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Parasitic Copepoda of the fishes of Italy

By Alessandro Brian

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NOTES

- I - Poem on page N° 7 not translated because, being a translation from ancient Greek into 18th century Italian, an ulterior translation into English would have taken too long without, apparently, adding to the work.
- 2 - "SISTEMATICA" (Foreword) has been translated as "SYSTEMATIQUE", thus paralleling "TECHNIQUE" (accepted from French), rather than as "SYSTEMATICS" because of this being, visually at least, plural in form as against the Italian's one and only singular as a noun. This is, of course, submitted to the Revisor for consideration and decision.
- 3 - GREEK LITERATION: Space for subsequent insertion of Greek literation by the ~~originators~~ courtesy has been left blank at the following points:
5-16 (8-13); 12-19 (10-30); 35-18 (18-26); 36-1 (18-28);
36-5 (18-31).
- 4 - UNTRANSLATED SCIENTIFIC NAMES:
EPOCUMENI, 14-2 (11-13);
CLOPORTIDE, 35-bottom line (18-27);
FILICTIDI, title N° 3, 44 (21); 45-6 (21-35); 45-15 (21-35);
46-20 (22-19); 47-8 (22-25); 48-7 (22-37);
48-12 (22-41); 49-11 (23-12); 51-15 (24-10).

NOTES (ctnd.)

MASCELLARI (Adj.): 65-I3 (29-I9); 73-I0 (33-8); 73-I3 (33-I0);
85-I9 (38-I5). This was, subsequently,
translated as JAWY.

REPRODUCTIONS: sketch-like marks appearing on pages 20, 21
original not reproduced.

MINOR LIBERTIES: Genious, variousome, varisome, favoursome,
padlets, flaskets, circlet and one or two more.

SYNTAX: The Reader will perceive from dates that the
translation is from 19th century Italian, a fact which
has added to the difficulties pertinent to the work
resulting, in some passages, in a kind of rasping,
if not jaggng, in the communication flow.

Respect for the Author understood, and fidelity
to text observed, the Reader's attention is kindly
requested to note at 85-I6 (38-I6) the absence in this
para of one conjunction connecting two alternatives,
namely the one which should follow the first one of
these preceded by SIA and WHETHER respectively.

CORRECTIONS

MISPELLING: "lernaea" and derivatives, wherever they occur, most probably misspelled because the result of an unjustifiable shot in the dark after remarking their absence from available references.

MISPUNCTUATION: This may have occurred in spite of the attention given to this important aspect of the work.

OMISSIONS: "color" between "the" and "drawings", 2-I3 (6-5);
"out" between "and" and "of", I6-bottom line;
"fixed" between "is" and "in", 88-bottom line (39-I4).

SUBSTITUTIONS: "Crustaceans" instead of "crustaceae";
"part" instead of "piece"; "fine" and "finer"
instead of "thin" and "thinner".
"Bench" instead of "table", 2-I2.

ALESSANDRO BRIAN
Doctor of Natural Sciences

PARASITIC COPEPODA of the
FISHES of ITALY

(With XXI Plates)

GENOVA
Litho-typographic shop of the Royal Institute
for the deaf-mutes

1906

F O R E W O R D

The present work is comparted as follows: HISTORY,
SYSTEMATIQUE, CHOROLOGY, BIBLIOGRAPHY.

The Systematique, which is the most important part,
covers all of the copepoda species hitherto found, as far
as I know, on the fishes of Italy.

In the Chorology, or geographical distribution, I
have included also the localities which, while not politically
italian, are, however, geographically considered as such.

The Bibliography reflects all the works published to
date, which deal with the parasitic copepoda without distinction
as to host.

I thank my beloved teacher, Prof. Corrado Parona, who

after having inspired this work to me, was generous with advice and encouragement, and placed at my disposal the rich material of the Zoological Museum of the Royal University of Genoa, of which he is The Principal.

Disclosed in the present publication, will also be the results obtained by the recent examination of a collection of such crustaceae, by myself performed, during the summer of 1903, at the Zoological station of Naples, where, by gracious concession of The Minister of public education and of The Principal and Founder of said renowned Institution, Prof. Dohrn, to whom I express my gratitude, I had a research table. There, from fresh and almost living material, I was able to execute one part of the drawings which supplement this book.

Beside Prof. C. Parona, Messrs. F. Mazza, E. Setti, V. Ariola, G. Damiani, Professors, the lamented A. Perugia and above all the preparator, Mr. B. Borgioli, to all of whom I address my acknowledgements, have cooperated to the collection of the fishes parasitic copepoda material, studied by myself, which is conserved at the Zoological Museum of the Royal University of Genoa.

H I S T O R Y

I. LERNIFORM COPEPODA

The first rudimentary knowledge of the parasitic copepoda is to be searched for in most ancient times.

Aristotle (384-321 B.C.), the most open and most research-nourished mind, the most diligent and profound observer of the whole antiquity, has doubtlessly been the first one to let us know of the existence of these animals. In his "Historia animalium", he recalls that the tuna and the sword fish are tormented by a species of worm which fixes itself on the fin underside and causes such irritation to the animal that often it springs out of the water and falls inboard of ships. "Thunni et gladii agitantur asilo canis exortu, habent enim utrique per id tempus sub pinna ceu vermiculum, quem asilum vocant, effigie scorpionis, magnitudine aranei, infestat hoc tanto dolore, ut non minus interdum gladius quam delphinus exiliat, unde fit, ut vel in navigia saepenumero incidat." Book VIII, Chap. 19.

Plinius the elder, cultivator of letters and sciences, in his "Historia Naturalis", encyclopedia of the knowledges of those times more than a treatise of natural history, did not fail to repeat Aristotle's assertion almost with the very same words. "Animal est parvum, scorpionis effigie, aranci magnitudine. Hoc se, et thynno, et ei qui gladius vocatur, cerebro delphini magnitudine excedenti, sub pinna affigit aculeo, tantique infestat dolore, ut in naves saepenumero exiliant. Quod et alias faciunt aliorum vim timentes, mugiles maxime, tam praecipuae velocitatis, ut transversa navigia interim superjactent." Book IX, chapter I6.

Oppiano from Cicilia, who lived in times which for the hellenic literature and poetry were elapsing slightly favoursome, proclivous as they were to erudition and to a varied and curious culture, composed, toward 180 A.D., a mythologic, didascallic poem on fishing (Alieutica in 5 books) poor as to inspiration, describing the sufferings of the tuna and of the sword-fish in pathetic language, and asserting that fishes are often killed by their pygmean assailants (I)

(I) Please see appendix.

Ateneo, a greek grammarian from Naucratis, who flourished after the death of Augustus and long lived in Rome, famed for his work "Deipnosophistae" (Banquet of the erudites), in 15 books, many times translated, precious to the history of letters, sciences, customs and crafts, as it contains almost 1500 excerpts of lost writers, repeats that that his predecessors had written with regard to these parasites.

These are the scant accounts relative to our subject which can be drawn from the works of the Greeks and of the Romans, accounts which give a concept of their scarce and gross knowledges with regard to such parasites. And they, to tell the truth, are due to very imperfect original observations by one only, that is, by Aristotle, to whom the various sciences lead back to, zoology first among all. From him, the history of our crustaceae begins.

Although it is evident that with the term (oeustrus sive asilus marinus) he had meant hinting to a lernein copepoda, not all the naturalists of today agree on its interpretation.

Gerstaecker, in the classic treatise (I), holds that it

(I) See p. 592 of work quoted in Bibliography.

may refer to a caligida (Cecrops) as well as to a parasitic isopod, but in spite of this it is difficult, he writes, to establish the true, due to the lack of well founded cognizances on this matter.

In the XVII century already, Boccone was thinking that it was a question of it being a Pennella. In 1865 (2) Steenstrup and Lütken were first to demonstrate that the animal discussed is a lernaeopodid, that is, precisely, the Brachiella Thynni of Cuvier, which, in my view, is more than certain. In fact, this parasitic copepoda is found with a certain frequency on the tuna, and always beneath the fins corner: it is rather noticeable as to size, and so oddly shaped in its external forms as to excite the imagination of the first observers. Nothing of more natural than Aristotle having felt discerning in this minute animal the form of the scorpion, considering it a much painful parasite to the host, owing to the various appendages it is constituted by, resembling feet but probably mistaken for suction organs. The four thin and lengthened out caudal appendages, the two oviferous bags equally stretching rearward with the two

(2) See p. 421 of work quoted in Bibliography.

delicate arms and the long neck also thinned down and leaning forward, certainly give to the animal an appearance which, when describing it, must have been much puzzling to the most ingenious observer of those times. It must not, therefore, astonishes us if Aristotle, comparing it to the spider as to size, could not find an insect other than the scorpion to collate it with in the external appearance. On the other hand, let us not forget that he recognized in this lernaepodid the nature of a worm since he named it vermiculum.

The roman empire fallen, and the last remnants of the hellenic flourishing in the arts and sciences after Alexander gone down, it began, with the byzantine and middle ages, for all the sciences and for the zoology specially, that very long lapse of time which Victor Carus, by a felicitous expression, termed, - period of the silence - lasting up to the XII century for the sciences all and beyond especially for our (9) carcinology, although compensated, to tell the true, by the enlightening progress due to the arabian school. This last epoch, as far as I know, has given no sign of knowing the existence of the parasitic copepoda.

Unfortunately, the silence lasted deep for centuries and that is until after the XII; and if in the XIII, XIV, XV centuries zoology began to develop, this was only as to that which concerns vertebrated animals mainly; but little as to the other ones and naught as to the crustaceans. It is a called-for to go through the whole of the middle ages and not little of the successive time, to find traces of new accounts on these animals and reach the XVI and XVII centuries when, with the reflourishing of sciences, zoology also was enlargerly cultivated. However, the first naturalists of this new period did not make anything new known to us, they referred to the writings by Aristotles and Plinius.

Ippolito Salviani, italian, from Città di Castello (1514-1572) in his "Aquatilium Animalium Historia" (with 99 copper plates)pp. 126-8, quotes at lenght the passages referring to the subject given us by Aristotle, Plinius, Oppiano and Ateneo.

Equally, Guglielmo Rondelet, naturalist born in Montpellier (1507-1566), in his "Libri de Piscibus Marinis", repeats the hints of the first authors on the tuna and

sword-fish parasite, and to prove his personal knowledge of the animal discoursed about, gives us the figure of a tuna with the parasite fixed near the pectoral fin. It adheres, he writes, so tenaciously that it can be removed by no shakes from the body of its host (I).

Corrado Gessner, famed naturalist, nicknamed the German Plinius, native of Zurich (1516-1565) in his "Historia Animalium - De Aquatilibus", 1558, dwells extensively on the very same animal. He describes its structure and appearance, and states: "Because of its being very small, few people know that this parasite is rarely seen except when the dog-star is rising, and then it is noticed not on many fishes, but only on the tuna, the sword-fish and, occasionally, on the dolphin, (and not on each individual)." He gives a little enlarged figure of it (p. 112, fig. annexed), and repeats the drawing of the parasite in situ on the tuna (p. 1152, fig. anxd.), as previously given by Rondelet. "Said animal adheres so powerfully, he observes, that it cannot be removed without wrenching it off. It sucks the fish blood; leech likewise, until it drops due to overfulness, and then dies." After this consideration he notices that these fishes(the tuna

(I) Let it be seen here reproduced on plate XIX, fig. 6 of the

present work of mine, the unsatisfactory drawing of the Oestrus sive Asilus of Rondelet as executed by this author, and published on p. 112 of his work "De Piscibus Marinis" in an ancient edition printed in Lyon, apud Matthiam Bonhomme.

especially is mentioned) are lean and bad at the summer peak, this being due to so miserably being tormented by such contagium, and they are more easily caught in this time than in winter, in which season they are in a better condition (pp. 112, 113). The specimen that he describes, having examined it himself, was of a white color, and was found adhering to "piscem Pagrum".

Hitherto, object of attention by the just recalled naturalists is always the tuna Brachiella. The first one to deal with a diverse species has been Tommaso Moufet who, in 1634, in his "Theatrum Insectorum", Chap. 38, p. 321, gives a very crude figure of animal which, close to a parasitic isopod, he distinguishes as Pediculus marinus, and which, in Gerstaecker's view, ought to be referred to a fish-louse, perhaps to gen. Dichelestium ?

Francesco Redi (born in Arezzo, 18 Febr. 1626; deceased in Pisa 1st March 1694), naturalist, physician and distinguished man of letters who, through his work, left indelible marks in

natural history and helminthology, did not know, to tell the true, any of the fishes parasitic copepoda. To him, conversely, goes the incontestable merit of having discovered the first copepoda of a regular form, having made known the Dorobygus of the Mentula (Observations on living animals found in living animals, Florence 1684), while this merit was being attributed to Stephan Blankaart because of a bad figure of Cyclops ? published in Amsterdam in 1868.

Don Antonio Giuseppe Pernetty, french writer, born in Roanne in 1716, deceased in Valence in 1801, being part as almoner of Bougainville's expedition to the Malouines islands (1763-4), published the report of it in Paris in 1770, and in this work of his (I), makes it known, without knowing it, the very same species which had drawn Aristotle's attention and that of his imitators (T. I, p. 93). He found it adhering to a tuna in the Atlantic, and in Pl. I, figg. 5 and 6, he gave two figures of it which, to me, seem to represent with fidelity the Brachiella Thynni.

Later on, Enrico Maria Ducrotay de Blainville, famed zoologist and anatomist, native of Arques (1778-1850),

(I) Pernetty A.G. - Histoire d'un voyage aux Iles Malouines, Paris, 1770.

illustrates this same form of copepoda, naming it Lerneomyzon incisa (Journal de Physique, xcv, 1822) and exhibiting a figure in which Baird (1850) recognizes the same animal described by Pernetty.

Boccone, a sicilian naturalist, in his "Natural research and observations" published in Amsterdam in 1674, let us know that in Messina his attention was attracted by Mr. Scilla, a renowned painter and antiques dealer of that town, on the fact that the Xiphias, or sword-fish, was well known by the fishermen of the coast due to its being tormented by a parasite that they call leech. The only information that he received was that the animal acts similarly to a gimlet which drives itself in the fish flesh. He happened however to obtain a specimen which he describes and outlines (quoted work, p. 284 and following ones, pl. p. 287). It buries, he writes, its whole head or trunk in the flesh of the sword-fish. And such parasite can affix itself on any part of the host body, but never places itself near the fins to avoid being damaged by their movements.

