Wägele, 1991

THESES ZOOLOGICAE

VOLUME 14

EDITOR: RONALD FRICKE

Synopses of the Antarctic Benthos
Volume 2
Editors: J. W. Wägele & J. Sieg

Antarctic Isopoda Valvifera

by

J. W. Wägele

KOENIGSTEIN
KOELTZ SCIENTIFIC BOOKS
1991

Author's Address

Johann-Wolfgang Wägele
Fachbereich Biologie
Universität Oldenburg
Postfach 2503
D-2900 Oldenburg/Germany

ISBN 3-87429-324-6
Koeltz Scientific Books (USA), RR7, Box 39
Champaign, Illinois 61821, USA
ISBN 1-878762-18-4
ISSN 0934-8956

CONTENTS

FOREWORD

The Synopses of the Antarctic Benthos are designed to meet the needs of zoologists and naturalists interested in the Antarctic ecosystem. All volumes are written by specialists in their own fields. It was intended to publish all the information needed for the identification of species leaving out data which are of interest only for specialized taxonomists. If you find specimens you cannot identify with the help of these volumes, your material may belong to new species, which should be described carefully and as completely as possible. Please send this material to a specialist.
The series will not be complete because of two reasons: The Southern Ocean has until today many unexplored areas, in future many new species will be described which were not known to our authors; for some taxonomic groups no specialists could be found. Nevertheless we hope that the volumes will help all those working with Antarctic benthos and that the efforts of the taxonomists who have given their knowledge, time and services to write a monograph will be used for the description and protection of one of the most untouched ecosystems of our planet.

J.W. Wägele, J. Sieg
(Editors)

1. INTRODUCTION

The Amphipoda and the Isopoda are the most frequent crustaceans found in benthic environments of Antarctica. These groups are also an important element of the sea floor fauna in temperate and tropical seas, but there the largest crustaceans are always the Decapoda. It seems that in Antarctica most of the decapod crustaceans disappeared in the course of the climatic changes that led to the glaciation of the southern continent. The life cycle, especially the larval development of most Decapoda could probably not be adapted to the short phytoplankton blooms and the low temperatures that slow down the metabolism. Antarctic invertebrate faunas have a high percentage of species with lecitotrophic larvae or direct development and brooding (Arnaud 1977, Dell 1972, Magniez 1983, Pearse et al. 1985, Picken 1979, 1980). This might be the reason for the success of the higher evolved Peracarida, who are entirely brooders.

The isopods considered in this monograph are those known from the area between the Antarctic convergence, the Subantarctic archipelagos and the littoral of the Antarctic continent, including the deep sea of the Southern Ocean. Several of the species mentioned in this series are still poorly known; it is no secret that some taxonomic publications of the past do not allow a clear determination of species, that several published drawings are not very useful. To prepare this monograph a series of taxonomic studies were carried out and published elsewhere, based on material from expeditions of RV "Polarstern" to the Atlantic sector of the Southern Ocean and on collections kept in different museums. Nevertheless, much work still remains to be done and still many species are waiting for their discovery and scientific study.

2. EARLY STUDIES ON ANTARCTIC ISOPODA

Early in the nineteenth century, when the southern borders of the circumpolar ocean were known, the most interesting elements of the Antarctic fauna seemed to be the whales, while only few scientists started to collect plants and invertebrates. One of these scientists was James Eights, who was “the first qualified naturalist to set foot on land south of the Antarctic Convergence“ (Hedgpeth 1971). He took part in Captain E. Fanning’s expedition to South America and Antarctica in 1829-1831 and collected a large number of natural history specimens, among these the first Antarctic isopods. His description of “Brongniartia“ trilobitoides from the shores of the South Shetland Islands was published in 1833. Eights was puzzled by the similarity with the extinct trilobites, but correctly placed his new species in the Crustacea Malacostraca. As we know today, this similarity is a consequence of the adaptations to life on sandy bottoms which are characteristic for the Serolidae (Wägele, 1989). In a note published in 1852 Eights suspected that his species was possibly a Serolis. It is the largest species of its family known until today. The same is true for *Glyptonotus antarcticus* (Family Chaetiliidae), “... a New Animal belonging to the Crustacea, discovered in the Antarctic Seas, by the author James Eights“ (1852), also from the shores of the South Shetlands.

Some smaller publications followed. Dana for example described in 1852 *Cleantis linearis, Chaetilia ovata* (Valvifera) and *Exosphaeroma gigas* from Patagonia, collected during Charles Wilkes’ U.S. Exploring Expedition, while during the Antarctic cruises no new isopods were taken. A Patagonian *Serolis* was named after the governor of Punta Arenas *S. schythei* by Lütken (1858). Studer (1879, 1882) studied the material collected by the German ’Gazelle’ expedition (1874-1876), described *Serolis cornuta* (now *Ceratoserolis)* and *S. ovalis, Arcturus furcatus* (now *Antarcturus*) and the interesting new genus *Arcturides* (for *A. cornutus* n.sp.), all from Kerguelen. Studer (1882) realized that *Arcturides* was morphologically a link between the Idoteidae and the specialized *Arcturus.* Further subantarctic collections were studied by Miers, among these materials brought back from Kerguelen by officers of the Antarctic expedition of James Ross, who visited the island in May and June 1840 (Miers 1879). The “Southern Cross“ expedition of 1898-1900 led by C.E. Borchgrevink, with the first wintering shore party on the continent at Cape Adare, yielded a first collection of 9 high-Antarctic species, most of them from Cape Adare, described by Hodgson (1902).

An important contribution to our knowledge of the Antarctic fauna was based on the material of the “Challenger“ expedition, led by C.W. Thomson to the area around Marion and Heard Island and the Kerguelen Islands between December 1873 and February 1874. The isopods were studied by Beddard, who published in 1884 beautiful plates of species of *Serolis* and in 1886 descriptions and excellent drawings of the remaining taxa. Though the descriptions were not as complete as those of the famous Norwegian zoologist G.O. Sars, the standard of these drawings was not reached by many of the scientists who published in the twentieth century. A first comprehensive study of the crustaceans of South Georgia was prepared by Pfeffer (1887, 1890). Here we find the names of some species, which are common in more southern areas, as *’Chelonidium’* (*Plakarthrium*) *punctatissimum* and *Glyptonotus antarcticus*, as well as other species, which do not reach farther south (Sphaeromatidae).

During the German Deep-Sea Expedition (1898-1899) with the “Valdivia“, a former Hamburg-America liner, four arcturids were obtained and later studied by zur Strassen (1902). Zur Strassen erected the new genus *Antarcturus* for the southern arcturids and described *A. oryx* from off Bouvet Island.

The first remarkable collection from high Antarctic sites was obtained during R. Scott’s “Discovery“ expedition, which led into the Ross Sea (1902). T.V. Hodgson collected and described (1910) 23 species, most of them illustrated in 10 fine plates. The material from the German South Polar Expedition (1901-1903) under E. von Drygalski with the “Gauss“, which was frozen in the ice close to the continent (66°2’9“S 89°38’5“E) is of comparable importance, but Vanhöffen’s drawings are of poorer quality (Vanhöffen 1914).

Jean Charcot’s first expedition with the “Français“ (1903-1905) also carried out biological programmes. The small collection of isopods was described by Miss H. Richardson (1906, 1908), who was busy studying isopods from all over the world. Richardson’s drawings were not better than Vanhöffen’s, redescriptions for many of these species are necessary. The last of the more famous names from the heroic era of the scientific exploration of Antarctica is Tattersall. He had prepared a study (Tattersall

1914) on the non-Antarctic Isopoda from the Scottish National Antarctic Expedition (1902-1904), the Antarctic 'Scotia'-material was in hands of Hodgson. Tattersall received the material from R. Scott's ill-fated “Terra Nova“ expedition (1910-1913), which contained among others 26 “truly Antarctic“ species (Tattersall 1921).

During the following decades several large collections were made, but until now no review on the Antarctic Isopoda has been published. Though an unknown percentage of the fauna remains to be discovered, the most frequent and conspicuous species from the continental shelf are probably known. The German “Polarstern“ expeditions to the Weddell Sea enabled us to study a hitherto less frequented area, which is now nearly as well sampled as the Ross Sea.

3. MORPHOLOGY AND GLOSSARY OF SPECIAL TERMS

3.1. MORPHOLOGY

The Isopoda are peracarid crustaceans with a reduced carapace. The Amphipoda, which are frequently caught in the same habitats as the Isopoda, have a laterally compressed, curved body, while the Isopoda are normally dorsoventrally flattened and have different appendages. The body is divided into a *cephalothorax* (head) which consists of the arthropod head (cephalon) and an incorporated thoracic segment with its associated appendages (maxillipedes), a *pereon* of 7 somites with the walking legs (pereopods) and a *pleon* of 6 somites, of which the last is fused with the terminal segment, the telson, forming the pleotelson. The appendages have the same arrangement as in other Malacostraca: There are 2 pairs of antennae on the cephalothorax and 3 pairs of mouthparts, the mandibles, the first and the second pair of maxillae; 8 pairs of thoracal appendages, of which the first is transformed to mouthparts, the maxillipeds, while the remaining 'pereopods' are uniramous walking legs; 5 pairs of biramous pleopods, which in isopods serve as gills and swimming appendages; 1 pair of uropods, serve as gills and swimming appendages; 1 pair of uropods, originally forming a tailfan together with the pleotelson. A generalized primitive isopod has the following features (see Fig. 1):

Cephalon without carapace, fused with first thoracal segment (the maxillipedal segment). Body normally with 7 free pereonites and 5 free pleonites. Sixth pleonite always fused with telson. First antenna (antennula) shorter than second antenna (antenna), with 3 peduncular articles and a multijointed flagellum; accessory flagellum vestigial or absent; first flagellar article usually short, with feather-like bristles; remaining flagellar articles with aesthetascs and/or short setae. Second antenna with 5 well developed peduncular articles, a sixth article may be present at the base of the antenna. Third peduncular article (basipodite) sometimes with small scale-like exopodite; flagellum long, multijointed. Mandibles with a palp of 3 articles, a lacinia mobilis under the pars incisiva, a row or tuft of spines (often reduced) between lacinia and pars molaris. First max-

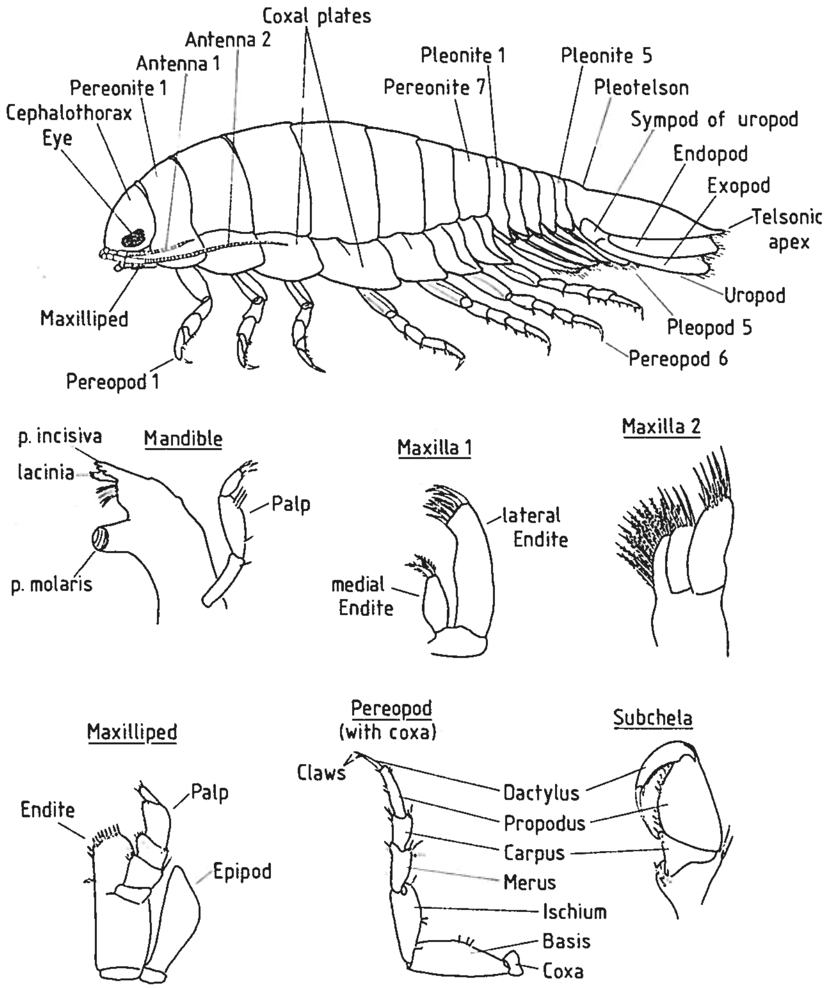

Fig. 1: Morphological features and terms used in isopod taxonomy.

Fig. 1 illustrates the morphology of a hypothetical, generalized isopod. Variations of this basic morphology are shown together with the keys to the different taxa.

illa (maxillula) with 2 endites; medial endite shorter than lateral endite; usually strong setae or spines on tip of endites. Second maxilla shorter and thinner than first maxilla, with 3 endites. Maxilliped partly covering

mouthparts, palp of 5 articles, basipodite with flattened medial endite; epipod of maxilliped of variable size and shape. All pereopods without exopods or epipods, but bearing oostegites (on coxa or coxal plate of all or on some legs) in ovigerous females. The oostegites form the marsupium (Fig. 2). Pereopods usually with 6 articles (basis, ischium, merus, carpus, propodus, dactylus), originally with a seventh basal article, the coxa (in suborders Phreatoicidea and Asellota); coxa often transformed into a coxal plate. Anterior pereopods may bear a subchela. Pleopods originally all of similar shape (often one pair specialized to enlarged, operculiform appendages that cover the remaining pleopods). Rami of pleopods leaf-like, flattened, with marginal swimming setae. Endopod of second pleopod in mature males with copulatory organ, the appendix masculina. Pleotelson and uropods originally forming a tail-fan. Sympod of uropods in this case shorter than the flattened, leaf-like rami. Anus ventrally at the base of the pleotelson.

3.2. GLOSSARY

aesthetasc: relatively long and broad chemosensory hair on the antenna 1

antennula: antenna 1

antenna: antenna 2

appendix masculina: stylet on endopod of male pleopod 2

cephalon: arthropod head consisting of the acron, the somites of the antennae and of the 3 first pairs of mouthparts

cephalothorax: unit consisting of cephalon and 1 or more fused thoracic segments

coxal plate: plate attached laterally to tergites of thoracic segments, ontogenetically formed by coxal article of a thoracopod

endite: medial protrusion of basal articles of appendages; usually masticatory protrusions of mouthparts

epipod: thin plate attached laterally to basal articles (protopodite) of thoracic leg, usually functioning as gills. In Isopoda a round plate is only present on the maxilliped.

lacinia mobilis: small movable plate with distal spines or teeth, at base of pars incisiva of mandible

marsupium: brooding pouch of females, on ventral side of body, delimited ventrally by oostegites and dorsally by the ventral integument of the body

maxilliped: thoracic appendage transformed to a mouthpart. In Isopoda first thoracic appendage; the corresponding somite is fused with the cephalon.

operculum: general name for object covering the entrance of a hole, a tube or a concavity. In Isopoda applied to pleopods that cover the branchial chamber.

oostegites: thin plates on coxae of pereopods of brooding females; the oostegites together form the ventral wall of the marsupium

pars incisiva: apical cutting edge of endite of mandible

pars molaris: proximal (lower) protruding part of endite of mandible, usually with distal grinding surface

pereon: part of thorax that remains after fusion of anterior somites with cephalon

pereonite: somite of pereon

pereopod: appendage of pereon (in Isopoda: usually walking leg)

pleon: posterior region of body that follows caudally the pereonites, bearing pleopods

pleonite: somite of pleon

pleopod: biramous swimming appendage of pleonite; in Isopoda functioning also as gills

pleotelson: last part of body of the Isopoda, consisting of telson and fused pleonites (at least with sixth pleonite)

telson: originally last segment of the Crustacea, probably homologous with the pygidium of the Annelida, without coelomic sacs or appendages

4. ANATOMY

Though some variations of the anatomy of the Isopoda are known, these features are not used in classical taxonomy. Therefore only the general aspects of the inner organization of an isopod are mentioned in the following.

The gut is divided into the following sectors: oesophagus and stomach are of stomodaeal origin, a midgut does not exist, the following proctodaeal sector can be divided into an anterior, often dilatable part used as a reservoir for ingested food, and a posterior rectal part, which begins with a sphincter and ends with the anus on the ventral side of the pleotelson. Thus the whole gut is of ectodermal origin. The stomach serves at the same time as pump, filter and valve, helping to suck in food, to transport ingested material into the anterior hindgut, to transport digestive enzymes which are produced in the 'midgut glands' (hepatopancreas) into the gut, to filter the chyme that is pumped from the gut into the digestive glands, where the main resorption takes place. The midgut glands consist of 1 to 4 paired tubes on each side of the gut, often reaching from the stomach to the last pereonites; they begin on the ventrocaudal end of the stomach in a common room, the antechamber of the midgut glands. Excretory organs are the maxillary glands, the antennal glands of other crustaceans are reduced. Gonads are paired organs. In the male each gonad usually has 3 vesicles (testes) in the anterior part of the body; the (motionless) spermatids are transported in a vas deferens to the ventral part of the seventh pereonite, where small penial papillae are present (originally the papillae are found on the seventh coxae). The central part of the vas deferens is enlarged to a sperm-storing room. Associated with the male gonad is the androgenic gland, often consisting of small groups of endocrine cells. The female gonad consists of a long ovary situated in the dorsal body cavity; the oviduct opens ventrally of the insertion of the fifth pereopod. Sometimes a receptaculum seminis is present, but its structure and function is still not well understood (see Wilson 1986). The respiratory organs are the pleopods, expecially their exopodite, while the endopodite is mainly responsible for osmoregulation. The heart is normally found in the pleon and posterior pereonites, it pumps the oxygenated blood into arteries. The dorsal main artery reaches to the cephalothorax. This artery may be accompanied by a pair of smaller vessels; lateral vessels originating separately from the heart or from a common trunk on each side lead to the pereopods. Generally the ramification of the arterial vessels is minute. In the somites and appendages the blood runs in lacunae backwards to the pleon, into the pleopods and from there to the pericardium. The heart communicates with the pericardium by one or two pairs of ostia. (Complete studies of the anatomy of the circulatory system do not exist, much work remains to be done.) The central nervous system begins with the supraoesophageal protocerebrum. This is laterally prolonged into the lobus opticus and the optic nerve, an area bearing the enigmatic organ of Bellonci and the neurohaemal sinus gland. In the anterior part of the protocerebrum median ocelli are present; the ocelli do not reach to the integument and have no lenses. Deuto- and tritocerebrum are not clearly separated, the tritocerebrum forms the circumoesophageal ring. The deutocerebrum innervates the first antennae, the tritocerebrum the second antennae. A long suboesophageal ganglion consists of the fused ganglia of the mouthparts. Laterally to this ganglion a plexus with neuroendocrine cells is present in the vicinity of the Y-organ. Each pereonite bears a pair of ganglia, the seventh pair is partly fused with the mass of the 5 fused pairs of pleonal ganglia. Some dermal glands exist in different areas of the integument, salivary glands are present in some families. (Some references: Bonnenfant 1961, Bullar 1876, Calman 1909, Chaigneau 1977, Charniaux-Cotton et al. 1966, Gabe 1960, Gruner 1965, Holdich & Ratcliffe 1970, Juilfs & Wägele 1987, Kästner 1967, Legrand & Juchault 1970, Martin 1976, Scheloske 1976, Schultz 1969, Siewing 1957, Storch 1982, Strömberg 1972, Veuille 1978a,b, Wägele et al. 1981, Wägele 1985, Wilson 1986).

