

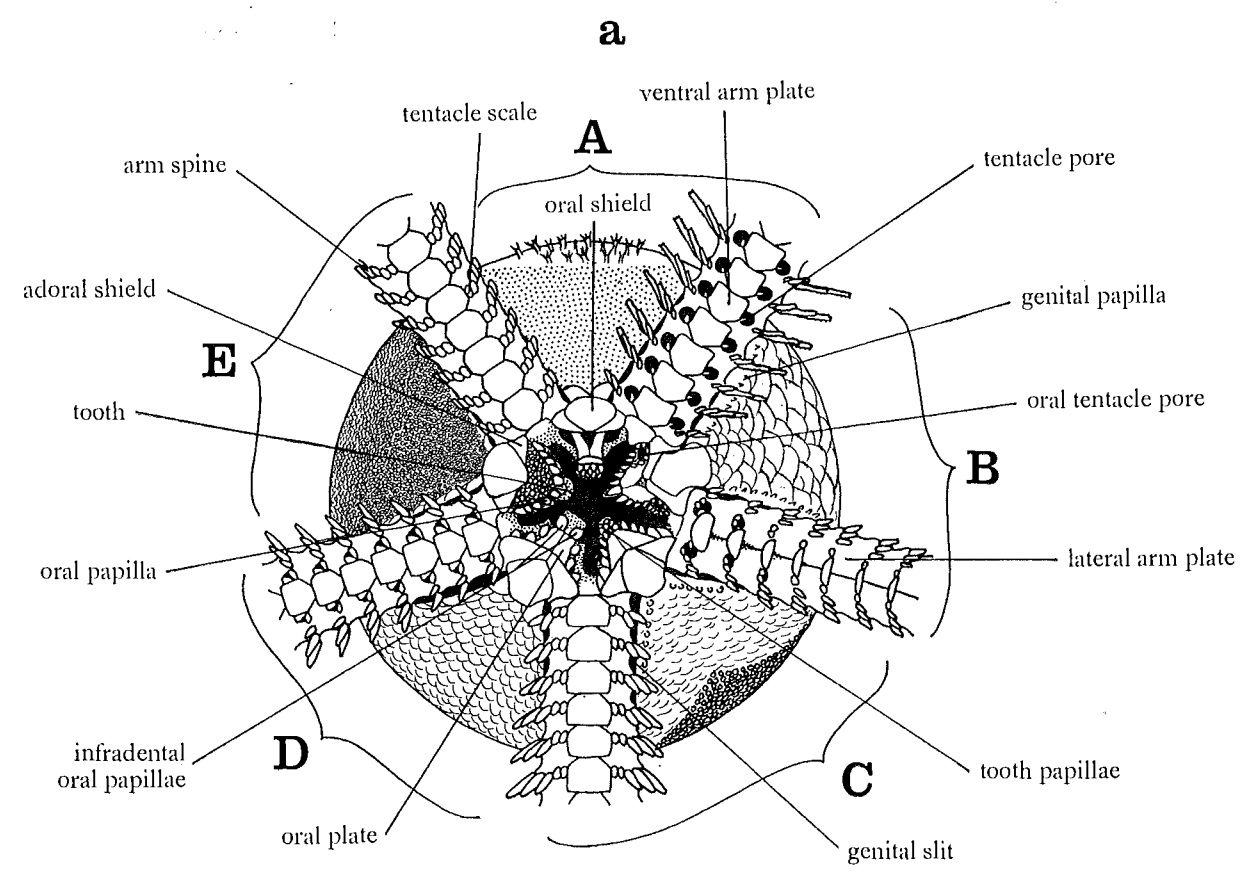
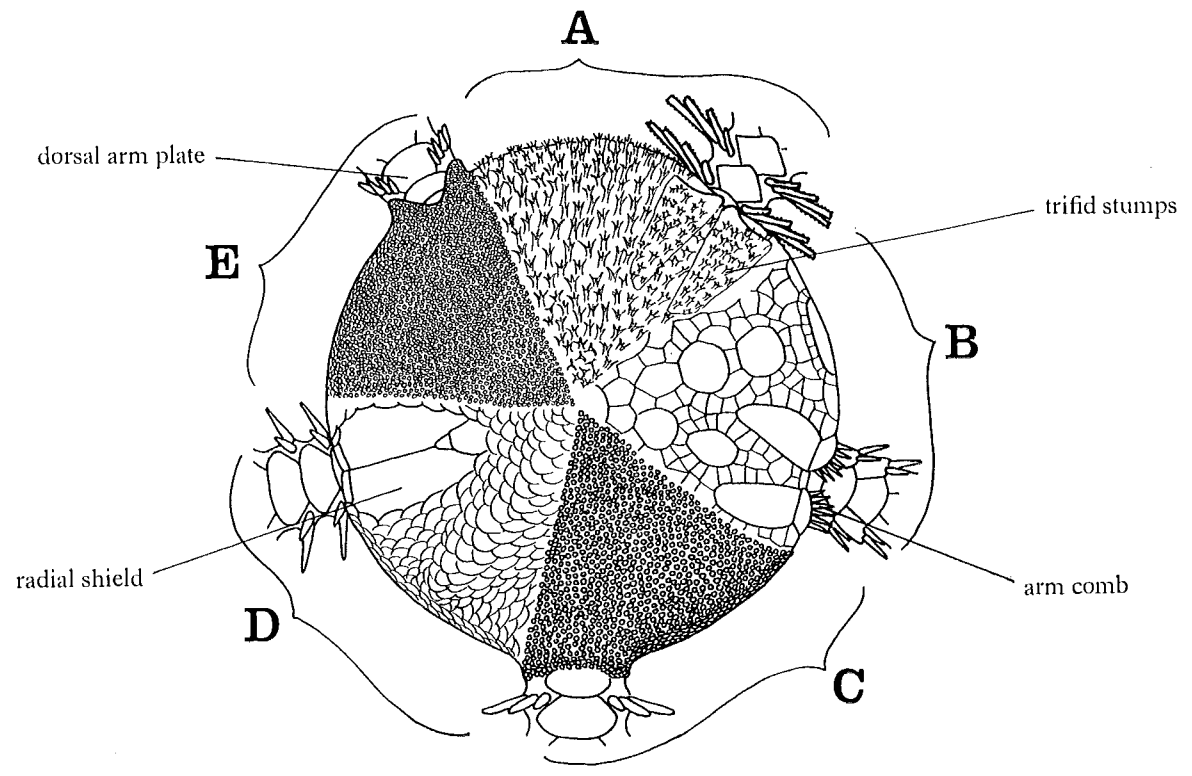
# OPHIUROIDEA

## INTRODUCTION

General accounts of the class are given in A. M. Clark (603 in reference list), Nichols (645) and Hyman (626). An invaluable key to the genera is that of Fell (611), while for a complete list of species (which can be supplemented by the Zoological Record since 1915), H. L. Clark's Catalogue of Ophiurans (161) provides a useful background. H. L. Clark in his Echinoderms of Torres Strait (169) has also provided monographic treatment of several relevant genera, notably most of the Ophiocomidae, while his Echinoderms of Australia (180) deals extensively with many Ophiotrichids.

In conjunction with the writing of this section on ophiuroids, preliminary papers were also written (A.M.C. 1967b, 1968 and 1969) dealing primarily with the families Ophiotrichidae and Amphiuridae. Some of the notes and synonymies given in those papers are duplicated here to some extent, particularly with regard to the Amphiuridae, the study of which was ready for the press simultaneously with this monograph.

The terms used in describing ophiuroids should all be made plain in the accompanying introductory figure.



DISTRIBUTION TABLE  
FOR  
OPHIUROIDEA

FIG. 20. Introductory figures of ophiuroids: a. dorsal and b. ventral composites of examples of five families: A Ophiotrichid, B Ophiurid, C Ophiocomid, D Amphiurid and E Ophiodermatid.









## DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
<i>purpurea</i> v. Martens	*	370	329 (*)	148 * 566	(181) *	..
<i>scorpio</i> (Müller & Troschel)	..	..	..	464	..	..
<i>scotiosa</i> Murakami	..	..	..	..	..	..
<i>spinosissima</i> Koehler	..	..	..	..	..	..
<i>Ophiothrix (Keystonea) hymenacantha</i> H. L. Clark <sup>13</sup>	..	..	..	..	..	..
<i>irregularis</i> (H. L. Clark)	..	..	..	..	..	..
<i>martensi</i> Lyman	..	..	..	..	..	..
<i>neroidina</i> (Lamarck) <b>344</b>	..	310 329	415	..	..	..
<i>propinqua</i> Lyman	34 * 51	161 * 370	19 * 317	(181) * 604	327 *	..
<i>pulchra</i> (H. L. Clark)	..	..	..	..	..	..
<i>smaragdina</i> Studer	..	..	..	..	..	..
<i>vicina</i> Koehler	..	..	..	..	..	..
<i>Ophiothrix (Placophiothrix) eurycolpodes</i> H. L. Clark	..	..	..	..	..	..
<i>fumaria</i> Müller & Troschel <sup>14</sup>	..	..	..	..	..	..
<i>hybrida</i> H. L. Clark	..	..	..	..	..	..
<i>lineocaerulea</i> H. L. Clark	..	..	..	..	..	..
<i>melanosticta</i> Grube	..	..	..	..	..	..
<i>striolata</i> Grube	..	..	..	..	..	..
<i>tenera</i> Brock	..	..	..	..	..	..
<i>virgata</i> Lyman	..	..	..	..	..	..
<i>Ophiothrix (Theophrix) pusilla</i> Lyman	..	..	..	..	..	..
<b>OPHIOCOMIDAE</b>						
<i>Ophiarthrum elegans</i> Peters	34 *	..	385 * 502	..	..	..
<i>lymani</i> de Loriol	..	370 *	..	..	..	..
<i>pictum</i> Müller & Troschel	..	..	..	..	..	..
<i>Ophiocoma anaglyptica</i> Ely	..	..	..	..	..	..
<i>brevipes</i> Peters	34 * 309	161 * 370	385 * 502	..	..	..
<i>dentata</i> Müller & Troschel <sup>15</sup> <b>464</b>	543 *	169 *	169 * (181)	..	..	..
<i>erinaceus</i> Müller & Troschel	51 * 161	370 * 432	161 * 442	148 * 464	329 *	..
<i>latilanza</i> Murakami	..	..	..	..	..	..
<i>pica</i> Müller & Troschel <b>464</b>	51 *	370 * 432	19 * 329	141 * 148	394	..
<i>pusilla</i> (Brock)	*	..	..	141 * 148	..	..
<i>schoenleini</i> Müller & Troschel <b>464</b>	..	..	..	..	..	..
<i>scolopendrina</i> (Lamarck)	(51) * 309	344 * 370	385 * 415	141 * 560	161 * 329	451 *
<i>valenciae</i> Müller & Troschel <sup>16</sup>	(51) *	370	502 * 565	141 * 464	..	451
<i>wendti</i> : sensu Koehler, 1907 (pt.) <sup>17</sup>	309 329	..	169 * 329	..	..	..
<i>Ophiocomella sexradia</i> (Duncan)	*	*	19	153 *	..	..
<i>Ophiomastix annulosa</i> (Lamarck) <b>344</b>	..	..	..	..	..	..
<i>asperula</i> Lütken	..	..	..	..	..	..
<i>bispinosa</i> H. L. Clark	(*)	..	19	66 *	..	..
<i>caryophyllata</i> Lütken <sup>18</sup>	*	..	*	..	..	..
<i>corallicola</i> H. L. Clark	..	..	..	..	..	..
<i>elegans</i> Brock	..	..	..	..	..	..
<i>flaccida</i> Lyman	..	..	..	..	..	..
<i>janualis</i> Lyman <b>637</b>	..	..	..	..	..	..
<i>luetkeni</i> Pfeffer	..	..	..	..	..	..
<i>mixta</i> Lütken	..	..	..	..	..	..
<i>palaoensis</i> Murakami	..	..	..	..	..	..
<i>sexradiata</i> A. H. Clark	..	..	..	..	..	..
<i>variabilis</i> Koehler	..	..	..	..	..	..

## FOR OPHIUROIDEA

	W. India & Pakistan	Maldiv area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..	..	147 * (181)	*	..	197 * 414	..	161 337	(*)	(*)	..
..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	471	..
..	..	..	..	..	326	..	337 341	..	..	..
..	..	..	..	..	..	178 180	..	..	..	..
..	..	..	..	..	..	180 233	..	..	..	..
..	..	..	..	223 402	62 341	34 * 169	337 396	..	399 *	..
..	..	..	160 * 196	223 322	197 * 416	169 *	337 399	419 471	340 526	..
..	51 * 147	..	..	322	161 326	161 180	161 * 337	192 471	340 * 393	..
..	..	..	..	..	..	180	..	..	..	..
..	..	..	..	..	..	180 * (549)	..	..	..	..
..	..	..	..	..	341	..	..	..	..	..
..	..	..	..	..	..	..	166	..	..	..
..	..	..	..	..	..	..	399 *	329 464?	..	..
..	..	..	..	..	..	..	341	(337)	161	..
..	..	..	..	..	..	180 *	..	..	..	..
..	..	..	..	..	161 * 341	161 * 180	(337 341)	279 389	..	..
..	..	..	..	..	326 *	34 * 180	161 * (399)	279 * 389	..	..
..	..	..	62 325	..	..	..	..	..	..	..
..	..	..	..	..	62 325	169 233	*	..	161 393	..
..	..	..	..	..	326 * 341	..	337 * 396	*	..	..
<b>OPHIOCOMIDAE</b>										
<i>Ophiarthrum elegans</i> Peters	34 *	..	385 * 502	..	..	..	161 337	419 * 471	161 * 340	..
<i>lymani</i> de Loriol	..	370 *	..	..	..	..	..	..	..	..
<i>pictum</i> Müller & Troschel	..	..	..	..	..	..	216 341	..	161	..
<i>Ophiocoma anaglyptica</i> Ely	..	..	..	..	..	..	..	..	137 230	..
<i>brevipes</i> Peters	34 * 309	161 * 370	385 * 502	..	..	..	161 341	419 471	136 * 161	131 * 161
<i>dentata</i> Müller & Troschel <sup>15</sup> <b>464</b>	543 *	169 *	169 * (181)	..	..	..	*	161	161 * 393	393 * 668
<i>erinaceus</i> Müller & Troschel	51 * 161	370 * 432	161 * 442	148 * 464	329 *	..	161 * 341	192 * 471	136 * 340	131 * 399
<i>latilanza</i> Murakami	..	..	..	..	..	..	..	471	471	..
<i>pica</i> Müller & Troschel <b>464</b>	51 *	370 * 432	19 * 329	141 * 148	394	..	(337)	471 *	136 161	131 * 161
<i>pusilla</i> (Brock)	*	..	..	141 * 148	..	..	..	..	..	..
<i>schoenleini</i> Müller & Troschel <b>464</b>	..	..	..	..	..	..	..	..	..	..
<i>scolopendrina</i> (Lamarck)	(51) * 309	344 * 370	385 * 415	141 * 560	161 * 329	451 *	..	192	46 * 154	..
<i>valenciae</i> Müller & Troschel <sup>16</sup>	(51) *	370	502 * 565	141 * 464	..	451	..	419 * 471	340 * 526	131 229
<i>wendti</i> : sensu Koehler, 1907 (pt.) <sup>17</sup>	309 329	..	169 * 329	..	..	..	..	..	329?	..
<i>Ophiocomella sexradia</i> (Duncan)	*	*	19	153 *	..	..	341	192 556	127 * 340	131 229
<i>Ophiomastix annulosa</i> (Lamarck) <b>344</b>	..	..	..	..	..	..	161 * 337	419 471	329 * 471	..
<i>asperula</i> Lütken	..	..	..	..	..	..	341	471	161 * 389	..
<i>bispinosa</i> H. L. Clark	(*)	..	19	66 *	..	..	..	*	164 * 471	..
<i>caryophyllata</i> Lütken <sup>18</sup>	*	..	*	..	..	..	(179) * 233	..	389 * 471	..
<i>corallicola</i> H. L. Clark	..	..	..	..	..	..	197 * 341	169 233	..	..
<i>elegans</i> Brock	..	..	..	..	..	..	..	161 233	..	..
<i>flaccida</i> Lyman	..	..	..	..	..	..	62	..	..	..
<i>janualis</i> Lyman <b>637</b>	..	..	..	..	..	..	326 * 341	161 233	337 * 396	..
<i>luetkeni</i> Pfeffer	..	..	..	..	..	..	..	169 233	..	..
<i>mixta</i> Lütken	..	..	..	..	..	..	129 508	..	169 * (337)	..
<i>palaoensis</i> Murakami	..	..	..	..	..	..	62 (326)	169 232	..	419 * 471
<i>sexradiata</i> A. H. Clark	..	..	..	..	..	..	..	..	136 * 389	..
<i>variabilis</i> Koehler	..	..	..	..	..	..	..	..	471	..
..	..	..	..	..	..	..	326 (341)	..	341	..

## DISTRIBUTION TABLE

	Is. of W. Indian Ocean *	Mascarene Is. *	E. Africa & Madagascar 325 * 502	Red Sea	S.E. Arabia	Persian Gulf
<i>†venosa</i> Peters <sup>18</sup>	..	..	..	..	..	..
<i>Ophiopsila pantherina</i> Koehler	..	..	..	66 *	..	..
<i>paucispina</i> Koehler	..	..	329	..	..	..
<b>OPHIONEREIDAE</b>						
<i>Ophionereis tamoyensis</i> A. M. Clark	..	..	..	..	..	..
<i>degeneri</i> (A. H. Clark)	..	..	..	..	..	..
<i>dubia</i> (Müller & Troschel)	..	161 370	(171) 565	66 * 464	..	130 * 451
<i>fusca</i> Brock	..	..	..	..	..	..
<i>hexactis</i> H. L. Clark	..	..	..	..	..	..
<i>lineata</i> H. L. Clark	..	..	..	..	..	..
<i>porrecta</i> Lyman 636	143 *	143 *	19 * 171	148 *	..	..
<i>semoni</i> (Döderlein)	..	..	..	..	..	..
<i>thryptica</i> Murakami	..	..	..	..	..	..
<i>tigris</i> H. L. Clark	..	..	..	..	..	..
<i>vivipara</i> Mortensen	..	444	19	..	..	..
<b>OPHIODERMATIDAE</b>						
<i>Cryptopelta callista</i> H. L. Clark	..	..	..	..	..	..
<i>granulifera</i> H. L. Clark	..	156 *	..	..	..	..
<i>longibrachialis</i> Koehler	..	..	..	..	..	..
<i>Distichophis clarki</i> Ely	..	..	..	..	..	..
<i>Ophiarachna affinis</i> Lütken	..	..	329?	..	..	..
<i>delicata</i> (H. L. Clark) <sup>19</sup>	..	..	..	..	..	..
<i>incrassata</i> (Lamarck) 344	156	..	156 * 329	..	..	..
<i>mauritiensis</i> de Loriol	..	370	*	..	..	..
<i>robillardii</i> de Loriol	..	370	..	..	..	..
<i>Ophiarachnella gorgonia</i> (Müller & Troschel) 464	(51)	161 * 370	156 * 502	..	..	..
<i>infernalis</i> (Müller & Troschel) <sup>20</sup> 464	..	..	156?	..	..	..
<i>macracantha</i> H. L. Clark	..	..	..	..	..	..
<i>parvispina</i> H. L. Clark	..	..	..	..	..	..
<i>septemspinosa</i> (Müller & Troschel)	*	161 *	156 * 396	..	..	..
<i>similis</i> (Koehler)	..	..	..	..	..	..
<i>snelli</i> (A. H. Clark)	..	..	..	..	..	..
<i>†sphenisci</i> (Bell) <sup>21</sup>	..	..	..	..	..	..
<i>stabilis</i> (Koehler)	..	..	..	..	..	..
<i>Ophiochaeta boschmai</i> A. H. Clark	..	..	..	..	..	..
<i>hirsuta</i> Lütken <sup>22</sup>	*	..	..	..	..	..
<i>Ophiochasma stellatum</i> (Ljungman)	..	..	..	..	..	..
<i>Ophioclastus hataii</i> Murakami	..	..	..	..	..	..
<i>Ophioconis cincta</i> Brock	..	..	..	..	..	..
<i>cupida</i> Koehler	..	..	..	(181 *)	(181 *)	..
<i>permixta</i> Koehler	..	..	146 *	..	..	..
<i>Ophioderma propinquum</i> Koehler	..	..	..	..	..	..
<i>tonganum</i> Lütken	..	..	..	..	..	..
<i>Ophiodyscrita acosmeta</i> H. L. Clark	..	..	..	..	..	..
<i>pacifica</i> (Murakami)	..	..	..	..	..	..

## OPHIUROIDEA

## FOR OPHIUROIDEA

W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is	China & S. Japan	South Pacific Is.	Hawaiian Is.
..	..	..	(402)	..	..	337	..	..	..
..	..	..	322	(341)	..	..	..	..	..
..	..	..	..	..	..	..	143 *	..	..
..	..	..	..	..	..	..	..	..	131
522 *	51 182	143 *	143 *	341 * 399	34 * 143	(161) 337	419 * 472	..	..
..	..	..	..	62 325	143	(341)	*	143 *	..
..	..	..	..	..	180	..	..	..	..
..	..	..	..	..	182	..	..	..	..
..	(48) * (181)	322	322	62 341	169 233	(341)	*	161 340	131 * 225
..	..	..	..	326 *	143 * 197	(337)	..	*	..
..	..	..	..	..	..	..	..	471	..
..	..	..	..	..	180 233	..	..	..	..
..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	180	..	..	..	..
..	..	..	..	..	179 *	..	..	..	..
..	..	..	..	326 (341)	..	(341)	..	..	..
..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	131 229
..	..	..	..	(341) 371	..	(341)	..	161 * 389	..
..	..	..	..	..	(179)	..	..	*	..
..	..	156 306	38 *	161 341	416 * 179	216 341	419 471	161 471	..
..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..
..	..	196 * 306	40 * 402	161 * 326	182 * 231	337 396	419 470	397 * 471	..
..	..	..	*	326 * 416	180 * 404	161 341	445 *	161 471	..
..	..	..	..	..	..	..	..	156 *	..
..	..	..	..	..	..	..	..	..	131 174
..	*	196	..	62 464	180 232	216 341	471 *	..	..
..	..	..	..	326 333	34 * 180	(341)	..	..	..
..	..	..	..	138	..	..	..	..	..
..	..	(322?)	(322?)	326	44 * 180	..	..	..	..
..	..	..	..	238 326	..	..	*	..	..
..	..	..	..	138	..	..	..	..	..
..	..	..	..	..	..	..	..	340 389	..
..	..	..	..	161 * 365	34 * 180	(341) * 397	..	..	..
..	..	..	..	..	..	..	..	471	..
..	..	..	..	62 341	180	(337) 341	..	471	..
..	..	..	..	(341)	(179) *	326 (341)	471	471	..
..	..	..	..	(326)	..	..	..	..	..
..	..	..	..	320	..	..	..	..	..
..	..	..	..	..	..	..	..	392	..
..	..	..	..	..	180	..	..	..	..
..	..	..	..	..	..	..	..	471	..

## DISTRIBUTION TABLE

	Is. of W. Indian Ocean	Mascarene Is.	E. Africa & Madagascar	Red Sea	S.E. Arabia	Persian Gulf
<i>Ophiopoeza dubiosa</i> de Loriol	..	370	..	..	..	..
<i>fallax</i> Peters <sup>23</sup>	..	370	415 * 502	*	..	451 604
<i>spinosa</i> (Ljungman)	..	..	..	..	..	..
<i>Ophiopsammus yoldii</i> (Lütken) 635	..	..	..	..	..	..
<i>Ophiostegastus †compsus</i> A. M. Clark	..	..	..	..	..	604 *
<b>OPHIURIDAE</b>						
<i>Dictenophiura stellata</i> (Studer)	..	..	..	..	..	..
<i>Ophiolepis cardioplax</i> Murakami	..	..	..	..	..	..
<i>cincta</i> Müller & Troschel	*	370 * 410	19 * 161	141 * 464	327	..
<i>irregularis</i> Brock	..	..	..	..	..	..
<i>nodosa</i> Duncan	..	..	..	..	..	..
<i>rugosa</i> Koehler	..	..	..	..	..	..
<i>superba</i> H. L. Clark	51	310 370	161 * 385	148 * 394	327*	..
<i>unicolor</i> H. L. Clark	..	..	..	..	..	..
<i>Ophioplocus imbricatus</i> Müller & Troschel	34*	370 * 464	385 * 502	..	..	..
<i>Ophioteichus multispinum</i> H. L. Clark	..	..	..	..	..	..
<i>Ophiotylos leucus</i> Murakami	..	..	..	..	..	..
<i>Ophiozonella projecta</i> (Koehler)	..	..	..	..	..	..
<i>Ophiura kinbergi</i> (Ljungman) 633	..	..	..	(181) * 560	181 * 451	451

## NOTES TO OPHIUROID TABLE

- <sup>1</sup> *Astrocladus exiguus*. This species is barely eligible for inclusion, the shallowest record being Lyman's of 10-20 fathoms.
- <sup>2</sup> *Ophiactis kroeyeri* Lütken, 1856, type-locality Peru, has been recorded from the Hawaiian Islands by Ljungman (1867a) under the name of *O. fragilis*. H. L. Clark (1915b) maintains that the two names are synonymous but doubts the Hawaiian locality; this doubt was echoed by A. H. Clark (1949) in his comprehensive study of Hawaiian Ophiuroidea.
- <sup>3</sup> *Ophiactis lymani* Ljungman has otherwise only been recorded from the Atlantic—the West Indies, West Africa and St. Helena—so this record needs verification.
- <sup>4</sup> *Ophiactis versicolor*. The specimens from Mozambique named *O. modesta* by Balinsky (1957) and Kalk (1958) are more likely to be conspecific with the type of *O. versicolor*.
- <sup>5</sup> *Macrophiothrix aspidota*. The records of Balinsky (1957) from Mozambique and Koehler (1907) from Madagascar may have been based on material of *M. robillardii*. Lyman's records from the East Indies also need confirmation.
- <sup>6</sup> *Macrophiothrix hirsuta*. Mortensen's record (1940) from the Persian Gulf may have been based on a specimen of *M. elongata* like that of A. H. Clark (1949). Records from the eastern Indian Ocean and the Pacific are more likely to be of *M. variabilis*.
- <sup>7</sup> *Macrophiothrix rhabdota*. The Philippine records need a critical reappraisal and comparison of specimens with the type-material.
- <sup>8</sup> *Macrophiothrix variabilis*. Koehler's Pacific records of *M. hirsuta* (1905a and later) are more likely to have been based on material of *M. variabilis*, which he considered a synonym.
- <sup>9</sup> *Ophiothela danae*. Balinsky (1957) has recorded *O. dividua* von Martens from Mozambique. As mentioned in note 63 to the ophiuroid key, this is now suspected to be a synonym of *danae*.
- <sup>10</sup> *Ophiothrix elegans*. H. L. Clark (1946) doubts the identity of Koehler's specimen (1922a) from the Philippines.
- <sup>11</sup> *Ophiothrix savignyi*. H. L. Clark's records (1915b) of *O. stelligera* from Mauritius and Zanzibar are more likely to have been based on material of *O. savignyi*, which is superficially rather similar. Ludwig's record from Zanzibar (1899) as *O. otiosa* is included positively on the strength of material from that locality in the British Museum collections.
- <sup>12</sup> *Ophiothrix (Acanthophiothrix) armata*. One of the specimens from the Great Barrier Reef Expedition named *O. stelligera* by H. L. Clark (1932) proved on re-examination to be referable to *O. (Acanthophiothrix) armata*.
- <sup>13</sup> *Ophiothrix (Keystonea) hymenacantha* is included here on the strength of H. L. Clark's note (1946) that the type-material was more likely to have come from the north coast of Australia than the south.
- <sup>14</sup> *Ophiothrix (Placophiothrix) fumaria*. See note 48 to the ophiuroid key for comment on the type-locality.

## FOR OPHIUROIDEA

W. India & Pakistan	Maldiva area	Ceylon area	Bay of Bengal	East Indies	North Australia	Philippine Is.	China & S. Japan	South Pacific Is.	Hawaiian Is.
..	..	..	..	(341)	..	..	..	340-	..
*	..	160?	..	62	..	341	..	..	..
..	*	..	..	135 341	161 233	161 337	..	136 365	131
..	..	..	41 *	161 (341)	34 * 180	161 337	..	..	..
..	..	..	..	..	..	..	..	..	..
..	..	..	(322)	(341) * 326	161 * 549	..	..	..	..
..	..	..	..	..	..	..	..	471	..
..	147 *	160 196	223 * 322	161 * 416	161 * 399	341 * 399	419 471	136 * 340	..
..	..	..	..	62 * (326)	..	..	*	..	..
..	..	..	40 223	326	180 233	..	..	..	..
..	..	(160 322)	..	326 * 341	..	..	..	..	..
..	*	160 196	38 *	161 * 341	34 * 161	161 * 337	419 471	45 * 161	..
..	..	..	..	..	180 *	..	..	..	..
*	..	160 * 196	40 * 394	129 * 341	34 * 182	161 * 341	419 471	136 * 340	174
..	..	..	..	..	180 233	..	..	..	..
..	..	..	..	..	..	..	..	471	..
..	..	..	..	326 (341)	..	..	..	..	..
181	..	160 *	41 * 322	161 326	161 * 180	161 341	161 * 399	(136)	(131)

<sup>15</sup> *Ophiocoma dentata*. The use of this name in place of *insularia* Lyman follows Devaney (1967)—see bibliography no. 668.

<sup>16</sup> *Ophiocoma valenciae*. Records from east of the Persian Gulf require confirmation.

<sup>17</sup> *Ophiocoma wendti*. See key note 68 for explanation of the authority of the species intended here. I doubt the identity of the Pacific specimens which Koehler referred to *wendti* in 1905 and 1907; they are probably referable to *O. schoenleini*, as is the case with the Philippine and Samoan specimens so-named by Koehler in 1922, according to Mr. Devaney (in correspondence).

<sup>18</sup> *Ophiomastix caryophyllata* and *venosa*. The records in the first column are based on recently-collected specimens from Aldabra; the E. African one for *O. caryophyllata* came from Zanzibar and the mascarene one of *O. venosa* from Rodrigues.

<sup>19</sup> *Ophiarachna affinis*. Koehler's record (1907) from Mozambique has been queried by H. L. Clark (1909). See note 83 to ophiuroid key.

<sup>20</sup> *Ophiarachnella infernalis*. In 1909 and 1915(b) H. L. Clark recorded this species from Zanzibar but in later works (1938 and 1946) he refers to it as an East Indian species.

<sup>21</sup> *Ophiarachnella sphenisci*. The specimen figured by Koehler (1898) under the name of *O. gorgonia* could well be referable to *O. sphenisci* since so many bare patches occur on the disc. Koehler's material was from Colombo and the Andaman Islands.

<sup>22</sup> *Ophiochaeta hirsuta*. The record in the first column is based on material from Aldabra.

<sup>23</sup> *Ophiopoeza fallax*. The origin of the Sinhalese record quoted by H. L. Clark (1915a) cannot be traced.

<sup>24</sup> *Amphiura (Ophiopeltis) iranica*. Treated as a synonym of *A. (O.) tenuis* in the key.