Mistakenly, Boccone refers this species to the or asilus marinus of Gessner etc. and adds that the figure of

it has not been given by either Gessner or others. Evidently, this naturalist only has attached importance to the fact that the parasite is found on the Xiphias or sword-fish, and therefore he deceived himself by considering it as the form known by Aristotle who, wrongly, had indicated it not only on the tunas but also on the sword-fishes; but if had (II) observed the figures given by Gessner and by Rondelet, he would not have incurred the error of asserting that the two species are identical. The form described by Boccone has been recognized by Baird (1850) as a Pennella (P. filosa, parasite of the Xiphias gladius).

The sicilian naturalist, in connection with this parasite, has made a curious observation: "this leech, so he writes, seems to be tormented by a bug that I never saw on any other animal. It is pea sized and is powerfully self attached on the animal", p. 292. Gessner himself, in quoting Aristotle's description of the asilus, had already exclaimed "adeo nihil est quod hoste carcat" p. 112, and the observation made by Boccone is clearly explained by the presence, noticed by many authors, of living parasites on the Pennella. I wish to hint to the Conchoderma and to the

Campanulariae, cirripede the first one and hydroids the second ones, which happen to live as or mess-fellows on said copepoda; strange association, this one, of a parasitic form on another one that I, too, had occasion to ascertain in Genoa on specimens from Pennella.

Muraltus, in "Miscellanea curiosa sive Ephemeridum Medico Physicarum Germanicarum Academiae Naturae Curiosorum" published in Nuremberg, in 1682, recalls that while sectioning a specimen of Mustela fluviatilis (Lota vulgaris Cuv.), he found an insect infixed in and hanging out from the eye. It was powerfully implanted by the arms and there was no doubt, so writes this author, that the parasite was so hurting to the eye as to render the fish blind.

Baker, in the "Philosophical Transactions" 1744, vol. XLIII, 35, f. 2, 3; describes a "new marine insect by himself discovered" somewhat similar to the preceding one that he names "eye-sucker" and that he found "fixed by the sucker" to the eye of the sardine. The figure is badly executed, so much so that it is not possible to determine its species; but we know how a Lernaea infests the common sardine,

and it has been drawn by I. Sowerby in the "British Miscellany". It is probably this species that it is a matter of, which today has received the name of Lernaeenicus sprattae Sow.

All of Linneo's predecessors, that that handled some of the crustaceans we are dealing here with, appear having performed very few personal observations of some relevance. Also those who gave some new and original accounts, did not know how to disencumber them from preconceptions and gross errors, and in that time, zoology drew little profit from them for the knowledge of this group.

By Linneo's successors only, in the first decades of the XIX century, as we shall see later on, the collection of accounts on various species with more exact observations began, and thus the ground was laid to the brilliant period for the history of our crustaceans which begins with Nordmann (1832). But still before reaching this epoch it is interesting to see that that on this subject Linneo himself and his continuators have done.

In 1746 Linneo, in the "Fauna Suecica" 1st edition, described with the name of Lernaea cyprinacea a parasitic

animal found on the *Cyprinus carassius*. Though today this species may have been acknowledged as belonging to the genus Lernaeocera, it has, however, been established from it the genus Lernaea. The famed Swedish naturalist, in his (I2) "Iter Vestrog", 1747, gave the account of another species found on the gills of a Gadus that he named Lernaea asellina which name has today been changed into that of Oralien asellina. In his second edition of the "Fauna Suecica", 1761, he added a third Lernaea as dwelling the gills of the salmon: and this is the same which was sketched and described by Gisler in the "Act. Holmens. (Acta Suecica):Kongl. Vetensk. Handling.", in 1751, under the name of Pediculus Salmonis, name which Blainville changed into that of Lernaeopoda salmonea.

In the "Systema naturae", 1st edition, 1766; Linneo finally added to the list of the lernaeae a fourth species, Lernaea branchialis, and these four species constitute all that that the great systematist was comprising in the genus Lernaea, which successively extended forth so as to gather the most variousome species and form a large group or family. But the genus just recalled was, later on, restricted within narrower and more natural limits, and of various species new genera

were made (Lernaeocera, Lernaeenicus, Lernaeopoda etc.)

Today, others are not comprised with the primitive name than the typical form of Lernaea branchialis, and only three or four other species.

Linneo, in describing such beings of so bizarre aspect, had no idea that they might belong to the crustaceans; on the contrary, he classified the above referred to forms, because of their body softness, in the mollusca, in the class of the Vermes, following his system; and two others forms of parasitic copepoda, which we have not quoted as yet, he comprised in the Zoophyti referring them to the gen. Pennatula (Pennella).

In the meantime, Linneo's contemporaries contributed quite enough to the widening of the knowledge on the lernaeid copepoda. Stroem (1762) was describing the Lernaea adunca; Ellis (1763) the Pennatula filosa and the P. sagitta; Baster (1765) the Lernaea Basteri (Blainv.); Goeze J.E. was publishing in 1784 an interesting work on the lernaeae; Moder (1786) was discussing anew the Pennatula filosa and the P. sagitta; Abildgaard (1794) was illustrating the Lernaea anomala (Bramae);

O. Fabricius (1794) was making the Lernaea Lavareti known; Holten (1802) the Lernaea Merlucci and the L. Exocoeti; Hermann (1804) the Lernaea squamicola and the L. Lotae; Delaroche (1811) the Chandracanthus Zei and the Ch. Thynni; Major (1824) the Lernaeopoda stellata and the L. samonea; Grant (1827) the Lernaea elongata; and Retzius (1829) the Lernaea Dalmani.

Many of these forms are today known by other generic names as, in large part, have rightly been taken from the genus Lernaea.

All of said naturalists and also others editors and Linneo's continuators, or, rather, systematic writers, have followed the swedish naturalist's views in holding that the lernaeae might be worms. Bruguière, in the "Encyc Method.", 1792, and Blumenbach in his "Handbuch", 1779, have adopted the arrangement established by Linneo in his system. Cuvier, in his "Tableau Élémentaire", 1798, was placing these copepoda among the Mollusca gasteropoda. Lamarck, in his "Système des Anim. sans Vertèb.", 1801, equally comprises them among the mollusca, arranging them with the bare Mollusques cephalés.

Bosc also ascribed them to the Mollusca; but he observes that they approach the intestinal worms. Lamarck, later on unsatisfied with this arrangement, in his "Philosophie Zoologique", 1809, sets them in the annelida together with the planarians and the leeches.

However, already at that time, against the (13)
linneonian opinion of regarding similar parasites as worms and further, in addition, as mollusca, isolated voices, here and there, begin to let themselves be heard, already much before the beckoning discovery by Nordmann, following the investigations on development.

Lamarck himself realized that his first opinion could not be exact and later, in his "Extrait du Cours de Zoologie", 1812, shows the necessity of forming a distinct class to receive those that he names Epizoaires, animals that he cannot refer exactly to none of the classes already determined of the animal reign; and in the "Hist. Nat. Anim. sans Vertèb." 1st edition, 1816, placing those among the Epizoaria, he says: "these animals approach the worms and the insects without belonging neither to the ones nor

to the others. They indicate the existence of a particular series, which probably forms a new class, and that may conveniently fill the large gap which exists between the insects and the worms."

The famous German naturalist Lorenzo Oken (1779-1851) professor at Jena, at Monaco and at Zurich, in his "Lehrbuch der Naturgeschichte.", 1815, following Linneo in placing the lernaeae among the mollusca, was however the first one to initiate the division of these in different genera. He, since that epoch, had glimpsed the affinity of the lernaeae with some forms of parasitic copepoda (Dichelesthium, Caligus, Argulus), since he gathered them with these in a special clan, that of the Armwürmer placing the forms of lernaeae comprised in his genus Anops with the genera of siphonostomata.

De Blainville lets us know that one or two years earlier, in 1814, him too had been induced to recognize the necessity of parting the lernaeae in different genera; and that he was persuaded to assign them a place among the Entomozoa, or articulate animals, regarding them "as an anomalous group of worms, intermediate between his Heteropoda

and Tetracapoda." Same as Oken, he had made the relation which evidently exists between them and the Caligidae known, but he was not, as yet, inclined to refer them to the crustaceans. This way of his of thinking he published in 1816, in his "Prodr. de Classification Nouvelle du Règne Anim.", and unless inspired by that precedently stated by Oken, it must be held personal. In an ulterior work specially devoted to the lernae, Blainville searched for, rather, the direct proof of their nature of crustaceans.

Wiegmann, also supported by the authority of other authors, i.e. A. Nitzsch and of old Leuckart, in his "Grundriss der Zoologie." 1832, brought them together with the Siphonostomi of Latreille in one and same order by him distinct as Parassita.

Cuvier, the founder of compared anatomy, already in the first edition of his celebrated work, "Règne Animal." had recognized a few genera of parasitic copepoda as crustaceans. Soon after having published said book, the physicist Surriray came to the important discovery that the eggs were contained in long filaments suspended by the abdomen, and that the young,

at birth, are not resembling their parents, but on the contrary are extremely similar to young Cyclops. De Blainville recalls the fact (Journal de Physique, 1822), in his excellent article "Lernaea." and fully admits the truth of the discovery by Surriray; and remarks the affinity between the caligida and the lerneidae. However, he maintained these last ones among the Epizoa. Desmarest, finally, in his "Consid. Gén. sur la Classe (I4) des Crustacées" 1825, p. 343, notes, seems to have been the first one to refer the lernaeae, as a group, to the class Crustacea.

To establish and confirm in a definitive manner this unification, a strictly scientific ulterior proof was, more than ever, wanted, and this was provided by Alessandro Nordmann's painstaking research.

No naturalist has so efficiently contributed to enlighten us on the life of the parasitic copepoda as Alessandro Nordmann, professor of Zoology and botanics at the Lyceum Richelieu in Odessa, who in 1832 published the celebrated "Mikrographische Beiträge" where the the results

are unveiled of his research on the generation and the development of the lernae, which have had, ever since, a well defined place in the class of the crustaceans. It is from that epoch that the beginning is dated of a period of truly scientific research on the copepoda, which revealed the close kinship relations between the lernae and the other siphonostomata² and made the knowledge of the morphology and systematique of the whole order take a remarkable step.

" The proof that a Caligus is linked to a Lernaea through evident intermediate forms, Gerstaecker writes (quoted work, p. 596), must, in time, have involuntarily led also to the supposition of the existence of affinity relations between the caligida and the cyclopida most similar according to their complexive body formation.....The discovery by Nordmann of youngs shaped in an entomostracan like form, the observation of their evolution through cyclopiform stages in the Achtheres and in the Tracheliastes, the meeting in them of pairs of mouth limbs and of antennae however very small, and in single cases (Pennella) also of pairs of rudimentary natatory feet, enlighteningly proved that they belong to the order of the copepoda also those forms having the aspect the most degraded

by parasitism and of vermicular nature".

As to the rest, Nordmann's work also opened a new horizon about the relations, until then unperceived and rarely apparent, between the females and the so called pygmean males in the ^{siphonostomata} and specially in the lernae; and through a series of instructive observations, the knowledge of the genera and of the species as to the internal anatomy, the ecological relations of the parasites in respect of their hosts, was likewise enriched. The progress which unfolded with the research on the copepoda after the appearance of Nordmann's work was remarkable beyond measure and rapid according to the most varied directions.

I should not finish so early if I wanted to summarize however briefly all the different works divulged in the following years, the swift mentioning of them will suffice.

In the year 1839, Rathke published his important observations on the anatomy of the Dichelesthium sturionis, and this shortly after the editing by Pickering and Dana of an interesting monography on a Caligus (mention of which will be made further on with regard to the caligida. At the

same time (1839) v. Siebold was discovering in the Cyclopsine castor (free copepod) the fecundation of the female by the performance of the spermatophores attached to the sides of the male genital ring, a process also noticed in the parasitarian forms.

Briefly, the studies by Nordmann above all moved (15) a vast number of observers such as Burmeister (1835), Kollar (1835), Johnston (1835-36) and Enrico Kröyer (1837-38), almost at the same time, to examining the most diversified fishes to search out their respective parasites, and to cast more light on the cognizance of new genera and species, as numerous as in part unlike and much queer-looking.

Milne Edwards, in 1840, was publishing his important work on the crustaceans, and, first one, arranged a natural classification system for the parasitic copepoda, which was followed later on by other attempts to methodic arrangement by Thorell (1861) and by Steenstrup and Lütken(1861).

After the discovery by Audouin and by Milne Edwards (1826) of the Nicothoëastaci on the common shrimp, a parasite shaped in an entirely own fashion, it was found out that the

fishes were not the sole hosts to such forms but that other far more lowly animals, especially the ascidians, the anellida, the echinoderms, the pennatulæ, the Balanoglossus and the Doris could harbour copepoda. Out of a numerous series of naturalists, some illustrated one, others many new species of such group of parasites.

These crustaceans not being comprised in those studied by myself, it will suffice that I quote the names of the authors who undertook them in the order of their publications date: Will (1844), Allman (1847), Leydig (1853), Thorell (1859) (1862-68), Sars (1861), Keferstein (1863), Boeck (1860) (1861), v. Bruzelius (1858), Hancock (1863), Mayer, Della Valle and Giesbrecht with works of recent publication.

With such works, the knowledge of a whole series of forms and, at the same time, of the copepoda ecologic relations, has advanced much; equally, the newly acquired cognizances on the intimate structure of many new species were not failing in exercising an essential influence on the views of that time as to systematique; and contributed, above all, to the renouncing of the until then maintained fixed separation of

the free copepoda from the ^{siphonostomata} _^ of Latreille. The kinship between the two groups already perceived by Burmeister (1837), although later on by himself denied, was made manifest with the work by W. Zenker (I) who was credited with having recognized between the two divisions the singleness of the type in the construction of the body, and with having referred the differences of the mouth parts to the diverse mode of living.

The naturalists who have turned to the study of the fishes parasitic copepoda in these last fifty years are most numerous. The copiousness of the bibliographic material is such that certainly it does not allow for its summarization in the present pages.

The ^{siphonostomata} _^ generally and the lernae formed the object of works in a special manner abounding with accounts or figures on the part of Dana (1853) who published a mighty work on the crustaceans of the United States; on the part of Steenstrup and Lütken (1861), of Krøyer (1863), of Nordmann (1864), of Heller (1865), who illustrated a most rich material of crustaceans collected during the voyage of the austrian ship "Novara".

