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(Plates XLVII. & XLVIII.).

The amount of variation exhibited by the species of the genus Asterias has, as might have been expected, led to the formation of a large number of forms which are at any rate nominally distinct. Tempting as the work of revision of such a genus ought to be, it has never attracted the attention of any zoologist who has written on the subject since the time of Müller and Troschel (1842). The most important and comprehensive work which has appeared is that of M. le Prof. Edmond Perrier, of the Jardin des Plantes. This essay, which was originally published in that still young but already so fertile journal the ‘Archives de Zoologie expérimentale’ of M. Lacaze-Duthiers, has since appeared separately.

M. Perrier’s work, though bearing the unambitious title of ‘Révision de la Collection de Stellérides du Muséum d’histoire naturelle de Paris,’ is so far extensive in its scope that it contains also a revision of the specimens in the British Museum, and descriptions of a number of the new species therein contained. In so far as Prof. Perrier has done his best to get their full value out of the descriptions of Dr. J. E. Gray, which, it must be owned, are peculiarly insufficient and unsatisfactory, and has also been in some cases bold enough to describe new species from single specimens, he has relieved me of two duties, which are always unpleasant.

Much, however, as M. Perrier has done with and for the genus Asterias, it would be not proper to pretend to say that he has given a complete revision of the genus: he details only forty-nine species, and does but little to indicate the affinities of the species he mentions, and nothing at all as to resolving them into either natural or artificial groups.

Nor can the present essay ask to be regarded as any thing else than a tentative effort in the direction of a complete revision. The collection in the British Museum is still in want of a number of described species; while, on the other hand, we must wait for a more perfect monograph till the specimens, which were doubtless collected by the ‘Challenger,’ and are now being worked out under able hands elsewhere, shall have found their proper place in the stores of the national collection. The rich collection made under the supervision of Mr. Alex. Agassiz will soon be described by M. Perrier.

1 Paris (Reinwald, 1875).
A synonymic Catalogue of the Asterida being, then, a desideratum for which we must still wait, I have here endeavoured to aid the author of that future catalogue by an attempt to adopt a method by which it will, as I hope, be easier than heretofore to recognize rapidly the characters of species already described, and to see what has been already more or less definitely effected in the determination of the synonymy.

The arrangement of the species either by natural characters, or by special points arbitrarily selected on account of their real or apparent convenience, has necessitated the careful examination of the characters of the species already represented by specimens in the British Museum, and the close study of the descriptions of the unrepresented species. When these descriptions are examined with a view to obtain from them information as to certain characters, we are soon struck by the variation in the modes of description, by which this group has suffered so much.

In directing attention, therefore, to the points by which, as I imagine, we can most satisfactorily and conveniently group the numerous species of this genus, I would take the opportunity of urging on those naturalists in whose care rare species may be, or to whom new species may come, to give us definite and exact information on these points, without, however, any prejudice to other structural characters which, seemingly useless at present, may to more sagacious naturalists prove to be of the highest systematic value.

There are some species described by Dr. Gray which it will, I believe, never be possible to recognize; no specimens in the Museum bear the labels of the names _A. echinata_, _A. aster_, _A. wilkinsonii_, and _A. multiradiata_ (Heliaster); and the descriptions that are given are certainly no aid at all to their identification. I propose to omit these names altogether from all the succeeding lists.

Of these lists, the first gives a catalogue of the names which have been applied to forms which are at present supposed to be specifically distinct from one another; to all these names there is added a reference to a work in which the species has been more or less completely described. In the case of nearly all descriptions made previously to the year 1840, reference is made to the account given by Müller and Troschel in their 'System der Asteriden;' in the case of Brandt reference is made, unless otherwise noted, to the 'Prodromus descriptionis Animalium ab II. Mertensio . . . observatorum,' published at St. Petersburg in 1835. The papers of Dr. Stimpson are

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1 The following quotations from a letter in which Prof. Perrier was kind enough to answer some questions which I addressed to him will show how far we are in accord on this point:—"Il m'a été impossible de retrouver au Museum l'Asterias bootes de Müller et Troschel, et je n'ai conservé le nom dans mes listes qu'à cause de l'autorité de ces auteurs. Je vous en dirai autant des Asterias aster et _A. wilkinsonii_ que je n'ai pu retrouver n' au British Museum ni ailleurs, et qui ne sont pas reconnaissables d'après les descriptions de Gray."
referred to by the numbers i., ii., iii. in brackets after his name; and these numbers refer respectively to:


The papers of Dr. Lütkeu to which references are made are contained in the 'Videnskabelige Meddelelser' (Copenhagen) for various years, which are distinguished by their respective dates.

So, too, the papers of Philippi which appeared in Wiegmann's 'Archiv für Naturgeschichte' are distinguished from one another by the year of their publication.

In the case of Dr. Gray, reference is made to his beautifully illustrated 'Synopsis of the Species of Starfish in the British Museum' (1866).

And, finally, when p. and a number follow alone the name of Perrier, reference is made to the already mentioned 'Révision,' and to the pagination of it as a separate publication.

In other cases the references given are so full as to need no explanation.

The letters B.M. are placed against the names of the species specimens which are in the British Museum.

I. List of the Species of Asterias now regarded as distinct.

1. acervata, Stimpson (i.), p. 271.
2. acutispina, Stimpson (i.), p. 262.
3. æqualis, Stimpson (i.), p. 273.
4. africana, M. Tr. p. 15. (B.M.)
5. alba, Bell, P. Z. S. 1881, p. 92. (B.M.)
6. amurensis, Lütken (1871), p. 296. (B.M.)
7. antarctica, Lütken (1856), p. 105. (B.M.)
8. bootes, Müller and Troschel, p. 17.
9. borbonica, Perrier, p. 61.
10. brachiata, Perrier, p. 65. (B.M.)
11. brandti, Bell, P. Z. S. 1881, p. 91. (B.M.)
12. brevispina, Stimpson (ii.), p. 88. (B.M.)
14. camuschatica, Brandt, Prod. p. 70. (B.M.)
15. capensis, Perrier, p. 73. (B.M.)
16. capitata, Stimpson (i.), p. 264.
17. clavatum, Philippi, 1870, p. 269.
18. compta, Stimpson (i.), p. 270.
19. conferta, Stimpson (i.), p. 263.
20. cribraria, Stimpson (i.), p. 270. (B.M.)

And also published in the Rec. des Actes de l'Acad. Imp. de St. Pétersbourg for 1834.
21. *cunninghami*, Perrier, p. 73. (B.M.)
23. *epichlora*, Brandt, p. 70. (B.M.)
29. *gelatinosa*, Meyen, Reise, i. p. 222. (B.M.)
31. *germaini*, Philippi, 1858, p. 266.
34. *hexactis*, Stimpson (i.), p. 272.
35. *hispida* (Pennant), Forbes’s British Starfishes, p. 95. (B.M.)
38. *katherinae*, Gray, p. 2. (B.M.)
41. *luetkeni*, Stimpson (i.), p. 265.
42. *lorida*, Philippi, 1858, p. 265.
43. *margaritifer*, M. Tr. p. 20. (B.M.)
44. *meridionalis*, Perrier, p. 76.
50. *neglecta*, Bell, P. Z. S. 1881, p. 94.
51. *nuda*, Perrier, p. 71. (B.M.)
52. *obtusispinosa*, Bell, P. Z. S. 1881, p. 92. (B.M.)
53. *ochotensis*, Brandt, Middendorff’s Reise, p. 28. (B.M.)
54. *ochracea*, Brandt, p. 69. (B.M.)
55. *pescimana*, Stimpson (i.), p. 266.
56. *pectinata*, Brandt, p. 70.
58. *polaris* 4, M. Tr. p. 16. (B.M.)
59. *polyplax*, Arch. für Naturg. 1844, p. 178. (B.M.)
60. *rarispina*, Perrier, p. 62. (B.M.)