KEY TO THE OPHIUROIDEA

- 1 Arms branching . . . . . 2
- 1' Arms simple . . . . . 9
- 2 Conspicuous high tubercles (or short blunt spines) on the arms (as well as the disc) dorsally but no belts of minute hooks on the arms, though the distal lateral arm spines (alternatively called tentacle scales) may be hook-like (pl. 13, figs. 1, 2) . . . . . *Euryale aspera* Lamarck, 1816
- 2' Dorsal side smooth or with a few low, flattened tubercles; transverse belts of minute hooks across the dorsal side of the arms . . . . . **GORGONOCEPHALIDAE** 3
- 3 Arm spines first appearing at the edge of the disc, after the first or second fork in the arms . . . . . **ASTROCLADUS** 4
- 3' Arm spines not developed before the fourth fork in the arms, well beyond the edge of the disc . . . . . 6
- 4 Madreporite not projecting into the soft interbrachial area (fig. 21); dorsal side with some enlarged tubercles, notably one at the distal end of each radial shield . . . . . *Astrocladus exiguus* (Lamarck, 1816)

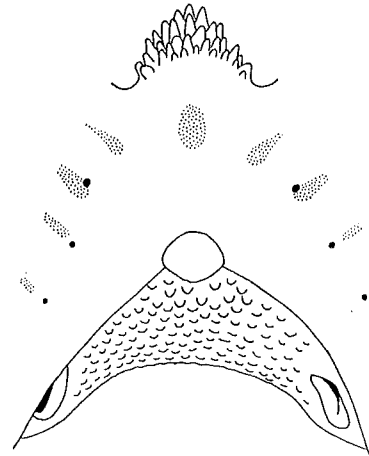


FIG. 21. *Astrocladus exiguus*, ventral view of one interradius.

- 4' Madreporite situated at the edge of the soft interbrachial skin close to the oral frame; no enlarged tubercles . . . . . 5
- 5 Most of the disc granules bearing one or more fine thorns . . . . . *Astrocladus tonganus* Döderlein, 1911
- 5' Disc granules rounded . . . . . *Astrocladus granulatus* H. L. Clark, 1938
- 6 The arms basally distinctly broader than high, with the ventral surface wide . . . . . *Astrochalcis tuberculosa* Koehler, 1905a
- 6' The arms basally about as broad as high, the ventral surface narrow. . . . . **ASTROBOA** 7
- 7 Enlarged tubercles among the granules on both sides of the disc . . . . . *Astroboa tuberculosa* Koehler, 1930
- 7' No enlarged tubercles, granulation fairly even . . . . . 8
- 8 Disc granules smooth, arms covered with fairly uniform granules contrasting sharply with the double belts of hooked granules . . . . . *Astroboa nuda* (Lyman, 1874)
- 8' Disc granules with thorny surfaces, arms covered with rounded granules and flattened platelets of varying size, rendering the double belts of hooked granules inconspicuous . . . . . *Astroboa clavata* (Lyman, 1861)
- 9 Dorsal arm plates rudimentary and often fragmented, concealed in wet specimens by thick opaque skin which also covers the disc (see pl. 13, figs. 3, 4); disc liable to considerable distortion when preserved . . . . . **OPHIOMYXIDAE** 10
- 9' Dorsal arm plates clearly visible (rarely concealed by granules or obscured by thin skin); if the disc is covered with skin then this is either thin and semi-transparent or bears spinelets but usually the disc scales are distinct or covered with spinelets or granules . . . . . 12
- 10 Arms relatively long, about ten times the disc diameter (d.d.); seven or eight arm spines (at least when the disc diameter is 15 mm.) . . . . . *Ophiomyxa longipeda* Brock, 1888
- 10' Arms usually four to six times the d.d.; rarely more than six arm spines . . . . . 11
- 11 No enlarged marginal disc scales beneath the skin . . . . . *Ophiomyxa compacta* (Koehler, 1905a)
- 11' Margin of disc interradially supported by a series of large, overlapping scales visible when the disc is dried or the skin dissolved away (pl. 13, figs. 3, 4)<sup>1</sup> . . . . . *Ophiomyxa australis* Lütken, 1869

<sup>1</sup> I am not entirely convinced that this is a valid specific character. H. L. Clark (1939 and 1946) has already referred *Ophiomyxa brevispina* and *irregularis* to the synonymy of *O. australis* Lütken; nor can I find a reliable means of distinguishing *O. robillardi* de Loriol, 1893 from *australis*. The degree of fragmentation of the dorsal arm plates is very variable and although specimens from the type-locality of *australis* (SE Australia) usually have a mosaic of several small plates between two larger ones some of them have only a single triangular median plate similar to that described for *robillardi*. Conversely, two specimens from Madagascar (close to Mauritius, the type-locality of *robillardi*) have a mosaic of plates, though the specimens I have seen

- 12 Seven arms, capable of being raised vertically, right from the oral frame, so that the mouth gapes open . . . . . *Ophiothauma heptactis* H. L. Clark, 1938
- 12' Five arms, sometimes six (rarely seven in asymmetric, regenerating fissiparous specimens, always projecting horizontally) . . . . . 13
- 13 Apex of each jaw with a single pointed papilla and three or more oral papillae each side (fig. 22b) in conjunction with long, more or less thorny arm spines and a disc covering of thorny stumps or slender spines obscuring the scales and radial shields . . . . . **OPHIACANTHA** 14

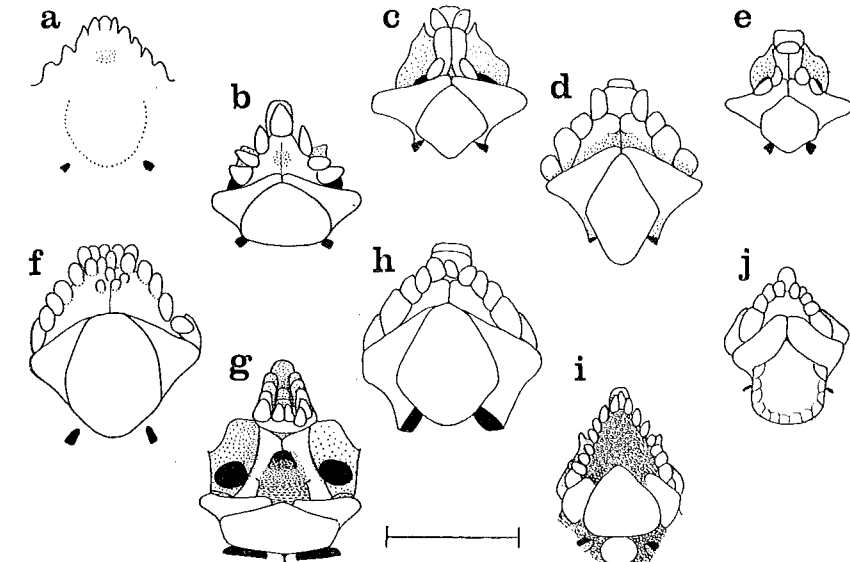


FIG. 22. Single jaws of: a. *Ophiomyxa australis*, b. *Ophiacantha discoidea*, c. *Amphiura septemspinosa*, d. *Amphioplus* (*Lymanella*) *hastatus*, e. *Ophiactis savignyi*, f. *Ophiocoma pica*, g. *Ophiothrix savignyi*, h. *Ophionereis lineata*, holotype, i. *Ophiarachnella infernalis* and j. *Ophiolepis cincta*. In a, f, i and j the scale equals 2 mm., in b, e and g it equals 1 mm. and in c and d 0.7 mm.

- 13' Apex of each jaw with a pair of oral papillae (Amphiuridae) or a cluster of smaller tooth papillae (Ophiotrichidae and Ophiocomidae), or, if there is only a single papilla, then the arm spines are smooth and rarely much longer than an arm segment and the disc scales are either clearly distinct (Ophiochitonidae and Ophiuridae), though sometimes bearing scattered spinelets (Ophiactidae), or covered with a dense coat of granules often extending on to the adoral shields and oral plates (Ophiodermatidae) (fig. 22c-j) . . . . . 17
- 14 Arms moniliform (constricted at the proximal end of each segment to give the effect of a string of beads), the uppermost spine of the second free segment conspicuously enlarged . . . . . *Ophiacantha gracilis* (Studer, 1882)
- 14' Arms not conspicuously moniliform; no abruptly enlarged spine on the second free segment . . . . . 15
- 15 Six or seven oral papillae each side; disc covered with slender spines; two tentacle scales . . . . . *Ophiacantha dissidens* Koehler, 1905a
- 15' Three oral papillae each side of the apical one; disc covered with stumps usually bearing three thorns at the tip; one tentacle scale . . . . . 16
- 16 About six arm spines when the d.d. is 6 mm. . . . . *Ophiacantha indica* Ljungman, 1867
- 16' Seven or eight arm spines when the d.d. is 4-5 mm. . . . . *Ophiacantha discoidea* Lyman, 1879
- 16" Nine or ten arm spines when the d.d. is 4-5 mm. . . . . *Ophiacantha tenuispina* H. L. Clark, 1938
- 17 A pair of regular rounded or oblong infradental papillae at the apex of each jaw below the lowest tooth, which is usually wide and square (fig. 22c, d)<sup>2</sup> . . . . . **AMPHIURIDAE** (except for some aberrant genera) 18
- 17' Apical papillae either multiple or single, rarely two but then these are usually asymmetrical on some or all the jaws<sup>2</sup> . . . . . 94

from Mauritius itself have one triangular median plate on the basal arm segments or just the two lateral plates with a median longitudinal suture between. This last condition is generally found in the specimens from Amboina (the type-locality of *O. brevispina*), Fiji and Tonga in the 'Challenger' collections, which also seem to have less strongly serrated edges to the oral papillae than either the Australian or Mascarene specimens, suggesting that *brevispina* may after all be distinguishable.

<sup>2</sup> In a few genera which should run down to 17', such as *Ophionereis*, *Ophiocomella*, *Ophiarachnella*, *Ophiolepis* and *Ophiozonella*, there is often no single apical papilla and the two innermost lateral oral papillae may be symmetrical on some jaws and could be mistaken for an infra-dental pair. The non-Amphiurid affinities of such species are shown by the presence of a modified outermost oral papilla or tentacle scale each side (fig. 22h-j), the proximal end of which is prolonged up into the oral slit above the next papilla.

- 18 A wide space or diastema between the infradental pair of papillae and the one (rarely two) distal oral papillae each side, the latter arising from the edge of the adoral shield or very close to it at the distal end of the oral plate (fig. 22c) . . . . . 19
- 18' Oral papillae present down the sides of the oral plates in more or less continuous series with the infradental ones, there being at least two papillae each side of the infradental pair (not counting the oral tentacle scale, which arises at a higher level in the mouth slit on the side of the oral plate) . . . . . 57
- 19 Some disc scales bearing erect spines and the scales themselves more or less completely obscured by skin (pl. 14, fig. 1); no tentacle scales (fig. 23b) . . . . . **OPHIOCENTRUS** 20

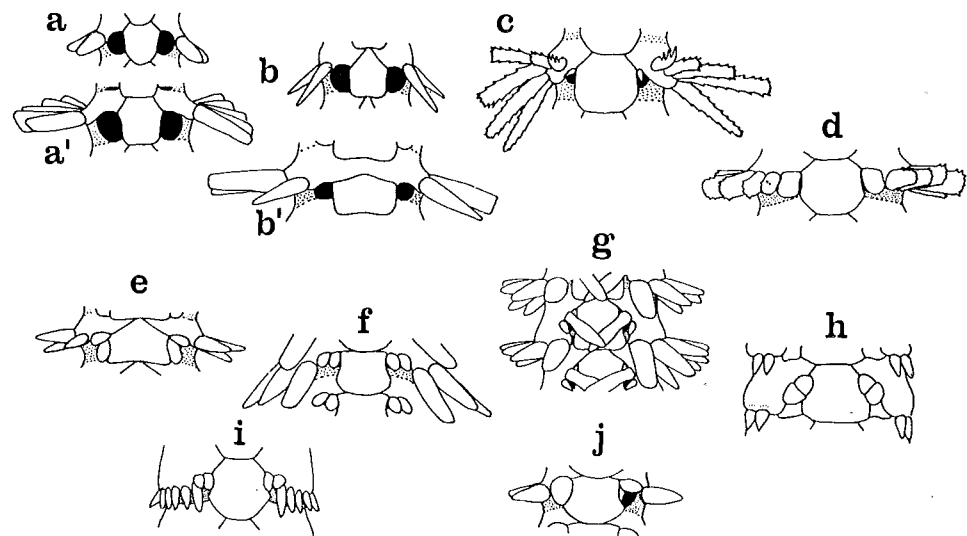


FIG. 23. Ventral view of proximal arm segments of: a. *Amphiura (Fellaria) octacantha*, holotype (a—fourth segment, a'—30th segment), b. *Ophiocentrus asper* (b—fifteenth segment, b'—60th segment), c. *Ophiothrix ciliaris*, d. *Ophiactis savignyi*, e. *Amphioplus (Lymanella) andreae*, 'topotype', f. *Ophiocoma anaglyptica*, holotype, g. *Ophiopsila pantherina*, holotype of variety *occidentalis* Burfield, h. *Ophiolepis cincta*, i. *Ophiarachnella infernalis* and j. *Ophionereis lineata*, holotype.

- 19' No spines on the disc, the scales distinct (though in some species they are absent over part or nearly all of the disc, particularly ventrally, but then the skin is transparent); tentacle scales present or absent . . . . . **AMPHIURA** 25
- 20 Arm spines numerous and spatulate, ten or more on the basal arm segments (though it is possible that smaller specimens of *O. putnami*, d.d. < 10 mm., will prove to have only seven or eight spines) . . . . . 21
- 20' Arm spines fewer, five to seven, of varying shapes, the middle ones often spatulate with rugose or squared tips . . . . . 22
- 21 Disc spines flattened; distal oral papilla very large and clavate . . . . . *Ophiocentrus putnami* (Lyman, 1871)
- 21' Disc spines needle-like; distal oral papilla pointed, triangular (pl. 14, fig. 1) . . . . . *Ophiocentrus verticillatus* (Döderlein, 1896)
- 22 Arm spines proximally seven, falling to five, the middle ones often the shortest (fig. 52d-g, p. 134) . . . . . *Ophiocentrus inequalis* (H. L. Clark, 1915b)
- 22' Arm spines five, sometimes six proximally, the middle ones not reduced in size . . . . . 23
- 23 Dorsalmost spines the shortest, on the distal segments (where the number falls to three) reduced to a stump or to a short flat paddle, widest in the middle; middle spines not hooked though often blunt-tipped . . . . . 24
- 23' Dorsalmost spine not the shortest; middle spines with the tip very rugose, developing a distally-directed hook beyond the base of the arm . . . . . *Ophiocentrus asper* (Koehler, 1905a)
- 24 Disc spines triangular in cross-section<sup>3</sup> . . . . . *Ophiocentrus albovidis* (Brock, 1888)
- 24' Disc spines not prismatic<sup>3</sup> . . . . . *Ophiocentrus dilatatus* (Koehler, 1905a)
- 25 Arms extremely long, well over ten times the d.d.; no tentacle scales; disc scaling more or less reduced, at least on the ventral side and often scales only present around or just proximal to the radial shields (fig. 24b) . . . . . 26
- 25' Arms usually much less than ten times the d.d.; one or two tentacle scales present; disc scaling usually complete but sometimes reduced . . . . . 32
- 26 Proximally seven or more (sometimes only six) arm spines, most of them with flattened, squared-off or flared tips (fig. 25c) . . . . . **AMPHIURA** (subgenus **FELLARIA**) 27

<sup>3</sup> *Ophiocentrus albovidis* is known only from the holotype; when more material is available from Amboina, the type-locality, I suspect that it will prove to be synonymous with *O. dilatatus*.

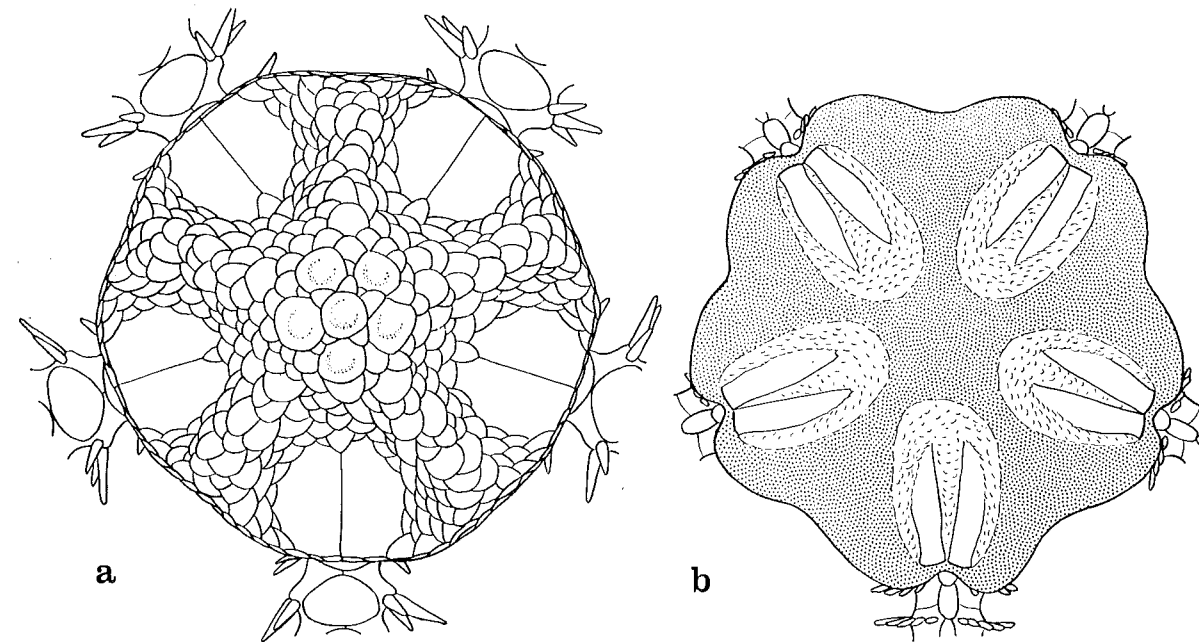


FIG. 24. Dorsal view of discs of: a. *Amphioplus (Lymanella) hastatus* and b. *Amphiura (Fellaria) octacantha*, holotype of *Ophionephthys decacantha* H. L. Clark.

- 26' Arm spines proximally only four or five, only the second from lowest strongly modified, either with an axe-headed shape and a distal hook (fig. 25a, b) or with the tip flattened and with flared thorns. (On the proximal segments the modification is slight) . . . . . 29

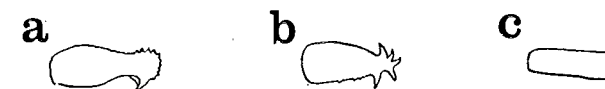


FIG. 25. Middle arm spines of: a. *Amphiura (Ophiopeltis) tenuis* (the hook directed distally), b. *A. (Ophiopeltis) hexactis* (from Mortensen, 1940a) and c. *A. (Fellaria) octacantha*, holotype.

- 27 Eight or nine arm spines proximally (? rarely ten); oral shields about as wide as long; distal oral papilla widest at the tip which is squared-off (fig. 26b) . . . . . *Amphiura (Fellaria) octacantha* H. L. Clark, 1915b
- 27' Proximally seven arm spines; oral shields much wider than long; distal oral papilla rounded, not widest at the tip . . . . . 28
- 28 Radial shields 'joining distally' . . . . . *Amphiura (Fellaria) heptacantha* (Mortensen, 1940a)<sup>4</sup>
- 28' Radial shields 'narrowly separated' . . . . . *Amphiura (Fellaria) africana* (Balinsky, 1957)<sup>4</sup>
- 29 Disc scaling well developed on the dorsal side but giving way to naked skin on the ventral side (fig. 50a-c, p. 133) . . . . . *Amphiura leptotata* H. L. Clark, 1915b
- 29' Scales only present near the radial shields, disc naked centrally, interradially and ventrally . . . . . **AMPHIURA** (subgenus **OPHIOPELTIS**) 30
- 30 Radial shields widely divergent in their proximal halves . . . . . *Amphiura (Ophiopeltis) phalerata* (Lyman, 1874)
- 30' Radial shields parallel and close together, if not in contact, for most of their length . . . . . 31
- 31 Distal oral papilla rudimentary; proximally four arm spines, the second with four or more very prominent divergent thorns at its tip (fig. 25b); six arms in the only known specimen . . . . . *Amphiura (Ophiopeltis) hexactis* (Mortensen, 1940a)

<sup>4</sup> I suspect that *Amphiura (Fellaria) africana* will prove to be a synonym of *heptacantha*; the two were not compared by Balinsky. The minor differences in the relative size and the separation of the radial shields and the extent of separation of the adoral shields interradially are very likely to be correlated with the better preservation (judging from the photographs) and larger size (d.d. 5-10 mm.) of Balinsky's type-material than Mortensen's (d.d. 3 mm.).

- 31' Distal oral papilla small but not rudimentary; five arm spines, the second with the tip axe-headed or simply rugose (sometimes inconspicuously so, especially on the proximal segments); five arms  
*Amphiura (Ophiopeltis) tenuis* (H. L. Clark, 1938)<sup>5</sup>
- 32 Two tentacle scales . . . . . 33
- 32' One tentacle scale . . . . . 40
- 33 Disc covered with skin on the dorsal side, except around the radial shields so that when partially (or wholly) dried the colour becomes dark with five light patches; ventral side also with naked skin or with very fine, obscured scales . . . . . 34
- 33' Disc covered with opaque scales, at least dorsally, so that when dried the disc appears pale all over . . . . . 35
- 34 Radial shields long, the length: breadth ratio about 4:1; ventral side of disc completely naked; distal oral papilla not very thick . . . . .  
*Amphiura crossota* Murakami, 1943
- 34' Radial shields shorter, length: breadth 2-3:1; ventral side of disc with minute obscured scales; distal oral papilla very thick . . . . .  
*Amphiura diacritica* H. L. Clark, 1938
- 35 Two similar distal oral papillae each side (fig. 26g); only three arm spines (fig. 47c, p. 131)<sup>6</sup>  
*Amphiura bidentata* H. L. Clark, 1938
- 35' One distal oral papilla each side; six or more arm spines (rarely only five) proximally . . . . . 36
- 36 Dorsal margin and ventral side of disc covered with skin with only a few scattered scales; arms very long, about 17 times the d.d. . . . .  
*Amphiura fasciata* Mortensen, 1940a
- 36' Disc covered with imbricating scales on both sides; arms not more than ten times the d.d. . . . . 37
- 37 Disc scales extremely small and indistinct; radial shields narrow, length: breadth at least 4:1 . . . . . 38
- 37' Disc scales moderate in size and the primaries distinctly enlarged; radial shields shorter, length: breadth 2-3:1 . . . . . 39
- 38 Middle arm spines cylindrical with thorny, squared-off tips or with a distally-directed hook; six spines proximally when d.d. = 2 or 3 mm., eight or nine only at d.d. > 10 mm.  
*Amphiura ambigua* Koehler, 1905a
- 38' All the arm spines spatulate; 10 spines proximally (when the d.d. is 5 mm.) (fig. 52a-c, p. 134).  
*Amphiura stictacantha* H. L. Clark, 1938
- 39 Arm spines five or six proximally (when the d.d. is 5 mm.), flattened and very blunt at the tips; oral shields with a distinct proximal angle where the adorals just meet or at least approach one another (figs. 26a, 47a)  
*Amphiura acrisia* H. L. Clark, 1938

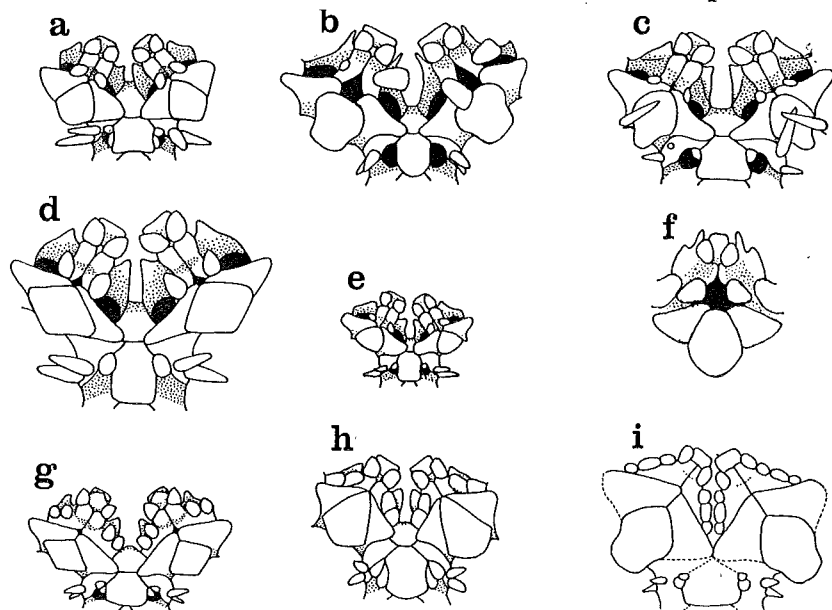


FIG. 26. Two jaws and an arm base of: a. *Amphiura (Amphiura) acrisia* (the distal oral papillae fore-shortened), b. *A. (Fellaria) octacantha*, holotype, c. *A. (Amphiura) phrixa*, holotype, d. *A. luetkeni*, holotype, e. *A. micra*, holotype, f. *A. kalki* (single jaw, from Balinsky, 1958), g. *A. bidentata*, holotype, h. *Amphioplus (Amphichilus) ochroleuca* and i. *Dougaloplus echinatus*.

<sup>5</sup> With synonym *Ophiopeltis iranica* Mortensen, 1940a, as suspected by Mortensen. Two specimens from Karachi show that the supposed difference in the spacing of the adoral shields does not hold good.

*Ophiopeltis philippinensis* Domantay & Domantay, 1967 might run down here. As noted in 1970, I doubt its validity. The holotype is incomplete, lacking the disc.

<sup>6</sup> *Amphioplus (Unioplus) repositus* may run down to this section of the key; it is most easily distinguished from *Amphiura bidentata* by the elongated shape of the oral shields.

- 39' Arm spines eight proximally (d.d. up to 6 mm.), their shape unremarkable, so presumably tapering slightly to blunt points; oral shields with a straight proximal side, by the extent of which the adorals are widely separated interradially (fig. 26f) . . . . .  
*Amphiura kalki* Balinsky, 1957
- 40 Arms six, rarely five . . . . . 41
- 40' Arms five . . . . . 42
- 41 A self-dividing species so that three arms are usually smaller than the other three  
*Amphiura sexradiata* Koehler, 1930
- 41' Not self-dividing, the six arms equal . . . . .  
*Amphiura velox* Koehler, 1910a
- 42 Proximal part of ventral interradial of the disc covered with naked skin, the scales ending abruptly  
*Amphiura crispa* Mortensen, 1940a
- 42' Ventral side of the disc completely covered with scales, or if some skin is showing (some specimens of *A. immira*) then there are patches of scales extending proximally and no abrupt edge to the scaled area . . . . . 43
- 43 Oral shields rhombic and distinctly broader than long (length: breadth c. 1:1.4) the proximal and distal halves symmetrical and all four sides quite straight or slightly concave (fig. 26d); primary disc scales not distinct<sup>7</sup> . . . . . 44
- 43' Oral shields spearhead-shaped or triangular, with the distal edge convex or with a blunt median lobe, length usually (but not always) equal to or more than the breadth (fig. 26c, e, f); rosette of primary disc scales often distinct (at least on unregenerated discs) . . . . . 46
- 44 Disc scaling fine but opaque, the disc pale in dried specimens; oral plates sunken only in the middle of their length and raised again towards the bases of the infradental papillae; lowest arm spine the longest (pl. 13, figs. 6, 7) . . . . .  
*Amphiura luetkeni* Duncan, 1879
- 44' Disc scaling very thin and obscure so that the disc appears dark in dry specimens except around the radial shields; oral plates sunken apically, not only in the middle; lowest arm spine not the longest . . . . . 45
- 45 Arm length c. ten times the d.d. (fig. 51a, b, p. 133) . . . . .  
*Amphiura microsoma* H. L. Clark, 1915b
- 45' Arm length only c. four times the d.d. (fig. 49c-g, p. 132) . . . . .  
*Amphiura brachyactis* H. L. Clark, 1938
- 46 Radial shields short, wide and D-shaped, length: breadth < 2.5:1 . . . . . 47
- 46' Radial shields more or less narrow and elongate, banana-shaped, length: breadth = 3:1 or more . . . . . 50
- 47 Distal oral papilla very wide-based and operculiform (fig. 50d, e, p. 133)  
*Amphiura leucaspis* H. L. Clark, 1938
- 47' Distal oral papilla papilliform or conical, more or less erect vertically and with length exceeding the basal width . . . . . 48
- 48 Oral shields spearhead-shaped with a blunt proximal angle and a long distal lobe (figs. 26c, 47e, p. 131)  
*Amphiura phrixa* H. L. Clark, 1938
- 48' Oral shields triangular with no long distal lobe (fig. 26e) . . . . . 49
- 49 Radial shields separate for their whole length, though approximating distally; tentacle scale long and narrow  
*Amphiura accedens* Koehler, 1910a
- 49' Radial shields in contact at their distal ends; tentacle scale short (figs. 26e, 47b, p. 131)  
*Amphiura micra* H. L. Clark, 1938
- 50 Ventral-most arm spine distinctly longer than the rest; primary disc scales not distinct (though the central one may be enlarged in *A. septemspinosa*) . . . . . 51
- 50' Ventral-most spine not the longest; all six primaries nearly always distinct . . . . . 54
- 51 Adoral shields not contiguous interradially; disc scaling very fine; disc soft and puffed, becoming indented in preservation . . . . . 52
- 51' Adoral shields contiguous; disc scales moderate in size and opaque, sometimes larger centrally; disc stiffer . . . . . 53
- 52 Centre of disc with opaque scales<sup>8</sup> . . . . .  
*Amphiura dejectoides* H. L. Clark, 1939
- 52' Centre of disc semi-transparent, appearing dark in preserved specimens<sup>8</sup>  
*Amphiura inhacensis* Balinsky, 1957
- 53 Seven arm spines proximally (at least at d.d. 2 mm.); arm length four or five times the d.d. (fig. 47d, p. 131)<sup>9</sup>  
*Amphiura septemspinosa* H. L. Clark, 1915b
- 53' Six arm spines (at the same size); arm length c. six times the d.d.<sup>9</sup> . . . . .  
*Amphiura ficta* Koehler, 1910a
- 54 The second from lowest arm spine and one or two others above it with rugose and squared-off tips, often bihamulate or with one distally-directed hook; radial shields not contiguous; tentacle scale moderately large . . . . . 55

<sup>7</sup> The difference in shape of the oral shields may be rather subtle since a few of the species of *Amphiura* which should be referred to 43' have shields which are distinctly wider than long and their shape could be interpreted as rhombic (as indeed Balinsky has done for *A. inhacensis*, where I would call the shape 'spear-headed') but then the two proximal sides are convex, though the distal ones are concave.

<sup>8</sup> This distinction may not hold good when more material is available and I suspect that *Amphiura inhacensis* will prove to be a synonym of *dejectoides*.

<sup>9</sup> These small differences in spine number and relative arm length may not prove significant but I can find no better characters by which to try and distinguish between *Amphiura septemspinosa* and *ficta*. Koehler's figures of *Amphiura ficta* are too diagrammatic to be of much use in comparison.