(I) Zenker W. - Ueber die Cyclopiden des süßen Wassers: Wiegmann's Archiv. f. Naturgesch. XX, p. 88-102, Taf. 6, 1854.

Beside this, many new genera and species, in part single forms, were partly made known by Van Beneden (1850-60), Kölliker (1852), Gerstaecker (1853-54), Pagenstecker (1861), (16) Turner and Wilson (1862), Steenstrup (1862), Bergsoe (1864), Hesse, Schaub and others.

Brühl (1860) made the discovery, morphologically important, of the presence of numerous, although extremely small, pairs of bifid feet of the Lernaeocera. Carlo Claus, who passed away a few years ago, professor in Vienna, highly distinguished himself through remarkable and numerous studies carried out on the copepoda, publishing epoch making memoirs. His observations, begun after 1857, yielded a most rich series of publications on the morphology and anatomy of these beings. He has been the worthy continuator of Nordmann's famed work. Especially important are the following memoirs: "Ueber den Bau und die Entwicklungsgeschichte Parasitischer Crustaceen", 1858; "Ueber die Familie der Lernäen.", 1861; "Ueber den Bau und die Entwicklung von Achtheres percarum.", 1861; "Beobachtungen über Lernaeocera, Peniculus und Lernaea." 1868.

The discovery made by Metzger in 1868 of the lernae

males has been of much interest. Beside, he found the young forms of the Lernaea branchialis in between the gills of Platessa flesus Cuv., while the adult female lives on fish of diverse species. His research and that by Schimkevitsch, Wierzejski but above all the recent ones by the russian Pedascenko brought a vast contribution to the knowledge of the Lernaea development. In 1877 Wierzejski has published a memoir through which he makes it known that the Pennella varians might present the same habits as those of the Lernaea branchialis since it might spend the first part of his parasitarian existence on the sepia and cuttle-fish gills to move, later on, on the dolphin where it spends the period of reproduction.

Gerstaecker, finally, has summarized in a voluminous treatise on the crustaceans (1866-1879) all that is known up to his times on the class of these ^{arthropoda} and signally of the copepoda. He has distributed the families according to modern concepts of systematique and gives the key to the knowledge of genera.

The systematic arrangement by Gerstaecker is in part

the same that Claus was establishing in 1862 (I), only modified and improved. He parted the copepoda in 16 families; and at the head of the system he set those fit for the free life and at the end of the series those most prejudiced in their animal functions owing to parasitism. Passage forms between free life and the parasitarian are intermediate. The system responds perfectly to the science's views of today about the adaptation of animals to environment and to their evolution. In fact the author, when composing a similar systematic prospectus of the entire order of the copepoda, was thinking of re-establishing in some manner the way and the steps through which nature, by a slow and gradual process, has tried to arrive, from the free forms (Pontellidae and Calanidae), to those conformed by a temporary parasitism (Corycaeidae and Notodelphyidae) and from these, finally, to the true parasites.

Gerstaecker was thus sketching the concept of the slow and continued degradation of the animal functions as opposed to the vegetative ones, caused by the way of life of our copepoda.

(I) Claus C. - Untersuchungen über die Organisation der Copepoden: Würzburger naturwissenschaftl. Zeitschr. III, p. 51-103.

This ingenious idea could materialize but in part, as the author himself admits, because he ran in to the difficulties which always supervene in every attempt to systematique. Even if the form and manner of living passages are shown in the copepoda, those do not seem having followed one direction only, rather, as it appears, they start from a common point towards two or several sides and by their whimsical course produce varied combinations. Due to this, it has been impossible for Gerstaecker to distribute the families over one series: he tried however to present an arborescent scheme the best responding to all the kinship relations between the copepoda. The difficulty was increasing due to the fact that at that time the semi-parasitic copepoda indicating the passage from the free forms to the parasitic ones, were as yet scarcely known. Although ulterior studies do not seem having increased by much the knowledge of them, they cannot, however, modify in anything this system of his, which is the only one founded on natural features.

As to that concerning the parasitic copepoda, in the system founded by Gerstaecker and in the distribution of genera, that I too shall follow, the systematic position of a certain

number of copepoda remains as yet uncertain because founded on the knowledge of the female only, but in time, new studies and further embryological research or the discovery of males, will make the few uncertainties which as yet subsist disappear, and by improving the system, will allow seeing all forms of parasitic crustaceans distributed according to their natural affinities. This picture will be the completion of the sketch so magisterially already perceived and outlined by this author.

In these last times, Italy may claim having had a distinguished illustrator of the copepoda in the lamented Sebastiano Richiardi, of the University of Pisa, who laboured with intelligence on the parasitic copepoda of which he collected a most rich material which he was hereto illustrating, unfortunately, in small part only. He instituted the family of the Philicthyidae, of which he described 19 species. I will tell further on of his work in this connection. Beside the catalogue of the Italian species he published not few others original works on new species of lernaeid copepoda (see Bibliography).

At the same time, Antonio Valle was publishing in various stages, the list of the parasitic copepoda of the fishes living in the Adriatic, which was also done by Stossich with the "Prospectus of the Adriatic Sea fauna". Before them, Cornalia already, in 1865, had signalled himself through a valuable study on the Lophoura (Rebelula).

These just quoted italian authors dealt with species belonging mostly to our fauna. The writer also has recently published some notes remarking the presence of a certain number of fishes parasitic copepoda, in the ligurian sea and in the island of Elba sea.

If the work of these few italians contributed in a certain way to make the geographical distribution of these animals in our seas known to us, this has not been a merit exclusive to them. Distinguished foreign naturalists also had, earlier, carried out searches in the Mediterranean and in the Adriatic, but never on purpose. Accurate as the investigations have been on the part of Heller, Hope, Claus, Carus, Kurz, Heider, Schaub, Hartmann, their works were restricted to some species only, and their being far away

from the sea and the difficulty in obtaining a large number (18) of fishes, did not allow them to extend the investigations to a larger number of such representants of our fauna. Nevertheless, Victor Carus, availing himself of the works of the above quoted authors, has given us in his "Prodr. faun. medit.", 1885, a sufficiently complete list of the forms living in our seas, adding a succinct diagnosis and the habitat of each species.

2. CALIGIDA

Hereto we have discussed the parasitic copepoda under the name of lerniforms (belonging to the families Dichelesthidae, Lernaeidae, Chondracanthidae, Lernaeopodidae) which display between them some commonness of form through a higher influence in them exercised by parasitism which has reduced them to quite strange and at times bizarre forms.

In this second part we discuss the caligida history separately, because they form a sole division of copepoda more or less shaped after an unique type, in which parasitism

has come but in part to modify the primitive form of free copepod. They still have some resemblances with the typical form of crustacean, because they still carry, clearly impressed in their body, in the adult state also, the mark of a Cyclops. Systematically speaking, said animals have, in the zoological scale, higher a place than the lernaenian copepoda do. On account of this, I ought to have discussed them at the beginning, in the first part, but since they constitute a group much less numerous and less varied in the forms than the preceding one, and because under the aspect of parasitism, I repeat, are less noticeable, I have thus felt convenient to give them a secondary place in this historical outline.

The authors are not sure as to whether Aristotle had known some form of caligida, although in some points of his "Hist. Anim." he doubtlessly hints to animals parasites of fishes. Gerstaecker, whom we have mentioned above, because author of the best known compend on the copepoda, holds that the described by the greek philosopher (quoted work, chap. VIII, 141) resembling must be taken as isopoda but not as Caligus; he much doubts,

instead, with regard to the (quoted work, chap. VIII, I28) as to whether Aristotle had intended hinting to a caligida (Cecrops) or to a Cymothoa (parasitic isopod). More above I have manifested my opinion in accordance with Steenstrup's and Lütken, by holding that the be no other than the Brachiella Thynni.

We have to come to times much nearer to us to see recalled with certainty some forms of caligidae. Linneo seems to be the first author ever to make an outline of them. In his "Fauna Suecica", 2nd edition, 1761, he briefly describes a species which live on the salmon and the cod, and proper to the norwegian sea. He recalls it with the name of Monoculus piscinus. In the same work he shows us another species of louse which was found on the salmon and which he calls Pediculus farionis. According to Baird (I) (British Entomostraca, 1850, p. 257) such forms, to us indicated with two diverse names, would be (I9) no other than a single species, or by the least two much kindred types of Caligus: and this is deduced from the general description of said small animals, both equally organized

(I) In inditing these historical accounts, I have, in part, availed myself, as to that concerning the first times, of the excellent publication of this english author; pp. 257-260.

and especially characterized by the possession of two long ovarian threads. From the fact also of both of them having been found on the same species of fish, Baird clearly deduces from it their affinity which Linneo himself already, in 1767 (12 edition Syst. Nat.) had perceived, and Gmelin in the 1788 edition, anew confirmed.

Linneo is not the only one who, in those times have quoted and described copepoda of this family. In 1762 Ström described and gave us a figure of two parasites which Baird (quoted work) also holds as Caligus, perhaps the male and the female only of the same species, to which the same name was given of Pediculi marini or fish-lice.

Baster also, in his "Opuscula Subseciva." 1765, gave the description and the figure of two or three diverse species of this genus, accompanying them with many details. The author has represented the body of these animals with the head upside down and mistook the two long ovarian threads for antennae, mistaking, that is, the tail for the head. These figures and Baster's description seem to have deceived Linneo also; notwithstanding having before already correctly described the

animal in his "Fauna Suecica," afterward, in the 12th edition of his "Syst. Nat.", 1767, he described the Monoculus piscinus, constituting two between them diverse species, (the two sexes) one through having two antennae longer than the body, and the other one through being entirely devoid of any.

Ström anow, in 1770, described another species of Caligus and evidently him too incurred into the error of mistaking the caudal part for the cephalic one.

Linneo, in his 12th edition of the "Syst. Nat." confused the Argulus with the Caligus. In the "Fauna Suecica" he had described those as separate species; but in the last work of his not only he brought back his own preceding description of the Argulus, as corresponding to the gen. Caligus, but added beside the figure given by Loeffling of this parasite, as evident proof of their identity. This erroneous synonymy was repeated by Fabricio "Systema Entomologiae," 1775, and by Gmelin "Systema Naturae", 1788. However Slabber, precedently to Gmelin's edition, in his work "Naturkundige Verlusstigungen" gave the figure of a caligida with the name of Oniscus lutosus, outlining the true antennae and some other

part with much correctness.

The merit of having better understood the anatomy of the crustaceans referring to this family is due to O. Fabricius and to Herbst. The species by them described, in the "Fauna Groenlandica", 1780, by the first one, and in the "Berlin Gesellschaft Skrifter", 1780 and 1782, by the second one, are accompanied, especially the last ones, by many details; and were much accurately illustrated.

Müller, in his "Prodr. Zool. Danicae", 1776, introduced for the forms hitherto mentioned the appellation of Binoculus, adopting this name from Geoffroy; but in his "Entomostraca", 1785, he founded the genus Caligus.

Hereto, no naturalist had clearly ascertained the position of the eyes in the caligidae; and it is the apparent lack of visive organs or, better, the supposed blindness of these animals, which had suggested to Müller the generic name just mentioned. This naturalist, although really observing the true eyes, did not consider them as such, and completely confused them with another organ. This oversight notwithstanding the description that he gives us of the genus and of the two (20)

species, is the best one of any other of his times.

Geoffroy described and figured, in his "Insects de Paris", a small crustacea under the name of Binoculus hemisphaericus, which shows a certain resemblance with a Caligus, and Linneo in the "Syst. Nat." 12th edition quoted it as a synonym for his Monoculus piscinus. This synonymity is repeated by Fabricio in his already quoted work: "Entom. Syst." 1793, and in the supplement to this work (1798). However Baird (quoted work) let us observe that this small crustacea is not a Caligus, but a completely different genus, to which Latreille has given the name of Prosopistoma.

Cuvier mentioned the (Calygus) Caligus in his "Tableau Élément." 1798; and Latreille in his "Hist. Nat. Crust. et Ins.", 1802, extensively illustrating this genus, and recalling of it the already, by Müller's and others' work, known features to us.

Risso, in his "Hist. Nat. des Crust. des Environs de Nice", 1816, and in his "Hist. Nat. de l'Europe Mérid." 1826, equally quoted various species referring to the Caligidae.

Always according to Baird, Tilesius, in a publication "Mem. de l'Acad. Imp. des Scien. de St. Pétersbourg", 1815, bringing back a long description of the two species by Müller, added some accounts on a certain number of other animals akin to the caligida, in which he felt attributing in part the cause of the sea luminosity phenomena; and Lamarck, in the first edition of his "Hist. Nat. des Anim. sans Vertéb.", 1818, briefly described the few precedently already known species. The genus was in the meantime being quoted and described in England by Leach in the article: "Crustaceology" published in the "Edinburgh Encyclopaedia", 1814; and in that other one "Annulosa" in the "Suppl. Encyc. Britann.", 1816: later on in the chapter "Entomostraca" of the "Dict. Sc. Nat." 1819. Afterward, Otto (1828), Burmeister (1831), Krøyer (1838-39), Milne Edwards (1833, Ann. Sc. Nat.; and 1840) have given us a large quantity of extremely interesting accounts on the caligida concerning their customs and specially the purposes of systematique.

In America, Pickering and Dana have studied with utmost care a species of Caligus there, abundantly, found on the common cod of their coasts, and published an important

monography of the species, in the "Americ. Journ. of Science", 1838. Such work enabled the knowledge of the morphology and of the internal anatomy of the Caligus as well, to make swift progress. But their research covered the adult form only and for a long time no other than this was known. Baird himself, in 1850, although having abridged almost all the forms of parasitic copepoda known up to his times and proper to the english fauna, showing his knowledge of them, gave, however, proof of ignoring the structure of the young caligida.

The form Chalimus, presented in Burmeister's memoir, 1831, is in fact considered as a distinct genus, while it is no other than a form corresponding to a young stage of the gen. Caligus, as Stein (1852) and Hesse later on remarked. Having discovered and made known the ulterior nauplian and larval phases of this genus, is Goodsir's - "Edin. Philos. Journal" - and the just quoted authors' merit. Goodsir, however, was showing the ignoring as yet of the nature of the form Chalimus.

Not only Baird (1850), already recalled, but also (21) Dana (1853) gave great momentum to the knowledge of the caligida, and other authors later on, especially Steenstrup

and Lutken (1861), Kroyer (1863) and Heller, through their classic works, revealed to scholars a vast number of genera and of species.