1 Probably a variety of *A. ochracea*, Brandt (Stimpson (iii.) p. 87).
2 I have searched for, but have been unable to find any description of this species (*v. infra*).
3 This reference seems, by some accident, to have been dropped out from M. Perrier’s bibliography, s. v. p. 51.
4 It must be remembered that Müller and Troschel used the generic term *Asteracanthion*; they were therefore within their rights in using the specific term *polaris*, although *Asterias polaris* was the name given (1824) by Sabine to *Ctenodiscus cristatus*.
61. rodolphi, Perrier, p. 41.  
63. rugispina\(^1\), Stimpson (i.) p. 267.  
64. rupicola, Verrill, Bull. U. S. Nat. Mus. i. 3, p. 71.  
67. sinusoida, Perrier, p. 74.  
68. spectabilis, Philippi, 1870, p. 271.  
70. studeri, Bell, P. Z. S. 1881, p. 91 (mollis, Studer).  
72. tenera, Stimpson (i.), p. 269.  
73. tenuispina, M. Tr. p. 16.  
74. troscheli, Stimpson (i.), p. 267.  
75. vancouveri, Perrier, p. 64.  
76. varia, Philippi, 1870, p. 272.  

The list which now follows gives, in alphabetical order, the more important of the specific titles which have been applied to species previously named. The list has been here limited to those forms which have been regarded by competent naturalists as members of the genus, as defined and limited by Müller and Troschel, or what may, for brevity, be styled the Asteracanthion division of the Asterias.

I may, in passing, be allowed to beg leave to be excused from entering into any defence of the use of the generic term Asterias. I can add nothing to the summary of contending facts which have been put out by the Rev. A. M. Norman\(^2\); and I willingly give in my adhesion to the majority of his arguments. The labours of synonymy are severe enough to justify me in refusing to go again into a detailed examination of a subject which seems to me to have been exhausted\(^3\).

To the left of some of the names there is placed the name of an authority who has directed attention to the synonymy of the species in question.

II. List of the Principal Names which are regarded as Synonyms.

1. albulus, Stimpson, = *Stichaster albulus.*
2. angulosa, O. F. M., = *glacialis*, O. F. M.

(Verrill.) 3. arenicola, Stimpson, = *forbesi*, Desor.
(Lütken.) 4. atlantica, Verrill, = *tenuispina*, Lamk.

5. aurantiaca, Meyen, = *Stichaster aurantiacus.*

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\(^1\) If the specimens collected by Dr. Cunningham have been correctly identified, *A. rugispina* must be very closely allied to *A. antarctica.*


D'Orbigny with resemblance to the conclusion drawn by Perrier in 1881. Prof. Perrier's decision, as communicated to me by letter, is that the species were identical. Thinking it remarkable that this resemblance had not before been noted, I wrote to Prof. Perrier asking him if he had in the Jardin des Plantes the type of *A. webbiana*. He answered "J'ai sous les yeux le type de l'A. webbiana de D'Orbigny; mais je suis convaincu, sans pouvoir cependant l'affirmer d'une manière absolue, que c'est seulement, comme l'A. madeirensis, une forme de l'Asterias glacialis." On comparing specimens named by M. Perrier, in the British Museum, of these last two species, I too feel convinced that they are identical. We have, then,

*Asterias glacialis*, O. F. Müller; Müller and Troschel, System der Asteriden, p. 44; &c.

Stellonia webbiana, d'O orbigny, in Webb and Berthelot's Iles Canaries, Zool (Moll.), p. 142, pl. ii. figs. 8-13.

Asteraceanthion webbianum, Duj. and Hupé, Echin., p. 350.


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1 M. Perrier's decision, as communicated to me by letter.

2 I owe this synonymy to M. Perrier. On comparing the description of D'Orbigny with undoubted specimens of "A. madeirensis," Stimpson, I came to the conclusion that the species were identical. Thinking it remarkable that this resemblance had not before been noted, I wrote to Prof. Perrier asking him if he had in the Jardin des Plantes the type of *A. webbiana*. He answered "J'ai sous les yeux le type de l'A. webbiana de D'Orbigny; mais je suis convaincu, sans pouvoir cependant l'affirmer d'une manière absolue, que c'est seulement, comme l'A. madeirensis, une forme de l'Asterias glacialis." On comparing specimens named by M. Perrier, in the British Museum, of these last two species, I too feel convinced that they are identical. We have, then,

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Asteraceanthion webbianum, Duj. and Hupé, Echin., p. 350.

It will be of interest to institute a comparison between the two lists here given and that of M. Perrier. Here we find altogether the not inconsiderable number of one hundred and eleven specific appellations; and of this only thirty-five are to be found in the second or synonymic list. M. Perrier describes all together forty-nine species; and when we look through his synonymy, we find that all together he makes mention of sixty-eight names. The proportion of accepted to synonymous terms is therefore almost exactly the same in the two lists. This is, I must say, a somewhat painful state of things; for I am inclined to regard an increase in the number of proved synonyms as a not unfair proof of advance in our knowledge of the forms described.

Advance of knowledge has, however, so far taken place since the publication of Perrier’s Révision, that our knowledge of the Arctic fauna and of that of the more southern seas has been somewhat increased, while the critical remarks of Verrill have somewhat reduced the number of species which, named by Valenciennes or by himself, M. Perrier had regarded as undescribed.

Comparatively lately (1878) Prof. Perrier has published an essay on the Geographical Distribution of the Starfishes, in the Nouvelles Archives du Muséum (2ème sér.); and in the nearly complete list of species which he there gives, he enumerates eighty-two species in the genus Asterias, or five more than are named in the list just given. This new list moreover contains the names of seven species not detailed by M. Perrier, viz.:—A. mollis of Studer (studei of Bell); A. perrieri, E. Smith; A. fulgens, Philippi; and A. alba, brandti, neglecta, and obtusi-spinosa of Bell.

On the other hand, M. Perrier’s list contains the following, which, as I think, have been demonstrated by Verrill to be synonymous of names already entered, viz. A. arenicola, A. borealis, A. fabricii, A. pallida, and A. stipsonii. A. madeirensis I have shown to be synonymous with A. webbiana; A. globifera will be placed with Uniophora; A. wilkinsoni and A. aster of Gray I cannot, as I have already said, even pretend to recognize. A. jehennesi would appear to be the same as A. calamaria.

Like M. Perrier, I retain in the lists the name of A. bootes, “à cause de l’autorité de ses auteurs;” but as the type is lost or unknown, the species will probably always be—what it has already been called, one of the “mysteries of Paris.”

