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7. On the Crustaceans of the Genera *Petalidium* and *Sergestes* from the 'Challenger,' with an Account of Luminous Organs in *Sergestes challengeri*, n. sp. By Dr. H. J. Hansen (Copenhagen).

[Received November 29, 1902.]

(Plates XI. & XII.[1])

During a stay in London in July and August, 1902, I examined various groups of Crustacea in the British Museum (Natural History). I beg the Director, Professor E. Ray Lankester, and Mr. F. Jeffrey Bell to accept my sincere thanks for the free use of the collection and for their kind help.

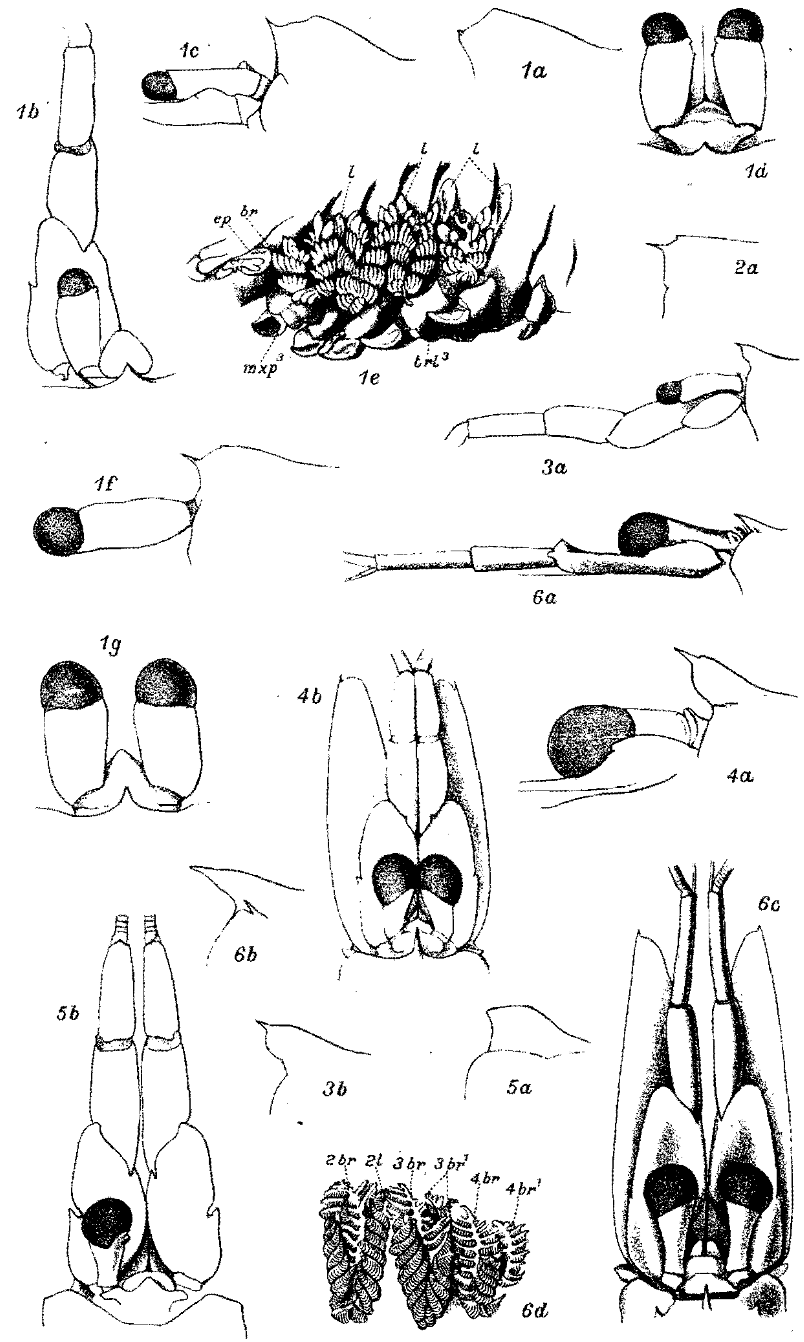
In the paper "On the Development and the Species of the Crustaceans of the Genus *Sergestes*" (Proc. Zool. Soc. Lond. 1896, pp. 936–70) I have given a revision of this extensive genus. I had studied a very rich material of pelagic forms belonging to the Copenhagen Museum, among which are all the types of Kröyer; besides I had examined types of 5 species established by Chun, Metzger, and Ortmann.

Among other things, I proved that "*of the* 59 (*or* 60) *hitherto described species only about* 20, *or one-third of the total number, have been established on adult animals, such as have almost or entirely arrived at sexual maturity; and that almost all the other species are true larvæ, and even of these a considerable number are larval stages of species already established on adult specimens*, . . ." Of earlier authors, C. Spence Bate has produced a very large contribution on the genus *Sergestes*, extending to eighty-eight quarto pages and seventeen plates, in his "Report on the 'Challenger' Macrura." He established the genus *Petalidium* on a new species, described 24 new species of *Sergestes* &c. In 1896 I wrote (p. 939): "This large contribution is of course of great importance, but unfortunately neither the descriptions nor the figures are so good as could be wished, and in numerous instances . . . a re-examination of the type specimens is absolutely necessary —the greater part of the new species are but larvæ." I have now studied all types which are preserved in the British Museum, and the present paper contains the results of my examination.

Bate describes 31 species of *Sergestes* as examined by himself: of these, 24 are established as new to science, 6 are considered to be Kröyerian species, and one is referred to *S. atlanticus* H. M.-Edw. The types of 9 of the species established by Bate do not exist in the British Museum; some specimens mentioned in his work and belonging to other species are also absent; but several specimens belonging to various species and omitted in the Report were found in the collection. I am therefore only able to give more or less incomplete notes, based on the study of the

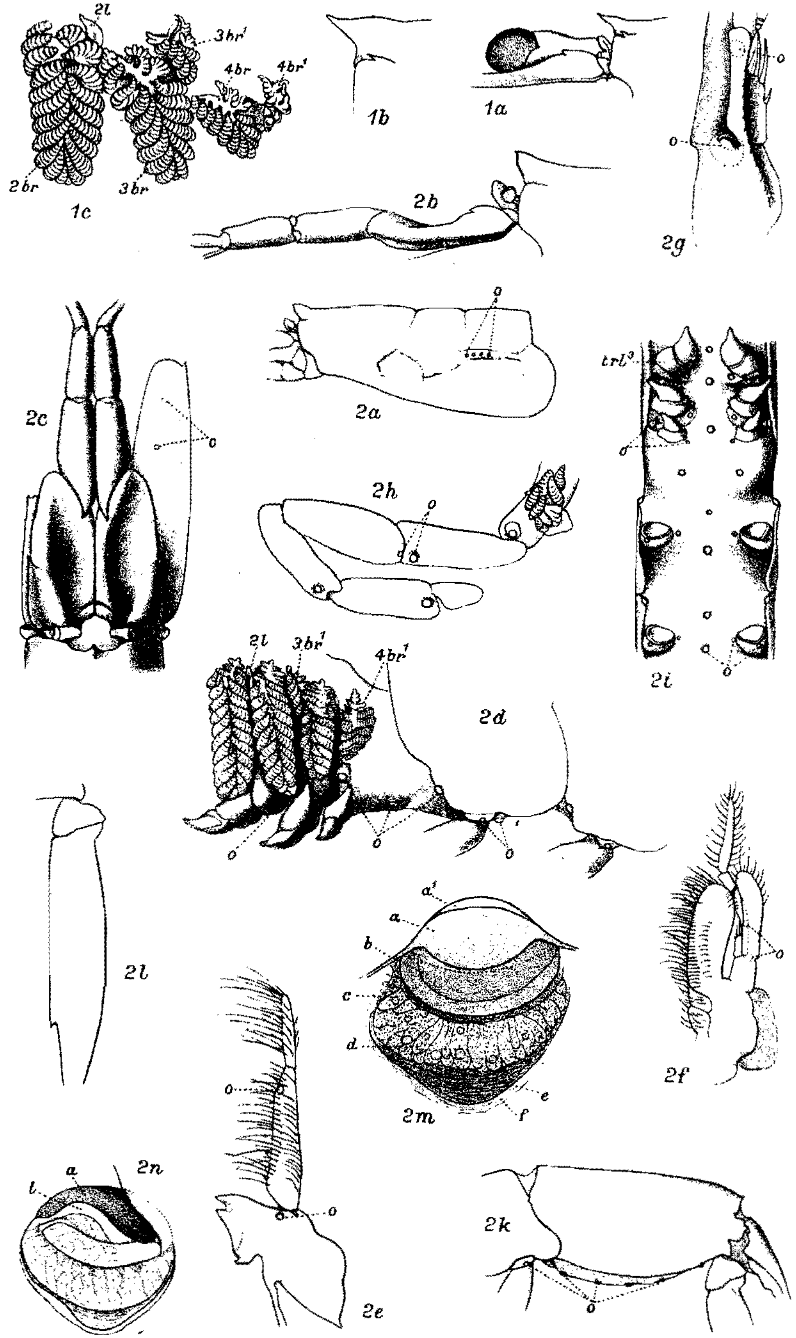
[1] For explanation of the Plates, see p. 78.

P.Z.S. 1903, vol. I. Pl. XI.



H. J. Hansen del. Edwin Wilson, Cambridge

FIG 1. PETALIDIUM FOLIACEUM. 2. PETALIDIUM JUN. 3. SERGESTES PROFUNDUS. 4. S. PREHENSILIS. 5. S. KRÖYERI. 6. S. SIMILIS.



H. J. Hansen del. Edwin Wilson, Cambridge.

FIG. 1. SERGESTES ARCTICUS. 2. S. CHALLENGERI.

specimens, on 22 of the species in question, 15 of which were established by Bate himself. Furthermore, he refers *Petalidium* Bate, *Sciacaris* Bate, *Acetes* H. M.-Edw., and *Lucifer* Vaugh. Thomps. to his family Sergestidæ; of *Lucifer* he describes two species, but the genus must be more thoroughly studied than has hitherto been done before the examination of the 'Challenger' specimens; *Sciacaris* Bate has one species, which is only a larva of a *Sergestes*, and the type seemed to be wanting in the Museum; of *Acetes*, Bate had no specimens; and *Petalidium* is mentioned below.

Of Bate's 31 species of *Sergestes* only 6 are really mature forms, 25 being larvæ. Special attention has been paid to the adult specimens preserved in the Museum and enumerated by Bate; on two of these specimens I have established two new species, and besides I add notes and some drawings to the representations of Bate. Unfortunately nearly all the specimens of rare and especially interesting species were very much mutilated.