Next to these illustrious names, it is binding to mention here Hesse, van Beneden, Gerstaecker, Olsson, who contributed, not to a small extent, in rendering various isolated species known to us. C.B. Wilson, who recently (1905) illustrated the caligidae of the United States fauna in a well turned out work, is worthy of recalling.

Unfortunately, among so many foreign authors, no Italian zoologist (1) before the last 30 years period, has given us accounts of some of this family representants (although some may have described lerneid copepoda only). Verany, 1846, for the Genoese region fauna, had hardly quoted two forms only of them (Caligus Rissoanus and Cecrops Latreillii). Conversely, in these last years, we find Richiardi who, in his Catalogue, (1880, quoted the names of a numerous series of caligidae belonging to our fauna. Also Valle, Stossich and the writer listed a good number of these parasites for various localities of Italy, but evidently their studies

were restricted to some parts only of our seas and had, more than anything else, faunistic importance.

Under this point of view, the work by Carus, whom I have quoted above, who, drawing from the precedent italian publications and from those by Heller and others, published a summarizing compend, a Prodromus of the Mediterranean's fauna, presenting all the caligidae known up to 1885, is worthy of mention.

3.

In the same way that I have had to separate the caligidae from the lerniform copepoda in weaving their history, because they are animals between them diverse, so I am now bound to discuss the Philiethyidae which, likewise, constitute an independent group. They may be considered as typical copepoda, akin to the ancestral forms, forming a family unlinked by kinship direct relations with those hitherto studied or at least with the copepoda most degraded by parasitism. This family, by the plainness of their organization,

by their segmentation regularity observed in the males, by the slight sexual dimorphism between male and young female, at least in the Leposphilus labrei, might rather be conjunct to the higher copepoda, but its systematic position has not as yet been well ascertained, nor it is now my task to determine it.

I have been induced to discuss the separately for another reason yet. The representants of this family have been studied for the largest part by our lamented Richiardi, and due to this I was anxious to remark, in a special paragraph, the merit he had in letting us know these parasitic copepoda. It is due to him if this family, one of (22)

(I) Certainly, Cornalia and Costa described forms of parasitic copepoda but not caligidae; Costa only figured one *Nemesis* only which belongs to the *Dichelesthidae*.

the last introduced in the class of the crustaceans, has shortly become so rich in species.

Prof. Leydig, in 1850, found by chance, on Corvina nigra, in the head muciparous canals, the first which he named Sphacrosoma (a name that Richiardi changed into that

of Sphacrifer, having been already used by Leach for a genus of coleoptera) and was the first one to give of it a rather incomplete description, which was thus leaving other accounts about the history of this elegant parasite, to be wished for.

After Leydig, no other zoologist treated any further, for a twentyfive years gap, of this crustacean. The accounts of it available in this time were so incomplete that neither the sex nor the number and form of the articulate appendages the head is provided with came to be known, which is why it has not been possible to establish its affinities, and conveniently place it in the systematic tables of the class of the crustaceans, and beside v. Beneden felt it was to be ascribed to the family of the Hirudineae next to its genus Histriobdella, and was persuaded that the study of the development would have confirmed the exactitude of his opinion and of such approachment. (I) Although Leydig had already affirmed that this crustacean could be comprised among the lernaea, this view of his had no followers. Richiardi only came to persuade the naturalists on the true nature of copepoda displayed by the above said , publishing, in 1874, an important study on other specimens of the same form.

(I) P.J. Van Beneden. - Les commenseaux et les parasites dans le règne animal. Paris, 1875. p. 74.

He then let it be noted that it could not be conserved among the lernaea as it constituted a genus akin to the Chondracanthus and guessed as of then that the Philichthys displayed features sufficient to form with it a distinct family. Richiardi, later on, discovered and studied other species, be it of Sphaerifer or of Philichthys, remarked of them the larval stages of Neuplius and more than ever, convinced himself of the independence from the other families.

The discovery and foundation of the genus Philichthys is more recent than the above recalled other form. Steenstrup, in 1861, studied one specimen of it collected in the frontal sinus of Xiphias gladius, and one year later also discovered the male form of it. He, at first in doubt as to whether he should refer it to the anellida, with the discovery of the male, in which he recognized the form of copepod, switched opinion and approached it to the crustaceans.

Bergsoe, in a trip to Italy, engaged in the study of this parasite which he found very common. But Heller, in 1865 yet was still maintaining some doubts on the nature of the Philichthys which, however, he was placing among the

Chondracanthidae.

Until then the genus was represented by but one species only: but soon Richiardi discovered many new ones of them and having studied the males and the forms of Nauplius and remarked the affinities of these forms with the Sphaeripher, cleared every doubt on their nature and indicated the distinct place of the in the systematic tables. He also saw the necessity of splitting the genus Philichthys in two genera and proposed, for a large number of them, the new name of Polyrrhynchus.

In following Richiardi's views, we have in this work, in the Systematique, considered the as a well distinct family. The merit is due to Richiardi of having clearly expressed, since 1874, his thought on the necessity of (23) separating these copepoda from the other ones in one special family. At the time he was thus writing: " in searching for the affinities of a great many species of parasitic crustaceans, the forms of one of the two sexes as well as those of both, must be reckoned with, and in this case the males of the Philichthys, which maintain nearly all of the

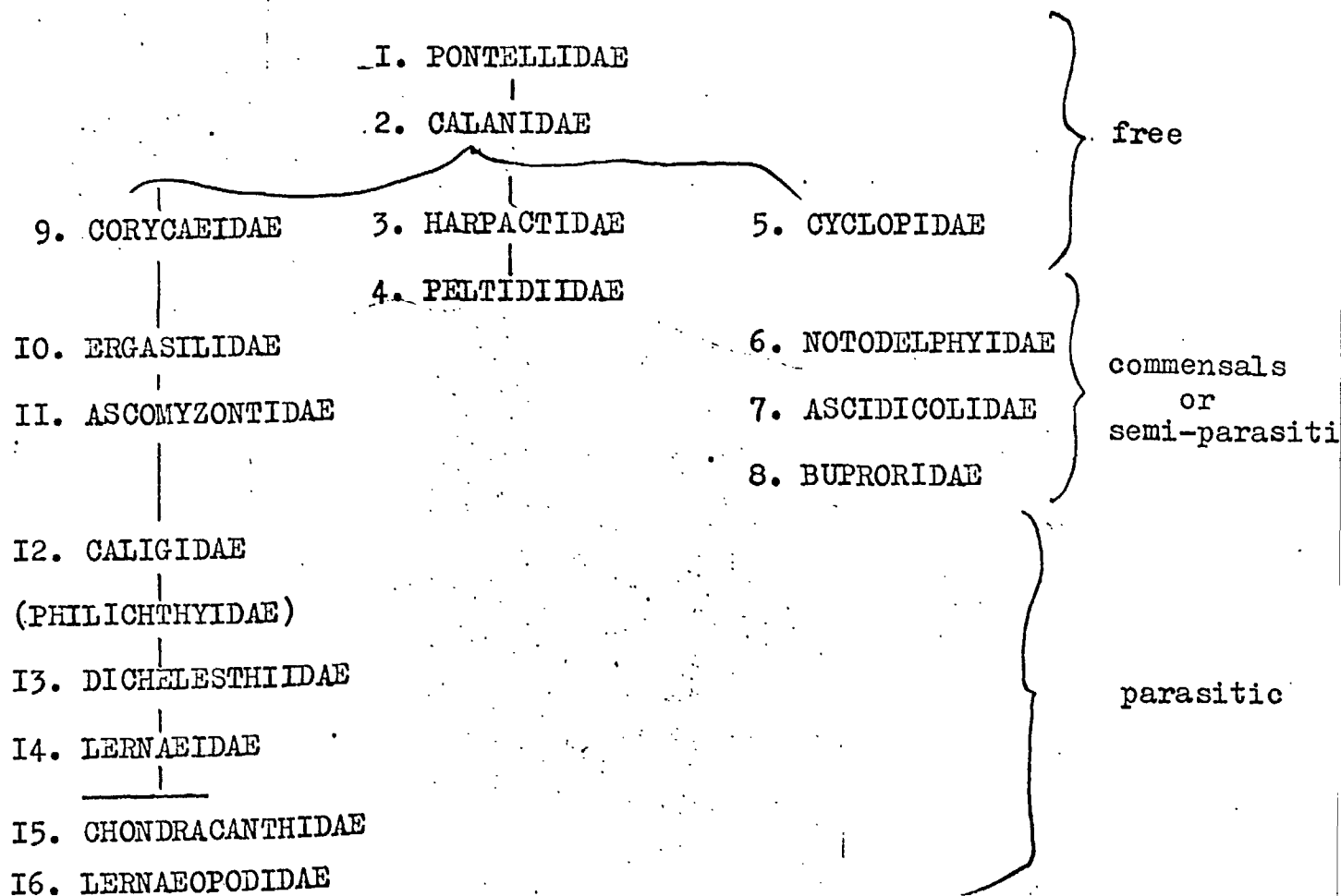
free copepoda features, and undergo few changes in respect of those of the Chondracanthus, give to the genus such uncontrastable a superiority that it cannot be placed in the one same family with these last ones, but rather allowed to constitute its own one, in which all the species living in the tubes and so called muciparous sinuses of the fishes will, probably, have to take place" (I).

The ulterior observations by Vogt (1877) and by Claus (1887), and specially those, most recent, by A. Quidor (1906) prove the truth of this affirmation. This author, in particular, has recognized that the by their head, by the five segments of the thorax and by the five abdominal segments are typical forms to which a rather high place in the systematique of copepoda belong which, as yet, remain to be exactly established..

(I) Richiardi S. - On the *Sphaerifer cornutus* etc. Acta Tuscan Society for Natural Sciences in Pisa, vol. II, N° 2, 1874, p. 12.

S Y S T E M A T I Q U E
 CATALOGUE OF PARASITIC COPEPODA
 HAVING BEEN VERIFIED
 ON THE FISHES OF ITALY

System of classification of the families belonging
 to the Order of the Copepoda
 according to Gerstaecker
 (1871)



In the following pages I have listed the parasitic copepoda of the fishes, in accordance with this system elaborated after a modern and scientific concept. To such series of families it is to be added today that of the Philichthyidae the systematic position of which, however, remains, as yet, to be exactly determined. Considering the latter akin to the Caligidae rather than to the lernaeid copepoda proper, I have allotted them a place between that family and the other one of the Dichelesthiidae. They remain beside to be included in Gerstaecker's prospectus, as to that concerning the parasitarian forms living on animals other than the fishes, the new, recently discovered families, Coniostomatidae, Herpyllobiidae and Monstrillidae, which have features proper to them; but for them also, the systematic position, as already for the , has not as yet been established in an exact manner and it is not my task to undertake it here. As apparent, the arthropod copepoda of the old Milne Edwards' system, which correspond to those living on fishes, which are the object of the present work, are found distributed, (25) in Gerstaecker's system, in the last five families (see N° I2, I3, I4, I5, I6). I have not felt it advisable

undertaking the semi-parasitic forms living on the tunicata and on pelagic hosts, because I should have had to widen the field of my searches and I would not have managed to have at my disposal the material wanted to make the work complete. Although belonging to the family Ergasilidae, (see N° 10), constituted by forms passing from the free copepoda to the parasitic ones, I have had to discuss various species of the genera Ergasilus, Bomolochus, and Eucanthus solely because they too are living on fishes.

Fam. I. - ERGASILIDAE

Gen. Eucanthus CLAUS.

Eucanthus Balistae CLAUS, ♀ and ♂.

Eucanthus Balistae CLAUS, 1864 (8), Pl. XXXVI, figg. 24-27.

- - RICHARDI, 1880 (9) p. 148.

- - CARUS, 1885 (2) p. 353.

HABITAT. - Claus noticed this form, which he described in 1864, about the Mediterranean (? Messina), on the gills of a Balistes sp.; Richiardi, on the gills of Balistes capriscus Linn.

Eucanthus Marchesetti VALLE,

Eucanthus Marchesetti VALLE, 1884 (5) p. I.

- - CARUS, 1885 (2) p. 354.

HABITAT. - Valle verified the presence of this new species, quite frequent, on the gills of the Motella tricirrata Block in the Adriatic. He named it without describing it.

Gen. Pseudoeucanthus n.

I have named this n. gen. with such name through the false resemblance to the gen. Eucanthus it displays.

A peculiar feature of the new genus is found in the form of the mandibular feet (posterior) which display a large falciform hook as the Eucanthus do but which, differently from these, are situated by the external side of the mouth apparatus and not rearward. In the remaining parts, the new form presents relations of affinity with the gen. Bomolochus, but more still with the above referred to Eucanthus. Its place is, systematically speaking, between the Lichomolgidae next to the gen. Terebellicola and Eucanthus, as better specified by the following summary:

Sub. fam. LICHOMOLGIDAE

Mouth aperture approached to the origin of the antennae.

Feet of the 4th pair likewise formed by two rami as the preceding ones.

Internal rami of the 4th pair of feet likewise formed by three articulations as in the preceding pairs.

Anterior antennae at the base not widened.

Constituted by six segments, by three segments the posterior ones.....TEREBELLICOLA Sars

Constituted by four segments; the posterior mandibular feet with a scythe shaped terminal hook, and arranged rearward of the mouth apparatus; external rami of the 4th pair lengthened to hook form.....EUCANTHUS Claus

Constituted by four segments; the posterior mandibular feet with scythe shaped terminal hook, and externally arranged by the sides of the mouth apparatus; external rami of the 4th pair of feet unhooked but purveyed with two setae at the extremity.....PSEUDOEUCANTHUS n.gen.

PSEUDOEUCANTHUS ALOSÆ n. sp., ♀ and ♂. Pl. XI, f. I-8

Eucanthus Alosae BRIAN, 1902 (5) p. 33.

This new form has the type of a Bomolochus but it deviates from it through the cephalothorax being less wide and the successive segments more similar between them.

The cephalothorax, as well as the abdominal segments are slightly convex at their dorsal surface: that, has oval form, while the abdomen is lengthened and its first segment is merged with the cephalothorax, and appears constituted by five articulations and somewhat decreasing in width and in length from the front to the rear. The post-abdomen is narrower and ever more abating toward the posterior extremity; it consists of three segments, to the last one of which two appendages are attached of lengthened rectangular form, tending to the oval and purveyed with a long seta for each lamina, and with four other shorter ones, arranged as per fig. I.

