44. The Classification and Phylogeny of the Calcareous Sponges, with a Reference List of all the described Species, systematically arranged.

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(Text-figure 133.)

"Le groupe ne se définira plus par la possession de certains charactères, mais par sa tendance à les accentuer."—*Bergson.*

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INTRODUCTION.

The first Calcareous sponges, "*Spongia ciliata*" and "*Spongia compressa*," were described in 1780 by Fabricius, but it was not until much later that the essential differences between the Calcareous and Non-calcareous Sponges were recognised. Fleming, in 1828, however, proposed the genus *Grantia* for the former group, including in it all the forms whose skeleton consisted of calcium carbonate. (Risso's earlier genus, *Sycon*, and Gray's *Scypha* were diagnosed differently.)

The next important advance in the history of the group was the erection of the genus *Leucosolenia* by Bowerbank in 1866, for certain sponges which we now include in the Homocœlidæ, in addition to other genera no longer employed. From that time forward numerous investigators studied the group, and many new species and several new genera were described, but no really serious attempt to deal with the question of the classification of these sponges was made until the time of Haeckel, who in 1870 published his 'Prodromus,' and in 1872 his famous Monograph of the group, with extremely detailed, though somewhat unsuccessful descriptions of all the then known species, including many which he described for the first time. Haeckel's so-called "natural" system, with its three families of Ascones, Leucones, and Sycones, based upon the type of canal system, and its twenty-one genera based upon the types of spicules present, is so well known, and has been so often criticised, that it needs no further description by us, especially as it proved extremely artificial, and expressed only to a very limited extent the true phylogeny of the group.

The scheme proposed by Poléjaeff in 1883 was considerably more successful, and his primary division of the group into Homocœla and Heterocœla has been made the basis of almost every classification since proposed. We are now beginning to realise, however, that this division also is of a very arbitrary character.

The next scheme of classification we need notice is that of Vosmaer, in Bronn's 'Klassen und Ordnungen des Thierreichs' [1887], which is almost identical with that of Poléjaeff, with the addition of the Pharetronidæ as a fourth family of the Heterocœla.

In 1891 von Lendenfeld proposed a modification of Haeckel's system, erecting a fourth family, the Sylleibidæ, intermediate in canal-system between the Leucones and Sycones, and reducing the number of genera in each family to two, according to the presence or absence of oxea. This was undoubtedly a considerable improvement upon Haeckel's system, but again it failed to interpret the interrelationships of the members of the group correctly, and it has since been almost entirely abandoned, though certain spongologists, notably Breitfuss, retained it with but little modification for a considerable time.

During the years 1891–1893 there was published by Dendy [1891 A, 1892 B, 1893 A] a scheme of classification based on almost wholly different lines. Retaining Poléjaeff's Orders Homocœla and Heterocœla, and, like that author, including in a single genus, *Leucosolenia*, all the species of Homocœla, he divided the Heterocœla into five families, whose differentiating characters were based far more on the structure and arrangement of the skeleton than on the canal system; and although this system has not been accepted by all writers, yet we ourselves feel that it embodies a more natural arrangement of the group than any of its predecessors, and we have made it the basis of the classification here proposed.

In 1896 Minchin published a paper entitled "Suggestions for a Natural Classification of the Asconidæ," which may fairly be said to mark a new departure in the taxonomic study of the Calcarea, in that it introduces for the first time the idea of the position of the nucleus in the collared cell as a character of taxonomic importance, a character which has since proved, in our opinion, to be of great value. We have not been able, however, to follow Minchin completely in those modifications of Dendy's classification of the group which he proposed, partly in the paper referred to, and partly in his well-known article in Lankester's 'Text-book of Zoology' [1900].

In 1898 Bidder, in a paper on "The Skeleton and Classification of Calcareous Sponges," proposed to carry out Minchin's ideas with regard to the nucleus of the collared cell to their logical conclusion, and to divide the Calcarea into two great groups accordingly—CALCARONEA and CALCINEA. Although not actually adopting this division, which we consider to be somewhat premature in the present state of our knowledge, we have ourselves followed much the same line of cleavage. Although he accepts to a large extent, with regard to his families, the system proposed by Dendy [1892 B], Bidder makes certain rearrangements which do not appear to be altogether satisfactory. He does good service, however, in indicating for the first time the relationship of Carter's *Clathrina tripodifera*, for which he proposes the genus *Dendya*, to Haeckel's *Leucaltis clathria* (=*Heteropegma nodus-gordii* Poléjaeff). In the same paper he discusses the position of the crystalline optic axis of the radiate spicule systems, and endeavours to assign taxonomic value to this character also, but whatever may be the theoretical value of his conclusions, which have since been accepted by Minchin [1909], we cannot consider that such a character is of any practical use to the systematist.

In 1908 Jenkin erected two new families, the Chiphoridæ and Staurorrhaphidæ, supposed to be differentiated by the presence of what he considered to be a new type of spicule, the "chiactine," from all previously recognised families. The peculiarity of these spicules was believed to consist in the orientation of the various rays both in relation to one another and to the other parts of the skeleton, and a special method of development was suggested for them. Finally, in 1909, one of us (Row) still further elaborated the "Chiact Theory," as it was called, and proposed yet another family, the Grantillidæ, in which more primitive, but similar, "prochiacts" were supposed to be present, and which was made by him the starting-point from which the Heteropiidæ were supposed to have been derived. As we shall show later, however, we do not now think that the spicules in question are more than very slight modifications of ordinary types, and we have abandoned all three families.

It is now more than forty years since any attempt was made at a complete revision of the Calcarea, and in the interval the number of known species has increased from 111, described in Haeckel's 'Kalkschwämme,' to 436 recognised by us at the present time. Having recently been engaged in examining collections of Calcarea of considerable importance and extent, we have had impressed upon us the necessity for a complete systematic catalogue of all the known species, the descriptions of which are scattered through an immense number of separate memoirs. In order to supply this want we have had to go through practically the whole of the literature of the group, and there is not a paper, to the best of our belief, which contains a reference to a new species which we have not seen. It is with considerable satisfaction that we find, as a result of this work, that the scheme of classification proposed by one of us twenty years ago [Dendy, 1892 B] is still applicable in its essential respects, and requires comparatively little revision in order to bring it up to date.

In the present memoir we propose to give diagnoses of all the families and genera employed, and to enumerate all the known species under the genera to which we assign them. We have decided to confine ourselves to the consideration of living forms, since our knowledge of fossil sponges is at present so unsatisfactory, and the number of described species so great.

We have had access, during the course of our work, to a large amount of material, comprising a large proportion of the known species. This has consisted chiefly of the collections in the Natural History Department of the British Museum, a large collection brought by one of us from Australia (see Dendy [1891 A and 1892 B]); the collections made by Mr. Cyril Crossland in the Red Sea (see Row [1909]), Zanzibar (see Jenkin [1908 A]), and Cape Verde (see Thacker [1908]); a collection made by the 'Sealark' Expedition in the Indian Ocean (see Dendy [1913]); and the magnificent collection made by the Hamburg South-Western Australian Expedition in 1905 (see Row [1913 MS.]). In addition, one of us (Row) visited Berlin and Jena in 1912, and obtained valuable information from the study of type specimens at those places.

With regard to the difficult question of synonymy, and the limits which should be assigned to each species, we have, nevertheless, been obliged to rely in most cases upon the published descriptions and determinations of the authors responsible, and we have unfortunately found that these descriptions are frequently very inadequate; while even where they are more complete, the fact that they have been prepared from the point of view of a different scheme of classification has sometimes made them difficult to use. We have, however, assumed that all descriptions are correct, except in cases where they have been shown by subsequent authors, from an investigation of type specimens, to be erroneous. Further, we have felt that we could not, merely on the basis of these published descriptions, undertake the responsibility of determining whether or not a species described as new by its author should more properly have been allocated to a previously known species. Thus we have proceeded on the principle that all species described as new must be considered to be distinct, unless they have been proved to belong to a previously known species by the subsequent reinvestigation of type specimens or otherwise. We have only given such synonyms and references as seem absolutely necessary, but where one species has been merged in another by any authority, and this result accepted by us, we give the synonym and the appropriate authority under the species in which it is now placed.

It is thus highly probable that, of the 436 species which we enumerate, a considerable proportion will ultimately prove to be identical with one another. This question, however, can only be decided by a very thorough study of the specific characters and range of variation in each case, probably necessitating in many cases a reinvestigation and comparison of the original types. Professor Minchin, in his paper on "The Characters and Synonymy of the British Species of Sponges of the genus *Leucosolenia*" [1905], has set a good example of the manner in which this critical revision of the group ought to be carried out.

We have, as a general rule, taken no notice of varieties as distinct from species, but certain of Haeckel's so-called "Specific Varieties," to which he has already given distinctive names, appear to us, after careful consideration of his descriptions, to deserve to rank as separate species.

In the preparation of this paper we have throughout borne in mind the requirements of the systematist, and it is hoped that its publication will greatly assist the determination and arrangement of species in the future. We have had to set aside a great number of published generic names as synonyms, but it is hoped that the appended list will enable the student to trace them in the present system.

We have indicated in the list of species under each genus that species which we recognise as the type, our method of procedure being to take, in the case of old genera, that species, of those which we assign to the genus, to which the name of the genus was first applied, while in the case of new genera we have chosen as our type the species which seems to exemplify best the special characters on which we have founded the genus.

As the publication committee of the Zoological Society has decided against the use of brackets around the names of authors of species in all cases, it must be understood that the authors cited are responsible for the specific but not necessarily for the generic names employed by us.

PRINCIPLES OF CLASSIFICATION.

It appears to us that the chief point to be borne in mind in attempting to arrive at any natural system of classification is the importance of utilising as many characters as possible. A classification based upon a small number of characters must necessarily be arbitrary and artificial, and characters which are of great importance in some cases may be of comparatively little use in others. There can be no doubt that there are certain significant characters which do indicate genetic relationships, but these characters are by no means the same in all cases, and they have to be carefully sought for and distinguished amidst a host of less important features. Sometimes it is the canal system that affords the best clue, sometimes the arrangement of the skeleton, sometimes the form of the spicules, and sometimes even the position of the nucleus of the collared cells. There must also be remembered the undoubted fact that the phenomenon of convergence has played a large part in the evolution of the Calcarea, and has led in many cases to totally deceptive resemblances, as, for example, between the genera *Leucetta* and *Leucandra*.

It seems likely, however, that the collared cell, or choanocyte, which itself is by far the most characteristic histological constituent of the sponge organisation, may ultimately prove, as suggested by Bidder [1898], to afford a means of dividing the whole of the Calcarea into two main branches, one having the nuclei of these cells placed basally, and the other having them apical. Indeed, the acceptance of this principle, if only in a tentative manner, constitutes the chief difference between our present views on the subject and those which we previously held; but in the present state of our knowledge it is a principle which must not be pushed too far, and we have only been able to make use of it as subsidiary to more easily determined characters. The acceptance of this principle, however, necessitates the wide separation of the Lelapiidæ from the other Pharetronid sponges with which they have hitherto been associated.

We shall discuss this question in some detail later on, but it may serve a useful purpose if we give at once a list of all the species of Calcarea in which we have been able to determine the position of the nucleus, and the results of our determination. This list includes no less than 75 species, as follows:—

Nuclei apical.	**Nuclei basal.**
Family Homocœlidæ.	
Leucosolenia bella Row.	*Leucosolenia falcata* Haeckel.
Leucosolenia complicata Montagu, *fide* Minchin.	*Leucosolenia stolonifer* Dendy.
	Leucosolenia ventricosa Carter.
Leucosolenia lucasi Dendy.	*Leucosolenia gardineri* Dendy.

Nuclei apical.	**Nuclei basal.**
Family HOMOCŒLIDÆ (*continued*).	
Leucosolenia variabilis Haeckel, *fide* Minchin.	*Leucosolenia coriacea* Montagu, *fide* Minchin.
	Leucosolenia depressa Dendy.
	Leucosolenia cavata Carter.
	Leucosolenia pelliculata Dendy.
	Leucosolenia proxima Dendy.
	Leucosolenia pulcherrima Dendy.
	Leucosolenia vitrea Row.
	Dendya tripodifera Carter.
	Ascute uteoides Dendy.
Family LEUCASCIDÆ.	
	Leucascus simplex Dendy.
	Leucascus insignis Row.
	Leucascus clavatus Dendy.
	Leucetta chagosensis Dendy.
	Leucetta expansa Row.
	Leucetta microraphis Haeckel.
	Leucetta prolifera Carter.
	Leucetta pyriformis Dendy.
	Pericharax heteroraphis Poléjaeff.
	Pericharax peziza Dendy.
Family LEUCALTIDÆ.	
	Leucaltis clathria Haeckel.
	Leucettusa dictyogaster Row.
Family MINCHINELLIDÆ.	
	Minchinella lamellosa Kirkpatrick.
Family MURRAYONIDÆ.	
	Murrayona phanolepis Kirkpatrick.
Family SYCETTIDÆ.	
Sycon boomerang Dendy.	
Sycon carteri Dendy.	
Sycon gelatinosum de Blainville.	
Sycon giganteum Dendy.	
Sycon lendenfeldi Row.	
Sycon ramsayi von Lendenfeld.	
Sycon raphanus O. Schmidt.	
Sycon setosum O. Schmidt.	
Sycon verum Row.	

Nuclei apical.	**Nuclei basal.**

Family Heteropiidæ.

Grantessa erinaceus Carter.
Grantessa hastifera Row.
Grantessa hispida Carter.
Grantessa poculum Poléjaeff.
Grantessa polyperistomia Carter.
Grantessa sacca von Lendenfeld.
Grantessa intusarticulata Carter.
Heteropia glomerosa Bowerbank.
Heteropia simplex Row.
Vosmaeropsis dendyi Row.
Vosmaeropsis depressa Dendy.
Vosmaeropsis macera Dendy.
Vosmaeropsis primitiva Row.
Vosmaeropsis wilsoni Dendy.

Family Grantiidæ.

Grantia compressa Fabricius.
Grantia genuina Row.
Grantia vosmaeri Dendy.
Grantia indica Dendy.
Teichonopsis labyrinthica Carter.
Grantiopsis infrequens Carter.
Ute syconoides Dendy.
Ute spiculosa Dendy.
Synute pulchella Dendy.
Leucandra hispida Carter.
Leucandra australiensis Carter.
Leucandra echinata Schuffner.
Leucandra meandrina von Lendenfeld.
Leucandra minima Row.
Leucandra phillipensis Dendy.
Leucandra thulakomorpha Row.
Aphroceras cataphracta Haeckel.

Family Amphoriscidæ.

Amphoriscus oblatus Row.
Leucilla australiensis Carter.
Leucilla princeps Row.

Family Lelapiidæ.

Lelapia australis Gray.

With the exception of this important feature, which in the main harmonises very well with our previous conclusions, the principles that we have followed in arriving at the classification set forth in the present paper are almost exactly those which were expounded by one of us some twenty years ago [Dendy 1891 A, 1893 A], as the following review of our present position will show.

The canal system, including the form of the flagellate chambers, is, we are convinced, of comparatively little taxonomic value in the higher Calcarea. In the lower forms it necessarily determines the arrangement of the skeleton, which must lie in the walls of the ascon tubes, however these may be arranged, and in the Sycettidæ the arrangement of the radial tubes has undoubtedly been the determining factor in the development of the articulate tubar skeleton. With the appearance of a definite dermal cortex, however, the arrangement of the skeleton begins to vary more or less independently of the canal system, so that with an identical canal system we find such different types of skeleton as that of the Grantiidæ, the Heteropiidæ and the Amphoriscidæ. In each of these families, while the type of skeleton remains fairly constant, the canal system ranges from syconoid to leuconoid, or at least sylleibid. The syconoid type is again met with on a totally different line of descent in the homocœl genus *Dendya*, and also in *Leucaltis*, and again gives rise to a leuconoid type both in the Leucascidæ and the Leucaltidæ.

Our view that it is the canal system rather than the skeleton that has repeatedly undergone convergent evolution is strongly supported by the distribution of the different types of spicules and of the two types of collared cells. The form of the spicule, however, must be used with great caution as a guide to genetic relationships, for it is largely a question of adaptation. The triradiate is undoubtedly the fundamental spicule form in the group, but one might almost say that it tends to become quadriradiate on the slightest provocation. Thus we almost invariably find quadriradiates in the gastral cortex, whose inwardly directed apical rays are undoubtedly of great value as a protection against enemies, such as small crustaceans, approaching through the osculum. Then, again, the ordinary triradiates of the dermal cortex not infrequently develop a more or less conspicuous, centripetally directed, apical ray; and this latter tendency appears to have led, in the case of the Amphoriscidæ, to a constant skeletal character which forms the most characteristic feature of the group. Similarly with regard to the distinction between equiangular and sagittal triradiates, we find that the latter can always be developed, when the situation in the sponge demands this form, by the bending back of the oral rays during growth. This nearly always takes place, for example, in the oscular collar, where there is no room for the oral rays to extend forward at the usual angle.

Whether or not there is a fundamental difference between an equiangular triradiate, however its rays may be bent, and an alate one in which the primitive oral angle is really different from the paired angles, and in which there is a corresponding difference in the position of the crystalline optic axis, as maintained by Bidder and Minchin, is another and much more difficult question to decide. The presence of regular equiangular triradiates seems most certainly to be very characteristic of the Leucascid-Leucaltid line of descent, and we have made use of it as one of the distinguishing features of the members of those groups. It is, however, extremely difficult in practice to distinguish between a sagittal spicule which owes its sagittal character merely to the backward bending of the oral rays, and one which is sagittal owing to a real inequality between the primitive angles.

There can be no question that a superficially sagittal condition may be attained in different ways, and one of the most interesting results at which we have arrived in the preparation of the present paper is that the so-called subdermal sagittal (pseudosagittal) spicules of the Heteropiidæ have a quite different origin from the ordinary sagittal form, the basal ray not being homologous in the two cases.

With regard to Jenkin's [1908 B] supposed families Chiphoridæ and Staurorrhaphidæ, we have come to the conclusion that these are based upon purely imaginary distinctions. It will be remembered that Jenkin maintained that in these families a special type of spicule, the "chiactine," constitutes the first (or only) joint of the tubar skeleton. It seems highly improbable, from purely *a priori* reasons, that this joint should be differently constituted in different syconoid sponges. As a matter of fact, no one, so far as we are aware, has demonstrated how it arises in ordinary cases, such as *Sycon* or *Grantia*, but everybody has been content to speak of it as being composed of subgastral sagittal triradiates. It is, moreover, well known that these triradiates may develop an apical ray, as they do in many species (e. g. *Sycon ensiferum*, *Sycon verum* and *Grantia indica*), and thus become quadriradiates. Jenkin thought that he had demonstrated that in certain cases the subgastral quadriradiates arise by rotation and re-orientation of the basal rays of gastral quadriradiates, owing to the pressure of the developing chambers, and regarded this mode of origin as distinguishing his so-called chiactines from other subgastral tri- and quadriradiates. As, however, he made no attempt to show how the subgastral triradiates and quadriradiates arise in other cases, this distinction cannot be regarded as having any value; and we ourselves are of opinion, from our own observations, that the spicules which constitute the first joint of the tubar skeleton probably arise in the same way in all cases, although we are not disposed to accept without further evidence the exact mode of origin described by Jenkin.

It is certain that, in some cases at any rate, the spicules at the growing margin of the osculum have not yet assumed their definitive orientation, but exhibit a confused arrangement. Some of them gradually become oriented as dermal cortical spicules, with their three rays lying parallel to the surface, others as subgastral spicules, with their basal rays centrifugally directed and their oral rays lying in the deeper part of the gastral cortex. The spicules of the other joints of the tubar skeleton, on the other hand, appear to arise in the walls of the chambers themselves, and this difference in mode of origin probably accounts for the difference which undoubtedly exists between them and the subgastral spicules.

We consider that the abolition of the families Chiphoridæ and Staurorrhaphidæ will effect a much needed simplification in the classification of the group, and also that it is highly desirable to do away with them from the point of view of practical convenience, for to draw a real distinction in practice between a so-called chiactine and an ordinary subgastral sagittal quadriradiate is quite impossible. The bending of the apical ray, whereby it is brought to lie nearly or quite in the same straight line as the basal ray, is merely a question of degree, as may be seen from the examination of the apical rays of ordinary gastral quadriradiates in various species.

The family Grantillidæ, proposed by one of us [Row, 1909] has, of course, also been abandoned by us. The rejection of Jenkin's chiact theory and the fact that we attach little importance to the mere presence of subdermal quadriradiates, have removed both the characters on which the family was founded, and it has consequently been merged in the Heteropiidæ.

The presence, however, of subgastral sagittal spicules (triradiates or quadriradiates) appears to be very characteristic of the Sycettid as contrasted with the Leucascid-Leucaltid line of descent.

The distribution of oxea in the Calcareous sponges presents an extremely difficult problem, as species possessing them occur side by side with species that lack them in almost all the large genera throughout the group. As a result we have found it impossible to assign to this character any such important place in our scheme of classification as previous authors have suggested, though as a matter of practical convenience we have used it as a basis for arranging the species of a genus in sections. Certainly the ability of some sponges to produce oxea may be looked upon as differentiating them, at any rate to some extent, from others which either have lost this power, although descended from oxea-bearing ancestors, or else have never possessed it.

Further, we have found that two types of oxeote spicules can be distinguished—the comparatively large, usually radially arranged form, and a much smaller for which we employ the term 'microxea.' In typical cases the latter are less than 0·1 mm. in length, and they are usually of a very definite hastate shape, with an enlargement at a short distance from the distal extremity. They thus form very characteristic and well-defined skeletal elements, and it is remarkable to find them recurring in so many perfectly distinct genera, belonging to most of the families within the group. It would obviously be impossible, in any natural systematic arrangement, to associate together all the species which possess microxea, for these species differ amongst themselves in nearly every other respect. It is noteworthy that in some cases these spicules occur in very small numbers, so that they might easily be overlooked, while in others they are extremely numerous; and it seems by no means impossible that some individuals of a species may possess them while others do not. Nevertheless, as a matter of convenience, we have decided to make use of the presence or absence of these spicules for the purpose of distinguishing sections of genera.

In this connection, however, it must be observed that we do not include, in our conception of the term microxea, those long, hair-like spicules frequently found surrounding the osculum, or sometimes echinating the surface. These we believe to be merely slightly modified or imperfectly developed large oxea, and we include them under that head, under the term 'trichoxea.'

One is tempted to explain the sporadic distribution of oxea by speculations which, in the present state of our knowledge, are perhaps unjustifiable; but we may perhaps venture to suggest that the presence of oxea constituted a characteristic feature of some remote ancestor, and that the faculty of producing them has never been entirely lost, but requires special genetic conditions of which we know nothing before it can become active in any particular species. It is quite possible that our sections are somewhat artificial, but a grouping of the species by easily recognisable characters, especially in the larger genera, can hardly fail to be of use to the systematist.

Further discussion of the principles of classification may conveniently be left until we come to deal with the various subdivisions of the group.

SYSTEMATIC ARRANGEMENT OF THE CALCAREA.

Class and Order **CALCAREA.**

Diagnosis. Sponges in which the spicules are composed of carbonate of lime (calcite), and consist of either triradiate or quadriradiate systems, or are oxea (monaxons).

For many years past it has been the almost universal practice amongst spongologists to divide the class Calcarea into two sharply contrasted orders, viz. Homocœla, in which the whole of the gastral cavity is lined by collared cells, and Heterocœla, in which the collared cells are confined to special flagellate chambers, a practice which was first initiated by Poléjaeff in

1883. It appears to us that the time has come, owing to our greatly increased knowledge of the group, to abandon this primary division, and we now propose to consider the class as consisting of a single order only.

One reason for taking this step lies in the discovery of various intermediate forms. Such are the species of *Dendya*, which in the radial arrangement of the ascon tubes approach closely to the Leucascid type of HETEROCŒLA, and the species of *Leucascus* itself, which are but slightly modified from homocœl ancestors and form the starting-point of a distinct evolutionary series within the group HETEROCŒLA; while von Lendenfeld's *Homoderma sycandra* is obviously merely a *Sycon* in which the collared cells persist in the central gastral cavity throughout the life of the sponge.

Another even more important reason lies in the fact that, as noted above, the group HETEROCŒLA is at least diphyletic in origin, the genus *Dendya* and the family Sycettidæ forming two distinct starting points from which the evolution of the higher Leuconoid forms has proceeded.

We therefore propose to divide the class CALCAREA straightway into families, of which the first will be the Homocœlidæ, practically co-extensive with the HOMOCŒLA of Poléjaeff. His group HETEROCŒLA, on the other hand, is here definitely abandoned, being represented by the families Leucascidæ, Leucaltidæ, Minchinellidæ, Murrayonidæ, Sycettidæ, Heteropiidæ, Grantiidæ, Amphoriscidæ and Lelapiidæ.

Family 1. HOMOCŒLIDÆ nov.

Diagnosis. The whole of the gastral cavity and its various outgrowths lined by collared cells throughout the life of the sponge. Sponge colony rarely radiate, and, if so, the central individual retains the primitive ascon structure, with a lining of collared cells and without a special gastral cortex. No true dermal membrane or true dermal cortex is ever developed.

In 1872 Haeckel proposed seven genera of "Ascon" Calcarea, based upon the permutations and combinations of triradiate, quadriradiate, and oxeote spicules. This constituted his so-called "natural" system, but he also had an "artificial" system based upon the type of colony formation. Both systems have shown themselves far from satisfactory in practice and have long since been abandoned.

In 1883 Poléjaeff, recognising the extreme difficulty of subdividing the group, placed the whole of the species in the genus *Leucosolenia* of Bowerbank, which takes priority over all Haeckel's genera and is the only genus recognised by Poléjaeff in his order HOMOCŒLA.

In 1891 von Lendenfeld proposed a modification of Haeckel's "natural" system, retaining only two genera, *Ascetta* and *Ascandra*, the former genus lacking oxea, the latter possessing them.

