

Paul'son, 1875

10709

ROLAND L. WIGLEY *J. Martin*

O. Paul'son

STUDIES  
on  
CRUSTACEA  
of the  
RED SEA

Part I

Translated from Russian



Published for the National Science Foundation, Washington D.C.,  
and the Smithsonian Institution by the  
Israel Program for Scientific Translations

ИЗСЛѢДОВАНІЯ  
РАКООБРАЗНЫХЪ КРАСНАГО МОРЯ

СЪ ЗАМѢТКАМИ ОТНОСИТЕЛЬНО РАКООБРАЗНЫХЪ ДРУГИХЪ МОРЕЙ

(IZSLEDOVANIYA  
RAKOOBRAZNYKH KRASNAGO MORYA  
s zametkami odnositel'no rakoobraznykh drugikh morei)

**О. Паульсона**

(O. Paul'sona)

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**ЧАСТЬ I**

(CHAST' 1)

Podophthalmata и Edriophthalmata (Cumacea)  
(Podophthalmata i Edriophthalmata (Cumacea))

СЪ ДВАДЦАТЬЮ ОДНОЮ ТАБЛИЦЕЮ РИСУНКОВЪ.  
(s dvadtsat'yu odnoyu tablitseyu risunkov)

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**КИЕВЪ**

Типографія С. Н. Кульженко на Мало-Житомирской ул., д. № 83

**1875**

(Tipografiya S. V. Kul'zhenko po Malo - Zhitomirskoi Ulitse, dom N 83)  
(KIEV, 1875)

*STUDIES on CRUSTACEA*  
*of the*  
*RED SEA*

with notes regarding other seas

O. Paul'son

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PART I

Podophthalmata and Edriophthalmata (Cumacea)

with 21 tables

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KIEV

Printed by S. V. Kul'zhenko, 83 Malo-Zhitomirskaya Street

1875

OTS 60-21821

Published  
for

THE NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C.

and

SMITHSONIAN INSTITUTION, USA

by

THE ISRAEL PROGRAM FOR SCIENTIFIC TRANSLATIONS

1961

Title of Russian Original:

Izsledovaniya rakoobraznykh krasnago morya  
s zametkami otnositel'no rakoobraznykh drugikh morei

Translated by: Francis D. Por, M.Sc.

Printed in Jerusalem by S. Monson

PST Cat. No 232

Price: \$1.75

[NOTE:

Wherever genera and species were given in Latin in the Russian original they were reproduced without change, except where printing errors had to be corrected. Thus, certain genera and species are given differently in the Introduction and in the text proper, as for instance, in the case of *Thalamita admete* in the Introduction, but *Thalamita Admete* in the text.]

Available from The Office of Technical Services  
U. S. Department of Commerce, Washington, 25, D. C.

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[Author's Introduction]

Many scientists disregard the work of the taxonomists, considering it an amorphous contribution to science that does not solve any of the scientific problems and represents only a superfluous ballast. This conception is not groundless, at least with regard to those orders of Crustacea on which I had the opportunity to work and which are the object of the present study. Regarding this, I take the liberty of putting forward the following point of view.

On the basis of existing works, one could reach the conclusion that the faunists have taken into consideration only the determination of the species, the smallest deviation from a known form being for them a reason for creating new species and genera whose number, consequently, grows considerably with every such study. For the ease of determination (otherwise I could not account for it) the faunists frequently proceeded to an even greater artificial splitting of the existing genera. In these studies we note the lack of any criticism, they seem to have been hastily done; preliminary lists of collected species are published, as if the entire task of the faunist would consist in increasing the number of species and adding his name to the newly described forms. This trend, inherited from the past, must meet everyone's opposition, chiefly if one takes into account Darwin's contemporary doctrine on the origin of species. This trend undoubtedly led to a situation in which taxonomic works, although not entirely ignored, have at best been found in the last place among other research works.

Embryological research, which is at present so much in the center of scientific interest, has led to exceptionally important and great results, but such research generally indicates the relationship between the great taxonomic categories of the animal kingdom. One can hardly expect embryology or comparative anatomy to indicate relationships between species in the near future. Our knowledge is far from being so complete that it can offer the possibility of considering external characters unworthy of being studied or as negligible; much more so, since anatomical characters often have a lesser importance in taxonomy. I propose that rather than speculating philosophically and providing the science with new theories which are discredited as quickly as they are formulated, one should also give the zoologists the task of studying certain species so that, by collecting facts in a limited field they may contribute to the purpose to which Darwin's theory is dedicated, a theory which is such a beneficial influence upon biology.

When species are studied, a rigorous evaluation of characters should be made. It is necessary to study to what extent every character is constant or variable in individuals belonging to the same species, and hence there is a need to concentrate attention on sex, and especially on age. No

one has ever studied variations in connection with age; although young individuals of some species differ greatly from the adults, such differences are often the reason for establishing new species. It is also necessary to investigate whether a character shows gradual transitions within certain limits, establishing at the same time, if possible, the direction in which the variation of this character occurs. During such research, data for the solution of another problem may also be found, that is the problem of the area in which the members of the respective group of animals were formed. Consequently, in his research, the faunist must not be led only by seeking and summarizing contrasting characters which, in fact, in most cases, do not exist; he must focus his attention upon transition forms, he must take into account existing relationships, he must use the method of unification, for showing the unity and interrelationship between the individuals of the group, and he must not stop at every aberration without any reason or critical approval, only to boast about a newly discovered form, which is but a matter of little importance.

Research in this spirit and in this trend are necessary, and this must be considered an axiom. Nevertheless I have never met, in any of the works in the vast bibliography which I used, the method indicated above. I would like to draw attention to the more extensive research works of Heller, Alph. M. Edwards [Milne-Edwards] and Stimpson, as works belonging to the last decade; one could have expected that these works correspond to modern demands of science. If these studies are characterized by a lack of criticism, to what extent could the facts furnished by them be of use? May one consider the determinations true or the facts exact with regard to the structure of the animal? Unfortunately one must consider such material with distrust; it is difficult to say to what extent it may be used. Verifying the present work, when the tables had already been printed, I had--in order to proceed to the solution of several problems--to make some new comparison, and these formed the object of the note which appeared in the volume IV of the "Zapiski Kievskogo Obshchestva Estestvoispytatelei"\* On this occasion, of course quite incidentally, I found incorrect data in the descriptions of the mouth parts and appendages of Porcellana, Remipes, and Hippa, and these errors were picked up again by all subsequent authors. As to the genus Tetralia, created by Dana from a number of Trapezia species, the principal differential character between these two genera is wrongly defined by all the authors. This character is also important, since it reconfirms that a general likeness, determined by a few unimportant and insignificant external characters, is sometimes of greater importance for the illustration of a relationship than the anatomical character of any organ, serving as a basis for the classification. So for instance, if one would follow the anatomical character that forms the basis of the Eriphinae subfamily, the genera Tetralia and Trapezia should be situated in two different subfamilies, thus falsifying the existing relationship between these two genera.

If with regard to some long-ago described genera part of which have a fairly large distribution, such instances are met, one involuntarily draws the sound conclusion that it is difficult to rely upon existing references. As to the determinations--these are made hastily and carelessly enough. As proof I present only a few examples from the Red Sea fauna, although their

\* [Records of the Kiev Naturalist Society.]

number is quite considerable. Heller considers Etisus spinipes as belonging in Pilodius, while Alph. M. Edwards created for it--on no intelligible basis--the new genus Chlorodopsis. Heller considers Pilodius fragifer as Chlorodius. The new genus created by Heller is identical with the genus Caphyra (Guerin) already included in *Hist. nat. des Crustacés*. The new genus Cryptochirus is identical with Lithoscaptus, described by Alph. M. Edwards. Describing Pilumnus spinifer, Heller refers to the illustration of Savigny; also in describing the new species Pilumnus Savignyi\* from the Red Sea, Heller refers to the same illustration by Savigny. One may also meet laconic notations, as for instance in Stimpson's work, in which the following is said with regard to Xantho distinguendus: "forsitan varietas Chlorodii exerati vel sanguinei", and so on.

Such faunistic studies do not even furnish a raw material, but bring forth quite unusable information, and therefore one must not wonder if the work of the systematist is considered as research which provides only a useless ballast.

Unfortunately, the method indicated above is applicable only to the smallest part of all existing works, since in collections, many species are represented only by one or two specimens whose description is, at present, considered as being only relatively useful; if such a description is to be of use to others as well, it must be a detailed one, and accompanied by accurate illustrations. In this respect, Heller's research on the Crustacea of the Red Sea have serious deficiencies. It is absolutely necessary to add measurements, a fact of outstanding importance when the faunist refers only to young specimens, since with the aid of these dimensions, one can establish by comparison the relative age of the individuals, and therefore, valid conclusions based upon known data may be drawn, even if only a small number of specimens is available. It is also necessary to note the number of specimens studied, which has not yet been done, since this is important for subsequent works. If a description is based upon only one single specimen, I always may admit a certain amount of variability in the described characters; but if a considerable number of specimens have been studied I can draw the conclusion that--in case of the description of a certain species--this species is invariable for the area considered and does not show varieties at present. Species that do not vary and have--so to speak--lost their plasticity, do really exist; such species must be made outstandingly obvious in order to serve the research work of future generations; the same attention must be paid to the species which pass through a period of variability. Outstandingly useful material in this regard is undoubtedly furnished when great numbers of species samples are collected. The detailed study of each specimen and the subsequent drawing up of a comparative table is a dull, monotonous and annoying task, and hardly yields the same results as other work requiring an equal amount of time, but such work has become an absolute necessity. I am of the opinion that now, more than ever, the species, i. e., the unities forming both the animal and vegetable kingdoms, must also be studied on the basis of actual facts, resulting directly from rational studies, and increase in this way the amount of facts confirming Darwin's theory of the origin of species.

Taxonomic works in this trend are an unquestionable contribution to

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\* [In this publication those species named after persons were capitalized, and, although this is not common usage today, we prefer to leave it as it appears in the Russian text.]

science, and may claim a more honorable place than that awarded to them at present.

I am far from asserting that the present work satisfies the demands that I expressed above. Everyone will agree that the material collected by Prof. Kovalevskii is incomplete, especially due to a lack of comparative material. I can only assert that I have exhaustively used the available material, and now I begin to note the conclusions drawn from the study of the taxonomic characters, limiting them only to a few examples in order to avoid useless repetition.

Pointed or blunt spines, tubercles, the number of each, or the lack of them, cannot always serve as the definition of a species. In very many cases, pointed spines become blunt tubercles with increasing age, as for instance the spines of the lateroposterior edge of the cephalothorax in Chlorodius niger; or they change their aspect in another way, e. g., in Thalamita admete (Table VIII, Figure 1a, 1b, 1c - Figure 1 magnified four times). If one considers Thalamita Chaptalii according to the lateroposterior edge of its cephalothorax, we find that this species is probably no other than a young individual of Thalamita admete, though in fact I cannot confirm this, since age is not noted either in Savigny or in Audouin. Finally, spines may disappear completely with age, as for instance on the mero- and carpopodites of the anterior legs in Chlorodius niger; young individuals of this species differ from adults also in other respects to such an extent that Heller created the new species Chlorodius depressus for them. It is strange that Alph. M. Edwards, who received approximately two hundred specimens from New Caledonia, does not anywhere note anything about variations undergone by Chlorodius niger with increasing age, and considers Chl. depressus as an independent species. In Table VI three figures are shown, representing young, intermediate and adult specimens of this species. I also observed the modification of the number of spines on the lateroposterior edges in Porcellana digitalis, great numbers of which I collected in Sevastopol' Bay. In the same way the determination of the Trapezia species, which Heller based on the existence or the lack of the lateral spine and the pattern of the other spines, is not confirmed. In Trapezia coerulea, the lateral spine is well developed and pointed at every age and in every specimen. In Trap. ferruginea it is pointed in young specimens; but always blunt in adults. In a young specimen of Trap. digitalis--a species which, according to Heller and Latreille, differs from all others by the lack of the lateral spine--a pointed spine is found on the lateroposterior edge; in some adult specimens, an insignificant, blunt prominence may be detected with the aid of a magnifying glass in the same place; finally, in a third group of specimens the lateroposterior edge is quite smooth. Based on the variability of this and other characters which also show gradual transitions, all species of the Red Sea described up to this time must be considered variations of T. ferruginea or T. coerulea.

In other forms the surface of the cephalothorax is smooth in the juvenile stage; subsequently tubercles and furrows are formed, delimiting areas on its surface, as for instance in Chlorodius niger. Similarly, in Achelous granulatus, the cephalothorax is almost smooth in young specimens while in the adult stage, broad and granulate tubercles are found on its surface. It is also known that species pass from time to time through periods of variability, during which every new character, as, for instance,

the areas developed on the cephalothorax in the present case, may become more or less evident in different species, and therefore the splitting of genera, based only upon such areas which are more or less evident on the cephalothorax, must be rejected. By comparing Chlorodius, Phymodius, and Leptodius, we find that in all known specimens of these genera, the features which characterize them are identical and constant, with the exception only of the surface of the cephalothorax, a character upon which Alph. M. Edwards has, in fact, created the new genera Phymodius and Leptodius. In Chlorodius, the anterior part of the cephalothorax has areas which are not clearly delimited; in Leptodius these areas are often clearly delimited; in Phymodius, finally, the whole surface of the cephalothorax is divided into such areas. A similar relationship also exists between the genera Atergatis, Lophactaea, and Zozymus, in which the generic characters are similarly identical and constant (see p 18) with the only exception being the surface of the cephalothorax and the lateroposterior edge, but which present gradual transitions from the simplest form to the most complex. According to Alph. M. Edwards, Atergatis is characterized by the smooth surface of its cephalothorax; in Lophactaea, the anterior part of the cephalothorax is divided into areas by grooves. If we focus our attention upon a number of species of Atergatis, we can find among them species in which the anterior part of the cephalothorax also shows areas delimited by grooves; however these grooves are far less deep than those of Lophactaea; but if some day we find specimens of Atergatis with even deeper grooves, then the determination of the genus will be based only upon the subjective opinion of the scientist. The areas reach their maximum development in Aterg. (Zozymus) aeneus which until now was included in the family Xanthidae. The shape of the lateroposterior edge of the cephalothorax also shows such transitions, ranging from a normal outline to a lobate one. I propose that if in a number of genera the typical characters which determine them are identical and constant, and only other characters vary, but in such way that gradual transitions exist from the simplest to the most complex form such genera should be unified in one single genus, so proving their unity. On this basis I have unified the genera Atergatis, Lophactaea, and Zozymus in one single genus, Atergatis, joining to it the new genus Zozymodes, created by Heller on the basis of a single young specimen, which differs from Zozymus only by a cavity on the anterior edge of the third joint of the hectognath. In studying other genera, I became convinced that this character changes not only in individuals of one species of different ages (Etisus sculptilis) but also in species of the same genus, as for instance in Actaeodes (Table V, 2b and 3b) and that this character must, therefore, not have a generic importance, especially in the present case, when only a single and young specimen was studied.

In his determinations, Alph. M. Edwards attaches great importance to the relative width of the cephalothorax, but pays no attention to age, although in our research, the cephalothorax becomes wider with increasing age and even changes its form. The ignoring of these modifications also supplied a motive for creating new species. Chlorodius niger for instance shows considerable variation of the cephalothorax: in young specimens the ratio of the width to the length is 1.25:1; in adult specimens, it is 1.5:1; in young Chlorodius ungulatus it is 1.43:1; in adults 1.47:1. In young specimens of Thalamita admete, it is 1.3:1; in adult specimens it is 1.5:1. In

young Macrophtalmus depressus it is 1.33:1, in adults 1.75:1. In three specimens of Atergatis roseus, these ratios appear as follows: 1.47:1; 1.62:1; and 1.8:1. In Cymo Andreossi the cephalothorax in young individuals is equal in width, in both the anterior and posterior parts; in adult specimens the anterior is wider than the posterior part. The genus Chlorodopsis, created by Alph. M. Edwards, differs, according to his indications, from Etisus, in two characters: a narrower cephalothorax and the presence of a hollow on the anterior edge of the third joint of the hectognath. If we refer to the facts indicated by Alph. M. Edwards himself, we shall find that the ratio between the width and the length of the cephalothorax is 1.57:1 in Etisus levimanus; in Chlorodopsis spinipes it is 1.51:1. This difference is too insignificant, all the more so since this ratio varies within much broader limits in a single species. So in Etisus sculptilis for instance (a species not included by Alph. M. Edwards in the genus Chlorodopsis), this ratio in young specimens is 1.31:1 and in adults 1.45:1. With regard to the second distinctive character, the hollow on the anterior edge of the third joint of the hectognath, we should emphasize that an identical hollow is also found in young specimens of Etisus sculptilis but this disappears almost completely with increasing age. Consequently, both characters by which the genus Chlorodopsis should differ from the genus Etisus are not resistant to criticism, and therefore the genus Chlorodopsis must be abolished.

In exactly the same way, the contour and dimensions of the frontal edge, which often serve as specific criteria, are subject to variations with increasing age. The frontal edge becomes narrower, more prominent, especially its median segment, and its bilobate form becomes tetralobate, e. g., in Etisus sculptilis and Thalamita admete. In this last species, the variations are outstandingly clear. In the juvenile stage, the frontal edge is rounded, being divided into two lobes by means of an incision, and the ratio between its width and the width of the superciliar edge is 1.4:1; in adult specimens this ratio is 2.89:1 and the contour of the frontal edge is considerably different, four lobes being formed. We may conclude from these facts that Thalamita Poissonii and Th. integra are in fact nothing but young specimens of Th. admete. In the same way, Euplax Boscii is probably a young specimen of a Thalamita and Xantho minor a young specimen of Xantho distinguendus. In Cymo Andreossi the frontal edge is arcuate in young individuals, and provided with sharp denticles, and the frontal area is smooth. In adult specimens of this species, the frontal edge is almost rectilinear, provided with blunt denticles, and the frontal area is covered with tubercles (Table VI, Figures 5 and 5a).

With regard to coloration, taxonomists proceed in a nonconsequent manner: in some cases they consider it a specific criterion, and in other cases they disregard it, as for example in specimens of Atergatis aeneus. On the contrary, in the genus Carpilius a vast number of species was created on the basis of the coloration only, but it is not difficult to follow the gradual changes of coloration of the cephalothorax. Considering that it has been proved that by the modification of food, changes in coloration may be obtained in some species, e. g., in the caterpillar Bombyx caja, or in Fringilla carduelis, we note that coloration must never be considered of specific importance. However, Herbst reports that he dealt with a great number of Carpilius and found that coloration is constant in most of the

specimens. Consequently, specimens greatly resembling C. maculatus and differing from it only by coloration, must be considered as varieties. In the same way, the coloration of the different forms of Trapezia from the Red Sea cannot have a specific significance. In Trapezia ferruginea the dominant coloration is reddish-yellow; but two out of the thirty-four specimens that we studied were colored like Trap. coerulea; the specimen described by Latreille was pale-yellow, sprinkled with black. This black color indicates a transition to Trap. digitalis. In all specimens of Trap. ferruginea a red spot is found on the distal end of the propodite of the walking legs. In Trap. guttata, the walking legs have a great number of such spots; in one of the specimens, the last foot-jaw (maxilliped) is also spotted. In Trap. rufopunctata, not only the legs but the whole surface of the body is covered with red spots, the number and form of these varying in different specimens. Consequently, the number of spots gradually increases. At the same time, however, I must remark that the pigment does not have the same properties in all specimens: in one specimen of T. guttata the spots disappeared following preservation in alcohol, so that it could not be distinguished from Trap. ferruginea.

The abdomen of the female also varies according to age. In young specimens of certain species, the abdomen is flat, narrow, and its edges are unarmed. In adult specimens, the abdomen becomes broad and protuberant, and the edges are provided with setae (Table I; Figures 2e and 2f). In some Leucosiadae the abdomen of the young female is very similar to that of the male.

We shall now discuss the appendages. Among the other characters which Dana used for dividing the family Cancridae into subfamilies, he considered the form of the dactyli of the anterior legs. He distinguished pointed and spoonlike dactyli ("digiti instar cochlearis excavati"). But since Dana has not precisely stated the notion of a spoonlike dactylus and used this character in a sufficiently arbitrary manner, complications appeared in connection with certain genera, as to whether they do or do not belong to the subfamily Chlorodinae, e. g., in the case of Pilodius. In Atergatis (Zozymus) aeneus, at least in the case of the Red Sea specimen and in the one described by Quoy and Gaimard, the dactylus is definitely pointed; nevertheless the genus Zozymus is included in the subfamily Chlorodinae.

Alph. M. Edwards very correctly states that all possible transitional forms from the pointed dactylus to the spoonlike one can be found, and consequently he unifies the genera Actaea and Actaeodes in one single genus Actaea. Although the opinion formulated by Alph. M. Edwards is correct, it cannot be applied to the same extent to which he applies it with regard to the genera Actaea and Actaeodes. Alph. M. Edwards also (1) did not clarify what he meant by a spoonlike dactylus, and (2) did not present proofs in support of the transition from the pointed tarsal joints of Actaea to those characterizing the genus Actaeodes.

This statement by Alph. M. Edwards induced me to study the structure of the dactylus in the Crustacea. I found that in some of these, the dactyli are pointed; in others they are spoonlike, i. e., the hollow on the distal end of the joint is bordered only on its anterior and outer edge. Between these forms of the dactyli, transitions may, in fact, be found. In a third group however, this hollow on the distal end of the dactyli is bordered

on its anterior and both lateral sides, and the edges are abrupt, so that they assume a clear horseshoelike form. I therefore suggest calling them horseshoelike. I found no transitions from the pointed dactyli to the horseshoelike ones, and since the latter form is not only very characteristic, but undoubtedly also has a certain relationship to the behavior of the animals, I retain the genus Actaeodes for those specimens included by Alph. M. Edwards in the genus Actaea, in which horseshoelike dactyli are found.

The anterior legs also give me the opportunity of making another remark. F. Mueller has, for the first time, shown the existence of dimorphous males in the same species in Amphipoda. Such males are also found among the crabs, but no one has yet remarked about them. In certain crabs, the anterior legs are more developed than in other males of the same species (e. g. in Menaethius monoceros); in others, even the form of the chela is modified (e. g. in Trapezia digitalis). In a third case (e. g. in Herbstia condyliata and Chlorodius ungulatus) on the contrary, males are found in which the anterior legs have the same pattern as those of the females.

Sexual dimorphism induced the smallest number of mistakes. I can illustrate only one case, namely, in "Voyage of Samarang" where the male of Chlorodius ungulatus was described as an independent species: Chlor. areolatus. Sometimes, notwithstanding the normal structure, females have certain specific male characters. Thus in all the works on Leucifer Reynaudii that I know, it is stated that the female differs from the male also by the lack of the appendages on the sixth abdominal segment and on the telson. In the female which I observed, the sixth segment of the abdomen bore the same lobate pleopods as the male, but differed in that instead of two appendages there existed only one. Similarly on the abdominal surface of the telson there is a rudimentary organ which corresponds to the lobate appendage of the male.

I therefore wish to draw attention to the unusually strange development of the lamina on the fifth and sixth pair of legs in the female of Siriella Edwardsii in comparison with those lamina which form the egg-sac.

The changes undergone by some crabs with increasing age indicate that even after having reached their definite form, they undergo a further metamorphosis through which the temporary existing parts of some organs, probably serving in the juvenile stages for defence, now disappear. But I must bear in mind that in this respect, very closely related species differ from one another. So for instance, Chlorodius ungulatus does not undergo changes with increasing age, while Chlor. niger shows, as we have illustrated, quite considerable modifications.

Unusually invariable characters which do not change, even with increasing age, are shown by the maxillary area. Variations are encountered only in exceptional cases. I found such variations of the maxillulae in Etisus sculptilis. Still, this variation is so unimportant that it has no influence upon the respective character.

Among the Brachyura and Anomura of the Red Sea I did not find species which were just passing through a period of variability. Nevertheless I am familiar with cases of Pilumnus hirtellus from the Mediterranean and Black Seas, and of Porcellana digitalis from the Black Sea, a sufficient number of both species of which were collected, and which are at present in a period of variability. Pilumnus villosus, spinifer and spinulosus must not be considered valid species. Out of 29 specimens, only five individuals correspond to the fairly detailed description of Pilumnus hirtellus



in "Crustaceen des südlichen Europa". The characters of the other 24 specimens show diverse variations and combinations, so there is no possibility of including them in the species described by Heller. The maxillary area, with its highly characteristic postorbital denticle of the inferior orbital edge also is among the characters common to all 29 specimens. Most of the specimens from the Mediterranean bear a very marked resemblance to P. villosus. According to the indications of Pennant and Bell, the specimens collected on the shores of England, as well as those collected by Prof. Kessler in the Black Sea, also bear a very marked resemblance to P. villosus. In fact, P. hirtellus was not even found in these two seas. Although Bell gave the name P. hirtellus to the species which he described, the included illustration as well as the text show that the English specimens belong to the variable Mediterranean form, P. villosus.

Porcellana digitalis, 40 specimens of which were collected in a Sevastopol' Bay station, shows a tendency toward the development of four new characters, each one appearing independently of the others in a series of specimens. In this species also, all the specimens differ to a greater or lesser degree from one another, and in some of them, the combination of two new characters appears in a single individual. One of these new characters is the presence of denticles on the cephalothorax, which lie parallel to the lateral edge. I found one to three such denticles on each side in 18 specimens. In three other specimens the number of denticles on the lateral edge increased from three to five, not taking into account those on the epi-branchial edge. Nevertheless, in four other specimens the dactylus of one of the anterior legs is longer, and equals the length of the propodite. The immovable dactylus is considerably widened, with an oblique cut at its distal end, and, in two specimens is also armed with denticles. In the other five specimens, the dactyli are modified in the same way, but less obviously. The anterior legs also differ from one another in other respects: in most specimens, the external edge of the propodite and of the immovable dactylus is smooth. In others, on the contrary, it bears spines. The internal edge of the carpopodite is either undulated or armed with 2 to 3 spines whereas the external edge is provided with 1 to 4 spines.

The spatulate dactylus found on one of the dactylopodites in some of the specimens of Porcellana digitalis from the Black Sea is also illustrated by Bell in the case of Porc. longicornis. This character, and especially the characteristic basipodite of the outer maxillae, induce us to presume that Porc. digitalis and Porc. longicornis belong to the same group of Porcellana which is undergoing variation at the present time. But in fact I cannot confirm this statement, since in the Museum of Kiev there is only one specimen of Porcellana longicornis from the Adriatic Sea, and even this one is in a poor state of preservation.

Besides the studies having a direct correlation with taxonomic research, I turned my attention to the structure of the cuticle, describing an articulation of a new type, not described by Langer, and verifying, with regard to Sar's work, the structure of the acoustic organ in Siriella.

We must now only refer to some data regarding the geographical distribution of the Podophthalmata of the Red Sea. Most of these, i. e., 55%, are exclusively specific to this sea. Up to 37% are also found in the tropical zones of the Indian and Pacific Oceans; of these 10.3% are common to the Red Sea and the Indian Ocean, 17.7% are common to the Red Sea,

Indian and Pacific Oceans, and finally, 8.7% are common to the Red Sea and the Pacific Ocean only. Almost 3% of these are common to the Red Sea and the Sea of Japan, and 5% are found not only north and south of the tropics, but also between them, namely, five species in the Sea of Japan, and three species south of the Tropic of Capricorn. The presence of these species out of the Tropical Zone, as for instance in the Sea of Japan, may be understood as a consequence of the phoretic action of the warm current, as has been proved for the mollusks of this sea by Academy Member Schrenk. Out of the remaining 6%, six species are found in the Mediterranean Sea and six species in the Atlantic Ocean, but only one in the area of the Canary Islands, one species in the Black Sea, and one on the western shores of America. Most of the species making up these 6% are also found in the Indian and Pacific Oceans. Of all these, the conclusion may be drawn that the Indian Ocean represents the center from which the species spread out in all directions, up to the limits of the tropical seas or further if a warm current made it possible. The species found in the area of the Canary Islands and in the Mediterranean Sea were isolated from the erythrean fauna during the period in which the northern part of Africa emerged. It would therefore be of great interest to find out if these forms are indeed identical with the Red Sea specimens or whether they differ from them to some degree. As to the species found in the Black Sea, it differs somewhat from the Red Sea form.

Cumacea have not yet been found in the tropical seas, and the species which I studied differs from all other species known until now by the existence of two eyes. By this, it resembled the embryonic stage described by Dohrn and therefore--from the phyletic point of view--Diops is older than any of the known species of the order Cumacea from the temperate zone.

Almost no members of the other crustacean orders from the Red Sea are known: their number does not exceed ten, and therefore I am obliged to confine my zoogeographical considerations only to the Podophthalmata. We soon hope to be able to publish the second part of this work which will include Crustaceans belonging to other orders, which were collected by Prof. Kovalevskii at Tor and Ras Muhammad in fairly considerable numbers.

In concluding, I express my profound gratitude to the Council of the University, for the enlightened attention awarded on the occasion of the publication of my research.

30 April 1875

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SUBORDO  
**DECAPODA.**

TRIBUS  
**BRACHYURA.**

SECTIO  
**OXYRHYNCHA.**

GENUS **MICROPHRYS.** M. EDW.

Microphrys. M. Edwards. Observations sur le squelette tégumentaire des Crustacés Décapodes.— An. des Sc. nat. 3-ième Série T. 16. p. 251.

**M. styx** Herbst.

Tab. 1. Fig. 1 a—1 f.

- Cancer Styx. Herbst. Naturgeschichte der Krabben u. Krebse. Bd. III. № 250. Tab. 58. Fig. 6.  
Pisa „ Latr. Encyclopedie méthodique T. X. p 141.  
„ „ M. Edw. Hist. nat. des. Crust. T. 1. p 308.  
Arctopsis „ Adams et White Voyage of Samarang p. 10.  
„ „ Alph. M. Edw. Faune carcinologique de l'île de la Réunion p. 6.  
Milnia „ Stimpson. Notes on North American Crustacea. An. of the Lyceum. New York T. VII.  
Microphrys „ Alph. M. Edw. Crustacés de la nouvelle Calédonie p. 247. Pl. XI Fig. 4.

The genus *Microphrys*, created by M. Edwards in his above-mentioned work, was forgotten or neglected by other scientists. In his research on the Crustacea of New Caledonia, Alph. M. Edwards brought it out of its forgotten state for the first time and drew the male of *M. styx*. We received the eighth volume of the Nouvelle Archive du Muséum containing this work at a time when our illustrations had already been printed, which explains the repetition of the illustration. However we did draw the female, and pointed out the interesting articulation between the last two joints of the pereopods.

In comparing the male and the female, the following differences are found: in the female, the first maxillipeds are open\*, the dactylopodites are shorter; the propodites are twice as long as the dactyli, less open, and lack the great tooth. The spines of the second pair of legs are strong. The abdomen is not composed of seven segments, as stated by Alph. M. Edwards, but of five segments, since segments three, four, and five are fused. One female.

Distribution: Red Sea; Indian Ocean; New Caledonia.

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Langer\*\* presupposes that in the articular movement of the Crustacea, the antagonistic action is carried out either by the contact of the joints or by the extension of the articular membrane. In Microphrys and in some other species, we found an articulation with a peculiar brake, owing to which the normal position of the dactylopodite toward the propodite can be modified only by an effort on the part of the animal.

The end of the propodite of each pereopod is greatly extended on its external surface, the arcuate edge of the prominence corresponding to the concavity; in the same way, the end of the internal surface is also extended, but to a lesser extent, and has a triangular incision on its superior edge. The edges of the extended ends are fairly close to one another, so that they press on the broad proximal end of the dactylopodite. Consequently, there is some connection between the two joints which is also strengthened by an articular membrane. At some distance from the proximal end of the dactylopodite there is a fold that gives rise to a groove which moves along the external outgrowth of the propodite when it contracts. On its internal surface, closer to the proximal end, there is another outgrowth which resembles a cone. In the position shown in Figure 1c, the pyramidal inferior part of this cone lies in a corresponding cavity of the propodite, so that this position is an immovable one. During articulation, two muscles usually act: a pronator muscle and a supinator muscle; during supination, a third muscle acts, which first moves the distal pointed end of the outgrowth toward the posterior end of the cavity, i. e., toward its depth, only after which can the dactylopodite be moved from its position by the contraction of the supinator muscle. In this case, the elasticity of the proximal end of the dactylopodite serves as an antagonist.

## GENUS PSEUDOMICIPPE HELLER.

*P. nodosa* Hell.

Heller. Beiträge zur Crustaceen Fauna des rothen Meeres. Sitzungsber. der Academie zu Wien. Bd. XLIII. p. 303. Tab. 1. Fig. 3-6.

Heller described only the female. The dactylopodite of the male is the same length as that of the female. The abdomen is composed of seven segments, all of which have a median carina; the last segment is somewhat longer than the preceding one, and has a hollow on its surface. One

\* [Open signifies imperfect closure, closed - perfect or complete closure.

\*\* Ueber den Gelenkbau bei den Arthrozoen. Denkschrif. der Academie zu Wien. Bd. XVIII. p 106.

male; the length of its cephalothorax, excluding the rostrum, was 13 mm and its width 9 mm.

Distribution: Red Sea.

## GENUS IXION n. g.

The cephalothorax is protuberant and narrow, and its length is twice its width. The rostrum is bifid. The orbit is large and tubulate, and has a narrow furrow on its superior and inferior edges. The basal joint of the antenna has a quadrangular shape; its anterior part, bearing the second joint, is considerably narrower; the outer and inner corners are abrupt. There is a slit between the basal joint and the superior orbital edge; the other joints are hidden below the rostrum. The width of the epistome slightly exceeds its length. The second and third joints of the first maxilliped are of equal length. The abdomen is made up of seven segments.

### *I. capreolus.*

Tab. II. Fig. 1 a--1 f.

The cephalothorax rises behind the frontal edge and reaches its maximum height in the gastric area, after which it decreases in both the lateral and posterior directions. The posterior gastric area also has a prominence which is delimited by a groove. The areas of the cephalothorax are very poorly delimited and the whole surface is covered by small depressions in which short, rigid setae are found. The rostrum is bifid. Near the tips of the somewhat contorted horns, there is a process which extends slightly in a dorsal direction. The horns are covered with setae, the inner surfaces of the processes are armed with a row of short spines. The second and third joints of the first maxilliped are of equal length and have a serrated inner edge. The basal joint of the second maxilliped is also serrated on its inner edge. The meropodite of the cheliped is protuberant on its outer, and flat on its inner side; the carpopodite is rounded; the propodite is longer than the dactylus, which has little denticles on the distal half. The second legs are the longest. The dactylopodite of the pereopod is the same length as the propodite and has a serrated inferior edge. The male abdomen is made up of seven segments. Female not identified. Two males.

Distribution: Red Sea.

## GENUS MITRAX. LEACH.

### *M. asper.* M. Edw.

*Mithrax asper* M. Edwards Hist. nat. des Crust. T. 1 p 320.

" " Dana Exp. Exp. p. 97 Pl. 2. Fig. 4.

*Dione affinis* De Haan. Fauna japonica p. 93. Tab. XXII. Fig. 4.

*Schizophrys*. White. An. und mag. of. natural history 2. Ser. T II. p. 262.

*Schizophrys seratus* Adams et White Voyage of Sam. p. 16.

" *aspera* Stimpson. American Journal of Sc. und. arts. 1860.

*Mithrax spinifrons* Alph. M. Edw. An. de la Societé entomologique de France 1867. p. 263.

*Schizophrys aspera* Alph. M. Edw. Nouvelle Archive du Muséum T. VIII. p 231. Pl. X. Fig. 1.

The only male from the Red Sea appears to be identical with the detailed illustration by Dehaan [de Haan]. The existing differences are only individual ones; so for instance, the outer edge of the propodite of the cheliped bears two tubercles instead of one near its base; the spine on the end of the meropodite of the pereopod is missing, and the flagellum of the antenna is much longer than that of the rostrum.

White did not indicate any differential character for the genus Schizophrys which he created, and the genus Dione, created for the same species by Dehaan, is defined by such an unessential and - it may be said - insignificant character, that one must agree with Dana who abolished these two genera and retained the old name Mithrax. It is strange that Alph. M. Edwards, who studied a great number of specimens, indicated and illustrated the modifications undergone by this species, but paid no attention to Dana's views although they prevent misunderstanding. We had no other species of Mithrax available for comparison.

Distribution: Red Sea; Strait of Balabac; Japan; Mauritius; Navigators Islands\*; New Caledonia.

## GENUS STILBOGNATHUS MARTENS.

The cephalothorax is more or less pyriform. The rostrum forms two long horns. The superior orbital edge also bears a horn which is directed obliquely outward. Before the outer margin of the cephalothorax there is a turned up process. The eyestalk is almost immovable and is equal in length to the orbital horn. The basal joint of the antenna is broad although longer than wide, and the anteroexternal corner forms a toothlike outgrowth. The epistome is well developed. The oral frame is constricted in its posterior portion. The second joint of the first maxilliped has an oblong hollow in its posterior part, and forms, on its anterior edge, a semi-circular outgrowth which corresponds to a hollow on the subsequent joint. Moreover, the distal part of the second joint forms, together with the subsequent joint, a prominence which is covered with chitin. The last joint has an outer carinate outgrowth. The abdomen is made up of five segments in both the female and the male.

### St. erytraeus. Mart.

Tab. 1. Fig. 2 a-2 f.

Martens. Verzeichniss der von Dr. Schweinfurth am rothen Meere gesammelten Gegenstände. Mit Holzschnitt  
Verhandl. der zool. bot. Gesellschaft in Wien Bd. XVI. p. 379.

The posterior part of the cephalothorax is broader in the male than in the female. The horns of its rostrum are parallel, while in the female they have narrowed tips. There is a hollow behind the frontal edge. The areas of the cephalothorax are not clearly delimited and are covered with tubercles of different sizes, which bear tufts of rigid setae. The basal joint of the antenna has a longitudinal groove and forms a kind of node before the articulation of the subsequent joint. The second joint is twice as long as the third joint. The first maxillipeds are open in their anterior half. The chelipeds are somewhat longer than the rostrum in both sexes, and are slightly stronger in the male. In the male the propodite is shorter than the dactylus,

\* [Samoa Islands]

and bears three tubercles on its outer surface. The dactyli are slightly open and serrated along the edges. The dactylopodites of the pereopods are smooth and have no denticles. The abdomen has a median, tuberculate carina. In the young female (Figure 2b) it is flattened and oval, with smooth margins and it only partly covers the plastron.\* In the adult female, the abdomen is considerably broader and covers the whole plastron. The fused segments form a considerable convexity and their edges bear setae. Two males and two females.

Distribution: Red Sea.

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## GENUS **MENAETHIUS** M. EDWARDS.

### **M. monoceros** Latr.

Tab. II. Fig. 2, 3a & 3b.

*Pisa monoceros* Latr. Encyc. meth. T. X. p. 139.

*Inachus arabicus* Ruppel Beschreibung von 24 Arten kürzschwänziger Krebse p. 24. Tab. V. Fig. 4.

*Menaethius monoceros* M. Edw. Hist. nat. der. Crust. T. 1. p. 339,

" " Heller. Beit. zur Crus. Fauna d. r. M. p. 306.

" " Alph. M. Edw. F. carc. de l'île de la R. p. 6.

" " Alph. M. Edw. Crust. de la nouvelle Calédonie p 252.

Alph. M. Edwards reached almost the same conclusion as we did, that is, that all the species described hitherto are identical with M. monoceros.

Although no illustration of M. monoceros existed until now, we drew a male and a female of the same age for comparison with others. The male differs from the female in that its chelipeds are the same length as the second pair of legs. In the female the chelipeds are somewhat shorter.

Inachus arabicus (Table II Figure 2) of which we had two specimens, must be considered a dimorphous male of M. monoceros in which the chelipeds are considerably longer than the second pair of legs. Such dimorphous males are also found in other species, but no one paid attention to them except F. Mueller. Thus, for instance, we studied five males of Herbstia condyliata in which the opposite occurs: the chelipeds have female characters. They are shorter than the second pair of legs and are only slightly stronger than those of the female. We also observed the same phenomenon in the males of Chlorodius ungulatus.

### Var. **M. subserratus** Adams et White.

Tab. II Fig. 4.

*Menaethius subserratus* Adams et White op cit. p. 18, Tab. IV. Fig. 1. 2.

" " Dana Exp. Exped. p. 122. Pl. IV. Fig. 7.

\* [This is no longer called the plastron: sternum is now used.]

In this variety, the body is more slender; the areas of the cephalothorax are flatter and some of the tubercles have been replaced by clearly delimited nodes. The gastric areas of the cephalothorax are fused.

Distribution: Red Sea; Philippines; Fiji and Samoa.

To the same variety also belong:

M. areolatus Dana op. cit. p 124. Pl. V. Figure 2. Red Sea; Sulu Sea.

M. angustatus " " " p 120. Pl. IV. Figure 5.

M. depressus " " " p 121. Pl. IV. Figure 6. Samoa Islands. Sulu Sea, Opolu.

M. tuberculatus Adams and White op. cit. p 19. Mauritius.

" " " Dana op. cit. p 123. Pl. V. Figure 1, Paumotu, Archipelago, Pacific Ocean.

We should mention that the character which Dana considered specific to M. areolatus, and which he drew for greater clarity, is found in all the forms of Menaethius. The facets of the chela are formed by little foliaceous hairs which are also found on the whole surface of the body. In the same way, all the forms of Menaethius have ocular tubercles which are found not only in front of the cornea but also on the eyestalks and on other parts of the body. These tubercles are, in fact, modified foliaceous hairs.

Var. M. innornatus Dana op. cit. p. 125 Pl. V. Fig. 3.

The frons is very wide; its width is twice the length of the rostrum. Consequently, the cephalothorax, instead of being triangular, becomes rectangular. The lateral edge bears only three simple pointed spines

Distribution: Hawaii.

Var. M. rugosus Alph. M. Edw. F. carinol. de l'île de la Reunion p. 7 Pl. XVII. Fig. 2a,

The cephalothorax is triangular; the areas are not clearly delimited; the spines of the lateral edge are simple and very rounded; the surface of the cephalothorax is covered with granulations not found in other forms.



**Var. *M. xyphia*.**

*Pisa xyphias* Latr. Encyc. meth. T. X. p. 140.

This variety is characterized by the lack of spines on the lateral edge.

Distribution: Australia (New Holland).

**GENUS ACANTHONYX LATR.**

***A. consobrinus* (Krauss) Alph. M. Edw.**

Tab. III. Fig. 1.

*Acanthonyx 4-dentatus* Krauss Sudafricanische Crustaceen. p. 48. Tab. III. Fig. 7.

„ *consobrinus* Alph. M. Edw. F. carcin. de l'île de la Réunion p. 7. Pl. XVII. Fig. 8.

Since in the *Brachyura* the number of spines on the lateral edge of the cephalothorax is variable and does not belong to the specific characters, and since one specimen had only three spines, we consider it more justified to retain the name given by Alph. M. Edwards.

The frons is sheer. The cephalothorax is protuberant and bears three tubercles covered by very short setae; one of these tubercles is on the rostrum in front of the horns; the other two are on the same level as the first spine of the anterolateral edge, and in front of them there are bent hairs which were also drawn by Alph. M. Edwards. Of the other four tubercles described by Krauss, three may be detected through a magnifying glass. A rudiment of a spine is also found in front of the first spine of the anterolateral edge. The cardiac and branchial tubercles of Alph. M. Edwards are identical with the tubercles of Krauss. The tufts of hairs on the propodite of the pereopods are more similar to the carpopodite than to the denticulated dactylopodite. One female.

Distribution: Red Sea; Reunion Island; Natal.

**GENUS HUENIA DEHAAN.**

***H. Hellerii*.**

Tab. III. Fig. 2a-2c.

This species bears a marked resemblance to *H. pyramidata*, but differs from it by its rostrum, the superior surface of which becomes narrower toward its distal end. Its somewhat concave inferior surface, however, becomes wider toward its distal end. The lateral surfaces are also somewhat concave and pubescent, and have a large incision at the ends. The gastric and cardiac areas form a broad tubercle. The dactyli of the chelipeds have small denticles, and are closed and adorned with an orange-colored stripe which disappears following prolonged preservation in alcohol.

The carpopodite of the second pair of legs has neither tubercles nor hollows. The propodite has no denticles. The dactylopodite is denticulated. The abdomen of the female is made up of five segments. The first two segments have a carina. The fused segments have very protuberant lateral sides and form a median groove. One female.

Distribution: Red Sea.

### GENUS LAMBRUS LEACH.

*L. affinis* Alph. M. Edw.

Var. *L. heraldicus*.

Tab. III. Fig. 4a-4c.

The Red Sea variety of the New Caledonian form is characterized by its denticulated rostrum. The tubercles on the cephalothorax are arranged differently. The superior surface of the propodite of the chelipeds is smooth. The carpopodite, however, is covered with small tubercles, but the artist neglected to show them. The meropodites of the pereopods are also covered by tubercles, but these are very flat and shiny. Finally the edges of the anterior part of the cephalothorax are covered with hairs which become considerably longer toward the end of the rostrum, forming a kind of brush. The penultimate segment of the abdomen bears a spine. One male.

Distribution: Red Sea.

### GENUS AULACOLAMBRUS n. g.

This genus differs from Lambrus by the broad and deep groove on the sides of its oral frame; this groove extends between the anteroexternal corner and the branchial slit. On its superior part, the groove is covered with hairs. The antennules have a longitudinal position. The epistome is rudimentary. The other characters are as in Lambrus.

*A. pisoides*. Adams et White.

The single male found in the museum greatly resembles Lambrus pisoides drawn in "Voyage of Samarang" (Table V Figure 4).

The width of the rostrum is equal to its length; in its anterior part it is abrupt, and it is denticulated in the middle of its anterior margin.

The distance between the two extraorbital spines is greater than half the width of the cephalothorax. The gastric area is formed by three large tubercles, the cardiac area by a single one. The hepatic area is very small and has a serrated edge. The branchial area bears three prominences which are parallel to the lateral edge and bear nine rounded denticles, followed by a long and a short spine. The whole surface of the cephalothorax is covered with granulations of various sizes. The superior orbital edge has a deep slit and the superciliar area is denticulated. The extra-orbital spine is developed and is followed by an infraorbital one, which differs from the postorbital spine by its deep incision. The anterior edge of the oral frame is strongly folded backward in its median part, and, as a result, a hollow is formed; all the lateral parts of the oral edge are slit. The first maxillipeds are not identical: the left one is normal in structure, but the right one has a slit corresponding to the fourth joint on the anterior edge, and not in the anterointernal corner.

The meropodite of the cheliped is shorter than the propodite. The mero-carpo, and the propodites bear pointed spines on their external and internal edges, and are covered with hairs. The spines on the external edge are stronger, and a small spine is always found between two large spines on the propodite. The dactylopodite is also armed with two to three spines. The pereopods are unarmed and covered with fairly thick hair. The abdomen of the female is made up of five segments.

Distribution: Red Sea; Philippines.

## GENUS PSEUDOLAMBRUS n. g.

The cephalothorax resembles that of Eurinolambrus, i. e., the edges have flattened, leaflike outgrowths which cover the meropodites of the second and third pair of legs. The orbital edge has no slits. The chelipeds are considerably shorter than in Lambrus. The pereopods are strongly compressed. The antennules have an oblique position and the outer antennules are as in Lambrus.

### *P. calappoides*. Adams et White.

Tab. III. Fig. 3a - 3b.

Parthenope callappoides. Adams. et White. Voyage of Samarang p. 34 Tab. V. Fig. 5.

The cephalothorax has a triangular shape. The frons has an anterior prominence; it is abrupt, has longitudinal furrows, and bears two anterior denticles, one on each side. The anterior gastric and cardiac areas are protuberant; the posterior branchial area is also prominent; however it becomes abrupt on the borders of the cephalothorax. The whole surface of

the cephalothorax appears to be carved. The anterolateral edge is slightly denticulated and is separated from the posterolateral edge by a deep incision formed by seven denticulated lobes whose borders almost touch each other. The last one is largest and is bilobate. The median part of the posterior edge has a strong backward prominence; between it and the last lateral lobe, three denticulated lobes are also found on both sides. The surface of the basal joint of the antennule shows an irregular concavity. The first two joints of the antennae are almost identical in length and are covered with blunt spines; the surface of the basal joint has a hollow. The epistome is well developed. The outer maxillipeds, the abdomen, and the ventral part of the cephalothorax - with the exception of the part lying immediately behind the inferior orbital edge - are granulated. The meropodite of the cheliped is triangular in section, and is half covered by the cephalothorax; its inner margin has three to four denticulated lobes, and its surface, like the surfaces of the subsequent joints, has fairly dense granulation. The carpopodite is rounded. The propodite is the same length as the meropodite, and in section shows an irregular quadrangular shape; at the base of the propodite there is a deep concavity; the left propodite looks as if it were fractured. The strongly compressed pereopods bear spines of various sizes along their upper and lower edges. The abdomen of the male is made up of five segments.

This species shows a great resemblance to Cancer saxatilis Seba (Table XIX, No 16 and 17) and to Parthenope callapoides; it cannot, however, be included in the genus Parthenope because of the structure of its outer antennule.

Distribution: Red Sea; Indian Ocean.

S E C T I O  
C Y C L O M E T O P A .

FAMILIA  
C A N C R I D A E .

GENUS ATERGATIS DEHAAN.

At. roseus Ruppel.

Tab. IV. Fig. 1. la.

- |                  |   |
|------------------|---|
| Carpilius roseus | Ruppel. loc. cit. p. 13. Tab. III. Fig. 3.                  |
| Cancer           | " M. Edwards Hist. nat. des Crust. T. 1. p. 374.            |
| Atergatis        | " Dehaan Fauna japonica pag. 17.                            |
| "                | " HellerBeit. zur. Crust. F. des. r. M. p. 309.             |
| "                | " Alph. M. Edwards. Etudes zool. sur les Cancériens p. 239. |

The unique male found in the collection of the museum is - except for a number of characters - identical with its description by Heller; but since we had in mind a purpose other than the determination of the species we are only obliged to indicate some omissions as well as the distinctive characters of our specimen.

