CRINOIDEA

By D. Dilwyn John, M.Sc.
Department of Zoology, British Museum (Natural History)

(Plates III–VI; Text-figs. 1–24)

INTRODUCTION

THE Discovery collection of crinoids is entirely of comatulids; no stalked form was taken. It was made between the years 1935 and 1937. There are three hundred and twenty-six specimens of which by far the greater number come from depths of between 100 and 600 m. Two hundred and sixty-nine are from the Antarctic region, the majority from the South American sector, a small number from the Ross Sea. Fifty-four are from the Burdwood Bank and the Patagonian shelf; they are of one species, *Isometra vivipara*, common to that region and the Antarctic.

The remaining three specimens, of *Comanthus novaezealandiae*, are from New

ERRATA

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p. 126, footnote: *for* pp. 40–1 *read* pp. 44–5

p. 153, eighth line from bottom:
for each syzygial pair *read* syzygial pairs

p. 201, fifth line: *for* fig. 90 *read* fig. 920

Phrixometra longipinna var. *antarctica* n.var.	5	,,
Phrixometra nutrix (Mortensen)	1	,,
Phrixometra rayneri n.sp.	1	,,
Subfamily *ISOMETRINAE*		
Isometra vivipara Mortensen	55	,,
Isometra flavescens n.sp.	12	,,
Isometra graminea n.sp.	8	,,
Isometra hordea n.sp.	12	,,
Family NOTOCRINIDAE		
Notocrinus virilis Mortensen	26	,,
Notocrinus mortenseni n.sp.	10	,,

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THE Discovery collection of crinoids is entirely of comatulids; no stalked form was taken. It was made between the years 1935 and 1937. There are three hundred and twenty-six specimens of which by far the greater number come from depths of between 100 and 600 m. Two hundred and sixty-nine are from the Antarctic region, the majority from the South American sector, a small number from the Ross Sea. Fifty-four are from the Burdwood Bank and the Patagonian shelf; they are of one species, *Isometra vivipara*, common to that region and the Antarctic.

The remaining three specimens, of *Comanthus novaezealandiae*, are from New Zealand.

The following is a complete list of the unstalked crinoids known from the shallower waters of Antarctic seas. The names of the two of which no specimens were secured are included in brackets. The number of specimens taken of each of the others is shown.

Family ANTEDONIDAE

Subfamily *HELIOMETRINAE*		
Promachocrinus kerguelensis Carpenter	163	specimens
Florometra mawsoni A. H. Clark	8	,,
Florometra antarctica n.sp.	3	,,
Anthometra adriani (Bell)	14	,,
(*Solanometra antarctica* (Carpenter))		
Subfamily *ZENOMETRINAE*		
Eumorphometra aurora n.sp.	1	,,
Eumorphometra fraseri n.sp.	1	,,
Eumorphometra marri n.sp.	1	,,
(*Eumorphometra concinna* A. H. Clark)		
Kempometra grisea n.g. and sp.	2	,,
Subfamily *BATHYMETRINAE*		
Phrixometra longipinna var. *antarctica* n.var.	5	,,
Phrixometra nutrix (Mortensen)	1	,,
Phrixometra rayneri n.sp.	1	,,
Subfamily *ISOMETRINAE*		
Isometra vivipara Mortensen	55	,,
Isometra flavescens n.sp.	12	,,
Isometra graminea n.sp.	8	,,
Isometra hordea n.sp.	12	,,

Family NOTOCRINIDAE

Notocrinus virilis Mortensen	26	,,
Notocrinus mortenseni n.sp.	10	,,

Nearly two-thirds of the specimens from the Antarctic are of *Promachocrinus kerguelensis*, the largest and most common of Antarctic crinoids. The bigger of the remaining species—those of the family Notocrinidae and the subfamilies Heliometrinae and Isometrinae—are represented by moderate or large numbers of specimens. Of the smaller species belonging to the subfamilies Zenometrinae and Bathymetrinae there are only one or two specimens, often imperfect, of each, despite the numerous dredgings made by the Discovery Committee's vessels. It seems probable that many more small species remain undiscovered in moderate depths in Antarctic seas.

I have included notes on the two species, *Solanometra antarctica* and *Eumorphometra concinna*, which are known to occur in the Antarctic but which are not represented in the Discovery collection; and on *Eumorphometra hirsuta* from Marion Island.

I have also partially redescribed from their types in the British Museum collection three non-Antarctic species, *Isometra lineata*, *I. angustipinna* and *Phrixometra longipinna*, to which certain of the Antarctic species are related.

How well many of the specimens are preserved may be seen by referring to the plates of this report. The larger were fixed by gently inducing them while still alive into tubes just wide enough to hold them, and then by adding strong spirit.

Myzostomum was found on *Promachocrinus kerguelensis*, the two species of *Florometra*, *Anthometra adriani*, *Isometra flavescens* and *Notocrinus mortenseni*.

In the lists of stations under each species the gear in which the specimens were caught is shown by means of symbols: OTL, DLH, etc. These symbols are explained in the introductions to the Station Lists in this series of reports (Vol. I, pp. 3–5, 1929; Vol. III, p. 4, 1930; Vol. IV, pp. 3–4, 1932) except for the following: DS, small dredge; DRR, a large dredge bag attached to the frame of a Russel bottom net.

I have examined the Antarctic comatulids, those collected by the National Antarctic ('Discovery') Expedition, 1901–4 and the British Antarctic ('Terra Nova') Expedition, 1910, in the British Museum collection. They were reported on by Bell in 1908 and 1917 respectively. He recorded *Antedon antarctica* (=*Solanometra antarctica*) which was not represented and did not recognize two species, *Florometra mawsoni* and *Notocrinus virilis*, which had not been described at that time but which were represented; he gave, too, only a few of the localities at which specimens were taken. I give at the end of this paper (p. 220) a complete record of the Antarctic comatulids taken by those expeditions.

The collection contains about fifty-eight pentacrinoid larvae.

About twenty of them are of *Isometra vivipara* and are attached to the upturned cirri of the females. The development of this species has been described by Mortensen (1920) and nothing is added here.

Clark (1921) has described a long series of pentacrinoid larvae of *Promachocrinus kerguelensis*. There are three in the present collection (p. 200).

The remaining larvae are of much greater interest, for they were not previously known. They are described in detail (pp. 202–219). There is a series of fifteen, the youngest

a prebrachial stage, the oldest with three whorls of cirri, which I believe to be of the new species *Isometra hordea*. There are twenty, the youngest with the beginnings of arms, the oldest with only two whorls of cirri, which are of *Notocrinus virilis*. The fully-formed larva of this species has been described by Mortensen (1920).

NEW FORMS

The proportion of new forms is very large: I have described ten new species and one new variety. One of the new species, *Notocrinus mortenseni*, belongs to the peculiar genus for which Mortensen found it necessary to establish a new family, the Notocrinidae (Mortensen, 1918); only the type species, *N. virilis*, also from the Antarctic and abundantly represented in the present collection, was previously known. Clark (1937) has recently described a new species of *Florometra*, *F. mawsoni*, from the Antarctic. It was taken by the Discovery vessels and they also found three specimens of a new species, *F. antarctica*.

There are three new species of *Isometra*. Two resemble *I. vivipara* but differ too strongly from it to be described as identical; the third, *I. hordea*, is undoubtedly a distinct form.

The other five new species are of smaller forms, each represented by a few specimens only. For one of them, unique among Antarctic comatulids in that it lacks oral pinnules, I have had to create a new genus, *Kempometra*. Three appear to be new species of *Eumorphometra* of which two species, one from the Antarctic and one from Marion Island, were previously known. I have described a new species and a new variety of *Phrixometra*, a genus previously known from one species taken off the River Plate.

CARE OF THE BROOD

The main interest of the collection is that it contains so many species which care for the brood; which are, in other words, viviparous.

The vast majority of comatulids shed their eggs directly into the sea. Only three viviparous species were previously known. In this paper I add to that number five new species and one new variety from the Antarctic, and two described species, one from the Antarctic and one from off the River Plate, which their authors had not recognized as viviparous. Thus there are now eleven known viviparous comatulids.

The three previously known species were *Isometra vivipara* from the Patagonian shelf, the Burdwood Bank and the Antarctic; *Phrixometra nutrix* from the Burdwood Bank; *Notocrinus virilis* from the Antarctic. All three were taken by the Swedish South-Polar Expedition and they and their viviparous habits were described by Mortensen (1918, 1920).[1]

[1] The care of the brood in *Isometra vivipara* had been described long before by K. A. Andersson (1904), who did not however recognize the species as new but regarded it as *Antedon hirsuta* (= *Eumorphometra hirsuta*).

The Discovery collection contains many specimens of *Isometra vivipara* and *Notocrinus virilis*; there is one male of *Phrixometra nutrix* from the Bransfield Strait in the Antarctic.

The following table includes these three species and the seven species and one variety which are shown in this paper to be viviparous; it is a complete list of the known viviparous crinoids.[1] The localities from which each is recorded are shown.

	Antarctic	Outside the Antarctic		
		Burdwood Bank	Patagonian Shelf	Off River Plate
Eumorphometra concinna A. H. Clark	+	–	–	–
Kempometra grisea n.sp.	+	–	–	–
Phrixometra longipinna (Carpenter)	–	–	–	+
P. longipinna var. *antarctica* n.var.	+	–	–	–
P. nutrix (Mortensen)	+	+	–	–
Isometra vivipara Mortensen	+	+	+	+
I. flavescens n.sp.	+	–	–	–
I. graminea n.sp.	+	–	–	–
I. hordea n.sp.	+	–	–	–
Notocrinus virilis Mortensen	+	–	–	–
N. mortenseni n.sp.	+	–	–	–

The table includes two species, *Eumorphometra concinna* and *Phrixometra longipinna*, which were not taken by the Discovery vessels. I owe my knowledge that the former is viviparous and the opportunity of describing its brood-pouches to Mr A. H. Clark: when he heard from me how many viviparous forms I was finding he re-examined *Eumorphometra concinna*, saw that the female had brood-pouches and immediately sent me some. Carpenter had described "much swollen ovarian" sacs in *Phrixometra longipinna*; I found them to be brood-pouches.

The table shows that of the eleven viviparous forms eight are known only from the Antarctic. One is known from the Antarctic and the Burdwood Bank, another from the Antarctic, the Burdwood Bank and the east coast of South America as far north as the River Plate. One is known from off the River Plate only.

If the table be compared with the list on p. 123 it will be seen that of the nineteen comatulids known from the Antarctic ten, over 50 per cent, are viviparous. More than 600 species of unstalked crinoids are known from other seas and only five of them, two of which also occur in the Antarctic (*Isometra vivipara* and *Phrixometra nutrix*), are viviparous; the other two are *P. longipinna* and the two viviparous forms from southern Australia.

The percentage of viviparous forms from the Antarctic may be considerably higher. All the Antarctic species of the Notocrinidae and the Isometrinae, but only four of the eight species of the Zenometrinae and Bathymetrinae, are viviparous. But the re-

[1] Since this was written two species from southern Australia have been described as viviparous (H. L. Clark, 1938, *Echinoderms from Australia*, Mem. Mus. Comp. Zoöl., LV, pp. 40–1).

maining four species of the Zenometrinae and Bathymetrinae are known from single specimens and each is a male. It may be that when the females are found some or all of these species will be discovered to be viviparous. The five large species of the subfamily Heliometrinae are not viviparous.

Dr Mortensen has shown in a recent Discovery Report (1937) that there is in Antarctic ophiuroids a similar very high percentage of viviparous forms. The Antarctic ophiuroid fauna is much richer in species than the crinoid fauna. About 50 per cent of them are viviparous. The highest percentage elsewhere is 15, in New Zealand.

When Mortensen (1918, p. 2) made known the first three viviparous forms he remarked that it added to their interest that each had a separate way of caring for the brood; he was indeed fortunate, for he had three most interesting species before him. The methods of the eleven viviparous forms now known are compared below.

In only one group, the species of *Isometra*, does the viviparous habit appear to have led to a modification of the hard parts. The segments of the genital pinnules of the females are strongly expanded to arch over and protect the ovary and brood-pouch. There is a much smaller expansion of the segments carrying the testes in the male—so much smaller that whereas in almost all comatulids males and females are indistinguishable to the naked eye, in the species of *Isometra* they may be recognized at a glance.

In all the viviparous species there is in the female a brood-pouch beside each ovary.

In *Notocrinus virilis* and *N. mortenseni* the gonads have a unique position. They do not lie, as in all other crinoids, along the pinnules, but in the axils between the pinnules and the arms, largely on the arms. The brood-pouches of the females are distal to the ovaries. The two species form an interesting contrast in the extent to which they protect the brood. A brood-pouch of a big *N. mortenseni* may contain as many as ninety-two embryos in all stages of development and varying in size from 0·25 to 0·48 mm. The largest have five broad bands of cilia; they presumably go through a free-swimming stage before metamorphosing into pentacrinoids. The brood-pouches of *N. virilis* each contain only one to three, usually two, embryos, all at the same stage of development. They are up to 2 mm. in length, that is, four times as long as those of *N. mortenseni*, and have no trace of ciliated bands. It must be supposed that they drop out of the brood-pouches to the sea floor and change into pentacrinoids there. A series of pentacrinoids is described on pp. 210–219.

In the other viviparous crinoids the brood-pouches lie alongside, or beyond, the ovaries on the pinnules. They lie alongside the ovaries and always on their distal sides, i.e. on the side of the pinnule nearest to the arm from which it springs, in *Eumorphometra concinna*, *Phrixometra longipinna*, *P. longipinna* var. *antarctica* and the four species of *Isometra*.

In these species each brood-pouch contains a fair number of small embryos which possess ciliated bands. (I can see no ciliated bands in those of *Phrixometra longipinna*, but I think that is because they are too young.) It is probable that in these species, as in *Notocrinus mortenseni*, the embryos pass some time in a free-swimming stage before

metamorphosing into pentacrinoids. Mortensen has described how short the free-swimming stage is in *Isometra vivipara*: the embryos travel no farther than the upturned cirri of their mothers before settling down and turning into pentacrinoids. This has not been observed in any of the other species. In *Phrixometra longipinna* and one of the females of the var. *antarctica* all the embryos in the brood-pouches are at the same stage of development. In the other species and the other female of *P. longipinna* var. *antarctica* they are, as in *Notocrinus mortenseni*, at various stages of development.

In the single known female of *Phrixometra nutrix* the brood-pouches lie on the oral side of some pinnules, on the aboral side of others. In *Kempometra grisea* the brood-pouches are on the aboral side of the pinnules, but they lie for the most part beyond, not alongside, the ovaries. In these two species the care of the brood is carried even farther than in *Notocrinus virilis*. *Phrixometra nutrix* protects the young throughout their larval existence so that they leave the parent as young comatulids. It seems probable that *Kempometra grisea* does the same.

The larvae of *Phrixometra nutrix* change into pentacrinoids in the brood-pouch. The stalk is attached to the wall of the brood-chamber or to the pinnule segment on its floor; the head projects through a slit in the wall. In the single known female the brood-pouches hold one or two pentacrinoids each; where there are two they are at the same or at different stages of development. No brood-pouch contains developing embryos (Mortensen, 1918).

In the two females of *Kempometra grisea* in this collection I found one large embryo in one pouch, two in another, a pentacrinoid larva in a third. The pentacrinoid is still completely enclosed in the pouch, which is not ruptured. No pentacrinoid emerges from any brood-pouch as in *Phrixometra nutrix*, nor is one attached to any part of the body. The ovary contains few, four to nine, very large eggs; they are up to 0·6 mm. long.

It is interesting to see that in those species in which the care of the young is carried the farthest—*Notocrinus virilis*, *Phrixometra nutrix* and *Kempometra grisea*—the number of young produced is the smallest.

DISTRIBUTION AND RELATIONSHIPS

The table below shows the localities from which the Antarctic comatulids are known. The localities within the Antarctic are divided into "continental coasts and adjacent islands" and "outlying islands". In the former category the term "and adjacent islands" has an application only to the Weddell Sea sector in which the South Shetland Islands, separated from the shores of Graham Land by neither great distance nor deep water, are grouped with it. No crinoid has yet been named from the South Orkney Islands though the 'Scotia' took feather-stars in Scotia Bay (Wilton, Pirie and Brown, 1908, p. 21). The South Sandwich Islands, South Georgia and the Shag Rocks are outlying islands in the Weddell Sea, or South American, sector. Heard Island and Kerguelen are in the Indian Ocean sector. Kerguelen lies on the extreme northern edge of the Antarctic area: the Antarctic convergence, the boundary between the sur-

face waters of the Antarctic and sub-Antarctic zones, passes through it (Deacon, 1937, p. 23 and fig. 5). Kerguelen and the adjacent islands may, however, be regarded as a sub-Antarctic district (see pp. 130–131).

	Antarctic localities								Non-Antarctic localities	
	Continental coasts and adjacent islands			Outlying islands					South America	
	Weddell Sea sector	Indian Ocean sector	Ross Sea sector	South Sandwich Islands	South Georgia	Shag Rocks	Heard Island	Kerguelen	Burd-wood Bank	Patagonian Shelf
P. kerguelensis	+	+	+	+	+	.	+	+	.	.
F. mawsoni	+	+	+	.	.	.	.	.	.	.
F. antarctica	+	.	.	.	.	.	.	.	.	.
A. adriani	+	+	+	.	.	.	.	.	.	.
S. antarctica	.	+	.	.	.	.	+	.	.	.
E. aurora	.	.	.	.	.	+	.	.	.	.
E. fraseri	+	.	.	.	.	.	.	.	.	.
E. marri	+	.	.	.	.	.	.	.	.	.
E. concinna	.	+	.	.	.	.	.	.	.	.
K. grisea	+	.	.	.	.	.	.	.	.	.
P. longipinna var. *antarctica*	+	.	.	.	+	.	.	.	.	.
P. nutrix	+	.	.	.	.	.	.	.	+	.
P. rayneri	.	.	.	.	.	+	.	.	.	.
I. vivipara	+	.	.	.	.	.	.	.	+	+
I. flavescens	.	.	.	.	.	+	.	.	.	.
I. graminea	+	.	+	.	.	.	.	.	.	.
I. hordea	+	.	.	.	.	.	.	.	.	.
N. virilis	+	+	+	.	.	.	.	.	.	.
N. mortenseni	+	.	.	.	.	.	.	.	.	.

The table shows that seventeen of the nineteen Antarctic comatulids occur in the Weddell Sea sector (in the wider sense, i.e. including outlying islands); six in the Indian Ocean sector, including Kerguelen and Heard Island; five in the Ross Sea sector. Four species, *Promachocrinus kerguelensis*, *Florometra mawsoni*, *Anthometra adriani* and *Notocrinus virilis*, occur in all three sectors and may therefore be presumed to be circumpolar. They are all large species and therefore the most likely to be taken by collecting expeditions. This and the fact that more collecting, and more careful collecting, has been done in the Weddell Sea sector than in any other makes me think that many of the species now known from there alone may later be found elsewhere around the continent; in other words I think it premature to discuss the distribution of the species within the Antarctic. Of the species that are known to be circumpolar *Promachocrinus kerguelensis* has been found at all the Antarctic localities where collecting has been done except the Shag Rocks; the other three are, so far as is known, confined to the coasts of the continent and the adjacent islands.

The most interesting feature of the table is that it shows that two Antarctic species do occur outside the Antarctic and that they occur towards or along the east coast of South America: *Phrixometra nutrix* on the Burdwood Bank, *Isometra vivipara* on the Burdwood Bank and on the Patagonian shelf as far north as the River Plate.

There are, I think, other reasons for believing that the shallower water crinoid fauna

of the Antarctic is related to that of the extreme south of South America. The *Phrixometra*, of which the Discovery vessels took five specimens, one at South Georgia and four in the Bransfield Strait, is so like Carpenter's *Phrixometra longipinna* from off the River Plate that I have described it as a variety. The only other species of the genus are *P. nutrix*, and *P. rayneri* from the Shag Rocks.

There are four species of *Isometra* in the Antarctic, one of which also occurs on the east coast of South America. Two other species are known, each described from a single Challenger specimen taken off the River Plate.

These facts point to a relationship between the shallow-water crinoid faunas of the Antarctic and of the east coast of the extreme south of South America. There appears to be a relationship with the west coast of South America too.

Of the four genera of the Heliometrinae represented in the Antarctic three, *Promachocrinus*, *Anthometra* and *Solanometra*, are monotypic and the species are confined to the Antarctic. The fifth, *Florometra*, of which there are two species in the Antarctic, has ten other species ranging northwards from Cape Horn along the west coasts of South and North America to the Behring Sea, westwards along the Aleutian Islands, and southwards to the Pacific coast of Japan.

It appears from these facts that the littoral crinoid fauna of the Antarctic is related to that of the south of South America. Workers on the other four classes of echinoderms have arrived at the same conclusion for those classes. Mortensen (1910, p. 100) wrote of echinoids: "The South American (Patagonian-Chilean) littoral region must be regarded as the centre of the whole Antarctic—sub-Antarctic region; a very great proportion of the echinoids occurring in the Patagonian region are known from this region alone, while others are also known from the Antarctic region." Koehler (1912, p. 242), after comparing the littoral asteroid, ophiuroid and echinoid faunas of the Antarctic, the Magellan region of South America, the Kerguelen district, New Zealand and the Cape concludes: "Il ressort clairement de cette discussion que la faune antarctique des Astéries, Ophiuries et Échinides,—du moins en ce qui concerne les espèces littorales,—a son point de départ dans la faune subantarctique des côtes de la pointe de l'Amérique du Sud. Les comparaisons que nous avons faites, la composition et les rapports des faunes établissent ce fait d'une manière indiscutable." Ekman (1925, p. 187) writing of holothurians concludes: "Hier möchte ich nur die Meinung aussprechen, dass die von anderen Forschern hervorgehobene, verhältnismässig nahe Verwandtschaft der antarktischen Litoralfauna mit derjenigen des Magellangebietes auch betreffs der Holothurien Gültigkeit hat, und dass allem Anschein nach beide aus einem gemeinsamen Entwicklungszentrum herstammen."

There is only one other species of *Eumorphometra* than those listed above; it is *E. hirsuta* (Carpenter) from Marion Island. Marion Island belongs to the Kerguelen group of islands comprising Kerguelen itself, Heard Island, the Crozets and Marion Island. It possesses in more groups of animals than one a characteristic littoral fauna, partly related to, or having species in common with, those of two other areas, the

Antarctic and the Magellan region of South America. So far as three classes of echinoderms—asteroids, ophiuroids and echinoids—are concerned the fauna of the Kerguelen group is much more nearly related to the fauna of the Magellan region than to that of the Antarctic (Mortensen, 1910, p. 100; Koehler, 1912, pp. 221–7). But Regan (1914, p. 36), having studied the fish faunas of the three regions, describes the Kerguelen group as an Antarctic district; and Norman in two papers on more recent collections of fishes confirms his views (1937, 1938). He says (1938, p. 100): "it is clear that, although the coastal fish fauna of the Kerguelen district shows certain features of resemblance to that of the Patagonian region and the Antipodes, its affinities are mainly with that of Antarctica."

Since no crinoid is known to occur both in the Kerguelen and Magellan districts, whereas two (*Promachocrinus kerguelensis* and *Solanometra antarctica*) are known both from Kerguelen and Heard Islands and the Antarctic, I have treated those islands, with the above reservations, as outliers of the Antarctic.

No other species of *Notocrinus* than *virilis* and *mortenseni* are known.

ACKNOWLEDGEMENTS

It is a great pleasure to acknowledge in the first place the constant and generous help I have received from Mr A. H. Clark. When he knew that I was finding many viviparous species he re-examined his co-types of *Eumorphometra concinna*, found that it too was viviparous, and sent me brood-pouches so that I might describe them. He has kindly compared my single specimen of *E. aurora* with *E. concinna* and has found that they are not, as I thought they might be, identical. He examined for me a specimen of *Kempometra grisea*, suggested the diagnosis of the genus which I have used, and helped me to decide upon the position of the genus.

Dr Mortensen has helped me by comparing a specimen of my *Isometra graminea* with one of his specimens of *I. vivipara*, taken by the Swedish Antarctic Expedition, from the Graham Land region; and Professor Sixten Bock of Stockholm kindly sent me, for examination and comparison, all the remaining specimens of *I. vivipara* taken by the Swedish Expedition. I take this opportunity of thanking them both.

The drawings for the text-figures were made by Miss E. C. Humphreys.

KEY TO THE COMATULIDS KNOWN TO OCCUR IN DEPTHS OF 0–1000 METRES IN ANTARCTIC SEAS

A Oral pinnules long and whip-like; P_1 of 30–60 or more segments; P_2 usually as long; large species.

B 6–11 rays and 12–23 arms—usually 10 rays and 20 arms — *Promachocrinus kerguelensis.*

BB 5 rays and 10 arms.

C Ossicles of the division series and the brachials with a conspicuous and usually high narrow median keel; cirri of large specimens of 60–80 segments; P_2 much shorter than P_1 ... ... — *Anthometra adriani.*

CC Division series and brachials not as above; cirri of not more, usually much less, than 40 segments; P_2 about as long as P_1.

D P_1 of 28–40 segments; cirri of not more than 31 segments; lower brachials with an abruptly elevated spinous patch in the distal portion of the dorsal surface or with the distal edge everted at right angles and strongly produced ... ... *Florometra mawsoni.*

DD P_1 of more than 40 segments; lower brachials smooth or, exceptionally, elevated into small and low spinous patches.

E P_1 of about 60 segments; cirri of 25–40 segments; lower brachials smooth; brachials beyond third syzygy all short, much broader than long ... ... *Solanometra antarctica.*

EE P_1 of 44–50 segments; cirri of 23–32 segments; lower brachials may have small spinous patches; brachials beyond third syzygy not much broader than long ... ... *Florometra antarctica.*

AA P_1 of less than 20 segments, usually short.

B Third and some of succeeding segments of genital pinnules strongly expanded to cover the gonads; oral pinnules short with their basal segments attached to the disk or to the arm by webs of tissue.

C P_2 shorter than P_1.

D Ventral surface of disk plated; P_3 is first genital pinnule *Isometra flavescens.*

DD Ventral surface of disk naked; P_4–P_6, usually P_5, first genital pinnule *Isometra vivipara.*

CC P_2 as long as or longer than P_1.

D Longest cirri of up to 70 segments; large robust species *Isometra hordea.*

DD Cirri of 28–43 segments; fragile species of medium size *Isometra graminea.*

BB No segments of genital pinnules strongly expanded.

C Gonads not on pinnules but in axils between pinnules and arms; perisome plated; oral pinnules short with their basal segments attached to the disk or to the arms by webs of tissue.

D Cirri long, of 36–76 short segments of nearly uniform length *Notocrinus virilis.*

DD Cirri shorter, of 21–32 segments of which some of the proximal are longer than the remainder ... ... *Notocrinus mortenseni.*

CC Gonads in normal position on genital pinnules; perisome not plated; oral pinnules (where present) entirely free.

D P_1 and P_a absent; P_3 a genital pinnule ... ... *Kempometra grisea.*

DD Oral pinnules present.

E Cirri of less than 20 (12–19) segments.

F First genital pinnule (P_2 or P_3) not much more than half as long as P_1 ... ... *Phrixometra longipinna* var. *antarctica.*

FF First genital pinnule (P_2 or P_3) about as long as P_1.

G Cirri about XLV ... ... *Phrixometra nutrix.*

GG Cirri about XXX ... ... *Phrixometra rayneri.*

EE Cirri of more than 20 segments (of up to 40 segments).

F Cirri of 30–40 segments ... ... *Eumorphometra fraseri.*

FF Cirri of less than 30 segments.

G Cirri in 2 or 3 closely placed alternating rows; P_1 longer and more massive than P_2; in the lower genital pinnules the segments carrying the gonad are slightly expanded *Eumorphometra marri.*

GG Cirri in 10 slightly irregular columns; P_1 not more massive than P_2; segments of genital pinnules not expanded.

H Elements of division series and brachials with central portion abruptly elevated and prominently spinous; axillaries shorter (broader than long) *Eumorphometra concinna.*

HH Elements of division series and brachials not as above; axillaries longer (longer than broad) *Eumorphometra aurora.*

SYSTEMATIC ACCOUNT

Family ANTEDONIDAE

Subfamily *HELIOMETRINAE*

Genus Promachocrinus Carpenter

Promachocrinus kerguelensis Carpenter (Plate III, fig. 1)

Promachocrinus kerguelensis Carpenter, 1888, p. 350, pl. i, figs. 1 *a–d*, pl. lxx; Clark, 1915 *a*, pp. 128–34, pls. iii–v, and list of earlier references with synonymy; Clark, 1915 *b*, many references, fig. 505; Bell, 1917, p. 2; Mortensen, 1918, pp. 18–20, fig. 16; Clark, 1921, numerous references including pp. 530–57, figs. 881–937 (on pentacrinoid young), pl. iv, figs. 1001–2, fig. 807; Mortensen, 1925 *b*, p. 2; Gislén, 1928, p. 11; Grieg, 1929 *a*, p. 3; 1929 *b*, p. 3; Clark, 1929, p. 662; Bernasconi, 1932 *a*, pp. 29–35, figs. 1–3, pl. i; 1932 *b*, pp. 86–7, fig.; John, 1937, p. 9; Clark, 1937, pp. 8–9.

Promachocrinus vanhöffenianus Minckert, 1905, pp. 496–501, figs. 1 and 2.

Promachocrinus joubini Vaney, 1910, pp. 158–62, figs. 1 and 2.

The stations at which it was taken are divided into five groups, according to locality, below.

South Georgia

St. MS 14. 17. ii. 25. East Cumberland Bay. 190–110 m. Gear DS. Two small specimens.

St. MS 71. 9. iii. 26. East Cumberland Bay. 110–60 m. Gear BTS. Twenty-eight specimens, mostly large.

St. MS 74. 17. iii. 26. East Cumberland Bay. 22–40 m. Gear NCS–T. Fragments.

St. 27. 15. iii. 26. West Cumberland Bay. 110 m. Gear DL. Bottom: mud and rock. One specimen; one pentacrinoid larva.

St. 39. 25. iii. 26. East Cumberland Bay. 179–235 m. Gear OTL. Bottom: grey mud. One specimen.

St. 42. 1. iv. 26. Off mouth of Cumberland Bay. 120–204 m. Gear OTL. Bottom: mud. Eight specimens.

St. 123. 15. xii. 26. Off mouth of Cumberland Bay. 230–250 m. Gear OTL. Bottom: grey mud. One specimen.

St. 144. 5. i. 27. Off mouth of Stromness Harbour. 155–178 m. Gear OTL. Bottom: green mud and sand. Six specimens.

St. 148. 9. i. 27. Off Cape Saunders. 132–148 m. Gear OTL. Bottom: grey mud and stones. Four specimens.

St. 149. 10. i. 27. Mouth of East Cumberland Bay. 200–234 m. Gear OTL. Bottom: mud. Five specimens.

St. 152. 17. i. 27. 53° 51′ 30″ S, 36° 18′ 30″ W. 245 m. Gear DLH. Bottom: rock. Two specimens.

St. 156. 20. i. 27. 53° 51′ S, 36° 21′ 30″ W. 200–236 m. Gear DLH. Bottom: rock. Eight specimens.

St. 345. 8. ii. 30. 55° 20′ S, 34° 47′ 30″ W. 180 m. Gear N 70 V. Bottom: small stones and shells. One specimen.

South Sandwich Islands

St. 363. 26. ii. 30. 2·5 miles S, 80° E of south-east point of Zavodovski Island. 329–278 m. Gear DLH. Bottom: scoria. Three specimens.

St. 366. 6. iii. 30. 4 cables south of Cook Island. 77–152 m. Gear OTL. Bottom: black sand. Six specimens; 1 pentacrinoid larva.

St. 371. 14. iii. 30. 1 mile east of Montagu Island. 99–161 m. Gear OTL. Five specimens.

Bransfield Strait region

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Six specimens.

St. 172. 26. ii. 27. Off Deception Island. 62° 59′ S, 60° 28′ W. 525 m. Gear DLH. Bottom: rock. Two specimens.

St. 175. 2. iii. 27. Bransfield Strait. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. Three specimens.

St. 177. 5. iii. 27. 27 miles south-west of Deception Island. 63° 17′ 30″ S, 61° 17′ W. 1080 m. Gear DLH. Bottom: mud, coarse sand and stones. Eight specimens; one pentacrinoid larva.

St. 1948. 4. i. 37. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen.

St. 1952. 11. i. 37. Between Penguin Island and Lion's Rump, South Shetlands. 367–383 m. Gear DRR. Bottom: soft mud. Forty-three specimens.

St. 1955. 29. i. 37. 61° 35·1′ S, 57° 23·3′ W. 440–410 m. Gear DRR. Two specimens.

St. 1957. 3. ii. 37. 7 miles east of Cape Bowles, Clarence Island, South Shetlands. 830 m. Gear DRR. Bottom: rough, stony. One specimen. 785–767 m. Gear DRR. Bottom: stones. One specimen.

West coast of Graham Land

St. 180. 11. iii. 27. 1·7 miles west of north point of Gand Island, Schollaert Channel, Palmer Archipelago. 160–330 m. Gear OTL. Bottom: mud and stones. Five specimens.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. 64° 20′ S, 63° 01′ W. 160–335 m. Gear OTL. Bottom: mud. Three specimens.

St. 182. 14. iii. 27. Schollaert Channel, Palmer Archipelago. 64° 21′ S, 62° 58′ W. 278–500 m. Gear OTL. Bottom: mud. Six specimens.

St. 599. 17. i. 31. Adelaide Island. 67° 08′ S, 69° 06′ 30″ W. 203 m. Gear DLH. One specimen.

The Ross Sea

St. 1644. 16. i. 36. Bay of Whales. 78° 24·8′ S, 164° 10·3′ W. 626 m. Gear BNR. Bottom: rocks and mud. One specimen.

St. 1652. 23. i. 36. Ross Sea. 75° 56·2′ S, 178° 35·5′ W. 567 m. Gear DRR. Nineteen specimens.

St. 1658. 26. i. 36. Off Franklin Island, Ross Sea. 76° 09·6′ S, 168° 40′ E. 520 m. Gear DRR. Four specimens, one very young.

Historical. Carpenter (1888, p. 348) included in his definition of the genus *Promachocrinus* the words "ambulacra. . . not provided with any definite skeleton".

Minckert (1905, p. 496, figs. 1, 2), on the basis of two fully grown specimens from the collection of the Deutsche Südpolar-Expedition, described the new species *P. van-*

höffenianus differing from *P. kerguelensis* in having: (i) longer cirrus segments, (ii) long and slender axillaries and second brachials, (iii) no lateral notch between the radial and the costal, and (iv) well-developed side-plates along the pinnule ambulacra.

Vaney (1910, pp. 158–62, figs. 1, 2) described the new species *P. joubini*, from one specimen from the west of Graham Land. It is described as being distinguished from *P. kerguelensis* by having clusters of spines on the lower brachials, by the position of its syzygies, and by the possession of a naked dorsal pole. Like *P. kerguelensis* it has rhombic axillaries and lacks an ambulacral skeleton; its cirri are tolerably like those of *P. vanhöffenianus*. Vaney considered it to be nearer the former than the latter.

Clark (1915) regards both Minckert's and Vaney's species as invalid, believing the specimens upon which they were based to have been immature *P. kerguelensis*. Mortensen (1918, p. 19) is not satisfied that Clark is correct, more particularly in regarding *P. vanhöffenianus* as identical with *P. kerguelensis*; nor is he convinced that the presence of an ambulacral skeleton is a sign of immaturity, a doubt shared by Grieg who is otherwise inclined to accept Clark's opinion (Grieg, 1929 *a*, p. 4; 1929 *b*, p. 4).

My examination of the present collection of 163 specimens from low and high latitudes in the Falkland sector of the Antarctic zone, and of thirty-eight specimens from the Ross Sea, and of one or two taken by the 'Challenger' near Kerguelen and Heard Island, has convinced me that there is only one, very variable, species.

Description. In the great majority of specimens there are 10 rays and 20 arms but individuals with 12, 16, 17, 18, 19, 22 and 23[1] arms occur. The arms of large specimens are commonly 180–200, and may be up to 250, mm. long.

The centrodorsal is usually a large high rounded cone, but it is variable. It may be more sharply conical; in smaller specimens it is often a moderately low cone. It is closely covered with cirri which may, exceptionally, number 200 or more. The cirrus sockets are arranged in slightly irregular alternating rows, so that those of alternate rows make slightly irregular columns. The dorsal pole is usually of medium size, smooth and rounded. In large specimens it is sometimes sunken and rough. It may, in either large or small specimens, be a sharply triangular or a rough truncated pillar-like projection. It may be very small or absent: though this is most often so in small specimens it may be so in large.