In the same year Dendy, in his "Monograph of the Victorian Calcarea Homocœla," while accepting Poléjaeff's conclusion that only a single genus could be recognised, proposed to divide that genus into sections and subsections, according to the type of colony formation and canal system. Three sections were recognised, *Simplicia*, *Reticulata* and *Radiata*, and the *Reticulata* were further subdivided into *Indivisa* and *Subdivisa*, according to the absence or presence of an endogastric network. Of these sections the *Radiata* now constitute the genus *Dendya* of Bidder, while the other two are of little value to the systematist.

In 1896 Minchin proposed to distinguish three genera of Homocœla, *Clathrina*, *Leucosolenia* and *Ascandra*, and in 1900, in Lankester's 'Text-Book of Zoology,' he recognised two distinct families, Clathrinidæ and Leucosoleniidæ, and gave (p. 110) the following classification and diagnosis :—

"Grade A. *HOMOCŒLA*, Pol., *s.* Ascones, H.

"Gastral layer continuous.

"Family 1. Clathrinidæ, Minchin. Form reticulate. Triradiate systems always present, equiangular; monaxons present or absent. Collar-cells with nucleus at base. Larva a parenchymula. Genera—*Clathrina*, Gray (= *Ascetta*, H., pars, *Ascaltis*, H., pars, etc., and *Leucascus*, D.); Figs. 2, 6, 7, 8; *Ascandra*, H., emend. (= *Homandra*, Ldf., for *Ascandra falcata*, H.); *Dendya*, Bidder, for *Clathrina tripodifera*, Crtr. Family 2. Leucosoleniidæ, Minchin. Form erect; monaxons always present; triradiates, if present, alate; collar-cells with nucleus apical; larva an amphiblastula. Genera—*Ascyssa*, H.; *Leucosolenia*, Bwk. (= *Ascandra*, H., pars, etc.); Figs. 3, 4, 5."

In 1909, Zool. Anzeiger, xxxv. p. 230, in response to criticisms by Hammer [1908] and Dendy as to the position of the nucleus in the collared cells, he emended his diagnoses as follows :—

"Class Calcarea. Sponges with the skeleton composed of calcite, in the form of spicules either monaxon, triradiate or quadriradiate in form.

"Grade 1. Homocœla. Calcarea with the gastral layer of collar-cells continuous, not forming separate flagellated chambers.

"Family 1. Clathrinidæ. Oscular tubes generally short, arising as shallow vents from the network of tubes, form of the body typically reticulate. Triradiate spicules always present, equiangular, and with the crystalline optic axis vertical to the facial plane of the rays; monaxon spicules present or absent. Collar-cells with the flagellum arising quite independently of the nucleus, which is spherical in form, and situated at the base of the cell. Larva a parenchymula.

"Family 2. LEUCOSOLENIIDÆ. Oscular tubes long, arising as distinct individuals from the stolon-like system of basal tubes; form of the body erect. Monaxon spicules always present; triradiates, if present, typically bilateral in form, with two paired, and one unpaired angles, and with the crystalline optic axis never vertical, but always inclined, to the facial plane of the rays. Collar-cells with the flagellum arising directly from the pear-shaped nucleus, which is situated at, or near, the apex of the cell. Larva an amphiblastula."

Without entering into a long discussion as to the theoretical value of these diagnoses, we may point out that in some respects they are in actual practice very difficult of application. Only very few of the numerous described species of homocœl sponges have been examined with reference to the mode of origin of the flagellum in the collared cells, the nature of the larva, or the direction of the crystalline optic axis in relation to the facial plane of the spicule. If it were necessary to investigate these very obscure characters in every case, the classification of the group would indeed make slow progress.

The more obvious characters which Professor Minchin first made use of for the subdivision of the group, viz., the equiangular or alate character of the triradiates and the position of the nucleus of the collared cell, together with the erect or reticulate form of the colony, lose their value when we extend our investigations beyond the familiar British species. The Australian species, *Leucosolenia lucasi*, *L. stolonifer* and *Ascute uteoides* all have the characteristic non-reticulate, "Leucosolenia" form, and all possess oxea (monaxons); *L. stolonifer* and *A. uteoides*, however, have collared cells with basally placed nuclei, while in *L. lucasi* the nuclei are apical, though unfortunately the position of the basal granule is—as is always the case in specimens preserved without very special precautions—indeterminable. In *L. stolonifer* and *L. lucasi*, again, some at any rate of the triradiates are apparently equiangular and indistinguishable from clathrinid spicules. The test concerning the direction of the optic axis is far too difficult to apply accurately to be of any general value.

As to the larvæ, again, not only are these rarely met with in the Homocœlidæ, but Professor Minchin himself has shown that there is a transition from the one type of larva (parenchymula) to the other type (amphiblastula). He says (Lankester's 'Text-Book of Zoology,' part ii. p. 75), "The type of parenchymula larva exemplified by *Clathrina reticulum* (Fig. 59, *1*), affords an easy transition to the so-called amphiblastula found in *Leucosoleniidæ*, and in the great majority of the HETEROCŒLA."

The genus *Clathrina* of Gray [1867] was originally based on the reticulate form of the sponge colony, and this is still almost the only character which could be made use of in practice as a distinction from *Leucosolenia*, but here again we know that no sharp separation can be drawn between the two types of external form, for one and the same colony may be reticulate in its lower, and non-reticulate in its upper portion.

In short, we do not think that any spongologist who has examined a large and representative collection of Homocœlidæ would be prepared to maintain Professor Minchin's subdivision of the group into Clathrinidæ and Leucosoleniidæ. It appears to us that the most that can be done at present is to pick out and diagnose in a more or less satisfactory way certain more or less isolated and well-characterised generic forms, and to leave the vast bulk of the species in the genus *Leucosolenia*.

At the same time we are of opinion, as already pointed out in the introduction, that Professor Minchin has indicated some characters at any rate which will in the future prove to be of very great value for taxonomic purposes, and we ourselves have made extensive use of the position of the nucleus in the collared cells, as roughly determined from the spirit material, in support of our views as to the evolution of the heterocœl Calcarea. The reason why this character appears to be of less value amongst the Homocœlidæ will be discussed in the section dealing with the phylogeny of the group.

There can be no doubt that the Homocœlidæ have all been derived from a common *Olynthus*-like ancestor, from which a number of lines of descent have branched out in various directions. Colony formation seems to have played the chief part in the process of evolution and many different types of colony have thus arisen.

At present we are only able to distinguish four genera in this family, *Leucosolenia*, *Ascute*, *Ascyssa* and *Dendya*. Three of these, *Ascute*, *Ascyssa* and *Dendya*, are easily and clearly definable, possessing well-marked characters, but the remaining genus, *Leucosolenia*, is distinguished almost entirely by negative characters, and contains a very large number of species, presenting a very great diversity amongst themselves, both in colony-form and spiculation.

Genus 1. Leucosolenia Bowerbank [1864–1882].

Diagnosis. Diverticula of the gastral cavity, if any, never radially arranged around a central tube. Skeleton composed of triradiate or quadriradiate spicules, to which oxea may be added. No uteoid dermal skeleton. Nucleus of collared cells basal or apical.

For illustrations of this genus see Dendy [1891 A].

The external form in species of this genus ranges from simple *Olynthus*-like individuals, which may be connected together by a basal stolon as in *L. lucasi* and *L. stolonifer*, to complex reticulate colonies which have acquired by integration a new individuality of a higher type, sometimes with pseudogaster, pseudosculum, pseudoderm and pseudopores, as in *L. ventricosa*, and sometimes with reversal of the canal system as in *L. cavata*. It may happen that one and the same colony exhibits a reticulate structure in one portion, and a non-reticulate in another, as in several forms figured by Haeckel [1872]. For further information as to the variations in the mode of colony formation the reader is referred to Dendy [1891 A].

Haeckel's *Ascandra falcata*, which we include in the genus *Leucosolenia*, has been made by both Minchin [1896] and von Lendenfeld [1891] the type of a special genus (with the generic names of *Ascandra* and *Homandra* respectively) on account of the peculiar appearance of the gastral layer, which is thrown into folds in such a way that in transverse section there appear to be present a series of shallow radial tubes. These endodermal ridges are always supported by the large apical rays of the gastral quadriradiates, which have either pushed the layer of collared cells out before them as they grow, or formed a foundation upon which the collared cells have spread. It may be pointed out that other Homocœlidæ also show this type of structure, e. g. *L. canariensis* and *L. gegenbauri*. We ourselves do not consider that this character is of sufficient importance, *per se*, to take generic rank; nor do we consider that there is any relationship between the "pseudoradial" character thus given to the gastral layer, and a true syconoid canal system, since, in the radial tubes of *Sycon*, for example, both dermal and gastral layers are folded, while in *Leucosolenia falcata* the gastral layer only is affected. Further, embryology shows that the radial tubes of *Sycon* are outgrowths from the central gastral cavity, and not formed by ingrowths into it. Had the syconoid type of canal system originated from some such condition as that of *Leucosolenia* (*Ascandra*) *falcata*, the sycon person would have been provided with a dermal cortex *ab initio*, whereas the more primitive Sycettidæ have the ends of the chambers freely projecting on the surface of the sponge.

The position of the nucleus of the collared cells in this genus is not, so far as we are aware, correlated with any particular type of spiculation or canal system, and we cannot, if only for practical reasons, make use of this character by itself for subdividing the genus. As a means of grouping the various species of the genus into sections, however, we may, as in the higher forms, adopt the criterion afforded by the presence or absence of oxea.

We recognise the following species as belonging to this genus:—

Section A. Oxea present.

1. L. amœboides *Haeckel*.
   Ascandra complicata, var. *amœboides* Haeckel [1872].

2. L. ANGULATA *von Lendenfeld.*
Ascandra angulata von Lendenfeld [1891].

3. L. ARACHNOIDES *Haeckel.*
Ascandra variabilis var. *arachnoides* Haeckel [1872].

4. L. ARMATA *Haeckel.*
Olynthus pocillum Haeckel [1870], *fide* Haeckel [1872].
Asculmis armata Haeckel [1872].
The earlier name is a *nomen nudum.*

5. L. ATLANTICA *Thacker.*
Leucosolenia atlantica Thacker [1908].

6. L. BELLA *Row.*
Leucosolenia bella Row [1913 MS.].

7. L. BOTRYOIDES (*Ellis and Solander*). Type species of the genus.
Spongia botryoides Ellis and Solander [1786].
Leucosolenia botryoides Minchin [1905].

8. L. BOTRYS *Haeckel.*
Ascandra botrys Haeckel [1872].

9. L. CERVICORNIS *Haeckel.*
Ascandra variabilis var. *cervicornis* Haeckel [1872].

10. L. CLARKII *Verrill.*
Ascortis clarkii Verrill [1873].

11. L. COMPLICATA *Montagu.*
Spongia complicata Montagu [1812].
Grantia botryoides Lieberkühn [1859], *fide* Haeckel [1872].
Olynthus hispidus Haeckel [1859], *fide* Haeckel [1872].
Leucosolenia complicata Minchin [1905].

12. L. CONFERVICOLA *Haeckel.*
Ascandra variabilis var. *confervicola* Haeckel [1872].

13. L. CONTORTA *Bowerbank.*
Leucosolenia contorta Bowerbank [1864–1882].
Ascandra contorta Haeckel [1872].

14. L. CORALLORHIZA *Haeckel.*
Sycorhiza corallorhiza Haeckel [1870].
Auloplegma haeckeli O. Schmidt MS., *fide* Haeckel [1872].
Ascortis corallorhiza Haeckel [1872].

15. L. CORDATA *Haeckel.*
Ascandra cordata Haeckel [1872].

16. L. DENSA *Haeckel.*
Tarrus densus Haeckel [1870].
Nardopsis gracilis Haeckel [1870], *fide* Haeckel [1872].
Ascandra densa Haeckel [1872].

17. L. DISCOVERYI *Jenkin.*
Leucosolenia discoveryi Jenkin [1908].

18. L. DUBIA *Dendy.*
Leucosolenia dubia Dendy [1891 A].

19. L. ECHINATA *Kirk.*
Leucosolenia echinata Kirk [1893].

20. L. ECHINOIDES *Haeckel.*
Leucosolenia echinoides Haeckel [1870].
Olynthus cyathus Haeckel [1870], *fide* Haeckel [1872].
Ascandra echinoides Haeckel [1872].

21. L. ELEANOR *Urban.*
Leucosolenia eleanor Urban [1905].

22. L. FABRICII *O. Schmidt.*
Leucosolenia fabricii O. Schmidt [1870].

23. L. FALCATA *Haeckel.*
Ascandra falcata Haeckel [1872].

24. L. FRAGILIS *Haeckel.*
Ascortis fragilis Haeckel [1872].
Leucosolenia botryoides James-Clark [1869], *fide* Haeckel [1872].
Leucosolenia thamnoides Haeckel [1870], *fide* Haeckel [1872].

Haeckel's earlier name is a *nomen nudum.*

25. L. HERMESI *Breitfuss.*
Ascandra hermesi Breitfuss [1896 B].

26. L. HISPIDISSIMA *Haeckel.*
Ascandra variabilis var. *hispidissima* Haeckel [1872].

27. L. HORRIDA *Haeckel.*
Nardopsis horrida O. Schmidt MS., *fide* Haeckel [1872].
Ascortis horrida Haeckel [1872].

28. L. INCERTA *Urban.*
Leucosolenia incerta Urban [1908].

29. L. IRREGULARIS *Jenkin.*
Leucosolenia irregularis Jenkin [1908 A].

30. L. LACUNOSA *Johnston.*
Grantia lacunosa Bean MS., *fide* Johnston [1842].
Grantia lacunosa Johnston [1842].
Ascortis lacunosa Haeckel [1872].

31. L. LAXA *Kirk.*
Leucosolenia laxa Kirk [1895].

32. L. LIEBERKÜHNII *O. Schmidt.*
Grantia botryoides Lieberkühn [1859], *fide* O. Schmidt [1862], and Haeckel [1872].
Grantia lieberkühnii O. Schmidt [1862].
Leucosolenia robusta Haeckel [1870], *fide* Haeckel [1872].
Ascandra lieberkühnii Haeckel [1872].

33. L. LUCASI *Dendy.*
Leucosolenia lucasi Dendy [1891 A].

34. L. MINCHINI *Jenkin.*
Leucosolenia minchini Jenkin [1908 B].

35. L. NITIDA *Haeckel.*
Olynthium nitidum Haeckel [1870].
Olynthium splendidum Haeckel [1870], *fide* Haeckel [1872].
Ascandra nitida Haeckel [1872].

36. L. PANIS *Haeckel.*
Ascandra panis Haeckel [1872].

37. L. PINUS *Haeckel.*
Leucosolenia botryoides Lacaze-Duthiers MS., *fide* Haeckel [1872].
Ascandra pinus Haeckel [1872].

38. L. RETICULATA *Haeckel.*
Tarrus reticulatus Haeckel [1870].
Ascandra reticulum, var. *reticulata* Haeckel [1872].

39. L. RETICULUM *O. Schmidt.*
Nardoa reticulum O. Schmidt [1862].
Ascandra reticulum Haeckel [1872].

40. L. SERTULARIA *Haeckel.*
Ascandra sertularia Haeckel [1872].

41. L. STOLONIFER *Dendy.*
Leucosolenia stolonifer Dendy [1891 A].

42. L. TENUIPILOSA *Dendy.*
Leucosolenia tenuipilosa Dendy [1905].
Leucosolenia canariensis Thacker [1908], pars, *fide* Row [1909].

43. L. TENUIS *Schuffner.*
Ascandra tenuis Schuffner [1877].

44. L. VARIABILIS *Haeckel.*
Leucosolenia variabilis Haeckel [1870].
Ascandra variabilis Haeckel [1872].
Leuconia somesi Bowerbank [1864–1882], *fide* Minchin [1896].
Leucosolenia variabilis Minchin [1905].

45. L. VENTRICOSA *Carter.*
Clathrina ventricosa Carter [1885–1886].
Leucosolenia ventricosa Dendy [1891 A].

SECTION B. Without oxea.

46. L. AGASSIZII *Haeckel.*
Ascaltis lamarckii var. *agassizii* Haeckel [1872].

47. L. BLANCA *Michlucho-Maclay.*
Guancha blanca Michlucho-Maclay [1868].
Olynthus (&c.) *guancha* Haeckel [1870], *fide* Haeckel [1872].
Ascetta blanca Haeckel [1872].

48. L. CANARIENSIS *Michlucho-Maclay.*
Nardoa canariensis Michlucho-Maclay [1868].
Nardoa sulphurea Michlucho-Maclay [1868], *fide* Haeckel [1872].
Nardoa rubra Michlucho-Maclay [1868], *fide* Haeckel [1872].
Ascaltis canariensis Haeckel [1872].
Leucosolenia nanseni Breitfuss [1896], *fide* Thacker [1908].
Ascaltis compacta Schuffner [1877], *fide* Thacker [1908].
Leucosolenia canariensis Thacker [1908].

49. L. CANCELLATA *Verrill.*
Leucosolenia cancellata Verrill [1873].

50. L. CAROLI *Haeckel.*
Ascaltis darwinii, var. *caroli* Haeckel [1872].

51. L. CAVATA *Carter.*
Clathrina cavata Carter [1885–1886].
Leucosolenia cavata Dendy [1891 A].

52. L. CEREBRUM *Haeckel.*
Ascaltis cerebrum Haeckel [1872].

53. L. CHALLENGERI *Poléjaeff.*
Leucosolenia challengeri Poléjaeff [1883].

54. L. CHARYBDÆA *Haeckel.*
Ascaltis gegenbauri var. *charybdæa* Haeckel [1872].

55. L. CLATHRATA *Carter.*
Leucetta clathrata Carter [1883].
Clathrina tripodifera var. *gravida* Carter [1885–1886], *fide* Row [1913 MS.].
Grantia cliftoni Bowerbank MS., *fide* Row [1913 MS.].
Leucosolenia intermedia Kirk [1895], *fide* Row [1913 MS.].
Leucosolenia clathrata Row [1913 MS.].

56. L. CLATHRUS *O. Schmidt.*
Grantia clathrus O. Schmidt [1862].
? *Clathrina sulphurea* J. E. Gray [1867], *fide* Haeckel [1872].
Tarrus labyrinthus Haeckel [1870], *fide* Haeckel [1872].
Nardoa labyrinthus O. Schmidt MS., *fide* Haeckel [1872].
Ascetta clathrus Haeckel [1872].

57. L. CONVALLARIA *Haeckel.*
Ascilla gracilis var. *convallaria* Haeckel [1872].

58. L. CORIACEA *Montagu.*
Spongia coriacea Montagu [1812].
Grantia multicavata Bean MS., *fide* Johnston [1842].
Clathrina sulphurea Carter [1871 A], *fide* Haeckel [1872].
Ascetta coriacea Haeckel [1872].

59. L. DARWINII *Haeckel.*
Leucosolenia darwinii Haeckel [1870].
Ascaltis darwinii Haeckel [1872].

60. L. DECIPIENS *Haeckel.*
Ascaltis cerebrum var. *decipiens* Haeckel [1872].

61. L. DEPRESSA *Dendy.*
Leucosolenia depressa Dendy [1891 A].

62. L. DICTYOIDES *Haeckel.*
Leucosolenia dictyoides Haeckel [1870].
Ascetta primordialis var. *dictyoides* Haeckel [1872].

63. L. FALKLANDICA *Breitfuss.*
Leucosolenia falklandica Breitfuss [1898 E].

64. L. FLEXILIS *Haeckel.*
Ascetta flexilis Haeckel [1872].

65. L. GARDINERI *Dendy.*
Leucosolenia gardineri Dendy [1913].

66. L. GEGENBAURI *Haeckel.*
Leucosolenia gegenbauri Haeckel [1870].
? *Nardoa spongiosa* Kölliker [1864], *fide* Haeckel [1872].
Ascaltis gegenbauri Haeckel [1872].

67. L. GOETHEI *Haeckel.*
Leucosolenia goethei Haeckel [1870].
Ascaltis goethei Haeckel [1872].

68. L. GRACILIS *Haeckel.*
Ascilla gracilis Haeckel [1872].

69. L. GRANTII *Haeckel.*
Leucosolenia grantii Haeckel [1870].
Ascaltis solanderii (=*Ascaltis botryoides* var. *solanderii*) Haeckel [1872], *fide* Haeckel [1872].

70. L. HIMANTIA *Johnston.*
Grantia botryoides var. *himantia* Johnston [1842].
Ascetta coriacea var. *himantia* Haeckel [1872].

71. L. JAPONICA *Haeckel.*
Ascilla japonica Haeckel [1872].

72. L. LAMARCKII *Haeckel.*
Leucosolenia lamarckii Haeckel [1870].
Aulorhiza intestinalis Haeckel [1870], *fide* Haeckel [1872].
Ascaltis lamarckii Haeckel [1872].

73. L. LOCULOSA *Haeckel.*
Ascetta primordialis var. *loculosa* Haeckel [1872].

74. L. MACLEAYI *von Lendenfeld.*
Ascetta macleayi von Lendenfeld [1885 A].

75. L. MINORICENSIS *Lackschewitsch.*
Leucosolenia minoricensis Lackschewitsch [1886].

76. L. MULTIFORMIS *Breitfuss.*
Leucosolenia multiformis Breitfuss [1898 B].

77. L. OSCULUM *Carter.*
Clathrina osculum Carter [1885–1886].

78. L. PEDUNCULATA *von Lendenfeld.*
Leucopsis pedunculata von Lendenfeld [1885 B].

79. L. PELLICULATA *Dendy.*
Leucosolenia pelliculata Dendy [1891 A].

80. L. PHILLIPINA *Haeckel.*
Ascetta blanca var. *phillipina* Haeckel [1872].

81. L. POTERIUM *Haeckel.*
Ascetta primordialis var. *poterium* Haeckel [1872].
Ascandra conulata von Lendenfeld MS., *fide* Breitfuss [1897].

82. L. PRIMORDIALIS *Haeckel.*
Prosycum primordiale Haeckel [1870].
Olynthus simplex Haeckel [1870], *fide* Haeckel [1872].
? *Grantia pulchra* O. Schmidt [1862], *fide* Haeckel [1872].
Nardoa arabica Michlucho-Maclay MS., *fide* Haeckel [1872].
Ascetta primordialis Haeckel [1872].

83. L. PROTOGENES *Haeckel.*
Ascetta primordialis var. *protogenes* Haeckel [1872].
Ascetta procumbens von Lendenfeld [1885 B], *fide* Dendy [1891 A].

84. L. PROXIMA *Dendy.*
Leucosolenia proxima Dendy [1891 A].

85. L. PSAMMOPHILA *Row.*
Leucosolenia psammophila Row [1913 MS.].

86. L. PULCHERRIMA *Dendy.*
Leucosolenia pulcherrima Dendy [1891 A].

87. L. ROSEA *Kirk.*
Leucosolenia rosea Kirk [1895].

88. L. SAGITTARIA *Haeckel.*
Ascetta sagittaria Haeckel [1872].

89. L. SCEPTRUM *Haeckel.*
Ascetta sceptrum Haeckel [1872].

90. L. SPINOSA *von Lendenfeld.*
Ascetta spinosa von Lendenfeld [1891].

91. L. STIPITATA *Dendy.*
Leucosolenia stipitata Dendy [1891 A].

92. L. VESICULA *Haeckel.*
Ascetta vesicula Haeckel [1872].

93. L. VITREA Row.
Leucosolenia vitrea Row [1913 MS.].

94. L. WILSONI *Dendy.*
Leucosolenia wilsoni Dendy [1891 A].

The following species are of doubtful value :—

95. L. LAMINOCLATHRATA *Carter.*
Clathrina laminoclathrata Carter [1885–1886].
Too imperfectly described to be recognisable.

96. L. PULCHRA *O. Schmidt.*
Grantia pulchra O. Schmidt [1865].
Possibly identical with *L. primordialis* Haeckel, *fide* Haeckel [1872].

97. L. SPONGIOSA *Kölliker.*
Nardoa spongiosa Kölliker [1864].
Possibly identical with *L. gegenbauri* Haeckel, *fide* Haeckel [1872].

98. L. SULPHUREA *Gray.*
Clathrina sulphurea J. E. Gray (non Carter) [1867].
Possibly identical with *L. clathrus* O. Schmidt, *fide* Haeckel [1872].

Genus 2. DENDYA Bidder [1898].

Diagnosis. Sponge colony consisting of a large central individual lined by collared cells, from which radially arranged diverticula are given off. Skeleton composed of equiangular triradiates to which quadriradiates may be added. Subgastral sagittal radiates never present. Nuclei of collared cells probably always basal.

For illustrations of this genus see Dendy [1891 A].

Carter's *Clathrina tripodifera* was included by Dendy [1891 A] in the genus *Leucosolenia*, as the sole representative of the "Radiate" section of that genus. Bidder [1898] proposed for its reception a new genus, *Dendya*, and the recent discovery by the 'Sealark' Expedition of a closely allied, but quite distinct, species in the Indian Ocean seems to justify the retention of Bidder's genus. Unfortunately Bidder associated his genus with Poléjaeff's *Heteropegma* (=*Leucaltis*) in a new family Heteropegmidæ, of which *Dendya* was made the type genus. While admitting a certain degree of relationship between *Dendya* and *Leucaltis*, we cannot agree that this is so close as to justify placing them in the same family, for not only is *Leucaltis* corticate, while *Dendya* is non-corticate, but *Leucaltis* is also heterocœl, while *Dendya* is homocœl.

The chief interest attaching to the genus *Dendya* lies in its radiate structure, which, at first sight, seems to suggest a possible starting point for the Sycettid as well as for the Leucascid-Leucaltid line of descent. We no longer consider, however, that *Dendya* stands very near the origin of the Sycettidæ, from the simplest of which it differs widely in the structure of the skeleton, especially in the absence of subgastral sagittal radiates, in the fact that the radial tubes tend to anastomose, and in the basal position of the nuclei of the collared cells. The tendency of the radial tubes to form reticulations is indeed a difficulty in the way of separating the genus sharply from *Leucosolenia*, a fact well illustrated by Carter's *Leucetta clathrata* (=*Leucosolenia clathrata*), which is intermediate between the two as regards the canal system while resembling *Dendya* in the presence of the characteristic dermal tripod spicules. [Row, 1913 MS.]

