now let us turn from retrospect to prospect—and, without forgetting the things that are behind, let us look forward to those that are before. Let us contemplate the tasks which lie before us in the immediate or early future. And first, in relation to Science, I will say that whilst I hope the old reputation of the Academy for distinction in the study of Mathematics will be maintained, I am most desirous that during my term of office the newer branches of research should be earnestly prosecuted among us. I refer particularly to the most recent lines of inquiry in the Physico-Chemical sciences, and in Biology. In this last province I trust that the important communications lately made to us on the development of the Cerebrum will be followed up by their distinguished author. In the other side of our labours, I look with confidence for the achievement of much excellent work. I expect that the ancient classics, Modern European, and Oriental literature will all be worthily cultivated here. In Greek and Latin studies, and in Comparative Linguistics we shall, I believe, obtain most valuable aid from the Classical School of Trinity College, which is now more flourishing and productive than at any former time. A foretaste of what it can do for us has been recently afforded in the admirable decipherments and explanations of the "Flinders Petrie Papyri," which have been laid before us and published in our *Transactions.* But, whilst I claim for the Academy the widest possible range in the study of Philology and Archæology, I would insist on the fact that, as the principal Society in this country occupied with the higher learning, we must act in the spirit of the precept "Spartam nactus es: hanc exorna" —we must be, in the best sense of the word, National. The duty lies upon us of continuing in the future the investigation of the ancient monuments, the history, and the Celtic language and literature of our own country, which has reflected so much honour on us in the past.

In Archæology proper, we need, I think, to develope an increased and, at the same time, an enlightened activity. The preservation of National Monuments is justly considered to be the duty of the State; and, as I have said, the Academy on several occasions, when circumstances seemed to afford an opening, has pressed this duty on the Government. But there is what may really be regarded as a form of preservation which as naturally belongs to Archæologists, namely, the perpetuation, for purposes of study, of the forms, dimensions and decorations of the monuments by photography, which is superior for this purpose to any sketch, together with a descriptive record. This has been done to a large extent with respect to the Pagan forts and to churches, as may be seen in Miss Stokes's admirable series in the Museum of Science and Art; but I think all our remains should be treated in the way I have mentioned. Only 16 out of 76 Round Towers were illustrated by Lord Dunraven, and about 20 out of a very large number of sculptured crosses by O'Neil. Every round tower and cross, every cromleac, every pillar-stone or circle of stones, should be photographed and its situation and measurements recorded; and we should thus be protected against the worst results of time and vandalism. We ought also to push forward the exploration of our ancient sepulchres, already well begun, and perhaps of some of our historic sites—only, however, under the superintendence of competent Antiquaries. And in all these operations we ought to keep ourselves in touch with those who, in Great Britain and Continental countries, are engaged in similar researches, and study carefully their methods and their results.

Separate maps, too, should be made, giving the localities of each species of monument, and these should not, in every case, be restricted to Irish remains. It was long since pointed out that, if a map of Europe and Asia were constructed, showing the exact places where cromlechs were found to exist, the mere inspection of it might indicate, if not the ethnological affinities of our people, at least the track which the builders of those monuments followed in reaching our island, and their distribution within it.

With respect to the study of our early history, as extracted from the annalists and hagiographers, I will only say that what we most require is, in my opinion, an increased application of the critical spirit. We have often in the past too readily assumed the truth of any statement found, as the phrase is, "in one of our old books," without examining the trustworthiness and the sources of knowledge of each authority. To take an example—in O'Curry's "Manners and Customs of the Ancient Irish," there is abundant learning—a wealth of quotation from the Chronicles—but in criticism it falls, I think, far short of the works of the recent Scottish historians. Criticism, I am aware, is not always popular; O'Donovan told how some of his former friends became hostile to him because he did not believe the whole Milesian legend.[1] But without rigorous and searching criticism we shall never separate what can be proved from what is conjectural—and so we shall never be sure that we are standing on firm ground.

And here I will venture a suggestion which has been often in my thoughts. Our members have worked comparatively little within the Academy on Irish history later than the Anglo-Norman Invasion, though outside of it a good deal has been done by Dr. Gilbert and others, especially in the publication of ancient documents. And yet there are many obscure portions of the record which research and discussion might elucidate. The small number of contributions of the kind here noticed is, no doubt, owing in some degree to the fear of treading—if I may make often quoted words do duty once more—*per ignes suppositos cineri doloso*. If so, I incline to think we have been unnecessarily timid; in any case we appear to me to have now arrived at a stage when, at least, a large part of our history could be handled amongst us with calmness and impartiality, and with the admission that, in relating events, we must

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[1] Stokes' "Life of Petrie," p. 380.