Of late years the only catalogue of the genus which claimed to be complete was published by MM. Dujardin and Hupé; it details, however, only thirty-seven species, of which nine have, with the progress of our knowledge, been since referred to other generic divisions.

This brief review will, I think, be sufficient to afford evidence of the pressing necessity of a closer and more critical study of the constituent species; what now will follow is to be regarded as a preliminary attempt to make some sort of introduction to a work
of greater value which neither specimens nor opportunities yet allow.

I now proceed to the consideration of the heads under which the numerous species of this genus are to be grouped. The genus *Asteracanthion* of Müller and Troschel was divided by a single coup into a group with spines on the back, and a group with stalked knobs on the back; those of the former group alone are now members of the emended genus. No other zoologist has, so far as I know, attempted any convenient grouping of the species, though Dr. Stimpson has rendered some assistance in this direction by pointing out the affinities of the species he describes.

It is, at the same time, obvious enough that there is a very large number of species in the restricted and emended genus *Asterias*; and the number is unwieldy even now, when our knowledge of the variations that may be found in it is very possibly altogether elementary. No good, however, is gained by hastily accepting or proposing ill-defined generic coups; the more necessary work just now is to sort out the species into different categories. These must be as natural as they can be; but where nature fails us, or becomes too obscure for our vision, we must make use of what are not so satisfactorily natural characters.

It is necessary to make some such preface as this, because I have to propose a primary subdivision of the genus to which, from purely theoretical considerations, it would be possible to raise some not unimportant objections; for I propose, first of all, to separate the species into those in which there are developed more than five rays, and those in which, so far as we know, the number five is constantly retained. To these two groups I propose to apply the terms *Heteractinida* and *Pentactinida*.

It is, so far as is yet known, only among the former, or Heteractinida, that the presence of more than one madreporic plate has been noted, though in forms which belong to the Heteractinida, but in which five arms only are developed (and this is not only possible, but an actual case) there may be, and at times are, two madreporites. The plurality of madreporic plates affords a good secondary point of difference; and I propose, therefore, to form subdivisions which may respectively be known as *polyplacid* and *monoplacid*.

The third distinctive character lies in the number of spines which border the ambulacra—the adambulacral spines: as an ordinary rule, one finds one or two rows of these; and the forms which belong to them may be distinguished respectively as Monacanthida and Diplacanthida.

It is a difficult matter to say exactly what is the real significance of the difference in the number of the rows of adambulacral spines. In the first place, it is necessary that we should have for a number

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1 This might almost be an echo of the words of Prof. Alex. Agassiz (see 'North-American Starfishes,' p. 122).

2 Whether this division be natural or artificial, it will, for the great majority be found, I think, to work pretty satisfactorily: the problem of heteractinism is still unsolved; and it is a serious question whether the heteractinism of e.g. *A. tenuispina* is exactly comparable to the polyactinism of e.g. *Heliaster*. 

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of rare species more exact and definite information than has yet been afforded. But little light is thrown upon the subject by a reference to the characters which obtain in Brisinga, owing to the extremely generalized character of that important form; the adambulacral spines are, according to the careful description of G. O. Sars, arranged in the adult in three longitudinal rows, of which those of the outermost row are distinctly the longest; "in very young specimens," however, it is to be noted that the "two innermost are yet undeveloped, so that there is only a single longitudinal row of furrow-spines along the middle of the adambulacral areas."

Although there is this tendency to a disposition of the adambulacral spines in one or two rows, there are (a) cases, e.g. A. panopla, Stuxberg, in which there are three rows, and (β) specimens of the common and widely-spread A. rubens and of other species which do not always exhibit a constant regularity: the spines may be set more or less distinctly along three planes; but it is rarely that three spines are found on one and the same plate; and it is clear that there is a tendency to the development of a single continuous series, arranged as nearly as possible in a perfectly straight row. If, further, we consider how extremely short is the longitudinal axis of the ossicles, and the size of the spines that are placed on them, and that the packing of the spines does nevertheless diverge but little into anything whatsoever of a zigzag arrangement, we are, I think, justified for the present in not enforcing any such further subdivision as would be expressed by such terms as isacanthid and anisacanthid.¹

There is a considerable body of fact which would justify such a division; but there is need of further study and fuller information to enable us to speak definitely as to the permanency of any real anisacanthid arrangement; the species in the following lists, which are distinguished by an asterisk sign are those in which this irregularity is most conspicuous.

III. Primary Groups of the Species of Asterias.

A. HETERACTINIDA.

I. POLYPLACIDA.

i. MONACANTHIDA.

calamaria. tenuispina.

ii. DIPLACANTHIDA.

*acutispina. polyplax.
capensis.

II. MONOPLACIDA.

i. MONACANTHIDA.

gelatinosa. perrieri.
gemmifer. rodolphi.
katherinae.

¹ These terms would, of course, express the difference between forms in which the spines are the same in number on all the plates, and those in which the spines are unequally distributed.
A. *æqualis* probably belongs to this group; but we have not sufficiently definite information as to the number of the madreporic plates, or of the rows of adambulacral spines.]

ii. **Diplacanthida.**

| acervata  | polaris  |
| borealis | scabra   |
| douglasi | studeri   |
| hexactis | *vancouveri*  |
| meridionalis |  |

Sp. incertæ sedis.

*camtschatica.*

B. **PENTACTINIDA.**

i. **Monacanthida.**

| africana | glucialis |
| antarctica | luetkeni |
| borbonica | margaritifera |
| *brachiata* | mexicana |
| brevispina | paucispina |
| capitata | rurispina |
| compla | rugispina |
| conferta | rupicola |
| cunninghami | sertulifera |
| fissispina | troscheli |
| forbesi | varia |
| fulgens |  |

Incertæ sedis.

*mitis.*

ii. **Diplacanthida.**

| alba | lurida |
| amurensis | mollis |
| bootes | neglecta |
| brandti | nuda |
| clavatum | obtusispinosa |
| cribraria | ochotensis |
| epichlora | *rubens* |
| fulca (?). | sinusoida |
| germaini (?). | spectabilis |
| grænilandica | stellionura |
| hispida | sulcisfera |
| japonica | *tenera* |
| littoralis | vulgaris |

Sp. incertæ sedis.

*fungifera.*

1 Sometimes one of the pair of spines disappears from certain plates.
iii. Polyacanthida.

*panopla.*

The number of species in the first two groups of the Pentactinida is still so large that we must now attempt to find some means by which they may be still further subdivided.

Among a certain number of forms we find a special modification of some of the dorsal spines, which come to form an encircling fringe around the madreporic plate. In some species these spines are obvious enough; but I know of no author except Prof. Verrill who has directed any attention to them, or attached any importance to their presence. As, however, I will show in detail further on, I cannot give in my adhesion to the validity of the genus *Lep- asterias*, even when the proposition comes from so deservedly honoured and distinguished a naturalist. I doubt, in fine, whether they can be used as any thing more than a convenient separation-character in a genus where specific characters are so rare.

