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HISTORY OF RESEARCH, INDIAN OCEAN FORAMINIFERA*

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ABSTRACT

Studies of foraminiferal assemblages of the Indian Ocean are represented by a few taxonomic papers per decade until the past 20 or 30 years when studies emphasizing foraminiferal ecology commenced. More than half of all the papers on modern assemblages of the Indian Ocean have been published in the past 10 years, developing primarily from the stimlus of the International Indian Ocean Expedition in the period of 1962-1965. Most of the recent papers highlight the study of foraminiferal-environmental relationships or of foraminifera and geochronology. The present publication rate indicates that this next decade will result in more than double the total number of existing reports on Indian Ocean Foraminiferida.

New investigations needed include studies of the biology of foraminifera, studies of population gradients, biometric studies, biochemical analyses, studies of foraminferal relationships to ocean pollution, and general foraminiferal-environmental studies to develop new tools for paleoecology. New technologies in geochemistry, in paleomagnetism, in computer analyses, in collecting devices, all need to be applied to foraminiferal studies to not only discover new relationships but to corroborate and increase the precision of known relationships.

INTRODUCTION

SCIENTIFIC research involving Indian Ocean Foraminiferida has been much neglected in contrast to that of other oceanic areas. An important step to correct this situation occurred in the past 10 years as a consequence, in large part, of the International Indian Ocean Expedition (1962-1965). At this time of expanding interest and attention it is appropriate to summarize the results and define the existing trends. This should facilitate the coordination of future investigations and highlight the neglected areas and kinds of research needed.

A history of foraminiferal research for the Indian Ocean requires definitions of (1) the area and (2) the kind of emphasis or scope of the subject under consideration. The Indian Ocean area (1) has been defined by the Marine Biological Association of India (Fig. 1) and this definition is followed in this report. It includes the Indian Ocean proper and a number of adjacent seas. Referring to the emphasis or scope (2), every paper on foraminifera within the defined area is included in this report regardless of the age of the fauna. Publications on faunas from land areas adjacent to the Indian Ocean are excluded with the one exception of the paper of Schwager (1866).

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The Neogene fauna from Kar Nicobar he describes includes many important species that are extant. Reports on sedimentology refer to foraminiferans as sediment particles (e.g., *Globigerina* ooze). Some reports of this type were listed in the bibliography where they seemed to be especially pertinent to foraminiferal research (E3, K1, M 6, M7, S8, V1).

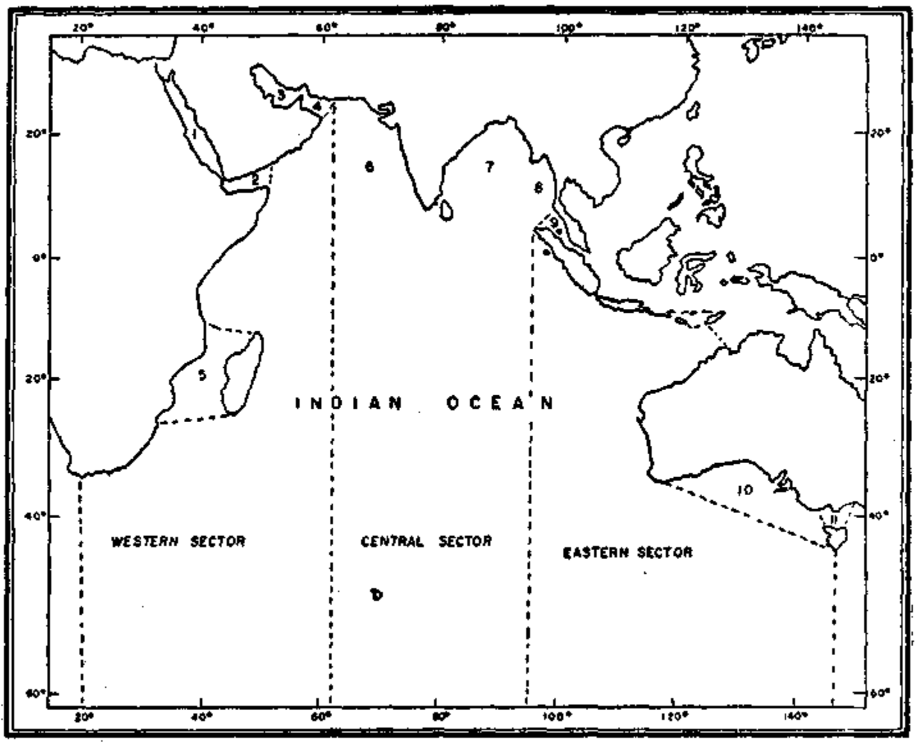

Fig. 1. Map showing the limits of the Indian Ocean and adjacent seas. 1. Red Sea, 2. Gulf of Aden, 3. Persian Gulf, 4. Gulf of Oman, 5. Mozambique Channel, 6. Arabian Sea, 7. Bay of Bengal, 8. Andaman Sea, 9. Malacca and Singapore Straits, 10. Great Australian Bight, and 11. Bass Strait.