We recognise the following species as belonging to this genus:—

1. D. PROLIFERA *Dendy*.
   Dendya prolifera Dendy [1913].

2. D. TRIPODIFERA *Carter*. Type species of the genus.
   Clathrina tripodifera Carter [1885–1886].
   Leucosolenia tripodifera Dendy [1891 A].
   Dendya tripodifera Bidder [1898].

Genus 3. Ascute nov.

Diagnosis. The diverticula of the gastral cavity, if any, never radially arranged around a central tube. With a uteoid dermal skeleton of colossal longitudinal oxea. Nuclei of the collared cells (? always) basal.

As the presence of a uteoid dermal skeleton is considered to form a good generic character in other families, we see no reason why it should not be used in the same way amongst the Homocœlidæ, and therefore propose this genus for Dendy's *Leucosolenia uteoides*, with which Carter's *Aphroceras asconoides* is doubtless to be associated. The nucleus of the collared cells is basal in the former species, but its position is not known in the latter.

In both the known species of this genus the sponge has the form of a group of simple ascon persons, attached to one another by their bases, and without any anastomoses in the colony.

We recognise the following species as belonging to this genus :—

1. A. asconoides *Carter.*
   Aphroceras asconoides Carter [1885–1886].
2. A. uteoides *Dendy.* Type species of the genus.
   Leucosolenia uteoides Dendy [1892 C].

Genus 4. Ascyssa Haeckel [1872].

Diagnosis. Diverticula of the gastral cavity, if any, never radially arranged around a central tube. Skeleton consisting entirely of oxea.

For illustrations of this genus see Haeckel [1872].

We consider the entire absence of radiate spicules as affording sufficient reason for the generic separation of Haeckel's two species of *Ascyssa* from all the other Homocœlidæ.

We assign the following species to this genus :—

1. A. acufera *Haeckel.*
   Ascyssa acufera Haeckel [1872].
2. A. troglodytes *Haeckel.* Type species of the genus.
   Ascyssa troglodytes Haeckel [1872].

Family 2. LEUCASCIDÆ Dendy [1892 B] (emend.).

Diagnosis. Sponge typically forming a massive colony, usually with several or many oscula, but sometimes integrated into a single individual with definite external form. Without any large central gastral cavity lined by collared cells, but with an exhalant canal system devoid of collared cells.

Flagellate chambers ranging from long and possibly branched, with a tendency to radial arrangement round the exhalant canals, to small, approximately spherical, and scattered. With a distinct and independent dermal membrane (or cortex) pierced by true dermal pores. Skeleton consisting mainly of equiangular and equiradiate spicules, which may become sagittal at the oscular margins. Radiates of the chamber' ayer without definite arrangement, but irregularly scattered in the walls of the elongated chambers, or between the small, scattered chambers. No subgastral sagittal radiates. Nuclei of collared cells probably always basal.

This family was provided by Dendy [1892 B] for the reception of the genus *Leucascus* with its two species, *L. simplex* and *L. clavatus*. Minchin [1900] refused to recognise either the genus or the family, and included the two species in his *Clathrina*, apparently ignoring the fact that none of the known species of *Clathrina*, or indeed any other homocœl sponge, possess an independent dermal membrane or cortex. It is true that many Clathrinas develop a pseudoderm, but this is invariably formed from the outermost tubes of the reticulation, and therefore includes a layer of endoderm (gastral layer). In *Leucascus*, on the other hand, the dermal membrane is formed exclusively of ectoderm and mesoglœa (dermal layer), and does not consist merely of the outer tubes of the reticulation. Moreover, the radiate and non-reticulate arrangement of the elongated chambers in *Leucascus* indicates a relationship with *Dendya* rather than with the Clathrinoid Leucosolenias.

We here extend our conception of the family Leucascidæ to include, not only the genus *Leucascus* and allied genera with a similar type of canal system, but also a number of species with a leuconoid type of canal system, which we have hitherto assigned to the genera *Leucandra* and *Leucilla*. The skeleton of these species, in the absence of all traces of syconoid ancestry such as subgastral sagittal triradiates, clearly indicates a wide phylogenetic separation from the typical Leucandras and Leucillas, such as *Leucandra aspera* and *Leucilla amphora*, and closely resembles that of *Leucascus*.

It will be remembered that Haeckel, in "Die Kalkschwämme" (vol. ii. p. 122, [1872]), placed his *Leucetta primigenia* (one of the species which was formerly assigned to *Leucandra*, but now placed in the Leucascidæ) at the beginning of his Leucones, which he derived directly from an *Ascon* ancestry. He says: "*Leucetta primigenia*, als die wahrscheinliche Stammform der Leuconen, steht in ihre Skeletbildung der gemeinsamen Stammform aller Kalkschwämme, der *Ascetta primordialis*, so nahe, dass man sie unmittelbar von der letzteren ableiten kann." We agree with these views so far as the relationship to the "Ascones" is concerned, but we can no longer agree that the more advanced types of "Leucones" (such as *Leucandra*) have had a leucettid ancestry.

There is certainly no indication whatever of the genus *Leucetta* having passed through a syconoid stage in its evolution, as we believe to be the case with the true Leucandras and Leucillas, and we therefore propose to re-establish this genus for certain leuconoid Leucascidæ.

We have also placed in this family the genus *Pericharax* Poléjaeff [1883], on account of the similarity of the skeleton and the basal position of the nucleus in the collared cells, while the genus *Leucomalthe* can only be placed here provisionally.

It should perhaps be mentioned here that von Lendenfeld's genus *Leucopsis* [1885 B] was also supposed by its author to represent a "Transition form between Asconidæ and Leuconidæ." The genus, with its single species, *Leucopsis pedunculata*, was, however, so imperfectly described that it is impossible to form any definite opinion as to its systematic position; it is very possibly merely a reticulate *Leucosolenia* with well developed mesoglœa and pseudogaster, an opinion which is supported by an examination of some of von Lendenfeld's type specimens, which one of us was able to make in Berlin. At all events, it appears to differ widely from any of our Leucascidæ, and it has been placed by us among the Leucosolenias.

We have been able to determine the position of the nucleus in no less than ten species of this small family, including five species of *Leucetta*, and in all cases have found it basal, a fact that affords strong support to our view that the genus *Leucetta* should be very widely separated from *Leucandra*, in which the nucleus is, so far as we are aware, always apical.

Genus 5. Leucascus Dendy [1892 B].

Diagnosis. Flagellate chambers greatly elongated, tubular, and sometimes copiously branched.

For illustrations of this genus see Dendy [1893 A].

We recognise the following species in this genus:—

Section A. Without oxea.

1. L. insignis *Row.*
   Leucascus insignis Row [1913 MS.].

2. L. simplex *Dendy.* Type species of the genus.
   Leucascus simplex Dendy [1892 B].

Section B. With large radially arranged oxea.

3. L. clavatus *Dendy.*
   Leucascus clavatus Dendy [1892 B].

Genus 6. Leucomalthe, Haeckel [1872] (emend.).

Diagnosis. Colony individualised, with definite external form and large central gastral cavity opening by a large single osculum. Flagellate chambers greatly elongated, tubular, copiously branched. Skeleton consisting of regular radiates, large longitudinally placed oxea scattered throughout the sponge body and not confined to the cortex, and minute, irregularly hastate microxea.

For illustrations of this genus see Haeckel [1872].

The name *Leucomalthe*, originally applied to one of Haeckel's subgenera, is retained for his *Leucandra bomba*, which presents many peculiarities distinguishing it from the rest of the species of that genus. Of these, the most important from the point of view of our present classification is the very unusual type of canal system figured by Haeckel, which shows a number of large and very much branched flagellate chambers radiating from a central gastral cavity. This is very different from the normal leuconoid canal system, and is fairly similar to that of *Leucascus*. On this account, and on account of the regular triradiates of the skeleton, we have placed this species among the Leucascidæ, though, it must be acknowledged, on somewhat doubtful grounds, and the peculiarities of its spiculation have necessitated the provision of a special genus to receive it.

The only known species is :—

1. L. bomba *Haeckel.*
   Leucandra bomba Haeckel [1872].

Genus 7. Leucetta Haeckel [1872] (emend.).

non *Leucetta* Poléjaeff [1883].
non *Leucetta* von Lendenfeld [1891].

Diagnosis. Canal system leuconoid, with small, spherical or subspherical flagellate chambers irregularly scattered through the chamber layer.

For illustrations of this genus see Haeckel [1872] and Dendy [1913].

Haeckel [1872] proposed the genus *Leucetta* for calcareous sponges with a leuconoid canal system and a skeleton composed of triradiate spicules only, taking *L. primigenia* for his type species.

Poléjaeff [1883] abandoned Haeckel's classification, but retained the name *Leucetta* in an entirely different sense, equivalent to our *Leucettusa*, taking one of Haeckel's species, *L. corticata*, for the type species of his genus.

Von Lendenfeld [1891] used the genus *Leucetta* to include "Leuconidæ with triacts or tetracts or both."

Dendy [1893 A] included Haeckel's species of *Leucetta* in the genus *Leucandra*, on the ground that the mere absence of quadriradiate or oxeote spicules, or both, could not be regarded as of generic significance.

As a result of further study of the Calcarea, we are convinced that the genus *Leucandra*, as used hitherto by Dendy, is not a natural one, but must be subdivided, although on lines different from any that have previously been suggested. It appears to us that certain species, namely those which we now assign to *Leucetta*, have originated, quite independently of the remainder, from the homocœl sponges through a leucascid ancestry, and have consequently never passed through a *Sycon* stage in their phylogeny. The species in question are characterised by their equiangular triradiates, and by the absence of any trace of the typical *Sycon* skeleton.

As regards the canal system, it appears that the same course of evolution, from a condition with elongated and more or less radially arranged flagellate chambers, to a condition with small scattered spherical chambers, has taken place in both cases, so that there has been a very complete convergence between the genera *Leucetta* and *Leucandra* as now understood by us. The true Leucandras, however, are distinguished by more or less distinct traces of the skeletal structure exhibited by their syconoid ancestors.

This view, so far as our present information goes, is supported by histological evidence; for, as already indicated, the position of the nucleus of the collared cells in *Leucetta* is basal, while in typical Leucandras it appears to be apical.

We also include in the genus *Leucetta*, as now conceived, certain species which we have hitherto regarded as belonging to the genus *Leucilla*. These species are characterised by the development to a varying extent of an inwardly pointing apical ray on some of the triradiates of the dermal cortex. They are to be distinguished from the true Leucillas on the same grounds as those on which the other Leucettas are distinguished from the true Leucandras, and we do not consider the mere presence of such apical rays by itself as a sufficient justification for generic separation.

As we are taking Haeckel's type species of *Leucetta* as the type of the genus as understood by us, we consider that we are justified in retaining his name for the genus, although that name has been used in different senses by subsequent writers.

We allocate the following species to this genus :—

Section A. Without oxea.

1. L. chagosensis *Dendy*.
   Leucetta chagosensis Dendy [1913].

2. L. FLORIDANA *Haeckel.*
Leucaltis floridana Haeckel [1872].

3. L. INFREQUENS *Row.*
Leucetta infrequens Row [1913 MS.].

4. L. MICRORAPHIS *Haeckel.*
Leucetta primigenia var. *microraphis* Haeckel [1872].
Leuconia dura Poléjaeff [1883], *fide* Dendy [1892 B].

5. L. PRIMIGENIA *Haeckel.* Type species of the genus.
Sycothamnus fruticosus Haeckel [1870], *fide* Haeckel [1872].
Lipostomella clausa Haeckel [1870], *fide* Haeckel [1872].
Leucetta primigenia Haeckel [1872].
Leuconia fruticosa Poléjaeff [1883].

Haeckel's two earlier names are *nomina nuda*, as they were not accompanied by diagnoses, and we have rejected them, although Poléjaeff has revived one of them.

6. L. PYRIFORMIS *Dendy.*
Leucetta pyriformis Dendy [1913].

7. L. PROLIFERA *Carter.*
Teichonella prolifera Carter [1878].
Leucilla prolifera Dendy [1892 B].
Leucetta prolifera Row [1913 MS.].

8. L. SOLIDA *O. Schmidt.*
Grantia solida O. Schmidt [1862].
Leuconia nivea J. E. Gray [1867], *fide* Haeckel [1872].
Leucaltis solida Haeckel [1872].

9. L. TRIGONA *Haeckel.*
Leucetta trigona Haeckel [1872].

SECTION B. With large, usually radially arranged oxea, but without microxea.

10. L. CARTERI *Dendy.*
Leucaltis floridana var. *australiensis* Carter [1885–1886].
Leucandra carteri Dendy [1892 B].

SECTION C. With both large oxea and microxea.

11. L. EXPANSA *Row.*
Leucetta expansa Row [1913 MS.].

The following species is doubtfully assigned to *Leucetta*:—

12. L. HOMORAPHIS *Poléjaeff.*
Pericharax carteri var. *homoraphis* Poléjaeff [1883].

The name *carteri* cannot be used for this species, as it is already employed in this genus.

Genus 8. Pericharax Poléjaeff [1883].

Diagnosis. Sponge colony individualised, with large central cavity (probably a pseudogaster) opening by a wide vent and surrounded by a very thick wall. Canal system leuconoid, with sub-spherical, scattered, flagellate chambers, and with subdermal cavities whose walls are supported by a special skeleton derived partly from the inturned rays of tangential dermal triradiates. Skeleton of the chamber layer confused, composed of equiangular triradiates of two very different sizes.

For illustrations of this genus see Poléjaeff [1883] and Dendy [1913].

This genus was proposed by Poléjaeff [1883] for a species, *Pericharax carteri*, from Tristan da Cunha, but recent authors, for the most part, have not accepted it. The discovery by the 'Sealark' Expedition of the original species, and of a new one closely allied to it, has enabled us to make a careful study of the question, and we are convinced that the genus is valid. The position which we assign to it is justified, not only by the character of the skeleton, but also, as in the case of *Leucetta*, by the basal position of the nucleus of the collared cells in both species.

The dermal triradiates in both species are very curious spicules, with a strong tendency to irregular curvature of the rays, often resulting in one or more of them dipping down deeply between the subdermal cavities.

Pericharax heteroraphis (Poléjaeff's *P. carteri* var. *heteroraphis*) must be taken as the type of the genus. The same author's *P. carteri* var. *homoraphis*, as we have noted above, appears to be quite distinct, and is not a Pericharax at all, but probably a Leucetta. *Pericharax poléjaevi* Breitfuss [1896 A], placed by its author in this genus on account of the presence of subdermal cavities, is really a typical Leucandra, for the presence of subdermal cavities without a special supporting skeleton cannot be regarded as of generic importance. Poléjaeff also included in the genus Haeckel's *Leucandra cucumis*, the position of which is discussed by us under the genus *Paraleucilla*.

We recognise the following as species of this genus:—

1. P. heteroraphis *Poléjaeff*. Type species of the genus.
   Pericharax carteri var. *heteroraphis* Poléjaeff [1883].

2. P. peziza *Dendy*.
   Pericharax peziza Dendy [1913].

Family 3. LEUCALTIDÆ nov.

Diagnosis. Sponge colony tubular and ramified, or even anastomosing, with many oscula, or individualised with large central cavity and single osculum. Wall of colony composed of at least two distinct layers, namely, a dermal cortex with strongly developed skeleton of tangential radiates, and a chamber layer with a skeleton greatly reduced or even absent. A thin gastral cortex or membrane may or may not be present. Skeleton composed, mainly at any rate, of equiangular radiates. No sub-gastral sagittal radiates. Nuclei of collared cells probably always basal.

The members of this family appear to have been derived from a *Dendya*-like ancestor by the development of a thick dermal cortex with a strongly developed cortical skeleton, and the consequent more or less complete reduction of the no longer necessary skeleton of the chamber layer. As in other families of Calcarea, the flagellate chambers range from greatly elongated and even branched, and more or less radially arranged, to small, subspherical and scattered.

Bidder [1898] has already pointed out that the nuclei of the collared cells in *Leucaltis clathria* Haeckel (*Heteropegma nodusgordii* Poléjaeff) are basal in position, and we are able to confirm this observation and to add that they are basal also in *Leucettusa dictyogaster* Row [1913 MS.].

The reduction of the skeleton of the chamber layer, correlated with the development of a thick dermal cortex with a special cortical skeleton, finds its parallel in the genus *Grantiopsis* amongst the Grantiidæ, but in that case the syconoid ancestry is very clearly indicated in the remains of an articulate tubar skeleton, while in *Leucaltis* the vestigial skeleton of the chamber layer shows no indications whatever of an articulate origin.

The characters above mentioned, in our opinion justify the close association of *Leucaltis* with *Leucettusa*, and the wide separation of these genera from both *Leucandra* and *Leucilla* in our scheme of classification.

We prefer to derive the Leucaltidæ directly from a *Dendya*-like ancestor, rather than indirectly through *Leucascus*, because *Leucaltis* still preserves the more primitive type of radial colony formation with what we presume to be a true central gastral cavity, while *Leucascus* has adopted a massive type of colony formation in which the exhalant canals are possibly to be regarded as pseudogastral in nature.

Genus 9. Leucaltis Haeckel [1872] (emend.).

Heteropegma Poléjaeff [1883].

Diagnosis. Sponge colony tubular, ramified and anastomosing, with many oscula. Flagellate chambers elongated and branched, more or less radially arranged round the central gastral cavities of the tubes.

For illustrations of this genus see Poléjaeff [1883] and Dendy [1893 A].

Dendy [1892 B, 1893 A] placed this genus in the family Amphoriscidæ, on account of the large subdermal quadriradiates possessed by the only known species. He also regarded the vestigial triradiates of the skeleton of the chamber layer as the remnants of an articulate tubar skeleton, being misled by the radial arrangement of the flagellate chambers. We are now convinced that in both these respects he was wrong, and that the genus is probably, as Bidder [1898] maintained, related to *Dendya*, from which it has been directly derived without passing through an intermediate syconoid stage.

In arriving at this conclusion we lay great stress upon the regular and equiangular form of the triradiates of both the chamber layer and the dermal cortex, and also upon the basal position of the nuclei of the collared cells. The genus may, in fact, almost be regarded as a *Dendya* with a thick dermal cortex.

Dendy [1913] has shown that only one species can be recognised in the genus. A re-investigation of the type specimen of Haeckel's *Leucaltis clathria* has convinced us that it is not only generically, but also specifically identical with Poléjaeff's *Heteropegma nodus-gordii*, and the latter name thus becomes a synonym of *Leucaltis clathria* Haeckel. As the other species of Haeckel's genus *Leucaltis* must be removed to older genera, *L. clathria* must be taken as the typical species, and we are therefore unable to retain Poléjaeff's name *Heteropegma.* Again, Carter's *Clathrina latitubulata* is only a variety of *Leucaltis clathria*, differing in some slight details of spiculation. Mr. Carter seems to have been led into provisionally placing his species in the genus *Clathrina* by the external form of the whole colony, which resembles a reticulate *Clathrina* on a gigantic scale. The reticulation, however, is not composed of simple ascon tubes as in *Clathrina*, but of a colony of a higher order, with numerous true ascon tubes lying in the thickness of the wall. Finally, Ridley's *Leucaltis bathybia* var. *mascarenica* is evidently, from his description, and from the slides which we have been able to examine, nothing but the same species.

The extent to which apical rays are developed on the tangential radiates of the dermal cortex varies greatly in different individuals.

We recognise only the following species in the genus :—

1. L. CLATHRIA *Haeckel.*
   Leucaltis clathria Haeckel [1872].
   Heteropegma nodus-gordii Poléjaeff [1883], *fide* Dendy [1913].
   Clathrina latitubulata Carter [1885–1886], *fide* Dendy [1913].
   Leucaltis bathybia var. *mascarenica* Ridley [1884], *fide* Dendy [1913].
   Leucaltis clathria Dendy [1913].

Genus 10. LEUCETTUSA Haeckel [1872] (emend.).

Leucetta Poléjaeff [1883].

Diagnosis. Sponge colony individualised, with definite external form and large central cavity opening by a large single osculum. Canal system leuconoid.

For illustrations of this genus see Poléjaeff [1883] under the name *Leucetta*, and Row [1913 MS.].

The remarkable reticulate type of colony formation found in *Leucaltis* prevents us from regarding that genus as directly ancestral to *Leucettusa*, but as regards canal system the two are related in the same way as *Grantia* and *Leucandra.*

Within the limits of the genus *Leucettusa*, however, we find considerable variation with regard to the form of the flagellate chambers. Poléjaeff's figure of the canal system of *Leucettusa* (*Leucetta*) *vera* shows the flagellate chambers in the outer part of the chamber layer elongated and radially arranged, while those in the inner part are subspherical and scattered, so that this species appears to be intermediate between *Leucaltis* and the more typical Leucettusas in this respect.

Leucettusa (*Leucetta*) *haeckeliana*, on the other hand, has the flagellate chambers all small and subspherical, and lying in the irregular trabeculæ of the chamber layer, which are separated by very wide, irregular exhalant lacunæ. In *Leucettusa dictyogaster* Row [1913 MS.] the trabeculæ bearing the flagellate chambers form a network which almost completely blocks up the central gastral cavity as an altogether askeletal layer. A section of this askeletal chamber layer, isolated from the cortex, would be almost indistinguishable from a similar section of *Oscarella*, which also has large collared cells with basally placed nuclei, so that the possibility presents itself that *Oscarella* may be nothing but a calcareous sponge which has lost the whole of its skeleton.

We also find in the genus *Leucettusa* various stages in the development of the subdermal quadriradiate spicules, which are entirely absent in *L. corticata* and *L. dictyogaster*, very sparse in *L. haeckeliana* and large and very numerous in *L. vera*. As already indicated, we no longer consider the presence of subdermal quadriradiates, taken by itself, to be a character of generic importance, being convinced that the addition of an apical ray to a triradiate spicule may take place whenever and wherever it may be required.

It will have been noticed that our genus *Leucettusa* is identical in scope with Poléjaeff's *Leucetta* [1883], but as we have found it necessary to retain Haeckel's name *Leucetta* for another genus, as previously explained, we have been obliged to adopt his subgeneric name for the group of species which Poléjaeff quite rightly separated out.

We recognise the following species as belonging to this genus:—

Section A. Without oxea.

1. L. corticata *Haeckel*. Type species of the genus.
   Leucetta corticata Haeckel [1872].

2. L. haeckeliana *Poléjaeff*.
   Leucetta haeckeliana Poléjaeff [1883].

3. L. imperfecta *Poléjaeff*.
   Leucetta imperfecta Poléjaeff [1883].

4. L. sambucus *Preiwisch*.
   Leucetta sambucus Preiwisch [1904].

5. L. vera *Poléjaeff*.
   Leucetta vera Poléjaeff [1883].

Section B. With microxea but without large oxea.

6. L. dictyogaster *Row*.
   Leucettusa dictyogaster Row [1913 MS.].

Family 4. MINCHINELLIDÆ nov.

Lithonina Döderlein [1892].
Lithoninæ Kirkpatrick [1911 A].

Diagnosis. Canal system leuconoid (in all known forms and presumably always so). Main skeleton composed of quadriradiates cemented together in various ways by calcareous cement. Apparently without subgastral sagittal radiates. Nuclei of collared cells (probably always) basal.

We have been able, owing to the kindness of Mr. Kirkpatrick, to examine preparations of *Minchinella* and *Murrayona*, in which the collared cells are sufficiently well preserved to enable us to determine the position of the nucleus. We find that this is basal in both cases, whereas in *Lelapia* we find it to be apical. As

Lelapia differs widely in other characters also from both *Minchinella* and *Murrayona*, we are forced to the conclusion that the so-called Pharetronid sponges are at least diphyletic in origin, and we have removed the Lelapiidæ to a position in the Sycettid line of descent. We shall, however, discuss the question further under the head of phylogeny.

The genera *Minchinella*, *Petrostroma* and *Plectroninia* all agree in the possession of a stony skeleton composed of fused quadriradiates, and thus differ widely from *Murrayona*. We therefore unite them in one family under the name Minchinellidæ, while relegating *Murrayona* to a special family of its own.

Genus 11. MINCHINELLA Kirkpatrick [1908].

Diagnosis. Sponge lamellar, with pore-bearing chimneys on one side and oscular chimneys on the other. The quadriradiates of the main skeleton cemented together into a compact network and completely embedded in the enveloping cement. Dermal skeleton of radiates, including tuning-fork spicules, and oxea.

For illustrations of this genus see Kirkpatrick [1908].

The only known species of the genus is:—

1. M. LAMELLOSA *Kirkpatrick*.
 Minchinella lamellosa Kirkpatrick [1908].

Genus 12. PETROSTROMA Döderlein [1892].

Diagnosis. The quadriradiates of the skeleton of the chamber-layer fused together laterally by calcareous cement into a network. Dermal skeleton of separate quadriradiates and triradiates and bunches of tuning-fork spicules.

For illustrations of this genus see Döderlein [1897].

The only known recent species of this genus is:—

1. P. SCHULZEI *Döderlein*.
 Petrostroma schulzei Döderlein [1892].

Genus 13. PLECTRONINIA Hinde [1900].

Diagnosis. Quadriradiates of the main skeleton with their facial rays truncated or expanded terminally and fused end to end with the facial rays of adjacent spicules, while the apical rays remain free and pointed. Dermal skeleton of separate radiates, including tuning-fork spicules, and oxea.

For illustrations of this genus see Kirkpatrick [1900 B].

The only known recent species of this genus are :—

1. P. DEANSII *Kirkpatrick.*
   Plectroninia deansii Kirkpatrick [1911 A].

2. P. HINDEI *Kirkpatrick.*
   Plectroninia hindei Kirkpatrick [1900 B].

The type of the genus is *P. halli* Hinde [1900], a fossil species from the Eocene of Victoria.

Family 5. MURRAYONIDÆ nov.

Murrayoninæ Kirkpatrick [1911 A].

