A TAXONOMIC REVIEW OF THE GENUS *EUCHIRELLA* GIESBRECHT, 1888 (COPEPODA, CALANOIDA).

I. GENERAL PART

by

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With 13 text-figures

Summary

The present paper comprises the first part of a revision of *Euchirella* Giesbrecht, 1888. In this General Part, the sources of the material are accounted for, an outline is given of the various techniques employed in this study and the genus is reviewed in a historical sense.

Introduction

The need for a revision of the family Aetideidae Giesbrecht, 1892, was already recognized by Brodskii (1950) in his monograph on the Calanoida of the Far Eastern Seas and Polar Basin of the U.S.S.R., in which work he also added considerably to a better understanding of the family. Since 1950, various authors have published important contributions to aetideid taxonomy, either by describing new genera and species, by reviewing one or more genera, or by increasing our knowledge on the detailed morphology of the Aetideidae (a.o., Vervoort, 1952a-i, 1957, 1963; Tanaka, 1957a, b; Matthews, 1964; Bradford, 1969, 1971; Tanaka & Omori, 1969a, b, 1970a, b; Park, 1973, 1974, 1975a, b, c, 1976a, b, 1978; Maclellan & Shih, 1974; Bradford & Jillett, 1980).

Despite these efforts, the taxonomy of the Aetideidae as a whole as well as the status of the thirty-odd genera contained in the family at present are still far from satisfactorily understood. For this reason, a project was started in 1970 which should eventually result in a complete revision of the family Aetideidae on a world-wide scale. The availability at the Rijksmuseum van Natuurlijke Historie of a vast amount of material originating from the Danish "Dana" Expedition (1928-30) offered the body for this long-term research. The composition of the aetideid material in this collection led the author to select the subfamily Euchirellinae Brodskii, 1950, as the first group of genera to be investigated; of these, the type-genus *Euchirella* Giesbrecht, 1888 was, of course, taken to form the spearhead.

This study of *Euchirella* will result in a series of papers comprising a complete review of the genus and its species, of which the present paper is the first. In Part II, the external morphology of the type-species, *Euchirella messinensis* (Claus,

1863), will be described in extenso to provide a base for the delimitation of the genus (Von Vaupel Klein, in press a, and in prep.). The following papers in this series will deal with the other species contained in *Euchirella*, provide generic and subgeneric definitions, and a key to the species. Next to this taxonomic survey, much time has been devoted to the detailed description of the morphology of these copepods, since it became clear already in an early stage of the investigations that our present knowledge of calanoid morphology is still fragmentary and, more often, even superficial (Von Vaupel Klein, 1972, 1980, and in press b). The treatise on *Euchirella* will be concluded by presenting a phylogenetic model of the genus in direct relation to the other genera of the Euchirellinae, including intra- as well as intergeneric comparisons of variable structures and an evaluation of their usefulness as taxonomic characters. Finally, it is my aim to successively study the other aetideids in the same way as I now deal with *Euchirella*.

Acknowledgements

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History of the Genus *Euchirella*

The first species referable to the genus *Euchirella* in its present conception was described by Lubbock in 1856 as *Undina pulchra* from the male sex only, while in the same work this author described the female as *Calanus latus*. Lubbock's descriptions, however, were not very precise and the position of the species within the genus *Undina* Dana, 1849, added nothing to the understanding of its exact status. Dana's *Undina*, viz., already contained a variety of species, definitely not closely related, which was due, in part, to the all too generally applicable generic concept (cf. Dana, 1849).

Claus (1863), having pointed out this unsatisfactory situation, redefined the use of the name *Undina* by a single species, *Undina messinensis* Claus, 1863, of which he described both sexes and on which he based a more sound generic

definition. In this same work Claus also tentatively referred Lubbock's (1856) species to his own restricted *Undina* without, however, actually deciding to place *pulchra* Lubbock in *Undina* sensu Claus as well.

It was Giesbrecht (1888), in an obvious attempt to clarify this obscure nomenclatorial situation, who created a nomen novum: "Genere Euchirella n. ,,Pro *Undina* Claus non Dana." (Giesbrecht, 1888: 336), thereby implicitly referring to *Undina messinensis* Claus as type-species for *Euchirella*, by monotypy. The species Giesbrecht included in *Euchirella* were that of Lubbock (1856) and five new species, viz., in this very order: *E. galeata*, *E. pulchra* (Lubbock), *E. bella*, *E. venusta*, *E. amoena*, and *E. curticauda*. The paper of 1888 giving hardly more than a list of names and one-line specific definitions, Giesbrecht (1892) subsequently published his magnum opus on the free-living Copepoda in the "Fauna und Flora des Golfes von Neapel", and the generic definition as well as the extensive descriptions of various *Euchirella* species given therein provide a well-defined concept for the genus. In following years, various new species were accomodated in Giesbrecht's *Euchirella*.

Then Sars (1920) recognized the relative heterogeneity of the species assemblages contained by that time in *Undeuchaeta* Giesbrecht, 1888 and *Gaidius* Giesbrecht, 1895, which caused him to establish a new genus, *Pseudochirella*, characterized by the author as: "... en quelque manière intermédiaire entre *Euchirella* et *Undeuchaeta*, ..." (Sars, 1920: 5). Sars' brief diagnosis of the new genus subsequently led to some confusion as to the exact limits of *Euchirella* and *Pseudochirella*, slight remnants of which have even persisted to the present day, although Sewell (1929) already pointed out some distinct differences between these two genera.

In general, however, *Euchirella* has remained a well delimited group of species on which Brodskii (1950) based the subfamily Euchirellinae. The recognition of the individual characteristics of both *Pseudochirella* and *Euchirella* was further enhanced by Vervoort (1952a, g, 1957, 1963) who added several discriminative criteria to separate the two genera and who briefly reviewed (Vervoort, 1963) the status of the species then contained in *Euchirella*. Finally, Tanaka (1957b), Tanaka & Omori (1969a, b), Park (1975c, 1976a, b), and Bradford & Jillett (1980) contributed more recently to the knowledge of the genus in several ways.

Etymology of the generic name. — Giesbrecht (1888, 1892) does not state the derivation of the name *Euchirella* and therefore a reconstuction of its composition is of interest. In ancient Greek, both the noun "εὖχειρ" and the adjective "εὐχερης" existed, meaning "dexterous", "skilful", "agile". If Giesbrecht really derived the name from the stem of one of these words, it might refer to the swimming behaviour of living specimens he observed. Another possibility might be that Giesbrecht created a de novo combination in composing the generic name. In my opinion, it more probably refers to the conspicuous in situ position of the maxillipeds, showing like little hands. From Greek "εὖ", "well", and "χείρ", "hand", the latter noun in the diminutive form, *Euchirella* could best be translated, then, by "[with] well [developed] little hands".

Anyway, from the spelling of the various specific names Giesbrecht (1888) combines with *Euchirella* (vide supra), it is clear that he considers the name a noun in the nominative singular, gender feminine.

Material and Methods

Collections Examined

Next to the above mentioned "Dana" collection, material of *Euchirella* was received on loan from various institutions and individuals. Data pertaining to all collections examined and the localities involved are tabulated below. The following abbreviations are used for scientific institutions, collections, or sampling programmes: CICAR - Cooperative Investigations of the Caribbean and Adjacent Regions; CPOM - Centro de Preclasificación Oceánica, México (City), Mexico; NIO - National Institute of Oceanography, Wormley nr. Godalming, Surrey, United Kingdom; NZOI - New Zealand Oceanographic Institute, Wellington, New Zealand; RMNH - Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; SAM - South African Museum, Cape Town, Republic of South Africa; SOSC - Smithsonian Oceanographic Sorting Center, Washington D.C., U.S.A.; USARP - United States Antarctic Research Program; USNM - United States National Museum, Washington D.C., U.S.A.; UZMK - Universitetets Zoologiske Museum, København, Denmark. In order to ensure quick reference to the stations mentioned in the text, their grouping according to the various collections is first stated in a concise form:

1. "Atlantide" Expedition
2. CPOM material (cf. CICAR programme)
3. "Dana" Expedition
4. "Discovery" Expedition: a, from NIO; b, from RMNH
5. Division of Sea Fisheries, SAM collections
6. NZOI collections
7. "Pesquería" material
8. "Snellius" Expedition
9. USARP material
10. USNM collections: a, "Albatross" material; b, "Bache" stations; c, "Carnegie" cruise VII; d, "Fisk Hawk" station; e, "Grampus" stations; f, "H.M. Smith" material; g, Johnson-Smithsonian Deep-Sea Expedition; h, "Orsom" cruise; i, "T.N. Gill" collections
11. UZMK collections: a, Danish East-Greenland Expedition; b, "Ingolf" Expedition; c, Lundbeck material; d, "Thor" Expeditions
12. Various other samples from RMNH collections.

Legends to the station lists: m.w. = metres wire out (estimated fishing depth of gear roughly one third the length of the wire); n.s. = not stated.

1. "Atlantide" Expedition 1945-46

A minor part of the "Atlantide" collections, originally preserved in UZMK. The present material is composed partly of duplicates of the main collection, which are to remain in RMNH, and partly of specimens which should eventual-

ly be returned to København. The present samples form a small portion of the material previously reported upon by Vervoort (1963). See Bruun (1950) for a detailed list of stations; see also fig. 1. Vessel: R/V "Atlantide".

Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
11	15-xi-1945	34°13'N 12°16'W	> 4000	35 m.w.
24	30-xi-1945	27°23'N 16°36'W	> 2000	500 m.w.
25	30-xi-1945	26°57'N 17°10'W	> 2000	10 m.w.
26	01-xii-1945	25°34'N 18°24'W	> 2000	10 m.w.
27	02-xii-1945	24°30'N 19°11'W	> 3000	10 m.w.
28	03-xii-1945	22°59'N 20°30'W	> 3000	10 m.w.
30	05-xii-1945	19°54'N 22°42'W	c. 4000	10 m.w.
62	10-i-1946	04°16'N 08°18'W	n.s.	400 m.w.
82	29-i-1946	05°27'N 00°07'E	> 600	1700 m.w.
83	29-i-1946	05°29'N 00°20'E	n.s.	10 m.w.
92	01-ii-1946	06°01'N 02°21'E	n.s.	10 m.w.
139	02-iv-1946	01°30'N 10°10'W	n.s.	1750 m.w.
144	13-iv-1946	08°22'N 14°08'W	n.s.	10 m.w.

2. CPOM material

Under the auspices of UNESCO, plankton samples have been collected by several member countries of the oceanographic CICAR programme. The samples were sorted at the Centro de Preclasificación Oceánica de México. The Director of CPOM, Dr. M. en C. César Flores C., kindly made arrangements to place the aetideid material at my disposal. See also figs. 1 and 2a, b. Data on depth of bottom or fishing depth of gear were not provided. Further details on the stations are available from CPOM.