The oviferous bags are big and of a lengthened oval shape (fig. 2). The eggs too are relatively big, and I have counted from 15 to 17 of them to each oviferous bag in a specimen; in another one, up to 37.

DIMENSIONS:

Overall length of the female body to the extremity of the caudal setae	1.08 mm.
Length of the cephalothorax only	0.34 "
Width of the cephalothorax	0.38 "
Length of the oviferous bags, variable between ...	0.50 - 0.60 mm.
Maximum width of same	0.10 - 0.16 "

The anterior antennae seem to be formed by 4 articulations; the basal articulation, rather wide and lengthened out, is anteriorly purveyed with feathered setae, rather wide at their base, in number of 15 about: much tenuous and short are the other articulations, ever more decreasing as they proceed farther and farther from the base, and the last one ends at the extremity with a tuft of tiny setae one of which specially appears more developed.

The anterior margin of the cephalothorax is not incised in the middle; it displays instead, below the forehead, two rearward turned hooklets, characteristic in the Bomolochus.

The antennae of the second pair(fig. 4), situated (27) at a short distance from the frontal margin and behind the aforesaid hooklets, consist of two articulations, a basal one rather big, and another one bent over the same, on the external side, which shows the free extremity divided in several spinae or hooks and in two hairy appendages at the margin. These last ones seem to be prolongations of the same internal lateral margin of the second articulation, which is also provided with tiny cilia or denticles arranged in two

or three lines, along its entire length.

The mouth is encircled by a frame of chitinous listels which give a complicated appearance to it. They are seen pointing toward its center first two chitinous stilettes, which are the mandibles (fig. 3), and below, two others bi-articulate stilettes with a wide triangular base, that is, the mandibular feet of the first pair. These are provided with very short setae on their terminal articulation. In between the two said pairs of members, that is between the mandibles and the mandibular feet it is seen, set in between, one pair of transverse chitinous pieces, each of which seem to be forming a circlet at the extremity, and inside of it, the points of the same mandibular feet seem to penetrate.

Characteristic is the pair of mandibular feet of the second pair (I) which are situated at the sides of the mouth and somewhat higher than it, and display a wide and long basal articulation, and a falciform hook with direction from the front toward the rear, and with the point turned toward the center of the cephalothorax.

The first pair of feet (fig. 5) is constituted by a

small basal lamina at the inferior margin of which a wider lamina is inserted, that is the indistinctly tri-articulate internal rami, and which carries six feathered setae on the inferior margin. Another seta is inserted farther in toward the interior of this small basal lamina. Instead, the external rami is found attached to one side of the basal lamina and arranged in such a way as to form a right angle with the internal rami: it carries six other feathered setae. This pair of feet is more or less similar to that of others Bomolochus.

The second pair of feet (fig. 6) is more normally shaped after the typical form: it resembles more the natatory feet of the freely living copepoda. The external rami is tri-articulate and carries three setae at the extremity, decreasing in length from the exterior to the interior. The two natatory rami are rather equal in length. The internal one also is tri-articulate and, if I have been able to see well, it carries three setae on the internal margin, one on the first articulation and two on the second one; the third articulation displays three or four of them, all feathered.

The third pair of feet (fig. 7) consists, as the

precedent ones, of two rami. The setae in the external rami, at the extremity, are only in number of three and increasing in length from the interior to the exterior. The articulations of this rami on the external margin, in this pair as well as in the second and in the fourth ones, appear provided with hair. The internal rami is quite smaller, shorter, and carries, for each articulation, by the internal side, one seta, and on the extremity, three or four more.

The fourth pair of feet (fig. 8) is shaped as the other ones are, consists of one rather lengthened out basal articulation and of two rami with three articulations. The number of setae, though, is different. The external rami carries three of them at the extremity and the internal rami only two, but another one is observed on the first and on the second articulation in this last one rami, by the internal side. The internal rami is, beside, quite smaller and more tenuous than the other one. Also the exterior margin of the internal rami is provided with hair, and the presence of these is also noticed in the preceding pairs, but mostly (28) in the external rami on the outer side or margin.

HABITAT. - Several specimens found by Dr. Damiani fixed to the eye of the Clupea alosa Cuv. in Portoferraio, on Febr. 17, 1900 and on April 19, 1901.

Gen. BOMOLOCHUS Nordmann.

Bomolochus Muraenae RICHIARDI,  Pl. XII, figg. 1-9.

Bomolochus Muranae RICHIARDI, 1880 (9) p. 147.

- - CARUS, 1885 (2) p. 353.

- - BRIAN, 1903 (9) p. 178.

Description of the female.

This form had not as yet been described but only named by Richiardi.

Seen dorsally, the cephalothorax (fig. 1) appears very convex and its frontal margin is whole, anteriorly circular, the posterior margin is nearly straight and quite wide. The second segment, rather short, maintains nearly the width of the cephalothorax, and so does the third segment. Narrower is instead the fourth abdominal segment, which shows the posterior margin rounded off and carries, almost hidden, on the neath, the fifth segment, the least conspicuous of them

all, very short and slightly less wide than the fourth segment: at the sides it carries the fifth pair of rudimentary feet. To this, the genital segment follows ever more narrowed down, (fig. 2), by little wider than it is long, and finally four segments increasingly and progressively attenuated at the sides, constituting the post-abdomen, terminated by two caudal laminae with very developed setae.

These four segments of the post abdomen have the posterior margin as being ciliated or, better, armed by spinae or denticles arranged in line on the posterior limit of each segment, and the two caudal appendages also show a certain number of these spinae or cilia on the posterior side.

Before passing to the description of the respective appendages, I collect hereunder the various measurements by myself taken on the body of this Bomolochus:

Dimensions: The overall length of the female, caudal setae included, varies from 2.24 mm. to 2.50 mm. and without setae from 1.74 to 1.80 mm. The width toward the posterior margin of the cephalothorax is nearly 0.70 mm. The width of the fourth segment 0.40 mm.

Lenght of the cephalothorax only	0.46 mm.
" " " first abdominal segment	0.24 "
" " " second " "	0.24 "
" " " third " "	0.26 "
" " " post-abdomen without caudal setae	0.54 "
" " " post-abdomen, genital segment included	0.60 "
Lenght of the longest caudal seta, variable from	
	0.50 mm. to 0.70 "
Width of the genital segment	0.27 " (29)
" " " first segment of the post-abdomen:	0.22 mm.
" " " second " " " "	0.17 "
" " " third " " " "	0.15 "
" " " fourth " " " "	0.11
Width of the caudal fork, that is of the two appendages complexively measured.....	
	0.066 mm.

Appendages. - The anterior antennae (fig. 4) are formed by four articulations and appear armed with setae and spinae: these last ones in number of two or three only for the first basal articulation. The setae are feathered, wide and short toward the base, thinner and long toward the free extremity of the antennae.

The posterior antennae (fig. 5) are composed of three articulations and the last one carries two obtuse appendages and hairy (like the whole articulation also is) and a tuft of hair or adunc spinae, of which I seemed able to count four or five.

The mandibles (fig. 3) are given by two bi-dentate stiletos at the extremity which advance freely toward the longitudinal median line and contact by their points. The jaws as in the gen. *Bomolochus* are rudimentary and represented by one chitinal lamina with a palp and three large feathered setae. Two others thinner stiletos, lengthened out and bi-dentate at the extremity, constitute the anterior

feet. Inferiorly, those of the second pair follow, represented by two big lengthened out laminae bent toward the interior, touching one another in the upper extremity and carrying, on the concave part of this anterior curvature of theirs, one filament and one denticle to each foot.

The first pair of feet (fig. 6) is represented by a small, narrow lamina, to which are inserted two wide natatory rami, one fixed on the external side, the other one toward the

inferior side, so as to form by their arrangement a right angle. Each of the rami carry traces of a primitive articulation, in the external one, nine wide and short feathered setae are counted, in the internal one, eight; and these last ones decrease in length from the interior to the exterior. Another seta is found fixed to the basal lamina more toward the interior, by each side of a common median basal piece. With the basal segment of the first pair of feet a true chitinal supporting apparatus is connected, constituted by listels and pieces joined together in the most varisome and characteristic way an idea of which the drawing only can give.

The second pair of feet (fig. 7) does not differ from the usual form proper to the genus. Two tri-articulate rami are noticed, fixed to a basal lamina for each of the feet. The external rami carries, by the outer side, five spinae, that is one on each of the two first articulations and three on the last one, which, in addition, carries six feathered setae still. The second articulation on the internal side also shows a long feathered seta. The internal rami shows, by the outer side, three spinae, one on the second and two on the last articulation, where also four setae are noticed.

Three more of these last ones are distributed, beside, on the internal side of the first and second articulation.

The third pair of feet also is nearly shaped like the second one. The tri-articulate external rami shows four spinae by the outer side, and seven setae distributed, in part on the extremity and in part on the internal side.

On the internal rami three spinae are counted by the (30) outer side, distributed on the second and third articulation: this last one carries only three setae on the extremity, and among them I also have noticed, if I am not mistaken, one fourth spina. Three other setae, arranged on the first and on the second articulation are seen by the external side of this same natatory rami.

The internal rami of the fourth pair of feet (fig. 8) carries only two setae and two spinae on the last articulation, two more setae by the internal side, distributed on the first and second articulation. On the other rami, five spinae are noticed by the external side and six setae fixed to the extremity of the last articulation, while one only on the internal side is fixed on the second articulation.

The fifth pair of feet (fig. 9) is constituted by a rather circular oval lamina, fixed to a short basal segment inserted on the fifth abdominal segment. The outer margin of this lamina is trimmed by three setae and the outline is ciliated.

Each of the caudal appendages carries four setae: the innermost one is three times longer than the close-by second one. This, in its turn, is at least three times longer of the two other ones situated slightly more outward of the caudal appendage self. In an individual, the longest caudal seta would even attain 0.71 mm. (that is, it was much longer than the post-abdomen and than the genital ring which, combined, hardly measure 0.60 mm.) In this same specimen, the second seta would attain but 0.27 mm.

HABITAT. - This species was first found by Richiardi on the gills of the Muraena helena Linn. Afterward, Dr. Damiani, on Dec. 24 1902, collected many specimens of it on the same host in Portoferraio and, thanks to his sending them over to me, I was able to described it, since Richiardi only had named it.

BOMOLOCHUS UNICIRRUS Richiardi, ♀ .Bomolochus unicirrus RICHARDI, 1880 (9) p. 147.

- - CARUS, 1885 (2) p. 353.

- - BRIAN, 1899 (3) p. 197.

- - BRIAN, 1902 (5) p. 30
Pl. I, figg. I - 8.- - THOMPSON I.C. and SCOTT A.,
1903 (2) p. 293.

HABITAT. - Richiardi found this copepod on the gills of the Lichia glauca Linn. and of the L. amia Linn. in the Mediterranean. I have examined two female specimens sent to me by Dr. Damiani in 1899 from Portoferraio and by him collected in the branchial cavity of Lichia glauca Linn. At first I only had named this species (1899), but since it only had been named by Richiardi, I have later felt it advisable to describe it (1902). Other specimens, which I refer to it, I have myself collected in Naples, on Aug. 3, 1903, on the Sphyraena vulgaris Cuv. and Val.

BOMOLOCHUS BELONES Burmeister, ♀ and ♂ .Bomolochus Belone Burmeister, 1833, p. 298, Pl. XXIV, f. I - 6

Bomolochus Belone Edwards, 1840 (2) p. 479.

- - Heller, 1866 (2) p. 29.
- - Hartmann, 1870 (2) p. II6 - I58,
Pl. III - IV.
- - Richiardi, 1880 (9) p. I47.
- - Valle, 1880 (3) p. 57.
- - Carus, 1885 (2) p. 353.
- - Bassett-Smith, 1899 (5) p. 442.
- - Brian, 1902 (5) p. 33.

HABITAT. - The first specimens were found on the (31)
gills of a Belone vulgaris Flem. (Esox Belone Linn.) by
Dr. Stannius (studied then by Burmeister) near the island of
Helgoland in the North Sea. Hartmann has the examined other
specimens from Nice, Trieste, and from Venice and found on
the gills of Belone vulgaris Flem. On the Belone rostrata Fab.
such parasite is quoted by Heller and by Valle for the
Adriatic equally; nay, Valle states it as common in that sea.
In the Mediterranean, it was also verified anew by Richiardi
on the gills of Belone acus Risso on which host it was also
collected by Dr. Damiani in Portoferraio and by myself in
Naples. Carus indicates for this species also the locality
of Borkum, the well known island of the North sea.

BOMOLOCHUS SOLEAE Claus, ♀ and ♂.

Bomolochus Soleae CLAUS, 1863 (8) p. 365 - 383
Pl. XXXV, figg. 16 - 20.

- - VAN BENEDEN (16) p. 78, Pl. I, f. 5.
- - RICHIARDI, 1880 (9) p. 147.
- - CARUS, 1885 (2) p. 353.
- - BASSETT-SMITH, 1899 (5) p. 443.
- - SCOTT A., 1901 (1)p. 349.

HABITAT. - Claus discovered this species fixed to the gills of the Solea vulgaris Cuv. on the coasts of the island of Helgoland (numerous specimens). For the coasts of Belgium it was later indicated by Van Beneden who, perhaps, was ignorant of its discovery, earlier, by Claus and, by chance, named it by the same name. He only found two female specimens of it, loaded with eggs, on an individual of Solea vulgaris Cuv. which was not more than 9 cm. in length; at the beginning of May. Richiardi found it also in the Mediterranean on the gills of said fish.

BOMOLOCHUS CORNUTUS Claus, ♀.

- Bomolochus cornutus CLAUS, 1864 (8) p. 365 - 383,
Pl. XXXV, figg. 21 - 23.
- - RICHIARDI, 1880 (9) p. 147.
- - VALLE, 1880 (3) p. 57.
- - CARUS, 1885 (2) p. 353.
- - BRIAN, 1898 (I) p. 9.
- - BASSETT-SMITH, 1899 (5) p. 443.
- - BRIAN, 1902 (5) p. 33.
- - BRIAN, 1903 (9) p. 83.