Diagnosis. Canal system presumably always leuconid. Skeleton of the chamber layer a rigid calcareous network, not composed of spicules. No subgastral sagittal radiates. Dermal skeleton composed chiefly of overlapping calcareous scales. Nuclei of collared cells basal.

This family seems to mark the culminating point of the Leucascid-Leucettid line of evolution, and there is no other known calcareous sponge with a skeleton so highly specialised as *Murrayona.*

It is at any rate possible that the aspicular main skeleton of *Murrayona* is derived from the cement-covered fibres of spicules which are known to occur in many of the fossil forms, by a gradual disappearance of the spicular core, analogous to what we find among the Chalininæ, during the evolution of the group. It is, however, a far cry from the one to the other, and we do not doubt that there are many other ways in which the Murrayonid skeleton may have arisen.

Genus 14. MURRAYONA Kirkpatrick [1910].

Diagnosis. With a definite pore-zone in which the dermal skeleton consists of small triradiates. Tuning-fork spicules present beneath the dermal scales.

For illustrations of this genus see Kirkpatrick [1910].

The only known species of this genus is :—

1. M. PHANOLEPIS *Kirkpatrick.*
   Murrayona phanolepis Kirkpatrick [1910].

Family 6. SYCETTIDÆ Dendy [1892 B].

Diagnosis. Flagellate chambers elongated, arranged radially around a central gastral cavity, their ends projecting more or less on the dermal surface and not covered over by a continuous dermal cortex strengthened by tangential dermal spicules. Tubar skeleton articulate, with subgastral sagittal radiates. Collared cells usually confined to the radial chambers in the adult, and probably always with apical nuclei.

The Sycettidæ, in our opinion, form the starting point of a distinct line of evolution, embracing the great majority of the recent heterocœl Calcarea. This view is supported by the fact that in all the 44 species of Sycettidæ, Heteropiidæ, Grantiidæ, Amphoriscidæ and Lelapiidæ in which it has been determined, the position of the nuclei of the collared cells is apical.

It would appear therefore that this line of evolution must have originated from homocœl ancestors with apical nuclei. Such forms are known to occur amongst the simple (*i. e.* non-reticulate) species of *Leucosolenia*, as for example *L. lucasi* and *L. bella*.

Why the transition from the simple homocœl to the radial heterocœl condition originally took place we can only guess. That it was by the outgrowth of radial buds is clearly indicated, however, by the ontogeny of the genus *Sycon* (compare Schulze [1875]). No real intermediate forms are known, however, for we can no longer consider that *Dendya* is on the same line of ancestry, while von Lendenfeld's *Homoderma sycandra* is already a highly specialised *Sycon* with the typical *Sycon* skeleton, and differing from other Sycons only in the persistence of the collared cells in the central gastral cavity. According to Minchin the Sycettidæ have arisen from his homocœl family Leucosoleniidæ, but we have already endeavoured to shew that in the present state of our knowledge it is impracticable to distinguish this family from his Clathrinidæ.

The presence of sagittal radiates in which the oral angle is wider than the lateral angles appears to be a very constant character of the Sycettidæ and their derivatives. It would seem, further, that the occurrence of such spicules in the articulate tubar skeleton is correlated with the development of very definite radial tubes, but it is extremely difficult, at any rate in practice, to distinguish such spicules individually from equiangular radiates which have become sagittal by bending of the oral rays. The presence of subgastral sagittal radiates is, however, especially characteristic of this line of evolution. The oxeote type of spicule also tends to assume more importance in the skeleton of this family than in the Leucascidæ and Leucaltidæ, in which families it but rarely occurs.

Genus 15. Sycetta Haeckel [1872] (emend.).

Diagnosis. The radially arranged flagellate chambers always completely separate from one another, and never possessing tufts of oxea at their distal ends. With no properly defined inhalant canals leading to the prosopyles.

For illustrations of this genus see Haeckel [1872] under *Sycaltis conifera* and *Sycetta primitiva.*

This is the simplest of all the genera with syconoid canal system, its primitive nature being shown by the absence of fusion between the flagellate chambers and by the absence of tufts of oxea at their distal ends, unless, indeed, this absence is due to the disappearance of ancestral oxea.

Sycetta asconoides Breitfuss [1896 B], to judge by the published description, apparently occupies an intermediate position between *Sycetta* and *Sycon*, as these genera are understood by us. The description states that the flagellate chambers are fused together laterally, but that they have no tufts of oxea at their distal ends. During a recent visit to Berlin, however, one of us (Row) had the opportunity of examining one of the type slides of this species, and found that Breitfuss had overlooked the presence of a few tangentially placed dermal triradiates. The occurrence of these spicules, of course, places the species in the genus *Grantia* in the family Grantiidæ, of which it is one of the simplest forms.

We include the following species in this genus:—

1. S. conifera *Haeckel.*
   Sycaltis conifera Haeckel [1872].
2. S. primitiva *Haeckel.* Type species of the genus
   Sycetta primitiva Haeckel [1872].
3. S. sagittifera *Haeckel.*
   Sycetta sagittifera Haeckel [1872].

Genus 16. Sycon Risso [1826] (emend.).

Diagnosis. Radial chambers usually more or less united at places where they come into contact with one another, and always crowned distally with tufts of oxeote spicules. Properly defined inhalant canals usually present, the outer ends of which may be covered by a thin pore-bearing dermal membrane without special skeleton.

For illustrations of the structure of this genus see Schulze [1875] and Dendy [1893 A].

As pointed out by Dendy [1893 A] the most characteristic feature of this genus is afforded by the tufts of oxeote spicules which crown the distal ends of the radial chambers, taken in conjunction with the absence of a dermal cortical, as distinct from a tubar, skeleton. In the more specialised species a pore-bearing dermal membrane stretches between the distal ends of the radial chambers, covering over the ends of the inhalant canals, but this contains no special skeleton of its own. The flagellate chambers may also exhibit a considerable amount of branching towards their distal extremities, but they never lose their elongated character and radial arrangement.

The genus is sharply distinguished from *Sycetta* by the presence of the tufts of oxea at the distal ends of the chambers, less sharply from *Grantia* by the absence of a special dermal cortical skeleton.

We include in our conception of the genus *Sycon* von Lendenfeld's genera *Homoderma* and *Sycantha*, and Jenkin's *Tenthrenodes antarcticus*, *Streptoconus australis* and *Hypodictyon longstaffi*. We have already mentioned that *Homoderma* is merely a *Sycon* with persistent collared cells in the central gastral cavity. Jenkin [1908 B] has shown conclusively that *Sycantha tenella* is a typical *Sycon*, but has erected a new genus *Tenthrenodes* for "Sycettidæ with linked chambers," an almost identical character with that on which the genus *Sycantha* was founded; and although Dendy [1893 A] retained *Sycantha* on these grounds, we no longer consider that such "linking" can be regarded as of generic importance. We may point out here that *Tenthrenodes scotti*, the other species included by Jenkin in his genus, is placed by us in the genus *Grantia*, on account of the presence of tangential triradiates in the dermal cortex. *Streptoconus australis* and *Hypodictyon longstaffi* are "chiact"-bearing forms which were placed by Jenkin in his family Chiphoridæ.

We assign the following species to the genus :—

1. S. ALOPECURUS *Haeckel.*
   Sycum alopecurus Haeckel [1870].
   Sycandra ampulla var. *alopecurus* Haeckel [1872].

2. S. AMPULLA *Haeckel.*
   Sycarium ampulla Haeckel [1870].
   Sycon petiolatus O. Schmidt MS., *fide* Haeckel [1872].
   Sycum petiolatum Haeckel [1870], *fide* Haeckel [1872].
   Sycandra ampulla Haeckel [1872].

3. S. ANTARCTICUM *Jenkin.*
   Tenthrenodes antarcticus Jenkin [1908 B].

4. S. ARCTICUM *Haeckel.*
   Sycum arcticum Haeckel [1870].
   Sycon raphanus O. Schmidt [1870], *fide* Haeckel [1872].
   Sycandra arctica Haeckel [1872].

5. S. ASPERUM *Gibson.*
   Sycandra aspera Gibson [1886].

6. S. AUSTRALE *Jenkin.*
Streptoconus australis Jenkin [1908 B].

7. S. BARBADENSE *Schuffner.*
Sycandra barbadensis Schuffner [1877].

8. S. BOOMERANG *Dendy.*
Sycon boomerang Dendy [1892 B].

9. S. BOREALE *Schuffner.*
Sycandra borealis Schuffner [1877].

10. S. CAMINATUM *Thacker.*
Sycon caminatum Thacker [1908].

11. S. CARTERI *Dendy.*
Sycon carteri Dendy [1892].
Sycantha tenella von Lendenfeld MS., *fide* Breitfuss [1897].
Sycon carteri Row [1913 MS.].

12. S. CILIATUM *Fabricius.*
Spongia ciliata Fabricius [1780].
Sycum giganteum Haeckel [1870], *fide* Haeckel [1872].
Sycocystis oviformis Haeckel [1870], *fide* Haeckel [1872].
Sycodendrum ramosum Haeckel [1870], *fide* Haeckel [1872].
Sycandra ciliata Haeckel [1872].

13. S. COACTUM *Urban.*
Sycandra coacta Urban [1905].

14. S. COMMUTATUM *Haeckel.*
Sycandra coronata var. *commutata* Haeckel [1872].

15. S. COMPACTUM *Lambe.*
Sycon compactum Lambe [1893].

16. S. CORONATUM *Ellis and Solander.*
Spongia coronata Ellis and Solander [1786].
Grantia ciliata Bowerbank [1864–1882], *fide* Haeckel [1872].
Sycandra coronata Haeckel [1872].
Sycon coronatum Dendy [1892 B].

17. S. EGLINTONENSIS *Lambe.*
Sycon eglintonensis Lambe [1900 B].

18. S. ELEGANS *Bowerbank.*
Dunstervillia elegans Bowerbank [1845].
Dunstervillia lanzerotæ Haeckel [1870], *fide* Haeckel [1872].
Sycandra elegans Haeckel [1872].

19. S. ENSIFERUM *Dendy.*
Sycon ensiferum Dendy [1892 B].
Sycon ensiferum Row [1913 MS.].

20. S. FORMOSUM *Haeckel.*
Dunstervillia formosa Haeckel [1870].
Sycandra elegans var. *formosa* Haeckel [1872].

21. S. GELATINOSUM *de Blainville.*
Alcyoncellum gelatinosum de Blainville [1834–1847].
Grantia virgultosa Bowerbank MS., *fide* Haeckel [1872].
Sycandra alcyoncellum Haeckel [1872], *fide* Dendy [1892 B].
Sycandra arborea Haeckel [1872], *fide* Dendy [1892 B].
Sycon gelatinosum Dendy [1892 B].

22. S. GIGANTEUM *Dendy.*
Sycon giganteum Dendy [1892 B].

23. S. HELLERI *von Lendenfeld.*
Sycandra helleri von Lendenfeld [1891].

24. S. HUMBOLDTII *Risso.* Type species of the genus.
Sycon humboldtii Risso [1826].
Dunstervillia corcyrensis O. Schmidt [1862], *fide* Haeckel [1872].
Dunstervillia schmidtii Haeckel [1870], *fide* Haeckel [1872].
Sycandra humboldtii Haeckel [1872].

25. S. IMPLETUM *Haeckel.*
Artynas villosum Haeckel [1870], *fide* Haeckel [1872].
Sycandra villosa var. *impletum* Haeckel [1872].

26. S. INCONSPICUUM *von Lendenfeld.*
Sycandra inconspicua von Lendenfeld [1885 B].

27. S. INCRUSTANS *Breitfuss.*
Sycon incrustans Breitfuss [1898 E].

28. S. KARAJAKENSE *Breitfuss.*
Sycon karajakense Breitfuss [1897].

29. S. KERGUELENSIS *Urban.*
Sycon kerguelensis Urban [1908].

30. S. LAMBEI, *sp. n.*
Sycon asperum Lambe [1896].

The new specific name has been given to the above species on account of the fact that the name *asperum* is already occupied in this genus. (See above.)

31. S. LANCEOLATUM *Haeckel.*
Sycum lanceolatum Haeckel [1870].
Sycandra ciliata var. *lanceolata* Haeckel [1872].

32. S. LENDENFELDI *Row.*
    Sycon lendenfeldi Row [1913 MS.].

33. S. LINGUA *Haeckel.*
    Sycortis lingua Haeckel [1872].

34. S. LONGSTAFFI *Jenkin.*
    Hypodictyon longstaffi Jenkin [1908 B].

35. S. MAXIMUM *Haeckel.*
    Sycandra arctica var. *maxima* Haeckel [1872].

36. S. MINUTUM *Dendy.*
    Sycon minutum Dendy [1892 B].

37. S. MUNDULUM *Lambe.*
    Sycon mundulum Lambe [1900 B].

38. S. MUNITUM *Jenkin.*
    Sycon munitum Jenkin [1908 A].

39. S. ORNATUM *Kirk.*
    Sycon ornatum Kirk [1897].

40. S. OVATUM *Haeckel.*
    Sycum ovatum Haeckel [1870].
    Sycandra ciliata var. *ovata* Haeckel [1872].

41. S. PARVULUM *Preiwisch.*
    Sycandra parvula Preiwisch [1904].

42. S. PEDICELLATUM *Kirk.*
    Sycon pedicellatum Kirk [1897].

43. S. PETIOLATUM *Haeckel* [1870].
    Sycum petiolatum Haeckel [1870].
    Sycandra ampulla var. *petiolata* Haeckel [1872].

44. S. POLARE *Haeckel.*
    Sycandra arctica var. *polaris* Haeckel [1872].

45. S. PROBOSCIDEUM *Haeckel.*
    Syconella proboscidea Haeckel [1870].
    Sycandra raphanus var. *proboscidea* Haeckel [1872]

46. S. PROCUMBENS *Haeckel.*
    Sycum procumbens Haeckel [1870].
    Sycandra raphanus var. *procumbens* Haeckel [1872].

47. S. PROTECTUM *Lambe.*
    Sycon protectum Lambe [1896].

48. S. QUADRANGULATUM *O. Schmidt.*
    Syconella quadrangulata O. Schmidt [1868].
    Sycandra quadrangulata Haeckel [1872].

49. S. RAMOSUM *Haeckel.*
Sycandra ramosa Haeckel [1872].
Leuckartea natalensis Michlucho-Maclay MS., *fide* Haeckel [1872].

50. S. RAMSAYI *von Lendenfeld.*
Sycandra ramsayi von Lendenfeld [1885 A].

51. S. RAPHANUS *O. Schmidt.*
Sycon raphanus O. Schmidt [1862].
Spongia inflata Delle Chiaje [1828], *fide* Haeckel [1872].
Sycarium vesica Haeckel [1870], *fide* Haeckel [1872].
Sycandra raphanus Haeckel [1872].

52. S. SCHMIDTII *Haeckel.*
Sycandra schmidtii Haeckel [1872].

This species must be distinguished from *Dunstervillia schmidtii* Haeckel, a synonym of *Sycon humboldtii* Risso.

53. S. SCHUFFNERI, *sp. n.*
Sycandra quadrata Schuffner [1877].

We propose this new name in order to avoid confusion with Haeckel's variety *quadrata* of *Sycon quadrangulatum* (O. Schmidt).

54. S. SETOSUM *O. Schmidt.*
Sycon setosum O. Schmidt [1862].
Sycandra setosa Haeckel [1872].

55. S. STAURIFERUM *Preiwisch.*
Sycandra staurifera Preiwisch [1904].

56. S. SUBHISPIDUM *Carter.*
Grantia subhispida Carter [1885–1886].

57. S. SYCANDRA *von Lendenfeld.*
Homoderma sycandra von Lendenfeld [1885 A].
Leucosolenia (?) *sycandra* Dendy [1891 A].
See also Row [1913 MS.], under *Sycon lendenfeldi.*

58. S. TABULATUM *Schuffner.*
Sycandra tabulata Schuffner [1877].

Very probably identical with Haeckel's variety *tabulata* of *Sycon elegans* Bowerbank.

59. S. TENELLUM *von Lendenfeld.*
Sycantha tenella von Lendenfeld [1891].
Sycon tenellum Jenkin [1908 B].

60. S. TERGESTINUM *Haeckel.*
Sycum tergestinum Haeckel [1870].
Sycandra raphanus var. *tergestina* Haeckel [1872].

61. S. TESSELLATUM *Bowerbank.*
Grantia tessellata Bowerbank [1864–1882].
Sycandra elegans var. *tessellata* Haeckel [1872].

62. S. TESSERARIUM *Haeckel.*
Sycandra quadrangulata var. *tesseraria* Haeckel [1872].

63. S. TUBA *von Lendenfeld.*
Sycandra tuba von Lendenfeld [1891].

64. S. TUBULOSUM *Haeckel.*
Sycandra coronata var. *tubulosa* Haeckel [1872].

65. S. VERUM *Row.*
Sycon verum Row [1913 MS.].

66. S. VILLOSUM *Haeckel.*
Sycarium villosum Haeckel [1870].
Sycum clavatum Haeckel [1870], *fide* Haeckel [1872].
Sycandra villosa Haeckel [1872].

67. S. VIRGULTOSUM *Haeckel.*
Sycandra alcyoncellum var. *virgultosa* Haeckel [1872].

Genus 17. SYCANDRA Haeckel [1872] (emend.).

Diagnosis. The radially arranged flagellate chambers more or less united where they come into contact with one another. Gastral cavity traversed by strands of tissue containing bundles of parallel oxea and forming a more or less strongly developed endogastric network. Radially arranged dermal oxea present.

For illustrations of this genus see Haeckel [1872].

We propose to use this generic name for O. Schmidt's *Ute utriculus* (=*Sycandra utriculus* Haeckel), which is sufficiently sharply distinguished by its skeletogenous endogastric network. There is only one other species in which this character is known to occur, namely *Leucettaga loculosa*, a member of the family Grantiidæ.

The species of *Sycandra* which precede *S. utriculus* in Haeckel's monograph having been relegated to earlier genera such as *Sycon*, *Ute* and *Grantia*, this species becomes the type of the genus.

The only known species is :—

1. S. UTRICULUS *O. Schmidt.*
Ute utriculus O. Schmidt [1870].
Sycandra utriculus Haeckel [1872].

Family 7. HETEROPIIDÆ Dendy [1892 B].

Diagnosis. With a distinct and continuous dermal cortex covering over the chamber-layer and pierced by inhalant pores. Subgastral sagittal and subdermal pseudosagittal radiates are present. Flagellate chambers varying from elongated and radially arranged to spherical and irregularly scattered. With or without an articulate tubar skeleton. Nuclei of collared cells probably always apical.

This family is identical in scope with the family as originally proposed by Dendy [1892 B], and the difference now made in the diagnosis is due to the fact that our conception of the subdermal triradiates has changed. Up to the present we have considered the characteristic subdermal spicules in this family as being truly sagittal, with the basal ray centripetally directed. We have now convinced ourselves, however, by a careful examination of a number of species, that this is not the case, but that the inwardly pointing ray is really one of the oral rays, and that the original basal ray has taken on the appearance and position of an oral ray. In other words, we find the clearest evidence that these spicules are derived from ordinary distally situated triradiates of the articulate tubar skeleton, which have undergone rotation followed by the acquisition of a secondary pseudo-symmetry. We therefore propose for them the name of *pseudosagittal*. It will be remembered that Poléjaeff [1883] recognised, in the case of *Grantessa (Amphoriscus) poculum* and *G. flamma*, that the subdermal triradiates are not ordinary sagittal spicules and that the centripetal ray is really one of the lateral (=oral) rays and not the basal ray. He, however, considered that they are triradiates of the dermal cortex which have undergone re-orientation, and not, as we maintain, tubar triradiates.

Various species of the genus *Grantessa* show quite clearly how the change has taken place. In *Grantessa hirsuta* we have a primitive type with long chambers and an articulate skeleton of many joints. At the distal ends of the chambers are tufts of oxea, towards which the basal rays of the triradiates of the distal joint of the tubar skeleton are inclined, as indeed occurs also in the genera *Sycon* and *Grantia*. Moreover, the whole spicule has become tilted until in some cases one of the original oral rays has assumed a position at right angles to the surface, while the other has come to lie nearly parallel to the surface, where it probably serves to guard the entrance to the inhalant canal. In more advanced cases, such as *Grantessa sacca* and *G. hispida*, the great elongation of the now inwardly directed oral ray increases the resemblance to an ordinary sagittal spicule, but a characteristic asymmetry of the outwardly directed (apparent oral) rays, accompanied by a definite kink or angulation in one of them, (which appears to be due to change of position during individual growth), affords a clear indication of what has really taken place. Finally, in the most advanced types, such as *Grantessa intusarticulata*, we find the pseudosagittal subdermal spicules assuming great dominance, almost to the exclusion of the typical articulate tubar skeleton, so that we arrive at the so-called inarticulate type.

The development of these characteristic spicules appears to antedate the appearance of a definite dermal cortex, for we find in *Sycon ensiferum* Dendy a similar canting of certain of the distal tubar triradiates, which renders this species almost indistinguishable from *Grantessa*. Indeed, it is this out-turning of one of the rays of the distal tubar triradiates that has, in our opinion, led to the formation of a dermal cortex, probably by the drawing out of the soft tissues of the sponge with the rays in question. Thus the origin of the dermal cortex in this family would be intimately connected with the development of these subdermal pseudosagittal triradiates. In the Grantiidæ, on the other hand, the dermal cortex appears to have originated in the development of tangentially placed triradiates in a previously aspicular pore-bearing dermal membrane.

These views undoubtedly tend to bridge over the gap between the Sycettidæ and the Heteropiidæ, and indeed the more primitive species of *Grantessa* are differentiated from *Sycon* and *Grantia* by very slight characters, and difficult to separate from them, but the rotation of the triradiates in question appears to have formed the starting point of a new line of skeletal evolution which seems to us to deserve recognition as marking a distinct family.

We consider the views here put forward as to the origin of the subdermal pseudosagittal spicules of the Heteropiidæ to be more in accordance with observed facts than those previously suggested by one of us (Row 1909) in regard to the "subdermal secondary sagittal triradiates" of *Grantilla*, which seem to be pseudosagittal spicules really similar to those of *Grantessa*.

We have changed the spelling of the name of the family from Heteropidæ to Heteropiidæ, the latter being more in accordance with the usual practice.

Genus 18. Grantessa von Lendenfeld [1885 B] (emend.).

Diagnosis. Canal system syconoid. No colossal longitudinally placed oxea.

For illustrations of this genus see von Lendenfeld [1885 B] and Dendy [1893 A].

The tubar skeleton in this genus ranges from articulate, with very numerous joints, as in *Grantessa sacca*, *G. erinaceus*, *G. hirsuta* and *G. hispida*, to inarticulate or nearly so, as in *G. glabra* and

G. polyperistomia. This character might indeed be used as a basis for the subdivision of the genus, were it not for the impossibility of drawing a satisfactory line between the two types of tubar skeleton.

We recognise the following species as belonging to this genus:—

Section A. With large, usually radially arranged oxea but without microxea.

1. G. compressa *Carter.*
   Heteropia compressa Carter [1885–1886].
2. G. erecta *Carter.*
   Heteropia erecta Carter [1885–1886].
3. G. erinaceus *Carter.*
   Leuconia erinaceus Carter [1885–1886]
4. G. flamma *Poléjaeff.*
   Amphoriscus flamma Poléjaeff [1883].
5. G. glabra *Row.*
   Grantessa glabra Row [1909].
6. G hastifera *Row.*
   Grantilla hastifera Row [1909].
   Grantessa hastifera Dendy [1913].
7. G. hirsuta *Carter.*
   Hypograntia hirsuta Carter [1885–1886].
   Grantessa hirsuta Row [1913 MS.].
8. G. hispida *Dendy.*
   Grantessa hispida Dendy [1892 B].
9. G. lanceolata *Breitfuss.*
   Ebnerella lanceolata Breitfuss [1898 B].
10. G. nitida *Arnesen.*
    Ebnerella nitida Arnesen [1901].
11. G. pelagica *Ridley.*
    Nardoa pelagica Ridley [1881].
12. G. pluriosculifera *Carter.*
    Heteropia pluriosculifera Carter [1885–1886].
13. G. poculum *Poléjaeff.*
    Amphoriscus poculum Poléjaeff [1883].
    Heteropia patulosculifera Carter [1885–1886], *fide* Dendy [1892 B].
    Grantessa poculum Dendy [1892 B].

14. G. POLYPERISTOMIA *Carter.*
Heteropia polyperistomia Carter [1885–1886].
Grantessa polyperistomia Row [1913 MS.].

15. G. SACCA *von Lendenfeld.* Type species of the genus.
Grantessa sacca von Lendenfeld [1885 B].

16. G. SYCILLOIDES *Schuffner.*
Sycortis sycilloides Schuffner [1877].

SECTION B. Without large oxea, but with microxea.

17. G. INTUSARTICULATA *Carter.*
Hypograntia intusarticulata Carter [1885–1886].
Hypograntia medioarticulata Carter [1885–1886], *fide* Dendy [1892 B].
Grantessa intusarticulata Dendy [1892 B].

SECTION C. With large, usually radially arranged oxea and with microxea.

18. G. KÜKENTHALI *Breitfuss.*
Ebnerella kükenthali Breitfuss [1896 A].

19. G. PREIWISCHI, *sp. n.*
Ebnerella compressa Preiwisch [1904].

This new specific name has been given to the species, as *compressa* is already occupied. (See above.)

20. G. SPISSA *Carter.*
Heteropia spissa Carter [1885–1886].

21. G. THOMPSONI *Lambe.*
Amphoriscus thompsoni Lambe [1900 B].

SECTION D. Without any oxea.

22. G. GLACIALIS *Haeckel.*
Sycaltis glacialis Haeckel [1872].

23. G. MURMANENSIS *Breitfuss.*
Amphoriscus murmanensis Breitfuss [1898 B].

24. G. SIMPLEX *Jenkin.*
Grantessa simplex Jenkin [1908 A].

25. G. STAURIDEA *Haeckel.*
Sycetta stauridea Haeckel [1872].
Djeddea violacea Michlucho-Maclay MS., *fide* Haeckel [1872].