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
184	59	"Virgilio Uribe"	Cosma 71-16/98	18-viii-1971	19°14.5′ 86°00′
185	59	,,	16/99	,,	,,
186	60	,,	16/100	,,	18°55.2′ 86°32.1′
187	60	,,	16/101	,,	,,
188	60	,,	16/102	,,	,,
189	60	,,	16/103	,,	,,
193	61	,,	16/107	,,	18°37′ 87°00′
195	62	,,	16/109	,,	18°31.5′ 87°11′
196	62	,,	16/110	,,	,,
198	64	,,	16/112	19-viii-1971	17°58.3′ 86°28′
199	64	,,	16/113	,,	,,
201	64	,,	16/115	,,	,,
203	65	,,	16/117	,,	17°27′ 86°01.5′
204	65	,,	16/118	,,	,,
213	67	,,	16/127	,,	16°35.8′ 85°01.9′
214	68	,,	16/128	20-viii-1971	16°58.5′ 84°31′
215	68	,,	16/129	,,	,,
218	69	,,	16/132	,,	17°21′ 84°00′
219	69	,,	16/133	,,	,,
220	69	,,	16/134	,,	,,
221	69	,,	16/135	,,	,,
222	70	,,	16/136	,,	17°40.8′ 83°33′
223	70	,,	16/137	,,	,,
224	70	,,	16/138	,,	,,
225	70	,,	16/139	,,	,,
226	71	,,	16/140	,,	18°05.9′ 83°00.5′
227	71	,,	16/141	,,	,,
229	71	,,	16/143	,,	,,
230	72	,,	16/144	21-viii-1971	18°24′ 82°36.8′
232	72	,,	16/146	,,	,,
233	72	,,	16/147	,,	,,
234	73	,,	16/148	,,	18°48.9′ 82°00′
236	73	,,	16/150	,,	,,

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
241	74	,,	16/155	,,	19°09′ 81°31.5′
243	76	,,	16/157	,,	17°58.8′ 81°30.7′
244	76	,,	16/158	,,	,,
246	77	,,	16/160	22-viii-1971	17°01′ 81°29′
247	77	,,	16/161	,,	,,
250	80	,,	16/164	,,	16°27′ 80°55.2′
251	80	,,	16/165	,,	,,
253	80	,,	16/167	,,	,,
254	81	,,	16/168	,,	16°48.5′ 80°12.5′
255	81	,,	16/169	,,	,,
257	81	,,	16/171	,,	,,
258	83	,,	16/172	24-viii-1971	16°54′ 80°01′
259	83	,,	16/173	,,	,,
260	83	,,	16/174	,,	,,
261	83	,,	16/175	,,	,,
262	84	,,	16/176	,,	17°09.3′ 79°40.3′
263	84	,,	16/177	,,	,,
265	84	,,	16/179	,,	,,
266	85	,,	16/180	,,	17°27′ 79°20.5′
267	85	,,	16/181	,,	,,
269	85	,,	16/183	,,	,,
270	86	,,	16/184	,,	17°45′ 79°00′
271	86	,,	16/185	,,	,,
272	86	,,	16/186	,,	,,
273	86	,,	16/187	,,	,,
274	87	,,	16/188	,,	17°54.8′ 78°44.5′
275	87	,,	16/189	,,	,,
276	87	,,	16/190	,,	,,
277	87	,,	16/191	,,	,,
278	90	,,	16/192	25-viii-1971	18°19′ 78°29′
279	90	,,	16/193	,,	,,
280	90	,,	16/194	,,	,,
281	90	,,	16/195	,,	,,
282	91	,,	16/196	,,	18°29.1′ 78°59.2′

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
283	91	,,	16/197	,,	,,
284	91	,,	16/198	,,	,,
285	91	,,	16/199	,,	,,
286	93	,,	16/200	,,	19°08′ 81°00′
287	93	,,	16/201	,,	,,
288	93	,,	16/203	,,	,,
289	95	,,	16/204	26-viii-1971	19°40′ 81°55′
290	95	,,	16/205	,,	,,
291	95	,,	16/206	,,	,,
292	95	,,	16/207	,,	,,
293	96	,,	16/208	,,	20°07′ 82°32.3′
294	96	,,	16/209	,,	,,
295	96	,,	16/210	,,	,,
296	96	,,	16/211	,,	,,
297	97	,,	16/212	,,	20°08′ 83°01.2′
298	97	,,	16/213	,,	,,
300	97	,,	16/215	,,	,,
301	98	,,	16/216	,,	21°30′ 84°00′
302	98	,,	16/217	,,	,,
303	98	,,	16/218	,,	,,
304	98	,,	16/219	,,	,,
305	99	,,	16/220	27-viii-1971	20°31′ 85°02′
306	99	,,	16/221	,,	,,
307	99	,,	16/222	,,	,,
308	99	,,	16/223	,,	,,
309	100	,,	16/224	,,	20°35′ 86°02.5′
310	100	,,	16/225	,,	,,
311	100	,,	16/226	,,	,,
312	100	,,	16/227	,,	,,
313	101	,,	16/228	,,	20°33′ 86°30′
314	101	,,	16/229	,,	,,
315	101	,,	16/230	,,	,,
316	101	,,	16/231	,,	,,
337	114	,,	16/256	31-viii-1971	22°19.5′ 92°02.4′
338	114	,,	16/257	,,	,,
339	114	,,	16/258	,,	,,
340	114	,,	16/259	,,	,,

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
341	115	,,	16/260	,,	22°19′ 92°29.5′
356	118	,,	16/275	,,	22°22′ 94°00′
358	119	,,	16/277	,,	22°20′ 94°29′
359	119	,,	16/278	,,	,,
360	119	,,	16/279	,,	,,
361	120	,,	16/280	01-ix-1971	22°21.2′ 95°00.8′
362	120	,,	16/281	,,	,,
363	120	,,	16/282	,,	,,
364	120	,,	16/283	,,	,,
365	121	,,	16/284	,,	22°20.8′ 95°30′
367	121	,,	16/286	,,	,,
368	122	,,	16/287	,,	22°18′ 96°03′
369	122	,,	16/288	,,	,,
371	122	,,	16/290	,,	,,
372	123	,,	16/291	,,	22°20.7′ 96°30.2′
373	123	,,	16/292	,,	,,
377	124	,,	16/296	,,	22°21′ 97°00′
378	124	,,	16/297	,,	,,
379	124	,,	16/298	,,	,,
381	127	,,	16/300	02-ix-1971	21°01′ 94°35′
382	127	,,	16/301	,,	,,
383	127	,,	16/302	,,	,,
384	128	,,	16/303	,,	20°28′ 94°31′
385	128	,,	16/304	,,	,,
387	128	,,	16/306	,,	,,
388	129	,,	16/307	03-ix-1971	20°01′ 94°32′
390	129	,,	16/309	,,	,,
397	131	,,	16/316	,,	18°58.5′ 94°29.7′
487	b 2-2	H.M. L.N.S. "Luymes"	CICAR XXXVIII-1	05-x-1972	17°41′12″ 64°14′00″
488	b 2-3	,,	,, -2	,,	17°46′36″ 64°17′00″
489	b 2-3	,,	,, -2	,,	,,

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
490	b 2-4	,,	,, -3	06-x-1972	17°49'12" 64°27'48"
491	b 2-4	,,	,, -3	,,	,,
495	1	"Virgilio Uribe"	UNAM 1-73/1	20-iii-1973	18°57' 95°00'
498	2	,,	73/4	21-iii-1973	19°00' 94°00'
499	6	,,	73/5	25-iii-1973	22°00' 93°02'
500	6	,,	73/6	,,	,,
501	6	,,	73/7	,,	,,
502	6	,,	73/8	,,	,,
505	6	,,	73/11	,,	,,
506	6	,,	73/12	,,	,,
508	6	,,	73/14	,,	,,
509	7	,,	73/15	,,	22°00' 94°00'
510	7	,,	73/16	,,	,,
511	8	,,	73/17	,,	22°05' 92°00'
512	8	,,	73/18	,,	,,
513	9	,,	73/19	26-iii-1973	22°00' 96°00'
517	9	,,	73/23	,,	,,
519	9	,,	73/25	,,	,,
521	10	,,	73/27	,,	22°00' 97°00'
522	10	,,	73/28	,,	,,
523	1239	R/V "Academic Kurshatov"	XIV	13-iii-1973	19°36.5' 80°30'
524	1239	,,	,,	,,	,,
525	1244	,,	,,	18-iii-1973	18°26.8' 80°34'
526	1244	,,	,,	,,	,,
527	1256	,,	,,	19-iii-1973	19°18.6' 80°34.6'
528	1256	,,	,,	,,	,,
529	1257	,,	,,	20-iii-1973	19°05' 80°10.3'
543	O.R. II/7	"Oregon II"	43	n.s.	23°55' 67°54'
546	II/13	,,	43	n.s.	20°59' 67°59'
547	II/15-2	,,	43	n.s.	20°00' 67°58'

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
548	II/15-3	,,	43	n.s.	20°00′ 67°58′
549	II/17	,,	43	n.s.	18°58′ 68°00′
551	II/76	,,	43	n.s.	13°00′ 60°00′
552	II/78	,,	43	n.s.	14°03′ 60°08′
554	II/82	,,	43	n.s.	16°02′ 60°00′
555	II/84	,,	43	n.s.	16°59′ 60°04′
556	II/86	,,	43	n.s.	17°59′ 59°58′
557	II/90	,,	43	n.s.	18°00′ 65°00′
558	II/92	,,	43	n.s.	16°57′ 65°01′
561	II/98	,,	43	n.s.	14°02′ 65°03′
567	II/135	,,	43	n.s.	15°10′ 70°01′
569	II/139	,,	43	n.s.	17°00′ 70°00′
570	II/141	,,	43	n.s.	17°29′ 72°29′
571	II/142	,,	43	n.s.	19°41′ 75°00′
573	II/146	,,	43	n.s.	18°00′ 75°00′
574	II/148	,,	43	n.s.	17°00′ 75°00′
575	II/150	,,	43	n.s.	15°59′ 74°56′
576	II/152	,,	43	n.s.	15°00′ 75°01′
577	II/154	,,	43	n.s.	17°00′ 75°00′
578	II/156	,,	43	n.s.	13°06′ 75°04′
579	II/158	,,	43	n.s.	11°59′ 75°01′
581	II/161	,,	43	n.s.	15°10′ 80°00′
582	II/162	,,	43	n.s.	16°10′ 80°00′

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
583	II/165	,,	43	n.s.	17°00′ 79°57′
584	II/166	,,	43	n.s.	21°30′ 85°00′
585	II/167	,,	43	n.s.	21°30′ 85°16′
586	II/169	,,	43	n.s.	21°29′ 85°32′
588	II/171	,,	43	n.s.	21°29′ 86°04′
589	13	"Discoverer"	NOAA-CARIB	23-x-1972	20°44.1′ 79°44.6′
595	9	,,	,,	22-x-1972	21°49.8′ 85°12.5′
596	9	,,	,,	,,	21°49.8′ 85°12.5′
598	8	,,	,,	,,	21°46.1′ 85°34.5′
599	8	,,	,,	,,	21°46.1′ 85°34.5′
601	7	,,	,,	,,	21°31.9′ 86°01.2′
602	7	,,	,,	,,	21°31.9′ 86°01.2′
604	6	,,	,,	21-x-1972	21°33′ 86°11.9′
605	6	,,	,,	,,	21°33′ 86°11.9′
626	22	"Virgilio Uribe"	Gist/2	13-viii-1973	19°52′ 73°28′
628	23	,,	/4	,,	19°56′ 73°38.2′
633	26	,,	/9	21-viii-1973	22°20.8′ 93°00′
644	9	"Virgilio Uribe"	Cosma 71-16/2	06-viii-1971	20°00′ 92°31′
646	9	,,	16/4	,,	,,
651	12	,,	16/9	07-viii-1971	21°00′ 92°47′
652	12	,,	16/10	,,	,,
653	12	,,	16/11	,,	,,
654	12	,,	16/12	,,	,,
657	13	,,	16/15	,,	21°01.5′ 93°37.2′
658	13	,,	16/16	,,	,,
659	14	,,	16/17	,,	21°00′ 94°30′

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
660	14	,,	16/18	,,	94°30′
661	14	,,	16/19	,,	,,
662	14	,,	16/20	,,	,,
665	15	,,	16/23	,,	21°00′ 95°23′
667	16	,,	16/25	,,	21°00′ 96°00′
672	19	,,	16/31-32	08-viii-1971	20°00′ 96°00′
675	20	,,	16/35	09-viii-1971	19°55′ 95°44′
676	20	,,	16/36	,,	,,
677	20	,,	16/37	,,	,,
678	20	,,	16/38	,,	,,
679	39	,,	16/40	12-viii-1971	24°26′ 87°00′
680	39	,,	16/41	,,	,,
681	39	,,	16/42	,,	,,
682	40	,,	16/43	13-viii-1971	24°00′ 87°00′
683	40	,,	16/44	,,	,,
684	40	,,	16/45	,,	,,
685	40	,,	16/46	,,	,,
690	47	,,	16/51	,,	22°57.8′ 86°59′
691	47	,,	16/52	,,	,,
692	47	,,	16/53	,,	,,
693	47	,,	16/54	,,	,,
694	48	,,	16/55	16-viii-1971	21°30′ 86°00′
695	48	,,	16/56	,,	,,
696	48	,,	16/57	,,	,,
697	48	,,	16/58	,,	,,
698	49	,,	16/59	,,	21°38′ 85°27′
699	49	,,	16/60	,,	,,
700	49	,,	16/61	,,	,,
701	49	,,	16/62	,,	,,
702	51	,,	16/63	,,	21°49.7′ 84°59.3′
703	50	,,	16/64	,,	21°46′ 85°07.4′
704	51	,,	16/65	,,	21°49.7′ 84°59.3′
706	51	,,	16/67	,,	,,
707	52	,,	16/68	,,	21°32′ 84°30′