Cirri: up to CC or more. There is always a sharp contrast between the apical cirri and those of the more ventral part of the centrodorsal: the latter are long, of up to 47 or, exceptionally, 65 segments; the former very much shorter and of fewer segments. The contrast is greatest in large specimens; the longest peripheral cirri may be three or more times as long as the shortest apical cirri. They may be up to 130 mm. long.

The segments of the cirri of different specimens vary greatly in length. I have seen none in which those of one cirrus are so nearly equal to one another as in Carpenter's figure. The range of variation is illustrated by the extremes shown in Fig. 1; a_1 and a_2 are a long and a short cirrus of a specimen with cirri of short segments, and a_3 and a_4 are

[1] Mortensen, 1918, p. 19.

those of a specimen with cirri of long segments. The cirrus a_1 is of 52 segments and is nearly 75 mm. long. The first three segments are short, the fourth is longer than broad; the fifth and sixth are nearly twice as long as broad, the seventh to about the twentieth or twenty-fifth twice as long as broad. The remainder gradually decrease in length until the most distal are as broad as long. In the segments following the first ten or so the distal edge projects slightly on the dorsal side; the projection is most marked, but not

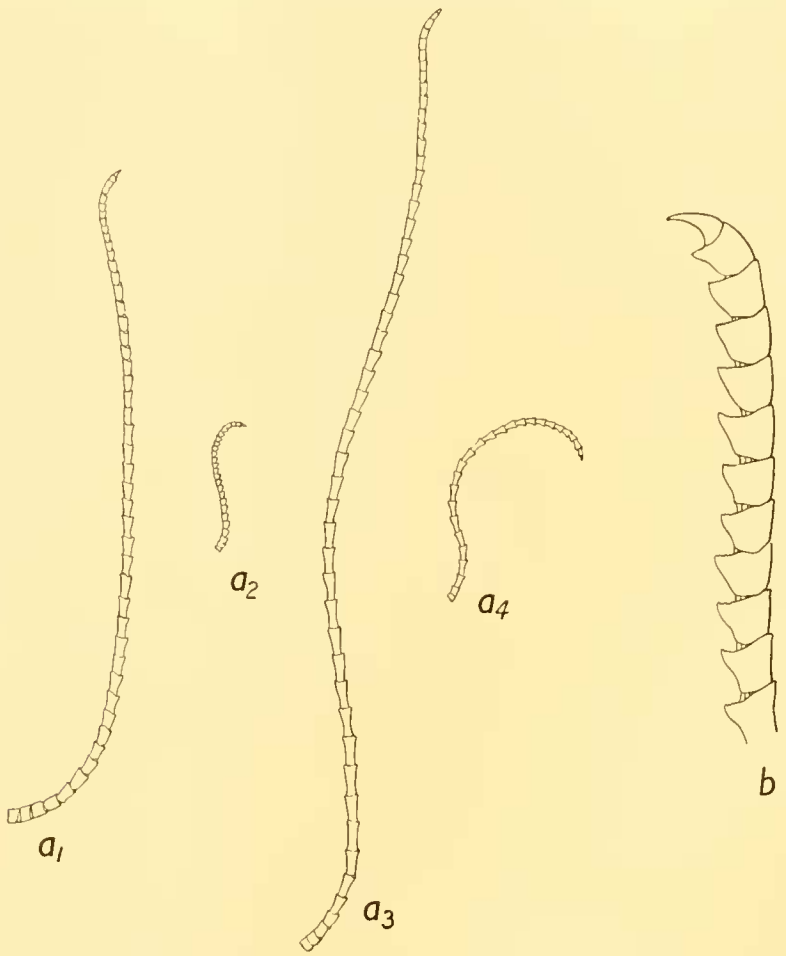

Fig. 1. *Promachocrinus kerguelensis*. a_{1-2}, long and short cirri of a specimen with cirri of short segments, × 1·25. a_{3-4}, the same of a specimen with cirri of long segments, × 1·25. *b*, distal segments of a short cirrus, × 9.

strong, in the distal segments. All but the basal segments are compressed from side to side, the distal most strongly.

The small apical cirrus of the same specimen, a_2, is of 24 segments and 15 mm. long. The basal segments, the first two or three, are broader than long; the proximal are longer than broad but not nearly so much so as in the long cirri. The distal segments are as broad as long and have the dorsal projection more strongly developed and more keel-like than do those of the larger cirri.

The more elongated cirrus, from another specimen, shown in Fig. 1 a_3, is of 51 segments and nearly 100 mm. long. The first two segments are broader than long, the third

about as long as broad. The fourth is longer than broad; the fifth is nearly, the sixth more than, twice as long as broad. The seventh and eighth are about three times as long as broad. The ninth to about the fourteenth are the longest: more than three times as long as broad.[1] Beyond the fourteenth the segments gradually decrease in length but the most distal are nearly twice as long as broad. They have a less well-marked projection on the dorsal side than those of cirrus a_1. The whole cirrus is less robust; it is slightly compressed from side to side.

The shortest apical cirrus from the same specimen, a_4, is of 26 segments and about 30 mm. long. The first two segments are broader than long, the third nearly twice as long as broad. The fourth is $2\frac{1}{2}$ times as long as broad; the fifth and sixth are the longest: nearly three times as long as broad. The segments beyond gradually decrease in length to the end, the most distal being, however, nearly twice as long as broad. The segments of this cirrus, particularly the outer and especially on the dorsal side, overlap one another much more strongly than do those of the long cirrus from the same specimen.

The terminal claw is mostly curved, claw-like and hyaline and there is usually a small opposing spine or the trace of one; but some of the longer cirri of younger specimens, or even all the cirri of older specimens, may entirely lack the opposing spine, and at the same time the terminal claw may be straight, not claw-like, and it may not be hyaline. The opposing spine may, however, be strong, especially on small apical cirri (Fig. 1 *b*).

The radials, primibrachs and first and second brachials are very variable in shape (Fig. 2 *a*). They differ, though not constantly nor in the same way, in different specimens, with age. Since very few preserved specimens have complete arms it is not possible to use arm length as a rough criterion of age. I have used instead the number of segments in the longer peripheral cirri: in Fig. 2 *a* the number beside each separate drawing is that of the segments in the longest peripheral cirrus of that specimen. In very young specimens in which the interradial rays are still smaller than the others the alternate radials are of a different shape and size (a_1): those of the radial ray are comparatively wide, wider at the base than distally; the interradial radials are longer, narrower plates, wider distally than at the base. The distinction in size between the alternate rays does not appear to last long. In older, but still small immature specimens, the radials and succeeding ossicles are of the shapes shown in a_2 or of similar shapes. The radial is long; the costals are not in opposition laterally. The axillary is shield-shaped, longer than broad; it makes no shoulder-like projection by its incision of the costal. In older specimens the radials are always shorter, and in large specimens they may be very short (Fig. 2, a_3 and a_4). In some, but by no means all, old specimens in which the radials are very short the costals are in partial lateral opposition, as if they had been brought down against one another by the reduction of the radials (a_3). The axillary may be of any of the shapes shown in Fig. 2 a_1–a_4, or of a shape intermediate between them. It may be elongated and longer than broad, or it may be broader than long; the second brachials vary with it. In the biggest specimens its incision of the costal and the incision of the first brachial by the second make shoulder-like projections which may

[1] I have seen these segments four times as long as broad in the cirri of another specimen.

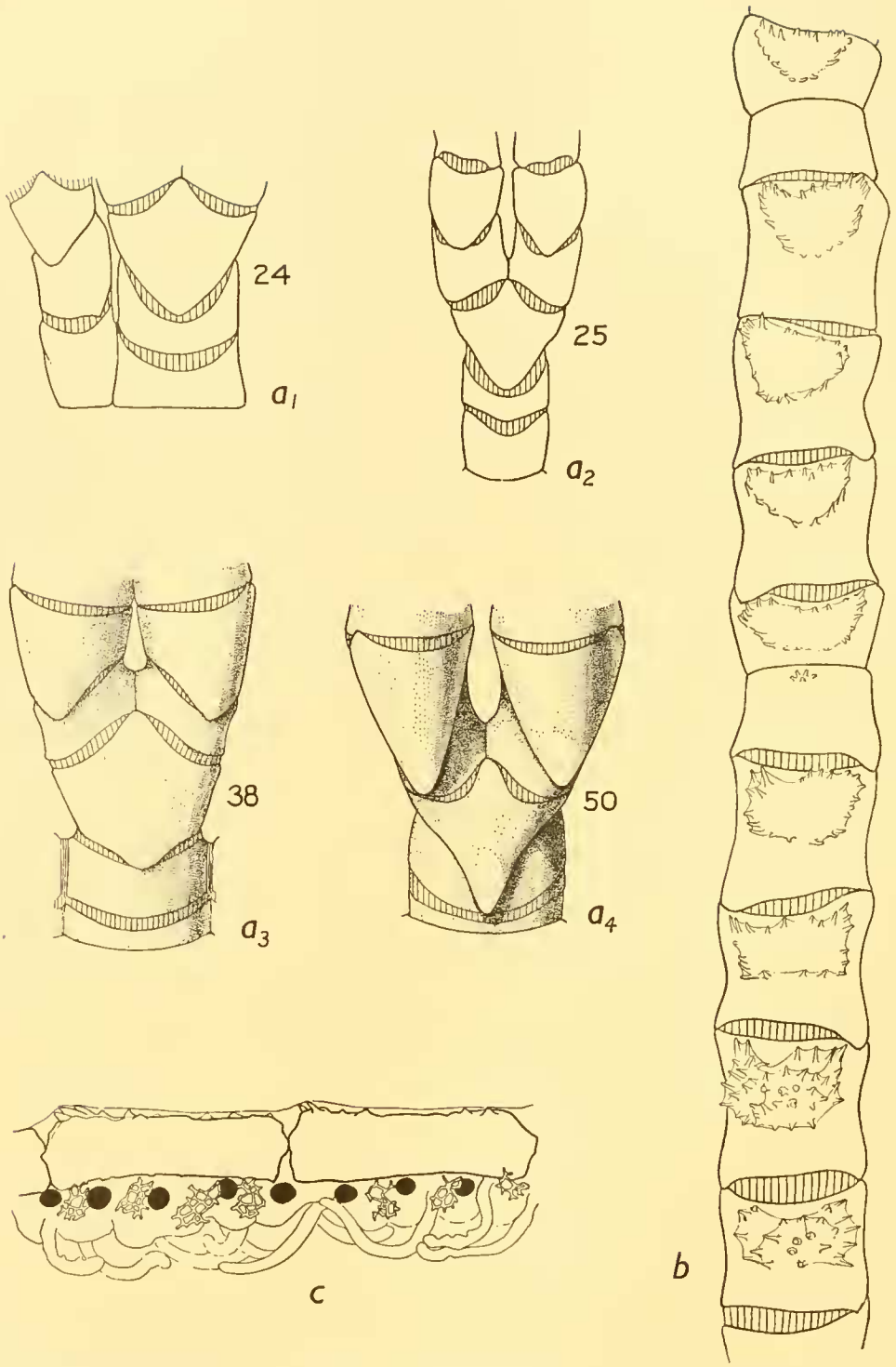

Fig. 2. *Promachocrinus kerguelensis*. *a*, radials, costals, axillaries and lower brachials of specimens of different ages; the numbers beside the figures are those of the segments in the longest peripheral cirrus of each specimen; 1 and 2, ×13; 3 and 4, ×7. *b*, fourth to fifteenth brachials showing the dorsal surfaces raised into spinous patches, ×11. *c*, largest side-plates found in the distal pinnules of specimens from the South Sandwich Islands, ×47.

be faint or exceedingly strong: they are faint when the axillary and second brachial are broad and short, strong when they are elongated (compare a_3 and a_4). The partial lateral apposition of the costals referred to above appears to come about only in those old specimens in which the axillaries are comparatively wide and form a faint, or no, shoulder with the costals.

The first syzygy is between the third and fourth brachials; the second and third are usually between the ninth and tenth and fourteenth and fifteenth respectively, though irregularities occur. The syzygial pairs beyond the third are separated by one to five, usually two or three, brachials.

The brachials between the first and third or fourth syzygies are rectangular or quadrate, usually broader than long, but sometimes as long as broad or even slightly longer than broad. Beyond the third or the fourth syzygy the brachials are triangular or wedge-shaped, broader than long or as long as broad. The distal brachials are rectangular, as long as or longer than broad. The brachials of young specimens are proportionately longer than those of older specimens.

The lower brachials may be smooth or spiny; the distal edges of the outer brachials are nearly always slightly raised and produced into spines. The brachials between the first and second syzygies may have more than the distal halves of their dorsal surfaces raised into rectangular patches of strong spines standing out at right angles to the surface, conspicuous in profile (Fig. 2 *b*); the patches become smaller in area and more triangular in shape between the second and third syzygies; beyond the third syzygy they become reduced to a row of strong forwardly directed spines along the distal edge of the segment, and they persist as such to the end of the arm. The spine patches of the lower brachials may be smaller and of a different shape, and they may not start till the sixth or seventh brachial or beyond, and the spines of the outer brachials may be correspondingly smaller; or the lower brachials may be quite smooth and those beyond may have slightly produced edges which are smooth or finely or strongly thorny.

P_1 is long and whip-like, of 40–60 or, exceptionally, of up to 75 segments; it is usually 15–22, sometimes as much as 26, mm. long. The first 6–12 segments are usually broader than long, or as long as broad, a little stouter than the following and roughly diamond-shaped. Their short and narrow dorsal surfaces may be raised into thorny crests. The following segments are of a regular shape and longer but not elongated: they are not so much as twice as long as broad; the more proximal may be raised dorsally into a fine thorny crest.

P_2 is usually of fewer segments: those examined were of 26–46 except for one which was of 62. The number is usually between five and ten less than that of P_1 of the same specimen. P_2 is of about the same length as P_1: it may be shorter or longer. The first 4–5 segments are usually more massive, compared with the others, than the basal segments of P_1; the others are slightly more elongated, though rarely so much as twice as long as broad.

The first genital pinnule is usually P_3 or P_4. P_3 is commonly of 16–40, sometimes of up to 60, segments. Whether it is an oral or a genital pinnule it may be of roughly

the same length as P_2, but sometimes, when it is a genital, it is very much shorter and of segments which diminish rapidly in stoutness from the base to the end. P_3 is usually of anything from 5 to 20 fewer segments than P_2 of the same specimen; all but its basal segments are more elongated, being as much as, or more than, twice as long as broad.

The middle genital pinnules are of about 20–26, exceptionally more, segments; they are 10–20 mm. long, sometimes considerably longer. The outer pinnules are of about the same length or longer. In both the genital and outer pinnules the first segment is very short, the second longer but not so long as broad, the others considerably longer than broad.

The way in which the primary ambulacral furrows on the disk divide so as to provide the arms is very variable though certain arrangements appear to be more constant than others (see below).

Sacculi are abundant on the pinnules.

Along the sides of the pinnule ambulacra there may be a single continuous series of large plates, three or four to each pinnule, the distal edge of one overlapping the proximal of the next. Each is curved in the axis of the pinnule and has its outer part curved over the ambulacral furrow. Clark (1921, p. 268, fig. 378) has described them at their highest development. When they are present the tentacles contain numerous knobbed spicules. The plates may be smaller, and therefore not touching one another, or very much smaller and fewer: in some specimens the pinnules have only one or two extremely simple small plates near the end (Fig. 2 *c*). They are often entirely absent. In some specimens with reduced plates the spicules are few; if the plates are very reduced they may be absent: this is so in over twenty-five specimens of the present collection. On the other hand, it is only in one specimen that there are spicules (and they are few) and no plates. (It was, of course, only three or four pinnules of any specimen that were examined.) The presence of plates and spicules has been regarded as a sign of immaturity. The examination of the present collection has shown that it is not so, but that there does appear to be some correlation between the degree of development of the plates and spicules in a number of specimens and the locality in which they occur (see below).

The colour is very variable. The entire specimen may be straw-coloured, very light grey, flesh-coloured, pale or brilliant yellow, orange, brown or purple; the greater part of it may lack stronger colours except for bands of dark brown or purple on the cirri, or the arms (when the bands often coincide with the syzygial pairs), or the pinnules, or all three; or portions of a specimen, such as the pinnules or the distal parts of the arms, may be brown or purple or yellow. There may be great variation in the colour of the specimens of one colony as is shown by a note, made at the time of capture, describing the eight specimens from St. 42: "The animals showed a gradation of depth of colouring ranging from cream to very light grey or flesh, to pale or deep chocolate brown, to dark purple. The colour was usually least developed on the cirri, and—grading through the arms—most enforced on the pinnules; it was sometimes equally developed on all." The gonads were bright orange.

The specimens from Sts. 1948–1957, from the Bransfield Strait region, were fixed and preserved by Mr J. W. S. Marr who made many notes concerning them. He writes, from his observations on captured specimens, that the species is "very powerful and active and swims with a remarkable grace of movement". Because of its activity it breaks itself into pieces if killed in a confined space. The best results were obtained by fixing in fresh water in ample space.

The species has previously been taken from depths between 10 and 650 m.; the majority of the present collection come from between 22 and 525 m. But eight specimens were taken from 1080 m. in the Bransfield Strait (St. 177); they are all small but they possess the usual twenty arms and do not appear abnormal. A pentacrinoid larva was also taken at this station.

Number of arms. The number of arms possessed by the specimens of this collection are shown, under the localities from which they come, in the following table:

	No. examined	Arms						
		22	20	19	18	17	16	12
South Georgia	60	1	59	—	—	—	—	—
South Sandwich Island	14	—	14	—	—	—	—	—
Bransfield Strait	62	—	41	1	16	1	3	—
Graham Land region	15	—	9	1	2	—	1	2
Ross Sea	23	—	22	—	1	—	—	—

The single abnormal specimen from South Georgia, with 22 arms, has eleven radials. The twenty-one specimens with 16, 17, 18 and 19 arms from the Bransfield Strait all come from one of the eight stations made in that region (St. 1952). Twenty-two specimens with 20 arms were taken with them. They are much younger and smaller than those with abnormal numbers of arms: their longest cirri consist of 25–38, mostly 30, segments; those of most of the specimens with 16–19 arms are of 50–65 segments. Five of the six specimens with abnormal numbers of arms from the Graham Land region are of medium size, their longest cirri of 39–45 segments; one is small, its longest cirrus of 28 segments.

In the 19-armed specimen from the Graham Land region (it is from St. 180) the single arm arises from a normal radial which is followed by a regular ossicle slightly longer than the costals of the other rays. Next is a still longer ossicle with a pinnule arising from either side of it. It is succeeded by a syzygial pair with a pinnule arising from the epizygal and beyond this the arm is normal. The single arms of the 19-armed and 17-armed specimens from the Bransfield Strait are different. The second ossicle beyond the radial is shaped like an irregular axillary, and a pinnule arises from one side of it. It is followed by a very short ossicle with no pinnules, which appears to correspond with the first brachial of normal arms; after it comes a longer ossicle shaped like the second brachial of normal arms, with a pinnule on the opposite side to the first. A syzygial pair

with a pinnule arising from the epizygal, on the same side of the arm as the first pinnule, comes next and thereafter the arm is normal.

Dorsal pole. In four of the specimens from the South Sandwich Islands I could see no dorsal pole; it is very small and difficult to detect in the other specimens, large and small, from the same locality. I failed to see a dorsal pole in one small specimen from South Georgia and in one from the Bransfield Strait. It was present in all the other specimens.

Cirri. Fig. 1 *a* shows extreme types of cirri: in a_1 and a_2 the segments are as short as in any full-grown specimen I saw; a_3 and a_4 are of cirri of very elongated segments, though I have seen others slightly longer. The specimens from the South Sandwich Islands and South Georgia have cirri of the first type though the segments are usually a little longer than in the figure; those of the South Sandwich specimens appear to be the shorter. Two specimens from South Georgia, by no means the largest, have cirri of the second, long, type. The specimens from the Bransfield Strait and the west coast of Graham Land have cirri of the long type, though not usually so long as those figured; those from the latter locality appear to have the longer. All but two of twenty-three Ross Sea specimens have cirri of the long type. In Fig. 1 *a*, 1 and 2 are from a specimen from the South Sandwich Islands, 3 and 4 from one from the west coast of Graham Land.

Division series and lower brachials. None of the bigger specimens from South Georgia have elongated axillaries and second brachials forming strong shoulders with the costals and first brachials; in the biggest the shoulders are but slight. On the other hand, most of the bigger specimens from the South Sandwich Islands and the Bransfield Strait and all from the west coast of Graham Land have axillaries and second brachials which are elongated and form strong shoulders with the costals and first brachials respectively. Among the Ross Sea specimens there are none so large and old as in the collections from the Falkland sector; nevertheless, most of them have moderately long axillaries and second brachials, but in only five do they form strong shoulders with the costals and first brachials respectively.

Ambulacral furrows on the disk. Mortensen (1918, p. 19) describes how variable is the arrangement of the ambulacral furrows on the disk, "hardly two specimens (of his collection) being alike"; Bernasconi (1932*b*, pp. 33–5, fig. 3 *a–e*) gives a figure showing the different arrangements in five specimens, though the differences are slight between each of two pairs. Most of the specimens of the present large collection are well preserved with their arms bunched together so that the disk is hidden. But in ten from one locality (St. MS 71) which are preserved otherwise the disk can be seen, and in each one of them the arrangement of the ambulacral furrows is different from that in any other; in one it resembles that of two (*a* and *b*) in Bernasconi's figure. Mortensen writes: "The normal condition evidently is that each primary ambulacral furrow divides so as to provide four arms; but often one or two of them (mostly the left posterior and the right anterior) divide so as to proceed to six arms." In seven of my ten specimens the left posterior divides so as to provide six arms, but the right anteriors are very variable.

Bernasconi's five drawings show the anterior primary furrow supplying only one pair of arms: it does so in seven of my specimens.

It appears that some of the primary ambulacral furrows divide in a less variable way than others.

Side plates and spicules. Clark (1915*a*, p. 132) thinks that the presence of well-developed plates is a sign of immaturity, and that poorly developed plates, or the absence of plates, is characteristic of mature individuals. I do not find it so in this collection. But there is a relation between locality and the presence or absence of well-developed plates: it is shown by the following table:

Locality	No. of specimens examined	No. with both plates and spicules	No. with plates only	No. with spicules only
West coast of Graham Land (Sts. 180, 182, 599)	11	7	0	1
Bransfield Strait (Sts. 170, 175, 177, 1948, 1952, 1955, 1957)	37	29	2	0
South Sandwich Islands (Sts. 363, 366, 371)	13	2	4	0
South Georgia (Sts. 39, 42, 123, 144, 148, 149, 152, 156, MS 71)	34	0	5	0

It is not only a question of numbers: the degree of plating varies as well. Of the seven specimens with plates from the west coast of Graham Land five are heavily plated; of the twenty-nine from the Bransfield Strait at least thirteen are heavily plated. The six specimens having plates from the South Sandwich Islands all have very small ones (the size of the largest is shown in Fig. 2*b*): in three of them the greatest number of plates in one pinnule is two, and they are minute and near the tip. In the five specimens from South Georgia possessing plates they are as small as, or smaller than, those of the South Sandwich specimens. In three of them there are two or three very reduced plates near the tips of some pinnules but none in others. So it is probable that if a larger number of pinnules of every South Georgia specimen were examined the proportion of individuals with plates would be found to be higher: but they would be very small plates, few in number and unevenly distributed. It is, at least, quite certain that none of the South Georgia specimens has even moderately developed plates; nor were spicules seen in the tentacles of any.

Although the South Sandwich specimens have plates nearly as small as those from South Georgia, two of them do have spicules in the tentacles as well and so, in this way, stand intermediately between the South Georgia population and that of the Bransfield Strait and the west coast of Graham Land where most of the specimens with plates have spicules too.

From these facts it would appear that in this sector of the Antarctic the *Promachocrinus kerguelensis* living in lower latitudes are most often without plates and always devoid of spicules, but that a small proportion have very reduced plates, few in number, on at least some of their pinnules; that the majority of those living in high latitudes have

big plates along the entire lengths of the pinnules and many spicules in the tentacles; and that those living intermediately are intermediate in character. But Mortensen (1918, p. 19) found no plates, not only in four specimens from South Georgia, but in sixteen from the east side of Graham Land. On the other hand, Grieg (1929*a*) described the pinnules of seven specimens from the Bransfield Strait as having well-developed cover-plates.

The pinnules of thirty-eight Ross Sea specimens, twenty from the present collection and eighteen from the National Antarctic and British Antarctic Expeditions, were examined. Thirteen have plates along the ambulacra and spicules in the tentacles; in eight the plates are strongly developed, in five they are small and scattered. Another thirteen have small and scattered plates but no spicules. One specimen has spicules in the tentacles and no plates along the pinnule ambulacra; eleven have neither plates nor spicules. Two pinnules of a small Challenger specimen from Kerguelen were examined. One has a single diminutive plate near the tip, the other none.

That the presence of highly developed plates and many spicules is not a sign of immaturity is shown by the following table (p. 145), in which forty-six specimens from the Bransfield Strait and the West Graham Land region are arranged in order of age, so far as that is shown by the number of segments comprising their longest cirri.

The table shows that it is not generally the immature but the larger that have the most highly developed plates. Specimens taken from one place may vary in the degree of their plating: for example, the smaller of the three specimens from St. 175 has highly developed plates and many spicules while the other two have none.

Although Minckert (1905, p. 499, fig. 2) described *P. vanhöffenianus* as being distinguished from *P. kerguelensis* by, among other things, the possession of a skeleton along the pinnule ambulacra, his drawing, to illustrate the plating, shows no plates but a reticulation in the ambulacral lappets such as I have seen in a large number of specimens. It is formed of pigment. Hartlaub (1912, p. 485) describes the same appearance. I have not noted it as present in specimens from South Georgia, but as being of frequent occurrence in those from the South Sandwich Islands, the Bransfield Strait, the region west of Graham Land, and the Ross Sea. It may occur together with, or in the absence of, plates; if the former, in such a way as to suggest to me that it follows a reduction in the size of the plates.

Florometra mawsoni A. H. Clark (Plate III, fig. 2)

Solanometra antarctica (part) Clark, 1913, p. 61.

Promachocrinus (*Promachocrinus*) *kerguelensis* (part) Clark, 1915*a*, p. 130 (bottom of page), pl. iv, figs. 1 *a*, *b*.

Florometra mawsoni Clark, 1937, pp. 10–14.

St. 180. 11. iii. 27. Schollaert Channel, Palmer Archipelago. 160–330 m. Gear OTL. Bottom: mud and stones. One specimen.

St. 181. 12. iii. 27. Schollaert Channel, Palmer Archipelago. 64° 20′ S, 63° 01′ W. 160–335 m. Gear OTL. Bottom: mud. Two specimens.

Specimen	Longest cirrus		Well-developed plates, many spicules	Small plates, spicules	Small plates, no spicules	Spicules, no plates	No plates, no spicules
	No. of segments	Length, mm.					
177 S2	22	—	−	+	−	−	−
177 S4	*c.* 22	<20	−	+	−	−	−
175 S1	24	20–25	+	−	−	−	−
1957	24	—	−	−	−	−	+
1952–8	25	—	+	−	−	−	−
177 S5	*c.* 25	25	−	+	−	−	−
1955	26	—	+	−	−	−	−
1957	27	—	−	−	−	−	+
182 M1	28	>40	−	−	−	−	+
180 M1	28	45	−	+	−	−	−
1952–7*g*	28	—	−	+	−	−	−
1952–7*h*	28	—	−	+	−	−	−
180 M2	29	—	−	−	−	−	+
1948	30	—	−	−	−	−	+
1952–2	30	—	−	+	−	−	−
1952–6*b*	30	—	−	+	−	−	−
1952–6*c*	30	—	−	+	−	−	−
1952–6*d*	30	—	−	+	−	−	−
1952–7*c*	30	—	−	+	−	−	−
1952–7*i*	30	—	−	+	−	−	−
170 S2	*c.* 30	27	+	−	−	−	−
170 S5	*c.* 30	25–30	+	−	−	−	−
1952–6*e*	31	—	−	+	−	−	−
1952–7*f*	31	—	−	+	−	−	−
175 M1	>31	>55	−	−	−	−	+
1955	32	—	+	−	−	−	−
170 S3	33	38	+	−	−	−	−
170 S4	33	35	+	−	−	−	−
175 S2	*c.* 33	*c.* 45	−	−	−	−	+
170 S1	34	30	+	−	−	−	−
1952–4	34	—	+	−	−	−	−
180 M4	36	55	−	−	−	+	−
170 LM	38	60	−	−	+	−	−
1952–6*a*	38	—	+	−	−	−	−
182 M2	39	*c.* 70	+	−	−	−	−
182 M3	39	*c.* 70	+	−	−	−	−
180 M3	42	55	−	+	−	−	−
599 M1	42	*c.* 50	+	−	−	−	−
182 M5	46	*c.* 80	+	−	−	−	−
182 L1	54	110	+	−	−	−	−
1952–1	58	—	+	−	−	−	−
1952–3*a*	60	—	+	−	−	−	−
1952–3*b*	61	—	+	−	−	−	−
1952–5	61	*c.* 130	+	−	−	−	−
1952–9	63	>115	+	−	−	−	−
1952–7*b*	64	>110	+	−	−	−	−

Note. Each specimen appears in the table under the number assigned to it in the study of this collection. In each the first number (e.g. 177 in 177 S2 or 1952 in 1952–7*g*) is the number of the station from which the specimen came.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. 64° 56′ S, 65° 35′ W. 130–100 m. Gear DLH, NRL. Bottom: mud, stones and rock. One specimen.

St. 599. 17. i. 31. Adelaide Island. 67° 08′ S, 69° 06½′ W. 203 m. Gear DLH. Bottom: no data. Four specimens.

St. 1652. 23. i. 36. Ross Sea. 75° 56·2′ S, 178° 35·5′ W. 567 m. Gear DRR. One very young specimen.

St. 1660. 27. i. 36. Ross Sea. 74° 46·4′ S, 178° 23·4′ E. 351 m. Gear OTL. Bottom: mud. One very young specimen.

I had written a full description of this species before knowing that Mr Clark had found it in the Australasian Antarctic collection and described it. I think it useful to add the following remarks and to publish the figures I had prepared.

The arms of the eight specimens vary in length from 50 to 110 mm.

I find the cirri to be XL–LXV, 16–31, but mostly 24–26. The most elongated segments, the fourth to seventh, are not quite so elongated as in Clark's description; the most distal are slightly longer: they are longer than their distal widths.

Clark describes how the distal edges of the radials are considerably produced outwardly at the sides. In all but one, a small specimen, of the present collection the distal edge of the radial is produced into a thin lip-like frill which may stand out at right angles or be curved farther backwards. It has the appearance of being formed of a row of spines all but the points of which are connected by a web, and it is stronger on the sides than in the mid-line. The distal edge of the costal is produced into a similar thorny frill.

Fig. 3 *b–e* shows the shapes of the brachials. The spinous processes on the distal edges of the lower brachials give the animal a very characteristic appearance. They may be small on, or absent from, the first and second brachials. They are strongest between the first and second syzygial pairs where they stand out at right angles to the arm. On the brachials beyond the third syzygy they are forwardly directed but still coarse and strong. (They are stronger than appears in Fig. 3 *d* which, being a dorsal view, does not show how strongly the edge of one segment overlaps the beginning of the next.) They persist to the end of the arm.

On one arm of one specimen there is only a single ossicle, larger than the normal first or second brachial, between the axillary and the first syzygial pair.

In the smallest adult specimen P_1 is of 25 segments, in the others of 28–39 segments and up to 12 mm. long. P_2 has from 24 to 38 segments. P_3 may be a whip-like oral pinnule, with heavier basal segments than the others, but in most of the specimens it is a genital pinnule.

The earlier genital pinnules may be considerably shorter than the orals. The number of segments in the genital pinnules varies from 14 to 23, the proximal usually having a smaller number than the distal. All but the first two segments are longer than broad. The distal edge of each is produced into a row of spines. The distal pinnules are like the genitals but slightly longer, of 20–30 segments.

The disk is naked.

Sacculi are abundant.

In some of the specimens there is a single row of small fenestrated plates along each

side of the ambulacral furrow in a few segments near the tips of the pinnules. They vary in number from about two to ten and when the bigger number is present the more

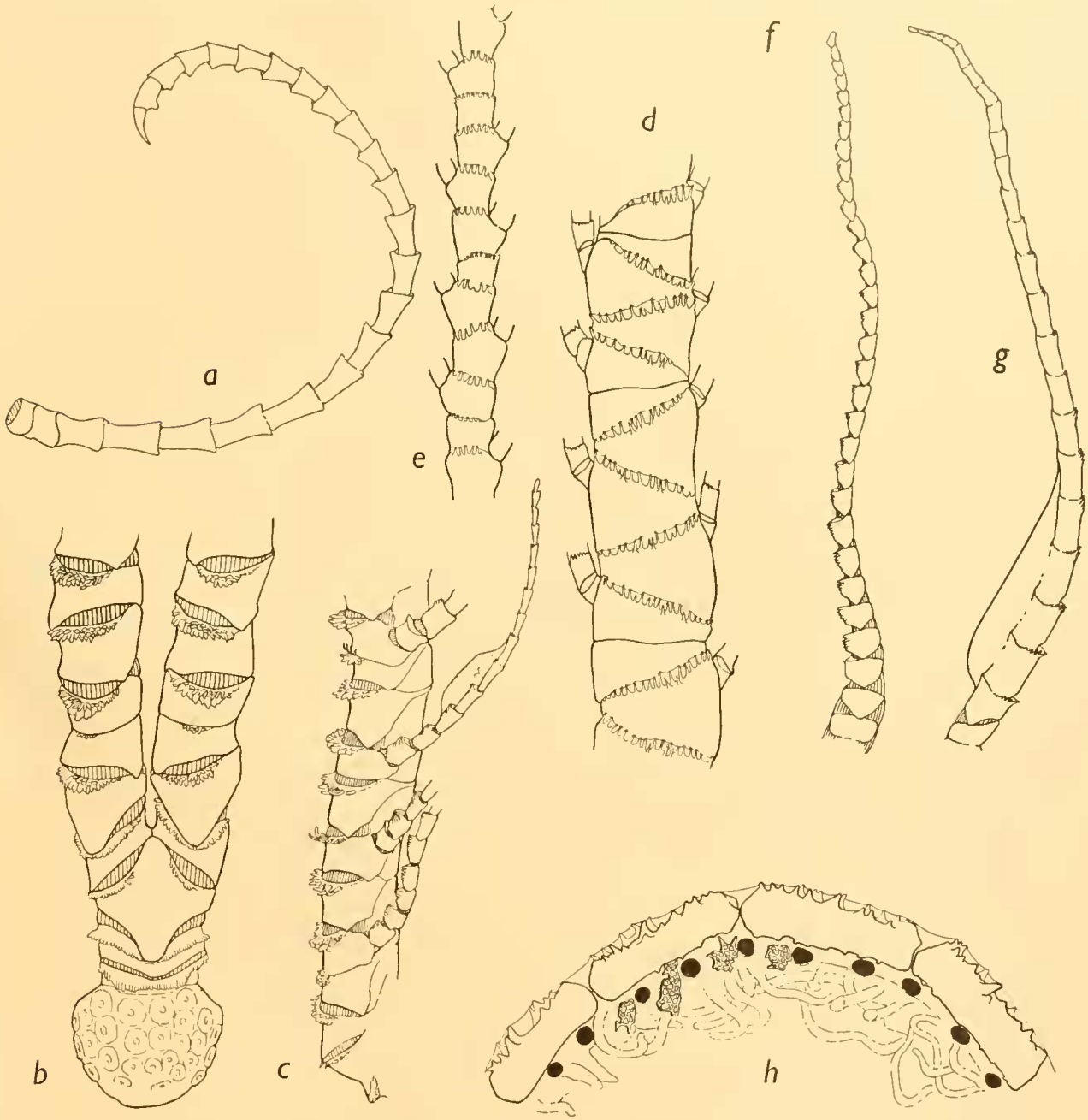

Fig. 3. *Florometra mawsoni*. *a*, cirrus, ×7. *b*, centrodorsal and proximal part of a ray, ×7. *c*, first to eleventh brachials in profile and P_3, ×7. *d*, brachials beyond third syzygy, ×11. *e*, distal brachials, ×11. *f*, P_1, ×11. *g*, P_{12}, ×11. *h*, side-plates of a distal pinnule, ×53.

proximal are very small, the distal larger (Fig. 3 *h*). In some specimens there are spicules in the tentacles. Both plates and spicules may be absent or one or both may be present.