The cephalothorax is very wide and protuberant. The rounded anterolateral edge forms a border which can hardly be observed in dorsal view; on the ventral side, however, the border is as clearly visible as that in A. dilatatus and nitidus. This edge also has rudimentary lobes. Its anterior half has a continuous contour, but at the edge of the other half, a small incision may already be observed, while the part corresponding to the fourth lobe differs from the first by a small prominence. We draw attention to this rather insignificant fact, in order to be able to prove later that the shape of the edge is not one of the essential characters. Of the areas of the cephalothorax, only the mesogastric and the anterior cardiac areas are delimited by slight furrows. With the exception of the mesogastric area and its posterior part, the surface of the cephalothorax is covered with small deep depressions, with punctiform hollows between them. The anterior edge of the third joint of the outer maxilliped bears setae. In A. integerrimus and other forms, three hair tufts are found on the internal edge of the meropodite of the chelipeds; the superior edge of the dactylopedite bears a sharp tooth with a large base. All pereopods bear hair tufts on the inferior edge of the second, third, and fifth joints. The width of the

cephalothorax is 40 mm; the length is 22.5 mm; the ratio between width and length, in our specimen, is 1.8:1, in the Vienna specimen it is 1.62:1, and in the Paris specimen 1.47:1. The specimen preserved in alcohol is a red color.

Distribution: Red Sea; Persian Gulf.

**Var. *A. marginatus* Ruppel.**

<i>Carpilius marginatus</i>	Ruppel. op. cit. p. 15. Tab. III. Fig. 4.
Cancer.	" M. Edwards H. n. des Cr. T. I. p. 375.
<i>Atergatis</i>	" Dekaan op. cit. p. 17.
"	" Krauss Sudafricanische Crustaceen. p. 28.
"	" Dana Exp. Exp. p. 158.

The coloration and the lack of punctiform hollows on the cephalothorax are actually characters which are too unimportant for the creation of a new species. The other characters correspond completely to those of *A. roseus*. The coloration can vary greatly in the same species, e. g., in *Atergatis floridus*, *Zozymus aeneus* (Aut), *Carpilius convexus*, etc. Width:length = 1.6:1.

Distribution: Red Sea, Natal; Sulu Sea.

**Var. *A. laevigatus* Alph. M. Edw. Etudes. zool. sur les Canc. p. 241. Tab. XV. Fig. 4.**

This variety differs from *A. roseus* by the very small punctiform hollows on the surface of its cephalothorax, which, as in *A. subdentatus*, can be observed only through a magnifying glass. The superior edge of the propodite of the cheliped bears a rudimentary carina. This is an intermediate feature between the rounded edge of *A. obtusus* and the sharp edge of *A. roseus*. In his description, Alph. M. Edwards states: main tres peu carénée en dessus - and in his analytical table: main arrondie en dessus. Width:length = 1.65:1.

Distribution: Malabar.

**Var. *A. obtusus* Alp. M. Edw. op. cit. p. 241. Tab. XV. Fig. 3**  
 " " " " " Nouvelle Archive du Muséum T. IX. p. 185.

It differs from *A. roseus* by its smooth cephalothorax. Alph. M. Edwards also draws attention to the setae found on the anterior edge of the third joint of the first maxilliped, but we observed them in *A. roseus* as

well. The relationship between the width and the length of the cephalothorax is also of no importance, the best proof for this being this relationship in various specimens of A. roseus. Width:length = 1.55:1.

Distribution: Cochín-China; New Caledonia.

Var. A. nitidus Alph. M. Edw. Etudes, sur les Canc. p. 243.

It differs from A. roseus by its wide cephalothorax, which is smooth and covered with short hairs. The width cannot serve as a differential character. Our specimen of A. roseus is also very wide; width:length = 1.8:1; we have shown repeatedly that these ratios vary greatly in the same species. This variety, like A. marginatus and A. scrobiculatus has a white border. Width:length = 2.1:1.

Distribution: Fiji ("Viti Archipelago").

Var. A. scrobiculatus Heller. Beit. zur Crust. Fauna des r. M. p. 310.

" " Alph. M. Edw. Etudes sur les Canc. p. 242.

It differs from A. roseus by the slightly lobated anterolateral edge, by the marked punctiform hollows on the cephalothorax and legs, and by the colored border. As to the anterolateral edge, we have observed that our specimen of A. roseus also shows a rudimentary lobation. In the same way the cephalothorax is covered with punctiform hollows, and depressions which represent a further development of the punctiform hollows. The cephalothorax is relatively narrow; width:length = 1.34:1. We have seen, however, that in A. roseus this ratio varies between 1.8 and 1.47:1.

Distribution: Red Sea.

Var. A. Montrouzieri Alph. M. Edw. Nouv. Arch. du Muséum T. IX p. 186. Pl. V. Fig. 5.

It differs from A. roseus by the rugosity along the anterolateral margin of the cephalothorax and by the granulated surface of the chelipeds. Judging by specimens belonging to other genera, we were convinced that the structure of the body surface is variable. Even if this structure were constant, the above-mentioned characters are too insignificant for the creation of a new species. Width:length = 1.64:1.

Distribution: Art Island.

Var. *A. reticulatus*. Dehaan, Fauna japonica p. 47. Tab. III. Fig. 4.

The rugosity of the cephalothorax noted in the previous variety is more marked and forms a reticular pattern on the cephalothorax and on the propodite of the chelipeds. The anterolateral edge has a continuous contour. The propodite of the cheliped in *A. roseus* is also rugose, but to a much lesser extent. In his analytical table, Alph. M. Edwards shows that in *A. reticulatus*, at the level of the contact between the anterolateral and the posterolateral edges, a fold is formed on the cephalothorax; Dehaan, however, does not mention anything about this, and the fold does not appear in his illustrations. Width:length = 1.41:1.

Distribution: Sea of Japan.

In all the above-mentioned varieties, the contour of the cephalothorax is identical. The surface of the cephalothorax, although different, shows gradual transitions; in some varieties it is smooth, in others small punctiform hollows are found which are visible only through a magnifying glass. In a third case, these hollows become deeper and finally they acquire the form of depressions. The walls of these depressions are irregular in height, forming at first a slight rugosity, which, however, subsequently forms a reticular rugosity. As we have seen the relationship between the width of the cephalothorax and its length cannot form a distinctive character, the coloration even less so. In some varieties, the upper edge of the propodite of the chelipeds is sharp; in others it is rounded; in *A. laevigatus* however, as we have seen, this character is not clearly expressed any more, and represents a transition from one case to the other.

This survey convinced us that the species of *Atergatis* discussed are actually nothing but varieties of *A. roseus*. It is, of course, very difficult to establish which of the species was the variety from which the others originated; it is definitely not *A. roseus*, since this has a very limited geographical distribution; it was probably a variety living in the Red Sea. If we consider *A. roseus* as the typical species and consider it as being a real species, we do so only because it was described before the others.

Let us now turn to the other species. Alph. M. Edwards correctly considers *A. subdentatus* (Dehaan) and *A. frontalis* (Dehaan) to be varieties of *A. integerrimus*; however, *A. subdentatus* bears a closer resemblance to *A. dilatatus* than to *A. integerrimus*. It is strange that Alph. M. Edwards considers *A. latissimus* (Etudes Zool. sur les Canc. p. 237, Table XIV Figure 1) as being an independent species, since actually it is absolutely identical with *A. frontalis*. In the illustrations of *A. frontalis* (Fauna japonica, Table XIV, Figure 3) which is absolutely identical to *A. latissimus* is found that the unique difference consists in the fact that in *latissimus* the punctiform hollows are smaller. Alph. M. Edwards stresses the considerable width of *A. latissimus*, but this character, although unimportant, is erroneous, since according to his own data, width:length = 1.6:1; consequently, the width is smaller than in *S. integerrimus* in which the ratio is 1.66:1. In *A. frontalis* the ratio is 1.59:1.

The result is that the thirteen species described by Alph. M. Edwards are reduced to four which differ from each other by the following characters:



Anterolateral edge of cephalothorax rounded at contact with posterolateral edge	-----	<u>roseus</u>	
	only a fold	<u>integerrimus</u>	
Anterolateral edge of cephalothorax forms, at contact with posterolateral edge	a toothlike fold projecting outward	Cephalothorax smooth; anterolateral edge has a continuous contour; inferior edge of propodite of pereopods sharp	<u>dilatatus</u>
		Cephalothorax bears very small prominences. Anterolateral edge has incisions; inferior edge of propodite of pereopods rounded	<u>floridus</u>

Varieties of A. roseus

Cephalothorax has homogenous coloration; surface	}	smooth	<u>obtusus</u>	
		has very small punctiform hollows	<u>laevigatus</u>	
		has evident, deep punctiform hollows	<u>roseus</u>	
		has rough anterolateral edge; chelipeds granulated	<u>Montrouzieri</u>	
Lateral edge of cephalothorax has different coloration, surface	}	has reticulate pattern, like propodite of chelipeds	<u>reticulatus</u>	
		smooth; anterolateral edge has no incisions	width of cephalothorax twice length	<u>nitidus</u>
			width of cephalothorax 1 1/2 times length	<u>marginatus</u>
			has evident punctiform hollows; anterolateral edge has slight incisions	<u>scrobiculatus</u>

Varieties of A. integerrimus

Surface of cephalothorax smooth; frons not very prominent; anterolateral edge without incisions	-----	<u>integerrimus</u>
Surface of cephalothorax has some depressions; frons slightly prominent; with straight edge; anterolateral edge has slightly visible incisions	-----	<u>subdivisus</u>
Surface of cephalothorax has many visible punctiform hollows; frons much more prominent, with bent anterior edge; anterolateral edge divided into four lobes by slight incisions	-----	<u>frontalis</u>

Varieties of A. dilatatus

Lateral spine very poorly developed; surface of cephalothorax without furrows	-----	<u>subdentatus</u>
Lateral spine well developed; areas of cephalothorax delimited by small furrows	-----	<u>dilatatus</u>

**At. anaglyptus Hell.**

Tab. IV. Fig. 2-2a,

*Atergatis anaglyptus* Heller. Beiträge z. C. F. des roth. M. p. 312.

*Lophactaea* " Alph. M. Edw. Etudes zool. sur les Cancériens p. 251.

We wish to make the following additions to the fairly exact existing data: the basal joint of the antennae is longer than the external frontal process and is adjacent to it. The superior-interior corner of the third joint of the first maxilliped almost lacks the incision for the subsequent joint (in the plate, this incision is too strongly marked). The anterointernal edge of the carpo- and meropodite of the cheliped and the superior edge of the ischiopodite of the other legs bear hairs. The orbit is round, its edge has no incisions, and only its superior border has slight grooves marking a separation. Near the posterior edge of the mesogastric area two concavities are found. The surface of the cephalothorax is covered with very small granulations visible only through a magnifying glass. The abdomen of the female is made up of seven segments. Two females. The width of the cephalothorax is 20 mm; the length is 13 mm.

Distribution: Red Sea.

**At. (*Zozymus* Aut.) *aeneus* Lin.**

Tab. IV. Fig. 3-3b.

*Cancer incomparabilis*. Seba nat. Thes. T. III. Pl. 19 g. Fig. 18.

" *aeneus* Linn. Mus. Lud. ulr. p. 451.

*Cancer floridus* Herbst. op. cit. T. 1. p. 264. Tab. XXI. Fig. 130.

" *amphitrite* " op. cit. T. III. p. 5. Tab. I, III. Fig. 1.

" *aeneus* Quoy et Gaimard. Voyage autour du monde p. 522. Pl. 76. Fig. 1.

*Zozymus* " M. Edw. Hist. nat. des Crust. T. 1. p. 385.

*Aegle* " Dehaan op. cit. p. 17.

*Zozymus* " Dana op. cit. p. 192. Pl. 10. Fig. 3.

" " Heller. Beit. z. C. F. des. r. M. p. 326.

The resemblance between *Zozymus* and *Atergatis* is such that during the determination of the Crustacea of the Red Sea we considered *L. aeneus* (Aut) as belonging to the genus *Lophactaea*. This resemblance between them is also shown by the genus *Lophozozymus* created by Alph. M. Edwards in 1864; he also included the species *Xantho incisus*, *X. octodentatus* and *X. superbus* in this genus. In 1867 he described some new species which he obtained from New Caledonia, and in 1873 he included them in the genus *Lophactaea*.

The reader may ascertain that *Zozymus aeneus* belongs to the genus *Atergatis* when making a general review and comparison of the genera.

The genus *Zozymus*, created by Leach, belongs to the family Xanthidae. M. Edwards and Dana consider the spoonlike dactyli as the outstandingly essential character of this genus. At present however, this genus has been almost completely split up. Out of its five species listed in "Hist. nat. des Crustacés", Alph. M. Edwards includes four in the genera *Atergatis*, *Liomera*, *Actaca* and *Carpilodes*, so that only *Z. aeneus* remains. Of the two species described in "Voyage au Pole Sud", according

to the research of Alph. M. Edwards Z. caniculatus is identical with Carpilodes rugatus. Thus, as far as we know, four species remained: the two created by Dana, Z. pumilus created by Jacquinot, and Z. aeneus. Although Dana does not clarify the action of the spoonlike dactylus, and makes arbitrary use of this character, it is very strange that he considers Z. aeneus as belonging to the subfamily Chlorodinae, because its dactyli are evidently pointed. The notion of the spoonlike dactylus has remained, to the present day, a very unclear notion, and as a result, Alph. M. Edwards has even unified the genera Actaea and Actaeodes into one single genus. Among the dactyli having a hollow at their end, two forms may be discerned; we have not been able to find any transitions between them. In one of these forms, the hollow is bordered only in its anterior and external part; we propose to call such a dactylus spoonlike; in this kind of dactyli we indeed do find transitions to the pointed form. In the second form, on the contrary, this hollow at the end of the dactylus has an anterior border as well as on both sides, like a horseshoe; we propose to call such a dactylus horseshoe-like; moreover, the edge of the horseshoe has another color, usually white.

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Heller has described only the areas of the cephalothorax in detail. In order to show the resemblance between the genera Zozymus and Atergatis, we must stress other characters as well. The cephalothorax is protuberant, has an oval shape, and the ratio between its width and its length is 1.5:1. The anterolateral edge is sharp and appears as a lobate border, and its length hardly exceeds that of the posterior edge; the first two lobes are rounded; the posterior edge of the third is pronounced, and the fourth lobe looks rather like a blunt tooth which extends onto the cephalothorax in the form of a fold. The edge and the border of the orbit have the same structure as in A. roseus. The relationship between the basal joint of the antenna and the frontal outgrowth is the same as in A. anaglyptus. The anterior edge of the third joint of the first maxilliped is straight, and the anterointernal corner forms an incision for the subsequent joint. The dactyli are not spoonlike at the end, but pointed (cf. the illustration by Quoy and Gaimard) and therefore Dana's statement, "the spoon-cavity of the fingers is not circumscribed on the inner side" seems incomprehensible to us. The propodite of the chelipeds has a carina along its superior edge, and its external surface, as well as that of the carpopodite, is very strongly wrinkled. The superior edge of the mero- and carpopodite and that of the propodite of the other legs have a carina and the external surfaces bears a deep longitudinal furrow; the propodite and the dactylopodite are pubescent. The abdomen of the female is made up of seven segments.

In the specimen of Quoy and Gaimard, many subdivisions of the areas are missing. The external surface of the carpopodite and propodite of the chelipeds is not wrinkled, but covered with tubercles; the other feet are even more pubescent. The specimens of Seba, Herbst, and Dana differ one from another by their color. The color of our specimen is lead-gray. One female.

Distribution: Red Sea; Indian Ocean; Mariana Islands; Moluccas Islands; Samoa Islands; Paumotu Archipelago.

A. *carinipes* Heller.

Tab. IV. Fig. 4-4b.

*Zozymodes carinipes* Heller. Beit. zur Crust. F. des r. M. p. 327. Tab. II. Fig. 16-18.

To the exact description by Heller we add that in our specimen, the frontal and epigastric areas are delimited, though not clearly. The superior edge of the propodite of the chelipeds has an aliform expansion, thus forming a very prominent carina. The carpopodite and propodite of the pereiopods are rounded on their inferior side. The dactyli of the chelipeds are spoonlike and not horseshoelike. The basic color of the cephalothorax is yellowish, with three wide longitudinal reddish-brown stripes, one of them median, and the other two lateral. After some time of alcohol preservation these stripes disappear. One male.

Distribution: Red Sea.

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As a result of the description of these four species we have considerably extended the genus Atergatis and have included in it the genera Lophacatea, Zozymus, and Zozymodes. In order to justify this point of view, we must show that in all members of these genera, the typical characters which define the genus are identical and constant. Only a number of other characters vary, but these variations are such that if we take as a starting point the simplest form of the character, we will find them in all the intergradations, from the simplest form to the most complex.

The following characters are common to all the species of these four genera, and actually define the genus Atergatis: all species have an oval cephalothorax, which shows considerable convexity in the transverse direction but this is even more pronounced in the longitudinal direction. The anterolateral edge is either sharp or rounded; it always forms a border and is longer than the bent posterior edge. The basal joint of the antenna is short and reaches only as far as the lateral frontal process; when it is longer, it adjoins the internal side of the frontal process. The orbit is round; its edge has no incisions, and grooves can be found only on its superior border; these furrows are not deep and mark the corresponding areas. The chelipeds are always well developed; the dactyli are either pointed or spoonlike, but never horseshoelike. The superior edge of the pereiopod has a carina. The abdomen of the male is made up of five segments, that of the female of seven.

The characters mentioned above are constant, while other characters - the nonessential ones - are variable. Such are: the surface of the cephalothorax, the form of the anterolateral edge, and the third joint of the pereiopods ["outer legs" in the original]. Let us now consider these characters.

Alph. M. Edwards pays special attention to the presence or lack of the areas on the cephalothorax and consequently separates a certain number of species from the genus Atergatis, creating for them the genus Lophactaea. The other characters of the two genera being identical, Atergatis is characterized, in his opinion, by a smooth surface; in

Lophactaea, on the contrary, the anterior half of the cephalothorax is divided into areas by means of furrows. If we study certain species of the genus Atergatis we find that the mesogastric and cardiac areas in A. roseus are not clearly delimited; in A. reticulatus, the proto- and mesogastric areas are delimited; in A. dilatatus the hepatic and branchial areas; in A. floridus, the areas even become somewhat protuberant. The grooves in these species are, of course, not as deep as those of the genus Lophactaea, but one day an Atergatis will be found with somewhat deeper grooves; in such a case, the determination of the genus will depend only on the subjective viewpoint of the student. In order to avoid such an arbitrary criterion, the genus Lophactaea must be abolished. The areas are most well developed in A. aeneus, in which they are also found in the posterior half of the cephalothorax; but also in the specimens of this species an unequal development of the areas is to be found.

As to the anterolateral edge, its contour is either continuous or lobate. In A. roseus the edge has a continuous contour, but specimens are found with slightly incised edges. These incisions are found in great numbers in other species; here they are strongly marked and finally become so deep that the edge becomes lobate, as in L. lobata (Alph. m. Edw. Etudes sur les Canc. Table XVI Figure 3). In this direction, the most marked development is attained by the same A. aeneus. The lobes may sometimes become toothlike, as in A. semigranosa Hell. In A. aeneus the last lobe is toothlike, in A. carinipes the two posterior lobes are toothlike. In A. aeneus, the pereopods have grooves, but these are also found in A. anaglyptus.

The given data shows that the generic characters of Zozymus aeneus correspond to those of Atergatis; the only difference is in the structure of the cephalothoracic surface, a difference which, like that of the anterolateral edge, is no more than a further development of the characters also found in other species of the genus in a rudimentary form. That is probably why they have been disregarded. Zozymus gemmula Dana, Z. pumilus Jacq. and Z. laevis in all probability belong to the genus Atergatis.

For a better appreciation of the characters shown by the first maxilliped, we must refer to the genus Zozymodes, which, according to Heller, differs by this character from the genus Zozymus. This single differential character is vague enough, and therefore insufficient for the creation of a genus. We base the vagueness of this character on the following facts. In a species of the genus Etisus (Table V. Figures 4b and 4e) there is an incision on the anterior edge of the third joint of the first maxilliped, but only in the juvenile stage; subsequently it disappears. Among the species of the genus Lophactaea, whose structure of the first maxilliped Alph. M. Edwards considers identical with that of Atergatis, we have found that in A. anaglyptus the third joint does not have incisions in the anterointernal corner, a fact which we have already observed. Such a deviation in the structure of the first maxilliped is also found among the spines of the genus Actaeodes (Table V. Figures 2b and 3b).

We must finally also refer to the structure of the legs. The external surface of the pereopods in A. carinipes bears a carina; quite correctly, Heller attaches no importance to this character, because it represents only a further development of the lateral convexity found in A. anaglyptus, as is clearly demonstrated in cross section (Table IV. Figures 4c and 4d).

Anterolateral edge rounded at contact with posterior edge ( <u>A. roseus</u> group).	<p>Surface of cephalothorax smooth or with slightly marked grooves ----- <u>roseus</u></p> <p>Anterior half of cephalothorax has clearly delimited areas; antero-lateral edge } has slight incisions; propodite of chelipeds } provided with blunt space ----- <u>cristatus</u></p> <p>Anterior half of cephalothorax smooth, or with slightly marked furrows ----- <u>integerrimus</u></p> <p>Anterior half of cephalothorax has clearly delimited areas ----- <u>lobatus</u></p>	<p>has a carina -----</p> <p>without carina; } divided into two parts by } <u>cristatus</u></p> <p>protogastric area } carina ----- } granulosus</p> <p>hardly divided in anterior } part ----- } Eydouxii</p> <p>----- semigranosus</p>
Anterolateral edge forms fold on cephalothorax at contact with posterior edge ( <u>A. integerrimus</u> group).	<p>Surface of cephalothorax smooth, or with slightly marked furrows ----- <u>integerrimus</u></p> <p>Anterior half of cephalothorax has clearly delimited areas ----- <u>lobatus</u></p>	<p>----- <u>integerrimus</u></p> <p>----- <u>lobatus</u></p>
Anterolateral edge forms fold on cephalothorax at contact with posterior edge; this fold forms outward, toothlike prominence. ( <u>A. dilatatus</u> group).	<p>External surface of pereopods without flat rounded expansion -----</p> <p>Surface of cephalothorax smooth, or with slightly marked furrows ----- <u>integerrimus</u></p> <p>Anterior half of cephalothorax has clearly delimited areas ----- <u>lobatus</u></p>	<p>Surface of cephalothorax has slightly marked furrows and inferior edge of propodite of pereopods ----- <u>dilatatus</u></p> <p>Anterior half of cephalothorax has clearly delimited areas ----- <u>lobatus</u></p> <p>Entire surface of cephalothorax divided into areas ----- <u>crispus</u></p>
External surface of pereopods has flat rounded expansion -----	<p>External surface of pereopods has flat rounded expansion ----- <u>carinipes</u></p>	<p>----- <u>carinipes</u></p>

The carina found on the propodite of the chelipeds in many species of Atergatis became more developed in the horizontal direction, forming an aliform outgrowth.

After having proved that the essential generic characters are common to the four genera and that the nonessential characters are intergradations, we think that the unification of the four genera in one genus Atergatis, as we propose, will be accepted. In a system which has the purpose of indicating the evolutionary relationship between living organisms, artificial splitting should be avoided.

As is shown in the next table which serves for the determination of the species of Atergatis, every species belonging to the old genera Atergatis, Lophactaea, Zozymus, and Zozymodes is included in one of the three groups of the new genus.

## GENUS CARPILIUS. LEACH.

C. maculatus L.

Var. C. convexus Forsk.

Tab. IV. Fig. 5-5c.

<u>Cancer convexus</u> Forskal	Descript. anim. quae in itinere orient. observavit p. 88.
" <u>adpersus</u> Herbst	op. cit. T. I. p. 264. Tab. XXI. Fig. 119.
" <u>Petraea</u>	" " " T. III. p. 18. Tab. LI. Fig. 4.
<u>Carpilius convexus</u> Rüppel	op. cit. p. 13. Tab. III. Fig. 2.
" "	Milne Edw. Hist. nat. des Crust. T. 1. p. 382. Tab. Fig. 9-10.
" "	Dana Expl. Exp. p. 159. Tab. VII. Fig. 5.
" "	Heller Beit. zur Crust. F. des r. M. p. 319.
" "	Alph. M. Edw. Etudes sur les Canc. p. 215.

From a careful comparison of C. convexus and C. maculatus, we find that the difference between them is limited to the following characters. In C. maculatus, the median part of the cephalothorax is smooth, while in C. convexus it has punctiform hollows; the spines of the lateral edge are more developed than in C. convexus; the lateral lobe of the frons is also more developed, i. e., it is separated by a deeper incision from the median lobe; the coloration must not be taken into consideration. The above differential characters are of too little importance for the creation of a new species, and therefore we consider C. convexus a variety of C. maculatus. In addition, we must ascertain that no author paid any attention either to age or to sex; had any of them done so, he would probably have observed that these differences do not exist at all. We shall further have the opportunity to show the modifications undergone by the frontal edge, and by the cephalothorax as a whole, in individuals of different age and sex, e. g., in Etisus, Chlorodius and Cymo.

As to coloration, to which authors attribute rather great importance, it is easily proved that also in this case it has absolutely no importance in the determination of the species. Comparing our specimen with that of Rueppel and Heller, we find that the Red Sea specimens show variable

coloration. In one specimen there is a large ocular spot on the middle of the cephalothorax; the rest of the cephalothorax bears many small red spots of various shapes; in addition, on the ventral side, behind the orbital edge, a large semilunar spot is present.

By comparing the existing illustrations, we may conclude that in certain species (C. Pitho Herbst and C. lividus Gibbes) the cephalothorax is homochromous, without any spots, its color being white, grayish, or reddish; in other species (C. adpersus Herbst) irregular spots of different sizes appear, which more or less fuse with one another and in certain species form reticulate stripes, as is seen, for instance, in the specimen drawn by Dana. In marmorinus, red pigment predominates and forms large irregular spots on the cephalothorax; the chelipeds are also adorned with large spots. In C. praetermissus (Gibbes) the pigment forms regular spots, up to twenty-five; in this variety, on the contrary, the pereopods are spotted. In C. maculatus, finally, according to various authors, only eleven to twelve spots are to be found, but these spots are large and symmetrically arranged. Heller, nevertheless, tells (Novarra Expedition) about a specimen from Tahiti in which the spots are irregular and asymmetrically arranged. C. Petraea Herbst is also a variety of C. maculatus; in the illustration its frontal lobe appears to be well developed, but in the text we can read: "Die Ausschnitte sind so schwach, dass die Stirn grade, fast wie abgestutzt erscheint".

Since Herbst repeatedly asserts that he studied a great number of specimens of Carpilius, and that in most of these the coloration was constant, the following varieties of C. maculatus may be identified.

Cephalothorax homochromous without spots	-----	<u>Pitho (lividus)</u>
Cephalothorax irregularly spotted;	} not spotted -----	<u>convexus (adpersus,</u> <u>Petraea)</u>
chelipeds		
Cephalothorax regularly spotted;	} not spotted -----	<u>maculatus</u>
pereopods		

Distribution: Red Sea; Indian Ocean.



## GENUS CARPILODES. DANA.

### *C. rugipes*. Hell.

Tab. IV. Fig. 6-6c.

*Actaeoetes rugipes* Heller Beit. zur Crust. F. des r. M. p. 330. Tab. II. Fig. 20.

*Carpilodes* " Alph. M. Edw. Et. sur. les Canc. p. 229. Tab. XIII. Fig. 4.

*Carpiloxanthus* " Heller Novarra Expedition p. 17.

Our specimens correspond completely with Heller's description, and we only wish to draw attention to the surface of the cephalothorax, which in young specimens is entirely covered with small granulations. Among these granulations hollows appear with increasing age; the hollows are especially marked in the posterior part of the cephalothorax. In Heller only the chelipeds are correctly drawn; the illustrations of Alph. M. Edwards are more correct. A few specimens of various ages.

Distribution: Red Sea; Tahiti.

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According to Alph. M. Edwards, *C. ruber* differs from the preceding species by the considerable width of its cephalothorax and by the almost smooth chelipeds. In comparing his illustration with the outstandingly exact figure of *C. rugipes* which we presented, we discovered that in this specimen, found in the Paris Museum, the ratio between the width and the length of the cephalothorax is 1.5:1; in our specimen it is 1.66:1, and in *C. ruber* it is 1.76:1. It is clear that the relative width of the cephalothorax cannot have any importance in the determination of the species. In the same way, the surface of the chelipeds cannot serve as a differential specific character, either since among the specimens of *Atergatis aeneus*, individuals are found in which the surface of the chelipeds is covered with granulations, and others in which it is wrinkled; nevertheless, no one has created a new species on the basis of the specimen found by Quoy and Gaimard. In the evaluation of the specific characters one must be consistent, and not attach importance to them in one case while denying their importance in another. As to the surface of the cephalothorax, we have already shown that it varies with age. On the basis of these factors, we consider *C. ruber* a variety of *C. rugipes*.

In determining the Crustacea brought by the Novarra Expedition, Heller described in "Verhandl. der zool.-bot. Gesellschaft zu Wien" 1862, p 520, the new species *C. granulatus*, which he subsequently considered identical with *C. tristis* Dana, in his extensive work which appeared in the publications of the Academy.

*C. Stimpsonii*, *C. Vaillantianus* and *C. rugatus* differ from one another only by the surface of the cephalothorax, but as we have already stated, the surface of the cephalothorax changes with age in the same species, so that this character can have no importance in the definition of a species.

Alph. M. Edwards considers *C. canaliculatus* synonymous with *C. rugatus*, but if we consider the illustrations of "Voyage au pôle Sud",

Table III, Figure 2, we observe that C. canaliculatus belongs to the group in which the protogastric area is completely separated by a longitudinal groove; Alph. M. Edwards does not allude to the error in the illustration.

According to Alph. M. Edwards, C. obtusus (Dehaan) and C. venosus differ from one another only by the branchio-hepatic furrow, which in the first species is fused with the brachio-gastric furrow, while in the second species it does not touch it. If we refer to Alph. M. Edwards' illustration, we find that on the right side, the branchio-hepatic furrow is fused with the brachio-gastric furrow and that, consequently, this character is hardly important. In C. obtusus, the mesogastric area is fused with the cardiac area, and the same character almost exists in C. venosus, since Alph. M. Edwards states: "region gastrique a peine separee de la région cardiaque". On this basis, there is no reason for the creation of a new species C. venosus.

The species of the genus Carpilodes known at present can be determined according to the table to follow.

Entire surface of cephalothorax divided into areas; surface of chelipeds		wrinkled - - - - - <u>rugipes</u> covered with very small granulations - - - - - <u>Var. ruber</u>
	not divided by furrow - - - - -	<u>tristis</u>
	divided by furrow	covered on entire surface by uniform-sized granulations - - <u>rugatus</u> covered only on anterior part with coarse granulations - - - - - <u>Var. Vaillantianus</u> wrinkled in anterior part - - - - <u>Var. Stimpsonii</u>
Posterior part of surface of cephalothorax smooth; protogastric area		Incomplete division; cephalothorax Complete division; mesogastric area fused with internal half of protogastric area - - - - - <u>obtusus (venosus)</u> completely delimited from protogastric area - - - - - <u>canaliculatus</u>

When a great number of specimens is studied, and attention is paid to the smallest variations, intermediate forms will probably be found and the differences between the above-mentioned characters will disappear. This idea is suggested by the illustration of C. granulatus by Alph. M. Edwards (Etudes Zool. sur les Canc. Table XII. Figure 5) where, on the right side, the protogastric area has a small groove. If this groove were to develop on the other side too, and more markedly, a form almost identical with C. rugatus would be obtained. In addition, one must not neglect the fact that all specimens which have been described until now have been red in color.

## GENUS ACTAEA DEHAAN.

### *A. hirsutissima* Rüpp.

Tab. V. Fig. 1-1a.

<i>Xantho hirsutissimus</i>	Rüppel, op. cit. p. 26. Tab. V. Fig. 6.
<i>Actaea hirsutissima</i>	Dehaan, op. cit. p. 18.
"	" Dana op. cit. p. 164. Pl. VIII. Fig. 3.
"	" Heller, Beit. zur. Crust. F. des. r. M. p. 314.
"	" Alph. M. Edw. Etudes sur les Canc. p. 263.

The male differs from the female by the color of the chelipeds. In the male, the internal surface of the propodite is black, except for an area near the dactylopodite. A few specimens.

Distribution: Red Sea; the Seychelles; Mauritius and Java, Pacific Ocean.

## GENUS ACTAEODES DANA.

Dana created this genus because of the presence of spoonlike dactyli; but since he did not accurately state this last notion, Alph. M. Edwards quite correctly states that between the pointed dactyli and the spoonlike ones, all possible intermediate forms are to be found. That is why he unifies the two genera *Actaea* and *Actaeodes*, which undoubtedly are very much alike, in one single genus *Actaea*. On page we showed the differences existing between the forms of the dactyli; on this basis, we retain the genus *Actaeodes* for those cases in which the dactyli are horseshoelike, since this pattern of dactyli is not only very characteristic, but it also undoubtedly has some relationship to the behavior of the animal.

### *Act. lividus* Dehaan.

Tab. V. Fig. 2-2b.

*Xantho lividus* Dehaan, op. cit. p. 48 Tab. XIII. Fig. 6.

The wide cephalothorax is strongly bent ventrally in its anterior part; in its posterior part, it is flat and does not have areas. The surface of the cephalothorax, like that of the legs, is covered with small granulations, and they are therefore lusterless; in addition to granulations there are hollows among which the two on the hepatic area are outstandingly deep and regular. They are drawn by Dehaan. The broad frontal edge is slightly prominent; it bears a very small denticulation and is divided into two lobes by an incision. The two lobes themselves are separated from the orbital edge by a hollow. The extraorbital spine is small and is separated by an incision from the denticulate inferior orbital edge which ends with a small blunt spine. The anterolateral edge is equal in length to the posterior one

and has four lobes. Behind the frontal edge there are two not clearly delimited frontal areas, behind which follow two epigastric areas; the protogastric area has a longitudinal furrow on its anterior part; the mesogastric area is not divided and has a lighter-colored stripe on its median part; a small urogastric area follows finally. The remaining areas may be seen in the attached figure. The basal joint of the antenna is broad and reaches the lateral frontal process; from its external corner a small process penetrates the orbital fissure. The third joint of the first maxilliped has an incision on its anterior edge in the male as well as in the female.

One of the chelipeds is slightly longer than the other; the meropodite hardly reaches the anterolateral edge and bears thick hairs on its external and internal border; the carpopodite is protuberant and tuberculated on its external part, and the anterointernal corner ends with a tooth. The external and internal surfaces of the propodite are slightly protuberant, the superior edge is broad and wrinkled, while the external surface is granulated; the dactyli have a brown color, bear furrows, are open, and are horseshoe-like at the ends. The external edges are denticulate. The dactyli are as long as the propodite. The joints of the other legs are pubescent, and the external surface of the propodite bears a clear longitudinal furrow. The dactylopodite of the last pair of legs is shorter than that of the preceding pair in both sexes. The abdomen of the male is made up of five segments, that of the female of seven. The ratio between the width and the length of the cephalothorax is 1 66:1. One male and one female.

Distribution: Red Sea; Japan.

Without any proof or arguments, Stimpson (Proceed. of the Acad. of Nat. Sciences of Philadelphia 1858 p 34) considers Xantho lividus identical with Chlorodius exaratus M. Edw. The structure of the antennae and their relationship to the frontal outgrowth is different from that in Chlorodius, and therefore Stimpson's opinion is erroneous.

#### *Act. frontalis.*

Tab. V. Fig. 3-3h.

This species differs from all the others by its tetralobate and very prominent frontal edge, which bears a deep median incision. The anterior part of the cephalothorax is triangular, very protuberant and its anterior part is strongly bent ventrally, although its frontal part rises slightly. The frontal, epi-, and protogastric areas are fused. The other areas are shown in the attached figure. The surface of the cephalothorax is covered with granulations, of which some are grouped in small transverse rows; in addition, sparse hairs are found. The anterolateral edge is longer than the posterior one, and bears four spines. As in the preceding species, there are preorbital and extraorbital spines on the orbital edge. The extraorbital spines are separated from the denticulated inferior orbital edge by an incision. The basal joint of the antenna has the same structure as in

Actaeodes lividus. The anterior edge of the third joint of the first maxilliped has no incision.

The external surface of the carpopodite of the chelipeds is not smooth, but granulated; on its anterior edge, the propodite is broad, and has a median slit by which it is separated from the granulated external surface. The horseshoelike dactyli are opened, slightly longer than the propodite and denticulated along their inferior edge. The ventral part of the cephalothorax is granulated. The joints of the pereopods are pubescent, while the dactylopodites of the last pair are equal in length to those of the penultimate pair. The abdomen of the male is made up of five segments, that of the female of seven. One male and two females. The ratio between the width of the cephalothorax and its length is 1.34:1.

Distribution: Red Sea.

### GENUS ETISUS LEACH.

Dana separated several species from this genus and formed with them the genus Etisodes, which differs from Etisus by its more clearly delimited areas, and by the shorter meropodites of the chelipeds.

The delimitation of the areas is not only an unimportant character for the creation of a genus but, in the present case, it is also rather arbitrary; this may be easily ascertained by comparing Etisus deflexus with Etisodes frontalis. From Dana's illustrations one may easily see that the areas are, on the contrary, more developed and marked in Etisus deflexus than in Etisodes frontalis; this is also confirmed by the text. The ratio between width of the cephalothorax and its length is also very variable, especially if age is taken into account. As to the length of the chelipeds, it can never serve as a generic character, since, as we have seen, it varies within the same species; so for instance, in Inachus arabicus, described by Rueppel, the chelipeds are much longer and the cephalothorax is narrower than those of Menaethius monoceros. Nevertheless, no one ever created a new genus for it, and everyone agrees that this form belongs to Men. monoceros. In addition, although these distinctive characters are also found in species of other genera, e. g., in Chlorodius, Dana has not divided this genus into two parts. Such unmotivated discrepancy in the evaluation of the characters is hardly intelligible. It seems that Dana himself has not considered the separation of Etisodes from Etisus very justified, since in his synoptic table, the first genus is not included.

We unify these two genera in one genus, Etisus.

*Et. sculptilis* Hell.

Tab. V. Fig. 4-4b.

*Etiodes sculptilis* Heller. *Beit. zur Crust. F. des r. M.* p. 333.

" " Alph. M. Edwards. *Nouv. Arch. du Museum* P. IX. p. 236. Tab. IX. Fig. 2.

Our specimen differs from Heller's description, as do the description and the illustrations of Alph. M. Edwards in "*Nouv. Arch. du Museum*", T. IX. These differences are as follows.

In our specimens, the surface of the cephalothorax is smooth, with a few punctiform hollows of various sizes. The rough transverse lines are completely lacking both in young and in adult specimens. The frontal edge is identical with Heller's description, but in the specimens from New Caledonia, according to the text and the illustrations, the frontal edge bears four almost equal pointed spines. The anterolateral edge and the posterior edge are the same length; in this way our Red Sea specimens resemble those of New Caledonia; in Heller's specimen, however, the anterolateral edge is much longer than the posterior one. If Heller's indication is exact, this character is a very important one, since as we know, it does not vary in individuals of the same species. The extraorbital spine is followed on the lateral edge by two lobes and then by two spines, which in young specimens are slightly longer and more pointed. Among our five specimens, there is one in which this edge bears the spines drawn by Alph. M. Edwards; the edges of the lobes, like the spines of the others, are granulated. The protogastric area is undivided, and only in one specimen, a small incipient furrow is found on the right side. The posterior part of the mesogastric area has no furrow, and the stripe found in its place (see figure) has a lighter color.

The external surface of the carpo- and propodite is smooth, except in young specimens, in which very small granulations may be seen through a magnifying glass. The superior edge of the propodite is also smooth, except in young specimens, and it is delimited from the external surface—according to the description by Heller—by a faint furrow. The dactyli are horseshoelike. On the dactylopodites of the other legs, before the claws, a prominent tooth is found. The largest specimen, drawn in the plate, showed a small dark spot which disappeared after preservation in alcohol. The other characters correspond to Heller's description.

Thus, our specimens differ from those of Heller by the lack of the furrow on the protogastric area, and by the relative length of the anterolateral edge. The specimens from New Caledonia described by Alph. M. Edwards, differ from Heller's description by the shape of the frontal edge and by the relative length of the lateral edge; they also differ from our specimens by the shape of the frontal edge and by the furrow on the protogastric area.

On the basis of this comparison, we propose that the specimens from New Caledonia and our specimen be considered two varieties of *Et. sculptilis* Hell.

We shall now relate the changes undergone by the specimens of this species with increasing age.

In young individuals the frontal edge is straight and divided by a small median incision into two lobes only; in adult individuals, the frontal edge is

somewhat more prominent and every lobe, in turn, is somewhat incised so that the frontal edge becomes tetralobate, the median lobes being much wider than the lateral ones. In young specimens, the orbital fissure is entirely filled by the outgrowth of the basal joint of the antennae (Table V. Figure 4d); in adult specimens, however, the anterior part of the fissure is closed by the contact between the postorbital spine and the superior orbital edge (Figure 4a). The anterior edge of the third joint of the first maxilliped bears an incision in young individuals- in adults, it disappears almost completely (in Figure 4b, the incision is too strongly drawn). In young specimens the surface of the cephalothorax and the chelipeds are covered by very small granulations; in adult specimens the granulations disappear, the surface becomes smooth, and punctiform hollows appear. With age, the cephalothorax becomes wider; in the smallest specimen, the ratio between the width and the length of the cephalothorax is 1.31:1, while in the largest it is 1.45:1. In young females, the abdomen is narrower (Figure 4f); in adults, it is wider; it becomes oval in form and the margins become covered with thick hair.

Distribution: Red Sea; New Caledonia.

Alph. M. Edwards considers Etisus rugosus Lucas "Voyage au pôle Sud" p 33 Pl. IV. Fig. 3) identical with Et. sculptilis.

#### Et. spinipes Hell.

Tab. VI. Fig. 1.

Pilodius spinipes Heller. Beit. zur Crust. F. des r. M. p. 340. Tab. III. Fig. 22

Chlorodopsis spinipes Alph. M. Edw. Nouv. Archiv du Muséum T. IX. p. 230. Pl. VIII. Fig. 6.

Heller's description of Pilodius spinipes corresponds completely with our specimen, but since the orbital fissure is entirely filled with the outgrowth of the basal joint of the antennae and the subsequent joints are found behind the orbit, it is clear that this species belongs to the genus Etisus. The dactyli are horseshoelike. Two males and one female.

Distribution: Red Sea; New Caledonia.

According to Alph. M. Edwards, the genus Chlorodopsis, which he created, differs from Etisus, by the width of the cephalothorax, and by the third joint of the first maxilliped, which bears an incision on its anterior edge.

As to the first differential character, let us now deal with the facts presented by Alph. M. Edwards. In Etisus levimanus the ratio between the width and the length of the cephalothorax is 1.57:1; in Chlorodopsis spinipes it is 1.51:1. This difference is too insignificant to be taken into consideration for the creation of a new genus. On the contrary, this ratio varies within much wider limits in the same species; so for instance, in the largest specimen of the preceding species the ratio between width and length is 1.45:1, while in the smallest it is 1.31:1. In Atergatis roseus, this variation is still greater. As to the second character, in the description of the preceding species, we noted the fact that the anterior edge of the

third joint of the first maxilliped may vary within the limits of the same species according to age; we have also shown the changes undergone by this joint in the species of one genus. Taking all these into account, the existence of the genus Chlorodopsis can hardly be accepted. .

## GENUS PILODIUS DANA.

*P. fragifer* Adams et White.

Tab. VI. Fig. 2.

*Chlorodius fragifer* Adams et White, Voyage of Sam. p. 40. Tab. XI. Fig. 2.

„ *polyacanthus* Heller. Reit. zur Crust. F. des r. M. p. 389. Tab. III. Fig. 21.

This typical crab, provisionally considered by Heller as belonging to the genus Chlorodius, belongs, in fact, to the genus Pilodius. The only female brought back from the Red Sea is absolutely identical to the clear illustration by Adams and White, and also bears two tubercles on the podophthalmita, in front of the cornea. The superior orbital edge bears four broad short tubercles. The extraorbital spine is somewhat smaller than the first spine of the anterolateral edge and is separated from the inferior orbital edge by an incision. The postorbital spine is well developed. The anterolateral edge has six spines, including the extraorbital one. The basal joint of the antennae is rather long, but it reaches only the narrow lateral-frontal outgrowth. The width of the third joint of the first maxilliped exceeds the length, and the slightly bent anterior edge forms a right angle with the external edge. As to other characters, only individual variations are found, so for instance, the anterior edge of the mesogastric area bears four tubercles, while its remaining part, like the surface of the cardiac and postbranchial areas, is covered only with small granulations. There is a small tubercle on the anterolateral edge.

On the internal surface of the propodite of the chelipeds, in the immediate vicinity of the superior edge there is a row of small tubercles which were accurately illustrated in Adams and White. In addition, on the same surface, but somewhat lower, two more tubercles are found; the dactylopropodite is covered with grooves and bears tubercles at its base: the dactyli are spoonlike. The external surface of the third joint of the pereopods is smooth in our specimen, while Heller's specimen is similar in this respect to the individual from the Philippines, i. e., it is covered with small blunt spines. The inferior edge of the fifth joint also has spines, but very short ones, while the dactylopropodite bears a few hairs at its end. The abdomen of the female is made up of seven segments, that of the male of five. The width of the cephalothorax is 7.5 mm, the length is 5.5 mm.

Distribution: Red Sea; Philippines.

Strahl (Carcinologische Beiträge. Archiv für Naturgesch. Jahrg. 28 p 270) erroneously considered Chlorodius fragifer Adams and White as belonging to the genus Halimede, since in this genus, the abdomen of the male is made up of seven segments.



## GENUS XANTHO LEACH.

### X. distinguendus Dehaan.

- Xantho distinguendus Dehaan. op cit. p. 48. Tab. XIII. Fig. 7,7a.  
" " Heller. Beit. zur Crust. F. des r. M p. 323.  
Chlorodius " Stimpson. Proceed. of the Acad. of nat. sc. of Philadelphia 1858 p. 34.

Of five specimens, the largest (the width of the cephalothorax is 12.5 mm, the length is 8,5 mm) coincides with the description and illustration by Dehaan, and also with the description by Heller. We must only remark that at the base of the movable dactylus of the greater cheliped in all specimens there is a large and blunt tooth as was accurately illustrated by Dehaan, Figure 7a; the superior edge of the propodite is broad and has a median slit. The male differs from the female by its mesogastric area. In the male, the posterior part of the area is very narrow and elongated; in the female, on the contrary, this area resembles that drawn by Dehaan. With increasing age, the ratio between the width and the length of the cephalothorax is also augmented. Five specimens of various ages and both sexes.

Distribution: Red Sea; Hong-Kong; Japan.

We consider Xantho minor Dana a young specimen of X. distinguendus, since the smallest of our specimens (the width of the cephalothorax is 5.8 mm and the length is 4.5 mm) is entirely included by the description of X. minor. A difference is found only in the frontal edge which, according to Heller, is very broad; this character is, however, not mentioned by Dana.

It is unclear on what ground Stimpson considers that X. distinguendus: "forsitan varietas Chlorodii exarati vel sanguinei M. Edw."

## GENUS EUXANTHODES n. g.

The cephalothorax is narrow and protuberant, especially in the longitudinal direction, while its anterior part is divided into areas by furrows. The protuberant anterolateral edge is somewhat longer than the concave posterior one, and has three to four hardly visible lobes. The orbital edge has a continuous contour, with no incisions. The antennules have a horizontal position and are separated from one another by a short, but relatively broad partition. The basal joint of the antenna is short but very broad, while its outgrowth entirely fills the orbital fissure; the two subsequent very small joints which articulate at its end, lie in the orbit. The epistome is short but broad. The endostome has no ridge. The width of the third joint of the first maxilliped exceeds its length, and the superior edge is somewhat concave. The dactyli of the chelipeds have a very reduced concavity at their end. The abdomen of the male is made up of five segments, that of the female of seven.

## *Eux. granulatus* Aud.

Tab. VI. Fig. 3 - 3a.

- Cancer granulatus* Audouin. Desc. de l'Egypte p. 268. Pl. VI Fig. 2.  
*Actaea granulata* Dehnan. op. cit. p. 47.  
*Cancer Savignyi* M. Edw. Hist. nat. des Crust. T. I. p. 378.  
*Actaea pura* Stimpson Proceed. of the Acad. of nat. sc. of Philadelphia 1858 p. 32.  
" *granulata* Alph. M. Edw. Etudes sur les Canc. p. 275.  
" " Alph. M. Edw. Nouv. Arch. du Muséum T. IX. p. 192.

This species is absolutely identical not only with the illustrations by Savigny in "Exp. de l'Egypte", but also with the description by Alph. M. Edwards in his "Etudes sur les Canceriens", and therefore we considered it quite unnecessary to describe it once more. For a better description we only stress the fact that the dactyli of the chelipeds are pointed and uncolored in the male, and longer than those of the female; here, on the contrary the base of the dactyli is black and its margins are slightly denticulated. The dactylopodites of the other legs are covered with short rigid hairs before the claw. One male and two females; the largest specimen was 19 mm in width and 14.5 in length.

Distribution: Red Sea; Mauritius and Kong-Kong; Mozambique; Port Jackson, Australia; New Caledonia.