Our present knowledge of the adult species of *Sergestes* of the Atlantic fauna is far from complete, but yet we are acquainted with so many species that it was possible for me in my earlier paper either to refer the *Mastigopus*-forms examined to the mature species, or to describe the older larval stages and sometimes the black-eyed but still immature forms, so that they can be recognized with certainty and referred to the mature forms when these are discovered in the future. All the Atlantic larval forms from the 'Challenger' seen by me have now been referred in a similar way. But many larvæ established by Bate as valid species of adult or sub-adult animals have been secured in the Pacific. Our knowledge of the mature stage of the species living in that vast ocean is still rudimentary; and I have therefore not been able to refer the larvæ of three of Bate's species to any species established on adult specimens. Bate's types of his species established on larval forms are often either defective or very young, wherefore I thought it of little use to describe and figure them again; but I have generally added some notes on their affinities, and sometimes also a few corrections to his descriptions. When the Pacific has been moderately well explored by further expeditions, many adult forms and their larval stages will be discovered; and a future student of the group will then be able to refer at least some of the larvæ, which I cannot interpret, to their adult forms. To the young larvæ described by Bate as species of *Mastigopus* I pay no attention at all: the types seem to be lost.

I think it convenient first to deal with all the 'Challenger' species in the same consecutive order in which they are described in Bate's Report; then to put together some results of the investigation; finally, to mention more fully the luminous organs in *Sergestes challengeri*, n. sp.

In order to abridge the descriptions, in the following pages—as in my earlier paper—I make use of some abbreviations:—

antenn. ped. = peduncle of the antennulæ; mxp.[2]–mxp.[3] = the second and third pair of maxillipeds; trl.[1]–trl.[5] = the first to the fifth pair of trunk-legs; br. = the first, br.[1] = the second branchia above the same legs; ext. br. of urp. = external branch of the uropods.

I. *Notes on the Species of* Petalidium *and* Sergestes.

a. Petalidium Bate.

To this genus Bate has referred only one species. It will be convenient to deal with the characters of the genus together with those of the species.

Pet. foliaceum Bate, pp. 348–50, pl. lx. (Plate XI. figs. 1*a*–1*g*.)

Bate mentions five specimens from two stations: Stat. 146, lat. 46° 46′ S., long. 45° 31′ E., 1375 fathoms; and Stat. 159, lat. 47° 25′ S., long. 130° 22′ E., 2150 fathoms. All these specimens are at present in the Museum, but even Bate's text and his figure of the entire animal show that most of the appendages presenting specific characters are wanting or have been mutilated. Bate writes (p. 349): "The great distinction between this genus and *Sergestes* exists in the form, character, and arrangement of the branchial plumes, which consist of a series of plates and cylindrical filaments, situated side by side in a series of rows at right angles to the stalk. There is but one plume to each of the five anterior somites of the pereion, the posterior two somites having none; between some of the somites is a large foliaceous plate." But this description is difficult to understand: his figure 3, representing the branchiæ, is defective, and his tabular view (p. 349) is wrong. He was of opinion that the foliaceous plates—of which he had seen only three—were pleurobranchiæ, while the "branchial plumes" were arthrobranchiæ; but this is incorrect: they are decidedly pleurobranchiæ as in *Sergestes*. *Petal. foliaceum* Bate differs from all species of *Sergestes* in one quite unimportant feature, that no trace of branchiæ is found above trl.[4], and in one important character, viz., the structure of the pleurobranchial plumes. This structure is very interesting (fig. 1 *e*). The most developed branchiæ are, as usual, those above trl.[1] and trl.[2]; each of these consists of an anterior and a posterior half, and each half of five (to six) transverse rows of branchial plates, generally five or six in each row, and these plates (some of the lowest excepted) are directed upwards. The pleurobranchiæ above mxp.[3] and especially trl.[3] are less developed, with a lower number of transverse rows, and partially with a lower number of plates in the rows. The pleurobranchial plumes in *Petalidium* look very different from those in *Sergestes*; the real differences are: a much lower number of rows, a much lower number of plates in the rows, and that the plates are much larger, curved upwards, and look much more independent. Behind the upper part of each of these four pleurobranchiæ originates a pleurobranchial lamella (*l.*), which is a reduced branchia; these lamellæ are very long above trl.[2] and trl.[3], while the two anterior lamellæ above mxp.[3] and trl.[1] are much less prominent. On mxp.[2] is found an epipod (*ep.*), with a branchia consisting of a few plates, and above it a rudimentary pleurobranchia consisting of one very small lamella.

Fig. 1 *a* and fig. 1 *c* show the rostrum, consisting of a carina with a short or very short terminal spiniform process. There are no supraocular or hepatic spines; the gastro-hepatic groove is well developed. A comparison of fig. 1 *c* with fig. 1 *d* shows that the eye-stalks are considerably depressed; they are from two and a half to nearly three times longer than the eyes at the inner terminal angle, with a small rounded knot turning inwards and a little upwards (fig. 1 *b*; fig. 1 *d*), and besides (always?) with an exceedingly small tubercle somewhat in front of the inner angle and more downwards on the inner side (fig. 1 *d*). In the antenn. ped. the basal joint is very broad (fig. 1 *b*), decidedly shorter than the outer margin of the two other joints together; the third joint is scarcely three times longer than broad, considerably longer than the outer margin and a little shorter than the inner margin of the second joint, which is stout, with its inner margin only a little more than twice as long as its breadth. (The specimen from which figs. 1 *c* and 1 *e* were drawn measures 51 mm. in length, and was captured on Stat. 146; figs. 1 *a*–1 *b* were drawn from the specimen secured on Stat. 159).

But besides these five specimens of *Petalidium*, I found still two smaller specimens of the same genus among the 'Challenger' animals. One of these had been determined as *Sergestes japonicus* Bate, but is not referred to that species in his text. It was captured at Stat. 158, 7/iii., 1874, 1800 fathoms, thus near one of the above-named stations. It measures only 21·5 mm. in length. Figs. 1 *f* and 1 *g* show that its rostrum has the terminal process somewhat longer than in the large specimens; the eyes are a little longer as compared with the length of their stalks, and these are proportionately somewhat broader, without a distinct knot at the end of the inner margin. There is no supra-ocular spine, but the hepatic spine is moderately developed; the gastro-hepatic groove is very distinct. No branchiæ above trl.[4] This small specimen belongs certainly to *P. foliaceum* Bate.

Bate established (pp. 428–31) his *Sergestes profundus* on two specimens, both badly mutilated. He describes each specimen separately, beginning with one captured at Stat. 137, lat. 35° 59′ S., long. 1° 34′ E., depth 2550 fathoms. But, unfortunately, this specimen does not belong to *Sergestes* but to *Petalidium*; the type is besides so mutilated that I should have preferred to omit it, if it had not been described by Bate. It measures 17·5 mm. in length. The rostrum is shown in fig. 2 *a*; it is described by Bate: "It consists of a short fine point projecting horizontally for about one-fourth the length of the ophthalmopod, and is dorsally furnished on the crest with a small tooth." The eye-stalks are as in the small specimen from Stat. 158 just described; the posterior branchiæ to a large degree are destroyed, and as to the other features, I refer to Bate's description (p. 429). I cannot say with certainty whether the animal is a very young specimen of *P. foliaceum* Bate, or belongs to an unknown form; the rostrum deviates considerably from the type of *P. foliaceum*, but its shape presents a stage between those in the adult and in a larva, nearly agreeing with that in a larval form mentioned below.

In my earlier paper on *Sergestes* I described *S. obesus* Kr. (=*S. sanguineus* Chun). I stated that it was a larva, a *Mastigopus*, and added (p. 968): "It is easily seen that this species cannot remain in the genus *Sergestes*, but whether it should be referred to *Petalidium* Bate, or a new genus should be established for its reception, is impossible to decide with certainty. The branchial plates recall the plates found in *Petalidium*, and therefore I provisionally transfer it to that genus. . . ." I had not seen any adult *Petalidium*, but suggested (p. 967) that the branchial plumes interpreted by Bate as arthrobranchiæ are in reality pleurobranchiæ. I can now decide that *S. obesus* Kr. is the *Mastigopus* of *Petalidium*: the branchiæ prove it; besides, trl.³ in the *Mastigopus* is exceedingly elongate, with the basal part very thick, and in the adult form the basal joint of the same pair (fig. 1 *e*) is exceedingly thick, very much thicker than those of trl.¹ and trl.². Finally, the shape of the rostrum of *S. obesus* Kr. agrees nearly with that of the young *Petalidium* from Stat. 137 just mentioned. I described the branchiæ of *S. obesus* Kr., stating that in the largest specimen a rudimentary branchia was found above trl.⁴; in the largest but one of the specimens I have now looked for this branchia, and found it. Finally, I stated that *P. obesum* (Kr.) is "decidedly distinct from *P. foliaceum* Bate," and I maintain this opinion, founding it on the fact that *P. foliaceum* does not possess any branchia above trl.⁴; and it is very improbable that such a branchia begins to develop itself in the *Mastigopus* and disappears again in the adult.

b. Sergestes H. M.-Edw.

Serg. intermedius Bate, p. 383 (no figure).

Bate mentions one specimen, 5 mm. in length, from the "China Sea, off Luzon." The specimen has been preserved; according to the rostrum, the eye-stalks, and the ext. br. of urp., it belongs to "*Serg. brachyorrhos* Kr.," which is the youngest *Mastigopus* of *S. edwardsii* Kr. (P. Z. S. 1896, pp. 963–64).

Serg. prehensilis Bate, p. 385, pl. lxxi. (Plate XI. figs. 4 *a*, 4 *b*.)