The species, then, which are provided with a cirquet of spines round their madreporic plate may be distinguished as the *Echinoplacida*; such among the Diplacanthid Pentactinida are:

- *A. fulva* (with 18 spines).
- *A. germani* (with spines indistinct).
- *A. lurida* (with 12 spines).
- *A. nudæ* (with spines irregularly distributed).
- *A. obtusispinosa* (with 12 spines).
- *A. sinusoida* (with spines irregularly distributed).
- *A. spectabilis* (with 18 spines).

It is curious to observe that, as yet, the echinoplacid condition has not been noted as obtaining among the Monacanthid Pentactinida; among the Polyactinida the echinoplacid condition seems only to have been observed in the diplacanthid monoplacid form *acervata*, where there are said to be 13 spines around the madreporic plate.

In a description of the species *A. brandti*, which I lately communicated to the Society, I have directed attention to the mode of arrangement of the greater number of the intermediate spines on special local modifications of the integument, which may be known as special plates. This arrangement should be familiar enough; for it is to be found in *A. tensispina*, and is represented in the figure of that species given by Müller and Troschel ("System der Aster." pl. i. fig. 1 b). The forms in which the spines thus rise from special plates may be distinguished as *autacanthid*.

In such a group we should find:—the Polyactinid *meridionalis, perrieri, tensispina*, and (probably) *seabra*; and the Pentactinid Diplacanthid *brandti* and *neglecta*.

When the spines retain the simpler disposition which is seen in *A. rubens* and most of the better known forms, we may speak of the arrangement as being *typacanthid*.

1 Of course such a naturalist as Philippi does not fail to note their presence.
2 P. Z. S. 1881, p. 91.
The more we get into subdivisions the more unsatisfactory will, it is obvious, our characters get; and I fully recognize the difficulty, nay, impossibility, of naturalists having any thing like a unanimous opinion on the value of the groups now to be proposed. I give them, however, for what they are worth. They depend on the characters of the spines on the abactinal surface; and, according as these are simple or rare, blunted or acute, we may get divisions to which we may apply the epithets of *simplices*, *rarispinose*, *obtusispinose*, or *acutispinose*. This unsatisfactory method of division is, at present, the only one which can be suggested for the Monacanthid Pentactinida.

When applied in tabular form, we get the following as the result of our attempt:—

**Genus Asterias.**

**Div. I. HETERACTINIDA.**

Species with, as a rule, more than five rays.

**A. Polyplacida.**

Species with more than one madreporic plate.

i. **Monacanthida.**

Adambulacral spines in a single longitudinal row.

α. **Echinoplacida.**

Madreporic plate with a circlet of spines.

β. **Anechinoplacida.**

No circlet of spines to madreporic plate.

(i.) **Autacanthida.** Dorsal spines placed on special plates.

* A. tenuispina.

(ii.) **Typacanthida.** Dorsal spines not placed on special plates.

* A. calamaria.

ii. **Diplacanthida.**

Ambulacral spines in a double row.

α. **Echinoplacida.**

β. **Anechinoplacida.**

(i.) **Autacanthida.**

0.

(ii.) **Typacanthida.**

* A. acutispina.

* A. polyplax.

* A. capensis.
B. Monoplacida.
Species with only one madreporic plate.

i. Monacanthida.
   a. Echinoplacida.
      0.

β. Anechinoplacida.
   (i.) Autacanthida.
      A. perrieri.
   (ii.) Typacanthida.
      A. gelatinosa.  A. rodophi.
      A. gemmifera.  [? A. aequalis.]
      A. katherinae.

ii. Diplacanthida.
   a. Echinoplacida.
      A. acervata.

β. Anechinoplacida.
   (i.) Autacanthida.
      A. meridionalis.  (?) A. scabra.
      A. polaris.
   (ii.) Typacanthida.
      A. borealis.  A. perrieri.
      A. douglasi (?).  A. studeri.
      A. hexactis (!).  A. vancouveri.

Div. II. Pentactinida.
Species with five rays only.

A. Polyplacida.
   0.

B. Monoplacida.
   i. Diplacanthida.
      a. Echinoplacida.
         A. fulva.  A. obtusispinosa.
         A. germaini.  A. sinusoida.
         A. lurida.  A. spectabilis.
         A. nuda.  A. sulcifera.

β. Anechinoplacida.
   (i.) Autacanthida.
      A. brandti.  A. neglecta.
      A. grænlandica.  A. stellionura.
(ii.) Typacanthida.

i. Simplices. Dorsal spines arranged on the type of *A. rubens*.
   - *A. amurensis*
   - *A. ochotensis*
   - *A. rubens*
   - *A. vulgaris*

ii. Rarispinose. Dorsal spines rare (as in *A. glacialis*).
   - *A. alba.*

iii. Retusispinose. Spines blunted and short.
   - *A. epichlora.*

   - *A. cribraria.*
   - *A. littoralis.*
   - *A. japonica.*
   - *A. tenera.*

ii. Monacanthida.
   a. Echinoplacida.

 β. Anechinoplacida.
   (i.) Autacanthida.

   0.

ii. Typacanthida.

   i. Simplices.
   - *A. cunninghampi.*
   - *A. forbesi.*

   ii. Rarispinose.
   - *A. africana.*
   - *A. glacialis.*
   - *A. glacialis.*
   - *A. webbiana.*
   - *A. paucispina.*
   - *(? A. fissispina.)*

   iii. Retusispinose.
   - *A. antarctica.*
   - *(? A. capitata.*
   - *A. troscheli.*
   - *(? A. conferta.)*

   iv. Acutispinose.

   0.

C. Polyacanthida.
   a. Echinoplacida.

   - *A. panopla.*

Mode of formulating Results.

By the use of the following symbols one may see at a glance which of these characters are possessed by any given species, by assigning the following symbols to the different characters:—

1 = monacanthid;  2 = diplacanthid;  3 = polyacanthid;

m = monoplacid;  p = polyplacid;

Thus, the formula for *A. rubens* is $2 \text{ats}$; for *A. rubens* is diplacanthid, anechinoplacid, typacanthid, with simple dorsal spines.

To distinguish between the Pentactinida and the Heteractinida I propose to place the formula for the latter under the mathematical sign of a square root; thus $\sqrt{1 \frac{p}{a}}$ is sufficient to distinguish *A. calamaria* as a monacanthid polyplacid heteractinid form. If we know, as we do in this case, further details, we may write the formula $\sqrt{1 \frac{p}{a}a}$; or, in other words, in addition, *A. calamaria* has no spines round its madreporic plate, and the dorsal spines are placed on special plates.

To take two other examples:—

*A. epichlora* = $2 \text{atr}'$, or is diplacanthid, anechinoplacid, typacanthid, and retusispinose (or has the spines blunted and short); the absence of the root sign shows it to be pentactinid.

For *A. gelatinosa* we have $\sqrt{1 \frac{m}{a}}$; or it is monacanthid and monoplacid, while the root-sign shows it to be heteractinid; as, also, it is anechinoplacid and typacanthid, we may write its full formula $\sqrt{1 \frac{m}{a}}$. 