To facilitate the survey of the major fields of interest, the references have been tabulated with respect to subject of research and geographical subdivisions (table 1). This table should serve as a key to the bibliography.

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History of Foraminiferal Research

The first chapter in research on Indian Ocean foraminiferal faunas commenced at the end of the 18th century when Fichtel and Moll (1798) described new species from the Arabian Sea and the Red Sea. D'Orbigny (1826) was the next to present a faunal description of various species from the Indian Ocean area. The material for these early studies was taken from accidental gatherings made by travelling scientists rather than from organized sampling programmes; samples were small and localities were poorly defined. Taxonomy, with little regard to the environmental origin of an assemblage, remained the main goal also in the first investigations based on more methodically sampled material: Schwager (1966) studied a Neogene fauna from one of the Nicobar Islands (Novara Expedition) and Moebius (1880) described the shallow water fauna from a reef area of Mauritius Island.

In the latter part of the 19th century the investigation of the world's oceans began to be of major concern for the scientific world. The Challenger Expedition (1873-1876) was the first of many cruises to systematically collect bottom samples. This started the second chapter in the history of foraminiferal research in the area of the Indian Ocean. Brady's monograph of the Challenger foraminifera (1884), although not restricted to the Indian Ocean, is one of the most important taxonomic papers on materials from this region. Following this break-through, a number of important taxonomic papers appeared in the next decades, based mostly on material collected on major cruises. Important studies relevant to the Indian Ocean were carried out by Chapman (1895), Millett (1898-1904), Heron-Allen and Earland (1914-1915), Wiesner (1921), Hofker (1927-51), Chapman and Parr (1935, 1937), and Parr (1932-1950). Still, the Indian Ocean was not a major research objective and foraminiferal studies were essentially taxonomic.

Stimulated by the beginning of extensive programmes in polar research (Antarctic expeditions), distribution patterns and ecology became issues to be considered. In addition to cruise reports of expeditions, many papers appeared describing shallow water faunas from areas of easy access along the coastal regions of Australia, India, etc., encompassing some aspects of ecological considerations. Studies by Howchin, Chapman, Parr, Said, Gnanamuthu, and Kurian exemplify these. Reports by Leroy (1938) and Said (1949-1950) were the first Indian Ocean studies in which foraminiferans were applied as ecological indicators.

A third chapter commenced as a result of the International Geophysical year in 1958. With this stimulus given to international co-operative programmes the groundwork was laid for the International Indian Ocean Expedition (1962-1965). Using the modern taxonomical framework the resulting studies were directed mostly toward ecological and/or paleontological problems. Special attention was paid to the patterns of distribution and variability of planktonic species, both in recent faunas and in the fossil record; some studies were directed particularly at depth distributions of benthic species.

General distribution patterns of living planktonic faunas in the Indian Ocean are best defined and shown by the many works of Beliaeva and by Bé and Tolderlund (1971); studies of planktonic species in tows on a more limited scale include the works of Ujiie (1968), Ujiie and Nagase (1970), Herman (1968), Boltovskoy (1969), and Zobel (1970). Studies of benthic assemblages, planktonic tests in bottom sediments, and faunal analyses of deep-sea cores are numerous. These include depth zonations near the Antarctic (Saidova, 1961; Bandy and Echols, 1964), and a depth zonation in the Andaman Sea (Frerichs, 1967, 1970). Additional studies of cores and foraminiferans in bottom sediments include the reports on the Red Sea by Said (1949, 1950), Herman (1965, 1968), Berggren (1969), Berggren and Boersma (1969) ; on the Andaman Sea by Frerichs (1967, 1968, 1970, in press) ; on the southwestern Indian Ocean by Herman (1963), Ericson and others (1963), Vincent (1969, 1970), Boltovskoy (1969), Glass and others (1967, core V16-66), Bandy and Casey (1969, core V16-66), Bandy, Casey, and Wright (1971) ; off southwestern Australia by Conolly (1967), and other areas (Olausson, 1960 ; Oba, 1967, 1969 ; Parker, 1967). Faunal studies of the littoral and neritic zones are many, including those of many Indian scientists and the work of J. W. Murray on assemblages of the Persian Gulf.