CPOM processing no.	Station no.	Vessel	Cruise no.	Date	Position lat./long. N/W
708	52	,,	16/69	,,	84°30′
709	52	,,	16/70	,,	,,
710	52	,,	16/71	,,	,,
711	53	,,	16/72	17-viii-1971	21°10.8′ 84°00′
712	53	,,	16/73	,,	,,
713	53	,,	16/74	,,	,,
714	53	,,	16/75	,,	,,
715	53	,,	16/76	,,	,,
716	54	,,	16/77	,,	20°48′ 83°30′
717	54	,,	16/78	,,	,,
718	54	,,	16/79	,,	,,
719	55	,,	16/80	,,	20°30′ 84°00′
721	55	,,	16/82	,,	,,
722	55	,,	16/83	,,	,,
723	56	,,	16/84	,,	20°11′ 84°31′
724	56	,,	16/85	,,	,,
725	56	,,	16/86	,,	,,
726	56	,,	16/87	,,	,,
727	57	,,	16/88	,,	19°51.8′ 85°01.9′
728	57	,,	16/89	,,	,,
731	58	,,	16/92	18-viii-1971	19°34.2′ 85°32.8′
733	58	,,	16/94	,,	,,
734	58	,,	16/95	,,	,,
735	59	,,	16/96	,,	19°14.5′ 86°00′
736	4	"Discoverer"	NOAA-CARIB	13-x-1972	20°05′ 95°05′
737	4	,,	,,	,,	,,
740	2	,,	,,	12-x-1972	21°13.2′ 93°30.5′
742	2	,,	,,	,,	22°18.3′ 92°35′
743	2	,,	,,	,,	,,

3. "Dana" Expedition 1928-30 (sqq.)

Material originally kept in UZMK; temporarily kept in RMNH, by courtesy of Dr. E. Bertelsen (København). See Jespersen & Vedel Tåning (1934) and Vedel Tåning (1944) for a detailed list of stations up to and including sta. 4815; see also figs. 5 and 6.

Station no.	Vessel	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
3682ii	R/V "Dana II"	29-iii-1929	01°42′N 124°29′E	3660	600 m.w.
3682iii	,,	,,	,,	3660	300 m.w.
3683	,,	02-iv-1929	04°03′N 123°26′E	4940	surface
3686	,,	06-iv-1929	08°34′N 119°55′E	2725	surface
3686vii	,,	,,	,,	2725	3500 m.w.
3734iii	,,	27-vi-1929	11°43′N 121°43′E	1170	300 m.w.
3735	,,	27-vi-1929	09°33′N 122°19′E	2320	surface
3740ii	,,	02-vii-1929	01°52′N 124°28′E	4400	600 m.w.
3740iii	,,	,,	,,	4400	300 m.w.
3782ii	,,	03-viii-1929	01°54′N 124°42′E	1100	600 m.w.
3782iii	,,	,,	,,	1100	300 m.w.
3786viii	,,	08-viii-1929	04°38′N 126°51′E	970	800 m.w.
3789vii	,,	11-viii-1929	01°48′N 123°20.5′E	4960	800 m.w.
3789viii	,,	,,	,,	4960	400 m.w.
3797ii	,,	16-viii-1929	02°30.5′S 118°35.5′E	1680	600 m.w.
3849i	,,	13-x-1929	08°11′S 92°41.5′E	5250	600 m.w.
3904ii	,,	18-xi-1929	05°18′N 90°55′E	3340	3000 m.w.
3904v	,,	,,	,,	3340	1500 m.w.
4119v	,,	30-v-1930	40°13′N 12°06′E	3200	1000 m.w.
4119x	,,	,,	,,	2700	4000 m.w.
4119xii	,,	,,	,,	2700	2000 m.w.
4119xx	,,	,,	,,	3350	50 m.w.
4760(?)[1]	C/V "Pacific"	08-i-1929	13°28′N 144°31′E	c. 2560	137 m.w.
4761	,,	19-iv-1932	25°10′N 127°45′E	n.s.	n.s.
4762	M/V "Panama"	11-ii-1933	08°13′S 02°54′E	n.s.	293 m.w.
4763	,,	24-ii-1933	39°26′S 47°49′E	n.s.	293 m.w.
4764	,,	28-ii-1933	39°21′S 69°59′E	n.s.	293 m.w.
4765	,,	08-iii-1933	40°06′S 112°57′E	n.s.	293 m.w.

Station no.	Vessel	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
4768	,,	22-iv-1933	19°20′N 119°48′E	n.s.	293 m.w.
4771	M/V "Fernmoor"	28-ii-1933	37°05′N 160°08′E	n.s.	91-110 m.w.
4774	M/V "Jutlandia"	29-iii-1933	31°10′N 171°35′W	n.s.	c. 220 m.w.
4777	M/V "Falstria"	29-iii-1933	35°59′N 129°25′W	n.s.	183 m.w.
4779	,,	19-iv-1933	30°44′N 145°55′E	n.s.	183 m.w.
4782	M/V "Jutlandia"	17-vi-1933	31°28′N 125°50′W	n.s.	c. 220 m.w.
4790	,,	07-vii-1933	35°30′N 145°00′E	n.s.	c. 220 m.w.
4797	M/V "Falstria"	18-i-1934	30°43′N 136°28′E	n.s.	201 m.w.
4815	C/V "Pacific"	10-i-1935	15°55′N 112°55′E	c. 2415	201 m.w.
6674 [2]	n.s.	20-vi-1947	52°20′N 27°30′W	n.s.	2000 m.w.
6674[ii] [2]	n.s.	,,	,,	n.s.	2000 m.w.

[1] " ?" stated on the labels attached to the sorted samples, and apparently added by the one who carried out sorting.
[2] Gear: S200.

4. "Discovery" Expeditions

A few samples of this material have been studied from two collections. Materials collected in 1926-27 were studied by A. Scott and reported upon by Hardy & Gunther (1935); for details on the localities see the station list (Anonymus, 1929); details on stations made in 1931-32 are contained in another list (Anonymus, 1941); see also fig. 7. Vessels: R.R.S. "Discovery" (for sta. 102 only); R.R.S. "Discovery II" (remaining stations).

a. "Discovery" material received on loan from NIO by courtesy of Dr. B. R. Rowbury (Wormley)

Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
725 (?)		(material from "various" stations, not with certainty referable to sta. 725)		

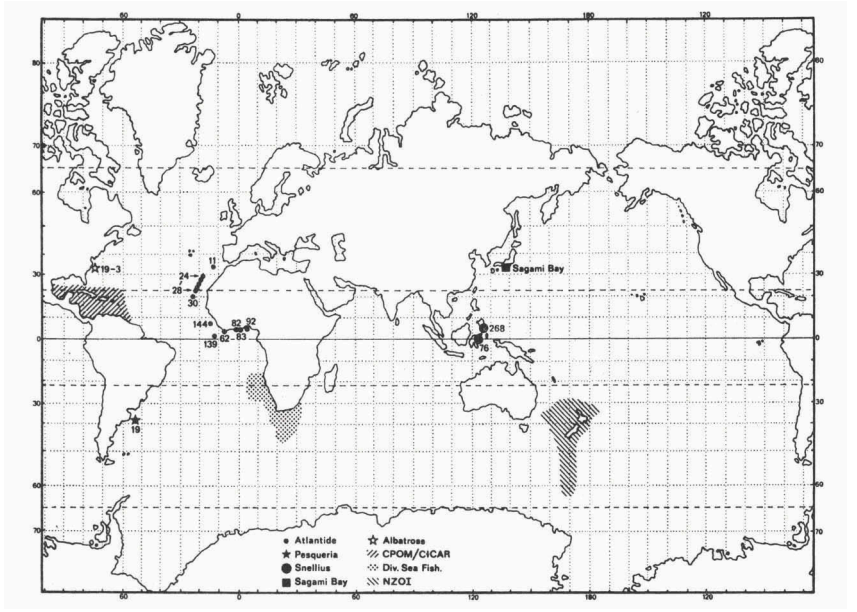

Fig. 1. Positions of stations mentioned in the text: including "Atlantide", "Pesquería", "Snellius", and Sagami Bay localities, and the "Albatross" station from RMNH collections. The areas of CPOM, Div. of Sea Fisheries, and NZOI are indicated; see figs. 2, 3, and 4 for detailed charts.

b. "Discovery" samples present in RMNH

Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
102	28-x-1926	35°29′20″S 18°33′40″E	1800	750-500 m
725	17-xi-1931	53°23.6′S 74°57.8′W	1960	250-196 m
841	02-iii-1932	37°46′S 08°39.3′E	n.s.	130-0 m
842	03-iii-1932	36°04.8′S 13°34.5′E	n.s.	155-0 m
847	11-iv-1932	43°07.4′S 25°04.6′E	5260	119-0 m

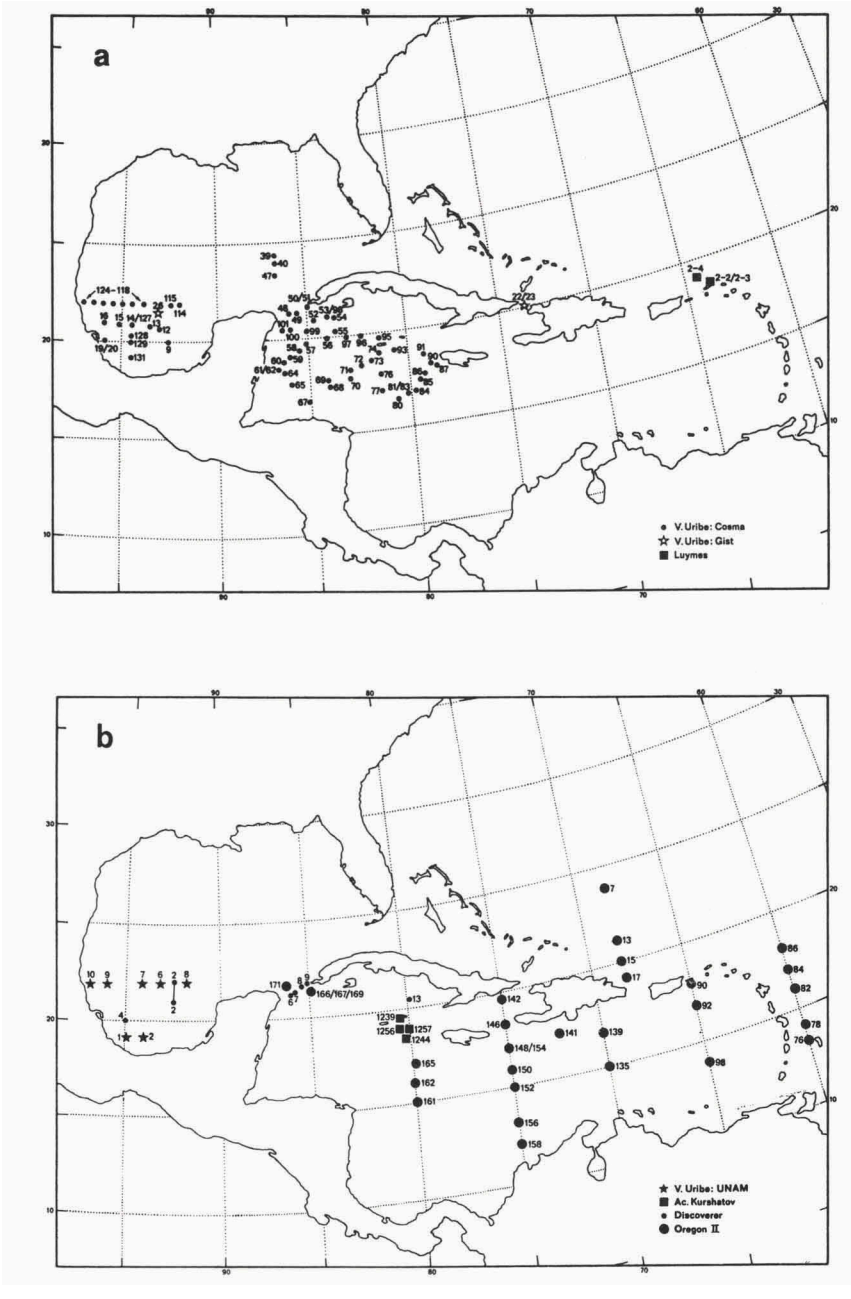

Fig. 2. Positions of stations mentioned in the text: a, b, the CPOM collections from the CICAR programme.