5. DEVELOPMENT AND REPRODUCTION

Isopods grow by molting, some of them probably during their whole life, others have a constant number of molts. The molt consists of two stages: generally the posterior part of the old cuticle is shed first, the anterior part follows after a few hours or days. The two halves of the exuvia are separated at the limit between the fourth and the fifth pereonite.

Eggs are probably fertilized within the oviducts. Sperm is transferred by the male into the female genital openings, rarely (Bopyridae) into the marsupium. The eggs are released into the ventral brood chamber (marsupium) formed by the oostegites (Fig. 2). There they develop, probably without additional maternal nutrition. Ventilation of the brood chamber is achieved by movements of the oostegites and/or by the maxilliped, which often bears a special ventilatory lappet (maxillipedal oostegite) in adult females. Few species have additional internal brood pockets formed by invaginations of the ventral integument, others (as *Eisothistos*) have no brood chamber and leave their eggs in crevices (or worm tubes as in the case of *Eisothistos*). No case of true viviparity is known.

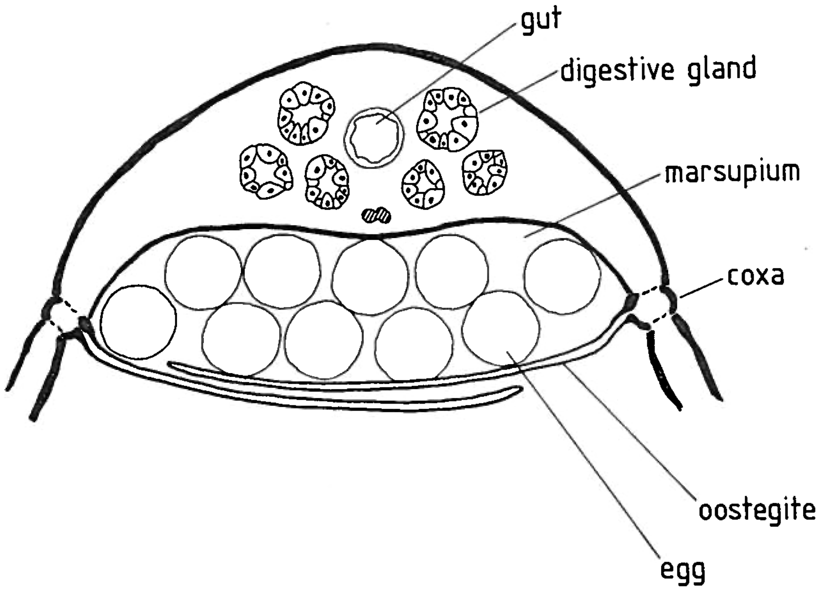

Fig. 2: Schematic cross section through a pereonite of a brooding female isopod.

Eggs develop in the marsupium to the manca stage. Of the egg membranes first the chorion is shed, later the vitelline membrane, when the pre-manca stage is freed. Mancas leave the marsupium a short time after the one-stage molt of the pre-manca and generally look much like adult specimens and have the same way of living. They differ from the adults only by the absence of the seventh pereopod and the immature state of the ovaries. Only rarely the seventh pereopod is also absent in the adult (Gnathiidae, some Anthuridea and Asellota). Morphological differences between immature and sexually mature forms are typical for parasitic groups (Gnathiidae, Bopyridae, Cymothoidae); the sexual dimorphism normally is restricted to few features (e.g. length of antenna 1), but in some genera males and females have a very different morphology (e.g. many Sphaeromatidae). These variations will be described later in the chapters dedicated to the families and genera.

6. THE BIOLOGY OF ANTARCTIC ISOPODA

Only few species have been observed alive in aquaria or by divers in their natural habitat, few populations have been studied over a longer period of time. Of most Antarctic isopods we only know that they exist, sometimes also, on which substratum they have been found. In the following a summary of the hitherto published studies on the biology of Antarctic isopods is presented.

The Antarctic Asellota, most of them belonging to the superfamily Janiroidea, are an important element of the isopod fauna. But as these species are very small in comparison with the Valvifera, Serolidae or Cymothoidea, they usually do not attract the attention of the scientists. *Austrosignum grande* Hodgson is an important species in areas of the McMurdo Sound. With an abundance of 29,000 Ind/m^2 it belongs to those species which dominate the dense assemblage at the McMurdo Station jetty (Oliver & Slattery 1985). At Marion Island Blankley & Grindley (1985) found *Santia bicornis* (Cleret) with a mean density of 588 Ind/m^2 and with a maximum of 15,000 Ind/m^2. Such high values are probably the result of a patchy distribution with a small local accumulation of many individuals. These small isopods are probably omnivorous and capable to live on small particles of organic material. Stomach contents have been investigated in some deep-sea janiroids of other oceans (Menzies 1956, 1962a, Wolff 1979). Food remains may consist of crustacean cuticles, Foraminifera and coccoliths, nematocysts, diatoms, remains of vascular plants, setae of polychaets. The Janiroidea are too small to be predators of benthic macrofauna.

Generally the Asellota are crawling and burrowing animals without the ability to swim. An exception are some groups of genera of the family Munnopsidae, where the posterior pereopods 5-7 are broadened and used as paddles to swim backwards (e.g. species of Eurycopinae). The closely related Desmosomatidae may also be able to swim in a similar way, though the posterior pereopods are more slender and probably not so effective (see Hult 1941, Sars 1899, Hessler 1982a,b). These taxa are of deep-sea origin and live on soft bottoms, into which they may burrow. Observations on behaviour and nutrition of Antarctic species are lacking.

The most conspicuous Antarctic valviferan isopod is *Glyptonotus antarcticus* Eights (family Chaetiliidae). This species is a giant with an adult size between 10 and 20 cm and a weight of up to 70 gr (White 1975). Though the abundance probably is not very high in comparison with some other invertebrates (e.g. *Laternula, Ophionotus* and certain Amphipoda in shallow water), this species is frequently found on all types of substrates around the Antarctic continent and also in the subantarctic area. This species is together with some Serolidae the best studied Antarctic isopod. The animals are nocturnal with a diurnal activity rhythm. During the day they seek shelter under stones and algae. In the night they crawl over the bottom in search of food. *Glyptonotus antarcticus* has been found in traps with carrion during experimental studies of necrophagy of Antarctic invertebrates (Pearse & Giese 1966, Presler 1986). The species is an important scavenger, though it is not so numerous in baited traps as some Amphipoda (*Cheirimedon femoratus, Waldeckia obesa, Orchomene plebs,* etc.) (Presler 1986). Glyptonotus feeds on polychaets, echinoderms, other crustaceans, carrion, including Krill (if available). Therefore these animals are easy to keep in aquaria. In comparison with other Isopoda, such as species of *Serolis, Natatolana,* and *Antarcturus, Glyptonotus antarcticus* needs more food; the animals must be fed at least twice a week to keep them healthy. Clarke (1979) studied the assimilation efficiency and found out that when fed every 2 days with shrimps *Glyptonotus* assimilated 90 % of the ingested food. As all other Isopoda the animals grow by moulting. During ecdysis the exoskeleton is divided between the fourth and fifth free thoracic somite; usually the posterior half of the cuticle is shed some time (22 – 100 hours) before the anterior half (White 1970). The intervals between 2 moults last between 100 and 730 days. As a minimum of 11 moults are necessary to attain maturity and as the embryonic development takes between 577 and 626 days (White 1970) the whole life cycle requires several (5 – 8?) years. After release of the brood females normally die, but 2 – 3 % may moult and breed again. White (1970) found ovigerous females at Signy Island during each month of the year. The contents of the marsupia were shown to be at different stages of development in different individuals at any one time. Males cling to females long before the coitus, the precopula may last for 190 days. Sperm transfer occurs in the hours after the posterior moulting of the female. The male manipulates the female so that their ventral sides are in opposition and then the second pair of male pleopods are flexed forward so as to locate the proximal ends of the appendix masculina close to the penal papillae and to help the transfer of sperm bundles to the oviducts of the female. The mean number of eggs are 512 at Signy Island, 746 at McMurdo Sound. Females in the Ross Sea are larger and therefore produce a greater number of eggs. The breeding cycle is nonseasonal. Young are released throughout the year, both young and adults are independent of elevated summer production (White 1977). Such variations in size and also in details of morphology are not uncommon in separate populations of Antarctic isopods. Individuals of *G. antarcticus* from deeper waters may have an acuter pleotelson ("*Glyptonotus acutus*" is not a separate species), the coloration of different populations varies.

Glyptonotus is a stenothermal polar form that does not tolerante high temperatlures. A heavy mortality above 6 °C was observed (White 1975). The animals are relatively active at temperatures around 0 °C, when compared with other species. White (1975) measured an average oxygen consumption of 21.7 to 68.8 l O_2/g/h at environmental temperatures (-1.5 to 0.5 °C), while Belman (1975) found a mean rate of 216 ± 24 l O_2/g/h. Mean Q_{10} at the same temperature: 2.18. The O:N values were usually about 30, but some were lower at about 6 (White 1977). Elevated metabolic rates as an indication for metabolic cold adaptation were not observed, but *G. antarcticus* attains a large size and grows relatively rapidly in comparison with other Antarctic Crustacea (White 1977). A regulation of its oxygen consumption under experimental hypoxic conditions was not observed (Belman 1975); the oxygen tension of the waters in which this species occurs remains uniform at about 69 per cent saturation.

Dayton et al. (1970) have found *G. antarcticus* frozen into the undersurface of the sea ice of the McMurdo area together with other benthic invertebrates. They are not necessarily killed by the ice crystals into which the animals are entangled during anchor ice formation at the sea floor and may escape and fall down to the bottom.

The family Idoteidae is only represented by few species, mainly from the genus *Edotia*, but the *Arcturidae* (Valvifera) are a very species-rich and frequently found group of Antarctic isopods. Many new species have been described recently (Wägele 1988a, Brandt & Wägele 1988, Brandt 1990). Probably the hemisessile mode of life resulted in the evolution of several local endemic species. The species have a patchy distribution, but the extension of the populated areas and the abundance are not known. Gruzov et al. (1967) reported on populations of *Antarcturus polaris* sampled on rock surfaces together with alcyonarians, hydroids and *Sterechinus*, which reached a biomass of 25 to 30 gr/m2 (wet in alcohol). The biology of these species is nearly unknown. The higher Arcturidae have a very peculiar, highly specialized morphology: The first pereopods are small and bear brushes of setae, the most important of which are the medio-ventral and dorsal setae of the propodus used for cleansing the filter combs of the pereopods 2 to 4. Long double rows of movable, long and smooth setae on the pereopods 2 to 4 form together with similar setae on the antennae a large filter basket. The pereopods 5 to 7 have short, stout spines and are used for climbing. The behaviour of *Antarcturus* was described by Wägele (1987a): Animals observed in aquaria use to climb on elevated substrata using their posterior pereopods. The long second antennae help to support the anterior part of the body. The pereopods 2 to 4 cannot be used to hold the animal to the ground as the podomeres are adorned with long filter setae, but these legs can nevertheless support the body, touching the ground with the tips of the last article. As long as the animals are undisturbed they do not move from the selected spot. Only rarely they swim over very short distances (few centimeters) and afterwards sink to the ground. When climbing on a hydroid, a sponge, or a stone, the movements are very slow. In their resting position the animals show a characteristic dorsal bending, with pereonites 5-7 nearly parallel to the ground, while the pleotelson and anterior segments are elevated. In this posture the animals can resist currents, which they need for their nutrition. The movements of the legs are far too slow to catch larger animals, only small planktonic organisms can be eaten. The animals stretch out the filtering legs, the setae are spread out, the basket of setae is oriented transversely to the current. Almost any particle that adheres to the long setae is ingested. The stomach of freshly caught animals contained a greenish mass with some intact diatoms, silicoflagellates, small sponge spicules and a few sand grains. In aquaria the animals even eat artificial fish food, small oligochaets and nauplii of *Artemia salina*. Large, living calanoid copepods were never caught: *Antarcturus* has no time to react before the copepod leaves the trap with a few quick jerks. It may be that occasionally the animals feed on carrion: *Antarcturus* is sometimes found in baited traps (Arnaud 1970). Food can also be collected with the filter setae brushing particles from the ground or from the surface of the own body. For grooming of the head also the first pereopods are used. Collected particles are brushed off the filter with the first pereopods and passed to the maxillipeds.

Nothing is known on reproduction, life cycle or substrate preference of Antarctic arcturids. Some sort of resource partitioning must occur, as several species may live in the same area. Near Signy Island we have found 7 different species in one bottom-trawl sample.

Of the suborder Anthuridea only few species live on the Antarctic continental shelf. Most of them belong to the specialized stinging and sucking Paranthuridae. Of the family Hyssuridae only the genus *Eisothistos* is known from the Southern Ocean. Anthuridea are worm-like isopods, but no species are longer and thinner than the mature females of *Eisothistos.* This genus shows several adaptations to life within serpulid tubes (Wägele 1981). The tail-fan is used to close the entrance of a tube. The worms are used as food. Serpulids having an operculum to close the tubes are also attacked, the operculum is bitten off. The mouthparts protrude frontally beyond the cephalothorax, enabling these isopods to eat a worm within its tube. Females have no oostegites, eggs are laid into the calcareous serpulid tubes. After or while spawning the females change their morphology without a moult: The body stretches for more than 100 %, becomes long and thin; only the head and the tail fan retain a larger diameter and delimit a section of the tube, in which the eggs can develop. This biology has been observed in Mediterranean species, but as *Eisothistos antarcticus* Vanhöffen has the same morphology, it must be assumed that this species lives in the same way as the Mediterranean relatives.

The most frequent paranthurids are *Accalathura gigantissima* Kussakin, *Leptanthura glacialis* Hodgson and *Paranthura antarctica* Kussakin (Wägele 1984). Paranthurids generally seem to use their stinging mouthparts to suck out other crustaceans. *Accalathura gigantissima* has been observed feeding on amphipods. Oesophagus and stomach are used to pump the food into the highly dilatable hindgut, where the food may be stored for long time (Wägele 1985). Mediterranean paranthurids also feed on Tanaidacea, other Isopoda and Pycnogonida. In *Accalathura gigantissima* an unusual voluminous fat body is present in some specimens (Wägel 1985). Wägele suggested that in the hypodermal fat body material is stored that is needed later for maturing oocytes. The fat body could have a function similar to that described from insects. In the North Sea species *Idotea baltica* vitellogenin synthesis was demonstrated in the adipose tissue (Souty & Picaud 1981). A conspicuous fat body is also present in Antarctic Cirolanidae, Aegidae, Serolidae, and in *Glyptonotus.*

The most important Antarctic family of the suborder Sphaeromatidea is the family *Serolidae.* The Sphaeromatidae and Plakarthriidae are only represented with very few species. The Serolidae can easily be found in shallow water and therefore have been used for several scientific studies.

Serolids are flattened, disc-shaped animals that nearly always live on soft

sediments. *Ceratoserolis trilobitoides* (Eights) observed in aquaria usually lived half covered with sand, motionless, the eyes free of sediment. The seleniform eyes have a large vision field, the animals do not have to move their head to see a large proportion of their surroundings. The second antennae have ventral brushes of short setae, which are used to push sand on the body or to clean the dorsal surface when they start to crawl around. The broad coxal plates cover the legs. Under the body of the animals a concavity remains free of sand; the water in this room streams towards the pleopods and is renewed from the surrounding interstices, especially from the frontal area of the animal. The smaller *Serolis polita* Pfeffer is completely buried in the sediment, but at the tip of the pleotelson a stream of water leaves the respiratory chamber and is expelled upwards, where a small funnel forms in the sediment. The tips of the pereopods bear on the propodus longer setae, which may prevent that the legs sink into softer sediments during walking. The thin respiratory pleopods 5 and the inner ramus of pleopod 4 are protected by the strongly chitinized, operculiform exopods of the fourth pleopods. The pleopods 1 to 3 are small and produce the respiratory water current, but are also used for swimming.

Serolids are predators and scavengers. In experiments they feed on dead shrimps, krill, fish, but they prefer living polychaets and crustaceans; cannibalism is common under laboratory conditions. Food is seized with the strong subchelae of the first pereopods and pressed against the mouthparts. A large, 10 cm long polychaet is devoured within few minutes by *Ceratoserolis trilobitoides.* Smaller species could be fed with copepods, with Artemia, amphipods (Bastida & Torti 1970, White 1972). The mouthparts are adapted to this carnivorous nutrition: The mandible is a cutting organ and has no grinding surface on the pars molaris.

The animals swim only when disturbed and sink again to the bottom after a short distance. Younger specimens of *S. polita* were seen swimming when food was added to the aquarium. A peculiar behaviour of *S. beddardi* Calman is the use of the stiff and pointed uropods as a defense organ. *S. beddardi* was found around King George Island in shallow, coarse sediment. When the animals are disturbed they bend their body slightly dorsally (in contrast to most other Isopoda) and spread the uropods in right angles to the body ventrally. A fish taking this animal into its mouth will probably feel the acute uropods on its tongue or palate.