often say "*intra peccatur et extra.*" Few Irish or, I may add, Scottish[1] writers any longer study the periods of Patrick and of Columcille in the old spirit which made them a battle-ground of ecclesiastical parties, and I do not see why in the civil history a similarly elevated point of view should not be reached. All recent historical study has introduced more and more the relative spirit, which regards the past, not from our modern point of view, but as it was seen by the best contemporary minds. And, instead of fixing attention altogether on a single people to the exclusion of side lights, modern historical research looks farther a-field, and often enables us to palliate the errors and evils of one social system by comparison with the contemporary condition of other countries. The tendency, in fact, of philosophic history is not so much to judge the opinions and systems of our predecessors as to explain them, to give them their proper place in a sequence of cause and effect, and to determine their relation to the social movement as a whole. I will add, in justice to a fellow-member whom we lost at too early an age, that the work of Dr. Richey on Irish History[2] seems to me to conform in a very high degree to these large and tolerant principles.

Lastly, in the department of Philology (taking that word in a wide sense), a task which a pious regard for the memory of Dr. Reeves requires us to accomplish, and on which we have actually entered, is the publication of the "Book of Armagh," as intended by our late President. His profoundly interesting Paper in relation to it, read during his too brief tenure of office, must be fresh in the recollection of most of us. But, for the information of those who did not hear, or have not since read, that account, I will mention the main facts which concern the Book. It is a MS. proved to be of the early years of the ninth century, which consists of three distinct portions: 1st, pieces for the most part in Latin, the rest in Irish, relating to the Life of St. Patrick, along with that most interesting and touching document, the Confession of the saint; 2nd, the Books of the New Testament in Latin, mainly agreeing with the Vulgate, but exhibiting remarkable differences, and with the addition of the apocryphal Epistle

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[1] See Preface to Skene's "Celtic Scotland," vol. ii.

[2] "A Short History of the Irish People down to the date of the Plantation of Ulster," edited by R. R. Kane, LL.D., 1887.

to the Laodiceans; and 3rd, the Life of St. Martin of Tours, by Sulpicius Severus. The editing of the whole has been entrusted to Dr. Gwynn. The biographical matter relating to St. Patrick, though the integrity of the work requires its reproduction, has already been published by the Rev. Edmund Hogan, and by Dr. Whitley Stokes;[1] and the Life of St. Martin presents no special difficulty. But on the Biblical parts of the "Book of Armagh" much labour will have to be expended; the editor will have to record the differences between the text and that of the standard copy of the Vulgate, and also the textual variants from the Irish Gospels of St. Dimma and St. Moling. The Primate, Lord John George Beresford, when Dr. Reeves had secured the book, purchased it from him for the price which he had paid, and presented it to Trinity College; and with noble liberality gave a further sum of £500, now increased by interest, to defray the expenses of publication.

Another task, which has also been in a certain sense bequeathed to us by one of our recent Presidents, is the reproduction of the Ogam inscriptions. Bishop Graves had been, I believe, the first to approach their study in a really scientific manner, and had written a number of papers respecting them, marked by his usual acuteness and sound judgment.[2] Ferguson was deeply interested in these inscriptions, and made them the subject of the Rhind Lectures which he delivered in Edinburgh. He rightly judged that they could not be thoroughly studied until accurate copies were collected in some centre, and having with his own hands taken paper casts of nearly all the examples in Ireland, England, and Wales, he had photographic negatives of them to the number of 163 executed for the Academy under his own superintendence. He then published in our *Transactions* a specimen fasciculus of a proposed Corpus of the inscriptions, in which they were to be represented by these photographs without any attempt at interpretation, but accompanied simply by a statement of the place where they were found and necessary details as to the fracture or weathering of the stones on which they are cut. The strong interest which the Ogams at first excited has, I

[1] *Documenta de S. Patricio ex Libro Armachano* (from the "Analecta Bollandiana"), 1884 and 1889: "Tripartite Life of Patrick, with other documents relating to the Saint" (Rolls Series, 1887).

[2] See especially *Proceedings of the R. I. A.*, vol. iv., pp. 70, 173, and 356.

think, somewhat diminished. Zeuss thought the method of writing which appears in them to be possibly of great antiquity, and Stokes believed there were found in them traces of a very primitive form of Celtic speech: but the tendency of recent research has been to bring them down to a more recent date, and the growing belief that they are often cryptic, that is, designedly obscure, has discouraged inquiry. Still the problem is worthy of a solution, towards which considerable steps have been made, and I think Ferguson's project should be carried out and the whole body of the inscriptions gradually reproduced as he suggested.