Bate has examined one specimen from Stat. 236, lat. 34° 58′ N., long. 139° 29′ E., off Japan, 775 fathoms. The type, an adult male, has been preserved; it differs from all other species known to me. It will be useful to redescribe its most essential characters, and two new figures are given (Pl. XI. figs. 4 *a*, 4 *b*). The

rostrum is rather long, directed forwards and considerably upwards; its terminal portion is produced into a spiniform process, and the upper margin of the rostrum has at the base of that process a sharp angle as a rudiment of a spine; the lower margin of the rostrum between its base and the apical spine is strongly convex, the upper margin nearly straight. Supra-ocular and hepatic spines are wanting, the gastro-hepatic groove slightly developed. The eyes are large, considerably depressed; seen from the side (fig. 4 *a*), they are somewhat longer than the whole stalk; seen from above, their basal margin is very oblique (fig. 4 *b*), so that the interior margin of the distal joint of the stalk is as long as the outer margin of the eyes. The antenn. ped. with the outer margin of the first joint is a little longer than that of the two other joints together, and only a little shorter than their inner margin; the second joint with the inner margin is three times longer than the breadth, and somewhat longer than the third joint, which is about two and a half times longer than broad. The antennal squama reaches nearly to the end of the antenn. ped., with its distal portion broad and the outer spine well developed. Mxp.³ is a little shorter than trl.² The branchiæ present a transition-form between those of *S. arcticus* Kr. (Pl. XII. fig. 1 *c*) and *S. robustus* Smith; the pleurobranchial lamella above mxp.² is very small. Of the branchiæ above trl.³, *br.*¹ is scarcely two-thirds as long as *br.*; of those belonging to trl.⁴, *br.* is slightly longer than *br.*¹, and *br.*¹ a little shorter than *br.*¹ above trl.³ The ext. br. of urp. is almost five times longer than broad, and the hairy portion of its outer margin is a little more than one-fourth of the total length.—Length 36·5 mm.

This species occupies an intermediate position between *S. arcticus* Kr. and *S. robustus* Smith. Bate's fig. 4, showing an antennule and an eye, is misleading, the antennular peduncle being too slender, with the basal joint too short, the third joint too long.

Serg. japonicus Bate, p. 387, pl. lxx. figs. 1, 2.

Bate enumerates three specimens from two localities: Stat. 232, lat. 35° 11′ N., long. 139° 28′ E., 345 fathoms; and Stat. 207, lat. 12° 21′ N., long. 122° 15′ E., 700 fathoms. All have been preserved, and belong to one species. In 1896 I wrote that *S. japonicus* Bate must be identical with *S. mollis* Smith (taken in the Atlantic, off the United States), and gave reasons for my view. On comparing Bate's specimens with Smith's elaborate description (Rep. U.S. Comm. Fish & Fisher. for 1882, p. 419, 1884) and his figures (Rep. U.S. Comm. Fish &c. for 1885, pl. xx. figs. 3–5), I arrived at the same result. It should be especially mentioned that an examination of the branchiæ showed the most complete agreement with Smith's description and drawing. For full information on *S. japonicus* Bate, I refer, therefore, zoologists to the papers of Smith.

As already mentioned, I found in the bottle with *S. japonicus* from Stat. 232 a tube containing a smaller animal determined to be *S. japonicus* and labelled Stat. 158. It is not mentioned in Bate's work. On a closer examination it turned out to be a specimen of *Petalidium*, and it has been described above.

SERG. KRÖYERI Bate, p. 388, pl. lxx. figs. 3, 4. (Plate XI. figs. 5 *a*, 5 *b*.)

Bate established this species on one large specimen, from Stat. 170, lat. 29° 55′ S., long. 178° 14′ W., 520 fathoms. The specimen is very mutilated; a new description with two figures (Pl. XI. figs. 5 *a*, 5 *b*) is here given.

The rostrum (fig. 5 *a*) is rather low, rounded above, with the upper front angle blunt and slightly projecting and the anterior margin concave; but it could not be settled whether the upper margin of the rostrum had been damaged or presented its natural shape. Supra-ocular and hepatic spines are wanting, the gastro-hepatic groove is strongly developed. The eyes (fig. 5 *b*) are large, somewhat depressed; seen from above nearly as long as broad, slightly longer than the outer, and decidedly, but not much, longer than the inner margin of the stalk. On the upper side of the stalk, close behind the eye and near the inner margin, is seen a rather small, subcylindrical, distally rounded process, directed obliquely forwards, inwards, and upwards; it seems to terminate in an organ. In the antenn. ped. the basal joint is broad, with the outer margin a little shorter than that of the two following joints together, but only two-thirds as long as the inner margin of the same joints; the second joint is stout, with the inner margin scarcely three times longer than the breadth; the third joint is stout, but yet considerably more slender than the second, scarcely three times longer than broad, somewhat longer than the outer and somewhat shorter than the inner margin of the second joint. The squama of the antennæ seems to be nearly as broad at the distal end as in *S. japonicus* Bate, but it could not be seen whether the outer spine is developed. Mxp.^{3} and all trunk-legs are wanting. The pleurobranchial lamella above mxp.^{2} is small. The branchiæ above trl.^{3} have been broken off on both sides; of the branchiæ above trl.^{4}, *br.* is nearly three-fourths as long as *br.* above trl.^{2}, while *br.*^{1} is slightly more than half as long as the same. The ext. br. of urp. with the apical part is wanting; the branch seems to have been at most four times longer than broad, perhaps without marginal spine, and with the haired part of the margin unusually short.—Length 60 mm.

The species is allied to *S. prehensilis* Bate and *S. robustus* Smith, but it is easily distinguished from all species hitherto discovered by the process on the eye-stalks.

SERG. ATLANTICUS H. Milne-Edw., Bate, p. 389, pls. lxviii. & lxix.

In my earlier paper I wrote (p. 947) that "I am not convinced that all the specimens from the localities enumerated (p. 390) belong to *S. atlanticus*," and I produced some grounds for that

opinion. The investigation of the material preserved in the British Museum proved the correctness of my disbelief, but, it must be admitted, to a degree not supposed.

Of the specimens enumerated by Bate, the following have not been preserved in the British Museum: "Stat. 42, lat. 35° 58′ N., long. 70° 35′ W., 2425 fathoms," "length 25 mm."—and "On May 6–18th, 1876, in lat. 32° 41′ N., long. 36° 6′ W. . . . one specimen . . . at the surface; and on the 7th of the same month, near the Azores . . . . two other specimens were taken at the surface." I can now state with certainty that if the specimen from Stat. 42 lived near the bottom in that enormous depth, it did not belong to *S. atlanticus*; perhaps it was captured near the surface, but at all events the locality must be omitted as uncertain. Most probably the specimens captured in May 1876 belonged to *S. atlanticus*. The specimens from the other stations enumerated by Bate belong to four species, and each station must be mentioned separately.

"North Atlantic . . . . Stations 62 and 63, on the passage from Bermuda to the Azores. Three specimens." In a bottle labelled "Between Bermudas and Azores" I found eight partly mutilated specimens of *S. atlanticus*.

"Between Teneriffe and St. Thomas." In a bottle with the same locality, three specimens of *S. atlanticus*.

"Station 320, ... lat. 37° 17′ S., long. 53° 52′ W., off Monte Video; depth 600 fathoms." Bate does not directly state the number of specimens, but he writes "Length 38 mm.," and the meaning is probably that he had one single specimen. In a bottle labelled "off Monte Video" I found six small and badly preserved specimens of *S. atlanticus* M.-Edw., and one large specimen of *S. arcticus* Kr., and it is decidedly the last-named specimen which was procured from 600 fathoms. As to *S. arcticus* Kr., the student is referred to Kröyer's work, to the description and drawings in various papers of S. Smith, to notes in my earlier paper, and to some remarks below, in the description of *S. similis*, n. sp., together with figs. 1 *a–c* on Pl. XII.

"Station 159, . . . south of Australia; depth 2150 fathoms. . . . Three specimens. . . Length 43 mm." In the collection three large specimens are present, but they belong to *S. arcticus* Kr., which thus has been proved to be distributed through the deeper Atlantic, from the southern part of Greenland to lat. 38° S., and to south of Australia.

Bate enumerates still two deep-water stations, viz. Stat. 232, off Japan, and Stat. 173, off Matuku, Fiji Islands; he examined one specimen from each of these localities, but the animals belong to two new species to be described below.

But before giving these descriptions I will sum up the results of the examination of the specimens referred by Bate to *S. atlanticus* H. Milne-Edw. (= *S. frisii* Kr.). The Copenhagen Museum possesses some hundreds of adult specimens of *S. atlanticus*, taken at a large number of places in the Atlantic, the Indian Ocean, and the western part of the Pacific, and all these were taken near the surface; the 'Challenger' specimens taken near the surface and referred by Bate to *S. atlanticus* really belong to that species, but his specimens secured at the deep-sea stations 320, 159, 232, and 173 belong to three other species.—I have found it unnecessary to attempt to point out what parts of Bate's long description (and which of his drawings) can be applied to *S. atlanticus*; the zoologist is referred to the good description of Kröyer together with the additional notes in my earlier paper.

SERG. SIMILIS, n. sp. (Plate XI. figs. 6 *a*–6 *d*.)

The type of this species is the above-mentioned specimen on which Bate writes (p. 320): "Stat. 232, . . . lat. 35° 11′ N., long. 139° 28′ E., off Japan; depth 345 fathoms. . . . Length 50 mm." The species is closely related to *S. arcticus* Kr. The rostrum (fig. 6 *b*) is nearly oblong-triangular, a good deal longer than in *S. arcticus* (Pl. XII. fig. 1 *b*) and directed more upwards; the anterior margin of the scutum below the rostrum is strongly convex (fig. 6*a*) and protruding, while it is nearly vertical in *S. arcticus* (Pl. XII. fig. 1 *a*). The supra-ocular and hepatic spines are well developed; the gastro-hepatic groove distinct. The eyes are nearly as in *S. arcticus*, large, broader than deep, scarcely as long as broad (fig. 6 *c*), decidedly shorter than the outer margin of the distal joint of the stalk, and one-half shorter than its inner margin. The antenn. ped. (fig. 6 *c*) is about as in *S. arcticus*; the outer margin of the basal joint is as long as the same margin of the two distal joints together; the second joint is rather slender, its inner margin almost four times longer than its breadth and scarcely longer than the third joint, which is slender, about six times longer than broad. The squama of the antenna is moderately broad at the end, with the outer spine projecting beyond the terminal margin. Of the long appendages, mxp.³, trl.³, and trl.⁵ are wanting, and the remaining thoracic legs are about as in *S. arcticus*. The branchiæ above trl.³ and trl.⁴ (fig. 6 *d*) present excellent differences from those in *S. arcticus* (Pl. XII. fig. 1 *c*); *br.*¹ above trl.³ is not quite half as long as *br.* above trl.⁴, and in spite of this not inconsiderable length it is semi-rudimentary, having only some posterior branches, nearly all short, and no anterior branches. Of the branchiæ above trl.⁴, *br.* is long, four-fifths as long as *br.* above trl.³; *br.*¹ is more than half as long as *br.*, very well developed, at least as long and more than twice as broad as *br.*¹ above trl.³ [In *S. arcticus* (Pl. XII. fig. 1 *c*)—from a specimen obtained in the most northern part of the Atlantic—*br.*¹ above trl.³ is about three-fourths as long as *br.* above trl.⁴, with well-developed branches on both sides; of the branchiæ above trl.⁴, *br.* is only a little more than half as long as *br.* above trl.³, while *br.*¹ is small, considerably narrower and shorter than *br.*¹ above trl.³] The ext. br. of urp. has the apical portion broken off, but it is narrow, and seems to have been a little more than five times longer than broad, thus slightly narrower than in *S. arcticus*, but otherwise of the same

shape and with the marginal spine well developed.—Length 54 mm.