<table>
<thead>
<tr>
<th>Species</th>
<th>Formula</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. acervata</td>
<td>$\sqrt{2 \frac{m}{ae}}$</td>
<td></td>
</tr>
<tr>
<td>2. acutispina</td>
<td>$\sqrt{2 \frac{p}{at}}$</td>
<td></td>
</tr>
<tr>
<td>3. aqualis</td>
<td>$\sqrt{1 \frac{m}{a}a}$</td>
<td>(?)</td>
</tr>
<tr>
<td>4. africana</td>
<td>$1 \text{atr}$</td>
<td></td>
</tr>
<tr>
<td>5. alba</td>
<td>$2 \text{atr}$</td>
<td></td>
</tr>
<tr>
<td>6. amurensis</td>
<td>$2 \text{ats}$</td>
<td></td>
</tr>
<tr>
<td>7. antarctica</td>
<td>$1 \text{atr}'$</td>
<td></td>
</tr>
<tr>
<td>8. barbonica</td>
<td>$1$</td>
<td></td>
</tr>
<tr>
<td>9. borealis</td>
<td>$\sqrt{2 \frac{m}{al}}$</td>
<td></td>
</tr>
<tr>
<td>10. brachiata</td>
<td>$1$</td>
<td></td>
</tr>
<tr>
<td>11. brandti</td>
<td>$2 \text{aa}'$</td>
<td></td>
</tr>
<tr>
<td>12. brevispina</td>
<td>$1$</td>
<td></td>
</tr>
<tr>
<td>13. calamaria</td>
<td>$\sqrt{1 \frac{m}{a}}$</td>
<td></td>
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<tr>
<td>14. camtschatica</td>
<td></td>
<td></td>
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<tr>
<td>15. capensis</td>
<td>$\sqrt{2 \frac{p}{at}}$</td>
<td></td>
</tr>
<tr>
<td>16. capitata</td>
<td>$1 \text{atr} (?)$</td>
<td></td>
</tr>
<tr>
<td>17. clavatum</td>
<td>$2 \text{r}$</td>
<td></td>
</tr>
<tr>
<td>18. compta</td>
<td>$1$</td>
<td></td>
</tr>
<tr>
<td>19. conferta</td>
<td>$1 \text{atr}' (?)$</td>
<td></td>
</tr>
<tr>
<td>20. cribaria</td>
<td>$2 \text{ate}$</td>
<td></td>
</tr>
<tr>
<td>21. cunninghami</td>
<td>$1 \text{ats}$</td>
<td></td>
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<tr>
<td>22. disticha</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. douglasi</td>
<td>$2 \sqrt{\frac{m}{at}}$</td>
<td></td>
</tr>
<tr>
<td>24. epichlora</td>
<td>$2 \text{atr}'$</td>
<td></td>
</tr>
<tr>
<td>25. fissispina</td>
<td>$1 \text{atr} (?)$</td>
<td></td>
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<tr>
<td>26. forbesi</td>
<td>$1 \text{ats}$</td>
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<tr>
<td>27. fulgens</td>
<td>$1$</td>
<td></td>
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<tr>
<td>28. fulva</td>
<td>$2 \text{e}$</td>
<td></td>
</tr>
<tr>
<td>29. fungifera</td>
<td>$2$</td>
<td></td>
</tr>
<tr>
<td>30. gelatinosa</td>
<td>$\sqrt{1 \frac{m}{at}}$</td>
<td></td>
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<tr>
<td>31. genniffer</td>
<td>$\sqrt{1 \frac{m}{at}}$</td>
<td></td>
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<tr>
<td>32. germaini</td>
<td>$\text{re}$</td>
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</tr>
<tr>
<td>33. glacialis</td>
<td>$1 \text{atr}$</td>
<td></td>
</tr>
<tr>
<td>34. greenlandica</td>
<td>$2 \text{aa}'$</td>
<td></td>
</tr>
<tr>
<td>35. hexactis</td>
<td>$\sqrt{2 \frac{m}{at}}$</td>
<td></td>
</tr>
<tr>
<td>36. hispida</td>
<td>$1 \text{ats}$</td>
<td></td>
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<tr>
<td>37. ianthina</td>
<td></td>
<td></td>
</tr>
<tr>
<td>38. japonica</td>
<td>$2 \text{ate}$</td>
<td></td>
</tr>
<tr>
<td>39. katherina</td>
<td>$\sqrt{1 \frac{m}{at}}$</td>
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</tr>
<tr>
<td>40. linekii</td>
<td>$1 \text{at}$</td>
<td></td>
</tr>
<tr>
<td>41. littoralis</td>
<td>$2 \text{ate}$</td>
<td></td>
</tr>
<tr>
<td>42. lucretii</td>
<td>$1 \text{ats} (?)$</td>
<td></td>
</tr>
<tr>
<td>43. lurida</td>
<td>$2 \text{e}$</td>
<td></td>
</tr>
<tr>
<td>44. marraratifera</td>
<td>$1$</td>
<td></td>
</tr>
<tr>
<td>45. meridionalis</td>
<td>$\sqrt{2 \frac{m}{at}}$</td>
<td></td>
</tr>
<tr>
<td>46. mexicana</td>
<td>$1$</td>
<td></td>
</tr>
<tr>
<td>47. mitis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48. mollis</td>
<td>$2$</td>
<td></td>
</tr>
<tr>
<td>49. mueller</td>
<td>$1 \text{atr}$</td>
<td></td>
</tr>
<tr>
<td>50. neglecta</td>
<td>$2 \text{aa}'$</td>
<td></td>
</tr>
<tr>
<td>51. muda</td>
<td>$2 \text{e}$</td>
<td></td>
</tr>
<tr>
<td>52. obtusispinosa</td>
<td>$2 \text{e}$</td>
<td></td>
</tr>
<tr>
<td>53. ochotensis</td>
<td>$2 \text{ats}$</td>
<td></td>
</tr>
<tr>
<td>54. ochracea</td>
<td>$1 \text{atr}'$</td>
<td></td>
</tr>
<tr>
<td>55. panopla</td>
<td>$3 \text{e}_{\text{ij}}$</td>
<td></td>
</tr>
<tr>
<td>56. paucispina</td>
<td>$1 \text{atr}$</td>
<td></td>
</tr>
<tr>
<td>57. pectinata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>58. perrieri</td>
<td>$\sqrt{1 \frac{m}{aaa}}$</td>
<td></td>
</tr>
</tbody>
</table>
59. polaris.  = √ \frac{2}{\text{maa'}}.  \\
60. polyplax  = √ \frac{2}{\text{pat'}}.  \\
61. rarispina  = 1 \text{ atr'}.  \\
62. rodolphii  = √ \frac{1}{\text{mat'}}.  \\
63. rubens  = 2 \text{ ats'}.  \\
64. rugispina  = 1 \text{ atr'}.  \\
65. rupicola (?)) = 1 \text{ atr'}.  \\
66. seabra  = √ \frac{2}{\text{maa'}}.  \\
67. sertulifera  = 1.  \\
68. sinusoida  = 2 \text{ e'}.  \\
69. spectabilis  = 2 \text{ e'}.  \\
70. stellionura  = 2 \text{ ats'}.  \\
71. studeri  = √ \frac{2}{\text{mat'}}.  \\
72. sulcifera  = 2 \text{ e'}.  \\
73. tenera  = 2 \text{ ats'}.  \\
74. tenuispina  = √ \frac{1}{\text{pat'}}.  \\
75. trachelis  = 1 \text{ atr'}.  \\
76. vancouveri  = √ \frac{2}{\text{mat'}}.  \\
77. varia  = 1.  \\
78. vulgaris  = 2 \text{ ats'}.  \\