26. G. ZANZIBARENSIS *Jenkin.*
Grantessa zanzibarensis Jenkin [1908 A].

Genus 19. HETEROPIA Carter [1885–1886] (emend.).

Diagnosis. Canal system syconoid. Dermal cortex with colossal longitudinal oxea.

For illustrations of this genus see Row [1913 MS.].

This genus stands in precisely the same relation to *Grantessa* that *Ute* does to *Grantia*. It is noteworthy that, in all known species of this genus, as in the more highly developed species of *Grantessa*, the tubar skeleton has been reduced to the subgastral sagittal triradiates, supplemented by the subdermal pseudosagittal triradiates, and has thus become "inarticulate."

The genus *Heteropia* was diagnosed by Carter in July 1886 as follows:—"Calcareous sponges in which the wall is simply composed of sarcode supported on large sagittiform triradiates, whose heads are fixed in opposite sides of it respectively, and whose long shafts, extending perpendicularly across it, more or less overlap each other."

Most of the species placed by Carter in this genus belong to the earlier genus *Grantessa* of von Lendenfeld. There is, however, one of his species, *Heteropia ramosa*, which is distinguished by the presence of colossal longitudinal dermal oxea, and which may be regarded as the type of Carter's genus. It is curious that Mr. Carter himself [1886] described it under the name of *Aphroceras ramosa*, whilst saying at the same time that it belonged to his genus *Heteropia*.

We recognise the following species as belonging to this genus:—

SECTION A. Without microxea.

1. H. GLOMEROSA *Bowerbank*.
   Leuconia glomerosa Bowerbank [1872–1876].

2. H. RAMOSA *Carter*. Type species of the genus.
   Aphroceras ramosa Carter [1886].

3. H. SIMPLEX *Row*.
   Heteropia simplex Row [1913 MS.].

SECTION B. With microxea.

4. H. RODGERI *Lambe*.
   Heteropia rodgeri Lambe [1900].

Genus 20. AMPHIUTE Hanitsch [1894].

Diagnosis. Canal system syconoid. Both gastral and dermal cortices with colossal longitudinal oxea.

For illustrations of this genus see Hanitsch [1895].

This genus may be regarded as derived from some more primitive type of *Grantessa* by the addition of colossal longitudinal oxea to both dermal and gastral cortices. Those in the gastral cortex are probably to be regarded as having been derived from the oxea of the oscular fringe, by downward extension. In the only known species microxea are present, and the articulate tubar skeleton still persists.

The only known species is:—

1. A. PAULINI *Hanitsch.*
   Amphiute paulini Hanitsch [1894].

Genus 21. VOSMAEROPSIS Dendy [1892 B].

Diagnosis. Canal system sylleibid (or leuconoid ?). Skeleton of the chamber layer composed of the centrifugally directed rays of subgastral sagittal triradiates and the centripetally directed rays of subdermal pseudosagittal triradiates, which may be supplemented or partially replaced by confused triradiates. No colossal longitudinal oxea.

For illustrations of this genus see Dendy [1892 B].

In all the known species of *Vosmaeropsis* we find that the canal system has not developed beyond the sylleibid condition, and there can still be distinguished in the chamber layer very clear indications of an inarticulate tubar skeleton ; in fact, the genus seems to have reached almost exactly the same level of evolution as *Megapogon* in the Grantiidæ, when allowance is made for the different type of skeleton in the two families. This would at any rate seem to suggest that the family Heteropiidæ is of comparatively recent origin, and that more complex forms, comparable to the higher types of the Grantiidæ, have not yet made their appearance, unless, indeed, they have merely escaped observation.

We recognise the following species in this genus :—

SECTION A. With large oxea and microxea.

1. V. DEPRESSA *Dendy.*
   Vosmaeropsis depressa Dendy [1892 B].

2. V. MACERA *Carter.* Type species of the genus.
   Heteropia macera Carter [1885–1886].
   Vosmaeropsis macera Dendy [1892 B].

3. V. WILSONI *Dendy.*
   Vosmaeropsis wilsoni Dendy [1892 B].

Section B. With large, usually radially arranged oxea, but without microxea.

Although the author's description does not conform to the above diagnosis, we include Poléjaeff's *Leucilla connexiva* in this section of the genus, for the figures given by him show oxea present, though no reference is made to them in the text, and our own examination of the type specimen revealed the presence of occasional trichoxea.

4. V. connexiva *Poléjaeff.*
   Leucilla connexiva Poléjaeff [1883].

5. V. cyathus *Verrill.*
   Leucandra cyathus Verrill [1873].

6. V. dendyi *Row.*
   Vosmaeropsis dendyi Row [1913 MS.].

7. V. primitiva *Row.*
   Vosmaeropsis primitiva Row [1913 MS.].

8. V. sericatum *Ridley.*
   Aphroceras sericatum Ridley [1884].

This species has been placed in *Vosmaeropsis* as a result of an examination of the type specimen made by us at the Natural History Department of the British Museum, which revealed the existence of typical subdermal pseudosagittal triradiates, though the author's original description does not mention them.

Genus 22. Grantilla Row [1909] (emend.).

Diagnosis. Canal system syconoid. Tubar skeleton (? always) inarticulate, composed of subdermal pseudosagittal triradiates and subgastral sagittal triradiates, supplemented by subdermal quadriradiates. No colossal longitudinal oxea.

For illustrations of this genus see Row [1909].

This genus was originally proposed by Row for two species, *G. quadriradiata* and *G. hastifera*, which were supposed to possess certain features that necessitated the provision of a new family, Grantillidæ. We now consider, however, that the characters in question do not represent any fundamental peculiarities of structure, and we have therefore abandoned the family, as already stated in the Introduction.

One of the two species originally assigned to *Grantilla*, *G. quadriradiata*, however, presents an association of subdermal quadriradiates with subdermal pseudosagittal triradiates, which is not known in any other species of calcareous sponge, and we therefore retain the name *Grantilla* for this species with an emended diagnosis. The development of subdermal quadriradiates has evidently taken place repeatedly in the phylogeny of the Calcarea. We have seen it already, for example, in *Leucetta*, *Leucaltis* and *Leucettusa*, and have not in those cases considered the presence of such spicules as of generic value. In *Grantilla*, however, they seem to assume more importance, and to take a larger share in the formation of the skeleton of the chamber layer. Nevertheless, had the genus not been already in existence, we should have hesitated to propose it on this character alone.

The only known species of the genus is :—

1. G. QUADRIRADIATA *Row.*
   Grantilla quadriradiata Row [1909].

Family 8. GRANTIIDÆ Dendy [1892] (emend.).

Diagnosis. With a distinct dermal cortex and a proper cortical skeleton of tangential radiates, sometimes supplemented by, and occasionally replaced by, oxea. Flagellate chambers ranging from elongated and radially arranged to small, spherical and irregularly scattered. Skeleton of the chamber layer ranging from regularly articulate to irregularly scattered. Typically with subgastral sagittal radiates. No subdermal pseudosagittal triradiates. Subdermal quadriradiates, if present, always associated with a chamber-layer skeleton containing confused triradiates. Nuclei of collared cells probably always apical.

It must frankly be admitted that the boundary line between the Sycettidæ and the Grantiidæ is by no means sharply defined. The great distinguishing feature is the presence in the latter of a distinct dermal cortex with its own proper skeleton. The development of such a cortex appears to have formed the determining condition for the further evolution of both the canal system and the skeleton, and it must therefore be regarded as of great systematic importance.

The first commencement of such a cortex is, however, so slight as to be almost indistinguishable from the mere pore-bearing dermal membrane of the most highly specialised Sycons. In *Grantia compressa* the cortex is so feebly developed that Dendy, in his early work [1892 B], included this species in the genus *Sycon*, laying more stress upon the presence of dermal tufts of oxea than we are now inclined to do in this connection. It appears to us that the line between *Sycon* and *Grantia*, and therefore between the Sycettidæ and Grantiidæ, must be drawn at the appearance of a dermal cortical skeleton of tangential radiates distinct from the skeleton of the radial chambers, and in accordance with these views *Grantia compressa* is excluded from the genus *Sycon*. Moreover, it must be pointed out that *G. compressa* is not the only member of this family in which dermal tufts of oxea occur, as they are present also in *Sycute dendyi* Kirk.

With the transition from the syconoid to the leuconoid type o canal system in this family, and the correlated replacement of th articulate tubar skeleton by irregularly scattered radiates, we ge a close approach to the more advanced Leucascidæ, such a *Leucetta* and *Pericharax*, and we have here one of those cases o convergence which are so frequently met with amongst sponges, but we have already laid sufficient emphasis upon this point. Even in the genus *Leucandra*, however, subgastral sagittal triradiates are usually present, and when they are absent their absence must be regarded as secondary.

So far as our experience goes the nucleus of the collared cells is always apical in position in this family. We have been able to determine it in 17 species, as enumerated in an earlier section of this paper.

The family is a very large one, comprising no less than 23 out of the 51 genera of recent calcareous sponges which we recognise, and containing a great diversity of structural types within it. There are, however, very great difficulties in the way of dividing it into subfamilies, the chief of these being the fact that the possible methods of deriving the various genera from one another within the family are manifold, and it is impossible to determine satisfactorily which are the true lines upon which evolution has proceeded. We might, for example, place all those genera which have a syconoid canal system and colossal longitudinal oxea in the dermal cortex together in a subfamily Uteinæ; or we might separate the genus *Uteopsis* from the others, and unite it with *Achramorpha* and *Anamixilla* in a subfamily characterised by the reduction of the tubar skeleton to a single joint. But neither of these two possible subfamilies would seem to be very sharply defined, and moreover, the characters in question are not confined to members of the Grantiidæ. In short, we feel that in the present state of our knowledge it is impossible to decide which method of grouping would express most correctly the real affinities of the genera concerned. This is the case with almost all the possible methods of grouping the genera, and we have therefore decided not to attempt to split up the family, but merely to indicate the approximate relationships of the genera, so far as this is possible in a linear series, by the order in which we have arranged them,

Although it seems probable that the majority of the genera in this family are descended from the genus *Sycon*, yet it is quite possible that some of them may be descended independently from *Sycetta*, and therefore that the family may be of diphyletic origin.

We have changed the name of the family from Grantidæ to Grantiidæ in accordance with the usual practice of systematic zoologists.

Genus 23. Grantia Fleming [1828] (emend.).

Diagnosis. Canal system syconoid. Colossal longitudinal oxea, if present, projecting from the surface. Tubar skeleton articulate, composed of radiate spicules, which may or may not be supplemented by oxea.

For illustrations of this genus see Dendy [1893 A].

It has been conclusively shown by Minchin [1896] that the type species of the genus *Grantia* is *G. compressa*, and that the name *Grantia* must always be given to the group of species associated with *G. compressa.* We have already pointed out that this species has a definite, though slight, dermal cortex, and that its true position is in the present family, and in fact, in the genus *Grantia* as defined by Dendy in 1892.

We may point out that *G. intermedia* Thacker stands alone in the genus, as far as is at present known, in the presence of apical rays on the tangential cortical radiates, and although we do not attach much importance to such spicules, we feel that their presence in this species indicates at any rate a possible starting point for the family Amphoriscidæ.

We recognise the following species as belonging to this genus :—

Section A. With large, usually radially arranged oxea, but without microxea.

1. G. atlantica *Ridley.*
   Grantia atlantica Ridley [1881].

2. G. brevipilis *Haeckel.*
   Sycandra capillosa var. *brevipilis* Haeckel [1872].

3. G. canadensis *Lambe.*
   Grantia canadensis Lambe [1896].

4. G. capillosa *O. Schmidt.*
   Ute capillosa O. Schmidt [1862].
   Sycandra capillosa Haeckel [1872].

5. G. chartacea *Jenkin.*
   Dermatreton chartaceum Jenkin [1908 B].

6. G. clavigera *O. Schmidt.*
   Sycinula clavigera O. Schmidt [1870].
   Sycandra clavigera (*Sycandra compressa* var. *clavigera*) Haeckel [1872].

7. G. comoxensis *Lambe.*
   Grantia comoxensis Lambe [1893].

8. G. COMPRESSA *Fabricius.* Type species of the genus.
Spongia compressa Fabricius [1780].
Sycum lingua Haeckel [1870], *fide* Haeckel [1872].
Sycarium rhopalodes Haeckel [1870], *fide* Haeckel [1872].
Sycandra compressa Haeckel [1872].
Sycon compressum Dendy [1892 B].

9. G. FOLIACEA *Montagu.*
Spongia foliacea Montagu [1812].
Sycandra foliacea (*Sycandra compressa* var. *foliacea*) Haeckel [1872].

10. G. GENUINA *Row.*
Grantia genuina Row [1913 MS.].

11. G. GRACILIS *von Lendenfeld.*
Vosmaeria gracilis von Lendenfeld [1885 B].

12. G. HODGSONI *Jenkin.*
Dermatreton hodgsoni Jenkin [1908 B].

13. G. INTERMEDIA *Thacker.*
Grantia intermedia Thacker [1908].

14. G. LOBATA *Haeckel.*
Sycandra lobata (*Sycandra compressa* var. *lobata*) Haeckel [1872].

15. G. LONGIPILIS *Haeckel.*
Sycandra capillosa var. *longipilis* Haeckel [1872].

16. G. MONSTRUOSA *Breitfuss.*
Grantia monstruosa Breitfuss [1898 B].

17. G. PENNIGERA *Haeckel.*
Sycandra pennigera (*Sycandra compressa* var. *pennigera*) Haeckel [1872].

18. G. SCOTTI *Jenkin.*
Tenthrenodes scotti Jenkin [1908 B].

19. G. TENUIS *Urban.*
Grantia tenuis Urban [1908].

20. G. VOSMAERI *Dendy.*
Grantia vosmaeri Dendy [1892 B].

SECTION B. Without any oxea.

21. G. ASCONOIDES *Breitfuss.*
Sycetta asconoides Breitfuss [1896 B].

Our reasons for placing this species under *Grantia* rather than under *Sycetta* have been stated when discussing the latter genus.

22. G. CUPULA *Haeckel.*
    Sycetta cupula Haeckel [1872].

23. G. INVENUSTA *Lambe.*
    Grantia invenusta Lambe [1900 B].

24. G. STROBILUS *Haeckel.*
    Sycetta strobilus Haeckel [1872].

SECTION C. With large, usually radially arranged oxea, and with microxea.

25. G. ACULEATA *Urban.*
    Grantia aculeata Urban [1908].

26. G. EXTUSARTICULATA *Carter.*
    Hypograntia extusarticulata Carter [1885–1886].
    Grantia extusarticulata Dendy [1892 B].

27. G. INDICA *Dendy.*
    Grantia indica Dendy [1912].

28. G. MIRABILIS *Fristedt.*
    Ascandra mirabilis Fristedt [1887].
    Grantia mirabilis Lundbeck [1909].

29. G. TUBEROSA *Poléjaeff.*
    Grantia tuberosa Poléjaeff [1883].

SECTION D. With microxea, but without large oxea.

30. G. LÆVIGATA *Haeckel.*
    Sycortis lævigata Haeckel [1872].
    Sycortusa lævigata von Lendenfeld [1885 B].

31. G. PHILLIPSII *Lambe.*
    Grantia phillipsii Lambe [1900 B].

The following are doubtfully assigned to this genus:—

32. G. SINGULARIS *Breitfuss.*
    Sphenophorina singularis Breitfuss [1898 B].
    The genus *Sphenophorina* is discussed at some length in the list of rejected genera.

33. G. URCEOLUS *Müller.*
    Spongia urceolus Müller [1788–1796].
    Stated by Johnston [1842] to be very probably a variety of *Grantia compressa.*

Genus 24. TEICHONOPSIS nov.

Diagnosis. Sponge consisting of a single stipitate person with enormously expanded gastral cavity and thin, much folded wall, whose convoluted edge represents the oscular margin. Canal system syconoid. Tubar skeleton articulate. Without colossal longitudinal oxea.

For illustrations of this genus see Dendy [1891 B].

We propose this genus for the reception of the remarkable species *T. labyrinthica*, usually known as *Grantia labyrinthica*, which forms the subject of a special memoir by one of us, Dendy [1891 B]. We now consider that the very peculiar external form is of sufficient importance to justify generic separation. The species was originally placed by Carter in his genus *Teichonella*, on account of some superficial resemblance to his *T. prolifera*; but although the name *Teichonella* has now been universally abandoned even for *Leucetta* (*Teichonella*) *prolifera*, we do not consider ourselves justified in reviving it for *Grantia labyrinthica*, for Mr. Carter himself subsequently dissociated this species from *Teichonella* and placed it in the genus *Grantia* [1885–1886].

The only known species is:—

1. T. LABYRINTHICA *Carter*.
   Teichonella labyrinthica Carter [1878].
   Grantia labyrinthica Dendy [1891 B].

Genus 25. GRANTIOPSIS Dendy [1892 B].

Diagnosis. Canal system syconoid. Dermal cortex as thick as the chamber layer, with many layers of tangential triradiates. Tubar skeleton articulate, the proximal joint being composed of subgastral sagittal quadriradiates (? or triradiates), the other joints of sagittal triradiates practically reduced to the basal ray by suppression of the paired rays. Without colossal longitudinal oxea.

For illustrations of this genus see Dendy [1893 A] and Row [1913 MS.].

This genus was first proposed by Dendy [1892 B] for his *Grantiopsis cylindrica*, and was considered by him to be a subgenus of *Grantia*. Jenkin [1908 B] placed it as a distinct genus in his family Staurorrhaphidæ, on the ground that the subgastral spicules were "chiactines." As we cannot accept the chiact theory, we again transfer the genus to the Grantiidæ, but consider it sufficiently distinct from *Grantia* to deserve generic recognition.

We have recently discovered, as the result of our study of Mr. Carter's MS. illustrations, in the possession of one of us, that that author's "*Hypograntia infrequens* (incertæ sedis)" is undoubtedly a species of *Grantiopsis*, and the same species has recently turned up again in the collection made by the Hamburg

South-Western Australian Expedition of 1905. As neither Mr. Carter's *Hypograntia* nor the species *H. infrequens* were ever recognisably diagnosed, we do not consider it necessary to abandon the generic name *Grantiopsis*. The question will be more fully dealt with in the forthcoming report on the above-mentioned collection [Row 1913 MS.].

We recognise the following species in this genus:—

1. G. CYLINDRICA *Dendy*. Type species of the genus.
   Grantiopsis cylindrica Dendy [1892 B].

2. G. INFREQUENS *Carter*.
   Hypograntia infrequens Carter [1885–1886].
   Grantiopsis infrequens Row [1913 MS.].

Genus 26. SYCUTE nov.

Diagnosis. Canal system syconoid. Dermal cortex provided with colossal longitudinally arranged oxea. Tubar skeleton articulate. Distal ends of the flagellate chambers crowned with tufts of oxea lying between the colossal longitudinal oxea.

For illustrations of this genus see Kirk [1894].

This genus has been provided for Kirk's *Sycon dendyi*, a species which is curiously intermediate in character between *Sycon* and *Ute*, retaining the well-defined tufts of oxea which are characteristic of *Sycon* and at the same time possessing the colossal longitudinal oxea characteristic of *Ute*.

The only known species is:—

1 S. DENDYI *Kirk*.
   Sycon dendyi Kirk [1894].

Genus 27. UTE O. Schmidt [1862] (emend.).

Diagnosis. Canal system syconoid. Tubar skeleton articulate. Dermal cortex well developed, containing colossal longitudinal oxea. No tufts of oxea at the distal ends of the flagellate chambers.

For illustrations of this genus see Dendy [1893 A].

We allocate the following species to this genus:—

SECTION A. Without microxea.

1. U. ENSATA *Bowerbank*.
   Grantia ensata Bowerbank [1864–1882].
   Sycandra glabra var. *ensata* Haeckel [1872].

2. U. GLABRA *O. Schmidt.* Type species of the genus.
   Ute glabra O. Schmidt [1864].
   Ute capillosa J. E. Gray [1867], *fide* Haeckel [1872].
   Sycandra glabra Haeckel [1872].

3. U. RIGIDA *Haeckel.*
   Sycandra glabra var. *rigida* Haeckel [1872].

4. U. SYCONOIDES *Carter.*
   Aphroceras syconoides Carter [1885–1886].

SECTION B. With microxea.

5. U. SPENCERI *Dendy.*
   Ute spenceri Dendy [1892 B].

6. U. SPICULOSA *Dendy.*
   Ute spiculosa Dendy [1892 B].

Genus 28. SYNUTE Dendy [1892 A].

Diagnosis. Sponge consisting of many Ute-like individuals completely fused together, and invested with a common cortex containing colossal longitudinal oxea.

For illustrations of this genus see Dendy [1893 A].

This genus represents the highest known type of integration met with amongst syconoid sponges.

The only known species is :—

1. S. PULCHELLA *Dendy.*
   Synute pulchella Dendy [1892 A].
   Synute pulchella Row [1913 MS.].

Genus 29. SYCODORUS Haeckel [1872] (emend.).

Utella Dendy [1892 B].

Diagnosis. Canal system syconoid. Tubar skeleton articulate. Gastral cortex with a layer of large longitudinally arranged oxea, but no oxea in the dermal cortex.

For illustrations of this genus see Haeckel [1872].

Dendy proposed the genus *Utella* in 1892 for the reception of Haeckel's *Sycandra hystrix*, and suggested that O. Schmidt's *Ute utriculus* might also be included in it. As we feel that the laws of priority necessitate our using Haeckel's subgeneric names, where possible, in preference to later ones, we propose to substitute *Sycodorus* for *Utella*, the species which precede *S. hystrix* in the subgenus in Haeckel's monograph having been assigned to earlier genera. For *Ute utriculus* we have retained the generic name *Sycandra.*

The only known species is :—

1. S. HYSTRIX *Haeckel.*
    Sycandra hystrix Haeckel [1872].

Genus 30. ACHRAMORPHA Jenkin [1908 B] (emend.).

Diagnosis. Canal system syconoid. Skeleton of the chamber layer reduced to the basal rays of the subgastral sagittal triradiates (which may become quadriradiates by the addition of an apical ray), with radial oxea lying between the chambers and projecting from the surface. No colossal longitudinal oxea.

For illustrations of this genus see Jenkin [1908 B]; and Breitfuss [1898 D] under *Ebnerella schulzei.*

This genus was proposed by Jenkin for the three species *glacialis*, *grandinis* and *nivalis*, which resemble one another closely, and which all possess the so-called chiactines of his supposed family Staurorrhaphidæ. The fact that another species, Breitfuss's *Ebnerella schulzei*, differs in no essential point except the absence of chiactines, affords strong evidence for our view that the latter are nothing but subgastral sagittal triradiates that have developed apical rays, and therefore not even of generic importance, since such spicules are known to occur in other Grantiidæ. These species, however, form a well-defined group, and we accordingly retain the generic name *Achramorpha*, with an emended diagnosis based upon what we believe to be more important characters.

We assign the following species to the genus :—

SECTION A. With microxea.

1. A. GLACIALIS *Jenkin.*
    Achramorpha glacialis Jenkin [1908 B].

2. A. GRANDINIS *Jenkin.*
    Achramorpha grandinis Jenkin [1908 B].

3. A. NIVALIS *Jenkin.* Type species of the genus.
    Achramorpha nivalis Jenkin [1908 B].

4. A. SCHULZEI *Breitfuss.*
    Ebnerella schulzei Breitfuss [1896 A].

SECTION B. Without microxea.

5. A. TRUNCATA *Topsent.*
    Grantia truncata Topsent [1907].

Genus 31. Uteopsis nov.

Diagnosis. Canal system syconoid. Tubar skeleton reduced to the basal rays of subgastral sagittal radiates, supplemented distally by radially arranged oxea. Dermal cortex well developed, and containing colossal longitudinal oxea.

For illustrations of this genus see Poléjaeff [1883].

We propose this genus for Poléjaeff's *Ute argentea*, which obviously differs widely from the other species of the genus *Ute.* The replacement of the distal portion of the tubar skeleton by oxea is a very unusual feature, and, from the analogy of *Grantiopsis*, we think it possible, but not probable, that these oxea are really radiates whose paired rays have been completely lost. It seems more probable that they are to be compared to the radial oxea of *Achramorpha.*

The "tubar" quadriradiates referred to by Poléjaeff presumably belong to the exhalant canals of the chambers, and not to the chambers themselves.

The only known species of the genus is :—

1. U. argentea *Poléjaeff.*
 Ute argentea Poléjaeff [1883].

Genus 32. Anamixilla Poléjaeff [1883].

Diagnosis. Canal system syconoid. Tubar skeleton reduced to the outwardly directed basal rays of the subgastral sagittal radiates. Skeleton of the chamber layer otherwise consisting of large triradiate spicules, arranged without regard to the direction of the chambers. Dermal cortex well developed, but without colossal longitudinal oxea.

For illustrations of this genus see Poléjaeff [1883].

As Dendy has previously pointed out [1893 A], this genus may be looked upon as a *Grantia* in which the ordinary tubar skeleton has been almost entirely replaced by the invasion of large triradiates from the dermal cortex. Thus the genus is of interest as indicating one method by which the confused chamber-layer skeleton of *Leucandra* may have arisen.

The only known species is :—

1. A. torresi *Poléjaeff.*
 Anamixilla torresi Poléjaeff [1883].

Genus 33. SYCYSSA Haeckel [1872].

Diagnosis. Canal system syconoid. Skeleton entirely composed of oxea. Dermal cortex well developed, but without colossal longitudinal oxea. Gastral cortex with a subgastral layer of oxea, arranged longitudinally.

For illustrations of this genus see Haeckel [1872].

This genus is highly remarkable for the complete suppression of the radiate spicules. An analogous condition is met with in *Ascyssa*, *Leucyssa*, *Trichogypsia* and *Kuarrhaphis*.

The only known species is :—

1. S. HUXLEYI *Haeckel.*
   Sycyssa huxleyi Haeckel [1872].

Genus 34. MEGAPOGON Jenkin [1908 B] (emend.).