But in my opinion, by far the most important work which lies before us is the production and publication of a really satisfactory Dictionary of the Irish Language. At the stage at which scholars have now arrived in the reproduction and study of Irish texts, the task is feasible; many partial glossaries have been compiled and old ones printed; very large collections and transcriptions have been made with a view to the work; and competent labour, duly organized, might now be employed to bring these materials into shape. Only the narrowness of our financial resources is a serious obstacle in the way of its early accomplishment. In my Centenary Address I appealed to the patriotic liberality of leading Irishmen—remarkably exemplified in other directions—for the support of this great and truly national enterprise. I now repeat the invitation. He who responds to it, and enables the Academy promptly to carry out this object, will render a memorable service to learning, and will cover his own name with immortal honour.

Further hints might be thrown out as to lines of action which are open to us. But I have already trespassed too long on your indulgence. I think I have shown that our body has done a good—I will even say a great—work for Ireland, and that much remains to engage the energies of its members in the future. I will conclude by expressing what is my confident expectation, as it is my earnest desire, that the Academy will long continue to be what it has been in the past—a common ground on which Irishmen, otherwise of differing views, may meet as friends, for mutual assistance and encouragement in the pursuit of truth, in the cultivation of letters, and in the illustration of our national memorials.

MONDAY, DECEMBER 12, 1892.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

William P. O'Neill signed the Roll, and was admitted a Member of the Academy.

James Ogilvie, Rev. Eugene O'Growney, and John Vinycomb were elected Members of the Academy.

Dr. Tarleton, F.T.C.D., read a Paper on "A Problem in Vortex Motion."

Prof. A. C. Haddon, M.A., read a Paper by himself and Mr. Charles R. Browne, M.B., "On the Ethnography of the Aran Islands, Co. Galway."

Prof. A. C. Haddon read a Paper, "Studies in Irish Craniology."

The Secretary read a Paper by the Rev. H. Friend "On a New Species of Lumbricus."

Donations to the Library were announced, and thanks were voted to the Donors.

The Secretary of Council moved the following Recommendation from the Council:—

"That it be recommended to the Academy to authorize the opening of a Subscription for the purchase of a Collection of Irish Manuscripts which were in the Library of the late Lord Bishop of Down and Connor and Dromore, President of the Academy."

The Recommendation was adopted, and a subscription list was then opened.

MONDAY, JANUARY 23, 1893.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Dr. V. Ball, C.B., F.R.S., read a Paper "On the Volcanoes and Hot Springs of India from Physical and Ethnological points of view."

Dr. W. Frazer read a Paper "On a Roman Skull from Lincoln, and on the Measurements of Irish Skulls."

By permission of the Academy, Mr. J. P. Johnston, M.A., read a Paper on "Initial Motion."

The President read a Letter from Charles H. Todd, Esq., Q.C., LL.D., presenting to the Academy an Oil Portrait of his brother, the late Rev. James Henthorn Todd, D.D. (President of the Academy, 1856–1861); also a Letter from the Right Rev. Charles Graves, D.D., Lord Bishop of Limerick (President of the Academy, 1861–1866), presenting a Portrait of himself to the Academy.

The Rev. Dr. Haughton, on behalf of a number of Subscribers, presented to the Academy a Portrait of the late Right Rev. William Reeves, D.D., Bishop of Down and Connor and Dromore (President of the Academy, 1891–2).

The Rev. Dr. Salmon, Provost of Trinity College, moved, and Sir John Banks, K.C.B., seconded a vote of thanks to Dr. Charles Todd, to the Right Rev. the Lord Bishop of Limerick, and to the Subscribers.

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, FEBRUARY 13, 1893.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Hugh Allingham; Professor Grenville A. J. Cole, F.G.S.; Rev. Henry Evans, D.D.; Rev. Samuel Hemphill, D.D.; Rev. John P. Mahaffy, D.D., F.T.C.D.; Robert Russell, M.A., F.T.C.D., were elected Members of the Academy.

Sir Thomas N. Deane, R.H.A., read a "Report on Ancient Monuments in County Kerry."

By permission of the Academy Professor Hartog read a Paper "On the Cytology of the Saprophytæ."

Donations to the Library were announced, and thanks were voted to the Donors.

MONDAY, FEBRUARY 27, 1893.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

Professor Grenville A. J. Cole and the Rev. Henry Evans, D.D., signed the Roll, and were admitted Members of the Academy.

Professor J. P. O'Reilly read a Paper "On Captain Cuellar's Narrative of his Adventures in Ireland after the Wreck of the Spanish Armada in 1588–89."

Rev. T. Olden, M.A., read a Paper "On the Burial-place of St. Patrick."

Charles R. Browne, M.D., read a Paper "On some Crania from Tipperary."

The following Science Grant, recommended by the Council, was approved :—

£20 to a Committee consisting of Dr. Scharff, Mr. R. Lloyd Praeger, Mr. A. G. More, Mr. R. M. Barrington, Mr. Greenwood Pim, Mr. H. Dixon, Dr. M'Weeney, Mr. G. H. Carpenter, Professor T. Johnson, and Professor E. P. Wright, to aid them in framing a Report on the present state of our knowledge of the Flora and Fauna of Ireland, and as to what is needed to bring this knowledge up to date.