- 54' Middle arm spines simply blunt at the tips; radial shields just contiguous distally; tentacle scale small, only partially covering the pore . . . . . 56
- 55 Proximally seven arm spines (at least at d.d. 4 mm.), the dorsal-most one slightly longer than the rest (fig. 49a, b, p. 132) . . . . . *Amphiura abbreviata* Koehler, 1905a
- 55' Proximally six arm spines (at d.d. 5 mm.), the dorsal-most one not noticeably enlarged . . . . . *Amphiura constricta* Lyman, 1879
- 56 Arm length about ten times the d.d.; disc scales small, no very long ones between the two radial shields of each pair; adoral shields just contiguous interradially . . . . . *Amphiura celata* Koehler, 1905a
- 56' Arm length only about four times the d.d.; disc scales moderate in size, one particularly long scale between the distal halves at least of the radial shields; adoral shields widely separated . . . . . *Amphiura immira* Ely, 1942
- 57 Only three oral papillae present and no oral tentacle scale . . . . . 58
- 57' Usually four oral papillae, if only three then the first oral tentacle scale is clearly visible above and between the infradental and the second papilla, on the side of the oral plate<sup>10</sup> . . . . . 66
- 58 Disc bearing blunt tubercles and covered with thick skin . . . . . *Ophiostigma rugosum* H. L. Clark, 1918
- 58' Disc with neither tubercles nor thick skin to obscure the scales; rarely some papillae or processes along the margin . . . . . 59

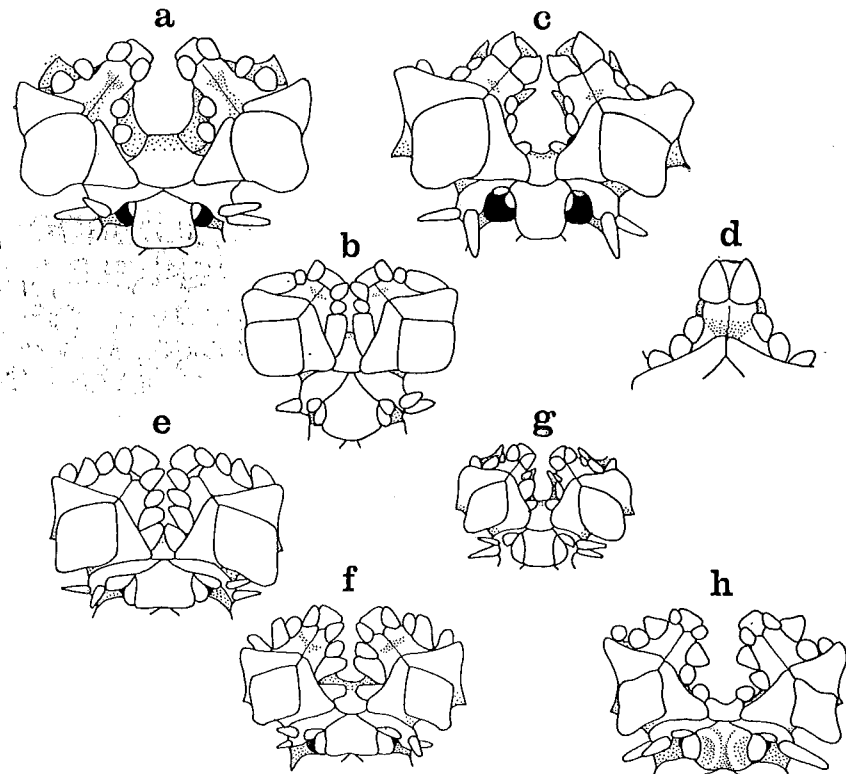


FIG. 27. Two jaws and an arm base of: a. *Amphiura (Amphisipina) duplicata*, paratype, b. *Amphipholis squamata*, c. *Amphioplus (Amphioplus) cyrtacanthus*, holotype, d. *A. personatus*, holotype (single jaw), e. *A. (Lymanella) laevis*, syntype of *Amphiura praestans* Koehler, f. *A. (Lymanella) andreae*, 'topotype', g. *A. (Amphioplus) didymus*, holotype and h. *Paracrocnida sinensis*, holotype.

- 59 The three oral papillae all arising from the oral plate, the outermost one not operculiform (though sometimes wider than the second); oral papillae not capable of completely closing the oral slit (fig. 27a) . . . . . 60

<sup>10</sup> After a study of Koehler's type-material of *Amphiura cesarea* and *intermedia*, referred to *Amphichilus* by Koehler (1930) and Matsumoto (1917) respectively, I think that both are better-placed in *Amphioplus*. The second papilla is perfectly in series with the other three in the type of *intermedia* and only slightly inset on some jaws in one specimen of *cesarea*. In fact there is considerable resemblance between *cesarea* and *Amphioplus impressus* (Ljungman), which I have concluded (1970) are conspecific. Conversely I find that *Amphiodia ochroleuca* (Brock) and *Amphiura reposita* Koehler have the oral tentacle scale present and the third oral papilla based on the adoral shield, so must be excluded from *Amphiodia* in which H. L. Clark placed them (1915b). Similarly *Amphiura (Amphioplus)* *condita* Koehler has only three oral papillae as well as an oral tentacle scale and so cannot be left in *Amphioplus* sensu stricto. *A. ochroleuca* has more or less extensively contiguous radial shields like *Amphichilus trichoides*, the type-species of *Amphichilus*, which I am ranking as a subgenus of *Amphioplus*. This is not the case with *A. reposita* and *condita*, which I am referring instead to the subgenus *Unioplus* of *Amphioplus*, all the other species of which are from deep water. The treatment of these taxa is dealt with at greater length in A.M.C. (1970).

- 59' Outermost oral papilla operculiform, at least twice as wide as the second one and arising partly from the edge of the adoral shield (fig. 27b); oral papillae together able to close the slit completely . . . . . **AMPHIPHOLIS** 65
- 60 No marginal spinose projections on the disc . . . . . **AMPHIODIA** sensu stricto 61
- 60' The marginal row of scales bearing spines or with acute spinose processes of the scales themselves (fig. 28) . . . . . 63

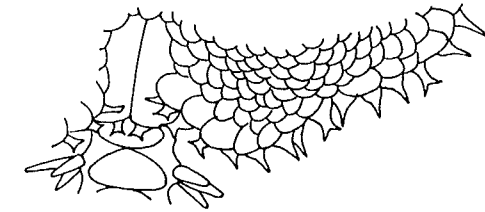


FIG. 28. Edge of part of disc with an arm base in dorsal view of *Amphiodia (Amphisipina) duplicata*, paratype.

- 61 Two tentacle scales; a self-dividing species (probably with six arms though this is not specifically stated in the description) . . . . . *Amphiodia dividua* Mortensen, 1933a
- 61' One tentacle scale; not reproducing asexually . . . . . 62
- 62 Ventral side of disc naked; radial shields almost covered by encroaching disc scales, a pair of thorny prolongations distal to each pair of radial shields (fig. 29) . . . . . *Amphiodia oblecta* Mortensen, 1940a

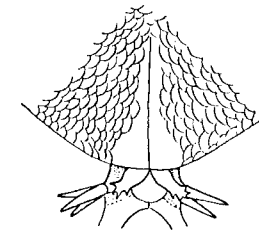


FIG. 29. Radial part of disc and one arm base of *Amphiodia oblecta* (from Mortensen, 1940a), showing the disc scaling extending on to the radial shields.

- 62' Ventral side of disc covered with granuliform scales; radial shields normally exposed, without distal processes . . . . . *Amphiodia fuscoalba* (Brock, 1888)
- 63 Marginal spines blunt, probably articulated to the scales . . . . . *Amphiodia [?Ophiophragmus] olivacea* (Brock, 1888)
- 63' Marginal scales with sharp spike-like prolongations (fig. 28) . . . . . **AMPHIODIA** (subgenus **AMPHISPINA**) 64
- 64 Processes on the marginal scales often bifurcate (fig. 28)<sup>11</sup> . . . . . *Amphiodia (Amphisipina) duplicata* (Koehler, 1930)
- 64' Processes on marginal scales with single points<sup>11</sup> . . . . . *Amphiodia (Amphisipina) microplax* (Burfield, 1924)
- 65 Rosette of primary disc scales distinct; oral shields as long as or longer than wide . . . . . *Amphipholis misera* (Koehler, 1899)
- 65' Primary rosette not distinct; oral shields wider than long (fig. 27b; pl. 13, fig. 5) . . . . . *Amphipholis squamata* (Delle Chiaje, 1829)\*
- 66 Disc either bearing scattered papilliform spinelets or else the ventral scales themselves all considerably thickened and projecting (fig. 30)<sup>12</sup> . . . . . 67

<sup>11</sup> I doubt that this is sufficiently reliable for specific distinction and believe that further material will show *Amphiodia duplicata* to be a synonym of *microplax*.

\*For which Thomas (1966:831) has proposed the new generic name *Axiognathus*. The use of this is discussed in A.M.C., 1970.

<sup>12</sup> The self-dividing six-armed species *Ophiocomella sexradia* (Duncan) may run down to this section of the key since it can have only two symmetrically-placed superficial tooth papillae resembling the infradental papillae of an amphiurid. When first described the species was referred to *Ophiocnida* and was subsequently placed in *Amphiacantha* by Matsumoto (1917) when describing *A. dividua*, which I consider to be a synonym of *sexradia*. Other synonyms (see Parslow and Clark, 1963, *Stud. Fauna Curaçao* 15) include *Ophiocoma parva* H. L. Clark and *Ophiocomella schultzi* A. H. Clark. *Ophiocomella* can be distinguished from those superficially-similar amphiurids with multiple oral papillae and disc spines by the enlarged and incurved oral tentacle scale at the distal end of the series of oral papillae, this being peculiar to the order Chilophiurida (including the Ophiocomidae but not the Amphiuridae) (see fig. 38c-e) and by the widely-spaced radial shields; when more than two tooth papillae occur the confusion should not arise, the affinities of *Ophiocomella* with the Ophiocomidae being evident.



- 88 Disc bare except around the radial shields, which are contiguous for a short distance near their distal ends  
*Amphioplus seminudus* Mortensen, 1940a
- 88' Disc scaled on the upper side; radial shields only just contiguous at their distal ends  
*Amphioplus personatus* (Koehler, 1905a)
- 89 Dorsal arm plates with a distinct median angle in the distal side so that the plate appears more or less trilobed (fig. 31a)<sup>22</sup> . . . . . 90
- 89' Dorsal arm plates with the distal side evenly convex or almost straight<sup>22</sup> . . . . . 91

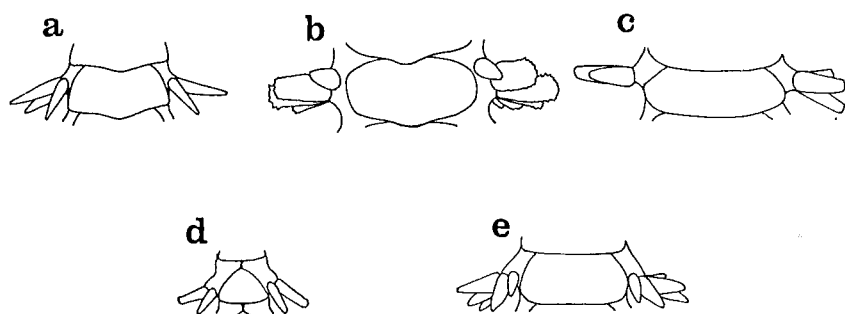


FIG. 31. Dorsal view of proximal arm segments of: a. *Amphioplus (Lymanella) andreae*, 'topotype', b. *Ophiactis savignyi*, c. *O. modesta*, d. *O. parva*, holotype, and e. *O. carnea*.

- 90 Radial shields broad, length: breadth c.2:1; arms moderate in length a.l:d.d. c.7:5:1 (fig. 48a, p. 132)  
*Amphioplus (Lymanella) andreae* (Lütken, 1872)
- 90' Radial shields narrow, length: breadth 3.5-4.0:1; arms very long, a.l:d.d. > 10:1 (fig. 48b, c)  
*Amphioplus (Lymanella) laevis* (Lyman, 1874)
- 91 Radial shields relatively broad, length: breadth usually 2-3:1; arm spines tapering, more or less pointed; primary rosette of disc scales often distinct; edge of disc sharp with a marginal row of somewhat projecting scales, often forming a scalloped edge and sometimes bearing spinose processes; a.l:d.d. c.6-7:1 . . . . . 92
- 91' Radial shields relatively narrow, length: breadth 3-4:1; arm spines more or less coarse and either blunt-tipped or else the uppermost one markedly flattened on the basal segments; no sharp edge to the disc; a.l:d.d. 4-5:1 . . . . . 93
- 92 Central disc scales larger than the peripheral ones and the primary rosette usually distinct if not conspicuous; radial shields large, equal in length to nearly half the disc radius (fig. 24a); marginal scales often with fine spinose processes . . . . . *Amphioplus (Lymanella) hastatus* (Ljungman, 1867b)
- 92' Disc scales fairly uniform, no marked increase in size centrally, the primary rosette inconspicuous, if distinct at all; radial shields rather variable in size but usually less than half the disc radius in length; marginal scales smooth (pl. 14, figs. 2, 3) . . . . . *Amphioplus (Lymanella) depressus* (Ljungman, 1867b)<sup>23</sup>

which nominal species was not taken into consideration by Koehler. However, the specimen from 'Albatross' station 5371, on which the description of *lucidus* was mainly based so that it could be termed the holotype, may represent a distinct species.

<sup>22</sup> Lyman (1874) described *Amphioplus laevis* as having the distal edge of the dorsal arm plates straight but, since in all other respects *laevis* agrees very closely with *A. praestans* (Koehler, 1905), which does have trilobed plates, I wrote to the Museum of Comparative Zoology to try and ascertain the true condition in *A. laevis*. I am indebted to Miss Amy Schoener for a drawing of the base of one of the two remaining arms of the holotype (fig. 48c). This shows that two out of three of the dorsal arm plates drawn have slightly undulating distal edges and could be called trilobed, much as in Mortensen's figure (1940a) of a specimen from the Persian Gulf which he referred to *laevis*. Although the plate figured widens out proximally to an unusual extent, I have little hesitation in relegating *praestans* to the synonymy of *A. laevis*.

Mortensen (1940a) provisionally considered *A. bocki* Koehler, 1927b to be a synonym of *laevis*, particularly as H. L. Clark (1917), who had access to Lyman's type-material, had referred to *laevis* a specimen from the Gilbert Islands, the type-locality of *A. bocki*. I can find no good reason for maintaining *bocki* as distinct, the apparently longer arms being correlated with the more nearly intact state of Koehler's type-material than that which has been referred to *laevis*.

*Amphioplus potens* Koehler, 1930 is based on a specimen with incompletely regenerated disc and abnormally short radial shields as a result. I believe that it will prove to be conspecific with either *A. (L.) andreae* or with *laevis*, depending on whether other specimens from the same locality—Kei Islands, 196 metres—have broad or narrow radial shields. Similarly some of the other nominal species referable to *Lymanella* may prove to be synonyms since all of them are very liable to lose their discs, the resultant regeneration producing at least temporary differences in the proportions of the radial shields as well as the loss of the primary rosette.

<sup>23</sup> Following H. L. Clark (1946) *Amphioplus relictus* (Koehler, 1898) is treated here as a synonym of *A. depressus*, though Dr. Clark was prompted by the apparent variation shown by the specimens which Koehler referred to *relictus* in 1922, some of which (those from Kagoshima) I consider are referable to *A. (Lymanella) japonicus* (Matsumoto), a close relative of *A. hastatus*. Also I think that the specimens from 'Siboga' station 51 which Koehler named *relictus* in 1905 may be better referred to *A. andreae* since they have slight distal angles to the dorsal arm plates.

- 93 Oral shields rhombic, their widest part only slightly distal to the middle; uppermost arm spine on proximal segments tapering at the tip, though markedly flattened  
*Amphioplus (Lymanella) caelatus* Ely, 1942<sup>24</sup>
- 93' Oral shields spearhead-shaped, with a short blunt distal lobe, widest towards the distal end; upper arm spine often more or less spatulate (both flattened and blunt-tipped) and the middle spine usually also blunt-tipped . . . . . *Amphioplus (Lymanella) integer* (Ljungman, 1867b)
- 94 Sexually di-morphic species, commonly occurring in pairs (fig. 32c) with the dwarfed male clasped upside-down beneath the centre of the normal-sized female whose mouth parts are more or less modified, the papillae usually with more or less fringed or irregular edges while the oral shields are somewhat sunken and reduced in size (fig. 32a) . . . . . 95
- 94' Not sexually dimorphic; oral or tooth papillae with smooth edges; oral shields not sunken and rarely reduced in size . . . . . 97
- 95 Disc scales and mouth parts of females obscured by granular dark-pigmented skin; tentacle scale rudimentary in adults; six or seven arm spines, the upper ones short; teeth very irregular and rugose  
*Ophiophaera insignis* Brock, 1888
- 95' Disc scales and mouth parts distinct, no dark skin; tentacle scale well developed; four or five fairly long arm spines; teeth fairly regular . . . . . 96

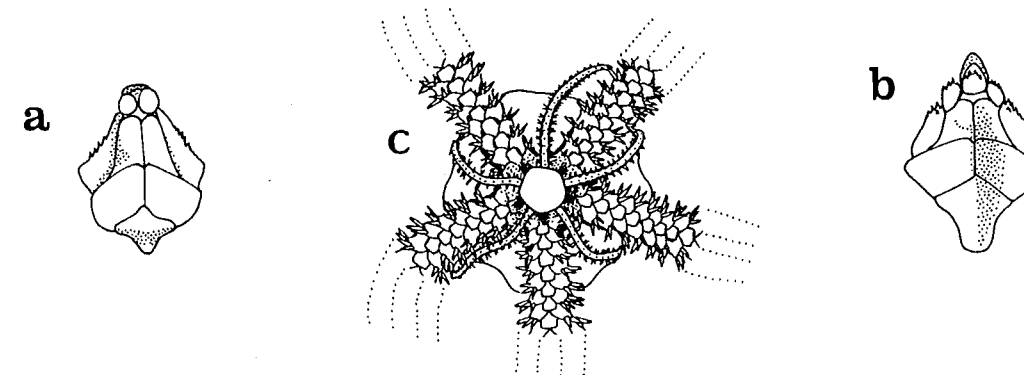


FIG. 32. Single jaws of: a. *Amphilycus scripta*, b. *Ophiodaphne materna*, holotype. c. Ventral view of disc of female *Amphilycus scripta* with superimposed dwarf male (from Mortensen, 1933a).

- 96 Teeth wide and blunt, a pair of more or less asymmetrical infradental papillae present (fig. 32a); many disc scales and the radial shields marked with short grooves; oral shields wider than long, the distal lobe narrow and very short . . . . . *Amphilycus scripta* (Koehler, 1904)
- 96' Teeth narrow and tapering to a rounded point, with one infradental papilla (fig. 32b); disc scales not grooved; oral shields longer than wide, the distal lobe large . . . . . *Ophiodaphne materna* Koehler, 1930
- 97 Teeth broad and square-tipped but with only a single papilla (or reduced tooth) if any, at the superficial end of the column of teeth, one or two (rarely three) distal oral papillae, usually well spaced from the apex of the jaw, particularly when single (fig. 22e); one fairly large rounded tentacle scale  
**OPHIACTIDAE** . . . . . 98
- 97' Teeth rounded or conical with one or many superficial papillae, if oral papillae are present they form a continuous series up the side of the jaw; often more than one tentacle scale, or if only one then this is elongated and may be pointed . . . . . 115
- 98 Normally two distal oral papillae each side (though odd jaws or individuals may have fewer; six or more arm spines proximally (five in smaller specimens of *savignyi* only) . . . . . 99
- 98' One distal oral papilla; up to five arm spines . . . . . 103
- 99 Commonly six arms, the number ranging from two to seven, the two to four-armed specimens being the immediate result of fission, the six- or seven-armed specimens having regenerated, though a few five-armed specimens do occur; dorsal arm plates elliptical with a more or less distinct small median distal lobe often emphasized by a pair of dark spots, one each side, so that the whole plate appears tri-lobed (fig. 31b); colour conspicuously variegated green and white (pl. 14, fig. 4)  
*Ophiactis savignyi* (Müller & Troschel, 1842)<sup>25</sup>

<sup>24</sup> The holotype and only recorded specimen of *Amphioplus caelatus* has d.d. only 2 mm. and may well prove to be an immature specimen of another nominal species; only the great geographical separation (western Indian Ocean—Hawaiian Islands) deters me from referring it to the synonymy of *A. integer*.

<sup>25</sup> *Ophiactis savignyi* is a 'tropicopolitan' species, occurring in both Atlantic and Indo-Pacific in the tropics and is sympatric over various parts of its range with similarly fissiparous members of the genus *Ophiactis* which have single distal oral papillae, relatively broader dorsal arm plates, four or five tapering arm spines rather than about six very blunt ones and blue rather

- 99' Five arms, not self-dividing; dorsal arm plates not distinctly trilobed . . . . . 100  
 100 Adoral shields large, meeting broadly interradially and sometimes also radially; arms either relatively long (c.8 × d.d.) or short (c.4 × d.d.) . . . . . 101  
 100' Adoral shields small (obscured by skin in *picteti*); arm length moderate (c.6 × d.d.) . . . . . 102  
 101 Oral shields distinctly longer than wide; arms relatively short, c.4 × d.d. . . . .  
     *Ophiactis brevis* H. L. Clark, 1938  
 101' Oral shields much wider than long; arms long, at least 8 × d.d. . . . . *Ophiactis hemiteles* H. L. Clark, 1915b  
 102 Oral shields obscured by skin; radial shields approximating distally but not contiguous for any length . . . . .  
     *Ophiactis picteti* (de Loriol, 1893b)  
     *Ophiactis sinensis* Mortensen, 1934  
 102' Oral shields distinct; radial shields contiguous distally . . . . . 104  
 103 Dorsal arm plates fan-shaped throughout, only narrowly in contact (fig. 31d) . . . . . 104  
 103' Dorsal arm plates elliptical or quadrilateral (except in juvenile specimens or towards the arm tip in adults), broadly in contact (fig. 31e) . . . . . 109  
 104 Five arms; radial shields comparatively large, their length c. half the disc radius; adoral shields widely separated interradially; four or five arm spines . . . . . *Ophiactis delagoa* Balinsky, 1957  
 104' Usually six arms, though five-armed individuals also occur; radial shields small or moderate in size, less than half the disc radius; adorals approximating or meeting interradially; three or four arm spines, except in *brachyura* which may have five proximally . . . . . 105  
 105 Arms relatively very short, only two or three times the d.d.; four or five arm spines proximally . . . . .  
     *Ophiactis brachyura* Döderlein, 1898<sup>26</sup>  
 105' Arms moderate in length, usually five or six times the d.d.; three or four arm spines proximally . . . . . 106  
 106 Radial shields small, little larger than the adjacent disc scales; arm spines conical . . . . .  
     *Ophiactis parva* Mortensen, 1926<sup>26</sup>  
 106' Radial shields moderate in size, distinctly larger than the disc scales; middle arm spines usually blunt at the tip . . . . . 107  
 107 Arm spines short and thick, the middle ones only about twice as long as their basal breadths and distinctly shorter than the segment . . . . . *Ophiactis delicata* H. L. Clark, 1915b<sup>26</sup>  
 107' Middle arm spines as long as the segment, more than twice as long as wide . . . . . 108  
 108 Disc spinelets with hyaline tips. . . . . *Ophiactis lymani* Ljungman, 1871<sup>26</sup>  
 108' Disc spinelets rare or absent . . . . . *Ophiactis acosmeta* H. L. Clark, 1938<sup>26</sup>  
 109 Radial shields small and inconspicuous; adoral shields meeting widely interradially; distal oral papilla thick and fairly narrow . . . . . *Ophiactis carnea* Ljungman, 1867b  
 109' Radial shields relatively large, their length equal to c. half the disc radius; adoral shields not meeting interradially within the oral shields; distal oral papilla broad and scale-like . . . . . 110  
 110 Dorsal arm plates not more than twice as wide as long; no green in coloration . . . . .  
     *Ophiactis fuscolineata* H. L. Clark, 1938  
 110' Dorsal arm plates at least twice as wide as long and often much wider, in larger specimens (d.d. > 6 mm.) the distal edge of these plates usually straight or even slightly concave, only convex at the bases of the arms; colour pattern usually including green (tending to turn to blue in preserved specimens) . . . . . 111  
 111 Adoral shields not meeting radially between the first and second ventral arm plates . . . . . 112  
 111' Adorals meeting radially and separating the first ventral arm plate from the second . . . . . 113  
 112 Oral shields with a prolonged distal lobe, length > breadth . . . . . *Ophiactis conferta* Koehler, 1905a<sup>27</sup>  
 112' No marked distal lobe to the oral shields, length < breadth. . . . . *Ophiactis versicolor* H. L. Clark, 1939<sup>27</sup>  
 113 Colour yellowish-brown when preserved . . . . . *Ophiactis quadrispina* H. L. Clark, 1915b<sup>27</sup>  
 113' Colour pattern including green (or blue) . . . . . 114

than green in the coloration (at least in the preserved state). In spite of all these differences, such specimens may be confused with *O. savignyi* since they are also epizoic on various sedentary or sessile invertebrates as well as being superficially rather similar and likewise fissiparous. In the West Indies the name given to the species sympatric with *savignyi* is *Ophiactis muelleri* Lütken, 1856 (*Vidensk. Meddr. dansk naturh. Foren.*, p. 12), while in the Indo-West Pacific various names have been used, included here under numbers 112 to 114, of which the oldest is *O. maculosa* von Martens, 1870 but the most widely used is *O. modesta* Brock, 1888. I believe that a detailed study may show that Atlantic and Indo-Pacific specimens are conspecific, so that we have a second tropicopolitan species of *Ophiactis*.

<sup>26</sup> The distinction of most of these species of *Ophiactis* is rather unsatisfactory in view of the small size of many of the type specimens (d.d. often < 3 mm.), the extensive (sometimes inter-oceanic) ranges already suggested for some species of the genus and the considerable variation in many of the morphological characters, notably the occurrence of disc spinelets, the proportions of the radial shields and the form of the oral and adoral shields. Possibly some of them represent younger stages of the nominal species in the following part of the key (i.e. 109-114), the fan-shaped form of the dorsal arm plates being a juvenile character.

Döderlein (1898) has recorded as *Ophiactis macrolepidota* Marktanner-Turneretscher two specimens from Amboina which appear to fall within the group of species derived from 104'. The type-locality of *macrolepidota* is 'Sidney' (presumably Sydney, NSW) but Marktanner's figures are poor and the species has not since been recognized among Australian specimens of *Ophiactis*.

- 114 Four arm spines, not exceeding the segment in length . . . . . *Ophiactis maculosa* von Martens, 1870<sup>27</sup>  
 114' Five arm spines, the second longer than the segment . . . . . *Ophiactis modesta* Brock, 1888<sup>27</sup>  
 115 No oral papillae, each jaw crowned with a more or less compact cluster of apical tooth papillae (fig. 22g) . . . . .  
     **OPHIOTRICHIDAE** 116  
 115' Oral papillae present on the sides of the jaws, apically either a cluster of tooth papillae or one or a few larger oral papillae . . . . . 199  
 116 Radial shields flat or only slightly convex . . . . . 117  
 116' Each radial shield with a more or less high longitudinal crest (fig. 33) . . . . . 196<sup>8</sup>

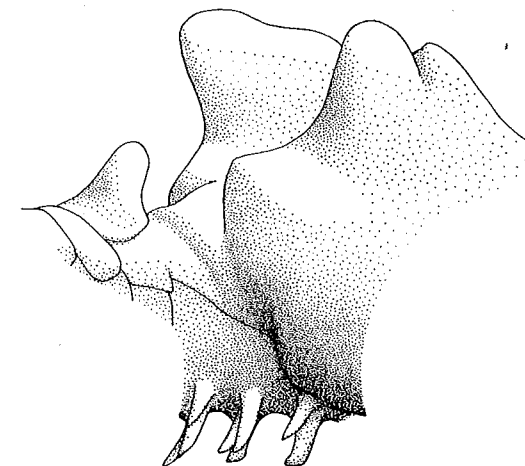


FIG. 33. Oblique side view of an arm base of *Ophiolophus* sp., Bassett-Smith Bank, N Australia, showing the crests on the radial shields and first dorsal arm plate.

- 117 Arms primarily flexible horizontally, dorsal and ventral arm plates well-developed and normally entire, the dorsal plates rarely (in some individuals of *Macrophiolithrix longipeda* or *Ophiolithrix (Keystonea) irregularis* for instance) split into two, nearly always naked but occasionally armed with scattered fine thornlets or inconspicuous grains; the skin covering the arms transparent, not concealing the limits of the plates; habit usually free-living, not essentially epizoic (except for the young of some species) (pls. 15, 16 & pl. 17, fig. 2) . . . . . 118  
 117' Arms flexible dorso-ventrally, the vertebrae modified, the distal ends of the arm particularly tending to curve or even to coil downwards, the cross-section of the arm more nearly cylindrical than flattened; except in *Ophiomaza* (pl. 17, fig. 1) the dorsal and ventral arm plates modified, either reduced, sometimes even lost, or fragmented, in both cases the arms covered with more or less thick skin, or else the dorsal side with granules or tubercles, sometimes forming a continuous coat and extending on to the disc; this dorso-ventral flexibility usually (possibly always) correlated with an epizoic or even commensal habit, associations not only with gorgonians being recorded but also with such forms as crinoids, cidarids and pennatulids (pl. 14, figs. 5-12)<sup>28</sup> . . . . . 187

<sup>27</sup> The types of all five of these nominal species are evidently very similar. Since some of the characters which have been used to distinguish them, such as the extent of the scaling on the ventral side of the disc and the occurrence of a distal lobe to the oral shield, are very variable, I think that most of them will prove to be synonyms. Unfortunately the oldest name *maculosa*, is based on a single poorly-described specimen (d.d. only 3 mm.) and until this has been re-examined, if it still exists, this question cannot properly be resolved. The extent of the adoral shields in *maculosa* is assumed here to be as in *modesta*. Döderlein (1896) and Brock himself commented that *modesta* may be synonymous with *maculosa*; the differences in the arm spines which are the only ones to emerge from the short description of *maculosa* are almost certainly attributable to the different sizes of the type specimens. The number of arms does not give a reliable distinction.

See also note 25.

<sup>28</sup> Döderlein (1898b) has described some miniature ophiuroids taken from the arms of comatulids at Thursday Island, Torres Strait, as a new genus and species, *Ophiophthirus actinometrae*, referring it to the Ophiotrichidae since the jaws appear to bear only a few apical papillae, which he assumed are tooth papillae. The characters displayed by these specimens are mostly those common to juvenile ophiuroids of many species, for instance the great extent over the disc of the primary rosette and the presence of only two arm spines. Mortensen (1933a) has described a very similar little ophiuroid, *Nannophiura lagani*, epizoic on *Lagamum* at 25+ m. in the East Indies, of which the only difference from *Ophiophthirus* may be the arrangement of what Mortensen thinks are oral papillae, prompting him to include the species in the family Amphiuroidae. How much of the similarity is correlated with the epizoic habit remains to be seen but I think it possible that the type-material of both nominal species will prove to be juveniles of species which are familiar to us in the adult stage, as Matsumoto (1917) and Fell (1960) have also commented, at least in regard to *Ophiophthirus*, and which are probably free-living. It is significant that Mortensen found no trace of gonads in sections of *N. lagani*, of which the types have d.d. only 0.5 mm. The types of Döderlein's *O. actinometrae* are hardly any larger, 0.7-0.8 mm. d.d. *Ophiophthirus* could well be the young of *Ophiomaza*, which is similarly epizoic (if not even parasitic) on comatulids, but the epizoic habit may be only transitory and the adult of *Ophiophthirus* a free-living form.