Serolids form precopulatory pairs with males riding on the females. Such pairs of *Ceratoserolis trilobitoides* (Eights) lived in aquaria for several months, the copulation could not be observed. The males have sexually dimorphic second pereopods with small subchelae, which are used to hold the cephalothorax of the female. Females are grasped with great force and often have small injuries produced by the male subchela (Moreira 1973a). We could observe that the male of *C. trilobitoides* used its first pereopod to pass food to the female on which it was riding.

C. trilobitoides (= S. cornuta) is the largest Antarctic serolid. Luxmoore (1982c) studied its life cycle: Absolute size of a given moult class varied from year to year. Maturity was not achieved until moult class 9, ovary maturation occurred in class 8. Maturity is probably reached after 3.5 – 4 years, the duration of adult life is not known. The life span (6 years?) is far in excess of the 1 to 2 years reported for any temperate marine isopod. Breeding lasts probably nearly 2 years (Wägele 1987b). Embryonic development is retarded as in *Glyptonotus*. This embryonic period is an important factor that prolongates the life of Antarctic invertebrates. Reasons for this retardation that have been discussed are genetically fixed adaptations to the polar environment, such as synchronization with summer primary production and elevated temperatures, physiological effects of temperature, the effect of egg size (Wägele 1987b).

In *C. trilobitoides* interesting variations of fecundity occur (Wägele 1987b): The largest eggs are present in the coldest, southernmost regions. In northern populations (Antarctic Peninsula) mean egg size was 2.97 mm, the number of eggs in females of 60 – 65 mm body length being about 90 – 160. Populations in the Weddell Sea (off Riiser-Larsen Ice Shelf) had eggs of 3.55 mm mean diameter, while females of 60 – 65 mm length had only 50 to 70 eggs. With decreasing temperature the number of eggs decreases but the size of the eggs grows. These intraspecific variations coincide with morphological races (Wägele 1986). Presumably the relative immobility of these animals, together with low fecundity and geographical or hydrographical barriers are responsible for the evolution of local races. This is an indication for the reduced genetic exchange with neighbouring populations, and a consequence is probably a reduced probability for colonization of unpopulated areas. Populations have been found between 100 and 1000 m in the Weddell Sea; at Signy Island the animals ar common in depths greater than 20 m. Clarke (1984) studied the organic omposition of *C. trilobitoides*: 50 % of the dry weight is ash, 17 % is chitin. Lipid content of males is about 1 % fresh weight. Females have almost 4 % lipid when the ovaries are maturing.

Another frequently mentioned species is *Serolis polita* Pfeffer. The species lives in shallow water, often between 3 and 20 m, on sand and mud, associated with *Laternula elliptica, Yoldia eightsi, Maldane sarsi, Ophionotus victoriae, Neobuccinum eatoni, Parborlasia corrugatus,* amphipods, etc. (Luxmoore 1982b, Zamorano et al. 1986 and own observations). Several aspects of its biology were studied by Luxmoore (1982a-c, 1984, 1985). At Signy Island *Serolis polita* reaches sexual maturity after 2 years at a length of about 2 cm. The population has an estimated density of 164 – 372 Ind/m². Juveniles may be found in different areas than adults. Juveniles first spread over the shallow, flat sandy areas, but in autumn they move to a somewhat deeper and more stable site. Breeding is possibly synchronized to exploit the summer bloom, juveniles leave the maternal brood pouch in spring. Egg laying takes place at a mean age of 28 months, the incubation period lasts 20 months. The mean number of eggs was 40 (at Signy Island). Females probably breed repeatedly at two-years intervals. Growth is slow, the life cycle probably needs at least 4 years. The energy budget was studied for 2 consecutive years (Luxmoore 1985). Mean biomass was 113 kJ/m². *Serolis polita* is a predator with an unspecialized diet, preferring amphipods (as *Cheirimedon femoratus*) and polychaets. Assimilation efficiency (80 %) and growth efficiency are high, but the energy turnover rate lies below that of other, nonpolar isopods. Respiration rates are low, also in *C. trilobitoides*. A somewhat higher specific metabolic rate was only found in *Glyptonotus antarcticus*. Growth of *S. polita* is significantly slower in winter than in summer (at Signy Island), and this was considered to be due to reduced food availability. 7 distinct moult classes were discerned. Seasonal growth rates decrease with age.

Serolis ovata Sheppard lives on gravel substrates from the littoral to 21 m at Signy Island (White 1972), normally associated with *S. polita*, but with lower abundance. Fragments of crustaceans were found in the stomach of this species. *Serolis pagenstecheri* Pfeffer is common at South Georgia, but also occurs farther south. Respiration rates were measured and found to be comparable to those of other Antarctic invertebrates, metabolic cold adaptation could not be detected (Maxwell & Ralph 1985). 10 moult classes were discerned, but samples were too small to reconstruct the whole life cycle (Luxmoore 1982b,c). The mean number of eggs (232) is relatively high in *S. pagenstecheri*; the dry weight of eggs was greater at Signy Island (60°S) than at South Georgia (54°S); as in the case of *C. trilobitoides* (see above) the more southern populations have larger eggs.

The family Sphaeromatidae has mostly tropical and subtropical species.

In polar seas and in the deep sea sphaeromatids are absent, with few exceptions. As far as known these isopods are generally omnivorous with a preference for vegetal food. *Exosphaeroma gigas* (Leach) is a subantarctic species common in intertidal and shallow habitats. Populations reach a density of 46 Ind/m2 with a biomass of 0.5 gr/m2 on the shores of Marion Island (Blankley & Grindley 1985). A common commensal of this species is the tiny asellote *Iais pubescens* (Dana). *Cymodocella tubicauda* Pfeffer can tolerate a colder climate and is found on the shores of maritime areas of the Antarctic continent. Gruzov (1977) reports that the animals move in spring with the appearance of algae from deeper water to a shallower zone above 3 – 4 m.

Antarctic Cymothoidea are not well studied, though species of the families Gnathiidae, Cirolanidae, and Aegidae are found everywhere in the Southern Ocean.

Protognathia bathypelagica (Schultz), the sole member of the family Protognathiidae, is a rare bathypelagic species with a morphology intermediate between the Cirolanidae and Gnathiidae (Wägele & Brandt 1988). The mandible is adapted for stinging and bears an acute pars incisiva. The pereonal segments 4 – 6 are dilatable, with a ventrally soft, expandable cuticle. In this area the gut is swollen. It is most probable that this species sucks blood from fish.

The Gnathiidae are more specialized. The life cycle of *Gnathia calva* Vanhöffen was studied by Wägele (1988b). Young animals have acute mouthparts which are used to suck blood from benthic fishes. Three instars of such 'pranizae' can be discerned. Each instar fills its gut once with blood and then rests hidden for a period of up to 2 years. The third instar is frequently found within small hexactinellid sponges, where the pranizae moult and metamorphose into mature specimens. These have reduced mouthparts and do not feed any more. Within the sponges usually a single male is found together with several females and immature adults. A single male can be the guard of up to 43 females or immature specimens. When a premale moults into a second male an interspecific fight eliminates one of the males. The animals depend entirely on blood as energy resource. The digestive tract is adapted to this mode of life, the anterior hindgut being a highly dilatable reservoir; in the posterior hindgut a 'rectal vesicle' filled with symbiontic bacteria is present (Juilfs & Wägele 1987).

A praniza of the third instar lived after feeding 2 years without moulting. A mature male can live for more than 2 years. The whole life cycle may need 4 to 5 years from the release of eggs to first maturity. The embryonic development lasts 12 months. Females produce an average of 129 eggs with a diameter of about 0.32 mm. Ovigerous females lived until the release of their offsprings and died 2 – 3 months later.

The biology of Antarctic Cirolanidae, Aegidae and Bopyridae is for the most part unknown. Cirolanid isopods of other seas are well known as scavengers and predators, they usually prefer fish. Antarctic species of *Natatolana* are necrophagous and have been found in baited traps (Presler 1986). Species of *Natatolana* kept in aquaria live half or completely burrowed in sand for many months (Wägele & Bruce 1989). They rarely come to the surface to swim short distances in search of food. The animals, fed with shrimp meat, filled their gut and then lived a long time from the ingested reserve, a typical strategy of scavengers. These species seem to need much less food than Glyptonotus and are probably able to search for food in a larger area due to their capacity to swim with less effort than other scavenging Antarctic isopods.

The Aegidae suck blood from fishes and live on this food for several (up to 12) months, hidden in large sponges, under stones etc. Exuviae are frequently found within rosselid sponges. Specimens of *Aega antarctica* Hodgson kept in aquaria for a period of 2 years showed a very slow growth. Mature animals that are about 20 mm long probably are 10 to 12 years old (Wägele, 1990).

Though the Isopoda never form a larger proportion of benthic biomass, they can be locally very numerous (Jazdzewski et al. 1986). In Chile Bay (Greenwich Island) Isopoda occurred in 58.9 % of all bottom samples taken with a 0.1 m^2 Petersen grab from a depth of between 35 and 355 m (Gallardo & Castillo 1969).

In McMurdo Sound isopods can have an abundance between 18 and 33,285 Ind/m^2 in a sponge mat at Cape Armitage (Dayton & Oliver 1977). They play an important role as scavengers, predators and parasites, the smaller species probably are detritivorous or omnivorous. Arcturids have an exceptional position in the food chain, they are essentially primary consumers. Generally the hitherto studied species show the same adaptations to the polar environment as other invertebrates: Gigantism in many species, large and yolky eggs, relatively fewer eggs in southern than in more northern populations, slow embryonic development, slow growth and very long life cycles, low metabolic rates and no obvious metabolic cold adaptation.

7. COLLECTION, PRESERVATION AND EXAMINATION

As most isopods are of small size (0.2 – 2 cm), many individuals will be lost when benthos is collected with trawls. Nevertheless, the use of e.g. an Agassiz trawl often is indispensable when large areas are to be sampled and there is not enough time for taking and sorting a large number of grab- or box-corer-samples. The latter method is ideal for the quantitative analysis of soft-sediment infauna. Bottom trawls will severely under-collect the infauna. In some areas the upper littoral is formed by hard bottom. Here the best samples can be collected by divers.

The collected sediment, the masses of sponges, bryozoa or other animals found in a trawl or the collected algae can be looked through quickly to pick out the larger species like *Glyptonotus antarcticus*, *Ceratoserolis trilobitoides* or *Aega glacialis*. To find smaller specimens, especially the Asellota, it is necessary to carefully wash portions of the sample and to sieve the suspended material. In these subsamples some animals can be seen with the naked eye, but others will require sorting with a dissecting microscope. The small specimens must be treated with great care, because antennae and legs easily break off.

The animals can be killed and fixed with formalin, autotomy is not known in isopods. Preservation should be in 70 % alcohol or neutral 5% formalin/seawater. In acidic formalin specimens may lose cuticular carbonate and become so soft that later dissection will be very difficult. Ethanol is the best working fluid because of its reduced toxicity.

Identification is best achieved by observing the specimens with the aid of a dissecting microscope. Most species can be identified by their general morphology, but sometimes dissection of appendages is necessary. These can be teased off best with needles when the specimen is placed in glycerin; the appendages should be mounted on a microscope slide and examined under higher magnification. Specimens with thin cuticle may require dehydration before placing in glycerin to prevent shrinking. For more permanent preparations the material can be mounted in glycerin jelly, polyvinyl lactophenol, glycerin drops surrounded by paraffine. Canada Balm or varnishes are not so recommendable.

8. SYSTEMATIC PART

8.1. CLASSIFICATION OF THE ISOPODA

The systematics of the Isopoda are still controversial, mainly because hitherto taxonomy was based on typological instead of phylogenetic arguments. The following is the classification proposed by Wägele (1989). Families are listed only for those suborders which occur in Antarctica.

Ordo: Isopoda Latreille, 1817

- Subordo: Anthuridea Leach, 1814
    - Familia: Anthuridae Leach, 1814
    - Familia: Hyssuridae Wägele, 1981
    - Familia: Paranthuridae Menzies & Glynn, 1968
- Subordo: Asellota Latreille, 1802
    - Superfamilia: Aselloidea Latreille, 1802
        - Familia: Asellidae Latreille, 1802
        - Familia: Atlantasellidae Sket, 1979
        - Familia: Microcerberidae Karaman, 1933
        - Familia: Stenasellidae Dudich, 1924
    - Superfamilia: Gnathostenetroidoidea Kussakin, 1967
        - Familia: Gnathostenetroididae Kussakin, 1967
    - Superfamilia: Janiroidea Sars, 1897
        - Familia: Acanthaspididae Menzies, 1962
        - Familia: Dendrotionidae Vanhöffen, 1914
        - Familia: Desmosomatidae Sars, 1897
        - Familia: Echinothambematidae Menzies, 1956
        - Familia: Haplomunnidae Wilson, 1976
        - Familia: Haploniscidae Hansen, 1916
        - Familia: Ischnomesidae Hansen, 1916
        - Familia: Janirellidae Menzies, 1956
        - Familia: "Janiridae" Sars, 1897
        - Familia: Joeropsididae Nordenstam, 1933
        - Familia: Katianiridae Svavarsson, 1987
        - Familia: Macrostylidae Hansen, 1916
        - Familia: Mesosignidae Menzies & George, 1972

- Familia: Microparasellidae Karaman, 1933
- Familia: Mictosomatidae Wolff, 1965
- Familia: Munnidae Sars, 1897
- Familia: Munnopsidae Sars, 1897
    - Subfamilia: Acanthocopinae Wolff, 1962
    - Subfamilia: Bathyospurinae Wolff, 1962
    - Subfamilia: Eurycopinae Hansen, 1916
    - Subfamilia: Ilyarachninae Hansen, 1916
    - Subfamilia: Lipomerinae Tattersall, 1905
    - Subfamilia: Munnopsinae Sars, 1897
    - Subfamilia: Syneurycopinae Wolff, 1962
- Familia: Nannoniscidae Hansen, 1916
- Familia: Paramunnidae Vanhöffen, 1914
- Familia: Pleurocopidae Fresi & Schiecke, 1972
- Familia: Santiiae Kussakin, 1988
- Familia: Thambematidae Stebbing, 1913
    - Superfamilia: Protojaniroidea Wägele, 1983
- Familia: Protojaniridae Wägele, 1983
    - Superfamilia: Pseudojaniroidea Wilson, 1987
- Familia: Pseudojaniridae Wilson, 1986
    - Superfamilia: Stenetrioidea Hansen, 1905
- Familia: Stenetriidae Hansen, 1905
    - Subordo: Calabozoida Van Lieshout, 1983 (not present in Antarctica)
    - Subordo: Cymothoida Leach, 1814
- Familia: Aegidae Leach, 1815
- Familia: Anuropidae Stebbing, 1893
- Familia: Bopyridae Rafinesque, 1815
    - Subfamilia: Asconiscinae Bonnier, 1900
    - Subfamilia: Bopyrinae Rafinesque, 1815
    - Subfamilia: Cabiropsinae Giard & Bonnier, 1887
    - Subfamilia: Crinoniscinae Bonnier, 1900
    - Subfamilia: Cryptoniscinae Gerstaecker, 1882
    - Subfamilia: Cyproniscinae Giard & Bonnier, 1887
    - Subfamilia: Dajinae Sars, 1882
    - Subfamilia: Entoniscinae Kossmann, 1882
    - Subfamilia: Hemioniscinae Bonnier, 1900
    - Subfamilia: Podasconinae Giard & Bonnier, 1893
- Familia: Cirolanidae Dana, 1853
- Familia: Corallanidae Hansen, 1890
- Familia: Cymothoidae Leach, 1814

    - Familia: Gnathiidae Leach, 1814
    - Familia: Phoratopodidae Hale, 1925
    - Familia: Protognathiidae Wägele & Brandt, 1988
    - Familia: Tridentellidae Bruce, 1984
- Subordo: Oniscidea Latreille, 1803 (not present in Antarctica)
- Subordo: Phreatoicidea Stebbing, 1893 (not present in Antarctica)
- Subordo: Sphaeromatidea Wägele, 1989
    - Familia: Bathynataliidae Kensley, 1978
    - Familia: Keuphyliidae Bruce, 1980
    - Familia: Limnoriidae White, 1850
    - Familia: Lynseiidae Poore, 1987
    - Familia: Plakarthriidae Richardson, 1904
    - Familia: Serolidae Dana, 1853
    - Familia: Sphaeromatidae Latreille, 1825
- Subordo: Valvifera Sars, 1882
    - Familia: Amesopodidae Stebbing, 1905 (?)
    - Familia: Arcturidae White, 1850
        - Subfamilia: Arcturinae White, 1850
        - Subfamilia: Holidoteinae Wägele, 1989
        - Subfamilia: Pseudidotheinae Ohlin, 1901
        - Subfamilia: Xenarcturinae Sheppard, 1957
    - Familia: Chaetiliidae Dana, 1853
    - Familia: Holognathidae Thomson, 1904
    - Familia: Idoteidae Samouelle, 1819

8.2. KEY TO SUBORDERS FOUND IN ANTARCTICA

The following key does not include the Calabozoida, the Oniscidea and the Phreatoicidea. These suborders do not occur in Antarctica.

