ZOOLOGY.—*The bathymetrical and thermal distribution of the unstalked criniods, or comatulids, occurring on the coasts of China and Japan.* AUSTIN H. CLARK, National Museum.[1]

The fauna of the coasts of China and Japan includes 92 recognized species and subspecies of comatulids, of which 2 are probably best considered as local aberrant forms, so that the actual number may be placed at 90.

Of these 90, 61 belong to the Indo-Pacific fauna, characterizing the Southern Japanese division of that fauna, which ranges from Hong Kong and Formosa to the Korean Straits and thence eastward to Tokyo Bay; 22 are Malayan, wide ranging types, each with a distribution different from that of the others; 4 are Antarctic, reaching Japan from the northeastward by way of Alaska and the Aleutian Islands; and 3 (plus varieties of one of them—5 in all) are Arctic. One of these last, *Heliometra glacialis maxima* (with *Heliometra glacialis biarticulata* and *Heliometra glacialis brachymera*) is very closely related to *Heliometra glacialis glacialis*, which occurs in the Arctic Ocean from west of Greenland to the Kara Sea, and southward to Nova Scotia and northern Norway, but the other two are of quite different origin; *Psathyrometra erythrizon* was originally Antarctic, like *Psathyrometra fragilis*, to which it is closely related, and entered the Seas of Okhotsk and Japan from the northeastward; *Thaumatometra tenuis* is most closely related to species in the

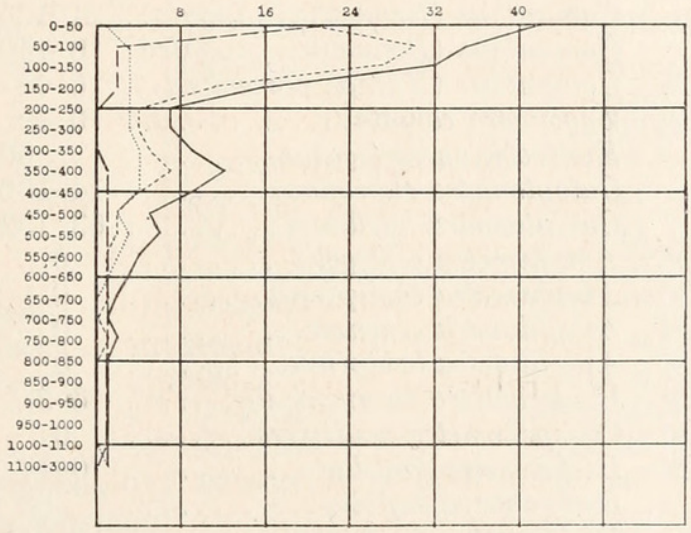

Fig. 1. The frequency at different depths of the comatulids of the coasts of China and Japan. ------ The Species of the Indo-Pacific Fauna; —— —— The Species of the Malayan Fauna; ..... The Species of the Arctic and Antarctic Faunas; ——— The Total for all Species.

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Bathymetric and thermal ranges of the comatulids occurring along the coasts of China and Japan

		Depth in fathoms	*Temperature*
M	*Comatella stelligera*	0–36	(24+)
	Comatella decora	95–106	13.28
M	*Capillaster macrobrachius*	0	(24+)
	Capillaster mariæ	0–59	16.72
M	*Capillaster multiradiata*	0–160	(24+)
M	*Comatula solaris*	0–14	(24+)
	Comatulides decameros	170	?
M	*Comaster gracilis*	0–30	(24+)
M	*Comaster fruticosus*	19–58	24.28
	Comaster serrata	30–106	13.28
	Comantheria intermedia	83	?
	Comantheria grandicalyx	0	(24+)
	Comantheria imbricata	36–50	?
	Comanthus (Bennettia) solaster	0–108	13.28–18.00
	Comanthus (Bennettia) pinguis	21–125	14.33–15.89
	Comanthus (Bennettia) japonica	0–140	11.28–16.72
M	*Comanthus (Vania) parvicirra*	0–44	(24+)
M	*Zygometra comata*	0–49	(24+)
	Eudiocrinus variegatus	60	?
	Catoptometra rubroflava	14–100	16.72
	Catoptometra hartlaubi	63–152	13.33
M	*Amphimetra schlegelii*	0	(24+)
M	*Amphimetra variipinna*	0	(24+)
M	*Amphimetra sinensis*	0	(24+)
M	*Amphimetra lævipinna*	0	(24+)
M	*Himerometra magnipinna*	0–21	(24+)
M	*Craspedometra acuticirra*	0	(24+)
M	*Dichrometra flagellata*	0–14	(24+)
	Dichrometra dofleini	83	(24+)
	Dichrometra döderleini	0–84	23.78
	Mariametra subcarinata	22–59	16.72
	Mariametra delicatissima	84	23.78
	Liparometra grandis	40	?
M	*Lamprometra protectus*	0–12	(24+)
M	*Cenometra bella*	0–20	(24+)
	Cyllometra albopurpurea	12–139	11.61–23.78
	Decametra tigrina	8–34	(24+)
	Prometra owstoni	55	?
	Oligometra japonica	5–8	?
M	*Oligometra serripinna*	0–50	(24+)
	Tropiometra macrodiscus	0–50	?
M	*Tropiometra encrinus*	0	(24+)
	Neometra multicolor	11–333	13.28–15.89
	Gephyrometra versicolor	53	16.50
	Gephyrometra propinqua	95	13.28