- 118 Dorsal side of the disc covered with the huge radial shields separated by only narrow bands of granule-covered scales, which are not much narrower interradially than radially (pl. 17, fig. 2); disc skin-covered ventrally, lacking scales<sup>29</sup> . . . . . *Ophiocnemis marmorata* (Lamarck, 1816)
- 118' Dorsal disc scales either armed with spinelets, spines or stumps (these last sometimes short and approximating in form to granules but even then armed with little thorns), alternatively the scales bare, at least dorsally; radial shields large or small though rarely more than two-thirds the disc radius in length, either bearing stumps or granules or else bare; ventral side of the disc usually with scales, at least peripherally . . . . . 119
- 119 Dorsal disc scales without armament (rarely with sparse short inconspicuous stumps or blunt spinelets centrally in specimens of a few species when d.d. is >10 mm.), though stumps are present on the peripheral and ventral scales<sup>30</sup> . . . . . 120
- 119' Dorsal side of the disc with some sort of armament on the scales, though the radial shields are often more or less bare . . . . . 128
- 120 Dorsal arm plates pentagonal or rhombic (the proximal angle being more or less truncated), with a marked distal angle and hardly, if at all, wider than long; adult size only about 5 mm. d.d.; no trace of an immature *Ophiopleron*-stage with the arm spines webbed . . . . . *Lissophiothrix delicata* H. L. Clark, 1938<sup>31</sup>
- 120' Dorsal arm plates hexagonal, elliptical, trilobed or broad fan-shaped, markedly broader than long and broadly contiguous (fig. 34); size often large, d.d. frequently exceeding 12 mm.; small specimens (d.d. < 5 mm.) often with the arm spines more or less webbed . . . . . 121

**OPHIOTHRIX** (subgenus **KEYSTONEA**) 121

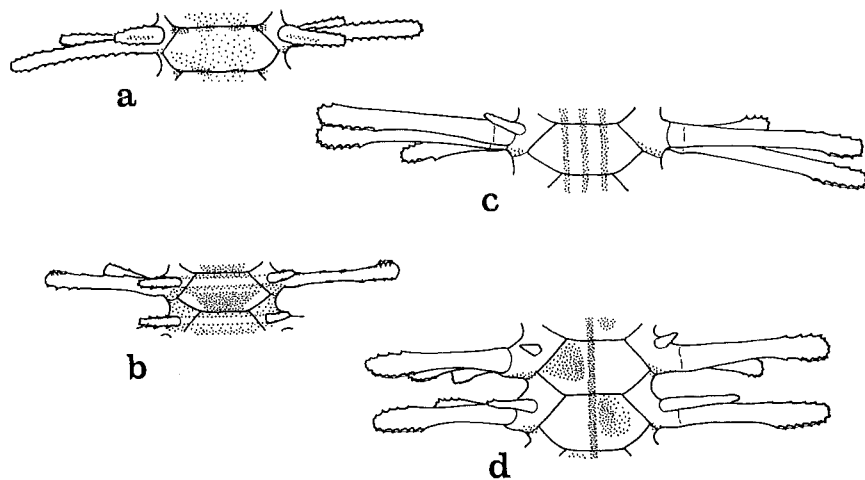


FIG. 34. Dorsal view of proximal arm segments of: a. *Ophiothrix (Keystonea) propinqua*, b. *O. (Keystonea) nereidina*, c. *O. (Keystonea) martensi martensi*, d. *O. (Keystonea) martensi australis*.

- 121 Dorsal arm plates irregular, many of them fragmented<sup>32</sup> . . . . . *Ophiothrix (Keystonea) irregularis* (H. L. Clark, 1938)
- 121' Dorsal arm plates regular and mostly entire . . . . . 122
- 122 Arms with continuous longitudinal markings dorsally, either a median dark line, or else a light line usually with darker edges . . . . . 123
- 122' Arms either variegated or with transverse markings or uniformly coloured, sometimes the variegations forming two discontinuous lines but not extending for the whole of the length of the arm . . . . . 125

<sup>29</sup> *Ophiocnemis venusta* de Lorient, 1900, with the vertebrae of its arms showing through the surface both dorsally and ventrally (evident from de Lorient's figures though not from his description), together with granulated radial shields and spaced disc scales obscured by skin, is clearly not congeneric with *O. marmorata* but is referable to *Ophiothela*.

<sup>30</sup> Some individuals of species of the *plana*-group of *Ophiothrix* may have the dorsal armament of the disc reduced or even absent altogether; these specimens differ from the subgenus *Keystonea* in having narrowly contiguous dorsal arm plates but this character fails to distinguish them from *Lissophiothrix* as described (unfortunately not figured) by H. L. Clark (1946).

<sup>31</sup> Both *Lissophiothrix delicata* and *Ophiotrichoides lymani* Ludwig from the Atlantic are closely related to *Ophiothrix* sensu stricto, which they resemble in the arm structure, differing only in the disc armament, which is lacking above in *Lissophiothrix* and also below in *Ophiotrichoides*. One cannot help suspecting that both are based on deficient specimens of *Ophiothrix* sensu stricto, though as many as 34 specimens of *L. delicata* were studied by H. L. Clark.

<sup>32</sup> Some specimens of *Ophiothrix (Keystonea) martensi* particularly have been recorded in which a number of the dorsal arm plates are subdivided and I suspect that the holotype of *irregularis* may prove to be conspecific with *martensi*. As for *Ophiothrix vindex* Koehler, 1930, I have no doubt that this is a synonym of *O. (Keystonea) martensi*.

- 123 Arms with a median dark line bordered by contrasting light colour, either on both sides together (subspecies *martensi*) (fig. 34c) or alternately on consecutive arm plates giving a zig-zag appearance (*martensi australis*) (fig. 34d); larger upper arm spines with almost smooth shafts and clavate rugose tips . . . . . *Ophiothrix (Keystonea) martensi* Lyman, 1874<sup>33</sup>
- 123' Arms with median light line, usually bordered by a pair of dark lines, though these may be poorly-defined; arm spines thorny for more than half their lengths . . . . . 124
- 124 Arms distinctly carinate dorsally; colour partly greenish, even in preserved specimens; the two radial shields of each pair completely separated, their adradial edges parallel; no elongated stumps on the central disc scales though these may have a slightly tubercular appearance . . . . . *Ophiothrix (Keystonea) smaragdina* Studer, 1883
- 124' Arms not carinate; basic colour blue; radial shields almost contiguous distally, their adradial edges concave; some larger specimens with blunt stumps on the central part of the disc . . . . . *Ophiothrix (Keystonea) vicina* Koehler, 1930<sup>33</sup>
- 125 Arms with a narrow light transverse band (yellow or orange in life) often well-defined by a pair of dark lines across each segment (fig. 34b); disc scales often outlined with contrasting colour; large specimens (d.d. > c.15 mm.) often with a number of tubercles or short blunt spinelets on the central part of the disc . . . . . *Ophiothrix (Keystonea) nereidina* (Lamarck, 1816)<sup>33</sup>
- 125' Arms without conspicuous transverse bands; dorsal disc scales with only scattered and very low tubercles, if any, not concentrated in the centre; d.d. rarely >10 mm. . . . . 126
- 126 Arms more or less symmetrically variegated in colour, predominantly blue but sometimes also partly reddish, often darker bands on the arms at intervals of about four segments, the disc usually a dull dark blue (sometimes long-preserved specimens may be badly bleached but some trace of patterning is usually left) (pl. 15, fig. 7) . . . . . *Ophiothrix (Keystonea) propinqua* Lyman, 1861
- 126' Arms either uniform in colour or with a small dark spot on each dorsal arm plate . . . . . 127
- 127 Seven or eight arm spines (at least at d.d. 8 mm.), the basal ones still retaining traces of the juvenile webbing between them, even at this size; colour uniformly pale . . . . . *Ophiothrix (Keystonea) hymenacantha* H. L. Clark, 1928
- 127' Only six arm spines when d.d. is 8 mm., with no trace of webbing; a small faint dark spot on each dorsal arm plate . . . . . *Ophiothrix (Keystonea) pulchra* (H. L. Clark, 1938)
- 128 Arm spines free, not webbed together by skin into vertical fans (though traces of webbing may be seen proximally in juvenile specimens, d.d. > 5 mm., of a very few species) . . . . . 129
- 128' Arm spines webbed for the entire length of the arm, even when d.d. exceeds 6 mm., basally the webs of each side of the segments often linked together dorsally (pl. 14, fig. 8) . . . . . **OPHIOPTERON** 186
- 129 Dorsal arm plates longitudinally ovate, much longer than wide, often with their edges thickened all round (fig. 35c), barely contiguous, even basally; arm spines very short, the longest less than twice as long as the corresponding segment; the disc densely covered with short trifid stumps, completely concealing the radial shields (pl. 15, fig. 8) . . . . . *Ophiothrix (Theophris) pusilla* Lyman, 1874
- 129' Dorsal arm plates of various shapes, rhombic, fan-shaped, hexagonal, elliptical or polygonal, rarely without lateral angles and then the shape is much broader than long, only thickened at the median distal extremity, if at all, contiguous to some extent for almost the entire arm length; the longest arm spines usually at least twice as long as the corresponding segment; disc either with stumps alone or with spines or spinelets in addition or instead, the limits of the radial shields often distinguishable or even obvious . . . . . 130
- 130 Dorsal arm plates rhombic or fan-shaped, the distal side continuously convex or with a median rounded angle, no extensive median straight edge transverse to the axis of the arm, the plates not more than twice as wide as long and sometimes longer than wide; consecutive plates in contact for usually much less than half their total widths (fig. 35a, b, d); adult size usually moderate, d.d. rarely exceeding 12 mm. . . . . 131
- 130' Dorsal arm plates usually about twice as wide as long or wider, more or less broadly in contact, the distal side usually with a straight (rarely even slightly concave) median part, usually at least half as wide as the whole plate (fig. 35e-j) (in some species of the subgenus *Placophiothrix* the distal side may be continuously

<sup>33</sup> *Ophiothrix vicina* is here referred to *Keystonea* from *Placophiothrix*, between which subgenera it seems to be intermediate, those specimens with stumps on the central disc scales running down to *Placophiothrix* while others with dorsally quite naked discs resemble *Keystonea*. The paratypes with the more naked form appear very similar in Koehler's photographs to *O. (Keystonea) propinqua* except for the continuous line on the arms.

*Ophiothrix andersoni* Duncan, 1887, is clearly a synonym of *O. (Keystonea) nereidina*, since it shares the distinctive transverse linear pattern.

After this monograph had gone to press I found a paper by Domantay and Domantay (1967) on Philippine ophiuroids which includes a description and figure of *Macrophiothrix clementii* Domantay, 1957 (b, *Araneia J. Agric.* (14) not available in libraries searched for the Zoological Record). Judging from the very distinctive colour pattern, *M. clementii* appears to be based on a large specimen (d.d. 15 mm.) of *Ophiothrix (Keystonea) nereidina* in which the dorsal disc scales of the interradii as well as the centre bear thorny stumps. The single specimen which Domantay and Domantay refer to (*Ophiotrichoides nereidina*) has d.d. only 5 mm. and the disc is presumably naked above.

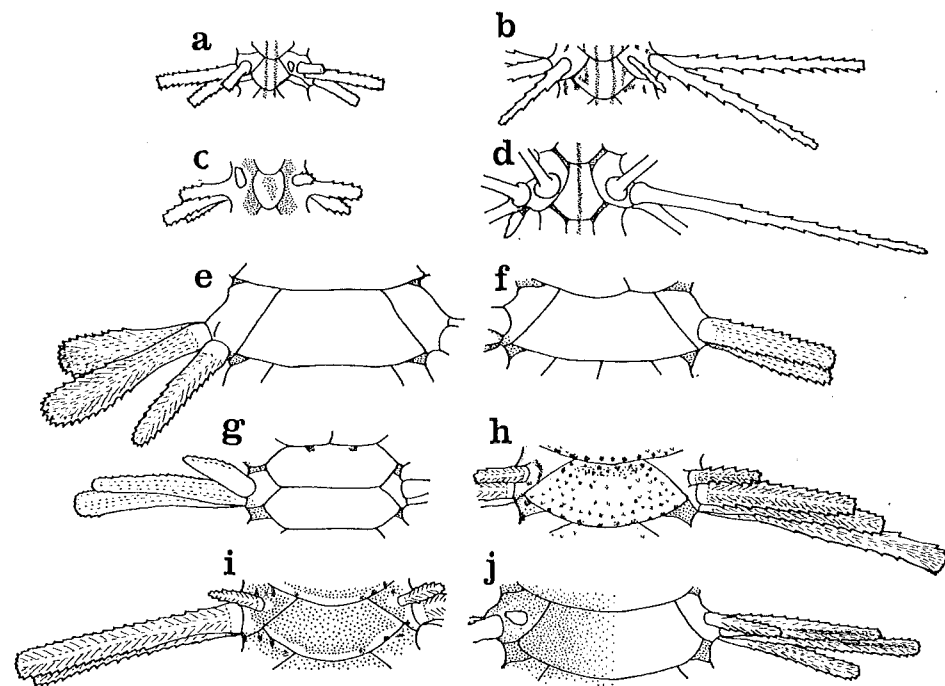


FIG. 35. Dorsal view of proximal arm segments of: a. *Ophiothrix (Ophiothrix) ciliaris*, b. *O. (Ophiothrix) trilineata*, c. *O. (Theophrix) pusilla*, d. *O. (Acanthophiothrix) purpurea*, e. *Macrophiothrix belli*, f. *M. longipeda*, g. *M. robillardii*, h. *M. hirsuta hirsuta*, i. *M. aspidota* and j. *M. megapoma*, holotype.

curved in smaller specimens, d.d. < 5 mm.); adult size often large, d.d. 10–20 mm. in many species, sometimes up to 35 mm.

131 Dorsal arm plates wider than long (fig. 35a, b); arm segments not attenuated, the consecutive spine ridges usually spaced from each other by about their own width; radial shields sometimes quite bare but more often with some short stumps, though these are generally more sparse than on the disc scales, among which there may be some spinelets or spines; arm spines rarely more than four times the corresponding segment length, usually about three times (pl. 15, figs. 1–3) . . . . . **OPHIOTHRIX** sensu stricto<sup>34</sup> 132

131' Dorsal arm plates at least as long as wide, often longer (fig. 35d); the arm segments attenuated so that the spine ridges are well separated; radial shields usually completely naked, rarely with a few peripheral stumps, especially adradially, the shields often very large and conspicuous, about two-thirds the disc radius in length; disc armament usually sparse, not concealing the underlying scales, consisting of a few long slender needle-like spines or occasionally some thorny stumps; arm spines, especially the basal and uppermost ones, very long and needle-like, in extreme cases even approximating in length to the disc diameter and regularly up to five or more times the segment length (pl. 15, figs. 4, 5, 11)

**OPHIOTHRIX** (subgenus **ACANTHOPHIOTHRIX**)<sup>34</sup> 148

<sup>34</sup> As another estimate for the degree of attenuation of the arms, in *Ophiothrix savignyi* the ratio of segment length to its minimum breadth is usually about 1:2 for the proximal segments, whereas in such species as *O. (Acanthophiothrix) purpurea* the ratio is between 1:1.0 and 1:1.5 and occasionally the segments may even be longer than wide.

*Ophiothrix vitrea* Döderlein, 1896 and *O. dirrhabdota* H. L. Clark, 1918 fall between these two alternatives, having the dorsal arm plates as long as wide or longer but at the same time the disc scales and radial shields obscured by trifold stumps (and thick skin in the case of *dirrhabdota*). Döderlein compared *O. vitrea* with *O. pusilla* (now referred to the subgenus *Theophrix*) but its arm spines are much longer, up to four times the corresponding segment length as opposed to less than twice the segment length in *pusilla*, where the shape of the elongated dorsal arm plates is ovate and the trifold stumps have short rather than long points. Döderlein does not mention lateral angles to the dorsal arm plates of *vitrea* but, as he notes that the distal edge is strongly convex and much wider than the proximal, they are probably elongate fan-shaped, as Koehler's rather indistinct photographs of 1922(a) also suggest. *O. dirrhabdota* differs from *vitrea* in having arm spines up to only two and a half times as long as the segment and numbering five or six rather than seven. *O. vitrea* also falls between the two parts of no. 132 dividing the species of *Ophiothrix* sensu stricto, since it has ventral arm plates with the distal edge straight or convex but the disc stumps trifold rather than multifid.

The *Ophiothrix plana*-group of species, which should run down to no. 141 of this key (namely *O. foveolata*, *abstinens*, *marginata*, *plana*, *lidisca*, *prostrata*, *tristis* and *trilineata*) is also intermediate between 131 and 131' but with the opposite combination of characters, the dorsal arm plates being wider than long (except in the relatively immature type-material of *marginata*) but the disc sparsely armed and the radial shields bare. These species are intermediate between *Ophiothrix* sensu stricto and the subgenus *Placophiothrix*, as well as having some affinities with the subgenus *Keystonea*. Since their dorsal arm plates

- 132 Ventral arm plates with the distal edge convex or straight; disc stumps usually multifid, most often with five or six points<sup>35</sup> . . . . . 133
- 132' Ventral arm plates with the distal edge distinctly concave; disc stumps (when present) usually trifold, though the peripheral ones may develop extra points as well as being elongated; stumps sometimes absent, leaving only spines or spinelets to make up the armament<sup>35</sup> . . . . . 136
- 133 Dorsal arm plates armed with fine thorns, especially near the distal edge; radial shields with only a few spaced stumps near the proximal end; arm spines opaque . . . . . *Ophiothrix miles* Koehler, 1905a 1905a
- 133' Dorsal arm plates without multiple thorns along the distal edge though there may be a median proximal or distal thorny stump like the disc stumps but smaller; radial shields usually with a more or less continuous covering of stumps, though these may be shorter and more sparse than on the rest of the disc; arm spines usually glassy . . . . . 134
- 134 No median stump, tubercle or spinelet on the dorsal arm plates (fig. 35a); arms usually marked with a longitudinal light line bordered by two narrow dark lines, rarely by a single broad median dark line . . . . . *Ophiothrix ciliaris* (Lamarck, 1816)<sup>36</sup> 134
- 134' Many dorsal arm plates with a single median stump, tubercle or spinelet placed near the junction of consecutive plates; colouration of the arm consisting primarily of transverse markings, if any . . . . . 135
- 135 Dorsal arm plates with a median distal spinelet bounded on each side by a dark purple spot . . . . . *Ophiothrix contenta* Koehler, 1930<sup>37</sup> 1930
- 135' Many dorsal arm plates with a proximal tubercle; a broad light coloured chevron across the distal part of each plate . . . . . *Ophiothrix echinotecta* Balinsky, 1957<sup>37</sup> 1957
- 136 Radial shields bearing some or many short, thorny-tipped, usually trifold stumps, often obscuring their limits; disc scales usually also obscured by stumps, sometimes intermixed with spines (see pl. 15, fig. 1) . . . . . 137
- 136' Radial shields quite bare; armament of disc scales rather sparse, hardly at all concealing the limits of the scales, often almost naked above (see pl. 15, figs. 2, 3) . . . . . 141
- 137 Dorsal arm plates armed with fine thorns, especially near the distal edge . . . . . *Ophiothrix savignyi* (Müller & Troschel, 1842)<sup>38</sup> 1842

have the distal edge continuously curved I consider that they are better retained in *Ophiothrix* s.s. (as diagnosed in my review of the genus (A.M.C., 1967b).

See also note 38.

<sup>35</sup> The holotype of *Ophiothrix elegans* Lütken, 1869, was described by Lütken as having disc stumps with two or three points and Koehler (1904) confirmed this. If this condition was normal, then *O. elegans* cuts across this dichotomy since its ventral arm plates appear to have straight distal edges (from Koehler's figure of the type). H. L. Clark (1946) considers that the Philippine specimen referred to *elegans* by Koehler in 1922(a) is conspecific with *O. melanogramma* Bell, which he himself ranks as a form of *O. stelligera* Lyman, 1874 (here referred to the synonymy of *O. ciliaris* (Lamarck)), this form being distinguished by the broad single dark stripe along the arms. This would seem to me a likely identity for the holotype of *O. elegans* were it not for the disc stumps and I cannot understand H. L. Clark's reference of *elegans* to *Placophiothrix*. A re-examination of the holotype of *elegans* and study of further material from the type-locality—the China Sea—is needed to clarify its relationships. Certainly the holotype of *O. melanogramma* has five or six points on most of its stumps and is undoubtedly conspecific with *ciliaris*, one of Lamarck's syntypes of which also shares the single broad dark arm stripe (Koehler, 1922a, pl. 52, fig. 7).

<sup>36</sup> Koehler (1922a) found that *Ophiothrix stelligera* Lyman is conspecific with *Ophiothrix ciliaris* (Lamarck, 1816) but persisted in using the later name because he said that Lamarck's material was in poor condition. As he simultaneously provided photographs of Lamarck's three syntypes of *ciliaris*, which he had described fully in 1904, and the one shown in pl. 53, figs. 6 and 7 appears to be quite well preserved and recognizable there seems to be no excuse for setting aside the priority of the name used by Lamarck.

Apart from *O. melanogramma* Bell (which name could be retained for the colour form with a single broad dark stripe on each arm, as H. L. Clark proposed in 1946) I consider that *O. carinata* von Martens, 1870 is also a synonym of *ciliaris*. Koehler described type-material of both in 1904 without comparing them directly. The apparent differences from his descriptions include the extent of the disc stumps on the lower surface, the shape of the tentacle scale, the carination of the dorsal arm plates and the development of thorns on the basal parts of the arm spines. Thanks to the authorities of the Oslo Museum I have been able to examine a number of specimens from Singapore, the type-locality of *O. carinata*, to compare them with material of *O. ciliaris* from various other localities. I can find no significant difference in the Singapore specimens since all these characters seem to be variable and not necessarily correlated with one another; particularly the carination of the arms is very marked in some specimens of *ciliaris* from other localities.

<sup>37</sup> In a specimen from Zanzibar in the British Museum collections named *Ophiothrix echinotecta* by me from its relative proximity to the type-locality of that nominal species, the median spinelet usually arises right at the junction of successive plates so that it is difficult to say whether it is proximal or distal with respect to the individual segments. A specimen from the collections of the Great Barrier Reef Expedition, which H. L. Clark named *O. stelligera*, has one or more small thorny median stumps near the proximal end of most of the dorsal arm plates and also has broad light chevrons across the distal part of many of the plates, as in *echinotecta*. Possibly there is a single wide-ranging species characterized by such median arm stumps which might prove to be the long-lost *Ophiothrix parasita* Müller & Troschel, 1843, from Australia, this having been described as having a median distal tubercle on each dorsal arm plate.

See also note 63.

<sup>38</sup> *Ophiothrix otiosa* Koehler, 1898, from the Malabar coast, is here considered to be a synonym of *O. savignyi*, as H. L. Clark suggested in 1939.



- 153 No disc spines; arms with longitudinal series of dark spots corresponding to the dorsal arm plates in the type and only recorded specimen . . . *Ophiothrix (Acanthophiothrix) deceptor* Koehler, 1922a
- 153' Disc spines more or less numerous; usually a continuous dark line on the arms (though West Pacific specimens may have this interrupted) (figs. 35d, 36; pl. 15, figs. 4, 11)  
*Ophiothrix (Acanthophiothrix) purpurea* von Martens, 1867<sup>46</sup>
- 154 More than six arm spines basally . . . . . 155
- 154' Up to six arm spines . . . . . 156
- 155 Ventral side of disc almost completely naked; ventral arm plates with the distal edge concave  
*Ophiothrix (Acanthophiothrix) scotiosa* Murakami, 1943
- 155' Ventral side of disc with a more or less extensive covering of spinelets; ventral arm plates narrow hexagonal, with the short distal edge straight . . . . .  
*Ophiothrix (Acanthophiothrix) picteti* de Loriol, 1893b
- 156 Colour (when dried) deep purple dorsally with lighter variegations on the disc and a series of light triangular patches along the arms, not necessarily corresponding to the dorsal arm plates  
*Ophiothrix (Acanthophiothrix) leucotrigona* H. L. Clark, 1918
- 156' Colour greyish with dark blue spots on the radial shields and arms  
*Ophiothrix (Acanthophiothrix) spinosissima* Koehler, 1905a
- 157 Arm length usually six to nine times the d.d., rarely (*virgata*) ten to twelve times; radial shields usually conspicuously bare, rarely with a few stumps, contrasting sharply with the moderately large disc scales and their armament, which consists of spaced, fairly smooth spines (rarely needle-like), spinelets or (in *fumaria*) spaced stumps, the scaling usually distinguishable; disc not markedly puffy interradially in preserved specimens (or inflated in live ones), though sometimes swollen interradially by the genital products; arm spines often distinctly opaque; d.d. commonly 10–15 mm. (pl. 15, figs. 6, 9, 10)<sup>47</sup>  
**OPHIOTHRIX** (subgenus **PLACOPHIOTHRIX**) 158
- 157' Arms usually at least ten times the d.d., up to twenty times, rarely (*M. speciosa*, *hirsuta cheneyi* and *calyptaspis* only seven to nine times); radial shields usually with some or many thorny granules or short stumps similar to, but shorter than, the stumps on the rest of the rather puffy disc, which completely obscure the countless underlying scales; several species (e.g. *aspidota*), however, with the radial shields more or less bare; arm spines usually transparent; adult size large, d.d. commonly 15–20 mm., up to c. 35 mm. (pl. 16, figs. 1–7)<sup>47</sup> **MACROPHIOTHRIX** 165
- 158 Disc scales with short stumps only two or three times as long as wide, having thorny blunt tips  
*Ophiothrix (Placophiothrix) fumaria* Müller & Troschel, 1842<sup>48</sup>
- 158' If stumps are present at all, it is only in conjunction with spines but the usual armament is spinelets or spines 0.5–1.0 mm. long . . . . . 159
- 159 Arms marked dorsally with scattered dark spots, sometimes forming one or two longitudinal series, or else variegated or uniformly coloured, no well-defined light median longitudinal stripe . . . . . 160
- 159' Arms with a median light stripe usually bordered by a pair of dark continuous longitudinal stripes . . . . . 162

<sup>46</sup> To the list of synonyms of *Ophiothrix purpurea*, namely *lepidus* de Loriol (according to H. L. Clark, 1938) and *fallax* de Loriol (according to A. M. Clark, 1952) is now added *O. lorioli* Döderlein, 1896. The type of *lorioli* was less than half the size of Döderlein's specimen of *purpurea*, both being from Amboina, and although he described it as simply white in colour his figure shows a dark median stripe on each arm, as characteristic of *purpurea*. Döderlein also probably failed to appreciate the great variation in the shape of the radial shields in *purpurea*, noting that those of *lorioli* are very like the shields of *fallax*. It is also possible that the holotype of *O. deceptor* Koehler is conspecific with *purpurea*, since both Brock and Koehler have remarked on East Indian specimens of *purpurea* with the longitudinal dark line broken up into individual spots, which is also the case in a specimen in the British Museum collections from the South China Sea. This last differs from the type of *deceptor* only in having some spines present on the disc, which might be attributable to better preservation.

For other affinities see note 45.

<sup>47</sup> Two species run down to this part of the key but tend to fall between these two alternatives. Firstly *Ophiothrix rotata* von Martens, 1870, is described as having a concave distal side to the dorsal arm plates in conjunction with an arm length of only five times the d.d. and the disc scales and radial shields 'gleichmässig granulirt'. Brock (1888) grouped *rotata* with species such as *stelligera*, *exigua*, *carinata* and *ciliaris* without reference to the dorsal arm plates as being peculiar in comparison with these, so it is probable that von Martens intended to describe them as *convex* distally. Secondly, *O. picturata* de Loriol, 1893a, agrees with *Macrophiothrix* in having short disc stumps but these obscure the outlines of the radial shields, unlike any species of *Macrophiothrix*, and the disc is contracted interradially in the holotype and only known specimen, not puffy. Re-examination of the respective type specimens is needed to settle their true relationships.

<sup>48</sup> *Ophiothrix fumaria* has been referred to *Placophiothrix* (A.M.C. 1967b) since it seems to be related to *O. (Placophiothrix) spongicola* from southern Australia, both having short disc stumps (almost granuliform in *spongicola* at least), the longest arm spines conspicuously clavate and the dorsal arm plates wide with gently convex distal edges. However, if Koehler (1907) is right in stating that Müller and Troschel's holotype of *fumaria* was from the China Sea (its locality was unknown according to them) then it is unlikely that the two are synonymous. The British Museum specimens from N.S.W. referred to *fumaria* by Bell are certainly conspecific with *O. (Placophiothrix) spongicola*.

Large individuals of *O. (Keystonea) nereidina* with some rugose granules or short stumps on the central disc scales may run down to this point in the key; they can be distinguished from *fumaria* by the transverse stripe on each arm segment dorsally.

- 160 Arms relatively short, only about four times the d.d.; only a few slender disc spines (at least in the type-material) . . . . .  
*Ophiothrix (Placophiothrix) eurycolpodes* H. L. Clark, 1918<sup>49</sup>
- 160' Arms at least seven times the d.d. in length; disc armed with more or less stout and numerous spines . . . . . 161
- 161 Spots on arms usually forming a single longitudinal series; some larger specimens uniformly dark above with no discrete spots; tentacle scales wide and rounded, relatively large for an Ophiotrichid; dorsal side of arms distinctly arched, the surfaces of the dorsal arm plates convex (pl. 15, figs. 9, 10)  
*Ophiothrix (Placophiothrix) melanosticta* Grube, 1868a<sup>49</sup>
- 161' Spots tending to form pairs or longitudinal series; tentacle scales very small; dorsal side of arms almost flat  
*Ophiothrix (Placophiothrix) striolata* Grube, 1868a
- 162 Arms relatively long, about twelve times the d.d. (even which this is only 6 mm.); arm spines relatively short, the longest less than twice as long as the segment (at least in the holotype)  
*Ophiothrix (Placophiothrix) virgata* Lyman, 1861
- 162' Arms of moderate length, five to nine times the d.d.; longest arm spines about three times the segment length . . . . . 163
- 163 The two radial shields of each pair almost completely contiguous; longest arm spines about twice as long as the segment and markedly clavate . . . . .  
*Ophiothrix (Placophiothrix) tenera* Brock, 1888
- 163' Radial shields completely separated by a row of scales; longest spines about three times the segment length and not conspicuously clavate, though some are slightly broadened at the tip . . . . . 164
- 164 The two dark lines on each arm continuous with lines running along the adradial edge of each radial shield (pl. 15, fig. 6)<sup>50</sup> . . . . .  
*Ophiothrix (Placophiothrix) lineocaerulea* H. L. Clark, 1928
- 164' No dark lines on the adradial edges of the radial shields<sup>50</sup>  
*Ophiothrix (Placophiothrix) hybrida* H. L. Clark, 1915b
- 165 Arms with three continuous light longitudinal lines dorsally; short spinelets often present among the disc stumps . . . . . 166
- 165' Arms variegated or spotted or otherwise patterned, only a single median light line, if any; disc with thorny stumps of fairly uniform height . . . . . 167
- 166 Colour reddish; dorsal arm plates with very sharp lateral angles; often spinelets present among the disc stumps  
*Macrophiothrix expedita* (Koehler, 1905a)<sup>51</sup>
- 166' Colour bluish; dorsal arm plates with lateral angles of c. 90°; disc armament of uniform stumps  
*Macrophiothrix rhabdota* H. L. Clark, 1915b<sup>51</sup>
- 167 Dorsal arm plates with acute, often prolonged, latero-distal angles, the shape of the plate trapeziform with the distal edge either straight throughout or with a pair of very obtuse angles dividing it into a straight or slightly concave median part and two shorter lateral parts which are hardly at all inclined proximally, so that the widest part of the plate is near or at the distal end (fig. 35e, f), rarely the distal edge slightly convex . . . . . 168
- 167' Dorsal arm plates fan-shaped, hexagonal or elliptical (fig. 35g–j), the distal edge either continuously curved or bent backwards at the sides so that the broadest part is set back from the distal end and may be at or near the middle of the plate, the lateral edges often more or less rounded but if angular then the angle is not less than 90°<sup>52</sup> . . . . . 171

<sup>49</sup> *Ophiothrix eurycolpodes* is newly referred to *Placophiothrix*. The type and paratype are the only specimens recorded and were not in good condition. The red and green colour of the paratype suggests an affinity with *O. (Placophiothrix) melanosticta*, though it evidently lacks the very characteristic black spots of that species; moreover, *melanosticta* is known from the Philippines—the type-locality of *eurycolpodes*. Comparison should also be made between *Ophiothrix foveolata* and *eurycolpodes*. Re-examination of the type-material of *Ophiothrix darwini* Bell, 1884, shows that this is a synonym of *O. (Placophiothrix) melanosticta*.