STATED MEETING.

THURSDAY, MARCH 16, 1893.

DR. J. K. INGRAM, S.F.T.C.D., President, in the Chair.

The Rev. Eugene O'Growney, signed the Roll, and was admitted a Member of the Academy.

Mr. James Brendan and Mr. W. R. Molloy were appointed scrutineers of the Ballots for the Election of President and Council and of Honorary Members.

The Ballot having been opened, the Secretary of Council read the following

Report of the Council for the Year 1892–93.

Since the date of the last Report the following Publications of the Academy have been issued :—

Cunningham Memoirs.

No. vii. "Contribution to the Surface Anatomy of the Cerebral Hemispheres." By D. J. Cunningham, M.D., D.SC., F.R.S.; with "A Chapter upon Cranio-Cerebral Topography," by Victor Horsley, M.B., F.R.S. With eight Plates.

Transactions, vol. xxx.

Part 1. "On the Tumuli and Inscribed Stones at New Grange, Dowth, and Knowth." By George Coffey, A.I.B. Plates I. to VI. and Map.

Part 2. "On an Ogham Inscription supposed to bear an Anglo-Saxon Name." By the Right Rev. Charles Graves, D.D., Lord Bishop of Limerick.

Part 3. "On the Anatomy and Physiology of Protopterus annectens." By W. N. Parker, PH.D. Plates VII. to XVII.

Part 4. "On the Relative Positions of 223 Stars in the Cluster χ Persei as determined Photographically." By Sir Robert Ball, LL.D., F.R.S., and Arthur A. Rambaut, M.A., D.SC. Plate XVIII.

Todd Lecture Series.

Vol. iii. "The Codex Palatino-Vaticanus, No. 830. Texts, Translation, and Index." By the Rev. Dr. B. Mac Carthy.

Vol. iv. "Cath Ruis na Ríg for Bóinn. With Preface, Translation, and Indices; also a Treatise on Irish Neuter Substantives, and a Supplement to the Index Vocabulorum of Zeuss' 'Grammatica Celtica.'" By the Rev. Edmund Hogan, S.J., F.R.U.I.

Of the *Proceedings*, Parts 2 and 3 of the Second Volume of the current Series were published in May and December respectively, and contained Papers on Science in its various branches, Classical Literature, and Antiquities.

The following Grants in aid of the preparation of Scientific Reports have been sanctioned by the Academy :—

£15 to Mr. Joly, to aid him in his Researches on the Volume-change of Rocks in passing from the solid to the liquid state.

£20 to Dr. Scharff, to enable him to continue his Researches into the Origin and Geographical Distribution of the Irish Land and Fresh-water Fauna.

£25 to Dr. W. H. Thompson, to aid him in determining the Course and Cerebral Connexions of certain Cranial Nerves, especially of the Auditory and Vagus.

£10 to Mr. R. Lloyd Praeger, to assist him in his Investigations concerning the Raised Beaches of the North Coast of Ireland.

£20 to a Committee consisting of Dr. G. F. Fitz Gerald, F.R.S., and Mr. J. E. Cullum, to assist them in their Magnetical Observations at Cahirsiveen.

£25 to a Committee consisting of Dr. E. P. Wright and Dr. W. N. Parker, to assist the latter in his Researches into the Anatomy of Protopterus annectens.

£15 to a Committee consisting of Mr. G. Coffey and Mr. J. H. Pentland, for the purpose of enabling them to investigate the Loughcrew Cairns.

£20 to a Committee consisting of Dr. Scharff, Mr. R. Lloyd Praeger, Mr. A. G. More, Mr. R. M. Barrington, Mr. Greenwood Pim, Mr. H. Dixon, Dr. M'Weeney, Mr. G. H. Carpenter, Prof. T. Johnson, and Prof. E. P. Wright, to aid them in framing a Report on the present state of our knowledge of the Flora and Fauna of Ireland, and as to what is needed to bring this knowledge up to date.

The following Members have been Elected since 16th March, 1892 :—

Hugh Allingham.
Charles R. Browne, M.B.
Grenville A. J. Cole, F.G.S.
Rev. Henry Evans, D.D.
Rev. Samuel J. Hemphill, D.D.
Rev. John P. Mahaffy, D.D., F.T.C.D.
Rev. Philip O'Doherty, C.C.
Bryan Lewis O'Donnell.

James Ogilvie.
Rev. Eugene O'Growney.
William Patrick O'Neill.
Thomas R. J. Polson.
Arthur Alcock Rambaut, M.A., D.SC.
Robert Russell, M.A., F.T.C.D.
William Joseph Myles Starkie, M.A., F.T.C.D.
Ven. Andrew Tait, D.D., LL.D., F.R.S.E.
John Vinycomb.
Laurence A. Waldron.