HABITAT. - Claus found this species which he described, for the first time on the gills of the rare Asterodermus coryphaenoides (young stage of Luvarus imperialis Raf. in Messina. The specimens by him observed had a length of 3 mm. Richiardi then, verified it parasitic on the gills of other fishes: Asterodermus elegans Risso, Exocaetus volitans Linn., Sayris Camperi Lac. and Clupea sardina Risso. Valle found it frequent on the gills of the Clupea papalina Bp. I quoted it for Genoa on the gills of the Scomberesox Rondeleti C. V., and on various occasions received specimens of it from Portoferraio where Dr. Damiani collected them in the branchial cave of Sayris Camperi Lac., and between the gills of Clupea sardina Cuv. and the opercle mucous membrane of Exocaetus Rondeletti C.V. It is common a species.

BOMOLOCHUS MINIMUS Richiardi.Bomolochus minimus Richiardi, 1880 (9) p. 147.

- - Carus, 1885 (2) p. 353.

Undescribed species. Richiardi found it on the gills of Serranus scriba Linn. in the Mediterranean.

BOMOLOCHUS OBLONGUS Richiardi.Bomolochus oblongus Richiardi, 1880 (9) p. 147.

- - Carus, 1885 (2) p. 353.

Undescribed species. It was collected by Richiardi on the gills of the Oblata melanura Linn. in the Mediterranean.

Gen. Bomolochus NORDMANN.Sub genus ANCHISTROTOS n.

Description of the female.

Length of the body about 1 1/2 mm. The cephalothorax has almost circular form; a small roundish salience is noted in the middle of the frontal margin. Four segments follow

this portion, slightly decreasing in width from the front to the rear and another one does of a rather globous form and somewhat wider and longer than the preceding ones, which constitutes the genital segment. Four other segments, gradually narrowing down as they approach the posterior extremity, constitute the post-abdomen, terminated on the rear by two small rectangular caudal laminettes, purveyed with two long setae each, one over the double longer than the other one, and by three other short tiny setae.

Nearly the same is, as in the gen. Taeniacanthus by Sumpf, the arrangement of the mouth parts on the lower surface of the cephalothorax: as in that genus, and also as in the gen. Eucanthus the presence is noticed also in our form, of two hooks corresponding to the hamuli of the caligidae, situated near the lateral margin of the cephalothorax, by one and by the other side, and slightly on the neath of the first pair antennae. These are long, constituted by six articulations, the two first ones joined together constituting the wide basal segment which shows many setae on the anterior margin (about 20 setae).

The antennae of the second pair (fig. 6) are formed by two articulations, and the last one carries at the extremity four long spinae slightly recurved toward the interior, and one ciliated appendage by one of the sides.

The mouth apparatus is constituted by one pair of mandibles, stiletto-like shaped, thrusting forward and reciprocally touching one the other by their extremity which seem to be bifid. The rudimentary jaws follow represented by some feathered filaments inserted on a common basal piece, and on the neath, the first pair of feet does, constituted by one double stiletto, small and inserted on a narrow and lengthened out basal segment: finally, behind these last ones, the second pair of feet, formed by a wide chitinal basal piece to which two rearward pointing lengthened out filaments are inserted in one of the extremities (fig. 4).

.The first pair of feet, inserted on the lower margin of the cephalothorax, is given by one basal lamina to which two other rami are fixed in the form of flat laminae purveyed with setae.

On each of the first three free abdominal segments, by the ventral side, one pair of natatory feet is fixed formed by two well developed rami; each foot is joined to its opposite by a thin median lamina. Each rami numbers three articulations and each articulation is purveyed with setae and spinae as shown by figures 9 and 10.

The fifth pair of feet is given by a narrow and lengthened out appendage fixed at each side of its own abdominal segment. This appendage carries three short setae on the extremity and another one on the external margin.

The genital orifice is set on each side of the body segment and is formed by a slit all around protected by chitinal listels specially arranged frame-like wise, and by three long setae taking origin from a small tubercle, rudiments representing the sixth pair of feet.

Dimensions:

Overall length of the body, variable between...	I. 4	--	I.6	mm.
Length of the caudal setae	0.24			mm.
" " " post-abdomen	0.34			"
" " " cephalothorax	0.44			"
Width " " same	0.50			"

Length of all the free abdominal segments,
genital ring included..... 0.36 mm.

Length of the oviferous bags,
variable between 0.84 - 1.00 mm.

Thickness of the same, about 0.13 mm.

The male (figg. I, 2, 7 - 10) is nearly alike to the female
just described.

HABITAT. - On the mouth walls of Gabius capito Cuv.
and Val.; many specimens collected by myself in Naples,
on July 13, 1903.

Gen. ERGASILUS Nordmann

(34)

ERGASILUS SIEBOLDI Nordmann, .

Ergasilus Sieboldi NORDMANN, 1832, (I), p. 15
Pl. II, fig. I.

- - KRÖYER, 1863 (2) p. 237,
Pl. XIII, fig. 2.
- - EDWARDS M., 1840 (2) p. 478.
- - CLAUD, 1875 (12) p. 339,
Pl. XXIII, fig. 12.
- - GIESBRECHT, 1882 (I) p. 88.
- - GARBINI, 1895, p. 473.

Ergasilus Sieboldi BASSETT-SMITH, 1899 (5) p. 443.

- - - POCHE F., 1902, p. 13.

HABITAT. - Common and in abundance in the fresh waters of Europe, it is found on the gills of Esox lucius Linn., of Cyprinus carpio Linn., of Abramis brama Flem., and of Silurus glanis Linn. etc. Garbini verified the presence of this copepod in Italy, in the Veronese region, on the gills of a Cyprinus.

In Monaco of Bavaria, I observed specimens of this species collected by v. Siebold and conserved at the Zoological Institute of that University. They were accompanied by the following indication " br. Cypr. Erythrophth Heilsberg." From a hint by Poche Franz it is noticed that Giesbrecht might have indicated as host of this copepod also the herring (?).

ERGASILUS NANUS Beneden v.,

Ergasilus nanus BENEDEN v., 1870 (16) p. 27
tbl. I, fig. 6.

- - - RICHIARDI, 1880 (9) p. 147.

- - - VALLE, 1880 (3) p. 57.

HABITAT. - Richiardi quoted this species by him found on the gills of Mugil cephalus Cuv., M. auratus Risso and M. saliens Risso, for the Mediterranean. Valle states it as very common on the gills of Mugil saliens Risso, in the Adriatic.

This species was first discovered by Van Beneden near the coasts of Belgium, parasitic of the gills of Mugil chelo Cuv., and by him indicated, beside, for the locality of Ostend and for the coasts of Britain. P.J. Van Beneden's son drew and published a figure of it in the work "Les poissons des côtes de Belgique" (Pl. I, fig. 6). In the legend to the plate it is written that this species might be parasitic to Mugil capito Cuv., while in the text, the M. chelo Cuv. is indicated as host

Fam. II. - CALIGIDAE

Gen. CALIGODES Heller

CALIGODES LACINIATUS (Kröyer), ♀ .

(Chondracanthus laciniatus KOLLAR, Museum name)

Sciaenophilus laciniatus Kröyer, 1863 (2) p. 153,
Pl. VIII, fig. 3.

Caligodes laciniatus (Kr.) Heller, 1865 (I) p. 180.

Caligodes laciniatus Brian, 1902 (5) p. 35.

- - Bassett-Smith, 1899 (5) p. 446.

- - Poche Fr., 1902, p. 13.

DISTRIBUTIO ET HABITAT. - For this species, Kröyer indicates the locality of the in the East India, while Heller notes it in the Indian Ocean as parasitic of one species of Belone.

I did examine a few and rare specimens collected in Genoa, in May 1899, by Mr. Borgioli, from the mouth corner of Tylosurus (Belone) imperialis Raf. (= Belone Contrainii C.V.)

Gen. CALIGUS Müller

DIVISION I. Post-abdomen with one articulation only.

CALIGUS CURTUS Müll., and (?)

Caligus curtus MÜLLER, 1785 (2), p. 130, pl. XXI, fig. I.

- - KRÖYER, 1837 (1) vol. I. p. 623, pl. VI, fig. 5.

- - DESMAREST, 1825, p. 340.

- - EDWARDS M., 1840, (2) p. 451.

Caligus Mulleri LEACH, 1816 (1) p. 405, pl. XX.

- - DESMAREST, 1825, p. 342, pl. I, fig. 4.

Caligus Mulleri EDWARDS M., 1840 (2) p. 450.

- - BAIRD, 1850, p. 271, pl. XXXII, fig. 4.
- bicuspidatus NORDMANN, 1832 (I) p. 28.
- elegans ? v. BENEDEN, 1851 (3) p. 91.
- diaphanus BAIRD, 1840, (3) p. 269, pl. XXXIII, f. I.
- americanus PICKERING and DANA, 1838, vol. XXXIV, pls. 3, 4, 5 etc.
- lacustris ? STEENSTRUP and LÜTKEN, 1861 (I), p. 13, pl. I, fig. 2.
- curtus BASSETT-SMITH, 1899 (5) p. 447.
- - WILSON, 1905, p. 578 pl. X.

Caligus rapax BRIAN, 1899 (3) p. 198.

DISTRIBUTIO ET HABITAT. - This species, under the name of Caligus Mulleri, was described by Baird, who, for this copepod, indicated various hosts, and as locality, the British sea (Belfast Bay, Lough Neagh): the hosts he quotes are:

Merlangus pollachius Cuv., Rhombus vulgaris Cuv.

Merlangus vulgaris Cuv., Coregonus pollan Thomps.,

Gadus aeglefinus Linn., Mugil chelo Cuv.

Bassett-Smith holds as identical to this species Baird's C. diaphanus, this author having described the male

only and entered it, for the British sea, as parasitic on the following fishes: Trigla pini Bloch, Lota molva Cuv., Merlangus carbonarius Flem., Pagellus centrodontus Cuv. and Val., Gadus morrhua Linn., Hippoglossus vulgaris Flem.

Milne Edwards does not give any indication as to the habitat of this species, whether he describes it as C. curtus or as C. Mulleri; only, discussing the C. americanus, which we know being synonymous with, he states it "found on the cod, by the Long Island approaches, North America". Unable to have the original works within reach, I could not learn whether Müller, Kröyer, Desmarest, Leach, who also described this species as C. curtus now, and as C. Mulleri then, may have indicated the habitat of such Caligus. Bassett-Smith, who has reviewed all the fishes parasitic copepoda known to this day, indicates as hosts to the C. curtus, the following ones only: "Gadidae, Trigla spp., Rhombus maximus Cuv., Mugil etc."

Gerstaecker, in his classic treatise, has assigned, to the forms of Caligus which Bassett-Smith has held as synonymous, diverse hosts:

for the C. lacustris: Esox lucius Linn., Perca fluviatilis Linn., Leuciscus rutilus Linn.;

for the C. Mulleri: Merlangus pollachius Cuv. and M. vulgaris Cuv.; Gadus aeglefinus Linn. and G. morrhua Linn., Mugil chelo Cuv., Pleuronectes rhombus Linn. and P. platessa Linn., Coregonus pollan Thomps.;

for the C. curtus: Merlangus vulgaris Cuv. and Gadus aeglefinus Linn.;

for the C. elegans: Gadus morrhua Linn.;

for the C. americanus: Gadus morrhua Linn.

As to the Caligus bicuspidatus, the data are missing as to locality and host. Since 1832 Nordmann would note, for the C. Mulleri, various species of Gadus as follows: Gadus callarias (young of G. morrhua Linn.) and Gadus aeglefinus Linn.

I did verify the presence of this species in the Mediterranean. Six female specimens were sent to me by Dr. Damiani from Portoferraio, there collected on the mouth mucous membrane of Mugil cephalus Cuv., June 16, 1899. In my precedent publications I had wrongly referred to this species a few specimens of Caligus taken off the Lichia amia Linn., specimens that herein, further on, I have considered as new species and described with the name of C. Lichiae.

Two other male specimens of *Caligus* were found in Genoa on the Mugil cephalus Cuv., Nov. 8, 1889, but I have a few doubts with regard to their determination.

The length for the females, by myself observed is 5 1/2 mm. Of the two males collected in Genoa, the biggest measures 4 1/2 mm. in length.

CALIGUS MINIMUS Otto, .

Caligus minimus Otto, 1828: Acta Acad. Caes. Leop., vol. XIV, p. 354, pl. XXII, fig. 7.

- - Risso, 1826 (2) p. 135.
- - Nordmann, 1832 (1)p. 25.
- - Bassett-Smith, 1899 (5) p. 447.
- - Scott A. 1901 (1) p. 349.

Caligus minutus Edwards M., 1840 (2) p. 450.

- - Edwards M., 1849: Atlas du Règne animal de Cuvier). Tab. 77, fig. 2.
- - Heller, 1865 (1) p. 163, tab. XIV, fig. I.
- - Heller, 1866 (2) p. 29.
- - Richiardi, 1880 (9) p. 148.
- - Valle, 1880 (3) p. 58.

Caligus minimus Carus V., 1885 (2) p. 358.

- - Brian, 1898 (1) p. 208.

- - Brian 1899 (3) p. 198.

DISTRIBUTIO ET HABITAT. - This species has the Labrax lupus Cuv. as host on which it is found fixed mostly on the gills or on the mucous membrane of the mouth cavity. It is quoted by Heller, by Richiardi and by Valle for the Mediterranean and for the Adriatic. Risso also indicated it for the locality of Nice. Dr. Damiani collected in Portoferraio. In Genoa, I verified it fixed in the branchial cavity of the above referred to fish. To this species of copepod, another host, the Clupea finta Cuv., must be assigned on which one specimen only was found, at first, by myself, considered (37) as Caligus Gurnardi Kröy., (1898 (1) p. 209), but that, with certainty, I have recognized as belonging to the species c. minimus Otto.

CALIGUS TRACHYPTERI Kröyer, Q.

Caligus Trachypteri Kröyer, 1863 (2) p. 57, pl. III, fig. I

- - Bassett-Smith, 1899 (5) p. 449.

- - Carus, 1885, (2) p. 358.

- - Brian, 1905 (10) p. 3 - 6, pl. 3

DISTRIBUTIO ET HABITAT. - Host to this species is a Trachypterus sp. fished near the shores of Sicily (Mus. Caes. Vindob., Kröyer).

I have found some specimens referring to this species in the material of copepoda collected in Naples by O.G. Costa in the first half of the XIX century, and which is conserved at the Zoological Institute of the neapolitan Royal University. These specimens did not have any indication as to host, only they were appearing erroneously determined by Costa as Notodelphys.

CALIGUS ALALONGAE Kröyer, ♂.

Caligus Alalongae Kröyer, 1863 (2) p. 35, pl. IV, fig. 6.

- - Gerstaecker, (?).