<sup>50</sup> This is the only difference I can find between the published details of *Ophiothrix hybrida* and the thirteen specimens of *O. lineocaerulea* in the British Museum collections, which show considerable variation in the disc armament. I suspect that the two will prove to be synonymous.

<sup>51</sup> Koehler (1922a) ranks the greyish-blue-coloured *Ophiothrix rhabdota* as a colour variety of *M. expedita*, which is normally some shade of red, though H. L. Clark (1938) refutes this. As noted in 1968, I am inclined to agree with Dr. Clark after seeing a paratype of *rhabdota*, which differs from the single available specimen of *expedita* in the shape of the dorsal arm plates—a character to which I give considerable weight in the family Ophiotrichidae. The bluish Philippine specimens which have been referred to *rhabdota* by Koehler and H. L. Clark need a critical comparison with material from Australia, the type-locality of *rhabdota*.

It is possible that *Ophiothrix dirrhabdota* H. L. Clark, 1918, from the Philippines, is based on young specimens of *M. expedita*; the holotype in the Museum of Comparative Zoology has d.d. only 5 mm. and is reddish in colour with a pair of dark stripes on the arms judging from the photograph.

<sup>52</sup> Despite the elaborate wording of this alternative, some individuals may still be hard to place; for instance, specimens of *M. longipeda* with d.d. < 10 mm. may have almost fan-shaped plates, though the lateral angles are markedly acute; also in *M. megapoma* and several other species that should run down to 167' the distal edge of the plate may be considerably flattened in the middle and the shape could be termed trapeziform. Koehler (1898) so described the dorsal arm plates of *M. speciosa* with the middle part of the distal edge 'déprimé' (presumably concave) but his drawing shows the plates as hexagonal with the lateral edges bent back well laterally, not almost in line with the median part as they are in the *longipeda*-group. *M. speciosa*

- 168 Oral shields armed with several spinelets or stumps along the distal edge similar to those on the ventral scales (fig. 37p) . . . . . *Macrophiothrix koehleri* A. M. Clark, 1968<sup>53</sup>
- 168' Oral shields completely bare . . . . . 169
- 169 Longer arm spines markedly clavate and bushy at the tips with the shafts almost smooth (fig. 35e; pl. 16, figs. 1, 2) . . . . . *Macrophiothrix belli* (Döderlein, 1896)
- 169' Longer arm spines with the sides parallel or only slightly divergent distally and finely thorny for most of their length, not at all clavate (fig. 35f) . . . . . 170
- 170 Radial shields granule-covered; colouration spotted (pl. 16, fig. 4) . . . . . *Macrophiothrix longipeda* (Lamarck, 1816)<sup>54</sup>
- 170' Radial shields predominantly bare; dorsal arm plates outlined in light colour defined by darker markings, usually linear, inset from the edge (pl. 16, fig. 3) . . . . . *Macrophiothrix galateae* (Lütken, 1872)
- 171 Oral shields armed with a number of spinelets or stumps along the distal edge similar to those on the ventral scales . . . . . 172
- 171' Oral shields bare . . . . . 175
- 172 Dorsal arm plates almost flat, the proximal and distal edges more or less equal in length and usually quite straight, the sides convex or angled so that the widest part of the plate is close to the middle of its length; ventral arm plates with the distal edge straight or slightly convex . . . . . 173
- 172' Dorsal arm plates arched or even slightly tent-shaped, the distal edge distinctly longer than the proximal and the lateral angles markedly distal in position, the outline being more or less fan-shaped (fig. 35j); ventral arm plates with the distal edge concave in the middle . . . . . 174
- 173 Dorsal arm plates elliptical, rarely with a suggestion of an angle just distal to the middle of the length; conspicuous dark spots on the arms dorsally . . . . . *Macrophiothrix sticta* H. L. Clark, 1938
- 173' Dorsal arm plates with a distinct though rounded angle just distal to the middle of the length; no dark spots on the arms . . . . . *Macrophiothrix spinifera* H. L. Clark, 1938
- 174 Tentacle scales large and rounded throughout; arms and radial shields often marked with dark spots, sometimes paired and spaced at intervals along the arms (pl. 16, fig. 6)<sup>55</sup> . . . . . *Macrophiothrix megapoma* H. L. Clark, 1938
- 174' Tentacle scales inconspicuous except on the distal parts of the arms; colouration usually more or less uniform, larger specimens often very dark above . . . . . *Macrophiothrix scotia* H. L. Clark, 1938
- 175 Radial shields bare . . . . . 176
- 175' Radial shields more or less densely armed with thorny granules or short stumps . . . . . 179
- 176 Disc stumps elongated, length: breadth c.4:1 . . . . . 177
- 176' Disc armament superficially appearing granuliform, the stumps hardly longer than broad . . . . . 178
- 177 Ventral arm plates almost square, the distal edge straight or slightly convex; arm length less than ten times the d.d. (at least in the holotype) . . . . . *Macrophiothrix speciosa* (Koehler, 1898)
- 177' Ventral arm plates hexagonal, narrower at the proximal end, the distal edge slightly concave; arm length c.16 times the d.d. (at least in the holotype) . . . . . *Macrophiothrix bedoti* (de Loriol, 1893b)
- 178 Disc armament of rugose granules, little longer than broad (fig. 37c) . . . . . *Macrophiothrix robillardii* (de Loriol, 1893a)
- 178' Disc armed with short cylindrical or tapering stumps, length: breadth 2.0-2.5:1 (fig. 37a; pl. 16, fig. 5) . . . . . *Macrophiothrix aspidota* (Müller & Troschel, 1842)
- 179 Dorsal arm plates armed with easily detached low thorny stumps or rugose granules; ventral arm plates relatively narrow, hardly, if at all, broader than long (fig. 37f; pl. 16, fig. 7) . . . . . *Macrophiothrix demessa* (Lyman, 1861)<sup>56</sup>
- 179' Dorsal arm plates either quite smooth or with the surface of the plate itself rugose in texture; ventral arm plates for much of the arm markedly broader than long (except in immature specimens, d.d. < c.8 mm., and in *M. elongata* where the arm length is at least 15 times the d.d., compared with rarely more than ten times in *demessa*) . . . . . 180
- 180 Ventral arm plates relatively narrow, the distal ones longer than wide and the proximal ones about as long as wide (fig. 37g) . . . . . *Macrophiothrix elongata* H. L. Clark, 1938

has very clavate arm spines, bare radial shields and somewhat elongated disc stumps as in *M. belli* but there are nine arm spines basally in the type and only recorded specimen at d.d. only 12 mm. compared with eight in *belli* even at d.d. 22 mm. On the strength of Koehler's figure, *M. speciosa* is included under 167'.

<sup>53</sup> This is a new name for *Ophiothrix galathea*: Koehler, 1922a, non *M. galathea* (Lütken), as noted by me in 1968.

<sup>54</sup> Re-examination of the type-material of *Ophiothrix microplax* Bell, 1884, shows that this is a synonym of *Macrophiothrix longipeda*.

<sup>55</sup> There is some variation with regard to the dorsal arm plates in *Macrophiothrix megapoma*; they may be slightly trilobed distally, as shown in H. L. Clark's figure 22 (1938) but in the holotype and some other specimens in the British Museum collections they are broadly fan-shaped and more or less angular laterally while the whole surface of the plate is more evenly arched than carinate (fig. 35j).

<sup>56</sup> As noted in 1968, *Macrophiothrix mauritiensis* (de Loriol) is almost certainly conspecific with specimens of *demessa* from Hawaii, the type-locality.

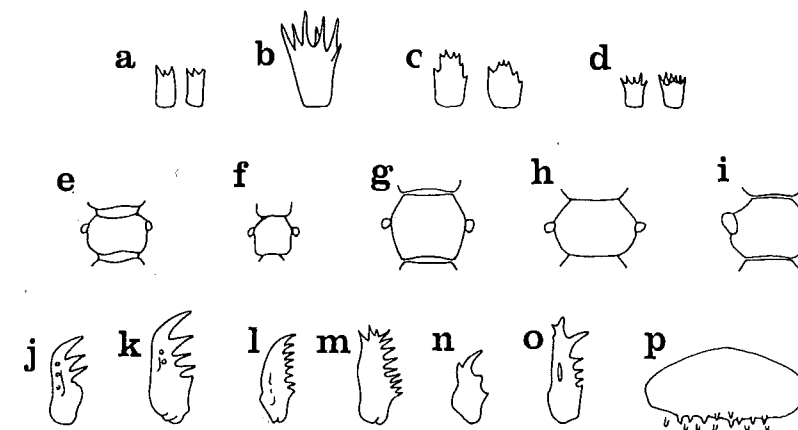


FIG. 37. Disc stumps of: a. *Macrophiothrix aspidota*, b. *M. hirsuta hirsuta*, holotype, c. *M. robillardii*, d. *M. variabilis*. e.-i. Proximal ventral arm plates of: e. *M. calyptaspis*, paratype, f. *M. demessa*, g. *M. elongata*, h. *M. lorioli*, holotype, i. *M. variabilis*. j.-o. Distal lowest arm spines of: j. *M. callizona*, paratype, k. *M. hirsuta hirsuta*, holotype, l. *M. longipeda*, m. *M. lorioli*, holotype, n. *M. rugosa*, holotype, o. *M. variabilis*. p. Oral shield of *M. koehleri*, holotype.

- 180' Ventral arm plates broader than long . . . . . 181
- 181 Ventral arm plates with the distal edge straight or slightly convex (fig. 37h) lowest arm spine distally very stubby with an irregular tip or only a single transparent curved tooth or else comb-like with numerous teeth (fig. 37l-n) . . . . . 182
- 181' Ventral arm plates with the distal edge distinctly concave (sometimes obscured by skin) (fig. 37e, i); the lowest arm spine hook-like with an extensive, more or less transparent, distal part with about three teeth on one side though the very tip may be slightly rugose (fig. 37j, k) . . . . . 183
- 182 Surface of dorsal arm plates strongly rugose; lowest arm spines abbreviated with few, poorly-developed teeth (fig. 37n) . . . . . *Macrophiothrix rugosa* H. L. Clark, 1938
- 182' Surface of dorsal arm plates smooth; lowest spines becoming comb-like (fig. 37m) . . . . . *Macrophiothrix lorioli* A. M. Clark, 1968<sup>57</sup>
- 183 Radial shields bearing short stumps similar to the disc stumps and slightly waisted with the tips most often trifold . . . . . 184
- 183' Radial shields bearing thorny grains; disc stumps more or less flared outwardly and usually multifid with five or more points (fig. 37b, d) . . . . . 185
- 184 Basally 10 or 11 arm spines (at least at d.d. 10 mm.); arm length about ten times the d.d.; disc stumps mostly trifold and tapering . . . . . *Macrophiothrix callizona* H. L. Clark, 1938
- 184' Basally up to eight arm spines (at d.d. c.10 mm.); arm length less than seven times the d.d. (though this might be due to regeneration in the two recorded specimens); disc stumps waisted and with three to six points . . . . . *Macrophiothrix calyptaspis* H. L. Clark, 1938
- 185 Dorsal arm plates smooth, usually somewhat trilobed with a median distal angle; disc stumps very short and broad with three to many small terminal points, length < 0.2 mm. (fig. 37d); lowest arm spines beyond the arm base with somewhat irregular tips beyond the large tooth (fig. 37o) . . . . . *Macrophiothrix variabilis* (Duncan, 1887)<sup>58</sup>
- 185' Dorsal arm plates usually bearing fine rugosities, especially near the distal edge and laterally, the median part of the distal edge flattened or evenly curved (fig. 35h); disc stumps strongly flared, multifid with long transparent points and relatively large, length usually 0.3-0.4 mm. (fig. 37b); lowest arm spines beyond the base perfectly hooked at the tip with the back of the terminal tooth smooth (fig. 37k) . . . . . *Macrophiothrix hirsuta* (Müller & Troschel, 1842)
- 186 Disc stumps with their elongated terminal spinules united by membrane to form funnels (pl. 14, fig. 8) . . . . . *Ophiopteron elegans* Ludwig, 1888<sup>59</sup>
- 186' Spinules of disc stumps without membrane . . . . . *Ophiopteron vitiense* Koehler, 1927b<sup>59</sup>

<sup>57</sup> This is a new name for *Ophiothrix punctolimbata*: de Loriol, 1893b, non *punctolimbata* von Martens, as noted by me in 1968.

<sup>58</sup> Revived in 1968 from the synonymy of *Macrophiothrix hirsuta* at the same time as *Ophiothrix cheneyi* Lyman, with synonym *brevipeda* H. L. Clark, was restored as a subspecies of *hirsuta* ranging along the coast of east Africa and extending into the southern part of the Red Sea.

<sup>59</sup> Mortensen (1932) has expressed a justifiable doubt whether *Ophiopteron elegans* and *vitiense* are really distinct. Koehler's photographs of each of them (1922a and 1927b) show no significant difference in superficial appearance and he notes (1922a) that the stumps in at least one specimen of *elegans* may have only a slight development of membrane.

- 187 Disc very smooth, with neither armament nor thick skin dorsally to obscure the limits of the large radial shields and the few interradial scales (pl. 17, fig. 1) . . . . . **OPHIOMAZA**<sup>60</sup> 188
- 187' Disc covered with thick skin and/or tubercles, spines or granules, sometimes in combination . . . . . 190
- 188 Ventral interradia covered with a pavement of smooth plates; tooth papillae numbering only about eight on each jaw, arranged in two vertical rows . . . . . **Ophiomaza cataphracta** (Brock, 1888)
- 188' Ventral interradia covered with thick skin, though small plates may be seen embedded in it in some specimens, particularly when dried; tooth papillae numerous, some median ones present to form a compact cluster . . . . . 189
- 189 Radial shields moderate in size, their length not more than half the disc radius; arm spines few, only three at d.d. 10.5 mm. . . . . **Ophiomaza moerens** Koehler, 1898
- 189' Radial shields very large, well over half r in length; four to six arm spines (pl. 17, fig. 1) . . . . . **Ophiomaza cacautica** Lyman, 1871
- 190 Arms short, rarely more than about five times the d.d.; dorsal and ventral arm plates reduced or absent so that if the usual dorsal covering of granules or tubercles is sparse or lacking then the vertebrae are just visible through the skin dorsally as well as ventrally; radial shields completely covered with skin, often with granules in addition . . . . . 191
- 190' Arms long, about ten times the d.d. or longer (pl. 14, fig. 7); ventral arm plates well-developed and hiding the vertebrae, dorsal ones more or less fragmented but concealed by the thick skin in spirit specimens; a bare patch of varying extent present on the distal part of each radial shield . . . . . **OPHIOGYMNA** 196
- 191 Entire dorsal surface of disc and arms densely covered with countless minute granules hiding the limits of the radial shields and consecutive arm segments; some individuals with a few additional conical spines interradially, especially marginally<sup>61</sup> . . . . . **Ophiopsammium semperi** Lyman, 1874
- 191' Armament of dorsal side extremely variable, even within single species, ranging from naked skin to a more or less continuous covering of coarse granules often also with conical spines or rounded tubercles, the limits of the radial shields and arm segments usually distinguishable even when a continuous granule-covering is present because of their contours and the arrangement of the granules (pl. 14, figs. 5, 6, 9-12)<sup>61</sup> . . . . . **OPHIOTHELA** 192
- 192 Normally six arms, fissiparous when small so that often three arms and half the disc are diminutive . . . . . 193
- 192' Normally five arms<sup>62</sup> . . . . . 194
- 193 Disc usually more or less red in preserved specimens . . . . . **Ophiothela hadra** H. L. Clark, 1915b<sup>63</sup>
- 193' Disc more often marked with blue, though red may also appear (pl. 14, fig. 5) . . . . . **Ophiothela danae** Verrill, 1869<sup>63</sup>
- 194 Disc and arms completely naked on both sides; preserved specimens usually with a conspicuous colour pattern including a marbled blue and yellow (or buff) pentagon in the centre of the disc with a broad green border extending along the dorsal side of the arms as a green ribbon sharply defined from the grey-blue sides of the arms and disc; usually only four arm spines, rarely up to six on a few basal segments (pl. 14, fig. 9) . . . . . **Ophiothela tigris** Lyman, 1871

<sup>60</sup> *Ophiomaza obscura* has recently (A. M. Clark, 1967b) been referred to *Gymnolophus* since the radial shields are carinate, unlike those of the other species of *Ophiomaza*.

<sup>61</sup> *Ophiothela beauforti* is so variable (pl. 14, figs. 10-12) that I doubt whether *Ophiopsammium* should be maintained as a genus distinct from *Ophiothela*.

Domantay and Domantay (1967; see note 33) describe six species of epizoic supposed Trichasterids, *Astrothamnus lucapensis*, *A. villadolidi*, *Astrothrombus celingae* and *ludingae*, all of Domantay (1957b), *Astrothrombus panningi* and *Bertingius typicus*, both new. The first five of these appear from the figures given to be based on specimens of *Ophiothela* and *Ophiopsammium*, to neither of which were specimens referred by the Domantays. The holotype of *Bertingius typicus* may on the other hand be conspecific with that of *Ophiomastix sexradiata* A. H. Clark, its peculiarities being attributable to the even smaller size.

<sup>62</sup> I do not share H. L. Clark's view that six-armed specimens are necessarily the young of five-armed larger ones.

<sup>63</sup> H. L. Clark's description of the Australian *Ophiothela hadra* is not very detailed and the type has d.d. only 1.7 mm. He compares it with *O. verrilli* Duncan (from Japanese waters), which was subsequently referred to the synonymy of *danae* by Matsumoto, with whom I agree following examination of the holotype of *verrilli*. The comparison used was that *hadra* has relatively shorter arms, hardly over twice the d.d. in the holotype. However, some of the diminutive specimens from Queensland in the British Museum collections have the arm length about five times the d.d. and I doubt whether this distinction is valid, though without better preserved material from Australia I cannot decide whether or not *hadra* can be kept separate from *danae*; certainly the few specimens available are conspicuously redder than those of *danae* which I have seen.

It is just possible that *O. hadra* is conspecific with the type of the long-lost *Ophiothrix parasita* Müller and Troschel, 1843, which was supposed to be collected from among the spines of an Australian cidarid, an association which *hadra* is known to share. In *parasita* there are also median knobs on the dorsal arm plates and the colour is reddish but there is no mention of the arms being other than five in number, the disc is covered with cylinders (stumps), the arm spines number as many as 7 proximally and the size (presumably arm span) is '1 Zoll' (about an inch or 25 mm.), which though small in comparison with the other species of *Ophiothrix* described by Müller and Troschel, is still somewhat larger than *hadra* is said to be.

In addition to *O. isidicola* Lüken and *O. verrilli* Duncan, synonymized with *O. danae* by Matsumoto, I would add *O. caerulea* H. L. Clark, 1915a (but not 1939) and possibly *O. dividua* von Martens, 1879; Mortensen (1940a) has recorded *danae* from the Persian Gulf (the type-locality of *caerulea* assuming 'Arabian Gulf' is a synonym) and a specimen from Muscat (Gulf of Oman) in the British Museum collections is indistinguishable from *danae* in my opinion.

- 194' Some spines or conical tubercles always present on the disc, at least around or below the margin, though the dorsal surface may be naked in some specimens or densely granule- and spine-covered in others, the usual condition intermediate between these two extremes with scattered granules and spines; colour pattern very variable, sometimes a light pentagonal area on the disc but with no sharply defined border and more often a general variegation and narrow transverse banding on the arms, no extensive green colouration; six arm spines, at least proximally. . . . . 195
- 195 Skin of disc and arms fairly thick, obscuring the limits of the radial shields at least; armament extraordinarily variable, ranging from complete absence on the disc dorsally, only marginal spines being present, to a continuous covering of coarse granules with conical tubercles or spines near the centre of the disc, usually some spaced spines centrally and granules especially localized towards the distal ends of the radial shields; arms either with coarse granules in varying density, or with a scattering of very fine grains, or naked (pl. 14, figs. 10-12)<sup>64</sup> . . . . . **Ophiothela beauforti** (Engel, 1949)
- 195' Skin thinner and more transparent on the disc; armament variable but not reaching the same extremes as *beauforti*, always at least a few dorsal spines present; arms with at least one coarse granule on each segment, usually several (pl. 14, fig. 6) . . . . . **Ophiothela venusta** (de Loriol, 1900)<sup>64</sup>
- 196 Scattered conical spines present on the disc centrally, interradially and towards the edges of the radial shields . . . . . **Ophiogymna pellicula** (Duncan, 1876)
- 196' No spines on the disc . . . . . 197
- 197 Arms with a narrow longitudinal light stripe dorsally; disc scales visible through the skin . . . . . **Ophiogymna lineata** H. L. Clark, 1938
- 197' Arms without longitudinal markings; skin of the disc opaque . . . . . **Ophiogymna elegans** Ljungman, 1867b
- 198 One or more tall tubercles or crests on the basal arm segments dorsally (see fig. 33) . . . . . **Ophiolophus novarae** Marktanner-Turneretscher, 1887
- 198' No dorsal processes on the arm bases. . . . . **Gymnolophus obscura** (Ljungman, 1867)
- 199 Both tooth papillae and oral papillae present (fig. 22f), the former usually numerous but occasionally (in small specimens of *Ophiopsila* and *Ophiocomella*) few, only two or three (fig. 38a, c-e) . . . . . **OPHIOCOMIDAE** 200
- 199' Only oral papillae present, usually only one apical papilla below the teeth, at most two or three . . . . . 230
- 200 Six-armed fissiparous forms, size small, d.d. up to 7 mm. but rarely exceeding 5 mm.; one tentacle scale (fig. 38a-f) . . . . . 201
- 200' Normally five arms, most species reaching a large size, d.d. sometimes exceeding even 25 mm.; usually two tentacle scales, sometimes one, rarely none . . . . . 202

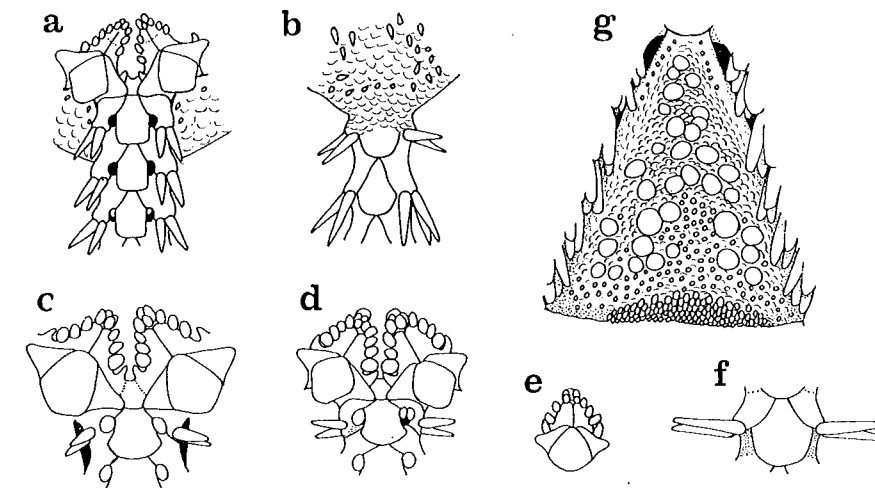


FIG. 38. a, b. *Ophiomastix sexradiata*, holotype, ventral and dorsal views of part of the disc and one arm base. c, d. *Ophiocomella sexradia*, two jaws and the basal arm segments of the holotypes of *Ophiocomella schultzi* (c) and *O. parva* (d). e. A regenerating jaw of the holotype of *O. schultzi*. f. *O. sexradia*, dorsal view of an arm segment. g. *Ophiocoma anaglyptica*, holotype, ventral interradius of disc.

<sup>64</sup> The holotype of *Ophiocnemis venusta* from Singapore with its granules on the distal ends of the radial shields, bare spaced central disc scales and lack of dorsal arm plates (evident from de Loriol's figure if not from his description) is clearly not congeneric with *Ophiocnemis marmorata* but is referable to *Ophiothela*. I cannot distinguish it from some of the John Murray Expedition specimens from the south Arabian coast which H. L. Clark referred to *Ophiothela caerulea* despite their five-armed rather than six-armed state. As already noted, I believe that the holotype of *caerulea* is conspecific with *O. danae*.

- 201 Uppermost arm spine distinctly longer than the lower ones . . . *Ophiomastix sexradiata* A. H. Clark, 1952<sup>65</sup>  
 201' Uppermost spines not distinctly the longest . . . *Ophiocomella sexradia* (Duncan, 1887)<sup>65</sup>  
 202 Disc scales more or less concealed by granules, spinelets or naked skin; tentacle scales ovate, the inner one never conspicuously elongated or inclined over the ventral arm plates . . . 203  
 202' Disc covered with small naked scales; the inner of the two tentacle scales much elongated beyond the basal segments and crossing the corresponding scale of the other pore in the middle of the ventral arm plate, so that the two resemble a pair of crossed swords (fig. 23g) . . . **OPHIOPSILA** 229  
 203 Disc covered, at least dorsally, with a dense coat of rounded granules, the marginal ones either similarly spherical or else very slightly elongated . . . **OPHIOCOMA** 204  
 203' Disc scales either bearing more or less numerous spinelets, sometimes in combination with granules, or else lacking armament altogether and covered with thick naked skin . . . 214  
 204 One to three consecutive segments of each arm, at about a third of the length from the base, with the second from uppermost spine conspicuously enlarged and clavate, the soft tissue around the tip being inflated in wet specimens; size small, not known to exceed 8 mm. d.d. . . *Ophiocoma pusilla* (Brock, 1888)<sup>66</sup>  
 204' If any spines are conspicuously clavate then it is the uppermost ones . . . 205  
 205 Ventral disc scaling partially naked, at least proximally and near the genital slits, often only a shallow V of granules extending below the ambitus of the disc. . . 206  
 205' Disc granulation completely covering the ventral interradial, though sometimes the more proximal granules may be spaced . . . 212  
 206 A number of conspicuous enlarged rounded scales in each ventral interradius (fig. 38g); marginal granules higher than wide<sup>67</sup> . . . *Ophiocoma anaglyptica* Ely, 1944  
 206' Ventral scaling evenly fine; marginal granules spherical . . . 207  
 207 Disc marked with a beautiful pattern of radiating light (golden) lines on a dark brown or black ground (pl. 18, fig. 4); five or six arm spines proximally . . . *Ophiocoma pica* Müller & Troschel, 1842  
 207' Disc either uniformly dark or else variegated; usually three or four arm spines, sometimes five basally . . . 208  
 208 Sporadic uppermost arm spines abruptly and conspicuously clavate and more or less bifurcate at the tip; arm spines distinctly banded dark and light (pl. 18, fig. 5); one tentacle scale for the greater part of the arm . . . *Ophiocoma wendtii*: Koehler, 1907 (pt.)<sup>68</sup>

- 208' Uppermost arm spines usually cylindrical or cigar-shaped, sometimes (some specimens of *erinaceus*) somewhat clavate but then alternate ones on each side of the arm are so modified; arm spines not banded though sometimes spotted; usually two tentacle scales, sometimes only one beyond the basal segments . . . 209  
 209 Colour uniformly dark, above and below . . . 210  
 209' Colour paler on the underside, variegated or sometimes uniformly dark above . . . 211  
 210 Two tentacle scales (pl. 17, figs. 5, 6). . . *Ophiocoma erinaceus* Müller & Troschel, 1842  
 210' One tentacle scale for the greater part of the arm, only one to about six basal segments with two scales . . . *Ophiocoma schoenleini* Müller & Troschel, 1842<sup>69</sup>  
 211 Disc granulation coarse, 3-6 granules/mm. length; uppermost arm spines usually thickened and cigar-shaped or cylindrical, rarely tapering, the longest averaging c.2-5 times the segment length but sometimes exceeding 3.0 times; often no more than four arm spines basally, even at d.d. > 20 mm. (pl. 17, figs. 3, 4) . . . *Ophiocoma scolopendrina* (Lamarck, 1816)  
 211' Disc granulation 'fine' (not precisely described); uppermost arm spines slender and tapering, some of them exceeding three times the segment length (judging from the figure); five spines on some basal segments, even at d.d. only 6.5 mm. . . *Ophiocoma latilanxa* Murakami, 1943<sup>70</sup>  
 212 Many marginal and ventral disc granules distinctly higher than thick; one tentacle scale; mean ratio of arm length:d.d. about 7.0:1 (pl. 18, fig. 1) . . . *Ophiocoma valenciae* Müller & Troschel, 1842  
 212' Marginal and ventral granules spherical like the rest; two tentacle scales; arm length:d.d. up to about 5.5:1 . . . 213  
 213 Disc pale in colour, often tinged with yellow or light green but not conspicuously patterned; arms usually also pale but sometimes with more or less distinct dark bands . . . *Ophiocoma brevipes* Peters, 1851  
 213' Colour of disc either uniformly dark or variegated, reticulated or spotted with dark markings (pl. 18, figs. 2, 3) . . . *Ophiocoma dentata* Müller & Troschel, 1842  
 214 Disc armed with spines, sometimes in combination with granules, occasionally spines rare and restricted to a few marginal ones (*O. venosa* and *flaccida*); a number of the uppermost arm spines more or less conspicuously clavate; one or two tentacle scales, rarely none (pl. 19, figs. 1-5) . . . **OPHIOMASTIX** 215  
 214' Disc completely naked; uppermost spines similar to each other, none abruptly and markedly clavate though some spines may be slightly so; one tentacle scale . . . **OPHIARTHURUM** 227  
 215 No tentacle scales . . . *Ophiomastix flaccida* Lyman, 1874  
 215' One or two tentacle scales . . . 216  
 216 Disc covered with a close armament, consisting either of spinelets alone or mixed and sometimes intergrading with granules, the spinelets usually in the form of short blunt cylinders but sometimes finer and more pointed, especially at d.d. < c.12 mm. (pl. 19, figs. 4, 5) . . . 217  
 216' Armament consisting of more or less spaced spinelets or spines with naked skin between, sometimes (*O. venosa*) the spines rare, or conversely (e.g. *O. caryophyllata*) numerous (pl. 19, figs. 1-3) . . . 220  
 217 Most tentacle pores with one scale, though the basal ones may have two . . . 218  
 217' Two tentacle scales . . . 219  
 218 Disc spinelets extremely fine (judging from Murakami's figure); arm spines thick cylindrical and blunt, the enlarged clavate<sup>71</sup> uppermost ones up to about three times the segment length and not restricted to the middle part of the arm; colour deep brown, arms with light bands on the distal part only, colour of spines not described . . . *Ophiomastix palaoensis* Murakami, 1943  
 218' Disc armament consisting of more or less elongated granules, many of them in the form of short blunt cylinders (though in small specimens, d.d. < 7 mm., the armament is relatively more elongated and acute, in the form of short spinelets); arm spines in contrast long and slender, the uppermost ones up to five or six times the segment length and the enlarged clavate ones concentrated at about the middle of the arm length; colour black or grey with fine white rings around or multiple stripes across each arm segment, the spines banded (pl. 19, figs. 4, 5) . . . *Ophiomastix asperula* Lütken, 1869<sup>72</sup>

but these five-armed specimens appear to be conspecific with *venusta*. It remains to be seen from geographically intermediate specimens whether *venusta* and *beauforti* can both be maintained. The only differences I can find between the Murray specimens and others from Mozambique are rather trivial and may not prove to be constant.