Diagnosis. Canal system sylleibid or leuconoid. Skeleton of the chamber layer retaining clear traces of the original articulate character and not confused; composed chiefly of subgastral sagittal quadriradiates, with their apical rays projecting into the gastral cavity; with a few sagittal triradiates arranged as usual. No gastral skeleton of tangentially placed radiates, except round the osculum. No colossal longitudinal oxea.

For illustrations of this genus see Jenkin [1908 B].

Jenkin included in this genus five species, *M. cruciferus*, *M. villosus*, *M. raripilus*, *M. pollicaris* and *M. crispatus*, and placed it in the family Staurorrhaphidæ on account of the presence of so-called chiactines. His figure of *M. villosus*, however, is alone sufficient to indicate that the "chiactines" are merely subgastral sagittal radiates which have developed apical rays, as in so many other cases, and we find it necessary to base the genus, which we believe to be a natural one, on other characters.

The absence of tangentially arranged gastral radiates, combined with the presence of the so-called "chiactines," might be used as an argument for the validity of the chiact theory, on the supposition that all the gastral tangential radiates had been converted into chiactines, but we must remember that in one species at any rate, *M. raripilus*, the so-called chiactines are associated with subgastral sagittal triradiates, which differ from them only in the absence of an apical ray, and there is no ground for supposing that the chiactines have any special significance. It is quite possible that all these subgastral sagittal spicules have been rotated into their present positions, as already pointed out in the Introduction, but this fact does not justify us in distinguishing the chiactines as fundamentally different from other subgastral sagittal radiates.

Megapogon villosus, with its sylleibid canal system and almost syconoid skeleton, exhibits a very interesting stage in the evolution of the leuconoid type, and the same is perhaps true of *M. pollicaris*.

We place the following species in this genus:—

1. M. CRISPATUS *Jenkin*.
   Megapogon crispatus Jenkin [1908 B].
2. M. CRUCIFERUS *Poléjaeff*. Type species of the genus.
   Leuconia crucifera Poléjaeff [1883].
3. M. POLLICARIS *Jenkin*.
   Megapogon pollicaris Jenkin [1908 B].
4. M. RARIPILUS *Jenkin*.
   Megapogon raripilus Jenkin [1908 B].
5. M. VILLOSUS *Jenkin*.
   Megapogon villosus Jenkin [1908 B].

Genus 35. LEUCANDRA Haeckel [1872] (emend.).

Diagnosis. Sponge usually a single person, or a colony of such persons in which the component individuals are readily recognisable. Canal system leuconoid. Skeleton of the chamber layer more or less confused, but frequently with vestiges of an articulate tubar skeleton in the form of subgastral or other sagittal triradiates. Dermal skeleton of tangentially placed triradiates, which may sometimes develop an apical ray. Colossal longitudinally placed oxea, when occurring in the dermal cortex, never forming a smooth layer, but always projecting conspicuously from the surface.

For illustrations of this genus see Vosmaer [1880] and Dendy [1893 A].

The genus *Leucandra* as here defined is much more narrowly circumscribed than it was by Dendy previously [1892 B]. In fact Dendy's genus is here represented by no less than 10 genera, namely, *Leucandra*, *Baeria*, *Leucopsila*, *Aphroceras*, *Leucettaga*, *Lamontia* and *Eilhardia* in the family Grantiidæ, and *Leucomalthe*, *Pericharax* and *Leucettusa* in other families, while certain species have been transferred to *Leucetta*. On the other hand, we include in the present genus certain species which possess subdermal quadriradiates, and which on that account were placed by Dendy in the genus *Leucilla*; for, as we had occasion to point out with regard to both *Leucetta* and *Grantia*, we do not consider that the mere presence or absence of a fourth ray on a radiate spicule in the dermal cortex can be regarded as of generic import. We shall discuss the true characteristics of *Leucilla* when dealing with that genus.

The genus *Leucandra* as now defined may be regarded as derived from a *Grantia*-like ancestor by the conversion of the syconoid canal system into a leuconoid one, with the simultaneous replacement of the articulate tubar skeleton by an irregularly scattered skeleton of the chamber layer (compare *Anamixilla*). Indications of the syconoid ancestry can, however, frequently be detected in the skeleton (compare *Megapogon*), while as regards canal system such species as *L. australiensis* Carter and *L. infesta* sp. n. (*Leucilla intermedia* Row [1909]), which are of the so-called sylleibid type, form connecting links between *Grantia* and *Leucandra*.

We recognise the following species as belonging to this genus:—

SECTION A. With large, usually radially arranged oxea, but without microxea.

1. L. ANANAS *Montagu*.
   Spongia ananas Montagu [1812].
   Spongia pulverulenta Grant [1826], *fide* Haeckel [1872].
   Scypha ovata S. F. Gray [1821], *fide* Haeckel [1872].
   Sycinula penicillata O. Schmidt [1870], *fide* Haeckel [1872].
   Leucandra ananas Haeckel [1872].

2. L. ANGUINEA *Ridley*.
   Leucortis anguinea Ridley [1884].

3. L. ANOMALA *Haeckel*.
   Leucetta pandora var. *anomala* Haeckel [1872].

4. L. ARMATA *Urban*.
   Leuconia armata Urban [1908].

5. L. ASPERA *O. Schmidt*.
   Sycon asperum O. Schmidt [1862].
   ? *Spongia panicea* Esper [?], *fide* Haeckel [1872].
   ? *Spongia inflata* Delle Chiaje [1828], *fide* Haeckel [1872].
   Leucandra aspera Haeckel [1872].

6. L. AUSTRALIENSIS *Carter*.
   Leuconia fistulosa var. *australiensis* Carter [1885–1886].
   Leucandra australiensis Dendy [1892 B].

7. L. CAMINUS *Haeckel*.
   Dyssyconella caminus Haeckel [1870].
   Leucandra caminus Haeckel [1872].

8. L. CAPILLATA *Poléjaeff.*
Leuconia multiformis var. *capillata* Poléjaeff [1883].

9. L. CIRRATA *Jenkin.*
Leucandra cirrata Jenkin [1908 B].

10. L. CIRRHOSA *Urban.*
Leuconia cirrhosa Urban [1908].

11. L. CLAVIFORMIS *Schuffner.*
Leucandra claviformis Schuffner [1877].

12. L. COMPACTA *Carter.*
Leuconia compacta Carter [1885–1886].

13. L. CRAMBESSA *Haeckel.*
Leucandra crambessa Haeckel [1872].

14. L. CRUSTACEA *Haeckel.*
Leucaltis crustacea Haeckel [1872].

15. L. CUMBERLANDENSIS *Lambe.*
Leucandra cumberlandensis Lambe [1900 B].

16. L. DONNANI *Dendy.*
Leucandra donnani Dendy [1905].

17. L. ECHINATA *Schuffner.*
Leucandra echinata Schuffner [1877].
Leuconia echinata Carter [1885–1886], *fide* Dendy [1913].
Leucandra echinata Dendy [1913].

18. L. EGEDII *O. Schmidt.* Type species of the genus.
Sycinula egedii O. Schmidt [1870].
Leucandra egedii Haeckel [1872].

19. L. FALCIGERA *Schuffner.*
Leucandra falcigera Schuffner [1877].

20. L. FISTULOSA *Johnston.*
Grantia fistulosa Johnston [1842].
Leucandra fistulosa Haeckel [1872].

21. L. GEMMIPARA *Thacker.*
Leucandra gemmipara Thacker [1908].

22. L. GOSSEI *Bowerbank.*
Leucogypsia gossei Bowerbank [1864–1882].
Leucandra gossei Haeckel [1872].

23. L. HIBERNA *Jenkin.*
Leucandra hiberna Jenkin [1908 B].

24. L. HIRSUTA *Topsent.*
Leucandra hirsuta Topsent [1907].

25. L. HISPIDA *Carter*.
Leuconia hispida Carter [1885–1886].

26. L. INFESTA, *sp. n.*
Leucilla intermedia Row [1909].
The new name is given to this species as *intermedia* is already occupied.

27. L. KERGUELENSIS *Urban*.
Leucandra kerguelensis Urban [1908].

28. L. LENDENFELDI *Breitfuss*.
Leuconia lendenfeldi Breitfuss [1897].
Leucortis elegans von Lendenfeld, MS., *fide* Breitfuss [1897].

29. L. LUNULATA *Haeckel*.
Leucandra lunulata Haeckel [1872].

30. L. MASATIERRÆ *Breitfuss*.
Leuconia masatierræ Breitfuss [1898 E].

31. L. MEANDRINA *von Lendenfeld*.
Leucandra meandrina von Lendenfeld [1885 B].

32. L. MINIMA *Row*.
Leucandra minima Row [1913 MS.].

33. L. MULTIFORMIS *Poléjaeff*.
Leuconia multiformis Poléjaeff [1883].

34. L. PHILLIPENSIS *Dendy*.
Leucandra phillipensis Dendy [1892 B].

35. L. PALLIDA *Row*.
Leucandra pallida Row [1913 MS.].

36. L. PULVINAR *Haeckel*.
Sycolepis pulvinar Haeckel [1870].
Mlea dohrnii Michlucho-Maclay, MS., *fide* Haeckel [1872].
Leucortis pulvinar Haeckel [1872].

37. L. THULAKOMORPHA *Row*.
Leucandra thulakomorpha Row [1913 MS.].

38. L. VAGINATA *von Lendenfeld*.
Leucandra vaginata von Lendenfeld [1885 B].

39. L. VALIDA *Lambe*.
Leucandra valida Lambe [1900 B].

40. L. VILLOSA *von Lendenfeld*.
Leucandra villosa von Lendenfeld [1885 B].

41. L. WASINENSIS *Jenkin.*
Leucilla wasinensis Jenkin [1908 A].
Leucandra wasinensis Dendy [1913].

SECTION B. With large, usually radially arranged oxea, and with microxea.

42. L. AMORPHA *Poléjaeff.*
Leuconia multiformis var. *amorpha* Poléjaeff [1883].

43. L. ANFRACTA *Urban.*
Leuconia anfracta Urban [1908].

44. L. APICALIS *Urban.*
Leucandra apicalis Urban [1905].

45. L. BALEARICA *Lackschewitsch.*
Leuconia balearica Lackschewitsch [1886].

46. L. BULBOSA *Hanitsch.*
Leucandra bulbosa Hanitsch [1895].

47. L. COIMBRÆ *Breitfuss.*
Leuconia coimbræ Breitfuss [1898 C].

48. L. CONICA *von Lendenfeld.*
Leucandra conica von Lendenfeld [1885 B].

49. L. CALLÆA *Haeckel.*
Leucandra crambessa var. *callæa* Haeckel [1872].

50. L. CROSSLANDI *Thacker.*
Leucandra crosslandi Thacker [1908].

51. L. CYLINDRICA *Fristedt.*
Leucandra cylindrica Fristedt [1887].

52. L. FERNANDENSIS *Breitfuss.*
Leuconia fernandensis Breitfuss [1898 E].

53. L. GLADIATOR *Dendy.*
Leucandra gladiator Dendy [1892 B].

54. L. HEATHII *Urban.*
Leucandra heathii Urban [1905].

55. L. JOUBINI *Topsent.*
Leucandra joubini Topsent [1907].

56. L. LORICATA *Poléjaeff.*
Leuconia loricata Poléjaeff [1883].

57. L. MINOR *Urban.*
Leuconia minor Urban [1908].

58. L. PLATEI *Breitfuss.*
Leuconia platei Breitfuss [1898 E].

59. L. PYRIFORMIS *Lambe.*
Leuconia pyriformis Lambe [1893].

60. L. RODRIGUEZII *Lackschewitsch.*
Leuconia rodriguezii Lackschewitsch [1886].

61. L. RUDIFERA *Poléjaeff.*
Leuconia rudifera Poléjaeff [1883].
Leucandra rudifera Thacker [1908].

62. L. SPISSA *Urban.*
Leuconia spissa Urban [1908].

63. L. TAYLORI *Lambe.*
Leucandra taylori Lambe [1900 A].

64. L. TYPICA *Poléjaeff.*
Leuconia typica Poléjaeff [1883].

65. L. VITREA *Urban.*
Leuconia vitrea Urban [1908].

SECTION C. With microxea, but without large oxea.

66. L. JOHNSTONII *Carter.*
Grantia nivea var., Johnston [1842].
Leuconia johnstonii Carter [1871 B].
Leucandra johnstonii Haeckel [1872].

67. L. LOBATA *Carter.*
Leuconia lobata Carter [1885–1886].

68. L. MULTIFIDA *Carter.*
Leuconia multifida Carter [1885–1886].

69. L. NIVEA *Grant.*
Spongia nivea Grant [1825–1826].
Leucandra nivea Haeckel [1872].

70. L. OVATA *Poléjaeff.*
Leuconia ovata Poléjaeff [1883].

71. L. PRAVA *Breitfuss.*
Leuconia prava Breitfuss [1898 C].

SECTION D. Without oxea of any kind.

72. L. BATHYBIA *Haeckel.*
Dyssycum periminum Haeckel [1870], *fide* Haeckel [1872].
Leucaltis bathybia Haeckel [1872].
Grantia arabica Michlucho-Maclay, MS., *fide* Haeckel [1873].

The earlier of Haeckel's names for this species, *periminum,* is a *nomen nudum,* as it never was accompanied by a diagnosis

73. L. BRUMALIS *Jenkin.*
Leucandra brumalis Jenkin [1908 B].

74. L. CURVA *Schuffner.*
Leucandra curva Schuffner [1877].

75. L. FRIGIDA *Jenkin.*
Leucandra frigida Jenkin [1908 B].

76. L. GELATINOSA *Jenkin.*
Leucandra gelatinosa Jenkin [1908 B].

77. L. HELENA *von Lendenfeld.*
Leucaltis helena von Lendenfeld [1885 B].

78. L. IMPRESSA *Hanitsch.*
Leucaltis impressa Hanitsch [1890].

79. L. INNOMINATA, *sp. n.*
Leucilla crosslandi Row [1909].

The new name is necessitated by the fact that the name *crosslandi* is already occupied in this genus.

80. L. INTERMEDIA *Haeckel.*
Leucetta pandora var. *intermedia* Haeckel [1872].

81. L. LEVIS *Poléjaeff.*
Leuconia levis Poléjaeff [1883].

82. L. NAUSICAÆ *Schuffner.*
Leucaltis nausicaæ Schuffner [1877].

83. L. PANDORA *Haeckel.*
Leucetta pandora Haeckel [1872].

84. L. PUMILA *Bowerbank.*
Leuconia pumila Bowerbank [1864–1882].
Leucaltis pumila Haeckel [1872].

85. L. SAGITTATA *Haeckel.*
Leucetta sagittata Haeckel [1872].

86. L. SCHAUINSLANDI *Preiwisch.*
Leucetta schauinslandi Preiwisch [1904].

87. L. TELUM *von Lendenfeld.*
Polejna telum von Lendenfeld [1891].

88. L. VERDENSIS *Thacker.*
Leucandra verdensis Thacker [1908].

The following species are doubtfully assigned to this genus:—

89. L. INFLATA *Delle Chiaje.*
Spongia inflata Delle Chiaje [1828].

Possibly identical with *Leucandra aspera, fide* Haeckel [1872].

90. L. PANICEA *Esper*.
Spongia panicea Esper, *fide* Haeckel [1872].
Esper's original reference to this species has not been found by us, but Haeckel [1872] states that the species is possibly identical with *Leucandra aspera*.

Genus 36. BAERIA Michlucho-Maclay [1870] (emend.).

Diagnosis. Canal system leuconoid. Skeleton of the chamber layer composed almost exclusively of irregularly scattered colossal quadriradiates. Microxea present in large numbers, and of very characteristic form, being almost always pierced with a small hole towards one end.

For illustrations of this genus see Haeckel [1872].

The very characteristic "needle-eye" spicules of this genus are really triradiates, in which two of the rays are very much reduced and have come to lie approximately side by side, being actually fused at their distal ends. In this way we get a linear spicule very slightly swollen at one end, and in the centre of the swelling a small hole, the remnant of the space between the two originally separate rays. That this is the true explanation of these spicules was made abundantly clear from an examination by one of us (Row) of a microscopical preparation of the species preserved at Jena, for while most of the spicules were found to correspond exactly to the type described above, a few of them had the reduced rays not fused together but widely open, thus maintaining the triradiate condition. Exactly similar spicules occur in *Kuarrhaphis cretacea* (q. v.).

It may perhaps be pointed out here that these spicules indicate a possible way in which all the calcareous monaxon spicules may have originated. At any rate their occurrence adds probability to the presumption that all calcareous oxea have been derived from triradiates in some way or other.

The only known species of the genus is :—

1. B. OCHOTENSIS *Michlucho-Maclay*.
Baeria ochotensis Michlucho-Maclay [1870].
Leucandra ochotensis Haeckel [1872].

Genus 37. LEUCOPSILA nov.

Diagnosis. Canal system leuconoid. Skeleton of the chamber layer composed almost exclusively of irregularly scattered colossal quadriradiates. Gastral cortex well developed, but without any radiate spicules, the whole of the gastral skeleton being formed of a dense layer of microxea.

For illustrations of this genus see Haeckel [1872].

The very peculiar character of the skeleton of the gastral cortex seems to justify the erection of a new genus for O. Schmidt's *Leuconia stylifera*.

The only known species is:—

1. L. STYLIFERA *O. Schmidt*.
   Leuconia stylifera O. Schmidt [1870].
   Leucandra stylifera Haeckel [1872].

Genus 38. APHROCERAS Gray [1858].

Diagnosis. Sponge usually a single person or a colony of such persons in which the component individuals are readily recognisable. Canal system sylleibid or leuconoid. Skeleton of the chamber layer more or less confused, but frequently with vestiges of an articulate tubar skeleton in the form of subgastral or other sagittal radiates. Dermal skeleton of tangentially placed triradiates supplemented by colossal oxea placed longitudinally and not projecting from the surface sufficiently to render it hispid.

For illustrations of this genus see von Lendenfeld [1891], under *Vosmaeria corticata*.

The genus *Aphroceras* was originally proposed by Gray [1858] to receive a sponge from Hong-Kong, whose chief characteristics, at any rate from our point of view, were the leuconoid canal system and the colossal longitudinal oxea of the dermal cortex. Since then other species which combine these characters have been described, and, although recent authors have not seen fit to accept this genus, we feel that these species form a very natural group, and we consider that the characters distinguishing it are sufficiently well defined to render it possible to separate it from its nearest ally, *Leucandra*. In fact, almost the only species that presents any difficulty is Haeckel's *Leucandra crambessa* and its varieties, in which the colossal oxea are not arranged longitudinally, but lie scattered quite irregularly over the surface of the sponge. This condition is somewhat intermediate between that of some Leucandras and that of *Aphroceras*, and we prefer to place this species in the genus *Leucandra*.

It may be advisable to state that we do not consider *Aphroceras* to have been derived from *Ute* or a Ute-like form, but directly from an ancestral *Leucandra*.

We recognise the following species as belonging to this genus:—

Section A. Without microxea.

1. A. alcicornis *Gray*. Type species of the genus.
   Aphroceras alcicornis Gray [1858].
   Cyathiscus actinia, Haeckel [1870], *fide* Haeckel [1872].
   Leucandra alcicornis Haeckel [1872].

2. A. cataphracta *Haeckel*.
   Leucandra cataphracta Haeckel [1872].

3. A. elongata *Schuffner*.
   Leucandra elongata Schuffner [1877].

Section B. With microxea.

4. A. cæspitosa *Haeckel*.
   Leucandra alcicornis var. *cæspitosa* Haeckel [1872].

5. A. cliarensis *Stephens*.
   Leucandra cliarensis Stephens [1912].

6. A. corticata *von Lendenfeld*.
   Vosmaeria corticata von Lendenfeld [1891].

Genus 39. Leucettaga Haeckel [1872] (emend.).

Diagnosis. Canal system leuconoid. Skeleton almost entirely composed of a confused mass of triradiates, which are mostly irregular and which form the dermal cortical skeleton as well as the skeleton of the chamber layer. Gastral cavity traversed by numerous endogastric septa, which possess a special skeleton of their own in the form of minute radiates.

For illustrations of this genus see Haeckel [1872].

This genus is proposed for the reception of Haeckel's *Leucetta pandora* var. *loculifera*, which is the only known species. It affords an example amongst leuconoid Calcarea of that remarkable development of endogastric septa which occurs also in certain Leucosolenias (e. g. *L. wilsoni*) among the Homocœlidæ, in *Leucettusa* among the Leucaltidæ, and in *Sycandra* among the Sycettidæ. We have, however, only considered it necessary to attribute generic importance to this character when it is combined, as in the present instance, with the presence of an endogastric skeleton.

We have revived this name, which was applied by Haeckel to one of the subgenera of his *Leucetta*, for this genus.

The only known species is :—

1. L. loculifera *Haeckel*.
   Leucetta pandora var. *loculifera* Haeckel [1872].

Genus 40. Paraleucilla Dendy [1892 B].

Diagnosis. Canal system leuconoid. Skeleton of the chamber layer composed of confused triradiates. Subdermal cavities present, supported by an inner and an outer layer of quadriradiates, whose apical rays cross each other in opposite directions. Dermal cortex with tangentially placed triradiates, between which lie large, longitudinally placed oxea.

For illustrations of this genus see Haeckel [1872].

This genus was proposed by Dendy [1892 B] to receive Haeckel's *Leucandra cucumis*, but abandoned by him in 1893 on the ground that it was not sufficiently distinct from *Leucilla*. He also pointed out that Poléjaeff had previously proposed the name *Pericharax* for the same sponge. Further consideration has, however, convinced us that the dermal quadriradiates of *Leucandra cucumis* are not really comparable to the subdermal quadriradiates of *Leucilla* and other Amphoriscidæ, being related solely to the cortex and not to the chamber layer at all. We therefore transfer the species to the family Grantiidæ, with which it has much more in common than with any other family of Calcarea. We know nothing, however, of the position of the nucleus of the collared cells. The first mentioned species of *Pericharax*, on the other hand, is *P. carteri* Poléjaeff [1883, p. 19] which we have now shown to belong to the Leucascid-Leucaltid line of descent. We cannot therefore associate *Leucandra cucumis* with either *Leucilla* or *Pericharax*, and it therefore appears to us that as it is clearly distinguished from other Grantiidæ by the presence of subdermal cavities with a special skeleton, it is necessary to revive the genus *Paraleucilla* for its reception. Haeckel, it is true, placed his *Leucandra cucumis* in the subgenus "*Leucogypsa*," but Bowerbank's name "*Leucogypsia*," if revived at all, which we think very undesirable, would have to be reserved for *Leucandra*.

The only known species is :—

1. P. cucumis *Haeckel.*
   Leucandra cucumis Haeckel [1872].
   Paraleucilla cucumis Dendy [1892 B].

Genus 41. Lamontia Kirk [1894].

Diagnosis. Sponge consisting of a single person with a specialised pore-zone below the terminal osculum. Canal system leuconoid. Skeleton of the chamber layer consisting of small scattered oxea. Dermal cortex with triradiates in addition to oxea. Gastral quadriradiates present.

For illustrations of this genus see Kirk [1894].

The only species of this curious genus is Kirk's *Lamontia zona* from New Zealand, which perhaps forms a transition from the genus *Leucandra* to the genus *Leucyssa*.

1. L. ZONA *Kirk*.
   Lamontia zona Kirk [1894].

Genus 42. LEUCYSSA Haeckel [1872] (emend.).

Diagnosis. Canal system leuconoid. Skeleton entirely composed of smooth oxea.

For illustrations of this genus see Haeckel [1872].

We can only suppose that this genus, which has only been observed by Haeckel, owes its peculiar skeleton to the complete suppression of ancestral radiates.

The only known species is :—

1. L. SPONGILLA *Haeckel*.
   Leucyssa spongilla Haeckel [1872].

Genus 43. TRICHOGYPSIA Carter [1871 B].

Diagnosis. Canal system leuconoid. Skeleton entirely composed of spined oxea.

For illustrations of this genus see Haeckel [1872].

In 1871 Carter proposed the genus *Trichogypsia* for his species *T. villosa*. In 1872, in "Die Kalkschwämme," Haeckel regarded this species as a variety of his *Leucyssa incrustans*, the specific name *incrustans* having been given by him *without description* in 1870 under the genus *Sycolepis*. The diagnosis of *Sycolepis* also contained no reference to the essential peculiarities of the species in question, and was subsequently abandoned by its author.

The name *Trichogypsia* has therefore priority in our opinion over both *Sycolepis* and *Leucyssa*, and we have retained it here for species which, like *T. villosa*, have spined oxea, while using Haeckel's name *Leucyssa* for those with smooth oxea.

We consider that Haeckel's variety *lichenoides*, which is the first variety of his *Leucyssa incrustans*, is specifically distinct from Carter's *Trichogypsia villosa*, and as the name *villosa* has priority over *incrustans*, we confine the latter to the form termed by Haeckel var. *lichenoides*.

We recognise the following species of this genus :—

1. T. INCRUSTANS *Haeckel*.
   Leucyssa incrustans var. *lichenoides* Haeckel [1872].

2. T. VILLOSA *Carter*. Type species of the genus.
Trichogypsia villosa Carter [1871 B].
Leucyssa incrustans var. *villosa* Haeckel [1872].

It is doubtful whether Haeckel's *Sycolepis incrustans* is really a synonym of *Trichogypsia villosa* or of *T. incrustans*.

Genus 44. KUARRHAPHIS nov.

Diagnosis. Canal system presumably leuconoid. Skeleton composed exclusively of perforated "needle-eye" spicules.

For illustrations of this genus see Haeckel [1872].

We propose this name for Haeckel's *Leucyssa cretacea*, which differs from all the other species included by him in the genus *Leucyssa* in the remarkable perforation of the "needle-eye" spicules. Spicules of practically identical form are found in the genus *Baeria*, and we must refer the reader to that genus for a discussion of their nature and origin. In *Baeria* they are still associated with triradiates and colossal quadriradiates. Whether *Kuarrhaphis* is to be regarded as derived from a Baeria-like ancestor by the complete suppression of the radiate spicules, or whether the remarkable "needle-eye" spicules have arisen independently in the two cases, it is impossible to decide.