1a Body with bilateral symmetry, sometimes slightly curved to one side; pereopods distinct 2

1b Body asymmetrical, pereopods not present or not easily seen, parasites on crustaceans (Fig. 5, 3H) .... **Cymothoida (Bopyridae)** (Fig. 5)

2a (1) Uropods lateral, forming a tail-fan or a modified tail-fan (Fig. 3A-C) 3

2b Uropods ventral, operculate, covering branchial cavity (Fig. 3D,E) .... **Valvifera** (Fig. 5)

2c Uropods terminal or subterminal or reduced (Fig. 3F-H) 5

3a (2) Body elongate, worm-like; uropods partially folded over or extending above pleotelson .... **Anthuridea** (Fig. 5)

3b Body never elongate, of oval or round outline; uropods with rami flattened, never folded up over or above pleotelson 4

4a (3) Body dorsoventrally very flattened, resembling a disc, or if oval and not so flattened: pleonites very short and partly fused and sympod and endopod of uropods fused (Fig. 3A) .... **Sphaeromatidea** (Fig. 4)

4b Body not disc-shaped, 4 or 5 free pleonites visible in dorsal view . ... **Cymothoida** (Fig. 3B,C) 7

5a (2) Coxal plates absent; pereopods with coxa (small first article) (Fig. 3J,K); rami of uropods styliform, not flattened, of varying length. Body always bilaterally symmetrical; most pleonites fused with pleotelson (max. 2 free pleonites) .... **Asellota** (Fig. 4)

5b Coxal plates present (Fig. 3L); if not visible, pereopods without coxa (only 6 articles remain) or pereopods reduced 6

6a (5) Body of adult usually not symmetrical; pleon never with branchial cavity, pleotelson very short; pereopods often reduced; parasites of crustaceans .... **Cymothoida (Bopyridae)** (Fig. 5)

6b Body symmetrical; pleopods in concavity of pleotelson and pleon; pereopods never reduced .... **Sphaeromatidea (Limnoriidae)** (Fig. 3G, 4)

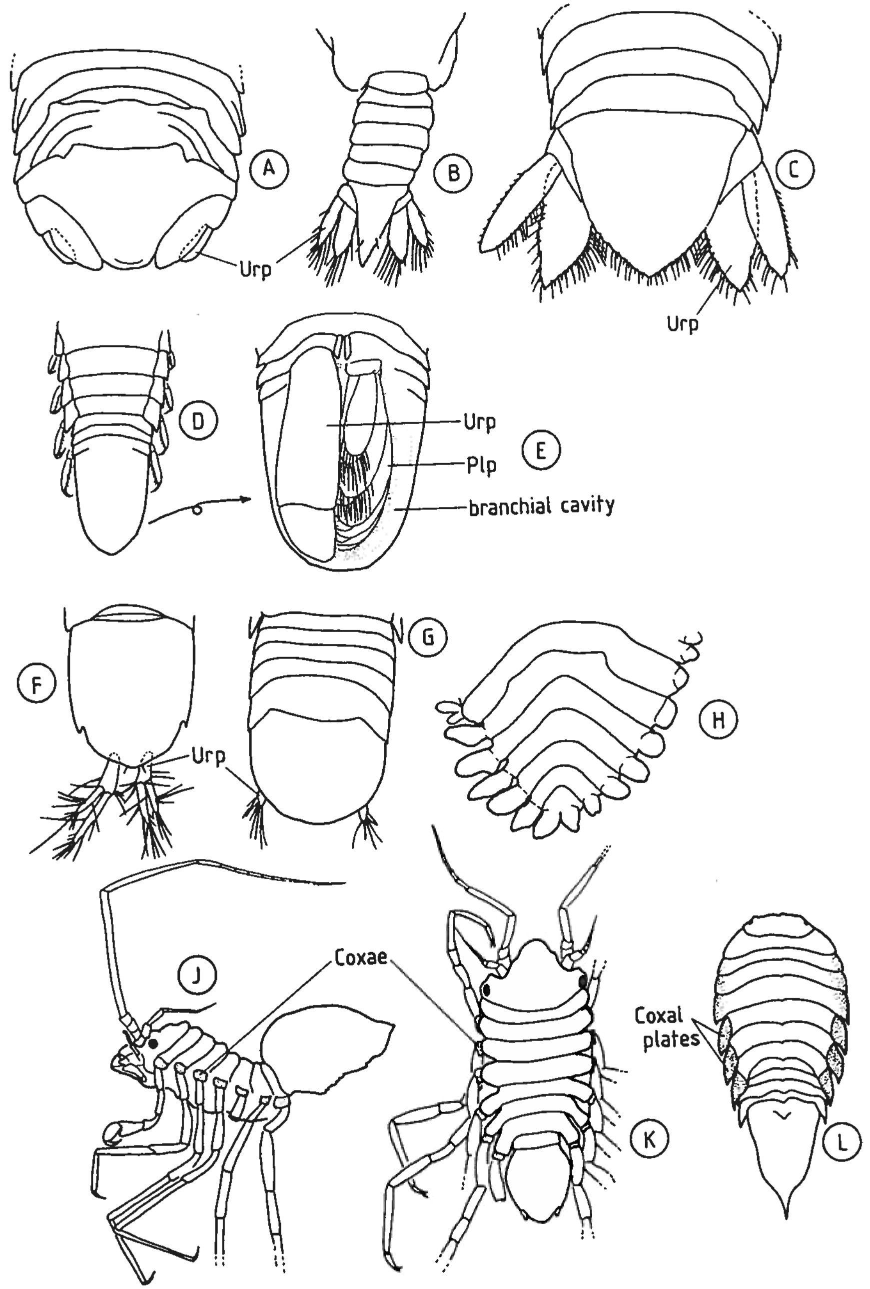

Fig. 3: Features used to identify the suborders.

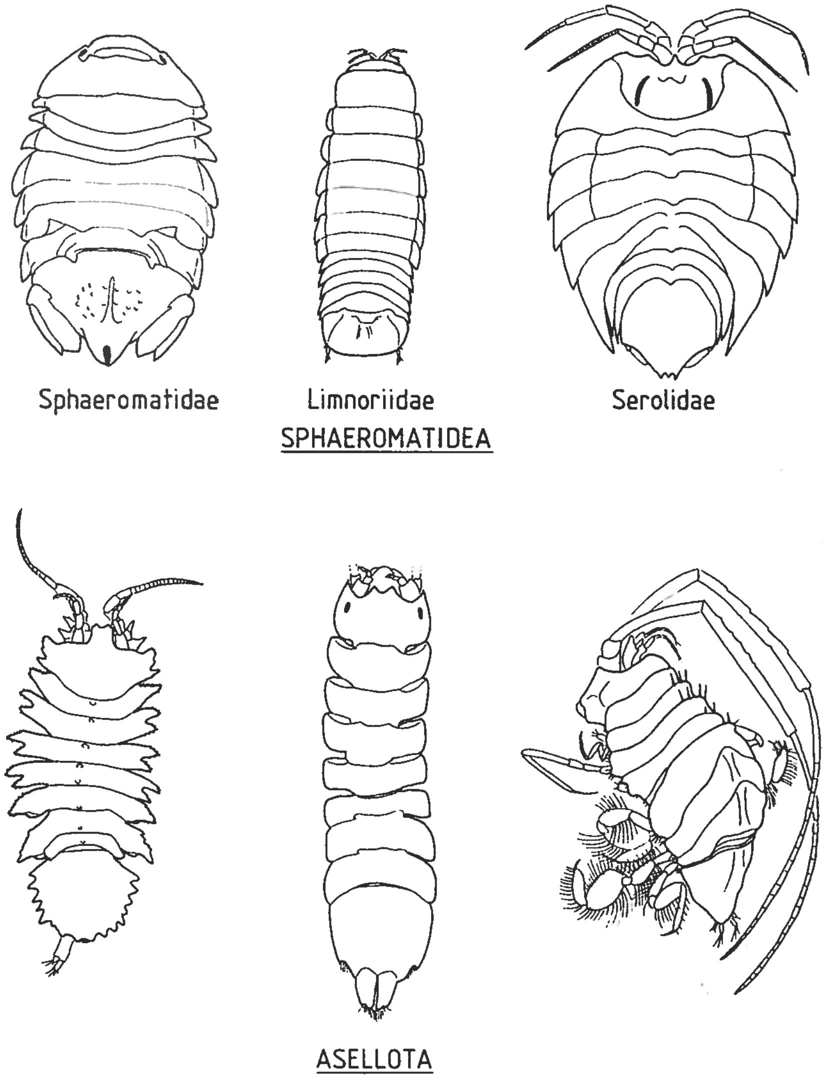

Fig. 4: Representatives of different suborders.

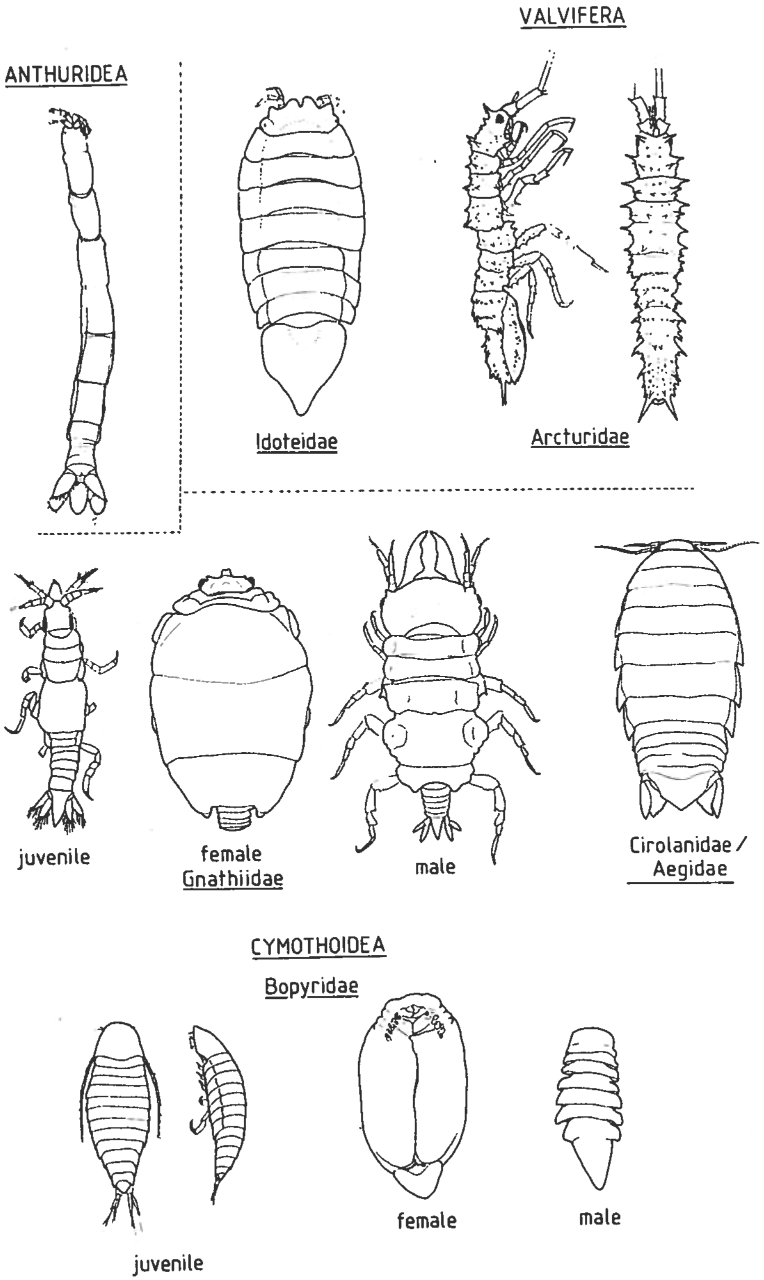

Fig. 5: Representatives of different suborders.

8.3. SUBORDER VALVIFERA SARS, 1882

Conspicuous synapomorphies are the ventrally concave pleotelson, which forms a respiratory chamber, the operculiform, ventral uropods, which consist of an enlarged sympodite and 2 (often only 1) short terminal rami, and the typical first antenna, which has only 2 flagellar articles: a short, ring-like first article and a long, cylindrical second article.

Diagnosis: Body slightly dorsoventrally flattened, with 7 free pereonites and maximally 4 free, short pleonites; pleonites 5 and 6 fused with pleotelson. Coxal plates present on all pereonites, first coxal plate always without dorsal suture between plate and somite, often further plates dorsally fused with tergites. Pleotelson longer than broad, ventrally concave, forming a respiratory chamber for the pleopods. First antenna short, with 3 peduncular and 2 flagellar articles. First flagellar article short, ring-like, second article long cylindrical, with several groups of aesthetascs. Second antenna with 5 peduncular articles and originally multijointed flagellum. Mandible without palp (exception: a species of the non-antarctic genus *Holognathus* Thomson, 1904), pars molaris with broad grinding surface; pars incisiva, lacinia mobilis and setal row present. Maxilla 1 with several spine-like teeth apically on lateral endite; the shorter medial endite with 3 to 4 setulated setae. Maxilla 2 with 3 endites, endites bearing several setae. Palp of maxilliped with 5 articles, endite surpassing second palpal article, basipodite shorter than palp, epipod often longer than basipodite. Anterior 3 pairs of pereopods originally shorter and stouter than pereopods 4 to 7, partly propodosubchelate (family Chaetiliidae). Pleopods all more or less similar, with long marginal swimming setae. Endopod of pleopod 2 of male with rod-like appendix masculina. Uropods inserting lateroventrally on pleotelson, sympodites enlarged and covering ventrally most part of respiratory chamber; apical rami short, forming small valves at the caudal exit of the respiratory chamber. Male genital papillae often basally fused, on ventral intersegmental cuticle caudally of pereonite 7.

8.4. KEY TO THE FAMILIES OF THE SUBORDER VALVIFERA SARS, 1882

Wägele (1989) distinguishes in this suborder 5 families. This is the result of a phylogenetic analysis of the presently known data; future research may yield more exact knowledge resulting in a different system. The following key is designed for all 5 families, of which only the Chaetiliidae, Idoteidae and Arcturidae have representatives in the Southern Ocean.

1a Pereopod 4 much shorter than 5-7 .... **Holognathidae**
1b Pereopod 4 not much shorter 2
2a Pereopods 1-3 strong, stout (subchelate); body slightly dorsoventrally flattened, not cylindrical; pleotelson long, tapering to terminal point; pleopods 1-3 with feather-like setae, usually smaller than pleopods 4 and 5 .... **Chaetiliidae**
2b Pereopods 1-3 of similar size as pereopods 4 to 7, or pereopod 1 stronger, often somewhat shorter than pereopods 2 and 3; pleotelson not tapering to terminal point, of long-oval outline (apex rounded, truncate or pointed); only pleopods 1 and 2 used for swimming, with marginal feater- like setae 3
3a Pereopods 3 and 4 absent .... **Amesopodidae**
3b Pereopods 3 and 4 present 4
4a Pereopod 1 distinctly shorter than pereopods 2 to 7 (Figs. 24B, 30C, 39B); pereonite 1 fused with cephalothorax; genital papillae of male long, medially fused (not separated); first male pleopod sexually dimorphic .... **Arcturidae**
4b Pereopod 1 generally stronger, but not smaller than pereopods 2 to 7; pereonite 1 free (Figs. 5, 9, 11); genital papillae short, separated, only basally fused; first pleopods similar in both sexes .... **Idoteidae**

Remark: In the following the genera Cleantis and Zenobianopsis are still included in the family Idoteidae, not in the Holognathidae.

8.5. Family Chaetiliidae Dana, 1853

Diagnosis: Head strongly produced laterally, moving eyes to a dorsal position; body broadened and dorsoventrally depressed; pereopods 1-3 subchelate or prehensile; cephalothorax in many genera with a pair of lateral notches; pleotelson comparatively long and pointed; uropods with 2 terminal rami; genital papillae of male not fused, separated. In primitive (?) genera 4 free, short pleonites are retained; antenna 1 often with more than 2 flagellar articles; pleopods 1 to 3 with marginal feather-like setae, pleopods 4 to 5 somewhat longer with fewer and shorter setae.

8.5.1 KEY TO THE GENERA OF ANTARCTIC CHAETILIIDAE

1a First antenna prolonged, of similar length as antenna 2; pereonite 7 smaller than preceding segments; adult specimens not longer than 20 mm .... MACROCHIRIDOTHEA
1b First antenna much shorter than antenna 2; pereonite 7 similar to pereonite 6; adult specimens very large, usually between 50 and 100 mm .... GLYPTONOTUS

8.5.2 GLYPTONOTUS Eights, 1852

Chaetiliid with 7 pereonites, free pleonites, long pleotelson. Coxal plates separated with dorsal sutures on pereonites 5-7. As in the other genera of the family the pereopods 1-3 are short and prehensile, the pereopods 4-7 long, with cylindrical articles and many spines. A peculiar feature of *Glyptonotus* (shared with *Austridotea* Nicholls, 1937, a freshwater genus of New Zealand) is the divided eye: eyes are present dorsolaterally on the cephalothorax, but a separated smaller portion lies on the ventral side. In contrast to most of the other genera of the family a lateral notch of the cephalothorax is absent. Mandible with cylindrical pars molaris, antenna 1 clearly shorter than antenna 2 (differences to other genera). Body of gigantic size in comparison to other Valvifera. Only species of *Saduria* from the Arctic Ocean attain also a size of more than 80 mm. Monotypic genus, with single species *G. antarcticus.*

Type species: *G. antarcticus* Eights, 1852

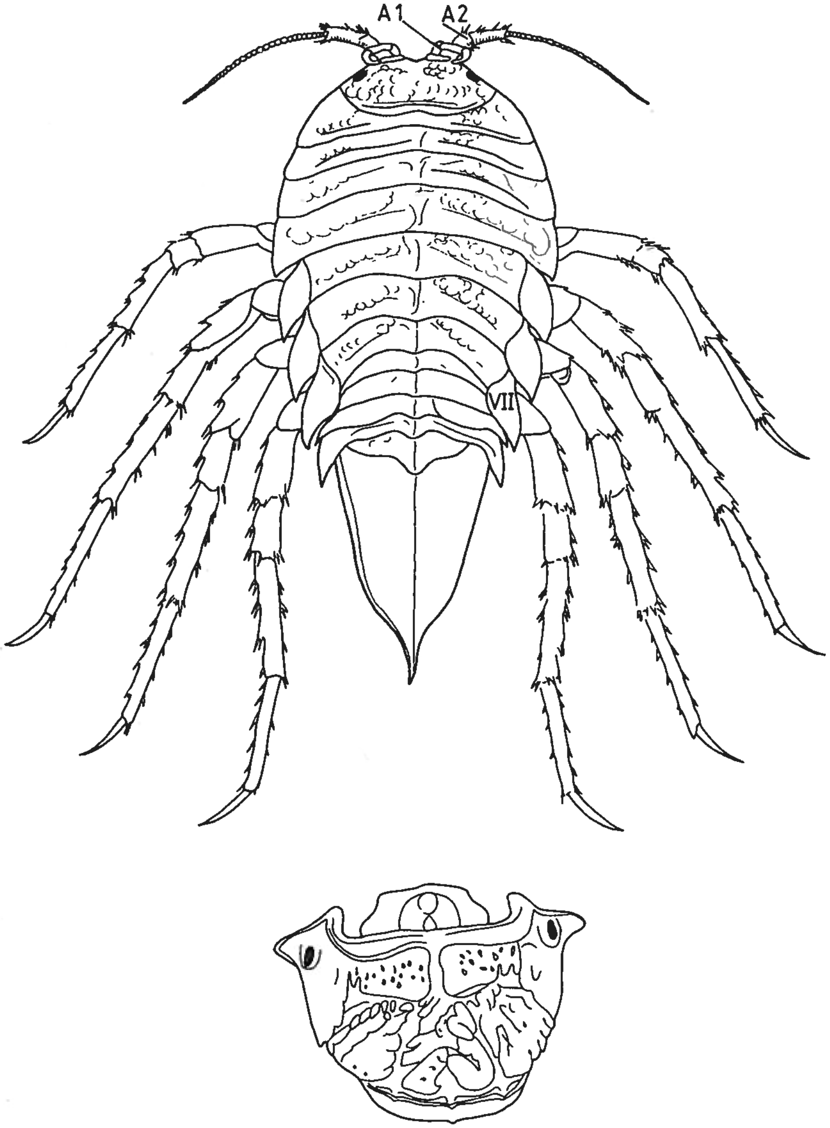

Fig. 6: *Glyptonotus antarcticus* Eights, 1852; dorsal view and enlarged dorsal surface of cephalothorax.