<sup>65</sup> Having studied the holotype of *Ophiomastix sexradiata* (fig. 38a, b) I am only deterred by the similarity in specific names from referring it to the same genus as *Ophiocomella sexradia*. At this small size (d.d. 3 mm.) both have the disc armament in the form of short conical spinelets, the length of which is exaggerated in the holotype of *Ophiomastix sexradiata* by their prostrate position, the specimen being poorly preserved. At least in larger specimens of *Ophiocomella sexradia* (d.d. 4 or 5 mm.) the armament becomes more nearly granular. Apart from the proportions of the arm spines the only significant differences that I can find are the apparent absence of tentacle scales on the first two pairs of pores in *Ophiomastix sexradiata*, compared with the frequent duplication of the scale on the first pore of *Ophiocomella sexradia*, also the difference in the shape of the ventral arm plates, those of *Ophiocomella sexradia* having the distal edge curved from the widest point just distal to the tentacle pores, whereas in *Ophiomastix sexradiata* the lateral and distal edges are each straight and not confluent, there being right angles between them so that the shape is narrow pentagonal, not bell-shaped. *Ophiocomella sexradia* has a number of synonyms, including *Ophiocoma parva* H. L. Clark, 1915b, *Ophiocomella schultzi* A. H. Clark, 1941 and probably also *Amphiacanthis dividua* Matsumoto, 1917 and *Ophiocomella clippertoni* A. H. Clark (1952 at least, if not 1939). It is not inconceivable that it will prove to be tropicopolitan, like the similarly fissiparous *Ophiactis savignyi*, taking in the West Indian *Ophiocomella ophiactoides* (H. L. Clark). See also note 61.

Alternatively it is possible that *Ophiocomella* will prove to be based on six-armed specimens of species such as *Ophiocoma pumila* and *valenciae*. The discovery of small six-armed ophiocomids in the Red Sea (A.M.C., 1967d) and Mozambique (Balinsky 1957), i.e. within the range of *valenciae*, undermines the argument that such specimens represent one or more species distinct from sympatric five-armed species of *Ophiocoma*. Until proper studies of life histories are carried out, the status of *Ophiocomella* as distinct from *Ophiocoma* must remain in doubt.

<sup>66</sup> In 1967(a) I referred *pusilla* back to *Ophiomastix*, from which it had been removed to *Ophiocoma* by H. L. Clark in 1921. Since then I have noticed a comparable, though less well marked, pustular distal expansion of the second from uppermost arm spines of several consecutive segments following the reduction in number of the spines from four to three in several specimens of *Ophiocoma brevipes* from the Solomon Islands and from Aldabra as well as in *O. valenciae* also from Aldabra. Although the clavate spines are so conspicuous in *pusilla* (see my fig. 5, 1967a), the fact that they are not the uppermost ones has always marked it off from the species of *Ophiomastix*, from which it also differs in the granule-covering of the disc. Accordingly I now consider that H. L. Clark was justified in referring it to *Ophiocoma*, where its affinities are with the *brevipes*-group of species, with relatively fine granulation completely covering the disc. Mr. Dennis Devaney of Hawaii, who has been making a particular study of *Ophiocoma*, has independently reached the same conclusion about the generic position of *pusilla*.

<sup>67</sup> Elongated marginal granules were found on the holotype of *Ophiocoma anaglyptica*, studied at the U.S. National Museum in 1953. These were not remarked on by Ely.

<sup>68</sup> Mr. Devaney of the Bishop Museum, Honolulu, tells me (in correspondence) that Müller and Troschel's holotype of *Ophiocoma wendtii*, locality unknown, is conspecific with a West Indian species of *Ophiocoma*, not with the specimen figured

by Koehler, 1907, pl. 13, fig. 38, with *Ophiocoma*-like disc but *Ophiomastix*-like arms, for which a new name remains to be provided.

<sup>69</sup> Possibly *Ophiocoma schoenleini* should be ranked as an eastern subspecies of *O. erinaceus*; the only difference seems to be the number of tentacle scales. All the uniformly black *Ophiocomas* from the Solomon Islands that I have seen are referable to *schoenleini*. It is significant that the related *O. scolopendrina* also shows a strong tendency for reduction of the scales to one in the Solomons, though less so than in the all-black specimens.

<sup>70</sup> I suspect that *Ophiocoma latilanxa*, like *O. lubrica* Koehler, 1898, with which Murakami compared it, will prove to be based on material of *O. scolopendrina* with unusually slender arm spines, the range in which I have found (Clark and Davies, 1966) to be 2.0-3.3 times the segment length.

<sup>71</sup> In fact the disc armament looks so fine and the only uppermost arm spines figured are so unlike even the least clavate spines of some species of *Ophiomastix* (though described as 'club-spines') that I am uncertain whether *palaoensis* should be included in this genus or referred to *Ophiocoma*.

<sup>72</sup> I doubt whether the specimen from Amboina which Döderlein (1896) referred to *Ophiomastix asperula* is conspecific with the holotype, since its arm spines are relatively short and fairly stout and the clavate ones are not restricted to the middle of

- 219 Colour uniform throughout, red in life but paler in preserved specimens *Ophiomastix mixta* Lütken, 1869  
 219' Colour patterned dark and light, spines banded *Ophiomastix elegans* Brock, 1888  
 220 Two tentacle scales . . . . . 221  
 220' One tentacle scale, except sometimes on the basal pores (*O. venosa* may have more than 10 proximal segments with two scales) . . . . . 225  
 221 A light-coloured rim all round each dorsal arm plate contrasting with the dusky colour of the rest of the arm; oral shields patterned with concentric dark and light rings; disc spines blunt (pl. 19, fig. 2)  
*Ophiomastix annulosa* (Lamarck, 1816)  
 221' Dorsal arm plates with various markings, only the distal edge (if any) marked with lighter colour; oral shields with parallel markings or scattered spots rather than concentric rings; disc spines sharp . . . . . 222  
 222 Uppermost arm spines all long and slender, even the enlarged ones, none conspicuously thickened and clavate; disc spines uniform in colour, dark or light, or grading from dark at one end to light at the other; colour predominantly dark, only narrow light bands across the distal edge of each dorsal arm plate<sup>73</sup> . . . . . 223  
 222' Some of the uppermost arm spines usually conspicuously clavate, sometimes cloven at the tip; disc spines banded or spotted light and dark; colour either about equally dark and light or predominantly light, at least the distal half of each dorsal arm plate light, if not the whole<sup>73</sup> . . . . . 224  
 223 Arm spines black, not banded<sup>74</sup> *Ophiomastix janualis* Lyman, 1871  
 223' At least the proximal uppermost arm spines banded, though sometimes indistinctly so (pl. 19, fig. 1)<sup>74</sup>  
*Ophiomastix luetkeni* Pfeffer, 1900  
 224 Dorsal arm plates pale all over, contrasting with the dark V's on either side made by the lateral arm plates  
*Ophiomastix corallicola* H. L. Clark, 1915b  
 224' The distal half of each entire arm segment light in colour, contrasting with the dark proximal half  
*Ophiomastix caryophyllata* Lütken, 1869  
 225 Disc marked with narrow dark lines tending to radiate irregularly from the position of the radial shields; many of the uppermost arm spines conspicuously clavate, often cloven at the tip; disc spines usually rare . . . . . *Ophiomastix venosa* Peters, 1851  
 225' Disc more or less extensively dull or dark coloured or with a few usually symmetrical light bands; uppermost arm spines never cloven at the tip but fusiform, cylindrical or sometimes slightly clavate (fig. 54b, p. 135); disc spines or spinelets variable in number, sometimes rare . . . . . 226  
 226 Disc with irregular light markings or uniformly brown or black; one tentacle scale throughout (figs. 39, 54a-c)  
*Ophiomastix bispinosa* H. L. Clark, 1917a<sup>75</sup>

the arm, unlike the type and H. L. Clark's specimen (1921, pl. 14, fig. 1); also the colour is different, the black being banded with white only at intervals of four or five segments, as in *O. bispinosa*.

<sup>73</sup> H. L. Clark's distinction of these two pairs of species (i.e. *Ophiomastix janualis* and *luetkeni* on the one hand and *O. corallicola* and *caryophyllata* on the other) by the relatively greater arm length of the first two does not hold good, at least for *caryophyllata*, a specimen of which in the British Museum from the same source as the holotype (Viti, Fiji Islands; Godeffroy Museum) has one arm almost intact and 140 mm. long, the d.d. being 15 mm., giving a ratio of c.10:1, compared with 5:1 as stated by Dr. Clark for *caryophyllata*.

A fine specimen (d.d. 24 mm.) in the British Museum collections from the Solomon Islands (pl. 19, fig. 3) cuts across this dichotomy since it has no clavate upper spines, like *janualis* and *luetkeni*, but the colour predominantly light and the disc and arms banded or spotted, more like *corallicola* and *caryophyllata*, though the exact pattern on the arms differs from both the last two. Possibly it is a hybrid between *caryophyllata* and *luetkeni*, both of which were taken at the same station, as well as *O. annulosa*.

<sup>74</sup> The only positive locality for *Ophiomastix janualis* according to H. L. Clark (1921) is Torres Strait, if indeed he was correct in regarding his material as conspecific with the immature holotype of uncertain locality. There are no specimens from Torres Strait in the British Museum collections but we have ten from the Solomon Islands which I consider to be conspecific with two from Cebu in the Philippines taken by the 'Challenger', also H. L. Clark has referred other 'Challenger' Cebu specimens to *O. luetkeni* though Lyman had called them *caryophyllata*. The refinements of colour distinction given in H. L. Clark's key—black and yellow in *janualis* as opposed to brown and whitish in *luetkeni*—are probably not appreciable in preserved specimens; in addition, in the Solomon Islands specimens the banding of the proximal arm spines may or may not be discernable. Although the name *janualis* antedates *luetkeni*, until a good size range of material encompassing d.d. 5.5 mm.—the size of the holotype of *O. janualis*—is available, I think that the identity of the species it represents is sufficiently uncertain to make the use of the name *luetkeni* preferable for these other specimens.

<sup>75</sup> In my opinion *Ophiomastix notabilis* H. L. Clark, 1938 (fig. 54a-c) is a synonym of *O. bispinosa* (fig. 39). In 1932 Dr. Clark recorded a specimen from the Great Barrier Reef as *O. bispinosa*, noting that it has three or four arm spines rather than the two or three of the holotype, which was much smaller (d.d. 5 mm. as opposed to 15 mm.). This is the same number as on the arm bases of the holotype of *O. notabilis* with d.d. 13 mm., which shares the colour pattern of the arms with white bands at intervals of four or five segments found in the holotype of *O. bispinosa*. The differences apparent in the two holotypes, notably in the opacity of the skin and in the relative proportions of the arm spines, I believe are correlated with the great size discrepancy. Other specimens with a similar colour pattern on the arms have been recorded by Döderlein from Amboina (as *Ophiomastix asperula*) by Burfield from the Red Sea (also as *asperula*) and by Balinsky from Mozambique (as *notabilis*), while there are several further ones in the British Museum collections from Saya da Malha Bank, the Maldives, Chagos Archipelago, Macclesfield Bank and Tongatabu; all of these I consider should be referred to *O. bispinosa*.

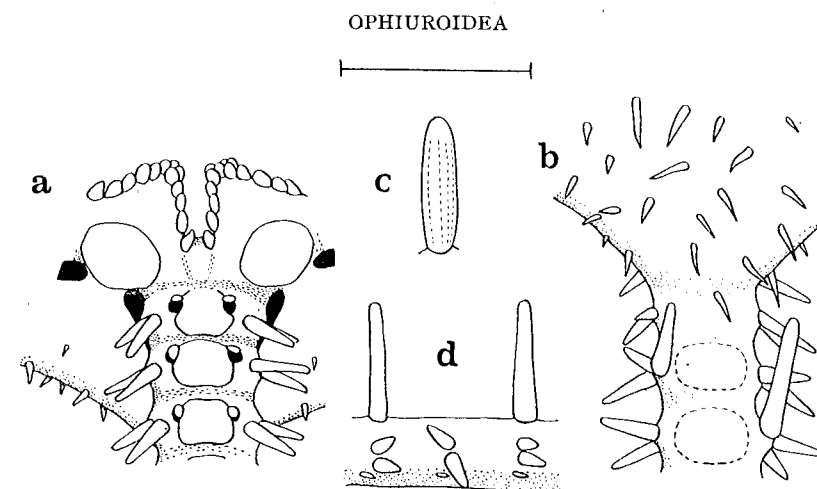


FIG. 39. *Ophiomastix bispinosa*, holotype. a. Part of disc and an arm base in ventral view, b. the same in dorsal view, c. a distal uppermost arm spine, viewed along the plane of the arm, and d. Three proximal arm segments in side view (the distalmost to the left), showing the alternation in number of the spines. The scale measures 2 mm.

- 226' Disc with a light radial band running inwards from each radial shield and a peripheral tangential band in each interradius; two tentacle scales on the first segment . . . . . *Ophiomastix variabilis* Koehler, 1905a<sup>76</sup>  
 227 Arm spines and arms uniform in colour, disc black . . . . . *Ophiarthrum lymani* de Loriol, 1893a  
 227' Arm spines and arms patterned in some way, banded, striped or spotted (though indistinctly in the variety unicolor of *O. elegans*) . . . . . 228  
 228 Disc beautifully patterned with grey, yellow and white, at least in life; arms with a dusky longitudinal stripe dorsally<sup>77</sup> . . . . . *Ophiarthrum pictum* Müller & Troschel, 1842  
 228' Disc either dark centrally and light peripherally or dark all over (reddish in life, black when preserved), no median dark stripe on the arms<sup>78</sup> . . . . . *Ophiarthrum elegans* Peters, 1851  
 229 Four arm spines . . . . . *Ophiopsila paucispina* Koehler, 1907  
 229' Seven or eight arm spines . . . . . *Ophiopsila pantherina* Koehler, 1898  
 230 Arms inserted below the disc; arm spines rarely much shorter than the segment, projecting sideways from the arm; a pair of supplementary dorsal arm plates present on each segment (fig. 40)

#### OPHIONEREIDAE 231

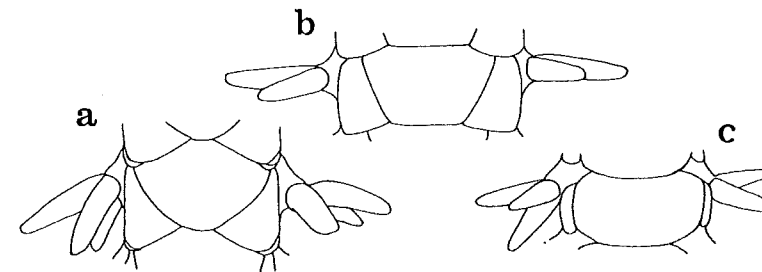


FIG. 40. Dorsal view of proximal arm segments of: a. *Ophionereis dubia*, with accessory scales to the supplementary dorsal arm plates, b. *O. porrecta*, c. *O. lineata*, holotype.

- 230' Arms projecting from and well fused to the edge of the disc; spines usually distinctly shorter than the segment and appressed to the arm, rarely (*Ophiarachma*) long and outstanding; supplementary dorsal arm plates only present in genera with short appressed arm spines (e.g. *Ophiopsis*, fig. 46c, d) . . . . . 241

<sup>76</sup> It should be noted that the holotype of *Ophiomastix variabilis* also has the light arm bands at regular intervals found in *O. bispinosa*. If the disc markings and the occurrence of a second tentacle scale on the first arm segment are variable, as may well be the case, it is possible that *bispinosa* may itself be a junior synonym of *O. variabilis*.

<sup>77</sup> Those specimens of *Ophiomastix venosa* which are particularly deficient in disc spines may run down here; they can be distinguished from *Ophiarthrum pictum* by the terminally flared uppermost arm spines.

<sup>78</sup> H. L. Clark (1921) notes that the differences between the three species of *Ophiarthrum* are mainly in colour; it therefore seems inconsistent that in 1932 he described unicolor as an Australian variety of *Ophiarthrum elegans* rather than as a separate species. It appears to form an obvious parallel in dull coloration to the little-known *O. lymani* from Mauritius.

- 231 No papillae bordering the genital slits . . . . . 232  
 231' Genital papillae present . . . . . 238  
 232 Disc scaling and limits of oral shields and plates concealed by skin, even when dry . . . . . 233  
 232' Disc scaling fine but distinct, at least dorsally, especially when partially or wholly dried, limits of oral shields also distinct . . . . . 234  
 233 Skin over oral shields very light in colour with a dark ring encircling them; arms with narrow dark bands separated by wider light intervals . . . . . *Ophionereis semoni* (Döderlein, 1896)  
 233' Oral shields not outlined by contrasting colour; arms with light and dark bands of almost equal extent . . . . . *Ophionereis tigris* H. L. Clark, 1938  
 234 Normally six arms; disc scaling dorsally indistinct and ventrally absent altogether . . . . . 235  
 234' Usually five arms (rarely small specimens may divide fissiparously giving rise to more or less irregular six-armed individuals); disc scaling entire and distinct, at least when partially or wholly dried . . . . . 236  
 235 Radial shields concealed (at least in the holotype); middle arm spine becoming very long on the widest part of the arm, much exceeding the segment in length (fig. 56f-i, p. 136) *Ophionereis hexactis* H. L. Clark, 1938<sup>79</sup>  
 235' Radial shields small but distinct; arm spines subequal, none exceeding the segment in length . . . . . *Ophionereis thryptica* Murakami, 1943<sup>79</sup>  
 236 Supplementary dorsal arm plates small, only half as long as even the basal arm segments . . . . . *Ophionereis vivipara* Mortensen, 1933a  
 236' Supplementary dorsal arm plates large, at least the proximal ones running the full length of the segment (fig. 40a) . . . . . 237  
 237 Size small, d.d. rarely much exceeding 5 mm.; arms slender with dorsal arm plates little if at all wider than long; arms pale in colour with narrow dark bands, disc with fine dark open reticulation . . . . . *Ophionereis dubia* (Müller & Troschel, 1842)  
 237' Size larger (d.d. 10 mm. in the holotype); arms stout with the proximal dorsal arm plates markedly wider than long, reaching a maximum of about three times as wide as long at the widest part of the arm; arms dull grey with occasional lighter segments, disc grey with a coarse dark reticulation . . . . . *Ophionereis amoyensis* A. M. Clark, 1953  
 238 Dorsal arm plates hexagonal and distinctly tapering towards their distal ends, the widest part at or near the proximal end (figs. 40b, 57, p. 136); supplementary dorsal plates well developed, at least those of the proximal segments running the full length of the segment; the series of genital papillae not extending up to the dorsal side distally . . . . . 239  
 238' Dorsal arm plates wide rectangular in shape, the sides either parallel or slightly convex so that the widest part is at about the middle of the length (fig. 40c); supplementary dorsal plates small, even the proximal consecutive ones not in contact; the distalmost genital papillae visible on the dorsal side at the bases of the arms . . . . . 240  
 239 Ventral arm plates widest distal to the tentacle pores; interradial dorsal disc scales large; size not known to exceed c.7 mm. d.d. (fig. 57, p. 136) . . . . . *Ophionereis degeneri* A. H. Clark, 1949<sup>80</sup>  
 239' Ventral arm plates about as wide proximal to the pores as distal to them; interradial disc scales distinctly smaller than the radial and peripheral ones; d.d. often >10 mm. . . . . *Ophionereis porrecta* Lyman, 1860<sup>80</sup>  
 240 No longitudinal stripe on the arms dorsally, though pairs of segments are darker making isolated bands . . . . . *Ophionereis fusca* Brock, 1888  
 240' A conspicuous longitudinal dark stripe on each arm dorsally (fig. 56a-e, p. 136) . . . . . *Ophionereis lineata* H. L. Clark, 1946<sup>81</sup>  
 241 Disc densely granulated, also the oral plates, sometimes even the oral and adoral shields<sup>82</sup> . . . . .

## OPHIODERMATIDAE 242

- 241' Disc scales naked . . . . . OPHIURIDAE 273  
 242 Oral shields naked . . . . . 243  
 242' Oral shields normally covered by granules, though occasionally one or two are left bare . . . . . 266

<sup>79</sup> I think it quite possible that *Ophionereis hexactis* and *thryptica* will prove to be synonymous.

<sup>80</sup> *Ophionereis degeneri* is very close to *O. variegata* Duncan from Japan, which was mistakenly referred to the synonymy of *O. porrecta* by Matsumoto, as I explained in 1953. This mistake prompted Murakami (1943) to describe *O. aplacophora*, supposedly differing from *porrecta* in lacking supplementary platelets between the consecutive lateral arm plates—a characteristic of *variegata*, not of *porrecta* of which I consider *aplacophora* to be a synonym. Murakami's references to *O. porrecta* should probably have been to *variegata*. Further studies need to be made on the variability of these nominal species, especially since Mr. Devaney of the Bishop Museum, Honolulu has written to me (August, 1966) commenting that he finds it difficult to distinguish *O. degeneri* from young specimens of *O. porrecta*.

<sup>81</sup> Since reviewing *Ophionereis* in 1953 I have seen the holotype of *Ophionereis lineata* and am doubtful now whether it can be distinguished from *O. fusca*, if my identification of a specimen from the New Hebrides as *fusca* is correct. The two specimens are very similar. Examination of material from Amboina, the type-locality of *O. fusca*, is needed before this question can be settled; the only published figure of such material—that of Koehler (1904)—is too diagrammatic to help.

<sup>82</sup> *Ophiarachnella sphenisci* (fig. 43b) is exceptional in having many disc plates enlarged, convex and naked, projecting from the general granulation.

- 243 Arm spines long and flaring, all of them easily exceeding the segment in length; apical oral papillae sometimes rather irregular, simulating the tooth papillae of Ophiocomids, though much less numerous (fig. 41b) . . . . .

## OPHIARACHNA 244

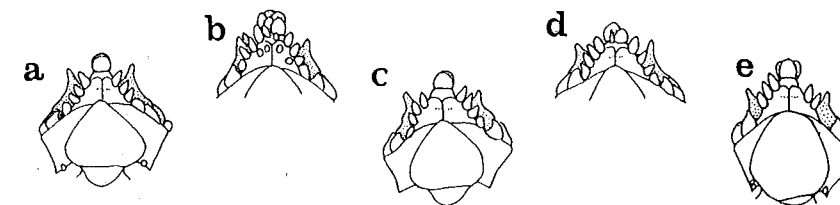


FIG. 41. *Ophiarachna delicata*, holotype, the five jaws, three with the complete oral and supplementary oral shields drawn in; in b and c some of the middle oral papillae are foreshortened and in e some are missing.

- 243' Arm spines, except the lowest one, rarely as long as the segment and more or less appressed to the arm (except in *Ophiocanis*, *Ophiopsammus*, *Ophiarachnella infernalis* and *macracantha*, of which the last may have the spines equalling the segment); little if any suggestion of clustering of the apical oral papillae . . . . . 247  
 244 Radial shields naked . . . . . *Ophiarachna robillardii* de Loriol, 1893a  
 244' Radial shields concealed by the disc granulation . . . . . 245  
 245 Arm spines four, rarely five basally; size very large, d.d. known to exceed 50 mm.; colour in life including extensive areas of uniform green, becoming yellow or buff in preservation and running along the arms above and below, contrasting with interradial areas of black-ringed light spots forming a reticulation and with the annulated arm spines (pl. 20, fig. 4) . . . . . *Ophiarachna incrassata* (Lamarck, 1816)  
 245' Arm spines five or six, even seven basally; d.d. not known to exceed c.30 mm.; no green in colour pattern, disc similarly-coloured or patterned all over and arms either banded or marbled dark and light, at least dorsally . . . . . 246  
 246 Arm spines conspicuously banded dark and light . . . . . *Ophiarachna affinis* Lütken, 1869<sup>83</sup>  
*Ophiarachna mauritiensis* de Loriol, 1893a<sup>83</sup>  
 246' Arm spines not banded but with a longitudinal line or series of spots up one side (pl. 20, figs. 5, 6) . . . . . *Ophiarachna delicata* (H. L. Clark, 1932)<sup>83</sup>

<sup>83</sup> In his key to the species of *Ophiarachna* H. L. Clark (1909) distinguishes *O. mauritiensis* from *affinis* by the shape of the oral shields and by the colour pattern. There are nine specimens of *Ophiarachna* from Zanzibar in the British Museum collections, besides two from 'Samoa or Viti' (Fiji Is.), the type-locality of *affinis* and originating from the Godeffroy Museum like the holotype, another from the New Hebrides and three from the Solomon Islands. The Zanzibar specimens include three colour forms:

Form A has the disc dull brown with a few widely scattered small dark spots and the arms intensely marbled dark and light, the distal dorsal arm plates having a tendency to develop a light border to the distal edge, though proximally the marbling is continuous; B has the disc finely reticulated with a light network around dark spots (or in one specimen with discrete light rings around the spots) and the marbling of the arms resolving itself into transversely aligned brown patches with a broad light band across the distal edge of each segment, even basally; C has the disc finely reticulated with a dark network around light spots and the arms dorsally bearing four well-defined narrow dark longitudinal lines, with a fine pattern of curved dark markings between the middle two long lines. In forms A and B the arms are also marbled on the ventral side but in C the ventral arm plates are pale but for a narrow dark rim to the distal edge. All the specimens have a tendency for alternation of dark and light colour at intervals of several segments on the dorsal side of the arms; this is least marked in those of form A and most obvious in those of form C. Two specimens of form C have also been taken recently in the northern Red Sea.

Form A with its marbled arms and almost plain disc approximates most closely to the holotype of *O. mauritiensis* (though in that the disc was described as uniform in colour), while the arms at least of form B appear to match the colour pattern of a specimen from Jolo (S. Philippines), which Koehler (1930) referred to *affinis* and both arms and disc agree with the type of *O. clavigera* Brock, from Amboina, which de Loriol, followed by Koehler and H. L. Clark, refer to the synonymy of *O. affinis*. The quadrilineate form C appears to be undescribed; however, several Pacific specimens show a tendency for the dark markings on the basically lighter segments of the arm to be arranged in longitudinal series. In one specimen from the Solomon Islands there are four series of dark blotches on the proximal half of the arm, the two middle ones fusing to make three series distally. Another from the same locality has the proximal marbling of the lighter segments resolving itself on the distal parts of the arms into two longitudinal lines while the 'Samoa or Viti' specimens have three longitudinal series of dark markings, the median one consisting of larger spots. One thing common to all these specimens affiliated to the C form is the narrow dark distal rim of the ventral arm plates. This is also seen in the Harvard Museum's specimen from Samoa figured by H. L. Clark (1915b), which, like the British Museum specimens, was purchased from the Godeffroy Museum and may have some standing as type-material of *O. affinis*. Clearly the colour variation in these specimens of *Ophiarachna* is considerable and renders uncertain any attempt at specific distinction between *affinis* and *mauritiensis* on the basis of our present knowledge. As for the oral shields, I can find no significant difference between the western Indian Ocean specimens and those from the Pacific; in all those that I have seen the shields are about as wide as long. There is some variation in the size and shape of the supplementary

247 Radial shields naked; a supplementary oral shield present distal to each oral shield (see figs. 22i, 42b)<sup>84</sup> . . . . . 248

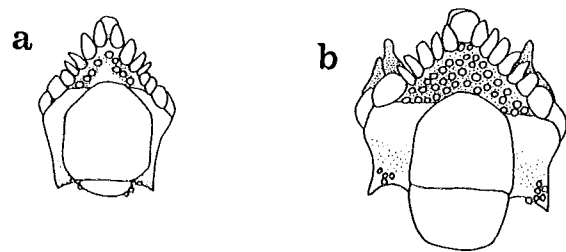


FIG. 42. Single jaws of: a. *Ophiarachna affinis*, b. *Ophiarachnella gorgonia*.

247' Radial shields concealed by granules; supplementary oral shields usually lacking or at least concealed by the granulation but sometimes evident in some interradii<sup>84</sup> . . . . . 257

248 Radial shields very large, the space between adjacent ones interradially less than the width of each shield and not much wider than the radial space, the shield length:d.d. = 1:4.0-4.5 (pl. 20, fig. 1)<sup>85</sup> . . . . . 258

*Ophioclasma stellatum* (Ljungman, 1867b)

248' Radial shields moderate in size or small, length:d.d. rarely less than 1:5.5, the interradii intervals distinctly wider than the radial ones (pl. 20, figs. 2, 3)<sup>85</sup> . . . . . 259

**OPHIARACHNELLA** 249

249 Some disc plates naked as well as the radial shields . . . . . 250

shield at the distal end of each oral shield but there seems to be no correlation between this and locality. Koehler (1907) has recorded *O. affinis* from Fernando Veloso (Mozambique) but this was queried by H. L. Clark (1909). Clearly the limits between *affinis* and *mauritiensis* need further investigation. One constant feature in all the descriptions of both of them is the banding of the arm spines, found also in *O. incrassata*. Such banding is shown in all the British Museum specimens of *Ophiarachna* with at least five arm spines basally except for one from the Solomon Islands with d.d. 21 mm. which has a longitudinal dark line on each spine (pl. 20, fig. 5). Its arms are patterned dark and light in such way that there is a broad light transverse band across the distal edge of each dorsal arm plate. The disc is patterned on the lower side with dark, more or less irregular, spots separated by a light reticulum but on the upper side the spots elongate and merge so that the effect is of a maze of sinuous light lines on a dark background, as on the disc of the Ophiotrichid *Ophiomaza obscura* as figured by H. L. Clark (1921, pl. 16, fig. 2), a species here referred to *Gymnolophus*. In spite of this unusual pattern, I believe that the specimen from the Solomons is conspecific with the holotype of *Ophiocoma delicata* H. L. Clark, 1932, which I consider should be referred to *Ophiarachna*; not only are there small supplementary oral shields present unlike *Ophiocoma* (not mentioned by H. L. Clark) but also the apical armament of the jaws is very sparse and much more like an Ophiidermatid than an Ophiocomid; on three jaws the lowest tooth is superficial, on the fourth it is slightly reduced in size and offset slightly with a single conical papilla alongside it and only on the fifth jaw (fig. 41b) is there anything approaching a cluster of papillae since the two lowest teeth are subdivided and there is a single apical oral papilla superficial to them. In addition this specimen has the first two full-sized ventral arm plates slightly spaced from each other, exposing a pair of pores between them—another characteristic of the Ophiidermatidae—and finally the outer tentacle scale overlaps the base of the lowest arm spine—again a common feature of this family.

With its fully granule-covered disc, *Ophiarachna delicata* is related to *O. incrassata*, *affinis* and *mauritiensis*, differing most obviously in the absence of transverse banding on the arm spines. The presence of no more than four arm spines in the holotype in comparison with the five of the Solomon Islands specimen and of *affinis* is likely to be correlated with its relatively small size, d.d. only 9 mm. This is probably also accountable for the complete absence of sporadic clavate lowermost arm spines, such as are found in the Solomon Islands specimen, though the occurrence of these is variable in *O. affinis* according to Koehler.

<sup>84</sup> *Ophiopeza fallax arabica* falls between these two alternatives, having the radial shields as well as some peripheral disc plates often partially naked. It also possesses more or less well-developed supplementary oral shields but these are normally concealed under the ventral granulation, which distinguishes it from *Ophiarachnella infernalis* to which it would run down from no. 248.

<sup>85</sup> The gap between the radial shield proportions found in *Ophioclasma stellatum* and *Ophiarachnella gorgonia* is bridged by the holotypes of *Pectinura nitens* Koehler, 1905a (subsequently referred to the synonymy of *Ophioclasma stellatum* by Koehler, 1930), *P. marmorata* Lyman, 1874 and *P. megaloplax* Bell, 1884. The last was taken at a depth of 14 fathoms (22 metres) (which eliminates it from this work) off Queensland and has radial shields 4.0 mm. long, compared with a d.d. of 21 mm., a ratio of 1:5.25; however, a second specimen, from Holothuria Bank off northern Australia, referred by Bell to *megaloplax*, has the ratio as low as 1:4.6. These two specimens are distinguished from *Ophioclasma stellatum* by the less tapering arms and the much wider dorsal arm plates, which occupy more than three-quarters of the arm width whereas in *O. stellatum* the dorsal arm plates only cover about two-thirds of the total arm width, the plates themselves being little more than twice as wide as long, compared with about three times as wide as long in *megaloplax*. In these proportions *megaloplax* approaches much closer to the variable species *Ophiarachnella gorgonia*, which has numerous synonyms including *Pectinura intermedia* Bell, *P. stearnsii* Ives, *P. venusta* de Loriol and, as mentioned below, I consider also *P. marmorata* Lyman. Certainly the distinction between *Ophioclasma stellatum* and *Ophiarachnella gorgonia* is so fine that I doubt whether it should be regarded as of generic weight.