General Trends

One method of assessing research productivity is in terms of numbers of papers and reports per unit of time. Certainly, there is the built-in fallacy that a single report such as that of Brady (1884) is vastly more extensive than the 17 short papers by Millett (1898-1904). In spite of this there is a general overall trend of interest in terms of productivity (Fig. 2). Until the last decade of the 19th century there are few papers ; because of the many papers of Millett in the 1898-1904 interval, there is an increase in productivity to 15 papers per decade dropping to about half this in the next two decades. An increase to 11 papers per decade occurred between 1931 and 1950, to 21 papers in the 1951-60 interval, and to at least 81 in the 1961-70 decade. About 20 papers have appeared in the past year ; this rate suggests that the next decade will result in more than double the total of at least 177 papers published to this time. This remarkable acceleration of scientific output stems from the stimulus and opportunities offered by the cooperative International Indian Ocean Expedition.

There are at least 14 countries involved in Indian Ocean foraminiferal research as represented in the papers we have compiled. Beliaeva of the U.S.S.R. alone has 16 titles of the 20 titles by Russian authors. The U.S.A. has more than 25 authors who have contributed to more than 32 papers. Identification of numbers of papers per country is subject to considerable variation depending upon procedures : studies by members of one country, while in another country, may be credited in various ways. Including the 17 short papers by Millett, there are 39 contributions from England. Generally, there are 20 titles or more from five countries: the U.S.A., the U.S.S.R., England, India and Australia. There are 14 titles from Germany and 6 or less each for 8 additional countries : Israel, France, Argentina, Portugal, Holland, Japan and Sweden.

Many studies resulting from the International Indian Ocean Expedition have appeared, many other reports are in preparation, and still many others will result from current and planned studies of the extensive samples now on file in the many different laboratories. Many institutions in India have investigators working on near shore assemblages. Studies under way in other countries are many. Russian scientists are working on planktonic faunas in the equatorial Indian Ocean and faunal assemblages of the Antarctic areas to the south. German scientists at Kiel and Hannover are investigating recent and fossil faunas in the Persian Gulf and the Arabian Sea. Active programmes are in progress in England at the universities in Bristol and East Anglia ; in France at the marine station of Endoume ; in Japan at the Natural History Museum in Tokyo, and at Tohoku University in Sendai ; and in Argentina at the Museum of Natural History, Buenos Aires. In the United States, current programmes involving Indian Ocean faunas include those at the Lamont-

Doherty Geological Observatory, University of Southern California, Woods Hole Oceanographic Institution, and Scripps Institution of Oceanography. Ships operating in the Indian Ocean area include the U.S.N.S. ELTANIN in the southern areas, the German vessel METEOR in the Persian Gulf and Arabian Sea, and cruises from time to time by vessels of Woods Hole, Lamont-Doherty, Scripps, and the National Oceanographic and Atmospheric Agency of the U.S.