**Characters of Leptasterias, Verrill.**—It may well be a fair question to ask, why, when a genus contains so many species, I do not avail myself of Prof. Verrill's generic division of Leptasterias. The answer falls under two heads:—First, the leading distinctive character is the comparatively large size of the papulae; but this is only a step from what we find in species that are still retained in the genus *Asterias* proper; the presence of a circle of spines around the madreporic plate is certainly not a characteristic of the Leptasteriads alone, as must have been abundantly shown in the earlier part of this paper; while, further, all specimens of *A. muelleri* are most certainly not echinoplacid. In the second place, the presence of a large number of species in a genus cannot, of itself, be any reason at all for establishing a number of insufficiently distinct genera. *Queri tibet de natura: ita est.* For the purposes of descriptive systematic zoology it may be, and is, necessary to break up an enormous genus into smaller convenient working groups; but it is better not to give to such groups titles which have a precise technical value.

For the present, at any rate, I think we may retain Gray's genus *Uniophora*.

**Characters of the Species of Asterias found in the British Seas.**

My attention was more particularly directed to this subject by the difficulty which I had in coming to any distinct idea as to the characters of *A. hispida*. Unable to distinguish any forms as such in the cabinets of the British Museum, I naturally turned for assistance to the well-known naturalist whose acquaintance with the marine fauna of our own coasts is only equalled by his kindness and courtesy. To the Rev. A. M. Norman, then, the national collection owes some specimens of what he distinguishes as *A. hispida*.

In addition to the specimens of *A. hispida* which he presented to the Museum, Mr. Norman sent for my inspection several other series of specimens from various localities. In the letter with which he honoured me, Mr. Norman hinted that *A. hispida* and *A. violacea* should now be united, he expresses some little doubt as to the accuracy of the determination of the specimens collected in the British

* [To make this paper as complete as may be, I add a reference to the species (*A. spitsbergensis*) lately described by Messrs. Danielsen and Koren. It appears to be pentactinid, polycanthid, and echinoplacid. See Ann. Nat. Hist. (5) viii. p. 66.—F. J. B. July 1st, 1881.]
seas as being the *A. muelleri* of Sars, and he concludes by directing my attention to a remarkable and rare specimen taken at Seaham.

The questions, then, which are proposed to us are:—

1. The characters of *A. hispida*.
2. Is *A. muelleri*, Sars, found on our shores?
3. Is *A. muelleri* really distinct from *A. glacialis*?
4. Have representatives of any other species, described or undescribed, been found in our seas?

(1) *The Characters of A. hispida.*

With regard to this species, Edward Forbes writes:—"It may easily be passed over as the young of one of the more common species; but it is very distinct." He gives as the specific character, "Rays short, rounded, spinous. Avenues ovate." It is, however, obvious that, without some further qualification, the shortness of the rays is a character of no significance whatever; the rays in young Asterids are always proportionally shorter than in older forms; as Sars remarks, in describing *A. muelleri*, "Bei jüngeren sind, wie bei allen Seesternen, die Arme verhältnissig kürzer."

What, therefore, we have to know is whether there is any difference, and, if so, what, between *A. hispida* and *A. rubens* in this respect.

The greater and the lesser radii may, as usual, be distinguished by the symbols *R* and *r*; the measurements are made in millimetres.

### *A. rubens.*

**Series a.** "Seaham, Mr. Hodge."

<table>
<thead>
<tr>
<th></th>
<th><em>R</em></th>
<th><em>r</em></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>11·5</td>
<td>3</td>
<td>3·2</td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>9·5</td>
<td>3</td>
<td>2·8</td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>7·0</td>
<td>2</td>
<td>2·0</td>
<td></td>
</tr>
</tbody>
</table>

**Series β.** "? *A. rubens*. St. Magnus Bay, Shetland; deep water."

<table>
<thead>
<tr>
<th></th>
<th><em>R</em></th>
<th><em>r</em></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>11·0</td>
<td>4</td>
<td>3·0</td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>9·5</td>
<td>3</td>
<td>3·1</td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>8·2</td>
<td>2·6</td>
<td>2·5</td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>6·5</td>
<td>2</td>
<td>2·0</td>
<td></td>
</tr>
</tbody>
</table>

### *A. hispida.*

**Series a.** "Oban, Mr. D. Robertson."

<table>
<thead>
<tr>
<th></th>
<th><em>R</em></th>
<th><em>r</em></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>19·5</td>
<td>8·0</td>
<td>9·0</td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>15·0</td>
<td>6·2</td>
<td>6·2</td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>12·0</td>
<td>6·0</td>
<td>5·0</td>
<td></td>
</tr>
<tr>
<td>iv.</td>
<td>11·0</td>
<td>4·2</td>
<td>5·0</td>
<td></td>
</tr>
</tbody>
</table>

**Series β.** Outer Skerries, Shetland.

<table>
<thead>
<tr>
<th></th>
<th><em>R</em></th>
<th><em>r</em></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>i.</td>
<td>17·0</td>
<td>5</td>
<td>6·0</td>
<td></td>
</tr>
<tr>
<td>ii.</td>
<td>15·5</td>
<td>4·5</td>
<td>4·5</td>
<td></td>
</tr>
<tr>
<td>iii.</td>
<td>12·0</td>
<td>4</td>
<td>4·5</td>
<td></td>
</tr>
</tbody>
</table>

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1 Faun. litt. Norv. p. 56.
Series \( \gamma \). Outer Skerries, Scotland. 

\[
\begin{array}{ccc}
\text{i. \ldots} & R = 10.5, & r = 3.0, \text{ or } R = 3.5r. \\
\text{ii. \ldots} & R = 10.0, & r = 3.0, \text{ or } R = 3.3r. \\
\text{iii. \ldots} & R = 9.3, & r = 3.0, \text{ or } R = 3.16r. \\
\text{iv. \ldots} & R = 9.0, & r = 3.0, \text{ or } R = 3.0r. \\
\text{v. \ldots} & R = 7.5, & r = 2.5, \text{ or } R = 3.0r. \\
\end{array}
\]

Breadth of ray.

3.5

Arranging these numbers in order, we find for *A. rubens*

3.83, 3.6, 3.5, 3.25, 3.16, 3.16, 3.15;

and for *A. hispida*

3.5, 3.4, 3.4, 3.3, 3.16, 3.0, 2.619, 2.437, 2.419, 2.0.

For *A. rubens*, then, the proportion of \( R \) to \( r \) does not fall below 3.15; and the specimen in which that obtains is comparatively young, and has \( R \) only equal to 8.2 millim.; in *A. hispida* it may fall as low as 2, and that in a specimen of moderate size, or with a long radius of 12 millim.

If we take only series \( a \) of *A. hispida* we find a marked shortness of ray; but, unfortunately, that series is so far aberrant that the smallest specimens have \( R \) proportionally the longest. If, on the other hand, we take series \( \gamma \) (and that is the series which Mr. Norman has presented to the British Museum), we find a set of proportions which can hardly be said to compare unfairly with series \( \beta \) of *A. rubens*.