- - Carus, 1885 (2) p. 358.

- - Bassett-Smith, 1899 (5) p. 449.

HABITAT. - Kröyer described only the male of this small caligida, which he noted for the Atlantic, and which was then quoted for the Mediterranean by Gerstaecker and by Carus, on the gills of Thynnus alalonga Cuv. and Val.

? CALIGUS LESSONIANUS Risso (C. Lessonius). and .

Caligus Lessonianus Risso, 1826 (2) p. 134.

- - Carus, 1885 (2) p. 359.

HABITAT. - It is a species found by Risso in Nice on the shark Notidamus griseus Cuv.

CALIGUS RISSOANUS M. Edwards, .

Caligus Rissoanus M. Edwards, 1840 (2) p. 452.

- - Carus, 1885 (2) p. 357.

HABITAT. - This copepod was found in Nice on an undetermined fish (Mus. Paris., H. Milne Edwards).

CALIGUS LICHIAE n. sp. Pl. XIV, fig. I - I4. Pl. XVI, f. 8 - II.

Caligus curtus Brian, 1898 (I) p. 208.

- - Brian, 1899 (2) p. 4.

Description of the female (Pl. XIV):

Length 5 1/2 - 6 mm. The cephalic shield is nearly round-shaped, dorsally convex: its sides, though, narrowens down more on the front than on the rear. The abdomen, of an almost rectangular form, with the highest length longitudinally-wise, is, however,

narrowed down more toward the limit of insertion with the free thoracic ring, and gradually widens out toward the posterior side which, seen from the back, appears incavated, while, from the ventral side, it shows two lobes at the incavo site. It is much more narrowed down than the cephalic shield is. Its length, the free thoracic ring also included, is almost equal to that of the cephalic shield only. The post-abdomen (fig. I4), terminated by two small caudal laminae with four feathered setae on each, is narrower and much more shorter than by about the half.

In the general form, exception made for the dimensions, this species resembles Steenstrup's and Lutken's C. isonix, only that, one difference is easily noticed in the width of the body at the point where the abdomen narrowens down to self insert in the free thoracic ring, width far more considerable in our form. If we come down to the details, its conspicuous differences are then noticed by the presence, in our species, of a larger number of setae in the second pair of feet, of spinules and of denticles in the antennae of the second pair and in the feet, which instead are missing in the C. isonix (if the figure given by the above authors is exact); and specially by the presence

of a queer feature, hitherto observed in the Caligus of the Lichia only, consisting in a particular apparatus situated on the lamina of the third pair of feet, as further under it will be described. And though at first it may seem that others species, in example the C. curtus, the C. rapax and the C. minutus resemble our form in the general appearance and slight of them be the differences, yet there are so peculiar features in the C. Lichiae as not to be held otherwise than as new species.

The antennae of the first pair (fig. 6) are bi-articulate. The second articulation (terminal) is thin, lengthened out to almost more than the double the first one. This last one is covered by numerous setae on the upper margin, the second one carries a tuft of them in its free extremity. The lunules (fig. 6) are quite conspicuous, set at the sides of the wide frontal margin, of a sub-roundish form.

The antennae of the second pair (fig. 7) horizontally arranged on the ventral side of the cephalic shield, are powerful tri-articulate hookform organs, the last articulation shaped as a hook, longer than the other ones. The mouth

rostrum (fig. 4) is squat, a little longer than it is wide, and at the sides it shows traces of jaws the extremities of which display an incipience of bifurcation; that is, the internal rami is hardly outlined. The hamuli (fig. 3) show a wide base and, as usual, have the point turned rearward and obtuse.

The furcula sternalis (fig. 5) has slightly diverging plain rami, its extremities tending to curve in somewhat toward the interior.

The first pair of feet (fig. 9) is unirami; each foot consists of three articulations, the first one short and squat, the second longer, the third one lesser in size. While the first one carries one seta and one appendage (verisimilarly the rudiment of the internal natatory rami), the third one, at its extremity, carries instead three shorter stings and one long seta on the corner. The second and the third one of these spinae, those set in between the corner seta and the external spina, have bi-dentate their extremity. By the lower side of the third articulation three long feathered setae are seen fairly developed.

The second pair of feet (fig. IO) is instead birami and each rami consists of three articulations. The big basal segment supporting these two rami is composed of two articulations, the first one, very short, carries one feathered seta. The second one, bigger and longer has the lower margin finely ciliated. The external rami, tri-articulated, shows for each articulation, one sturdy spinule recurved at the exterior; the third terminal articulation, in addition, beside one rigid seta, carries six feathered setae, while the first and second articulation only have one by the internal side, and all of these setae increase in length from the exterior to the interior. The internal rami articulations are also purveyed with setae distributed in this order: six for the third articulation, two for the second articulation and one for the first articulation and also increasing in length from the exterior to the interior.

The third pair of natatory feet (fig. II) is constituted by a wide basal lamina to which each foot is fixed by each side, formed by two bi-articulate laminae purveyed with setae and spinae. At the base of the external rami there is, in addition, one powerful recurvate hooked spina

while the basal articulation has only one feathered seta by one side and one spina by the other one; the second articulation carries three rigid setae or spinae by the external side and, internally, four feathered setae. The internal rami (fig. I2), also bi-articulate, displays a series of feathered setae increasing in length from the exterior to the interior and in number of six on the terminal articulation, and of one on the short and indistinct basal articulation.

The presence is characteristic, on the large basal lamina of the third pair of natatory feet, of two very outpushing padlets, of ovoidal or spherical form, trimmed with numerous small warts, and with two chitinal, curved sticklets by their internal side, very sturdy and leaning out in the manner of two springs. (I) I presume that the two roundish protuberances be adhesion organs and that instead the two chitinal sticklets be instrumental in keeping the posterior part of the cephalothorax lifted away from the surface of the organ fixed on which these parasites live, and this to allow water to circulate and aerify the natatory appendages of the caligida.

The fourth pair of feet (fig. I3), unirami, |

(I) See the identical organization in the male: Pl. XVI, f. II

is constituted by four articulations; the first one, basal, is most long, the three other ones, which represent the second segment, hardly attain, taken together, the length of the first one, and all of the three said articulations are armed with spinules, the first and second ones with one only, the last one with three spinules decreasing in length from the interior to the exterior.

DESCRIPTION OF THE MALE (Pl. XVI):

Length $4 \frac{1}{2}$ - 5 mm. As in the female, the cephalic shield is almost round (fig. 8) its longitudinal diameter being nearly equal to the transverse one: its sides, though, narrowens down rather toward the front, yet let one quite spacious frontal lamina remain, slightly sinuose in the middle and recurvate at the sides.

The free thoracic ring is much more narrowed down than the cephalic shield is and continues rearward with the abdomen prolongating into the subsequent post-abdomen which also keeps being very narrowed down, only that, the abdomen appears wider, by little, toward its terminal part.

These three segments taken together show a length nearly equal to that of the above mentioned cephalic shield.

The antennae of the first pair are bi-articulate. The second articulation thin, much more lengthened out and narrower than the first one.

The antennae of the second pair (fig. 9) have nearly horizontal an arrangement, their second articulation is big, striate on its surface and the third articulation hookform, recurvate and with one spinule on the internal outline.

The hamuli are turned rearward and carry at the base a small spina turned toward the interior.

The rostrum is, by little, longer than it is wide and squat. At the sides it carries two palps with striate the extremity and with one small denticle on the internal outline so as to make the extremity appear split in two rami of which one, the internal one, is in the rudimentary state.

The first pair of jawy feet appears with the second articulation, the terminal one, lengthened out in form, thinner than the first one, and with one spinule on the internal

margin, toward the third part, near the free extremity; this last one deeply split in two whetted and pointed rami, of which one somewhat longer.

The second pair of jawy feet (fig. 10) has a wide and big basal piece which on the lower margin, in the vicinity of its point of origin, shows one conspicuous denticle. The hookform articulation is bi-articulate and the basal articulation on the internal side, near the point of its articulating with the terminal part, shows one big sting-like seta.

The furcula sternalis is wide with two plain rami, short and diverging.

In the first pair of feet each foot is tri-articulate, the basal articulation short and wider, with one seta and one appendage on the lower outline (this last one is the rudiment of the internal natatory rami), the second one, almost by the double lengthened out.

The short last terminal articulation carries three spinules on the extremity and four setae on the lower margin.

Of the three spinules, the external one is very slightly longer than the other two; these last ones, both with bi-dentate the extremity. Of the four setae on the lower margin, the first corner one is a plain and rigid seta, thinner and with higher length than the spinae; the other three setae are feathered and very developed.

The second pair, the third and fourth ones as in the female. The abdomen much narrower than in the other sex with some setae at the sides in the vicinity of the genital apertures. The two caudal appendages, inserted on the post-abdomen (apparently uni-articulate), are small and with four feathered setae. Here too, in the third pair of feet, the same lamina, sturdier and more spacious than usual, shows by the two sides two padlets of oval or spherical form, trimmed with warts-like points, and two recurved, cylindric chitonical parts by their sides, pushing out like two springs, organs that I never have observed in any other species of Caligus (fig. II).

The most conspicuous difference between the male form and the female one is given by the structure of the genital

ring which, as it will appear from the figures, is much narrower in the male and posteriorly split in two lobes (if looked at from the ventral side). The caudal appendages, with four feathered setae, resemble those of the female.

HABITAT. - On the gills of the Lichia amia Linn., (4I) Genoa, April 22, 1891; in the frontal sinuses of the same species of fish, Portoferraio, June 19, 1898. These last ones specimens were collected by Dr. Damiani.

Accepting the determination by the lamented I.C. Thompson, I had, in my first work (1898 (I) p. 208) considered this species akin to the C. curtus under which name I then had occasion to quote it in that catalogue and later on, also in another note of mine (1899 (2) p. 4).

CALIGUS LIGUSTICUS n. sp., ♂. Pl. XV, figg. I -8.

Caligus fissus Richiardi ?, 1880 (9) p. 148.

- - Carus, 1885 (2) p. 359.

- - ? Brian, 1898 (I) p. 209.

Description of the male:

Length 3 mm. Large frontal lamina with small, laterally situated suction organs, with two short antennae, without median incision. Large, almost round cephalothorax (fig. 1), longer than half the length of the body, with two most tiny eyes dorsally set on the median line and joined one to the other. The last thoracic segment is small and nearly spherical, joined to the abdomen, much bigger but of the same form. The post abdomen, much narrower, shows two appendages each trimmed with three long feathered setae and with a fourth shorter one (fig. 3).

Peculiar features of this form appear in the roundish form of the cephalic shield, in the spacious and almost curveless frontal margin, in the most tiny and indistinct lunules which cannot be seen without eye-glass, and in the particular construction of the first pair of natatory feet and of the fourth pair, which are hereunder described.

The anterior antennae (fig. 4) have squat the basal articulation, roundish and by little longer than the free terminal articulation; the one and the other purveyed with setae. The lower antennae are bi-articulate and powerful:

the first segment is, near its base, purveyed with one spina having the point turned toward the rear.

The first pair of jawy feet seems to be tri-articulate. It is formed by a short basal segment parted by slight strangulation only from the succeeding more lengthened out articulation, which in its turn carries the third articulation, most fine, bent over the basal portion and bifid at the extremity. In the second pair of jawy feet, it is fixed to a big and long basal segment a powerful hook bent over itself.

The furcula sternalis (fig. 5) shows two plain rami, obtuse at their somewhat diverging extremities.

The first pair of natatory feet (fig. 6) appears, as usual, with only one rami, constituted by three articulations; the first one thick and uppermostly terminated by one seta; the second one, finer and longer, it too terminated by one small seta. The last one, at its end, carries one big, rigid seta and two most tiny ones at the base, while the lower outline shows three most long feathered setae. In the second natatory foot (fig. 7) the internal rami is indistinctly tri-articulate and appears constituted by a short basal

articulation and by a large, rectangular lamina, lengthened out and shaped so as to appear bi-articulate, (42) and this lamina carries eight feathered setae on its outline, increasing in length from the exterior to the interior. The basal articulation also carries one feathered seta toward the interior. The external margin of this rami is ciliated. The external rami is instead distinctly tri-articulate and the first articulation carries one seta by one side and one most long spina by the other. Likewise the second one, rather short, carries one seta and a short hooked spina, the last one instead carries two small hooked spinae, one rigid seta and six feathered setae which, them too, increase on from the exterior toward the interior.

Nothing of extraordinary is to be observed in the form of the third pair of natatory feet, shaped after the type usual in the *Caligus* (fig. 8).

The fourth pair of feet is constituted by a quite long basal articulation, and by one flat, foliaceous lamina with that articulated, which is formed by three articulations; the first and the second ones carry one rigid seta by the exterior

and the third one three rigid setae, all of them very long and nearly even as to dimensions.

The three specimens by myself examined seem to be males and all have a length of 3 mm.

HABITAT. - On the gills of Box salpa Linn. : one specimen from Genoa and another one from Portoferraio. On a Sargus Rondeletii Cuv. and Val. also another specimen of Caligus was collected which I consider referable to this species, and was sent to me by Dr. Damiani from the island of Elba.

CALIGUS PRODUCTUS Dana, ♀ .

Caligus productus Dana, 1854 (2) pl. XC, fig. 4.

- - ? Krøyer, 1863 (2) p. 64, pl. III, f. 4.
- - Steenstrup and Lütken, 1861 (1) p. 357, pl. III, fig. 6. Not Müller.
- - Brian, 1898 (1) p. 208.
- - Bassett-Smith, 1899 (5) p. 452.
- - Wilson, 1905 p. 597 pl. XVI.

The only specimen received for examination is a female 4 - 4 1/2 mm. long in a very poor state. Observed

with the microscope after having treated it with potash, I could recognize in the form of the appendages and in its general construction the main features proper to the species so as to correspond to the figure that Steenstrup and Lütken gave of it: only that the splitting in two articulations of the post-abdomen did not appear well distinct to me, although it appears much lengthened out. I have noted the salient feature given by the lack of feathered setae in the first pair of natatori feet and the one displayed by the fourth pair of feet, purveyed with five spinae considerably increasing in length, slightly curved, the last one among the others slightly longer. The lunulae are big and conspicuous; the furcula sternalis possesses two plain rami, quite lengthened out, at first slightly diverging and then converging a little at the extremities.

HABITAT. - The species, which seems to me rare in the Mediterranean, having received of it but one specimen, was collected in Genoa on the Chrysophrys aurata Linn. It has been indicated for the West Indies on the fishes Coryphaena sp. and Baliste sp.