There is no information as to the colour of the specimens in life. In spirit they are

pale straw with a dark bluish tinge in places. In one specimen the bluish tinge is confined to the outer pinnules. In the others it occurs on some of the brachials and the basal segments of some of the pinnules: it is always strongest on the brachials of the syzygial pairs and the bases of the pinnules arising from them and is sometimes present only on these ossicles. In one specimen the syzygial pairs stand out as dark bands along the whole length of the arm, darkest along the middle arm. There is no blue coloration on the calyx, the centrodorsal or the cirri. In one specimen the centrodorsal and radials are yellow.

One of the specimens was infested with two cysts of *Myzostomum cysticolum*.

Distribution. There are in the British Museum collection eight specimens of this species from the Ross Sea which had been labelled *Anthometra adriani* or *Solanometra antarctica*. One is from Discovery Winter Quarters and another two are Discovery specimens labelled "Mt Erebus and Terror". The remaining five are Terra Nova specimens (see p. 220).

The species is then known from the coast of the continent in the Ross Sea, Indian Ocean and Weddell Sea sectors of the Antarctic; it is not known from any of the outlying islands.

Florometra antarctica, n.sp. (Plate III, fig. 3)

St. 180. 11. iii. 27. Schollaert Channel, Palmer Archipelago. 160–330 m. Gear OTL. Bottom: mud and stones. Two specimens.

St. 599. 17. i. 31. Adelaide Island. 67° 08′ S, 69° 06½′ W. 203 m. Gear DLH. Bottom: no data. One specimen.

Description. One of the three specimens is nearly complete and has arms about 95 mm. long. In another, less complete but more massive, the arms must have been over 100 mm. long. The third specimen is smaller, with arms so broken that it is impossible to estimate their length when complete.

The centrodorsal is a large rounded cone closely covered with cirrus sockets arranged in regular or fairly regular columns (Fig. 4 *a*). The dorsal pole is rounded and rough in two of the specimens, sunken in the third.

Cirri LXIX–LXXVII, 23–32, usually 27–32. The cirri are long and strong, much longer in proportion to the length of the animal than in *Florometra mawsoni*, particularly so in the largest specimen. The first two segments are short, the third is about as long as broad. The fourth is twice as long as broad and fairly strongly waisted. The fifth to about the ninth are about two-and-a-half times as long as broad and faintly waisted. Beyond the ninth the segments gradually decrease in length though all are longer than broad. The distal segments possess a strong dorsal spine, the apex of which is subterminal. The opposing spine and the terminal claw are strong (Fig. 4 *b*).

In the specimen with arms 95 mm. long the basal rays are visible externally as small triangular plates (Fig 4 *a*). In the other two specimens, the largest and the smallest, I can see only four basal rays.

The radials are short, especially in the mid-line, because their distal edges are strongly

concave. They are in apposition for the greater part of their length but the distal corners are free. The distal edge may be smooth or raised into a low finely-thorny ridge. The costals are longer than the radials, not in apposition laterally. The distal edge of each is raised on either side of the incision by the axillary into a thorny lip at right angles to the surface of the ossicle.

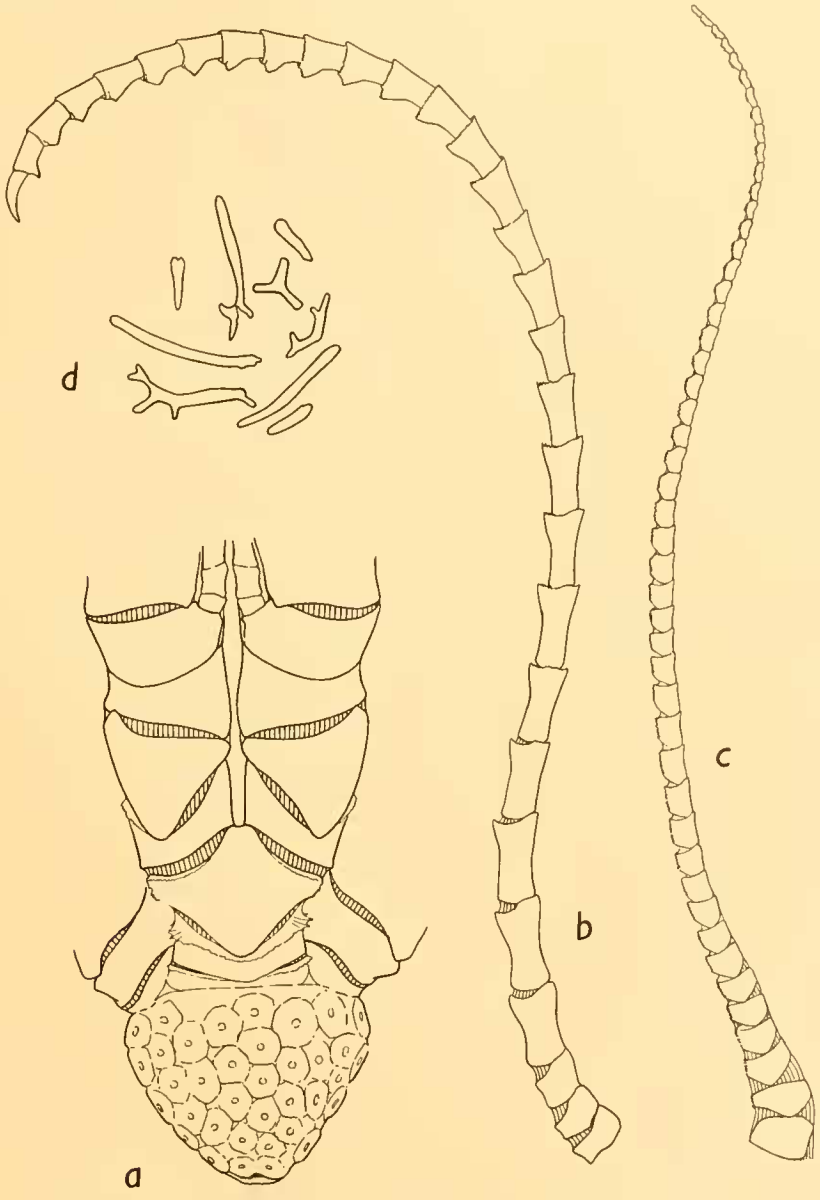

Fig. 4. *Florometra antarctica*. *a*, centrodorsal and parts of three rays, ×7. *b*, cirrus, ×7. *c*, P_1, ×11. *d*, spicules from tentacles of distal pinnules, ×114.

The axillaries and the first and second brachials are of the shapes shown in Fig. 4 *a*. The axillary is wider than the costal and forms a shoulder where it incises it; its distal edge is smooth but there are small spines on the free outer portions of its proximal edges. The inner edges of the first brachials are much shorter than the outer; they do not meet,

or at most their corners meet, above the axillary; the distal edges are smooth or finely thorny. The second brachial forms a slight shoulder where it incises the first; there may be fine spines along part of its proximal edge but its distal edge is smooth.

The first syzygy normally occurs between the third and fourth brachials but in one specimen it is between the fourth and fifth brachials on one arm, between the tenth and eleventh on another. The second syzygy is usually between the ninth and tenth brachials but it also occurs between the eighth and ninth and the tenth and eleventh. Syzygies are numerous beyond the second with one to four brachials between the pairs.

The brachials between the first and third syzygial pairs are nearly rectangular, wider than long; those beyond are at first wedge-shaped and then triangular, a little broader than long; farther out on the arm they become rectangular, at first broader than long, then as long as broad.

In the two large specimens the distal edges of the brachials between the first and second syzygies are smooth. The first one to three of these brachials are smooth in the small specimen but the others are raised distally, in the mid-line only, into a group of spines much smaller and lower than those of *F. mawsoni* but, like them, standing out at right angles to the arm. The distal edges of the brachials beyond the third syzygy are the same in all three specimens: they are produced into a row of strong forwardly directed spines.

The oral pinnules are longer and composed of a greater number of segments than in *F. mawsoni* and the first genital pinnule is farther out on the arm. P_1 is of 44–50 segments, 16 mm. long (Fig. 4 *c*); P_2 of 38–45 segments, 15–16 mm.; P_3 of 35–43 segments, about 13 mm. None of the segments of the oral pinnules is much longer than broad; the proximal have spiny dorsal carinations which become reduced to low rounded protuberances on the segments at the tip of the pinnule. The first genital pinnule is P_4 or, more often, P_5. P_5 is of about 23 segments and 11 mm. long; the gonad lies along the fourth to the tenth or eleventh segments. The other genital pinnules are of between 23 and 30 segments and up to 16 mm. long; the gonads usually lie along the third to eighth segments. All but the first two segments of the genital pinnules are considerably longer than broad. Their distal edges are beset with fine spines.

The disk is naked. Sacculi are abundant. None of the specimens shows any trace of an ambulacral skeleton. In the largest specimen there are many spicules, some smooth and rod-like and others branched, in the tentacles of the distal segments of the outer pinnules (Fig. 4 *d*).

The specimens are of a pale straw colour in spirit, darker on the pinnules than elsewhere. There is a yellowish tinge on the distal parts of the cirri and pale brown spots on the gonads and the tissues on the inner sides of the arms. Some of the brachials have a bluish tinge along the sides.

One of the specimens has a large cyst of *Myzostomum cysticolum* v. Graff lying between the bases of a pair of its arms with its lower extremity resting on the disk.

Florometra antarctica is distinguished from *F. mawsoni* by its considerably longer oral and genital pinnules which are composed of a greater number of segments. The

distal edges of the lower brachials are not everted into strong spiny ridges at right angles to the dorsal surface as in *F. mawsoni*. The cirri, although they do not comprise more or many more segments than those of *F. mawsoni*, are much heavier and longer.

Genus Anthometra Clark

Anthometra adriani (Bell) (Plate III, fig. 4)

Antedon adriani Bell, 1908, p. 4, pl. ii; 1917, p. 2.
Promachocrinus (*Anthometra*) *adriani* Clark, 1913, p. 60; 1915 *a*, pp. 135–7, pls. vi–vii.
Anthometra adriani Mortensen, 1918, p. 18; Clark, 1921, many references including description of side plates (p. 270) and of pentacrinoid young (pp. 557–9, fig. 938); Mortensen, 1925 *b*, p. 2; Gislén, 1928, p. 11; Clark, 1929, p. 662; Grieg, 1929 *a*, p. 4; John, 1937, p. 10; Clark, 1937, pp. 14–16.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. 64° 56′ S, 65° 35′ W. 130–100 m. Gear DLH, NRL. Bottom: stones, mud and rock. Two specimens.

St. 1660. 27. i. 36. Ross Sea. 74° 46·4′ S, 178° 23·4′ E. 351 m. Gear OTL. Bottom: mud. One broken specimen.

St. 1952. 11. i. 37. Between Penguin Island and Lion's Rump, South Shetlands. 367–383 m. Gear DRR. Bottom: soft mud. Nine specimens.

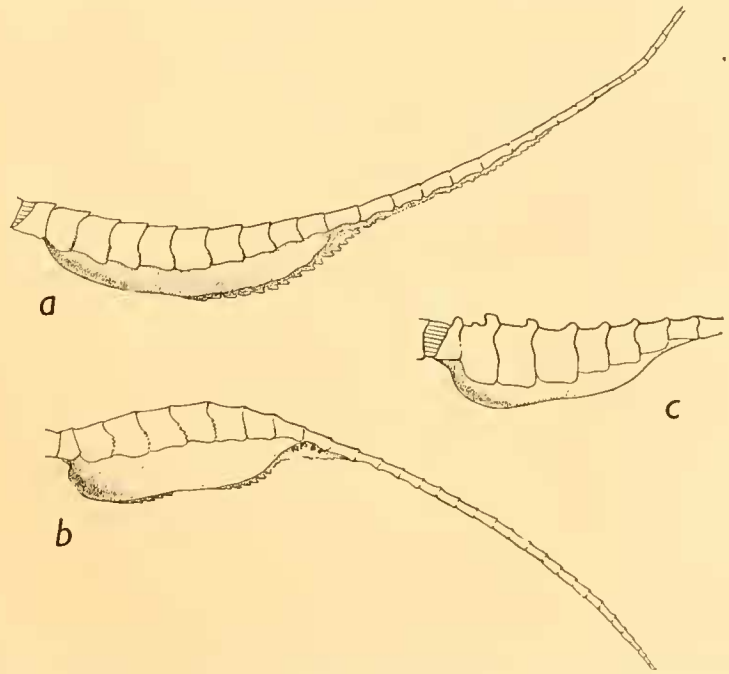

Fig. 5. *Anthometra adriani*. *a*, a male genital pinnule from the side. *b*, a female genital pinnule from the side. *c*, the same obliquely from above. All ×7.

It appears from my own counts and those of others that the cirri of large specimens may be numerically described as follows: L–LXX, 60–86, up to 90 mm. long.

Gislén says that some of the segments of the proximal pinnules are expanded and that it thus "forms a transition to the Isometrinae". It is the segments of the genital pinnules along which the gonad lies that are expanded, and they are a little more expanded in the female than the male. Figures are given (Fig. 5): the female pinnule is from a well preserved Terra Nova specimen with nearly complete arms which are

250 mm. long, a much greater length than any previously recorded; the male pinnule is from a smaller specimen.

One of the specimens from St. 190 is infested with a *Myzostomum* on the disk.

Genus Solanometra A. H. Clark

Solanometra antarctica (P. H. Carpenter)

Antedon antarctica P. H. Carpenter, 1888, p. 144, pl. i, figs. 6 *a–d*, 7 *a*, *b*, pl. xxv.
Antedon australis P. H. Carpenter, 1888, p. 146, pl. xxvi, figs. 4, 5, pl. xxvii, figs. 14–20.
Promachocrinus (*Solanometra*) *antarctica* Clark, 1915 *a*, p. 135—list of earlier references and synonymy.
Solanometra antarctica Clark, 1937, p. 9.

There are no specimens of this species in the present collection.

Bell records it (as *Antedon antarctica*) from the Ross Sea both in his Discovery (1908) and Terra Nova (1917) reports. I have re-examined the specimens and find that not one of them is *Solanometra antarctica*.

The species is known only from the Challenger specimens taken near Heard Island (of which there are six in the British Museum collection, three each from Sts. 150 and 151), and from the Australian Antarctic Expedition's collection from near the coast of Adélie Land on the Antarctic continent.

Subfamily *ZENOMETRINAE*

Genus Eumorphometra A. H. Clark

Eumorphometra aurora n.sp. (Plate IV, fig. 1)

St. 160. 7. ii. 27. Near Shag Rocks. 53° 43′ 40″ S, 40° 57′ W. 177 m. Gear DLH. Bottom: grey mud, stones and rock. One specimen.

Description. All the arms are broken off at what I judge to be about three-quarters of their length; the parts remaining are composed of about 30 brachials and are nearly 20 mm. long.

The centrodorsal is a rounded cone not so high as it is broad at the base. The ventral edge is produced into very low and wide corners interradially. The cirrus sockets are arranged in ten columns, one close against another, the arrangement of which is regular but for the most ventral circle which is composed of fourteen.

Cirri *ca.* XLI, 17–28. They increase in size from the apex of the centrodorsal to the edge. Those around the dorsal pole are of about 17–19 segments and short; the next circle are longer, of 21–23 segments; the outermost are of 27 or 28 segments and up to 10 mm. or more in length, about twice as long as the apical (Fig. 6 *a*). The first three segments of the cirri are broader than long, the fourth is as long as broad, and the fifth to the eighth or ninth are slightly longer than broad. All these have the distal end slightly flared, more strongly on the dorsal than the ventral side, so that they are a little

wider distally than at the base. The more distal segments are about as long as broad. Their dorsal sides are raised into low keel-like protuberances highest near the end of the segments, making them wider distally than proximally. The terminal claw is short and the opposing spine small.

The radials are nearly rectangular and fairly long, about half as long as broad (Fig. 6 *b*). The distal half is half-cup shaped. In profile the proximal half makes only

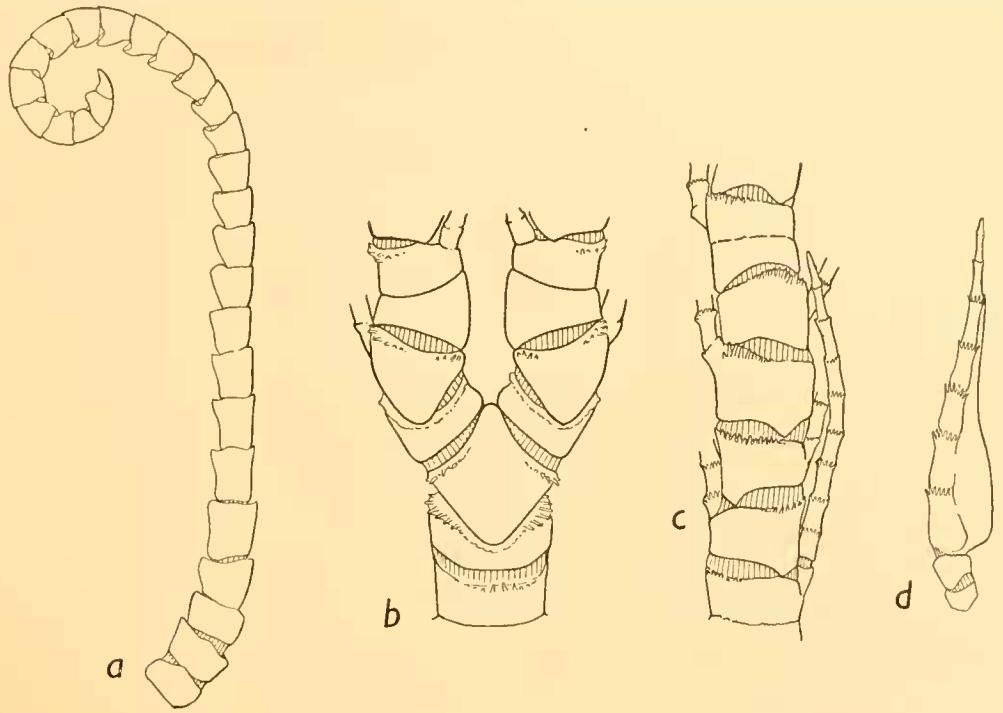

Fig. 6. *Eumorphometra aurora*. *a*, cirrus. *b*, proximal part of a ray. *c*, fourth to tenth brachials and P_a. *d*, P_6 from the side. All × 13.

a slight angle with the dorsoventral axis but the distal half bends sharply outwards. The costals are not quite so long as the radials; they are widely separated from each other and are not deeply incised by the axillaries. The axillaries are slightly longer than broad. The first and second brachials are of the shape shown in Fig. 6*b*; the former are widely separated. The distal edges of the radials, costals, axillaries and the first and second brachials are raised into very fine spines.

Syzygies occur between the third and fourth, ninth and tenth, and fourteenth and fifteenth brachials, and thereafter with intervals of two brachials between each syzygial pair.

The fifth to eighth brachials, between the first and second syzygies, are nearly rectangular, about one-and-a-half times as broad as long (Fig. 6 *c*). Those between the second and third syzygies are wedge-shaped and longer than broad. The more distal brachials are longer on one side than the other, slightly longer than broad. The distal edges of all the brachials beyond the first syzygy are faintly raised and produced into short spines; they are most conspicuous on the distal brachials, but are much shorter and less conspicuous than those of *E. hirsuta*.

There is no strong contrast between the different kinds of pinnules. In all, the distal edges of the segments are faintly flared out and produced into spines; the flare is not strong enough to give the joints a swollen appearance. P_1 is slender and tapers evenly from the base to the tip. It is 4–5 mm. long, of 13 rounded segments all but the first two or three of which are longer than broad, the distal more so than the proximal; the distal are up to three times as long as broad. P_2 is similar to P_1 but of fewer segments and shorter, of 8–9 segments, about 3 mm. long. It tapers more rapidly and its distal segments are more elongated. In the genital pinnules the first two segments are short, the others longer than broad, the middle segments being more elongated than in the oral pinnules. P_3 is the first genital pinnule; it is of 8–9 segments like P_2 but is slightly longer, 3–4 mm. long. It bears a large egg-shaped gonad on the third to fifth segments: a testis, for the specimen is a male. The genital pinnules extend to P_7 or P_8 (Fig. 6 *d*). They are all of about the same number of segments as P_3, but the distal are a little longer, up to 5 mm. long; their gonads are more fusiform being along the third to sixth segments. The pinnules immediately beyond the genitals are about 5 mm. long and of about 12 segments, the first two short, the others considerably longer than broad. There are no complete outer pinnules left.

The disk is naked. Sacculi are few and inconspicuous.

Along the pinnule ambulacra there are small rods, three to each segment, which are perforated, forked or branched at the end. They are very reduced side-plates and are better developed along the middle than the proximal segments. At the ends of some, but not all, there are equally reduced cover-plates. Both are similar to, but more reduced than, those of *Phrixometra nutrix* (Fig. 11*e*).

The specimen is white in spirit.

Mr A. H. Clark has kindly made for me a direct comparison of this species and *Enmorphometra concinna*. *E. aurora* is considerably larger, its centrodorsal is lower and broader with more numerous cirrus sockets more irregularly arranged; its longer cirri have more segments; its radials and axillaries are longer; the elements of its division series and its brachials do not have their central portions abruptly elevated and prominently spinous as in *E. concinna*.

I have been able to compare *E. aurora* directly with *E. hirsuta*. *E. aurora* is far less spinous; the shapes of the elements of the division series and of the first two brachials are quite different in the two species. The cirrus sockets of *E. hirsuta* are in about fifteen irregular columns.

E. aurora is easily distinguished from *E. fraseri* by its smaller number of cirrus segments; and from *E. marri* by the facts that its cirrus sockets are in columns not alternating rows, that P_1 is not much more massive than P_2, and that the segments of the lower genital pinnules carrying the gonads are not expanded.

Eumorphometra fraseri, n.sp. (Plate IV, fig. 2)

St. 1955. 29. i. 37. North of South Shetland Islands. 61° 35·1′ S, 57° 23·3′ W. 440–410 m. Gear DRR. One specimen.

Description. No arm is complete; the longest is of 44 brachials, 28 mm. long. The centrodorsal is a high and pointed cone with a sharp and rough dorsal pole. The ventral edge of the centrodorsal is produced into low corners interradially. It is thickly covered with cirrus sockets.

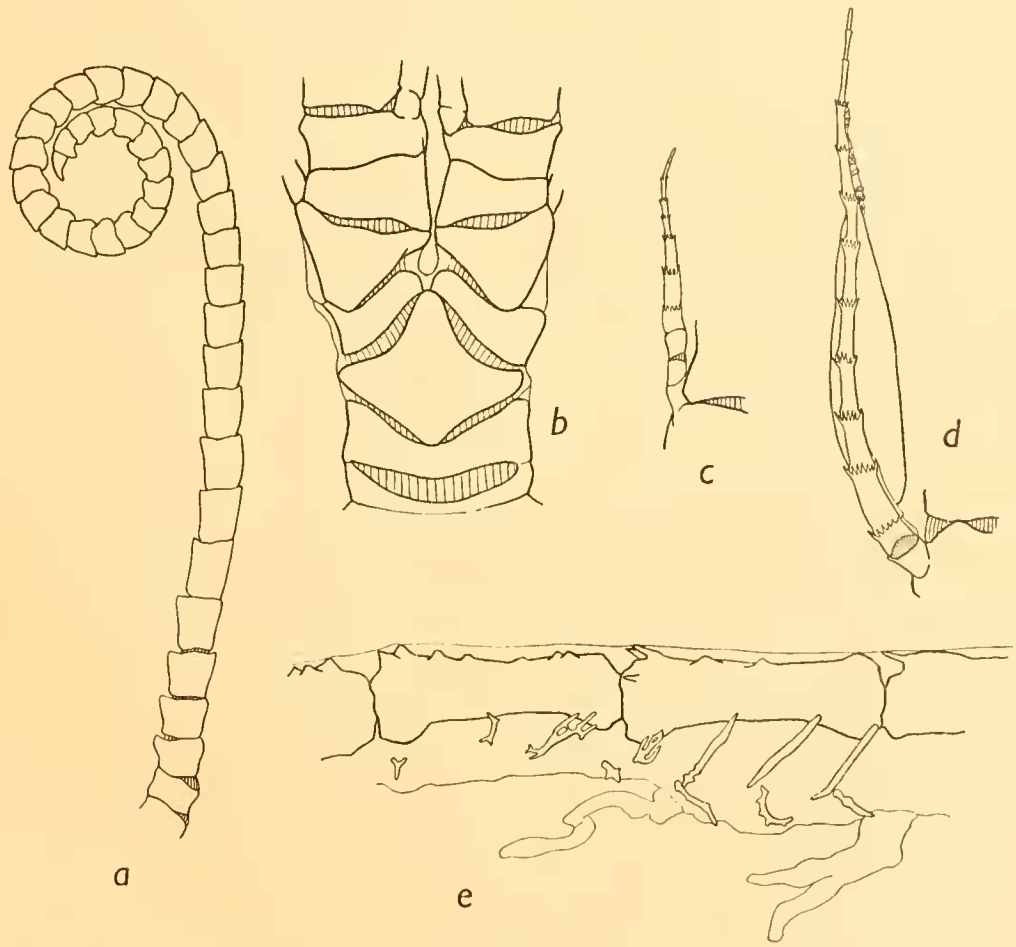

Fig. 7. *Eumorphometra fraseri*. *a*, cirrus. *b*, proximal part of a ray. *c*, P_a. *d*, P_7. *e*, ambulacral skeleton of distal pinnule. *a–d*, ×13; *e*, ×66.

Cirri XLV, 34–40, arranged in slightly irregular closely placed columns, three to each radius, two to four cirri in each column. The peripheral cirri appear to be slightly longer than the more apical, about 12 mm. long.

The first, second and third segments are about twice as wide as long (Fig. 7 *a*). The third segment is wider distally than proximally, the greater width being on the dorsal side, and it is waisted, more strongly on the dorsal than the ventral side. The fourth and fifth segments are of similar shapes but the fourth is more than half as long as wide and

the fifth is nearly as long as wide. The sixth to the tenth are slightly longer than wide; they are wider distally than proximally but not so much so as in the third to fifth segments: they are of a more regular shape, not waisted. The eleventh and twelfth segments are as long as broad. The remaining segments are broader than long. Beyond about the fifteenth the dorsal edge becomes curved instead of straight and on the distal segments it is produced into a low, strongly rounded dorsal spine. The opposing spine is strong and stands out at right angles; the terminal claw is strong.

The cirri, in common with the rest of the proximal half of the specimens, were orange-yellow in life. The colour is lost in spirit. The first five or six segments are lighter than the remainder. On many cirri the eighth to tenth segments are much darker, being a rusty yellow, than the others.

The radials are short narrow strips with concave and everted distal margins (Fig. 7*b*). The costals are short, about one-sixth as long in the midline as they are wide. They are in contact laterally. They are deeply incised by the posterior projection of the axillaries which makes shoulder-like projections with them. The axillary is a little broader than long. Its proximal edges are nearly straight whereas the distal are deeply concave; it follows that the posterior projection is broadly rounded, the anterior sharper. The edges of the costals and axillaries are everted and finely thorny.

Syzygies occur between brachials 3 + 4, 9 + 10 and 14 + 15, beyond which they are numerous, the pairs being separated by two to three, or exceptionally four, brachials.

The first brachial is short with a slightly longer external than internal edge; its distal margin is slightly incised by the second brachial. The second brachial is approximately an equilateral triangle; the distal edge is slightly concave. The internal edge of the first syzygial pair is considerably longer than the external.

The fifth to eighth brachials, between the first and second syzygial pairs, are roughly rectangular, somewhat broader than long. They are alternately longer on one side than the other. For some distance beyond the second syzygy the brachials are triangular and about as long as broad. Farther out on the arm they are quadrangular with one side, alternate sides in successive brachials, considerably longer than the other; they are slightly longer than broad. The distal edges of the lower brachials, between the first and the third or fourth syzygial pairs, are produced into single rows of strong tooth-like spines; those of the more distal segments are smooth.

P_1 and P_2 are incomplete or hidden. P_a and P_b are each about 5 mm. long. P_a is of 11 segments and tapers to the distal end (Fig. 7*c*). The first segment is as long as broad; the second and third are slightly longer than broad. The fourth and fifth are about twice as long as broad. The slender distal segments are longer, three or more times as long as broad. The distal edges of the more distal segments are produced into strong spines. The ventral side of the pinnule is thickly covered with sacculi, though there is no ambulacral groove.

P_b is usually an oral pinnule of 9 slender evenly tapering segments. The first is about as long as broad, the second slightly longer. The remainder are elongated: the third is twice, the fourth about three times, as long as broad; the fifth to ninth are about five

times as long as broad. The distal edges of the segments are produced into a small number of spines; the entire dorsal edge of one or two of the lower segments may be rough with spines.

On some arms P_b is a genital pinnule.

P_3 is usually the first genital pinnule and it carries a large fusiform testis—for the specimen is a male—along the third to seventh segments. A P_3 which is of 9 segments and 5 mm. long appears to be nearly complete. The first two segments are short, the remainder elongated, the fourth and succeeding segments being four or more times as long as broad. In the other genital pinnules the segments are not so elongated. The genital pinnules extend to P_{10} or P_{12}; in the middle genital pinnules the gonad lies along the third to eighth segments.

P_7 may be taken as an example (Fig. 7 *d*). It is of 13 segments and 6 mm. long. The first two segments are short. The third to eighth increase from two to four times as long as broad. The distal end of each is flared out into a thorny cup around the base of the next; the base of each is swollen to a less extent. The distal segments are longer, more regular and more slender.

The outer pinnules are of about 18 segments and 8 mm. long. The first two segments are short, the third and fourth longer than broad, the remainder about twice as long as broad. Their distal edges are thorny.

The disk cannot be seen.

Sacculi are numerous and conspicuous along the pinnule ambulacra.

The pinnule ambulacra are lined by rod-like side plates, three to each segment. They are mostly simple smooth rods but they may be knobbed and they may have forked or perforated ends; at the end of some pinnules they are shorter and have a different, more plate-like form (Fig. 7 *e*). Strongly knobbed spicules occur in the tentacles.

The following is a colour note made at the time of capture: "Proximal half, including cirri, orange yellow; distally the arms and pinnules are much banded with delicate grey, producing a dark effect."

E. fraseri is distinguished from the other species of the genus by its greater number of cirrus segments. Apart from this difference the cirri are generally similar to those of the other species.

Eumorphometra marri, n.sp. (Plate IV, fig. 3)

St. 1948. 4. i. 37. East of Clarence Island, 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen and fragments of another.

Description. The single specimen is in good condition with arms of about 60 brachials, 25 mm. long.

The centrodorsal is hemispherical with a rounded dorsal pole; its ventral edge is straight. The cirrus sockets are arranged in two or three closely placed alternating rows.

Cirri XLII, 23–28; the apical are of fewer segments and shorter than the peripheral. The first segment is nearly twice as broad as long; the second is two-thirds as long as

broad (Fig. 8 *a*). The third and fourth are as long as broad. The fifth is slightly longer than broad. The sixth to eighth are shorter than the fifth, but each is longer than broad. All the remaining segments are slightly broader than long. From the twelfth onwards they are wider distally than proximally and the dorsal edge is rounded but it is not raised into a keel or spine. The opposing spine is strong; it has the shape of an equilateral triangle and arises from the entire dorsal edge of the penultimate segment. The terminal claw is moderately strong and curved.

The radial is short with a concave distal edge; its width is six times the length in the midline (Fig. 8 *b*). The costal is four times as wide as the lateral, greatest, length. It is moderately deeply incised by the axillary. The costals are not in apposition. The axillary is one-and-a-third times as broad as long. The proximal edges are faintly concave, the posterior projection broadly rounded; the distal edges are deeply concave so that the anterior projection is narrow and pointed. The radials, costals and axillaries are smooth.

Syzygies are numerous. The positions of the first three are 3 + 4, 9 + 10, 14 + 15; the pairs occur thereafter at intervals of one to three, usually two, brachials.

The first brachial is short with a longer exterior than interior edge; it is slightly incised by the second. The second is a little broader than long with a broadly rounded posterior projection and a concave distal edge. Both brachials are smooth. The interior edge of the first syzygial pair is considerably longer than the exterior. The brachials between the first and second syzygies are slightly broader than long. The fifth is rectangular with its interior proximal corner produced backwards. The succeeding brachials are similar, with, alternately, the exterior and interior proximal corners produced backwards. They gradually change in shape so as to be wedge-like at the second syzygy. Beyond the second syzygy the brachials are triangular, a little longer than broad. Farther out on the arm they become quadrangular, with oblique proximal and distal edges, and more elongate. The distal edges of all the brachials beyond the first syzygy are everted and rough with spines.

P_1 is longer and much more massive than P_2; P_3 is the first genital pinnule. P_1 is of 14 segments, 4 mm. long, and extends as far as P_2 (Fig. 8 *c*). The segments are strong and rounded and a little longer than broad; their dorsal surfaces and distal edges are rough. P_2 is of 10 segments, 3 mm. long; all but the first segment are longer than broad: the fourth and succeeding segments are twice as long as broad. P_3 is of 10–12 segments, about 3 mm. long, and has an ambulacral furrow (Fig. 8 *d*). The first two segments are short. The third to seventh, along which the gonad lies (a testis, for the specimen is a male), are considerably longer. They are slightly expanded. The third is as long as broad. The fourth is as wide but slightly longer. The fifth is not so wide as the fourth; it is longer than broad. The sixth is narrower and about twice as long as broad; the seventh is more than twice as long as broad. The remainder are narrow and elongated, about three times as long as broad. All the segments have strongly everted and spinous distal edges; the spines are strongest on the aboral edge of the expanded segments.

The genital pinnules extend to P_{18}. They resemble P_3 except that the expansion of the segments along which the testis lies gradually lessens; it disappears about P_{10}

(Fig. 8 *e*). The genital pinnules gradually increase in length and number of segments; P_4 is of 10 segments, 3·5 mm.; P_{10} of 13 segments, 4·5 mm.; P_{18} of 14 segments, 5 mm. On the adoral side of each testis, opposite the third segment of the genital pinnule, there is a small papilla through which presumably the spermatozoa pass to the outside.

The distal pinnules are of 17 segments, all but the first two of which are two to three times as long as broad; they have everted and spinous distal edges.

Sacculi are very numerous and conspicuous, regularly arranged along the pinnule ambulacra.

There are reduced rod-like side-plates along the pinnule ambulacra; they may be simple smooth rods, or they may be knobbed, or have branched or reticulated ends. There are no spicules in the tentacles.

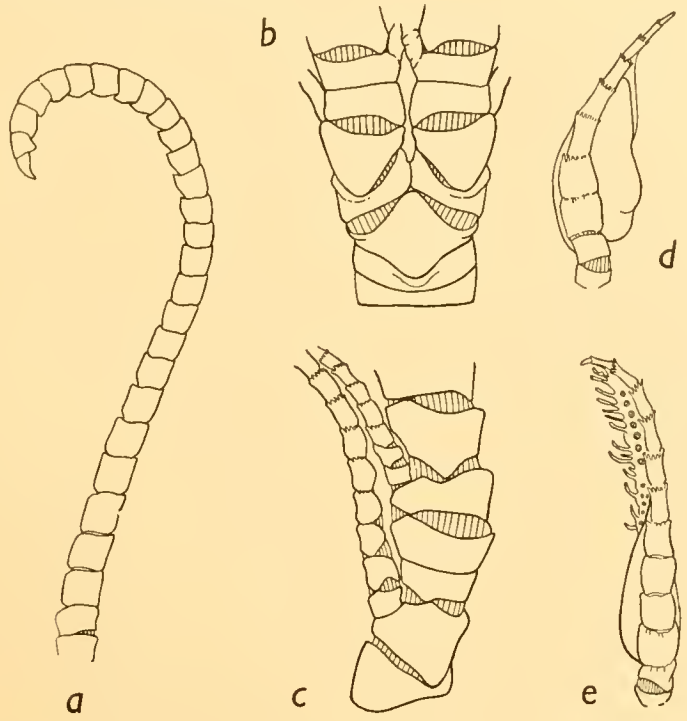

Fig. 8. *Eumorphometra marri*. *a*, cirrus. *b*, proximal part of ray. *c*, lower brachials and portions of P_1 and P_2 from side. *d*, P_3. *e*, P_{10}. All ×13.