The only known species is:—

1. K. CRETACEA *Haeckel*.
Leucyssa cretacea Haeckel [1872].

Genus 45. EILHARDIA Poléjaeff [1883].

Diagnosis. Sponge calyciform, with pores on the inner and oscula on the outer surface of the cup. Canal system leuconoid. Skeleton of the chamber layer confused, composed of triradiates of various shapes and sizes, and of microxea. Cortex of inner surface with microxea and sagittal triradiates, cortex of the outer surface with large oxea and sagittal triradiates.

For illustrations of this genus see Poléjaeff [1883].

The only known species of the genus is Poléjaeff's *Eilhardia schulzei*, a highly remarkable sponge in many ways, the distribution of the pores and oscula being exactly the reverse of the usual condition in cup-shaped sponges, and indicating that the sponge cannot be regarded as a single leuconoid person with expanded osculum, in the same way as the calyciform *Pericharax peziza*.

Although the genus *Eilhardia* was abandoned by Dendy [1892 B], we now consider that it is fully entitled to recognition.

The only known species is:—

1. E. SCHULZEI *Poléjaeff.*
   Eilhardia schulzei Poléjaeff [1883].

Family 9. AMPHORISCIDÆ Dendy [1892 B] (emend.).

Diagnosis. Flagellate chambers ranging from elongated and radially arranged to small, spherical and irregularly scattered. With a distinct dermal cortex supported by a skeleton of tangentially placed radiates to which oxea may be added. Some or all of the dermal radiates with large apical rays, which project inwards through the chamber layer to a greater or less extent, and form the principal part of its skeleton. No articulate tubar skeleton, but sometimes, in the leuconoid forms, a confused skeleton of quadriradiates in the chamber layer. Nuclei of collared cells probably always apical.

The most conspicuous feature of this family lies in the large dermal or subdermal quadriradiates with centripetally directed apical rays. Such spicules may indeed be present in certain species of *Leucandra*, but in such cases they are always associated with a confused chamber-layer skeleton of scattered triradiates, which is never the case in the Amphoriscidæ. If there be a confused chamber-layer skeleton in this family it is found to be composed of quadriradiates, which presumably have been derived from the subdermal and subgastral quadriradiates themselves by immigration.

The evidence seems to indicate that *Leucandra* and *Leucilla*, though difficult to separate in practice, owe their resemblance largely to convergence, and that each has been independently evolved from some syconoid ancestor, in the one case directly from some such form as *Grantia*, in the other through some such form as *Amphoriscus*.

In some Amphoriscidæ large subgastral quadriradiates are present, and in others, or even in the same, subgastral sagittal triradiates (or quadriradiates) resembling the sagittal radiates of the first joint of an articulate tubar skeleton. Whether the centrifugally directed ray of the large subgastral quadriradiates is homologous with the basal ray of the subgastral sagittal triradiates, or whether it is an apical ray added to a tangential triradiate of the gastral cortex, is a question which we cannot decide without further evidence.

Genus 46. Amphoriscus Haeckel [1870] (emend.).

Diagnosis. Canal system syconoid. Without any special root-tuft of anchoring spicules.

For illustrations of this genus see Haeckel [1872] under *Sycaltis* and *Sycilla*, and Poléjaeff [1883].

We recognise the following species in this genus :—

Section A. Without oxea.

1. A. chrysalis *O. Schmidt.*
   Ute chrysalis O. Schmidt [1864]. Type species of the genus.
   Sycilla chrysalis Haeckel [1872].

2. A. cyathiscus *Haeckel.*
   Amphoriscus cyathiscus Haeckel [1872].
   Sycilla cyathiscus Haeckel [1872].

3. A. cylindrus *Haeckel.*
   Sycilla cylindrus Haeckel [1872].

4. A. kryptoraphis *Urban.*
   Amphoriscus kryptoraphis Urban [1908].

5. A. oviparus *Haeckel.*
   Sycaltis ovipara Haeckel [1872].

6. A. semoni *Breitfuss.*
   Amphoriscus semoni Breitfuss [1896 C].

7. A. testiparus *Haeckel.*
   Sycaltis testipara Haeckel [1872].

8. A. urna *Haeckel.*
   Amphoriscus urna Haeckel [1870].
   Sycilla urna Haeckel [1872].

Section B. With microxea, but without large oxea.

9. A. buccichii *von Ebner.*
   Amphoriscus buccichii von Ebner [1887].

10. A. elongatus *Poléjaeff.*
    Amphoriscus elongatus Poléjaeff [1883].

11. A. gregorii *von Lendenfeld.*
    Ebnerella gregorii von Lendenfeld [1891].

12. A. oblatus *Row.*
    Amphoriscus oblatus Row [1913 MS.].

Genus 47. Syculmis *Haeckel* [1872] (emend.).

Diagnosis. Canal system syconoid. With a root-tuft of oxea and anchoring quadriradiates.

For illustrations of this genus see Haeckel [1872].

This is a highly specialised genus of a single species, but had it not already been proposed by Haeckel, we should hardly have felt justified in distinguishing a special genus on the characters available.

The only known species is :—

1. S. synapta *Haeckel.*
   Syculmis synapta Haeckel [1872].

Genus 48. Leucilla Haeckel 1872 (emend.).

Diagnosis. Canal system sylleibid or leuconoid. Skeleton of the chamber layer typically composed of the centripetally and centrifugally directed apical rays of subdermal and subgastral quadriradiates, but subgastral sagittal triradiates and confused chamber-layer quadriradiates may be present, while the subgastral quadriradiates may be absent.

For illustrations of this genus see Haeckel [1872] and Dendy [1893A].

The resemblance of this genus to some species of *Leucandra* has already been pointed out. It also resembles by convergence some species of the genus *Leucetta*, but may be distinguished by the fact that traces of syconoid ancestry are still to be met with in the skeleton (e. g., the presence in some species of subgastral sagittal triradiates), while the triradiates are not of the characteristic regular type occurring in the Leucascidæ. The position of the nucleus of the collared cells, as determined in *Leucilla australiensis* and *L. princeps*, is, moreover, apical, instead of basal as in the Leucascidæ.

We recognise the following species as belonging to this genus :—

Section A. Without oxea.

1. L. amphora *Haeckel.* Type species of the genus.
   Leucilla amphora Haeckel [1872].
2. L. australiensis *Carter.*
   Leuconia johnstonii var. *australiensis* Carter [1885–1886].
   Leucilla australiensis Dendy [1892 B].

3. L. capsula *Haeckel.*
 Lipostomella capsula Haeckel [1870].
 Leucilla capsula Haeckel [1872].

Section B. With large radially arranged oxea or trichoxea, but without microxea.

4. L. echinus *Haeckel.*
 Leuculmis echinus Haeckel [1872].

5. L. oxeodragmifera *Row.*
 Leucilla oxeodragmifera Row [1913 MS.].

6. L. princeps *Row.*
 Leucilla princeps Row [1913 MS.].

7. L. proteus *Dendy.*
 Leucilla proteus Dendy [1913].

8. L. uter *Poléjaeff.*
 Leucilla uter Poléjaeff [1883].

Section C. Without large oxea, but with microxea.

9. L. nuttingi *Urban.*
 Rhabdodermella nuttingi Urban [1902].

10. L. saccharata *Haeckel.*
 Leucandra saccharata Haeckel [1872].

The following species apparently also belongs to this genus, but was very inadequately diagnosed :—

11. L. leuconides *Bidder.*
 Sycaltis leuconides Bidder [1891].

Family 10. LELAPIIDÆ nov.

Dialytinæ Kirkpatrick [1911 A].

Diagnosis. Canal system presumably always leuconoid. Skeleton of the chamber layer containing fibres or bundles of modified sagittal triradiates placed side by side, but not cemented together. Nuclei of collared cells (presumably always) apical.

This family appears to be a highly specialised offshoot from the leuconoid Grantiidæ. The presence in *Lelapia* of distinct subgastral sagittal triradiates and the apical position of the nuclei of the collared cells afford very strong evidence in support of this view, and necessitate, as we have already pointed out, its wide separation from the other so-called Pharetronid sponges.

The presence of tuning-fork spicules in *Lelapia* cannot be taken as indicating close affinity with the latter, for, as is well known, such spicules occur in Haeckel's *Leucandra* (*Leucortis*) *pulvinar* and *L.* (*Leucetta*) *pandora*, while they are replaced in *Kebira*, the only other known genus of Lelapiidæ, by radiates in which the oral rays have been practically suppressed.

Genus 49. Lelapia Gray [1867].

Diagnosis. Skeleton of the chamber layer composed of large scattered oxea and loose fibres of tuning-fork spicules. Dermal skeleton of tangential triradiates and microxea. Gastral skeleton of tangential triradiates and quadriradiates.

For illustrations of this genus see Dendy [1893 B].

This genus was originally based by Gray on figures published by Bowerbank of the characteristic tuning-fork spicules. Carter really first described the sponge, adopting Gray's name, *Lelapia australis*, for the species which he studied. There is, of course, no guarantee that Carter's species is either generically or specifically identical with that which furnished the spicules figured by Bowerbank. There is some probability, however, from the locality, and from the fact that the spicules are stated by Bowerbank to have been "loosely fasciculated," that the two species are really identical, and in any case the genus and species may conveniently be retained for the sponge described by Carter.

The only known species is :—

1. L. australis *Gray.*
   "*A new species of sponge*" Bowerbank [1858–1862].
   Lelapia australis Gray [1867].
   Lelapia australis Carter [1885–1886].
   Lelapia australis Dendy [1893 B].

Genus 50. Kebira Row [1909].

Diagnosis. Skeleton of the chamber layer composed of large longitudinally arranged oxea, and of loose fibres of sagittal triradiates whose paired rays are vestigial. Dermal and gastral skeleton of tangential triradiates.

For illustrations of this genus see Row [1909].

The only known species is :—

1. K. uteoides *Row.*
   Kebira uteoides Row [1909].

GENERA AND SPECIES "INCERTÆ SEDIS."

Genus 51. Sycaltis Haeckel [1872] (emend.).

Diagnosis? Canal system syconoid (?). Skeleton of the chamber layer confused.

The sense in which we employ this genus is obviously quite different from that in which it was used by Haeckel, who based it upon the presence of triradiate and quadriradiate spicules and the absence of oxea. Most of the species assigned to it by him have been relegated to other genera, but his description of the undermentioned species appears to indicate that it possesses characteristics separating it widely from any syconoid sponge of normal structure, and therefore, although there seems to be some similarity between this sponge and *Leucascus*, we prefer to consider it as "*incertæ sedis*" rather than to assign any definite position to it in our classification. It may be related to *Anamixilla*.

The only known species is :—

1. S. perforata *Haeckel*.

   Sycaltis perforata Haeckel [1872].

The following species are so inadequately known as to render all attempts to identify them ineffectual :—

Ute viridis O. Schmidt [1868].

Medon barbata Duchassaing and Michelotti [1864].

Medon imberbis Duchassaing and Michelotti [1864].

The following species have been referred to without description :—

Grantia striatula Bowerbank MS., referred to by Bowerbank [1864–1882, vol. i. p. 233].

Leucogypsia algoaensis Bowerbank MS., referred to by Bowerbank [1864–1882, vol. i. p. 166].

Ute papillosum O. Schmidt, referred to by Gray [1867].

(We have not been able to discover any reference to a species of this name in any of Schmidt's papers, and think that Gray's reference is probably a misprint for *Ute capillosum* O. S.)

LIST OF REJECTED GENERIC NAMES.

The following list includes all the generic names that have, so far as we are aware, been applied to calcareous sponges, but which we have not made use of in this paper. Many of them have been used in various senses by different authors, and in such cases all the instances which are of systematic importance have been referred to, though the list of references is by no means complete. Under each genus the date and type-species are given, in order to simplify the work of determining the true names of genera in accordance with the laws of priority, should any of these names be revived for future use. We also give (in brackets) the name under which the type species will be found in the present paper.

Alcyoncellum *Quoy et Gaimard* [1833].

Type species, as regards calcareous sponges, *A. gelatinosum* de Blainville, (=*Sycon gelatinosum*).

The name *Alcyoncellum* was originally proposed by Quoy and Gaimard for certain hexactinellid sponges, but was subsequently used by de Blainville [1834–1837] to include *Sycon* (*Alcyoncellum*) *gelatinosum*. Gray [1867] has also used the name for a genus of calcareous sponges, and with the same type species. The name is now regarded as a synonym of both *Euplectella* and *Sycon*.

Amphoridium *Haeckel* [1870].

Type species *A. viridis* O Schmidt.

Schmidt's *Ute viridis* is absolutely unrecognisable, even generically.

Amphorula *Haeckel* [1870].

Type species *A. solida* O. Schmidt, (=*Leucandra solida*).

Artynas *Haeckel* [1870].

Type species *A. compressus* Fabricius, (=*Grantia compressa*).

Artynella *Haeckel* [1870].

Type species *A. compressa* Fabricius, (=*Grantia compressa*).

Artynes *Gray* [1867].

Type species *A. compressa* Fabricius, (=*Grantia compressa*).

Artynium *Haeckel* [1870].

Type species *A. compressum* Fabricius, (=*Grantia compressa*).

Artynophyllum *Haeckel* [1870].

Type species *A. compressum* Fabricius, (=*Grantia compressa*).

Ascaltis *Haeckel* [1872].

Type species *A. canariensis* Michlucho-Maclay, (= *Leucosolenia canariensis*).

Ascandra *Haeckel* [1872].

Type species *A. cordata* Haeckel, (=*Leucosolenia cordata*).

The name *Ascandra* has been used in almost exactly Haeckel's sense by several subsequent writers, notably von Lendenfeld, Breitfuss, Arnesen, and various systematists who have followed the modification of Haeckel's original system proposed by von Lendenfeld in 1891. The name has also been used by Minchin [1896, 1900, &c.] in an entirely different sense for a genus whose type, and only, species was *A. falcata*, placed by us in the genus *Leucosolenia*. In the latter sense it is the equivalent of von Lendenfeld's *Homandra*.

ASCETTA *Haeckel* [1872].

Type species *A. primordialis* Haeckel, (= *Leucosolenia primordialis*).

As employed by Haeckel, this genus includes only species whose whole skeleton is composed of triradiates; von Lendenfeld, however, has used it [1891] to include all those ascon sponges which do not possess oxea.

ASCILLA *Haeckel* [1872].

Type species *A. gracilis* Haeckel, (=*Leucosolenia gracilis*).

ASCOMETRA *Haeckel* [1872].

Type species *A. primordiale* Haeckel, (= *Leucosolenia primordialis*).

The name *Ascometra* was used by Haeckel, in the "artificial system" given at the end of his 'Monographie,' to replace the name *Thecometra* used for exactly the same group in his earlier 'Prodromus,' and for no apparent reason save nomenclatorial symmetry. He gave his new genus, however, a different type species.

ASCORTIS *Haeckel* [1872].

Type species *A. horrida* Haeckel, (=*Leucosolenia horrida*).

ASCULMIS *Haeckel* [1872].

Type species *A. armata* Haeckel, (=*Leucosolenia armata*).

ASCURIS *Haeckel* [1872].

Type species *A. arrecifæ* Haeckel, (= a variety of *Leucosolenia canariensis*).

ASTROSCLERA *Lister* [1900].

Type species *A. willeyana* Lister.

Although originally described as a member of the Calcarea, this sponge is now known to be an aberrant member of the Noncalcarea (*vide* Kirkpatrick [1912]).

AULOPLEGMA *Haeckel* [1870].

Type species *A. loculosum* Haeckel, (=*Leucosolenia loculosa*).

AULORHIZA *Haeckel* [1870].

Type species *A. intestinalis* Haeckel, (= *Leucosolenia lamarckii*).

CALCISPONGIA *de Blainville* [1834–1837].

Type species *C. compressa* Fabricius, (=*Grantia compressa*).

This genus was proposed by de Blainville in exactly the same sense as Fleming's *Grantia* [1828]. Since the latter genus takes priority, *Calcispongia* becomes merely a synonym of it.

CLATHRINA *Gray* [1867].

Type species *C. clathrus* O. Schmidt, (= *Leucosolenia clathrus*).

This genus has been employed by Minchin [1896, 1900] as the type genus of one of his families of homocœl sponges. We have already (p. 718) given our reasons at length for not accepting his conclusions.

CLYSTOLYNTHUS *Haeckel* [1870].

Type species *C. vesicula* Haeckel, (=*Leucosolenia vesicula*).

CŒNOSTOMELLA *Haeckel* [1870].

Type species *C. caminus* Haeckel, (=*Leucandra caminus*).

CŒNOSTOMIUM *Haeckel* [1872].

Type species *C. crambessa* Haeckel, (=*Leucandra crambessa*).

CŒNOSTOMUS *Haeckel* [1872].

Type species *C. primigenius* Haeckel, (=*Leucetta primigenia*).

CYATHISCUS *Haeckel* [1870].

Type species *C. actinia* Haeckel, (=*Aphroceras alcicornis*).

DERMATRETON *Jenkin* [1908 B].

Type species *D. chartaceum* Jenkin, (=*Grantia chartacea*).

This genus was proposed by Jenkin for certain species of the family Grantiidæ, which possess "linked" chambers. We do not consider that this character is of generic rank, and we have therefore included both these species in the genus *Grantia*.

DJEDDEA *Michlucho-Maclay* MS. (*fide* Haeckel [1872]).

Type species *D. violacea* Michlucho-Maclay MS., *fide* Haeckel [1872], (=*Grantessa stauridea*).

The generic name *Djeddea* is quoted by Haeckel in the synonymy list attached to his *Sycetta stauridea*. This seems to be the only authority for the name.

DUNSTERVILLIA *Bowerbank* [1845].

Type species *D. elegans* Bowerbank, (=*Sycon elegans*).

Bowerbank's genus was adopted by Haeckel as one of the genera of his "artificial" system, but no other author seems to have made use of it save Gray. It is now considered to be merely a synonym of *Sycon*.

DYSSYCARIUM *Haeckel* [1872].

Type species *D. egedii* O. Schmidt, (=*Leucandra egedii*).

In proposing this genus Haeckel states that it is equivalent to O. Schmidt's *Sycinula*. Both these are considered by us to be synonyms of *Leucandra*, but the question is discussed in more detail under *Sycinula*.

DYSSYCONELLA *Haeckel* [1870].

Type species *D. pumila* Bowerbank, (=*Leucandra pumila*).

DYSSYCUM *Haeckel* [1870].

Type species *D. fistulosum* Johnston, (=*Leucandra fistulosa*).

DYSSYCUS *Haeckel* [1872].

Type species *D. primigenius* Haeckel, (=*Leucetta primigenia*).

A genus of the artificial system, identical with *Dyssycum* of the 'Prodromus' of 1870. There does not seem to be any reason for the change of spelling, but such changes, and sometimes more radical ones, were made by Haeckel in several cases in his later work.

EBNERELLA *von Lendenfeld* [1891].

Type species *E. buccichii* von Ebner, (= *Amphoriscus buccichii*).

GUANCHA *Michlucho-Maclay* [1868].

Type species *G. blanca* Michlucho-Maclay, (=*Leucosolenia blanca*).

HETEROPEGMA *Poléjaeff* [1883].

Type species *H. nodus-gordii* Poléjaeff, (=*Leucaltis clathria*).

As we have shown when discussing *Leucaltis*, Poléjaeff's name is merely a synonym of the latter.

HOMANDRA *von Lendenfeld* [1891].

Type species *H. falcata* von Lendenfeld, (= *Leucosolenia falcata*).

This genus is the equivalent of *Ascandra* in Minchin's sense [1896, 1900, &c.], but must not be confused with *Ascandra* in the original sense of Haeckel. The latter genus was used by von Lendenfeld in almost exactly Haeckel's sense, so that, since he considered *A. falcata* to be worthy of generic separation, a new name became necessary. At a later date Minchin revised the classification of the homocœl sponges, and relegated the name *Ascandra* to *A. falcata*, so that the name *Homandra* was rendered unnecessary. (See, for details, Minchin [1896, 1897].) We have given above (p. 720) our reasons for considering the separation of *L. falcata* from the genus *Leucosolenia* to be inadvisable.

HOMODERMA *von Lendenfeld* [1885 A].

Type species *H. sycandra* von Lendenfeld, (=*Sycon sycandra*).

This genus was proposed for a somewhat aberrant *Sycon*, and was made by its author the only genus of a new family of Ascones, the Homodermidæ. The question has been dealt with to some extent above (p. 716), and is fully investigated in Row's report on the Calcarea of the Hamburg South-Western Australian Expedition of 1905 (see Row [1913 MS.]).

HOMETTA *von Lendenfeld* [1891].

A genus proposed by von Lendenfeld on hypothetical characters, and without any species.

HYPODICTYON *Jenkin* [1908 B].

Type species *H. longstaffi* Jenkin, (=*Sycon longstaffi*).

This genus was erected by Jenkin for the above species, and placed by him in his supposed family Chiphoridæ, on account of the presence of chiactines, being separated from *Streptoconus* on account of the "linking" of the chambers. Neither of these characters is considered by us as of generic value.

HYPOGRANTIA *Carter* [1885–1886].

Type species *H. infrequens* Carter, (=*Grantiopsis infrequens*).

This genus was proposed by Carter for several species of diverse nature, and the diagnosis was extremely unsatisfactory. Further, the first (*i. e.* type) species was said by its author to be "incertæ sedis." Under these circumstances we do not feel that we can allocate the name to any of our genera.

LEUCKARTEA *Michlucho-Maclay* MS., *fide* Haeckel [1872].

Type species *L. natalensis* Michlucho-Maclay MS., *fide* Haeckel [1872], (=*Sycon ramosum*).

The only warranty for this name seems to be that it is included in the synonymy list attached to Haeckel's *Sycandra ramosa* as a MS. name of Michlucho-Maclay's.

LEUCOGYPSIA *Bowerbank* [1864–1882].

Type species *L. gossei* Bowerbank, (=*Leucandra gossei*).

One of the four genera of Calcareous sponges proposed by Bowerbank in his 'Monograph of British Sponges.' It is now usually considered to be a synonym of *Leucandra*, and although perhaps it has right of priority over the latter, yet we feel that the name *Leucandra* is so well known that it should be preserved.

LEUCOMETRA *Haeckel* [1872].

Type species *L. primigenia* Haeckel, (=*Leucetta primigenia*).

LEUCONIA *Grant* [1841].

A genus proposed by Grant and used by many subsequent authors very nearly in the sense in which we use *Leucandra* (*e. g.* Carter, Poléjaeff, Urban, etc.), but as shewn by Vosmaer [1887] and Dendy [1893 A], the name is not valid, as it had been previously applied to a genus of Mollusca.

Leucopsis *von Lendenfeld* [1885 B].

Type species *L. pedunculata* von Lendenfeld, (=*Leucosolenia pedunculata*).

This species was supposed by von Lendenfeld to be a transition form between Haeckel's Ascones and Leucones, but it seems to us that the structure described is far more probably that of a Clathrinoid *Leucosolenia* provided with a stalk.

Leucortis *Haeckel* [1872].

Type species *L. pulvinar* Haeckel, (=*Leucandra pulvinar*).

Leuculmis *Haeckel* [1872].

Type species *L. echinus* Haeckel, (=*Leucilla echinus*).

Lipostomella *Haeckel* [1870].

Type species *L. clausa* Haeckel, (=*Leucetta primigenia*).

Medon *Duchassaing et Michelotti* [1864].

Type species *M. barbata* Duchassaing et Michelotti (*incertæ sedis*).

A genus comprising two species, both of which are quite unrecognisable, and may even not be calcareous sponges.

Merlia *Kirkpatrick* [1908].

Type species *M. normani* Kirkpatrick.

This sponge was originally described as a member of the family Pharetronidæ, but recently Kirkpatrick has shown that its true place is among the Non-calcarea.

Mlea *Michlucho-Maclay* MS., *fide* Haeckel [1872].

Type species *M. dohrnii* Michlucho-Maclay MS., *fide* Haeckel [1872], (=*Leucandra pulvinar*).

The only authority for this name seems to be Haeckel, who published several MS. names in the synonymy lists attached to various species in his Monograph.

Möbiusispongia *Duncan* [1880].

Type species *M. parasitica* Duncan.

An organism originally described as a parasitic calcareous sponge, but it seems very doubtful whether it belongs to the sponges at all. We certainly do not feel inclined to recognise it, without further evidence, as a member of the Calcarea.

Nardoa *O. Schmidt* [1862].

Type species *N. reticulum* O. Schmidt, (= *Leucosolenia reticulum*).

Minchin [1896] has shown that this name was previously used for a genus of ASTEROIDEA, and is therefore permanently unavailable.

NARDOMA *Haeckel* [1872].

Type species *N. nitida* Haeckel, (=*Leucosolenia nitida*).

NARDOPSIS *Haeckel* [1870].

Type species *N. gracilis* Haeckel, (=*Leucosolenia gracilis*).

NARDORUS *Haeckel* [1872].

Type species *N. primordialis* Haeckel, (=*Leucosolenia primordialis*).

OLYNTHELLA *Haeckel* [1872].

Type species *O. coriacea* Montagu, (=*Leucosolenia coriacea*).

OLYNTHIUM *Haeckel* [1870].

Type species *O. nitidum* Haeckel, (=*Leucosolenia nitida*).

OLYNTHUS *Haeckel* [1870].

Type species *O. simplex* Haeckel, (= *Leucosolenia primordialis*).

This name, as an actual generic name, is considered by us to be merely a synonym of *Leucosolenia*, but we may point out that its author proposed it for what he considered to be the most primitive adult sponge known, and, although we now believe that he probably erred in considering specimens of this form to be adult, yet the name is still retained for a hypothetical genus of ancestral Calcarea, and for an early stage in the ontogeny of the individual. Even should adult *Olynthus*-forms occur, however, we do not consider that they would be generically separable from *Leucosolenia*.

POLEJNA *von Lendenfeld* [1891].

Type species *P. uter* Poléjaeff, (=*Leucilla uter*).

One of the genera based by von Lendenfeld on the presence of a sylleibid canal system, a character which we do not consider of generic importance.