249' Disc granulation leaving only the radial shields exposed (though the disc granules are easily rubbed off in many species) . . . . . 252

250 Many disc plates, both dorsally and ventrally, bare and markedly convex, standing out from the granulation (fig. 43b) . . . . . *Ophiarachnella sphenisci* (Bell, 1894)<sup>86</sup>

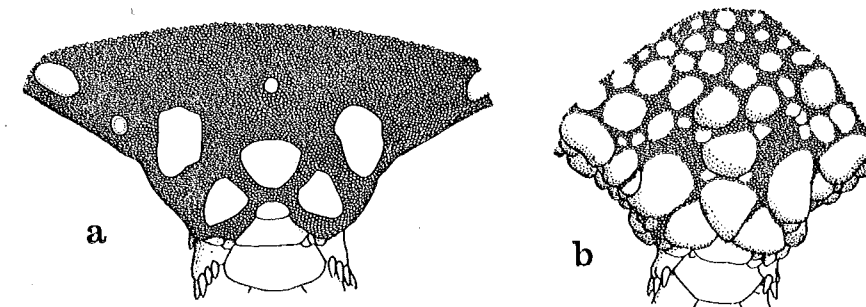


FIG. 43. Dorsal view of part of the disc and one arm base of: a. *Ophiarachnella infernalis* and b. *O. sphenisci*, holotype.

250' Bare plates usually limited to a few peripheral ones and not markedly convex (fig. 43a) . . . . . 251

251 At least one peripheral plate in each interradius bare besides three at the base of each arm between and distal to the pair of radial shields, often some other bare plates in addition; oral shields fairly large, exceeding in area the combined area of the two adoral shields

*Ophiarachnella infernalis* (Müller & Troschel, 1842)

251' No bare interradii plates, only the three at each arm base; oral shields small, not more than twice the area of each adoral (pl. 20, fig. 3) . . . . . *Ophiarachnella similis* (Koehler, 1905a)

252 Eight to ten oral papillae (rarely seven), including the second oral tentacle scale at the distal end of the series, the proximal papillae all narrow; radial shields variable (distinctly elongated and moderate in size in *gorgonia*, 1:d.d. = 1:5-9 but small and circular in *parvispina*, though this may be due to encroachment of the disc granulation in the holotype); arm spines appressed, the lowest hardly, if at all, longer than the rest and not as long as the segment<sup>87</sup> . . . . . 253

252' Five to seven leaf-like oral papillae; radial shields regularly almost circular in shape and small, 1:d.d. = 1:10-20+; arm spines erect and standing out from the arm in well-preserved specimens, the lowest spine distinctly larger than the rest and easily exceeding the segment in length<sup>87</sup> . . . . . 254

253 Radial shields small and circular (at least in the holotype, d.d. only 5 mm.); supplementary oral shields small and distinctly narrower than the oral shields . . . . . *Ophiarachnella parvispina* H. L. Clark, 1925a

253' Radial shields moderately large and distinctly elongate; supplementary oral shields large, often equalling the oral shields in width (pl. 20, fig. 2) . . . . . *Ophiarachnella gorgonia* (Müller & Troschel, 1842)<sup>88</sup>

<sup>86</sup> *Ophiarachnella rugosa* H. L. Clark, 1938 is a synonym of *O. sphenisci*, the holotype of which (d.d. 8.5 mm.) has 7 (rarely 8) spines on the basal arm segments, rather than 6 as described by Bell, whereas the holotype of *rugosa* at d.d. 15 mm. has 10 or 11 spines. Another specimen with d.d. c.15 mm. from Thursday Island, Torres Strait in the British Museum collections also has 10 or 11 spines, this was named *O. infernalis* by Bell but I cannot distinguish it specifically from the type of *sphenisci*. The numerous bare and convex disc plates are so distinctive and similar while the type-localities of *sphenisci* and *rugosa* are geographically so close (Holothuria Bank and Broome, both in north-west Australia) that I am convinced the types are conspecific. The confusion arose because of Bell's poor description. Also the specimen from Colombo or the Andaman Islands figured by Koehler (1898) appears to be referable to *O. sphenisci* rather than to *O. gorgonia*, to which Koehler rather surprisingly referred it. The numerous bare plates appear very similar to those of Australian specimens. The only other possibility is that it could be a specimen of *infernalis* with extreme reduction of the disc granulation, in which case the limits between *infernalis* and *sphenisci* would need further examination.

<sup>87</sup> The cumulative effect of these characters may prove to be enough to warrant a division into two subgenera, in which case the *infernalis*-group of species (250) is allied with *gorgonia* (253) rather than with the *septemspinosa*-group (254).

<sup>88</sup> In 1909 H. L. Clark referred *Ophiarachnella marmorata* (Lyman, 1874), to the synonymy of *O. gorgonia* but in 1915(b) and his following papers on Australian echinoderms (1921, 1938 and 1946) he restored it, though without giving details of his means of distinguishing between the two because he considered no Australian specimens to be referable to *marmorata*. Koehler (1922b) in his work on ophiuroids from the Philippines, the type-locality of *marmorata*, followed Clark's synonymy of 1909, using the name *gorgonia* for all his specimens. Lyman had distinguished *marmorata* from *gorgonia* by the 'puffed' disc and the relatively narrower and less flattened arm bases of the latter. The type of *marmorata* also had the peripheral disc scales somewhat swollen and their contours evident through the disc granulation. Judging from these characters, all the specimens in the British Museum collections from northern Australia are *marmorata* rather than *gorgonia*, the reverse of what would be expected and in direct contradiction to Dr. Clark's identifications. Accordingly I feel that it is better to regard *marmorata* as a synonym. It is unfortunate that the type-locality of *gorgonia* is unknown.

- 254 Radial shields distinctly darker in colour than the surrounding part of the disc; known to reach a very large size, d.d. > 30 mm.<sup>89</sup> . . . . . 255
- 254' Radial shields not contrasting in colour; size not known to exceed 20 mm. d.d. . . . . 256
- 255 Middle and upper arm spines fairly long and tapering, equalling the segment in length; colour brownish with darker bands on the arms, disc with lighter markings interradially  
*Ophiarachnella macracantha* H. L. Clark, 1909
- 255' Middle and upper arm spines somewhat flattened and distinctly shorter than the segment; disc generally dull grey all over, arms with lighter bands, if any markings  
*Ophiarachnella septemspinosa* (Müller & Troschel, 1842)
- 256 Colouration evidently not patterned; oral plates (at least in the holotype) lacking granules  
*Ophiarachnella stabilis* (Koehler, 1905a)
- 256' Disc marked with rounded dark patches, their rims even darker; arm spines distinctly banded dark and light; oral plates covered with granules . . . . . *Ophiarachnella snelli* (A. H. Clark, 1964)<sup>90</sup>
- 257 Genital slits subdivided into two, so that there are four apertures in each interradius<sup>91</sup> . . . . . **OPHIODERMA** spp. 258
- 257' Genital slits not subdivided . . . . . 258
- 258 Disc densely covered with spinelets as well as granules, the latter sometimes resembling very short truncated stumps (fig. 44a); armament of oral plates also spiniform (fig. 44b) . . . . . **OPHIOCHAETA** 259

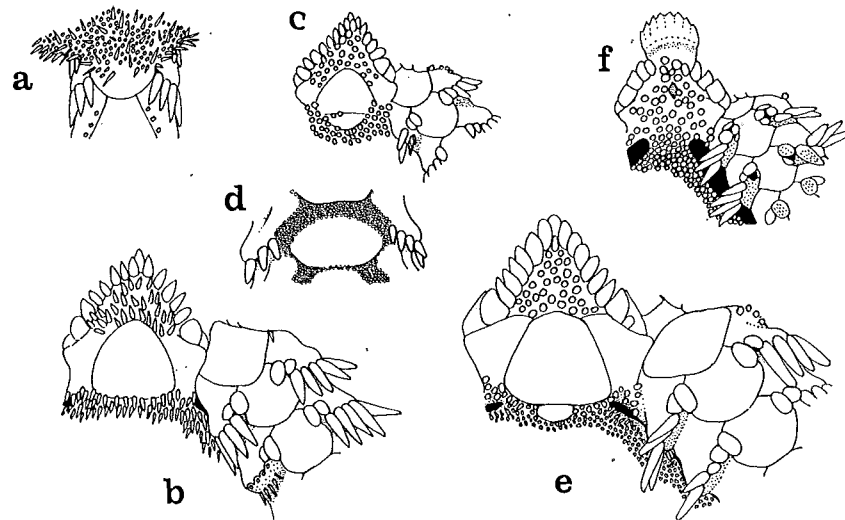


FIG. 44. a, b. *Ophiochaeta hirsuta*, a, dorsal view of part of the edge of the disc and an arm base, the spines of one side of the second free segment lost, b, ventral view of a jaw and one arm base, the spines of one side of the second segment lost, revealing the secondary spinelets beneath. c. *Distichophis clarki*, ventral view of a jaw and one arm base showing the secondary spinelets on one side of the first segment. d. *Ophiostegastus compsus*, holotype, dorsal view of the third free arm segment showing the granules separating the plates. e. *Ophiopeza spinosa*, ventral view of a jaw and one arm base, f. the same of *Ophiconis cincta*.

<sup>89</sup> *Ophiarachnella elegans* (Bell) from Macclesfield Bank, South China Sea, in depths of 13 fathoms (24 metres) or more, may run down here. It differs from *O. septemspinosa* and *macracantha* by the extensive mid-brown dorsal colour with about every fifth arm segment much lighter and light markings on the disc interradially; a similar pattern on the arms exists in some specimens of *septemspinosa* but there the ground colour is grey or green.

<sup>90</sup> *Ophiarachna snelli* is here referred to *Ophiarachnella* in spite of the erect arm spines, since all these spines except for the lowest one are markedly shorter than the segment and are very like those of *Ophiarachnella elegans* and *septemspinosa*. The colour pattern may serve to distinguish *snelli* but I think that when better samples are available there is bound to be some synonymizing in this section of *Ophiarachnella*. A second specimen of *O. snelli* was taken by the Royal Society's expedition of 1965 to the Solomon Islands; it has d.d. 16 mm. and the disc almost decolorized but the banding of the arm spines is still well marked.

<sup>91</sup> This is the generic character of the true *Ophioderma*, to which genus two problematical Indo-West Pacific species have been referred, *O. tongana* Lütken, 1872 and *O. propinqua* Koehler, 1895 (both names needing to be neutered). Neither has since been recorded, except mistakenly by Lyman, 1882, as explained by Mortensen (1933b, p. 382), when he noted that the type specimen of *tonganum* is lost. The type of *propinquum* was in the collections of the St. Petersburg Museum. In neither of the descriptions were the genital slits described, so it is only a supposition that the slits are duplicated in these nominal species since *Ophioderma* is otherwise unknown from the Indo-West Pacific. As for distinguishing features, the type of *O. propinquum* (d.d. 28 mm.) had fragmented dorsal arm plates and the ventral plates with a concavity in the middle of the distal edge, while that of *O. tonganum* (d.d. 9 mm.) had double white lines on the arms at intervals of four or five segments; both had the adoral shields concealed by granules.

- 258' Disc covered with granules, which may be slightly elongated in a few species but not enough to be termed spinelets; armament of oral plates granuliform (fig. 44c, e) . . . . . 260
- 259 Spinelets and granules intermingled on the outer parts of the ventral interradii and dorsally  
*Ophiochaeta hirsuta* Lütken, 1869<sup>92</sup>
- 259' A fairly abrupt transition between dorsal granules and ventral spinelets occurring at the periphery of the disc  
*Ophiochaeta boschmai* A. H. Clark, 1964<sup>92</sup>
- 260 A pair of supplementary dorsal arm plates present on each arm segment (as in *Ophionereis*)  
*Ophioclastus hataii* Murakami, 1943
- 260' No supplementary arm plates present . . . . . 261
- 261 Arms markedly carinate or arched above, the dorsal arm plates very broad, more than twice as broad as long; longer arm spines, at least basally, about equal in length to the segment and more or less flaring (pl. 21, figs. 7, 8) . . . . . *Ophiopsammus yoldii* (Lütken, 1856)<sup>93</sup>
- 261' Arms flattened above, dorsal arm plates not carinate and not much broader than long, even proximally; arm spines only about half the segment length throughout and more or less appressed to the arm. . . . . 262
- 262 Granulation present between the arm segments dorsally, at least on the proximal half of the arm (fig. 44d)  
*Ophiostegastus compsus* A. M. Clark, 1968
- 262' No granulation on the arms . . . . . 263
- 263 Margin of disc unspecialized, the plates underlying the granules not enlarged or convex<sup>94</sup>  
*Distichophis clarki* Ely, 1942
- 263' Marginal plates of disc enlarged and convex, covered with appreciably larger granules than the rest of the disc  
**OPHIOPEZA**<sup>95</sup> 264
- 264 Supplementary oral shields, if present at all, then more often than not concealed under the granulation (pl. 21, figs. 5, 6) . . . . . *Ophiopeza fallax* Peters, 1851
- 264' Supplementary oral shields present in most or all of the interradii and bare of granules . . . . . 265
- 265 Eleven or twelve arm spines (at least at d.d. 8 mm.); colour brownish  
*Ophiopeza spinosa* (Ljungman, 1867b)<sup>96</sup>
- 265' About nine arm spines (at d.d. 8 mm.); colour yellowish-green . . . . . *Ophiopeza dubiosa* (de Loriol, 1893a)<sup>96</sup>
- 266 Teeth extremely wide with hyaline edges (fig. 44f) . . . . . **OPHIOCONIS** 267
- 266' Teeth opaque and more or less narrow . . . . . 269
- 267 No disc spinelets present, only granules . . . . . *Ophioconis cupida* Koehler, 1905a<sup>97</sup>
- 267' Some disc spinelets present, at least marginally . . . . . 268
- 268 Both marginal and dorsal disc spinelets present . . . . . *Ophioconis permixta* Koehler, 1905a<sup>97</sup>
- 268' Only marginal spinelets present . . . . . *Ophioconis cincta* Brock, 1888<sup>97</sup>

<sup>92</sup> Both these species were taken by the 'Snellius' expedition and were drawn by me at the Smithsonian Institution in 1953 after Mr. A. H. Clark had written the description of *Ophiochaeta boschmai*; my figure of this species is the one reproduced in his posthumous paper of 1964, which accounts for the discrepancies between descriptions and figures, notably the absence of comment about the small secondary spines almost hidden by the primaries as shown in the figure. I have observed this feature also in the 'Snellius' specimen of *Ophiochaeta hirsuta* from the Solomon Islands (fig. 44b), as well as in *Ophiarachna quinquespinosa* Koehler, *Ophiopeza spinosa* (Ljungman) (fig. 44e) and *Distichophis clarki* Ely (fig. 44c); in fact Ely used its presence in the last species to characterize his new genus *Distichophis* but its occurrence is clearly too widespread for it to be of generic significance.

<sup>93</sup> As noted in 1968, I consider that *yoldii* is congeneric neither with *Pectinura vestita* nor with *Ophiopeza fallax*, hence the revival of the name *Ophiopsammus*.

<sup>94</sup> The lack of specialization of the marginal disc scales may well be due to the relatively small size of the specimens of *Distichophis* known (d.d. 4 mm. or less) and I believe that a good series of specimens from the Hawaiian Islands will show that Ely's type is conspecific with *Ophiopezella spinosa* (now referred to *Ophiopeza*). My only observations of *spinosa* are derived from a specimen in the British Museum collections from the Maldives Islands (d.d. c.6 mm.) and a larger one studied at the U.S. National Museum from the Marshall Islands (d.d. 10 mm.) shown in fig. 44e. The latter has small secondary arm spinelets like the holotype of *D. clarki* (see note 92) but that specimen differs in having relatively larger supplementary oral shields and rounded rather than angular disc granules; the fewer arm spines (seven or eight as opposed to up to nine in the Maldives specimen and twelve in the Marshall Islands one) and the reduction to a single tentacle scale beyond the basal segments must be correlated with the small size of the type of *D. clarki*, which may also be true of the other characters. The Maldives specimen does not have any secondary arm spinelets although on the first few segments the lateral plates extend beyond the bases of the main series of spines.

<sup>95</sup> As noted in 1968, I consider that there is insufficient evidence for including *Ophiopeza* in the synonymy of *Pectinura*; also H. L. Clark's distinction of *Ophiopezella* by the convexity of the marginal disc plates does not hold good since this also occurs in *Ophiopeza fallax*; accordingly *Ophiopezella* has been referred to the synonymy of *Ophiopeza*.

<sup>96</sup> See note 95 for the use of this combination.

The 'Siboga' East Indian specimens which Koehler (1905a) referred to the south Australian species *Pectinura arenosa* Lyman and likewise those from the Torres Strait also referred to *arenosa* by Döderlein (1896), proved on examination by me to be specifically distinct from Lyman's species; I believe that they are referable to *Ophiopeza spinosa*, or possibly to *O. dubiosa* (if that is distinct from *spinosa*), which Koehler (1930) recorded from the Kei Islands, far afield from Mauritius, the type-locality. I am indebted to Prof. H. Engel for the opportunity to examine these specimens.

<sup>97</sup> As noted in 1965, I consider that Matsumoto was wrong to split off at least these three species from *Ophioconis forbesi* in the separate nominal genus *Ophiurodon*, of which the type-species is *Ophioconis grandisquama* Koehler, 1904, not seen by

- 269 Two tentacle scales; arm plates at least partially covered with granules similar to those on the disc  
**OPHIODYSCRITA** 270  
 269' One tentacle scale; disc granulation not extending on to the arms  
**CRYPTOPELTA** 271  
 270 Five or six short blunt arm spines, at least at d.d. 4 mm., each only about a third as long as the segment  
*Ophiodyscrita pacifica* (Murakami, 1943)<sup>98</sup>  
 270' Eight pointed arm spines at d.d. 5 mm., most of them about half as long as the segment (figs. 45c, 54d-f,  
 p. 135)  
*Ophiodyscrita acosmeta* H. L. Clark, 1938

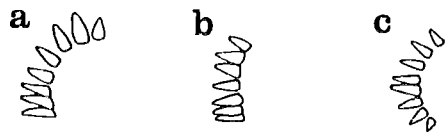


FIG. 45. Arm spines of: a. *Cryptopelta callista*, holotype, b. *C. granulifera*, holotype and c. *Ophiodyscrita acosmeta*, holotype.

- 271 First ventral arm plate concealed by granules  
*Cryptopelta longibrachialis* Koehler, 1930  
 271' First ventral arm plate naked  
 272 Arms flattened dorsally right from the base; arm banding showing clearly on the ventral side as well as dorsally (fig. 55a, b, p. 135)  
*Cryptopelta callista* H. L. Clark, 1938<sup>99</sup>  
 272' Arms almost cylindrical basally, only slightly flattened though the distal part is conspicuously so; arm banding indistinct, only showing on the dorsal side (fig. 55c, d)  
*Cryptopelta granulifera* H. L. Clark, 1909<sup>99</sup>  
 273 Second oral tentacle pore superficial, opening more or less outside the series of oral papillae; arm combs present (fig. 46b)  
 273' Second oral tentacle pore concealed behind the oral papillae when the jaws are closed; no arm combs  
 274 First dorsal arm plate lacking papillae to oppose the needle-like spinelets of the arm comb (fig. 46b; pl. 22, figs. 5, 6)  
*Ophiura kinbergi* (Ljungman, 1867b)  
 274' First dorsal arm plate, within the notch of the arm combs, with papillae along its abradial edges opposing the short comb papillae  
*Dictenophiura stellata* (Studer, 1882)  
 275 Dorsal arm plates either with supplementary plates (fig. 46c, d) or else themselves fragmented (pl. 22, fig. 1)  
 275' Dorsal arm plates entire, no supplementary plates present  
 276 Dorsal arm plates more or less extensively fragmented  
*Ophioplocus imbricatus* (Müller & Troschel, 1842)  
 276' Symmetrical supplementary arm plates present, the primary dorsal plates entire  
**OPHIOLEPIS** 277  
 277 Dorsal arm plates and some of the larger disc plates armed with single large rounded well-defined knobs or tubercles  
 277' No knobs or tubercles, though some of the larger dorsal plates may be thickened  
 278 Ventral arm plates widest distally with acute latero-distal angles;<sup>100</sup> oral shields with a sharp proximal angle  
*Ophiolepis rugosa* Koehler, 1898  
 278' Ventral arm plates rounded latero-distally;<sup>100</sup> a separate platelet proximal to each oral shield at the apex of the proximal lobe, at least in the holotype  
*Ophiolepis nodosa* Duncan, 1887

me. Matsumoto was mistaken about the proportions of the arm spines in *Ophiocoris forbesi*, which are as long as those in the three Indo-Pacific species dealt with here. Also in 1965 I noted the possibility that *O. cincta* and *permixta* are really conspecific, since H. L. Clark's eleven specimens from northern Australia (1938), referred by him to *cincta*, showed considerable variation in the disc armament, some possessing both dorsal and marginal spinelets, as in the type of *permixta*, while others have marginal spinelets only, as in *cincta*, still others lacking spinelets altogether, as in the type of *cupida*, which could also be considered for synonymy.

<sup>98</sup> Murakami included *pacificus* in *Ophiocryptus* although it has only two genital slits in each interradius rather than four as in the type-species, *Ophiocryptus maculosus* H. L. Clark. Having studied the holotype of *Ophiodyscrita acosmeta* I have no hesitation in removing *pacifica* to *Ophiodyscrita*; both species have simple genital slits, the arms more or less extensively covered with granules (though more nearly completely so in the type of *acosmeta*) and very similar oral papillae.

<sup>99</sup> H. L. Clark in his key of 1946 also distinguishes *Cryptopelta callista* and *granulifera* on the basis of the shape and size of the arm spines. Although the form given for the spines of *granulifera* does apply to the specimen from the Great Barrier Reef Expedition (which is in the British Museum collections), the holotype from Mauritius, which I was able to study some time ago at the Museum of Comparative Zoology, Harvard, differs in having the lowest spine no larger than the adjacent ones and all the spines rather short and blunt (fig. 45b). In fact I can see very little difference between the holotypes of *callista* and *granulifera*.

<sup>100</sup> This distinction is based on Duncan's poor illustrations of *Ophiolepis nodosa* and I doubt if it really holds good. The differential characters given by Koehler to justify distinction of *O. rugosa* seem to me unconvincing; they include the arrangement of the disc plates (which in fact appears rather similar from the figures), the shape of the oral shields (in which I suspect the holotype of *nodosa* was abnormal) and the smaller number of oral papillae in the type of *rugosa* (which could be correlated with its smaller size), besides the form of the ventral arm plates.

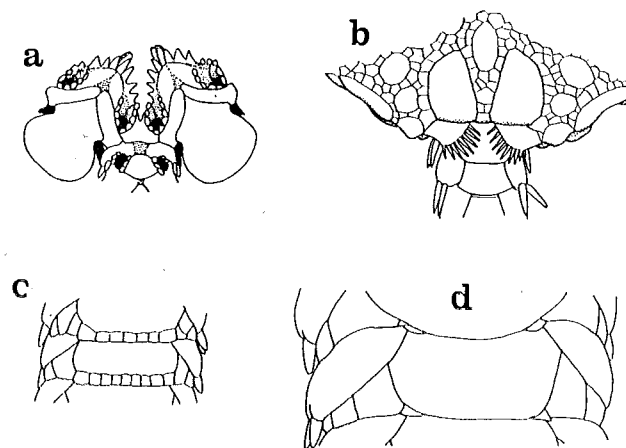


FIG. 46. a, b. *Ophiura kinbergi*, a. Two jaws and b. dorsal view of part of the disc and one arm base. c. *Ophiolepis cincta*, dorsal view of proximal arm segment and d. the same of *O. superba*.

- 279 Arrangement of disc plates irregular  
*Ophiolepis irregularis* Brock, 1888  
 279' Disc plates symmetrically arranged  
 280 Radial shields distinctly larger than the largest disc plates; supplementary dorsal arm plates not forming series right across the distal edge of each segment (fig. 46d); five to eight arm spines; size often very large, d.d. up to c.30 mm.  
 280' Radial shields hardly, if at all, larger than the largest disc plates; supplementary plates bordering the whole distal edge of each dorsal arm plate (fig. 46c);<sup>101</sup> up to four (rarely five) arm spines; size not known to exceed d.d. 20 mm., rarely > 15 mm.  
 281 Arms conspicuously marked with dark bands, the disc usually also with dark markings, most often a central patch extending outwards in each interradius (pl. 22, figs. 3, 4)  
*Ophiolepis superba* H. L. Clark, 1915a<sup>102</sup>  
 281' Colour fairly uniform without conspicuous pattern  
*Ophiolepis unicolor* H. L. Clark, 1938  
 282 Larger disc plates not conspicuously thickened at the edges, the whole disc rather smooth, the interstitial disc plates or scales forming a 'plastering' between the large plates (pl. 22, fig. 2)  
*Ophiolepis cincta* Müller & Troschel, 1842  
 282' Larger disc plates distinctly thickened at the edges, giving a roughened surface and irregular profile to the disc  
*Ophiolepis cardioplax* Murakami, 1943  
 283 A few marginal plates in each interradius greatly enlarged and convex  
*Ophioteichus multispinus* H. L. Clark, 1938  
 283' Marginal plates unspecialized, not forming a raised rampart to the disc.  
 284 Disc plates smooth with larger thick plates ringed by smaller ones  
*Ophiotylos leucus* Murakami, 1943  
 284' Disc plates each bearing one or more coarse tubercles, no rings of small plates encircling the larger ones  
*Ophiozonella projecta* (Koehler, 1905a)

SUMMARY OF TAXONOMIC CHANGES—OPHIUROIDEA

(Some also expressed in preliminary papers.)

- Ophiomyxa robillardi* de Loriol, 1893a, a synonym of *O. australis* Lütken, 1869—see (key) note 1.  
*Ophionephthys iranica* Mortensen, 1940a, a synonym of *Amphiura (Ophiopeltis) tenuis* (H. L. Clark, 1938)—see note 5.  
*Amphioplus cesareus* (Koehler, 1905a), a synonym of *A. impressus* (Ljungman, 1867b)—see note 10.  
*Amphichilus intermedius* (Koehler) Matsumoto, 1917, referred back to *Amphioplus*—see note 10.  
*Amphiodia ochroleuca* (Brock, 1888), referred to subgenus *Amphichilus* of *Amphioplus*—see note 10.

<sup>101</sup> This can only be assumed for *Ophiolepis cardioplax* since Murakami failed to describe the supplementary arm plates.  
<sup>102</sup> H. L. Clark's lamentable introduction of the new name *superba* for this species, formerly well-known as *Ophiolepis annulosa* (Blainville, 1834) (not 1843 as given by Murakami, 1943) has been rejected, notably by Matsumoto (1917), Koehler (1922a and 1930) and Murakami (1943). Unfortunately there is no denying that *Ophiura annulosa* Blainville is a junior primary homonym of *Ophiura annulosa* Lamarck, 1816 (now included in *Ophiomastix*). Nor is it feasible to try and attribute the name *Ophiolepis annulosa* to Müller and Troschel, 1842, since they themselves refer it back to de Blainville. The International Commission would need to exercise its plenary powers to validate the name *Ophiolepis annulosa* and since the name *superba* has become fairly well-known and accepted by a proportion of the specialists in the last fifty years through H. L. Clark's several comprehensive works, I do not feel justified in applying for an exemption to the rules at this late date.

- Amphichilus* Matsumoto, 1917, reduced to subgenus of *Amphioplus*—see note 10.  
*Amphiodia reposita* (Koehler, 1905a) and *Amphioplus conditus* (Koehler, 1905a), referred to *Amphioplus (Unioplus)*—see note 10.  
*Amphiacantha dividua* Matsumoto, 1917, a synonym of *Ophiocomella sexradia* (Duncan, 1887)—see note 12.  
*Ophiocnida echinata* (Ljungman, 1867b) and *Amphiacantha acanthina* (H. L. Clark, 1911), referred to *Dougaloplus* nom. nov. (1970) for *Amphiacantha* Matsumoto—see note 14.  
*Amphioplus praestans* (Koehler, 1905a), a synonym of *A. (Lymanella) laevis* Lyman, 1874—see note 22.  
*Ophiocnemis venusta* de Loriol, 1900, referred to *Ophiothela*—see notes 29 and 64.  
*Ophiothrix vindex* Koehler, 1930, a synonym of *O. (Keystonea) martensi* Lyman, 1874—see note 32.  
*Ophiothrix (Placophiothrix) vicina* Koehler, 1930, referred to *Ophiothrix* subgenus *Keystonea*—see note 33.  
*Ophiothrix andersoni* Duncan, 1887, a synonym of *O. (Keystonea) nereidina* (Lamarck, 1816)—see note 33.  
*Ophiothrix carinata* von Martens, 1870, *O. stelligera* Lyman, 1874 and *O. melanogramma* Bell, 1884, synonyms of *O. ciliaris* (Lamarck, 1816)—see notes 35 and 36.  
*Ophiothrix otiosa* Koehler, 1898, a synonym of *O. savignyi* (Müller & Troschel, 1842)—see note 38.  
*Ophiotrachoides liodisca* (H. L. Clark, 1915b), referred back to *Ophiothrix* sensu stricto rather than to *Keystonea*, though possibly affiliated with *Lissophiothrix delicata*—see note 43.  
*Ophiothrix lorioli* Döderlein, 1896, a synonym of *O. (Acanthophiothrix) purpurea* von Martens, 1867—see note 46.  
*Ophiothrix eurycolpodes* H. L. Clark, 1918, referred to *Ophiothrix* subgenus *Placophiothrix* and possibly affiliated with *O. (P.) melanosticta* Grube, 1868a—see note 49.  
*Ophiothrix darwini* Bell, 1884, a synonym of *O. (Placophiothrix) melanosticta* Grube, 1868a—see note 49.  
*Ophiothrix microplax* Bell, 1884, a synonym of *Macrophiothrix longipeda* (Lamarck, 1816)—see note 54.  
*Ophiothela caerulea* H. L. Clark, 1915b, a synonym of *O. danae* Verrill, 1869—see note 63.  
*Ophiomastix pusilla* Brock, 1888, referred to *Ophiocoma*—see note 66.  
*Ophiomastix notabilis* H. L. Clark, 1938, a synonym of *O. bispinosa* H. L. Clark, 1917—see note 75.  
*Ophionereis aplacophora* Murakami, 1943, a synonym of *O. porrecta* Lyman, 1860—see note 80.  
*Ophiocoma delicata* H. L. Clark, 1932, referred to *Ophiarachna*—see note 83.  
*Ophiarachnella rugosa* H. L. Clark, 1938, a synonym of *O. sphenisci* (Bell, 1894)—see note 86.  
*Ophiarachnella marmorata* (Lyman, 1874), a synonym of *O. gorgonia* (Müller & Troschel, 1842)—see note 88.  
*Ophiarachna snelli* A. H. Clark, 1964, referred to *Ophiarachnella*—see note 90.  
*Ophiocryptus pacificus* Murakami, 1943, referred to *Ophiodyscrita*—see note 98.  
New taxa of Domantay & Domantay, 1967—see notes 5, 33 and 61.