The species is easily distinguished from *S. arcticus* Kr. by the shape of the rostrum, together with the anterior margin of the scutum, and especially by the branchiæ above trl.³ and trl.⁴; in all other features these two species are closely allied.

SERG. CHALLENGERI, n. sp. (Plate XII. figs. 2 *a*–2 *n*.)

The type of this species is the specimen on which Bate writes (p. 390): "Station 173, July 24th, 1874; lat. 19° 9′ 35″ S., long. 179° 41′ 50″ E.; off Matuku, Fiji Islands; depth 315 fathoms; bottom, coral mud. One specimen, male. Dredged. Length 24 mm." He referred it to *S. atlanticus*. I have the pleasure of appending the name of the renowned ship to this *Sergestes*, which is one of the most interesting species of Crustacea secured by the expedition. Unfortunately the single specimen is very mutilated.

The rostrum (fig. 2 *b*) is rather low, short, obliquely triangular, turning somewhat upwards; its apex is acute and very slightly produced. The supra-ocular spine is wanting; the hepatic spine is rudimentary; the gastro-hepatic groove (fig. 2 *a*) is deep, and the cervical groove very distinct. The eyes have been broken off, only the basal part of the stalks being left. In the antenn. ped. (fig. 2 *c*) the outer margin of the basal joint is a little longer than that of the two other joints together; the second joint is moderately robust, its inner margin a little more than three times longer than the breadth; the third is slightly more than two and a half times longer than broad, a little shorter than the outer margin of the second joint, and only three-fifths as long as the inner margin of the last-named joint. The squama of the antenna is distally very broad (fig. 2 *c*), with the outer spine scarcely projecting beyond the terminal margin. Mxp.³ and trl.³–trl.⁵ are wanting; of trl.¹ the apical part has been lost, but these legs seem to have been a little longer than mxp.², and to be more slender than in *S. arcticus*, but otherwise not showing any difference of importance. Of the branchiæ (fig. 2 *d*), *br.* above trl.² and trl.³ are long and narrow; *br.*¹ above trl.² is as usual a lamella; *br.*¹ above trl.³ is slightly more than one-third as long as *br.*, especially with its anterior branches well developed; of the branchiæ above trl.⁴, *br.* is about three-fourths as long as *br.* above trl.³, while *br.*¹ is proportionately large, much longer and broader than *br.*¹ above trl.³, and even more than half as long as *br.* above trl.³ The ext. br. of urp. (fig. 2 *l*) has the apical portion wanting, but the branch seems to have been nearly five times longer than broad, with the marginal spine well developed and situated as in *S. arcticus*.—Length 23 mm.

By the shape of the joints of the antenn. ped., the development of the branchiæ above trl.³ and trl.⁴, and the shape of the ext. br. of urp., this species is related to *S. robustus* Smith, *S. prehensilis* Bate, and *S. kröyeri* Bate. *But it is sharply distinguished from* *all other species hitherto known by possessing an enormous multitude of luminous organs* arranged regularly on the lower surface and near the lower lateral margins of the cephalothorax, on the six abdominal segments (figs. 2 *d*, *i*, *k*), on the sides of the shield (fig. 2 *a*), and on all the appendages preserved (figs. 2 *c*, *d*, *e*, *f*, *g*, *h*) with exception of the maxillulæ and maxillæ. The organs are easily seen; they look almost similar to the eyes in Araneæ, and they differ much in size and direction. I have deemed it advisable to deal with the special arrangement and the structure of these organs in a separate section of this paper.

SERG. DORSISPINALIS Bate, p. 394, pl. lxxii. fig. 1.

Bate does not state directly the number of specimens, but he had probably only one. The length is "9 mm." and the locality "south of Australia, March 1874." An animal with a label of exactly the same contents was preserved in a microscopical preparation. It is a *Mastigopus* related to *S. arcticus* Kr., *S. similis*, n. sp., &c., but it could not be referred to any adult form. In the preparation the abdomen is seen from the side, and the cephalothorax essentially from below; the spine on the scutum on which Bate writes "just anterior to the [cervical] suture, in the median dorsal line, is a small, anteriorly directed tooth," is in reality the gastro-hepatic spine, which besides has been drawn in a position too remote from the front. Bate's figure is not correct in some other respects: in the antenn. ped. the second joint is about as long as the third, and both together somewhat shorter than the first; the eyes reach to the end of the first joint; the squama is longer than in the figure, reaching almost beyond the second joint of the antenn. ped. and distally narrow; the ext. br. of urp. is a little longer and conspicuously more narrow than in the figure, while its marginal tooth is indicated correctly.

SERG. LATERODENTATUS Bate, p. 395 (no figure).

Bate has examined one specimen, measuring 8 mm. in length, and captured "south of Australia, March 1874." The type could not be found in the Museum. According to the description it is a *Mastigopus* belonging to the *arcticus*-group, probably a younger stage of the same species as that to which the preceding larva, *S. dorsispinalis* Bate, belongs.

SERG. NASIDENTATUS Bate, p. 398, pl. lxxii. fig. 2.

Bate does not state directly the number of specimens, and presumably he had only one; the length was 10 mm. and the locality the Pacific Ocean, between Valparaiso and Juan Fernandez. The type does not exist in the Museum. The species is a *Mastigopus*; in my earlier paper I had already referred it to the same group as *S. arcticus*, and nothing further can now be added.

SERG. DIAPONTIUS Bate, p. 399, pl. lxxii. fig. 3.

Bate does not state the number of specimens, but presumably he had only one. The length is 18 mm. and the locality the Atlantic Ocean, April 7, 1876. In a preparation bearing the name of the species, and besides "Surface, 7 April, 1876, Atlantic," one specimen is preserved: it must be Bate's type, but it measures only 16·5 mm. in length. In Bate's figure the armature on the dorsal line of the abdomen is not correct; on the third segment a spine has either been broken off or is rudimentary, the base being distinct; the spine on the fourth segment is only half as long as that on the fifth, shorter than in the figure, and directed obliquely backwards; on the sixth segment a very short spine is visible. The basal part of the rostrum is somewhat ascending, the distal spiniform and horizontally porrected. The ext. br. of urp. has the outer margin hairy in about $\frac{3}{5}$ of its length, and the marginal tooth is very small. The distal part of mxp.^{3} is very incorrectly drawn by Bate in his fig. 3 *i*; it is four-jointed; the third joint is short, much shorter than the fourth, and both together about as long as the second; the first of these joints terminates below in two strong setiform spines, both somewhat longer than the second joint, which terminates in two spines of the same length as the preceding pair; the fourth joint terminates also in two spines, somewhat, but not much, shorter than the four just mentioned. (I cannot understand how Bate drew his misleading figure; it must prevent every student of his Report from arriving at a correct judgment.) In the British Museum I have drawn tolerably accurate sketches of the rostrum, the ext. br. of urp. and the distal part of mxp.^{3}, and I have compared them with a few specimens in the Copenhagen Museum, previously determined and shortly described by me as the *Mastigopus* of *S. penerinkii* Bate, H. J. H.: I found the agreement to be so close, that I must consider *S. diapontius* Bate and *S. penerinkii* Bate (the type of the latter form unfortunately is not present in the Museum) as two *Mastigopus*-stages of the same species; the type of *S. penerinkii* Bate measured only 8 mm. in length and is a young *Mastigopus*, while *S. diapontius* Bate is the large larva.

Bate describes *S. diapontius* on p. 399, *S. penerinkii* on p. 418; and the name *S. diapontius* must therefore be accepted for the species. In my earlier paper I described the black-eyed adult form as *S. penerinkii* Bate, H. J. H., but I think that it must now be necessary to adopt the name *S. diapontius*, not only for the *Mastigopus*, but also for the mature form, which therefore in the future must be named *S. diapontius* Bate, H. J. H.

SERG. ARMATUS Kröyer, Bate, p. 401, pl. lxxiii. fig. 1.

Bate enumerates three localities: one of them is "September 12, 1875, between Japan and Honolulu, South Pacific Ocean"; the second is "Station 256, July 21, 1875; . . . . north of the Sandwich Islands; depth 2950 fathoms." But in the collection I found a statement aberrant from both, viz.: "Surface. Japan to Honolulu, July 1875. Type." This bottle contained two small specimens, but neither of them can be the type for Bate's figure. Both specimens belong to Group II. in my earlier paper, but neither of them belongs to *S. armatus*, both having on the rostrum a well-developed sub-basal dorsal spine, which is absent in *S. armatus* Kr. and in Bate's figure. I have been unable to refer the specimens, which measure about 8·5 and 11 mm., to any species known to me, and I thought it useless to describe and figure them.—One specimen from Port Jackson, Australia, the third locality in Bate's report, measures at most 5·2 mm. without the rostrum, which has been broken at the middle, but possesses a very fine sub-basal spine. It is so small and so badly preserved that a reference to any species has been impossible.

Finally I found a specimen from "Sidney," determined by Bate as *S. armatus*, but not mentioned in his work. It is only as long as the preceding specimen and impossible to determine.

The result is that I have perhaps not seen the specimen figured by Bate, which may belong to *S. armatus* Kr., and, according to the explanation of the plate, measured about 10 mm. in length, while his specimens of this length examined by me disagree with his figure by possessing a sub-basal upper spine on the rostrum.

SERG. EDWARDSII Kröyer, Bate, p. 403, pl. lxxiii. fig. 2.