PROSYCUM *Haeckel* [1870].

Type species *P. simplicissimum* Haeckel, (= *Leucosolenia primordialis*).

RHABDODERMELLA *Urban* [1902].

Type species *R. nuttingi* Urban, (=*Leucilla nuttingi*).

SCYPHA *S. F. Gray* [1821].

Type species *S. coronata* Ellis and Solander, (= *Sycon coronatum*).

The genus *Scypha* actually has priority over Risso's *Sycon*, but the latter has so long been in general use that it seems desirable to retain it. Moreover, the earlier name was proposed by a botanist for organisms which he regarded as plants, and the generic diagnosis was hopelessly erroneous and misleading.

SOLENIDIUM *Haeckel* [1872].

Type species *S. nitidum* Haeckel, (=*Leucosolenia nitida*).

SOLENISCUS *Haeckel* [1870].

Type species *S. loculosus* Haeckel, (=*Leucosolenia loculosa*).

SOLENULA *Haeckel* [1872].

Type species *S. coriacea* Montagu, (=*Leucosolenia coriacea*).

SPHENOPHORINA *Breitfuss* [1898 B].

Type species *S. singularis* Breitfuss, (=*Grantia ? singularis*).

This name was originally proposed for a sponge showing certain apparently great peculiarities in its skeletal structure and in the form of its spicules. Possibly, if the structure described really represents that of the sponge, it merits a distinct genus, but the fact that only a fragment was found, and that that fragment had been preserved in spirit for no less than 33 years before it was examined by Breitfuss, led us to doubt whether there had not been some corrosion of the spicules during that time. This opinion was supported by an examination of type slides which one of us (Row) was able to make when in Berlin recently, for the appearance of the specimens is just what might be produced by the very slow eating away of the terminal portions of the spicule-rays by very dilute acid. Under these circumstances we feel that the genus had better be abandoned for the present, at any rate until further material of the species assigned to it has been obtained, and we have accordingly placed the only described species provisionally in the genus *Grantia*.

SPHENOPHORUS *Breitfuss* [1898 B].

Type species *S. singularis* Breitfuss, (=*Grantia ? singularis*).

An earlier name for the previous genus, abandoned by its author as being preoccupied.

SPONGIA *Linnæus* [1758–1759].

The name under which the earlier known species of Calcareous sponges were, in common with non-calcareous forms, described, but now entirely abandoned.

STREPTOCONUS *Jenkin* [1908 B].

Type species *S. australis* Jenkin, (=*Sycon australe*).

One of the genera of Jenkin's family Chiphoridæ, which has been abandoned by us for reasons given above.

SYCANTHA *von Lendenfeld* [1891].

Type species *S. tenella* von Lendenfeld, (=*Sycon tenellum*).

This genus was retained by Dendy [1892 B], but although the species placed in it by von Lendenfeld is certainly aberrant, we agree with Jenkin [1908 B] that it does not merit generic recognition.

SYCARIUM *Haeckel* [1870].

Type species *S. ampulla* Haeckel, (=*Sycon ampulla*).

SYCIDIUM *Haeckel* [1870].

Type species *S. gelatinosum* de Blainville, (=*Sycon gelatinosum*).

SYCILLA *Haeckel* [1872].

Type species *S. cyathiscus* Haeckel, (=*Amphoriscus cyathiscus*).

SYCINULA *O. Schmidt* [1868].

Type species *S. aspera* O. Schmidt, (=*Leucandra aspera*).

This name, strictly speaking, may have priority over *Leucandra*, but it was only mentioned casually by Schmidt, without diagnosis, although he indicated *S. aspera* as type of the genus, and it has never been accepted, except by Haeckel for one of his "artificial" genera, whereas *Leucandra* has come into fairly general use. And further, if the name *Leucandra* were changed, it apparently should be changed to *Leucogypsia* rather than to *Sycinula*.

SYCOCYSTIS *Haeckel* [1870].

Type species *S. oviformis* Haeckel, (=*Sycon ciliatum*).

SYCODENDRUM *Haeckel* [1870].

Type species *S. ramosum* Haeckel, (=*Sycon ramosum*).

SYCOLEPIS *Haeckel* [1870].

Type species *S. incrustans* Haeckel, (=either *Trichogypsia incrustans* or *T. villosa*).

SYCOMETRA *Haeckel* [1870].

Type species *S. compressum* Fabricius, (=*Grantia compressa*).

SYCONELLA *O Schmidt* [1868].

Type species *S. quadrangulata* O. Schmidt, (= *Sycon quadrangulatum*).

SYCOPHYLLUM Haeckel [1870].

Type species *S. lobatum* Haeckel, (= *Grantia lobata*).

SYCORRHIZA Haeckel [1870].

Type species *S. coriacea* Montagu, (=*Leucosolenia coriacea*).

SYCORTIS *Haeckel* [1872].

Type species *S. lævigata* Haeckel, (=*Grantia lævigata*).

SYCORTUSA *Haeckel* [1872].

Type species *S. lævigata* Haeckel, (=*Grantia lævigata*).

One of the subgenera into which Haeckel divided his genus *Sycortis*, raised by von Lendenfeld [1891] to generic rank.

SYCOTHAMNUS *Haeckel* [1870].

Type species *S. fruticosus* Haeckel, (= *Leucetta primigenia*).

SYCUM *Haeckel* [1870].

Type species *S. ciliatum* Fabricius, (=*Sycon ciliatum*).

A modification of Risso's generic name *Sycon* for which there does not seem to have been any adequate reason.

SYCURUS *Haeckel* [1872].

Type species *S. primitivus* Haeckel, (=*Sycetta primitiva*).

TARROMA *Haeckel* [1870].

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TARROPSIS *Haeckel* [1872].

Type species *T. coriacea* Montagu, (=*Leucosolenia coriacea*).

TARRUS *Haeckel* [1870].

Type species *T. densus* Haeckel, (=*Leucosolenia densa*).

TEICHONELLA *Carter* [1878].

Type species *T. prolifera* Carter, (=*Leucetta prolifera*).

A genus proposed by Carter for two species, whose slight similarity of external form misled him into thus associating them. One of these has now been placed by us in the genus *Leucetta*, the other is the type of our genus *Teichonopsis*. For a criticism of the genus *Teichonella* and its species see Dendy [1891 B].

TENTHRENODES *Jenkin* [1908 B].

Type species *T. antarcticus* Jenkin, (=*Sycon antarcticum*).

For a discussion of this genus and its species see under *Sycon* (p. 744).

THECOMETRA *Haeckel* [1870].

Type species *T. loculosa* Haeckel, (=*Leucosolenia loculosa*).

UTELLA *Dendy* [1892 B].

Type species *U. hystrix* Haeckel, (=*Sycodorus hystrix*).

We have found it necessary to substitute Haeckel's name *Sycodorus* for the above.

VOSMAERIA *von Lendenfeld* [1885 B].

Type species *V. gracilis* von Lendenfeld, (=*Grantia gracilis*).

One of the genera based by von Lendenfeld on the presence of a "sylleibid" canal system, a character which we do not consider to be of generic importance.

WAGNERELLA *Merejkowski* [1878][1]

Type species *W. borealis* Merejkowski.

An organism originally described as a calcareous sponge, but shewn by Mayer [1879] to be a Heliozoan.

In addition to the above, an enormous number of subgeneric names, both "artificial" and "natural," were proposed by Haeckel in his two works on the group, but the list is sufficiently swollen out with discarded generic names, without including subgeneric ones also.

PHYLOGENY OF THE CALCAREA.

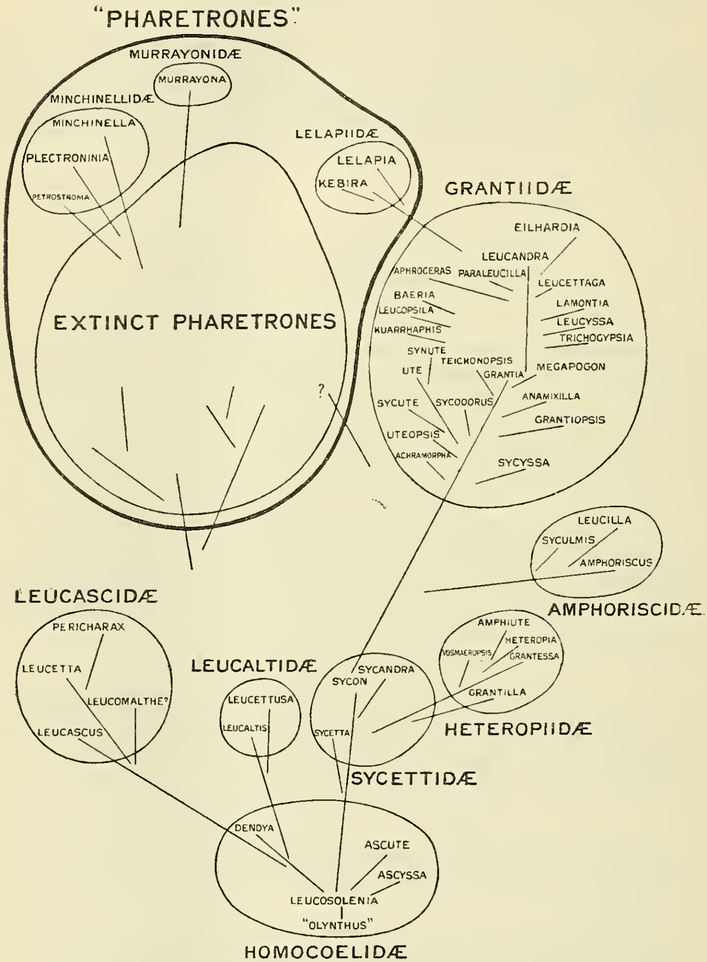
Our views as to the phylogeny of the Calcarea, elaborated in the foregoing pages, may now be summarised as follows, and illustrated by the accompanying phylogenetic tree. This tree differs in certain important respects from that published by one of us twenty years ago [Dendy, 1893 A], which is only to be expected when we consider the great advances made in our knowledge of the group in the interval. All the families of the earlier scheme, and the general ideas of their relationships to one another in the main lines of descent, are, however, retained with but little alteration, but we recognise now four additional families of recent Calcarea, the Leucaltidæ, the Minchinellidæ, the Murrayonidæ and the Lelapiidæ, while several genera have had to be transferred from one family to another.

One of the most important advances in the classification of the group was made by Minchin [1896], in his demonstration that even among the homocœl sponges two types of collared cells are met with, with apical and basal nuclei respectively; a suggestion which was followed up by Bidder [1898], who, it will be remembered, proposed to divide, not only the Calcarea, but the whole of the sponges into BASINUCLEATA and APINUCLEATA accordingly, or, confining the suggestion to the Calcarea, to divide these into CALCARONEA with apical, and CALCINEA with basal, nuclei.

We think it quite likely that the latter of these two suggestions will ultimately prove to be thoroughly sound. With regard to the former, however, we consider it highly probable that several distinct types of collared cells will be shewn to exist in the non-calcareous sponges, though as yet we have very little information on this point.

Continuing the observations of Minchin, we find that in the genus *Leucosolenia*, which admittedly stands at the bottom of the line of evolution of the Calcarea, both types of collared cells exist, but apparently not side by side in the same species; and we find further, that the two principal lines of descent, which

Text-fig. 133.



PHYLOGENY OF CALCAREOUS SPONGES.

appear, on quite other grounds, to have sprung from the homocœl sponges, are characterised respectively by the two types of collared cells. It is interesting to note that these two main lines of descent were clearly indicated twenty years ago, as represented by the Leucascidæ and Sycettidæ respectively.

It must, of course, be remembered that the real difference between the two types of collared cells concerns, as Minchin has shewn [1909], the relation of the flagellum, with its basal granule, to the nucleus. This relation has, of course, only been determined in a very few cases. In *Leucosolenia coriacea*, for example, the basal granule is situated at the apex of the cell and the nucleus at the base, while in *L. complicata* the flagellum appears to spring from the nucleus itself, which is apically situated. There can be no doubt that the actual position of the nucleus itself in the collared cell may vary temporarily under certain conditions, but in good spirit-preserved material it appears always to settle down into a characteristic position, which is either basal or apical, and which may be determined without resort to special methods of cytological investigation. We do not wish to lay undue stress upon this character at present, and we should not venture to use it were it not associated with other distinctive features, but we have been surprised, in view of our former opinion as to the systematic value of such a character, to find how constant the position of the nucleus is in the two lines of descent indicated. This will be sufficiently evident from reference to the table given in the Introduction.

We have in vain attempted to split up the unwieldy genus *Leucosolenia* into smaller groups. The utmost we have been able to do has been to isolate from the main body of species three well-marked types, *Ascyssa*, *Ascute* and *Dendya*. We do not consider that Minchin's proposal to divide the homocœl sponges into two families, Leucosoleniidæ and Clathrinidæ, is at all practicable in the present state of our knowledge, and if it be true, as he himself has pointed out [1909], following Goldschmidt, that the two types of relation of flagellum to collared cell may occur in the same genus of Protozoa (*Mastigina*), we see no reason for supposing that both may not occur in the genus *Leucosolenia*. According to our view, this is a large and heterogeneous group of primitive forms all closely related to one another and merging into one another to a large extent, from which the two lines of descent referred to have led the way to the evolution of the higher Calcarea.

We will take the *Dendya*, or Leucascid-Leucaltid, line first, in which the nucleus of the collared cells is basal. The starting point of this line seems to have been from some form closely related to *Dendya*. The radiate arrangement of the colony in this genus formerly misled Dendy [1893 A] into regarding it as on the line of evolution of the Sycettidæ, but there are several strong arguments against this view. The radiate arrangement appears to be but a modification of a reticulate "Clathrinid" character, and actual open anastomoses may occur between the radial tubes, which, in spite of what has been said by more than one author, appears rarely if ever to be the case in true Sycettidæ or their descendants. To this must be added the primitive type of skeleton, composed exclusively of equiangular radiates, which do not exhibit the characteristic arrangement met with in the syconoid sponges, with their differentiated gastral cortex and articulate tubar skeleton. In this connection we may especially note the absence of subgastral sagittal triradiates (or quadriradiates), which form such a constant feature of the Sycettidæ and their derivatives.

The *Dendya* line seems to have given off two branches, represented by the Leucascidæ and Leucaltidæ respectively. The Leucascidæ are undoubtedly the more primitive of the two. The genus *Leucascus* itself, indeed, might very easily be mistaken for a homocœl sponge were it not for the presence of a distinct and independent pore-bearing dermal membrane; it retains the elongated, branched, and more or less radially arranged flagellate chambers of its *Dendya*-like ancestors. Within the family evolution has led to the development of a more highly differentiated dermal cortex in *Leucetta* and *Pericharax*, accompanied by great reduction in the size of the flagellate chambers and complication of the inhalant and exhalant canal systems. In this way has arisen that remarkable convergence between *Leucetta* and *Pericharax* on the one hand, and the leuconoid Grantiidæ on the other, which has for so long prevented the appreciation of the fundamental distinction which really exists between these forms. The remaining genus in the family, *Leucomalthe*, is a highly specialised and aberrant type, which is only included here provisionally, until we know more of its minute anatomy and histology.

In the Leucaltidæ the distinctive peculiarity has been the enormous development of the dermal cortex with its special skeleton, and the accompanying reduction of the skeleton of the chamber layer to a more or less vestigial condition, or even its complete disappearance. In this family, again, as regards canal system, we meet with the customary transition from the long chambers and radial arrangement of the more primitive forms (*Leucaltis*) to the spherical chambers and scattered arrangement of the highest (*Leucettusa*).

To this line of descent must also be relegated two out of the three surviving families of "Pharetrones," namely, the Minchinellidæ and the Murrayonidæ. We found this conclusion upon the basal position of the nucleus in the collared cells in *Minchinella* and *Murrayona*; but it must be borne in mind that as regards their general organisation also the members of these two families differ very widely from *Lelapia* and *Kebira*, the only representatives of the Lelapiidæ, the third surviving family of "Pharetrones."

We are therefore compelled to regard the so-called family Pharetronidæ as of diphyletic origin, and the resemblance, such as it is, between the Lelapiidæ on the one hand, and the Minchinellidæ and Murrayonidæ on the other, as due to convergence.

As to how many of the vast group of extinct "Pharetronid" sponges should be associated with the Minchinellidæ and Murrayonidæ, and how many with the Lelapiidæ, is a question which we cannot attempt to decide, but we think there is evidence to shew that the great majority belong to the basinucleate group, though this opinion, of course, rests only on skeletal characters. It seems highly probable that in past times the *Dendya* line of descent led to the evolution of the dominant Pharetronid group, while at the present day this group has dwindled away and has been replaced chiefly by the now dominant Grantiidæ on the apicinucleate line of descent.

The great antiquity of the Pharetronid group, considering its high degree of organisation, is highly remarkable. It dates back far into the Palæozoic Epoch, perhaps even to Silurian times [Ulrich, 1889], and almost certainly to Devonian [Zittel, 1878], so that it seems that the Calcarea had already reached one of their highest states of evolution at the commencement of the Palæozoic Epoch. Throughout the Secondary Period the Pharetrones were dominant, and very numerous genera and species have been described, whereas at the present day they are almost extinct, though possibly a few more forms yet remain to be discovered.

Of course it is quite possible that the predominance of the Pharetrones over other types of Calcarea in past times is apparent rather than real, owing to the fact that they alone, on account of their coherent skeleton, had much chance of being preserved in a fossil condition. Thus there may have been a kind of "geological selection" of these forms in a fossil condition, but it is indeed noteworthy that the apparently much more primitive groups should predominate over these ancient and highly specialised forms to such an extent as they do at the present day.

It is possible that a fresh outburst of evolutionary vigour on the part of the more primitive persistent groups may have occurred in comparatively recent times.

Turning now to the Sycettid line of descent, we must remind the reader, in the first instance, that this appears to have given rise to the vast majority of the recent Calcarea.

The most primitive genus on this line appears undoubtedly to be *Sycetta*, with its radially arranged chambers standing entirely separate from one another, with no trace of dermal cortex, and without tufts of oxea at the distal ends of the radial chambers. This genus already possesses a well-developed articulate tubar skeleton, the first joint of which is composed of subgastral sagittal triradiates, which appear never to have been developed along the *Dendya* line of descent, but which are remarkably constant throughout the whole of the Sycettid line, although absent by suppression in a few cases where the skeleton has undergone extreme modification. We are unable to indicate any intermediate forms between the genus *Sycetta* and the Homocœlidæ. It presumably arose from some homocœl ancestor which formed colonies by radial budding, not unlike those of *Dendya*, but the apical position of the nucleus of the collared cells and the much more advanced type of skeleton shew that the relationship to *Dendya* itself cannot be a close one, while the interval to be bridged over between the most primitive *Sycetta* and any *Leucosolenia* is a very wide one. Moreover, *Sycetta* itself seems to be in the nature of a *cul-de-sac*, for the entire absence of the characteristic oxeote spicules of *Sycon* makes it doubtful whether we can derive the latter genus directly from the former, though both have probably sprung from some common ancestor. If, however, *Sycon* derives its oxea from an ancestral *Leucosolenia*, it is difficult to account for the absence of these spicules in *Sycetta*, but the distribution of oxea in the Calcarea is an extremely difficult problem about which we have perhaps said enough in an earlier part of this paper.

The fact that certain species of *Sycon*, for which von Lendenfeld [1885 A] proposed his genus *Homoderma*, retain the collared cells as a lining to at any rate a portion of the central gastral cavity throughout life, certainly shews that one can draw no hard and fast line of distinction between the Homocœlidæ and the old group Heterocœla in this respect, but the forms in question have such a highly specialised syconoid skeletal system that they hardly help us to bridge over the interval between the Homocœlidæ and the Sycettidæ.

The family Sycettidæ is a very small one, the typical genus being *Sycon* with a large number of species, while the only other known genera are *Sycetta* and *Sycandra*, each with a very small number of species and each representing an offshoot which probably leads no further. From the Sycettidæ two lines of descent appear to lead to the Heteropiidæ and Grantiidæ respectively.

In both these families the important step in further evolution, as in the Leucascidæ and the Leucaltidæ, has been the development of a dermal cortex, but this cortex appears to have arisen somewhat differently in the two cases. In the Heteropiidæ it is clearly associated with the out-turning of certain of the oral rays of the distal tubar triradiates so as to arch over the entrances to the inhalant canals. We may assume that with these rays the dermal tissues of the sponge have spread over the intercanals and have given rise ultimately to the special cortical spicules developed *in situ*. The rotation of the distal tubar triradiates in the manner indicated, and the preponderating development of the now centripetally directed oral rays, have finally converted these spicules into the "pseudosagittal" triradiates which constitute the outstanding feature of the Heteropiidæ. They are, so to speak, a new discovery, which the sponge utilizes to the utmost, until finally their strong centripetally directed oral rays, in association with the opposed basal rays of subgastral sagittal triradiates, give rise to an "inarticulate" tubar skeleton, which replaces the articulate tubar skeleton of the ancestral *Sycon*.

The evolution of the canal system within the family appears to have followed the usual lines up to a certain point. The known species of *Vosmaeropsis* exhibit the type of canal system described by von Lendenfeld as "sylleibid," intermediate between syconoid and leuconoid, but a Heteropiid with a typical leuconoid canal system has not yet been found.

In the Grantiidæ, on the other hand, the development of a dermal cortex appears to have been inaugurated by the appearance of a thin pore-bearing dermal membrane over the ends of the inhalant canals in some syconoid ancestor, such as is known to occur in some species of the genus *Sycon* at the present day (e. g. *S. boomerang*).

The Grantiidæ must be regarded as the dominant family of Calcarea at the present day, comprising, as they do, no less than 23 genera, and exhibiting a very wide range of structure both as regards skeleton and canal system. It might be possible to divide these genera into syconoid and leuconoid subfamilies, but we should have no guarantee of the monophyletic origin of the latter from the former. Nevertheless, the scarcity of sylleibid forms, which might be regarded as connecting links between the two types, is somewhat remarkable, and suggestive of a natural cleavage. The known species of the genus *Megapogon*, however, are sylleibid, and although most of the Leucandras have small chambers, *L. australiensis* Carter and *L. infesta* sp. n. (=*Leucilla intermedia* Row [1909]) have very large ones, and might also be considered as transitional forms. Also we must remember that in a considerable number of cases we have no accurate information as to the canal system.

The arrangement of the genera within the family is a very difficult problem. They appear to group themselves around two central types, *Grantia* and *Leucandra*, but as we have just mentioned, our knowledge of the exact type of canal system in many forms is very imperfect, while in others the only evidence of their close relationship to *Leucandra* is the canal system itself. The appearance of this part of our phylogenetic tree will probably be greatly modified by subsequent investigations. Such aberrant genera as *Leucopsila*, *Baeria*, *Kuarrhaphis*, *Leucyssa* and *Trichogypsia* can only be included in the Grantiidæ provisionally.

The difficulty of arranging the genera probably arises from the fact that great gaps exist in the family owing to extinction of intermediate forms. It might be argued that this family cannot be very ancient, because hardly any of their fossil remains have been discovered, but this may possibly be accounted for by the fact that they do not possess a coherent skeleton, and accordingly become disintegrated soon after death.

It is, however, quite possible that some of the very imperfectly known extinct Pharetrones may really be offshoots from this family, as we believe to be the case with the recent Lelapiidæ. The customary association of the latter with the Pharetrones is based upon the presence of a fibrous skeleton composed of modified radiates, especially the tuning-fork spicule, and a fibrous skeleton of this type is perhaps present in some of the extinct genera. We have, however, purposely avoided discussing the latter in this paper, as we do not know enough about them to warrant us in drawing any but the most general conclusions. As we have already pointed out, the apical position of the nucleus of the collared cells in *Lelapia*, and the presence in it also of subgastral sagittal triradiates, render the Grantiid origin of the Lelapiidæ reasonably certain.

In addition to the Lelapiidæ, one other family, the Amphoriscidæ, seems to have originated from the Grantiid stock. This family derives its distinctive character from the development of strong, centripetally directed apical rays on the tangential radiates of the dermal cortex. Such apical rays have undoubtedly appeared several times independently in the evolution of the Calcarea. We find them, for example, in some species of *Leucetta*, in *Leucaltis*, in some species of *Leucettusa*, in one species of *Grantia* (*G. intermedia*), in some species of *Leucandra*, and in *Grantilla*, as well as in this group. It may well seem doubtful whether, in view of these facts, the character in question ought to be regarded as of family significance in the Amphoriscidæ; but inasmuch as the latter appear to us to comprise a natural assemblage of three closely related genera in which this character is no longer casual but has assumed great importance in the structure of the skeleton, we have decided to retain the group, at any rate for the present. We have, however, considerably reduced the size of the family by the removal of *Leucaltis* (*Heteropegma*), together with some of the species formerly placed in *Leucilla*, but now divided between *Leucetta*, *Leucettusa* and *Leucandra*, to which they seem to be more closely affiliated by other characters, leaving in the genus *Leucilla* a group of species which are, we believe, all directly descended from *Amphoriscus*.

The most primitive Amphoriscidæ, belonging to the genus *Amphoriscus*, have a syconoid canal system and a somewhat feebly developed dermal cortex, and we accordingly consider the family to be an offshoot from low down on the Grantiid stem. Finally, we may point out that in this family again the canal system has undergone its usual transformation from the syconoid to the leuconoid type, with intermediate sylleibid forms.

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EXHIBITIONS AND NOTICES.

May 20, 1913.

Prof. E. A. MINCHIN, M.A., F.R.S., Vice-President, in the Chair.

The SECRETARY read the following report on the Additions that had been made to the Society's Menagerie during the month of April, 1913:—

The registered additions to the Society's Menagerie during the month of April were 205 in number. Of these, 95 were acquired by presentation, 79 by purchase, 9 were received on deposit, 1 in exchange, and 21 were born in the Gardens.

The number of departures during the same period, by death and removals, was 156.

Amongst the additions special attention may be directed to:—

1 White-handed Gibbon (*Hylobates lar*), from Penang, deposited on April 10th.