If now we take a series of older specimens of *A. rubens*, we may be led to certain conclusions; the set taken, though not in any way specially selected, is very favourable:

\[
\begin{array}{ccc}
\text{i. \ldots} & R = 65, & r = 13.5, \text{ or } R = 4.81r. \\
\text{ii. \ldots} & R = 60, & r = 13.0, \text{ or } R = 4.61r. \\
\text{iii. \ldots} & R = 56, & r = 13.0, \text{ or } R = 4.60r. \\
\text{iv. \ldots} & R = 46, & r = 12.0, \text{ or } R = 3.83r. \\
\end{array}
\]

We are therefore, as it seems to me, led to the conclusion that for *A. rubens* there is a gradual increase, during growth, in the length of \( R \) as compared with \( r \).

In some cases, as with series \( \gamma \), sets of specimens of *A. hispida* may well fall into the series; but, on the other hand, they may (as does series \( a \)) exhibit so great a variation as to lead to the suspicion that they must have been subjected to more or less abnormal conditions. And, finally, we cannot with safety appeal to the shorter rays of *A. hispida* as a definite and constant mark of specific differentiation.

The next specific character given by Forbes is “rays rounded;” but the same term is applied to *A. rubens*; then we have “spinous” for *A. hispida*, and “very spiny” for *A. rubens*.

The last character, and one which is regarded as being a good mark of distinction in this genus, is the form of the “ambulacral avenues;” they are lanceolate in *A. rubens*, and “elongate-ovate” in *A. hispida*. As it is obvious that the form of the ambulacula will depend not a little on the width of the rays at their base, I proceed
to examine the proportion between the greater radius and the width of the base of the arm. The absolute measurements have already been given; these, when worked out, give the following proportions:

$A. \text{hispid}a -$2·1, 2·16, 2·18, 2·20, 2·24, 2·419, 2·5, 2·6, 2·83, 2·85, 3·0, 3·4$;

$A. \text{rubens} -$3·0, 3·06, 3·25, 3·28, 3·50, 3·6$.

It is, then, so far clear that the base of the arms is wider in $A. \text{hispid}a$ than in $A. \text{rubens}$ for specimens of, or about, the same size.

When we measure larger specimens of the commoner species, we find the proportional value of the base of the arm to be 2·62, 2·86, 3·45, and 3·76.

And this series falls in as well with $A. \text{hispid}a$ as with $A. \text{rubens}$; there is, however, this essential difference—that, in the former, $R$ varies between 19·5 and 7·5 millim., while in the case of $A. \text{rubens}$ $R$ has the minimum value of 42 millim., and a maximum value of 64 millim.

After all, however, it is hardly necessary to raise the question of proportions; for $A. \text{hispid}a$ would seem to have never more than one row of adambulacral spines, whereas $A. \text{rubens}$ has freely two; and, in the second place, there are absent from it the larger pincer-formed "pedicellariae."

Now arises an important and difficult question,—Is the absence of these pedicellariae any thing more than a specific characteristic? In other words, should it not be regarded as a mark of generic difference. Sufficient information is not yet at hand to justify any final decision; but I would suggest that the question be kept before the minds of naturalists who busy themselves with these difficult forms. I am myself inclined to believe that there is only a tendency to their complete disappearance, and that the difference is purely specific.

On the other hand, we know far too little as to the conditions of existence under which these creatures live. Is it not possible that, after all, $A. \text{hispid}a$ is but a pure variety, or a local race, or a form stunted by living under disadvantageous conditions. It is, indeed, possible; but, at present, the weight of evidence is in favour of Forbes's original position, that $A. \text{hispid}a$ is a distinct species.

(2) Characters of $A. \text{muelleri}, \text{Sars}.$

The collection of the British Museum contains two specimens bearing the "étiquette" of $A. \text{muelleri}.$ One, in spirit, was named by Dr. Lütken, and it may therefore be regarded as a good, though, of course, not by any means necessarily a "typical" specimen of the species; the other, which is dried, bears a label "Asterocanthion (sic) mülleri:" it was "purchased of Brandt;" but there is no evidence as to who named it.

The specimen named by Dr. Lütken has $R$ equal to 13 millim., while $r=3$, and the breadth of the arms at their base is 3·5 millim.

1 Compare especially the interesting remarks of Prof. Rupert Jones in his very philosophical paper on Variation in the Foraminifera (Monthly Micr. Journ, 1876 pp. 61-92)
On comparing this with one of Mr. Norman’s specimens, in which $R=16$, $r=3$, we are at once struck by the greater development of spines on the abactinal surface of the latter, where it is possible to make out five very distinct rows of spines, while in the former only three are to be accurately distinguished. In consequence of this difference the specimens do not, as may be imagined, present any very close resemblance. When we refer to the original description of Sars we find some explanation; for he says, “Auf dem Rücken derselben 3–5 Reihen, von denen 3 deutlich, die 2 anderen weniger deutlich oder häufig unvollständig sind.” Though no two specimens in the set of seven which were taken off Shetland differ from one another so markedly as do the two just referred to, yet they differ sufficiently to show that the specimens of the species which are found in the British Seas, just as much as those found off the Scandinavian coasts, do vary, in this particular, within very wide limits. The spines on Mr. Norman’s specimens seem to be sharper and rather longer than those on the specimen named by Dr. Lütken. The proportions, and the resulting general appearance, are very much the same; and I can see no reason why the specimens should not all be regarded as members of the same species.

The above discussion contains an answer to the third question; for in demonstrating the characters of *A. muelleri* it proves the distinctness of that species from *A. glacialis*.

The consideration of exceptional forms from the British seas may well be postponed for further information and a larger series of specimens.

In here describing some forms under new names I am taking the course which, after careful consideration, seems to me to be at present that which is best adapted for the advancement of science. The exact limits of the species of this genus can only be defined by enormous collections.

**Descriptions of new or rare Species.**

**Asterias philippi,** sp. nov. (Plate XLVII. figs. 1, 1a.)

It is necessary to make this new species for two specimens preserved in alcohol, and forming portion of the old Haslar collection; they were collected by J. O. Goodridge, Esq., Surgeon R.N., and are stated to have come from “South America.”

General formula $\sqrt[4]{2maa'}$.

Rays six, rather stout; disk moderate; adambulacral spines in two rows, madreporic plate single, anechinoplacid, lateral and actinal spines autacanthid—general formula $\sqrt[4]{2maa'}$. The adambulacral spines present a remarkable appearance, owing to their small size, their delicacy, and their close packing; in addition to this the integument around them is raised up into processes almost as long as the spines, and thus increases the appearance of crowding. A well-marked groove separates these from the outer spines, of which there are two rows on the actinal surface, while a third occupies the side of the ray. All these spines, the best-developed of which may be as
much as 3 millim. long; are autacanthid; and their bases are surrounded by shorter spines or papilliform processes of the integument. Towards the tip of the arm the innermost row disappears. The large space between the outermost or third row, or that which runs along the lower portion of the side of the arm on either side, presents in its lower portion irregular and feebly-developed spines; along the middle line of the back of the arm there runs an irregular row of spines or clumps of spines; and on either side of this there is a still more irregular row. The middle row is continued onto the disk, the centre of which is occupied by a clump of five autacanthid, more or less blunt and rounded tubercle-like spinous processes; at an equal distance from this central clump, and at the base of each ray, there is another clump, a little more irregular in character; an accessory clump may be developed near the central one. The same clump-arrangement is exhibited all along the back of the arm, but varies within very wide limits, and only one spine may be developed. The whole integument is thick and granular, the madreporic body more or less prominent, pedicellariae rather rare. General colour light orange-yellow (after immersion in spirit for at least twenty-five years). \( R = 90, r = 23; \) \( R = 101, r = 25. \)

So far as we may judge from two specimens, the species will be found to exhibit considerable variation.