Division II. Post-abdomen with two articulations.

CALIGUS PELAMYDIS Kröyer, ♀.

Caligus Pelamydis Kroyer, 1863 (2) p. 50, pl. IV, f. 4.

- - Richiardi, 1880 (9) p. 148.
- - Valle, 1882 (4) p. 1.
- - Carus, 1885 (2) p. 357.
- - Brian, 1899 (3) p. 198.
- - Bassett-Smith, 1899 (5) p. 452.
- - Wilson, 1905, p. 594, PL. XIII, XIV.

DISTRIBUTIO ET HABITAT. - This species is indicated by Kröyer as parasitic of the Pelamys sarda, but in which locality does not seem to me as appearing from his work.

Carus, however, assigns to this species a wide area of distribution including also the Atlantic, while Gerstaecker quotes it for the Mediterranean only. It has been verified on the shores of Italy by both Richiardi and Valle, for the Adriatic and for the Mediterranean. The first one recalls it as living on the mucous membrane of the branchial cavity of the Pelamys sarda Bl. and of the Scomber scomber Linn.

The second one, on March 28, 1881, found many specimens of this species on the mucous membrane of the mouth and branchial cavity of a Pelanys sarda Bl.; likewise, specimens of it were collected on this fish adhering to the mucous membrane of the branchial cavity, by Dr. Damiani in Portoferraio, March 12, 1899.

CALIGUS DIAPHANUS Nordmann, ♀ .


Caligus diaphanus Nordmann, 1832 (I) p. 26.

- - Krøyer, 1863 (2) p. 79, pl. VII, f. 5.
- - Heller, 1866, (2) p. 30.
- - Olsson, 1868, (I) p. 10.
- - Richiardi, 1880 (9), p. 148.
- - Valle, 1880 (3) p. 58.
- - Carus, 1885, (2) p. 357.
- - Brian, 1899 (3) p. 198.
- - Bassett-Smith, 1896. Jour. M.B. Assn. Plymouth.
- - I.C. Thompson and A. Scott, 1903, (12) p. 293.
- - Bassett-Smith, 1899, (5) 452.

DISTRIBUTIO ET HABITAT. - This species has nothing to do with the homonymous one described by Baird and by M. Edwards. Its presence was verified by numerous naturalists (Nordmann, Kröyer, Olsson) in the North Atlantic on the gills of various species of Trigla. First one, Heller quoted it for our seas and for the Adriatic on the gills of Trigla lineata Linn. and T. corax Bp. Richiardi found it in the Mediterranean on a large number of hosts: on the mucous membrane of the branchial cavity of Pagellus mormyrus Cuv., P. erythrinus Cuv., Trigla cuculus and Trigla corax Bp. T. milvus Lac., T. lineata Linn. and Platessa passer Bp. In the Adriatic Valle verified it as common on the skin and on the gills of not only the Trigla lineata Linn. and T. corax Bp. but on the T. aspera Viv. and T. lyra Linn. I received specimens from Portoferraio, there collected by Dr. Damiani on the mucous membrane of the branchial cavity of Trigla corax Bp., May 12 1899, on the gills of Pagellus mormyrus Cuv., in October 1901 and on the gills of Pagellus acarne Cuv., August 5 1901, and on the branchial arcs of Trigla lineata Linn., Febr. 9 1903. (44)

In Naples I collected this species on the gills of

Pagellus mormyrus Cuv., Aug. 28, 1903 and on the branchial opercles of Trigla corax Bp., Aug. 1903. I.C. Thompson and A. Scott quote the Caligus diaphanus also for the far away locality of Aripu (Ceylon), having been collected in the mouth and on the dorsal fin of a Therapon puta.

CALIGUS VEXATOR Heller, .

Caligus vexator Heller, 1865 (1) p. 165, pl. XIV, f. 2.

- - Heller, 1866 (2) p. 31.
- - Richiardi, 1880 (9) p. 148.
- - Valle, 1880 (3) p. 58.
- - Carus, 1885 (2) p. 359.
- - Brian, 1898 (1) p. 209.
- - Brian 1899 (3) p. 198.
- - Bassett-Smith, 1899 (5) p. 451.

DISTRIBUTIO ET HABITAT. - Heller described first this species taken on the gills of Dentex vulgaris Cuv. and Val., in the Mediterranean and in the Adriatic.

Valle found it frequent in the Adriatic on the gills of this fish. Richiardi quotes it for the Mediterranean,

collected on the mucous membrane of Dentex vulgaris Cuv. and Val., of D. gibbosus Rafn. and of Pagrus vulgaris Cuv. and Val.

I verified its presence in Genoa, coming from the gills of Dentex vulgaris Cuv. and Val. (Febr. 12, 1890) and many times received specimens from Dr. Damiani in Portoferraio, taken once from the branchial arcs of Pagrus vulgaris Linn., May 2 1899, and other times from the gills of Dentex vulgaris Cuv. and Val. (October 1901 and April 24 1903).

To my knowledge, it is a species exclusive to our seas.

CALIGUS CORYPHAENAE Steenstrup and Lütken, ♀ and ♂.

Caligus coryphaenae Steenstrup and Lütken, 1861 (1) p. 360, pl. IV, fig. 7.

Caligus bengoensis Scott, 1895 (1) p. 130, pl. XIV, fig. 19.

Caligus Thynni ? Dana, 1854 (2).

Caligus scutatus ? Edwards M., 1840 (2) p. 453.

Caligus coryphaenae Richiardi, 1880 (9), p. 448.

- - - Valle, 1880 (3) p. 58.

Caligus coryphaenae Carus, 1885 (2) p. 358.

- - Brian, 1899 (2) p. 4.

- - Bassett-Smith, 1899 (5) p. 451.

DISTRIBUTIO ET HABITAT. - This species, investigated by Dana and described under the name of Caligus Thynni (?) was collected, according to this author, in the Atlantic (27° lat. North). Steenstrup and Lütken who described the Caligus Coryphaenae with much exactitude also note it in the Atlantic (30° lat. North) indicating a species of Coryphaenae as host. Under the name of Caligus bengoensis, Scott quotes it for the fauna of the Guinea, and under the one of C. scutatus (?), Milne Edwards recorded its habitat in the East Indies. It is moreover recorded by Richiardi for the shores of Italy, as parasitic on the mucous membrane (45) of the branchial cavity of the Coryphaena hippurus Linn., and by Valle for the Adriatic as somewhat rare on the gills of the Coryphaena pelagica Lac.

I received specimens of it from Portoferraio, sent to me by Dr. Damiani who found them adhering to the gills of a Coryphaena hippurus Linn. on Oct. 23, 1898; and on

Sept. 19, 1902, other specimens from the same locality also collected on the host just referred to.

CALIGUS PHARAONIS Nordmann.

Caligus pharaonis Nordmann, 1832 (1) p. 28

- - Edwards M., 1840 (2) p. 453.
- - Gerstaecker (?)
- - Carus, 1885 (2) p. 557.

HABITAT. - Was first found in the Red Sea on the opercle of a Chaetodon and was afterward indicated for the Mediterranean by Gerstaecker and by Carus.

CALIGUS AFFINIS Heller.

Caligus affinis Heller, 1866 (2) p. 30.

- - Richiardi, 1880 (9) p. 148.
- - Valle, 1880 (3) p. 57.
- - Carus, 1885 (2) p. 357.

HABITAT. - Heller verified the presence of this species in the Adriatic on the gills of Umbrina cirrhosa Linn. Richiardi recalls it also for the Mediterranean by

himself found on the mucous membrane of the branchial cavity of the above mentioned fish. On this host it is also quoted by Valle for the Adriatic stating it as rare. No author has given any figure of this form.

UNDESCRIBED SPECIES

CALIGUS TRACHINI Richiardi,

Caligus Trachini Richiardi, 1880 (9) p. 148.

- - Carus, 1885 (2) p. 359.

HABITAT. - On the mucous membrane of the branchial cavity of Trachinus draco Linn., Mediterranean

CALIGUS TRACHURI Richiardi.

Caligus Trachuri Richiardi, 1880 (9) p. 148.

- - Carus, 1885 (2) p. 359.

HABITAT. - On the mucous membrane of the branchial cavity of Trachurus trachurus, Castelnuovo, Mediterranean.

CALIGUS SERRANI Richiardi.

Caligus Serrani Richiardi, 1880 (9) p. 148.

- - Carus, 1885 (2) p. 359.

HABITAT. - On the skin surface of Serranus gigas
Brünn. Mediterranean.

CALIGUS LEPIDOPI Richiardi.

(46)

Caligus Lepidopi Richiardi, 1880 (9) p. 148.

- - Carus, 1885 (2) p. 359.

HABITAT. - On the skin surface of Lepidopus caudatus
Euphr. Mediterranean.

CALIGUS PETERSII Richiardi.

Caligus Petersii Richiardi, 1880 (9) p. 148.

- - Carus, 1885 (2) p. 359.

HABITAT. - On the mucous membrane of the branchial
arcades of Carcharias lamia Risso. Mediterranean.

Gen. LEPEOPHTHEIRUS Nordmann.

Division I. Post-abdomen with one articulation

LEPEOPHTHEIRUS THOMPSONI Baird, ♀ and ♂.

- Caligus piscinus Guérin, 1840, pl. 35, fig. 2
 - - Edwards M., 1840, (2) p. 456.
- ? Caligus gracilis v. Beneden, 1851 (3) p. 90
 pl. 2, figg. I - 7.
 - - Richiardi, 1880 (9) p. 148.
- Lepeophtheirus gracilis Carus, 1885, (2) p. 359.
 - - - Brian, 1898 (I) p. 210.
- ? Caligus branchialis Malm (mscr).
 - - Steenstrup and Lütken, 1861,
 (I) p. 362 pl. II, fig. 3.
 - - Olsson, 1863 (I) p. 12.
- ? Lepeophtheirus Rhombi Krøyer, 1863 (2) p. 118,
 pl. V, fig. 5.
 - - ♂ Brian, 1899 (3) p. 199.
- Lepeophtheirus Thompsoni Baird, 1850 (3) p. 278,
 pl. XXX, fig. 2.
 - - Bassett-Smith, 1899 (5) p. 455.
 - - Thompson I. C. and Scott A.,
 1903 (2) p. 294.
 - - Wilson, 1905, p. 619 Pl. XVIII.

DISTRIBUTIO ET HABITAT. - Guérin described first this copepod with the name of Caligus piscinus and indicated it

in the Atlantic Ocean on the "Merlan commun" (Merlangus vulgaris or Gadus merlangus). Van Beneden was quoting his Caligus gracilis, synonymous of the above named, for the belgian shoreline on the body and in the branchial cavity of the Pleuronectes rhombus Linn. and of the Rhombus maximus Linn., and asserting having found this parasite in abundance on the first of these two hosts. Baird investigated specimens harbouring on the Rhombus maximus Linn. and collected by Thompson in March 1837.

Richiardi identified, as Van Beneden did, the specimens of this species with the name of C. gracilis v. Bened. and quoted them for the Mediterranean, fixed on the mucous membrane of the branchial cavity of the Rhombus laevis Rond. and of the R. maximus Cuv.

I have examined in Genoa several specimens coming from the gills of a Rhombus maximus Cuv. Received from Dr. Damiani one specimen collected on such a host in Portoferraio, March 6, 1899.

END OF TEXT, 1st part of two.

APPENDIX TO TRANSLATION N° 9663-2.

(Acknowledgements - Notes - Corrections. - For reference purposes, text lines only, on each separate page, are ideally numbered by 5s, top line being N° I. Unbracketed numbers refer to page and line of target text, bracketed ones to original).

ACKNOWLEDGEMENTS

As per preceding work, translation N° 3234, and:

The gracious courtesy of McGill University -
Marine Sciences in granting access to their library;

the same as above of the Italian Cultural Service.

the usefulness of Roget's Pocket Thesaurus,
Cardinal's edition by Pocket Book of Canada, Montreal.

the information from: Dictionary of the Italian
language, by Nicola Zingarelli; Zanichelli, Bologna, Ed.,
consulted at the above mentioned Service.

NOTES

- I - Poem on page N) 7 of original not translated because of its apparent irrilevancy.

- 2 - "SIATEMATICA" (Foreword) as been translated as "SYSTEMATIQUE", thus parallelling the accepted from French "TECHNIQUE", rather than as "SYSTEMATICS" because of this being, visually at least, pural in form as against the Italian's one and only singular as a noun. This is, of course submitted to the Revisor for consideration and decision.

- 3 - GREEK LITERATION - Space for subsequent insertion of Greek literation by the Division's courtesy has been left blank at the following points:

5-16 (8-13); 12-19 (10-30); 35-18 (18-26); 36-1 (18-28);

36-5 (18-31).

- 4 - UNTRANSLATED SCIENTIFIC NAMES:

EPOCUMENI, 14-2 (11-13);

CLOPORTIDI, 35-bottom line (18-27);

FILICTIDI, Title N° 3, 44 (21); 45-6 (21-35); 45-15 (21-35);

46-20 (22-19); 47-8 (22-25); 48-7 (22-37); 48-12 (22-41)

49-II (23-12); 51-15 (24-10).

NOTES (ctnd.)

MASCELLARI (Adj.), 63-13 (29-19); 73-10 (33-8);
73-13 (33-10); 85-19 (38-15). This was, subsequently
translated as JAWY.

REPRODUCTIONS, sketch-like marks appearing on pages
20, 21 original not reproduced.

MINOR LIBERTIES: Genius, variousome, varisome, favoursome,
padlets.

CORRECTIONS

MISPELLING: most probably required for "lernaea" and derivatives.


OMISSIONS: "color" between "the" and "drawings", 2-13 (6-5);
"out" between "and" and "of", 16-bottom line;
"fixed" between "is" and "in" 88-bottom line (39-14)

REDUDANCIES: 45-13 "only"; 7-13 "the" before "zoology";
15-4, one "that" too many; 22-bottom line, one "the" too many.

CHANGES: "Crustaceans" instead of "crustaceae";
"part" instead of "piece"; "fine" and "finer" instead of
"thin" and "thinner".

SYNTAX: 85-16 (38-16) Respect for the Author stated, and fidelity to text observed, the Reader's attention is kindly requested to note the absence in this para of one conjunction connecting two alternatives, that is, the one which should follow SIA and WHETHER respectively.

Montreal, July 1966.


Aldo de Nicolini, translator.