Bate enumerates three localities. The first is "North Atlantic, April 1873": in the Museum I found a specimen labelled "14 April, 73, off Africa, surface," which most probably is that indicated in the text, and it belongs to *S. edwardsii* Kr. The second locality is "Pacific Ocean, surface, September 1875": in the collection a specimen bearing the same inscription is *S. edwardsii* Kr. From the third of Bate's localities, Cape Verde Islands, I found no specimen, but a specimen without locality and signed "type" is an adult specimen of *S. edwardsii* Kr. (That Bate's statement "Greenland (*Kröyer*)" is wrong here, and in almost all other places, has already been pointed out both by Ortmann and myself.)—Furthermore, I found two small specimens of *S. oculatus* Kr., the *Mastigopus* of *S. edwardsii* Kr., which had been determined by Bate as *S. edwardsii* and labelled "Aug. 23, 1873, lat. 2° 25′ N., long. 20° 1′ W., 100 fathoms," but these specimens are not mentioned in Bate's Report.

Bate's description of the characters of *S. edwardsii* Kr. is incomplete; the reader is referred to my earlier paper.

SERG. RINKII Kröyer, Bate, p. 404, pl. lxxiii. fig. 3.

Bate mentions two localities: "New Hebrides, August 23, 1874," and "South Pacific, 1875." From the first of these localities the anterior half of a specimen was present. Furthermore, I found two specimens labelled "Oct. 19, 1875, S. Pacific, drawn," and one and a half specimen labelled "Oct. 18, 1875, surface": both these localities are in all probability identical with the second one in Bate's Report. It may be very possible that all these specimens belong to *S. rinkii* Kr., which is the *Mastigopus* of *S. arcticus* Kr., but having in London no material from the North Atlantic of *S. rinkii* Kr., for direct comparison of minute details, and some other species allied to *S. arcticus* being known from the Indian Ocean and the Pacific, I could not determine the larvæ enumerated with absolute certainty.

One specimen from Cape York, determined as *S. rinkii*, but not mentioned in the Report, is *S. corniculum* Kr., in a stage a little younger than that figured by Bate as the last-named species.

One specimen, labelled "25. 8. 73," determined as *S. rinkii*, but not mentioned in the Report, measures nearly 7 mm.; it belongs to *S. penerinkii* Bate, the young larva of *S. diapontius* Bate, H. J. H.

SERG. OCULATUS Kröyer, Bate, p. 406, pl. lxxiv. fig. 1.

Bate enumerates six localities. From Stat. 106 three specimens were obtained, from Stat. 257 one specimen, from Stat. 103 one specimen, finally from "September 12, 1875, South Pacific," one specimen: all six specimens correctly referred to the Kröyerian species, which is the *Mastigopus* of *S. edwardsii* Kr. (compare my earlier paper). From the two remaining localities, viz. "North Pacific, near the Sandwich Islands, August 21, 1875," and "August 27, 1873 . . . off St. Paul's Rock," no specimens could be discovered.

SERG. OVATOCULUS Bate, p. 408, pl. lxxiv. fig. 2.

Bate gives the locality "The North Atlantic Ocean." In the collection I found three specimens with the label "14 June, 1873," which agrees with my quotation from the text. These three specimens are identical with *S. ancylops* Kr., which is the *Mastigopus* of *S. atlanticus* H. Milne-Edw.

SERG. PARVIDENS Bate, p. 409, pl. lxxiv. fig. 3.

Bate has the following localities: "The tropical part of the Atlantic; Pacific Ocean, north of the Sandwich Islands; off Sydney and Wellington, Australia." Just below he writes: "Specimens of this species or variety were taken during the passage from Teneriffe to St. Thomas"; and in the collection one specimen from the last-named locality is present: it belongs to *S. vigilax* Stimpson, the *Mastigopus* of *S. vigilax* Stimps., H. J. H.; it agrees with Bate's description and figure, and it had already been pointed out by Ortmann and myself that *S. parvidens* Bate belonged to *S. vigilax* Stimps. Examples from the other localities mentioned by Bate could not be found.—From "Cape York" two specimens determined as *S. parvidens* were present: one of them is a young *S. oculatus* Kr. (the *Mastigopus* of *S. edwardsii* Kr.); the other is allied to *S. incertus* H. J. H., but is so badly preserved that a determination was impossible. In a preparation a small specimen from the "China Sea," determined as *S. parvidens*, was preserved; it seems to be *S. oculatus* Kr., but it is in a very bad condition.

SERG. CORNICULUM Kröyer, Bate, p. 410, pl. lxxv. fig. 1.

Bate writes: "Cape York; north of New Guinea; North-west Pacific." In the collection I found one specimen from Cape York labelled "type," furthermore, one and a half specimen from the same locality, all correctly referred to the Kröyerian species. In a preparation I found a specimen determined as *S. corniculum* from "N.W. Pacific"; it measures 10·4 mm. in length, but according to the shape of the ext. br. of urp., the eyes, &c., it is not that species but *S. ancylops* Kr., the *Mastigopus* of *S. atlanticus*. From the third locality, "north of New Guinea," no specimen could be found.

SERG. ANCYLOPS Kröyer, Bate, p. 413, pl. lxxv. fig. 2.

Bate has two localities: "New Hebrides; Pacific, July 20, 1875." I found one specimen from "New Hebrides" correctly referred to the Kröyerian form.—In three other tubes, specimens not mentioned in Bate's text were present; they belonged to three other species, but are mutilated and could not be determined.

SERG. LONGIROSTRIS Bate, p. 415, pl. lxxv. fig. 3.

Bate writes: "Mid Atlantic, April 1876," and according to the following line he had one specimen. But in the collection I found three tubes, each containing one specimen, all determined as *S. longirostris*, and two of them from "N. Atlantic," while the third had no locality; all three specimens are the young *Mastigopus* of *S. corniculum* Kr., H. J. H. The specimen without locality seems to be the type for Bate's figure of *S. longirostris*, but it measures scarcely 3 mm. in length, the rostrum not included, and in Bate's figure the eye-stalks are too long, the eyes too small, and the third joint of the antenn. ped. too short (it is in reality as long as the second).

SERG. JUNCEUS Bate, p. 416, pl. lxxvi. fig. 1.

According to the text Bate has seen one small specimen from the "South Pacific Ocean." It could not be detected in the collection. But in my earlier paper I pointed out that it must be the young *Mastigopus* of *S. tenuiremis* Kr., H. J. H.

SERG. LONGISPINUS Bate, p. 417, pl. lxxvi. fig. 2.

Bate has two localities: "Station 106 . . . Mid Atlantic" . . . and "Station 354 . . . . North Atlantic Ocean." The collection contained two specimens referred to this species and labelled "23 Aug. 1873, 70 meters"; in the text we find "Station 106, August 25, 1873; lat. 1° 47′ N., long. 24° 26′ W.; Mid Atlantic Ocean"; but in spite of the small difference as to the date (probably originating from a misscript) I am sure that one of the two specimens was captured at Stat. 106. The other specimen is probably from Stat. 354. Bate writes: "the specimen from the tropical part of the Atlantic" and "that from the North Atlantic," which indicates that he had only one specimen from each of the two stations mentioned; and I suppose, therefore, that both specimens have later on been put together in the same tube. Both specimens, which are in a very bad condition, belong correctly to *S. longispinus* Bate (the direction of some of the dorsal spines on the abdomen is very characteristic), and this form is in reality the *Mastigopus* of *S. cornutus* Kr. (compare my earlier paper, p. 953).

SERG. PENERINKII Bate, p. 418, pl. lxxvi. fig. 3.

Bate records the length to be 8 mm. and the locality "North Atlantic Ocean." No specimen referred to this species could be found in the collection. But above I have mentioned a specimen of this species referred by Bate to *S. rinkii*, and it may perhaps be that described by him as *S. penerinkii*. He writes (p. 419) that the last-named "species bears a strong resemblance to *Sergestes rinkii* Kröyer, but differs . . .". The specimen in question, referred by him to *S. rinkii*, measures nearly 7 mm. in length and was captured "25. 8. 73," that is to say, Mid Atlantic.—In my earlier paper I have described the *Mastigopus*, and besides the mature form as *S. penerinkii* Bate, H. J. H.; but above it is pointed out that this name must be cancelled as a synonym, and the species be named *S. diapontius* Bate, H. J. H.

SERG. FERMERINKII Bate, p. 419, pl. lxxvi. fig. 4.

Bate has examined one specimen, captured in the "Pacific Ocean, lat. 24° S., long. 148° W.," and measuring 5 mm. The specimen is not to be found in the Museum collection. According to the figure it is a very young *Mastigopus* belonging either to *S. diapontius* Bate, H. J. H., or to a closely-allied species of the same group.

SERG. LONGICOLLUS Bate, p. 421, pl. lxxvii. fig. 1.

Bate enumerates two localities. The first of them is "South Atlantic Ocean, October 5, 1873; near Station 131; lat. 29° 35′ S., long. 28° 9′ W." In a preparation labelled "5. 10. 73" I found the large specimen drawn by Bate; in a tube labelled "surface, at night, 5 Oct. 1873, South Atlantic," a small specimen was preserved. Thus both specimens are from the first locality in the text, and both belong to *S. longicollus* Bate, which is the *Mastigopus* of *S. tenuiremis* Kröyer, H. J. H. In the large specimen drawn by Bate the eyes present a thick yellowish layer around the black central part; the dorsal spine on the sixth abdominal segment is exceedingly small.

The second locality in Bate's text is "Station 295, November 5, 1875; lat. 38° 7′ S., long. 94° 4′ W.; South Pacific Ocean; depth 1500 fathoms; . . . Taken at night." In the collection a specimen is preserved labelled "5. Nov. 75, night, S. Pacific, surface." The determination is correct; and the specimen, which measures 9·2 mm. in length, is evidently that mentioned by Bate; but the label proves that it was taken at the surface, wherefore the depth recorded in the text is most misleading.—In a third tube two specimens labelled 18/10 75 were preserved; they had been correctly referred by Bate to his *S. longicollus*, but are not mentioned in his text.

A preparation contained a specimen of the same species labelled "*Sergestes tenuiremis*, South Atlantic, 6. 10. 73." It is not mentioned by Bate, who even writes (p. 421) that "No specimen in the 'Challenger' collection corresponds precisely with the description and figure given by Kröyer" of *S. tenuiremis*. On the other hand, *S. tenuiremis* Kr. and *S. longicollus* Bate are, as already stated, the same species.

SERG. PRÆCOLLUS Bate, p. 423, pl. lxxvii. fig. 2.

Bate has examined one specimen, measuring 25 mm., from the "North Pacific Ocean." The specimen could not be found. The shape of the eyes in Bate's figure shows that it has been a large *Mastigopus*. In my earlier paper I write (p. 958): "is at least rather nearly related to *S. corniculum* Kr., from which it seems to differ by a somewhat different shape of the ext. br. of urp., and by having the fifth abdominal segment 'dorsally produced to a point.'"