We have lost by death, within the year, nine Members :—

W. Oliver Barker, M.D , elected January 13, 1868.
Henry Burden, M.D., elected February 9, 1874.
Sir J. Bernard Burke, C.B., LL.D., elected April 10, 1854.
William Sidney Cox, C.E., elected February 13, 1882.
Harry Napier Draper, F.C.S., elected June 26, 1876.
William Vallancey Drury, M.D., elected January 9, 1843.
Richard John Mahony, D.L., elected April 10, 1882.
George Porte, elected April 14, 1862.
Richard Palmer Williams, elected January 14, 1839.

We have also lost by death one Honorary Member in the Section of Science :—

August Wilhelm von Hofmann, F.R.S., elected March 15, 1873.

And one Honorary Member in the Section of Polite Literature and Antiquities :—

John Obadiah Westwood, F.S.A.

The Committee appointed for the purpose made their Visitation of the Academy's Collection of Irish Antiquities, now in the Museum of Science and Art, Dublin, on February 15, 1893, and have given in their Report on the condition and arrangements for exhibition of the Collection. They state that the arrangement of the objects, as carried out so far, is very satisfactory. A considerable proportion of the objects which, when in the Academy House, could be seen only on one side, are now visible all round, which of course is a great advantage in every case; but, as regards such objects as the Cross of Cong, shrines, croziers, &c., is a matter of much importance. The mounting such articles as shrines, bells, &c., on separate stands, made specially for each, is a very great improvement, and displays them in a manner more in accordance with the individual importance and interest which they possess. Some cases are filled with bronze celts, spear-heads, and swords mounted on staves and handles, which enables the spectator to realize better the character and use of those weapons. Printed descriptive labels have been attached to a large proportion of the objects exhibited. This work, which is of great importance, is still progressing.

The inner square room allotted to the Academy's Collection, or north-west pavilion, is still unavoidably used, partly for the storage of objects not yet displayed and partly for carrying on in it various operations connected with the arrangement of the Museum, and is not at present open to the public.

In the Crypt there are many large objects of stone, wood, &c., which, though not yet accessible to the general public, can always be seen by students who specially desire to examine them. The Ogham stones are as well displayed as circumstances will permit. They have been placed beside the windows, with their legends turned towards the spectator.

Of the *Annals of Ulster* there have been printed off 376 pages of Vol. II., and there is no reason to anticipate any unreasonable delay in the speedy completion of this volume.

The *Yellow Book of Lecan* is not yet ready, but 388 pages are now printed off, and it is fully expected that the work will be completed by the summer.

In the Todd Lecture Series, Rev. Edmund Hogan has completed the publication of his first series of lectures for the first year, and the second series will be delivered during the incoming season.

Through the liberality of some Members of the Academy we have been able to secure for our Library, by purchase, thirty-two manuscripts in the Irish language, of the seventeenth and eighteenth centuries, formerly in the possession of the Right Rev. Dr. Reeves, Bishop of Down and Connor, and they will form an important addition to the valuable collection already in the Library of the Academy.

To render fully available to students of science and literature the large collection of publications of learned societies and institutions, and periodicals from all parts of the world in the Academy's Library, a classified catalogue has been prepared, under direction of the Librarian, and can now be consulted at all times.

The Council having had under consideration a letter written by Col. Kirkwood, R.E., Commandant of the Irish Branch of the Ordnance Survey, in reference to the desirability of securing all available information for the re-survey of Ireland now going on in certain counties, have, with his permission, printed his letter, which will be transmitted to the Members of the Academy, with the hope that such Members as have definite information on the sites, &c., of old remains will aid, to the best of their ability, the efforts now being made to secure, as far as is possible, accuracy and completeness in the re-survey.

The following is the letter referred to:—

"Ordnance Survey Office,
"Phœnix Park, Dublin,
"20*th December*, 1892.

"Dear Sir,

"As you are no doubt aware, it was decided a few years ago to revise the Ordnance Survey Maps of Ireland, and to publish the work on a very much larger scale than had been hitherto adopted. This amounts practically to a re-survey of the whole of Ireland on a large scale, with the exception of mountainous or uncultivated districts.

"It therefore offers an exceptional opportunity of correcting, revising, or adding such information connected with antiquities or sites of antiquities as can be given on the maps.

"The original survey of Ireland was made between the years 1829 and 1842, the resulting plans having been published on a scale of six inches to a mile. At the time that survey was being carried out very great care was taken to identify and name all antiquities or sites of antiquities which were then known or could be traced.