Glyptonotus antarcticus Eights, 1852 (Figure 6)

= *G. acutus* Richardson 1906, 1913, Hodgson 1910, Vanhoeffen 1914
= *G. antarcticus var. acutus* Tattersall 1921, Pesta 1928, Nordenstam 1933, Hale 1937, Stephensen 1947
= *G. antarcticus var. obtusus* Meyer Rochow 1980

Diagnosis: Cephalothorax and somites dorsally sculptured, often with epizoic organisms. Pleonites and anterior part of pleotelson (corresponding to last pleonite) dorsally with medial keel, on each segment with caudally directed point; a high keel also on pleotelson. Lateral eyes visible in dorsal view (except the small, separated ventral portion of the eyes). Antennae short, barely surpassing first pereonite. Maxilliped with 5 broad palpal articles, covering the maxillae. Mandibles stout, with strong, black pars incisiva; left mandible with large, black lacinia mobilis; molar processes comparatively small, grinding surface of yellowish colour. Mandibles covered frontally by a protruding clypeo-labral complex. Pereopods short and prehensile, carpus and propodus with many spines on palm. Pereopods 4-7 long, caudal pereopods longer than pereopod 4; spines arranged in transverse rows on ventral side of legs (directed to the substratum). Coxal plates 4 to 7 with acute caudolateral points; similar (smaller) points formed by epimera of the pleonites 3 and 4. Pleopods hidden in respiratory chamber; pleopods 1-3 with short marginal featherlike setae; pleopods 4 and 5 somewhat longer, without these setae. Male specimens with conspicuous penial papillae ventrally on caudal margin of pereonite 7; appendix masculina of pleopod 2 longer than rami of pleopod 2. Sympod of uropods with mediodistal acute point; two terminal rami are present, the outer covering ventrally the inner ramus.

This species cannot be confounded with other Antarctic isopods.

Coloration: olive-brown, appendages often less dark and yellowish; keels, margins of segments and of coxal plates lighter, with red-brown tint. Colour slightly varying in different populations.
Size: From 9 mm (manca stages) to more than 120 mm.
Distribution (Fig. 7): Antarctic and subantarctic circumpolar, very frequent, but not very abundant; among others known from Ross- and Weddell Sea, South Sandwich I., South Georgia, South Orkneys, South Shetlands, Antarctic Peninsula, archipel of Pointe Géologie (see e.g. Hodgson 1910, Richardson 1913, Vanhöffen 1914, Collinge 1918, Tattersall 1921, Nordenstam 1933, Hale 1937, 1946, Stephensen 1947, Sheppard

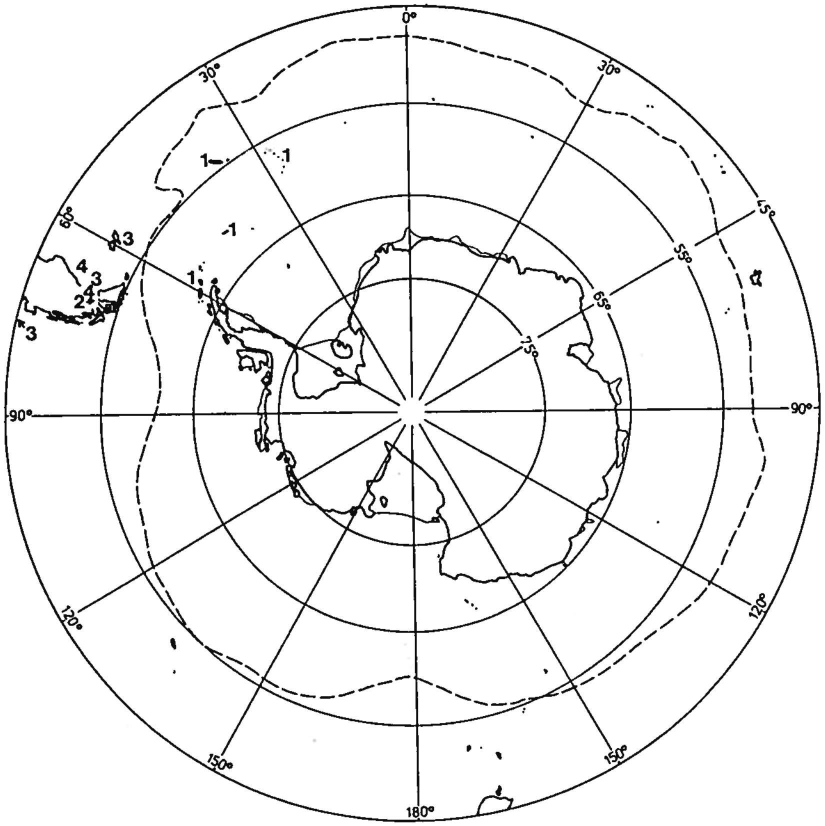

Fig. 7: Distribution of chaetiliids. 1: Northernmost localities of the otherwise circumpolar *Glyptonotus antarcticus*; 2: *Macrochiridothea michaelseni*; 3: *M. stebbingi*; 4: *M. Kruimeli.*

1957, Amar & Roman 1973, Kussakin 1982); littoral to about 600 m, in the Weddell Sea also down to 790 m (unpublished).
Sheppard (1957) remarked that the separation of two species depending on the form of the pleotelson (tip acute or rounded) is "a matter of great difficulty"; it is impossible to draw a line between the different types of morphology. *G. acutus,* erected by Richardson (1906), differed from *G. antarcticus* only in proportion. Sheppard (1957) showed that the ratio of body length to breadth varies, a gradient of morphological types was found. The typical "acutus"-form and the "antarcticus"-form have a similar distribution. The tip of the pleotelson is often acute after moulting and becomes blunt after some time from abrasion; but there are also differences between populations from horizontally or vertically separated localities. Not only the proportion, also the coloration varies.

8.5.3 MACROCHIRIDOTHEA Ohlin, 1901

= *Chiriscus* Richardson, 1911

Diagnosis: Cephalothorax partly immersed in pereonite 1, laterally expanded, margins incised or entire. Eyes dorsal, often absent, not divided into 2 portions. Coxal plates 5-7 dorsally with sutures. Pereonite 7 much narrower than pereonite 6. Pleonites 1-3 completely free; pleonite 1 much narrower than following pleonites. No partial sutures on the remaining pleotelson. Antenna 1 about as long as antenna 2. Molar of mandible absent (except for single seta). Maxillipedal palp of 4 articles, about 3 times as long as endite, penultimate article proximally broad. Pereopods 1-3 subchelate, pereopods 4-7 ambulatory, pereopod 6 the longest; all pereopods with dactylus, usually minute. Genus typical of the colder littoral areas of South America.

Type species: *M. michaelseni* Ohlin, 1901

KEY TO THE ANTARCTIC/SUBANTARCTIC SPECIES

1a Body dorsally tuberculated 2
1b Body dorsally smooth .... **M. michaelseni** (Fig. 8A)
2a Pleotelson anteriorly with tubercles; pleonites 2 and 3 with free lateral margins, pleonite 4 without lateral margin .... **M. stebbingi** (Fig. 8C,D)
2b Pleotelson anteriorly devoid of tubercles; all 4 pleonites with free lateral margins, pleonite 4 smaller than 2 or 3 .... **M. kruimeli** (Fig. 8B)

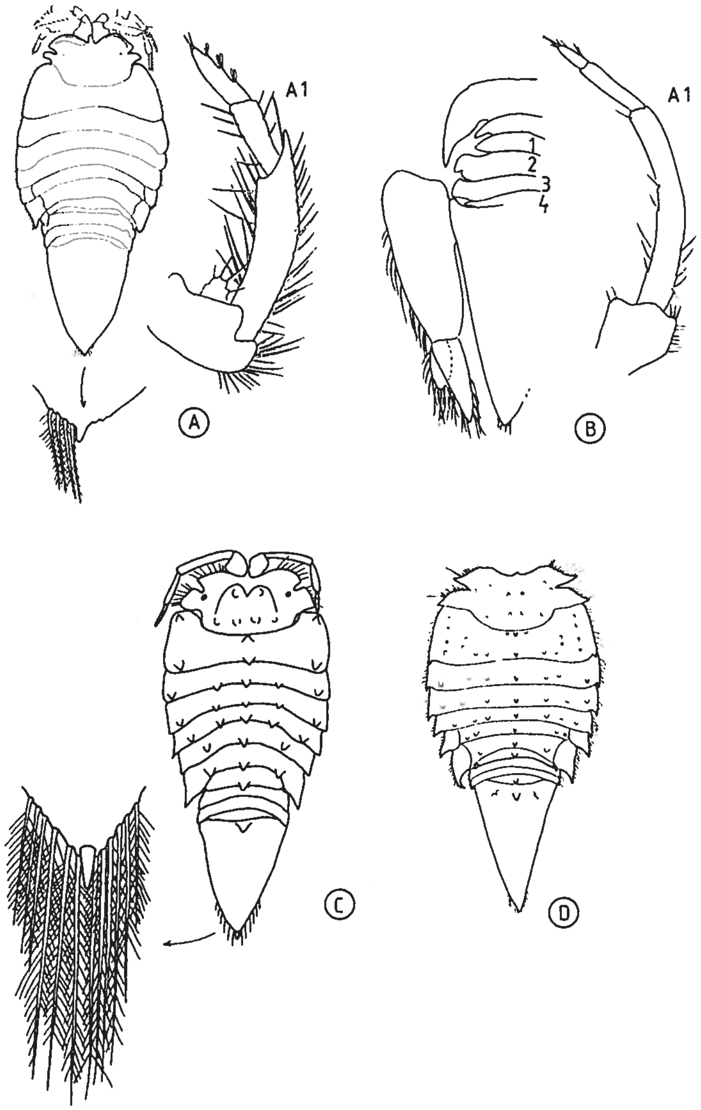

Fig. 8: Species of *Macrochiridothea. A: M. michaelseni* Ohlin, 1901 (after Moreira 1973), detail of pleotelson and antenna 1; *B: M. kruimeli* Nierstrasz, 1918 (after Moreira 1973), pleonites, pleotelson with left uropod, and antenna 1; *C, D:* M. *stebbingi* Ohlin, 1901 after Menzies 1962 *(C)* and Moreira 1973 *(D).*

Macrochiridothea michaelseni Ohlin, 1901 (Figure 8A)

Diagnosis: Body dorsally smooth, lacking tubercles. Very small eyes present near lateral incision of cephalothorax. Second peduncular article of antenna 1 with a strong distomedial projection. Coxal plates visible on pereonites 5 to 7. Pleonites 1 and 4 narrow, without free lateral margin, pleonites 2 and 3 broader, with distinct epimera. Pleotelson with a distinct, narrow apical point on either side of which are 3 to 4 plumose setae.

Length of adult male: 11.5 mm; females smaller.
Distribution (Fig. 7): Magellan Strait, Punta Arenas (Chile), intertidally in exposed sandy beaches as well as in brackish pools, down to 22 m (Ohlin 1901, Menzies 1962, Moreira 1973).

Macrochiridothea stebbingi Ohlin, 1901 (Figure 8C,D)

= *M. stebbingi var. multituberculata* Nordenstam, 1933

Diagnosis: Body dorsally with large tubercles, one tubercle medially on each pereonite and on pleonite 4. Small eyes near lateral incision of cephalothorax. Cephalothorax with frontal row of 2 and posterior row of 4 tubercles along distal margin, lateral margins crenulated and bordered by long setae. Lateral cephalic lobes rounded as in Fig. 8C. Laterocaudal margins of pereonites pointed. Coxal plates distinct on pereonites 5 to 7, pereonite 7 very narrow. Pleonite 1 not visible in dorsal view, pleonites 2 and 3 with free lateral margins, pleonite 4 narrower, without lateral margin. Pleotelson with 1 anterior dorsomedial tubercle. Apex of pleotelson with small spine, with 5 to 6 plumose setae on either side.

Size of adult females 7 to 15 mm, males smaller (4.2 to 10 mm).
Distribution (Fig. 7): Tierra del Fuego, Magellan Strait, Falkland Islands, Southern Chile (41°35'S, 72°58'20"W) (Ohlin 1901, Nordenstam 1933, Sheppard 1957, Menzies 1962b, Hurley & Murray 1968, Moreira 1972, 1973b). Intertidal to 309 m depth, on coarse sediments.

Moreira (1972, 1973) described a *"M. stebbingi"* (Fig. 8D) from off Brazil (Rio Grande do Sul), which obviously is a different species. Moreira's species has no eyes, acute lateral cephalic lobes, and smaller dorsal tubercles.

Macrochiridothea kruimeli Nierstrasz, 1918 (Figure 8B)

Diagnosis: Body dorsally tuberculated, small, feebly pigmented eyes present. Cephalothorax with few short hairs on anterior margin. Coxal plates and pereonite 7 as in foregoing species. Pleonites 1 to 4 with free lateral margins, pleonites 1 and 4 narrower. Apex of pleotelson narrow, acutely pointed, without terminal spine.

Size of adult female 15 mm, males smaller.
Distribution: Magellan Region, Punta Arenas (Chile); between Falkland Islands and the mainland of South America (49.5°S, 66.5°W), probably intertidally and down to 107 m (Nierstrasz 1918, Nordenstam 1933, Sheppard 1957, Menzies 1962b, Moreira 1973b).

8.6. FAMILY IDOTEIDAE SAMOUELLE, 1819

Diagnosis: Valviferans having all 7 pairs of pereopods subsimilar, specialized for clinging or grasping. First pereopod often with somewhat broader propodus. Pereonite 1 not coalesced with cephalothorax. Body generally somewhat depressed, ovate or elongate. Maximally 4 free pleonites, often fused. Antenna 1 shorter than antenna 2, flagellum short. Flagellum of antenna 2 multi-articulated, sometimes reduced to 1 or few articles. Mandibles without palp, maxillipedal palp of 3 to 5 articles. Uropods with 1 or rarely 2 terminal rami. Male genital papillae usually fused basally. Pleopods 1 and 2 modified for swimming and production of the respiratory current, with marginal plumose setae; pleopods 3 to 5 specialized for respiration and osmoregulation, with few or none marginal setae. In comparison with chaetiliids the coxal plates are less broad, the pleotelson is shorter and less acute. (A good synapomorphy is not known for this family). Many genera of this family are weekly defined, of many species only insufficient descriptions are known.

8.6.1 KEY TO THE ANTARCTIC GENERA OF IDOTEIDAE

1a Pereopod 4 very short (Fig. 10: P4), propodus oval; pleotelson cylindrical; all somites of body of similar width 2
1b Pereopod 4 not shorter than pereopods 3 or 5; pleotelson dorsally convex, but broader than high and with caudal point; pereonites 3-5 broader than pereonites 1 and 7 3
2a Uropod with 2 distal rami (Fig. 9: Urp); flagellum of antenna 2 with maximally 3 to 4 articles .... CLEANTIS
2b Uropod with only 1 distal ramus (Fig. 10: Urp); flagellum of antenna multiarticulated (more than 7 articles)............... ZENOBIANOPSIS
3a Flagellum of antenna 2 with only 1 article (Fig. 11: A1); pleon with no free pleonite (all segments fused) 4
3b Flagellum of antenna 2 with more than 1 article; pleon with at least 1 free pleonite.. 5
4a Antenna 2 of similar size as antenna 1, or shorter; coxal plates of anterior segments fused with tergites (no suture visible); pleotelson tapering to pleotelson tapering to caudal point .... EDOTIA

4b Antenna 2 longer than antenna 1; coxal plates 2 to 7 separated by sutures from tergites; pleotelson expanded posteriorly, broader than proximally (Fig. 21A) .... ERICHSONELLA

5a Pleotelson and pleon with 1 incomplete and 2 complete sutures (2 "free" pleonites) (Fig. 21B-D) .... IDOTEA

5b Pleotelson and pleon with 2 incomplete and 1 complete suture (Fig. 22) .... PARIDOTEA

Remark: According to new results of Dr. G. Poore (personal communication) the genera Cleantis and Zenobianopsis might be transferred to the family Holognathiidae.

8.6.2 CLEANTIS Dana, 1849

Diagnosis: Body, including pleotelson, cylindrical, with straight lateral margins. Cephalothorax with anterolateral eyes. Caudal end of pleotelson forming a flat disc. Coxal plates of pereonites 2 to 7 distinctly separated from tergites. Pleon composed of 3 free pleonites, pleotelson with lateral sutures of a fourth, fused pleonite. Antenna 2 short and stout, but longer than antenna 1; flagellum with one or few articles, first article large, sometimes bearing further 1-3 small articles. In males large flagellar article subdivided, with up to 4-5 joints. Maxillipedal palp with 5 articles. First three pereopods anteriorly directed, stout; fourth pereopod short, directed laterally; pereopods 5 to 7 longer, directed caudally, more slender than pereopods 1-3. Uropod with 2 terminal rami, lateral ramus larger than medial one.

Until now only 1 species has been found in the Patagonian region; genus not known from Antarctica.

Type species: *C. linearis* Dana, 1849

Cleantis granulosa Heller, 1861 (Figure 9A)

Diagnosis: Cephalothorax broader than long, frontal margin in the middle slightly sinuate. A transversal groove in front of the eyes, a curved groove at the posterior margin. Coxal plates 2 to 4 small, subrectangular, on the last three segments triangular, pointed and visible from above.