It has the same general formula as has \( \text{A.} \text{meridionalis} \), and, so far as one may judge from the diagnosis, \( \text{A.} \text{scabra} \); from the former it may be at once distinguished by the less regular repartition of the spines of the abactinal surface, and by the complete absence of any bare interbrachial space on the actual surface of the disk. I am quite unable to form any conception of \( \text{A.} \text{scabra} \) from Capt. Hutton's description.

\textbf{Asterias inermis, n. sp.} (Plate XLVII. figs. 2, 2a.)

This species is also found on a specimen collected by Mr. Goodridge, and bears Ecuador as its locality.

General formula 2aa'.

It is remarkable for the very feeble development of spines on its abactinal surface, where, though all autacanthid, they form the merest projections.

Rays five, broad at base, tapering rapidly but regularly; two rows of adambulacral spines; madreporic plate anechinoplacid, obscure, quite at the margin of the disk; spines of actinal surface short, slender, delicate and autacanthid. Of all the spines the longest are the adambulacral; but they do not exceed 2 millim. in length. Beyond these there is a row of spines, generally one only on each plate; in the next outer row the spines are rather sharper and longer, and there are sometimes two on one plate. Beyond this the rows begin to get somewhat indistinct, and the spines still shorter. Plates carrying very short, white, tubercle-like spines are closely packed, without any apparent order, over the whole of the abactinal surface.
General coloration (after at least twenty-five years' immersion in spirit) white, the suckers yellowish. \( R = 41, r = 13 \). Arms 13.5 millim. broad at base, 3 millim. at tip of arm.

**Asterias verrilli**, n. sp. (Plate XLVII. figs. 3, 3a.)

General formula 1atr.

Arms five, stout; disk large; ambulacral grooves very wide, adambulacral spines in a single row, madreporic plate anechinoplacid, and almost exactly midway between the centre and the margin of the disk, small and obscure; typacanthid spines on abactinal surface rare, irregular, short, stout, with knobbed ends, more numerous in younger specimens. Respiratory papulae numerous, and in the adult arranged in distinct groups. Clumps of two, three, or four spines, proportionally longer in the young forms, occupy the margins of the actinal surface of the arms; they are longest and most distinct nearest the disk. The side is separated from the dorsal surface of the arm by a somewhat obscure and not closely packed row of short stout spines. \( R = 48, r = 16 \). \( R = 3r \); breadth of arms at base = 14 millim., near tip 4.5 millim.; \( R = 28.5, r = 7.5 \), or \( R = 3.8r \).

If the specimens have been correctly referred to one species, the spines on the dorsal surface are rather more distinct in the smaller forms, the row of spines running along the upper edge of the side of the arm is more distinct, and the general appearance of the specimens is somewhat different, owing to the greater length and number of the spines on them.

The largest specimen, which has been for about forty years in spirit, and the companion specimen are of a brownish coloration. They were collected by the "Antarctic Expedition" in St. Martin's Cove; the three smaller specimens, which were presented to the Museum in 1868, were collected by Dr. Cunningham in "Peckett Harbour and Gregory Bay," and off Elizabeth Island, and are cream-white.

**Asterias spirabilis**, n. sp. (Plate XLVIII. fig. 4.)

This species, which was collected in 1842 off the Falkland Islands, is remarkable for the very great development of the membranous respiratory processes.

General formula 1atr.

Arms five, rather long, thick, tapering regularly, not wide at the base; disk comparatively small. Adambulacral spines in a single row; madreporic plate small, obscure, about midway between the centre and the edge of the disk. The whole of the abactinal surface and the sides of the rays are quite soft, owing to the great development of the membranous papulae, which completely cover the disk and arms and almost totally obscure the tubercles of the back. The rather closely packed, not specially stout, adambulacral spines are separated from those that lie beyond them by a fringing line of large respiratory processes. The sides of the actinal surface are
occupied by short, frequently peg-shaped spines, which are generally set in transverse rows of three. Beyond and above this in the adult there are no indications of any rows of spines.

The specimen from which the above description has been drawn up, and which is presumed to be adult, has \( R \) equal to 60, and \( r \) to 13; the arms are 15 millim. wide at the base, 4.5 near tip of arm; one arm has been lost.

General coloration (after 40 years in spirit) light brown.

Some much smaller specimens \( (R=23, r=7.5; R=18, r=8) \) from the same locality and collector, appear to belong to the same species: the development of the respiratory processes, though exceedingly well marked, has not attained to such an extraordinary pitch as in the more adult specimen; and, as a consequence, the tubercular spines on the abactinal surface and at the sides of the arm are more apparent. The processes, owing to some difference in refraction, and not because of the development of pigment, exhibit the most curious similarity to bivalved pedicellaræ. Spaces bare of spines are found at the angles of the disk on the actinal surface.

Two specimens rather larger \( (R=34, r=9) \), which have a very close resemblance to the others in the number and arrangement of the adambularacral spines and the arrangement of the respiratory processes, differ from them in the well-marked development of rounded tubercle-like spines over the whole of the abactinal surface and in the absence of the bare space at the angle of the disk. They may for the present, at any rate, be regarded as varieties; they are from the Falkland Islands also, but are of a rather deeper colour.

**Asterias rollestoni**, n. sp. (Plate XLVIII. figs. 5, 5a.)

General formula 2ate.

Arms five, rather long, tapering gradually; disk of moderate size; adambularacral spines in a double row, those of the inner less numerous than those in the outer. Madreporic plate placed about halfway between the centre and the edge of the disk, anechinoplacid, very distinct, with a well-marked groove around it. The whole of the abactinal surface rough with irregularly disposed typacanthid spines, of which a rather obscure wavy line can be detected along the middle line of each ray.

The adambularacral spines are stouter in the outer than in the inner row, but even there are not at all thick; they are flattened, with broad, not pointed, free ends. The spines in the two rows beyond these are remarkably broad at their free end; and the character is more striking than in *A. japónica* of Stimpson; they are thickly beset with pedicellaræ. Two rows of much smaller spines are placed at the sides of the abactinal surface. The glistening white abactinal tubercles diminish somewhat in size from the centre of the disk towards the apex of the arms; the respiratory processes are not collected into groups, but are distributed over the whole surface.

\( R=34, r=9.5 \). Breadth of arms at base 11 millim., near tip 2.5. Madreporic plate 3 millim. across.
1st. ASTERIAS PHILIPPII.
2nd. A. INERMIS.
3rd. A. VERRILLI.