"I need hardly remind you that the work was then under the direction of an officer, who was also a not undistinguished member of your Society—I refer to Captain, afterwards Sir Thomas, Larcom;—and that no trouble was spared either by him or by his chief, Colonel Colby, to carefully carry it out. It is also almost superfluous to mention that the names and antiquities having been studied and considered by such men as O'Donovan, Curry, Petrie, together with other skilled Irish scholars, everything possible was done to ensure a result which, I believe, has ever since met with almost universal approbation.

"But since that time a period of over half a century has elapsed, and much has been done by your own and other learned Societies to trace the ancient history of Ireland, to inquire into its antiquities, to localize the sites of antiquarian or historical interest, and generally to clear up much that then only existed in the shape of tradition or was but very imperfectly known.

"The new survey, for such it is practically, is now being published on a scale of $\frac{1}{2500}$, or approximately 25 inches to a mile, the area of each of the old six-inch sheets being shown on sixteen of the new $\frac{1}{2500}$ scale maps.

"This scale admits of all objects being shown with great minuteness and accuracy, and as it would evidently be of great public interest that such sites as I have alluded to should appear on these maps as completely and correctly as possible, I venture to appeal to your Council, and through that body to the Members of the Royal Irish Academy, to assist the officers of the Ordnance Survey Department in carrying this out.

"I do not propose to inquire afresh into those sites or the names of those antiquities which already appear on our six-inch maps, and which were most carefully gone into when the original survey was made, unless, indeed, any palpable error which may possibly have passed unnoticed should be detected; but I propose to limit our inquiries to such names or sites as may have previously been omitted, but which might advantageously now be given.

"The antiquities which I may specially refer to, and which if well authenticated should be shown on our maps, are such as—ancient earthworks, particularly those which can be identified by name; standing stones, or so called druidical circles; sites of battles, old castles, halls, manor-houses, abbeys or priories, crosses, round towers, moats, tumuli, and sites of antiquities, including places where objects of antiquarian interest such as ancient coins, pottery, &c., have been found.

"Occasionally, also, it may occur that a site of an ancient building of antiquarian interest has been overlooked from a more modern building having been erected over it; this, if known, I should be glad to have pointed out, in order that the original occupation of the site may be indicated.

"Again, throughout Ireland numerous mounds appear on the six-inch map, simply with the name of "Fort." Many of these, I have reason to believe, were really tumuli, whilst others appear to have been comparatively recently formed for herding or other purposes. I therefore propose to omit the name of "Fort" in future on the maps, unless they can actually be identified as such, or their correct Irish names can be given.

"Any assistance, therefore, in identifying these "forts," either as tumuli or by their correct designation, would be of the greatest value.

"I should add, that the new survey is now being carried out in the following counties, viz. :—

> "Galway, commencing with the Eastern half.
> "Mayo, commencing with the South-East part.
> "Clare, commencing with the Eastern half.
> "Kerry, commencing with the district immediately South of Tralee, and including the Dingle promontory.

"Information respecting such points as I have mentioned throughout these districts, and subsequently throughout the remainder of these counties, would therefore, at the present time, be of the very greatest use.

"I am sure the Members of your Council will recognize the advantages of having any such known sites properly and accurately identified and marked on the maps of the Ordnance Survey, in order, at least, that there may be no possibility of the labours of those who have ascertained such sites being lost.

"I trust, therefore, that they will accept my apologies for any trouble they may be given in this matter, and will also accept my thanks in advance for any assistance they may be able to give the officers of the Ordnance Survey Department in their interesting inquiries.

"Believe me,

"Yours faithfully,

"Hendley Kirkwood, Lieut.-Col. R.E.

"*To* The Secretary,

"Royal Irish Academy,

"Dawson-street."

The Council have also received a number of letters from the Board of Works, requesting the advice of the Council as to the insertion, under the provisions of the Act 55 & 56 Vict. c. 46, of the names of certain Irish monuments on the schedule of those proposed to be placed under the care of the Board of Works. To these letters the Council have given careful consideration, and have recommended that the following structures be placed on the Schedule :—

Sligo Abbey,	Co. Sligo.
Abbey Knockmoy,	Co. Galway.
Bective,	Co. Meath.
Roscommon Abbey and Castle,	Co. Roscommon.
Fore Abbey,	Co. Westmeath.
Ballintubber Castle,	Co. Roscommon.
Yellow-steeple, Trim,	Co. Meath.
Kinneigh Round Tower,	Co. Cork.
Round Tower of Oughterard,	Co. Kildare.
Cross at Arboe,	Co. Tyrone.
Borrishoole,	Co. Mayo.
Abbey O'Dorney,	Co. Kerry.
Cahershaughnessy,	Co. Clare.
Round Tower of Dromcliffe,	Co. Clare.
Killowen Abbey,	Co. Clare.

The Council think it well to append hereto a very brief statement of the course of legislation bearing on the preservation of ancient monuments in Ireland.