It is absolutely incomprehensible to us, on what grounds this species is considered as belonging to the genus *Actaea* with which it has nothing in common with regard to the structure of the antennae, as we have drawn. The orbital fissure is completely filled by the outgrowth of the basal joint of the antennae—a character unknown in the genus *Actaea*; in addition, the orbital edge has a continuous contour and has neither incisions nor indications of spines.

On the basis of existing descriptions, it does not resemble any of the reported genera, and since we did not have sufficient comparative material at our disposal, we were obliged to create a separate genus for it, which will, however, be abolished when closely related genera are better determined and studied.

We must also point out here that the last maxillipeds which play such an important part in the determination of the genera, are very inaccurately described in the genus *Euxanthus*. Unfortunately, because of the very small number of specimens of this genus, we had no possibility of amending this inaccuracy. Referring to *Euxanthus*, Dana (p 173) states: "The orbital fissure occupied by the basal joint of this outer antenna is quite filled with this joint... in one species this cavity (i. e., from which the subsequent joint of the outer antennae articulates) is elongated toward the orbit and is scarcely separated from it, while in the other it is nearly circular and is wholly separated from the orbit". Referring to *Euxanthus rugulosus*, described in Novarra Expedition, p 13, Heller states: "Das erste Stielglied der äusseren Antennen liegt in schiefer Richtung zwischen dem äusseren Stirnfortsatze und dem Postorbitalzahne eingeklemmt, das zweite Glied entspringt aus des Mitte des ausgeschweiften Vorderendes unter dem Superciliarläppchen und ist sammt dem kurzen dritten Gliede und der kleinen Endgeissel von der Orbita entfernt. Hiedurch schliesst sie sich unzweifelhaft dem Genus *Euxanthus* Dana an."

In his determination of the genus Euxanthus, Alph. M. Edwards (Etudes sur les Canc. p 289) says: "L'article basilaire des antennes externes est tres longue et se prolonge comme celui des Etyses dans l'hiatus orbitaire externe; seulement, la tigelle mobile, qui est très petite, au lieu d'etre excluse de l'orbite, s'insère dans cette cavité, a l'extrémité de l'article basilaire, dans une petite depression".

## GENUS CHLORODIUS. LEACH.

*Ch. niger*. Forsk.

Tab. VI. Fig. 4-4b,

<i>Cancer niger</i>	Forskal. op. cit. pag. 89.
<i>Chlorodius</i> "	Rüppel op. cit. p. 20 Tab. IV. Fig. 7.
" "	hirtellus Adams et White Voyage of Sam. p. 40 Tab. XI. Fig. 4.
" "	Dana op cit. p. 216. Pl. XII Fig. 5.
" "	Heller Beit. zur Crust. F. des r. M. p. 335.
" <i>depressus</i>	Heller. " " " " " p. 338.
" "	Hilgendorf. von der Deeken's Reisen in Ost-Afrika p. 74.
" "	Alph. M. Mdw. Nouv. Arch. du Muséum T. IX. p. 214

We have received almost 200 specimens of this widely distributed species from the Red Sea; by studying them thoroughly we concluded that Chlorodius depressus Hell. is no other than a young specimen of Ch. niger.

In the younger individual, the cephalothorax (Figure 4) is narrower than that of the adult; the ratio between the width and the length of the cephalothorax is 1.25:1, while in the adult it is 1.5:1. The surface of the cephalothorax is smooth in the young stage; subsequently a tubercle appears on the hepatic area and one on the branchial (Figure 4a), while in the adult stage (Figure 4b), there are two on each of these areas and, in addition, the epi-, proto-, and mesogastric areas are delimited. The anterolateral edge is almost straight in the juvenile stage, and the last three spines are pointed; with increasing age, this edge becomes oblique and slightly rounded, while the spines become short and blunt; nevertheless, in a fairly large specimen (width of the cephalothorax is 16 mm; length is 11 mm), the last spine remained pointed. In the juvenile stage, the eyes are large and exceed the orbits in size; with increasing age, the eyes become relatively smaller.

The meropodite of the chelipeds in young individuals has a pointed tooth on the anterior edge (Figures 4 and 4a) which subsequently completely disappears (Figure 4b) or is reduced to the dimensions of a small tubercle. In young individuals the superointerior corner of the carpopodite is extended into a broad outgrowth which bears two pointed teeth; however, these soon disappear so that only the broad outgrowth remains, and even this disappears in some adult specimens. The meropodite of the chelipeds is always shorter in the female than in the male, since in the male the chelipeds are generally stronger. The upper edge of the meropodite of the pereopods is clearly denticulated in young specimens; subsequently, this denticulation is hardly visible.

Hilgendorf presumed that Ch. depressus is a young Ch. niger, but he presented no proofs of this.

Distribution: Red Sea; the Seychelles; Mauritius; Bourbon Island; Zanzibar; Madagascar; Philippines; Fiji; Navigators Islands; Tongatabu; Wakes; Upolu; Sulu Sea; Mangsi Island; Ryukyu Islands; New Caledonia.

Alph. M. Edwards considers Ch. cytherea and nebulosa Dana identical with Ch. niger, a statement with which we suppose one can agree; but it is strange that after studying about 200 specimens from a single station, he did not conclude that Ch. depressus is also a juvenile Ch. niger.

#### Ch. ungulatus M. Edw.

- Savigny. Desc. de l'Egypte Tab. V. Fig. 6.  
Chlorodius ungulatus M. Edwards. Hist. nat. des Crust. T. I. p. 400. Tab. XVI. Fig. 6-8.  
Xantho Dehaanii Krauss op. cit. p. 29 Tab. I. Fig. 2.  
Chlorodius areolatus Adams et White op. cit. p. 41. Tab. LX. Fig. 3.  
" ungulatus Dana op. cit. p. 205. Tab. XI. Fig. 8.  
" Dehaanii Heller Beit. zur Crust. F. des r. M. p. 337.  
" " Heller Navarra Expedition p. 19.  
Phymodius ungulatus Alph. M. Edw. Nouv. Arch. du Muséum. T. IX. p. 218.

Until now, no one paid any attention to age and sex; owing to this, the species was split into a number of species, as shown by the above synonyms.

Out of twenty specimens of various ages and both sexes, some entirely correspond to X. Dehaanii Kr. and Ch. Dehaanii Hell. Both of these authors refer to the illustrations of Savigny, who drew a male, in which, it is true, the meropodite of the chelipeds is shorter than usual. Such aberrations with regard to the length of the chelipeds are found, however, in some of the preceding species as well, and we studied two males of an intermediate age and of the same size (corresponding to the illustration of M. Edwards, Table XVI, Figure 6) in which in one case, chelipeds were identical with the illustrations, while in the other, on the contrary, the meropodites were shorter and the chelipods had a feminine character. Other specimens of ours correspond to the illustration of Savigny; the surface of the pereopods is also granulated; and not only the superior edge of the meropodite bears small spines (as stated by Heller in Navarra Expedition) but also the carpo- and the propodite; it is true that here the spines are covered with hairs. In some of them the pereopods bear sparse hairs, and in others dense hair. In the young specimens, the spines of the anterolateral edge are pointed, but this edge becomes more rounded with age and the spines become blunt. As to the chelipeds, we may further add that the superior part of the internal surface of the propodite is granulated in both sexes. The tubercles on the carpo- and propodite are short and pointed, or large and blunt—according to age. The external and internal surfaces of the meropodite are granulated. On the superior edge, one tubercle is found, and on the inferior edge, there are three to four granules, which, in the male, have the form of spinules. The horseshoelike dactyli are open and have

two to three denticles in the female; in the male, the dactyli are stronger and have only one large tooth each. The color of the cephalothorax and of the legs corresponds to the illustration by M. Edwards.

M. Edwards drew the male of Ch. ungulatus. Although his description is rather short, it corresponds, as we have shown, to some of our specimens; he states that in Ch. ungulatus, the surface of the cephalothorax is sparsely granulated. This character is absolutely correct for young individuals, but in adults, the areas have a very dense granulation. The pereopods are not correctly drawn, but the text notes that they are covered with spines.

The description of Ch. ungulatus by Dana also corresponds with our males. The protogastric area is divided by a longitudinal furrow; the mesogastric area is in some specimens divided into three parts, while in others no division is found. In the same way, 5L and 6L are in some cases more or less divided by a furrow. The dactyli of the chelipeds are open, and the anterior edge of the third joint of the first maxilliped is bent.

The male differs from the female by its long and unequal chelipeds; the meropodite of the male exceeds the cephalothorax in length on one side much more than on the other, as drawn by M. Edwards; but we have observed that there are also males with typical female chelipeds. In the female, the chelipeds are equal in length and the meropodite hardly exceeds the cephalothorax. In the male, the black coloration of the index\* extends to the internal surface of the propodite; the external surface of the propodite is entirely covered by granulations. The illustration of Chlorodius aerolatus by Adams and White corresponds completely with our females. We had at our disposal females of various ages; the largest was 25 mm wide, and 17 mm long; another was much smaller (width of the cephalothorax is 10 mm, length is 7 mm) but was ovigerous. These figures again show that the cephalothorax becomes wider with increasing age.

The groups into which Dana divided the species of the genus Chlorodius have been used by Alph. M. Edwards for the creation of the new genera Phymodius and Leptodius. These three genera have identical characters, with the exception of the surface of the cephalothorax, which in Chlorodius does not have clearly delimited areas in its anterior part; in Leptodius the areas are well developed in the anterior part; in Phymodius finally, the whole surface of the cephalothorax is divided into areas. It is clear that we are here concerned with the same evolution as in Atergatis, Lophactaea, and Zozymus. We do not see, therefore, any reason to split the genus on basis of character which presents intergradations from the simplest form to the most complex. In the present case, the evolution from the simple to the complex form was, of course, a very long one; we reached this hypothesis on the basis of the study of Chlorodius niger specimens of various ages. In a very young stage, the surface of the cephalothorax is smooth, and later the above-mentioned areas gradually appear. This change in the surface of the cephalothorax is clearly drawn in Table VI, Figures 4, 4a, and 4b. The development of these areas became stronger over a long period of time, and then, according to the law of succession, began to appear also in the juvenile stage. We suppose that on the basis of these considerations, most scientists will agree with us that the

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\* [ This word appears in Latin in the text. ]

genera Leptodius and Phymodius must be abolished, since they are quite artificial.

Distribution: Red Sea; Natal; Strait of Balabac; Philippines; Australia; Mangsi Island; Navigators Islands; Tahiti; New Caledonia.

## GENUS CYMO DEHAAN.

### *C. Andreosyi* Aud.

Tab. VI. Fig. 5—5a.

Pilumnus	Andreosyi	Audouin Desc. de l'Egypte Pl. V. Fig. 5.
Cymo		Dehaan op. cit. p. 22
"	Andreosyi	Dana op. cit. p. 225. Pl. 13. Fig. 2.
"	melanodactylus	Dana " " " " " " Fig. 1.
"	Andreosyi	Heller Beit. zur Crust. F. des. M. p. 346.
"	"	Alph. M. Edwards. Nouv. Archiv. du Muséum. T. IX. p. 252.
"	melanodactylus	" " " " " " " " p. 252.

In young specimens (which are 6.2 mm wide) the frontal edge is arcuate, bears pointed spines, and the frontal areas are smooth. In the adult specimens (15.5 mm wide) the frontal edge is almost straight, bears blunt spines, the areas are covered by tubercles, and between the frons and the beginning of the superior orbital edge there is a large cavity for the flagellum of the antenna. The surface of the cephalothorax is quite correctly described by Heller; in large specimens, it is usually covered with many granulations; however, specimens are found of the same age, among which some have a smooth surface without granulations and without furrows, and others in which the surface is granulated, and the hepatic and branchial areas have a fairly clear contour of furrows. None of the Red Sea specimens had the incision drawn by Dana on the lateral edge of C. Andreosyi.

In young individuals, the carpopodite and the propodite of the chelipeds are covered with large pointed spines and are pubescent; in the adult specimens, these joints are almost hairless and the spines have become granulations. Two of our specimens had black dactyli, the others had white.

C. melanodactylus drawn by Dana has the characters of a young C. Andreosyi. Our opinion is confirmed by the form of the cephalothorax, which in all young specimens has the same width over its entire length, while in adult specimens the anterior part is wider. In addition, the spines of the frontal edge are always more pointed in young specimens, while in adult specimens they are blunt. Finally, as already shown, in two specimens of intermediate age, the dactyli were black, and therefore the color has no importance. The rudimentary lobe drawn on the lateral edge of C. melanodactylus (Dana) is also found on some of our specimens, being caused by very prominent granulations. The smallest specimen had a width of 6.5 mm, and an equal length; the largest specimen had a width of 15.5 mm and a length of 14.2 mm. The 7 mm wide female was ovigerous. Savigny's illustration is very accurate [17 specimens].

Distribution: Red Sea; Java; Upolu; Tahiti; Fiji; Navigators Islands; New Caledonia.

FAMILIA

ERIPHIDAE.

GENUS PILUMNUS LEACH.

*P. Forskalii* M. Edw.

Tab. VII. Fig. 1-1a.

*Cancer incanus?* Forskal op. cit. p. 92.

*Pilumnus Forskalii*. M. Edwards. Hist. nat. des Crust. T. I. p. 419.

Neither illustrations nor exact descriptions of this species have been available until now. The cephalothorax is protuberant in the longitudinal direction. The frontal edge is smooth and extremely bent ventrally; it has a median incision; a deep hollow is found on every side and forms two broad median lobes; there is a pointed spine on both sides. The superior orbital edge is smooth; the preorbital, and especially the extraorbital spines are well developed. Between the latter and the denticulated inferior orbital edge, there is no incision; the postorbital spine is not actually large, but seems to be so, since the orbital fissure is not filled by the basal joint of the antenna, the third joint of which is longer than the second one. The anterolateral edge bears three spines, and in front of the first there is another small submarginal spine. The anterior part of the surface of the cephalothorax is divided by deep furrows, and the areas are covered with tubercles which in turn are covered with long, thick, yellowish hair; the posterior part of the cephalothorax has no tubercles and the hair is shorter.

The chelipeds are unequal in size. This is more obvious in the male; the meropodite bears a pointed spine on its superior edge; on the inferior edge there is a row of granulations. The external surfaces of the carpo- and propodite are covered with blunt, conical tubercles, which, on the propodite are arranged in horizontal rows; their inferior and internal surfaces are smooth. The dactyli are dark-brown and have no furrows but have blunt denticles. The base of the large dactylus is covered with granulations and hair. The pereopods are flattened, and, like the chelipeds, are covered with long, rigid hair; the superior edge of the meropodites is sharp. In the carpo- and propodite, this edge is not sharp, but rounded and covered with small tubercles. In the carpopodite this edge is separated from the external surface by a furrow. The tubercles, as well as the furrow, were omitted by the artist and therefore do not appear in the figure. The color of the body is yellow, and in a few cases, red spots are found on the cephalothorax. In the collection, there are eight specimens which resemble one another exactly, the male differing from the female only by the greater size of its chelipeds. The width of the largest specimen is 16 mm and its length is 12 mm.

Distribution: Red Sea; and, according to Heller, the Canaries.

By comparing P. Forskalii with Heller's description of P. vespertilio, we find that the latter has: 1) a smaller extraorbital spine; 2) two teeth on the superior edge of the chelipeds; and 3) the tubercles disposed in transverse rows on the propodite of the chelipeds. These differences are so small, that our specimens could have been considered P. vespertilio. We did not consider them as such, however, since M. Edwards, who described P. Forskalii for the first time, separated it because of the horizontal rows of tubercles on the propodite. This unique character is also of little importance, and therefore it will be necessary for a zoologist from Paris to give a more accurate description of the specimen which M. Edwards used as a type for P. Forskalii, and, in the case of P. vespertilio as well as in the case of P. Forskalii to refer to the relationship between the antenna and the orbital fissure, a relationship which is outstandingly characteristic and constant within one species.

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According to Heller's description, P. Savignyi\* differs from P. vespertilio by its less protuberant cephalothorax, by the denticulation of the internal edge of the meropodite of the chelipeds, by the lack of tubercles on the inferior half of the external surface of the carpo- and propodite of the chelipeds, and finally by the softer and thinner hairs. All these differential characters seem to be specific, and if we take into account the fact that the specimens of P. Savignyi were younger than those of P. vespertilio, all these differences may also be ascribed to age. This assertion can be

\* In describing this species, Heller refers to the illustration of Savigny in "Desc. de l'Egypte" (Table V. Figure 4), and in his study "Crustaceen des südlichen Europa's" he also presents this illustration when describing P. spinifer. However, this illustration differs from P. Savignyi in that it lacks the fourth spine on the subhepatic area, and from P. spinifer in that it has three spines on the anterolateral edge.

In addition, we want to stress here that P. spinifer and P. villosus should not be considered species. Following an exhaustive analysis of 29 specimens from the Mediterranean and Black Seas (we also worked out a comparative table) we found that five specimens correspond exactly to the very extensive description of P. hirtellus in "Crustaceen des südlichen Europa's". The characters of the other 24 specimens are combined in such a way that none of these specimens may be included in any of the three species described by Heller. The constant characters found in all 29 specimens are the following: the frontal edge; the inferior orbital edge with its characteristic postorbital spine (see Table VI. Figure 8); the one to three small spinules found under the lateral edge between the second and the third spine; and finally, the basal joint of the antenna, which does not fill the corresponding part of the orbital fissure.

Since near the British shores (see Pennant "British Zoology", p 6, Table V. Figure 11, and Bell "British stalk-eyed Crustacea" p 68) and in the Black Sea, the specimens found mostly resemble P. villosus—and the same is true for most of the Mediterranean forms. We may assume that the original species in these seas was P. villosus (having characters which have almost disappeared) and that in the Mediterranean, conditions appeared owing to which some of the descendants of P. villosus were modified and developed into P. hirtellus, whose characters are quite stable at present. Another group of descendants is also undergoing changes at present and therefore P. spinifer and P. villosus (no longer identical to its original form) must not even be considered varieties, since the sense of the term "variety" must be—within all possible limits—defined, and not used in the case of any nonhereditary modification



supported by facts. Of the eight adult specimens of P. Forskalii, we also had four young specimens which showed these differences, so that P. Savignyi must be considered a young specimen either of P. vespertilio or of P. Forskalii.

In all four young specimens, the number of spines on the lateral edge, the relationship between the antenna and the orbital fissure, the superior and inferior orbital edges, and the chelipeds, have the same structure as in the adult P. Forskalii; however they differ from it by the following characters:

1. In the specimen which was 6.5 mm wide, the cephalothorax is less protuberant; the surface is covered with punctiform hollows and sparse short hairs; the areas are less clearly delimited; the internal surface of the propodite of the chelipeds is granulated, and the anterointernal corner of the carpopodite ends with a pointed tubercle.

2. In the two specimens which were 8 and 9 mm wide, the cephalothorax is less protuberant, it is smooth and bears sparse hairs; the beginning of the superciliar part has the shape of a pointed tooth; the anterointernal corner of the carpopodite of the chelipeds ends with a pointed tooth. These specimens correspond exactly with P. Savignyi Heller.

3. In the specimen which was 10.5 mm wide, the cephalothorax is less protuberant, it is granulated, and the areas in the anterior part are poorly delimited; the hair is sparse; the internal surface of the propodite of the chelipeds is granulated, and the anterointernal corner of the carpopodite ends with a pointed tubercle.

#### **P. Schrenckii.**

Tab. VI. Fig. 6-6b.

The frontal and the superior orbital edges are denticulated. The cephalothorax is protuberant in the longitudinal direction. The frontal edge is strongly bent ventrally; it is divided by a median incision into two slightly concave lobes which end with a spine, and is delimited from the superior orbital edge by a deep hollow. The superior orbital edge bears a preorbital and an extraorbital spine; the latter is separated from the inferior orbital edge by an incision. Only the second half of the inferior orbital edge is denticulated. On the external surface of the extraorbital spine there is a very small spine which can be observed only through a magnifying glass. The postorbital spine is rounded and poorly developed. The inferior part of the orbital fissure contains the basal joint of the antenna. The third joint of the antenna is shorter than the second. The surface of the cephalothorax, as well as the legs, are covered with a tomentum\*, from which longer hairs arise. The anterior part of the cephalothorax is divided into areas but these areas can only be seen when the tomentum is removed. There are four tubercles on the hepatic area, while on the external branchial area there is only one tubercle, on the left side. The anterolateral edge bears three pointed spines; their superior part shines and therefore the spines are easily seen.

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\* [A covering of very fine hair, more fine than pubescent.]

The chelipeds are of almost equal length; there is a pointed spine on the superior edge of the meropodite; the other edges are smooth; the anterointernal edge of the carpopodite is denticulated and on the convex external surface there are three rows of pointed tubercles; one of the rows is on the superior edge. The convex external surface of the propodite is covered with pointed tubercles, which become smaller and more blunt in the posterior direction and also cover the immovable dactylus. In the superior part, the tubercles are disposed in oblique longitudinal rows, which continue on the inferior part of the propodite, forming an angle. The dactyli have blunt teeth; the base of the large dactylus is covered with granulations; it has furrows only in large specimens. The pereopods are flattened and are shorter and broader than those in the preceding species. One male. The width of the cephalothorax is 10.8 mm and the length is 8 mm.

Distribution: Red Sea.

### *P. Vauquelinii* Aud.

Tab. VI. Fig. 7.

*Pilumnus Vauquelinii* Audouin. Desc. de l'Egypte p. 266. Savigny Pl. V. Fig. 3.

" " Heller. Beit. zur Crust. F. des r. M. p. 344.

We take the liberty of making a small addition to Heller's outstandingly precise description. The length of the anterolateral edge in our specimen is almost equal to the length of the posterior edge, and the anterolateral spine is rather far from the extraorbital spine, which, in turn, is followed by a small rounded infraorbital spine. The internal edge of the meropodite of the chelipeds is denticulated. One male. The width of the cephalothorax is 13 mm, and the length is 9.5 mm.

Distribution: Red Sea.

## GENUS *ACTUMNUS* DANA.

### *Act. obesus* Dana.

Tab. VII. Fig. 2-2a.

*Actumnus obesus*. Dana op. cit. p. 245. Tab. XIV. Fig. 3.

" *globulus* Heller. Beit. zur Crust. F. des r. M. d. 341. Tab. III. Fig. 23.

" " Alph. M. Edwards. Etud. zool. sur les Cancer. p. 366. Pl. XVIII. Fig. 4.

The only female brought from the Red Sea differs slightly from *Act. globulus* described by Heller; we shall emphasize this difference and make some additions to the description.

The cephalothorax is protuberant. The frontal edge is covered with hair, it is slightly prominent and is separated from the superciliar area by a small hollow. The superior orbital edge is granulated, but lacks incisions. The preorbital spine may only be observed under tenfold

magnification, and only on the right side; the inferior edge is pubescent; the postorbital spine is rounded and poorly developed. The anterolateral edge is the same length as the posterior one, and is divided into four lobes by three small incisions; the edges of the incisions are granulated and therefore seem to be denticulated. In connection with our figure, it should be pointed out that the edge following the third incision (i. e., the fourth lobe) is not straight in our specimen, as shown in our figure, but bent ventrally; if we consider this part (the one with the granulated edge) as being the posterior one, then the anterolateral edge is shorter than the posterior edge, and, in this way, corresponds with the Paris specimens. The post-lateral edge is concave and smooth. The whole surface of the cephalothorax is covered with white, shining granulations (in Heller's and Alph. M. Edwards' specimens the posterior part is smooth); among the granules there are hairs which are shorter than the granules. The development of the areas may be followed in the figure; 2M has no incision. The basal joint of the antenna is free, it reaches the frontal process and its superior-external corner forms a thin outgrowth, which enters the orbital fissure, where only the first two joints of the antenna are found. The pterygostome is smooth and covered with short hair which is not shown in the figure.

The external surface of the carpopodite of the chelipeds is sparsely granulated. On the propodite, in contrast, there is a dense granulation which does not, however, reach the inferior edge. The dactyli are spoon-like, with blunt teeth; the large dactylus is almost entirely granulated and at its base there is a tuft of hair. The pereopods are flattened; their external surface is covered with the same short hair as the cephalothorax, and only along the sharp superior edge is this hair longer. The color of the cephalothorax and of the pereopods is yellowish. The chelipeds are pink.

Distribution: Red Sea.

If we now compare Act. globulus Hell. with Act. obesus, we shall find that the first differs from the second by its mesogastric area, which in A. obesus is simple, while in A. globulus its inferior part is divided into two parts by a furrow. One can hardly attach any importance to this difference, since in the Vienna specimen, 2M has an incision, while in our specimen this incision is lacking. The branchial area is not divided in Dana's illustration, but the text states that: "5L, 6L are separate"; consequently, it is identical with A. globulus. Another difference, as unimportant as the preceding one, is found in the arrangement of the granules on the cephalothorax. In our specimen and in A. obesus, the whole cephalothorax is granulated but in Alph. M. Edwards' and Heller's only the anterior part is. Hence it results that the specimen from our collection differs as much from the Vienna specimen as from the specimen from Tahiti, and since the differences are very insignificant, we consider Act. globulus identical with Act. obesus. Act. miliaris Alph. M. Edwards, which shows no essential difference from Act. obesus, probably also belongs to this last species.

## GENUS TRAPEZIA LATREILLE.

From this genus Dana separated the species in which the frontal edge is almost straight and denticulated and the meropodite of the chelipeds is shorter. From these species, he created the genus Tetralia. In characterizing these two genera, Dana, followed by others, included an erroneous remark with regard to the most essential character which separates the two genera. Dana states: "in both genera. . . . . the outer antennae are excluded from the orbit". This statement is wrong and fits only the genus Trapezia, in which the antennae are cylindrical. In Tetralia, on the contrary, this joint of the antennae is rhomboidal (Table VII. Figure 7a) and fills the narrow orbital fissure, so that its hairy external edge lies in the orbit. In addition, the second joint of the second maxilliped is relatively shorter and has a prominent internal edge; in Tetralia, on the contrary, the second joint is longer and the internal edge is straight (see Table VII. Figures 4 and 7).

### Tr. ferruginea Lat.

- Trapezia ferruginea Latreille. Encycl. T. X. p. 695.  
" cymodoce Audouin. Desc. de l'Egypte p. 265. Savigny Tab. V. Fig. 2. Fig. 2f.  
" coerulea Rüppel. op. cit. p. 27. Tab. V. Fig. 7.  
" ferruginea Dana op. cit. p. 260. Tab. XVI. Fig. 1.  
" subdentata Gerstäcker. Carcinol. Beit. Arch. für Naturg. Bd. XXII. p. 127.  
" ferruginea Heller Beit. zur Crust. F. des r. M p 349. Tab. IV. Fig. 40

We have found inaccuracies in the diagnoses of T. ferruginea and T. coerulea. M. Edwards and Dana consider that Figure 2 of Savigny's Table V refers to T. ferruginea; this is not entirely true, since these figures were undoubtedly combined from two different Trapezia. Figure 2 refers to T. coerulea. Figures 2<sub>2</sub> and 2 f refer to T. ferruginea. The same is true of the illustration by Rueppel (Table V. Figure 7)—an author who separates species only according to the color of the cephalothorax. The illustrations refer to T. ferruginea. The thirty-four specimens have furnished fairly sufficient material for the study of the constant and the variable characters and for determining the differences from T. coerulea.

The frontal edge is not identical in all specimens; in two, it is almost straight and corresponds in this respect with the descriptions by Latreille, Heller, and Dana, who had one specimen each at their disposal; in all the other specimens, it greatly resembles T. coerulea, the only difference being that the external part of the lateral lobes is rounded and denticulated. The extraorbital and postorbital spines are small and in one specimen the latter was even missing (see the outstandingly accurate illustration in Savigny, Table V. Figure 2<sub>2</sub>). In all adult specimens, the lateral spine appears in the form of a small blunt prominence; in all young specimens it is pointed and resembles that of T. coerulea. When the carapace

[? the meaning of Russian text is not clear] reaches 11 mm in length, it becomes smaller and blunt.

The meropodite of the chelipeds has four to six teeth; in most cases, six. The superior-internal corner is extended in the form of a small blunt tooth; in some cases it is pointed; the external surface of the carpo- and propodite is smooth in all specimens. The dactyli are light-colored, but in some specimens they are dark, as they are in T. coerulea. In all specimens without exception there is a red spot at the end of the propodite of the pereopods. In almost all the specimens, the antennules are covered with red spots; such spots are sometimes also found on the antennae. The dominant color of the cephalothorax is reddish-yellow; in two specimens it is grayish-blue, as in T. coerulea; in two others it is bluish-red. Gerstaecker's specimen is grayish-red; the specimen which Latreille described was a pale-yellow color, mixed with black.

The constant and distinguishing characters with respect to T. coerulea are: 1) the smooth surface of the carpo- and propodite of the chelipeds, and 2) the red spot found at the end of the propodite of the chelipeds. The largest specimen was 17 mm wide and 13.5 mm long.

Distribution: Red Sea; Samoa Islands, Tahiti; Sulu Sea.

#### Var. T. coerulea Rüppel.

Tab. VII. Fig. 4-4a.

Trapezia cymodoce Audouin op. cit. p. 265. Savigny Pl. V. Fig. 2.

„ coerulea Heller. Beit. zur Crust. F. des. r. M. p. 348.

The analysis of 54 specimens showed us that the following characters are constant: in all specimens and at all ages, the lateral spine is always pointed and well developed. The external surface of the carpo- and propodite of the chelipeds is covered with thick hair, in all specimens without exception, and the frontal edge has the structure which is illustrated in our Figure 4, and in the outstandingly accurate characterization by Heller. The extraorbital and postorbital spines are well developed; in some specimens the latter even extends over the frons. The two chelipeds are almost equal in size.

The characters which are especially subject to variation are the shape and the number of the teeth on the meropodite of the chelipeds. In some, these are simple, in others they are double or serrated; they vary in number from four to six. The tubercle in the anterointernal corner is usually small and blunt, and only seldom pointed. In some individuals the antennules are spotted, in others this is seen on the antennae. The color of the cephalothorax is usually grayish-blue; in the males it is brownish-red, and in eight specimens the color is something intermediate between the latter two colors. The ratio between the length and the width of the cephalothorax is very variable: 1:1.12; 1:1.13; 1:1.5; 1:1.27. The largest specimen was 20 mm wide and 16 mm long.

Distribution: Red Sea.

From the comparison of these two Trapezia, we find that T. coerulea differs from T. ferruginea by the following characters: 1) the pubescent surface of the carpo- and propodite of the chelipeds, and 2) the lack of spots at the end of the propodite of the chelipeds. Although these characters are constant, they are an insufficient justification for a new species, and therefore we consider T. coerulea a distinct variety of T. ferruginea formed in the Red Sea. T. ferruginea is a widespread species, which in all probability also gave rise to the other varieties.

#### Var. T. guttata Rüppel.

Trapezia guttata Rüppel. op. cit. p. 27.

" " Heller. Beit. zur Crust. F. des r. M. p. 351.

The frontal edge is like that in T. ferruginea. The extra- and post-orbital spines, like the pointed spine on the lateral edge, are well developed. The propodite of the chelipeds is naked; the toothlike prominence on the anterointernal corner of the carpopodite is pointed in young individuals and blunt in adults. The shape and number of the teeth on the meropodite is variable, and may be from one to ten. The color of the body is yellowish. The pereopods bear red spots, which at present have disappeared in the smallest specimen because of preservation in alcohol; because of this it can hardly be distinguished from T. ferruginea; the well-developed extra- and postorbital spines are the only distinctive character. On the basis of these facts, we consider T. guttata variety of T. ferruginea, which also has red spots which are only found on the ends of the propodite. In the case of the largest specimen, (cephalothorax 13 mm wide and 10 mm long) the outer maxillipeds are spotted as a result of which this specimen resembles the following variety.

Distribution: Red Sea.

#### Var. T. rufopunctata Herbst.

Tab. VII. Fig. 3-3a.

Cancer rufopunctatus Herbst. op. cit. T. III. p. 206. № 206. Tab. XLVII. Fig. 6.

Trapezia rufopunctata Latreille Encycl. method. T. X. p. 695.

" " Lucas. Voyage au pôle sud. T. III. Crustacés p. 41. Pl. IV. Fig. 8.

" tigrina Eudoux et Souleyet. Voyage de la Bonite. Zool. T. I. p. 232. Pl. II. Fig. 4.

" rufopunctata Dana op. cit. p. 225. Tab. XV. Fig. 3.

" maculata Dana op. cit. p. 226. Tab. XV. Fig. 4.

" " Stimpson Ann. of the Lyceum of nat. hist. of New York Vol. VII. p. 219.

Grapsillus maculatus M'Leay. Smith's Illustrations of the zoology of South Africa. Invertebratae. p. 67.

Trapezia rufopunctata Gerstäcker. Carcinol. Beit. Arch. für Natugesch. Jahrg. XXII. p. 123.

" " Heller. Beit. zur Crust. F. des r. M. p. 350.

" " Hilgendorf. von der Deckens Reisen in Ost-Afrika p. 75. Tab. II. Fig. 3.

" " Alph. M. Edwards. Nouv. Arch. du Muséum T. IX. p. 258.

In the only male at our disposal, the frontal edge has the structure of that of T. ferruginea. The extra- and postorbital spines are well developed,

the latter is curved, with a pointed end, and is longer than the frontal edge. The lateral spine is also well developed. The teeth on the mero- and carpopodite of the chelipeds have the same development as in Dana's specimen. Through a powerful magnifying glass, a denticulation may be observed on the inferior edge of the propodite. The cephalothorax is white with red spots which are very far apart; these spots are larger on the cephalothorax than on the other parts of the body.

Gerstaecker considers the T. rufopunctata described by Dana as an independent species. We cannot agree with this. The pointed tooth on the carpopodite and the large pointed teeth on the meropodite are, in our specimen, identical with those of the specimen from Tahiti, and the spots are even farther apart. The only difference, that of the frontal edge—which however resembles that of Hilgendorf's specimen from Zanzibar—is also unimportant, since Alph. M. Edwards, who studied a great number of specimens, demonstrated the variability of this edge in T. rufopunctata.

Distribution: Red Sea; Zanzibar; Indian Ocean; Hawaii; Sokoro Island, near the western shore of Mexico; New Caledonia.

The variety T. flavopunctata Eudoux and Souleyet appeared because of a stronger development of the teeth along the inferior edge of the propodite of the chelipeds. This variety is nearly related to T. rufopunctata; according to the synonym of Alph. M. Edwards, it may even be identical to it.

#### Var. T. digitalis Latr.

Tab. VII. Fig. 5-6.

Trapezia digitalis	Latreille. Encycl. T. X. p. 696.
" leucodactyla	Rüppel. op cit. p. 28.
" digitalis	Heller. Beit zur Crust. F. des r. M. p. 352.

T. digitalis described by Heller, differs somewhat from T. digitalis Latr. We shall discuss below the difference which appears between their males.

Lateral spines, although small, are present in this variety as well; these were not observed by anyone until now. In the youngest specimen of the eight, the spine on the right side is more developed and pointed; in another specimen, instead of these spines, only prominences remained, which in turn almost completely disappeared in a third case, so that the edge is slightly prominent, and has the form shown in our table; in only two specimens, a denticulation could also be found on the superciliar part of the orbital edge. The extraorbital spine is well developed; the postorbital spine is small in some species, and in others it is large, curved and pointed. The chelipeds of the female are equal in size; in the male, one cheliped is somewhat longer than the other; not only the shape, but also the number of teeth on the meropodite is variable: there may be four to eight. The tuberculiform tooth on the carpopodite is either blunt or pointed; the external surface of the carpo- and propodite is covered with a hardly visible tomentum; the dactyli are white, except for the base of the movable dactylus. The dactyli of both legs, in both sexes, close perfectly. The color of the

cephalothorax is, in some specimens, dark-brown, almost black, and in others lighter. The chelipeds are also a dark-brown color with the exception of the inferior half, which is whitish.

We have also studied two males, which differ somewhat from the form described above, but are absolutely identical with the T. digitalis described by Latreille. These specimens are characterized by the open dactyli on the large cheliped and by the large denticulated tooth at the base of the immovable dactylus (Table VII, Figure 6). In one of them, one of the chelipeds is much longer than the other. On both sides, on the lateral edge, a small prominence may be observed through a magnifying glass; in front of each of these prominences there is a small hollow. The prominences correspond to the spines, which have almost completely disappeared in T. digitalis. The lateral prominences probably escaped the attention of Latreille because of their small size.

Since until now only males with such dactyli had been known, the other characters being absolutely identical, these undoubtedly represent only the dimorphous males of those specimens which Heller considered T. digitalis.

If we take all the characters into account, we find that T. digitalis differs from T. ferruginea only by the coloration of the cephalothorax.

Distribution: Red Sea.

#### Var. T. Cymodoce Herbst.

Cancer Cymodoce	Herbst. op. cit. Bd. III. p. 23. N 220. Tab. LI. Fig. 5.
Grapsilus dentatus	M'Leay op. cit. p. 67. Pl. III.
Trapezia miniata.	Lucas. Voyage au pôle sud. T. III. Crust. p. 43 Tab. IV. Fig. 10.
" Cymodoce	Gerstäcker. Carc. Beit. Arch. für Naturg. Jahrg. XXII. p. 125.
" "	Heller. Beit. zur Crust. F. des r. M. p. 352.
" dentata	Dana op. cit. p. 258. Tab. XV. Fig. 6
" Var. subintegra	" " " " " Fig. 7.
" Cymodoce	Hilgendorf. op. cit. p. 26. Tab. II. Fig. 4.
" "	Alph. M. Edwards Nouv. Arch. du Muséum T. IX. p. 230.
" dentata	" " " " " " p. 231.

T. Cymodoce is characterized by its protuberant cephalothorax. In our only female, the frontal edge is almost straight and bears very small spines. The extra- and postorbital spines are like those in T. rufopunctata. The spine on the lateral edge is pointed. The anterointernal corner of the carpopodite ends with a pointed tubercle. The cephalothorax has a rusty color. The width of the cephalothorax is 7.5 mm; the length is 6 mm.

Distribution: Red Sea; Zanzibar; Tahiti; Fiji; Tongatabu; New Caledonia.

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All members of this genus which we studied greatly resemble one another. In some, the lateral spine gradually becomes smaller and may disappear completely; simultaneously, the frontal edge becomes shorter and its spines disappear. In others, the lateral spine and the frontal edge are almost unchanged, but in contrast spots appear on the body, which also appear in one member of the first group (*T. ferruginea*). In a third case, finally, the lateral spine is retained, but the frontal edge is modified and the cephalothorax becomes protuberant.

These modifications are intergradations and therefore all the varieties of the forms of this genus in the Red Sea must be considered as varieties of *T. ferruginea*.

We suggest the following determination table:

	protuberant	-----	-----	<i>Cymodoce</i>	
Cephalothorax	flat; lateral spine	well developed, pointed; carpo- and propodite of chelipeds	hairy	-----	<i>coerulea</i>
			smooth	-----	<i>guttata</i>
	small, blunt, or lacking, well developed only in young stage	Color of cephalothorax	Pereiopods spotted	-----	<i>rufopunctata</i>
			Whole body spotted	-----	<i>rufopunctata</i>
			black; lateral spine sometimes missing	-----	<i>digitalis</i>
			reddish-yellow; lateral spine always present	-----	<i>ferruginea</i>

## GENUS TETRALIA DANA.

### *T. cavimana* Hell.

Tab. VII. Fig. 7 & Tab. IX. Fig. 1-14.

*Tetralia cavimana* Heller. Beit. zur Crust. F. des r. M. p. 253. Tab. III. Fig. 24,25.

In the seven specimens studied, the straight edge of the meropodite of the chelipeds is either smooth or bears minute denticulations, and in all the specimens ends with a broad outgrowth, which bears three teeth in some of the specimens. In two specimens, the carpopodite of the smaller cheliped bears a pointed tooth. In two specimens, the color of the cephalothorax is dark-brown; in four specimens it is yellowish-red, and in one it is white with a black stripe along the frontal edge. In this last specimen there is a black spot at the end of the propodite of each of the chelipeds. The other characters correspond to Heller's description.

Distribution: Red Sea.

The section made through the hollow of the propodite of the chelipeds did not reveal the function of this formation. The borders of the hollow (Table IX Figure 1) bear simple, rigid hairs, disposed in three rows; the rest of the surface is covered with thick pennate hairs, among which the openings of a great number of canaliculi are found. Under the cuticle, a finely granulated layer with nuclei can be observed; this is followed by a thick cellular-fibrous layer, rich in large pigment cells.

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While performing the sections, we involuntarily concentrated our attention on the structure of the cuticle and reached the conclusions that in spite of the great number of studies carried out\*, [see following page] its structure is not yet entirely elucidated. Three layers may be observed in the cuticle (Table IX Figure 1a). In the superior and in the inferior, the horizontal layers are narrower and therefore the transverse lines which separate them are very near to one another, while in the median layer, they are very far apart. In addition, the superior and inferior layers are easily distinguished from the median layer. The dark transverse lines probably have a density different from that of the rest of the fundamental substance.

In the inferior layer, the substance of these lines is dissolved and the strata are distinct from one another; in the other layers, the strata are not distinct, with the exception of the outermost, homogeneous layer (the epithelial layer of Lavallo), which has a relatively great thickness and forms tubercles on the surface in Astacus fluviatilis. In Tetralia and Trapezia, this layer forms only a very thin film. Pigment is deposited in the superior layer. The cuticle is crossed by wide filamentous canals in the longitudinal direction; these canals reach only the superior layer, where they become hairs, spines, etc. In addition, there are other narrow canals which we propose to call cuticular canals; they cross the whole cuticular layer and have an opening at the surface. Both these kinds of canals have their own parietal membrane and can easily be isolated by maceration. The numerous dark colored longitudinal lines, considered by all as being porous canals (with the exception of Lavallo, whose study was not taken into consideration in this respect), have in fact the structure of dense filaments, which can easily be isolated when the layers are separated, i. e., they may be extracted easily from the homogeneous fundamental substance, their ends breaking either transversely or with a pointed tip (Table IX Figure 1b). The homogeneous fundamental substance forms an elastic layer--in sections it always has an undulated surface; the dark transverse lines are situated more deeply and form a hollow between the layers; the membranes of the filamentous and cuticular canals form undulated lines.

How could the formation of the longitudinal filaments be explained? Leydig already explained their origin--and in our opinion, quite correctly; but he was wrong in believing that the filaments are canals. He supposes "that at the surface of the epithelial cell, filaments develop like vibrating cilia and that between them, a homogeneous substance is deposited, produced by the rest of the cell surface". The filamentous canals are formed in a similar way; in this case, the whole cell surface forms a single

- \* 1. Valentin. Repertorium für Anat. und. Physiologie Bd. I, 1836. We cannot agree with Valentin's study. According to other opinions, he was the first to study the hard shell of Arthropoda and to suppose that calcareous salts are deposited in the porous canals.
2. Meyer. Ueber den Bau der Hornschale der Käfer. Mueller's Arch. 1842. Meyer believed that the external and internal surface of the elytra in Lucanus cervus are covered with an epithelium. The structure of the median layer is not clear in his study.
3. Meckel. Mikrographie einiger Drüsenapparate der niederen Thiere. Mueller's Arch. 1846. p 18. Meckel supposed that the hard shell of Crustacea was formed from cells and, like Meyer, he believed this cover to be keratinous.
4. Lavalley. Recherches d'anatomie microscopique sur le test des Crustacés Décapodes. Ann. des sc. nat. 1847. Lavalley's studies found that the hard cover of the Crustacea is acellular. In the exoskeleton he distinguished three layers, which he very unsuccessfully named: epidermal layer (lacking in some cases), pigment layer, and dermal layer. He ascribed the cellular contours which are seen on the surface to the second layer. He considered the porous canals homologous to the filaments, in which no canals may be seen. In his opinion the transverse layers are formed by filaments; since these layers cannot be separated from one another, Lavalley admits that the transverse lines are not formed out of the substance which connects the layers, but he considered them as being thickenings of the longitudinal filaments, which always appear at the same level and at certain distances.
5. Siebold. Lehrbuch der vergl. Anat. der wirbl. Thiere 1848. Siebold believes the cellular contour observed on the surface of the exoskeleton to be parietal thickenings of the cellular layer, which subsequently fused. He was not able to observe calcium deposited in the porous canals.
6. Leydig. Zum feineren Bau der Arthropoden. Mueller's Archiv. 1855. Leydig denies the cellular structure of the cuticle as the deposition of calcareous strata in the porous canals. He admits the existence of two kinds of canals: wide canals, which become filaments, and narrow ones, the so-called porous canals. The latter are filled with air. He believes the black spots observed on the surface of the cuticle to be the openings of the porous canals. He compares both kinds of canals with the corpuscles of the connective tissue, which cross through the fundamental substance, and admits that the whole hard cover of the Crustacea is a chitinized connective tissue.
7. Koelliker. Untersuchungen zur vergleichenden Gewebelehre. Verh. der physik.-medic. Gesellsch. in Würzburg. Bd. VIII 1856. Koelliker confirms Leydig's studies, but does not agree that the hard shell of the Crustacea is a kind of connective tissue, since the cuticle is nothing but an excretion of the epithelial cells found immediately under the hard shell. Therefore, he considers this tissue as being a special cuticular tissue. He also considers the porous canals as empty spaces filled with liquid.
8. Haeckel. Über die Gewebe des Flusskrebses. Mueller's Arch. 1857. Haeckel did his research simultaneously with Koelliker but published it one year before. His general conclusions are identical with those of Koelliker.
9. Gegenbaur. Anatomische Untersuchungen eines Limulus 1858. Gegenbaur found four kinds of canals in the cuticle of Limulus: wide canals, ending with hairs or with spines and outstandingly narrow canal-like cavities (i. e., porous canals) which do not reach the surface. He also described other narrow canals which open at the surface, and have their ends surrounded by funnel-like thickenings; finally, there was a fourth kind of canal, relatively broad, open at the surface and having transverse ramifications, through which these canals connect with the porous canals, forming a net. According to Gegenbaur this net supplied food to the cuticle. Gegenbaur, who based his assumptions on the development of the connective tissue, does not agree with Leydig's comparison of this tissue with the cuticle—since the differences in development are in this case only quantitative and allow no distinction, if the comparison of a whole series of similar phenomena is at stake—he nevertheless considers the opinion of Koelliker and Haeckel as being better founded; he considered the hard shell of the Crustacea a cuticle, since it is not completely identical with the connective tissue.
10. Leydig. Vom Bau des thierischen Körpers. 1864. In this study Leydig confirms his previous conception and here explains only the formation of the porous canals, which he considers real canals. He admits that setae, which are subsequently surrounded by the chitinous substance produced by the cells grow from the epithelial cells.

outgrowth, the external layer of which becomes chitinized in order to form the wall of the canal, while the internal part remains unchanged. When longitudinal filaments are formed, they become completely chitinized, since their diameter is very small. In this case, we witness a somewhat modified evolution of a process which occurs in Infusoria, for instance. In these, the surface is covered with a thin cuticle, and the vibrating cilia, which are outgrowths of the external parenchyma, pierce through the cuticle; in the case of the Infusoria, the cuticle is formed only around the vibrating cilia. If we imagine that the deposition of the homogeneous substance was simultaneous with the growth of the cilia—which in this case would have another function leading to their chitinization—then the forming of the longitudinal filaments in the cuticle would be satisfactorily explained. No one should, therefore, consider them canals, since under the most powerful magnification, no lumen can be observed in them.

**T. cavimana Var. cinctipes.**

Tab. VII. Fig. 8.

The frontal edge is denticulated and is separated by a small concavity from the beginning of the superciliar portion, which lacks spines. The extraorbital spine is small and the postorbital spine is lacking. The lateral edge is smooth. The chelipeds are unequal in size, the end of the internal edge of the meropodite does not form an outgrowth: this region is somewhat rounded and denticulated. At the base of the propodite of the large chelipeds, a small external hollow is found, as in *T. cavimana*, and the inferior edge of the propodite is serrated. The color of the cephalothorax is light yellowish-brown and all the legs bear dark brown stripes which are not fully developed on the chelipeds. One female.

Distribution: Red Sea.

**T. heterodactyla Hell.**

*Tetralia heterodactyla* Heller. Beit. zur Crust. F. des r. M. p. 354.

Of this species, we had at our disposal only one female, in which the postorbital spine was lacking. The other characters correspond to Heller's description.

Distribution: Red Sea.

FAMILIA.

PORTUNIDAE,

GENUS NEPTUNUS DEHAAN.

In "Etudes Zool. sur les Portuniens", Alph. M. Edwards unifies the following genera into the genus Neptunus: Amphitrite (pro parte), Posidon, Arenaeus, and Lupa (pro parte); subsequently, however, in "Recherches sur la faune carcinologique de la Nouvelle Calédonie", he creates the new genus Xiphonectes for Neptunus vigilans and longispinosus.

N. pelagicus Linn.

Cancer pelagicus	Linn. Mus. Reg. Louisa Ulrr. p. 434.
" "	Forskal. op. cit. p. 89.
" reticulatus	Herbst op. cit. T. III p. 65 № 215 Tab L.
" cedonulli	" " " T. II p. 157 Tab. XXXIX.
Portunus pelagicus	Latreille. Encycl. T. X p. 188.
" "	Audouin. op. cit. p. 260 Sovigny Pl. III.
Lupa pelagica	Desmarest. Consid. sur les Crust. p. 98 Pl. VIII Fig. 2.
" "	M. Edwards Hist. nat. sur les Crust. T. I p. 450.
Neptunus pelagicus	Dehaan. op. cit. p. 37 Tab. IX & X.
Lupa pelagica	Dana op. cit. p. 271.
Neptunus pelagicus	Alph. M. Edwards. Faune carcinolog. de l'île de la Réunion p. 2.
Lupa pelagica	Heller. Beit. Cur. Crust. F. des r. M. p. 353.
Neptunus pelagicus	Alph. M. Edwards. Etudes Zool. sur les Portuniens p. 320.
" "	Heller. Navarra Exp. p. 27.
" "	Alph. M. Edwards. Nouv. Arch. du Muséum. T. IX p. 156,

In this species, the length of the chelipeds is greatly variable. In our male, the meropodites are half the length of the cephalothorax; in the specimen illustrated in "Exp. de l'Egypte" they are longer than the cephalothorax. In Desmarest, they are the same length as the cephalothorax, while in C. cedonulli and in Nep. pelagicus (Dehaan), they are shorter than the cephalothorax. The anterior edge of the meropodite also has a variable number of teeth. One male.