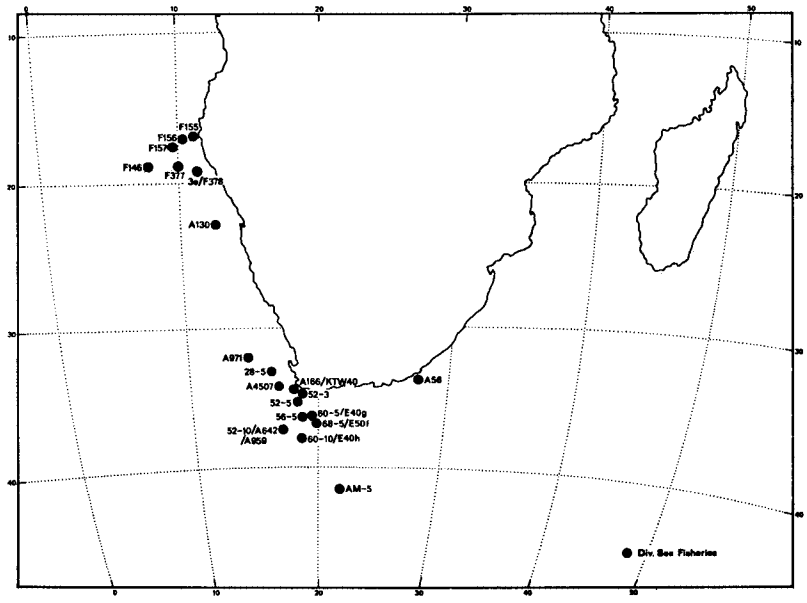

Fig. 3. Positions of stations mentioned in the text: the origin of the Division of Sea Fisheries material from the SAM collections.

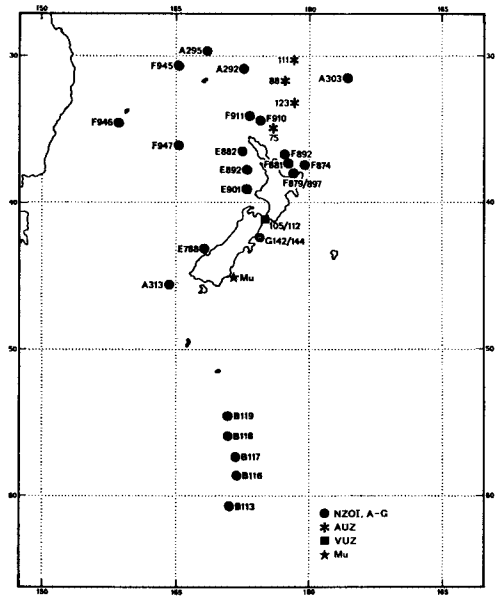

Fig. 4. Positions of stations mentioned in the text: the stations represented in the collections from NZOI.

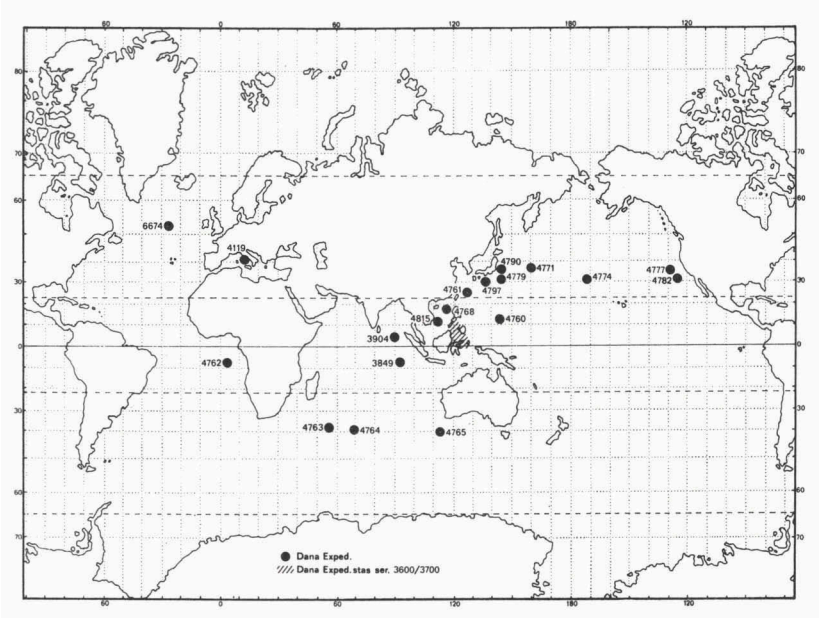

Fig. 5. Positions of stations mentioned in the text: the "Dana" stations; for a detailed chart of stations 3682-3797, see fig. 6.

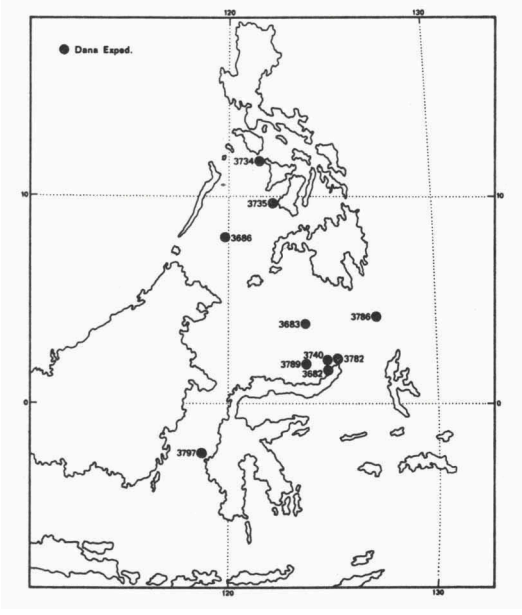

Fig. 6. Positions of stations mentioned in the text: "Dana" stations 3682-3797.

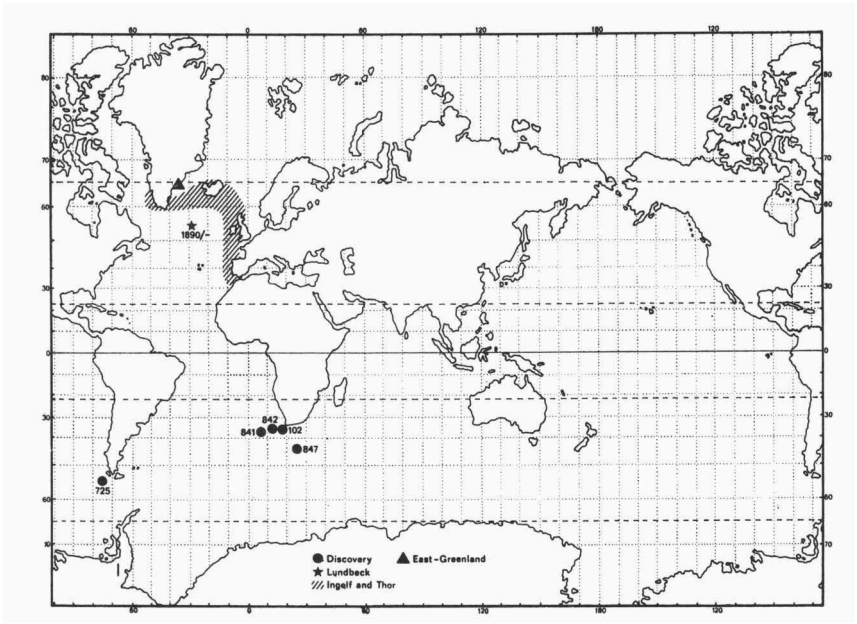

Fig. 7. Positions of stations mentioned in the text: including localities of the "Discovery", East-Greenland, and Lundbeck material; the area of the "Ingolf" and "Thor" stations has been indicated; for a detailed chart see fig. 8.

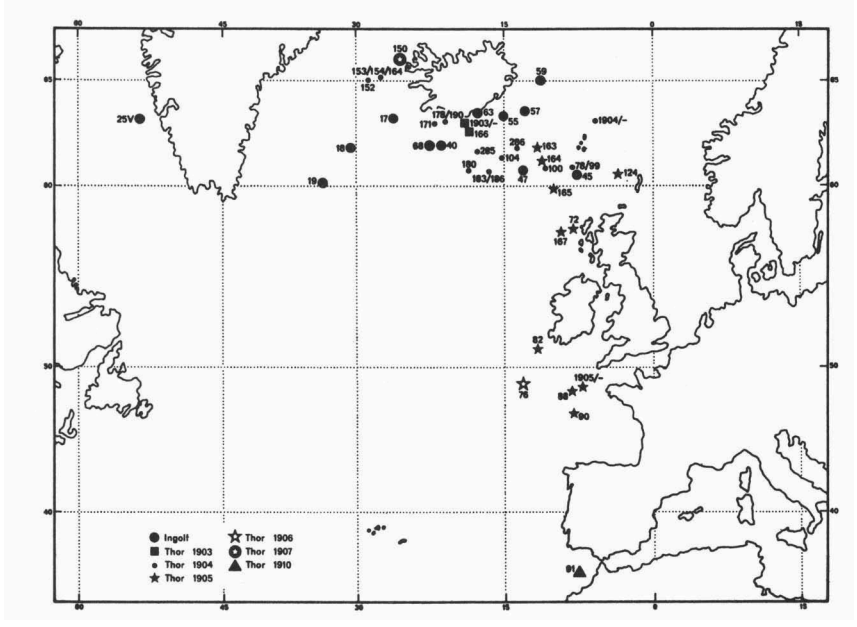

Fig. 8. Positions of stations mentioned in the text: the "Ingolf" and "Thor" Expeditions.

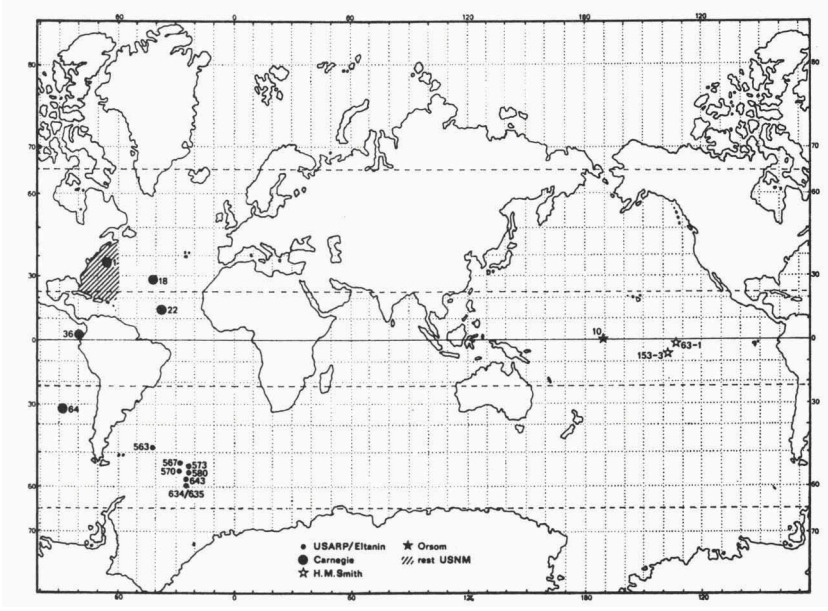

Fig. 9. Positions of stations mentioned in the text: including the USARP material and, from the USNM collections, the "Carnegie", "H.M. Smith", and "Orsom" stations. The areas covered by the "Bache" stations and by the USNM collections under 10d, e, g, and i (see text) are indicated; for a detailed chart see fig. 10.