When the Bill for the Disestablishment of the Church of Ireland was under consideration in the House of Commons the President of the Royal Irish Academy, Lord Talbot de Malahide, communicated with

Mr. Gladstone "on behalf of the National Monuments of Ireland" (Council Minutes, 17th May, 1869), and the Committee of Antiquities had been in the previous month requested to prepare a list of such Monuments, which it was "desirable to have placed under the supervision and protection of the Government."

The Irish Church Act (32 & 33 Vict. chap. 42) passed on the 26th July, 1869. Its 25th section dealing with this subject is subjoined:—

(1.) Where any church or ecclesiastical building or structure appears to the Commissioners to be ruinous, or if a church to be wholly disused as a place of public worship, and not suitable for restoration as a place of public worship, and yet to be deserving of being maintained as a national monument by reason of its architectural character or antiquity, the Commissioners shall by order vest such church, building, or structure in the secretary of the Commissioners of Public Works in Ireland, to be held by such secretary, his heir and assigns, upon trust for the Commissioners of Public Works, to be preserved as a national monument, and not to be used as a place of public worship, and the Commissioners shall ascertain and by order declare what sum is in their judgment required for maintaining as national monuments the churches, buildings, and structures so vested, and shall pay such sum accordingly to the said secretary, to be held upon trust for the said Commissioners, and to be applied by them in maintaining the said churches, buildings, and structures.

In pursuance of the above section of the Act, the Commissioners of Irish Church Temporalities, who were appointed by that statute, made several orders, vesting Churches, &c., in the Secretary of the Board of Works, and finally, for the purpose of amending and consolidating said orders, and to extend same, they made an order, dated "Saturday the 30th day of October, 1880," enumerating the structures, so vested, and ordering that the £50,000 paid to the Secretary of the Board of Works should be applied in maintaining them.

This Order and the Schedule of Structures will be found at pp. 134–40 of the Appendix to the (final) "Report of the Commissioners of Church Temporalties in Ireland for the period 1869-80," forming Appendix No. 10 therein.

The list contains 169 entries of structures, situated in 152 townlands and included in 137 parishes. They are numbered according to parishes—an arrangement which may mislead a careless reader as to the total number of structures affected by the Act. These parishes are again arranged under baronies and counties, the latter being in alphabetical order, and all appearing except Roscommon and Westmeath. The majority of the entries—all in fact but 50—contain more items than one. Some are stated indefinitely in the plural, as for instance, "churches," and some have "&c." appended. Counting such items as the former as at least two, and the latter as one, the total number of objects or structures affected by this order is, at the least, 370.

The most frequently recurring item in the list is "Ruins of Churches." Six cathedrals are included, Ardfert, Aghadoe, Cashel, and Kilfenora, with Ardmore and Trim, so-called. Chapels figure three times, Oratories twice. There is one Hermitage. The Round Towers included (taken chiefly from the list supplied by the Academy), number 32. Crosses number 38 and Stones 3 (one being Ogham), 23 Abbeys, 14 Monasteries, and 1 Friary are named. Of buildings of a more secular character there appear 4 Castles, 3 Cashels, 9 Forts, (chiefly of the Aran group). A Mound, a Monument, a Well, a Gateway, a Burial-ground, a Tomb, and a Pillar are each once named. Two structures are styled indefinitely "buildings," and St. Columb's House at Kells is included. This classification may be useful in view of the provisions of the Act of this year (1892) to be presently noticed.

The structures were taken charge of by the Board of Works, and an Inspector appointed to carry out such work of maintenance as might be required, and the annual Reports of the Board include notices of the action taken respecting such structures.

The intention of the Commissioners appears to have been to include in this schedule as large a number of antiquarian objects as they reasonably could, and to interpret the Act liberally. Indeed, it may be doubted, whether some of the buildings included were ruins in the ordinary sense of that term, and may be questioned whether some did not belong to private owners, and not to the Disestablished Church.

In the case of the "Rock of Cashel," the land adjacent to it was vested with it.

Almost simultaneously with the passing of the Irish Church Act, the necessity of affording protection to National Monuments throughout the United Kingdom engaged attention in England, and was the subject of a statement by the First Commissioner of Works in the House of Commons. Soon after Sir John Lubbock introduced a Bill into Parliament, applicable to the whole of the United Kingdom, having previously consulted the Royal Irish Academy as to the nature of the desired enactment, and the Monuments to be scheduled for Ireland.

The Bill in a much modified form, and after the lapse of nearly ten years, became law in 1882 (45 & 46 Vict. c. 73). It provided for the Commissioners of Works acquiring and maintaining certain monuments, and made the injury or defacement thereof an offence punishable by law. The 10th section made provision for additional monuments being scheduled from time to time by order in Council, and a list of seven Irish monuments so added in June, 1890—four being round towers—is included in the Report of the Board of Works.