SERG. SEMIARMIS Bate, p. 423, pl. lxvii. fig. 1.

Bate has two localities: "West Pacific Ocean" and "Station 354, May 6, 1876; .... Mid North Atlantic." After the description he writes: "*Observations.*—A specimen (pl. lxvii. fig. 2) very similar to the type was taken in the Atlantic ..."; and then he describes the specimen. I must suppose that he considered the specimen from the "West Pacific Ocean" to be the type of his *S. semiarmis*, and that the specimen described separately (p. 425) is that from "... May 6, 1876. ..." Neither of the specimens could be detected in the Museum; both are larvæ, but a reference is impossible. In the collection I found one specimen determined as *S. semiarmis* and labelled "13 April 1876, Atlantic, off coast of Africa, surface"; it is a *Mastigopus* of *S. diapontius* Bate, H. J. H.

SERG. LÆVIVENTRALIS Bate, p. 425, pl. lxvii. fig. 3.

Bate had probably only one specimen, 7 mm. in length, from "North of New Guinea"; it could not be found in the Museum. It is a young *Mastigopus* belonging to a species closely related to *S. arcticus* Kr.

SERG. SPINIVENTRALIS Bate, p. 426, pl. lxvii. figs. 5 & 6.

Bate has only one locality: "North Pacific Ocean"; the animal described measured only 3·5 mm. in length, and some of its parts are shown in figs. 5 *a*, 5 *l*, and 5 *v*, but fig. 5 *v*, representing the ext. br. of urp., does not correspond at all with the description in the text (p. 427). The animal is not to be found in the collection: it is a small *Mastigopus* related to *S. vigilax* Stimps. and allied species. Bate's fig. 6 *a* represents the head

of "*Sergestes spiniventralis* var." from the "West Pacific"; it has been suggested that the animal is allied to—or identical with—the *Mastigopus* of *S. vigilax* Stimps., H. J. H., but the specimen could not be found. The collection contained one specimen determined as *S. spiniventralis* and labelled "Sidney to Wellington, 17. 6. 74"; it measures about 7·5 mm. in length, and the naked part of the outer margin of the ext. br. of urp. is slightly more than one-fourth of its length. The specimen is in all probability a young *Mastigopus* of *S. vigilax* Stimps., H. J. H.

SERG. PROFUNDUS Bate, p. 428 (no figure). (Plate XI. figs. 3 *a*, 3 *b*.)

Bate has referred two specimens to this species. He describes each specimen separately: the first of them, from Stat. 137, belongs to *Petalidium*, perhaps to *P. foliaceum*, and has been dealt with above. The other specimen, from "Stat. 300, December 17, 1875; lat. 33° 42′ S., long. 78° 18′ W.; west of Valparaiso; depth 1375 fathoms; .... Trawled," is a real *Sergestes*, related to *S. inous* Faxon, but differing in the shape of the rostrum. Having removed the first-mentioned specimen from the genus *Sergestes*, I should think it justifiable to apply the name *S. profundus* Bate to the last-named specimen, instead of proposing a new name. The animal is quite membranous, and is crimson everywhere—a fact proving that it lives in the depth of the sea, and that its colour has been durable to the highest and most unusual degree. The posterior part of the abdomen is wanting, and the animal is on the whole so mutilated and flabby, that I would have omitted it if it had not been described by Bate; but for that reason I have thought it necessary to add some notes with two figures (Pl. XI. figs. 3 *a*, 3 *b*). It agrees with *S. inous* Fax. as to the membranous quality of the skin and the posterior branchiæ, but differs from it in the shape of the rostrum, which is of moderate length, with the upper margin somewhat, and the lower margin partly, strongly convex, and distally it is produced in a moderately short spine (Pl. XI. fig. 3 *b*). (Unfortunately I have not seen any specimen of the gigantic species *S. inous* Fax., and can therefore not decide whether the specimen described by Faxon had the rostrum uninjured.) Supra-ocular and hepatic spines are wanting. The eyes (Pl. XI. fig. 3 *a*) are black, comparatively small, somewhat shorter than broad, not half as long as the eye-stalks, and not broader than the distal end of the stalks. In the antenn. ped. the outer margin of the first joint is almost as long as that of the two distal joints together, therefore somewhat shorter than their inner margin; the third joint is a little shorter than the inner margin of the second, and seems to be about three and a half times longer than deep. The squama does not reach the end of the antenn. ped., and the outer distal spine is well developed. According to Bate the part preserved measures 18 mm., and the probable length of the entire animal is 24 mm.

SERG. VENTRIDENTATUS Bate, p. 431 (no figure).

Bate gives the locality "north of the Sandwich Islands" and the length "7 mm." A specimen labelled in accordance with the text is preserved in balsam; it is a young *S. oculatus* Kr., the *Mastigopus* of *S. edwardsii* Kr.

SERG. UTRINQUEDENS Bate, p. 433 (no figure).

Bate gives the locality "North Pacific Ocean," and the length "3·5 mm." No specimen could be found in the collection. Bate's specimen is a very young *Mastigopus*; in my earlier paper I have placed it near *S. corniculum* Kr., but a final interpretation is impossible to me.

SERG. DISSIMILIS Bate, p. 437 (no figure).

In the collection one specimen, from Cape Verde Islands, is preserved; it is certainly the type described by Bate. In my earlier paper I had determined it as one of the larval stages of *S. arcticus* Kr., but this is not correct. The rostrum is slightly more than one-third the length of the eye-stalks, its basal part somewhat ascending, with a very small spine on the upper angle, its distal part is a slender horizontal spine. The hepatic spine is short. The eyes are only a little higher than the distal end of the eye-stalks, and these increase gradually in thickness from the base outwards. In the antenn. ped. the distal half of the first joint has the margins nearly parallel, and the two other joints are a little thicker than in the corresponding *Mastigopus* of *S. arcticus*. Fourth to sixth abdominal segments each with a very small dorsal spine directed backwards; the spine on the sixth segment is the longest. The ext. br. of urp. is almost, but not quite, five times longer than broad. All these characters agree with those found in a *Mastigopus* of *S. mediterraneus* H. J. H. preserved in the Copenhagen Museum; and sketches drawn in London of the shape of the distal part of the squama and the telson agree also with the last-named form. I must therefore consider *S. dissimilis* Bate as identical with *S. mediterraneus* H. J. H. The result is that the last name must be withdrawn as a synonym, and the species, of which the sub-adult stage has been described in my earlier paper, must be called *S. dissimilis* Bate, H. J. H.

II. *Some Results of the Investigation.*

In my earlier paper on *Sergestes* I have paid as much attention as possible to the animals described by Bate; in nearly all cases I was able to state whether the specimen was an adult form or a *Mastigopus*, and several of the species were interpreted. After the study of the material preserved in the British Museum, I have now been able to confirm most of my earlier statements, to interpret an additional number of the specimens mentioned by Bate, and to correct two faults committed by myself. I had erroneously referred *S. dissimilis* Bate to *S. arcticus* Kr., instead of identifying it with *S. mediterraneus* H. J. H. (see above). Furthermore, I had divided a number of species, enumerated on p. 949 as Group I. A. *b.* β, into two sections, according to difference in the thickness of the distal joints of the antenn. ped.; but a study of the types of *S. prehensilis* Bate and *S. kröyeri* Bate showed that Bate's drawings of the antennulæ of these species are incorrect and misleading, wherefore my arrangement of them was wrong.

It may be useful to put together the alterations and additions which may now be accepted in the Conspectus on pp. 949–51 in my earlier paper. In Group I. the following particulars must be added or altered:—To *S. atlanticus* H. M.-Edw. belongs only a part of *S. atlanticus* sens. Bate, besides the form referred by Bate to *S. ancylops* Kr. From *S. arcticus* Kr., *S. dissimilis* Bate must be removed, and the latter species is to be established separately with *S. mediterraneus* H. J. H. as a synonym; furthermore, some of the specimens referred by Bate to *S. atlanticus* belong to *S. arcticus*. Near *S. arcticus* Kr., must be inserted *S. similis* H. J. H., established on one of Bate's specimens of *S. atlanticus*. *S. prehensilis* Bate and *S. kröyeri* Bate must be removed from their place and inserted above near *S. japonicus* Bate, together with *S. profundus* Bate, in its new restriction, and *S. challengeri* H. J. H., established on one of the specimens referred by Bate to *S. atlanticus*. *S. longirostris* Bate must be withdrawn as being a *Mastigopus* to *S. corniculum* Kr., H. J. H., and *S. corniculum* sens. Bate is the same species. As uncertain remain: *S. dorsispinalis* Bate, *S. laterodentatus* Bate, *S. nasidentatus* Bate, *S. læviventralis* Bate, *S. rinkii* Bate, ? Kr., all larval forms belonging to species related to *S. arcticus* Kr., or perhaps partly belonging to *S. arcticus* itself; furthermore, the larvæ *S. præcollus* Bate, *S. utrinquedens* Bate—both at least rather closely related to *S. corniculum* Kr., H. J. H.,—and *S. semiarmis* Bate.

In Group II. there is hardly anything to alter, but some additions to make. To *S. edwardsii* Kr. belongs *S. edwardsii* Kr., Bate, *S. oculatus* Kr., Bate, *S. intermedius* Bate, and *S. ventridentatus* Bate. *S. penerinkii* Bate must be cancelled as synonymous with *S. diapontius* Bate; and the adult form described as *S. penerinkii* in my earlier paper must be named *S. diapontius* Bate, H. J. H. The rest of Group II. remains unaltered. *S. fermerinkii* Bate, *S. spiniventralis* Bate, and the species referred by Bate to *S. armatus* Kr. could not be interpreted.

Besides, the investigation has yielded some results on the bathymetrical and geographical distribution of some of the species. It has been proved that the large specimens (exceeding 30 mm. in length) referred by Bate to *S. atlanticus* Kr. are deep-sea forms belonging to other species: *S. atlanticus* is common near the surface; according to Ortmann it has been taken in the intermediate net from 700–500 m., but it does not live in the greater depths of the sea. *S. arcticus* Kr. has a very wide geographical range, through the deeper to very deep tracts of the Ocean (see above); *S. japonicus* Bate has been captured in the northern part of the Atlantic and the northern part of the

Pacific. *S. atlanticus* H. Milne-Edw., *S. edwardsii* Kr., *S. vigilax* Stimps., H. J. H., *S. tenuiremis* Kr., H. J. H., and *S. corniculum* Kr., H. J. H., have been proved to be distributed through the tropical and subtropical parts of the Oceans almost around the globe, viz., from lat. 23° N., lat. 32° N., or even lat. 42° N. in the Atlantic, throughout the Indian Ocean to Australia, New Hebrides, and "South Pacific."