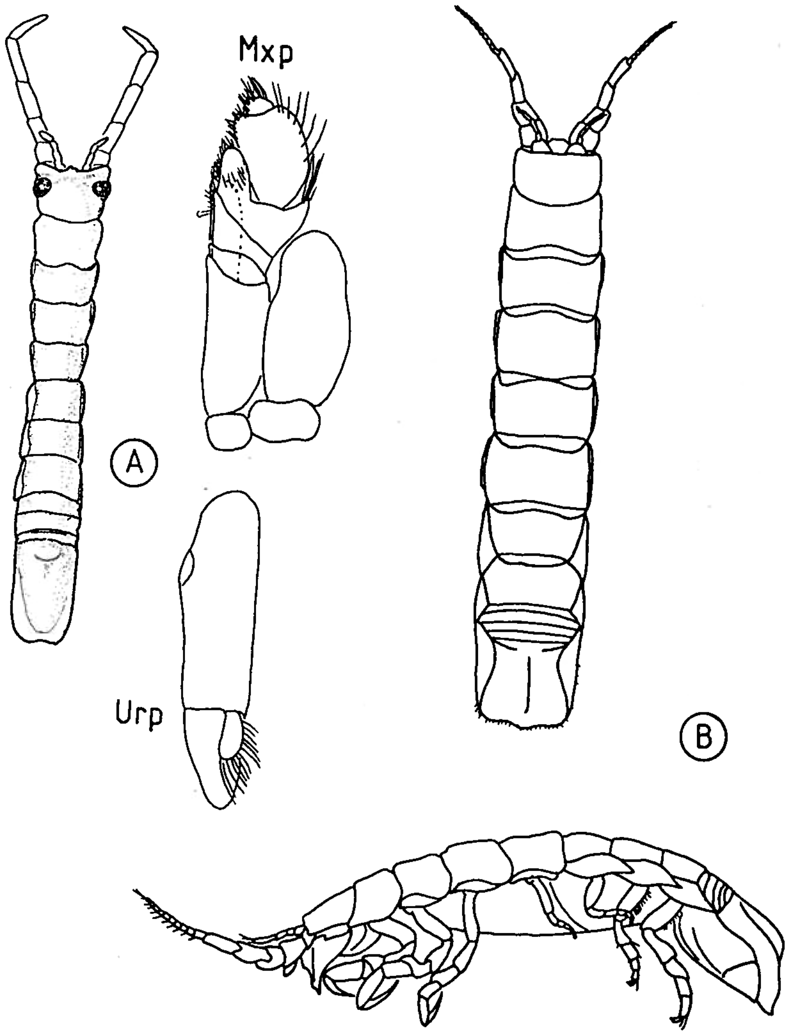

Fig. 9: *A: Cleantis granulosa* Heller, 1861, with maxilliped (Mxp) and uropod (Urp) (after Ohlin, 1901); *B: Zenobianopsis caeca* Hale, 1946, dorsal and lateral view (after Hale 1946).

Pleon with three free pleonites, a fourth pleonite indicated by lateral sutures on pleotelson. Pleotelson very faintly granulate, its distal margin slightly concave in the middle. Antenna 2 with a single-jointed, ventrally

densely setiferous flagellum; ventral surface of the last peduncular joint of antenna smooth. Palp of maxilliped with 5 articles, the last article being minute. Pereopods as typical of the genus, the fourth pair being the smallest. Uropods each with 2 terminal rami. Lateral ramus larger, provided with a long plumose seta at its upper proximal angle; medial ramus subrectangular, furnished with plumose setae on its dorsal and distal margins. Length of adult specimen about 15 to 25 mm.
Distribution: Argentina, south of La Plata, 36°50'S, 55°54'W. Tierra del Fuego; St. Paul (Heller 1861, Ohlin 1901, Nordenstam 1933).

8.6.3. ZENOBIANOPSIS Hale, 1946

Diagnosis: Body long and slender, with almost parallel sides. Cephalothorax firmly connected with pereonite 1, wider than long, anterior margin almost straight. Eyes absent. Coxal plates not fused with tergites 2 to 7, plates 5 to 7 larger than anterior plates. Pleon with 2 to 5 short free pleonites. Caudal end of pleotelson forming round disc; lateral margins of pleotelson curved up, particularly in posterior half. Antenna 2 longer than antenna 1, with multiarticulated flagellum (more than 7 articles). Maxilliped with five-jointed palp. Pereopods ambulatory, as in Cleantis: first pereopod prehensile, pereopods 2 and 3 similar, but less stout; fourth pair shortest; pereopods 5 to 7 caudally directed, more slender than pereopods 1 to 3. Uropod with only a single ramus. Genus with only 2 Antarctic species.

Type species: *Z. caeca* Hale, 1946

KEY TO THE ANTARCTIC SPECIES OF ZENOBIANOPSIS

1a Caudal margin of pleotelson nearly straight; 4 pleonites discernible in dorsal view, separated by sutures .. *Zenobianopsis caeca* (Fig. 9B)
1b Caudal margin of pleotelson rounded; only 2 pleonites completely separated by sutures, further 2 pleonites indicated by lateral sutures on pleotelson .... *Zenobianopsis rotundicauda* (Fig. 10, below)

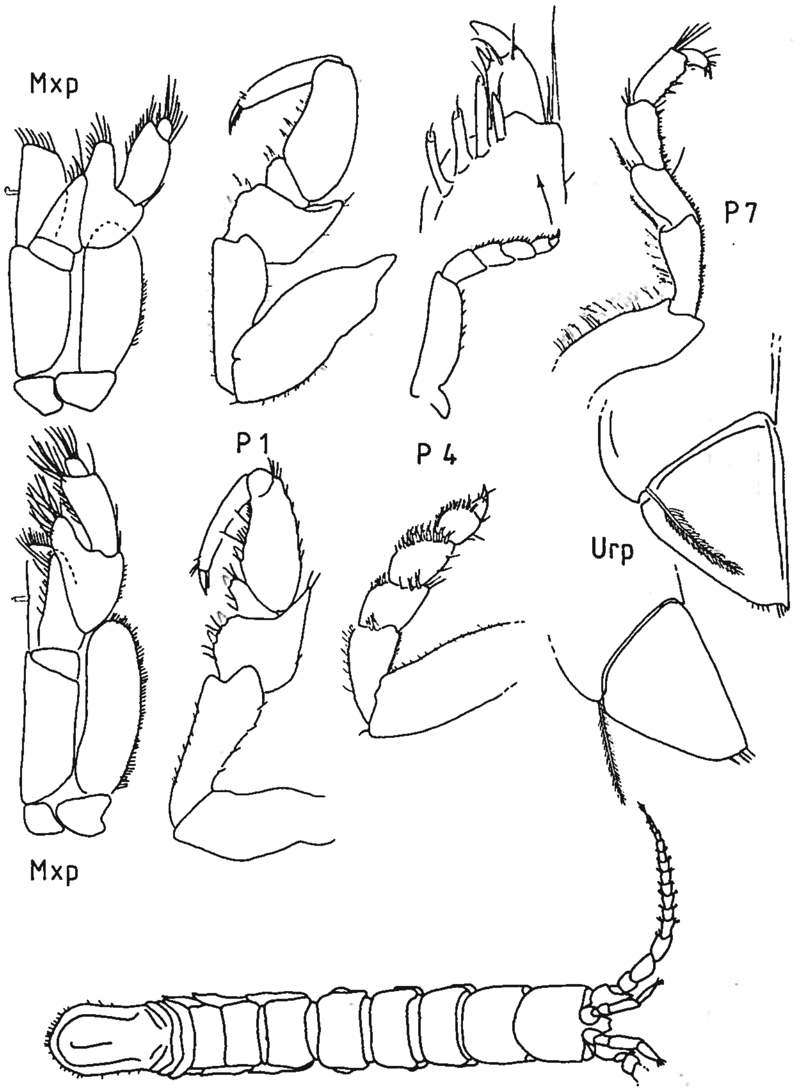

Fig. 10: Appendages of *Zenobianopsis caeca* Hale, 1946 (after Hale 1946): maxilliped (Mxp), pereopods 1, 4 and 7 (P 1, P 4, P 7), tip of uropod (Urp), in comparison with appendages of *Z. rotundicauda* Kussakin, 1967 (row below) (after Kussakin 1967); below: dorsal view of *Z. rotundicauda*.

Zenobianopsis caeca Hale, 1946 (Figures 9B, 10)

Diagnosis: Body narrow, with almost parallel margins, more than five times as long as greatest width. Dorsally and on sides with shallow irregular coarse pits and grooves. Cephalothorax half as wide as long, eyes absent. Coxal plates 2 to 7 present, plates 6 and 7 visible in dorsal view. Pleon and pleotelson together about one third as long as pereon, with 4 separated pleonites, fifth pleonite indicated by lateral sutures. Pleotelson with a median ridge for greater part of length; ending abruptly in a slightly concave terminal surface; sides bent upwards. Second antenna longer than first, with 5 peduncular and 10 flagellar articles (in female). Mandibles very prominent in lateral view of cephalothorax. Maxilliped with 5 palpal articles, epipod suboval, 2 times as long as wide. Pereopods 1 to 3 subchelate and similar except that the carpus of pereopod 1 is much shorter than in P2 and P3. Fourth pereopod less than half as long as third, fifth pereopod slightly longer. Distal ramus of uropod nearly triangular, slightly wider than long.

Zenobianopsis rotundicauda Kussakin, 1967 (Figure 10)

Diagnosis: Similar to *Z. caeca,* but anterior margin of head somewhat concave, pleon with only 2 completely separated pleonites. Coxal plates 2 to 7 present, posterior plates 5 to 7 visible also in dorsal view. Pleonite 5 completely fused to pleotelson, without traces of sutures. Pleotelson with distinct longitudinal medial carina; lateral margins bent upwards; posterior margin rounded, bearing numerous setae. Antenna 2 stouter than in *Z. caeca*, fifth peduncular article longer than fourth article; flagellum with 12 articles (in male). Pereopod 1 subchelate, pereopods 2 and 3 with narrower propodus and longer carpus. Pereopod 4 shortest, with long basis, the other articles very short. Pereopods 5 to 7 more slender than the anterior pereopods.

Colour of alcohol-fixed specimen a dirty white.
Locality (Fig. 12): Only known from Indian sector of Antarctica, off Prince Edward Coast (67°17'4"S 45°14'E), at depths between 640 and 1180 m (Kussakin 1967).

8.6.4. EDOTIA Guérin-Méneville, 1843

= *Desmarestia* Nicolet, 1849
Epelys Dana 1852; Harger 1878
Edotea Ohlin 1901, Richardson 1905, Menzies & Barnard 1959

Diagnosis: Body oval, broadest at pereonites 3 to 5. Coxal plates of anterior segments fused to tergites (exception: *E. bilobata*), not fused on pereonites 5-7 (Sheppard 1957). Pleon composed of up to 3 pleonites plus incisions of another pleonite laterally on pleotelson. Often all pleonites fused with pleotelson to a single plate. Palp of maxilliped with three articles. Flagellum of antenna 2 rudimentary, consisting of single thick article with minute apical article. All pereopods subsimilar, ambulatory, with stout propodus. Uropods uniramous.

Colour white, with no trace of pigmentation.
Length: 17 mm
Locality (Fig. 12): Only known from off Enderby Land, 66°45'S 62°3'E, depth 219 m (Hale 1946).

Type species: *E. tuberculata* Guérin-Méneville, 1843

KEY TO ANTARCTIC AND SUBANTARCTIC SPECIES OF EDOTIA

1a Eyes on slender lateral stalks of cephalothorax .... *Edotia oculata* (Fig. 11)
1b Eyes on round lobes or on flat sides of cephalothorax 2
2a Anterior pleotelson dorsomedially with 3 transverse grooves, that do not reach the lateral areas of pleotelson; eyes small, not on lobes; cephalothorax dorsally with many small tubercles .... *E. tuberculata* (Fig. 13)
2b Anterior pleotelson without these 3 transverse grooves or sutures 3
3a Cephalothorax of hammerhead-form, eyes on large lobes; 3 large acute tubercles medially on cephalothorax .... *E. pulchra* (Fig. 14)
3b Cephalothorax of 'normal' form 4
4a Pleotelson with lateral points of the first, still visible pair of pleonal epimera; pleotelson tapering to acute apex . *E. magellanica* (Fig. 15)

4b Pleotelson without anterior epimera 5
5a Eyes on round lateral lobes of cephalothorax 6
5b Eyes on flat sides of cephalothorax 7
6a Eyes small; cephalothorax with 2 mediofrontal lobes like blunt horns .... *E. bilobata* (Fig. 16)
6b Eyes large; cephalothorax without 'horns' .... *E. oculopetiolata* (Fig. 17)
7a Eyes small; coxal plates laterally yes small; coxal plates laterally protruding, separated from each other .... *E. corrugata* (Fig. 18)
7b Pleotelson long, pentagonal, with parallel anterolateral margins; eyes small; coxal plates not separated .... *E. lilljeborgi* (Fig. 20A)
7c Eyes small; coxal plates laterally rounded, not much protruding, in anterior pereonites not separated; oval pleotelson with clear sutures of 3 anterior pleonites and a fourth pleonite indicated by lateral sutures .... *E. doellojuradoi* (Fig. 20B)

Edotia oculata Ohlin, 1901 (Figure 11)

Diagnosis: Body oval, depressed, due to protruding coxal plates and stalked eyes of characteristic outline. Small eyes on long lateral cephalic stalks. Cephalothorax with 2 shallow dorsomedial elevations. Body broadest at pereonite 4. Pleotelson oval, distally tapering to a rounded point, dorsally convex, with a deep transverse groove in the area behind the three first fused pleonites. Body surface smooth, with short hairs. Antenna 1 longer than antenna 2, flagellum composed of 1 article, nearly as long as third article. Antenna 2 with 5 peduncular articles and a small flagellar article. Maxilliped with three palpal articles, the first of which is smallest, last article broad, outer and apical margins rounded; endite with 5 to 6 spinulose spines. Pereopods rather long and slender; first pair shortest, with oval propodus, on palm a row of spines; fourth and fifth pereopods longest. Uropod vaulted, with a deep groove running along the lateral margin; terminal ramus elongate triangular.

Colour: gray-whitish.
Length: 7 to 9 mm.
Distribution (Fig. 12): Off the coast of Argentina, from 38°S (56°W) to 52°S (64-66°W), in 100 to 219 m depth (Ohlin 1901, Sheppard 1957). Not known from south of the Antarctic Convergence.

Edotia tuberculata Guérin-Méneville, 1843 (Figure 13)

= *Anisotus falklandicus* White 1847
? *Desmarestia chilensis* Nicolet & Gay 1849
? *Epelys annulatus* Dana 1853
Edotia ? *chilensis* Miers 1883
Edotia tuberculatus Stebbing 1914

Diagnosis: Body long oval, flattened, margins continuous with small incisions between coxal plates. Cephalothorax with small dorsolateral eyes, 2 pairs of dorsal shallow elevations covered with tiny tubercles. Last

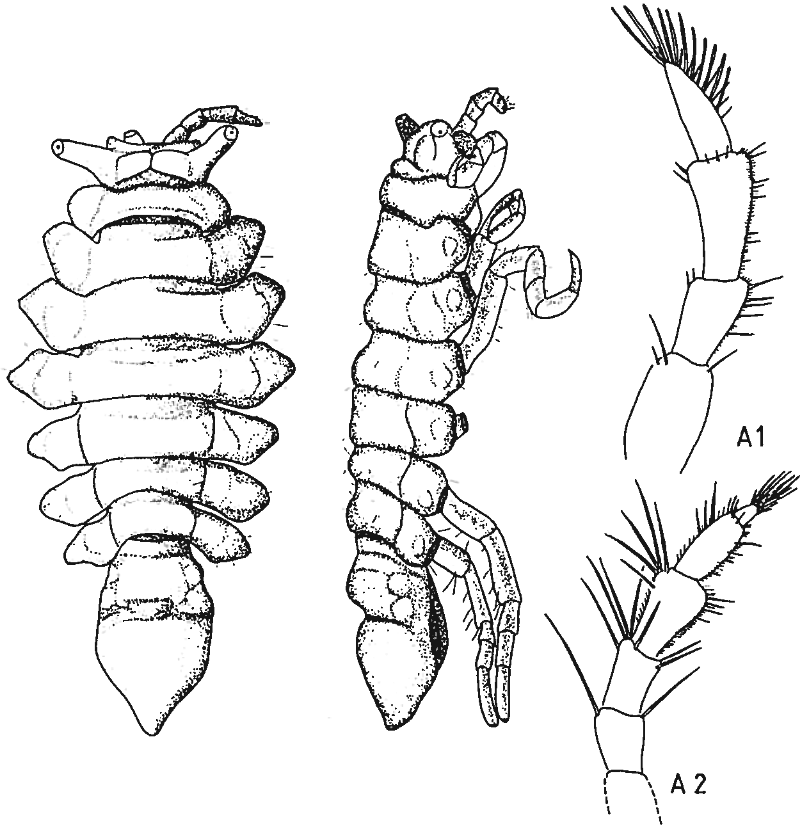

Fig. 11: *Edotia oculata* Ohlin, 1901 (after Brandt 1990), with antenna 1 and antenna 2.