#### SUMMARY OF RELATIONSHIPS NEEDING FURTHER INVESTIGATION

- Ophiocentrus dilatatus* (Koehler, 1905a) and *alboviridis* (Brock, 1888)—see note 3.  
*Amphiura (Fellaria) (originally Ophionephthys) africana* (Balinsky, 1957) and *heptacantha* Mortensen, 1940a—see note 4.  
*Amphiura inhacensis* Balinsky, 1957 and *dejectoides* H. L. Clark, 1939—see note 8.  
*Amphiura septemspinosa* H. L. Clark, 1915b and *ficta* Koehler, 1910a—see note 9.  
*Amphiodia (Amphisina) duplicata* (Koehler, 1930) and *microplax* Burfield, 1924—see note 11.  
*Paracrocnida persica* Mortensen, 1940a, *P. (originally Ophiophragmus) sacensis* (Balinsky, 1957) and *P. (originally Ctenamphiura) sinensis* (A. H. Clark, 1917)—see note 15.  
*Amphioplus (Unioplus) conditus* (Koehler, 1905a) and *repositus* (Koehler, 1905a)—see note 17.  
*Amphioplus didymus* and *stenaspis* both H. L. Clark, 1938 and *parviclypeus* H. L. Clark, 1915b—see note 19.  
*Amphioplus lucidus* Koehler, 1922a and *cyrtacanthus* H. L. Clark, 1915b—see note 21.  
*Amphioplus potens* Koehler, 1930 and *A. (Lymanella) andreae* (Lütken, 1872) or *laevis* (Lyman, 1874)—see note 22.  
*Amphioplus caelatus* Ely, 1942 and *A. (Lymanella) integer* (Ljungman, 1867b)—see note 24.  
*Ophiactis versicolor* H. L. Clark, 1939, *quadrispina* H. L. Clark, 1915b, *modesta* Brock, 1888, *maculosa* von Martens, 1870 and *muelleri* Lütken, 1856—see notes 25 and 27.  
*Ophiophthirus actinometrae* Döderlein, 1898 and immature *Ophiomaza*—see note 28.  
*Ophiothrix (Keystonea) irregularis* (H. L. Clark, 1938) and *martensi* Lyman, 1874—see note 32.  
*Ophiothrix merguensis* Duncan, 1887, possibly referable to *Macrophiothrix*—see note 40.  
*Ophiothrix tristis* de Loriol, 1893a and *trilineata* Lütken, 1869—see note 44.  
*Ophiothrix (Acanthophiothrix) proteus* Koehler, 1905a and *scorpio* (Müller & Troschel, 1842)—see note 45.  
*Ophiothrix (Acanthophiothrix) deceptor* Koehler, 1922a and *purpurea* von Martens, 1867—see note 46.  
*Ophiothrix (Placophiothrix) lineocaerulea* H. L. Clark, 1928 and *hybrida* H. L. Clark, 1915b—see note 50.  
*Ophiothrix dirrhabdota* H. L. Clark, 1918 and *Macrophiothrix expedita* (Koehler, 1905a)—see note 51.  
*Ophiopsammium* with type-species *O. semperi* Lyman, 1874 and *Ophiothela* with type-species *O. mirabilis* (Verrill, 1867)—see note 61.  
*Ophiothela hadra* H. L. Clark, 1915b and *Ophiothrix parasita* Müller & Troschel, 1843—see note 63.  
*Ophiothela dividua* von Martens, 1879 and *danae* Verrill, 1869—see note 63.  
*Ophiomastix sexradiata* A. H. Clark, 1952 and *Ophiocomella sexradia* (Duncan, 1887)—see note 65.

- Ophiocoma schoenleini* Müller & Troschel, 1842, possibly better ranked as a subspecies of *erinaceus* Müller & Troschel, 1842—see note 69.  
*Ophiocoma latilanxa* Murakami, 1943 and *scolopendrina* (Lamarck, 1816)—see note 70.  
*Ophiomastix palaoensis* Murakami, 1943, possibly referable to *Ophiocoma*—see note 71.  
*Ophiomastix bispinosa* H. L. Clark, 1917 and *variabilis* Koehler, 1905a—see note 76.  
*Ophionereis thryptica* Murakami, 1943 and *hexactis* H. L. Clark, 1938—see note 79.  
*Ophionereis degeneri* A. H. Clark, 1949, *variegata* Duncan, 1879 and *porrecta* Lyman, 1860—see note 80.  
*Ophionereis lineata* H. L. Clark, 1946 and *fusca* Brock, 1888—see note 81.  
*Ophiocasma* with type-species *O. stellatum* (Ljungman, 1867b) and *Ophiarachnella* with type-species *O. gorgonia* (Müller & Troschel, 1842)—see note 85.  
*Distichophis clarki* Ely, 1942 and *Ophiopeza spinosa* (Ljungman, 1867b)—see note 94.  
*Cryptopelta callista* H. L. Clark, 1938 and *granulifera* H. L. Clark, 1909—see note 99.  
*Ophiolepis rugosa* Koehler, 1898 and *nodosa* Duncan, 1887—see note 100.

[Figures 47–57 are based on type material in the Museum of Comparative Zoology, Harvard and the U.S. National Museum, unless otherwise stated.]

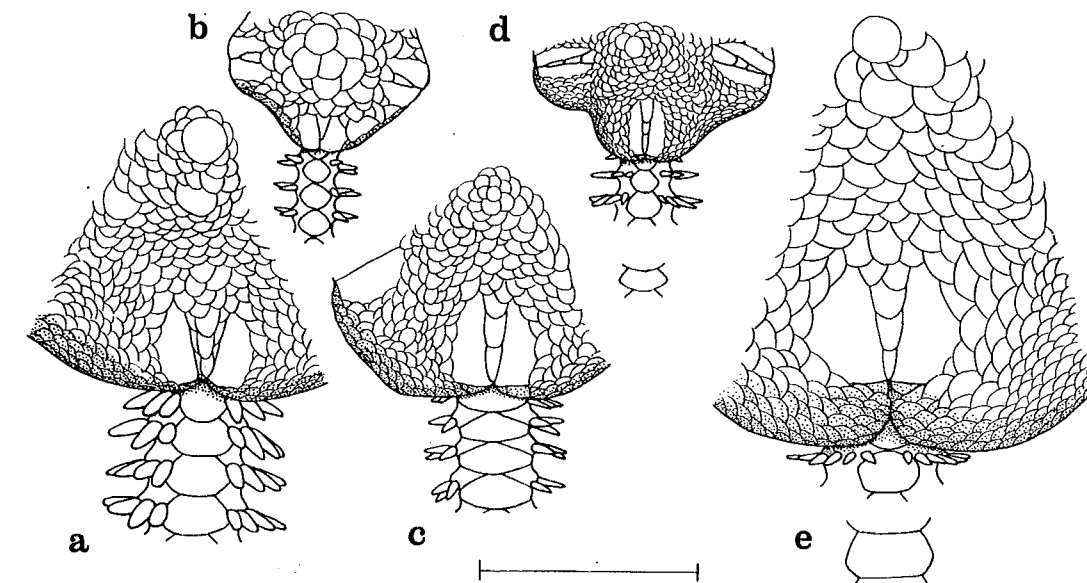


FIG. 47. Parts of disc and an arm base viewed from above of: a. *Amphiura acrisia* H. L. Clark, 1938, holotype, Broome, NW Australia. b. *A. micra* H. L. Clark, 1938, holotype, Broome. c. *A. bidentata* H. L. Clark, 1938, holotype, Broome. [In this last species the lowest tooth is unusually angular for an *Amphiura* and the two distal oral papillae each side are based on the oral plate (not on the adoral as shown by H. L. C.), also the first ventral arm plate is superficial, not inclined into the oral slit.] d. *A. septemspinosa* H. L. Clark, 1915b, holotype, Torres Strait; the specimen is in poor condition and the drawing of the arms needed some imaginative reconstruction, however, the dorsal arm plates certainly appear to be widest at about the middle of their length, not proximally as given by H. L. C., also the adoral shields do meet interradially; the tentacle scales are very hard to distinguish, the 'central' disc plate is off-centre, the distal oral papilla is flattened, elongate and erect, being shown foreshortened in fig. 22c, and the arm spines taper without being much flattened while their tips are rather thorny. e. *A. phriza* H. L. Clark, 1938, holotype, Broome; cf. with *A. coacta* Koehler, 1905a and *A. catephes* H. L. Clark, 1938. The scale equals 2 mm.

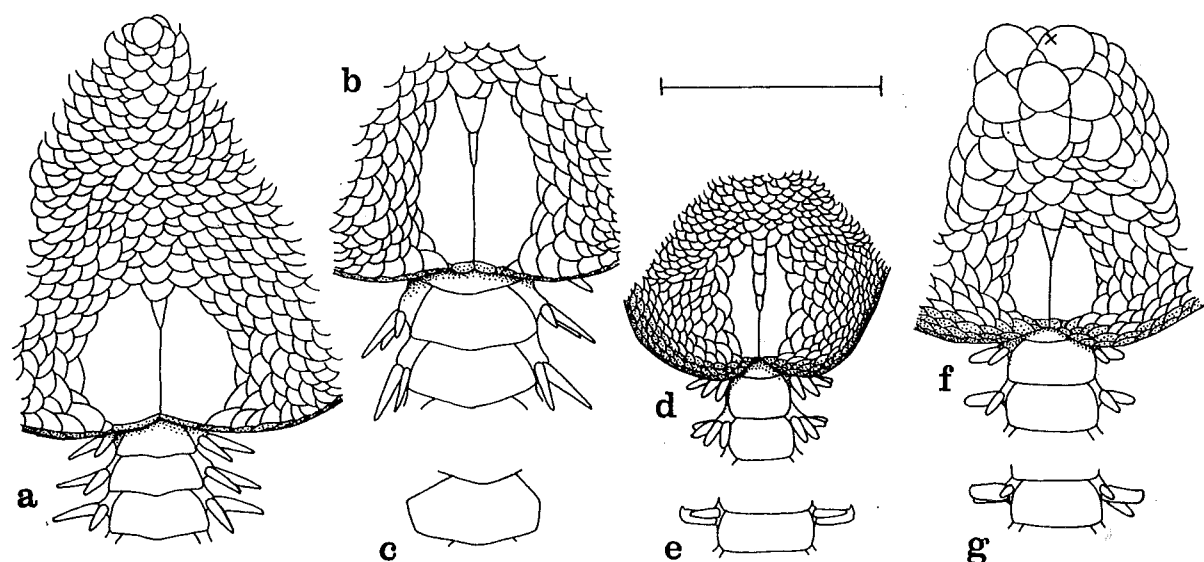


FIG. 48. Parts of disc and an arm base viewed from above of: a. *Amphiprion (Lymanella) andreae* (Lütken, 1872), 'topotype', Rade d'Alepy, Museum of Comparative Zoology no. 1462, d.d. 7.5 mm. b. *A. (Lymanella) laevis* (Lyman, 1874), a syntype of *A. praestans* (Koehler, 1905a), M.C.Z. 5590, 'Siboga' st. II. c. *A. laevis*, holotype, Philippines, second free dorsal arm plate [drawn by Miss A. Schoener; the arms badly broken and distorted]. d. *Amphiprion (Amphiprion) didymus* H. L. Clark, 1938, holotype, Broome. e. The same, fiftieth free arm segment, the spine number reduced from five to three, the middle of which is modified. f. *Amphiprion (Amphichilus) ochroleuca* (Brock, 1888), M.C.Z. 4986, Broome, d.d. 6 mm.; the specimen is unusual in having the radial shields partly contiguous (X marks the central point of the disc). g. The same, thirteenth segment. The scale equals 2 mm.

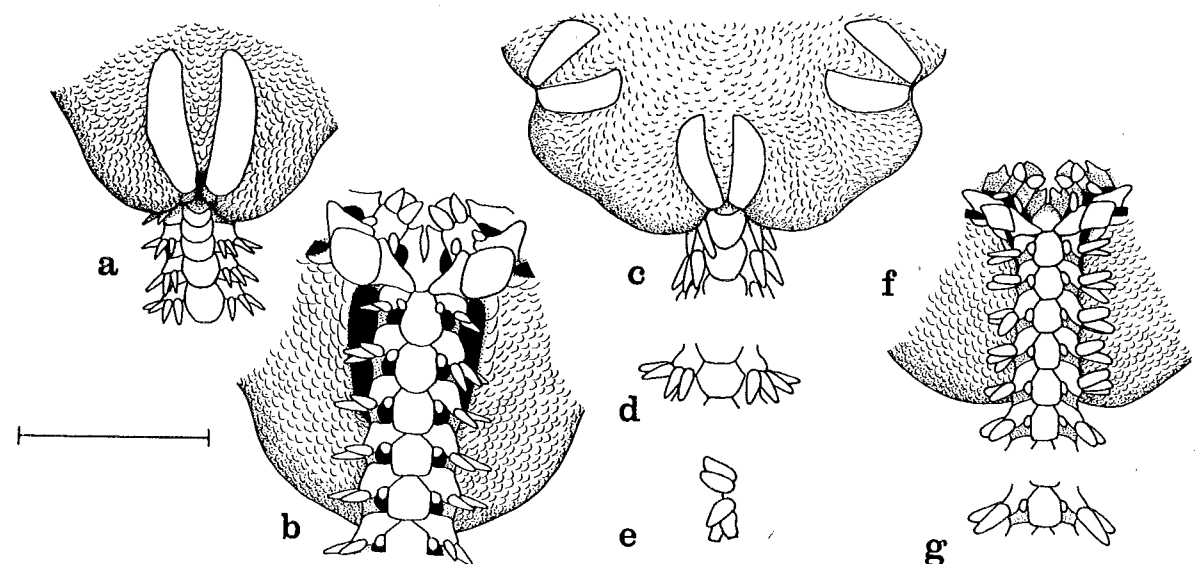


FIG. 49. a, b. *Amphiprion abbreviata* Koehler, 1905a, Copenhagen Museum, Amboina, Kei Islands Expedition, d.d. 5 mm., a. from above, b. from below; the specimen differs from the description of the holotype in having indistinct primary disc scales, wide oral shields and small tentacle scales; cf. with *A. luetkeni*. c-g. *Amphiprion brachyactis* H. L. Clark, 1938, holotype, Broome, c. from above, d. eighth free arm segment from above, e. spines of twelfth free segment, from the side, f. disc from below, g. eighth free segment from below. The scale equals 2 mm. for a and c-g but 3 mm. for b.

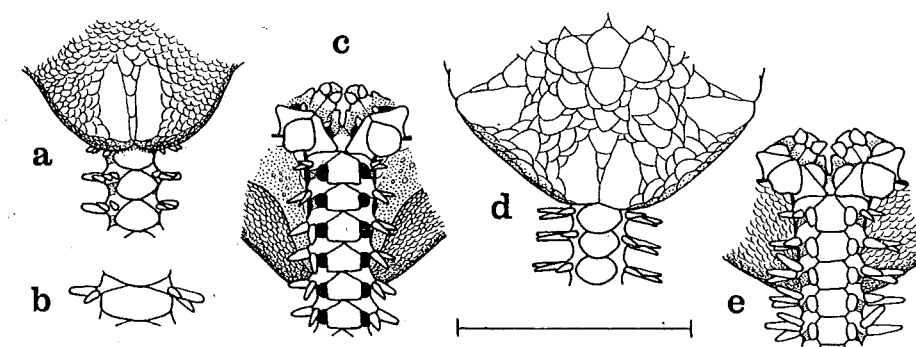


FIG. 50. a-c. *Amphiuura leptotata* H. L. Clark, 1915b, holotype, Philippine Is., a. from above, b. fifteenth free arm segment from above, c. two jaws and an arm base from below; the ventral side of the disc is very dirty and damaged, in the proximal part of each interradius there appears to be skin with perhaps a few isolated scales, as shown. d, e. *A. leucaspis* H. L. Clark, 1938, holotype, Lagrange Bay, W Australia, d. from above, e. from below; again the specimen is rather dirty and the outlines of the disc scaling and arm plates are obscured, the primary scales, however, are distinguished by their yellowish colour. The scale measures 2 mm.

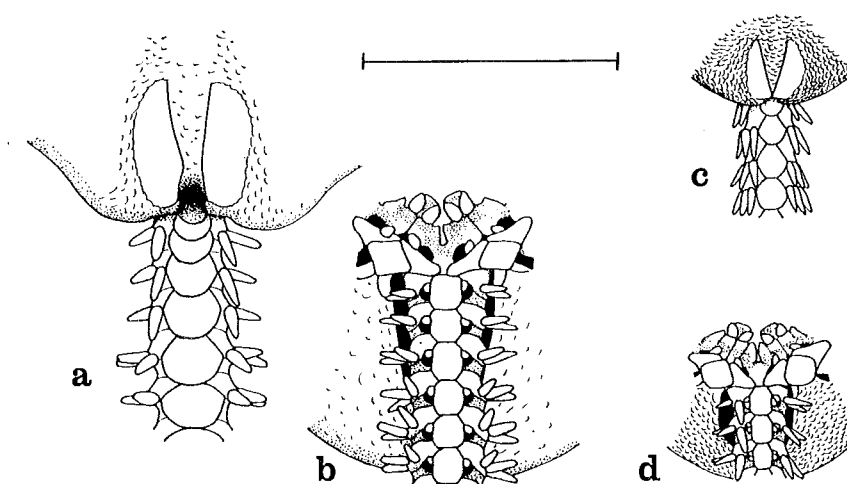


FIG. 51. a, b. *Amphiuura microsoma* H. L. Clark, 1915b, holotype, Torres Strait. a. from above, b. from below; the scales are barely distinguishable in the skin covering most of the disc, producing a dark blue coloration except for white areas around the radial shields and a brownish white patch near the centre where the scaling is more opaque; the tissue appears to have ruptured between the distal ends of the radial shields. c, d. *A. nannodes* H. L. Clark, 1938, holotype, Rottneest I., W Australia, c. from above, d. from below; the outlines of the plates and very thin scales are rather obscured by dirt. [*A. nannodes* is excluded by its locality from the table and key but is included here together with my other drawings of H. L. Clark's Australian amphiuroid types since he gave no figure.] The scale measures 2 mm.

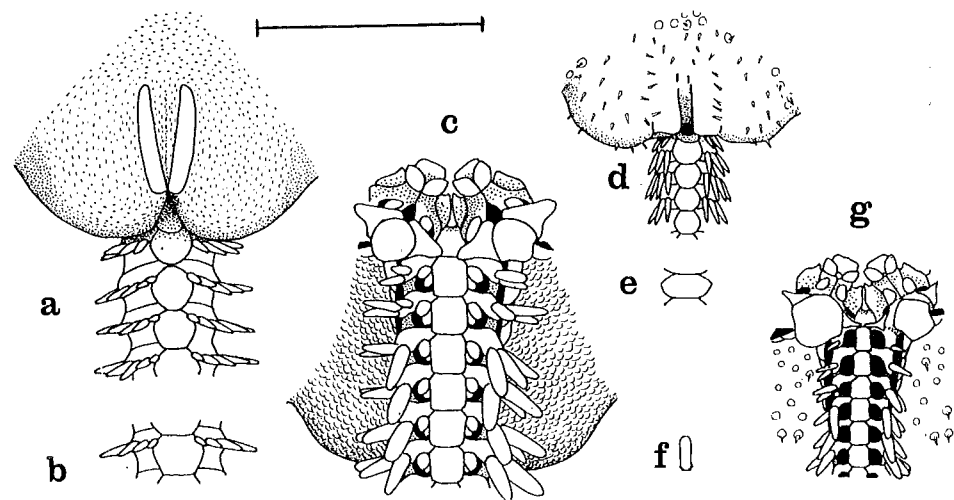


FIG. 52. a-c. *Amphiura stictacantha* H. L. Clark, 1938, holotype, Broome, a. from above, b. the tenth free arm segment from above, c. two jaws and an arm base from below; the disc scales are extremely fine and obscured by dirt; the tentacle scales, especially the more distal one of each pore, are very transparent; the distal oral papillae are very flattened and erect, being foreshortened in the drawing. d-g. *Ophiocentrus inequalis* (H. L. Clark, 1915b), holotype, Hong Kong, d. from above, e. a dorsal arm plate from the broadest part of the arm, f. the second from lowest arm spine in ventral view, g. two jaws and an arm base from below, the oral shield on the left is the madreporite. The scale measures 4 mm. for a-c and 2 mm. for d-g.

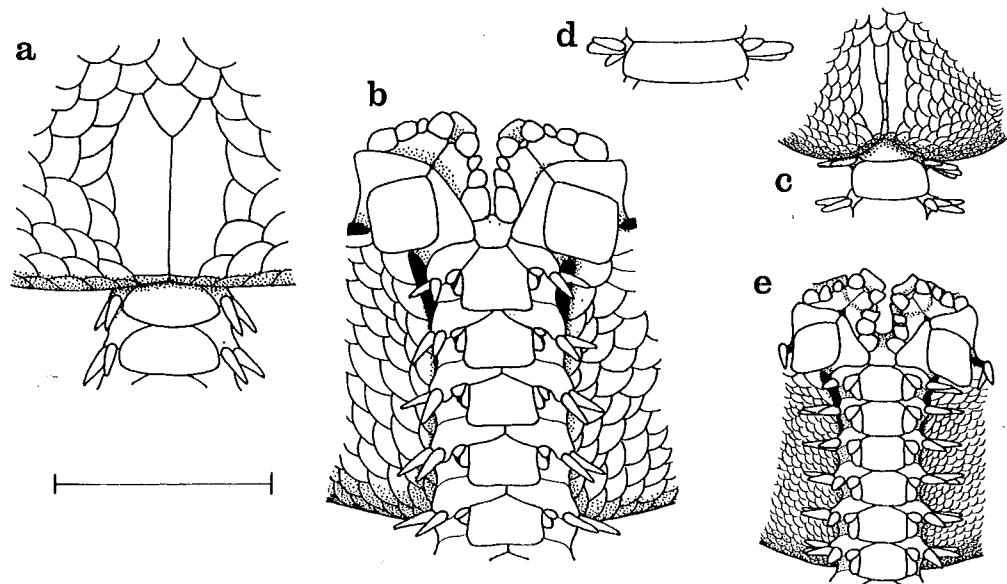


FIG. 53. a, b. *Amphioplus impressus* (Ljungman, 1867b), 'Albatross' station 5371, Philippine area, d.d. 7.5 mm., a. from above, b. from below. c-e. *A. stenaspis* H. L. Clark, 1938, holotype, near Darwin, c. from above, d. twenty-seventh arm segment from above, the arms being markedly wider beyond the base, e. two jaws and an arm base from below. The scale measures 2 mm.

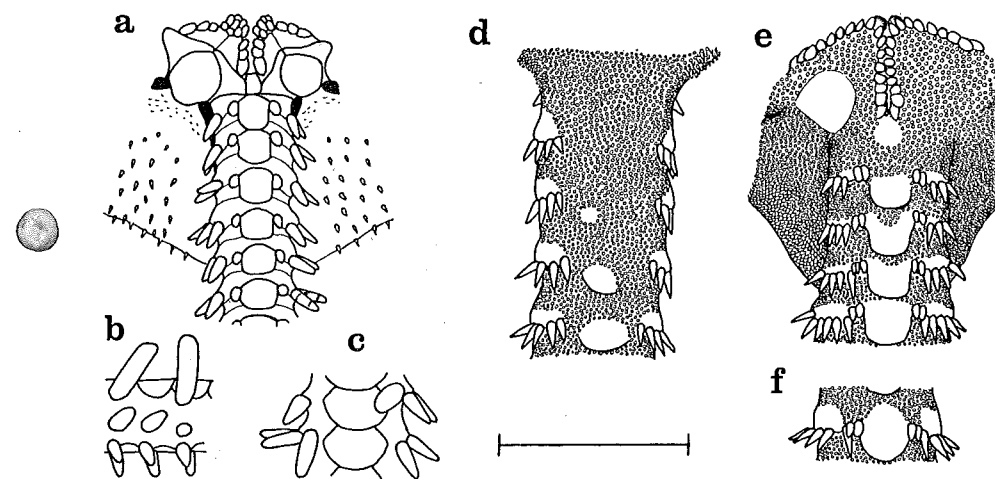


FIG. 54. a-c. *Ophiomastix bispinosa* H. L. Clark, 1915b, holotype of *O. notabilis* H. L. Clark, 1938, Broome, a. from below, the oral shield on the left probably the madreporite, b. the fifth to seventh free arm segments from the side showing the alternation in occurrence of the uppermost spine, c. the twelfth and thirteenth free arm segments from above; the oral papillae, oral shields, tentacle scales and some ventral arm plates and arm spines are white in colour, contrasting with the almost black, smooth, shiny skin elsewhere; on the darker parts of the arms the spines are striped transversely; contrary to H. L. Clark's description the adorals appear to me to meet interradially. d-f. *Ophiodyscrita acosmeta* H. L. Clark, 1938, holotype, Broome, d. from above, e. from below; two of the five oral shields are bare as shown on the left, f. the fourteenth actual arm segment (the eleventh free one) from below. The scale measures 5 mm. for a-c and 2 mm. for d-f.

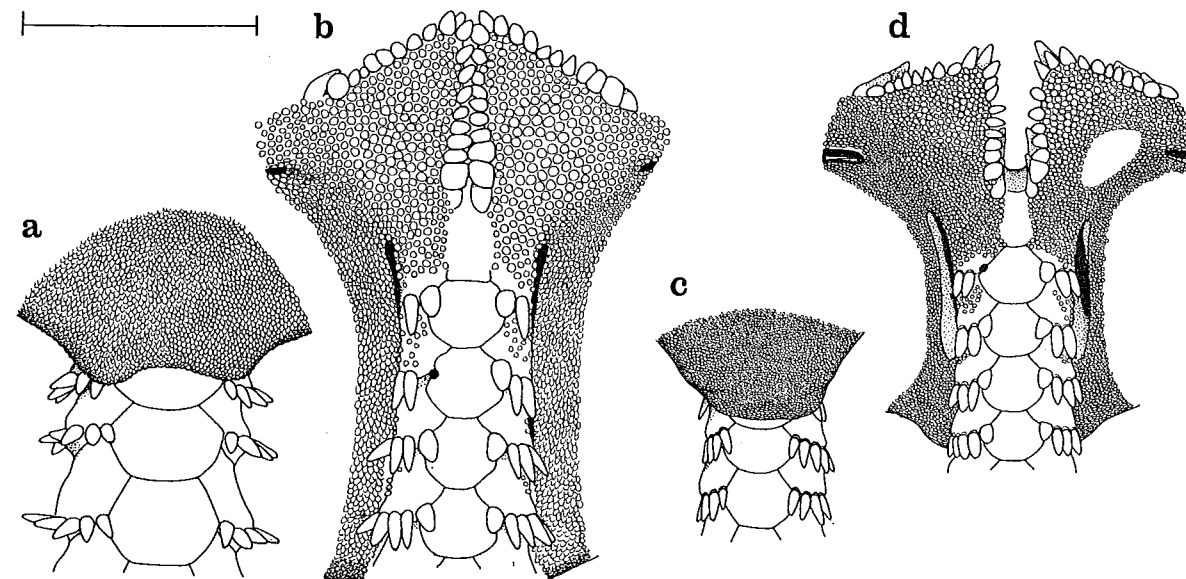


FIG. 55. a, b. *Cryptopelta callista* H. L. Clark, 1938, holotype, Broome, a. from above, b. from below; one oral shield (not shown) is partially bare; the drawing of the arm spines is largely reconstructed since many of the proximal ones are lost. c, d. *C. granulifera* H. L. Clark, 1909, holotype, Mauritius, c. from above, d. from below; two oral shields are partially bare as shown on the right. The scale measures 2 mm.

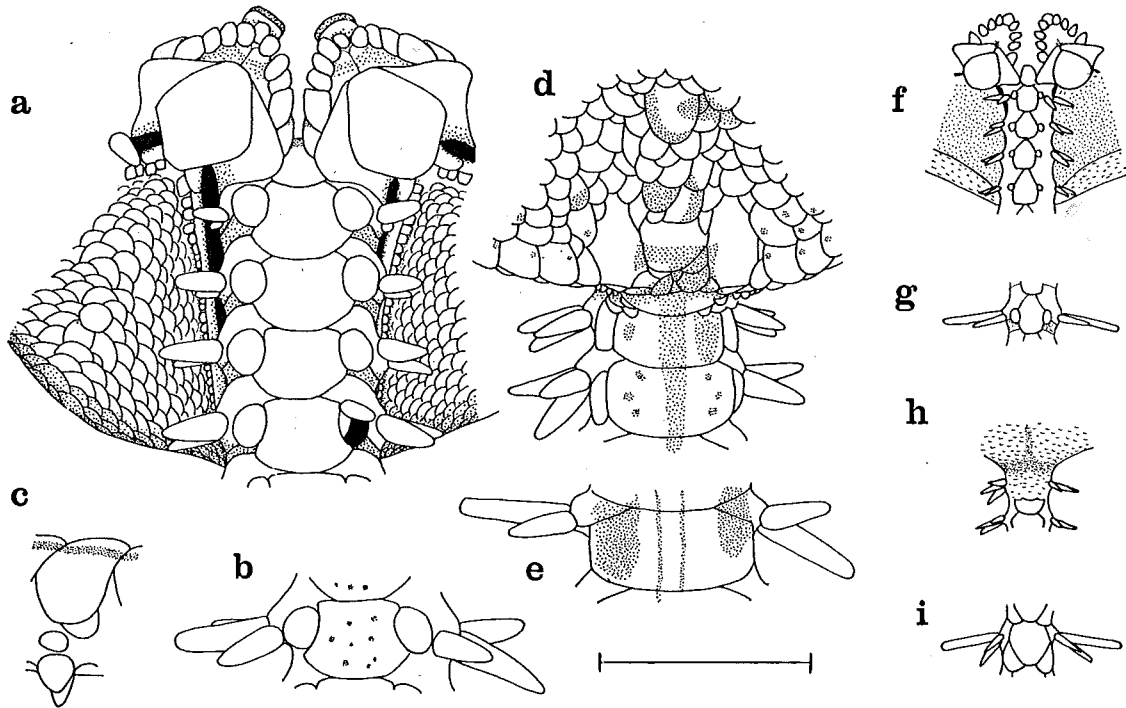


FIG. 56. a-e. *Ophionereis lineata* H. L. Clark, 1946, holotype, Lindeman I., Queensland, a. from below, b. tenth actual arm segment (sixth free one) from below, c. twentieth free arm segment from the side, d. part of disc and an arm base from above, e. seventh free arm segment from above. f-i. *O. hexactis* H. L. Clark, 1938, holotype, Darwin, f. from below; the proximal part of each interradius is covered with dark naked skin, the distal part with small indistinct scales, g. the fourteenth actual arm segment (ninth free one) from below, h. part of disc and an arm base from above, i. twelfth free arm segment from above, the limits of the arm plates rather indistinct. The scale measures 2 mm.

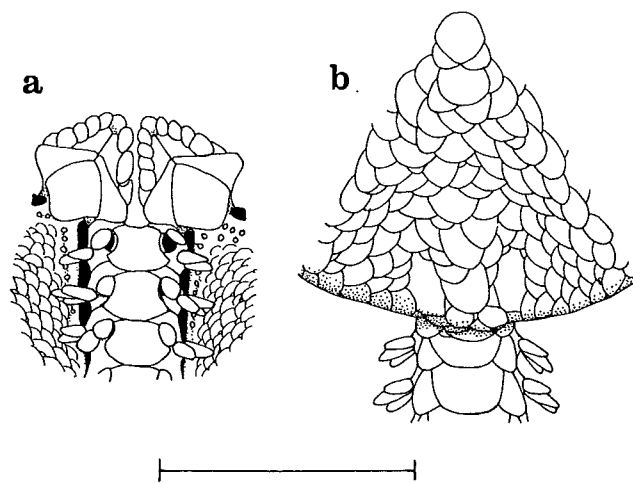


FIG. 57. *Ophionereis degeneri* A. H. Clark, 1949, holotype, Hawaiian Is., a. from below, b. from above; cf. *O. porrecta* Lyman.