E. marri is distinguished from the other species of the genus by having its cirrus sockets arranged in two or three alternating rows, not in columns; by the fact that P_1 is not only longer but much more massive than P_2; and by having the segments of the lower genital pinnules which carry the gonads slightly expanded.

Eumorphometra hirsuta (P. H. Carpenter)

Antedon hirsuta P. H. Carpenter, 1888, p. 188, pl. xxxi, fig. 5.

This species is known only from the single Challenger specimen from 140 fathoms near Marion Island. It may be useful to add here a few notes based upon a re-examination of the specimen.

The cirrus sockets are arranged in about fifteen irregular columns; the columns are least regular near the ventral edge of the centrodorsal, around which there are about twenty sockets.

Cirri about XXXV, 25–30. The distal segments, from about the tenth outwards, have a rounded dorsal keel which is not shown in Carpenter's figure; it is stronger than that of *E. fraseri*.

P_1 is long, stiff and slender, of 12 evenly tapering segments, 4·5 mm. long. The first two segments are heavy and broader than long; the third and fourth are about as long as broad; the remainder are elongated and become more and more slender to the tip of the pinnule. The distal edges are thorny.

P_2, of 11 segments and about 4 mm. long, is similar. Carpenter describes it as carrying a gonad: if it is a gonad, it is very small.

The remaining pinnules arise from regenerated brachials and do not bear gonads.

Eumorphometra concinna A. H. Clark

A. H. Clark, 1915 *a*, p. 118, pl. ii, figs. 2 and 3.

This species is known from the five specimens taken by the Deutsche Südpolar Expedition in 380–400 m. off Gaussberg in the Indian Ocean sector of the Antarctic. It has not been recorded since. Upon re-examining a female co-type Mr Clark found that there were brood-pouches alongside the ovaries. Knowing of the number of brood-protecting species that I had among the Discovery collection, he immediately sent me a portion of the arm and a number of detached pinnules with permission to describe them here.

The arm fragment is from the middle of an arm and carries a few of the distal genital pinnules and the first of the outer pinnules. The distal edges of the brachials are raised into stronger spines than those of the corresponding brachials in *E. aurora*. Along the pinnule ambulacra there are reduced rod-like side- and cover-plates like those of *E. aurora*, except that some are strongly thorny.

The brood-pouches lie on the aboral side of the pinnules, nearest the arm. The walls are so thin that the contents of the pouch can be seen through them. The eggs in the ovaries and the embryos in the brood-pouches are of different sizes and at various stages of development. The biggest eggs are oval and as much as 0·2–0·25 mm. long. The biggest of the brood-pouches contains 13 embryos. Seven are without trace of skeletal plates or ciliated bands; they are spherical or irregularly oval, 0·21–0·29 mm. Six are oval embryos with the beginnings of skeletal plates within them. One is smaller than the others, 0·34 mm. long, and with no ciliated bands. There are about 14 small stem-plates and a very large terminal plate, and there are five orals and five basals but no infrabasals. Three other embryos in good condition are slightly bigger, 0·37–0·40 mm. long and 0·29–0·36 mm. wide, and possess ciliated bands. They have about 18 stem-plates. In two of them there are two very small infrabasal plates—I cannot see a third in either of them or any infrabasal plates in the third embryo. The three posterior bands

of cilia are hoop-like and clear, but the first and second bands are difficult to follow; the former seems to surround a depression, the apical pit, and the latter to coalesce with it for a portion of its course.

Kempometra n.g.

DIAGNOSIS. A genus of Zenometrinae including species of small size; P_1 and P_a are absent; the centrodorsal is rounded conical, not higher than broad at the base, its surface showing no differentiation into radial areas; cirrus sockets in 15 closely crowded columns; cirri with few, up to 16, segments all of which but for the first two and the penultimate are longer than broad; no dorsal spines; opposing spine usually absent, if present more or less vestigial; brachials and pinnulars have everted and spinous ends; viviparous.

Kempometra grisea n.sp. (Plate IV, fig. 4)

St. 1957. 3. ii. 37. 7 miles east of Cape Bowles, Clarence Island, South Shetlands. 830 m. Gear DRR. Bottom: rough, stony. Two specimens, both females.

DESCRIPTION. One of the specimens is almost complete with arms nearly 40 mm. long, of more than 60 brachials; in the other all but one of the arms are broken.

The centrodorsal is a cone nearly as high as broad with its ventral edge produced into low corners interradially. The cirrus sockets are arranged in fifteen closely crowded columns, three or four to a column, the sockets of one column alternating in position with those of the next. The sockets are considerably longer than wide.

Cirri *ca.* L; 9–16, usually 14, up to 9 mm. long. The apical cirri are considerably smaller than the peripheral; they may be only half as long and they are usually of 9–12 segments. The description which follows is of the longer cirri (Fig. 9 *a*). The first two segments are wider than long though the second is longer than the first. The third is about one-and-a-half times as long as broad; the fourth to the sixth are more than twice as long as broad. The segments beyond the sixth gradually decrease in length, though all, except the penultimate, which is about as broad as long, are longer than broad. They are slightly wider than the first six segments and each is a little wider distally than proximally, but there is no trace of a dorsal spine. The whole cirrus is laterally compressed, more strongly in the distal than in the proximal half. The opposing spine is usually absent but may be represented by a minute terminal tubercle. The terminal claw is small and hyaline. The texture of the cirrals as of the brachials is very finely thorny.

The radials are fairly long and wider distally than proximally; the length is less than one-third the greatest width (Fig. 9 *b*). The costals are widely separated from one another for the whole of their length. They are deeply incised by the posterior projection of the axillaries; whereas the lateral edges are more than half as long as the greatest width, the length in the mid-line is only about one-tenth of the width. The axillaries are longer than broad and form shoulder-like projections with the costals; the two proximal sides are slightly, the two distal sides strongly, concave. The shapes of these ossicles and of the

lower brachials are shown in Fig. 9 *b*. The long second brachials incise the first and form slight shoulders with them.

Syzygies occur between brachials 3 + 4, 9 + 10 or exceptionally 8 + 9, 13 + 14 or 14 + 15, and thereafter at intervals of two to four, usually three, muscular articulations.

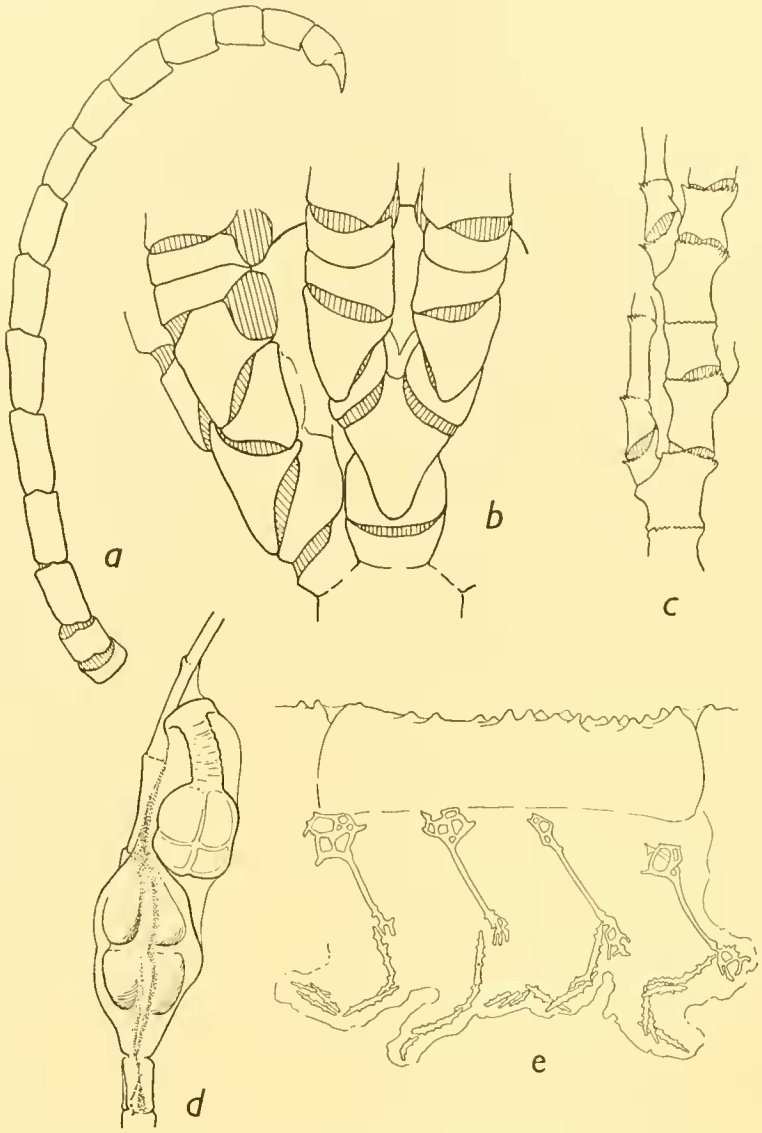

Fig. 9. *Kempometra grisea*. *a*, cirrus. *b*, proximal parts of two rays. *c*, forty-third to forty-seventh brachials. *d*, P_3 from the under side showing the ovary containing large eggs and the brood-pouch containing a pentacrinoid larva. *e*, side-plates and spicules of distal pinnules. *a–b*, ×13. *c–d*, ×15. *e*, ×80.

The two brachials following the first syzygial pair are rectangular, about twice as broad as long. Those for some distance beyond are somewhat wedge-shaped and about as long as broad. The distal brachials are elongated and slender, rectangular, with the articulations, muscular and syzygial, slightly swollen (Fig. 9 *c*). The distal edges of the brachials are everted and produced into frills of tooth-like spines; their entire surfaces, as well as those of the ossicles of the division series, are very finely thorny.

There are no oral pinnules: P_1 and P_a are absent from all arms of both specimens. The first pinnule is P_2, which arises from the outer side of the fifth brachial and carries a gonad. There are two, three, or more usually four, genital pinnules on each side of the arm. The gonad on the outermost genital pinnule, and more rarely that on P_2, may be small. None but the smaller outer genital pinnule has an ambulacral furrow; the course that the furrow would follow, if present, on the other genital pinnules is shown by a double line of pigment. P_2 is of 8 segments, about 4 mm. long. The first segment is slightly longer than broad; the second is about one-and-a-half times as long as broad. The remaining segments are long. The third and fourth are about four times as long as broad. The distal segments (but for the terminal, which is shorter and pointed) are as long but more slender. The other genital pinnules are similar but of more segments and slightly longer: P_3 is of 9 segments, more than 4 mm. long (Fig. 9 *d*); P_4 is of 9 segments and 5 mm. long.

The distal pinnules are of about 15 segments and 7 mm. long. The first segment is broader than long, the second about as long as broad; the articulation between them is greatly widened. The other segments are about four times as long as broad, becoming slightly longer and more slender distally; the articulations are swollen and the distal ends of the segments are everted and spinous.

The species is brood-protecting: on each genital pinnule there is a brood-pouch as well as an ovary. It does not lie alongside the ovary as in some other brood-protecting species, but somewhat to the side of and distal to it. The ovary lies on the third and fourth segments of the genital pinnule and, in dorsal view, projects farther on the side away from the arm from which the pinnule springs than on the other. The brood-pouch lies along part of the fourth, along the fifth and a part of the sixth, segments and projects more on the side towards the arm from which the pinnule springs than on the other (Fig. 9 *d*). On some pinnules the brood-pouch is empty. Two in which it is not have been cleared and mounted. In each there are two or three small eggs, 0·10 mm. in diameter, in the proximal corner of the ovary. In one the remainder of the ovary appears to be occupied by one enormous egg. In the other there are five large eggs of an irregular oval shape, two about 0·25 mm. long, the other three much larger, the largest 0·62 mm. long by 0·36 mm. broad. The brood-pouch of the first contains one large egg with no trace of skeletal plates to be seen within it; in the other there are two, the largest of which is 0·67 mm. long by 0·51 mm. broad.

A third genital pinnule which was examined, a P_3, shows how far this species protects its brood (Fig. 9 *d*). The ovary contains a small number of large eggs like those already described, and perhaps some small eggs; in the brood-pouch is one young pentacrinoid larva, *ca.* 1·3 mm. long, its crown consisting of two closed circles of plates, the basals and orals, in contact with one another, its stalk of ten or more stout joints and a large terminal plate. It lies with its crown against the ovary, the end of its stalk against the sixth segment of the pinnule. Whether this stage represents the farthest to which the pentacrinoid larvae develop before being released from the brood-pouch cannot be said. None is attached to any part of either specimen.

So far as can be seen the disk is not plated. The anal cone is very high, higher than the level of the second syzygy.

The sacculi of the distal pinnules are regularly arranged.

There are three or four side-plates to a segment (Fig. 9 *e*). Each is a long straight rod arising from a branching or reticulate base, with an end which is thorny or slightly branched, or expanded into a small reticulate plate, smaller than that at the base; the plates of the proximal segments are more simple, those of the distal more complex. Continuous with the end of each plate is a row of knobbed and curved rods, the end of one overlapping that of the next, arranged in an arc which travels backwards (towards the base of the pinnule) and inwards; they appear to lie along the edge of the marginal lappets. I see no spicules in the tentacles.

The colour in life was described as: "Dark grey markings on a white ground. General effect grey." It remains so in spirit. The dorsal surfaces of the radials, the ossicles of the division series and the brachials are dusky grey, though the proximal edges of the brachials may, like the muscular articulations, be white. The pinnulars, especially the lower pinnulars of the distal pinnules, are of a darker colour than the brachials; the slightly swollen articulations are white. The cirri appear white in comparison with the rest of the animal; a few of the basal segments, the penultimate segment and one or two of those preceding it may be of a dusky tinge; the terminal claw is hyaline. The disk is yellowish; the anal cone and the ambulacra of the disk, arms and pinnules, are darkly pigmented.

Subfamily *BATHYMETRINAE*

Genus Phrixometra A. H. Clark

Phrixometra longipinna (P. H. Carpenter) var. antarctica n.var.

(Plate IV, figs. 5 and 6)

St. 156. 20. i. 27. Off South Georgia. 53° 51′ S, 36° 21′ 30″ W. 200–236 m. Gear DLH. Bottom: rock. One specimen.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. Four specimens.

The specimens from two localities that I describe here as belonging to one new variety differ in some ways from one another. I have thought it better to describe the specimens from each station separately rather than to draw up one description wide enough to cover them all. A partial re-description of *P. longipinna* follows the description of the variety.

Description. The specimen from St. 156 is a rather broken female. None of the arms is complete; the longest is of 35 brachials and 20 mm. long; it seems probable that the arms were 25–30 mm. long in life. Most of the cirri are retained but many are incomplete.

The centrodorsal is a rounded cone with a rather large and rough dorsal pole. The cirrus sockets are closely crowded; they are arranged in indistinct columns, not nearly

so regular as those of *P. longipinna* (see below, p. 169). The ventral edge of the centrodorsal is produced into corners interradially.

Cirri *ca.* XLV, 17–19 (Fig. 10 *a*). The first segment is very short, the second as long as broad. The third segment is nearly twice as long as broad, a little constricted in the middle, and considerably wider distally than proximally. The fourth, fifth and sixth are the longest segments, twice to two-and-a-half times as long as broad. They are slightly constricted in the middle and have expanded distal ends. The seventh and eighth segments are twice as long as broad and considerably wider distally than proximally. They and the remaining segments are laterally compressed. The ninth to the twelfth are of roughly equal length, but each is a little wider distally than the one before it. All the distal segments are a little longer than broad. The distal part of the cirrus is considerably wider than the median part. The opposing spine is strong; it stands out at right angles to the penultimate segment, its inner edge straight, its outer convex. The terminal claw is strong and curved.

The radial is very short (Fig. 10 *b*). The costal is much longer; it is narrower distally than proximally and it is deeply incised by the posterior projection of the axillary which makes a projection with it. The costals are not in lateral contact. The axillary is about as long as broad; the proximal edges are straight, the distal deeply concave.

Syzygies are very numerous. The first is between the third and fourth, the second between the ninth and tenth, the third between the fourteenth and fifteenth brachials. There are the following exceptions: on one arm the first, on another the second syzygy, is between the eighth and ninth brachials; on another arm the third syzygy is between the twelfth and thirteenth brachials.

The first brachials are short, their inner edges shorter than the outer and not in apposition. They are strongly incised by the second brachials which are slightly longer than broad, roughly triangular with the inner and distal edges concave, the outer convex. The interior edge of the first syzygial pair is longer than the exterior and greater than the width of the ossicles. The brachials between the first and the second syzygy, the fifth to eighth, are roughly rectangular in shape; the fifth is slightly broader than long or is square while the others are slightly longer than broad. Those between the second and third syzygies are longer on one side than the other and a little longer than broad. The distal brachials are more elongate and rectangular (Fig. 10 *c*).

The radials, primibrachs and first four brachials are smooth. The distal edges of the following brachials are slightly raised and are produced into spines which are small in the lower part of the arm but larger and conspicuous on the outer brachials.

In all the pinnules the first two segments are short; the others are longer than broad or elongated, with their distal edges strongly flared and spiny so that the joints have a swollen appearance. The oral pinnules are the longest, nearly twice as long as the first genitals and about one and one-third times as long as the outer pinnules (Fig. 10*d*). P_1 is not complete on any arm. P_a, P_2 and P_b are of 18–19 segments, 8 mm. long. P_3, the first genital, is of *ca.* 10 segments and about 4 mm. long (Fig. 10 *e*); P_5 resembles it but has a larger gonad. P_6 is of 14 segments about 6 mm. long, and P_9, the last genital

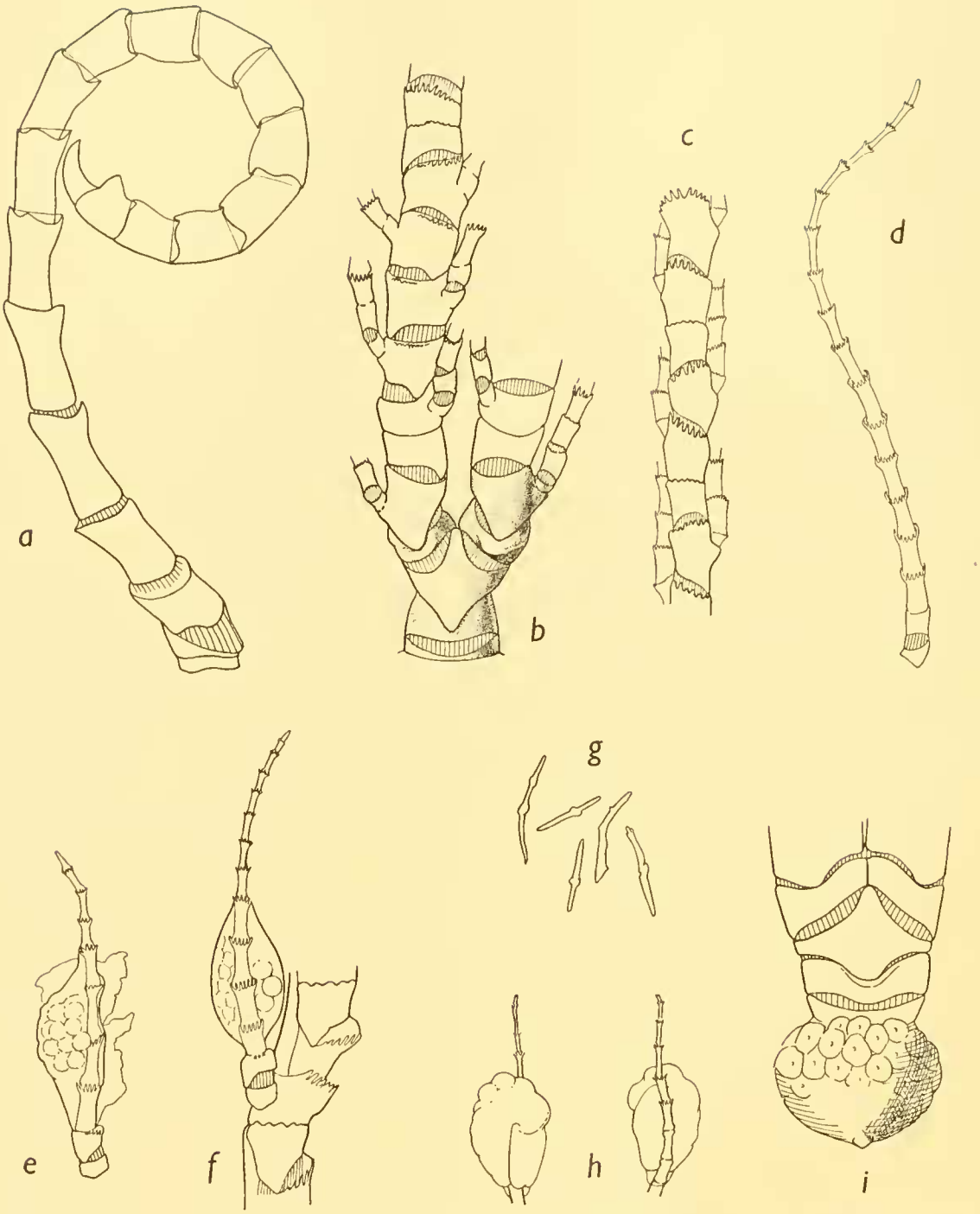

Fig. 10. *Phrixometra longipinna* var. *antarctica*. *a*, cirrus. *b*, proximal part of a ray. *c*, twenty-eighth to thirty-fourth brachials. *d*, P_a. *e*, P_3 from the left arm of a ray with an ovary on the left, a broken and empty brood-pouch on the right. *f*, P_6 from the left arm of a ray; most of the embryos have been lost from the brood-pouch on the right. *g*, spicules from the tentacles. *h*, P_d from right arm of a ray, on left from below, on right from above. *i*, centrodorsal and proximal part of ray. *a*, ×25. *b–f*, *h–i*, ×13. *g*, ×260. (*a–g* from specimen from St. 156; *h–i*, from specimens from St. 1948.)

pinnule, is of 17 segments, 6 mm. long. The ambulacral furrow is absent from the lower genital pinnules but present on the outer. The distal pinnules are of about the same number of segments and length as the last genital, P_9.

The elongated segments of the oral pinnules are up to three times as long as broad; those of the lower genital pinnules may be a little more elongated; those of the outermost pinnules are shorter, up to about twice as long as broad.

The disk cannot be seen.

Sacculi are fairly conspicuous, more numerous and more regularly arranged on the outer than on the genital pinnules. There are no side- or cover-plates along the pinnule ambulacra. Some of the tentacles have within them numbers of rod-like spicules (Fig. 10 *g*).

The specimen is of a pale straw colour in spirit except for the syzygial pairs which are dusky and stand out as dark bands along the arms.

This new variety, like the parent species (see below), is brood-protecting: the embryos undergo their development in pouches alongside the ovaries. The pouches are always on the aboral side of the pinnule, nearest the arm and the outside. The ovaries and brood-pouches of the middle genital pinnules lie along the third to fifth segments. Both can be seen at the same time from the outside and their walls are so thin that their contents can be seen through them (Fig. 10 *e*, *f*). The ambulacral furrow of the outer genital pinnules lies along the dividing line on the ventral side. I have not been able to see the pore which must exist in the septum dividing ovary and brood-pouch. The wall of each pouch is split open for the whole of its length exposing the embryos within. There are ten or eleven in each pouch; they occur in one layer and each is lightly attached to the floor of the chamber, the dividing septum, by an extremely thin membrane. They are roughly spherical, except that one end is strongly flattened to form the suctorial disk, from 0·21 to 0·24 mm. in diameter, considerably smaller than those of *Eumorphometra concinna*, and all appear to be at the same stage of development. The vestibulum is clearly marked. There are four bands of cilia, one lying around the edge of the suctorial disk; I cannot see traces of a more anterior band. The skeleton consists of about 18 stem-joints and a larger terminal plate and of ten large but openly branching plates, five orals and five basals, which may be nearly in contact with one another.

The single female from St. 1948 is very much smaller than that from St. 156 and its arms are even less complete; one of the longest is of 21 brachials and 10 mm. long.

The centrodorsal is a moderately low and slightly rounded cone. The dorsal pole is large, bare and rounded. The arrangement of the closely crowded cirrus sockets appears to be in part in columns and in part in alternating rows.

Cirri L, 12–17. The apical have the smaller number of segments and are considerably shorter than the peripheral. The cirri closely resemble those of the specimen from St. 156 except that they are smaller and that the opposing spine is much smaller or it is obsolete.

The radials, primibrachs and brachials resemble those of the specimen from St. 156.

The distal edges of the costals are everted. The distal edges of the lower brachials are more strongly everted and spiny than in the other specimen.

The pinnules are generally similar to those of the specimen from St. 156, but there are differences: there is only one oral pinnule, for P_2 carries an ovary and brood-pouch; the segments of the pinnules, particularly of the orals, are less elongated. Nevertheless P_1 is about twice as long as the first genital, P_2. The segments of the pinnules have expanded and spiny distal ends. P_6 is the lowest pinnule to have an ambulacral furrow.

P_1 is of 18 segments, about 5 mm. long. The third and succeeding segments are a little more than twice as long as broad. P_2 is of 8 segments, 2·5–3 mm. long. The first segment is slightly longer than broad, the second nearly twice as long as broad. The remaining segments are nearly four times as long as broad. The gonad lies along the third to fifth segments. No complete P_3 can be seen. P_4 is of 10 segments, 3·5 mm. long, and is similar to P_2 except that the ovary and brood-pouch lie along the third to sixth segments. P_6 is the last genital pinnule. It is of more than 12 segments and more than 4 mm. long. It carries a very small ovary and brood-pouch on the third and fourth segments. The earlier of the distal pinnules are of 14 segments and more than 4 mm. long.

Sacculi are numerous and conspicuous.

There are rod-like side- or cover-plates with perforated or branched ends along some of the pinnule ambulacra, and some of the tentacles contain large numbers of smooth and knobbed rod-like spicules.

The first four or five segments of the cirri are yellow; the remainder are of a dusky hue. The rest of the specimen is overlaid with a light yellow tinge.

An enormous brood-pouch lies alongside each ovary and runs farther than it distally. The large numbers of embryos that the brood-pouches contain may clearly be seen through their thin walls; the walls of many are ruptured. The ovary lies a little to the adoral side of the pinnule. The brood-pouch lies on the aboral side, nearest the arm and the outside, but distally it passes also across the ventral side of the ovary and may extend farther adorally than the ovary, so that it is crescent- or comma-shaped. The embryos in the brood-pouch are in various stages of development, but the most highly developed are always in the distal part; if any part of the brood-pouch is ruptured it is this; which makes it appear that the ruptures may be natural, freeing the fully formed larvae. The relationships of the ovary and brood-pouch are shown in Fig. 10 *h*.

There are about seventeen embryos in a large brood-pouch. They lie not in a single layer, and are not all at the same stage of development, as in the specimen from St. 156 and in *Phrixometra longipinna*: they are arranged in an irregular double layer and are in various stages of development, the most highly developed being at the distal end (see above). Presumably the eggs pass from the ovary into the brood-pouch at the proximal end. The fully formed larvae are similar to those of the specimen from St. 156, but they are considerably bigger, 0·30–0·36 mm. long.

I have no doubt that the three very broken males from this station are of the same species. They do however differ from the female in some ways. They are larger and the

ossicles of the division series and the lower brachials are more massive and conspicuously wider than in the female (Fig. 10 *i*). The cirri are longer. These may perhaps be signs of greater age.

In two specimens P_3 is the first genital, in the other P_2. The following are the numbers of segments and the lengths of some pinnules:

First specimen:	P_1	20 segments	5 mm.
Second specimen:	P_2, the first genital pinnule	12 segments	4 mm.
Third specimen:	P_1	19 segments	6 mm.
	P_a	16 segments	5 mm.
	P_3, first genital pinnule—none complete; but		
	P_c	11 segments	3·5 mm.

The testes are long fusiform bodies, the biggest lying along the third to eighth segments of the genital pinnules.

The disk is naked, the anal cone very high.

Phrixometra longipinna (P. H. Carpenter)

Antedon longipinna Carpenter, 1888, p. 185, pl. xxx, figs. 1–3.
Phrixometra longipinna A. H. Clark, 1917, p. 131.

Carpenter described this species from "three mutilated individuals" taken by the 'Challenger' from 600 fathoms off the River Plate. It has not been recorded since. I have re-examined the type specimens.

The centrodorsal is a straight-sided or rounded cone with a greater diameter than height. The cirrus sockets are in fifteen regular or slightly irregular columns. Carpenter describes the cirri as being about 30 in number, of 20–25 segments. Only two cirri are now left, one incomplete of 20 segments, one complete of 19. They differ from those of the var. *antarctica*, as Carpenter's fig. 3, which is a good picture, shows. The longest segments are only just more than twice as long as broad. The distal segments are not strongly compressed: they are not broader than the more elongated middle segments, so that the end of the cirrus does not appear heavier than the middle.

The ossicles of the division series and the brachials are very like those of the var. *antarctica*, as a comparison of Carpenter's figures and mine will show. The distal edges of the outer brachials are strongly thorny.

Carpenter's description of the pinnules is misleading. He states that those following the first two pairs are "all long, decreasing but slowly in size", whereas the most conspicuous feature of the pinnules is, as in the var. *antarctica*, a sharp contrast in the number of the segments and the lengths between the orals and the genitals.[1] The contrast is far stronger than in either of the specimens of the var. *antarctica*: the oral pinnules reach much farther along the arms. Their elongated segments, beyond the third, are four to six times as long as broad.

[1] Clark (*loc. cit.*) in his diagnosis of *Phrixometra* repeats the error in other terms, saying that the pinnules following the orals are similar to them.

The oral pinnules were of 18 elongated segments and about 7 mm. long, but not one of them is now complete. The following are the numbers of segments remaining in, and the lengths of some of, the oral pinnules. In one specimen P_a is of 13 segments, 6·5 mm. long; in a smaller specimen P_1 is of 12 segments and 5 mm. long; and P_a and P_2 are of 12 segments, 6 mm. long. Some of the earlier genital pinnules are complete and are as follows: P_3 of about 9 segments, 4 mm.; P_4 similar in the same specimen, of 10 segments and about 3 mm. long in another. The ambulacral furrow first appears on P_5. The distal pinnules are of about 18 segments and about 6·5 mm. long.

One of the specimens is a female. What Carpenter described as its "much swollen ovarian sacs" are brood-pouches similar to those of the first specimen (from St. 156) of var. *antarctica*. They lie alongside the ovaries on the third to fifth segments of the genital pinnules. Each is split open for the whole of its length exposing the embryos within. There may be up to 30, arranged in a single layer. They are irregularly spherical, 0·18–0·24 mm. in diameter. They appear to be at the same and at an early state of development, having no skeletal plates within them and no bands of cilia around them.

There is no doubt that the specimens I have described above as the var. *antarctica* are nearly related to *P. longipinna*. They are distinguished from it by the smaller number of segments in the cirri and by the proportions of those segments; by not having the cirrus sockets arranged in such definite columns; and by the less elongated segments of the oral pinnules.

But the specimens of the var. *antarctica* from the two localities differ from one another. The number of cirrus segments is smaller in those from St. 1948 than in that from South Georgia. In the South Georgia specimen P_3 is the first genital pinnule as it is in two of the males from St. 1948; in the other male and in the female it is P_2. The elongated segments of the oral pinnules are more elongated in the South Georgia specimen than in those from St. 1948, though less so than in *P. longipinna*. The shapes of the brood-pouches and the arrangement of the embryos in them differ in the two females; the brood-pouch of the South Georgia specimen resembles that of the parent species.

It was long before I could decide how to treat the specimens. I hope this may be the best way.

Phrixometra nutrix (Mortensen) (Plate IV, fig. 7)

Thaumatometra nutrix Mortensen, 1918, pp. 15–18, figs. 14–15, pl. v. 1920, pp. 56–8, fig. 8, pl. xxviii.

St. 175. 2. iii. 27. Bransfield Strait, South Shetlands. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. One specimen.

Description. Mortensen described this species from one poorly preserved female, lacking any fully developed cirri, from the Burdwood Bank. The present specimen is a male from the Bransfield Strait with most of its cirri present, fully developed and complete. In other ways it is imperfect. No arm is complete: some are broken off at the first syzygy, others at the second or third; two are regenerated, one from the second

the other from the third syzygy, and are about 13 mm. in length. Most of the arms complete to the second syzygy are broken but not detached at the first. It is a fragile species.

The centrodorsal is low and rounded. The dorsal pole is rather large, rounded and a little rough. The cirrus sockets are closely set, indistinctly arranged in columns.

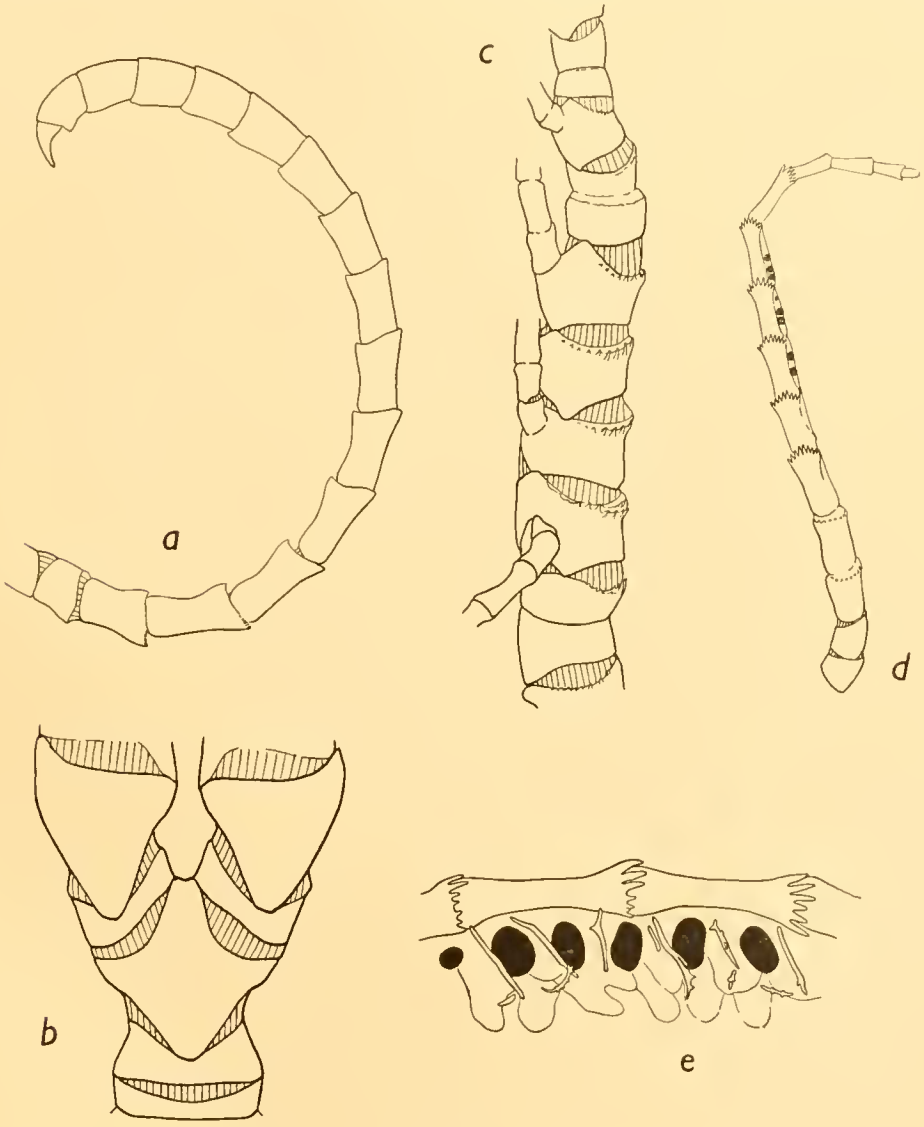

Fig. 11. *Phrixometra nutrix*. *a*, cirrus, ×27. *b*, proximal part of a ray, ×33. *c*, third to thirteenth brachials seen obliquely from the side, ×20. *d*, P_1, ×20. *e*, ambulacral skeleton of distal pinnule, ×55.