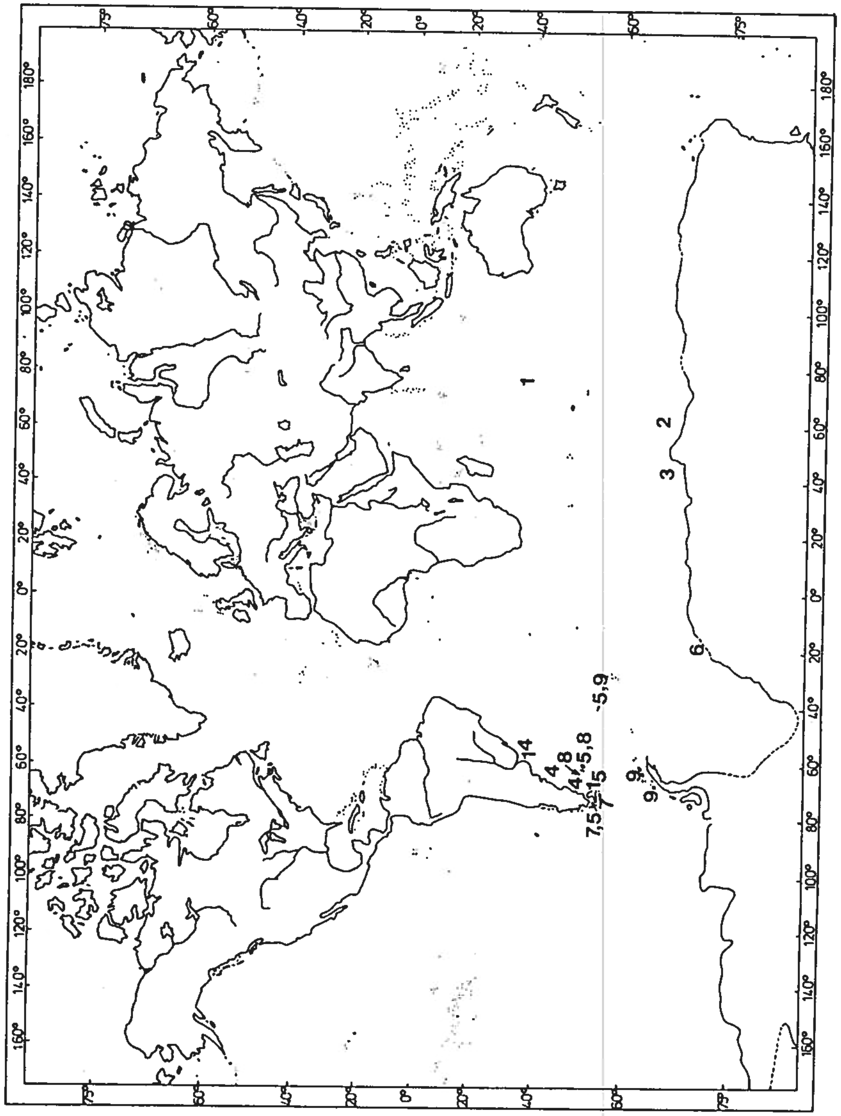

Fig. 12: Distribution of idoteid species. *1: Cleantis granulosa; 2: Zenobianopsis caeca; 3: Z. rotundicauda; 4: Edotia oculata; 5: E. tuberculata; 6: E. pulchra; 7: E. magellanica; 8: E. bilobata; 9: E. oculopetiolata.*

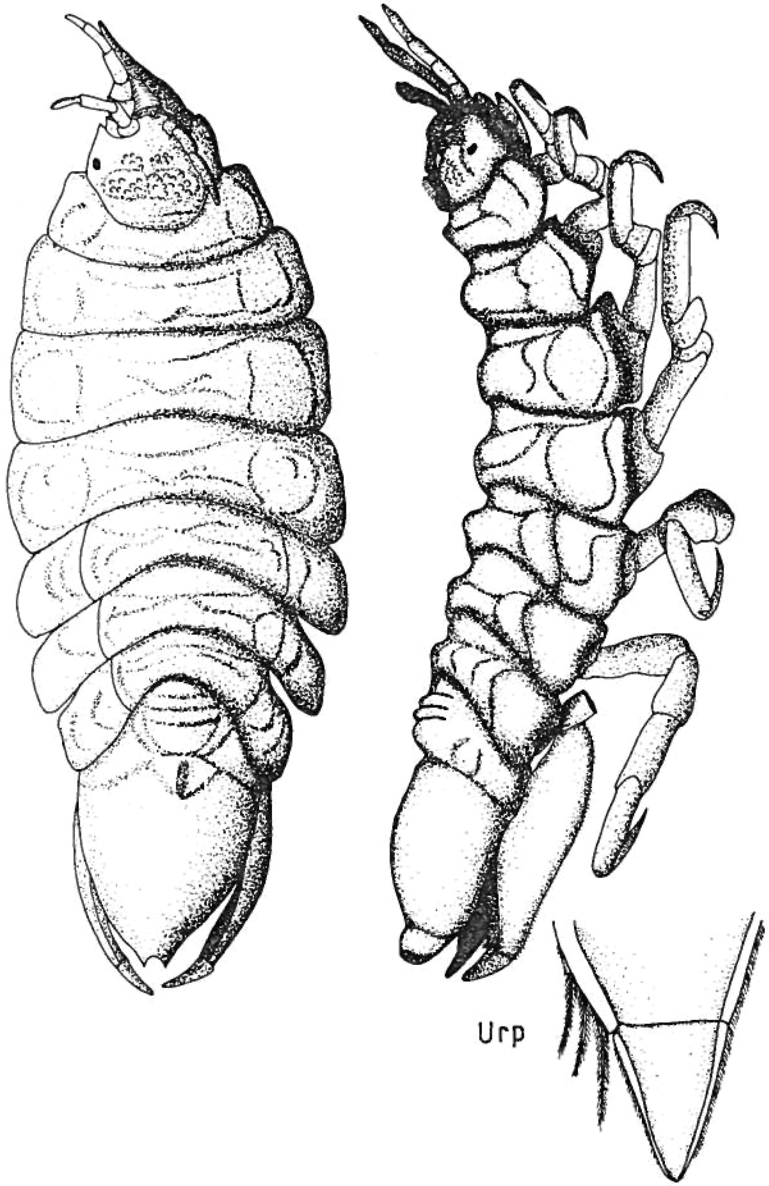

Fig. 13: *Edotia tuberculata* Guérin-Méneville, 1843 (after Brandt 1990), with tip of uropod (after Nordenstam 1933).

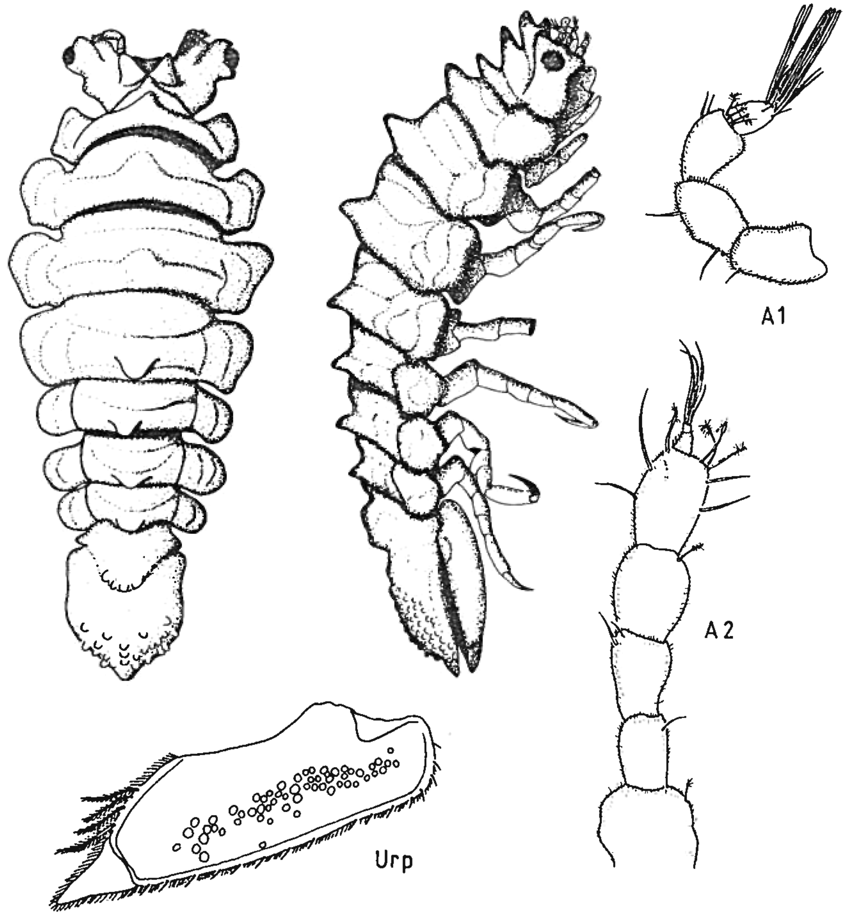

Fig. 14: *Edotia pulchra* Brandt, 1990 (after Brandt 1990), with both antennae and uropod.

pereonite covering lateral borders of anterior pleotelson, dorsomedially on pleotelson of this area three incomplete transverse grooves indicating the fusion of 3 pleonites. Pleotelson dorsally convex, apex with concave border, where a funnel for the respiratory current is formed by pleotelson and uropods. Dorsal surface of pereonites sculptured (see lateral view Fig. 13). Second antenna longer than first, with 3 flagellar articles; first flagellar article nearly six times as long as second, third very small.

Mouthparts and pereopods in general similar to other species of the genus. Terminal ramus of uropods rather small, triangular. Colour: dorsally dark olivaceous, ventrally greyish. Younger specimens much lighter, sometimes nearly white.

Length: up to 30 mm.
Distribution (Fig. 12): Very common in the Strait of Magellan and the Fuegian Archipelago; Falkland Islands; South Georgia; in 5 to 310 m depth (Miers 1883, Dollfus 1891, Ortmann 1911, Giambiagi 1925, Brandt 1990).

Edotia pulchra Brandt, 1990 (Figure 14)

Diagnosis: Body long-oval, broadest at pereonite 3, with characteristic hammerhead-cephalothorax. Eyes on lateral lobes of cephalothorax; dorsally 3 acute 'horns' on head (Fig. 14). Further acute dorsal elevations medially on each pereonite; pleotelson with deep transverse groove in anterior part; dorsally convex, with round tubercles. Coxal plates rounded, protruding laterally, separated from each other; pereonites without dorsal scales or tubercles. Antennae very short, antenna 2 longer than antenna 1. Antenna 2 with 2 tiny flagellar articles. Pereopod 1 with long basis, carpus shorter than in other pereopods, propodus and dactylus forming subchela; medial surface with longitudinal row of setae. Pereopods 2 and 3 also propodosubchelate, with long rectangular carpus; pereopod 4 more slender than pereopod 3; pereopods 5 to 7 with cylindrical propodus, longer than anterior pereopods. Uropod basis with small tubercles on ventral surface; terminal ramus elongate triangular.

Length: 10 mm (female).
Locality (Fig. 12): Weddell Sea, 72°27.28'S 17°32.94'W, depth 455-473 m (Brandt 1990).

Edotia magellanica Cunningham, 1871 (Figure 15)

Diagnosis: Body long-oval, flattened, margins continuous. Eyes small, on flat sides of cephalothorax. Dorsocaudal margins of pereonites elevated. Pleotelson tapering to rounded apex, dorsally convex, anterior part with 3 transverse shallow grooves indicating the fusion of 3 relatively long

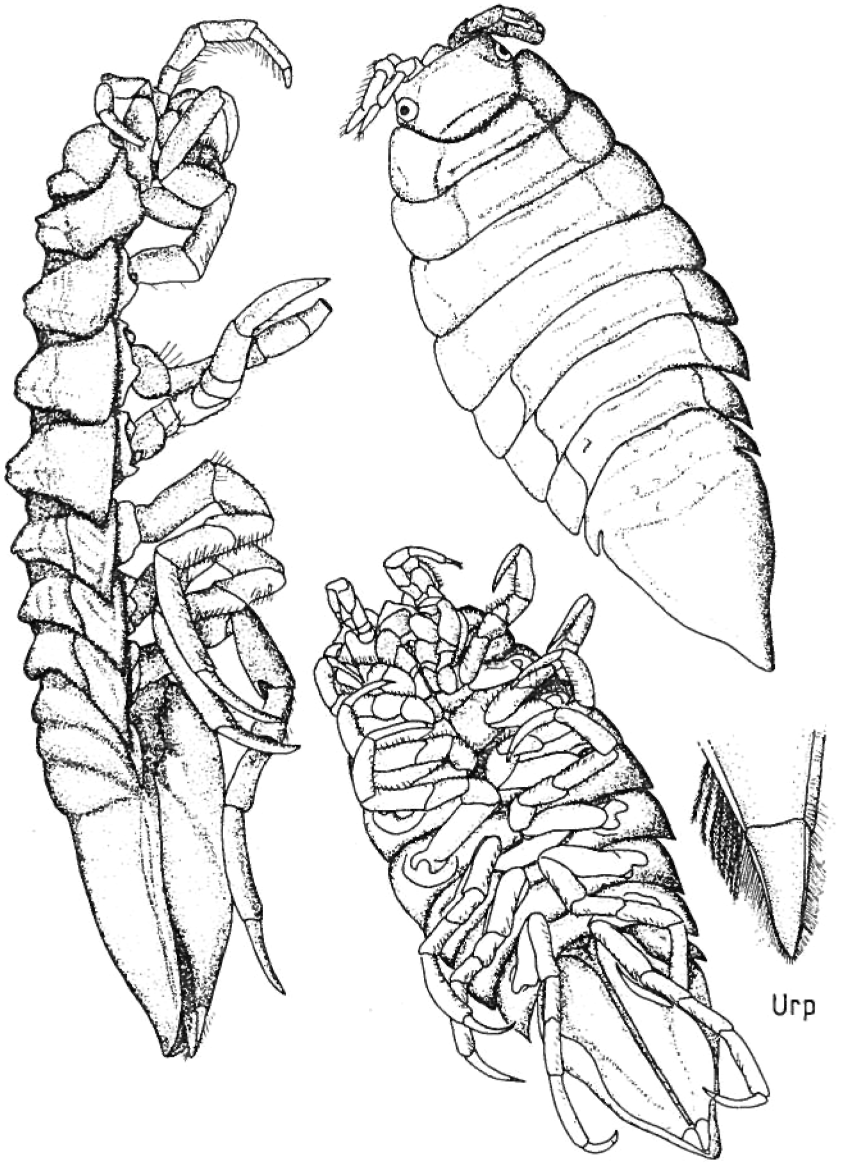

Fig. 15: *Edotia magellanica* Cunningham, 1871 (after Brandt 1990, with tip of uropod (after Nordenstam 1933).

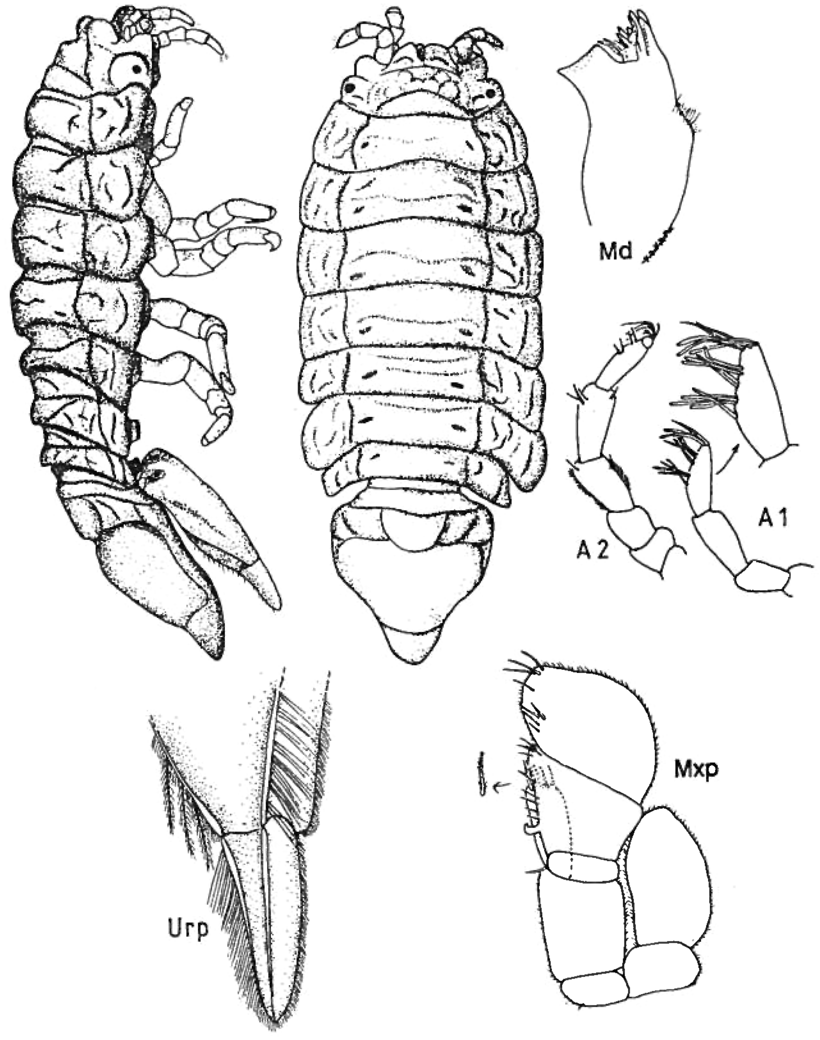

Fig. 16: *Edotia bilobata* Nordenstam, 1933 (after Brandt 1990, and Nordenstam 1933), with mandible, maxilliped, both antennae, and tip of uropod.

pleonites; first pleonite with still visible, separated lateral epimera. Second antenna longer than antenna 1. Mouthparts and pereopods rather similar to those of *E. tuberculata* (Ohlin 1901).

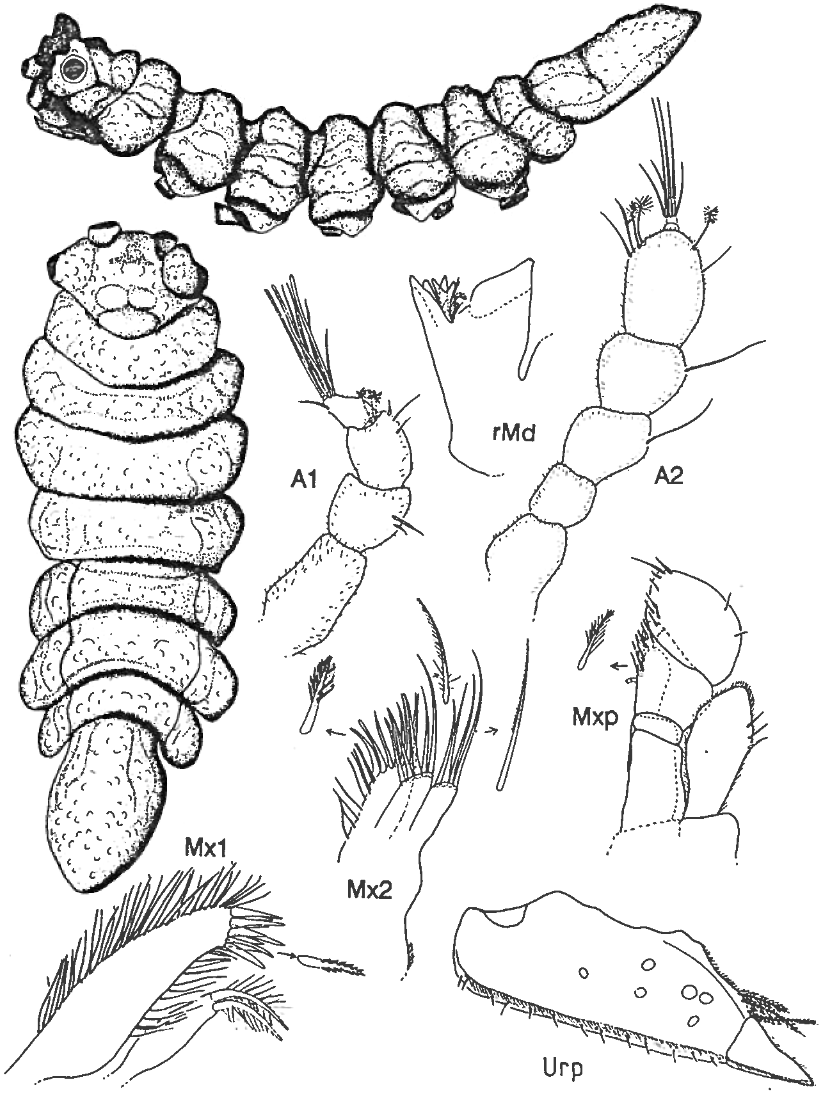

Fig. 17: *Edotia oculopetiolata* Sheppard, 1957 (after Brandt 1990), with details of mouthparts (rMd = right mandible, Mx1, 2 = maxilla 1, 2, Mxp = maxilliped), both antennae (A 1, A 2), and uropod (Urp).