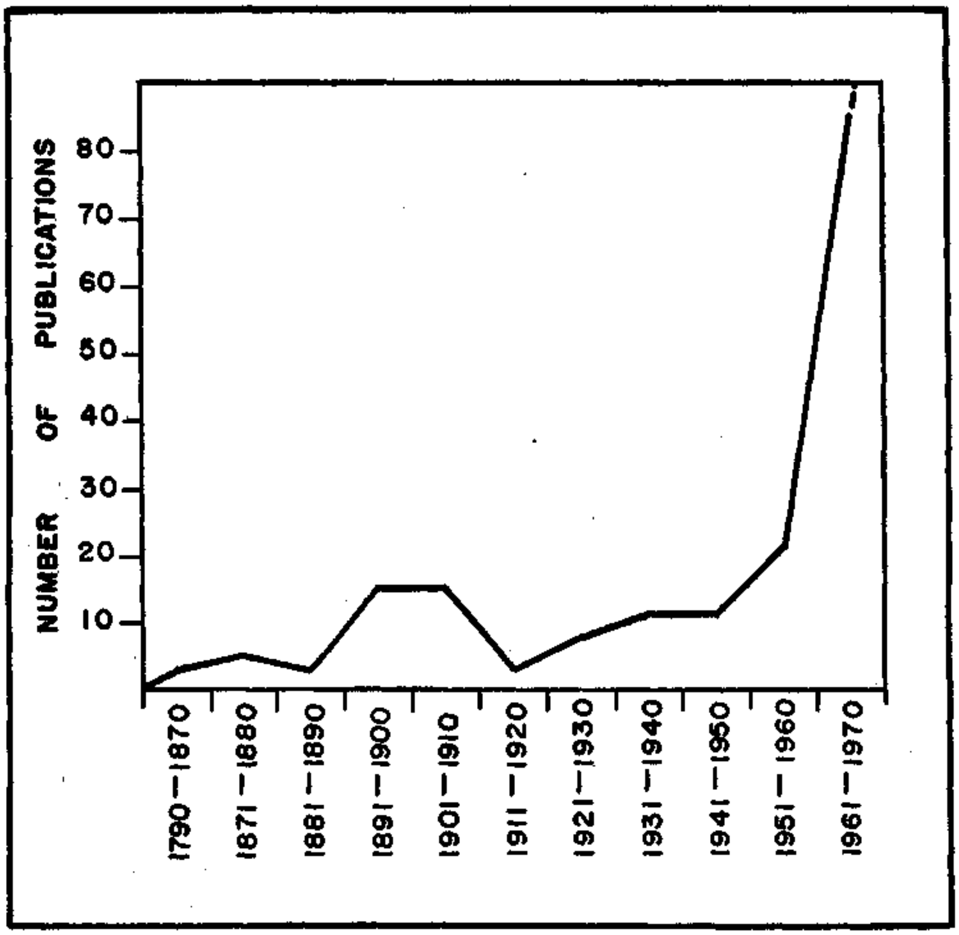

Fig. 2. Number of papers on Indian Ocean foraminiferans per decade. Seventeen short papers by Millett (1898-1904) are responsible for the increased values in the trend at the turn of the century

Discussion

Areas of investigation hardly touched upon at this time include (1) studies of the biology of Indian Ocean species, (2) studies comparing the planktonic living populations of the water column with the planktonic tests resting on the sea floor, (3) definition of population gradients of planktonic species across boundaries of water masses, (4) biochemical studies of test composition and protoplasmic composition in terms of habitats, (5) studies of foraminiferal populations as related to ocean pollution, exemplified by Bandy and others (O. L. Bandy, J. C. Ingle, Jr., and J. M. Resig, 1965, Foraminiferal trends, Hyperion Outfall, California—Limnology and Oceanography, v. 10, no. 3, p. 314-332), (6) studies of live-dead ratios as a cross calibration of sedimentation rates or sediment transport compared with values obtained by isotope studies and other means, and (7) analyses of diversity gradients with water depth in the different areas of the Indian Ocean.

The discovery of sea floor spreading and the ability now to compare patterns of foraminiferal evolution and ecological variability with magnetic reversals and paleotemperature data (oxygen isotope data) all combine to stimulate studies of faunal distribution and ecology with a much expanded base of interest involving the separate disciplines of geophysics, biology, paleontology, isotope geology, and the many related aspects of each. With this increased scope of interest, the number of involved scientists has increased in a most significant way. Thus, many of the kinds of studies are now of major interest to investigators of interdisciplinary areas and each new discovery must stand the critical examination and review by this diverse group. Examples of this interaction are the studies of deep-sea cores utilizing planktonic datum planes and paleomagnetic data as two independent methods of correlation (compare Glass and others, 1967 ; Bandy and Casey, 1969 ; and Bandy, Casey, and Wright, 1971).

Other examples of strong interdisciplinary interests in common problems are those that relate to paleoclimatic studies. Similarity of cycles, suggested in a bipolar model (Bandy, 1968) based upon planktonic foraminiferal studies has been corroborated or supported by other planktonic studies (Morin and others, 1970) and by the isotope data of Epstein and others (S. Epstein, R. P. Sharp, and A. J. Gow, 1970, Antarctic Ice Sheet : stable isotope analyses of Byrd station cores and interhemispheric climatic implications.—science, v. 168, p. 1570-1572). New and different techniques are needed for evaluating such cycles in the geologic past ; core studies of the Indian Ocean offer excellent opportunities for such investigations.