Cirri *ca*. XLVII, 12–18. The first two segments are very short, the first shorter than the second; the remainder are longer than broad, the distal only slightly so (Fig. 11 *a*). The third to the sixth or eighth are the longest; they are slightly constricted in the middle, more strongly on the dorsal than the ventral side. The segments beyond are wider at the distal than the proximal ends but no dorsal spines are developed. The distal segments are noticeably wider than the middle segments. The terminal claw is strong

but the opposing spine, which is directed obliquely forwards, is weak. A few developing cirri of the kind described and figured by Mortensen are present.

The shapes of the radials and axillaries are as Mortensen describes them, but the costals are more conspicuously narrower distally than proximally, and more deeply incised by the axillaries, than he shows (Fig. 11 *b*). The shapes of the lower and of the distal brachials are shown in Fig. 11 *c*; the latter are elongated. The distal edges of the brachials beyond the first syzygy are raised and produced into short but stout spines.

The first two segments of all the pinnules are short; the remainder are elongated with their distal edges flared out and produced into thorns. P_1 is of 14 segments, about 5 mm. long (Fig. 11 *d*). P_2 is a genital pinnule. On no arm does it consist of more than 9 segments or is it more than 4 mm. long, but on none is it complete; it seems probable that it was originally of 14 segments like P_1 as Mortensen describes it. The large fusiform gonad begins on the third and lies along the fourth, fifth and sixth segments. P_3 is of 10 segments, 4–5 mm. P_5, of 11 segments and 4–5 mm. long, is the first to have an ambulacral furrow.

There are no gonads on the pinnules of the regenerated parts of the only two arms which are nearly complete. The outer pinnules of these arms are of about twelve segments.

The disk is naked, the anal cone very high.

Sacculi conspicuous, irregularly arranged on the lower part of the arms and the genital pinnules, regularly arranged on the outer pinnules.

In Mortensen's specimen there were no side- or cover-plates. Along the middle segments of the outer pinnules of this Discovery specimen there are side- and cover-plates, three pairs to each segment, but they are so reduced as to be simple and rod-like (Fig. 11 *e*).

The shapes of the ossicles of the division series and of the brachials and, above all, of the cirri, of this species and the next and of *P. longipinna* var. *antarctica* are so alike that I think they ought to be placed in the same genus. For that reason I have removed Mortensen's species, *nutrix*, from *Thaumatometra* to *Phrixometra*, and placed my new species in the same genus.

Phrixometra rayneri n.sp. (Plate IV, fig. 8)

St. 160. 7. ii. 27. Near Shag Rocks. 53° 43′ 40″ S, 40° 57′ W. 177 m. Gear DLH. Bottom: grey mud, stones and rock. One specimen.

Description. This is a small fragile species, and in the single specimen, which is a male, some of the pinnules are damaged and most of the arms are broken. Two of the arms are nearly complete and are about 20 mm. long.

The centrodorsal is small, low and rounded; the dorsal pole is rather large and rough. The ventral edge of the centrodorsal is produced into low corners interradially.

The cirrus sockets are closely set in two rows around the periphery, the sockets of one row in line with those of the other, i.e. they are arranged in columns of two.

Cirri *ca.* XXX, 14–17. The cirri of the ventral row are a little longer, *ca.* 6 mm., and usually of one or two more segments than those of the dorsal row, *ca.* 5 mm. The first segment is very short, the second about as long as broad; the remainder are longer than broad, the distal only slightly so (Fig. 12 *a*). The third to the fifth are the longest; they are slightly constricted in the middle, a little more strongly on the dorsal than the ventral side. The distal edge of the second to the fourth or fifth segment is produced into a

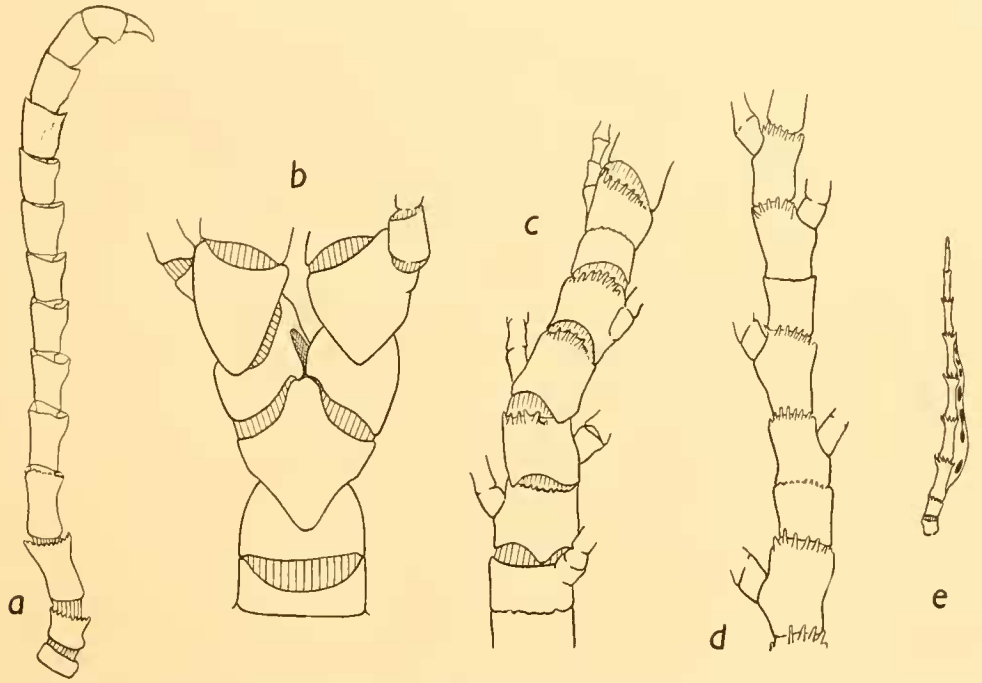

Fig. 12. *Phrixometra rayneri*. *a*, cirrus, ×20. *b*, proximal part of ray, ×27. *c*, fourth to tenth brachials, ×27. *d*, distal brachials, ×20. *e*, P_5, ×13.

strong thorny flare around the base of the next; the outer segments have their distal edges flared only on the dorsal side, and to a less extent and the flare is not thorny. There are no dorsal spines. The segments beyond the sixth or seventh are wider distally than at the base and they are conspicuously wider and heavier than the proximal segments. The terminal claw is short. The opposing spine is at right angles to the penultimate segment; its short distal edge is convex, its longer proximal edge concave. The cirri are very similar in general appearance to those of *P. nutrix*.

The radials, having concave distal edges, are fairly short in the mid-line but long interradially (Fig. 12 *b*). The costals are considerably longer than the radials, deeply incised by the axillaries; their lateral edges are rounded, not in apposition. The axillaries are about as long as broad, their distal edges strongly concave; the lateral corners are finely thorny.

The first brachials are deeply incised by the second; their inner edges are much shorter than the outer. The distal edges of all the brachials beyond the first syzygy are raised

into a row of strong spines, much longer than those of *Phrixometra nutrix*. The brachials between the first and second syzygies are roughly rectangular, about as long as broad (Fig. 12 *c*); the distal are elongated, roughly oblong (Fig. 12 *d*). Syzygies are numerous, the first between the third and fourth brachials, the second between the ninth and tenth and the third between the fourteenth and fifteenth; beyond the third the syzygial pairs occur at intervals of only one brachial.

In all pinnules the first segment is short, the second as long as or a little longer than broad. The remainder are elongated and somewhat constricted in the middle, the proximal less so than the distal; the distal edge of each is produced into a wide spiny flare around the base of the next, giving the joints a swollen appearance (Fig. 12 *e*). P_1 is of 11 or 12 segments, *ca.* 3 mm. long; P_2 of about 13 or 14 segments, *ca.* 4 mm. long, with no gonad. P_3 is the first genital pinnule; it is shorter than P_2, of about 9 segments, *ca.* 3 mm. long. There are only three pairs of genital pinnules, all resembling P_3. The long yellow gonad lies along the third to sixth segments. P_5 is the first to have an ambulacral furrow. The outer pinnules are of up to 14 or 15 segments, 4–5 mm. long.

The disk cannot be seen. The anal cone appears to be high.

The sacculi are fairly conspicuous, irregularly arranged along the genital pinnules, regularly along the outer.

There are no side- and cover-plates along the ambulacra of the outer pinnules nor any spicules in the tentacles.

The colour in spirit is whitish, the gonads a pale yellow.

I hesitated for a long time before describing this specimen as a species distinct from *nutrix* which it so strongly resembles. The cirri of the two species are similar and so are the pinnules, except that the oral pinnules of this species are more rigid and spiny. The species is altogether more spiny than *nutrix*. P_3 is the first genital pinnule, not P_2 as in *nutrix*.

What makes me describe it as a new species is that it has only 30 cirri whereas Mortensen's female specimen of *nutrix* and my male have 45.

Subfamily *ISOMETRINAE*

Genus Isometra A. H. Clark

Clark (1908, p. 133) formed this genus with *Antedon lineata* Carpenter 1888 as genotype and *Isometra angustipinna* (Carpenter) as the only known species. He wrote: "*Isometra angustipinna* is without doubt the young of *Antedon lineata*, Carpenter." Carpenter's species *A. lineata* and *A. angustipinna* were each described from one specimen taken at the same Challenger station off the mouth of the River Plate, the depth being 1097 m. Neither has since been recorded. As thorough an examination as their frail condition would allow has been made of the two specimens. Each is mature and

they differ too much from one another to be regarded as of one species. They must therefore be known as *Isometra lineata* and *I. angustipinna*, and brief descriptions of them as such are given below.

Mortensen (1918) described *I. vivipara* from shallow water off the coasts of Uruguaya and northern Argentina, from the Burdwood Bank, and from the eastern side of Graham Land.

In the present collection there are many specimens of *I. vivipara* from near the Falklands and from the Burdwood Bank, and one specimen, differing slightly from them, from the Bransfield Strait. There are small numbers of three new species, all viviparous, one from the Shag Rocks, another from near Clarence Island in the South Shetlands, the third, represented by specimens from Bismarck Strait, to the west of Graham Land, from the Bransfield Strait and from the Ross Sea on the other side of the continent. Two of the new species are very close to *I. vivipara*.

The genus appears to be a well-marked natural assemblage.

Isometra lineata (Carpenter)

Antedon lineata Carpenter, 1888, p. 183, pl. xiii, figs. 4, 5.
Isometra angustipinna (part), Clark, 1908, pp. 133–4.

The single specimen is much larger than that of *I. angustipinna*: Carpenter gives its spread as "probably about 18 cm."

The most complete of the remaining cirri is detached and probably lacks one or two basal segments. It is of 30 segments. Stumps of other cirri remain on the centrodorsal so that an almost complete description of a cirrus is possible. The first two segments are short; the third is longer, but broader than long. The fourth to about the tenth are longer than broad, decreasing in length towards the tenth. The remainder are broader than long and the more distal have a strong and characteristic dorsal spine the point of which is sub-terminal; it is well shown in Carpenter's figure. The spine is reduced on the two or three segments before the penultimate. The ventral edge of the cirrus is smooth. The opposing spine is strong and triangular; the terminal claw is large and strongly bent.

The shapes of the primibrachs and lower brachials are shown in Fig. 13 *a*; they have sharp and nearly straight side-edges as in the other species of *Isometra*. The syzygial pairs beyond the third are separated by one to four, usually two or three, brachials.

P_1 is of about 9 long slender segments and is *ca.* 5 mm. long; the first three segments are attached by a web of tissue to the disc. P_2 and P_3 are shorter, about 3·5 mm., of 8–9 segments; the first two segments of P_2 are attached by a web of tissue to the arm. The first genital pinnule is so far out as P_6 or P_7; they are of about 9 segments and *ca.* 5 mm. long. The third and fourth segments of the genital pinnules are slightly and almost symmetrically expanded (Fig. 13 *b*); they are considerably longer than broad. The specimen is a male.

The distal pinnules have side- and cover-plates, two or three pairs to each segment, along the ambulacra. The drawing (Fig. 13 *c*) is of the single preparation made; in it the cover-plates are displaced, being pushed back so as to overlap the side-plates.

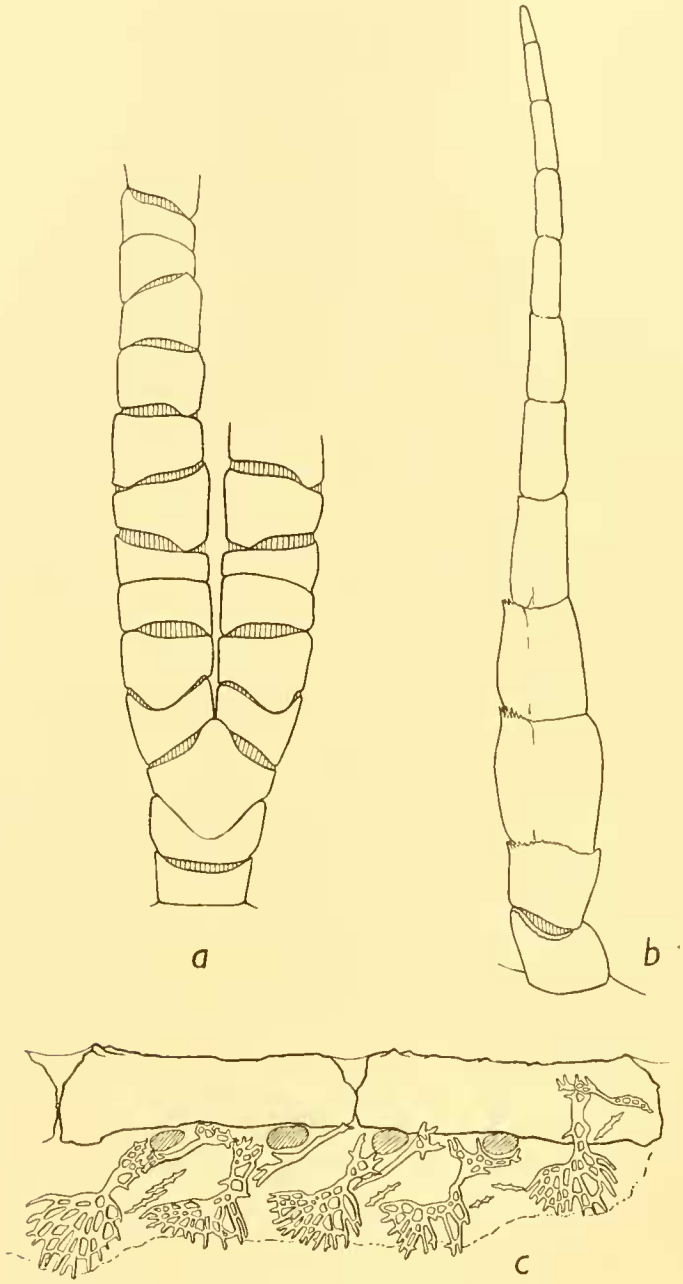

Fig. 13. *Isometra lineata*. *a*, proximal part of a ray, ×8. *b*, a genital pinnule, P_{11}, ×16. *c*, side- and cover-plates of a distal pinnule, ×66.

The latter are rods with branching and reticulate ends. The cover-plates are of a beautiful bush-shaped form: the narrow base—the root-like part—is connected with wide-spreading fan-like branches by a short stem which is always narrow and usually not perforated. Some of the tentacles contain knobbed spicules.

Isometra angustipinna (Carpenter)

Antedon angustipinna Carpenter, 1888, p. 189, pl. xxix, figs. 1–4.
Isometra angustipinna (part) Clark, 1908, p. 133.

The single specimen is small: Carpenter gives its spread as probably 5 cm.

Only one cirrus remains attached to the centrodorsal, an upturned cirrus of 27 segments but of an immature appearance. There is one small, detached, cirrus of 22 segments which is complete and mature. The first two segments are short, the third is longer than broad and flared at the end. The fourth to about the eighth are longer than broad, but decreasing in length; their ends are flared, more strongly on the dorsal than the ventral side but sufficiently on the ventral side to make that edge of the lower part of the cirrus uneven. The other segments are shorter, about as long as broad, with no dorsal spine but a faint keel which becomes obsolete on one or two segments before the opposing spine. The opposing spine is strong, the terminal claw strongly curved.

The shapes of the primibranchs and lower brachials are shown in Fig. 14 *a*; they have sharp, straight side-edges. The syzygial pairs beyond the third are separated by only one brachial.

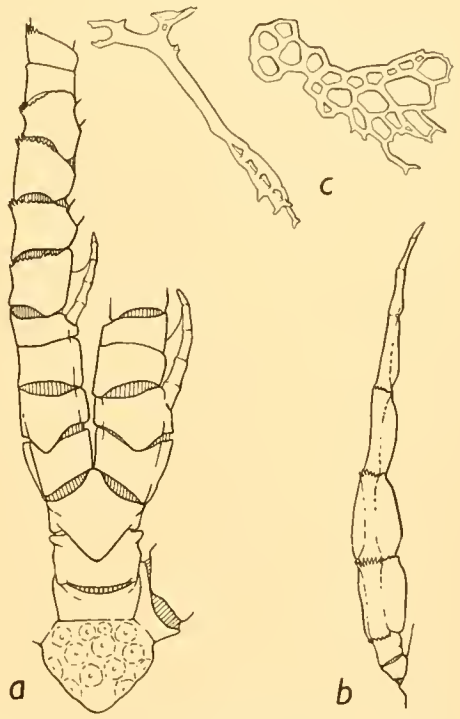

Fig. 14. *Isometra angustipinna*. *a*, centrodorsal and proximal part of a ray, ×8. *b*, P_4, a genital pinnule, ×12. *c*, a side- and a cover-plate from a distal pinnule, ×150.

P_1 is very short, about 2 mm., of five or six segments of which all, or nearly all, are attached to the disk by a web of tissue. On some of the arms P_2 is of the same length as P_1 and of about six segments, but on most it is a genital pinnule about 5 mm. long. The third and fourth segments of the genital pinnules are more strongly and less symmetrically expanded than those of *I. lineata*. They are longer than broad and more strongly expanded on the distal than the proximal side (Fig. 14 *b*). The gonads are fully developed and appear to be testes.

The arms are broken off shorter, and the pinnules which remain are in a much poorer state of preservation, than those of *I. lineata*, so that, although an ambulacral skeleton can be seen, it is difficult to be sure of its nature. There appear to be two sets of plates, side- and cover-plates, one or two pairs on either side of each segment. One of each is shown in Fig. 14 *c*; the "side-plate" is rod-like with a root-like base; the "cover-plate" with its fan-like distal portion, resembles the plates of *I. lineata*. No spicules can be seen in the tentacles.

There are good reasons for regarding this specimen as a different species to *I. lineata* and not as the young of it. Although it is so much smaller, its gonads are mature. P_2 is the first genital pinnule, not P_6 or P_7 as in *lineata*. The cirri are quite different, as Carpenter's figures show.

Carpenter describes the arms of both as smooth. This is more true of *lineata* than *angustipinna*. In the latter the distal edges of all brachials beyond the first four or five are raised and produced into spines; in the former the distal edges of the brachials are not everted and only those beyond the second syzygy have spines: the lower brachials are quite smooth.

Isometra vivipara Mortensen (Plate V, figs. 1 and 2)

Isometra vivipara Mortensen, 1918, pp. 10–15, figs. 6–13, pl. i, figs. 6–10, pl. ii, figs. 5–7. 1920, pp. 31–48, pls. xiv–xxiii. Clark, 1923, p. 42.
Antedon hirsuta Andersson, 1904, pp. 1–7, Taf. i–ii.

St. 175. 2. iii. 27. Bransfield Strait, South Shetlands. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. One female.

St. 652. 14. iii. 31. Burdwood Bank. 54° 04′ S, 61° 40′ W. 171–169 m. Gear OTL. Fifteen males and three females; pentacrinoid young.

St. WS 81. 19. iii. 27. 8 miles N 11° W of North Island, West Falkland Island; from 51° 30′ S, 61° 15′ W to 51° 30′ 30″ S, 61° 10′ W. 81–82 m. Gear OTC. Bottom: sand. One male and two young.

St. WS 83. 24. iii. 27. 14 miles S 64° W of George Island, East Falkland Island; from 52° 28′ S, 60° 06′ W to 52° 30′ S, 60° 09′ 30″ W. 137–129 m. Gear N 7–T. Bottom: fine green sand and shells. Twelve large specimens with most or all of the arms broken off; four recognizable as males and six as females.

St. WS 85. 25. iii. 27. 8 miles S 66° E of Lively Island, East Falkland Island; from 52° 09′ S, 58° 14′ W to 52° 08′ S, 58° 09′ W. 79 m. Gear OTC. Bottom: sand and shell. The centro-dorsals, calices, and arm-bases of two specimens, and fragments of arms, both male and female.

St. WS 212. 30. v. 28. 49° 22′ S, 60° 10′ W. 242–249 m. Gear N 7–T. Bottom: green sand, mud and pebbles. One immature specimen.

St. WS 228. 30. vi. 28. 50° 50′ S, 56° 58′ W. 229–236 m. Gear OTC. Bottom: coarse white sand. One female.

St. WS 248. 20. vii. 28. 52° 40′ S, 58° 30′ W. 210–242 m. Gear OTC. Bottom: fine green sand, pebbles and shells. One male and three females.

St. WS 824. 19. i. 32. 52° 29′ 15″ S, 58° 27′ 15″ W. 146–137 m. Gear OTC. Bottom: green speckled sand, and shells. Two incomplete specimens, one a female.

St. WS 877. 4. iv. 32. 52° 35′ 30″ S, 61° 04′ W. 350 (–0) m. Gear NR. Bottom: no data. Seven males and four females; pentacrinoid young.

All but one of these 55 specimens come from nine stations near the Falkland Islands or on the Burdwood Bank, from depths of between 79 and 350 m. These are a few of very many trawling stations made on the Burdwood Bank, around the Falkland Islands, between them and Tierra del Fuego and the American mainland, and on the Patagonian shelf to the north. Some are shown in *Discovery Reports*, Vol. I, Station List, pl. iv and Vol. III, Station List, pl. iii. A later trawling survey of the area has been made, but the Station List including it has not been published. It consists of a larger number

of stations, arranged in lines running out from the American coast to the 100 fathom line, and covers a greater area, particularly to the north, the last line being in the latitude of 44° S, than either of the two previous surveys. From it there are specimens of *I. vivipara* from two stations only, the last two in the list above, both of them very near the Falkland Islands. It is strange that it should not have been taken at any of the stations farther from the Falklands, to the west and north and along the Patagonian coast, especially since the depths of many of them fall within the range of those at which the species occurred around the Falkland Islands; and especially since the species is known to occur much farther north, for some of Mortensen's specimens came from the coasts of Uruguaya and northern Argentina.

Some of Mortensen's specimens came, too, from far south, from the east side of Graham Land in the Antarctic. But from the trawl and dredge hauls made by the Discovery vessels along the coasts of the Falkland Dependencies—many at South Georgia, few at the South Sandwich and South Orkney Islands, and many in the Bransfield Strait and on the west side of Graham Land—there is only one specimen of *I. vivipara*. It is from the Bransfield Strait and, although it differs in some ways from those described by Mortensen and from the remainder of the present collection, it is not regarded here as a separate variety or species (see below).

Distribution. *I. vivipara* is known from off the coasts of Uruguaya and north Argentina; from around the Falkland Islands and on the Burdwood Bank; and from the Bransfield Strait and the east coast of Graham Land in the Antarctic.

Descriptive remarks. The 54 specimens from near the Falkland Islands and from the Burdwood Bank agree fairly closely with Mortensen's description. They are up to 70 mm. in arm length. The majority are of a white or pale straw colour in spirit; some have a reddish tinge in parts as, for example, on the proximal cirrals; one is a light brown and two a very pale yellow. In all the first seven or eight cirrals are slightly darker than those beyond, which are white; the change may be sharp or gradual.

The number of cirri and the number of segments of which they are made may be greater than Mortensen gives. Cirri up to LX, 26–43. The first two segments are short, the third is longer. The fourth or the fifth is as long as broad. The fifth to about the tenth may be longer than broad, the first of them appreciably so. The distal segments are wider than long and are produced into dorsal spines which may be low as Mortensen (1918, p. 11, fig. 7) shows but are often stronger; they may be stronger than those shown in Fig. 15 *a*. The opposing spine is erect, the terminal claw short but strong.

The normal positions of the first two syzygies are, as Mortensen says, between the third and fourth and the ninth and tenth brachials but there are many irregularities. In one specimen a first syzygy is between the sixth and seventh brachials. In others where the first syzygy is normally placed the second may occur between any pair of brachials between the fifth and the eleventh. In one specimen there is a chain of syzygies on one arm uniting each of the pairs of brachials from the third and fourth to the eleventh and twelfth, beyond which the sixteenth and seventeenth are the next syzygial pair.

The specimens vary from being entirely smooth to being finely thorny along the distal edges of the outer brachials and very finely so along the distal edges of the pinnulars (Fig. 15 *b*).

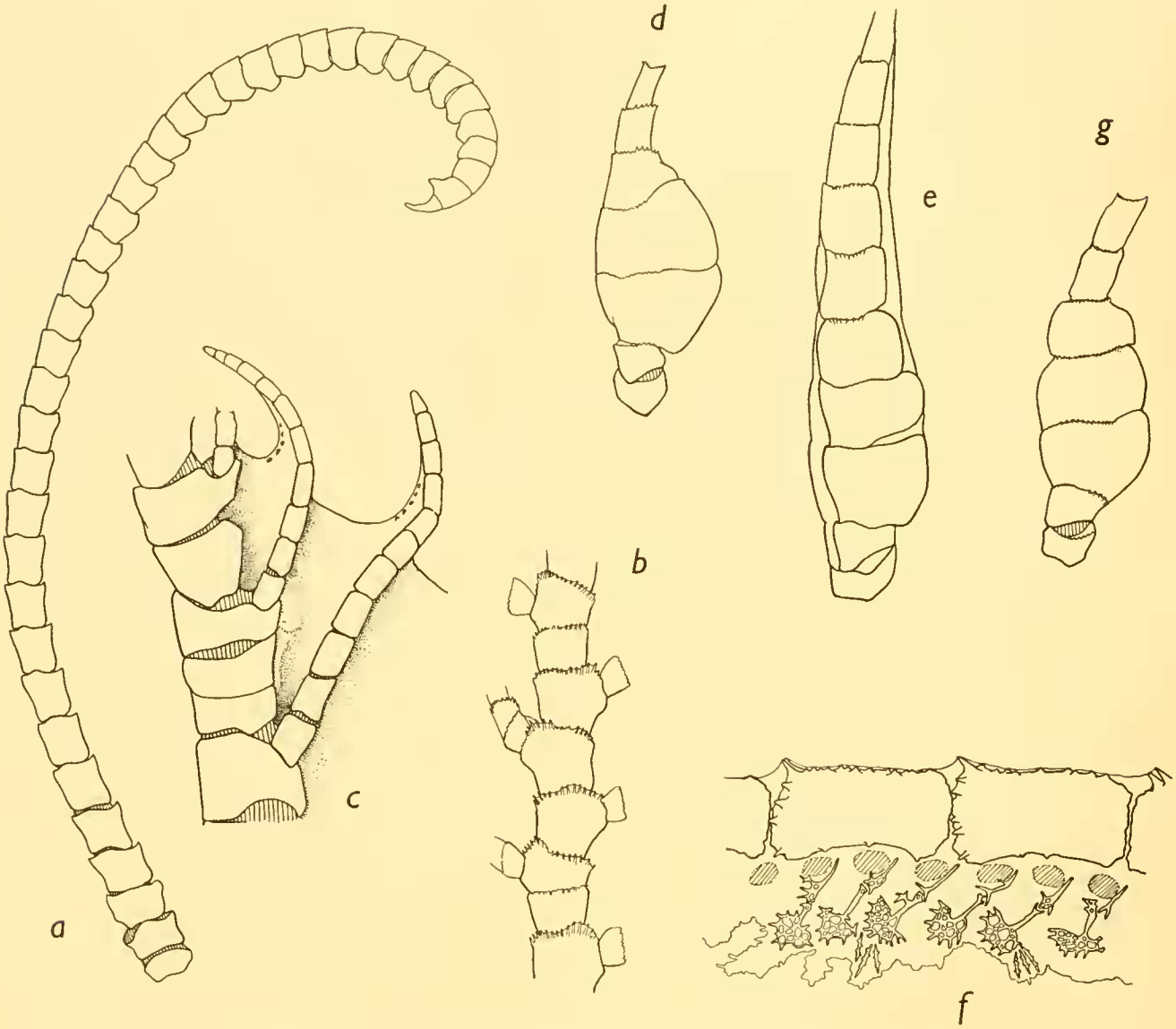

Fig. 15. *Isometra vivipara*. *a*, cirrus. *b*, distal brachials. *c*, proximal part of an arm with P_1 and P_2. *d*, a middle genital pinnule of a female. *e*, a middle genital pinnule of a male. *f*, well developed side- and cover-plates of distal pinnule. *g*, P_7 of the female from the Bransfield Strait. *a* and *c*, × 11; *b*, *d*, *e*, and *g*, × 13. *f*, × 60.

P_1 is always longer and usually stouter than P_2, and P_3 is usually slightly shorter than P_2. P_1 is of 10–17, usually 10–13, segments, and 5–9 mm. long. It is not free proximally, for its first four to six segments are closely attached to the disk, and the next one or two are connected by a web of tissue with the disk (Fig. 15 *c*). It is sometimes much stouter than P_2 with its basal segments strongly compressed so that they are keeled dorsally; it is sometimes only slightly heavier with none of its segments compressed. The basal

segments of the other oral pinnules are attached to the arm by a web of tissue. P_2 is of 9–13, usually 10, segments and 5–7 mm. long. P_3 is of 9–14, usually 10–12, segments and 4–7 mm. long.

The first genital pinnule is P_4, P_5 or P_6, usually P_5. The last may be so far out as P_{26}, or perhaps farther. The genital pinnules (Fig. 15 *d*, *e*) are about 10 mm. long and are usually of 16–19, but exceptionally of up to 24, segments. The distal pinnules are a little shorter and of slightly fewer segments.

Mortensen (1920, p. 32) found as many as eight eggs and embryos in one brood-pouch. That there are much larger numbers in the females of this collection may be seen without dissection or preparation, but one brood-pouch of each of three specimens was examined. The first contained ten eggs and three young embryos; the second, eight eggs and eleven embryos of all ages; the third, six eggs and twenty-one embryos of all ages. The oldest embryos are more fully developed than Mortensen's "full-grown larvae" (1920, pl. xxii, figs. 6–8) for the oral and basal plates are in contact with one another and reach to near both poles; these larvae appear almost completely mail-clad.

A distal pinnule of each of 16 specimens, including two that were immature, was examined. The ambulacral skeleton is usually as Mortensen describes it (1918, p. 13, fig. 12, pl. ii, fig. 5). In four specimens, three mature and one immature, the side- and cover-plates are better developed and the latter are of the bush-like form of those of *I. lineata*. They are best developed in one of the mature specimens (Fig. 15 *f*). Spicules may be very abundant in the tentacles.

In all the specimens in which the disk can be seen it is naked.

Six of the twelve more complete females carry small numbers of pentacrinoids on their cirri.

The single specimen from the Bransfield Strait (St. 175), which is a female with arms over 50 mm. long, is somewhat different. (i) On all the arms P_3 is the first genital pinnule and P_{13} the last; the distal pinnules are of 15–17 segments and about 8 mm. long. (ii) The most expanded segments, the third to the fifth, of the middle genital pinnules are not so wide as those of females from the Falklands and the Burdwood Bank (Fig. 15 *g*). The brood-pouches contain many fewer eggs and embryos. The contents of two were examined: in each there were three embryos and one egg. In one the embryos were as large and as well developed as those described above. (iii) The position of the second syzygy is abnormal: on eight of the arms it is between the eleventh and twelfth, on one between the sixth and seventh, and on the other between the twelfth and thirteenth brachials. (iv) The side- and cover-plates of the pinnule ambulacra are well-developed: the side-plates are plate- not rod-like. There are few spicules in the tentacles.

P_1, of about 12 segments and over 5 mm. long, is slightly longer but not stouter than P_2 which is of about 10 segments and 5 mm. long. The outer brachials and pinnulars have finely thorny distal edges.

Isometra flavescens n.sp. (Plate V, figs. 3 and 4)

St. 160. 7. ii. 27. Near Shag Rocks. 53° 43′ 40″ S, 40° 57′ W. 177 m. Gear DLH. Bottom: grey mud, stones and rock. Six males and six females.

DESCRIPTION. This species is fairly small but robust. The arms of all twelve specimens are broken at the tips. They appear to have been just over 40 mm. long when complete. The specimens are described as having been "mustard-yellow" in colour when alive,

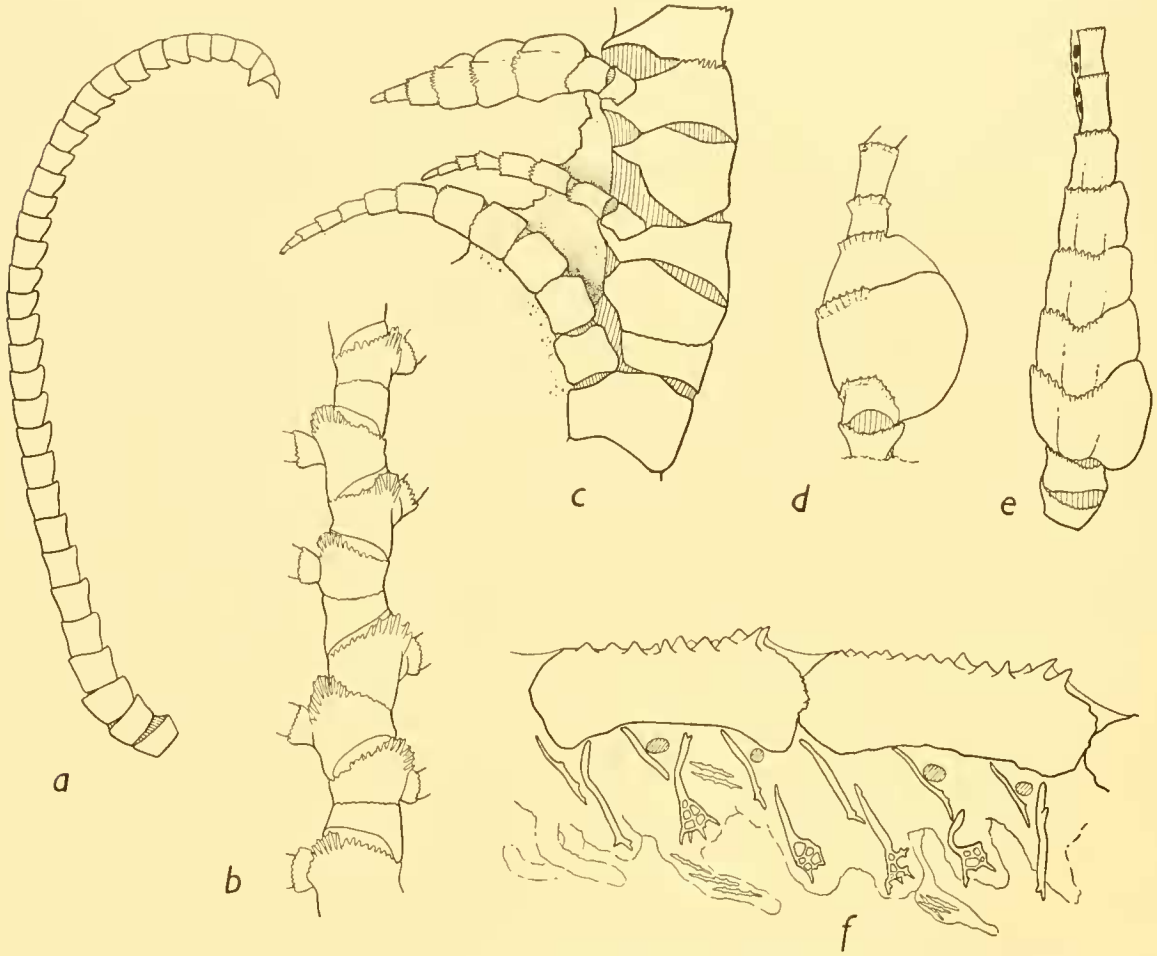

Fig. 16. *Isometra flavescens*. *a*, cirrus. *b*, distal brachials. *c*, proximal brachials and P_1, P_2 and P_3. *d*, a middle genital pinnule of a female. *e*, a middle genital pinnule of a male. *f*, ambulacral skeleton of a distal pinnule. *a–c*, ×11. *d*, *e*, ×13. *f*, ×66.

and they are still a strong yellow in spirit. In four of the males the yellow colour is overlaid by a dusky shading on the pinnulars, or on the pinnulars and brachials, giving them a dark appearance. The basal segments of the cirri are deep yellow while the distal appear in contrast a pure white.