Distribution: Red Sea; Persian Gulf; Indian Ocean; Java; Borneo; the Moluccas; the Philippines; Sea of China; Sea of Japan; Port Jackson; New Caledonia; Samarang.

## GENUS XIPHONECTES ALPH. M. EDW.

This genus differs from *Neptunus* by its four frontal spines, since the anterior part of the superciliar region does not form the spines, which in *Neptunus* are considered frontal spines. The lateral edge has up to nine small spines, of which some may be rudimentary or lacking. The extra-orbital and the last spine are horizontal and are large and well developed. The antennules have a horizontal position. The basal joint of the antenna is short and fills the orbital fissure; the other joints lie in the ocular cavity. The second maxilliped reaches only the anterior edge of the oral frame. The epistome has no outgrowth. The endostome bears a crest.

### *X. longispinosus* Dana.

Tab. VIII. Fig. 4, 4 a.

Amphitrite	longispinosus	Dana. op. cit. p. 277 Pl. XVII Fig. 2.	
"	vigilans	" " " p. 278 Pl. XVII Fig. 3.	
Neptunus	" "	Alph. M. Edw. Etudes sur les Portuniens p. 336.	
"	longispinosus	" " " " " " " " " p. 337.	

The frontal edge is slightly raised and bears four rounded spines of which the median is much smaller than the lateral ones. The superior orbital edge has two small incisions and the anterior end of the superciliar area does not form spines. The anterolateral edge bears eight spines on the right side, of which four are rudimentary and the sixth is small; on the left side there are nine spines, and the fourth and sixth are rudimentary. The cephalothorax has an hexagonal shape. The gastric, branchial, and cardiac areas are protuberant and do not show the subdivisions noted by Dana. Only the median part of the epistome is developed. The second maxillipeds correspond to Dana's illustration. The anterior edge of the oral frame is prominent and has fairly large hollows on its median part as well as on the outside of the crest of the endostome.

The meropodite of the left cheliped has four teeth on its internal edge, while the meropodite of the right cheliped has five teeth, of which the posteriormost is very small; at the end of the external edge there is a tooth. The other joints correspond to Dana's description. The meropodite of the last pair of pereopods is short, wide, and without spines; the inferior edge of the propodite is smooth, and the end of the dactylopedite is rounded. One female. The width of the cephalothorax is 6.5 mm, and the length 4.8 mm.

Distribution: Red Sea; Hawaii; Fiji.

In the specimens from the Pacific, the frons is somewhat narrower and the principal areas of the cephalothorax are divided into secondary areas. These characters are no doubt related to age (our specimen is one-third the size of Dana's); in relation to this, we found new proofs in

studying a considerable number of Th. Admete specimens, in which the frontal edge varies greatly with age. Alph. M. Edwards also relates that the number of spines on the lateral edge changes, and in all probability the lateral spine changes as well; consequently, the two species by Dana are identical.

## GENUS ARCHIAS n. g.

The cephalothorax is flat, but its principal areas are protuberant. The frontal edge bears six spines, not including the superciliar one. The almost straight anterolateral edge has six spines (including the extraorbital); the posterior spine is twice as long as the preceding one, and becomes thinner in the horizontal direction. As to the frontal spines, this genus corresponds to Goniosoma, but differs from it by its antennae, the second joint of which lies in the orbit. The antennules have an oblique position. The endostome has a crest. The last two joints of the fifth pair of legs are foliaceous. The last three segments have a median saddle on the sternites.

### A. sexdentatus.

Tab. VIII. Fig. 3-3b.

The cephalothorax is covered with very small granulations. On the gastric area there are three granulated stripes. The anterior cardiac area has two prominences, and laterally, on each of the branchial areas, a spherical tubercle is found. The frontal edge bears four rounded lobes, the median ones being more prominent; the other two lobes have the form of pointed spines and are to be found in the hollow between the frontal edge and the superciliar spine. The superior orbital edge has two incisions. The extraorbital spine is separated from the inferior orbital edge by an incision; the postorbital spines appear to have been cut off. The eyes are larger than those of Xiphonectes. The basal joint of the antenna is elongated; its anterior and external parts form an outgrowth which is curved inward and does not reach the frontal edge, so that the subsequent joint lies in the orbit. The second lateral spine is smaller than the others, while the posterior one is twice as long as the one preceding it and is continued on the cephalothorax in the form of a granulated fold.

The chelipeds are of medium length; the internal edge of the mero-podite bears two spines and the external edge ends with a tooth; the antero-internal corner of the carpopodite is elongated in the form of a long pointed spine, and on the external surface an additional small tooth is present; the

superior edge of the propodite has two carinae which end in spines; a third spine is found in the immediate vicinity of the movable dactylus, while a fourth is found at the base of the external crest; besides these, the external surface has two additional crests. The dactyli are pointed and furrowed, their edges are denticulated and their tips cross. The meropodite of the last pair of legs is elongated and the end of its external edge bears a tooth; the inferior edge of the propodite has two spines on one leg and one on the other. The dactylopodite bears claws. One male.

Distribution: Red Sea.

## GENUS ACHELOUS. DEHAAN.

### *Ach. granulatus* M. Edw.

- Lupa granulata* M. Edwards. Hist. nat. des Crust. T. I p. 454.  
*Amphitrite gladiator* Dehaan. op. cit. p. 66 Tab. XVIII. Fig. 1.  
 ,, *speciosa* Dana op. cit. p. 276 Tab. XVII Fig. 1.  
*Achelous granulatus* Alph. M. Edwards Etudes sur les Port. p. 544.  
 " " " " " Faune carcin de l'île de la Réunion p. 2.  
 " " " " " Nouv. Arch. du Muséum T. IX p. 131.

In the only male of the seven specimens, the cephalothorax is adorned with small red spots. The young specimens differ from the adults by their almost smooth cephalothorax on which granulations are hardly visible, and by the lack of the furrow on the external surface of the superciliar spine. With increasing age, the second maxillipeds become more and more prominent, and the frontal edge becomes narrower; in young specimens the ratio between the width of the frontal edge and the width of the orbit is 1.5:1, while in adult specimens it is 1.4:1. We noted that the change in the width of the frontal edge occurs with increasing age; this also occurs in *Thalamita Admete* and again proves our supposition that *Xantho minor* is a young specimen of *X. distinguendus* (see page 41)

Distribution: Red Sea; Island of Bourbon; Mauritius; Java; New Caledonia; Fiji; Samarang.

## GENUS THALAMITA LATR.

### *Th. Admete* Herbst.

Tab. VIII. Fig. 1-1c.

- Cancer *Admete* Herbst. op. cit Bd. III p. 40 Tab. LVII. Fig. 1.  
 Portunus ,, Audouin op. cit. p. 262 Savigny op. cit. Pl. IV. Fig. 4.



Thalamita	<u>Admete</u>	Latreille Règne anim. 2. od T. IV p. 33.
"	"	M. Edwards Hist. nat. des Crust T. I p. p. 459.
"	"	Dana op. cit. T I p. 281.
"	"	Heller Crust. des südl. Europa p. 79.
"	"	" Beit. zur Crust F. des r. M p. 355.
"	Savignyi	Alph. M. Edwards. Etud. zool. sur les Port. p. 357.
"	Admete	Heller Navarra Exp. p. 28.
"	Savignyi	Alph. M. Edwards. Nouv Arch. du Muséum T. IX p. 163.
Portunus	Poissonii	Audouin op. cit. p. 262 Savigny Pl. IV Fig. 3 n 5.
Thalamita	integra	Dana op. cit. p. 281 Pl. XVII Fig. 6.
"	"	Alph. M. Edwards Etud. zool. sur les Port p. 368.
"	"	Stimpson. Proceed. of the nat. sc. of Philadel. 1858 p. 39

To the accurate description by Herbst we will only add that in two adult specimens, the surface of the cephalothorax is covered by small granulations, among which there are short hairs. There are two spines on the internal edge of the superior side of the propodite of the chelipeds in the male, and three in the female; on this joint there is a total of five spines in the male, while there are six in the female. The bases of the dactyli are a pink color, followed by a dark-brown stripe, and the ends are white. The superior and inferior edges of the dactylopropodite of the last pair of legs bear spines.

The external and internal surfaces of the propodite of the chelipeds are granulated in our specimens, but the transverse stripes on the cephalothorax are poorly marked; in the male, these lines are smooth, while in the female they have granulations which are hardly visible through a magnifying glass. We find, therefore, that the characters on the basis of which Alph. M. Edwards separated Th. Savignyi from Th. Admete are individual variations. In spite of various combinations of these characters, it seems that Alph. M. Edwards paid no attention to Herbst's description of Th. Admete, since in it Herbst asserts that the external surface of the propodite of the chelipeds is granulated. Thus, this character cannot serve as a specific character for Th. Savignyi. One adult male and one adult female.

The young specimens are clearly different from the adults by their frontal edge as well as by their lateral spines; they may easily be considered a different species if one does not follow the changes undergone by these characters with increasing age. In the youngest specimens, the cephalothorax is somewhat protuberant, but with age it becomes flatter. In the youngest specimen, which was 6 mm long, the frontal edge is rounded (Table VIII Figure 1), and it is divided into two lobes by a median incision. The superciliar edge, oriented toward the frontal edge, is very small, the ratio between its width and that of the frontal edge being 1:14. With increasing age this ratio decreases, and the frontal lobes gradually acquire the adult form, i. e., the two semicircular lobes become four, and the external edges of the two lateral lobes descend almost perpendicularly on the superciliar area. A table of the changes undergone by the frontal edge with increasing age in five specimens follows:

Length of the cephalothorax	Ratio of width of superciliar edge to width of frontal edge
6 mm	1:14
8 mm	1:9.2
10 mm	1:4.88
13 mm	1:3.72
18 mm	1:2.89

The edge of the carina on the basal joint of the antennae seems to be smooth, but through a magnifying glass a denticulation may be observed. The specimens which we studied did not show a transition toward the denticulated prominence existing in the adults. The first four spines on the lateral edge in the youngest specimens have the form of lobes rather than of teeth; with increasing age, however, the distance between the spines increases, the spines become more prominent, triangular, and pointed. The transverse line on the cephalothorax is hardly visible in young specimens; it becomes more marked with age, and the whole surface of the cephalothorax becomes granulated and covered with very short hairs. The pterygostome is granulated.

The external and the internal surfaces of the propodite of the chelipeds is covered with granulations which can be observed only through a magnifying glass; in two specimens, these surfaces are smooth. The number of spines on the superior surface of the propodite increases with age; in the youngest specimens there are three spines, in the older there are four and subsequently five and six; finally, the external surface has two slightly marked carinae. The external surface of the carpopodite also has two spinules which can only be observed through a powerful magnifying glass. On the inferior edge of the propodite of the fifth pair of legs, denticles are always found; their number increases with age. The superior and the inferior edges of the dactylopodite of this pair of legs bear pennate hairs in the young specimens, but with increasing age, these hairs are gradually replaced by spines, at first on the superior edge and then on the inferior. In the largest specimen which is 18 mm long, almost the whole surface bears spines; on the inferior edge, spines are found only in the vicinity of the terminal spine with which the dactylopodite ends. The color of the cephalothorax and the legs is white in all the specimens, with the exception of one specimen, in which there are brown spots on both the cephalothorax and the legs, and in which the base of the dactylus is pink. The ratio between the width and the length of the cephalothorax changes with increasing age; in the youngest specimen this ratio is 1:1.3; in the oldest it is 1:1.5.

As the age increases, the ten young specimens studied gradually acquire a greater resemblance to Th. Admete. The unique character is that the carina on the basal joint of the antennae does not change—that is, it does not take the form of a denticulated line. This transition will probably be found when the intermediate stages are studied. At any rate, the form of the carina is a very unimportant character. Some of the younger specimens greatly resemble Th. Poissonii and we therefore consider that this species created by Audouin is actually made up of young specimens of Th. Admete.

The lateral edge of the eleventh specimen (which was 6.5 mm long)

illustrated in Table VIII Figure 2, resembles Th. integra Dana. If we compare this specimen with the young specimens of Th. Admete mentioned above, we shall find that it differs from them by its spine and by the lack of the carina on the external surface of the propodite of the chelipeds. This specimen corresponds to the fairly detailed description of Th. integra by Alph. M. Edwards; we therefore consider Th. integra a young Th. Admete as well. In this last species, the fourth spine is always much smaller than the others, and therefore specimens may easily develop in which this spine is rudimentary; the carina on the external surface of the propodite of the chelipeds also appears in a late stage; in addition, we note that the spines on the superior surface of the propodite of the chelipeds are situated differently in Dana's specimen than in the specimen described by Alph. M. Edwards; in one specimen there are two spines on the internal edge, only one on the external edge, and also only one on the base.

Distribution: Red Sea; Indian Ocean; Sulu Sea; Samoa Islands; New Caledonia; Uzima; Kikai Shima; Hugoleu; Wake Island; Hawaii.

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\*                      \*  
\*

The genus Thalamonyx created by Alph. M. Edwards in 1869 for two small Portunidae bears the mark of young specimens of Thalamita. In describing the species Thalamonyx Danae, Alph. M. Edwards draws the reader's attention to the fact that the female which was 10 mm long was already ovigerous. He consequently considered it an adult with definitively established characters. In our opinion, the presence of eggs has no importance, because in many Crustacea growing continues independently of the maturation of the gonads. We have, for instance, an ovigerous female of Chlorodius ungulatus which is 7.5 mm long and another female 17 mm long. Some Crustacea do not undergo modifications with increasing age, e. g., Chlorodius ungulatus; other species of the same genus, e. g., Ch. niger undergo considerable changes and therefore in order to determine small individuals, it is necessary to study a whole series, representing various ages.

We might be wrong concerning the two Portunidae attributed to the genus Thalamonyx; but considering the modifications noted in Th. Admete, our hypothesis must be taken into account since, as we have already stated, both species of Thalamonyx have the characters of young Thalamita.

## GENUS CAPHYRA GUÉRIN.

C. polita Hell.

Camptonyx politus. Heller. Beit. zur Crust. F. des r. M. p. 357. Tab. III Fig. 26, 27.

In the specimen which was 4.5 mm in length the frontal spines have the form of lobes; in the other two specimens which were 8 mm long, the

spines are pointed. The inferior edge of the propodite and of the dactylo-  
podite of the second, third, and fourth pair of legs are pubescent; the pro-  
podite of the last pair of legs, which is much shorter than those of the pre-  
ceding pairs, has both edges pubescent. Heller's illustration is not accur-  
ate since the cephalothorax is too long. Three females.

Distribution: Red Sea.

Caphyra laevis Alph. M. Edwards differs from C. polita only by the  
denticulated edge of the meropodite of the chelipeds. The relative width of  
the cephalothorax is probably of no importance in this case either; in our  
smallest specimen, the ratio between length and width is 1:1.11, in the  
largest, 1:1.22, and in C. laevis, 1:1.55. The gastric area of C. polita  
has no prominent transverse line as stated by Alph. M. Edwards; It has  
only--as in C. laevis--two slightly prominent lines which are directed in-  
ward from the last lateral spine, and do not meet in the middle of the  
cephalothorax. C. laevis must be considered a variety of C. polita.

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Fourteen years have elapsed since the publication of "Etudes Zoolo-  
giques sur les Crustacés récents de la famille des Portuniens". In this  
period, not only new genera were discovered, but also the characterization  
of some old genera have undergone changes. We, therefore, consider it  
useful to enclose an analytical table for the determination of the Portunidae  
genera.

Determination Table of the Pectinidae Genera

		Has six spines including superciliar	Second maxilliped longer than frontal edge Second maxilliped has normal length	<u>Lupa</u> <u>Nepertus</u>
Basal joint of second maxilliped* immovable* subsequent joints lie in orbit	Anterolateral edge has nine spines, two of which may be rudimentary. Last spine same as penultimate	Just spine at most twice as long as penultimate; frontal edge	has four spines; superciliar area forms no spine; two of eight lateral spines are rudimentary has four spines, including superciliar Cephalothorax protuberant; epistome incomplete; chelipeds long and prismatic	<u>Xiphonectes</u> <u>Eucrosta</u> <u>Achilus</u> <u>Szyla</u>
	Anterolateral edge has six spines. Last superciliar one	Length as penultimate	Cephalothorax protuberant; epistome developed; chelipeds protuberant	<u>Archias</u>
Frontal edge wide, eye- stalk normal length	Lateral edge bears five spines; dactylo- pods of last pair of legs	lancoolate oval	frontal edge bears four spines; lateral spines are thin, spaced lateral edge bears three spines, lateral spines broad, close together	<u>Carcinus</u> <u>Bathynectes</u> <u>Portunus</u> <u>Neocarcinus</u>
Basal joint of second maxilliped** im- movable, filling subsequent joints lie outside orbit	Lateral edge bears three to seven spines; median saddle on sternites as in Lupinae; last pair of legs have normal position and normal dactylopedite	Frontal edge very wide; anterolateral edge has three to five spines; dactyli	pointed; lateral edge bears five spines poonlike; lateral edge has three to four spines	<u>Thalamita</u> <u>Thalassinoides</u> <u>Conicocma</u> <u>Thalassozy</u> †
Basal joint of second maxilliped † mov- able, cylindrical	Lateral edge narrow, length almost equal to width; lateral edge rounded, bearing either denticles or small lobes; median saddle on sternites as in Lupinae; last pair of legs has normal position; their dactylopedite oval or with narrowed, curved tip with clawlike dactylopedite	Frontal edge of medium width; anterolateral edge bears five to seven spines; frontal edge has two rounded lobes; lateral edge has five spines	two rounded lobes; lateral edge has five spines bearing either denticles or small lobes; median saddle on sternites of last three segments; last pair of legs bent upward and with clawlike dactylopedite	<u>Limocarcinus</u> <u>Calypta</u> <u>Carya</u> <u>Lupocyclichus</u> <u>Pollibia</u>
Frontal edge very narrow, eye-stalks very long. PODOPTHALMINAE.	Lateral edge very wide, anterolateral edge has six spines; median saddle on sternites as in Lupinae; last pair of legs has normal position; their dactylopedite oval or with narrowed, curved tip with clawlike dactylopedite	Length equal to width or width exceeding length; anterolateral edge bears five well-developed spines; median saddle on sternites as in Carcininae.	Last joint of fourth pair of legs is natatory Last joint of fourth pair of legs is lanceolate	<u>Platycarcinus</u> <u>Pedophilanthus</u> <u>Euphyllax</u>

\* [Should be antenna instead of maxilliped.]  
 \*\* Porymus holatus served Stimpson as the type for the new genus Liocarcinus (Bull. of the Mus. of comp. Zool. Harvard College 1870).  
 \*\*\* [Antennae]  
 † [Antennae]  
 ‡ This genus is doubtful

S E C T I O  
C A T A M E T O P A .

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FAMILIA

O C Y P O D I D A E .

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GENUS O C Y P O D E F A B R .

*Oc. ceratophthalma* Var. *ceratophthalma*—*aegyptiaca*.

In "Carcinologische Beiträge (Arch. für Naturg. Jahrg. XXII p 134) Gaerstaecker compares the new species *Oc. aegyptiaca*, which he created, with *Oc. ceratophthalma* Pall., and finds the following differences: in *Oc. aegyptiaca* 1) the meropodites of the pereopods are the same width over their entire length; 2) only the propodite of the second pair of legs has a brush of hairs; 3) the eyestalks are narrower; 4) the cephalothorax is less protuberant; 5) the anteroexternal corner of the cephalothorax protrudes slightly beyond the line of the lateral edges. However, Gaerstaecker finally draws the following conclusion: "bei der Aehnlichkeit beider Arten könnte es übrigens vielleicht zweifelhaft erscheinen, welcher von beiden der wirkliche *Cancer ceratophthalmus* Pallas sei".

The specimens found in the Museum of Kiev must not be considered as belonging either to *Oc. aegyptiaca* or to *Oc. ceratophthalma*, since they combine characters from both these species. The meropodites of their pereopods become narrower in the distal direction; in two males, the ratio between the width of the meropodite at its middle and the width at the end is 1.25:1 and 1.29:1; in two females it is 1.35:1 and 1.44:1. The cephalothorax is extremely protuberant. By these two characters, the specimens resemble *Oc. ceratophthalma*, but the following characters belong to *Oc. aegyptiaca*. The anteroexternal corner of the cephalothorax lies inside the lateral edge; in only one female did it lie almost on the line of the lateral edge. If we use Pallas's illustration for a comparison, we find that the eyestalks are slightly narrower. A brush is found only on the propodite of the

second pair of legs; in the female, the brush is reduced and appears only in the form of a narrow pubescent stripe. The furrows on the cephalothorax are more marked in the male, and resemble the letter H; in one female these furrows are hardly visible, and then only in the anterior part. The anterior edge of the sounding file [strident apparatus] bears thick hairs in the male; in the female it is smooth or bears only sparse hairs.

Our specimens represent an intermediate form between Oc. ceratophthalma and Oc. aegyptiaca. They differ from the first species by the lack of a brush on the second pair of legs and by their narrower eye-stalks; they differ from the second species by their distally-narrowed mero-podites. As to the anteroexternal corner, its position in one of the females is the same as that in Oc. ceratophthalma.

Distribution: Red Sea.

## GENUS GELASIMUS LATR.

### G tetragonon Herbst.

Cancer tetragonon.	Herbst. op. cit. T. I p. 257 Tab. XX Fig. 110.
Gelasimus "	Rüppel. op. cit. p. 25 Tab. V Fig. 5.
" "	M. Edwards Hist. nat. des Crust. T. II p. 52.
" "	" " Ann. des sc. nat. 3 Ser. T. XVIII p. 147 Pl. III Fig. 9.
" "	Heller Navarra Exp p. 37.
" "	Hilgendorf. op. cit. p. 84.

We had only one male at our disposal, in which both the internal and the external surfaces of the propodite of the chelipeds is granulated, like the external surface of the dactyli. The cephalothorax is a dark grayish-blue color and has small dark spots; at the base of the immovable dactylus of the large chelipeds there is a reddish-yellow spot which also extends to the anterior part of the propodite.

Distribution: Red Sea; Zanzibar; Nicobar Islands; Tongatabu; Tahiti.

## GENUS MACROPHTHALMUS LATR.

### M. depressus Herbst.

Tab. VIII. Fig. 5-7.

Macrophthalmus depressus.	Rüppel op. cit. p. 19 Tab. IV Fig. 6.
" "	M. Edwards. Ann. des sc. nat. 3 Ser. T. XVIII p. 159.

We consider it necessary to make the following addition to Ruelpell's description: the lateral spine is followed by a small hollow, and, as a result, a very small spinule appears. The superior and inferior orbital edges

are denticulated--the inferior one to a greater extent. The flagellum of the antenna reaches the cornea of the eye. The meropodite of the chelipeds is covered with thick hairs in the males; the superior edge of the propodite of the chelipeds is granulated; the internal surface of the dactyli is pubescent, and the movable dactylus has a quadrangular tooth at its base. The chelipeds of the females are like those of Macrophthalmus japonicus. The end of the superior edge of the meropodite of the second pair of pereopods bears one tooth. The pereopods are covered with hairs, with the exception of the dactylopedite. Our specimen has a width of 21 mm and a length of 12 mm. Rueppel's illustration is poor.

Figure 7 represents a young specimen of the same species. The cephalothorax is 8 mm wide and 6 mm long, and differs from that of the adults by its shape; in this specimen, the ratio between the length of the cephalothorax and its width is 1:1.33; in two specimens, one male and one female, with a length of 9.5 mm the ratio is 1:1.6, while in the largest specimen (Figure 6) it is 1:1.75. Consequently, the cephalothorax becomes wider with increasing age. The cephalothorax is granulated--the granules may be observed only under twentyfold magnification--and is covered with sparse hairs; in specimens 9.5 mm long, the cephalothorax is also hairy, but in the largest specimen, it is smooth. Only the furrow surrounding the gastric area is present. The frontal edge is relatively broader, but it also becomes narrower with increasing age. The superior and inferior orbital edges are denticulated, but denticles can be observed only under twentyfold magnification. The eyestalks are thicker; they have the same thickness as those of the 9.5-mm-long female. Simultaneously with the widening of the cephalothorax and the narrowing of the frontal edge, the eyestalks become longer, but their thickness remains almost the same. The flagellum of the antenna reaches the cornea. The end of the superior edge of the meropodite of the pereopods bears a tooth; in addition, the superior and inferior edges of the meropodite of the second, third, and fourth pairs of legs are spinulated, the spinules of the superior edge being much smaller. An identical structure is also found in the 9.5-mm-long specimens, the only difference being that the spinules of the superior and inferior edge are so small that their presence is revealed only by passing a pin along the edge. The dactylopedite of the pereopod is hairy; in the 9.5-mm-long specimens the hairs are found only on the dactylopedite of the last pair of legs, while in the largest specimens they disappear altogether.

If we follow the classification of the Catametopa given by M. Edwards in "Ann. des sc. nat. 1852" then the specimen which we considered a young Macrophthalmus depressus should be included in the genus Euplax, in which Macrophthalmus Boscii, a form that also suggests a young Macrophthalmus, was also included. To solve this problem, a great number of M. depressus specimens would be required for comparison with Savigny's M. Boscii. In Vol VII of "Arch. du Museum", M. Edwards described another species, Euplax leptophthalmus in some detail and also included an illustration. By its differential characters, this species may indeed serve as the type for the new genus Euplax.

Distribution: Red Sea.

Macrophthalmus japonicus Dehaan differs from M. depressus by its somewhat modified chelipeds. In M. japonicus the surface of the



carpopodite is granulated; the internal surface of the propodite is protuberant and smooth, and the dactyli are smooth. By all its other characters, it is identical to *M. depressus*, as may be observed in Dehaan's outstanding illustration. *M. japonicus* should therefore be considered a variety of *M. depressus*.

## GENUS *CLEISTOSTOMA* DEHAAN.

*Cl. Leachii* Var. *penicillata*.

Tab. VIII. Fig. 6-6b.

This variety differs from *C. Leachii* by the presence of a thick brush on the internal surface of the propodite of the penultimate pair of legs in the male. The external surface of the pereopods in both sexes is smooth and not granulated; the interior edges of the meropodite and of the propodite have a fine serration. The immovable dactylus of the chelipeds is the same width along its entire length in the male. The cephalothorax is smooth and naked, and the areas are not clearly delimited. There is a groove in the middle of the frons which does not appear in the illustration. The lateral edge is granulated and bears sparse hairs. The inferior orbital edge forms a fairly large hollow in the extension of the external angle. The surface of the third joint of the second maxilliped, as well as the pterygostome, are finely granulated, but this does not appear in the illustration; on the second joint there are hairs which are disposed in an oblique row; the internal edge of the second and third joints are thickened. Eight males and three females.

Distribution: Red Sea.

### FAMILIA

## GRAPSIDAE.

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## GENUS *METOPOGRAPSUS* M. EDW.

*M. messor* Forsk.

*Cancer messor.* Forskal. op. cit. p. 88.

- Grapsus Gaimardii. Andouin. op. cit. p. 258. Savigny Pl. II Fig. 3.  
 " messor Krauss op. cit. p. 43.  
 Metopograpsus " M. Edwards. Ann. des. sc. nat. 3 Ser. T. XX p. 165.  
 " " Heller. Beit. zur Crust. F. des r. M. p. 362.

A single female.

Distribution: Red Sea; Natal; Malabar Coast; Madras; Ceylon; according to Heller, also the zone of the Canaries.

## GENUS GRAPSUS LAMK.

### G. rudis M. Edw.

- Grapsus rudis. M. Edwards. Hist. nat. des Crust. T. II p. 87.  
 " " M. Edwards. Ann. des sc. nat. 3 Ser. T. XX p. 168.  
 " Pharaonis. M. Edwards. " " " " " " " p. 168.  
 " " Heller. Beit. zur. Crust. F. des r. M. p. 362.  
 " rudis. Heller Navarra Exp. p. 47.  
 " " Stimpson Proceed. of. nat. sc. of. Philadelphia. 1858. p. 102.

According to M. Edwards, G. Pharaonis differs from G. rudis by the rounded end of the inferior edge of the propodite of the last pair of pereopods and by the length of the propodites. As we shall demonstrate later, these cannot serve as differential characters.

Of the five specimens, in one male the anterior end of the inferior edge of the meropodite of the last pereopod is not rounded on the right legs, but is provided with two well developed teeth; on the left leg, these teeth are rudimentary; the propodites of this specimen, however, are not longer than the propodites of the other specimens in which the end of the meropodite of the last pereopods is rounded.

We present here the measurements of two males. The first corresponds to G. rudis and the length of its cephalothorax is 54.5 mm; the other male corresponds to G. Pharaonis and its length is 50 mm.

	<u>G. rudis</u>	<u>G. Pharaonis</u>
Length of the propodite of the first pair of legs	12 mm	11 mm
Length of the propodite of the second pair of legs	15 mm	14 mm
Length of the propodite of the third pair of legs	22 mm	21 mm
Length of the propodite of the fourth pair of legs	missing	25 mm
Length of the propodite of the fifth pair of legs	21 mm	20 mm

Both characters which M. Edwards considered specific to G. Pharaonis are individual variations, and therefore G. Pharaonis must be considered identical to G. rudis. We also note the fact that in the former, the gastric area has a greater number of squamate prominences, while in the others their number is smaller, and the oblique lines on the branchial area bear very short hairs.

Distribution: Red Sea; Ceylon; Sandwich and Bonin Islands.

### G. strigosus Herbst.

Cancer strigosus.	Herbst. op. cit. Bd. III Heft. I p. 55 Tab. XLVII. Fig. 7.
Grapsus "	Latreille. Hist. des anim. sans vert. T. V. p. 249.
Gonyopsis "	Dehaan. op. cit. p. 33.
Grapsus "	M. Edwards. Hist. nat. des Crust. T. II p. 87.
" "	Pöppig. Crustacea chilensis. Arch. für Naturg. Jahrg. II p. 136.
" "	M. Edwards. Ann. des sc. nat. 3 Ser. T. XX p. 169.
" granulosus	M. Edwards. " " " " " " " " p. 169.
" strigosus	Stimpson. Proceed. of nat. sc. of Philadelphia 1858 p. 102.
" "	Heller. Navarra Exp. p. 47.

On the anterior part of the protogastric area, there are more tubercles than squamate lines, while on its posterior part only squamate lines are to be found; the character according to which M. Edwards separated G. granulosus from G. strigosus is not only of minor importance, but also shows intergradations. Therefore, G. granulosus must be considered identical with G. strigosus. Three males and one female.

Distribution: Red Sea; Ceylon; Nicobar Islands; Ryuku Islands; Hong-Kong; Talcahuano (Chile); according to Heller, also the zone of the Canaries.

### FAMILIA.

## PINNOTHERIDAE.

### GENUS PINNOTHERES LATR.

P. Rouxi M. Edw.

Tab. IX. Fig. 2-2a.

Pinnotheres Rouxi M. Edwards. Ann. des sc. nat. 3 Ser. T. XX p. 218. Pl. XI Fig. 7.

The width of the cephalothorax is greater than the length; the cuticle is very soft. The gnathostegite is naked; the internal edge of the carpo-

and prognathite bears thick hairs; the prognathite is considerably longer than the carpognathite, while the dactylognathite (which ends with a tuft of hairs) is very small; the first pair of legs shows no peculiarities; the dactyli bear one tooth each at their bases, and the internal edges are pubescent; in one of the specimens, the dactylopodites of all pereopods are pubescent, while in another specimen this condition appears only on the fifth pair of legs. Two females.

The description by M. Edwards is too short and our determinations are based only on the similitude of the second pair of maxillipeds, according to M. Edwards' illustration.

Distribution: Red Sea; Indian Ocean.

## GENUS OSTRACOTHERES M. EDW.

### Ost. Tridacnae Rüpp.

- Pinnotheres veterum. Audouin. *op. cit.* p. 270 Savigny Pl. VII Fig. 1.  
 " Tridacnae Rüppel. *op. cit.* p. 22 Tab. V Fig. 2.  
 Ostracotheres Savignyi M. Edwards: *Ann. des sc. nat.* 3 Ser. T. XX p. 219 Pl. XI Fig. 10.  
 " Tridacnae M. Edwards. " " " " " " " p. 219.  
 " " Heller. *Beit. zur. Crust. F. des r. M.* p. 371.

The cephalothorax and the legs are covered with a tomentum; the inferior edge of the meropodite and the external surface of the carpo- and propodite of the third and fourth pairs of legs have a hairy stripe; on the last pair of legs, this stripe is found on the internal surface of the joints; in one female, the hairy stripe of the fifth pair of legs is hardly developed, and in another female it is missing. Therefore O. Tridacnae is identical to O. Savignyi; the length of the cephalothorax of the females is the same as the width; in the male, the cephalothorax is somewhat longer, its posterior part is greatly narrowed and the frontal edge is fairly prominent and not greatly bent ventrally; in some, the frontal edge is straight, while in others it has a small hollow. One male and three females; two females have a yellow color, and the other two specimens are dark grayish-blue.

Distribution: Red Sea.

O. affinis, from Mauritius, differs—according to M. Edwards—from O. Tridacnae (Savignyi) by the shape of its gnathostegite and by its short flagellum. In four of our specimens, the second maxillipeds are like those in Figure 10 Pl. XI; in the fifth specimen the gnathostegite is shaped like that in Figure 11, i. e., as in O. affinis; the flagellum, however, is the same length as that in O. Tridacnae, i. e., the protognathite is much longer than the carpognathite. In all specimens the flagellum of the scaphognathite is biarticulated, and it seems that with respect to this, a mistake was made in the illustration by M. Edwards.

## GENUS ELAMENA M. EDW.

### E Mathaei M. Edw.

Tab. IX Fig. 3-3b.

Hymenosoma	Mathaei	Desmarest. Consid. sur les Crust. p. 163.
"	"	Rüppel. op. cit. p. 21. Tab. V Fig. 1.
Elamena	"	M. Edwards. Hist. nat. des Crust. T. II p. 36.
"	"	Krauss. op. cit. p. 51.
"	"	M. Edwards. Ann. des sc. nat. 3 Ser. T. XX p. 223.
"	"	Heller. Beit. zur Crust. F. des r. M. p. 371.

Of this interesting species only one male was captured. The length of its cephalothorax is equal to the width, and in this respect it differs from the female, in which, according to Heller, the cephalothorax is wider. The general contour of the cephalothorax is like that of the female, and the cuticle is transparent; the surface is concave, and the principal areas are delimited by furrows; the orbit is not clearly marked; the eyes are short and thick, and covered by the frontal area. The pterygostome forms a toothlike external outgrowth, which corresponds to the extraorbital spine. The antennules are in the horizontal plane and are separated by a partition which almost reaches the anterior border of the frons. The antennae are slender, cylindrical and have a movable basal joint; the first and the third joints are of equal length, while the second one is longer; the epistome is broad and its median outgrowth reaches the partition which separates the antennules. The oral opening is quadrangular; the third joint of the second maxilliped is shorter than the second joint, the first legs are missing; the others are long and naked, and only the internal edge of the falciform dactylo-podite is covered with hairs and bears terminal claws. The abdomen of the male is made up of five segments; the third and fourth segments are the longest.

Distribution: Red Sea; Mauritius and Bourbon Island; Natal; Western Port on the southern coast of Australia.

## GENUS LITHOSCAPTUS ALPH. EDW.

### L. paradoxus Alph. M. Edw.

Lithoscaptus paradoxus. Alph. M. Edwards. Faune carcin de l'île de la Réunion p. 10.  
Cryptochirus coralliodytes Heller. Beit. zur Crust. F. des r. M. p. 366 Tab. IV Fig. 33-39.

The sternite becomes gradually narrower beginning from the first pair of legs, but does not become linear, as shown by Alph. M. Edwards; in the female, the end of the abdomen reaches the second maxilliped, while the seventh segment is bent inward; the longest segments are the fourth and the fifth. Twelve females and one male.

Distribution: Red Sea; Bourbon Island.

This genus must be considered as belonging to the family Pinnotheridae forming within its limits the subfamily Cryptochirinae, the characters of which are as follows: the cephalothorax is protuberant and almost twice as long as its width. The antennules do not have concavities and are in the horizontal plane; the basal joint of the antenna is movable; the third joint of the second maxilliped is much shorter than the second joint. The apertures of the female genital organs are on the sternites.

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SECTIO  
**OXYSTOMATA.**

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FAMILIA  
**DORIPPIDAE.**

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GENUS **CYMOPOLIA** ROUX.

*C. carinipes.*

Tab. IX Fig. 4-4a.

The cephalothorax is quadrangular, flat and extremely rugose because of the deep anastomosing furrows; the raised parts are granulated. The frontal edge is slightly prominent and is divided into two lobes by a small median hollow; however, in the middle of the frontal area there is a deep groove, and the two lobes are protuberant; the groove does not appear in the figure. The superciliar area is long and its edges are smooth; the pre-orbital spine is clearly delimited by two deep incisions and is followed by a well-developed extraorbital spine. On the inferior orbital edge, an infra-orbital and a postorbital spine are found, both well developed; the inferior parts of these spines are superposed, and therefore a small slit is found between them. The eyes are short and thick, and the eyestalk bears three tubercles before the cornea. On the subhepatic area there is a wide tubercular prominence, with denticulated external borders. The lateral edge is straight and forms three lobes, the longest of them being the first, the one ending in the extraorbital spine; the basal joint of the antenna is movable; it fills the orbit, and bears two aliform outgrowths which are directed inward; the second joint is shorter than the third. The epistome is broad and has an arcuate anterior margin. The lateral part of the oral frame exceeds its anterior border and reaches the base of the antennae. The carina of the endostome has the form of a massive broad projection. The second joint of the second maxilliped is much longer than the third; its surface, except for the oblique groove, is granulated.

The anterior legs are short; along the external surface of the propodite there is a crest; the inferior edge is pubescent. The second pair of

legs is much shorter than the third and the fourth. The inferior and superior margins of the meropodite of the second, third, and fourth pairs of legs are denticulated; the external surface of the meropodite has two crests and is granulated; the surface of the carpopodite is smooth and has two crests while its superior and inferior edges form a carina which is best developed on the very smooth propodite; the dactylopodite is lanceolate. The fifth pair of legs is small and bent dorsally. One male; the width of the cephalothorax is 7 mm, the length 6 mm.

Distribution: Red Sea.

## FAMILIA

### CALAPPIDAE.

#### GENUS CALAPPA FABR.

##### *C. tuberculata* Fabr.

Tab. IX. Fig. 5.

- |                             |   |
|-----------------------------|---|
| <i>Calappa tuberculata.</i> | Fabricius. Supp. ent. syst. p. 345.                                   |
| <i>Cancer tuberculatus.</i> | Herbst. op. cit. p. Tab. XIII. Fig. 78.                               |
| <i>Calappa tuberculata.</i> | Desmarest. op. cit. p. 109 Pl. X Fig. 1--1a.                          |
| " <i>tuberculosa.</i>       | Guérin. Iconographie Crust. Pl. XII Fig. 2.                           |
| " <i>tuberculata.</i>       | M. Edwards Hist. nat. dea Crust. T. II p. 106.                        |
| "    "                      | Kraus. op. cit. p. 52.  |
| "    "                      | Dana op. cit. p. 393.   |
| "    "                      | Heller. Beit. zur Crust. F. des r. M. p. 372.                         |
| "    "                      | Hess Beit. zur Kenntniss der Decapoden--Krebse Ost-Australiens p. 31. |
| "    "                      | Heller Navarra Exp. p. 69.  |

The lateral edge of the broad part of the cephalothorax has five spines and in this respect corresponds to the illustration by Desmarest, in which the cephalothorax is correctly illustrated; an exception is the furrow which separates the shieldlike widening, and which in our specimens is concave on the outside and not convex.

Distribution: Red Sea; Natal; Sulu Sea; Nicobar Islands; Fiji; Tongatabu; Tahiti; Sidney; Auckland.

Dana assumes (Voyage de la Bonite, Pl. III Figures 9--10) that *C. Sandwichii* is a form identical with *C. tuberculata*. We suppose that Souleyet is right in considering it a variety of *C. tuberculata*, from which it differs by the very sinuous posterior edge of the cephalothorax. The spines on the posterolateral edge are very distant from one another; the last one is at the level of the posterior edge of the cephalothorax. The large tubercles on the cephalothorax are disposed in longitudinal rows. The abdomen of the male is the same width over its entire length while in *C. tuberculata* the abdomen becomes much narrower after the third segment.



## GENUS MATUTA FABR.

### M. victor Fabr.

Cancer lunaris.	Forsk. op. cit. p. 91.
Matuta victor.	Fabricius Supp. ent. syst. p. 369.
" Lesueurii.	Rüppel. op. cit. p. 7 Tab. I Fig. 3.
	Dehaan. op. cit. p. 127 Var. secunda.
" victor.	Krauss. op. cit. p. 52.
" "	M. Edwards Hist. nat. des Crust. T. II p. 115.
" "	Alph. M. Edwards. Faune carc. de l'île de la Réunion p. 10.
" "	Heller. Beit. zur Crust. F. des r. M. p. 372.
" "	Hilgendorf op. cit. p. 93 Tab. III Fig. Fig. 2.
" "	Heller. Nov. Exp. p. 69.

The superior edge of the carpopodite of the second pair of legs is rounded and ends in a spine; on the third pair of legs this edge has two carinae while the fourth has only one carina. The other characters correspond to Rueppel's description and illustration.

We had three males which, according to age, show the following differences. In the 19-mm-long specimen the tubercles of the cephalothorax are not clearly marked. The external surface of the movable dactylus is rounded and the denticulated transverse crest on the third segment of the abdomen is small, being much lower than the crest on the second segment. In the second specimen (28 mm) the tubercles on the cephalothorax are well developed. The external surface of the movable dactylus has a crest; the crests on the second and third abdominal segments are equal in size with the exception of the concavity found on the middle of the crest of the third segment; therefore, this concavity indicated by Hilgendorf, cannot serve as a character typical of *C. lunaris*. In the third specimen which is the largest (31 mm long) the tubercles on the cephalothorax are also well developed, and therefore Dehaan's statement—that tubercles become less prominent with increasing age—may be true, but not for all individuals since in our specimens the contrary is true. The crest of the external surface of the movable dactylus has become serrated; the transverse crest on the third abdominal segment shows no concavity and is much more prominent than the crest on the second segment.

Distribution: Red Sea; Zanzibar; Natal; Bourbon Island; Nicobar Island; Malabar Coast; Madras; Singapore; Java; Celebes; Timor; Tahiti.

#### FAMILIA

### LEUCOSIADAE.

In 1855, using the rich material of the British Museum, Bell published the monograph of the family Leucosiadae, but the characterization of the

genera is not quite satisfactory. Unfortunately he paid no attention to the afferent canal\*, which has such a typical structure. In the museum of Kiev, only members of seven genera can be found: Leucosia, Philyra, Nursia, Ebalia, Persephona, Ilija and Callidactylus; the afferent canal of these genera is illustrated in the present study. From a comparison, we find that the anterior and lateral margins of the canal have a different structure in every genus; in addition, in some of them, the canal has no crest, while in others, although there is a crest, it has a different position and direction; along this crest or in front of it there is a row of hair which probably prevents impurities from entering the branchial cavity. We had only one species from each of the seven above-mentioned genera, and we therefore cannot conclude to what extent the structure of the afferent canal is constant in the species of the genus.

Stimpson\*\* has recently described a number of new genera, of which Carinapsis is identical with Leucisca McLeay.\*\*\*

## GENUS LEUCOSIA FABR.

L. urania Var. signata.

Tab. X Fig. 1-1c.

The frontal edge is rounded and is less prominent than in the figure. The posterior part of the lateral edge is smooth and not granulated. On the anterior part of the cephalothorax there is an M-shaped figure; on the posterior part are two round spots. The lateral thoracic sinus reaches the hepatic area. On its inferior edge there are three large granules after which the edge becomes smooth for some distance, and finally becomes granulated again. The anterior margin of the afferent canal is sinuous; the arcuate crest has a median position, and in front of it there is a row of hairs.

At the base of the superior surface of the meropodite of the chelipeds there are small granules which are followed by four large granules, disposed in a square. The granules become gradually smaller on the external edge and finally disappear in the distal direction; on the internal edge, they do not reach the end; the inferior edge is rounded and covered with a great number of granules, especially at its base. The carpo- and propodite are smooth. The pereopods have dark-colored transverse stripes. The abdomen of the male is made up of four segments. The third to sixth segments are fused; the sixth segment is the longest; the surface is smooth. Four males, of which two are 13.7 mm long and the others 7.5 mm long; in the latter, the cephalothorax is unadorned.

Distribution: Red Sea.

[ \* The canal through which water flows to the branchia ].

\*\* Proceedings of the Academy of Natural Sciences of Philadelphia 1858 and Bulletin of the Museum of Comparative Zoology, Harvard University, [Russian original reads Harwards College] Cambridge, Vol II 1870.

\*\*\* Smith's illustrations on the zoology of South African Invertebrates. 1849

## GENUS PHILYRA LEACH.

*Ph. platycheira* Dehaan.

Tab X Fig. 3-3c.

*Myra variegata*. Ruppel. op. cit. p. 17 Tab. IV Fig. 4.

*Philyra platycheira*. Dehaan. op. cit. p. 132. Tab. XXXIII Fig. 6.

" " Bell. Monograph of the Leucosiadae. Trans. of the Linn. society T. XXI p. 300.

" " Stimpson. Proceed. of the Acad. of. Philadelphia 1858 p. 160.

The cephalothorax is subrhomboidal, the length being almost equal to the width; the surface is covered with small granules, which can be seen only through a magnifying glass. The frontal edge forms a pointed median spine which is bent ventrally; as a result, the edge seems to be almost straight; on the frontal area there is a broad and deep median groove. The median part of the lateral edge is granulated. The posterior edge of the cephalothorax is rounded and thickened. There is one tubercle on the hepatic area. The branchial areas are separated from the median part by furrows which are not clearly marked. The anterior margin of the oral frame is prominent and covers the frontal edge. The orbital edge has two incisions which delimit a rounded extraorbital spine. The antennules are in the horizontal plane. The antennae fill the orbital fissure; the flagellum is formed of a single joint ending with two setae. The anterior and posterior parts of the oral frame are equal in breadth. The anterior margin of the afferent canal has a large incision, and the crest, covered with hairs, is found on the anterior half. The third joint of the second maxilliped is somewhat shorter than the second joint; in the female there is a row of hairs parallel to the internal edge; these hairs are missing in the male. The anterior part of the scaphognathite is broader than the posterior part, and the external edge is hairy.

The length of the cephalothorax is 10 mm, the chelipeds of the male are 21 mm long, and those of the female, 17.5 mm; the internal edge and the base of the external surface of the meropodite are granulated. The propodite and the dactyli are flattened [compressed]. The dactyli are curved and furrowed. The internal edge of the immovable dactylus is covered with thick hairs, and its end always bears two teeth in both the female and in the male; in a single male the whole edge was covered with denticles. The internal edge of the movable dactylus forms a sharp blade. The abdomen of the male is made up of three segments, segments two to six being fused; the abdomen of the female is made up of four segments; segments three to six are fused. The cephalothorax is light in color; on some of the specimens there are irregular brown lines, which form a reticulate pattern on the cephalothorax and on the chelipeds. Six males and twelve females. The young specimens differ from the adults by their shorter legs and by the narrower and flatter abdomen of the females.

Distribution: Red Sea; Hong-Kong; the Philippines; Japan.

The specimens from the Red Sea differ from Dehaan's description by the presence of denticles on the immovable dactylus; they differ from

Bell's generic diagnosis by the two incisions on the orbital edge. Bell probably considered the incision of the anterior margin of the afferent canal, which is found before the eye, as a third incision.

Myra variegata, described by Rueppel, is in all probability Phil. platycheira, a fact suggested by the ornamentation of the cuticle, as he mentioned. According to Rueppel, the chelipeds of the male are only slightly longer than the cephalothorax. This apparent incongruence is the result of the fact that Rueppel studied a young male—or that he confused it with a young female; in the young female the abdomen is narrow and flat and resembles the abdomen of the male, and therefore if we take into account the facts which we mentioned with regard to young specimens of Ph. platycheira, Rueppel's statement is not far from the truth.

## GENUS NURSIA LEACH.

Bell considers the transverse position of the antennules and the convex external edge of the scaphognathite characteristic for this genus. The species described below undoubtedly belongs to this genus, although the antennules have an oblique position and the external edge of the scaphognathite is straight. These two characters can hardly be considered as specific to the genus, although we have no material which enables us to prove it.

### *N. granulata* Rüpp.

? *Nursia granulata* Rüppel. op. cit. p. 17 Tab. IV F. 3.

Tab. X Fig. 2—2f.

The cephalothorax of the male is hexagonal. The frontal edge is broad and somewhat concave. The posterolateral edge has two slightly prominent corners; the posterior edge has three spinules: the median is smaller than the two lateral ones. The cephalothorax of the female is rhomboidal; the front is narrower, and the posterior part of the cephalothorax gradually becomes narrower; the posterior edge is rounded and has only two small lateral spinules; the surface of the cephalothorax in both sexes is granulated; the granules become smaller in the anterior direction and finally completely disappear; on the posterior part of the cephalothorax in the male there are a few large granules. The median part of the frontal area is concave. The hepatic area is raised. The branchial areas are

separated from the median part by deep furrows; the posterior cardiac area is also clearly delimited. The orbital edge has two incisions, while the orbit has no contact with the hollow of the antennules; these have an oblique position. The pterygostome bears a tubercular projection. The anterior margin of the oral frame is slightly narrower than the posterior one. The anterior margin of the afferent canal is fairly concave; there is an incision on the lateral margin; the curved crest is found on the anterior half and is covered with hairs. The surface of the gnathostegite is smooth; the third joint is almost the same length as the second, and its internal edge is denticulated. The scaphognathite is shorter than the gnathostegite and is the same width over its entire length; the superior end is rounded; the surface is smooth; the external edge is straight and pubescent.