Multiple approaches are under way to better understand foraminiferal-environmental relationships employing classic and newly developing technologies. Some examples of this are seen in the applicability of the shifting variability range of *Neogloboquadrina dutertrei* in relation to temperature (Bandy and others, 1967) or of the environmental controlled variation of benthic species as illustrated in the work of Lutze (G. F. Lutze, 1964, Statistical investigations on the variability of *Bolivina argentea* Cushman.—Cushman Found. Foram. Res., Contr., v. 15, p. 105-116).

Areas of the Indian Ocean not yet studied are many (table 1) ; these need consideration in the planning of cruise programmes for the next decade or two. Improvement is needed urgently in terms of collecting devices, in the utilization of appropriate computer techniques, and in the coordination of studies involving physical, chemical, and biological parameters. Valuable and needed contributions include discoveries of new relationships, new and improved techniques, new collecting devices, as well as the description of new taxa.

TABLE 1

*Tabulation of references according to subject and subdivisions of the Indian Ocean and adjacent areas.**

		area	general	W	C	E	Antarc.	1	2	3	4	5	6	7	8	9	10	11
PLANKTONIC FORAMINIFERA	distribution	water column	B7-11,14, B15,23,33	K2		U3,4	B19,20 U2						Z2					
		bottom sediment	B10,13-15, B17,18,21, B24,39,M6, M7,P2,T1, S10		C9, C10		B19,20, B32, C11, P12,U2					B34		B16,G1, S16,V2	F2	K1		
		core	O3	E5, G4,H3	H2, O1,2	C14 V1		B25,26, H4,O4				H4, V3,4	P10,11 B14	V2	F2,3			
	application	stratigr.+ paleomag.	B1-3, P1	E5, G4,S5	H2			B6					P10					
		ecology	B8,9,15, P2,Z1		O1,2	C14, V1,2						H4, V3,4		G1	F2,3			
		taxonomy	B5-7,37, E3,P1,Z1	A1,H6		H2, S11	C11, B2,W1	S1					C2, S15,Z2	G2	S9		C7	
		test composit.	B12,22															
BENTHIC FORAMINIFERA	distribution	littoral + shelf			C9	L3 5	B32, S4,13	E4, H1,S3		H1,L6, H9-12		B27, L1	B30	B28,29, G1,R1, S16-18, V2	F2,4	K1		
		deep sea					B4,S4, S12,O1								F2,4			
		living forams		T1						H1,L6, L7,H13				R1,2				
		core													F2			
		ecology				L3	S13	S3		H9-12, H14				R1,2, S7	F4			
	taxonomy	littoral + shelf	B6,35-37, E3,N1, O5	A1,C1, C8,H6, H7, W2,3		C3,5, H8-12, M2,3	C11,13 P6 W1,W2	A2,C1, C17,F1 L1,R3, S1,2		H8-10, H12, H14		B38, H5	C2,13 S12, S14, S15	B29,31 C12,O12, G2,3,5,6 K3,4,S9			C5,10, E1,H13, P3,4,6, P7-9	C4,6, P5
		deep sea	B6,35-37, E3,N1,O5			H8-12	C11, P6,W1	B37				B38	C2				C10, P6,8	(

*For convenience, references are identified by keys which combine the first letter of the author's name with a number: for example, A1 refers to Albani, 1965; A2 to Avnimelech, 1959, etc.

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Indian Ocean Foraminifera

This bibliography lists all publications known to us that relate to the defined scope. Where the content of a paper is not obvious from the title a brief annotation specifies the kind of research and geographical locations. References which we were unable to check directly are marked with an asterisk. Russian titles are transliterated from the original publication following the 'Manual of Foreign Languages' by G. F. Osterman (Central Book Co., New York, 1952, 4th ed., p. 224). English translations are given to all Russian titles. Three earlier bibliographies which partially cover the scope of this report (C15, S6, Y1) are quoted as well as a series of 'Collected Reprints' of the IIOE, published by the UNESCO (U5). References mentioned in this report which do not involve Indian Ocean assemblages are given in the text. References added while this paper was in press were not tabulated and are listed in the appendix.

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B32 BLANC-VERNET, L. 1965. Note sur la répartition des foraminifères au voisinage des côtes de Terre Adélie (Antarctique). *Rec. Trav. St. Mar. Endoume,* **52**. (*Bull.* no. 21) : 191-205, pl. 1-2, 3 text-fig. [Benthic and planktonic species of dredge samples from 10 to 270 metres depth.]