The centrodorsal is conical, closely beset with cirrus sockets which may entirely cover it or leave free a small flattened dorsal pole. The sockets are arranged in rows which are regular near the apex but less so near the periphery. The ventral edge of the centrodorsal is slightly produced at the interradial corners.

Cirri XXXVII–XLVII, in one LX; 25–35. They are very like those of *I. vivipara* except that the segments are not so numerous and fewer of them are longer than broad (Fig. 16 *a*). The opposing spine is strong and erect, the terminal claw short and strongly curved.

The radials and primibrachs are of the same shape as in *I. vivipara*. In the three smaller specimens the radials are nearly as long as the costals in their mid-line but in the others they are shorter. The axillary may make a slight shoulder-like projection with the costal where it incises it. In an arm of one male the radial, costal and axillary are represented by one ossicle considerably shorter than the sum of those three ossicles on adjacent arms. The primibrachs and the first two brachials have sharp and nearly straight side edges. The brachials throughout the arm are of a similar shape but they are altogether less smooth. Those between the first and second syzygies have raised distal edges produced into small thorns and they are slightly waisted. The distal edges of the middle brachials, and even more of the outer, are raised and produced into very strong thorny ridges (Fig. 16 *b*).

The first and second syzygies are usually between the third and fourth and the ninth and tenth brachials respectively but there are as many irregularities in proportion to the number of the specimens as in *I. vivipara*.

The pinnules differ from those of *I. vivipara*. P_1 is longer and stouter, sometimes much stouter, than P_2 (Fig. 16 *c*). P_3 is a genital pinnule in most if not all of the arms of both males and females. P_1 is of 9–14 segments and 5–7 mm. long; the first four to six segments are attached to the disk and are in some specimens much heavier than those which follow, and they are in one compressed from side to side. P_2 is of 7–10 segments, 3·5–5 mm. long; its first two to four segments are attached to the arm by a web of tissue.

The species is viviparous and the middle segments of the genital pinnules are expanded as in *I. vivipara*. Because the ends of the arms are broken it is impossible to say how far the genital pinnules usually extend. In one of the smaller specimens, a female, they end at P_{13}, but in a larger male they extend beyond P_{16}. The following are the numbers of segments and the lengths of some genital pinnules:

♀	P_4	9 segments	–
	P_{11}	14 ,,	8 mm.
♂	P_5	11 ,,	–
	P_8	13 ,,	7 ,,
	P_{10}	14 ,,	7·5 ,,
	P_{15}	18 ,,	8 ,,

In the males the expansion of the third and succeeding segments of the genital pinnules is greater and more asymmetrical, being mainly on the aboral side, than in *I. vivipara*. In the females the expansion is confined even on the largest—the middle—genital pinnules to the third and fourth segments (Fig. 16 *d*, *e*).

The segments of all pinnules, except those of P_1 and perhaps some of those of P_2, have strongly thorny distal edges. On the expanded segments of the genital pinnules the thorniness is confined to the mid-line and the adoral side of the distal edges; it is absent from the aboral side where nearly all the expansion lies.

The contents of two typical brood-pouches were dissected out. One contained six eggs and six embryos, the other six eggs and eight embryos. The embryos represent many stages in development. The oldest are similar to and of the same size (0·5–0·6 mm. long) as those of *I. vivipara* having the oral and basal plates in contact with one another (see p. 181).

The ventral surface of the disk, but not the parts between the arm bases, is plated. In none of the specimens could the nature and arrangement of the plates be completely seen without breaking away the arms and this was done with one small male. In it the disk ambulacra are lined by strong plates. At the apices of two of the interradii there are large plates like orals; they cannot be seen at the apices of the other three interradii.[1] The interradii are occupied by some very large, and other small, plates. In the anal interradius two of the large plates are conspicuous; one rests on the perisome and the other, in contact and in line with it, rests on the base of the anal cone, on which there are other plates. In nine other specimens some plates can be seen on the disk, as follows: (i) some light plates on the disk; (ii) and (iii) large plates on the disk; (iv) and (v) heavy plates along the disk ambulacra; (vi) what appear to be oral plates; (vii) a heavily plated anal cone; (viii) two large plates, one at the base of and one on the anal cone, in contact and in line as described above; (ix) the same and other plates on the anal cone. In the two remaining specimens the arm bases are too firmly pressed together for the disk to be seen.

Sacculi are numerous, regular and conspicuous on the arms and pinnules of the dusky coloured males; they are inconspicuous on the other specimens.

The distal pinnules of some specimens have no ambulacral skeleton, but those of others have reduced side- and cover-plates. The most highly developed are shown in Fig. 16*f*. The side-plates are reduced to rods which may be simple or forked; the basal parts of the cover-plates are simple stems but the ends of most are spread out fan-wise and are reminiscent of those of the other species of *Isometra* with reduced ambulacral skeletons. The tentacles may or may not contain spicules which may be knobbed or smooth, and scarce or abundant.

None of the females carries pentacrinoids on its cirri.

Seven of the specimens were infested with *Myzostomum*, six on the disk, one on the arms.

This species may readily be distinguished from the much larger *I. hordea* by the nature of the oral pinnules and the cirri. It is smaller than *I. vivipara*, more robust though smaller than the largest specimens of *I. graminea*. It differs from both in colour, the nature of the pinnules and the degree of thorniness of the brachials and pinnules. It differs from *I. vivipara*, which has a naked disk, in that its disk is plated; it differs from *I. graminea* in having a more heavily plated disk.

[1] See p. 187, under *Isometra graminea*.

Isometra graminea n.sp. (Plate V, figs. 5 and 6)

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago. 64° 56′ S, 65° 35′ W. 93–130 m. Gear DLH, NRL. Bottom: ? stones, mud and rocks. A complete female, a specimen with the arms broken off, and parts of the arms of a male and a female.

130–100 m. Gear DLH, NRL. Bottom: ? stones, mud and rocks. One male.

St. 1652. 23. i. 36. Ross Sea. 75° 56·2′ S, 178° 35·5′ W. 567 m. Gear DRR. Bottom: mud. Three males and one female.

St. 1872. 12. xi. 36. Bransfield Strait. 63° 29·6′ S, 54° 03·1′ W. 247 m. Gear N 100 H. Bottom: soft mud. One female.

Description. The male and the female from the Bismarck Strait and the female from the Bransfield Strait are in good condition. The lengths of their arms, from the axillaries, are 40, 40 and 48 mm. respectively. There are larger specimens from the Ross Sea with arms up to 60 mm. long. Notes were made of the colour of some of the specimens when they were captured. The Bransfield Strait specimen was pale straw yellow. Two of the Ross Sea males were "pale yellow brown", one "pale dirty yellow white"; the female was a deep orange brown. The latter is light brown in spirit, whereas the remaining specimens vary from white to yellowish white. The bases of the cirri may be darker in colour and the perisome have a faint greenish tinge.

The centrodorsal is a rounded cone with its ventral edge produced into very slight interradial corners. There is a bare dorsal pole in all except three of the specimens, one from each of the three stations, in which the centrodorsal is entirely covered with cirri. The cirrus sockets are close-set, arranged in alternating rows which may be slightly irregular.

Cirri XXVI–XLIII, 28–41 (Fig. 17 *a*). The lower segments beyond the fourth are longer, except in the specimen from St. 1872, than in *I. vivipara* and *I. flavescens*. There is a slight difference between the cirri of the specimens from the Bismarck and Bransfield Straits and those from the Ross Sea. In the latter the first three cirrals and to a lesser extent the fourth are considerably stouter than the succeeding cirrals; this is not so in the specimens from the other side of the continent. The following description covers those of specimens from both regions. The first two segments are short, the third a little longer. The fourth is longer than broad (except in the specimen from St. 1872). The fifth to about the eighth or ninth are appreciably longer than broad (except in the specimen from St. 1872 in which they are very little longer than broad). The fourth to the eighth or ninth segments may be faintly waisted. The segments beyond decrease in length; the distal are broader than long and each is produced into a moderate or strong rounded dorsal spine. (The figure is of a short cirrus; in the longer, of more segments, many more of those in the distal part are raised into rounded keel-like dorsal spines.)

The radials vary in length. In the smaller specimens they are longer in the mid-line than the costals, but in the largest specimens they are much shorter. The distal edge is wider than the proximal and concave. The costals are not in contact with one another; they are incised by the posterior projections of the axillaries which may form slight

shoulders with them. In one specimen, from St. 190, the radials, costals and lower brachials are raised into a keel-like ridge in the mid-line. The ossicles of the division series and the brachials of the proximal part of the arm are narrower and less massive than those of *I. vivipara* (Fig. 17 *b*).

The side edges of the axillaries and lower brachials are sharp and straight. The brachials are of the same shape, the positions of the first two syzygies are the same and other syzygies are as numerous, as in *I. vivipara*. The distal edges of the outer brachials are raised into moderately strong and conspicuous spines.

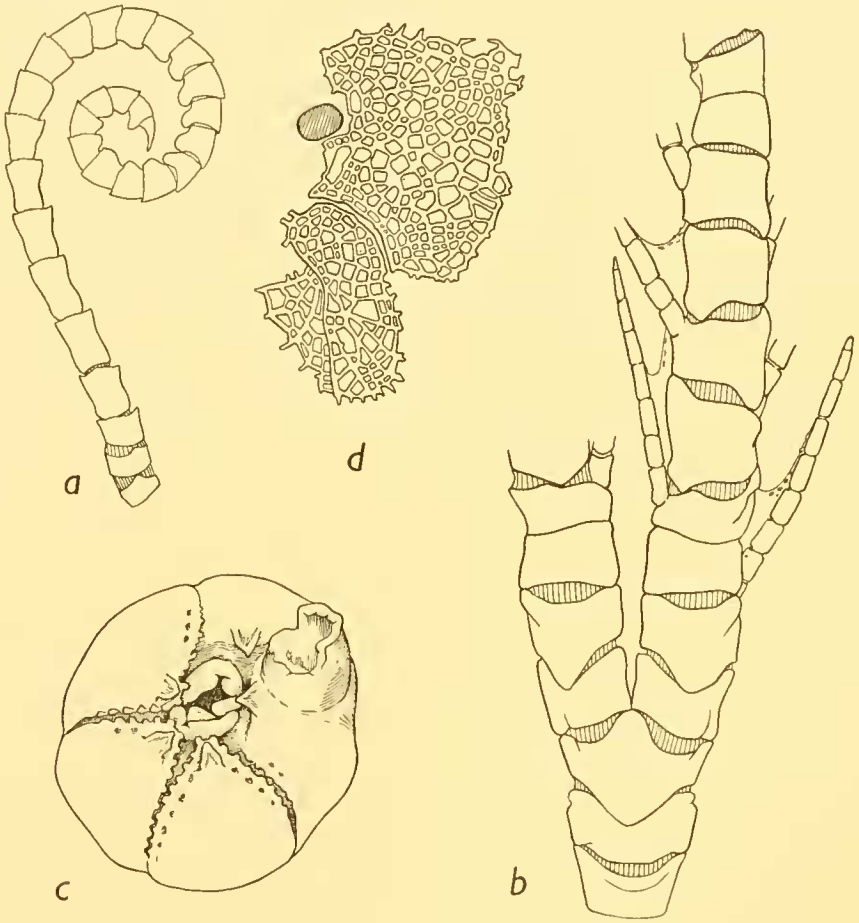

Fig. 17. *Isometra graminea*. *a*, cirrus, ×13. *b*, proximal part of a ray, ×13. *c*, disk, in which the anal cone is broken and two of the ambulacral grooves imperfectly seen, ×11. *d*, a side- and a cover-plate of a distal pinnule, ×66.

The oral pinnules differ from those of *I. vivipara* and *I. flavescens*, for P_2 is as stout and as long as, or longer than, P_1, and P_3 is longer than P_2. P_1 and P_2 are of 8–10 segments and 3–6 mm. long, depending on the size of the animal; P_3 is of 9–12 segments, 3·5–7 mm. long. The first three or four segments of P_1 are attached by a web of tissue to the disk, and the lower segments of P_2 and P_3 are similarly attached to the arm. The first genital pinnule is P_4 or P_5, of about 10–12 segments; the last is P_{13} to P_{16}, of about 15 segments and 7–9 mm. long.

The species protects the brood like *I. vivipara* and *I. flavescens* and, as in those species, the third and fourth segments of the genital pinnules of the females are enormously expanded, mainly on the aboral side, to cover the ovary and brood-pouch. In the middle genital pinnules the fifth segment is expanded to a smaller degree.

The third and succeeding segments of the male genital pinnules are expanded to cover the testes. The expansion is a little stronger on the aboral than the oral side, but it is not so asymmetrical as, and it is much smaller than, in the female; the expanded segments gradually merge into the unexpanded distal segments.

The contents of one brood-pouch of the female from the Palmer Archipelago were examined. There is one egg, one larva similar to that of *I. vivipara* figured by Mortensen as a full-grown larva (1920, pl. xxii, fig. 8), and three other larvae with the plates better developed so that the orals and basals touch one another—a stage intermediate between Mortensen's figures 8 and 9 (*ibid.*). They are of the same size as those of *I. vivipara*. Similar larvae occur in the brood-pouches of the female from the Ross Sea; in one brood-pouch there were seven. Those of the specimen from St. 1872 are younger.

On the disks of the Palmer Archipelago specimens there is at the apex of each interradial area a sharp calcareous plate with its apex projecting over the peristome[1] (Fig. 17 *c*). A broad depression runs radially along each plate because its sides are curled upwards. The bases of the plates are not distinct but they appear to be straight. Similar plates are present in one of the Ross Sea specimens and appear to be present in two others; in the fourth, and in the specimen from St. 1872, the disk cannot be seen. Clark (1915 *b*, pp. 340–1) says that the oral plates of young comatulids "are always resorbed long before adult life is reached, no trace of them whatever remaining"; these plates of *Isometra graminea* must therefore be, what Clark calls in the same place, secondary perisomic orals, though he describes them as occurring only in certain species in which the disk is heavily plated; there are no other plates on the disk of *I. graminea*.

The sacculi are inconspicuous. They are often fairly regular on the pinnules, less so on the arms; they occur on the disk.

The pinnule ambulacra are protected by large side- and cover-plates (Fig. 17 *d*), three pairs to each segment. The side-plates overlap one another so as to make a continuous wall: the divisions between them are difficult to see. The cover-plates are more rounded with a fan-like system of supporting rods terminating in peripheral spikes; in this they somewhat resemble the cover-plates of *I. lineata*, *I. angustipinna*, *I. vivipara* and *I. flavescens*. The tentacles contain strongly knobbed spicules.

The species is altogether less robust than *I. vivipara* and *I. flavescens*, and may easily be distinguished from them by the differences in the proportionate sizes of the oral pinnules. It is as readily distinguished from the much more robust *I. hordea* by the differences in the cirri.

[1] All five plates are easily seen in the broken specimen. Two can be seen in the female and one in the male between the more widely separated arms: I have no doubt there are five present.

Isometra hordea n.sp. (Plate V, figs. 7 and 8)

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Three specimens.

St. 1873. 13. xi. 36. Off Cape Bowles, Clarence Island. 61° 20·8′ S, 54° 04·2′ W. 117 m. Gear DRR. Bottom: rock and stones. One specimen.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. Four specimens.

St. 1955. 29. i. 37. North of South Shetland Islands. 61° 35·1′ S, 57° 23·3′ W. 440–410 m. Gear DRR. Four specimens.

Description. The larger specimens are moderately big and massive but they appear to be more brittle than the smaller for none of them is complete. The longest remaining arm of the stoutest specimen consists of 42 brachials and measures 45 mm. A much younger and slighter specimen has one complete arm of 93 brachials, 56 mm. long.

The centrodorsal varies from a low rounded hemisphere to a high rounded cone and it is usually covered with closely crowded cirrus sockets arranged in alternating rows (Fig. 18 *b*). The dorsal pole may be large or small and either smooth or so beset with tubercles as to be very rough; or there may be no bare dorsal pole. The ventral edge of the centrodorsal is usually straight but it may be produced into low interradial corners.

The centrodorsal of the largest most massive specimen (St. 1948) is remarkable. It is a high rounded cone. The only cirri remaining are three or four rows around the ventral edge yet they number 52. Over all the rest of the surface, excepting the small smooth dorsal pole, the cirrus sockets have become quite obliterated by a honey-comb-like growth of stereom.

Cirri XL–LX; 25–70. They are of two sizes: there are short apical cirri and peripheral cirri which may be twice as long. In the smaller specimens the apical cirri are of 25–35 segments and 10 mm. long, the longer outer cirri are of 38–50 segments and 20 mm. or more in length. In the larger specimens the apical cirri may be of up to fifty segments and 16 mm. long; the peripheral cirri are of 50–70 segments and up to 40 mm. long. The following is a description of the peripheral cirri of large specimens (Fig. 18 *a*).

The first four segments are considerably broader than long, the fifth about three-quarters as long as broad. The sixth to about the twelfth are very slightly longer than broad. Four or five beyond the twelfth are as long as broad. Thereafter the segments gradually decrease in length until the distal, which may be twice as broad as long. The long proximal segments are perfectly regular. In the region of the twelfth to fifteenth segments a small swelling appears at the distal end of the dorsal edge. By the twenty-fifth or so it has developed into a long low keel with a straight edge occupying the distal three-quarters of the dorsal edge. On the shorter distal segments the keel is shorter with a curved edge. It becomes weak on the three or four segments before the opposing spine. The opposing spine is usually strong and upstanding, the terminal claw moderately strong. There is a sharp difference in colour between the first six to ten segments,

which are yellow, and the others which are white. In two specimens the four or five most distal segments of some cirri are a deep brown.

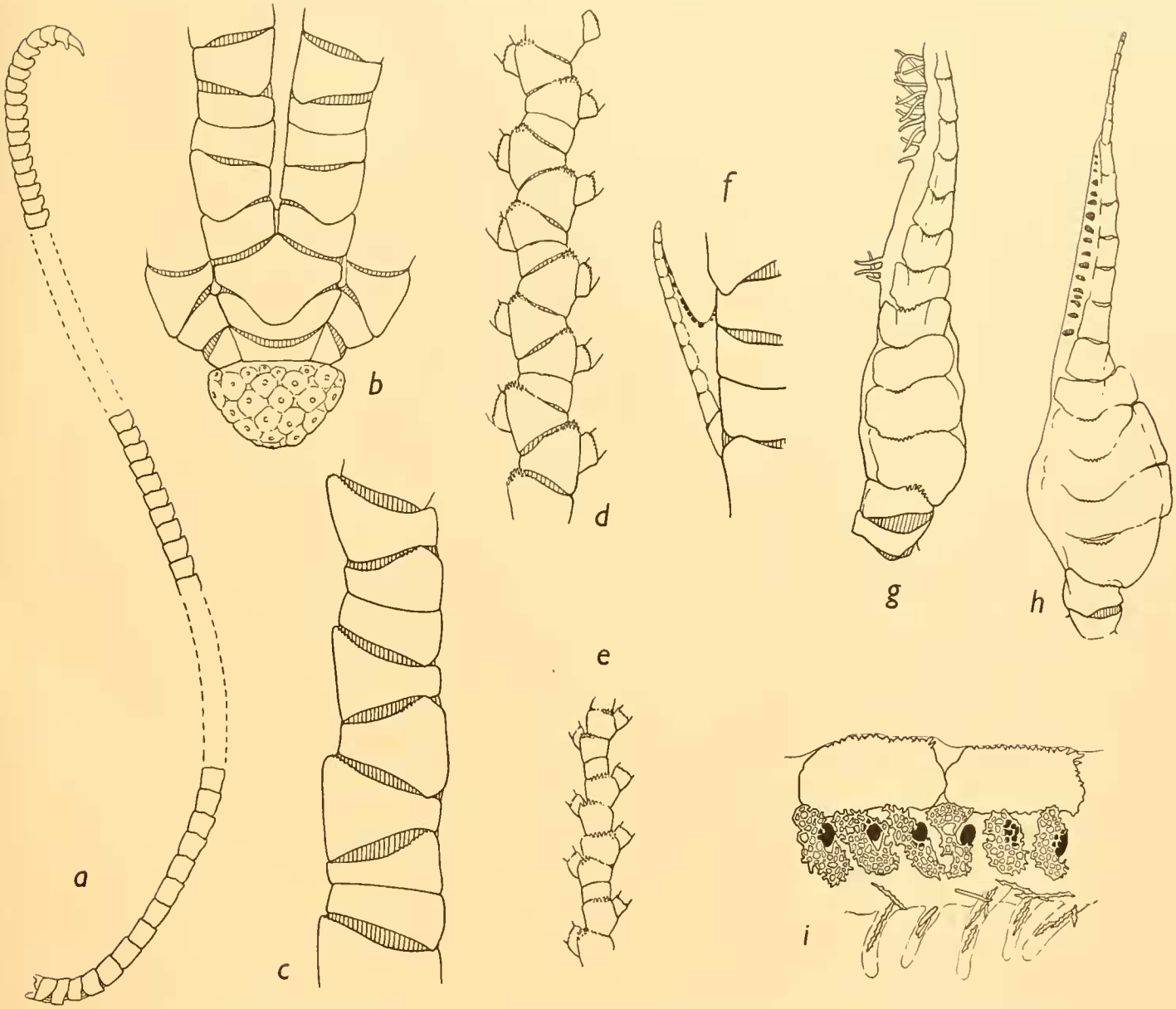

Fig. 18. *Isometra hordea*. *a*, cirrus, ×4. *b*, centrodorsal and proximal parts of rays, ×7. *c*, brachials of third syzygial pair and beyond, ×13. *d*, thirty-first to forty-fifth brachials, ×11. *e*, sixtieth to seventieth brachials, ×11. *f*, P_1, ×11. *g*, a middle genital pinnule of a male, ×8. *h*, a middle genital pinnule of a female, ×8. *i*, ambulacral skeleton of distal pinnules, ×60.

Smaller cirri, whether of large or of small specimens, resemble the above, but there are fewer segments longer than broad and the dorsal keel begins sooner.

The radials are short even in young specimens; they are very short in the older. (Fig. 18 *b* is of a specimen of medium size having complete arms of about 90 brachials which are 58 mm. long.) They are wider distally than proximally and have concave

distal margins. The costals are three to four times as broad as long. They are not incised by the axillaries: they are bent back beneath its posterior projection. In older specimens they are bent back farther than in the figure, so far that their mid-line, seen in profile, is in line with the base of the centrodorsal. The costals of younger specimens are not in opposition, those of older specimens are. The axillary is considerably broader than long in younger specimens but nearly as long as broad in the older in which the posterior projection is more strongly developed. The outer edges of the costals and axillaries are straight and sharp.

Syzygies are numerous. The normal positions of the first three are 3 + 4, 9 + 10, 15 + 16, but there may be small irregularities. Beyond the third syzygy the syzygial pairs are separated by two or three, or exceptionally one or four to six, brachials.

The outer edges of the lower brachials are sharp and their sides flat. The exterior edges of the first brachials are longer than the inner; the inner are in partial or complete contact. The first brachial is only slightly incised by the second in younger specimens, more deeply in older specimens. The outer edge of the second brachial may be twice as long as the inner. The inner edge of the first syzygial pair is longer than the outer. The brachials between the first and second syzygies are considerably broader than long and longer on one side than the other—on alternate sides in successive brachials. An obvious feature of older specimens is the strong moulding of these and a few succeeding brachials. Their surfaces are not flat: the inner distal corner of the fourth brachial (an epizygal) is raised, in common with the inner proximal corner of the fifth brachial, into a prominence; the outer distal corner of the fifth brachial and the contiguous corner of the sixth brachial are raised into a similar prominence; and so on. The surfaces of these lower brachials are quite smooth.

From the second to the fourth syzygies the brachials become more wedge-shaped. The distal edges of the outermost may be slightly everted and produced into fine spines (Fig. 18 *c*). The shape of the brachials then passes to that of a rounded triangle; the base slopes across the arm and the rounded apex, produced into a strongly overlapping edge armed with strong spines, is directed towards the side from which the pinnule arises. The zigzag appearance may be stronger than that shown in Fig. 18 *d*. In the distal brachials the shape again becomes quadrangular; the distal edges remain strongly everted and spiny (Fig. 18 *e*).

The pinnules gradually increase in length from P_1 to the distal pinnules; they become shorter again towards the tip of the arm. P_1 is short and stout, 4–5 mm. long and of 10, 11 or 12 smooth rounded segments which are longer than broad (Fig. 18 *f*). P_2 is similar and of the same number of segments but slightly longer and stouter, 5–8 mm. long. P_3 is similar, of 11–13 segments and slightly longer. P_4 may be similar to P_3 or it may be the first genital pinnule. As in the other species of *Isometra* the oral pinnules are not entirely free. P_1 is attached to the disk by its first four or five segments, and the first four or five segments of P_2 and P_3 are connected by webs of tissue with the under side of the arm.

This species, like the other Antarctic *Isometras*, is viviparous. The first genital

pinnule is P_4, P_5 or exceptionally P_6, of up to 15 segments and of the same length as, or slightly longer than, the last oral pinnule. The genital pinnules extend to P_{13} in smaller specimens, P_{18} in larger, and the last of them may be of 18–26 segments and 9–14 mm. long. The first two segments of the genital pinnules are short and stout with the aboral portions of their distal edges produced into spines. The segments carrying the gonads are much more strongly expanded in the female than the male. In the smallest specimen, which has arms 35 mm. long, none of the segments of the genital pinnules is expanded.

In the largest male the testes of the middle genital pinnules lie along the third to eighth segments and they are expanded, more strongly on the aboral than the oral side (Fig. 18 *g*). The testes of the lower and outer genitals of big males, and those of younger males, are smaller and consequently fewer segments are expanded. The third or the fourth segment is the widest and longest. The remaining segments along which the testes lie decrease in width gradually and evenly. The expanded segments are raised into a keel-like crest in the mid-line. The narrow portion of the distal edge which is a part of the crest may be thorny. The distal segments beyond the gonad are strongly compressed.

There are three females. In the smallest only the third to fifth segments of the genital pinnules are expanded, as in *I. vivipara*; the expansion appears to be a little less on the aboral side than in *I. vivipara*. In the largest, a massive but broken specimen, many of the genital pinnules (at least from P_7–P_{10}) have five segments, the third to seventh, expanded; in a few pinnules the eighth segment is slightly expanded (Fig. 18 *h*). The expansion of the segments of one pinnule is not always even: not infrequently the sixth segment is very narrow on the aboral side, the corner of the fifth being produced alongside it, sometimes so much so as to meet the seventh. Other similar irregularities occur. In the female, as in the male, the expanded segments are raised into a crest in the mid-line.

The ovary is a long fusiform body lying along the adoral side of the pinnule. It is longer than the brood-pouch and the strongly expanded segments: in a pinnule in which the brood-pouch lies along the third to sixth segments and they are strongly expanded, the ovary extends to the eighth segment. In the largest female the brood-pouches are empty. In one of medium size they are crowded with embryos and so large that they bulge out beyond the edges of the expanded segments. A transverse depression runs across the ventral face of the brood-pouch: it is due to a septum which divides the pouch into two equal compartments. Its purpose appears to be to support the brood-pouch for the contents of the two compartments are similar. One brood-pouch of the medium-sized specimen was examined. The proximal compartment contained fourteen embryos of which thirteen were young and without skeletal plates; the fourteenth contained skeletal plates. The distal compartment contained ten embryos without plates. The brood-pouches of the third and smaller specimen are smaller: the proximal compartment of one contained four embryos in one of which there are plates; the distal compartment contained four embryos of which three have plates.

The embryos vary from 0·5 to 0·8 mm. in length. Some of the younger are of very irregular shape where they have been tightly packed against their neighbours. In the largest embryos the sucking disk and vestibulum are clearly marked; the oral plates and the basal plates are nearly in contact with each other and one another. I cannot see infrabasals; there are about 20 stem-plates and a very large terminal plate. The basal circle embraces the stem. I have seen bands of cilia around some of the embryos.

Most of the distal pinnules are of the same number of segments and length as the outer genital pinnules but they become shorter towards the end of the arm. (In small specimens they are of 16–20 segments, 8–10 mm. long.) The first two segments are short and stout with strongly spiny distal edges. The remainder, but for the last four or five, are strongly compressed from side to side and gradually taper; their distal edges are beset with fine spines. The ambulacral furrow does not extend on to the last four or five segments; they are slender and rounded and strongly spiny.

The disk appears to be naked in the few specimens in which parts of it can be seen, the anal cone high.

Sacculi are abundant and conspicuous, regularly arranged on the disk, the arms and the pinnules; in some of the specimens they have retained in spirit a beautiful red colour.

Along the pinnule ambulacra of the small- and medium-sized specimens there are heavy well-developed side-plates, about three pairs to each segment, but no cover-plates (Fig. 18 *i*). Spicules occur in most of the tentacles; they may be simple smooth rods, but are more often very thorny and are sometimes branched. The large specimen lacks distal pinnules; there are no side plates along its genital pinnules but there are abundant spicules in its tentacles.

Notes of the colour of five of the specimens were made at the time of capture. Four of them were lighter in the proximal than the distal part. The proximal third to half varied from straw-yellow to bright orange yellow; the distal part from a delicate pink to a deep orange brown. The fifth specimen was orange yellow. The specimens retain yellow or pink tinges, deeper in the more distal part, in spirit. The basal segments of the cirri are darker in colour than the rest.

A series of pentacrinoid larvae of this species is described on pp. 202–210.

This is by far the largest and most robust species of *Isometra* (Plate V). It is distinguished from all others by its longer cirri made up of more numerous segments. From *I. vivipara* which most nearly approaches it in size, and from *I. flavescens* which is smaller, it is further distinguished by differences in the proportional lengths of the oral pinnules.

Family *NOTOCRINIDAE*

Genus **Notocrinus** Mortensen

Notocrinus virilis Mortensen (Plate VI, fig. 1)

Mortensen, 1918, pp. 2–10, figs. 1–5, pl. i, figs. 1–5, pl. ii, figs. 1–4, pls. iii–iv. 1920, pp. 49–53, fig. 7, pls. xxiv–xxvi. Clark, 1921, many references, pl. 49, figs. 1329–30, pl. 55, figs. 1349–52. Clark, 1929, p. 664. Grieg, 1929 *a*, p. 5. Clark, 1937, p. 16.

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Seventeen specimens.

St. 175. 2. iii. 27. Bransfield Strait, South Shetlands. 63° 17′ 20″ S, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. Seven specimens.

St. 1658. 26. i. 36. Off Franklin Island, Ross Sea. 76° 09·6′ S, 168° 40′ E. 520 m. Gear DRR. One specimen.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen.

All but one of the twenty-six specimens of this robust species are in good condition. Six have arm lengths of between 100 and 130 mm., nine of between 80 and 95 mm., five of between 60 and 75 mm., four of between 40 and 55 mm., and the smallest is 28 mm. long. The largest are, I think, bigger than any of the Swedish Expedition's collection and it is perhaps for that reason that I have to make some of the small additions that follow to Mortensen's full description.

The radial may be longer than the costal as in Mortensen's figure (1918, pl. ii, fig. 1), or of the same length or shorter.

The examination of the cirri of the specimens of this collection leads to the following numerical description, wider than Mortensen's, of the cirri: XXI–XLII, 36–76. There is a distinct and sharp change in colour between the proximal and distal cirrus segments: the first eight to thirteen are of a deep straw colour which may be tinged with red; those beyond are nearly white.

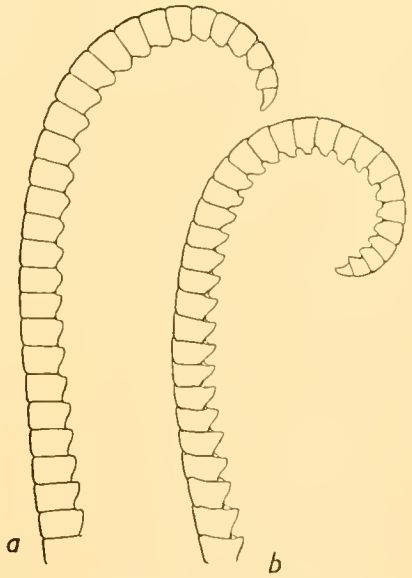

Fig. 19. *Notocrinus virilis*. *a*, distal part of cirrus from specimen from Graham Land region, × 5. *b*, same from specimen from Ross Sea, × 5.

There are in the Museum collection two specimens of this species, from the Terra Nova station 295 (348 m.) in the Ross Sea, which, unlike that recorded by Clark (1929, p. 664) from the same region, retain their cirri. They, and those of the single specimen of the present collection which comes from the Ross Sea, differ from those of typical specimens from the Falkland Sector of the Antarctic in that the dorsal prominences of the distal segments are more strongly developed and spine-like, as a comparison of *a* and *b* in Fig. 19 will show. Some of the cirri of large Falkland Sector specimens may, however, have dorsal prominences nearly as big as those of Ross Sea specimens.

As in *N. mortenseni* (see below) the oral pinnules are not entirely free. P_1 and P_2 are attached to the disk by their first three to five segments; the first three to four segments of the other oral pinnules are attached by a web to the tissues of the arm. In all but the smallest specimens P_1 is of 11–16 segments, 6–10 mm. long; P_2 of 11–18 and P_3 of 12–20 segments, each 6–11 mm. long. In the smallest specimens the oral pinnules are of slightly fewer segments. The first genital pinnule is P_3 or P_4; the last may in large specimens be so far out as P_{27}. The outer pinnules may be up to 20 mm. in length.

The syzygies are more irregularly arranged than Mortensen records. The first is abnormally placed on certain of the arms of seven specimens: on one arm it is 2 + 3, on six 4 + 5, on two 8 + 9, and on one so far out as 18 + 19. On arms where the first syzygy is normally placed there are examples of the second occurring between almost every pair of brachials between the fifth and the twenty-second. There are three examples of the first syzygial pair (3 + 4) being immediately followed by another, 5 + 6, and in each the pinnules are abnormal. Two are on arms of the specimens from St. 1948. In one the epizygal of the first pair, in the other the epizygal of each pair, bears two pinnules, one on either side. The third example is on an arm of the Ross Sea specimen (St. 1658) where the first three syzygial pairs are 3 + 4, 5 + 6, 7 + 8; the epizygal of the second pair bears two pinnules, one on either side.

The sacculi are usually inconspicuous but in some specimens are of a dark brown colour.

Some of the embryos are bigger than those seen by Mortensen, as much as 2 mm. long, but all seem to be at the same stage of development. Mortensen found no pentacrinoids but suggested that they may attach themselves to the walls of the marsupia as in *Phrixometra nutrix*. There is none so attached to the females of this collection and I do not think they have this habit, for from Sts. 170 and 175 come twenty pentacrinoid larvae, one attached to the cirrus of an adult *Notocrinus virilis*, the remainder to foreign bodies, which are certainly of *N. virilis*. They do not include any of the younger, prebrachial stages. The series is described on pp. 210–219.

Distribution. The species appears to be circumpolar in distribution for it is known from the South American, the Indian Ocean and the Ross Sea sectors of the Antarctic. It has been taken from depths between 80 and 650 m.

Notocrinus mortenseni n.sp. (Plate VI, fig. 2)

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Two specimens.

St. 187. 18. iii. 27. Neumayr Channel, Palmer Archipelago. 64° 48′ 30″ S, 63° 31′ 30″ W. 259–354 m. Gear OTL. Bottom: mud. One specimen.

St. 190. 24. iii. 27. Bismarck Strait, Palmer Archipelago, 64° 56′ S, 65° 35′ W. 315 m. Gear DLH. Bottom: mud and rock. Three specimens. 130–100 m. Gear DLH, NRL. Bottom: mud, stones and rock. One specimen. 93–130 m. Gear DLH, NRL. Bottom: mud, stones and rock. Two specimens.

St. 1948. 4. i. 37. East of Clarence Island. 60° 49·4′ S, 52° 40′ W. 490–610 m. Gear DRR. One specimen.

DESCRIPTION. The largest specimen has arms 105 mm. long. The single specimen from St. 1948 has shorter but much more massive arms; it is considerably older than any of the others and is as robust as big specimens of *N. virilis*. The species has much shorter cirri, shorter stouter pinnules and smaller gonads, than *N. virilis*.

The centrodorsal may be conical or hemispherical with a bare and smooth dorsal pole (Fig. 20 *a*). The ventral edge is produced into small corners or low wide projections interradially. In some of the younger specimens the corners are raised into ridges free of cirrus sockets; in the others and in the older specimen they are occupied, like the rest of the centrodorsal, with closely placed cirrus sockets.