The chelipeds of the male are of equal length; in the female, one of them is more developed; the internal surface, the base of the external surface, and the edges of the meropodite are granulated. On the carpo- and propodite, granules are smaller and in the female they have almost disappeared. The dactyli are curved and furrowed, and the internal edges bear sparse hairs; in the young male, and in the female, the internal edges are smooth, while in the adult male they are denticulated. The pereopods have no peculiar characters; the dactylopodite is pointed, and its length equals that of the two preceding joints; its end is of a brown color. The sternum and the abdomen of the young male are granulated; in the adult, the granules on the sternum are hardly visible, the abdomen is smooth, and a tubercle is found on the penultimate segment. One female and two males; one of the males has dimensions equal to those of the female. The width and length of the cephalothorax in the large specimens is 6.5 mm.

Distribution: Red Sea.

## GENUS *CALLIDACTYLUS* STIMP.

### *C. Kesslerii*.

Tab. XI Fig. 1-1c.

The frontal edge is narrow, rounded and very thickened. The external surface of the orbit is very peculiar: it has two trabecular thickenings and its edges have three incisions; the eyes are vertical in position. The cephalothorax is oval; the hepatic area has a median tubercle; the branchial areas are separated from the median part by two furrows; the posterior cardiac area is separated by a small furrow. The surface of the cephalothorax is covered with granules which are larger in the posterior than in the anterior part; five of the granules are slightly larger; one of these is on the posterior cardiac area; others, shaped like the letter V, are found on the median part of the cephalothorax. In front of the posterior edge of the cephalothorax there are three foliaceous lobes which are disposed in a row. The afferent canal is narrow; the crest is in the inferior

part, starting from the external margin, downward and outward; the crest bears hairs which do not appear in the figure. The anterior margin of the afferent canal is thickened, bent dorsally in a right angle, and exceeds the frontal edge; there is a furrow on its anterior surface; the antennules have an oblique position and the basal joint is soft. The pterygostome is raised. The gnathostegite slightly exceeds the anterior margin of the oral frame; the merognathite is much shorter than the ischiognathite, its surface being somewhat concave and covered with bacilliform granules; the internal part of the surface of the ischiognathite seems to be cut off obliquely in its interior; it is smooth; the remaining part is granulated; in the female, the longitudinal row of hairs is missing; the anterior part of the internal edge is hairy. The scaphognathite has a length equal to that of the gnathostegite; its external edge is rounded; the anterior part is covered with bacilliform granules, and the posterior part is rounded.

The surface of the first pair of legs is covered with small granules. The dactylus is slightly longer than the propodite and is furrowed; the external edge is serrated and the internal edge bears denticles. The superior and inferior edges of the propodite of the other legs are sharp; the dactylopropodite has no peculiar characters; both its edges are covered with hairs which were overlooked by the artist. The abdomen of the female is made up of five segments; segments four to six are fused; the median part is separated from the lateral parts by a shallow groove. The cephalothorax is 9.5 mm wide and the length--excluding the posterior lobe--is 10.5 mm. One female.

Distribution: Red Sea.

This species deviates from the generic characterization made by Stimpson in the structure of the dactylopropodite of the pereopods and in the anterior margin of the afferent canal. The presence or absence of a crest on the dactylopropodite may hardly be considered a generic character. As to the anterior edge, no data exist concerning its variability within the species of the genus. Consequently, we consider this species as belonging to the genus Callidactylus, as the other characters correspond to Stimpson's indications.

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As already shown, the characterizations of the genera of the Leucosiadae are not satisfactory; the contradictory opinions of the authors with regard to the genera prove this. Martens\* for instance, considers the genera Ebalia and Lithadia as being identical. Alph. M. Edwards\*\* unifies the genera Myra and Myrodes. Nursia is very incompletely characterized by Bell, and some of the characters indicated by him probably vary in different species. Bell considers\*\*\* Iphiculus as belonging to the Parthenopidae; Stimpson †, on the contrary, includes this genus in the

\* Uber cubanische Crustaceen. Arch. fur Naturg. Jahrg. 38.

\*\* Nouv. Arch. du Museum T. X. p 45.

\*\*\* Bell "Mon. of the Leucosiadae p 312. - "Voyage of Samarang" Crustacea p 57 Table XIII. Figure 5.

† Proceedings of the Academy of Natural Sciences, Philadelphia, 1858.

Leucosiadae. Bell considers\* Iphis novem-spinosa (Adams and White) as belonging to the genus Arcania, which in all probability is a heterogeneous genus; in relation to this it is enough to consider Arc. septem-spinosa, (Bell), Arc. tuberculata, or laevimana.

Notwithstanding the incomplete elucidation of this family, we decided to present an analytical table for the determination of its genera, the number of which has increased considerably since the publication of the "Monograph of the Leucosiadae".

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\* "Voyage of Samarang". Crustacea p 56 Table XIII. Figure 1.

Determination Table of the Leucosiadae Genera

Eyes covered by frons; antennules horizontally; scaphognathite somewhat longer than ischnognathite	broader distally; anterior margin of the oral frame is the same width as the posterior margin	<u>Leucisia</u> <u>Philyra</u>
Eyes not covered; scaphognathite of the heterognath cephalothorax not hexagonal	is broader than the gnathostegite and its external edge is protuberant	<u>Omychomorpha</u>
The lateral edge of the cephalothorax is smooth; the posterior edge has an incision, slight or marked; hexagonal cephalothorax	is broader distally; not broader distally; cephalothorax external edge is straight	<u>Leucosia</u>
Dactylia move in a vertical plane	Posterior edge has three spines	<u>Beilis</u> <u>Iliscabanha</u>
The lateral edge of the cephalothorax is either smooth or has one very small denticle (Pterophora (Lichtensteini); the posterior edge has one to five spines)	Posterior edge has four spines; the two median ones are near the posterior edge and the two lateral ones are on the branchial area	<u>Ilia</u> <u>Leucosilla</u> <u>Ranadilla</u> <u>Myra</u> <u>Myrodes</u> <u>Myropsis</u>
Periopods not covered by cephalothorax	Cephalothorax ovoid; its length exceeds its width; posterior edge bears three spines	<u>Callidactylus</u>
Dactylia move in a horizontal plane	Dactylia equal in length to the propodite or shorter than it	
Antennules in contact with the orbit; posterior edge of the cephalothorax bears three spines	Dactylia shorter than the propodite	
Dactylia much longer than the propodite; cephalothorax polygonal; oblique antennules	Anterior margin of the afferent canal has three spines; external antennules soft	<u>Pterophora</u> <u>Phylxia</u> <u>Nundilia</u>
Antennules not in contact with the orbit	Anterior margin of the afferent canal is smooth; a lateral incision and a crest are found	<u>Nunisa</u>
Lateral edge of the cephalothorax lobate; or denticulate	Afferent canal? Cephalothorax round; lateral edge lobate; external edge of the scaphognathite straight	<u>Nucis</u>
Lateral edge extended in a long spine or in a cylindrical outgrowth	Afferent canal? Cephalothorax hexagonal; lateral edge lobate; external edge of the scaphognathite protuberant	<u>Lithadia</u> <u>Arcania</u> <u>Iphis</u> <u>Iax</u>
Posterior edge of the cephalothorax has a deep hollow on both sides	Antennules in vertical plane with a long lateral spine	<u>Speleophorus</u> <u>Ceophorus</u>
Posterior edge of the cephalothorax has no hollows; cephalothorax covers	with a long, broad, cylindrical lateral outgrowth	<u>Cryptocnemus</u> <u>Tilo</u>
	only the meropodites the whole leg, excluding the dactylopedite	
	The edges of the cephalothorax are horizontal, without incisions	
	The edges of the cephalothorax are bent dorsally and divided into lobes by incisions	

The genus Iphiculus is not included in the table; see p 121.



FAMILIA.

DROMIADAE.

GENUS CRYPTODROMIA STIMP.

*Cryp. tomentosa* Hell.

? *Dromia tomentosa* Heller. Beit. zur Crus. F. des r. M. p. 241.

Our specimens (two females) differ from *D. tomentosa* by the lack of the spine on the anterolateral edge, in front of the occipital furrow, and by its short chelipeds, which are the same length as the second pair of legs. The other characters correspond entirely with the description of *D. tomentosa*. In addition to these data, one must also take into account other characters not mentioned by Heller. Between the extraorbital and postorbital spines there is a deep hollow which forms an incipient groove, extending between the anterior part of the lateral edge and the subhepatic area; there is a spine on the edge of this area. The flagellum of the antenna lies in the groove. The endostome has a crest. The furrows of the sternite are far from one another; they reach the second segment, and end in tubercles. The length of the cephalothorax of one female is 5 mm, and of the other 6 mm; the width of the cephalothorax of the first female is 6.5 mm and that of the second is 7.8 mm.

Distribution: Red Sea.

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TRIBUS  
**ANOMURA**

FAMILIA  
**HIPPIDAE.**

**GENUS REMIPES LATR.**

*R. testudinarius* Var. *pictus* Heller.

Tab. XI Fig. 2-2f.

*Remipes pictus.* Heller *Beit. zur Crust. F. des r. M.* p. 245.  
.. *test. Var. pictus.* Paul'son. *Zapiski Kievskogo Obshchestva Estestvoispytatelei.*

V. IV Tab. I Fig. 1-3.

According to Hilgendorf\*, every specimen of *R. testudinarius* differs slightly from every other specimen; consequently, he considers *R. pictus* and *R. ovalis*\*\* as being only forms of *R. testudinarius* since the specific characters stated by Heller and Alph. M. Edwards do not justify the creation of these new species. Unfortunately, Hilgendorf did not indicate which characters of *R. testudinarius* are stable and which are variable. Such an indication would have been very desirable since no detailed description of *R. testudinarius* is yet available, and therefore it is difficult to establish to what extent *R. pictus* differs from *R. testudinarius* (if such a difference does indeed exist). If we consider the data (which as a matter of fact, is incomplete and partially wrong) existing on this species\*\*\*, we find that in addition to the color of the cephalothorax, which was indicated by Heller, *R. pictus* has the following characters: the first third of the lateral edge of the cephalothorax is rounded and smooth; the remaining two-thirds are sharp and spinulated and hairs are found in the spaces between the spines. The endognath † of the second pair of maxillae forms two lobes, the first one

\* Van der Decken's *Reise in Ost-Africa* Crust. p 94.

\*\* Alph. M. Edwards. *Faune carc. de l'île de la Reunion*, p 12 (Table XVII Figure 5).

\*\*\* The mouthparts of *Remipes* and *Hippa* were incorrectly interpreted by all the students. The mandible and the and the first pair of maxillae differ from the general type. An elucidation in this matter may be found in our note in *Zapiski. Kiev. Obshch. Estestv. Volume IV* and in its illustrations.

† We have retained the terms "endognath" and "exognath" instead of the modern endopodite and exopodite, in order to preserve the old style of this work.

being long and directed upward. The internal corner of the third joint of the last maxilliped does not form a toothlike outgrowth and the penultimate joint of the cheliped bears an incision; consequently the animal may bend the last joint.

In order to be complete, we shall add other characters to these. Among the 81 specimens, we found no differences with regard to the cephalothorax; in all the specimens the posterior part was the widest, and this species differs in this respect from R. ovalis, in which the anterior part of the cephalothorax is wider than the posterior part. There are transverse lines on the surface. In all specimens, the frontal edge has four rounded spines\*; in some cases the median spines are slightly shorter than the lateral ones while in other cases they are equal in length; in almost all specimens, with the exception of some young individuals, all these spines are serrated. There is a groove along the lateral edge and the hairs are disposed in short rows. The antennae are usually made up of five joints, but in some cases, a flagellum made up of one or two joints may be observed. The basicerite has a squamate process on its internal surface. The third joint is the shortest of the five. Only Saussure, in describing R. cubensis, mentions the process of the basicerite in Remipes, but he states that this is found on the external part; this is probably a misprint. The second joint of the antennules is very broad and forms a groove in which the third joint lies when it is bent. In the female the short flagellum is made up of ten joints, and in the male of eight. The anteroexternal corner of the first joint of the last maxilliped forms a blunt outgrowth. The fifth and sixth joints of the second to fourth pairs of legs have a prominent hairy line on the external surface. Of the 81 specimens, in nine cases the cephalothorax was white and the transverse lines were not clearly marked; considering the softness of the cuticle, these specimens molted recently; the color of the other specimens corresponds to Heller's description.

On the antennae and on the legs, there are hairs with a very peculiar structure, having a sensory function. The canal in which the bulb is found, becomes narrower at some distance from the base of the hair. From this narrow place, round furrows appear on the surface; between these furrows there are button-shaped projections having a central hollow. The tip of the hair has a funnel-like concavity from which the bulb originates, and which is covered with a very thin membrane which is pubescent on one side. This outgrowth has an apical concavity which is covered; the spheroid central filament of the bulb ends in this concavity. This filament is in all probability a nerve having ramifications to every central hollow of the buttonlike projections on the surface of the hair.

Distribution: Red Sea.

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\* In the case of R. testudinarius, a different number of frontal spines is indicated.

Saussure explains this by the fact that the students described different species (Mém. pour servir à l'hist. nat. du Mexique ect.).

FAMILIA  
**PORCELLANIDAE.**

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As to the antennae, by which Stimpson characterized the genera belonging to Porcellanidae, we refer to our work in the fourth volume of the "Zapiski Kievskogo Obshestva Estestvoispytatelei (Kiev Society of Naturalists). We received Stimpson's work during the printing of Table XI. At that time we did not suppose that the characterization of a genus as widespread as *Porcellana*, could contain inaccuracies. Our work contains illustrations of the antennae of all Porcellanidae species found in the Museum of Kiev, including those from the Red Sea.

**GENUS PETROLISTHES STIMP.**

*Petr. ornatus.*

Tab. XI. Fig. 3.

*Petrolisthes ornatus.* Paul'son. Zapiski Kievskogo Obshestva Estestvoispytatelei.

V. IV Tab. I. Fig. 10.

The cephalothorax is ovoid and its width is almost equal to its length. The frons is narrow and very prominent; there is a triangular spine which is slightly bent downward in the middle of its straight anterior edge, and, in a groove is present in the middle of the surface of the frons. The superior orbital edge is straight. The whole surface of the cephalothorax is covered with tubercles of various heights. The occipital furrow is well developed and the cardiac area is divided by a furrow. The antennae are long; the basal joint is square; the anteroexternal corner ends in a small, pointed, triangular tooth. The second and third joints of the antennae are of equal length; on the anterior edge of the second joint there is a bent toothlike outgrowth; the third joint bears a rounded lobe.

The first pair of legs is long. The length of the carpopodite is equal to that of the propodite and the proximal part of the internal edge bears a short, wide, denticulated tooth which is followed at some distance by another small tooth. The external edge is uneven and its surface is covered with tubercles. The propodite is somewhat protuberant and broad and bears

a groove along its internal edge; its surface is covered with tubercles which become larger and more pointed as they approach the hairy external edge. The inferior side of the dactylus bears small thick hairs at its base. There is a groove along the internal edge of the movable dactylus. The pereopods are granulated and the inferior edge of the propodite and of the dactylopodite bear spines. One male.

Distribution: Red Sea.

### *Petr. virgatus.*

Tab. XI Fig. 4.

*Petrolithes virgatus.* Paul'son. Zapiski Kievskogo Obshchestva Estestvoispytatelei.

V.IV Tab.I Fig.9.

The cephalothorax is compressed, covered with hairs, and its length exceeds its width; the frontal edge projects in the form of a triangle with a rounded tip. The superior orbital edge is straight. The occipital furrow is very poorly marked and immediately behind it, on the lateral edge, a small spine may be observed under twentyfold magnification. On the posterior part of the cephalothorax there is a pattern having the form of four rhomboids. The basal joint of the antenna is square, and its anteroexternal angle ends in a pointed spine.

The carpopodite of the first leg is shorter than the propodite; the internal edge bears three pointed teeth; the external edge is smooth, but ends in a pointed tooth. The propodite is flattened; the external edge is denticulated and hairy. The external edges of the dactyli also bears hairs, as does the entire surface of the cheliped; the hairs are short, like those of the cephalothorax. On the inferior edge of the dactylopodite of the pereopods there are spinules. The cephalothorax is white with four longitudinal red stripes. One female.

Distribution: Red Sea.

### *Petr. Boscii* Aud.

- |                           |  |
|---------------------------|--|
| <i>Porcellana Boscii.</i> | Audouin op. cit. p. 271 Savigny Pl. VII Fig. 2.              |
| <i>Petrolithes</i> "      | Stimpson Proc. of the Acad. of nat. sc. of. Phil. 1858.      |
| <i>Porcellana</i> "       | Heller Beit. zur. Crust. F. des r. M. p. 256.                |
| "                         | Heller Crust. des südl. Europa p. 184.                       |
| <i>Petrolithes</i> "      | Paul'son. Zapiski Kievskogo Obshchestva Estestvoispytatelei. |

V.IV Tab.I Fig.7.

The basal joint of the antenna is almost square; the anterior edge is straight, and the anteroexternal angle forms a slightly prominent quadrangular outgrowth; the second joint is shorter than the third, and its anterior edge has a broad quadrangular outgrowth. The young specimens (length--3.5 mm) differ from the adults; in the young specimens the cephalothorax

is covered with squamate stripes; in older specimens (8 mm) the anterior part of the cephalothorax has transverse stripes instead of the squamate ones. The interior edge of the carpopodite of the chelipeds bears three to four pointed teeth in young specimens, and the external edge of the propodite is pubescent; in older specimens the teeth on the internal edge are rounded and denticulated.

Distribution: Red Sea; Mediterranean.

### *Petr. rufescens* Hell.

*Porcellana rufescens* Heller. *Beit. zur Crust. F. des r. M.* p. 255. Tab. II Fig. 4.

*Petrolisthes* " Paul'son. *Zapiski Kievskogo Obshchestva Estestvoispytatelei.* V.IV Tab.I Fig. 8.

*Porcellana leptocheles* Heller. *Beit. zur Crust. F. des r. M.* p. 258 Tab. II Fig. 6.

The basal joint of the antenna is square; the anterior edge is straight and the anteroexternal corner ends in a pointed triangular spine; the second joint is shorter than the third, and its anterior edge has a quadrangular outgrowth. The young specimens do not differ from the adults. Twelve specimens.

Distribution: Red Sea; Persian Gulf.

We have only one male from the specimens which Heller considered *P. leptocheles*. Following a very detailed comparison, we concluded that it differs from *P. rufescens* only by its chelipeds, which are narrower and somewhat longer. We had more than one opportunity to show that in the males the length of the chelipeds is variable, and consequently we consider *P. leptocheles* identical to *P. rufescens*, or a dimorphous male of this species. In describing *P. leptocheles*, Heller overlooked some characters, and therefore, in order to avoid any doubt, we shall prove that these characters are also identical to those of *P. rufescens*. Behind the orbital edge there is a small groove which is directed outward; on the surface of the cephalothorax, behind the eyes there is a prominent, somewhat protuberant line; the epibranchial spine is missing. At the end of the inferior edge of the propodite of the chelipeds there is a spinule, while on the inferior edge of the dactylopodite, there are three spinules.

## GENUS *PISOSOMA* STIMP.

### *Pis. natalensis* Krauss.

Tab. XI Fig. 5.

*Porcellana natalensis*. Krauss. *op. cit.* p. 58. Tab. IV Fig. 1.

*Pachyholis* " Stimpson. *Proc. of the Acad. of nat. sc. of. Phil.* 1858 p. 228

*Pisosoma* Paul'son. *Zapiski Kievskogo Obshchestva Estestvoispytatelei.* V.IV Tab.I Fig.12.

Our sole male differs from Krauss' description by the lack of the

two tubercles behind the frontal area, and by the presence of a tuft of hairs on the internal surface, at the base of the dactyli of the large cheliped; these hairs are missing in the specimens from Natal. The frontal edge seems to be straight, although it projects slightly in the middle. This was accurately drawn by Krauss. The cephalothorax is 3.5 mm wide and 3.3 mm long. According to these dimensions, our illustration is inaccurate. The antennae are long; the anterior edge of the basal joint is raised and directed outward, and the anterior corner ends in a pointed denticle. The length of this denticle does not exceed the width of the second joint, and bears a triangular lobe. Stimpson considers this species as belonging to the genus Pachycheles, but since the basal joint is not longer than the edge of the cephalothorax, we consider this species as belonging to the genus Pisosoma.

Distribution: Red Sea; Natal.

## GENUS POLYONYX STIMP

*Pol denticulatus*.

Tab. XI Fig 6.

*Polyonyx denticulatus*. Paul'son. Zapiski Kievskogo Obshchestva Estestvoispytatelei.

V.IV Tab. I Fig. 11.

The cephalothorax is protuberant, smooth and is slightly wider than it is long. The frons is broad and not prominent; its edge is triangular, but bent ventrally, and as a result it seems to be straight. The superior orbital edge is concave and the eyes are large. The occipital furrow is hardly visible. The hepatic edge is separated from the branchial edge by a wide hollow; there are three spines on the former, including the extra-orbital, while the latter bears four slender spines which are inaccurately represented in our illustrations. These spines are slender, and project inwards more, consequently the branchial edge is less prominent outward. The antennae are long; the anterior edge of the basal joint projects upward and outward considerably, forming a broad and high tooth; the second joint is longer than the third, and bears a small denticle at the end of the anterior edge.

The first legs are unequal in size. The carpopodite is broad and the internal edge bears three to four pointed teeth; the posterior legs also bear denticles; there is a hair before each denticle. The propodite is twisted around its axis, so that the dactyli move in the vertical plane. The propodite is protuberant, its superior and inferior edges are sharp; the inferior edge of the left leg is denticulated, while only traces of denticles can be observed on the right leg. The dactylopedite of the pereopods is short and bears two claws. Four specimens; the largest is 3.2 mm long and 3 mm wide. In the smallest specimen (2.5 mm long) the surface of the cephalothorax bears sparse hairs.

Distribution: Red Sea.

In determining the genus Polyonyx, Stimpson does not refer to the fact that the dactyli move in the vertical plane, and it is therefore possible that in the specimens to which he referred the dactyli moved in the horizontal plane. We studied many specimens of Porcellana digitalis, captured in the Sevastopol Bay, and we found considerable variability, especially concerning the dactyli. In most of them, the dactyli move in the horizontal plane, in some of them in an oblique plane, and in others in the vertical plane. The plane in which the dactyli move, therefore, not only lacks generic significance but is also of no specific importance in the species of Porcellanidae.

Among the characters of this genus given by Stimpson, we find that the frons is narrow and the eyes are small; but if we consider Porcellana biunguiculata (Dana) which Stimpson included in the genus Polyonyx, we observe that the frons is broad and the eyes are not small.

FAMILIA

PAGURIDAE.

GENUS **DARDANUS** n. g.

The orbital area is open [that is, forms an opening through which the eye protudes] and bears a movable median outgrowth, as in Diogenes. The first legs are almost equal in size. The left one is slightly longer than the right; the dactyli are spoonlike. They move in the vertical plane and their ends are cornual. The median part of the frontal edge is slightly prominent, but the anterior margin of this prominence is straight or rounded, lacking the small hollow drawn in our illustration. The last maxillipeds are somewhat separated at their bases, but far less than in Eupagurus; the basal joint is much shorter than the second one. The fourth pair of legs is subchelate.

**Dard. Hellerii** Hell.

Tab. XII Fig. 4—4c.

Pagurus depressus. Heller. Beit. zur Crust. F. des r. M. p. 249.

We will make only a few additional remarks, since this species corresponds to Heller's description of P. depressus. Heller, however, did not observe the outgrowth on the middle of the orbital area. The orbital outgrowth is oval (Figure 4 b) and has two distal denticles and a small



median groove. The podophthalmite has three hairy hollows at its base. On its right side the wide cornual plate on the dorsal surface of the abdomen ends in large calcareous plates (Figure 4c) which bear incisions and hairs on their posterior edges. The color of the legs is yellowish and only the external surface of the meropodites is red.

We had at our disposal two females of different dimensions and features. The large specimen represented in the illustration is very flattened and it was living in the shell of the genus *Strombus* (? *St. tricornis* L.) which has a very narrow opening. The other female was brought to us without the shell, but its shelter was, at any rate, larger, since its body is not flattened and consequently the length of the anterior part of the cephalothorax exceeds its width. The peduncle of the antenna is shorter, and is far from the cornual plate. The calcareous plates of the right side of the abdomen are missing.

Since the compression of the body is not one of the constant [stable] characters of this species and depends only on the width of the opening of the shell chosen by the Paguride, we propose that this species bear the name of the one who described it for the first time.

Distribution: Red Sea.

## GENUS *EUPAGURUS* BRANDT.

*Eup. cavicarpus*.

Tab. XII Fig 3-3a.

The form of the first legs slightly resembles that of *Eup. monticulosus*; but the former differs from the latter by the following characters. The eye-stalks are much longer and more slender. The peduncle of the antenna is the same length as the eyes; the scaphocerite reaches the cornea in some specimens, while in others it reaches the margin of the eye. The last joint or the last two joints of the last maxillipeds project farther than the eye.

The meropodites of the first pair of legs are somewhat longer than the eyes (our artist shortened them slightly in the figure). The external surface of the carpo- and propodite of the large chelipeds is covered with thick pointed tubercles, and there is a groove along the superior and inferior edge of the propodite; the median part is protuberant; in one specimen there is a small crest. The internal surface of these joints is granulated; and in all specimens there is a small, round, deep hollow on the carpopodite. The external surface of the propodite of the smaller cheliped bears three crests which are covered with tubercles. The third pair of legs is slightly longer than the second. The superior edge of the mero--carpopodite and half of the dactylopodite of those legs is denticulated; the dactylopodite has no furrow, but its inferior edge bears hairs which are not shown in the figure. The dactylopodite of the fourth pair of legs is long, longer than the propodite, and ends in a claw. Five females; all are of small dimensions and ovigerous; we have drawn the largest in the illustration.

Distribution: Red Sea.

### GENUS CLIBANARIUS DANA.

*Cl. signatus* Hell.

*Clibanarius signatus*. Heller. Beit. zur Crust. F. des r. M. p. 252.

One male.

Distribution: Red Sea.

### GENUS CALCINUS DANA.

*Cal. cristimanus* M. Edw.

*Pagurus cristimanus* M. Edw. Ann. des sc. nat. 3 Ser. T. X p. 64

*Calcinus cristimanus*. Heller Beit. zur Crust. F. des. r. M. p. 254.

One male.

Distribution: Red Sea. M. Edwards does not indicate the locality.

### GENUS CENOBITA LATR.

*Cen. rugosa* M. Edw.

*Cenobita rugosa*. M. Edwards. Hist. nat. des Crust. T. II p. 241.

" " Dana op. cit. p. 471 Tab. XXX Fig. 1.

" " Heller. Beit. zur Crust. F. des r. M. p. 254.

" " Heller Navarra Exp. p. 82.

" " Hilgendorf op. cit. p. 99 Tab. VI Fig. 2.

Twenty-six specimens.

Distribution: Red Sea; Zanzibar; Madras; Ceylon; Nicobar Islands; Tahiti; Sidney.

Determination table of the Paguridae Genera

Symmetrical abdomen - CANCELLINAE		Abdomen of male bears copulatory appendage after last pair of legs		Cancelus
		Orbital area has movable median outgrowth		Paguristis*
		First pair of legs unequal length; pointed dactyli		
		First pair of legs almost equal length; spoonlike dactyli with cornual tips		Diogenes
				Dardanus
		Dactyli move in horizontal plane		Isocheles
		Dactyli pointed		Clibanarius
		Spoonlike dactyli with cornual tips		
Bases of last maxilliped near one another		Orbital segment smooth		
Abdomen of male does not bear copulatory appendages after last pair of legs		Dactyli move in vertical plane		Petrochirus
		Tip of dactyli calcified		
		Frontal edge does not have median spine; orbital area open		
		Frontal edge has median spine; orbital area closed		Calcinus
Asymmetrical abdomen		Tip of dactyli cornual		Pagurus
		Frontal edge straight; maxillae have flagellum		
		Frontal edge has spine; maxillae lack flagellum		Aniculus
		Copulatory appendages at bases of last pair of legs		Spiropagurus
		Copulatory appendages not at bases of last pair of legs		Eupagurus
Bases of maxillipeds very distant		Frontal edge straight; abdomen soft		Cenobita
		Frontal edge denticulated; abdomen covered dorsally with calcareous plates		Birgus

Scaphognathite of hectognath without flagellite [palp]; first joint of antennules very long - CENOBITINAE

---\* [Paguristes]

Scaphognathite of hectognath has a flagellite [palp]; first joint of antennule very short - PACURINAE

FAMILIA  
GALATHEIDAE.

GENUS GALATHEA FABR.

*Gal. longimana.*

Tab. XII Fig. 2-2a.

This species is characterized by the structure of the last maxilliped, by its narrow rostrum, the position of the spinules on the cephalothorax, and by its very long chelipeds; in this species, the meropodite together with the subsequent joints is  $2\frac{1}{2}$  times longer than the cephalothorax. The occipital furrow is clearly marked. There is a squamate stripe on the anterior part of the cephalothorax, while a transverse stripe may be seen on its posterior part; both stripes bear short hairs. The length of the rostrum is more than twice its width; behind it there are two pairs of spinules which are disposed in two rows, and after the orbital edge there are three additional spinules on each side. On the hepatic edge there is one spine, and another is found on the subhepatic area; the branchial edge of the cephalothorax bears six spines. The last maxillipeds reach the extremity of the frons; the third joint is much shorter than the second, its internal edge bears two spines, and the external edge, one spine; the fourth and fifth joints are equal in length.

One half of the length of the meropodites of the chelipeds extends beyond the rostrum. The propodite, together with the dactyli, is longer than the cephalothorax (including the rostrum). The external surface and the edges of the mero- carpo- and propodite are covered with spines. The dactyli of the male are open, the apexes are red, and each dactylus has two teeth on its internal edge. The superior edges of the mero-, carpo- and propodite of the pereopods bear denticles, which are not drawn; the inferior edge of the dactylopropodite bears spinules. The chelipeds of the female are more slender, the dactyli are closed, and the internal edges are denticulated. One male and one female.

Distribution: Red Sea.

*Gal. aegyptiaca.*

Tab. XII Fig. 1-1b.

The cephalothorax has no occipital furrow, and its surface shows only transverse lines covered with short hairs. The rostrum has a width which almost equals its length, and behind it, on the first stripe there are two median spines, while on the second stripe there is a lateral spine, as in

Gal. squamifera. The last maxillipeds are longer than the rostrum; the second joint is somewhat shorter than the third; the internal edge of the last joint bears two long spines; the fifth joint is longer than the fourth.

The chelipeds are twice as long as the cephalothorax; almost one half of the length of the meropodites extends beyond the rostrum; the propodite together with the dactyli has the same length as the cephalothorax together with the rostrum; the external surface and the edges of the mero-, carpo-, and propodite and of the dactyli bear spines. The superior edge of the mero-, carpo-, and propodite of the pereopods bear denticles, and there are spinules on the inferior edges of the propodite and dactylopropodite.

The third joint of the last maxillipeds and the length of the meropodite of the chelipeds are like those of Gal. strigosa; the arrangement of the spines on the cephalothorax and the length of the last maxillipeds are like those of Gal. squamifera. Gal. aegyptiaca differs from these two species by the lack of the occipital furrow and by its open dactyli. Two males.

Distribution: Red Sea.

#### Gal. brevinana.

This species is characterized by its short chelipeds, only one fourth of the length of which extends beyond the cephalothorax; the meropodite only reaches the extremity of the frons; the propodite together with the dactyli is shorter than half of the cephalothorax. The surface of the cephalothorax has an occipital furrow and transverse stripes. The hepatic edge has two spinules; on the branchial edge there are five spinules, and one is found on the subhepatic area. The rostrum is somewhat narrower than that of Gal. aegyptiaca, and behind it, there are two spines. Other such spines are not found on the surface of the cephalothorax. The last maxillipeds reach the extremity of the rostrum; the third joint is shorter than the second, and the internal edge bears two spines, of which the superior one is much shorter. The pereopods are like those of Gal. aegyptiaca. One female.

Distribution: Red Sea.

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TRIBUS  
**MACROURA**

FAMILIA  
**LORICATA.**

GENUS **SCYLLARUS** FABR.

Sc. Gundlachii (Dehaan.) Martens.

Tab. XII Fig. 5-5a.

Scyllarus arctus. Var. II Dehaan. Fauna jap. p. 154 Tab. XXXVIII Fig. 2.

" Gundlachii Martens Über. cubanische Crust Arch. für. Naturg. Jahrg. 38 p. 129 Tab. V Fig. 13.

Martens indicated only a number of differences between this species and *Scyl. arctus*, and in all probability, his species is identical with the second variety of *Scyl. arctus*, described by Dehaan. The characters described by these two authors are very incomplete and therefore, considering the specimens from the Red Sea identical with the above forms, or deviating only very slightly from these, we present below the detailed characters of this species, which differs greatly from *Scyl. arctus*.

The tergite plate is wider than that of *Scyl. arctus* and does not have two spines at its anterior end; the tubercle on the middle of the fifth segment is missing. Behind the frontal plate, there are two wide concavities. The entire surface of the cephalothorax is covered with tubercles; the superior edge of the median carina is rounded and forms three spines; two of these spines are found in front of the occipital furrow and there is one behind it; the lateral edge is denticulated. The surface of the first joint of the maxilliped is uneven. The second joint reaches the superior edge of the fourth joint; its external edge has three denticles; the internal edge has one denticle and the rest of the edge in front of it is denticulated; a median carina is found, and on its external part there are four tubercles which are disposed in a row. The anterior edge of the fourth joint forms five blunt, smooth lobes; the internal edge bears two teeth. The first joint of the maxillulae is shorter and broader than that in *Scyl. arctus*. The external surface of the second and third joints of the last maxilliped is smooth in

Scyl. arctus and protuberant in Scyl. Gundlachii; in the last one, the second joint is longer than the third, while in Scyl. arctus, the second joint is shorter than the third. The second and third segments of the abdomen have a median carina; the lateral edges of the abdominal segments are rounded; the posterior edge of the hard part of the last segment has no denticles. The propodites of legs two to five are the same length and appear like those of Scyl. arctus. Every joint of the five pair of legs has a violet stripe. Two males, 19 mm long.

Distribution: Red Sea; Cuba and Sea of Japan.

Scyllarus Haanii, which was found in China was described by Berthold\* and greatly resembles Scyl. Gundlachii; it differs from it however by the short propodites of its first pair of legs and by the small spinules on the last abdominal segment. The species created by Berthold is not identical to Scyl. Haanii v. Siebold, described by Dehaan himself, and therefore it may be called Scyllarus Bertholdii.

#### FAMILIA

### CRANGONIDAE.

#### GENUS NIKA RISSO.

*N. aequimana.*

Tab. XIV Fig. 6—6a.

The frontal edge is slightly prominent and continues into a narrow pointed rostrum which reaches the extremity of the eyes. The base of the basal joint of the antennules has a short broad process. Heller\*\* asserts that this process is missing in Nika, nevertheless it is present in N. edulis of the Mediterranaen. A portion of the penultimate joint of the last maxillipeds extends beyond the peduncle of the antennules. There is an antennal spine on the anterior edge of the cephalothorax. The second pair of legs is almost equal in length (the ratio of their lengths is 226:205); the meropodite has eleven joints, as in N. hawaiiensis, with the sole difference that the first four joints are not fused. The end of the telson and the foliaceous process of the antenna are damaged. One ovigerous female. The body, including the rostrum, is 6 mm long. The cephalothorax is 4.5 mm long; the rostrum is 1.5 mm long.

Distribution: Red Sea.

N. euquimana may possibly represent only a variety of N. hawaiiensis since in the latter neither the last maxilliped nor the relative length of the second pair of legs are known.

\* Berthold. Zur Krebskunde Chinas p 23 Table II Figures 2—3.

\*\* Crustaceen des südlichen Europa p 231.

## GENUS NIKOIDES n. g.

The mandibles are slender and strongly bent; the masticatory surface is not widened and on its superior part a small denticle may be observed; the palp is missing. The last maxillipeds are not broad, but leglike. The first pair of legs are thicker than the second pair; the first are chelate, the others end in a claw, and have exopodites. A portion of the meropodite as well as the carpopodite of the second pair of legs are cylindrical. The antennules bear two flagella each.

This genus differs from *Nika* by the existence of exopodites on the first pair of legs and by the cylindrical meropodite of the second pair of legs.

### Nik. Danae.

Tab XIV Fig. 5-5d.

The rostrum is shorter than the eyes and slightly bent ventrally. It has an apical incision and hairs along its inferior edge. The peduncle of the antennules is the same length as the spine of the antennae; the basal joint is long and concave, and at its base bears a short, broad, foliaceous process, the external corner of which ends in a spinule. A portion of the penultimate joint of the last maxilliped extends beyond the peduncle of the antennae. On the anterior edge of the cephalothorax, before the antenna, there is a spine. The right leg of the second pair is much longer than the left; the anterior part of the meropodite and of the carpopodite are cylindrical. The dactylopodite of the other legs ends in a claw and a tuft of hair; the fourth pair of legs is the longest. The posterior part of the telson is like that of *Nika edulis*, i. e., triangular and pointed; under it, on each side there is a thick, pennate seta, and more laterally there are two spines on each side, the internal spines being longer than the external ones. One specimen, 34 mm long.

Distribution: Red Sea.

## GENUS TOZEUMA STIMP.

### Toz. armatum.

Tab. XV Fig. 2-2o.

The rostrum is very long and at least equal in length to the cephalothorax together with the subsequent two segments; the superior edge is straight and has a crest, which begins at the cephalothorax not far from the



base of the eyes; the inferior edge is serrated, and has a large quadrangular incision at its base; beyond this, the frontal outgrowth becomes gradually narrower in the distal direction. The antennules together with the flagella are shorter than the short foliaceous process of the antennae; the first joint is longer than the other two; the superior surface is concave and has at its base a spine, which is longer than the first joint. The peduncle of the antenna is short and the basal joint is provided with a short spine; the flagellum is long. The anterior edge of the cephalothorax forms a long spine at its contact with the inferior edge. The last maxilliped has no exognath and the last joint ends in spines; the maxilliped reaches only to the end of the basal joint of the antennae.

The first pair of legs is much shorter and thicker than the second pair, and bears a chela; the carpopodite is the same length as the propodite; the dactyli are shorter. The first joint of the carpopodite of the second pair of legs is longer than the other two joints, which are of equal length. The inferior edge of the meropodite of the other legs bears a subapical spine; the carpopodite has no spines, while the propodite bears six pairs of spines. The dactylopodite is pointed, with four spines on its inferior edge. Beyond the third segment, the abdomen is bent ventrally in a right angle; at the level of the bend, the surface of the third segment has a hooklike spine; the posterior edges of the fourth and fifth segments each bear one spine, and near the lateral edge of the fifth segment there is a lateral spine. The sixth segment is longer than the preceding one but shorter than the narrow telson, which ends in a furca. Three pairs of spines are present on the surface of the telson; the uropods are narrow and shorter than the telson. Four specimens.

Distribution: Red Sea.

FAMILIA  
LEPTOCHELIDAE.

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The mandibles are broad and undivided\* and have a foliaceous palp. The first two pairs of legs are of equal length, and their carpopodite is not cylindrical.

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\* In describing *Leptochela gracilis*, Stimpson states: "mandibularum corona margine interno dentata, medio profunde fissa". In our species we did not observe such a division of the masticatory surface. (Proceedings of the Academy of Natural Sciences of Philadelphia 1870 p 42).

## GENUS LEPTOCHELA STIMP.

The frontal edge has short outgrowths. The antennules have two flagella. The hectognath is leglike and bears an exognath; the last joint is shorter than the two preceding it. The first four pairs of legs have exopodites, the first two being chelate. The third pair of legs are shorter than the ones preceding and have neither chelae nor claws; the other legs are shorter, but broader than the third pair of legs, and the dactylopodite ends in a rudimentary claw. This genus is closely related to *Pasiphaea*, but differs from it, as from the other genera, in many respects, so that a new family was created for it.

### *Lep. aculeocaudata*

Tab. XVI Fig. 1-1a.

The rostrum does not extend beyond the eyes, and it begins in the form of a crest in the middle of the cephalothorax. The eyestalks are short and thick. The peduncle of the antennules is shorter than the foliaceous process of the antennae; the first joint is longer than the other two. The superior surface is concave; the basal spine reaches the end of the first joint, being more or less fused with it, and is twisted around its axis; this is not represented in our illustration. The peduncle of the antennae is the same length as that of the antennules; the external edge of the foliaceous process is straight; the internal is convex, and has a terminal spine; in addition, the first joint has a very short free basal spine. The endognath\* of the maxillulae is bilobate, and the exognath bears a spine. The endognath of the maxilla is trilobate. The exognath of the first maxilliped is very broad; the endognath is bilobate, and a mesognath is found between them. The exognath of the second maxilliped is very broad and the last joint of the endognath has a spiniform end. The last joint of the last maxilliped is shorter than the preceding joint and has no spines at its end. The first and second pair of legs are of equal length and are equally strong; the ischiopodite is longer than the mero- and carpopodite; the internal edge of the basipodite bears four spines, and not three as shown in the figure; on the mero- and carpopodite, a row of blunt spines is found; the dactyli are twice as long as the propodite, and their internal edges are serrated. The third pair of legs are less well developed and shorter than the second pair; the internal edges of the basi-, ischio-, mero-, and carpopodite are spinulated; the dactylopodite has no claws and ends in hairs.

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\* [ We have retained the terms "endognath" and "exognath" instead of the modern endopodite and exopodite, in order to preserve the old style of this work. ]

The fourth and fifth pair of legs are equally well developed and shorter but stronger than the third pair; the fifth pair of legs are shorter than the fourth and have no exopodite; the ischiopodite bears two spines, and the meropodite one; the dactylopodite has a rudimentary claw. The abdomen is not bent, as in most members of the Caridae, but is elongated; the first three segments are of equal length; the subsequent three segments are also equal in length, but they are longer than the first; the telson is twice as long as the sixth segment; the ratio of their lengths is 2:3:6. The telson has an almost uniform width; on its surface there are two pairs of spines, the superior ones being very close to one another. The posterior edge is convex and covered with five pairs of spines, the external having smooth margins; the margins of the other spines are serrated. The external plate of the meropodite is shorter than the internal plate; its external edge is spinulated; on the internal plate only the inferior part of the external edge is spinulated. Two specimens, 11 mm long.

Distribution: Red Sea.

#### FAMILIA

### PALAEEMONIDAE.

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#### GENUS ALPHEUS FABR.

Among the members of this genus we found two groups; in one of them, the first four pairs of legs have a peculiar exopodite, and a rudimentary epipodite; the fifth pair of legs has only epipodites. In the members of the other group, these branches are missing. On this basis, we consider all those species in which these branches do not exist as belonging to the genus Alpheus. In Alpheus, the fifth pair of legs differ from the two preceding ones - a character which also has not been noted before; the carpopodite of this pair of legs has no spine and is longer than that of the third and fourth pairs of legs; the number of spines on the propodite is always smaller than that on the two preceding pairs of legs, and the external surface has pubescent stripes, the number of which is, as far as we could ascertain, constant within the species.

*Alph. tumido-manus.*

Tab. XIII Fig. 2-2h.

The rostrum is longer than the orbital outgrowth but does not reach the end of the first joint of the antennules; it begins in the form of a broad crest on the frontal area, between the eyes. The first joint of the antennules

is  $1\frac{1}{2}$  times longer than the second, which in turn is twice as long as the third; the basal spine reaches the middle of the second joint; the external flagellum is made up of nine joints up to its bifurcation. The foliaceous process of the antennae is narrow and only on one fourth of its length is fused with the spine; the spine is much longer than the foliaceous process and reaches the end of the peduncle; the basal joint of the peduncle bears two additional spines, one much shorter than the other. The second maxilliped is longer than the peduncle of the antennae, and the end of the last joint is spinulated.

The first pair of legs are unequal in length; the dactyli move in the horizontal plane; the posterior part of the propodite of the stronger leg is widened, especially in the female, and has a reticular pattern; the chelae are pink, and the end of the dactylus is blue; the movable dactylus is blunt and is one third of the length of the propodite. The second pair of legs are much shorter than the third pair; the first joint of the carpopodite is longer than the other joints; the second, third and fourth joints are equal in length; the fifth joint is as long as the third joint together with the fourth; the length of the chela is equal to that of the third, fourth and fifth joints together. The dactylopedite of the other legs becomes gradually narrower in the distal direction, it is pointed, and the second claw is found on the inferior edge. The end of the inferior edge of the carpopodite of the third and fourth pairs of legs bears one spine, while the inferior edge of the propodite bears eight spines. The propodite of the fifth pair of legs has five spines and eight pubescent stripes. The articular stalk of the pleopods is very short. The telson is protuberant, with a median groove which becomes wider in the distal direction. The exterior edge is convex. There are angular spines under which two articulated spines are found; in addition, on the surface of the telson there are two pairs of spines. The uropods are longer than the telson, and their external plate bears two teeth, beyond the transverse suture; between the teeth there is an articulated spine.

The length is 19 mm. One female and one male; the latter is slightly smaller.

Distribution: Red Sea.

#### Var. *Alph. gracili-manus*.

Tab. XIII Fig. 3-3c.

We had only one female of this variety at our disposal; it is characterized by a shorter rostrum, which is equal to the orbital outgrowths in length. The chela of the largest pereopod is more slender, its posterior part is not widened, and has no reticular pattern. The second pair of legs are somewhat longer than the third. The remaining characters are like those of *Alph. tumido-manus*.

The third specimen differs from the preceding ones by the external flagellum of the antennules which has eleven joints up to the bifurcation, and by its pleopods which have no articular stalk.

*Alph. fossor.*

Tab. XIII Fig. 5-5g.

The rostrum is smooth and is narrower and slightly longer than the orbital outgrowths, but shorter than the first joint of the antennules. The peduncle of the antennule is somewhat shorter than the peduncle of the antenna; the first two joints are equal in length, the third is shorter; the external flagellum has six joints up to the bifurcation. The basal joint reaches the tip of the first joint. The foliaceous process of the antenna reaches the end of the second joint of the antennules; it is shorter than the antennal spine and is fused with it to its middle; the basal joint of the peduncle has two more spines, one of them being much shorter than the other. The last maxilliped is longer than the peduncle of the antennae.

The first legs are not equal in size. The dactylus of the larger leg is short and blunt. The second pair of legs is slightly longer than the third; the first joint of the carpopodite is slightly longer than the third joint together with the fourth and fifth. The second, third and fourth joints are equal in size; the fifth joint is equal to the two which precede it; the chela and the first joint are equal in length, and the superior edge of the propodite bears a concavity. The dactylopodite of the other legs is broad, especially its first half, and it ends with two claws which are preceded by a third rudimentary claw; the internal surface is very concave, and the dactylopodite is spoonlike, with prominent edges and has claws. At the end of the inferior edge of the carpopodite of the second and third pairs of legs there is a spine while there are seven spines on the propodite. The propodite of the fifth pair of legs has only two spines, and six pubescent stripes. The telson becomes slightly narrower distally; the posterior edge is convex; it bears large angular spines; under each of these there are two additional spines. Sixteen specimens. The largest is 13 mm long.

*Alph. triunguiculatus.*

Tab. XIV Fig. 1-1g.

The rostrum is smooth, very narrow, slightly longer than the orbital outgrowths, and almost reaches the end of the first joint of the antennules; in another specimen the rostrum reaches only the middle of the first joint, since the latter is much longer in this specimen. The peduncle of the antennule is equal in length to the foliaceous process of the antenna; the first two joints are almost equal in length; in the other specimen, the first joint is twice as long as the second; the basal spine reaches the middle of the second joint; the external flagellum has six joints up to the bifurcation. The spine of the foliaceous process of the antenna is longer than the peduncle of the antennules and a third of its length is fused with the foliaceous process; the basal joint has two additional spines, one of them being much shorter

than the second. The last maxillipeds are considerably longer than the stalk of the antenna.

The first legs are unequal in size; the propodite is twisted around its axis, so that the dactyli move in an oblique plane; the movable dactylus is situated over the immovable one; the blunt movable dactylus is almost one third the length of the propodite; the superior edge of the propodite ends in a hook. The second pair of legs are longer than the third pair. The first joint of the carpopodite is much longer than the others; the second, third and fourth joints are of equal length; the fifth joint is equal in length to the two preceding joints together, while the chela is equal in length to the third, fourth and fifth joints together. The dactylopodite of the other legs has a shape identical to that of the preceding species, but it has three well developed claws. There is a spine at the end of the inferior edge of the carpopodite of the second and third pair of legs and there are eight spines on the propodite. The inferior margin of the propodite of the fifth pair of legs bears two spines and ten pubescent stripes. The articular stalk of the pleopods is long. The posterior edge of the telson is convex; it bears small angular spines, under each one of these there are two additional spines. Two specimens; the largest is 20 mm long.

Distribution: Red Sea.

#### Alph. Charon Hell.

Tab. XIII Fig. 4-4g.

Alpheus Charon. Heller. Beit. zur Crust. F. des r. M. p. 272 Tab. III Fig. 21, 22.