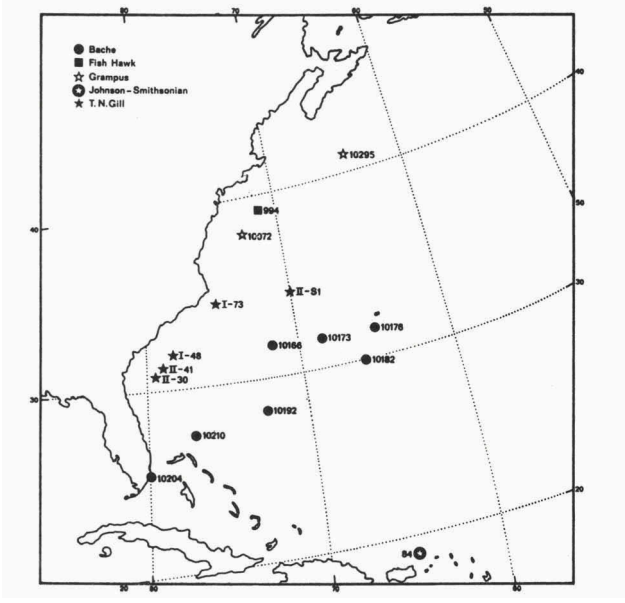

Fig. 10. Positions of stations mentioned in the text: the smaller collections from USNM material, viz., "Bache", "Fish Hawk", "Grampus", Johnson-Smithsonian Deep-Sea Exped., and "T.N. Gill".

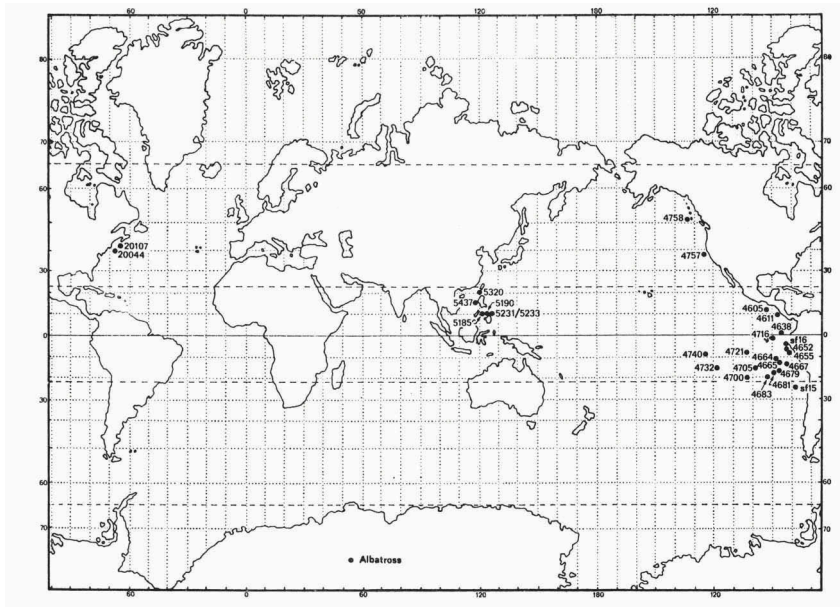

Fig. 11. Positions of stations mentioned in the text: the "Albatross" collection (separately preserved stations only; see also fig. 12).

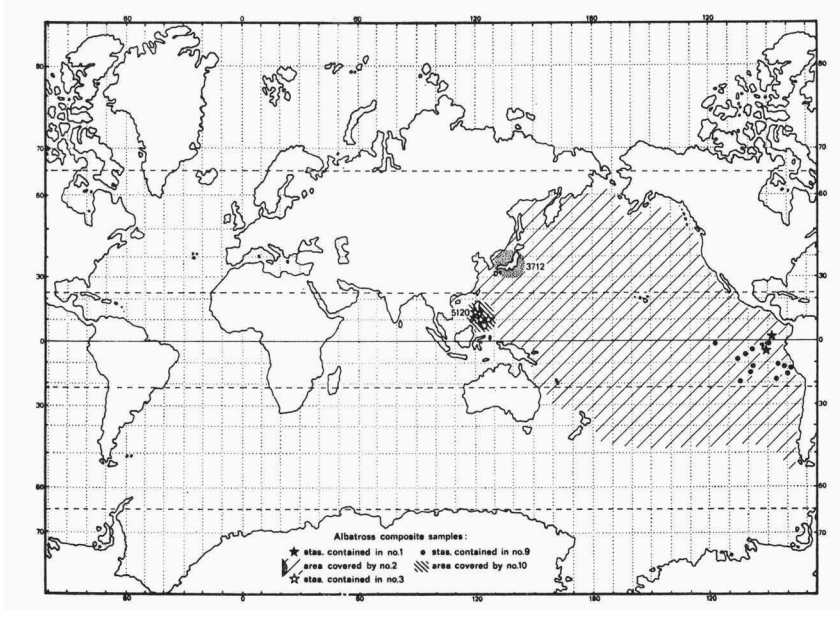

Fig. 12. Positions of stations mentioned in the text: composition of "Albatross" composite samples nos. 1, 2, 3, 9, and 10 (see text).

5. Division of Sea Fisheries, South African Museum

By kind courtesy of Dr. A. de Decker (SAM), collections of the Division of Sea Fisheries were made available to me for study. Detailed station lists up to April 1st, 1961, have been published in the 30th, 31st, and 32nd Annual Reports of this Division (cf. Div. Sea Fish. Ann. Rep., 1961, 1963, 1964, respectively); see also figs. 1 and 3. Vessels: station numbers with A: "Africana II"; with F: "Sardinops".

Station no.	Routine no.	Date	Position lat./long. S/E	Depth of bottom (m)	Data on fishing depth of gear
n.s.	52-3	n.s.	34°40′ 18°15′	n.s.	n.s.
3580	—	28-i-1959	19°00′ 09°53′	4353	150-0 m
A 56	—	05-vi-1959	33°06.2′ 27°57.6′	80	70-0 m
A 130	—	22-vii-1959	22°53′ 11°54′	2871	100-0 m
A 166	—	14-viii-1959	33°41.8′ 18°05.5′	128	100-0 m
A 642	—	13-iv-1960	37°03′ 16°37′	4499	150-0 m
A 959	—	12-x-1960	37°00′ 16°33′	4535	100-0 m
A 971	—	17-x-1960	32°21′ 14°28′	3219	100-0 m
A 1590	E 40 g	19-i-1962	36°00′ 18°40′	3080	n.s.
A 2137	E 40 g	14-x-1962	c. 36°00′ 18°40′	3080	150-0 m
A 2138	E 40 h	,,	c. 36°54′ 18°12′	n.s.	150-0 m
A 2139	E 50 f	15-x-1962	c. 35°38′ 19°15′	n.s.	150-0 m
A 2690	28-5	21-ix-1963	c. 33°05′ 16°05′	n.s.	2300-0 m
A 3143	60-5	14-viii-1964	35°51′ 18°42′	2580	n.s.
A 3153	52-5	16-viii-1964	35°17′ 18°06′	2420	n.s.
A 3321	52-10	18-x-1964	36°40′ 16°28′	4280	n.s.
A 3661	68-5	08-vi-1965	c. 36°09′ 19°37′	n.s.	800-0 m
A 3921	60-10	15-x-1965	c. 37°15′ 17°55′	n.s.	600-0 and 1500-0 m

Station no.	Routine no.	Date	Position lat./long. S/E	Depth of bottom (m)	Data on fishing depth of gear
A 3933	52-10	18-x-1965	c. 36°40′ 16°28′	n.s.	600-0 m
A 4351	52-5	17-ix-1966	c. 35°17′ 18°06′	n.s.	600-0 m
A 4486	60-5	11-i-1967	c. 35°51′ 18°42′	n.s.	600-0 m
A 4495	56-5	12-i-1967	c. 35°34′ 18°07′	n.s.	600-0 m
A 4507	—	24-i-1967	33°25′ 17°20′	n.s.	100-50 m
A 5547	3e	15-i-1971	19°02′ 10°45′	n.s.	600-0 and 1400-0 m
F 146	—	30-iv-1959	19°05′ 08°14′	4600	150-0 m
F 155	—	02-v-1959	17°04′ 10°57′	2240	150-0 m
F 156	—	,,	17°09′ 10°14′	3160	100-0 m
F 157	—	03-v-1959	17°14′ 09°18′	3940	150-0 m
F 377	—	27-x-1959	19°04′ 10°05′	3600	1000-0 m
F 378	—	28-x-1959	19°01′ 10°58′	1300	100-0 m
F 3304	56-5	10-xi-1964	35°40′ 18°05′	2800	n.s.
F 3597	56-5	14-v-1965	35°39′ 18°00′	1920	n.s.
F 4200	60-5	11-vii-1966	c. 35°51′ 18°42′	n.s.	600-0 m
F 4526	52-5	15-xi-1966	c. 35°17′ 18°06′	n.s.	1500-0 m
n.s.	AM-5	n.s.	41°59′ 21°59′	n.s.	n.s.
KTW 40	—	03-x-1958	33°42′ 18°05′	130	100-0 m

6. NZOI collections

Euchirella material was received on loan from collections of NZOI by courtesy of Drs. J. M. Bradford and D. E. Hurley. See Bradford & Jillett (1980) for a detailed station list; see also figs. 1 and 4. Legends: stations with A, B, E, F, or G: NZOI stations; AUZ = Auckland University Zoology Department; VUZ = Victoria University Zoology Department; Mu = Otago University Zoology Department. Name(s) of vessel(s) and data on depth of bottom were not provided.

Station no.	Date	Position	Data on fishing depth of gear
A 292	05-vi-1956	30°45'S 173°16'E	1000-500 m
A 295	07-vi-1956	29°03.5'S 168°36'E	500-0 m
A 303	03-vii-1956	31°40'S 177°33'W	1000-450 m
A 313	17-viii-1956	46°46'S 164°35'E	914-0 m
B 113	02-xii-1958	60°22'S 170°54'E	125-0 m
B 116	03-xii-1958	58°20'S 171°14'E	125-0 m
B 117	04-xii-1958	57°11'S 171°06'E	500-0 m
B 118	,,	55°34.5'S 170°27'E	500-0 m
B 119	,,	54°31'S 170°20'E	500-0 m
E 788	17-x-1967	44°00'S 168°11'E	1193-0 m
E 882	22-iii-1968	36°00'S 172°42'E	1212-0 m
E 892	24-iii-1968	37°20'S 173°35'E	1224-0 m
E 901	25/26-iii-1968	38°00'S 173°19'E	1248-0 m
F 874	03-x-1968	37°18'S 178°11'E	1357-0 m
F 879	04-x-1968	37°25.5'S 177°30'E	1267-0 m
F 881	,,	37°07.5'S 177°14'E	1260-0 m
F 892	05-x-1968	36°58.5'S 176°41'E	1260-0 m
F 897	06-x-1968	37°25'S 177°30'E	1269-0 m
F 910	10-x-1968	34°56'S 175°23'E	1397-0 m
F 911	11-x-1968	34°38'S 174°36'E	1697-0 m
F 945	22-x-1968	31°19.5'S 165°19'E	200-0, 500-0, and 1000-500 m
F 946	02/03-xi-1968	34°32.5'S 157°31.5'E	200-0, 500-200, and 1000-0 m
F 947	05-xi-1968	36°18.5'S 165°05.5'E	200-0 and 500-0 m

Station no.	Date	Position	Data on fishing depth of gear
G 142	20/21-ix-1967	42°25.5′S 174°01.8′E	100-0, 250-100, and 500-250 m
G 144	21-ix-1967	42°24.8′S 174°01.6′E	100-0, 250-100, and 500-250 m
AUZ 75	22-vii-1962	35°15′S 176°15′E	200(?)-0 m
AUZ 88	24-vii-1962	31°57′S 177°38′E	100(?)-0 m
AUZ 111	30-vii-1962	30°26′S 178°15′W	100(?)-0 m
AUZ 123	02-viii-1962	33°13′S 178°24′E	100(?)-0 m
VUZ 105	28-xii-1957	41°47′S 175°01′E	914-0 m
VUZ 112	29-i-1961	41°45′S 174°55′E	732-0 m
Mu 67/57 s	19-v-1967	45°50′S 170°48′E	1000-0 m
Mu 67/94 s	18-viii-1967	,,	1000-0 m
Mu 67/116 s	24-x-1967	,,	1000-0 m
Mu 67/147 s	15-xii-1967	,,	1000-0 m

7. "Pesquería" material

A small collection was received on loan from Dr. F. C. Ramírez, Instituto de Biologia Marina, Mar del Plata, Argentina. Vessel: "Pesquería"; date and depth of bottom not stated; see also fig. 1.