		Depth in fathoms	*Temperature*
	Pectinometra flavopurpurea	63–200	8.67–17.22
	Calometra callista	107–139	11.61
	Calometra separata	55–150	13.28–15.89
	Asterometra macropoda	103	15.89
	Asterometra anthus	103	15.89
	Asterometra lepida	35	?
	Cosmiometra aster	369–405	4.44– 5.44
	Cosmiometra conifera	?	?
	Stenometra dorsata	52–170	11.28–15.89
	Daidalometra hana	107–139	11.61
	Parametra alboflava	103	15.89
	Parametra orion	71–170	10.78–15.89
	Thalassometra latipinna	345	5.05
	Thalassometra pubescens	440	5.44
	Pachylometra septentrionalis	?	?
	Glyptometra lata	361	5.95
	Chlorometra garrettiana	95	13.28
	Strotometra hepburniana	100–135	11.28
	Pœcilometra scalaris	361	5.95
	Euantedon sinensis	?	(24+)
	Compsometra serrata	8–35	?
	Iridometra adrestine	13–107	11.61
	Iridometra psyche	30–107	11.61
	Iridometra briseis	59	16.72
	Thysanometra tenelloides	70–197	8.67–13.50
Arc.	*Psathyrometra erythrizon*	390–406	0.39
Ant.	*Psathyrometra fragilis*	300–533	1.61– 2.17
	Perometra diomedeæ	39–139	11.61–20.39
	Erythrometra ruber	55–150	11.11–15.89
Arc.	*Heliometra glacialis maxima*	32–428	−1.22– +1.72
Arc.	*Heliometra glacialis biarticulata*	?	?
Arc.	*Heliometra glacialis brachymera*	[172]	[1.05]
Ant.	*Florometra mariæ*	70–337	4.83–13.50
Ant.	*Florometra rathbuni*	533–587	2.17–383
	Cyclometra clio	107	?
	Nanometra bowersi	139–191	9.67–13.33
Arc.	*Thaumatometra tenuis*	80–620	0.39–1.72
	Thaumatometra isis	361	5.95
	Thaumatometra comaster	300–533	1.61– 2.17
	Thaumatometra cypris	775	3.11
	Thaumatometra parva	120–265	?
Ant.	*Bathymetra abyssicola*	2900	1.83
	Thaumatocrinus borealis	361	5.95
	Pentametrocrinus tuberculatus	169–333	8.89
M	*Pentametrocrinus diomedeæ*	103–186	13.33–15.89
	Pentametrocrinus japonicus	139–662	3.17–13.33
M	*Pentametrocrinus varians*	361–1050	3.17– 5.95

The frequency at different depths of the comatulids occurring on the coasts of China and Japan

Fathoms	*All species*	*Indo-Pacific species*	*Malayan species*	*Arctic and Antarctic species.*
0–50.....	42	20	21	1
50–100.....	35	30	2	3
100–150.....	32	27	2	3
150–200.....	16	11	2	3
200–250.....	7	4	0	3
250–300.....	7	4	0	3
300–350.....	9	5	0	4
350–400.....	12	7	1	4
400–450.....	9	4	1	4
450–500.....	5	2	1	2
500–550.....	6	2	1	3
550–600.....	4	1	1	2
600–650.....	3	1	1	1
650–700.....	2	1	1	0
700–750.....	1	0	1	0
750–800.....	2	1	1	0
800–850.....	1	0	1	0
850–900.....	1	0	1	0
900–950.....	1	0	1	0
950–1000.....	1	0	1	0
1000–1100.....	1	0	1	0
1100–3000.....	1	0	0	1