The rostrum is smooth and much narrower than the orbital outgrowth; it has parallel edges and a pointed tip. It is longer than the orbital outgrowths and reaches the end of the first joint of the antennules. Our specimens differ from Heller's description by the second joint of their antennules, which has a length equal to that of the third, both being somewhat shorter than the first. The first joint of the carpopodite of the second pair of legs has almost the same length as the other joints; the superior edge of the pereopods is hairy. Heller also describes a transverse suture which is found on the last third of the telson; this is probably a misprint, referring, in fact, to the external plate of the uropods. To this data we add some supplementary characters not shown by Heller. The external flagellum of the antennules is formed of seven joints up to the bifurcation; the last maxillipeds are longer than the peduncle of the antennae and end in spines. The chela is somewhat twisted; therefore the dactyli move in an oblique plane, the immovable dactylus being situated over the movable one. The inferior edge of the propodite of the fifth pair of legs has three spines and five pubescent stripes. The posterior edge of the telson is slightly convex; the corners do not bear angular spines but two spines are found under each of the corners. One male, 11.5 mm long.

Distribution: Red Sea.

**Alph. tricuspidatus Hell.**

Tab. XIII Fig. 1-1f.

*Athanas nitescens.* Audouin. op. cit. p. 274. Savigny Pl. IX Fig. 4.

*Alpheus tricuspidatus.* Heller. Beit. zur Crust. F. des r. M. p. 267 Tab. III Fig.

Our specimen differs from Heller's description by the size of the joints of the antennules, their peduncles being somewhat longer than the foliaceous process of the antennae. The propodite of the last pair of legs has five spines and six pubescent stripes. The posterior edge of the telson is convex; there are no angular spines; under each corner, two articulated spines are found.

**GENUS ALPHEOIDES n. g.**

This genus differs from *Alpheus* only in that there are appendages on the basis of the pereopods (Table XIV, Figures 3 and 3a). The first four pairs of pereopods have two kinds of appendages on the external side of the coxopodite; the function of these appendages is unknown. One of them is shaped like a hook with a handle, and corresponds to the exopodite; the other corresponds to a very shortened epipodite; it is formed of a short cone with a tip covered with long thick hair and projects from the opening of the joint. Each appendage has a basal plate; the last pair of legs has no exopodite, but the plate of the epipodite is much larger than that of preceding legs; the hairs of this epipodite are not drawn. We have found such appendages in other forms also, e. g., in *Lysmata seticaudata*.

**Alphd. insignis Hell.**

*Alpheus insignis.* Heller. Beit. zur Crust. F. des r. M. p. 269 Tab. III Fig. 17, 18.

We will add some supplementary data to Heller's description. The external flagellum of the antennules is made up of eleven joints up to the bifurcation. The appendages of the pereopods are like those of *Alphd. crassimanus*. The external surface of the propodite of the fifth pair of legs has seven pubescent stripes, which grow in length as they approach the dactylopodite. The posterior edge of the telson is slightly convex; the corners have no angular spines, and under each of them, two spines are found.

Distribution: Red Sea.

### *Alphd. laevis* Rand.

Tab. XIV Fig. 3-3a.

<i>Alpheus laevis</i>	Randall. Jour. Acad. nat. sc of Philad. T. VIII p. 141.
" "	Dana. op cit. p. 556 Tab. XXXV Fig. 8.
" "	Heller. Beit. zur Crust. F. des. r. M. p. 269.

The propodite of the last pair of legs has three spines and four apical pubescent stripes. The dactylopodite of the third and fourth pair of legs is short, as if it were cut off; in the last pair of legs it is pointed. The posterior edge of the telson is slightly convex; the corners do not bear spines, and under each of them there are two spines. The propodites of the chelipeds are spotted, and the spine of the external plate of the uropod is red. Many specimens.

Distribution: Red Sea; Tonga (Friendly Islands); Fiji; Hawaii.

### *Alphd. crassimanus* Hell.

*Alpheus crassimanus*. Heller. Navarra Exp. p. 107. Tab. X Fig. 2.

We add the following to Heller's description. The end of the last joint of the antennae is not spinulated; nor are there any spines on the end of the inferior edge of the carpopodite of the third and fourth pair of legs; the propodite has eight spines. The propodite of the fifth pair of legs is not spinulated, but in its second half, sixteen pubescent stripes are found, which increase in length as they approach the dactylopodite. The exopodite of the first four pairs of legs is narrower and longer than in *Alph. laevis*, and the endopodite has only two hairs. The first pair of pleopods has two plates in the male as well as in the female, one of them being very short. The second pair of pleopods has two equal plates; in the male one of these has two articular stalks, but in the female there is only one stalk. The posterior edge of the telson is slightly rounded; no angular spines are found, and under each corner there are two spines.

Distribution: Red Sea; the Nicobars.



## GENUS ARETE STIMP.

*Ar. monoceros* Hell.

*Alph. monoceros*. Heller. Beit. zur Crust. F. der r. M. p. 274.

In characterizing this genus, Stimpson states: "pedes secundi breves, carpis quadriarticulatis" - this seems to be a misprint, instead of penta-articulated, the more so since in Alph. monoceros Heller describes a carpopodite made up of five joints. In the sole specimen of the museum, all the legs are missing; we therefore could not ascertain who is right.

Distribution: Red Sea.

## GENUS RACILIUS n. g.

The body is unusually compressed, in the form of a sheet [of cardboard] and has sharp edges on the abdominal segments; there is a crest on the cephalothorax which continues in a short rostrum. The eyes are covered by the spinous cephalothorax. The antennules have two flagella. Appendages, similar to those of Alpheoides are present at the basis of the pereopods. The first pair of legs are the same length and equally strong and have giant chelae; their dactyli move in the vertical plane. The carpopodite of the second pair of legs is made up of five joints. The mandibles are like those of Alpheus. The anterior joint of the last maxilliped is not as short as that of Alpheus. The uropod is quite different from that of Alpheus and Alpheoides. This genus is closely related to the genera Alpheus, Alpheoides, Arete and Betaeus, forming a homogenous group within the subfamily of the Alpheinae with them.

*R. compressus*.

Tab. XIV Fig. 2-2g.

The body is greatly compressed laterally; the height of the cephalothorax is greater than its width. Along the whole dorsal edge there is a carina, which continues as the rostrum. There is a concavity at the level of the eyes in the cephalothorax. The rostrum is narrow and short, and reaches the end of the first joint of the antennules. The peduncle of the antennules is equal in length to that of the foliaceous process of the antennae;

the first joint forms a small aliform expansion, and the basal spine reaches the end of the first joint; the external flagellum is broken, and we therefore cannot ascertain whether it is bifurcated or not; at any rate, on the twelfth joint, no signs of bifurcation are seen. Half of the length of the foliaceous process is fused with the spine, whose length it equals; the free spine is also the same length. The third joint of the last maxilliped is shorter than the second and the fourth; the end of the last joint bears no spine. The first pair of legs are equally long and strong; the chelae are giant and different from one another; the dactyli of the right first leg are short, and the movable dactylus is broadened and rounded apically; the dactyli of the left first leg are long, and the movable dactylus is pointed. The first joint of the carpopodite of the second pair of legs is equal in length to the third, fourth and fifth joints together; the second, third and fourth joints are equal in size; the fifth joint is the same length as joints three plus four. The chela almost equal the two preceding joints of the carpopodite in length. The other legs end in a pointed claw, and the inferior edges of the carpopodite are not spinulated. At the end of the propodite of the fifth pair of legs there are five pubescent stripes. As a consequence of the strong compression of the body, all the abdominal segments have sharp dorsal edges. The telson becomes very narrow in the distal direction, and every corner bears a spinule; there are no spines on the dorsal surface. The internal plate of the uropod has a strong spine at the end of the external surface; on the external plate, a longitudinal suture delimits a short, broad, external part, and an internal one; the inferior edge of the external part has a large median articulated spine.

Distribution: Red Sea.

## GENUS *VIRBIUS*. STIMP.

Tab. XVI Fig. 3-3f.

The cephalothorax has no crest. The rostrum starts from the frontal edge and has no crest either. The mandibles are bifid; the upper branch is denticulated, the lower branch is more slender and has an incision at its end; there is no palp. The endognath of the maxillulae is bilobate; the upper lobe becomes broader apically, and its internal edge is spinulated; the inferior lobe is strongly bent, and, like the exognath, ends in a long spine. The exognath of the first pair of maxillipeds is situated very high, above the endognath; the anterior part is long and narrow, and there is a hairy joint at its end; the endognath is bilobate. The second pair of maxillipeds has no peculiar characters. The exognath of the last maxillipeds (Table XVIII Figure 1d) is very short and the last joint of the endognath bears spines. The antennules have two flagella; the apical part (last two joints) of the thick flagellum abruptly narrows; a hairy scale is present at its base. The first pair of legs are chelate and shorter and thicker than the second pair; the dactyli are broad and spoonlike, with denticulated edges. The carpopodite of the second pair of legs, which is also chelate, is made

up of three joints. The dactylopodite of the other legs ends in a claw, and its inferior edge bears articular, knifelike spines (Table XVIII Figure 1g). The males are smaller than the females, and differ from them by the first pair of the pleopods; in the males one of the plates is much shorter than the other (Table XVIII, Figure 1k); in the female, the plates have the same length, but differ in width.

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The specimens from the Red Sea were numerous, we had a few hundred at our disposal, of which we studied about fifty. All possible intergradations and various combinations of some of the characters were seen, so that we had great difficulties in making the characterization, the alternative being the creation of a lot of species, showing gradual transitions. In order to avoid this, we call the specimens of the Red Sea V. Proteus.

#### V. Proteus.

Tab. XVIII Fig. 1-1k. & Tab. XVI Fig. 2-5.

If the comparison of the specimens is made only on the basis of the rostrum and the antennae, at least two divisions may be observed, which, however, also cannot be clearly delimited and characterized.

A). The first group will include all specimens in which the rostrum is low, i. e., has the same height over its entire length; the peduncle of the antennules is either longer than the rostrum or the same length; the foliaceous process of the antenna is somewhat longer than the peduncle of the antennules. This division contains two groups, and its specimens not only show transitions from one group to the other, but also toward the other division.

GROUP I. The peduncle of the antennules is equal to the rostrum in length.

The specimen drawn in Table XVIII Figure 1, 1k, may serve as a type for this group. The cephalothorax and the abdomen have the usual form of the genus Virbius; the dorsal part of the fifth and sixth abdominal segments, and a part of the fourth, are much narrower than the rest of the segments, and as a consequence a lateral groove is formed. In several places the cephalothorax and the abdominal segments bear pennate hairs. The anterior edge of the cephalothorax has supraorbital, antennal and branchial spines. The rostrum is bifurcate apically, its superior and inferior edges are smooth. The basal spine of the antennules is somewhat longer than half of the superior joint; another small spine is found on the internal edge of this joint, in the second half; the thick flagellum is made up of eight broad joints. The last maxillipeds are shorter than the peduncle of the antennules. The first pair of legs reaches only the anterior edge of the cephalothorax. The second pair of legs is shorter than the maxilliped;

the joints of the carpopodite have the same length, and the chela is longer than the last joint. Of the other legs, the third pair is the longest, somewhat exceeding the rostrum in length. The propodite of the third pair of legs is broader than that of the fourth and fifth pairs. The dactylopodite ends in a pointed claw, and on the inferior edge there are ten knifelike spines which become longer as they approach the claw. The sixth segment is shorter than the telson, and its posterior edge is smooth. The posterior edge of the telson has six spines, of which the exterior ones are very short; the other spines alternate with hairs; the edges of the spines are pubescent, with the exception of the external edge of the second pair.

Within this group the rostrum shows the following variations:

a). The superior edge has one or two basal spines; the inferior edge is smooth. In some specimens, the last maxillipeds reach the end of the peduncle of the antennules.

b). The superior edge has two to five spines, one of them being on the cephalothorax, behind the eyes; the inferior edge is smooth.

c). The superior edge has one to two spines, and the inferior edge has one to three spines in its second half; as a consequence, the distal part of the rostrum becomes somewhat higher than the proximal part and so forms a transition to the second division.

d). The superior edge has one basal spine and the inferior edge has a subapical one. The peduncle of the antennules is equal in length to the rostrum, but much shorter than the foliaceous process of the antennae. In this respect, this specimen is also a transition toward the second division. The posterior margin of the telson has eight spines. The number of spines is usually found in the subsequent group, and in the second division; the members of this group have six spines, with the exception of one specimen.

GROUP II. The peduncle of the antennules is much longer than the rostrum; the rostrum is the same length as the eyes or shorter than them.

Within this group, the rostrum has a variable structure; in some specimens the superior and inferior edges are smooth, while in others, the superior edge has one spine (Table XVI Figure 4); the tip is pointed or bifurcate. The slender flagellum of the antennule either is equal in length to the thick flagellum, or is much shorter, or both flagella are short (Table XVI Figure 5a). The basal joint of the antennules has an apical spine in addition to the basal spine (Table XVI, Figure 5a) and because of this is a transition toward the second division. In most specimens the posterior edge of the telson has eight spines instead of six; in one specimen with eight spines, the posterior edge of the sixth segment also bears a spine.

In connection with the individuals of this group, we must note that they are all smaller than those of the preceding group, and we never found ovigerous females among them. Among the specimens of the first group and those of the second division, ovigerous females were very frequently found.

B). In the specimens of the second division, the rostrum is somewhat foliaceous, i. e. it is higher distally than proximally; the superior and inferior edges are always spinulated. The foliaceous process of the antennae is equal in length to that of the rostrum, and is much longer than the peduncle of the antennules.

The specimen drawn in Table XVI Figure 2 represents a transition between this division and the first group of the first division. The posterior

edge of the telson has eight spines in some specimens, while in others it has six.

In other specimens (Table XVI Figure 3), the rostrum becomes still higher distally. The first joint of the antennules has an apical spine in addition to the basal one. The posterior edge of the telson has six spines.

In all probability, an even greater number of variations might be found; but if we limit ourselves to the data which we presented with regard to the fifty specimens studied, the conclusion may be drawn that two species lived some time ago in the Red Sea; in one of them, the rostrum had almost parallel edges and was smooth; in the other, the rostrum was foliaceous with spinulated edges. In one of the species, the posterior edge of the telson had six spines, while in the other it had eight spines. Another conclusion may also be drawn, that - as for instance in *Pilumnus* from the Mediterranean, or in *Porcellana digitalis* from the Black Sea - the specimens of this species are at the present moment undergoing strong individual differentiation, and that no individual of these varieties - if we may call them such - has hitherto obtained a sufficient selective advantage over the others in order to be able to eliminate them.

## GENUS PONTONIA LATR.

### *P. biunguiculata.*

Tab. XV. Fig. 1--1a.

This species differs from the preceding, by its broad gnathostegite, and by the second pair of legs, which are of equal length. The rostrum is short and triangular and has a broad base. Its end is bent somewhat ventrally, and its length is equal to that of the peduncle of the antennules. The eyes are small. The first joint of the antennules and its spine are broad and leaflike. The thick flagellum is apically bifurcated. The foliaceous process of the antenna is oval, and ends in a hooklike spine. The superior branch of the mandibles is strongly bent. The endognath of the maxillae is elongated and its inferior part has two incisions. The second and third joints of the last maxilliped are almost completely fused, and are very broad, especially in the female. The second pair of legs are well developed and equal in size; in the male, the dactyli of the right leg are shaped differently from those of the left. This difference is best seen in the accompanying illustration. In the female, the second pair of legs is less well developed, but the dactyli of both legs are equal in size. The dactylopedite of the other legs ends in two claws, and at the base of each claw there is a broad hairy outgrowth. The telson is protuberant; the posterior edge is rounded and bears four soft spiniform outgrowths; the median outgrowths are shorter than the lateral ones; between each internal and external outgrowth there is a hair. One male and one female.

Distribution: Red Sea.

## GENUS OEDIPUS DANA.

*Oed. dentirostris.*

Tab. XIV Fig. 7-7d.

The wide frons projects between the two eyes as a quadrangular plate. This plate subsequently becomes a triangular outgrowth, somewhat bent ventrally at the apex; there is a median crest with five spinules which extends only on the rostrum; on the inferior edge there is a subapical spinule, and the space between it and the end of the rostrum is hairy. The peduncle of the antennules reaches the end of the rostrum; the first joint is very broad and has a small apical spine in addition to the long narrow basal spine. The flagella are broken but a bifurcation may be seen at the end of the thick one. The foliaceous process of the antennae is much longer than the peduncle of the antennules. The last two joints of the hectognath are the same length as the second joint. The first pair of legs has no peculiar characters; the second pair of legs is missing. The dactylopodite of the other legs ends in a claw; its base forms a large triangular outgrowth. There is a pubescent stripe at the end of the propodite. The posterior edge of the telson is rounded and bears six spines, the lateral ones being very short; the median spines are somewhat shorter and more slender than the two intermediate ones. One specimen.

Distribution: Red Sea.

## GENUS HARPILIUS DANA.

*H. Beaupresii* Aud.

*Palaemon Beaupresii.* Audouin op. cit. p. Savigny Tab. X Eig. 4.  
*Harpilius* " Heller. Beit. zur Crust. F. des r. M. p. 280.

We draw the attention to the fact that the exognath of the hectognath is not made up of two joints as Heller presumes, but only of a monoarticulate scaphognathite; its superior part bears hairs on both sides and does not have the articulation drawn by Savigny. A few specimens.

Distribution: Red Sea.

## GENUS ANCHISTIA DANA.

*Anch. elegans.*

Tab. XVII Fig. 1-1h.

The rostrum is somewhat bent dorsally and its length is equal to that of the foliaceous process of the antennae; the superior edge has six spines, the first of these being on the cephalothorax, behind the eyes; the subsequent four spines are equidistant from one another, and the sixth one is in the middle of the remaining part of the rostrum; its end is bifurcated; the anterior part of the inferior edge has three spines, the first of them being situated at the level of the penultimate spine of the superior edge. The anterior part of the cephalothorax bears three spines: one supraorbital, one antennal, and one branchiostegal. The peduncle of the antennules is shorter than the rostrum, reaching only its last spine; the basal spine is shorter than the first joint; the external flagellum bifurcates in its third quarter. The foliaceous process of the antennae is narrow, with almost parallel edges. The external edge of the second joint of the hectognath bears one spine, and the last joint ends in a long pointed spine.

The first pair of legs are equal in size, longer than the rostrum and reach the propodite of the second pair of legs. At the end of the meropodite of the second pair of legs there is a spine; the surface of the meropodite, like that of the ischiopodite, is covered with squamate lines. The end of the carpopodite bears two teeth. The propodite is twice as long as the dactyli. The other legs have no peculiar characters and end in simple claws. The end of the telson is pointed and the posterior edge has six spines, those of the second pair being the longest; the internal spines are half the length of the preceding ones and are pubescent. The characteristic posterior edge of the telson in this species, shows its close relation to Palaemon, in which the pubescent spines of Anchistia, became pennate hairs. Two specimens, the larger 16 mm long, including the rostrum.

Distribution: Red Sea.

*Anch. Edwardsii.*

Tab. XVII Fig. 2-2b.

The rostrum is almost horizontal and is equal in length to that of the foliaceous process of the antennae; the superior edge bears seven spines; the first four are equidistant from one another, and two of those are found on the cephalothorax, behind the eyes; the other three spines are also disposed at equal distances, but are separated from the first four by a space; the end of the rostrum is bifurcated, and its inferior edge bears three spines. On the anterior part of the cephalothorax, the same spines are found as in Anch. elegans. The peduncle of the antennules reaches the end

of the rostrum; the basal spine is longer than the half of the first joint; the external flagellum is biramate in its final quarter. Half the length of the chelae extends beyond the rostrum. The second pair of legs are equal in size and are longer than the rostrum by the length of the chelae; the dactyli are shorter than the propodite. The claws of the other legs and the telson are identical to those of the above species. One specimen, 14 mm long, including the rostrum.

Distribution: Red Sea.

#### **Anch. Petitthouarsii Aud.**

*Palaemon Petitthouarsii*. Audouin. op. cit. p. 275 Savigny Pl. X Fig. 3.

*Anchistia inaequimana*. Heller. Beit. zur Crust. F. des r. M. p. 283.

" " Heller. Navarra Exp. p. 109.

In our specimen the difference in the length of the second pair of legs is more obvious than was shown by Savigny; in all other respects our specimens correspond exactly to his illustrations. In describing the Crustacea of the Navarra Expedition Heller considered Anch. inaequimana similar to Anch. Petitthouarsi. Eight specimens.

Distribution: Red Sea; Tahiti.

### **GENUS ANCHISTIOIDES n. g.**

The body is compressed. The peduncle of the antennules is very short; the external flagellum is very thick and becomes bifurcated at its middle. The foliaceous process of the antennae is broad. The mandibles are like those in Anchistia.

The anterior edge of the cephalothorax has one spine. The endognath of the maxillae is rudimentary. The exognath of the first maxilliped is foliaceous. The last maxilliped are slender, and lack the exognath, and the last two joints are much shorter than the second one. The first two pairs of pereopods are chelate, the second pair being more well developed than the first. The internal plate of the first pair of pleopods is short in the males, but divided into two parts; the internal part has a hook, which is found only on the appendages of the subsequent pleopods in the Caridae. The second pair of pleopods has the same structure as those of Anchistia and Palaemon. The posterior edge of the telson is straight and not pointed.



**Ancht. compressus.**

Tab. XIX Fig 5-5a.

The rostrum is long and foliaceous and has a carina which begins on the middle of the cephalothorax; the superior edge has ten large spines; the inferior edge has six small spinules; the end is pointed. The peduncle of the antennules is short and does not reach even the middle of the rostrum; the first joint is very short, but considerably broadened; in addition to the basal joint which covers the orifice of the auditory organ, a distal spine is also found. The second joint is also broadened laterally. The external flagellum of the antennules is very thick and covered with thick hairs, and its superior half is not fused. The basal joint of the antennae bears no spines; the foliaceous process reaches the end of the rostrum, and its anterior edge is cut obliquely. On the anterior edge of the cephalothorax, there is only an antennal spine. The chelae of the first pair of legs extend beyond the rostrum. The second pair of legs are broken, but considering the basal joint, they appear to have been stronger than the first pair. The other legs and in claws and each one has a denticle on its inferior edge. The telson is three times as long as the sixth segment; the posterior edge is straight and bears six spines, the external ones being very small. The internal spines are hairy, longer and more slender than the intermediate. On both sides between the intermediate spine and the internal one, a thick hair is found. The plates of the uropods are equal and have a length equal to that of the telson. One male; the length of its body is 15 mm.

Distribution: Red Sea.

**GENUS PALAEMON FABR.**

***P. torensis.***

Tab. XVII Fig. 3-3f.

The rostrum is in the horizontal plane with the tip slightly bent dorsally; the superior edge has eight or nine spinules which are spaced at equal distances; two of them are situated on the cephalothorax behind the eyes; the last two thirds of the inferior edge bears seven spinules; the end is bifurcated; on the anterior part of the cephalothorax there is an antennal and a branchiostegal spine. The peduncle of the antennule is much shorter than the foliaceous process of the antenna; the basal spine is longer than the middle of the first joint, which is wide, and also ends in an apical spine; the thick flagellum is bifurcated in the first quarter of its length, and is somewhat longer than the rostrum. The foliaceous process of the antenna reaches the end of the rostrum. The last pair of maxillipeds reach the propodite of the first pair of legs; the last two joints are somewhat longer than the second, the second half of which is spinulated. The first pair of legs is somewhat longer than the peduncle of the antennule. The second pair of legs is longer than the rostrum either by one half of the

length of the propodite, or by the length of the dactyli. The sixth segment is shorter than the telson. Its posterior edge is pointed and bears two spines [apparently two pairs of spines]. The median spines are very long and a pair of pennate hairs is found between them. Ten specimens, the largest is 27 mm long.

The shape of the rostrum is variable in this species and there are intergradations. Two varieties of this species may be distinguished.

Var. A. (Table XVII Figure 4). The rostrum is narrow, strongly bent dorsally, and longer than the second pair of legs. The remaining characters are like those of *P. torensis*. Three specimens.

Var. B. (Table XVII Figure 5). The rostrum is foliaceous and shorter than the second pair of legs. The remaining characters are like those of *P. torensis*. Six specimens, the largest being 31 mm long. *P. torensis* is the intermediate form between the two varieties.

Distribution: Red Sea.

## GENUS PALAEMONELLA DANA.

This genus, created by Dana, differs from *Palaemon* by its biarticu- lar mandibular palp. In the specimens from the Red Sea and the Mediter- ranean, the palp is not short, but has the usual length. The median spines on the posterior edge of the telson are much shorter than those of *Palaemon*, and are equal in length to the hairs found between them.

### *Pal. gracilis.*

Tab. XVII Fig. 6-6f.

The rostrum is horizontal and foliaceous, and somewhat longer than the foliaceous process of the antennae; the superior edge bears seven or eight spinules, three of which are on the cephalothorax, behind the eyes; the anterior part of the inferior edge bears three spines; the end is bifur- cated. The peduncle of the antennule is equal in length to the foliaceous process of the antennae; the basal spine is short, and the apical spine is pointed; only the last quarter of the external flagellum is free. The last maxillipeds reach only the second joint of the antennules; the second joint is shorter than the subsequent two; the last joint ends in a spine. The first pair of legs is very slender and reaches the propodite of the second pair of legs, which in turn extend beyond the rostrum with half the length of the chelae. The sixth abdominal segment is the same length as the telson. Eight specimens, the longest is 43 mm long, including the rostrum.

Distribution: Red Sea.

FAMILIA  
**PENEIDAE.**

GENUS **APHAREUS** n. g.

The mandibles are simple and undivided and have a palp. The second and third maxillipeds have no exognath; the last two joints of the hectognath are cylindrical. The pereopods have no process; the first three pairs are slender and chelate. The last pair is not cylindrical. The pleopods have two plates. The rostrum is short; the eyestalks and the antennules are long.

**Aph. inermis.**

Tab. XVIII Fig 3-3a.

The peduncle of the antennules is longer than the foliaceous process of the antenna; the basal spine of the first joint is small and fairly distal; the second and third joints are equal in length, they appear triangular in section, and the third joint is broader than the second. The anterior part of the cephalothorax has a median carina which forms a spine, and then continues into a short rostrum; laterally, two spines are found: the supra-orbital and the hepatic. The pentognath is leglike. The hectognath is longer than the peduncle of the antennule; it becomes much narrower distally, and the last two joints are tetrasedgmented. The third pair of legs is the longest of the pereopods. The other legs end in a pointed dactylopodite and the joints bear long hairs. The sixth abdominal segment has a median carina and is twice as long as the fifth segment. The telson is pointed and bears four spines on each side. The uropod is longer than the telson. The internal plate is shorter than the external one. One specimen, 26 mm long.

Distribution: Red Sea.

## GENUS *SICYONIA* M. EDW.

*S. lancifer*. Oliv.

Tab. XVIII Fig. 2-2b.

*Palaemon lancifer*. Olivier. Encyc. meth. Tab. VIII p. 664.

This species which Olivier described for the first time from an incomplete specimen, has not been studied since.

The rostrum is equal in length to the peduncle of the antennules, and its serrate carina reaches the end of the cephalothorax, which bears five spines; the superior edge of the rostrum has five spines; its end is bifurcated, the inferior branch is bent downward as in *S. sculpta*; on the inferior edge, there is only one large subapical spine near which three other very small and slender spines are found. The antennules are like those of *S. sculpta*, the sole difference being that the last two joints are much shorter than the first. The antennae are like those of *S. sculpta*; the foliaceous process is the same length as the peduncle of the antennule, the end of which reaches the last maxilliped. On the anterior part of the cephalothorax there is only one large spine, viz., the hepatic. The dactyli of the first three pairs of legs are longer than the propodite. The inferior lateral edge of the first abdominal segment is sharp. In the other segments, it ends in a spine, while on the posterior edge one or two additional spines are found. The carina which is found on the tergite of the first three segments, has a groove along its entire length; on the fourth and fifth segments, the groove is found only in the posterior half, while on the sixth segment, the carina has no groove but ends in a posterior spine. In the male, the processes of the first two pleopods are not fused. The telson is the same length as that of *S. sculpta*. One male, 24 mm long, including the rostrum.

Distribution: Red Sea; Indian Ocean.

## GENUS *PENEUS* LATR.

In characterizing this genus, M. Edwards made an error, which Heller later also made. They considered the first four pairs of pereiopods as having epipodites, while actually only the chelipeds have epipodites; an exopodite is found on every pereiopod. The internal plates of the first pair of pleopods are fused only in adult males; in young males they are free. The sternal plates of the female, situated between the fourth and fifth pair of legs, may serve as a distinctive character in the identification of the species; the plates may be missing in some species.

*P. longipes.*

Tab. XIX Fig. 1-1a.

Among the properties which characterize this species are its very long fifth pair of legs, which reach the end of the foliaceous process of the antenna. The cephalothorax and the abdomen are covered with very short hairs. The rostrum is slightly bent upward, and has a pointed end; the superior edge has ten spines. The tenth spine is on the cephalothorax and reaches the posterior end of the cephalothorax in the form of a crest; the inferior edge is smooth and hairy. The flagella of the antenna, are the same length as the peduncle, to which they are connected. The eyestalk is short. The anterior part of the cephalothorax has four spines: one supraorbital, one antennal, one hepatic, and one pterygostomial. The second joint of the first pair of legs has a large spine on its internal edge; the exopodite is short and thick. The third, fourth, fifth, and sixth segments have a dorsal carina; there is a spine on the posterior edge of the sixth segment. In the female, a triangular sternal plate is found between the fourth pair of legs, while between the fifth pair of legs there is a narrow [thin] but broad, quadrangular plate which has a median incision on the anterior edge. The telson is much shorter than the uropods. There is a groove on its surface; the end of the telson is pointed, and bears a small articulated spine. On each side, three spines are found. One female, 54 mm long.

Distribution: Red Sea.

*P. velutinus* Dana.

Tab. XIX Fig. 2-2a.

*Peneus velutinus*. Dana. Expl. Exp. p. 604. Tab. XL Fig. 4.

As in the afore-mentioned species the surface of the cephalothorax and of the abdomen is covered with short pennate hairs. On the cephalothorax there is neither carina nor groove. The rostrum is somewhat shorter than the foliaceous process of the antenna; the superior edge has eight spines, the first of which is on the cephalothorax behind the eyes; the inferior edge has no spines and is hairy. On the anterior part of the cephalothorax, the same spines are found as in the afore-mentioned species. The last maxillipeds reach the end of the foliaceous process of the antenna. The second and third joints of the first pair of legs each bear one spine. A spine is found only on the second joint of the second pair of legs; on the third pair of legs there are no spines. The exognath is slender and long. The fifth pair of legs is shorter than the others. The third, fourth, fifth and sixth segments have a dorsal carina. The appendages of the first pair of pleopods are unequally developed in the male; in the large specimen

they are fused, in the small one they are free. The appendage on the internal plate of the second pair of pleopods which is found in *P. canaliculatus*, is missing in this species; instead, the plate is well developed and has a groove. The female has no sternal plate between the fourth and fifth pair of legs. The telson is pointed apically, and on its second half it bears four spines on each side; the median spines are longer than the other two; a groove is present on the surface. Three males and two females. The largest specimen is 56 mm long, excluding the rostrum, which is 8 mm long.

Distribution: Red Sea; Hawaii.

### *P. canaliculatus* Oliv.

Tab. XIX Fig. 3-3a.

<i>Palaemon canaliculatus</i> .	Olivier. Encycl. meth. T. VIII p. 660.
<i>Peneus</i> "	M. Edwards. Hist. nat. des Crust. T. II p. 414.
"	Dehaan. Fauna japonica p. 190.
"	Heller. Navarra Exp. p. 121.

In the male the internal plate of the first pair of pleopods bears a groove; on the second pair, the internal plate is formed of two pieces, the superior having an appendage; the internal plates of both pairs of pleopods are fused with one another. Between the fourth pair of legs of the female there is a quadrangular sternal plate bearing a median crest. The sternal plates found between the fifth pair of legs are free. They are foliaceous, and have curved edges. One male and one female.

Distribution: Red Sea; Japan; Tahiti.

### *P. semisulcatus* Dehaan.

Tab. XIX Fig. 4.

<i>Peneus semisulcatus</i> .	Dehaan. op. cit. p. 191 Tab. XLVI Fig. 1.
"	Heller. Navarra Exp. p. 121.

In the female, between the fourth pair of legs there is a quadrangular prominence bearing an outgrowth, which enters the space formed by the two plates of the fifth pair of legs; the internal edges of these plates are bent upward. The sole female which we studied differs from Dehaan's specimens by the short flagella of the antennules; they are half the length of the peduncle. The first pair of legs has only one spine.

Distribution: Red Sea; Hong-Kong; Japan.

FAMILIA  
**SERGESTIDAE.**

**GENUS LEUCIFER THOMP.**

**L. Reynaudii. M. Edw.**

Tab. XIX Fig. 6-6g.

- Leucifer Reynaudii. M. Edwards. Hist. nat. des Crust. T. II p. 469. Pl. 26 Fig. 10.  
" typus Eydoux et Souleyet. Voyage de la Bonite p. 249 Pl. IV Fig. 1-12.  
Semper. Reisebericht aus Manilla. Zeits. für w. Zool. Bd. p. 106.  
Claus. Über einige Schizopoden u. niedere Malocostraken Messina's Zeits. für w. Zool.  
Bd. XIII p. 433 Tab. XXVIII Fig. 21-26.  
Leucifer Reynaudii. Dohrn. Untersuchungen über Bau u. Entwicklung der Arthropoden. Zeits. für w. Zool.  
Bd. XXI p. 356 Tab. XXVII Fig. 1-10.

The fairly detailed works of Semper, Claus and Dohrn, on this genus, have been published recently, so we shall confine ourselves to some additional remarks and amendments.

The antennae and the mouthparts correspond to Claus's description; in Dohrn, the antennules and maxillulae are incorrectly drawn. On the anterior part of the cephalothorax there is a spine and the anterior edge of the prominence on which the eyes are found is provided with three spines. The first two pleopods differ in the male and female; the second difference however, i. e., regarding the sixth abdominal segment, emphasized by Dohrn, is characteristic of the male, but not to the extent that Dohrn presumed. We will first consider the male. The last pair of pereopods is subchelate at the basis there is a vesicular appendage \* with a completely developed spermatophore. The peculiar appendage of the first two pairs of pleopods have not been correctly drawn yet. The appendage of the first pair is tetra-articulated; the first three joints are almost square; the fourth resembles chela and shows a transverse thickening of the cuticle. The end of the leg is made up of eleven joints, which bear long pennate hairs. The second pair of legs has two natatory branches and a spoonlike process with an orifice at its end; one of the branches has eleven joints, and the second nineteen joints. The sixth segment entirely corresponds to the figure drawn by Claus and Dohrn. On the inferior surface of the telson, in the last third, a lobate process is found which corresponds in structure to the appendage of the sixth segment. On its surface there are five rows of orifices, leading to a short canal (Figure 6c). In the specimens preserved in alcohol it has not been possible to ascertain whether these orifices are connected with a gland or not.

In the female, the first pair of pleopods have no appendages and in this respect they differ from those of the male; the sixth abdominal segment, however, has the same foliaceous appendages, as in the male, but in the female, only one appendage is found instead of two, and this is followed by a small spine which is missing in the male. This appendage is

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\*[The petasma]

moved by a special muscle. The telson of the female is somewhat narrower and longer than that of the male, and there is a small median pad on its inferior surface, formed of large cells (Figure 6g) corresponding probably to the lobate process of the male; we could, however, not observe orifices on its surface. One male, 13.8 mm long, and one female, 11.5 mm long.

Distribution: Red Sea; Mediterranean Sea; Indian Ocean.

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SUBORDO

# SCHIZOPODA.

FAMILIA

MYSIDAE.

GENUS SIRIELLA DAHA.

*S. brevicaudata.*

Tab. XX Fig. 1—1m.

The rostrum is very small. The antennules are equal in length to the foliaceous process of the antennae. In the female, the first joint is longer than the third, while in the male the third joint is longer than the first, and its internal edge forms a groove whose borders are covered with long, slender hairs. The external flagellum is thicker than the internal one, and its internal edge bears aesthetascs. The second joint of the antenna has no spiniform outgrowth and no hair; the foliaceous process becomes broader apically, it is rounded, and bears a lateral spine. The first and second pairs of maxillipeds have a structure identical to that of *S. Edwardsii*, described by Claus. The other legs become gradually shorter; the natatory branch is made up of ten joints, not including the broad base, the free corner of which has no spine. The dactylopodite ends in a long claw; its end is longer than its base, and bears a long spine at the end of the inferior edge. In the female, at the bases of the last two pairs of legs there are protuberant plates\* which form the ovisac; the plates on the sixth pair are larger than those on the preceding pairs. In the male, the bases of the last pair of legs are connected with a vesicular genital appendix, in which there is a vesicula seminalis with a short excretory canal\*\*. The pigment spots on the

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\* [oostegites]

\*\* The genital appendage (Figure 1g) is incorrectly drawn. We had at that time a poorly preserved male, and its desquamating epithelium was the cause of the mistake in the figure. In volume IV of the "Zapiski Kievskago Obshchestva Estestvoznani" we included another figure with a more detailed description of the genital organ.

sides of the abdominal segments have a ramified pattern. On the pleopods of the male there are hooklike curved gills which were described by Claus; the large branch of the pleopod has a tuft of hairs on its external surface. The uropod is concave; the telson is very short and three spines are found on each side of its proximal part; this is succeeded by a smooth portion, which in turn is followed by spines; the posterior edge has six spines, between which two long hairs are found. The external plate of the uropod is longer than the internal edge, and bears five spines immediately before the median suture; the internal edge of the internal plate also has spines. Nine specimens.

Distribution: Red Sea

### *S. jaltensis* Chernyav

Tab. XX Fig. 2-2b.

*Siriella Jaltensis*. Chernyavskii. Materialy dlya svavneniye Zoografii Ponta. p. 50 Tab. IV  
Fig. 12-13.

The Red Sea specimens are very similar to the species from the Black Sea, described by Chernyavskii. The differences are very unimportant and are in the individual rather than the specific sphere. The rostrum is shorter than in *S. jaltensis*. The natatory branches of the legs are made up of ten joints, while in *S. jaltensis* they are made up of twelve. The external corner of the broad base of this branch ends in a small spine in the specimens from both seas. The median spine on the posterior edge of the telson is three times longer than the lateral spines in *S. jaltensis*, while in the Red Sea specimens, the three spines are of equal length; on the second half of the lateral edge, long spines alternate with short spines. The external plate of the uropod is somewhat longer than the internal plate, and its external edge bears seven spines before the transverse suture. The internal edge of the internal plate is also provided with spines. The dactylopodite is similar to that of the aforementioned species; the internal edge of the ischiomero-, carpo-, and prognathite of the first maxillipeds in *S. jaltensis* however, bears a special cyathiform organ not found in other species. Two small females, much smaller than the Black Sea specimens; their length is 44 mm.

Distribution: Red Sea; Black Sea.

### *S. Edwardsii* Claus.

Tab. XX Fig. 3-3k.

Claus. Ueber die Gattung *Cynthia* als Geschlechtsform der Mysidengattung *Siriella*. Zeits für wiss. Zoologie Bd. XVIII Tab. XVIII.

The sole female captured in the Red Sea differs from *S. Edwardsii*

in very unimportant details of the structure of the uropod. In our specimen, the telson has two pigment spots, and the end of the external plate beyond the transverse suture seems to have the external part cut off and bears three spines. The natatory branches of the last two pairs of legs are made up of ten joints; the third pair is made up of eleven. The last legs are characterized not so much by their structure as by their orientation, and they differ considerably in this respect from the genus Siriella. At the basis of the last pair of legs there is a large plate; at the basis of the fifth pair there is a smaller plate; both these plates, however, are not protuberant and do not participate in the formation of the ovisac. The ovisac (Figure 3e) is consequently separate from these plates. In studying this species, we did not suppose that such a difference existed, and in dissecting the ovisac and the legs in order to count the joints of the branches, we did not pay attention to the point of insertion and therefore could not conclude to which pair of legs the ovisac was connected, since this is formed by a single pair of plates; at any rate, we could not find another pair. The plates of the ovisac have been preserved [in alcohol] together with the eggs and the legs, so that the facts stated above may be ascertained at any time. We purposely drew the other parts of the body, in order to show the resemblance between our specimen and S. Edwardsii described by Claus. Although the structure of the last two pairs of legs is normal, their oostegites do not participate, as in other forms of Siriella, in the formation of the ovisac, and therefore we could have considered this specimen as being a new genus; however, we consider this as being unjustified, the more so since we had no possibility of ascertaining this fact on other specimens. This specimen is possibly characterized by an individual aberration, similar to that in which the number of the phalanxes is increased, in birds or man.

Distribution: Red Sea; Pacific Ocean; Valparaiso.

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SUBORDO

# STOMATOPODA.

GENUS **GONODACTYLUS** LATR.

*G. brevisquamatus.*

Tab. XXI Fig. 3-8g.

The width of the frontal plate is much greater than its height; the median spine is longer than the lateral ones, and is bent downward. The foliaceous process of the antennules is narrow and somewhat longer than the second joint of the peduncle. The length of the cephalothorax exceeds its width; it is divided into three parts by two longitudinal furrows. The last four segments of the pereion [the thorax] are open and the first is shorter than the others. All the segments are protuberant and become somewhat broader toward the end of the body. The first five segments of the pleon [the abdomen] are smooth. On the sixth segment, which is shorter than the preceding ones there is a median spherical prominence which bears a median furrow; on its lateral sides two longitudinal thickenings are found; this segment has no spines. The telson is not fused with the preceding segment and exceeds it in length; its surface "relief" is like that of the sixth segment - only the furrow is missing; the posterior edge has four spines; the median ones are longer than the lateral and end in an articulated spine. The plates of the uropod are very characteristic for this species. The basal joint is somewhat longer than the external plate; its end is curved and pointed, and the internal edge bears a spine which is situated rather proximally; the internal plate is shorter than the external and its surface is concave. The external plate is made up of two parts, the proximal part is elongated and reaches the end of the second part; its external edge bears seven spines. The last three spines are much larger than the preceding ones, and are bent upward and outward. The surface of the body is covered with spots. One male, 24 mm long.

Distribution: Red Sea.

### G. chiragra Fabr.

Squilla chiragra.	Fabr. Spec. Insect. T. I p. 515.
Cancer "	Herbst. op. cit. T. II p. 100 Tab. XXXIV Fig. 2.
Squilla "	Desmarest. Consid. sur les Crust. p. 281.
Gonodactylus chir.	Latreille Encyc. meth. T. X p. 473 Tab. 325 Fig. 2.
" "	Milne Edwards. Hist. nat. des Crust. T. II p. 528.
" "	Dana. Expl. Exp. T. I p. 623.
" "	Heller. Crust. des südl. Europa p. 309.
" "	Heller. Navarra Exp. p. 126.

A large number of specimens were available. The sixth segment of the pleon and the telson are not equally well developed in all specimens-- but these differences are individual in character.

Distribution: Red Sea; Mediterranean Sea; the Nicobars; Borneo; Tongatabu; Fiji; Tahiti.

### GENUS PSEUDOSQUILLA DANA.

#### P. stylifera Lam.

Squilla stylifera.	Lamarck. Hist. des anim. sans vetr. T. V p. 189.
" "	Latreille. Encyl. meth. T. X p. 472.
Gonodactylus stylif.	M. Edwards. Hist. nat. des Crust. T. II p. 530. Pl. XXVII Fig. 9-14.
" "	Guérin. Iconographie Pl. XXIV Fig. 1.
Pseudosquilla "	Dana. op. cit. p. 622 Tab. XLI Fig. 4.

One female.

Distribution: Red Sea; Mauritius; Fiji; Sandwich Islands.

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SUBORDO  
**CUMACEA.**

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GENUS **DIOPS** n. g.

This genus differs from all known Cumacea in that it has two eyes. The cephalothorax becomes broader toward the posterior end, and has a large anterior incision, in which a short bifurcated rostrum is found. The last four segments of the pereion are not covered by the cephalothorax. The antennae are made up of five joints and have two flagella. The peduncle of the antennules is very short and made up of three joints. The first two pairs of pereiopods each have a natatory branch made up of seven joints; the second joint is the longest, and the last one is very short. The first pair of pereiopods ends in a claw; the second pair has no dactylopodite. The other of the pereiopods have no swimming rami and bear claws. The segments of the pleon are apodal. The basal joints of the furca are short and bear two conical, pointed articular processes.

*D. parvulus.*

Tab. XIX Fig. 1-1r.

We had only one female of this species, with a length of 3.5 mm. The median part of the cephalothorax is convex, and laterally, in the vicinity of the posterior edge there are two lobate prominences; the anterior edge is concave and forms a spine at the level of the inferior corner. The last two segments of the pereion are completely open; the two preceding ones are only open laterally. The eyes are very distant from one another and have a short immovable stalk; the cornea has no facets and comes off easily from the eye but remains attached to the lateral side of the cephalothorax. The antennules are made up of five joints; the second and third joints each have a small lateral outgrowth, on which aesthetascs are found; the last two joints are very narrow and end in two flagella. The antennae are much shorter than the antennules and are made up of three joints; the flagellum

is shorter than the peduncle. The mandibles have no unusual characters. The labium bears a deep median incision. The maxillulae have a bilobate endognath; the articulation of the posterior lobe was not clearly seen but it is moved by a muscular fiber whose other end is inserted on the antero-external lobe; the end of the posterior lobe has only one flagellum. The maxillae are so damaged that we cannot give a detailed description of them. Dohrn\* considers that the maxillulae with their flagella are the true maxillae and in this respect contradicts the opinion of Sars\*\*. In order to establish the truth, we have studied a collection of Cumacea captured by N. A. Krichagin in the Black Sea, and ascertained that Sars was right. The first pair of maxillipeds is made up of five joints; the first joint is much longer than the others, and its internal part is prominent. On the basis of ontogenic studies, Dohrn considers this the principal endite, which did not reach full development; the other joints correspond to the natatory branch; the internal edge of the second joint of the natatory branch bears five membranous teeth (Figure 1g); the third joint is joined to a long hair, and at the end of the fourth joint, hooklike bent hairs are to be found. The anterior part of the gill apparatus is damaged, but the posterior part is intact on both sides, and differs from that in all the other Cumacea by having the appearance of a short, broad plate, bearing five simple, long, thick hairs on its external part. We subsequently had the opportunity of studying the gill apparatus of some Black Sea specimens preserved in alcohol, and we found that this organ is joined to the basal joint of the first maxilliped, and is not connected to it by a chitinous crosspiece, as stated by Dohrn. The broad basal piece to which the gill plates are attached is rounded in its posterior part, and on the external part it has a groove which continues as a long outgrowth having an anterior orientation and ending in a funnel\*\*\*.

This organ can hardly be called a gill since - according to Sars' studies - some species lack these gill plates, and in *Diops parvulus*, they are replaced by hairs. Sars assumes that in this apparatus the respiration takes place predominantly in the basal part (the flagellum). We suppose that the gill of the Cumacea is nothing but a modified aquiferous organ, aiding the respiration which takes place in the teguments and the body appendages. This organ somewhat resembles the external processes of the first pair of maxillipeds in the Oxystomata, in which the posterior process creates a current of water, while the anterior one, which extends to the anterior edge of the mouth, participates in the formation of an efferent canal, as in the Cumacea. The process of Tanais which was described for the first time by F. Mueller†. According to Dohrn‡ this process is connected with the base of the first maxilliped, as in Cumacea, and not with the maxillae as was supposed by Mueller. Dohrn takes it as a gill; Mueller, on the contrary, considers it an organ which renews the water and localizes the respiratory function in *Tanais* in the lateral parts of the cephalothorax

\* Untersuchungen über Bau und Entwicklung der Arthropoden Heft I. Über den Bau und die Entwicklung der Cumaceen. Table II und III.

\*\* Om den aberrante Krebsdyrgruppe Cumacea og dens nordiske Arter, Forhandl. i Videnskabs-Selsk, Christiania 1864.

\*\*\* Dohrn describes this end otherwise. Sars admits that as a consequence of the fact that the outgrowths of the two parts are near one another, a short canal is formed, which moves forward during the elimination of the water. In the Black Sea specimens, every part has its efferent canal.

† Fur Darwin.

‡ Unters. über Bau u. Entw. der Arthr. Heft. II Zur Kenntniss vom Bau und der Entw. von *Tanais*. Table XI, XII.

along which a permanent stream of water passes; in his opinion the legs cannot carry out respiration, since the blood cells do not enter them. Sars observed a completely different situation in Cumacea: "blood circulation can be observed very easily in the legs; the blood cells reach the very end of these, following irregular tracts". (I Fadderne og Halevedbaengene er isaer Blodcirculationen let at iagttagge; Blodkuglerne traenge her med, som det synes, unregelbundne Baner, lige ind i deres yderste Spids). It seems strange that Mueller's attention was not drawn to this interesting process in Tanais, and for the sake of defending his assertion, he localized the respiration of this animal in a limited surface. It is impossible to suppose that in the legs, which carry out much muscular activity, no oxygenation of the tissues occurs.

Since Sars' work is written in Norwegian, a language not widely known, we believe that it is useful to quote one of his observations with regard to respiration. When the animal was absolutely quiet, Sars could observe the movement of the posterior part of the gills under the microscope: during the elimination of the water, it projected outward, and during the absorption of water, it was retracted. As soon as the animal began to move, the movements of the gills ceased, and the water beneath the cephalothorax was not renewed. The interval between the motion and rest - according to Sars - are long. The inactivity of this organ during the activity of the animal may be explained - in our opinion - by the fact that then the other parts of the body, being also surrounded by fresh, oxygenated water, are nonetheless able to perform respiration.