III. *Luminous Organs in* Sergestes challengeri, n. sp. (Plate XII.)

The luminous organs briefly mentioned above are generally easy to discover; each resembles a very convex, vitreous, faintly yellowish lens, which is circular and sharply defined. They differ much in size, some of them being very small and many proportionately large. It may be advisable, first, to give a conspectus of the organs observed on the single and unfortunately very mutilated specimen, next to add some remarks on their distribution, then to describe their structure, finally to compare them with luminous organs in other Crustacea.

Conspectus of the Organs observed.

	Organs.
On each side of the scutum a row with four organs.	8
On the clypeus one organ	1
On the lower side of the head one unpaired organ and one near the lateral margin	3
On the lower surface of the thorax and on its infero-lateral margins	26
On the lower side of the third joint of the antenn. ped. one organ	2
On the lower side of each squama four organs	8
On the mandible and its palpus two organs	4
On the first maxilliped two organs	4
On the second maxilliped five organs	10
On the first trunk-leg three organs	6
On the lower surface and on the lateral wall of the first abdominal segment	6
Do., do. of the second abdominal segment	6
Do., do. of the third abdominal segment	4
Do., do. of the fourth abdominal segment	3
On the lateral wall of the fifth abdominal segment.	2
Along the median line of the sixth abdominal segment.	6
On the outer side of the basal joint of each of the pleopods one organ	10
On the peduncle and on the inner branch of each uropod two organs	4
On the lower side of the outer branch of each uropod two organs	4
Total number of organs ...	117

The eye-stalks, the maxillipeds, and the four posterior pairs of the trunk-legs have been broken off. I am convinced that at least most, and perhaps all, these appendages possess some organs, and the lowest number the species possesses must therefore be about 150!

On the distribution and direction of these organs the following remarks may be offered. The four organs on each side of the scutum are arranged rather close in a longitudinal row situated on the ridge bordering the branchial cavity above (fig. 2 *a*). The organ on the clypeus is large: one organ is situated on the segment bearing the antennulæ, and one on the lower surface of the head near the lateral margin a little in front of the mandible; these four organs look essentially downwards. The arrangement of the organs on the three posterior thoracic segments can be seen in figs. 2 *i* and 2 *d*. It is observed that two large organs are placed at the lower margin of *br.* above trl.³ and of *br.*¹ above trl.⁴ These organs look outwards and downwards, and the part containing the glandular mass &c. behind the lens is somewhat protruding, which produces an aspect as if these organs had been inserted on the end of a kind of rather thick, short stalk. The remaining organs on the segments mentioned are found on the lower surface (fig. 2 *i*); those placed at the inner angle of the legs are small or very small, while some in the median line are large. In fig. 2 *i* fifteen thoracic organs have been drawn; the remaining eleven thoracic organs are situated on the anterior segments and arranged in a rather similar way. The four organs on the lower surface of each squama of the antenna are arranged for some distance in a row; two of them are seen through the squama in fig. 2 *c*. The mandible (fig. 2 *e*) has one organ below at the antero-inferior margin near the insertion of the palp; another organ is seen on the lower surface of the first joint of the palp near its distal end. The first maxilliped (fig. 2 *f*) has on the upper side one organ just at the origin of the exopod, and one on the lower side of the following joint of the endopod; the first-named organ looks forwards and a little inwards (fig. 2 *g*), and the upper margin above it is produced nearly as a lamella, overlapping the major part of the lens when seen from above (figs. 2 *g* & 2 *n*). Of the organs on the outer—in the natural position of the appendage in reality the lower—surface of mxp.² (fig. 2 *h*), that at the base of the third joint is very small and the others large; the organ on the first joint looks essentially downwards, and is "stalked," as the above-described organs near the lower margin of the posterior branchiæ. Of the three organs on trl.¹, two are placed on the inner side of the long fourth joint, one near the base and the other near the distal end; the third organ is situated on the anterior side near its end. Each of the five anterior abdominal segments has a large organ on the lower part of the anterior margin of the lateral plate (figs. 2 *d* & 2 *i*); it looks forwards and somewhat downwards, besides sometimes a little outwards. Each of the two anterior segments has besides on the lower surface (fig. 2 *i*) four organs, one of which is large and two of the others very small; on the third and fourth segments these organs are gradually reduced in number, and none of them are found on the fifth. The sixth abdominal segment has a median row of six organs, which are seen in fig. 2 *k* with the exception of the first, this being hidden by the lateral wings of the preceding segment. The very short basal joint of the peduncle of each of the pleopods has on the outer side a small organ, looking outwards and at least sometimes a little downwards. Each uropod has one organ on the peduncle, situated on its inner surface near the lower margin and close to the base, besides one organ on the interior (lower) surface of the inner branch near its base; finally, two organs on the interior (lower) surface of the outer branch, one of them near the middle and the other on the distal narrowing part.

From the preceding description it is seen that most of the organs look downwards, a smaller number somewhat outwards or forwards, rather few almost totally outwards, and none upwards, with the exception of one on the first maxilliped. With the exception of the few lateral organs on the scutum, all the others are found on or near the lower surface of the body and on the appendages.

The structure of the organs is very interesting, and very different from all hitherto known in any invertebrate animal. I have examined more closely three organs, viz., that situated on the third joint of the first maxilliped, one of the "stalked" organs near br. above trl.[3], and one from the antero-inferior margin of the fourth abdominal segment. The two last-named organs have been cut off, most of the adhering tissue removed by dissection, and the organs examined with moderately high magnifying power. I have found no difference of any importance between the three organs from such distant parts of the animal's body.

The organ taken as type is that from the infero-lateral margin of the thorax; it has been drawn (fig. 2 *m*) in optical vertical section. The skin forms a chitinous, large, and very thick biconvex lens (*a*), which is vitreous and a little yellowish; the major central part is covered by a rather thin limpid layer (a^1), but this layer I could not perceive on the two other organs examined. The lens is circular in outline; its diameter is about two-thirds as long as that of the inner portion of the organ at its thickest part. The inner side of the biconvex lens is covered by a large and rather thick concavo-convex lens (*b*), which is somewhat thinner than the outer lens, but with the diameter a little longer than that of the same; the lateral margin of the inner lens is oblique, very broad, touching the external chitin around the outer lens. This inner lens, which consists of two layers, is homogeneous, vitreous, and slightly greyish; but the difference between the colour of the outer and the inner lens is in the figure purposely a little more strongly marked than in nature. These two lenses remind one of optical instruments in which the lens is

composed of crown-glass and flint-glass. Behind the inner lens is found a thick layer of glandular cells (*d*), which are light greyish, very large, and most of them elongate, radiating towards the centre of the outer lens. The diameter of this layer is somewhat larger than that of the inner lens; and when the luminous organs are examined in their natural position with a strong pocket-lens, this layer can often be seen through the skin as a whitish ring around the lens. Between the layer of large cells and the inner lens a thin layer (*c*) seems to exist, but its quality could not be made out, and I do not venture to propose any hypothetical explanation. Behind the glandular layer is seen another (*e*), which is yellowish, with numerous transverse fine stripes, and without trace of cellular structure; it is rather thick in the middle, but thin around the sides of the glandular layer. The internal surface of the organ seems to be covered by a thin layer (*f*) of connective tissue. That the posterior layer with the transverse stripes is—as in the Euphausiidæ—a reflector can be taken for granted. But it is impossible to decide whether the light is produced by the glandular layer or by the inner lens. Whether the thin layer enveloping the whole organ is pigmented or not cannot be seen on this old material, which has been preserved twenty-eight years in spirit; that the organs are immovable scarcely needs to be stated. Future investigation of living animals and of sections of fresh material must elucidate whether the organs are especially innervated or not, and, besides, fill up the other gaps in the interpretation of the function and structure of the layers in these compound structures.

A brief comparison of the luminous organs in *Sergestes challengeri* with those in other Crustacea is not without interest. Of animals belonging to that class, luminosity has been observed in some Copepods, a few Ostracods, Euphausiidæ, and one macrurous Decapod. Giesbrecht has published a thorough and interesting study: "Ueber das Leuchten der pelagischen Copepoden und das thierische Leuchten im Allgemeinen" (Mitth. zool. Stat. Neapel, 11 B., 1895, pp. 648–689). He has examined a small number of pelagic Copepoda—necessarily restricting himself to all the luminous forms which he could procure in a living state in the Gulf of Naples—showing that these animals possess a number of small dermal glands, the secretion of which produces the luminosity when it, by exhaustion from the glands, comes in contact with the surrounding water. In a few Ostracoda a brilliant luminosity is produced in a similar way from glands in the labrum; it was already suggested by G. W. Müller in 1890, and has since been observed and published by another author. Furthermore, I can mention that during a voyage in the Indian Ocean, Dr. Th. Mortensen met with a vast number of a pelagic Ostracod which showed a most brilliant light, and he observed how this was produced. Finally, the present writer has observed nearly the same in a number of a large Ostracod which had been procured in Davis Strait. Late in the evening I observed luminous points in recently sieved bottom material from 318 fathoms, and undertook instantly some manipulations with the animals: the luminous fluid came from the head, probably from the large labrum, and flowed backwards between the shells, illuminating brilliantly the space between them, especially on the ventral side. As to the Entomostraca, we can therefore not speak of "luminous organs" in the common sense of the word, the light being always produced in the above-described way.

In almost all Euphausiidæ real and highly-developed luminous organs are found, but they differ in structure very much from those in *Serg. challengeri*. The reader is referred to Sars's Report on the 'Challenger' Schizopoda, and to Chun, "Leuchtorgane und Facettenaugen" (Bibliotheca Zoologica, Heft xix. Lief. 4, 1896). The highest number of organs met with in this family is only ten: one on each eye-stalk, two on each side of the thorax near its inferior margin, and one in the median line of each of the four anterior abdominal segments. The light is produced by the "Streifenkörper" (Chun)—"a flabelliform bunch of exceedingly delicate fibres, exhibiting in fresh specimens a most beautiful iridescent lustre" (Sars, *op. cit.* p. 71)—situated a little behind the centre of the organ in a mass of large cells; a biconvex lens, which is present in the organs with the exception of those on the eye-stalks, is internal, while the outer chitinous skin is thin; a reflector is developed nearly as in *Sergestes*.