Cirri XXXVIII–LX or more, 21–32 (Fig. 20 *b*). The cirri are composed of stout segments and they are strongly curved; having but half as many segments as those of *N. virilis* they are much shorter in proportion to the size of the animal. Their segments are not uniform in length as in *N. virilis*. The first three are short, the fourth or fifth is as long as broad. The fifth or sixth to the ninth or twelfth are longer than broad—less so in old specimens than in Fig. 20*b*, which is from a young specimen. Those beyond gradually become shorter until the distal are wider than long. On one of the segments between the sixth and the fifteenth a small projection appears at the distal end of the dorsal side; it gradually develops into a strong low keel occupying nearly the whole of the dorsal side of the more distal segments. The terminal claw is small and the opposing spine is not well developed: when most strongly developed it is more keel- than spine-like. In the old specimen both claw and spine are much smaller than in the figure. The cirrus segments may be all of one colour, white or dirty white; or the first six or more may be of a darker colour, usually yellow, than the distal. The last three or four, including the terminal claw, may also be dark in colour.

No basal plates are visible.

The shapes of the radials, costals, axillaries and lower brachials of the younger specimens are shown in Fig. 20 *a*. The radials are large and in lateral contact; the contact is not always complete as in the figure, the distal corners may be free. The proximal margin of the radial is convex; the distal edge is wider and concave. The costals are not in contact with one another. Each forms a shoulder with the posterior projection of the axillary which incises it. The costals are narrower distally than proximally. The proximal edges of the axillary are nearly straight, the distal are concave.

The radials and the costals are of very different shapes in the old specimen from St. 1948. The radials are reduced to narrow strips, perhaps one-tenth as long as wide. The costals are in lateral contact for about half their length; the lateral edges of the distal half bend sharply inwards towards the axillary so that the distal width of the ossicle is about three-quarters of the greatest proximal width.

Syzygies are numerous. The first is normally between the third and fourth brachials but in one arm of one specimen it is between the eleventh and twelfth. The second is usually between the ninth and tenth though it occurs also between the sixth and seventh, the eighth and ninth, and between every pair from the tenth to the sixteenth. The third is usually between the fourteenth and fifteenth and those beyond are numerous to the end of the arm with one to four or more brachials between each pair.

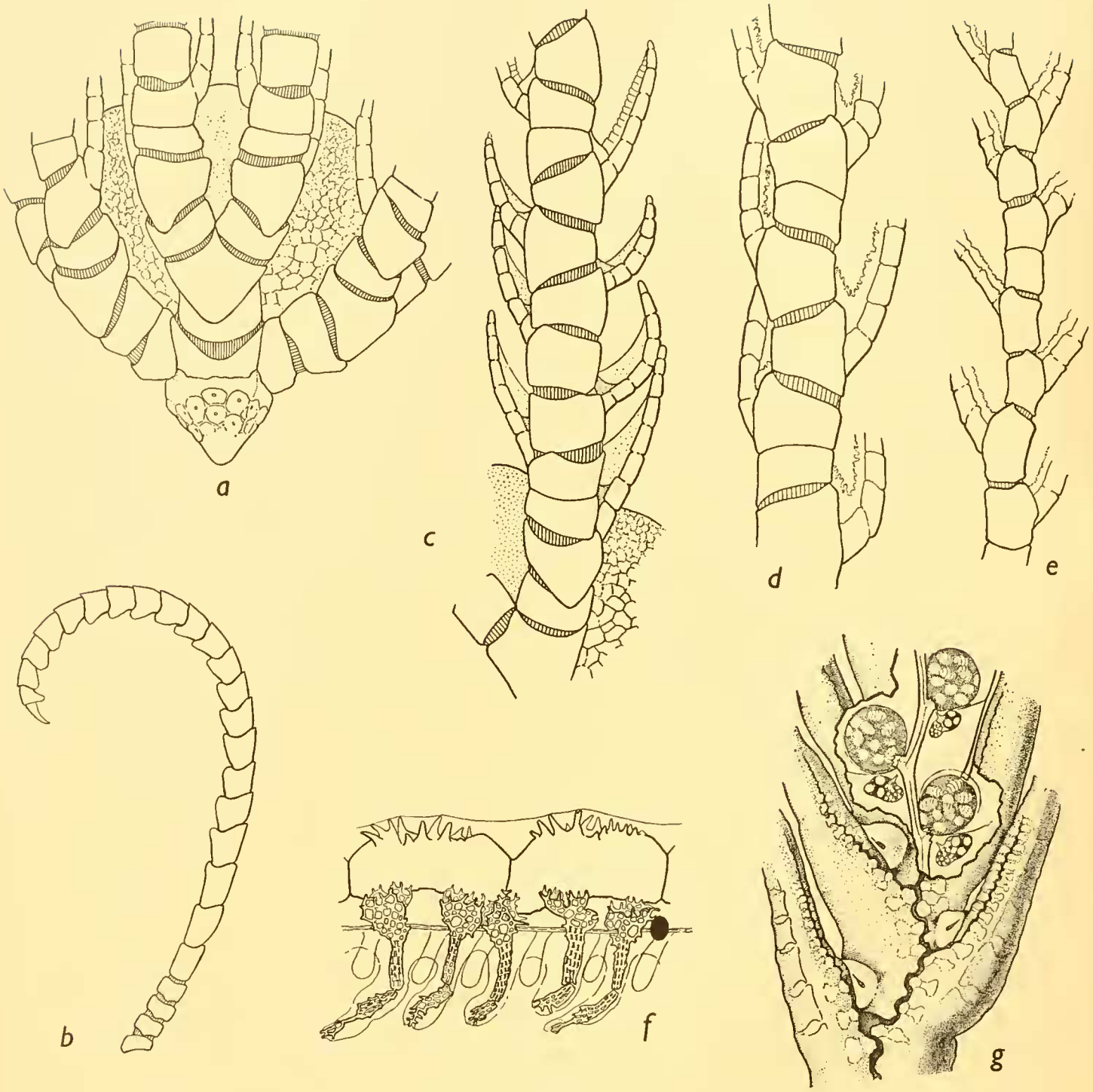

Fig. 20. *Notocrinus mortenseni*. *a*, centrodorsal and proximal parts of three rays, ×7. *b*, cirrus, ×7. *c*, first twelve brachials of an arm with pinnules, ×7. *d*, brachials of the middle part of an arm, ×11. *e*, distal brachials, ×11. *f*, ambulacral skeleton of a distal pinnule, ×40. *g*, ventral view of a portion of an arm of a female in the region of the genital pinnules; in the upper half the skin has been cut away to show the ovaries and brood-pouches, ×7.

The arms of the longest specimens are composed of about 114 brachials. The first brachial is slightly incised by and much shorter than the second (Fig. 20 *c*). The two beyond the first syzygial pair, the fifth and sixth, are almost rectangular and, more especially in the larger specimens, broader than long. Those beyond, to the third syzygy, are wedge-shaped, almost triangular, and nearly as long as broad. The distal become less triangular and more quadrate and, towards the end of the arm, as long as or longer than broad (Fig. 20 *d*). Towards the end the arm has a zigzag shape because each brachial bends to the side from which its pinnule springs (Fig. 20 *e*).

The oral pinnules (Fig. 20 *c*) are short and stout and taper to blunt ends. They are composed of a small number of rounded segments each of which, except perhaps for the first, is slightly longer than broad. P_1 is always heavier and slightly longer than P_2 and P_3, which are of the same length. In the younger specimens P_1 is of 8–10 segments, 5·5–7 mm. long; P_2 and P_3 are of 7–10 segments, 5–6 mm. long. In the old specimen from St. 1948 P_1 is of 13 segments and 11 mm. long, P_2 and P_3 are of 12 segments and 9 mm. long. P_4 is usually an oral pinnule and variable even on the different arms of a single individual: it is of 7–12 segments, sometimes of the same length as, most often longer than, P_2 and P_3. It is sometimes a genital pinnule of more segments and greater length.

P_1 is not entirely free: its first two to four segments are directly attached to the disk and one or two beyond are connected with the disk by a web of tissue. The first segments of the other oral pinnules are similarly attached to the arms by webs of tissue.

The number of genital pinnules on one side of the arm varies in the nine younger specimens from eight to nineteen and is twenty-three in the older specimen. The gonads lie at their bases as in *N. virilis* (see below). The first genital pinnules are longer than the orals and they gradually increase in length. The most distal genital and the first of the outer pinnules are the longest; those beyond decrease in length to the tip of the arm. P_5 is usually the first genital pinnule; it is of 11 segments and about 8 mm. long in the younger specimens, of 17 segments and 12 mm. long in the old specimen. The distal genitals are of 17–22 segments, 12–14 mm. long. The pinnules at the tips of the arms may be of only 9 or 10 segments, about 10 mm. long.

The genital and outer pinnules are composed of round segments the first one or two of which are as long as broad, the others slightly longer than broad. Their distal edges may be produced into a row of fine spines. The ends of the pinnules are often strongly curved. The dorsal sides of the last three or four segments are arched.

The disk is incompletely plated. There is a close pavement of thin plates completely or almost completely covering the space between the bases of the arm pairs of the younger specimens: in the older specimen the plates are few and isolated; there are usually no plates on the small part of the disk to be seen between the two arms of one pair. On the ventral side of the disk of the younger specimens the plates are fewer and larger. There are one or two large plates at the oral corners of each interradius and rows of large plates along the ambulacral grooves. The anal cone is covered with small plates. The ventral side of the disk of the older specimen cannot be seen.

Side- and cover-plates are well developed along the arm and pinnule ambulacra. There are two to three pairs of each to every pinnular (Fig. 20*f*). The side-plates have a wide base produced into a column, to the ends of which the long and narrow cover-plates are attached. In the older specimen the bases of the side-plates along the lower segments of the pinnules are reduced.

Sacculi are very few and inconspicuous, widely and irregularly spaced.

The gonads lie as in *N. virilis* in the angles between the pinnules and the arms. Only two of the specimens are males; both are rather small and probably far from physically mature. Their testes are very much smaller and less conspicuous than those of *N. virilis* though they are easily seen from the side. They are about 1–2 mm. long, triangular in shape, lying with one side along the first two segments of the pinnule and another along the arm. Regarding the side which runs along the arm as the base, there is near the apex, but slightly below it on the inside, a small papilla through which I assume there is a pore for the passage of the spermatozoa to the outside.

The female reproductive organs consist of ovaries and brood-pouches as in *N. virilis* (Fig. 20*g*). In the younger specimens the brood-pouch does not touch the ovary of the next pinnule on the same side of the arm; in the older specimen from St. 1948 (which is a female) it does. The ovaries are oval, less than 1 mm. long in the younger specimens, about 1·5 mm. in the older. Each lies at the base of the pinnule, resting against it and the arm, and is not usually visible behind the base of the pinnule from the outside. The brood-pouch lies in the angle between the arm and the pinnule, separated from the ovary by a thin septum in which there is a large round pore. Larvae escape from the brood-pouch by a slit-like orifice on the inside. The brood-pouches are easily seen from the outside and their walls are so thin that the embryos, and the ciliated bands of the most developed, may be seen through them. There are many more though much smaller embryos than in *N. virilis*. In the larger brood-pouches of the younger specimens there may be over 30 embryos; one of the lower brood-pouches of the older specimen was dissected out and found to contain no less than 92 embryos. The embryos vary in size from 0·25 to 0·48 mm. The smallest are globular and only a little larger than the biggest eggs in the ovary; the largest are oval with five broad bands of cilia: they are fully formed larvae at much the same stage of development as those of *N. virilis* described by Mortensen (1920) which are four times as long and have no trace of ciliated bands. They presumably pass on to a free-swimming stage before settling down and changing into pentacrinoid larvae. The older embryos are found in the distal part of the brood-pouch, the younger in the proximal part near the ovary.

One brood-pouch may contain every stage between the egg and the fully formed larva. I have not worked out the development. The fully-formed larva has two circles of plates, the orals and basals, and at least two infrabasal plates. There are six to eight stem joints; I see no supplementary terminal plates.

The younger specimens are of a pale straw colour in spirit; the older has a dusky hue.

Some *Myzostomum* were found on the genital pinnules.

This species may readily be distinguished from *Notocrinus virilis* by its cirri. They are shorter, of about half as many segments, and the segments are not of uniform length as in *N. virilis*.

Family *COMASTERIDAE*

Comanthus novaezealandiae A. H. Clark

Genus Comanthus A. H. Clark

Comanthus novaezealandiae Clark, 1918, p. 42; Mortensen, 1925 *a*, pp. 387–8, figs. 64–5; Clark, 1931, p. 588.

St. 934. 17. viii. 32. Off Three Kings, North Island, New Zealand. 34° 12′ S, 172° 11′ E. 92–98 m. Gear OTL. Bottom: hard, comminuted shells and bryozoans. One young specimen and fragments of an older specimen.

St. 935. 17. viii. 32. Off Three Kings, North Island, New Zealand. 34° 11′ S, 172° 8′ E. 84 m. Gear DRL. Bottom: hard. Two large specimens.

The young specimen has only 12 arms; one of the larger has 16, the other 17, arms. The longest remaining arm, which is incomplete, of the largest specimen is of 116 brachials and nearly 100 mm. long.

The cirrus sockets are irregularly arranged, here in a single, there in a double, row around the edge of the centrodorsal. There are 38 and 34 in the larger specimens, 18 in the young specimen. The cirri are of 16–18 segments in the larger specimens. The seventh segment is a transition segment with its distal quarter a dirty white like the succeeding segments, the remainder a darker colour like the segments proximal to it. The segments beyond the seventh are less rounded and conspicuously wider laterally than the others; the dorsal spine develops rapidly beyond the seventh segment.

Mortensen has figured the oral and genital pinnules. P_1 is of 34–38 segments and about 8 mm. long; P_2 is similar and nearly as long. The terminal comb of the oral pinnules is double, for the inner ventral edges of the last 10–12 segments carry blades similar to but slightly smaller than those on the outer ventral edges.

P_3, of about 15 segments, is much shorter than the oral pinnules—4–5 mm. long. The outer genital pinnules are of 18 segments and about 7 mm. long. The distal pinnules are of longer segments, 20–25 in number, and are as long as the orals. The distal dorsal edges of the third to the fourth or fifth segments of the genital and outer pinnules are raised into strong thorny protuberances. The remaining segments are smooth except for a varying number of the distal segments, a smaller number in the outer than the genital pinnules, which are raised dorsally into spines which may be high and recurved.

The distal edges of the brachials are raised and produced into fine spines. The syzygial pairs are usually separated by three brachials.

PENTACRINOID LARVAE

There are thirty-eight pentacrinoids belonging to three species, *Promachocrinus kerguelensis*, *Isometra hordea* and *Notocrinus virilis*, in the collection. There are only three of *Promachocrinus kerguelensis*, but good series, fifteen and twenty respectively, of

Isometra hordea and *Notocrinus virilis*. In describing them I have followed A. H. Clark in calling the plate in the posterior interradius the *radianal* plate: it is the anal plate of other authors.

Mortensen (1920, p. 74) says that it appears to be a general rule among comatulids that: the anal (radianal) plate develops in the radial midline like the true radials but before any of them; the right posterior radial is the last of the radials to develop; it appears to the right of the anal plate and outside the radial midline, and only later, during growth, assumes the radial position by pushing the anal plate to the left.

Clark has described a long series of *Promachocrinus kerguelensis* pentacrinoids containing specimens much younger than mine. There is not in my series of *Isometra hordea* and *Notocrinus virilis* any specimen with the radianal plate but with no right posterior radial. Nevertheless the younger stages of *Isometra hordea* do appear to confirm Mortensen's general rules.

In specimen No. 2 of *Isometra hordea* all the radials are present, but the right posterior is smaller than the others; in No. 3 each of the radials except the right posterior carries a costal and an axillary (Fig. 21 *b*, *c*). These conditions probably arose because the right posterior radial was the last to appear. No. 2 shows too that the radianal appears first in the radial midline, the posterior radial to the right of and slightly above it. In some of the stages which follow (Nos. 3 and 5–7) the suture between the posterior and right posterior orals—which is the axis of the right posterior ray—lies to the right of the suture between the corresponding basal plates. This, it is probable, is because the right posterior radial of each first appeared to the right of the radial midline; it comes to occupy the true radial position later.

Similarly, in three of the younger pentacrinoids of *Notocrinus virilis* (Nos. 3, 6 and 7) the axis of the right posterior ray lies to the right of that of the suture between the posterior and right posterior basals.

Pentacrinoid larvae of Promachocrinus kerguelensis Carpenter

A. H. Clark (1921, pp. 530–57, figs. 881–937) has described a series of forty-three pentacrinoids of *Promachocrinus kerguelensis*, the youngest without any radial structures, the oldest with large and prominent interradial plates and three whorls of cirri on the proximal columnal.

There is in the present collection a pentacrinoid from South Georgia (St. 27, 110m.) with interradial structures which is certainly *P. kerguelensis*; there are two younger pentacrinoids, one from the South Sandwich Islands the other from the Bransfield Strait region, which I believe to belong to this species. All three were taken in March.

No other crinoid but *P. kerguelensis* is known from the South Sandwich Islands, though others may well occur. The pentacrinoid from there (St. 366, 77–152 m.) is the youngest of the three. It resembles Clark's No. 33 (pp. 546–7, figs. 922–3). The crown is 1·3 mm. long. The stem is incomplete, of 23 columnals, the longest of which

are four to five times as long as broad. The radials are just in contact. The only complete arm is of two brachials. I see no side-plates or sacculi.

The pentacrinoid from the Bransfield Strait region (St. 177, 1080 m.) resembles, so far as the shape and proportions of the radianal, radial and basal plates are concerned the specimen shown in Clark's fig. 90 (p. 545). But it is older and larger: the crown is 1·8 mm. long; the stem, of 26–30 columnals and a terminal plate, is nearly 7 mm. long. The arms are of three to six brachials.

The South Georgia pentacrinoid closely resembles the oldest of Clark's series, his pentacrinoid No. 43 (pp. 551–3). The crown is 9 mm. long but the arms are not complete. Only 12 columnals remain.

The centrodorsal is as high as it is broad and truncated distally. It has four whorls of cirrus sockets. Those of the most apical whorl are radial in position, the next are interradial, and so on. The cirri of the lower interradial row are the longest, being of 15 segments and reaching to about the fifth brachial. Those of the more apical radial whorl are shorter and of fewer, 11–12, segments but they are more mature in appearance. Both rows of cirri are in general similar to those described by Clark. The next, interradial, row are of 12–15 segments and reach to the first or second brachial but they are of immature form. The peripheral, radially situated, cirri are mere rudiments.

The columnal next to the centrodorsal is short, about three times as broad distally as it is long. Its width is equal to that of the base of the centrodorsal, greater than that of its truncated tip. It is wider distally than proximally for the distal half is raised into five forwardly projecting rounded lobes which are in contact only on the distal edge of the columnal. They perhaps represent the beginnings of the five plates that Clark describes as arising from the corresponding columnal of his pentacrinoid No. 43; but they are in the distal half of the columnal whereas Clark's arose from the proximal edge. Two narrower discoidal columnals follow and they are succeeded by a still narrower columnal which is half as long as broad. The remaining columnals are elongated.

Short basals are visible.

The radial radials approach the adult form. The interradial radials are much narrower but they reach nearly as far forward. Each carries a small costal and axillary, small oblong plates, the latter reaching nearly as far forward as the radial axillaries; there are no brachials on the interradial rays.

The radial arms are long and well developed but none is complete; the longest remaining is of about 20 brachials. They resemble those of Clark's specimen but I cannot see side-plates; it is certain that there are not large conspicuous plates such as Clark describes. This is interesting: the specimen comes from South Georgia where few adults have side-plates and those that do possess them have but few and small and scattered plates; Clark's specimen came from near Gaussberg, and it has been shown (pp. 143–4) that adults from such high latitudes have on the whole more and better developed side-plates.

From the eleventh brachial onwards there are long but incomplete pinnules. P_1, P_a and P_2 are also present but very small, of 1–3 segments.

Large triangular oral plates are present near the mouth.

The posterior interradius is damaged and too broken to show if the radianal plate remains.

Pentacrinoid larvae of Isometra hordea n.sp.

There are fifteen pentacrinoid larvae from St. 170 (23. ii. 27. Off Cape Bowles, Clarence Island, 61° 25′ 30″ S, 53° 46′ W, 342 m.) which form a series. The youngest is a prebrachial or cystid stage; the oldest has three whorls of cirri on the topmost columnal of its stem, and arms of about thirty brachials.

From the same station there are eighteen pentacrinoids of *Notocrinus virilis* which are described hereafter (p. 210).

The adult crinoids taken at this station were:

Promachocrinus kerguelensis	6
Isometra hordea	3
Notocrinus virilis	17
N. mortenseni	2

It does not follow that the pentacrinoids of the present series belong to any one of these species but it is probable that they do. I believe them to be *Isometra hordea*. They are not of *Promachocrinus kerguelensis*, the stages of which are known (see above). They do not closely resemble the pentacrinoids of *Notocrinus virilis* as one would expect those of *N. mortenseni* to do. On the other hand, they do appear to show some resemblances to *Isometra hordea*.

The shapes and proportions of the primibrachs and brachials of the oldest larvae and of *I. hordea* are similar. The distal brachials of the oldest pentacrinoid have a slight zigzag character suggestive of that of the middle part of the arms of *I. hordea*. The pinnule ambulacra are lined by side-plates and the tentacles have numerous spicules, the former not unlike, the latter resembling, those of *I. hordea*.

1. This is the only specimen of a cystid or prebrachial stage (Fig. 21 *a*).

The crown is 0·9 mm. long. The column is of 26 segments and 3·4 mm. long. The distal part of the column is narrower than the proximal. The first four or five columnals are very short and discoidal, much shorter than wide, but increasing in length. The middle columnals are nearly as long as wide, the distal are slightly longer. All are considerably wider medianly, where they are encircled by a narrow girdle, than at either end; they are evenly rounded off towards each end. The terminal plate is thick and rounded.

The base of the basal cup is considerably wider than the topmost columnals. The sides are faintly convex. The height of the cup is about two-thirds of the distal width. The orals form a cup slightly higher than the basals. The lateral edges of the orals are strongly bent outwards to give a high double ridge along each of the sutures between them. When the crown is seen with these ridges in profile the oral cup has more strongly convex sides than the basal.

2. In this stage the five radials and the radianal plate are present (Fig. 21 *b*). The crown is about 1 mm. long, the column 5·8 mm.

The column consists of 28 columnals and a terminal plate. The first six columnals are of roughly equal lengths, short and discoidal. The remainder are somewhat barrel-shaped; each is encircled by a narrow median girdle and, with the exception of a small number following the discoidal columnals and a small number at the distal end, is slightly longer than broad. The articular faces of the longer columnals are broadly oval, the long axes of those of the two ends of one columnal being at right-angles to one another. The long axes of the opposing faces of two contiguous columns coincide. For these reasons the alternate articulations of a part of the column appear, from some angles, to be of different kinds. The terminal plate is thick and rounded.

The base of the basal cup is not wider than the proximal columnals. Its height is equal to that of the oral cup; it is considerably less than its distal diameter. The lateral edges of the oral plates are more strongly bent outwards, especially proximally where a furrow lies between those of adjacent plates, than in the pre-brachial stage.

A small rounded radial plate is present in each of the angles between the basals and the orals. To the left of and a little below one of them which is smaller than the others is a slightly smaller plate, the radianal. In this radius the suture between the basals and that between the orals are not in line with one another as in other radii: the former is slightly to the left of the latter with the anal plate lying directly in line with it; the radial is in line with the suture between the orals.

3. Length of crown 1·0 mm. (Fig. 21 *c*); length of column 5 mm.

The column consists of 25 segments and a terminal plate and is similar to, though shorter than, that of the previous stage. Most of the columnals are encircled by a strong median girdle. The terminal plate is small, round and simple.

The basal cup is about two-thirds as long as its distal diameter. Its base is not wider than the proximal columnals; its sides are only slightly convex. The oral cup is a little longer than the basal. The radials are very much bigger than in the previous stage; the corners of the basals are cut away to receive them. The right posterior radial is strongly asymmetrical being undeveloped on the left side where the much smaller radianal plate lies. The right distal angle of the posterior basal is strongly cut away to accommodate the radianal plate. Each of the radials except the right posterior bears a small costal, and a smaller axillary; they lie in the furrow between the strongly turned out lateral edges of the oral plates but are massive enough to project beyond the edges of them in profile. The right posterior radial bears no ossicles.

The suture between the posterior and the right posterior basals and that between the corresponding orals are only a little out of line with one another.

4. Length of crown 1·0 mm.; length of column 4·6 mm.

The column is of 27 segments and a terminal plate and is similar to that of the previous stage. The first seven columnals are short and discoidal; the second is slightly longer and wider than the others which are of equal size. The terminal plate is thick and circular.

The proximal edges of the basal plates are slightly rounded. The base of the basal cup is wider than the proximal columnals. It is shorter than its distal diameter and

shorter than the oral cup and its sides are nearly straight. The radials are slightly smaller than in the previous stage. The radianal is similarly placed. Each of the radials, including the asymmetrical right posterior, bears a costal and an axillary smaller than those of the previous stage.

There is a strong contrast between the nearly straight-sided basal cup and the oral cup which has a broadly-rounded dome-like profile because of the strongly everted edges of its plates.

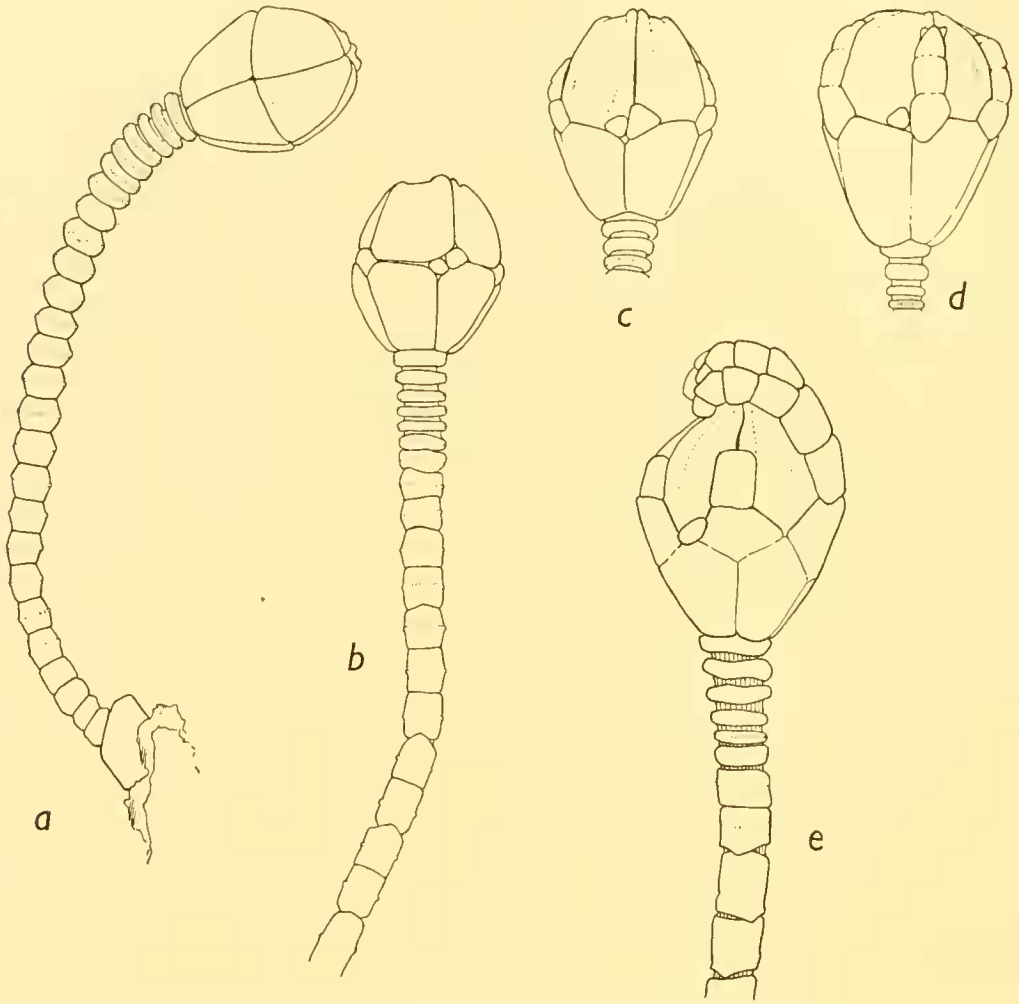

Fig. 21. Pentacrinoid larvae of *Isometra hordea*. *a*, crown and column of No. 1. *b*, crown and part of column of No. 2. *c*, crown and proximal columnals of No. 3. *d*, same of No. 5. *e*, same of No. 8. All ×26.

5. Length of crown 1·2 mm. (Fig. 21 *d*); length of column 5·4 mm.

The column is of 28 segments and similar to that of the previous stage; as in that stage the second of the proximal discoidal segments is larger than the others, which are of equal size. The terminal plate is large and irregular.

The sides of the basal cup are only very slightly convex. Its base is of the same width as the proximal columnal with which it is closely associated. It is about two-thirds as long as its diameter at the basi-oral suture, a little longer than the oral cup. The lateral

edges of the orals are still more strongly everted than in the previous stages; the radials are considerably, the costals and axillaries very much, larger. The axillary is as large as the costal and carries two very small first brachials.

The radianal causes the posterior basal and the right posterior radial to be asymmetrical. The suture between the posterior and the right posterior basal plates is out of line with, to the left of, that between the corresponding oral plates; the axis of the ray coincides with the latter.

6. Length of crown 1·3 mm.; length of column 6·7 mm.

The column is of 33 segments. The first is very short and closely in contact with the basal cup. The next five are short and discoidal and become progressively and gradually smaller: that is, the second is slightly longer and wider than the third, and so on. The remaining columnals are similar to those of the stages already described: all but two or three following the discoidal proximal segments and three or four near the terminal plate are longer than broad, somewhat barrel-shaped, each with a narrow projecting girdle; the articular faces are broadly oval and the long axes of the two faces of each columnal are at right angles to one another. The terminal plate is simple.

The base of the basal cup is a little wider than the topmost columnal. Its distal diameter is nearly twice its length; its sides are nearly straight.

The proximal portions of the lateral edges of the orals are widely separated by the well-developed radials, costals and axillaries against which they are turned up; the distal portions are in contact with one another. The radials are five-sided, about as long as broad; they do not meet one another. The posterior basal and the right posterior radial are made asymmetrical by the radianal; the axis of the right posterior ray is not in line with, but considerably to the right of, the suture between the posterior and right posterior basals. The radianal appears to override the posterior oral.

The costals and axillaries are strongly developed; the latter reach as high as the apex of the oral dome and each carries a pair of first brachials, and some a pair of second brachials, which reach farther.

This is the first stage in which the radial structures reach beyond the orals.

7. The crown is damaged, about 1·3 mm. long; length of column 7 mm.

The stem is of 26 columnals and a small thick terminal plate. The first five columnals are short; the first and second are wider than the third to fifth. The remaining columnals, except for two or three following the short proximal columnals and three or four before the terminal plate, are longer than broad, the longest being one and a half times as long as broad. In other ways they resemble those of the stages already described.

The basals and radials together form a straight-sided cup (as in the next stage, see Fig. 21 *e*). The radials are pentagons with rounded angles; they do not meet. The right posterior radial is made asymmetrical by the radianal which rests closely against it, and the ray it bears lies to the right of the line of the suture between the posterior and right posterior basals. The radianal is nearly in contact with the left posterior radial; it rests on the posterior oral.

Some of the arms are broken; others are of three brachials curling in over the apices of the oral plates (which appear to be in contact).

8. Length of crown 1·4 mm. (Fig. 21 *e*); length of column 7·7 mm.

There are 31 columnals and a small thick round terminal plate. The first five columnals are short and discoidal. The first is as wide as the base of the basal cup, the second is as wide but a little longer, the third resembles the first; all three are a little irregular. The fourth and fifth are narrower, shorter and more regular. The remainder, but for three or four following the discoidal segments and three or four adjoining the terminal plate, are considerably longer than broad—nearly one and a half times as long as broad. They are in other ways similar to those of the earlier stages described in this series; the median girdle is very faint and does not project.

The sides of the basi-radial cup are nearly straight. The radials almost meet in all interradii except the posterior where they are widely separated by the radianal. The radianal still causes a strong asymmetry in the right posterior radial; it is also in contact with the left posterior radial. It rests on the posterior oral. The anterior arms are of four brachials and curl in over the orals. No other ossicles than the costals remain on the posterior radials: that on the left is smaller than that on the right. The orals rest against the lower edges of the costals; they turn in under the axillaries and brachials and where the latter are lost it may be seen that the edges of the orals are in contact (Fig. 21 *e*). They are strongly everted.

9. Length of crown 2·7 mm. (Fig. 22 *a–c*); length of column 9 mm.

The stem is of 30 columnals and a round and simple terminal plate. The first five segments are short and irregularly discoidal. The first three are wider and slightly longer than the fourth and fifth. The sixth is longer, but broader than long; the seventh is almost as long as broad, the eighth longer than broad. The ninth to about the sixteenth are considerably longer, nearly twice as long as broad. The remainder gradually decrease in length, the last two or three being shorter than broad. Most of the longer segments have a very faint median girdle which does not project.

The sides of the basi-radial cup are straight. The radials, with the exception of the posterior pair, are in broad contact with one another. The posterior are separated by the radianal which lies in the midline of the posterior interradius, in contact with both radials and making each of them equally asymmetrical: whereas the other radials are seven-sided they each have six sides. The radianal rests on the posterior oral and extends as far forward as the distal edges of the radials. The orals, which are in contact with the inner distal edges of the radials, are broad plates with the lateral edges of the distal portion, which bends strongly in over the disk, strongly everted and in contact with one another.

The arms are of ten or eleven brachials. I can see no sacculi and side-plates along the ambulacra. There are no pinnules.

10. Length of crown 3·2 mm.; length of column 10 mm.

There are 34 columnals in the stem which is similar to that of No. 9. There are six short irregularly discoidal proximal columnals. The first is very short and closely

attached to the basal cup. The second to fourth are wider and more robust than the first and fifth and sixth; the second is wider than the third and the third than the fourth. None of the columnals has a median girdle. The terminal plate is large.

The sides of the basi-radial cup are straight. All but the posterior radials are in broad contact. The proximal corners of the posterior radials meet, cutting off the radianal plate from contact with the basal for the first time; the distal portions of the posterior radials are separated by the radianal. Its centre lies to the right of the midline of the posterior interradius and it is in contact with the costal of the right posterior ray as well as with the two radials; its centre is in line with the articulation between the radial and the costal. Both the posterior radials are made asymmetrical by the radianal, the right far more so than the left, for its left distal corner is cut away to accommodate the radianal. The radianal overlaps the posterior oral.

The bases of the orals are in contact with the inner distal edges of the radials. They are flat plates with slightly out-turned edges which bend in over the disk, where their edges appear to meet, and are evenly rounded distally: they do not narrow to bar-like projections.

The costals and axillaries are considerably stouter than in the previous stage (No. 9). The arms are of 12 or 13 brachials. There are no pinnules and I can see no sacculi or side-plates along the arm ambulacra.

11. Length of crown 3·5 mm.; length of column 11 mm.

There are 36 columnals and a large lobed terminal plate. The first five columnals are short and irregular. The first and second are as wide as the base of the basal cup, the second a little longer than the first. The third and fourth are slightly, the fifth considerably, narrower. The remainder of the stem is similar to those of Nos. 9 and 10. None of the segments has a median girdle.

The sides of the basi-radial cup are straight. All the radials are in broad contact though that of the posterior radials is incomplete distally because of the radianal which lies in contact with both of them and the costals they bear. It is a nearly circular plate lying in the mid-line of the posterior interradius, its proximal edge opposite the articulations between the radials and the costals, its centre opposite a point a third of the way along the costals. Its contact is closer with the right than the left posterior ray. It lies much nearer to the outside than the oral.

The orals lie deep within the arms, their bases in contact with the inner distal edges of the radials, their lateral edges underneath the edges of the arms on either side. They bend in over the disk, gradually narrowing as they do so: their edges probably do not meet over the disk.

The costals, axillaries and brachials are considerably more robust than in No. 10. The arms are of about 14 brachials; the ninth and tenth brachials of some arms bear the beginnings of the first pinnules to be formed. I see no sacculi and no side plates along the arm ambulacra.