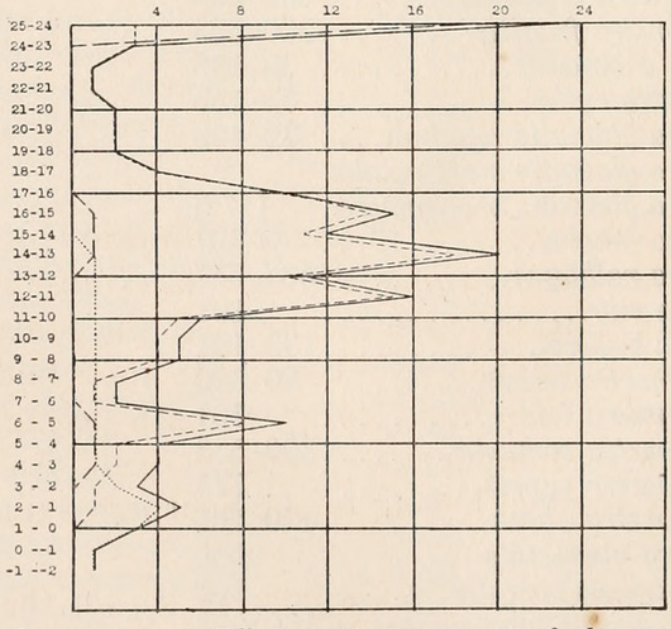

Fig. 2. The frequency at different temperatures of the comatulids of the coasts of China and Japan. - - - - - - The Species of the Indo-Pacific Fauna; —— —— The Species of the Malayan Fauna; ..... The Species of the Arctic and Antarctic Faunas; ———— The Total for all Species.

The frequency at different temperatures of the comatulids occurring on the coasts of China and Japan

Degrees Centigrade	*All species*	*Indo-Pacific species*	*Malayan species*	*Arctic and Antarctic species*
25–24.....	23	3	20	0
24–23.....	3	3	0	0
23–22.....	1	1	0	0
22–21.....	1	1	0	0
21–20.....	2	2	0	0
20–19.....	2	2	0	0
19–18.....	2	2	0	0
18–17.....	4	4	0	0
17–16.....	10	10	0	0
16–15.....	15	14	1	0
15–14.....	12	11	1	0
14–13.....	20	18	1	1
13–12.....	11	10	0	1
12–11.....	16	15	0	1
11–10.....	6	5	0	1
10– 9.....	5	4	0	1
9– 8.....	5	4	0	1
8– 7.....	2	1	0	1
7– 6.....	2	1	0	1
6– 5.....	10	8	1	1
5– 4.....	4	2	1	1
4– 3.....	4	2	1	1
3– 2.....	3	1	0	2
2– 1.....	5	1	0	4
1– 0.....	3	0	0	3
0– −1.....	1	0	0	1
−1– −2.....	1	0	0	1

Southern Japanese division of the Indo-Pacific fauna, and probably reached the Sea of Japan through the Korean Straits.

In the foregoing lists are included all the comatulids known from Chinese and Japanese waters, with their bathymetric and thermal ranges. The fauna to which each belongs is indicated as follows: *M.*, Malayan; *Arc.*, Arctic; *Ant.*, Antarctic; those not especially marked belong to the Southern Japanese division of the Indo-Pacific fauna.

In the diagram (fig. 1) on which are shown the bathymetric ranges of the species of the different faunal units which collectively constitute the comatulid population of the Chinese and

Japanese coasts it is interesting to note that the species of each of these units show the same line that the corresponding species of the same units show in other parts of the world. The mingling of the faunas here, as elsewhere, has resulted in a distinctive collection of individuals which, however, is easily resolved into the original component units, and these component units are found to retain all the distinctive features of the parent faunal groups from which they were originally derived. In their relation to temperature the three faunal groups are very different. The Malayan species, which are mostly confined to the littoral, almost all occur in water with a temperature above 23°, but they are also represented between 12°, and 16°, and 2° and 7°. The Indo-Pacific species have their maximum between 10° and 18°, and especially between 13° and 14°; they are also numerous between 5° and 6°. The Arctic and Antarctic types, which do not occur in water warmer than 15°, are most numerous between 0° and 2°.

We get, therefore, the following optimum temperatures for these three components of the Japanese and Chinese fauna:

Malayan.....	**23+°**	12°–16°	2°–7°
Indo-Pacific.....	23+°	**13°–14°**	5°–6°
Arctic and Antarctic...			**0°–2°**

The point 2° to 7° (including 5° to 6°) is characterized especially by the genera of Oligophreata with highly developed side- and covering-plates along the ambulacra of the pinnules and arms (included in the families Thalassometridæ and Charitometridæ) which, occurring from 0 to 1600 fathoms, are most noticeable between 350 and 400 fathoms; most of these belong to the Indo-Pacific fauna, but a few are Malayan.

Although on the Japanese coast it is possible to take species of the Indo-Pacific and the Antarctic, and of the Indo-Pacific and Malayan, faunal units in one and the same dredge haul, it is evident that this overlapping, which in some places is quite extensive, does not mean that these faunal units here have lost or are losing their identity.