The Danish zoologist Cand. mag. Ad. S. Jensen has directed my attention to a book by a French author, and lent me a German translation: 'Die Leuchtenden Tiere und Pflanzen. Von Henri Gadeau de Kerville. Aus dem Französischen übersetzt von W. Marshall, 1893.' In this popular treatise I saw that the 'Talisman' had captured a deep-sea shrimp with numerous luminous organs. I attempted in the 'Zoological Record' and elsewhere to discover where that animal had been described, but in vain, and I will therefore reprint the passage in question from the German book:—"Während der wissenschaftlichen Expeditionen des Talisman fing man in einer Tiefe von 500 m. einen langschwänzigen Krebs (*Acanthephyra pellucida* A. Milne-Edwards), welcher ein lebhaftes Licht um sich zu verbreiten im stande war und zwar mittels folgender verschiedener Leuchtorgane; erstens befand sich eins am Vorderrand einer Deckschuppe der Augen, zweitens verlief eine lange leuchtende Linie am Aussenrand des Tarsus des fünften Beinpaares, an dessen innern Basis sowie an der des vorhergehenden Beingliedes sich weiter leuchtende Flecke befanden, drittens lagen ganz ähnliche Flecke an der Basis des zweiten Gliedes des dritten und vierten Beinpaares und ebenso je einer an der Basis des Tarsus derselben Gliedmassen, viertens sah man einen langen Fleck an der Basis am Endgliede des hintersten Kieferfusspaares, fünftens verlief ein schimmerndes Querband über die Hüfte des hintersten Thorakalfusspaares, sechstens war eine Doppelreihe glänzender Punkte an jedem Gliede der Aussengeissel der Brustfüsse, sowie an dem äusseren Blatt der Bauchfüsse vorhanden, siebentens zeigte sich eine doppelte Linie leuchtender Punkte entlang der äusseren Geissel der Innenfühler und achtens verlief eine im hinteren Teile zusammenhängende, im vorderen in Punkte aufgelöste Linie parallel zum Unterrande des Rückenpanzers." The arrangement of the organs in *Acanthephyra pellucida* is rather different from that in *Sergestes challengeri*, but it shows yet more resemblance to it than to that in the Euphausiidæ. Both in *S. challengeri* and in *A. pellucida* an astonishingly high number of organs exist, but as to the structure of the organs in the last-named form unfortunately nothing is known. I suppose that they are real compound organs, not dermal glands as in the Entomostraca.

If we look for comparison between all luminous animals, it will be found that only some deep-sea or pelagic fishes and two Cephalopoda of the genus *Histioteuthis* (according to Verany and Joubin) possess a number of real organs which can be compared with that found in *Serg. challengeri* and *Acanth. pellucida*.

I have looked for luminous organs in all adult species of *Sergestes* known to me and in *Acanthephyra purpurea* A. M.-Edw., but the result was absolutely negative. It is a very curious fact that about 150 very compound organs are found in one species of *Sergestes*, while they seem to be quite absent in all other species hitherto known of the genus. It may be added that the luminous species does not deviate from some of the other forms in any other character of importance: it belongs, even within the genus, to a group which contains several deep-sea forms closely allied to each other. Considered in this light, the existence in one species of about 150 compound organs seems to me a most astonishing feature.

Supplementary Note.

In the preceding section it has been mentioned that among the Cephalopoda two species of *Histioteuthis* possess a large number of compound luminous organs. My friends Prof. G. B. Howes and Rev. Th. R. R. Stebbing have very kindly directed my attention to two papers, which contain some additional knowledge of the same topic and may be quoted here. W. E. Hoyle (Mem. & Proc. of the Manchester Liter. & Philos. Soc. vol. xlvi. part vi. 1902) points out and describes the structure of twenty-nine luminous organs in *Pterygioteuthis margaritifera*, but this number, though rather high, is yet considerably lower than that in *Sergestes challengeri*. C. Chun ('Aus den Tiefen des Weltmeeres,' Jena, 1900) describes and figures (p. 532) the arrangement and the colours of twenty-four luminous organs in "*Enoploteuthis diadema* Ch., n. sp." Furthermore, he writes (pp. 532–33): "Ähnliche, wenn auch etwas kleinere Organe, besetzen bei Vertretern der Gattung *Calliteuthis* die ganze Körperoberfläche von den Armen bis zu den Schwanzflossen. Die Bauchseite ist auch hier wieder reichlicher mit ihnen ausgestattet, als die Rückenfläche." An accompanying figure of a "*Calliteuthis* n. sp.," seen from the ventral side, shows a number of organs considerably surpassing that in *Serg. challengeri*.

EXPLANATION OF THE PLATES.

Plate XI.

1. *Petalidium foliaceum* Bate. p. 54.

Fig. 1 *a*. Rostrum of a specimen from Stat. 159, from the side.
1 *b*. Eye and left antennular peduncle of the same specimen, from above.
1 *c*. Rostrum of a specimen from Stat. 146, from the side; × 5.
1 *d*. Eyes of the same specimen, from above; slightly more than × 5.
1 *e*. Basal part of mxp.[2]—mxp.[3] and trl.[1]—trl.[5], together with the branchial apparatus of the last-named specimen; × 5. *br.*, rudimentary pleurobranchia to mxp.[2]; *ep.*, epipod on mxp.[2] with its branchia; *l.*, four pleurobranchial lamellæ belonging to mxp.[3] and trl.[1]—trl.[3]
1 *f*. Lateral view of the front part of the scutum and the eye of a young specimen—measuring 21·5 mm. in length—from Stat. 158.
1 *g*. Rostrum and eyes of the same specimen, from above.

2. *Petalidium* sp. p. 55.

Fig. 2 *a*. Front portion of the scutum of a young specimen from Stat. 137, described by Bate as *Sergestes profundus* Bate.

3. *Sergestes profundus* Bate. p. 69.

Fig. 3 *a*. Front part of the scutum, eye, and antennular peduncle of the specimen from Stat. 300; × 15/2.
3 *b*. Rostrum of the same specimen.

4. *Sergestes prehensilis* Bate. p. 56.

Fig. 4 *a*. Rostrum, eye, and base of the antennular peduncle, from the side.
4 *b*. Front end of the scutum, eyes, peduncles of the antennulæ and squamæ, from above.

5. *Sergestes kröyeri* Bate. p. 58.

Fig. 5 *a*. Rostrum, from the side.
5 *b*. Front end of the scutum, left eye, and the peduncles of the antennulæ, from above; × 4.

6. *Sergestes similis*, n. sp. p. 60.

Fig. 6 *a*. Front end of the scutum, left eye, and peduncle of the antennula, from the side; × 14/3.
6 *b*. Rostrum and supra-ocular spine, from the side; × 12.
6 *c*. Front end of the scutum, eye, peduncles of the antennulæ and squamæ, from above; × 5.
6 *d*. Branchiæ above trl.[2]—trl.[4]; × 11/2. *2 br.*, first branchia to trl.[2]; *2 l.*, branchial lamella to trl.[2]; *3 br.*, first branchia to trl.[3]; *3 br.*[1], second branchia to trl.[3]; &c.

Plate XII.

1. *Sergestes arcticus* Kr. p. 60.

Fig. 1 *a*. Front end of the scutum, eye, and basal portion of the antennular peduncle, from the side; × 9/2.
1 *b*. Rostrum and supra-ocular spine of the same specimen; × 11.
1 *c*. Branchiæ above trl.[2]—trl.[4]; × 8. The lettering as in fig. 6 *d* on the preceding Plate.

2. *Sergestes challengeri*, n. sp. p. 61.

In the following figures *o* signifies luminous organs.

Fig. 2 *a*. Scutum, with the basal parts of the eye-stalk, antennula and antenna; × 5.
2 *b*. Front end of the scutum, basal part of the eye-stalk, and antennular peduncle; × 17/2.
2 *c*. Front end of the scutum with the anterior appendages, from above; × 9. Of the eye-stalks only the basal joint remains; of the left squama the distal half is omitted; on the right squama the two distal ones of the four luminous organs are seen through the plate.

Fig. 2 *d*. The basal parts of the three posterior thoracic legs, the branchiæ above trl.[2]—trl.[4], and the lower part of the two anterior abdominal segments, from the side; × 11. The lettering of the branchiæ as in fig. 6 *d* on the preceding Plate.
2 *e*. Left mandible, from below; × 13.
2 *f*. Left first maxilliped, from below; × 13.
2 *g*. Middle part of the first maxilliped, from above; × 44. o^1, upper proximal luminous organ; o^2, distal luminous organ seen through the endopod.
2 *h*. Left second maxilliped with its epipod and branchia, from the outer side; × 13.
2 *i*. The three posterior thoracic segments and the two anterior abdominal segments, from below, showing 31 luminous organs; × 9. Of the pleopods, only the basal joint—with its luminous organ—has been drawn.
2 *k*. Sixth abdominal segment with the basal part of the telson and the uropods, and the posterior part of the fifth abdominal segment with a part of the pleopod; × 13/2.
2 *l*. Exterior branch of the left uropod, from the outer side; × 17/2. The apical part is wanting.
2 *m*. Luminous organ from the side of the thorax near *br.* above trl.[3], seen in optical vertical section; × 180. *a*, chitinous lens; a^1, its thinner external layer; *b*, inner lens; *c*, thin layer between the inner lens and the thick glandular layer *d*; *e*, reflector; *f*, enveloping thin layer.
2 *n*. Sketch of the luminous organ from the upper side of the first maxilliped; × 180. *a*, lens, partly overlapped above by the protruding chitinous plate *l*.

February 3, 1903.

Howard Saunders, Esq., F.L.S., Vice-President, in the Chair.

The Secretary read the following report on the additions to the Society's Menagerie during the month of January 1903:—

The registered additions to the Society's Menagerie during the month of January 1903 were 58 in number. Of these 15 were acquired by presentation and 9 by purchase, and 34 were received on deposit. The total number of departures during the same period, by death and removals, was 120.

The following papers were read:—

1. Notes on the Hair-Slope of four Typical Mammals. By Walter Kidd, F.Z.S.

[Received November 27, 1902.]

The Otter, Domestic Dog, Ox, and Horse have been selected for consideration as showing very different arrangements of their hairy coverings, and as affording by their environments and habits the probable explanation of the differences found. Two Carnivores and two Ungulates are thus compared and contrasted.

(1) In the Otter, taken as a type of the long-bodied hairy mammal with very short limbs, the hair presents an unbroken slope from the snout to the tip of the tail. On the head and