12. Length of crown 5·6 mm. (Fig. 22 *d*); length of column *ca.* 12 mm.

There are 36 columnals and a large lobed terminal plate. The first columnal is short

and as wide as the base of the basal cup to which it is closely attached. It bears the beginnings of five radially situated cirri, each, except for the left posterior which is broken off, of about three to five segments. The proximal border of the second columnal is deeply notched radially opposite each of the developing cirri. The third to fifth columnals are as short as the first and second; they are irregularly discoidal. The sixth to eighth are longer, the ninth slightly longer than broad. The remainder of the stem is similar to that of No. 11; none of the columnals has a median girdle.

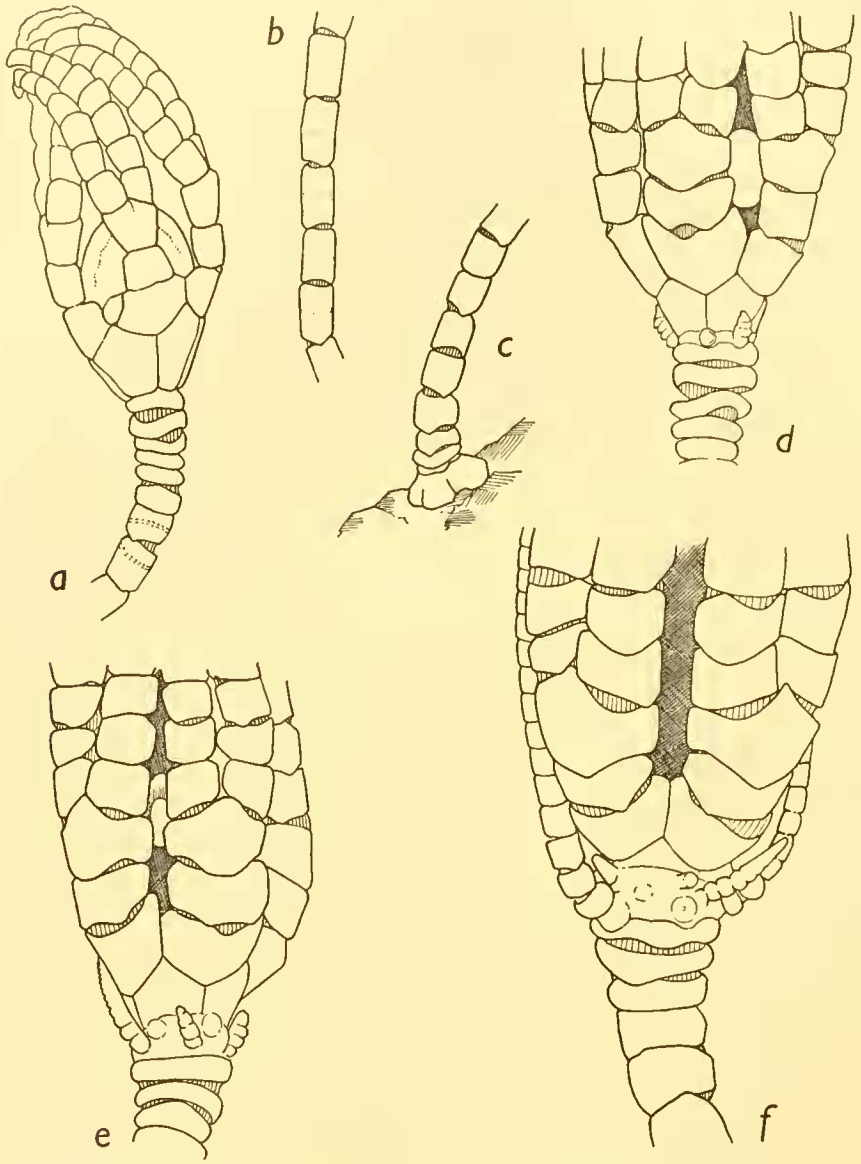

Fig. 22. Pentacrinoid larvae of *Isometra hordea*. *a*, crown and proximal columnals of No. 9. *b*, tenth to fourteenth columnals of No. 9. *c*, last columnals and terminal plate of No. 9. *d*, proximal portions of crown and column of No. 12. *e*, same of No. 14. *f*, same of No. 15. All ×18.

The radials are longer than the basals. They are all in broad and complete lateral contact. The right distal corner of the left posterior radial extends farther forwards than the contiguous corner of the right posterior radial; the radianal plate is in contact with

the former but not with the latter. It is a long narrow plate lying between the posterior rays, just below the level of their edges. The oral plate can be seen deep within the arms behind it (but not in such a way as to be shown in the figure). The proximal border of the radianal plate is half-way along the costal, its distal border opposite the beginnings of the first brachials.

In two of the remaining interradii the arms are too closely pressed together for the oral plate to be seen. In each of the other two the oral is visible, its base opposite the middle of the axillary, i.e. for the first time out of contact with its radials, its distal portion sloping steeply inwards. I can see no plates in the perisome separating it from the radials.

The costals, axillaries and brachials are more massive than in the previous stage. The lateral edges of the axillaries are parallel. The arms are of about 20 brachials; from the ninth brachial onwards there are pinnules of up to eight segments. There are a few small irregularly arranged sacculi on some arms. There appear to be small side-plates along the arm ambulacra.

13. Length of crown 5·4 mm.; length of column 12 mm.

The column is of 34 columnals and a large lobed terminal plate. It is very similar to that of No. 12. The first columnal bears five slightly longer cirri, the longest as long as the side of a basal plate.

The crown is very similar to that of No. 12. The sides of the basi-radial cup are straight in the proximal basal portion, bulge slightly outwards in the radial portion. The right distal corner of the left posterior radial extends a little farther forward than the contiguous corner of the right posterior radial—not nearly so much so as in No. 12: the radianal is far removed from it. The proximal edge of the radianal plate is opposite a point half-way along the costal; the proximal edges of the orals are opposite the distal edges of the costals. There are a few sacculi and small side-plates along the arms.

14. Length of crown 6·8 mm. (Fig. 22 *e*); length of column 13 mm.

There are 35 columnals and a large lobed terminal plate. The first columnal is longer and more massive than in the previous stages. It bears two whorls of cirri, a radial whorl of five larger cirri arising from large sockets occupying nearly the entire length of the segment, and an interradial whorl of five very small cirri arising from the proximal half of the segment. The longest of the radial cirri consist of more than 12 segments and are longer than the basal plates. The second columnal is discoidal, of the same diameter as, but shorter than, the first; its proximal edge is not notched opposite the cirri of the first. The third is shorter and narrower than the second and irregularly discoidal. The fourth and fifth are still narrower but slightly longer. The remainder of the column resembles that of the stages described above.

The contiguous distal corners of the posterior radials are unequal as in Nos. 12 and 13. The radianal plate is more distant from them than in those younger specimens: its proximal edge is opposite a point a third of the way along the axillary; it extends to a third of the way along the first brachial. It is smaller than in specimen 13. It rests on the anal tube which ends opposite the distal half of the first brachial. The oral plate may be seen deep behind the end of the anal tube. In other interradii it may be seen that the

other oral plates are pushed farther distally than in the younger specimens; their proximal edges are level with those of the first brachial.

The costals and axillaries are as wide as the radials and of the shapes shown in Fig. 20*e*. The arms are of 22–24 brachials with pinnules arising from the tenth and succeeding brachials. The longest pinnules are of ten or more segments. There are side-plates and a few sacculi along the arms.

15. Length of crown *ca.* 11 mm. (Fig. 22*f*).

This is a far bigger and older specimen than the last (No. 14).

The stem is of 32 columnals and a very large and lobed terminal plate. The first columnal is considerably longer than in No. 14, and tapers somewhat distally. It bears three whorls of cirri. The largest is a radial whorl arising from the distal half of the columnal, one in each radius; the longest are of 27 segments and extend as far as the seventh brachial. They terminate in claws and their penultimate segments carry small opposing spines. A whorl of much smaller cirri arises interradially from half-way along the columnal. There are five cirri in this whorl, one in each of three interradii, two in the fourth and none in the fifth which is contiguous with it. The beginnings of a third, radial, whorl arise from the proximal border of the columnal.

The second columnal is short and discoidal and slightly wider than the tapered end of the first; its proximal border is incised opposite each of the large radial cirri, so deeply opposite some cirri as to extend for the length of the segment and so cut its periphery into lobes. The third columnal is short and discoidal and very slightly narrower than the second. The fourth and fifth are irregular and narrower and longer. The remainder of the columnal is similar to the same parts of those of the stages already described.

The basal plates are very reduced; in the radial mid-line they appear to be less than one-sixth as long as the radials. The radials are long and in close contact with one another. The costals and axillaries are as wide as the radials. The arms are too closely pressed together for the oral plates or the radianal to be seen.

The arms are of about 30 brachials. Syzygies occur between brachials 3 + 4, 9 + 10 or 10 + 11, 13 + 14, 18 + 19. Long pinnules or 12 or more segments arise from the tenth and succeeding brachials. The beginnings of the first pinnules (P_1) are present on the second brachials.

There are fairly regularly arranged small dark sacculi along the arms and small side-plates along the arm ambulacra. There are small side-plates, one or two to each segment, along the pinnule ambulacra and numerous spicules in the tentacles. A few of the spicules are nearly smooth but most are strongly thorny and some are branched. The side-plates are not unlike, and the spicules resemble, those of adult *Isometra hordea*.

Pentacrinoid larvae of Notocrinus virilis Mortensen

St. 170. 23. ii. 27. Off Cape Bowles, Clarence Island. 61° 25′ 30″ S, 53° 46′ W. 342 m. Gear DLH. Bottom: rock. Eighteen specimens (Nos. 1–7, 10–20).

St. 175. 2. iii. 27. Bransfield Strait. 63° 17′ 20″, 59° 48′ 15″ W. 200 m. Gear DLH. Bottom: mud, stones and gravel. Two specimens (Nos. 8 and 9).

That these twenty pentacrinoids from the Bransfield Strait region are of *N. virilis* is shown by the fact that they all carry in superficial pits in the orals, and sometimes in other adjacent ossicles, glandular sacs similar to those described from the posterior end of the embryos by Mortensen (1920) who has described the eggs and embryos of the species. One of the larvae (No. 7) occurred on a cirrus of an adult *N. virilis*. The last three of the series (Nos. 18–20) have small plates in the naked perisome which separates the oral plates from the radials: the perisome of adult *N. virilis* is strongly plated. The oldest larva has along the arm ambulacra strong side- and cover-plates of the same nature as those of *N. virilis*.

The series is not so complete as that of *Isometra hordea*. There is no prebrachial stage: the youngest larva has arms of two or three brachials. The oldest has only one whorl of cirri on the topmost columnal of its stem; its arms are of nineteen brachials.

The adult crinoids taken at St. 170 are shown on p. 202. Those at St. 175 were:

Promachocrinus kerguelensis	3
Phrixometra nutrix	1
Isometra vivipara	1
Notocrinus virilis	7

1. Length of crown *ca.* 1·4 mm. (Fig. 23 *a*); length of column *ca.* 6·4 mm.

The column is of 34 columnals and a thick roughly circular terminal plate which appears to be simple: I cannot see any supplementary plates like those known in the larva. The first seven columnals are short and discoidal. The most proximal is in close contact with the basal plates. From the second to the seventh there is a gradual decrease in width. The eighth is about one-third, the ninth about a half, as long as broad; the proximal half of each is encircled by a narrow projecting girdle. The remaining segments are about as long as broad except for five or six at the distal end which are shorter. They are rounded off to, and narrower at, each end than in the middle, where they are encircled by a narrow projecting girdle. They are somewhat barrel-shaped. The articular faces are very broadly oval, the long axes of those at the opposite end of each columnal at right angles to one another. The columnals are of a coarse texture like the ossicles of the crown.

The sides of the basal cup are strongly rounded. Its height is equal to about half its diameter at the distal end. The distal corners of the basal plates are deeply cut away to receive the radials. The crown is damaged on one side and one ray has been broken away: it must be the right posterior ray, for there is no sign of the radianal plate against any of the other radials. In three rays that are complete the arms are of two, or sometimes three, brachials. They curl in above the apices of the orals.

The surfaces of the lower part of the oral plates are only a little sunken below the level of those of the basals, the radials, the costals and the axillaries with which their edges are in contact. The texture of all the plates is coarse but that of the orals coarser than any; the surface of the proximal part of each is deeply pitted and some of the pits carry pale yellow spherical bodies which must be the glandular sacs known from the posterior end of the embryo (Mortensen, 1920, p. 52, pl. xxiv, fig. 2). In preparations of embryos slightly older than that figured by Mortensen I have seen the sacs lying close

against the oral plates, and although they were not partly enclosed in their stereom it seemed that they might easily become so as growth went on.

Such sacs occur in all the older larvae to be described in this series. They are sometimes abundant and may occur in superficial pits in the surfaces of the basals, the radials, the costals and the axillaries as well as in the orals.

2. Length of crown 1·6 mm. (Fig. 23 *b*); length of column 6·7 mm.

The stem is of 36 columnals and similar to that of the previous stage. A larger number, about 12, of the distal columnals are shorter than broad and they are slightly wider than the other columnals; they become progressively wider as they approach the terminal plate. The terminal plate is simple, thick and slightly irregular.

The radials are widely separated from one another. The rays are bigger than in No. 1; the arms are of five brachials and extend well beyond the orals. The proximal edges of each oral rest against the basal, the radials and the costals of its interradius. Opposite the axillaries it narrows into a strap-like projection with slightly out-turned edges which curves in over the disk. The projections of the five orals do not enter into close contact. The orals are of very coarse texture. The surface of the proximal portion of each is pitted and some of the pits carry glandular sacs of diverse sizes. One or two of the radials and costals carry similar sacs. There is a single sacculus on one of the arms which has exactly the same appearance as the glandular sacs.

The radianal plate occupies an unusual position: its centre lies to the left, not right, of the mid-line of the posterior interradius and it lies close against, and causes asymmetry in, the left, not the right, posterior radial. The corner of the right posterior radial is just in contact with it. The distal half of the radianal rests upon the posterior oral.

3. Length of crown 1·9 mm. (Fig. 23 *c*); length of column 8 mm.

The stem is of 39 columnals and a terminal plate which is large and lobed but does not appear to be composed of more than one element. The column is generally similar to that of the younger stages but there are slight differences: the discoidal proximal segments, of which there are nine, are even shorter, whereas the majority of the middle segments are slightly longer, being a little longer than broad.

The radials are widely separated. Three of the rays are stronger than in the previous stage, the arms of about six brachials. The anterior and the left anterior rays are small, bearing only the first brachials; they are shorter than the orals. The lateral edges of the orals become free opposite the costals, beyond which the plates rapidly narrow to inwardly curved strap-like ends. Some of the orals are in contact with the basal plates of their interradius, others separated from it by a very narrow strip of perisome. A wide area of perisome separates the posterior oral from its basal. On it lies the radianal plate with its distal end overlapping the oral.

The centre of the radianal plate lies to the right of the mid-line of the posterior interradius but it is not in contact with the right posterior radial, which, nevertheless, is strongly asymmetrical. The axis of its ray lies far to the right of the suture between the posterior and right posterior basals. The proximal left-hand corner of the radianal touches the left posterior radial.

Strong side-plates are developed along the ambulacra of the arms.

4. Length of crown 2·1 mm.; length of column 7 mm.

The stem is of 41 columnals and a thick lobed terminal plate which appears to be simple; it is generally similar to that of the previous stage. There are ten very short

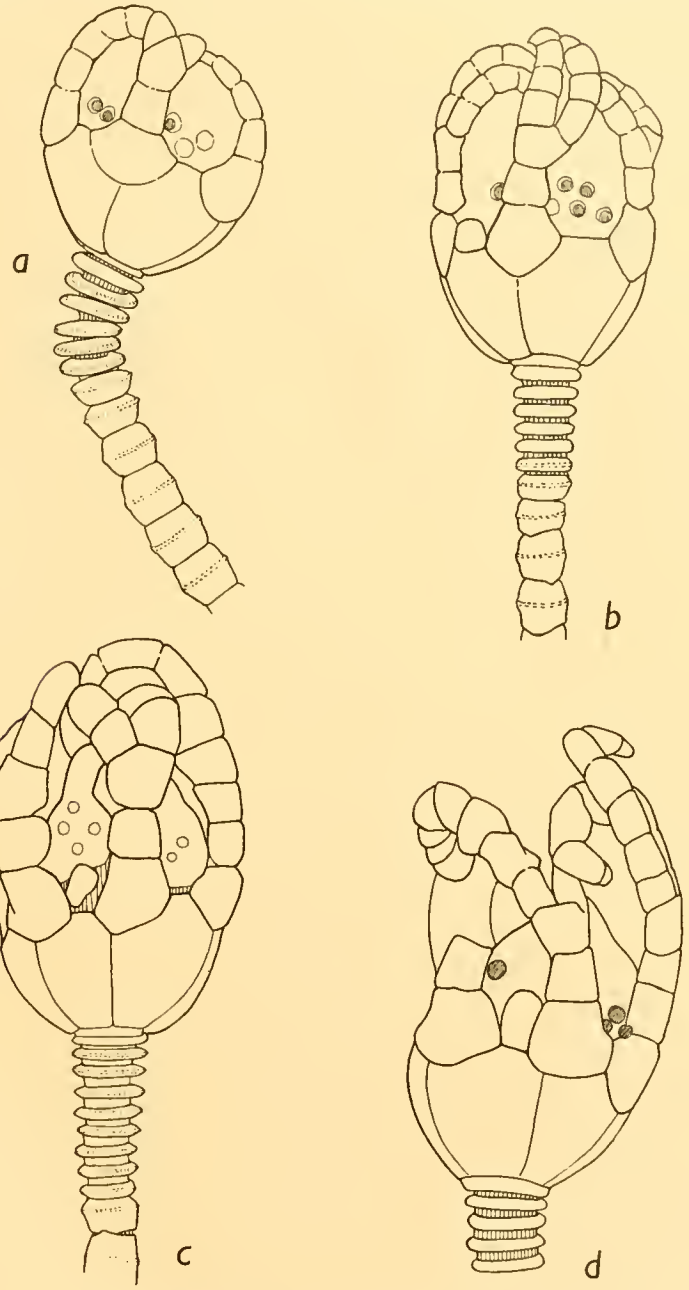

Fig. 23. Pentacrinoid larvae of *Notocrinus virilis*. *a*, crown and proximal columnals of No. 1. *b*, same of No. 2. *c*, same of No. 3. *d*, same of No. 6. All ×27.

discoidal proximal columnals, those nearer the basal cup wider than the others. Most of the remaining columnals in the first half of the stem are nearly as long as broad but those of the distal half become progressively and gradually shorter towards the terminal plate.

The basal cup has strongly rounded sides. The radials are widely separated from one another. The arms of only two rays are complete; they are of five brachials. The radianal plate is in broad contact with the right posterior radial which it makes asymmetrical; it is in contact with the proximal half of the left posterior radial. It overrides the oral; no naked perisome is to be seen in this interradius. In other interradii the orals may be separated from the basals by a narrow strip of perisome.

The edges of the orals become free opposite the costals, beyond which the plates narrow as they turn in over the disk.

There are side-plates along the ambulacra of the arms.

5. Length of crown 1·9 mm.; length of column 9 mm.

The column is generally similar to that of previous stages. There are 43 columnals and a round terminal plate which appears to be simple. The first seven columnals are short and discoidal and become progressively more narrow from the first to the seventh. The tenth to about the twentieth are about as long as broad, the remainder broader than long.

The crown is smaller than in the previous stage and the basal cup is not so strongly rounded. Some of the radials are widely separated, others less so, and one pair, the right posterior and the right anterior, are in contact. The centre of the radianal plate is to the right of the mid-line of the posterior interradius; it is in broad contact with the right posterior radial which it makes asymmetrical. It is in less complete contact with the left posterior radial.

None of the orals is separated from the more proximal ossicles of its interradius by naked perisome. They are shaped as in the previous stage.

The arms are of about six brachials.

6. Length of crown 2 mm. (Fig. 23 *d*); length of column 9 mm.

The stem is similar to that of the previous stage. There are 42 columnals and a large, rather thin and slightly lobed, terminal plate which does appear to be made up of more than one element.

The sides of the basal cup are strongly rounded; its height is about half its distal diameter. The radials, except for the right and left posterior, are nearly or quite in lateral contact. By their lateral growth they have pushed the orals out of contact with the basals; where they are not quite in contact small naked areas of perisome separate them from one another. The right and left posterior radials are separated by the radianal plate which lies in broad contact with the former and in contact with the proximal third of the latter. It causes the right posterior radial to be asymmetrical and the longitudinal axis of its ray lies far to the right of the suture between the basals on which it rests. The radianal plate rests on the oral.

The lateral edges of the orals become free opposite the end of the costals; beyond that point they narrow and bend in over the disk. They are of the usual coarse texture, deeply pitted proximally with some of the pits carrying glandular sacs.

The left posterior ray is broken off at the costal. The arms of the other rays are of about eight brachials. There are a few small sacculi of the same appearance as the glandular sacs. The arm ambulacra are lined by large side-plates.

7. Length of crown 2·2 mm.; length of column 10 mm.

There are 45 columnals and a large faintly lobate terminal plate which is single. The first eight columnals are short and discoidal, of roughly equal length but gradually decreasing in diameter from the first to the sixth. The remainder of the column resembles those of previously described stages.

The radials are widely separated. The radianal is in contact with the right posterior but not the left posterior radial. Its proximal half lies on the naked perisome which separates the posterior basal from the oral; its distal half lies on the oral. The orals of the other interradii are separated from their basals by very narrow strips of perisome. They are shaped as in previous stages and are richly supplied with glandular sacs: there are as many as eight on one plate.

Three of the rays have arms of eight brachials. The costals and axillaries of the right posterior ray are smaller than those of others and its arms are of no more than three or four brachials; the right anterior ray has equally short arms but they appear to be broken, not undeveloped.

The right posterior radial is made asymmetrical by the radianal, and the whole of the ray, but for a corner of the radial itself, lies to the right of the line of the suture between the basals upon which it rests.

There are a few irregularly placed sacculi, of a similar appearance to the glandular sacs, along the arms, and strong side-plates along the ambulacra.

8. Length of crown 2·4 mm.; the column is incomplete.

Only 13 columnals remain. The first five are short and discoidal but longer than those of previous stages. The sixth is about half as long as wide, the remainder about as long as wide; they are encircled by a narrow projecting girdle which is in the proximal half of the sixth columnal but median in all the others.

The crown is very similar to that of the previous stage except that: the radianal plate lies entirely to the right of the mid-line of the posterior interradius; all the arms are of equal size, of about six brachials; the basals and one of the radials—as well as the orals—carry many glandular sacs in pits.

9. Length of crown 3 mm. (Fig. 24 *a*); the column is incomplete.

Only 29 columnals remain. The first is short and closely associated with the basal cup. The second to fifth are short and discoidal. The sixth is discoidal but longer. The seventh is about half as long as broad. The eighth to near the twentieth are as long as broad, the remainder slightly broader than long.

The crown is similar to, though larger than, those of the two previous stages. Each of the basal plates is swollen so that the sutures between them run along depressions. The distal half of the radianal plate lies, not on the oral, but on a lobe of tissue at a higher level than, and overlapping the proximal edge of, the oral plate. I assume it to be the beginnings of the anal tube.

As in the previous stage from the same station (St. 175) there are glandular sacs on other ossicles than the orals.

The arms are of seven or more brachials.

There are five specimens of roughly the same age as those described as numbers 3 to 9 above, though for the most part they are slightly larger. They do not call for individual description. The terminal plate appears to be single in all, though it is difficult

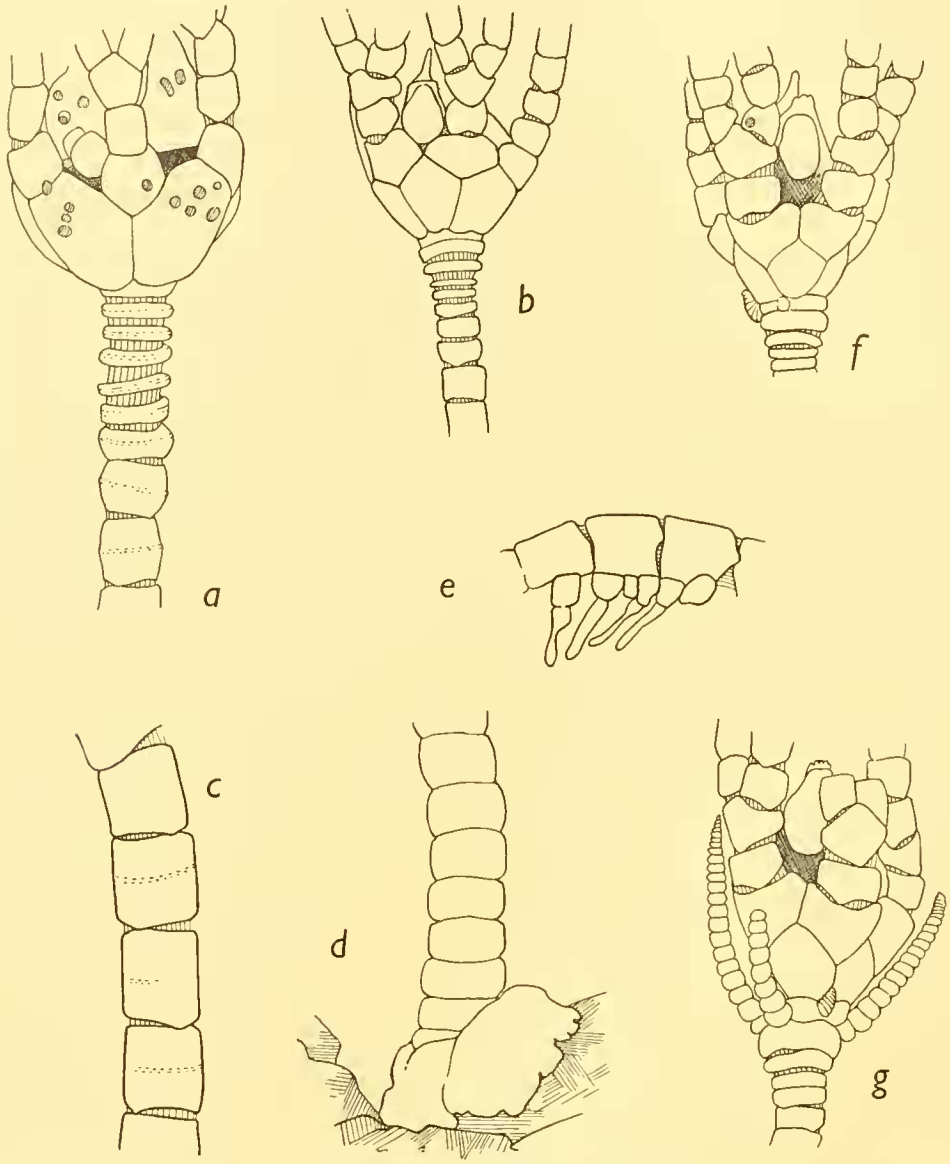

Fig. 24. Pentacrinoid larvae of *Notocrinus virilis*. *a*, proximal portions of crown and column of No. 9, ×18. *b*, same of No. 15, ×14. *c*, tenth to thirteenth columnals of No. 15, ×26. *d*, last columnals and terminal plate of No. 15, ×26. *e*, a few brachials of No. 15 showing size of side- and cover-plates, ×26. *f*, proximal portions of crown and column of No. 18, ×14. *g*, same of No. 20, ×14.

to be certain that it is. The longest columnals of the stem of one or two are longer than any yet described. In some the orals are in contact with the basals, in others separated from them by narrow strips of perisome. Most of the radials are nearly in contact with one another in all. In none of the specimens does the anal tube show behind the radianal plate as in number 9.

The measurements of the specimens and the number of columnals in the stem and of brachials in the arms are as follows:

10. Crown 2·9 mm.; stem: 39 columnals, 9·6 mm.; arms of about 8 brachials.
11. Crown 2·5 mm.; stem: 43 columnals, 10 mm.; arms of about 8 brachials.
12. Crown 2·5 mm.; stem: 34 columnals, 11 mm.; arms of 8–10 brachials.
13. Crown 2·9 mm.; stem: 39 columnals, 10 mm.; arms of 8–10 brachials.
14. Crown 2·7 mm.; stem: 44 columnals, 10·4 mm.; arms of 10 brachials.

The next specimen is considerably older than any of the preceding:

15. Length of crown 4 mm. (Fig. 24 *b–e*); length of column 10·5 mm.

The stem is of 39 columnals and a thick slightly lobed terminal plate. The first columnal is incomplete so that the second, although for the most part in touch with it, is in touch with the basal cup too; it is not shown in the figure, in which the most proximal columnal is the second. The second to seventh columnals are short. The third is narrower than the second. The fourth to seventh are of the same diameter as one another, narrower than the third. There is a gradual increase in length from the fourth to the seventh columnal, the seventh being half as long as wide. The tenth is as long as broad; the eleventh to the fourteenth are slightly longer than broad (Fig. 24 *c*). The remaining columnals gradually decrease in length: the most distal are wider than long (Fig. 24 *d*). Only faint traces of the encircling girdles of the columnals remain. The articulating surfaces of the two ends of each columnal, or at least of the longer columnals, are broadly oval with the longer axis of one end at right angles to that of the other; this is only just perceptible.

The sides of the basi-radial cup are nearly straight; its height is about half its distal diameter. The basals are considerably longer than the radials. The radials, except for the posterior pair, are in broad contact with one another; beyond the parts of the lateral edges which are in contact they narrow a little. The middle of the wide distal edge is indented for the articulation of the costal; it occupies about a half of the distal edge of the radial. The lateral edges of the posterior radials meet proximally, but are cut away beyond to allow room for the radianal plate: it follows that both the radials are asymmetrical, and they are equally so.

The radianal plate is diamond-shaped and longer than broad. Its proximal half is in contact with the radials and costals; the distal half lies on the anal tube which is much wider than it and has gently converging lateral edges and a straight distal margin. It is very near the edge of the disk: the level of the radianal plate is only a little below that of the radials.

The narrow end of the posterior oral may be seen beyond the anal tube, far below its level, curving over the disk (Fig. 24 *b*). The other oral plates bend sharply in over the disk and rapidly narrow in their distal halves; they are separated from the radials by a narrow naked strip of perisome. The surface of the wider proximal part of each oral is pitted and some of the pits carry glandular sacs.

The arms are of 15–16 brachials with large side- and long cover-plates (Fig. 24 *e*) and irregularly arranged sacculi. On the distal portions of some arms there is one sacculus

to each segment. The rudiments of pinnules arise from the eleventh and succeeding brachials.

16. Length of crown 3·5 mm.; length of column 11 mm.

The column is similar to that of No. 15. There are 40 columnals and a damaged terminal plate.

The crown is similar to that of No. 15. The radials are longer, being only slightly shorter than the basals; the dorsal surface of each is strongly rounded. The posterior radials are in contact for more than half their length, beyond which they are cut away to accommodate the proximal part of the radianal. The other radials are in complete lateral contact. The radianal plate rests on the anal tube, completely covering it. There is no naked perisome in the posterior interradius, and the orals of other interradii are either in contact with the radials or separated from them by an extremely narrow strip of perisome.

17. Length of crown 5 mm.; length of column 9 mm.

There are 37 columnals and a large lobed terminal plate. The first columnal is short and it bears the rudiment of a cirrus in each of the radii except the right posterior. The remainder of the column resembles that of earlier stages; each segment is encircled by a faint but distinct median girdle.

The crown is generally similar to, though smaller than, those of Nos. 15 and 16. The radials, including the posterior pair, are in complete lateral contact. The dorsal surfaces of the ossicles of the division series and of the brachials are strongly rounded. The arms are of seventeen brachials of which the tenth and succeeding carry pinnules.

18. Length of crown 5 mm. (Fig. 24*f*).

The stem is of 40 columnals and a large lobed terminal plate. The first columnal is short and it bears the rudiment of a cirrus in the anterior, the left anterior, and the left posterior radii. The second columnal is as wide as the first and longer. The third to fifth are narrower and discoidal. The remainder of the column resembles those of younger stages.

The basal plates are slightly longer than the radials. The radials are in complete lateral contact. The radianal plate is far out of contact with the posterior radials, being separated from them by naked perisome; its proximal edge is opposite the distal end of the costals. It is an oval plate resting on the anal tube which extends some way beyond it—to opposite the end of the first brachial. The posterior oral plate is clearly visible behind the anal tube. The proximal borders of the orals of other interradii are opposite a point half way along the axillaries so that they are widely separated from the radials by an area of perisome; a number of plates are present in it. The oral plates are of coarse texture with their proximal surfaces pitted as in younger specimens. The distal end of each narrows to a bar which bends in over the disk.

The rays resemble those of No. 17. A few large sacculi occur at irregular intervals along the arms.

19. Length of crown 8 mm.; length of column 13 mm.

There are 41 columnals and a large terminal plate which is damaged. The first

columnal is much bigger than in any of the younger stages: it is more than one-third as long as broad. Long cirri of about 15 segments, which reach the ends of the radials, arise from it in all radii but the posterior in which there is only the beginning of a cirrus, about one-quarter the length of the basal plates. The second segment is as wide as the first but it is short. The third and fourth are narrower and they are discoidal. The column is otherwise similar to those of younger stages.

The basals are longer in proportion to the radials than in No. 18. In other ways the crown resembles that of No. 18. The only complete arm is of 22 brachials with pinnules arising from the eleventh and succeeding brachials. There are very strong side- and cover-plates along the arm and pinnule ambulacra and a few irregularly arranged sacculi along the arms.

20. Length of crown 9 mm. (Fig. 24 *g*); length of column 13 mm.

The stem is of 38 columnals and a large lobed terminal plate. The first columnal is not so big as in No. 19 but its cirri, of which there is a single radial whorl, are longer though they are of unequal lengths. The anterior and left anterior are of about 22 segments and reach to the first brachial; the right anterior is somewhat shorter; the left posterior is broken; the right posterior is a rudiment one-third as long as the basal plate. The cirri arise from sockets which incise the columnal for its entire length. The second columnal is as wide as, and longer than, the first. There are indentations in both its proximal and distal margins opposite the larger cirri of the first columnal. The remainder of the column resembles that of slightly younger specimens. The columnals of the middle part of the stem are each encircled by a narrow median girdle.

The crown resembles those of Nos. 18 and 19. A glandular sac occurs in a pit in the surface of one of the axillaries as well as in the orals.

The arms are of 19 brachials. Pinnules of up to nine or ten segments occur on the ninth and succeeding brachials; the lower pinnules are not yet beginning to form. There are strong side- and cover-plates, of the same nature as those of the adult *Notocrinus virilis* along the ambulacra. There are a few irregularly arranged sacculi along the arms.

ANTARCTIC COMATULIDS PREVIOUSLY IN THE BRITISH MUSEUM COLLECTION

From the National Antarctic ('Discovery') Expedition, 1901–4

Promachocrinus kerguelensis

Off Coulman Island	100 fathoms	4 specimens
Winter Quarters		1 ,,
,,	No. 10 Hole	4 ,,
East end of Barrier	100 fathoms	1 ,,
Mount Erebus and Terror	500 ,,	1 ,,

Anthometra adriani

Winter Quarters	124 fathoms	2 ,,
,,	130 ,,	2 ,,
,,	No. 10 Hole	3 ,,
Mount Erebus and Terror	500 fathoms	6 ,,

Florometra mawsoni

Winter Quarters	178 fathoms	1 ,,
Mount Erebus and Terror		2 ,,

From the British Antarctic ('Terra Nova') Expedition, 1910

The localities are all in the Ross Sea. Their positions are given in Harmer and Lillie, 1914, List of Collecting Stations, Natural History Report, Vol. II, No. 1 of the Expedition's series of reports.

Promachocrinus kerguelensis

St. 194	2 specimens	St. 340	4 specimens
St. 294	3 ,,	St. 341	1 ,,
St. 314	1 ,,	St. 349	9 ,,
St. 316	1 ,,	St. 355	6 ,,
St. 317	2 ,,	St. 356	1 ,,
St. 339	5 ,,		

Anthometra adriani

St. 194	1 specimen	St. 316	5 specimens
St. 225	1 ,,	Off Barne Glacier	1 ,,
St. 314	3 ,,		

Florometra mawsoni

St. 314	4 specimens	St. 316	1 specimen

Notocrinus virilis

St. 295	2 specimens	St. 314	fragments
St. 341	1 ,,		

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