The expenses of carrying out the Act were to be defrayed from funds to be voted by Parliament, and the Treasury were to appoint one or more Inspectors of Ancient Monuments.

The schedule appended to this Act includes in all 68 monuments, arranged according to counties in alphabetical order, the names of parishes being added, and in Ireland baronies also. Of these there are 29 in 13 counties of England and Wales, 21 in 12 counties of Scotland, and 18 in 9 counties in Ireland, or rather in 10, as the Greenmount Tumulus is in Louth, not Kerry.

The latter are chiefly earthen mounds and enclosures, involving no considerable outlay. There are also stone structures, such as Staigue Fort and New Grange, but mediæval buildings are not included, and the schedule includes neither churches nor castles.

After an interval of ten years a short amending Act (55 & 56 Vict. c. 46) has been passed in the last session of Parliament, which extends only to Ireland. It enables the Board of Works, at the request of the owner of any ancient or mediæval structure, erection, or monument, the preservation of which is a matter of public interest, by reason of historic, traditional, or artistic interest attaching thereto, to become guardians thereof, as if scheduled in the previous Act.

It also enables them to apply "any surplus income" from the

£50,000 paid to them from the funds of the Disestablished Church towards the maintenance of any structures entrusted to their guardianship, of the character described in the 25th section of the Irish Church Act.

They have therefore the power of bringing within the Ancient Monuments Act of 1882, with the consent of the owner, any such structure as they consider suitable, but as regards monetary provision therefor, they are to look to any surplus there may be from the Church fund, and no reference is directly made as to Parliamentary provision of funds under the "Lubbock Act" if such surplus prove inadequate.

Such is the scope and operation of the existing legislation on the subject. It rests with the Board of Works to obtain the requisite consent of owners.

The Report was adopted.

Visitors were admitted, and by permission of the Academy Professor A. C. Haddon, M.A., read a Paper on "Art and Ornament in British New Guinea."

Visitors having withdrawn, on the Report of the Scrutineers, the President declared the following elected as President and Council for the ensuing year :—

PRESIDENT.

JOHN KELLS INGRAM, LL.D., S.F.T.C.D.

COUNCIL.

Committee of Science.

Edward Perceval Wright, M.D.
V. Ball, LL.D., F.R.S., C.B.
F. A. Tarleton, LL.D.
Daniel J. Cunningham, M.D., F.R.S.
Benjamin Williamson, D.SC., F.R.S.
J. P. O'Reilly, C.E.
George L. Cathcart, M.A.
George Henry Kinahan, C.E.
Rev. Samuel Haughton, M.D., F.R.S.
W. J. Sollas, D.SC., F.R.S.
Robert F. Scharff, B.SC., PH.D.

Committee of Polite Literature and Antiquities.

Robert Atkinson, LL.D.
Rev. Maxwell H. Close, M.A.
Right Hon. Sir Patrick J. Keenan, C.B., K.C.M.G., LL.D.
P. W. Joyce, LL.D.
John R. Garstin, M.A., F.S.A.
John T. Gilbert, LL.D., F.S.A.
William Frazer, F.R.C.S.I.
Rev. Denis Murphy, S.J.
L. C. Purser, M.A., LITT. D.
Most Rev. Bishop Donnelly, D.D.

The Ballot was then opened for the Election of Officers. Mr. Hamilton Bell, and Dr. C. R. Browne were appointed Scrutineers.

The following were declared elected as Honorary Members :—

In the Section of Science.

George H. Darwin, Cambridge.
Baron Ferd. von Richthofen, Berlin.
Edward Strasburger, Bonn.

In the Section of Polite Literature and Antiquities.

Karl Brugmann, Leipzig.
Emil Hübner, Berlin.
Robert Munro, Edinburgh.

The President, under his hand and seal, appointed the following Vice-Presidents for the coming year :—

Rev. Samuel Haughton, M.D., F.R.S.
John R. Garstin, M.A., F.S.A.
Right Hon. Sir Patrick Keenan, C.B., K.C.M.G., LL.D.
Daniel J. Cunningham, M.D., F.R.S.

On the Report of the Scrutineers, the President declared the following elected as Officers for the ensuing year :—

TREASURER—Rev. M. H. Close, M.A.
SECRETARY—Edward Perceval Wright, M.D.
SECRETARY OF THE COUNCIL—Robert Atkinson, LL.D.
SECRETARY OF FOREIGN CORRESPONDENCE.—Joseph P. O'Reilly, C.E.
LIBRARIAN—John T. Gilbert, LL.D.
CLERK OF THE ACADEMY—Robert Macalister, LL.B.

Donations to the Library were announced, and thanks voted to the Donors.

The Academy adjourned.