Cruise/ Station no.	Position	Data on fishing depth of gear
II/19	38°S 54°W	vertical haul from 77 m

8. "Snellius" Expedition 1929-30

In the course of the present study only incidentally a few samples of the vast amount of "Snellius" material have been examined. These collections are preserved in RMNH; part of the material has been reported upon by Vervoort (1946, 1949) and a detailed station list was provided by Boschma in 1936; see also fig. 1. Vessel: H. Nl. M.S. "Willebrord Snellius".

Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
76*	20-ix-1929	01°46.5'N 123°08'E	c. 100	300 m.w.
268*	19-v-1930	05°46'N 126°37'W	c. 30	100 m.w.

9. USARP material

Through the kind cooperation of Dr. F. Ferrari, SOSC, Smithsonian Institution, material from the United States Antarctic Research Program was received on loan for this study. See also fig. 9. Vessel: USNS "Eltanin", cruise no. 8; depth of bottom not recorded.

Station no.	Date	Position	Data on fishing depth of gear
563	07-iv-1963	48°15'S 40°24'W	732 m
567	13-iv-1963	54°25'S 27°12'W	1135 m
570	14-iv-1963	56°04'S 27°24'W	933 m (c.)
573	16-iv-1963	55°11'S 24°10'W	4008-3978 m
580	21-iv-1963	57°23'S 23°11'W	3074 m
634	20-v-1963	59°40'S 24°47'W	664 m
635	21-v-1963	59°35'S 24°41'W	1537 m
643	24-v-1963	57°45'S 24°17'W	1160-617 m

10. USNM collections

By courtesy of Drs. T. E. Bowman and R. B. Manning (Washington), a large collection of *Euchirella* specimens was received on loan from USNM. The collection, originating from various sources, has been revised and will be reported upon separately. Only data relevant to *Euchirella* are reproduced in the present paper. Parts of this collection have been worked up previously by (a.o.) G. O. Sars (not published), Wilson (cf. 1932, 1942, 1950), and Tanaka & Omori (cf. 1969a).

a. "Albatross" material

For detailed station lists, reference is made to Wilson (1950) (annotated by W. L. Schmitt), who reported on these collections earlier and who also indicates G. O. Sars' share in the study of the "Albatross" samples. See also figs. 11 and 12. Vessel: U.S. Fisheries Steamer "Albatross".

Station no.	Date	Position	Depth of bottom	Data on fishing depth of gear
sf 15	24-ii-1888	22°54'S 77°10'W	n.s.	surface
sf 16	01-iii-1888	04°21'S 81°59'W	n.s.	surface
3712	07-v-1900	"Off Honshu Is., Japan"	n.s.	surface
4605	17-x-1904	12°20'N 92°13'W	2200 fms	300-0 fms
4611	18-x-1904	10°32'N 88°25'W	1800 fms	300-0 fms
4638	06-xi-1904	00°27'N 87°13'W	1450 fms	surface [1])
4652	11-xi-1904	05°45'S 82°40'W	2200 fms	surface [1])
4655	12-xi-1904	05°57'30"S 81°50'W	2200 fms	400-0 fms
4664	17-xi-1904	11°30'S 87°19'W	2500 fms	300-0 fms
4665	,,	11°45'S 86°05'W	2500 fms	surface
4667	18-xi-1904	12°00'S 83°40'W	2600 fms	surface
4668	19-xi-1904	12°09'S 81°45'W	n.s.	300-0 fms
4671	20-xi-1904	12°07'S 78°28'W	n.s.	surface
4676	05-xii-1904	14°29'S 80°24'W	n.s.	surface
4679	07-xii-1904	17°26'S 86°46'W	2485 fms	300-0 fms
4681	08-xii-1904	18°47'S 89°26'W	2395 fms	300-0 fms
4683	09-xii-1904	20°02'30"S 91°52'30"W	2385 fms	300-0 fms
4700	25-xii-1904	20°29'S 103°26'W	2200 fms	300-0 fms
4705	28-xii-1904	15°05'S 99°19'W	2031 fms	300-0 fms
4707	29-xii-1904	12°53'S 97°42'W	n.s.	300-0 fms

Station no.	Date	Position	Depth of bottom	Data on fishing depth of gear
4715	02-i-1905	02°40′30″S 90°19′W	n.s.	300-0 fms
4716	,,	02°18′30″S 90°02′30″W	1700 fms	surface
4717	13-i-1905	05°11′S 98°56′W	n.s.	300-0 fms
4719	14-i-1905	06°30′S 101°17′W	n.s.	300-0 fms
4721	16-i-1905	08°07′30″S 104°10′W	2084 fms	300-0 fms
4732	21-i-1905	16°32′30″S 119°59′W	2012 fms	300-0 fms
4740	11-ii-1905	09°02′S 123°20′W	2422 fms	300-0 fms
4742	15-ii-1905	00°04′S 117°07′W	n.s.	300-0 fms
4757	04-v-1906	39°18′N 123°58′W	146 fms	100-0 fms
4758	19-v-1906	52°02′N 132°53′W	1600 fms	300-0 fms
5120	21-i-1908	13°45′30″N 120°30′15″E	n.s.	350-0 fms
5185	30-iii-1908	10°05′45″N 122°18′30″E	638 fms	550-0 fms
5190	01-iv-1908	10°08′15″N 123°16′45″E	n.s.	250-0 fms
5231	07-v-1908	10°01′15″N 124°43′15″E	n.s.	80-0 fms
5233	,,	10°00′22″N 124°45′06″E	n.s.	100-0 fms
5320	09-xi-1908	20°58′N 120°03′E	n.s.	500-0 fms
5437	08-v-1909	15°45′54″N 119°42′45″E	n.s.	600-0 fms
20044	22-ii-1920	40°07′N 68°03′W	750 m	vertical net
20107	16-iv-1920	42°19′N 66°02′W	n.s.	surface net

[1]) Wilson (1950) records 300-0 and 400-0 fms, respectively; however, the label written by G. O. Sars mentions "tow at surface" for both stations.

Remarks. — When sorting the plankton material originating from the "Albatross" and the "Carnegie" cruises the investigators, among whom C. B. Wilson and G. O. Sars, regularly put specimens from various localities together in one tube when they were convinced that all belonged to the same species: a habit not uncommon in those days as the same procedure was followed by, e.g.,

A. Scott in processing the "Siboga" collections. Modern views in taxonomy have rendered such composite samples practically useless except in tracing the ancient author's concept of a certain species.

However, not all composite collections are composed of materials from such widely distant positions as "between Antarctica and Plymouth" or "various stations in the Pacific Ocean". The collections examined contain a few composites from limited geographical areas, which are to be considered of some (restricted) value and therefore have been taken into account in the present study; these include the composite samples listed below. See also figs. 9 and 12.

"Albatross" composite samples

No. 1. Includes sta. 4638 and sta. 4716, two positions situated relatively close together near the Galapagos Archipelago (fig. 12).

No. 2. Includes "sta. 3712 [and] various [other] stations in the Pacific Ocean, 1906-08", as stated on the labels. Though too vague a characterization to be of value, the material is included here because Tanaka & Omori (1969a) have reported upon it. See fig. 12 for the position of sta. 3712: though also rather inaccurate, this single station covers a restricted area somehow.

No. 3. Includes stations 5120, 5190, and 5231, all three located closely together in the Philippine Islands (fig. 12).

No. 9. Includes a relatively close group of stations off Peru, in the equatorial East Pacific, viz., stations 4667, 4668, 4671, 4676, 4679, 4700, 4705, 4707, 4715, 4717, 4719, 4721, and 4742. See fig. 12.

No. 10. Includes "sta. 5120 [and] various [other] stations in the Philippine Islands, ... 1908". Thus, also an assemblage taken in a rather limited region; see fig. 12.

"Carnegie" composite samples

No. 1. Includes stations 36 and 64, both off the Pacific coast of South America, see fig. 9.

b. "Bache" stations

The positions of these stations are also shown in figs. 9 and 10. Detailed data on the stations are provided by Bigelow (1917b). Vessel: U.S. Steamer "Bache".

Station no.	Date	Position	Depth of bottom	Data on fishing depth of gear
10166	30-i-1914	32°33'N 72°14'W	n.s.	1100-0 m
10173	04-ii-1914	32°27'N 68°22'W	more than 4570 m	200-0 m
10176	05-ii-1914	32°30'N 65°48'W	n.s.	150-0 m
10182	19/20-ii-1914	30°27'N 66°05'W	n.s.	1800-0 or 1000-0 m [1]
10192	26-ii-1914	28°35'N 73°33'W	n.s.	1000-0 m

Station no.	Date	Position	Depth of bottom	Data on fishing depth of gear
10204	20-iii-1914	25°33'N 80°03'W	n.s.	150-0 m
10210	22-iii-1914	27°59'N 77°25'W	n.s.	1000-0 m

[1]) Data on various labels are not consistent.

c. "Carnegie" cruise VII, 1928-29

Material originating from the collections made during the Last Cruise of the "Carnegie" and reported upon previously by Wilson (1942) to which paper reference is made for detailed data on the stations; see also fig. 9. Vessel: "Carnegie".

Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
LCC 1	12-v-1928	38°14'N 67°34'W	4900	surface
LCC 18	17-viii-1928	29°47'N 40°36'W	4054	0, 50, and 100 m
LCC 22	27-viii-1928	13°25'N 38°00'W	5980	,,
LCC 36	30-x-1928	02°54'N 80°02'W	4880	100 m
LCC 64 (*a*)	03-i-1929	31°54'S 88°17'W	3879	0, 50, and 100 m
LCC 64 (*b*)	03-i-1929	31°54'S 88°17'W	3879	1000 m

Remarks. — See remarks on "Albatross" material, above.

d. "Fish Hawk" station

A single sample of material collected by the "Fish Hawk" was contained in the collections. Data on fishing depth of gear were not recorded; see figs. 9 and 10. Vessel: "Fish Hawk".

Station no.	Date	Position	Depth of bottom
994	08-ix-1881	39°40'N 71°30'W	368 fms

e. "Grampus" stations

This material was studied by C. O. Esterly, and the results published in Bigelow's (1915, 1917a) reports, which also provide detailed station lists; see figs. 9 and 10. Vessel: U.S. Fisheries Schooner "Grampus".

Station no.	Date	Position	Data on fishing depth of gear	Depth of bottom (m)
10072	21-vii-1913	38°50′N 73°51′W	24-0 fms	n.s.
10295	24-vi-1915	42°22′N 64°16′W	500-0 m	> 500

f. "H.M. Smith" material

Part of the collections reported upon previously by Grice (1962), who also provides a station list. Depth of bottom was not stated; see fig. 9. Vessel: "Hugh M. Smith".

Cruise no.	Station no.	Date	Position	Data on fishing depth of gear
31	153-3	22-xi-1955	05°41′S 139°54′W	126-63 m, closing net
35	63-1	19-viii-1956	01°10′S 134°57′W	169-0 m, oblique tow

g. Johnson-Smithsonian Deep-Sea Expedition

See figs. 9 and 10; no record of vessel available; depth of bottom not stated.