Let us now continue with the description of our species. The first joint of the second maxilliped is longer than the other joints, and forms, in the superior external part, a protuberant projection, in front of which there is a long, thick hair; the end of the last joint bears clawlike hairs. At the basis of the last pair of maxillipeds there is a natatory branch; the first joint is very broad and resembles the gnathostegite of the crabs, covering in the same way, mouthparts; behind it the superior external part is convex, and in front of it there is a long, thick hair. Such hairs are also found on the subsequent two joints. The last joint has three claws, with spinulated inferior edges (Figure 1k). The first two pairs of pereiopods have natatory branches; the basal joints of these legs is very broad. The first pair is much longer than the second, and ends in a claw; the second pair of pereiopods has no dactylopodite. The last three pairs of pereiopods are somewhat longer than the second pair; they end in a claw, and have no natatory branches. The pleon is much shorter than the pereion and is apodal; the fifth abdominal segment is the longest and its surface has longitudinal thickenings. On the posterior edge of the sixth segment there are two tubercles which are situated on the sides of the anus. The basal joint of each furcal ramus is short and has two pointed, articulated appendages, the external ones being shorter and narrower than the internal; they are made up of three joints, the last one having the appearance of a spine. The first joint of the internal appendage is longer than the second, and is spinulated along its internal edge.

Distribution: Red Sea.



**D. spinosus.**

**Tab. XXI Fig. 2.**

We had only one specimen of this species at our disposal; it was 1 mm long. We did not dissect it. The cephalothorax is oval, with no prominences. The first two pairs of pereopods are similar in structure to those of the aforementioned species. The segments of the pleon are of equal length, and are spinulated, like those of the pereion.

Distribution: Red Sea.

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Table

Table of the Geographical Distribution of the Crustacea of the Red Sea

The symbol  $\wedge$  indicates the species found north of the Tropic of Cancer.  
 The symbol  $\vee$  indicates the species found south of the Tropic of Capricorn.  
 The symbol + indicates the species found between the two Tropics.

		Atlantic		Indian Ocean						Pacific Ocean				Atlantic					
		Black Sea	Mediterranean	Red Sea	Persian Gulf	East Africa	South Africa	Southern Asia	West. Australia	Eastern Asia	Indonesian Ar.*	East. Australia	Polynesia	N. W. America	S. W. America	S. E. America	N. E. America	Western Europe	West Africa
<b>Oxyrhyncha.</b>																			
1	<i>Microphrys styx</i> Herbst. . . . .	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
2	<i>Micippe miliaris</i> Gerst. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
3	" <i>platipes</i> Rüpp. . . . .	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
4	<i>Pseudomicippe nodosa</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
5	<i>Cyclax spinicinctus</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
6	<i>Ixion capreolus</i> Paus. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
7	<i>Mitrax asper</i> M. Edw. . . . .	.	.	+	.	+	.	.	.	$\wedge$	+	.	+	.	.	.	.	.	.
8	<i>Stilbognathus erytreus</i> Mart. . . . .	.	.	+	.	.	.	.	.	$\wedge$	+	.	+	.	.	.	.	.	.
9	<i>Stenocinops curvirostris</i> A. M. Ed. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
10	<i>Meuaethius monoceros</i> Latr. . . . .	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
11	Var. <i>subserratus</i> Ad. et White . . . . .	.	.	+	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.
12	<i>Acanthonyx consobrinus</i> A. M. Ed. . . . .	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
13	<i>Iluenia pyramidata</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
14	" <i>Hellerii</i> Paus. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
15	<i>Lambrus pelagicus</i> Rüpp. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
16	" <i>heraldicus</i> (Var.) Paus. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
17	<i>Aulacolambrus pisoides</i> Ad. et Wh. . . . .	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
18	<i>Pseudolambrus calappoides</i> A. et Wh. . . . .	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
<b>Cyclometopa.</b>																			
19	<i>Atergatis roseus</i> Rüpp. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
20	Var. <i>marginatus</i> Rüpp. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
21	Var. <i>scrobiculatus</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
22	<i>Atergatis granulatus</i> Rüpp. . . . .	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.
23	" <i>semigranulosus</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
24	" <i>anaglyptus</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
25	" <i>aeneus</i> Linn. . . . .	.	.	+	.	.	.	+	.	.	+	.	+	.	.	.	.	.	.
26	" <i>carinipes</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

\* Indonesian Archipelago

		Atlantic		Indian Ocean						Pacific Ocean					Atlantic Ocean			
		Black Sea	Mediterranean	Red Sea	Persian Gulf	East Africa	South Africa	Southern Asia	West. Australia	Eastern Asia	Indonesian Ar.	East. Australia	Polynesia	N. W. America	S. W. America	S. E. America	N. E. America	Western Europe
27	<i>Atergatopsis Frauenfeldii</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
28	<i>Carpilius convexus</i> (Var) Rüpp.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
29	<i>Carpilodes rugipes</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
30	<i>Actaea hirsutissima</i> Rüpp.	.	.	+	.	+	.	+	.	.	.	+	+	.	.	.	.	.
31	" <i>fossulata</i> Girard.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
32	" <i>pilosa</i> Alph. M. Edw.	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.
33	<i>Actacodes speciosus</i> Dana.	.	.	+	.	+	.	+	.	.	.	+	+	.	.	.	.	.
34	" <i>tomentosus</i> M. Edw.	.	.	+	.	.	.	+	.	.	.	+	+	.	.	.	.	.
35	" <i>lividus</i> Dehaan.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
36	" <i>frontalis</i> Pauls.	.	.	+	.	.	.	.	.	∧	.	.	.	.	.	.	.	.
37	<i>Hypocoelus sculptus</i> M. Edw.	.	.	+	.	.	.	.	.	∧	.	.	.	.	.	.	.	.
38	<i>Euxanthodes granulatus</i> Aud.	.	.	+	.	+	.	+	.	+	.	+	+	.	.	.	.	.
39	<i>Xantho asper</i> Rüpp.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
40	" <i>hirtipes</i> Latr.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
41	" <i>distinguendus</i> Dehaan.	.	.	+	.	.	.	.	.	∧	.	.	.	.	.	.	.	.
42	<i>Epixanthus Kotschii</i> Hell.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.
43	<i>Etisus maculatus</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
44	" <i>sculptilis</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
45	" <i>spinipes</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
46	<i>Chlorodius niger</i> Rüpp.	.	.	+	.	+	.	.	.	+	+	.	+	.	.	.	.	.
47	" <i>ungulatus</i> M. Edw.	.	.	+	.	+	+	.	.	+	+	+	+	.	.	.	.	.
48	" <i>sanguineus</i> M. Edw.	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	.
49	<i>Pilodius fragifer</i> Ad. et White.	.	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.	.
50	<i>Cymo Andreossyi</i> Aud.	.	.	+	.	.	.	.	.	+	+	.	+	.	.	.	.	.
51	<i>Pilumnus Forskalii</i> M. Edw.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
52	" <i>Schrenckii</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	∧
53	" <i>Vauquelinii</i> Aud.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
54	" <i>vespertilio</i> Leach.	.	.	+	.	.	+	.	.	.	.	+	+	.	.	.	.	.
55	<i>Actumnus obesus</i> Dana.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.
56	<i>Rüppelia tenax</i> M. Edw.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
57	<i>Trapezia ferruginea</i> Latr.	.	.	+	.	.	.	.	.	.	+	.	+	.	.	.	.	.
58	" Var. <i>coerulea</i> Rüpp.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
59	" Var. <i>guttata</i> Rüpp.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
60	" Var. <i>rufopunctata</i> Herb.	.	.	+	.	+	.	+	.	.	.	.	+	+	.	.	.	.
61	" Var. <i>digitalis</i> Latr.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
62	" Var. <i>Cymodoce</i> Herbst.	.	.	+	.	+	.	.	.	.	.	.	+	.	.	.	.	.

		Atlan- tic		Indian Ocean						Pacific Ocean					Atlantic Ocean				
		Black Sea	Mediterranean	Red Sea	Persian Gulf	East Africa	South Africa	Southern Asia	West. Australia	Eastern Asia	Indonesian Ar.	East. Australia	Polynesia	N. W. America	S. W. America	S. E. America	N. E. America	Western Europe	West Africa
63	<i>Tetralia cavimana</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
64	Var <i>cinctipes</i> Pauls . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
65	" <i>heteroactyla</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
66	<i>Neptunus pelagicus</i> Linn. . . . .	.	.	+	+	.	+	+	∧	+	+	+	.	.	.	.	.	.	.
67	<i>Xiphonectes longispinosus</i> Dana . . . . .	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
68	<i>Archias sexdentatus</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
69	<i>Achelous granulatus</i> Dehaan. . . . .	.	.	+	.	+	.	.	.	.	.	+	.	.	.	.	.	.	.
70	<i>Scylla serrata</i> Forskal . . . . .	.	.	+	.	.	+	+	∧	+	+	.	.	.	.	.	.	.	.
71	<i>Goniosoma sexdentatum</i> Herbst. . . . .	.	.	+	.	.	+	+	.	+	+	.	.	.	.	.	.	.	.
72	<i>Thalamita Admete</i> Herbst . . . . .	.	+	+	.	.	+	+	.	+	+	.	.	.	.	.	.	.	∧
73	" <i>Chaptalii</i> Aud. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
74	" <i>crenata</i> Latr. . . . .	.	.	+	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.
75	<i>Caphyra polita</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<b>Catametopa.</b>																			
76	<i>Ocypoda aegyptiaca</i> Gerbst. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
77	Var. <i>ceratophthalma-aegyptiaca</i> P. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
78	" <i>cordimana</i> Desm. . . . .	.	.	+	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.
79	" <i>cursor</i> Linn. . . . .	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	∧
80	<i>Gelasimus tetragonon</i> Rüpp. . . . .	.	.	+	.	.	+	+	.	.	.	.	.	.	.	.	.	.	.
81	<i>Doto sulcatus</i> Forsk. . . . .	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
82	<i>Macrophthalmus depressus</i> Herbst. . . . .	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
83	? <i>Euplax Boscii</i> Aud. . . . .	.	.	+	.	.	+	.	.	.	.	+	.	.	.	.	.	.	.
84	<i>Cleistostoma Leachii</i> Aud. . . . .	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
85	Var. <i>penicillata</i> Pauls . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
86	<i>Metopograpsus messor</i> Forsk. . . . .	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	∧
87	<i>Grapsus rudis</i> M. Edw. . . . .	.	.	+	.	.	+	+	.	.	.	+	.	.	.	.	.	.	∧
88	" <i>strigosus</i> Herbst . . . . .	.	.	+	.	.	+	+	.	.	.	.	∨	.	.	.	.	.	∧
89	<i>Plagusia squamosa</i> Herbst. . . . .	.	.	+	.	+	+	+	.	.	.	.	.	.	.	.	.	.	.
90	<i>Acanthopus planissimus</i> Herbst. . . . .	.	.	+	.	.	+	+	.	.	.	+	.	.	.	.	.	.	.
91	<i>Pinnotheres Rouxii</i> M. Edw. . . . .	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
92	<i>Ostracotheres Tridacnac</i> Rüpp. . . . .	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
93	<i>Elamene Mathaei</i> M. Edw. . . . .	.	.	+	.	+	+	.	∨	.	.	.	.	.	.	.	.	.	.
94	<i>Lithoscaptus paradoxus</i> A. M. Edw. . . . .	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.

		Atlantic		Indian Ocean						Pacific Ocean					Atlantic Ocean				
		Black Sea	Mediterranean	Red Sea	Persian Gulf	East Africa	South Africa	Southern Asia	West. Australia	Eastern Asia	Indonesian Ar.	East. Australia	Polynesia	N. W. America	S. W. America	S. E. America	N. E. America	Western Europe	West Africa
<b>Oxystomata.</b>																			
95	<i>Cymopolia carinipes</i> Pauls . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
96	<i>Calappa tuberculata</i> Fabr. . . .	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.
97	<i>Matuta victor</i> Fabr . . . . .	.	.	+	.	+	+	.	.	.	+	.	.	.	.	.	.	.	.
98	<i>Leucosia urania</i> Var. <i>signata</i> Paul.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
99	<i>Philyra platycheira</i> Dehaan . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
100	<i>Nursia granulata</i> Rüpp. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
101	<i>Callidactylus Kesslerii</i> Pauls . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
102	<i>Oreophorus horridus</i> Rüpp. . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
103	<i>Dromia unidentata</i> Rüpp . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
104	<i>Cryptodromia tomentosa</i> Hell . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
<b>Anomura.</b>																			
105	<i>Remipes testudinarius</i> Var. <i>pic-</i> <i>tus</i> Hell . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
106	<i>Petrolisthes ornatus</i> Pauls. . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
107	" <i>virgatus</i> Pauls . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
108	" <i>Boscii</i> Aud . . . . .	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
109	" <i>rufescens</i> Hell . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
110	<i>Pisosoma natalensis</i> Krauss . . . .	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
111	<i>Polyonyx denticulatus</i> Pauls . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
112	<i>Porcellana carinipes</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
113	<i>Porcellana inaequalis</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
114	<i>Pagurus varipes</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
115	<i>Dardanus Hellerii</i> Hell. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
116	<i>Eupagurus cavicularius</i> Pauls . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
117	<i>Clibanarius carnifex</i> Hell . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
118	" <i>signatus</i> Hell . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
119	<i>Calcinus rosaceus</i> Hell . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
120	" <i>crispimanus</i> M. Edw . . . . .	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
121	<i>Cenobita rugosa</i> M. Edw . . . . .	.	.	+	.	+	.	.	.	.	+	+	.	.	.	.	.	.	.
122	<i>Galathea longimana</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
123	" <i>aegyptiaca</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
124	" <i>brevimana</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
125	" <i>strigosa</i> Fabr. . . . .	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	^

	Macroura.	Atlantic		Indian Ocean						Pacific Ocean					Atlantic Ocean				
		Black Sea	Mediterranean	Red Sea	Persian Gulf	East Africa	South Africa	Southern Asia	West. Australia	Eastern Asia	Indonesian Ar.	East. Australia	Polynesia	N. W. America	S. W. America	S. E. America	N. E. America	Western Europe	West Africa
126	<i>Palinurus Ehrenbergii</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
127	<i>Scyllarus Gundlachii</i> Mart.	.	.	+	.	.	.	.	.	^	+	.	.	.	.	.	.	.	.
128	<i>Nika sequimana</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
129	<i>Nikoides Danae</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
130	<i>Tozeuma armatum</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
131	<i>Lysmata pusilla</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
132	<i>Leptochela aculeocaudata</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
133	<i>Alpheus tumido-manus</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
134	<i>Var. gracili-manus</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
135	<i>fossor</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
136	<i>triunguiculatus</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
137	<i>Charon</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
138	<i>tricuspidatus</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
139	<i>gracilis</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
140	<i>parvirostris</i> Dana.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
141	<i>Alpheoides insignis</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
142	<i>laevis</i> Rand.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.
143	<i>crassimanus</i> Hell.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
144	<i>Edwardsii</i> Aud.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
145	<i>Arete monoceros</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
146	<i>Racilius compressus</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
147	<i>Virbius Proteus</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
148	<i>Hippolyte Hemprichii</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
149	<i>paschalis</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
150	<i>orientalis</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
151	<i>Pontonia biunguiculata</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
152	<i>Oedipus nudirostris</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
153	<i>dentirostris</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
154	<i>Harpilius Beaupresii</i> Aud.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
155	<i>Anchristia elegans</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
156	<i>Edwardsii</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
157	<i>Petitthouarsii</i> Ame.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
158	<i>Anch'roides compressus</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
159	<i>Palaemon Audouinii</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
160	<i>torensis</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
161	<i>Palaemonella gracilis</i> Pauls.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
162	<i>Hymenocera elegans</i> Hell.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

		Atlantic		Indian Ocean					Pacific Ocean					Atlantic Ocean					
		Black Sea	Mediterranean	Red Sea	Persian Gulf	East Africa	South Africa	Southern Asia	West. Australia	Eastern Asia	Indonesian Ar.	East. Australia	Polynesia	N. W. America	S. W. America	S. E. America	N. E. America	Western Europe	West Africa
163	<i>Aphareus inermis</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
164	<i>Sicyonia lancifer</i> Oliv. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
165	<i>Peneus longipes</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
166	" <i>velutinus</i> Dana . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
167	" <i>canaliculatus</i> Oliv. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
168	" <i>semisulcatus</i> Dehaan. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
169	<i>Stenopus hispidus</i> Latr. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
170	<i>Leucifer Reynaudii</i> Thomp. . . . .	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	<b>Schizopoda.</b>																		
171	<i>Siriella brevicaudata</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
172	" <i>jaltensis</i> Tschern. . . . .	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
173	" <i>Edwardsii</i> Claus. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
	<b>Stomatopoda.</b>																		
174	<i>Gonodactylus chiragra</i> Fabr. . . . .	.	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
175	" <i>brevisquamatus</i> Pauls. . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
176	<i>Pseudosquilla stylifera</i> Lam. . . . .	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.
	<b>Cumacea.</b>																		
177	<i>Diops parvulus</i> Pauls . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
178	" <i>spinus</i> Pauls . . . . .	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.

The second part of the study will contain a similar table for other orders of Crustacea.

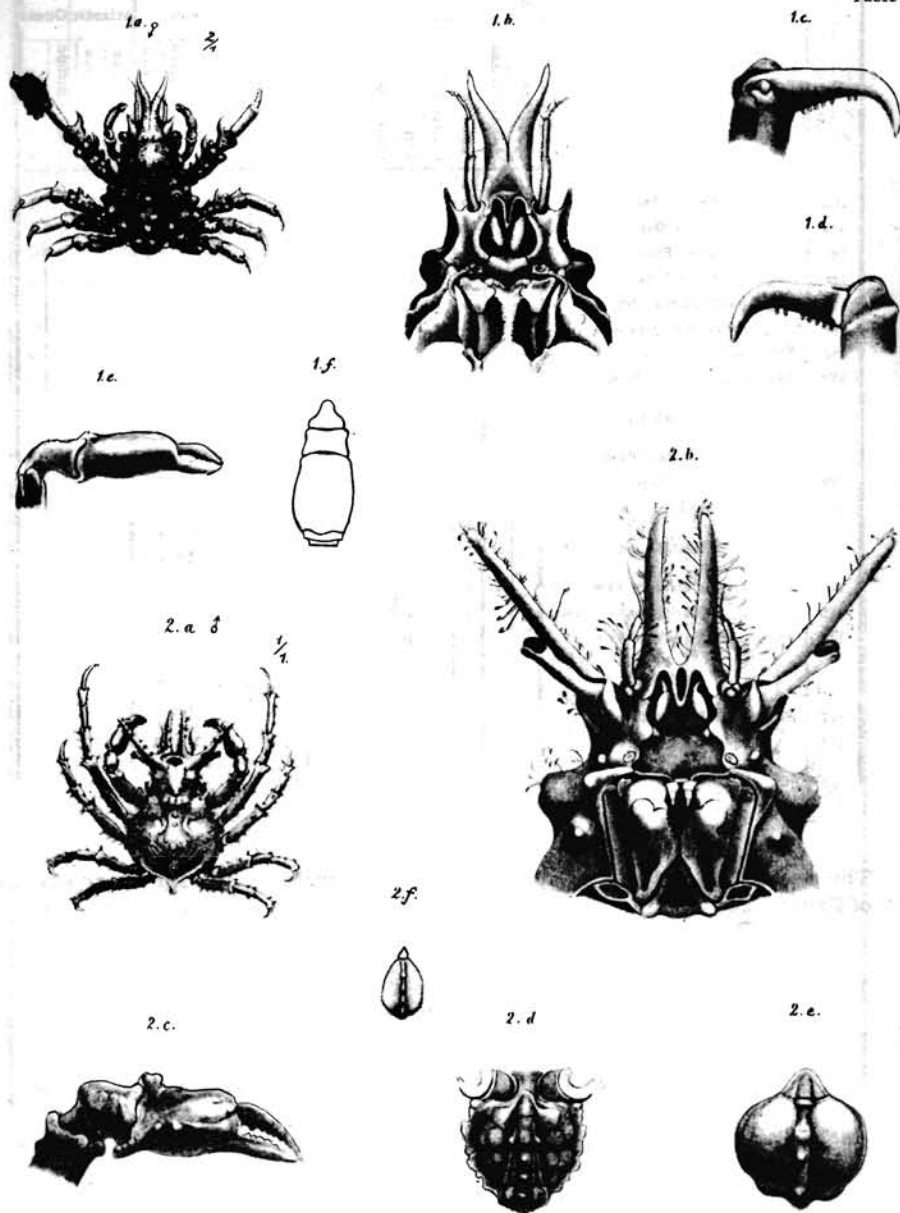


Figure 1a—*Microphrys styx*; 1b—anterior part of the animal - ventral view; 1c—the end of the propodite and the dactylopodite - internal view; 1d—the end of the propodite and the dactylopodite - external view; 1e—chelipeds; 1f—abdomen

Figure 2a—*Stilbognathus erytraeus*; 2b—anterior part of the animal - ventral view; 2c—chelipeds; 2d—abdomen of male; 2e—abdomen of adult female; 2f—abdomen of young female



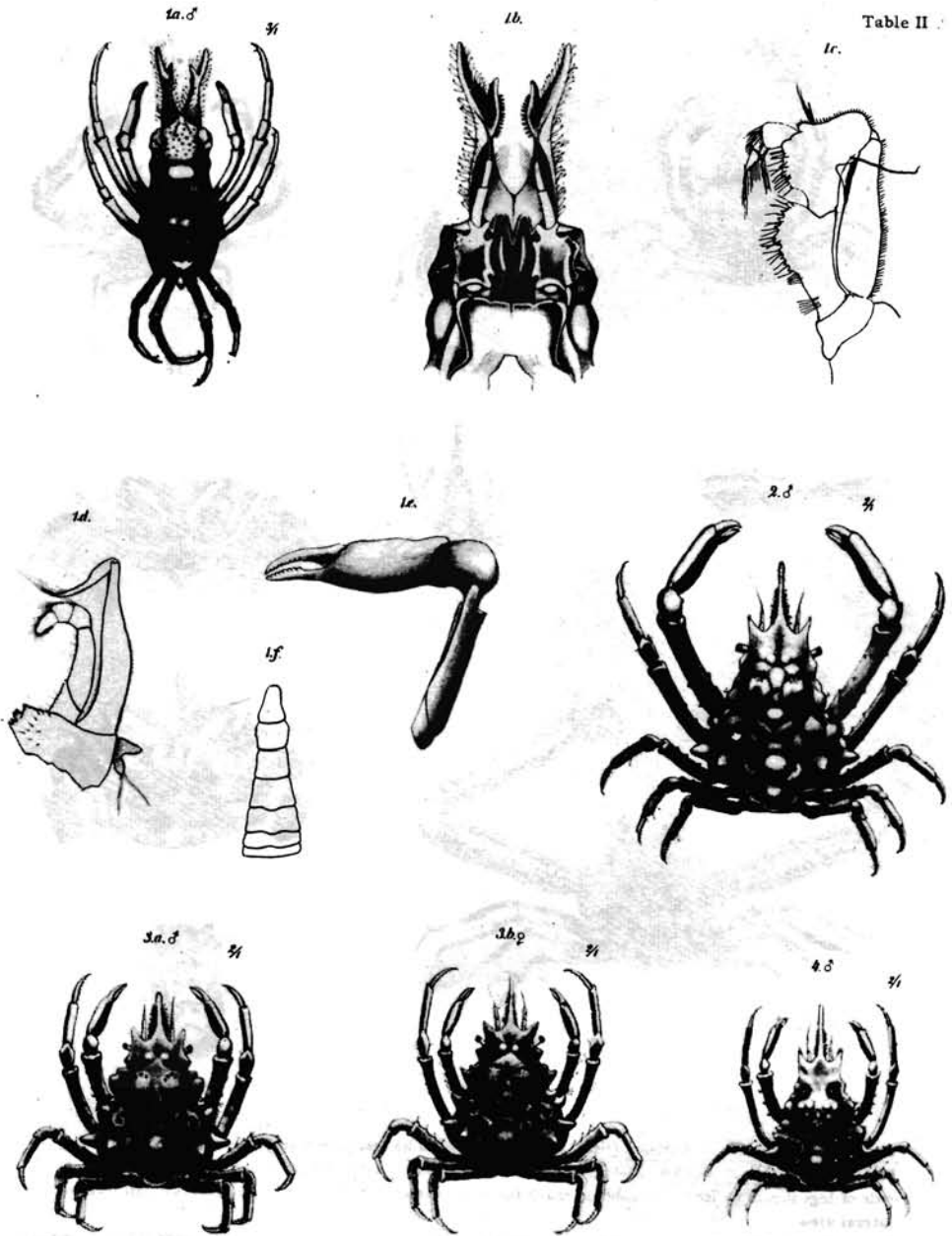


Figure 1a—*Ixion capreolus*; 1b—anterior part of the animal - ventral view; 1c—hectognath; 1d—pentognath; 1e—cheliped; 1f—abdomen  
 Figure 2 - Dimorphous male of *Menaethius monoceros*  
 Figure 3 - *Menaethius monoceros*; 3a—female; b—male  
 Figure 4 - *Menaethius subserratus* var. *M. monoceros*

Table III

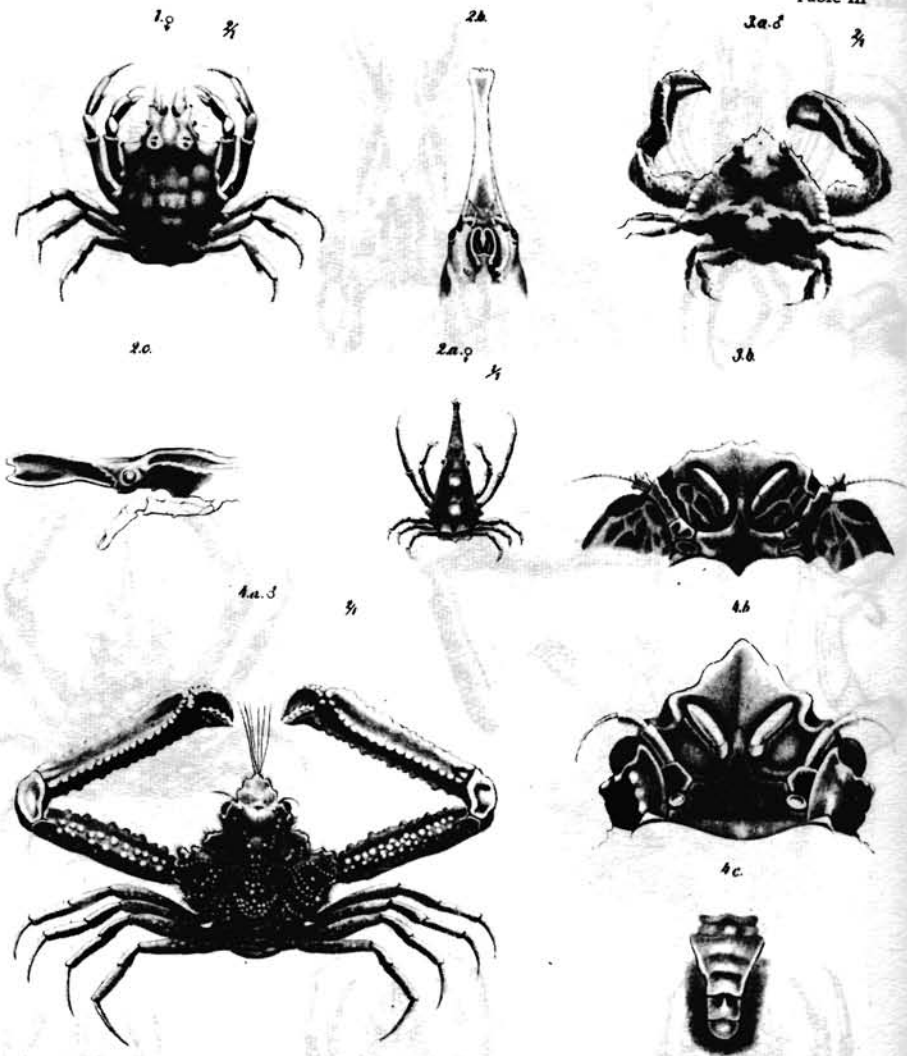


Figure 1—*Acanthonyx consobrinus* (first lateral spine should be less prominent)

Figure 2 a—*Huenia Hellerii*; 2b—anterior part of the animal, ventral view (the meropodite of the second pair of legs should be longer and should reach the propodite of the chelipeds); 2c—anterior part of the animal lateral view

Figure 3a—*Pseudolambrus calappoides*; 3b—antennal area (the second joint of the antennae should be somewhat shorter)

Figure 4a—*Lambrus affinis* var. *heraldicus*; 4b—antennal area (the second joint of the antennae should be somewhat shorter); 4c—abdomen

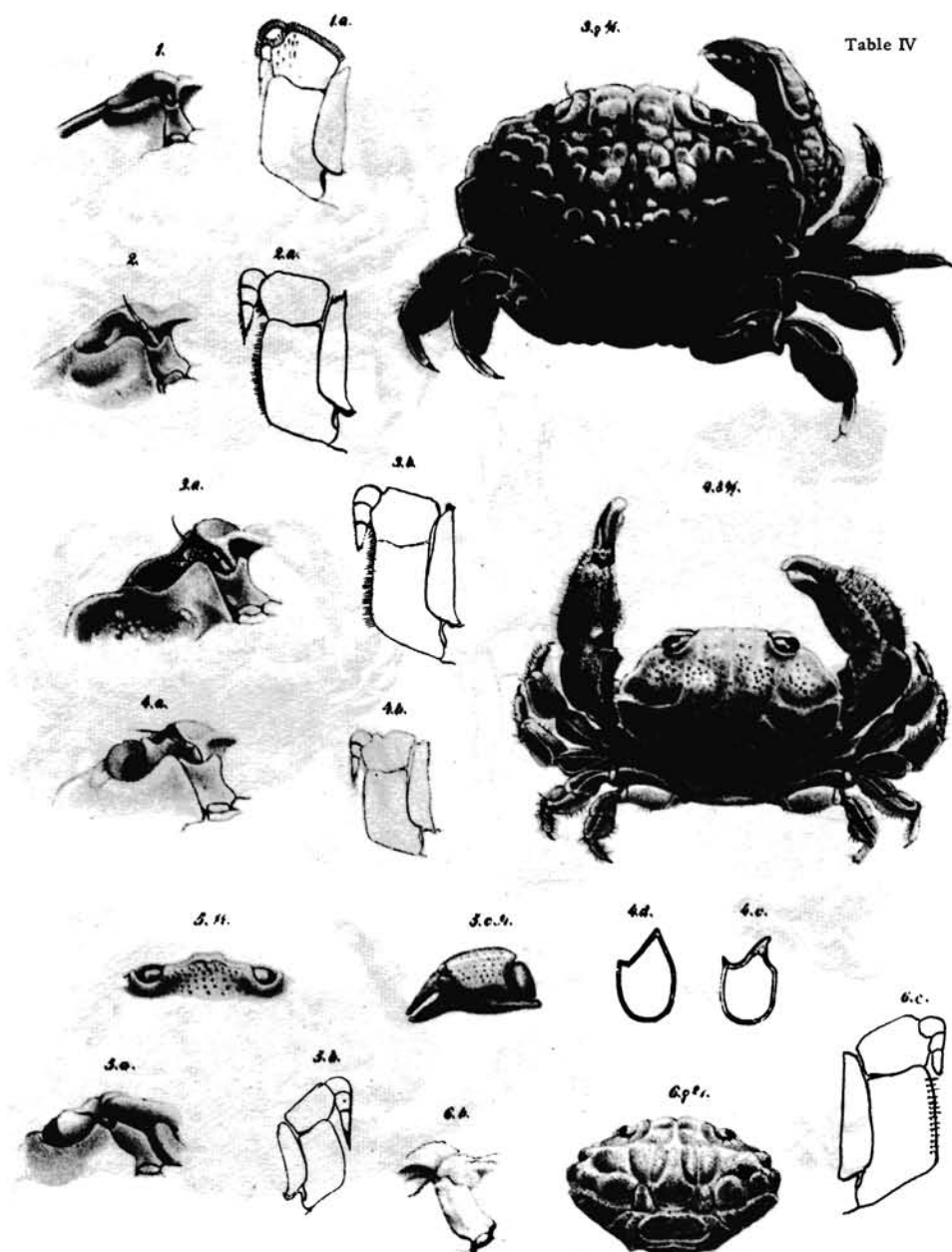


Figure 1. *Atergatis roseus*. Antennal area; 1a—hectognath

Figure 2. *Atergatis anaglyptus*. Antennal area; 2a—hectognath

Figure 3. *Atergatis aeneus*. 3a—antennal area; 3b—hectognath

Figure 4. *Atergatis carinipes*. 4a—antennal area; 4b—hectognath; 4c—transverse section of the carpopodite;

4d—transverse section of the carpopodite of *A. anaglyptus*

Figure 5. *Carpilius maculatus* var. *convexus*. Frontal area; 5a—antennal area; 5b—hectognath; 5c—the

smaller cheliped. Figure 6. *Carpilodes rugipes*. 6b—antennal area; 6c—hectognath

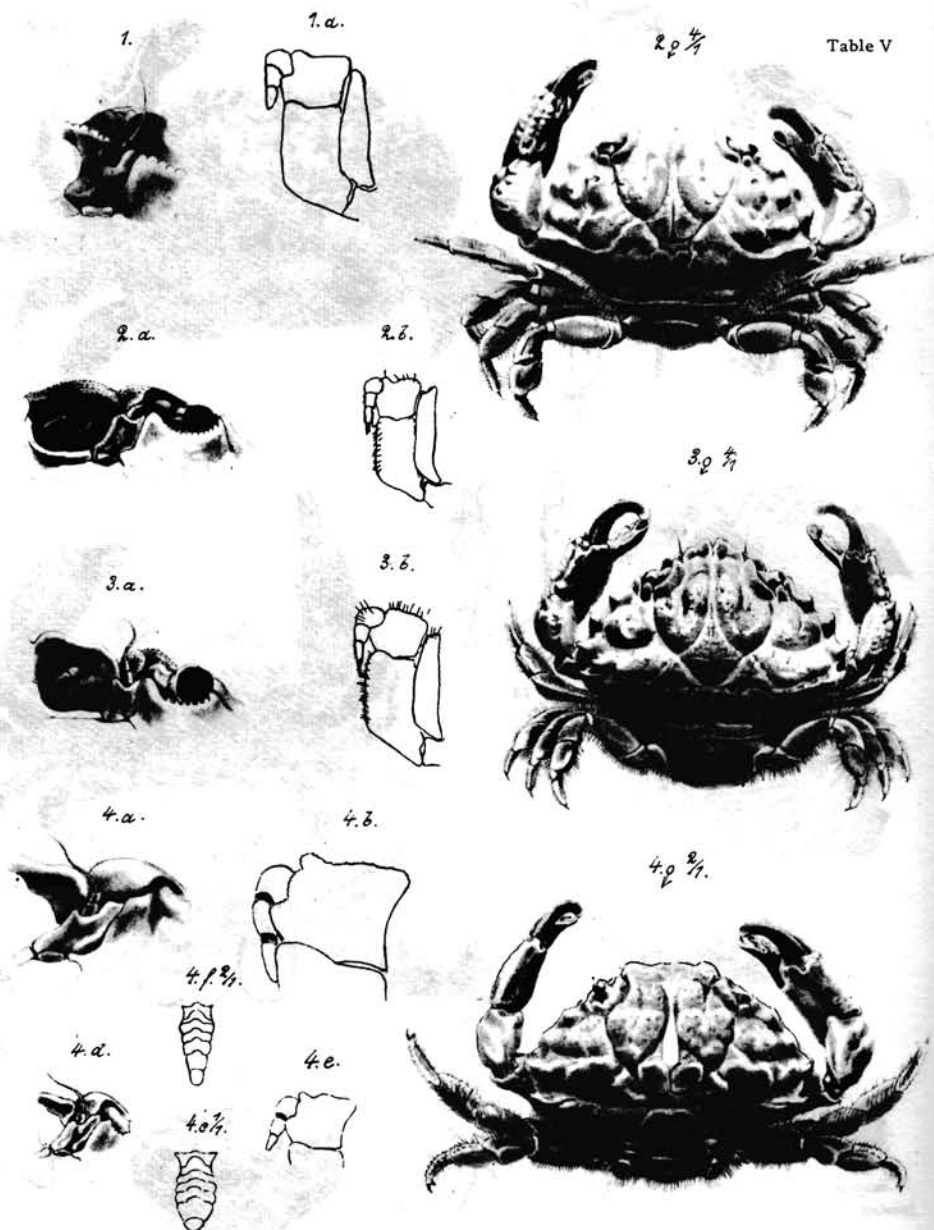


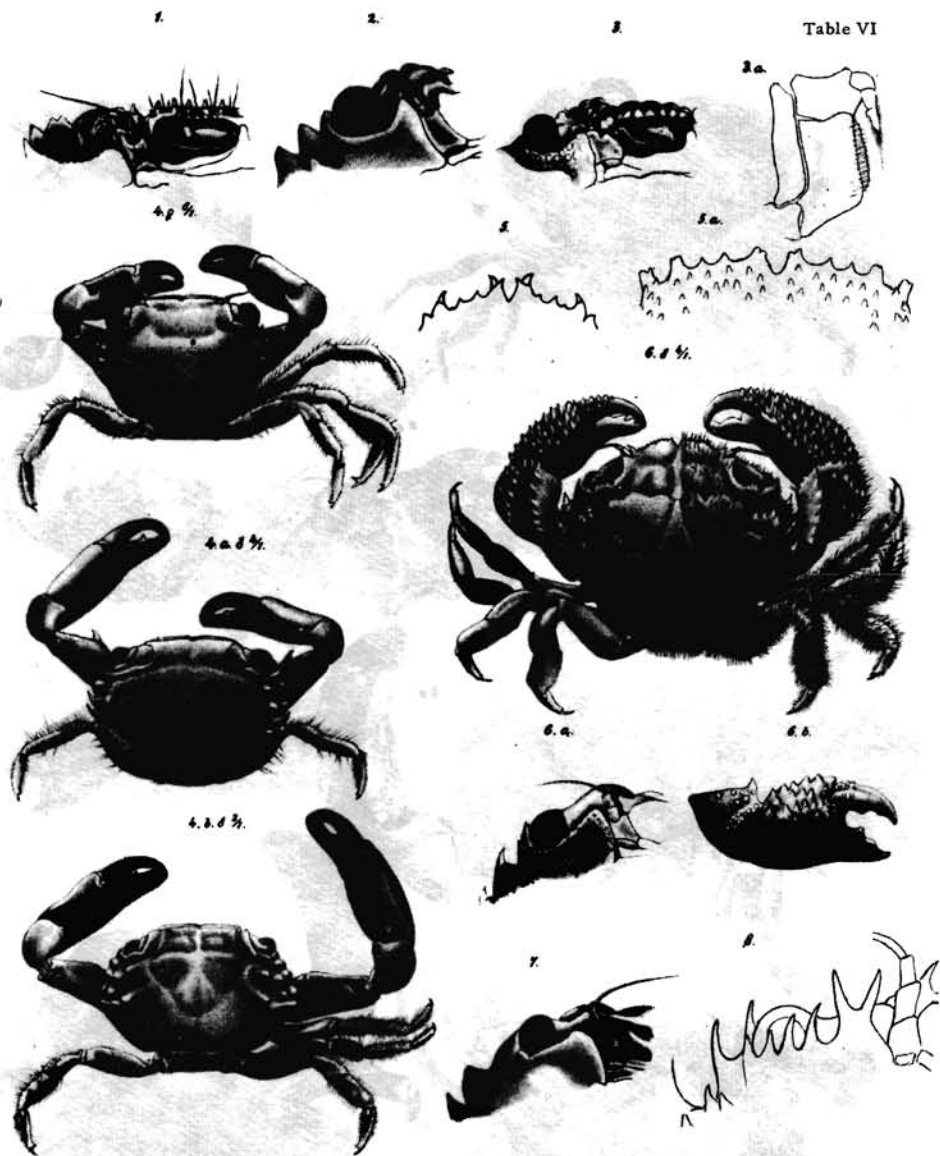
Figure 1. *Actaea hirsutissima*. Antenna; 1a—hectognath

Figure 2. *Actaeodes lividus* (the tubercles on the left chela are too strongly marked); 2a—antennal area (the basal joint of the antennae should be broader); 2b—hectognath

Figure 3. *Actaeodes frontalis*. 3a—antennal area; 3b—hectognath

Figure 4. *Etisus sculptilis* (the frontal incision is not sufficiently marked); 4a—antennal area of adult

4b—hectognath of adult; 4c—abdomen of adult; 4d—antennal area of young specimen; 4e—hectognath of young specimen; 4f—abdomen of young female

Figure 1. *Etisus spinipes*Figure 2. *Pilodius fragifer*Figure 3. *Euxanthodes granulatus*. Antennal area; 3a—hectognathFigure 4. *Chlorodius niger*. Young specimen (*Ch. depressus* Hell.) 4a—specimen of intermediate age; 4b—adult specimenFigure 5. *Cymo Andreosyi*. Frontal edge of young specimen; 5a—frontal edge of adult specimenFigure 6. *Pilumnus Schrenckii*. 6a—antennal area (the denticulation of the orbital edge is stronger and the second joint of the antennae is longer and broader than the third); 6b—chelaFigure 7. *Pilumnus Vauquelinii*Figure 8. *Pilumnus hirtellus*

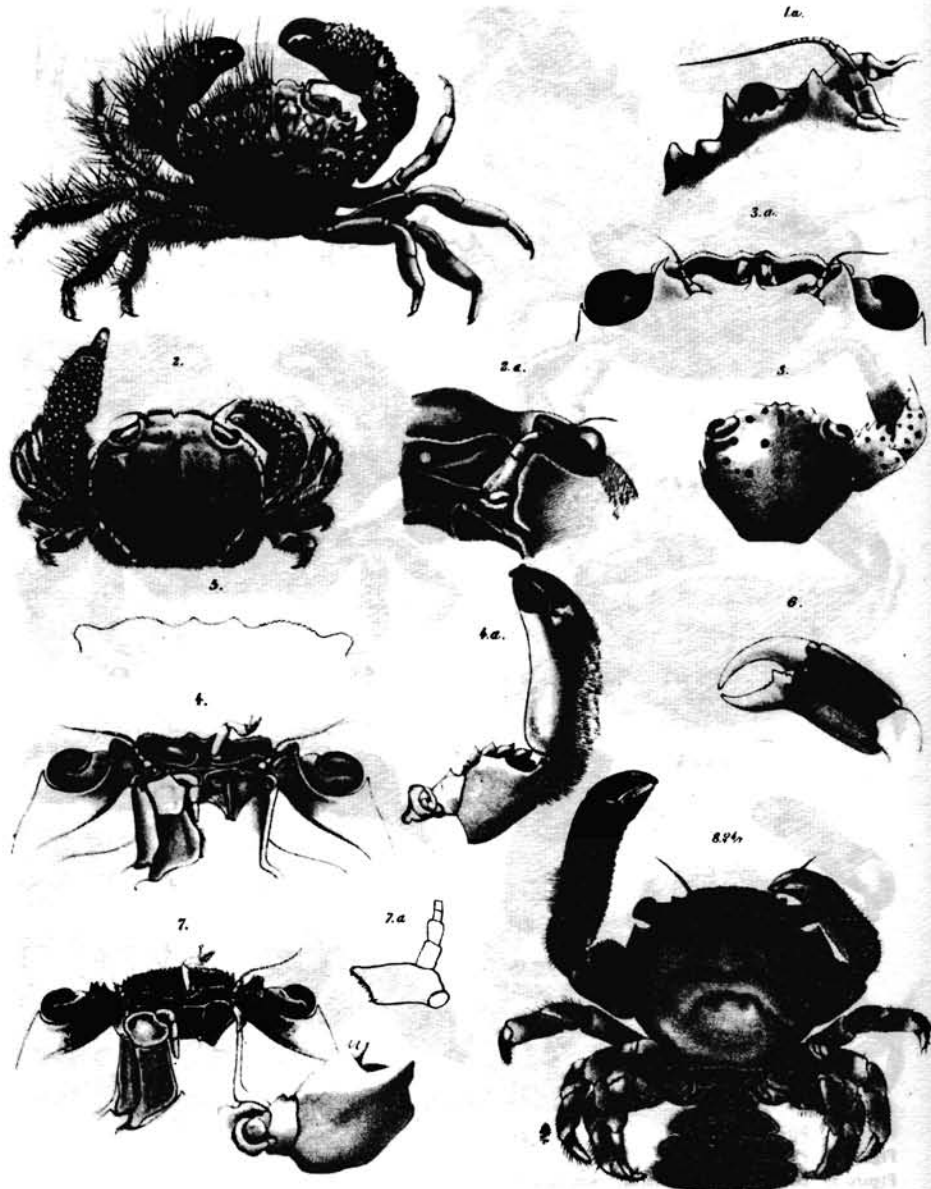


Figure 1. *Pilumnus Forskalii*. 1a—antennal area  
 Figure 2. *Actumnus obesus*. 2a—antennal area  
 Figure 3. *Trapezia rufopunctata*. 3a—antennal area  
 Figure 4. *Trapezia coerulea*. 4a—cheliped  
 Figure 5. *Trapezia digitalis*. Frontal edge  
 Figure 6. *Trapezia digitalis*. Chela  
 Figure 7. *Tetralia cavimana*. 7a—antenna  
 Figure 8. *Tetralia cavimana* var. *cinctipes*

Table VIII

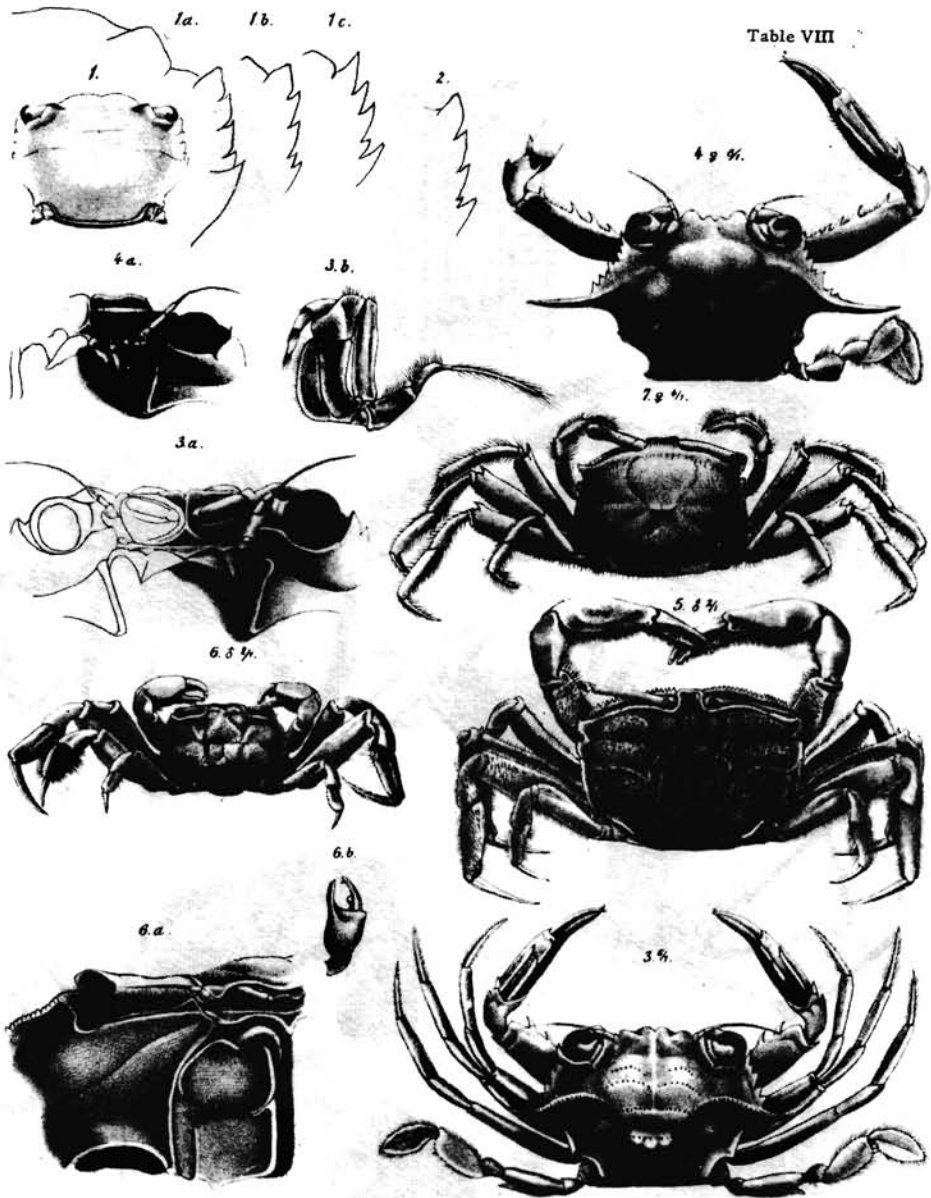


Figure 1. *Thalamita admete*. Very young specimen; 1a—lateral edge of the same specimen under higher magnification; 1b—lateral edge of an intermediate age specimen; 1c—lateral edge of an adult.

Figure 2. Lateral edge of a young *Thalamita admete* (*Thal. integra* Dana).

Figure 3. *Archias sexdentatus* (the cardiac area has only two prominences); 3a—antennal area; 3b—hectognath

Figure 4. *Xiphonectes longispinosus* (the spines on the end of the carina on the propodite of the chelipeds have not been drawn); 4a—antennal area.