Length: up to 17.5 mm
Colour: brown-yellowish, with darker shadows
Distribution (Fig. 12): Strait of Magellan, Tierra del Fuego (Cunningham 1871, Giambiagi 1925, Nordenstam 1933, Nierstrasz 1941); down to 58.5 m.

Edotia bilobata Nordenstam, 1933 (Figure 16)

Diagnosis: Body long-oval, flattened, coxal plates with continuous lateral margins. Cephalothorax with small dorsolateral eyes on round lobes; frontal margin between the antennae furnished with 2 rounded lobes ('horns'). Pereonites dorsally smooth, but with shallow transverse groove and on coxal plates longitudinal grooves. All coxal plates separated from tergites by sutures. First pleonite indicated by a transverse groove, followed caudally by a distinct semi-circular dorsomedian elevation; caudal part of pleotelson dorsally convex, except lateral margins and tip; apex broadly rounded. Antenna 2 slightly longer than antenna 1, with three-jointed flagellum; first flagellar article narly as long as last peduncular article, articles 2 and 3 small. Maxilliped with three-jointed palp, endite apically with 5 setulated spines. Lower part of uropod bent upwards, forming a longitudinal channel; terminal ramus about three times as long as broad, distally narrowly rounded.

Length: up to 10 mm.
Colour: whitish to yellowish.
Distribution (Fig. 12): Falkland Islands, and between Falklands and Argentina, depth 36 to 341 m (Nordenstam 1933, Sheppard 1957).

Edotia oculopetiolata Sheppard, 1957, (Figure 17)

= *Edotia tuberculata* Nordenstam 1933

Diagnosis: Body long-oval, flattened, pereonites with rounded margins. Dorsal surface shallowly sculptured (Fig. 17), with small tubercles. Cephalothorax with large lateral eyes on round lobes. Pleotelson oval, dorsally convex, but flatter than in other species of the genus. Antenna 1 considerably longer and stouter than antenna 2. Flagellum of antenna 1 consisting of a terminal article somewhat shorter than the last peduncular article. Antenna 2 with tiny, two-jointed flagellum. Palp of maxilliped three-jointed, distal article broadest, medially fringed with short setae. Outline of pereopods as in other species (for details see Brandt 1990). Uropod with acute triangular terminal ramus.

Size: up to 11 mm.
Distribution (Fig. 12): South Shetland Islands and adjacent areas, Palmer Archipelago, South Georgia, in 18 to 391 m (Sheppard 1957, Brandt 1990).

Edotia corrugata Sheppard, 1957 (Figure 18)

Diagnosis: Body long-oval, coxal plates laterally protruding and distinctly separated from each other; male narrower and more flattened than female. Eyes small, with little pigment, on flat sides of cephalothorax; posterior part of cephalothorax raised and separated from the anterior part by a transverse groove; in the middle of the latter a single, rounded protuberance. Caudal margins of pereonites elevated; body surface smooth, without tubercles. Pleotelson elliptical, with rounded tip, dorsally high, convex; anterior third separated by transverse groove from posterior part. Antenna 1 longer than antenna 2, last article about half the length of third peduncular article. Flagellum of antenna 2 rudimentary, consisting of a single tiny article. Pereopod 1 subchelate, shorter and stouter than remaining pereopods, remaining pereopods (according to Sheppard 1957) rather similar to each other. Inner margin of uropod bent upwards to form a dorsally directed flange which is continuous with the similarly formed ramus. Ramus elongate triangular.

Length: up to 6.5 mm.
Locality (Fig. 19): off Patagonia, 49°29'S, 66°27'W, 107 to 104 m (Sheppard 1957).

Edotia lilljeborgi Ohlin, 1901 (Figure 20A)

Diagnosis: Body long-oval, broadest at third pereonite, coxal plates not separated from each other, dorsal surface smooth. Cephalothorax small, a little longer than pereonite 1, but not so broad. Eyes small, on flat sides of cephalothorax. Pleotelson rather long, with a lateral notch as indication for the fusion of the first pleonite; apex insinuated by a small notch. Antenna 1 shorter than antenna 2. Flagellum of the latter short, with

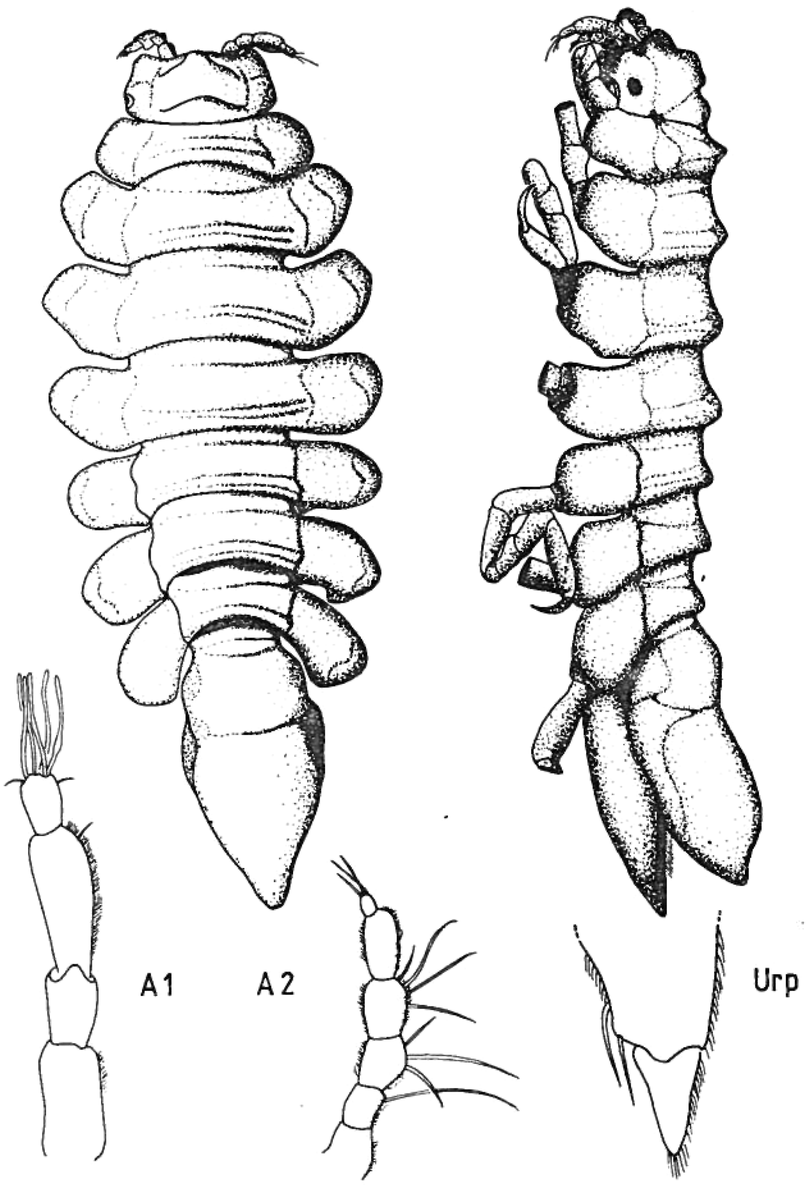

Fig. 18: *Edotia corrugata* Sheppard, 1957 (after Brandt 1990), with both antennae and tip of uropod.

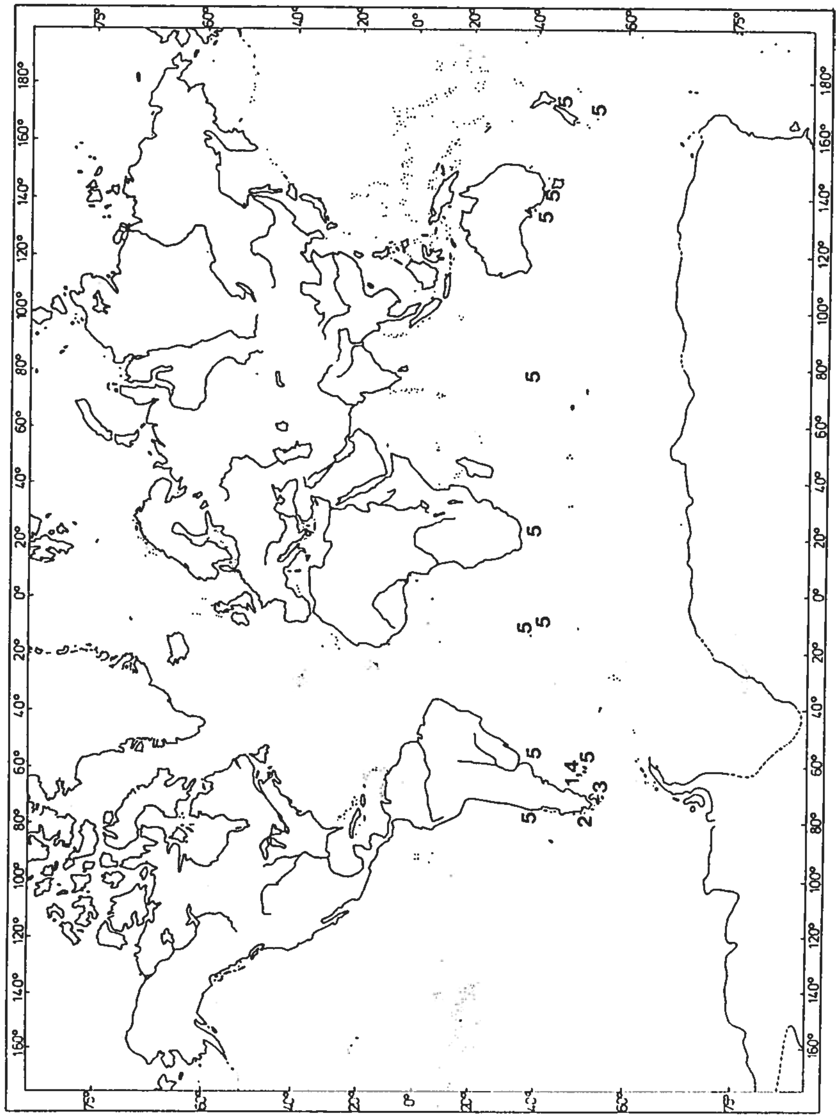

Fig. 19: Distribution of idoteid species. *1: Edotia corrugata, 2: E. lilljeborgi, 3: E. doellojuradoi, 4: Erichsonella nordenskjöldi, 5: Paridotea ungulata.*

three articles, the last one minute. Mouthparts as in other species, maxilliped with three palpal articles, last article broadest and of round outline. Uropod with triangular terminal ramus, apex rounded.

Colour: grey-yellowish with shadows of brownish-violet on cephalothorax and on pleotelson.
Length: up to 5 mm.
Locality (Fig. 19): Only known from Smyth Channel (Puerto Bueno, western Patagonia) (Ohlin 1901).

Edotia doellojuradoi Giambiagi, 1925 (Figure 20B)

Diagnosis: Body long-oval, broadest at pereonite 3, dorsally convex, smooth, without tubercles. Eyes small, on flat sides of cephalothorax. Pleotelson oval, somewhat shorter than pereonites 4 to 7 together; a transverse groove separating anterior third from convex posterior part; suture of first fused pleonite distinct, of second pleonite only laterally visible. Antenna 1 shorter than antenna 2. Flagellum of antenna 2 of 4 articles, the first of which as long as last peduncular article, following articles short. Palp of maxilliped with 3 articles.

Colour: yellowish with purple blotches (violet in young specimens).
Length: up to 14.5 mm.
Locality (Fig. 19): only known from Tierra del Fuego (Isla Dawson, Puerto Harris), within mytilids; possibly also occurring off Mar del Plata (Argentina) (Giambiagi 1925).

8.6.5. ERICHSONELLA Richardson, 1900

= Erichsonia Dana, 1849
Cleantis Miers, 1883 (pro parte)

Diagnosis: Segments of body of subsimilar width. Cephalothorax wider than long, frontal margin medially excavate, laterally protruded; eyes lateral, conspicuous. Coxal plates separated by sutures from tergites on pereonites 1 to 7, sometimes fused on pereonite 1. Antenna 2 longer than antenna 1, clavate, flagellum elongate, obtuse, uni-articulate. Chewing mouthparts, maxillipedal palp with 4 articles. Pereopod 1 slightly shorter than other pereopods, ventral surface of propodus with 3 to 4 rows of pec-

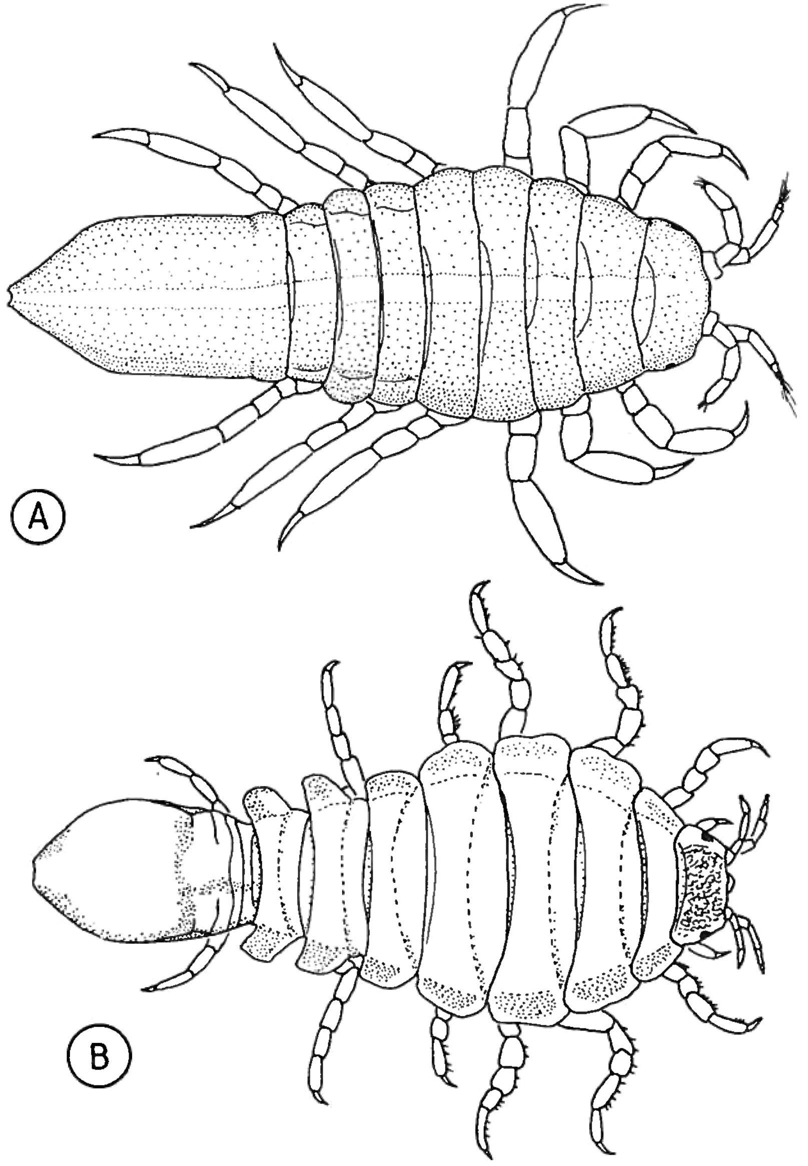

Fig. 20: *A: Edotia lilljeborgi* Ohlin, 1901 (after Ohlin 1901); *B: Edotia doellojuradoi* Giambiagi, 1925 (after Giambiagi 1925).

tinate setae; pereopods 2 to 7 subequal in length. Pleotelson a single structure, without suture lines, no free pleonites present. Pleotelson longer than wide, expanded and widest posteriorly. Uropods uniramous (modified after Pires 1984). A New World shallow-water genus, most species are known from tropical and subtropical coasts.

Type species: *E. floridana Benedict, 1901*

Erichsonella nordenskjöldi (Ohlin, 1901) (Figure 21A)

= *Erichsonia nordenskjöldi* Ohlin, 1901

Diagnosis: Sides of the body as seen in dorsal view strongly serrated. A bifid tubercle on the cephalothorax and a tubercle in the middle of the posterior margin of each pereonite. Anterior margin of cephalothorax somewhat concave. Eyes hemispherical, prominent, when preserved in alcohol without pigment. Coxal plates hardly visible in dorsal view. Pleotelson elongate pentagonal, posterolateral corners produced into a broad, pointed tooth. Females broader in the central pereon (third and fourth pereonite broader). First antenna surpassing the end of the second joint of antenna 2; flagellum of a single, long article. Antenna 2 rather long, in male reaching caudally to the end of the pereon, in female somewhat shorter. Antenna 2 consisting of 5 peduncular and a long, slightly clavate flagellar article. Maxilliped with four palpal articles; distal article oblong, as large as the three proximal articles together; endite with about 10 spinulose spines on distal margin. All pereopods of about the same length, except the first pair which is shorter. Appendix masculina on endopod of male pleopod 2 surpassing rami. Terminal ramus of uropod small, triangular.

Colour: brownish.
Size: up to 14 mm.
Locality: "Patagonia" (Ohlin 1901).

8.6.6. IDOTEA Fabricius, 1798

= *Idothea* Fabricius 1796, Fabricius 1799, Richardson 1905 etc. (see Heegard & Holthuis 1960)

Diagnosis: Body long-oval, dorsoventrally depressed. Cephalothorax