Station no.	Tag no.	Date	Position	Data on fishing depth of gear
84	455	26-ii-1933	18°39′N 65°17′W	300 fms

h. "Orsom" cruise material

Material reported upon earlier by Grice (1962) to which paper reference is made for other details on this station. Depth of bottom not stated; see fig. 9. Vessel: "Orsom".

Cruise no.	Station no.	Date	Position	Data on fishing depth of gear
56-4	10	04-x-1956	00°35'N 170°11'E	oblique tow 150 m

i. "T.N. Gill" collection

Material reported upon earlier by Bowman (1971); see also figs. 9 and 10. Vessel: "Theodore N. Gill".

Cruise no.	Station no.	Date	Position	Depth of bottom	Data on fishing depth of gear
I	48	28-ii-1953	32°24'N 78°43'W	120 fms	50-0 m, oblique tow
I	73	06-iii-1953	34°09'N 75°22'W	1700 fms	58-0 m, oblique tow
II	special sta. 1	12-v-1953	34°00'N 70°17.5'W	2250 fms	n.s.
II	30	27-iv-1953	31°00.2'N 79°38.3'W	n.s.	n.s.
II	41	05-v-1953	31°41'N 79°00'W	n.s.	n.s.

11. UZMK collections

By courtesy of Dr. T. Wolff (København), material was received on loan from UZMK. It originates from the East-Greenland, "Ingolf", Lundbeck, and "Thor" collections and has been reported upon by With (1915).

a. Danish East-Greenland Expedition 1900

See fig. 7.

Cruise/ Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
EXP 1900/346	18-ix-1900	"Kap Dan (Tarsuak Fjord)" [1]	n.s.	surface

[1]) Recte: "Tarsiusak Fjord".

b. "Ingolf" Expedition 1895-96

See With (1915) for a detailed station list; see also figs. 7 and 8. Vessel: R/V "Ingolf".

Station no.	Date	Position	Data on fishing depth of gear
17	16-vi-1895	62°49′N 26°55′W	200 m.w.
18	17-vi-1895	61°44′N 30°29′W	200 m.w.
19	18-vi-1895	60°29′N 34°14′W	n.s.
25V	? -1895	63°30′N 54°25′W	n.s.
40	09-viii-1895	62°00′N 21°26′W	n.s.
45	12-v-1896	61°32′N 09°43′W	n.s.
47	14-v-1896	61°32′N 13°40′W	n.s.
55	19-v-1896	63°33′N 15°02′W	n.s.
57	20-v-1896	63°37′N 13°02′W	n.s.
59	,,	65°00′N 11°16′W	n.s.
63	01-vi-1896	62°40′N 19°05′W	n.s.
68	03-vi-1896	62°06′N 22°30′W	n.s.

c. Lundbeck sample

See also fig. 7.

Cruise/ Station no.	Leg.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
1890/-	W. Lundbeck	18-v-1890	55°25′N 29°05′W	n.s.	n.s.

d. "Thor" collections 1903-10

See also figs. 7 and 8. Vessel: R/V "Thor".

Cruise/ Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
1903/-	14-vii-1903	63°05'N 20°07'W	557	n.s.
1903/166	,,	62°57'N 19°58'W	957	n.s.
1904/-	03-viii-1904	63°10'N 07°31'W	n.s.	70 m.w.
1904/78	12-v-1904	61°07'N 09°30'W	n.s.	835 m.w.
1904/99	22-v-1904	61°15'N 09°35'W	n.s.	n.s.
1904/100	,,	61°21'N 11°00'W	n.s.	180 m.w.
1904/104	24-v-1904	62°47'N 15°03'W	n.s.	1500 m.w.
1904/152	19/20-vi-1904	65°00'N 28°10'W	n.s.	200 and 1000 m.w.
1904/153	20-vi-1904	65°20'N 27°12'W	n.s.	800 m.w.
1904/154	,,	65°27'N 27°10'W	n.s.	800 m.w.
1904/164	21-vi-1904	65°27'N 27°10'W	n.s.	n.s.
1904/171	02-vii-1904	63°46'N 22°56'W	n.s.	n.s.
1904/178	09-vii-1904	63°08'N 21°30'W	n.s.	750 m.w.
1904/180	10-vii-1904	61°34'N 19°05'W	n.s.	400 and 1800 m.w.
1904/183	11-vii-1904	61°30'N 17°08'W	n.s.	1800 m.w.
1904/186 (?)	,,	61°30'N 17°08'W	n.s.	25 m.w.
1904/190	14-vii-1904	63°29'N 21°25'W	n.s.	110 m.w.
1904/270	viii-1904	"Island"	(probably a composite sta.)	
1904/285	01-ix-1904	62°49'N 18°46'W	n.s.	100 m.w.
1904/286	02-ix-1904	"Mellenz, Verkmanni og Ferobank" 61°49'N 14°11'W	n.s.	100 and 800 m.w.
1905/-	20-vi-1905	48°09'N 08°20'W	n.s.	300 m.w.
1905/72	08-vi-1905	57°52'N 09°35'W	n.s.	300 and 1500 m.w.
1905/82	15-vi-1905	51°00'N 11°43'W	n.s.	800 and 1200 m.w.

Cruise/ Station no.	Date	Position	Depth of bottom (m)	Data on fishing depth of gear
1905/88	20-vi-1905	48°09′N 08°30′W	n.s.	300 m.w.
1905/90	21-vi-1905	47°47′N 08°00′W	n.s.	300 m.w.
1905/124	23-vii-1905	61°04′N 04°33′W	n.s.	1000 m.w.
1905/163	28-viii-1905	62°36′N 12°05′W	n.s.	300 m.w.
1905/164	29-viii-1905	61°20′N 11°00′W	n.s.	300 m.w.
1905/165	,,	60°00′N 10°35′W	n.s.	1000 m.w.
1905/167	31-viii/ 01-ix-1905	57°46′N 09°65′W	n.s.	300 and 1500 m.w.
1906/76	11-vi-1906	49°27′N 13°33′W	n.s.	2800 m.w.
1907/150	18-vi-1907	65°50′N 26°53′W	n.s.	400 m.w.
1910/91	18-vi-1910	35°53′N 07°26′W	n.s.	1600 m.w.

12. Various other samples from RMNH collections

Two other samples from the collections of RMNH were examined in the present study; see fig. 1.

Cruise/ Station no.	Vessel	Date	Position	Depth of bottom	Data on fishing depth of gear, etc.
19-3	M/V "Albatross III"	24-v-1949	33°49′N 76°32′W	90 fms	"vertical haul" no. 127
"Sagami Bay"	n.s.	23-iv-1965	Sagami Bay, Japan	n.s.	ORI-C net, oblique, 0-1000 m

Preservation and Preparation-Techniques

All specimens have been preserved in alcohol 70% (ethanol). Observations on specimens in situ were made both under dissecting microscope and compound microscope, with the specimens in mono-ethylene-glycol; direct transfers may be made from alcohol 70% into this medium and vice versa. For observation with the compound microscope, specimens were placed in glass cuvettes made of a

microscope slide with two small glass strips (in one or more layers) glued upon it in such a way, that the intermediately remaining slit was tapering; both ends of the slit were likewise provided with a small piece of glued-in glass (fig. 13). The specimen was then placed in the slit, which had already been filled with mono-ethylene-glycol, and pushed up the narrower end until a stable position was reached. Various cuvettes were prepared for examining species of different sizes in dorsal as well as in lateral view.

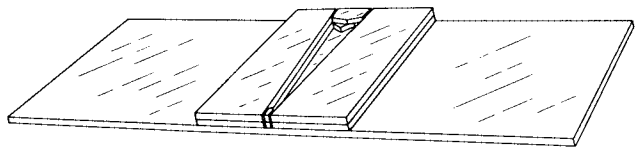

Fig. 13. A glass cuvette mounted on a microscope slide, for the examination of in toto copepod specimens with the compound microscope (see also text).

Dissection was likewise performed in mono-ethylene-glycol with the specimen placed in a small Petri dish or in a depression slide. Preparation was brought about with the smallest insect pins (minuten Nadeln 0.15 mm) mounted in matches and sometimes also by using a pair of watchmaker's forceps, a lancet no. 15, or a pair of Vannas' iridectomy scissors. Dissected appendages or other parts of the body were then transferred through alcohol 70% and mounted on depression (gnathobases of mandibles) or normal (other structures) microscope slides in Berlese's Fluid (Edward Gurr Ltd., London, U.K.). Staining was not applied. Observations of slide preparations were done by compound microscope using light- and darkfield as well as phase contrast and Nomarski's differential interference contrast techniques.

Preparations for the scanning electron microscope (S.E.M.) were made by successively (a) ultrasonic cleaning of the whole specimen for 100 sec., (b) dissection in mono-ethylene-glycol, (c) transfer of the dissected parts through alcohol 70% and alcohol 96%, (d) air-drying for half a minute, and then (e) sticking the parts on S.E.M. stubs provided with double-sided adhesive tape. The position of larger parts was secured by the additional use of silver glue ("Leitsilber 200" of Emetron, Hanau, F. R. Germany). If necessary, small structures (e.g., setae) were removed by dry preparation of the already mounted parts. These S.E.M. preparations were coated with one thin layer of gold only and examined in a "Cambridge Stereoscan" and/or in a "Jeol JSM-35". When re-examining older preparations, possibly present dust was removed by the careful use of clean air jets from an aerosol.

Measurements of whole specimens were taken with an ocular micrometer mounted in a dissecting microscope. Total length has been taken in the mid-sagittal plane, from the anteriormost point of the head to the middle of a line connecting the posteriormost corners of the furcal rami, with the copepod in dor-

sal view; consequently, the furcal bristles are not included. Greatest width was taken as a dimension of the cephalothoracic pleuro-tergites perpendicular to the copepod's longitudinal axis, in dorsal view as well. Greatest height of the body was taken from the dorsal outline of the cephalothoracic integument to the ventralmost point of the opposing sternal structure (i.e., sternal keel), perpendicular to the longitudinal axis with the copepod in left lateral view. The proportional lengths of cephalothorax and urosome were taken up to the intersegmental suture separating these two body regions, from the dorsal aspect. The size of the female genital somite is given relevant to the specific situation in the various species, taking into account comparable measures as much as possible, i.e., disregarding asymmetrical outgrowths. Dimensions of smaller structures, e.g., somites, appendages, integumental organs, etc., were measured either with an ocular micrometer mounted in a compound microscope or taken from drawings, micrographs, or S.E.-micrographs. Lengths of somites or segments partly telescoping into each other were taken to be the lengths of the externally exposed portions only.

Abbreviations Used in the Text

C - cephalon; CTh - cephalothorax; Ur - urosome; Th1, 2, 3, 4 + 5 - thoracic somites 1, 2, 3, 4 + 5; Gnsom - genital somite; A1 - antennula; A2 - antenna; Md - mandibula; Mxl - maxillula; Max - maxilla; Mxp - maxillipes; P1, 2, 3, 4 - natatory legs 1, 2, 3, 4; P5 - male fifth legs; Ba -basipodite; Ba1, 2 - basipodal segments 1, 2; Re - exopodite; Re1, 2, 3 - exopodal segments 1, 2, 3; Ri - endopodite; Ri1, 2, 3 - endopodal segments 1, 2, 3; *s* - [♀] with attached spermatophore.

Discussion

Research Scheme

The revision of a family may be accomplished (a) by revising the complete family as a whole, (b) by revising the genera one by one and conclude with a generic review of the family, or (c) by starting with the generic revision and next revise all genera successively. The ultimate result needs not be different but the three schemes all have their practical merits and demerits, and my choice of the scenario under (b) has to be accounted for.

Revising a family in a phylogenetic sense, purpose of the present studies, means trying to falsify (part of) the existing, classical model of its natural system and rebuild this into a new, phylogenetic model. The classical model usually comprises an, essentially Linnaean, hierarchical classification of (assemblages of) species, in which the group-concept is typological and the hierarchy is based on relative measures of (mainly morphological) similarity. Groups are defined by those characters which are shared by all members and which, at the same time, distinguish members from non-members. Thus, a combination of characters from the specific level functions as an absolute criterion for membership and this combination has to be reconsidered every time admittance of a potential new member is taken into consideration: the limits of the group are

fundamentally subject to change. The last recognition is not surprising since the only character that could have been characteristic at the level of the group, viz., the pattern formed by its members, is not considered in this model because relationships between members are not described. This implies that in trying to falsify the classical model it is necessary to go down to the specific level when reassessing the status of the groups, because these derive their definitions entirely from their constituting species.