Figure 5. *Macrophthalmus depressus*. Adult specimen

Figure 6. *Cleisostoma Leachii* var. *penicillata*. 6a—antennal area; 6b—chela

Figure 7. *Macrophthalmus depressus*. Young specimen

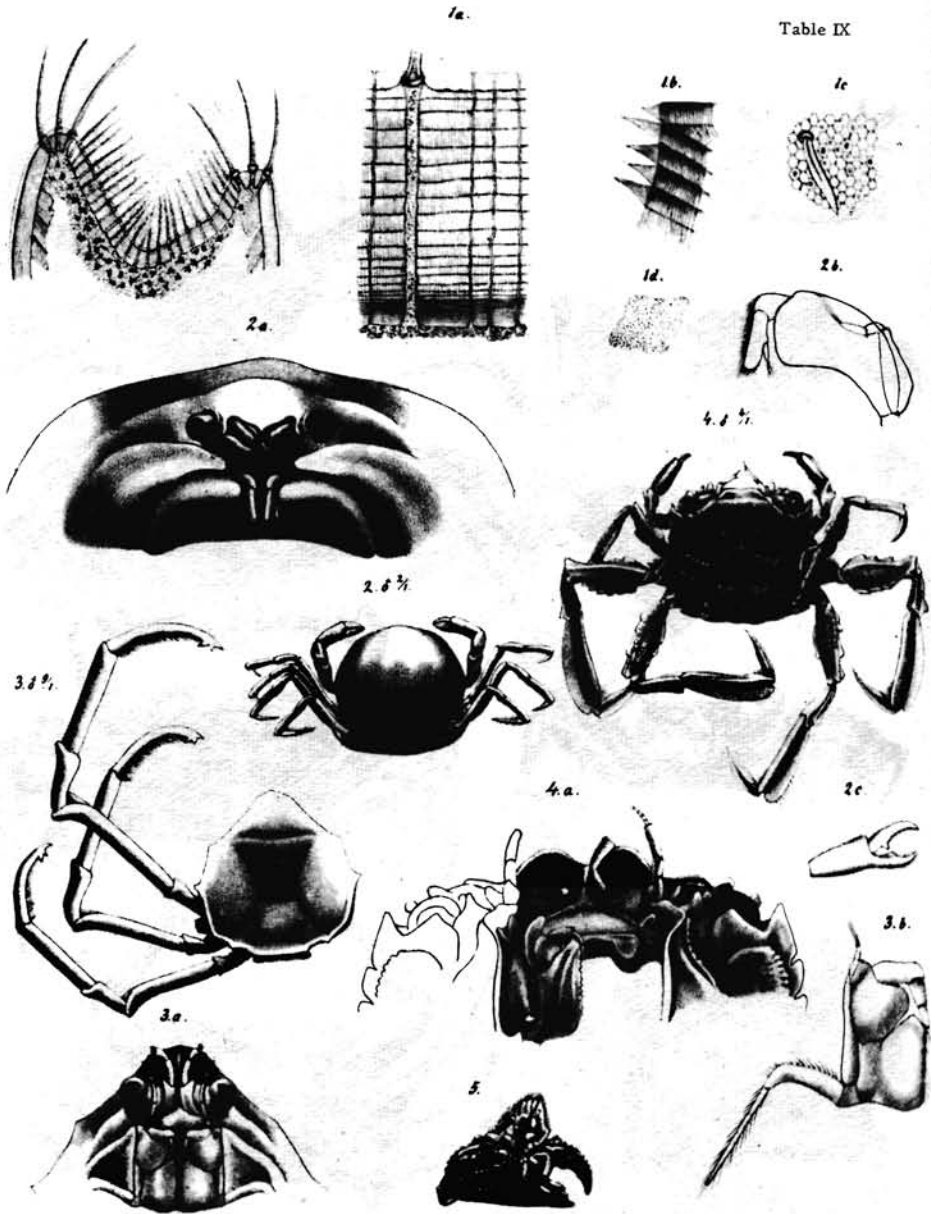


Figure 1. Transverse section through the hollow on the propodite of the chelipeds in *Tetralia cavimana*; 1a—transverse section through the cuticle; 1b—the stratified part of the cuticle; 1c—surface of the cuticle; 1d—tangential section through the cuticle  
 Figure 2. *Pinnotheres Rouxi*. 2a—antennal area; 2b—hectognath; 2c—chela  
 Figure 3. *Elamena Mathaei*. 3a—antennal area; 3b—afferent canal  
 Figure 4. *Cymopolia carinipes*. 4a—antennal area  
 Figure 5. *Calappa tuberculata*. Chela



Table X

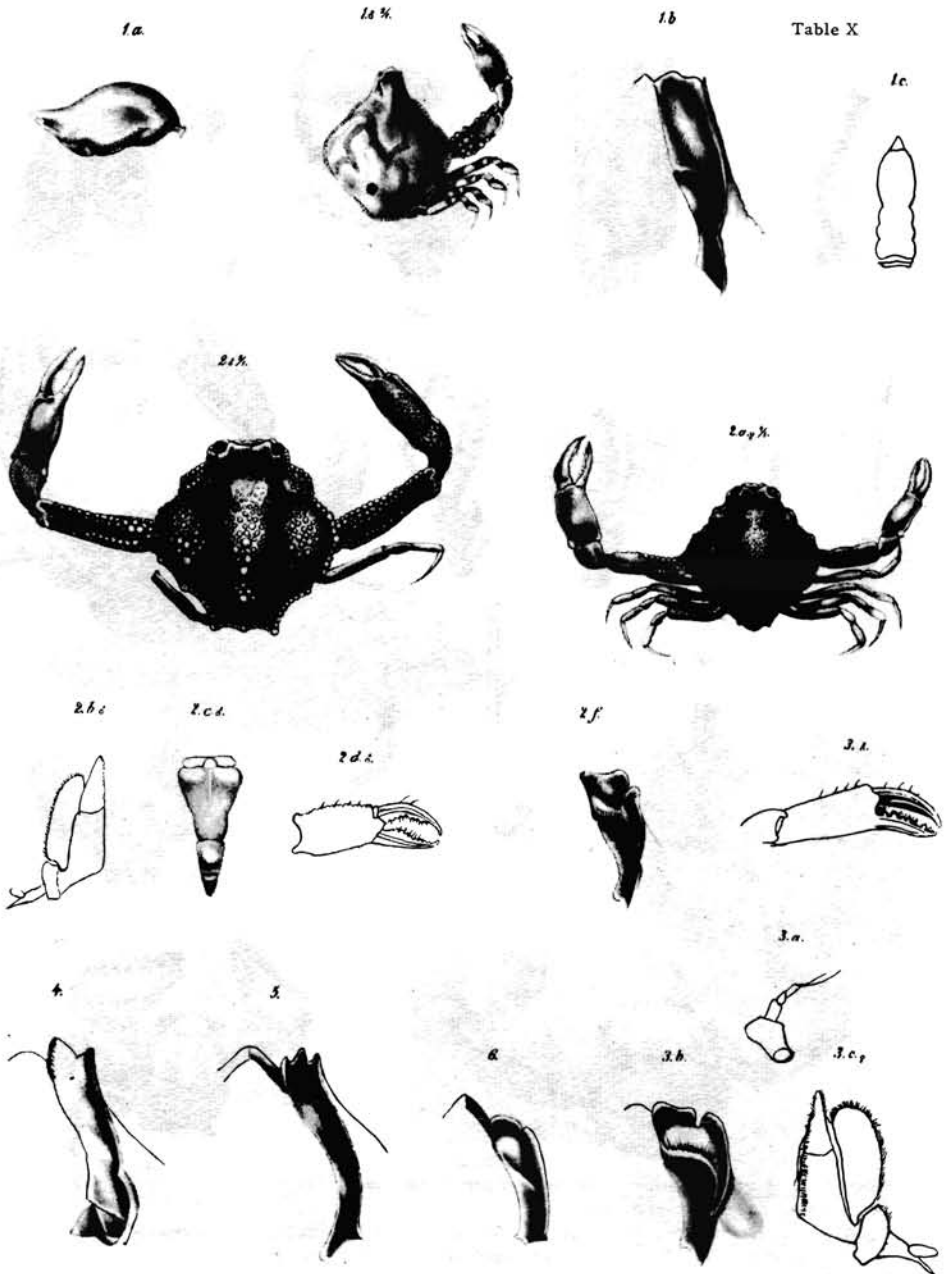


Figure 1. *Leucosia urania* var. *signata*. 1a—cephalothorax - lateral view; 1b— afferent canal; 1c—abdomen  
 Figure 2. *Nursia granulata*. Male 2a—female; 2b—hectognath; 2c—abdomen; 2d—chela; 2f—afferent canal.  
 Figure 3. *Philyra platycheira*. Chela. 3a—antenna; 3b—afferent canal; 3c—hectognath  
 Figure 4. *Persephona Guaia*. Afferent canal  
 Figure 5. *Iia nucleus*. Afferent canal  
 Figure 6. *Ebalia Cranchii*. Afferent canal

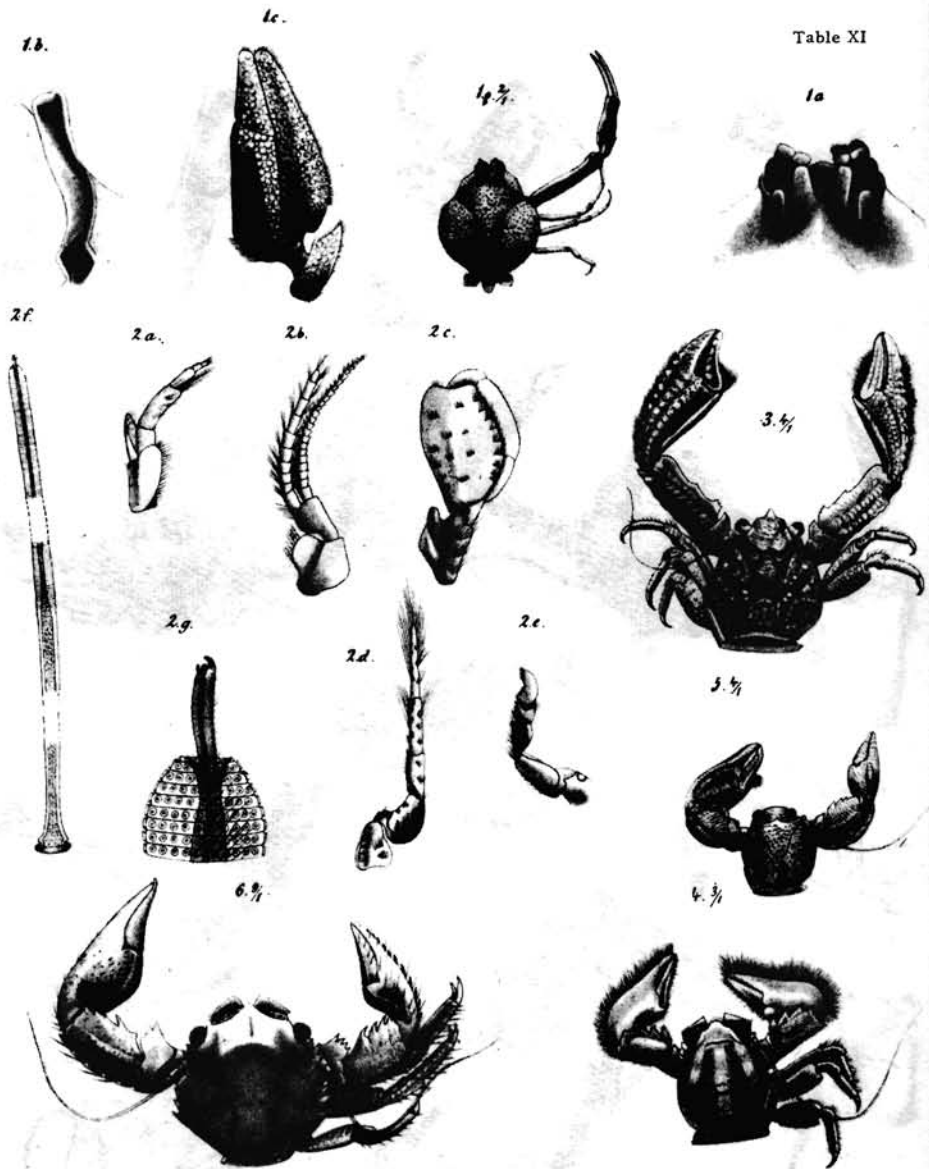


Table XI

Figure 1. *Callidactylus Kesslerii*. 1a—anterior part of the animal; 1b—afferent canal; (the hairs on the crest have not been drawn); 1c—hectognath

Figure 2. *Remipes testudinarius* var. *pictus*. 2a—antenna; 2b—antennule; 2c—hectognath; 2d—cheliped; 2e—third leg of female; 2f—one of the hairs found on the antennae; 2g—greatly magnified tip of this hair

Figure 3. *Petrolisthes ornatus*

Figure 4. *Petrolisthes virgatus* (the spine found on the lateral edge immediately behind the occipital furrow has not been drawn);

Figure 5. *Pisosoma natalensis* (the cephalothorax should have been wider)

Figure 6. *Polyonyx denticulatus* (when the animal is in the horizontal position, the frontal edge appears to be straight)

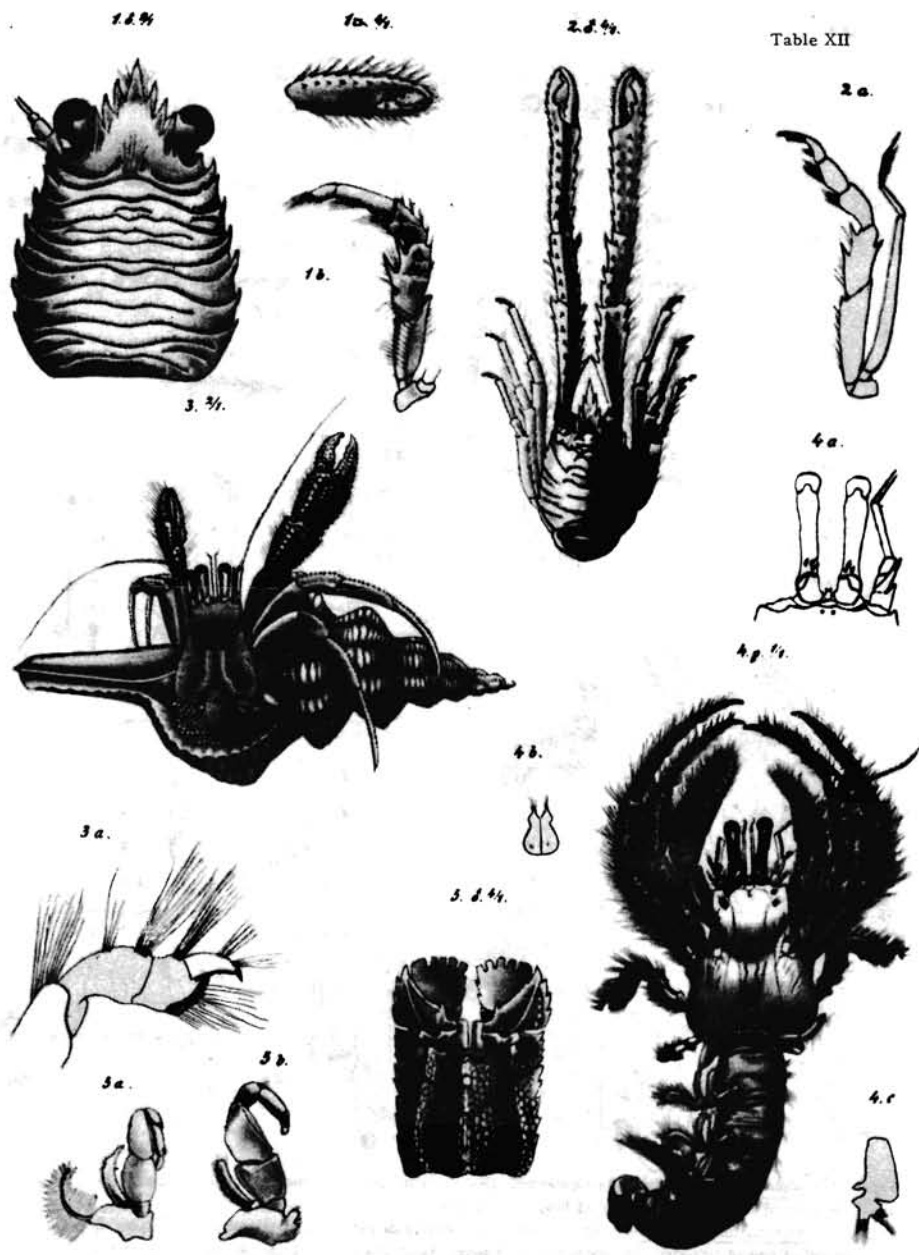


Table XII

Figure 1. *Galathaea aegyptica*. 1a—chela; 1b—hectognath.  
 Figure 2. *Galathaea longimana*. (the number of spines on the edge is incomplete - see text); 2a—hectognath.  
 Figure 3. *Eupagurus cavicularpus*. 3a—end of the fourth pair of legs.  
 Figure 4. *Dardanus Hellerii*. 4a—frontal edge with eyes; 4b—median outgrowth of the orbital segment; 4c—one of the calcareous plates of the abdominal segments as seen from the right side.  
 Figure 5. *Scyllarus Gundlachii*. 5a—hectognath; 5b—hectognath of *Scyllarus arctus*.

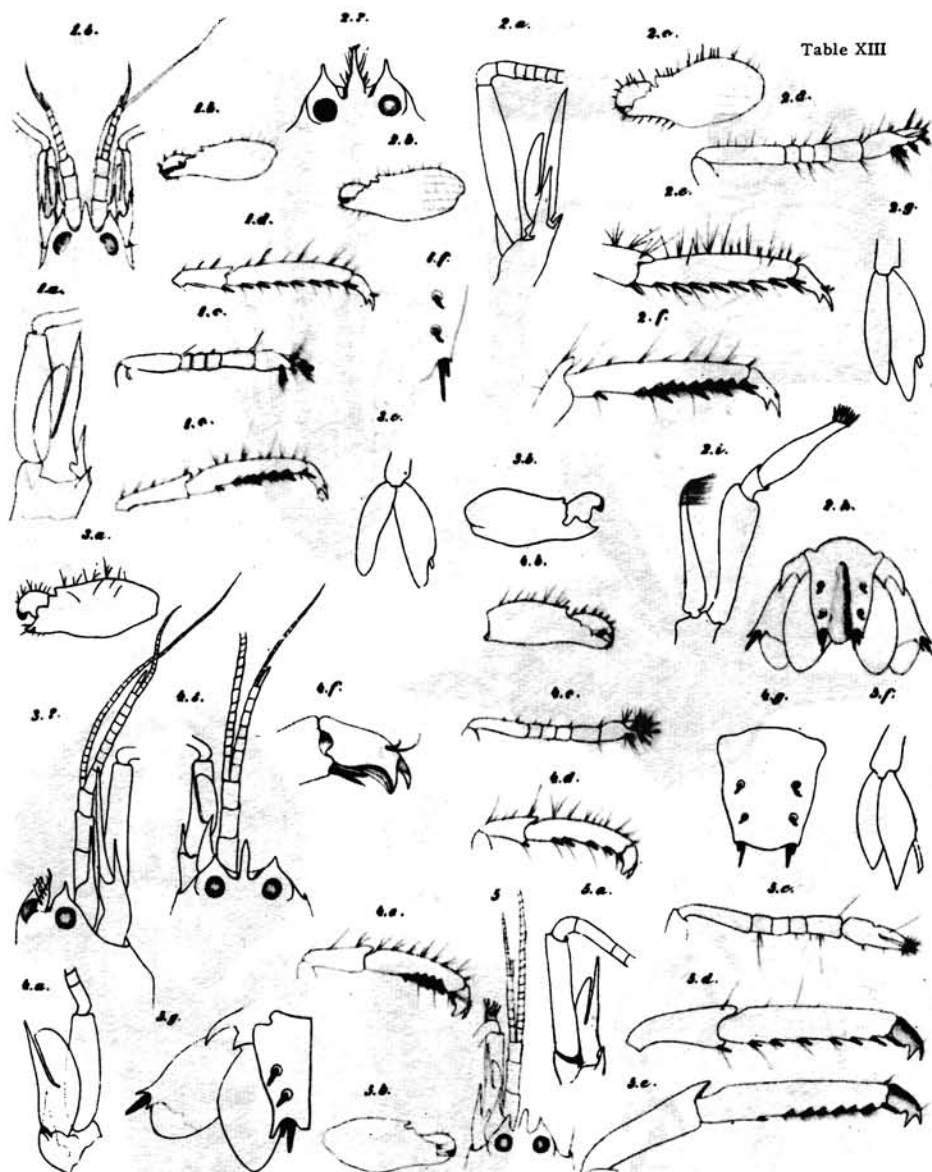


Figure 1. *Alpheus tricuspidatus*. 1a—antenna; 1b—chela of the large cheliped; 1c—second pair of legs; 1d—third pair of legs; 1e—fifth pair of legs; 1f—telson

Figure 2. *Alpheus tumido-manus*. 2a—antenna; 2b—chela of the large cheliped of the male; 2c—chela of the large cheliped of female; 2d—second pair of legs; 2e—third pair of legs; 2f—fifth pair of legs; 2g—pleopod; 2h—telson; 2i hectognath [not in Russian text]

Figure 3. *Alpheus tumido-manus* var. *gracili-manus*. 3a—chela of the large cheliped - lateral view; 3b—chela of the large cheliped - medial view; 3c—pleopod

Figure 4. *Alpheus Charon*. 4a—antenna; 4b—chela of the large cheliped; 4c—second pair of legs; 4d—third pair of legs; 4e—fifth pair of legs; 4f—dactylopodite of the last three pairs of legs; 4g—telson

Figure 5. *Alpheus fossor*. 5a—antenna; 5b—chela of the large cheliped; 5c—second pair of legs; 5d—third pair of legs; 5e—fifth pair of legs; 5f—pleopod; 5g—telson



Figure 1. *Alpheus triunguiculatus* (the rostrum is somewhat shorter than the first joint of the antennules)  
 1a—foliaceous process of the antennae; 1b—chela of the large cheliped, 1c—second pair of legs; 1d—third pair of legs; 1e—fifth pair of legs; 1f—pleopod; 1g—telson  
 Figure 2. *Racilius compressus*. 2a—antenna; 2b—hectognath; 2c—chela of the left cheliped; 2d—second pair of legs; 2e—third pair of legs; 2f—fifth pair of legs; 2g—uropod  
 Figure 3. *Alpheus laevis*. Coxopodite of third pair of legs; 3a—the plate of the fifth pair of legs, on which the epipodite is found (the hairs of the epipodite have not been drawn)  
 Figure 5. *Nikoides Danae*. 5a—mandible; 5b—right first leg; 5c—second pair of legs; 5d—antennule  
 Figure 6. *Nika aequimana*. Frontal edge with rostrum (the edges of the frons are not convex, but slightly concave); 6a—second pair of legs  
 Figure 7. *Oedipus dentirostris*. 7a—hectognath; 7b—dactylopodite of the first three pairs of legs; 7c—rostrum, lateral view; 7d—posterior edge of the telson



Figure 1. *Pontonia biunguiculata*. 1a—antennule; 1b—antenna; 1c—mandible; 1d—maxillula; 1f—maxilla; 1g—first pair of maxillipeds; 1h—second pair of maxillipeds; 1k—hectognath; 1m—dactylopodite of last three pairs of legs; 1n—posterior edge of telson

Figure 2. *Tozeuma armatum*. 2a—antennule; 2b—antenna; 2c—mandible; 2d—deutognath; 2f—tritognath; 2g—pentognath; 2h—hectognath; 2k—second pair of legs; 2m—dactylopodite of last three pairs of legs; 2n—uropod; 2o—base of the rostrum, lateral view.

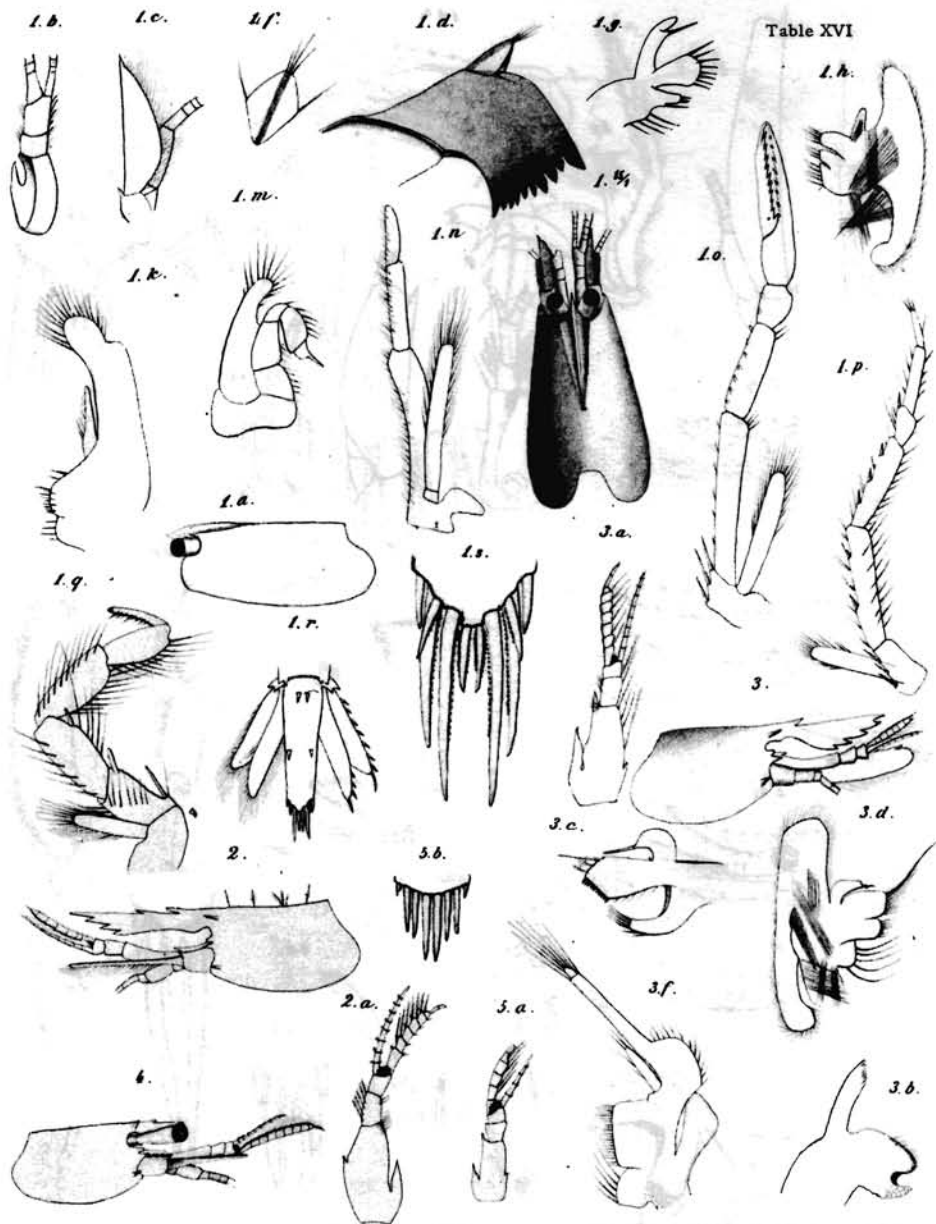


Figure 1. *Leptocheila aculeocaudata*. 1a—cephalothorax, lateral view; 1b—antennule; 1c—antenna; 1d—mandible; 1f—mandibular palp; 1g—deutognath; 1h—tritognath; 1k—tetratognath; 1m—pentognath; 1n—hectognath; 1o—first pair of legs; 1p—third pair of legs; 1q—fourth pair of legs; 1r—uropod; 1s—posterior edge of telson

Figure 2. Variety of *Virbius Proteus*. 2a—antennule

Figure 3. Variety of *Virbius Proteus*. 3a—antennule; 3b—mandible; 3c—deutognath; 3d—tritognath; 3f—tetratognath

Figure 4. Variety of *Virbius Proteus*

Figure 5. Variety of *Virbius Proteus*. 5a—antennule; 5b—posterior edge of telson

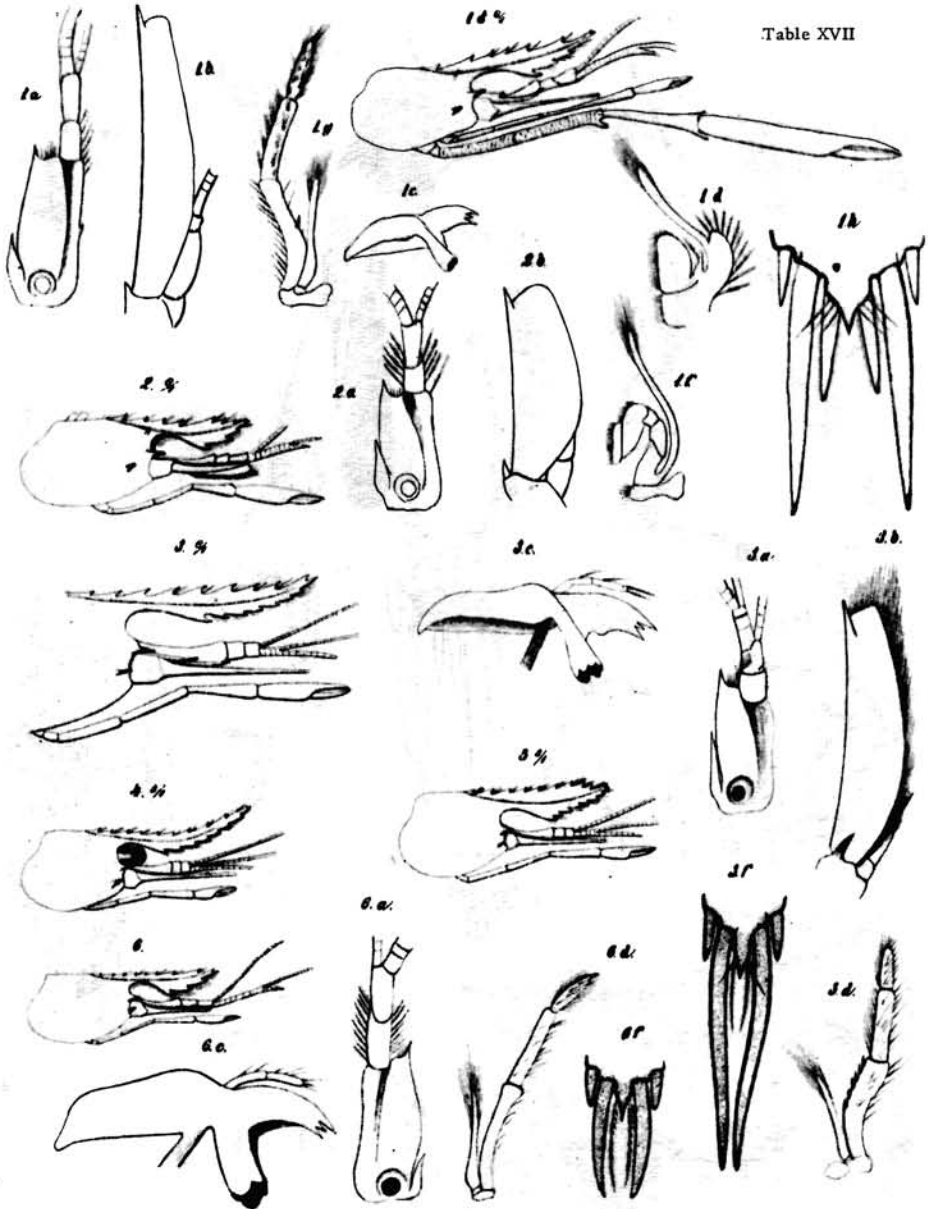


Figure 1. *Anchistia elegans*. 1a—antennule; 1b—antenna; 1c—mandible; 1d—tetratognath; 1f—pentognath; 1g—hectognath; 1h—posterior edge of telson  
 Figure 2. *Anchistia Edwardsii*. 2a—antennule; 2b—antenna  
 Figure 3. *Palaemon torensis*. 3a—antennule; 3b—antenna; 3c—mandible; 3d—hectognath; 3f—posterior edge of telson  
 Figure 4. Variety A of *Palaemon torensis*  
 Figure 5. Variety B of *Palaemon torensis*  
 Figure 6. *Palaemonella gracilis*. 6a—antennule; 6c—mandible; 6d—hectognath; 6f—posterior edge of telson



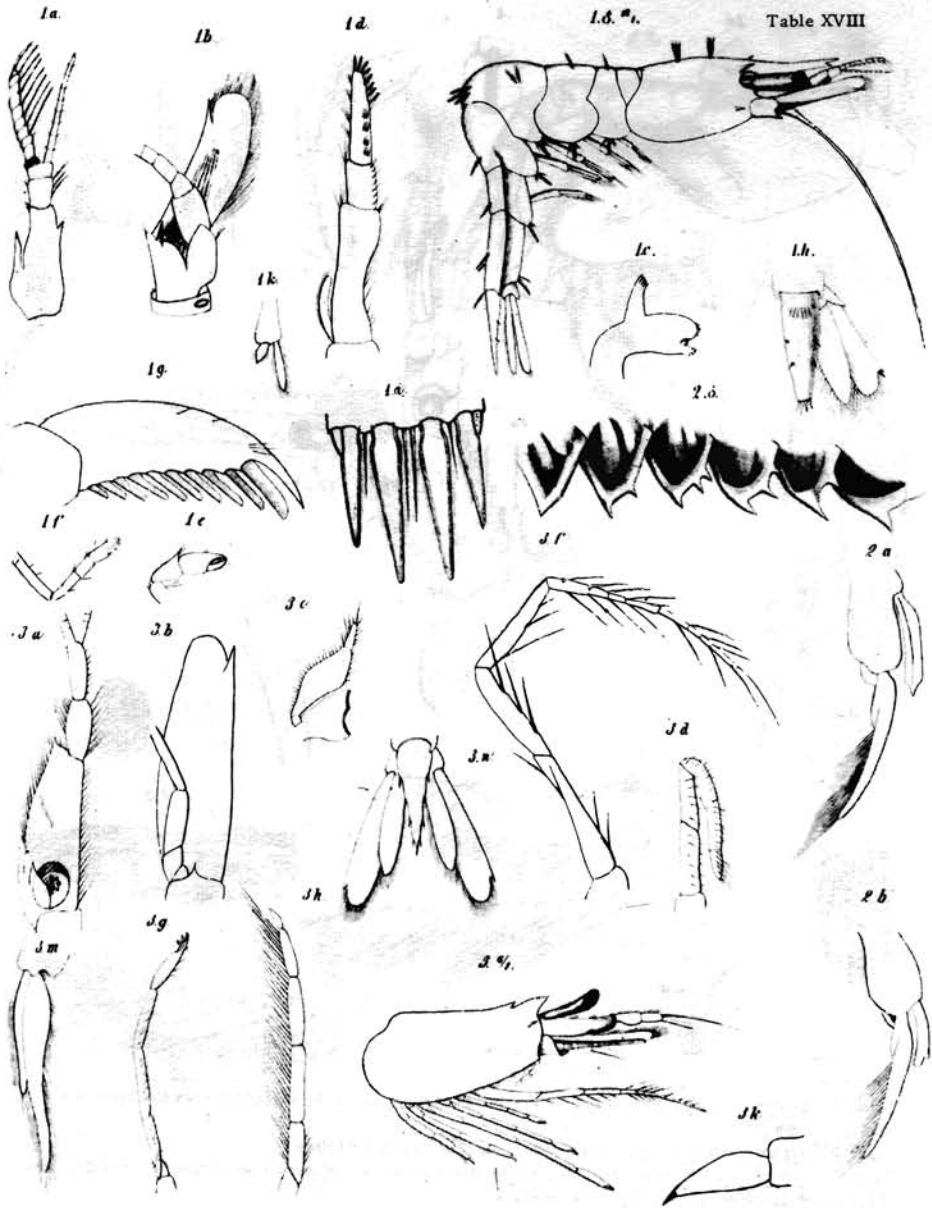


Figure 1. *Virbius Proteus*. 1a—antenna; 1b—antennule; 1c—mandible; 1d—hectognath; 1e—first pair of legs; 1f—second pair of legs; 1g—dactylopodite of the last three pairs of legs; 1h—uropod; 1i—posterior edge of telson; 1k—first pleopod of male

Figure 2. *Sicyonia lancifer*. Lateral side of the first abdominal segments; 2a—first pleopod of male; 2b—second pleopod of male

Figure 3. *Aphareus inermis*. 3a—antennule; 3b—antenna; 3c—mandible; 3d—pentognath; 3f—hectognath; 3g—first pair of legs; 3h—fourth pair of legs; 3k—dactylopodite of the last two pairs of legs; 3m—one of the pleopods; 3n—uropod

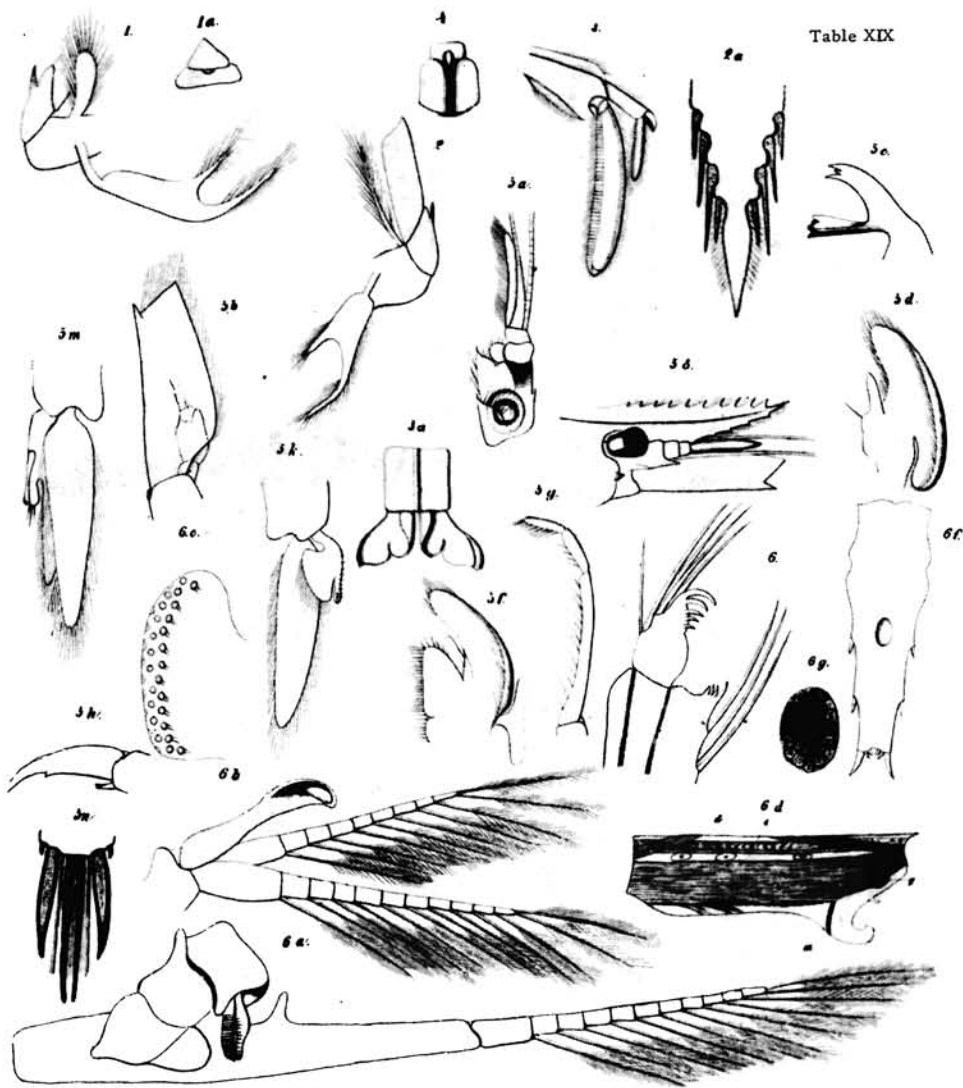


Figure 1. *Peneus longipes*. One of the chelipeds; 1a—the plates on the thorax between the bases of the fourth and fifth pair of legs in the female

Figure 2. *Peneus velutinus*. One of the chelipeds; 2a—end of the telson

Figure 3. *Peneus canaliculatus*. Second pleopod of male; 3a—the plates on the thorax between the bases of the fourth and fifth pairs of legs in the female

Figure 4. *Peneus semisulcatus*. The plates on the thorax between the bases of the fourth and fifth pairs of legs in the female.

Figure 5. *Anchistioides compressus*. 5a—antennule; 5b—antenna; 5c—mandible; 5d—deutognath; 5f—tritognath; 5g—hectognath; 5h—dactylopodite of the last three pairs of legs; 5k—first pleopod of male; 5m—second pleopod of male; 5n—posterior edge of telson

Figure 6. *Leucifer Reynaudii*. The dactylopodite and a part of the propodite of last pair of pereiopods; 6a—first pair of pleopods of the male; 6b—second pair of pleopods of the male; 6c—process on the ventral side of the telson, male; 6d—sixth abdominal segment of female (d. - intestine, e - ovary; g. - ganglion; m. - muscle which moves the process); 6f—telson of female; 6g—prominence on the ventral side of the telson, female

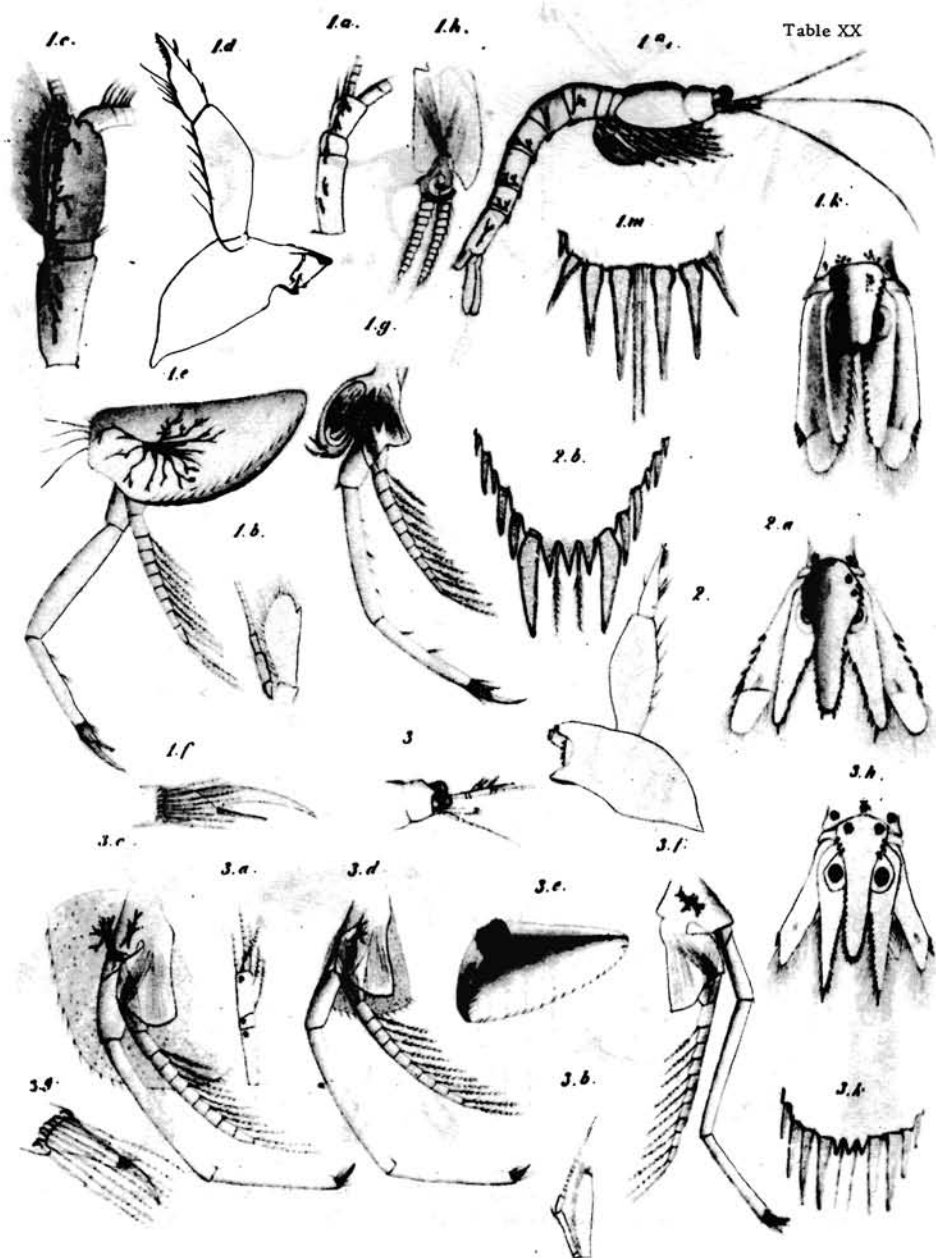


Figure 1. *Siriella brevicaudata*. 1a—antennule, female; 1b—antenna; 1c—antennule, male; 1d—mandible; 1e—fifth pair of pereopods, female; 1f—dactylopodite of the pereopods; 1g—last pair of pereopods, male; 1h—one of the pleopods, female; 1i—one of the pleopods, male; 1k—uropod; 1m—posterior edge of telson  
 Figure 2. *Siriella jaltensis*. Mandible; 2a—uropod; 2b—posterior edge of telson  
 Figure 3. *Siriella Edwardsii*. 3a—antennule, female; 3b—antenna; 3c—last pair of pereopods, female; 3d—penultimate pair of pereopods, male; 3e—one of the oostegites; 3f—third pair of pereopods; 3g—dactylopodite of the pereopods; 3h—uropod; 3k—posterior edge of telson

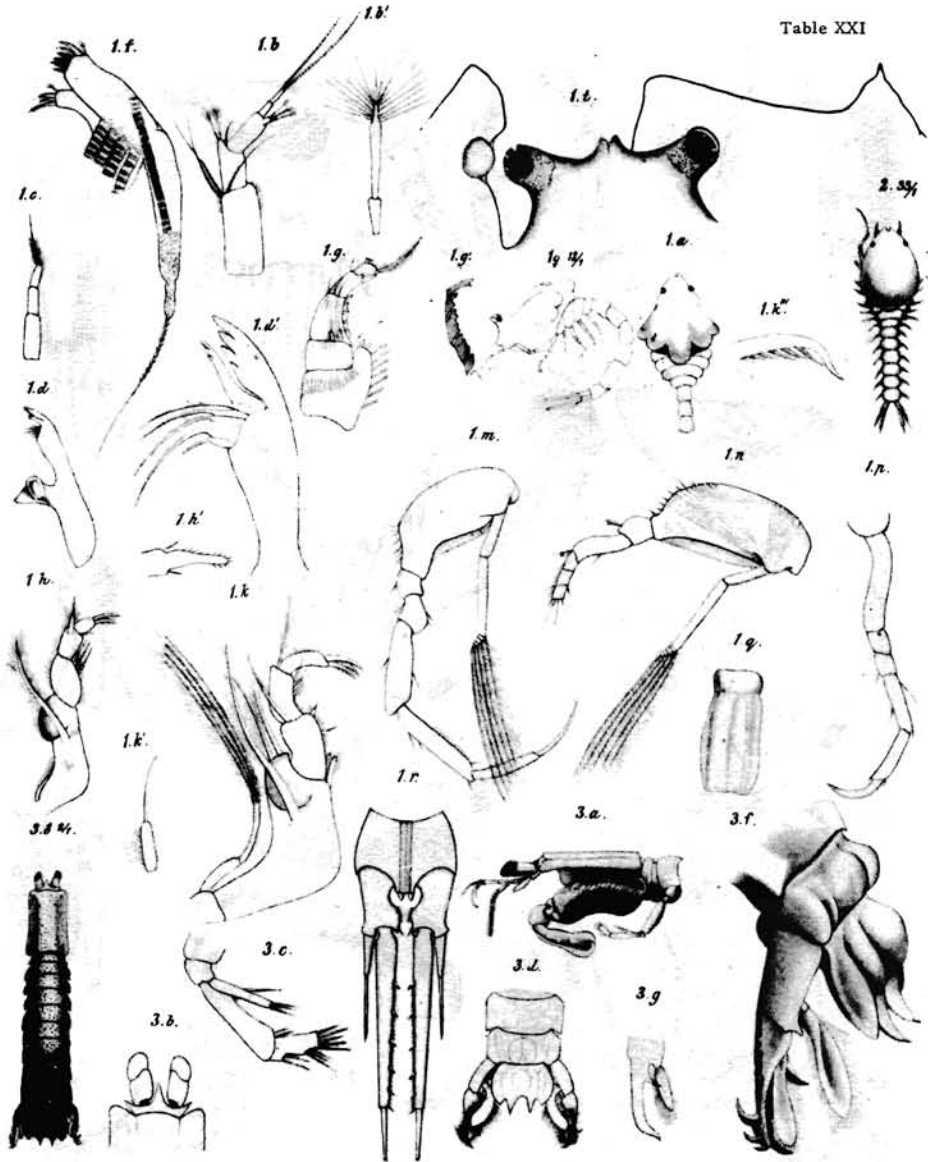


Figure 1. *Diops parvulus*. 1a—dorsal view; 1b—antennule; 1c—antenna; 1b'—one of the aesthetascs of the antenna; 1d—mandible; 1d'—anterior edge of mandible; 1f—deutognath; 1g—tetratognath; 1g'—the membranous tooth of the second joint of the natatory branch of the tetratognath; 1h—pentognath; 1h'—hook-like hair of the hectognath; 1k—hectognath; 1k'—one of the aesthetascs of the hectognath; 1k'''—one of the claws of the hectognath; 1m—first pair of pereopods; 1n—second pair of pereopods; 1p—third pair of pereopods; 1q—fifth abdominal segment; 1r—sixth abdominal segment with bifurcated articulation; 1t—frontal edge with eyes. Figure 2. *Diops spincus*

Figure 3. *Gonodactylus brevisquamatus*. 3a—thoracic part, lateral view; 3b—frontal plate with eyes; 3c—third pereopod; 3d—last three abdominal segments; 3f—uropod, lateral view; 3g—inferior end of the basal joint of uropod