Of course, in any revision re-evaluation of the status of the species themselves necessitates a study at the specific level. The species remains the basic taxonomic unit in both the classical and the phylogenetic model. According to the definition of Mayr (1942, 1963), it is the only taxon forming a natural group in a functional sense, being a genetically closed unit, independent of other such groups but with interdependence of all its constituents, viz., via actual or potential genetic relationships. This means that a species forms a group with characters of its own, which can be recognized and described. Though recent species are neontologically non-dependent, the theory of evolution presumes the presence of historical (ancestor-descendant) relationships between species and consequently of sister-brother relationships between recent species.

The morphological similarity within a species is used as a standard for assessing the degree of dissimilarity, necessary to distinguish any group as distinct from another group. This implies that the hierarchy in the system can only be relative, as the measure of time between the origin of the categories and the present is not defined in an absolute sense. The theoretical postulate by Hennig (1966) to fix the genesis of all ranks in geological time, has never been seriously followed in practice, so that all taxa of supra-specific level remain fundamentally arbitrary. In this context, it is worth realizing that the species itself is fundamentally non-arbitrary, as the criterion for distinguishing a species, viz., reproductive isolation, is a criterion of nature itself which was merely recognized by man and not invented. However, reproductive isolation is determined only sporadically and relative measures of (dis)similarity combined with zoogeographical data are substituted to determine the limits of species. Therefore, the species is an arbitrary category, too, albeit only in practice.

In the phylogenetic approach as primarily outlined by Hennig (1965, 1966) the tentative translation of the recent diversity of nature into a cladogram and (next) into a phylogenetic tree, is based on the assumption that branching in evolution is essentially dichotomous, whereby every group is linked to one sister-group. Historical relationships between members of groups are described and form a central element in the definition of the group: characteristic characters of the group are only the uniquely derived (apomorphous) character states shared by all members, thus referring to a common ancestor. The apomorphous states are considered in comparison to the relatively plesiomorphous conditions which are retained in the sister-group. Once the branching point with the sister-group is fixed, the group's combination of synapomorphies forms an absolute and stable criterion for membership. The relative rank of the group may be disputed,

but its contents are evident, because all descendants of the common ancestor are by definition members of the group. Such a pattern can only be a character at the level of the group, not of any member on its own. This implies that any group may only be properly defined if (some of) the apomorphous character states of (some of) its members can be related to plesiomorphous conditions in the sister-group. Once this has been established, groups can be compared as such, without the necessity to take all constituting species into consideration. In general, however, evaluation of the relative apo- or plesiomorphy of character states may only reliably be accomplished by the principle of out-group comparison (cf. De Jong, 1980). This means that in characterizing any group, its sister-group as well as a group at the next-higher level have to be taken into account.

So, from the above it should be quite clear that revising a classical system in a phylogenetic sense in fact involves knowledge of all taxonomic levels throughout the study, and this is why the scheme as under (a), i.e., revising the family as a whole, is fundamentally preferable. However, in a family of the size of the Aetideidae, 200-300 species in about 30 genera, this approach would require too long a period, and also the availability of too much material concurrently. Therefore, the second-best possibility had to be chosen from the two remaining schemes.

In the scheme under (c), variation at the specific level will be either not at all or only imperfectly known at the stage of the generic 'revision'. For want of a better standard, the groups from the classical system will have to be compared as represented by their type-taxon, which, according to the rules of zoological nomenclature, needs not be characteristic of the group. This scheme thus comprises a comparison of nominal genera in the initial stages, and hence yields a redefinition of pure names, not of their meaning. The resulting generic 'revision', therefore, has to be considered as (un)reliable as the classical system, and it will have to be reconsidered once the revision of the genera has been completed.

On the other hand, the scheme under (b) will provide insight into variation at the specific level already in the revision of the very first genus. Admittedly, the absence of a proper definition of the sister-group in this stage will interfere with out-group comparison as the type-species of the most closely related genus will have to be taken as representative for the presumed sister-group. In this case, too, part of the knowledge from the classical system will have to be relied upon until verified or falsified. However, in this scheme such chances have to be taken only one at a time, and they may be redressed in the very next step, viz., in the revision of the sister-group itself. Therefore, the scheme under (b) is considered essentially preferable to that under (c), and consequently has been adopted in the present series of investigations.

The last item to be settled, then, is the ultimate classification to result from the phylogenetic model, once this will be completed. As pointed out by Wiley (1979), the Linnaean hierarchy is not suited to reflect all information of a

phylogenetic system: this information, however, may be contained in full in his specially adapted system of "Annotated Linnaean Hierarchy" (see Wiley, 1979), which accordingly will be followed in due course.

Materials Available

Since separate sampling programmes for only one revision are out of the question, existing materials had to be relied on for this study. Thanks to the "Dana" collections as well as to the cooperation of colleagues from abroad, a collection of *Euchirella* could be assembled covering all major areas of the world's oceans. The examination of various other available collections, e.g., the "Snellius" material, had to be abandoned since these have been sorted only in part or not at all as yet. A shipment of Aetideidae from the International Indian Ocean Expedition unfortunately never reached Leiden and must be considered lost in the mail, as its despatch has been verified by the authorities of the Indian Ocean Biological Centre, India. In material from such a variety of sources sampling techniques used are necessarily manifold, so hardly any other ecological data than an indication of vertical distribution may be expected. Likewise, standard techniques for fixation at sea will have been applied and hence the material is not especially suited for subsequent histological processing of specimens. Aetideid males are usually scarce, a phenomenon dealt with in extenso by Mazza (1966), and the present material is no exception to this rule. However, a few males of most species are available for study.

Thus, it may be concluded that the collections now at hand will meet the requirements of a revision as intended. Besides, I think it important that such valuable collections as, e.g., from the "Dana" Expedition, which have for the better part merely been stored for more than half a century, are being examined at last. Various countries are executing ambitious plankton sampling programmes today, bringing ashore thousands of samples, while in the meantime existing collections of good quality are left untouched for decades in succession: a most regrettable situation, in my opinion.

Observation Techniques

The dissecting microscope was used in observing gross morphology as well as relative positions of body tagmata and appendages in situ. Standard observation techniques were applied but a single remark should be made about the darkfield technique, which proved extremely well suited for observing copepod morphology and for sorting. The best results were obtained by a combination of an Olympus SZ-III stereomicroscope mounted on an Olympus JM light/darkfield illumination stand.

The compound microscope was used routinely in all regular, detailed observations and in preparing the drawings. When observing slide preparations, the finest images were obtained by using the differential interference contrast technique with the aid of an Olympus BH research microscope equipped with HEP

WF 10 × eyepieces and plan-achromatic objectives. In all detailed checks the 40 × objective was used yielding a total, dry magnification of 625 × , in combination, viz., with the two intermediate 1.25 × stages of both Wollaston-prism holder and drawing attachment BH-DA. A higher dry magnification was not possible since a 60 × plan-achromat is not available from the manufacturer and an ordinary achromat of this magnification yielded low-quality images only. Since most of the in toto preparations are too thick, 100 × oil immersion lenses proved hardly ever applicable. Complete specimens were observed with a 10 × objective at most, as a consequence of their dimensions. Phase contrast as well as inverted phase contrast techniques were tested using the Olympus equipment but did not yield the results obtained by interference contrast.

Although the availability of the interference contrast technique permits quick checks of the clear-cut images, it must be admitted that all structures, even the finest, may well be seen with classical lightfield techniques using ordinary achromatic objectives, provided that these are of good quality. In fact, in the early stages of this study observations were made with a Leitz SM compound microscope equipped with a 40 × achromat and WF 16 × eyepieces, yielding a total, dry magnification of 800 × , viz., including the 1.25 × of the intermediate drawing attachment stage. All structures that were observed by interference contrast could be discerned just as well using the Leitz equipment. Taking the above into consideration, it is not at all surprising that most fine structures were already observed by the older authors, who had old-fashioned compound microscopes at their disposal which were, however, equipped with excellent quality optics. In fact, from many of their figures and from casual remarks in their descriptions it is quite clear that they noticed subtle structures as well. Their apparent lack of attention to these can only be explained by the overwhelming amount of information they had to digest of which so much was really new: they just had to confine themselves to dealing with the more obvious structures only, to be able to examine at least the major part of their material.

Staining of slide preparations, a rather common habit in copepod research, was never applied in this study. Admittedly the objects are more easily recovered but in my opinion this is the only advantage of staining as far as in toto preparations are concerned. In most stained slides, delicate structures are much harder to be discerned than in clear, unstained preparations. In my experience the observer had better rely on subtle differences in thickness of the various structures, causing visible changes in lucidity just by variations in absorption and refraction of light. Of course, the use of stains may be useful in tracing the chemical composition of certain parts but this was not the purpose of the present investigations.

Examination of dissected specimens by scanning electron microscope was used as another routine procedure. Various intricate techniques have been described for the preparation of specimens to be observed by S.E.M. (see, e.g., Heywood (ed.), 1971; Lee, 1972; Fleminger, 1973; Pulsifer, 1975; Ferrari & Bowman, 1980). These frequently include chemical cleaning in KOH, ultrasonic cleaning,

freeze-drying, or critical point-drying. Both ultrasonic cleaning and various freeze-drying techniques have been tested. From the results obtained it had to be concluded that the effect of ultrasonic cleaning is limited, at least at the frequency available (50 Kc) using alcohol 70% as a medium, and periods of vibration ranging from 10 to 300 seconds. Though loose particles were generally removed when cleaning was carried on for over 60 seconds, resistant mucus, e.g., could not be got rid of. Since no damage to the material as a result of this treatment was observed, a 100 seconds cleaning was used routinely. Two different freeze-drying techniques did not yield better results than simple air-drying as regards shrinking and distortion. The latter two phenomena had already proven not to do much harm, so air-drying was the technique generally adopted. The resistance of the material to this admittedly rather rude method may well be related to the comparatively rigid integument of *Euchirella* species as compared to various other calanoids and also cyclopoids. In particular in the genera *Eucalanus* and *Oithona* studied by S.E.M. by, respectively, Fleminger (1973) and Ferrari & Bowman (1980), the integument is very delicate and flabby, rendering it much more sensitive to distortion when air-dried. The actual coating procedure appeared not to be of influence because directly comparable results were obtained after coating with either two layers of gold and one layer of carbon; or a single, thick layer of gold (c. 0.20 μm); or one thin layer of gold only (c. 0.05 μm). In fact, differences could hardly be expected at the magnifications used, viz., up to 20,000 × on one occasion but normally not over 5,000 × . Thus, the single layer of 0.05 μm was routinely applied.

To obtain sharp images at magnifications in excess of 3,000 × , the usual accelerating voltage of 10-15 KV had to be changed to 25 KV on some occasions. However, this did not always yield a better image, since the then relatively thin copepod cuticle (as compared, e.g., to the insect integument) began to vibrate, resulting in a hazy picture as well. A serious disadvantage of using this higher voltage was burning-in of the scanned area; apparently, this rather delicate biological material cannot stand concentration of such a high-energy beam on so limited an area.

In general, however, the S.E.M. pictures were of good research quality, as all details of interest could be examined satisfactorily. No effort was made to improve this quality any further since, if possible at all, this would have lengthened preparative procedures considerably. Besides, the beauty of clean S.E.-micrographs shows very nice but does not add anything to their scientific value. Finally, it must be stated that with the exception of the granular areas (an integumental structure, see Von Vaupel Klein, in press a), all S.E.M.-observed structures could readily be discerned by light microscope as well. This does not detract from the value of S.E.M. observations, however, as the 'three-dimensional' images greatly facilitate interpretation of the structures observed by compound microscope.

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* = non vidi.

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