B33 BOLTOVSKOY, E. 1969. Living planktonic foraminifera at the 90° E. meridian from the equator to the Antarctic. *Micropaleontology,* **15** (2) : 237-255, pl. 1-3, 4 text-fig., 1 tab. [Distribution of 27 species in plankton tows between 0 and 1500 m. depth.]

B34 BOLTOVSKOY, E. 1969. Tanatocenosis de Foraminiféros planctonicos en el estrecho de Mozambique. *Revista Espanola de Micropaleontologia,* **1** (2) : 117-129, pl. 1-3. [32 species from one sample.]

B35 BRADY, H. B. 1879. Notes on some of the Reticularian Rhizopoda of the 'Challenger' Expedition. I. On new or little known Arenaceous types. *Quart. J. Microsp. Sci.,* n. ser., **19** : 20-63, pl. 3-5. II. Additions to the knowledge of Porcellaneous and Hyaline types. *Ibid.,* **19** : 261-299, pl. 8. [Includes material from the Indian Ocean.]

B36 BRADY, H. B. 1881. Notes on some of the Reticularian Rhizopoda of the 'Challenger' Expedition. III. (1) Classification ; (2) Further notes on new species ; (3) Note on Biloculina mud. *Ibid.,* **21** : 31-71. [Taxonomic study, including material from the Indian Ocean and the Red Sea.]

B37 BRADY, H. B. 1884. Report on the Foraminifera collected by H.M.S. 'Challenger' during the Years 1873-1876. *Rep. Sci. Res. Voyage Challenger, Zool.,* **9** : 21 + 814 p., 22 text-fig., 4 tab., 2 maps and atlas with 115 pl. [Most important taxonomic study.]

B38 BRAGA, J. M. 1960. Foraminiferos da Costa de Mozambique. Junta de Investigacoes do Ultramar. *Estud. Ensaios e Documentos*, **67**: 19-211, pl. 1-20. [Description of 270 species; bottom samples from 16-700 m. depth.]

B39 *BURMISTROVA, I. I. 1969. Kolichestvennoie raspredelenie bentosnykh foraminifer v poverkhnostnom sloie osadkov cevernoi chasti Indiiskogo Okeana. (The quantitative distribution of the benthic foraminifera in the surface layer of the sediments in the north part of the Indian Ocean.) *Akad. NAUK, SSSR*, Sbornik 'Osnovnye problemy micropaleontologii i organogennogo osadkonapleniia v okeanakh i mariakh.' Isdatelstvo NAUKA, Moscow, p. 176.

C1 CARTER, H. J. 1877. On a Melobesian Form of Foraminifera (*Gypsina melobesioides*, Miki); and further observations on *Carpenteria monticularis*. *Ann. Mag. Nat. Hist.*, ser. 4, **20**: 172-176. [Material from the Red Sea and Mauritius.]

C2 CHAPMAN, F. 1895. On some Foraminifera obtained by the Royal Indian Marine Survey's S.S. 'Investigator,' from the Arabian Sea, near the Laccadive Islands. *Proc. Zool. Soc., London*, p. 4-55, 1 pl. [Description of 277 species from 6 bottom samples from unrecorded depth.]

C3 CHAPMAN, F. C. 1900. List of the Foraminifera from the boat-channel., Flying Fish Cove, Christmas Island, 11 fathoms. *Ibid.*, 1900, p. 141. [List of 24 species.]

C4 CHAPMAN, F. 1902. Recent Foraminifera-Shoreham District. *Victorian Naturalist*, **19** (8): 112-113. [List of 17 species from intertidal areas, SE of Melbourne, Australia.]

C5 CHAPMAN, F. 1903. Notes on an interesting occurrence of the pelagic foraminifera, *Cymbalopora* (*Tretomphalus*) *bulloides*, on the coast of South Australia. *Ibid.*, **19** (11): 153-154. [Reference to a paper by Earland.]

C6 CHAPMAN, F. 1907. Recent Foraminifera of Victoria: some littoral gatherings. *J. Quekett Micro. Club*, ser. 2, **10**: 117-146, pl. 9-10. [Faunal description.]

C7 CHAPMAN, F. 1915. Report on the Foraminifera and Ostracoda obtained by F.I.S. 'Endeavour' from the east coast of Tasmania, and off Cape Wiles, South Australia. *Dept. Trade and Customs, Fisheries, Zool. (Biol.) Res. Endeavour* 1909-1914, **3** (1): 3-51, pl. 1-3. [Faunal description from 3 samples.]

C8 CHAPMAN, F. 1924. A first report on foraminifera collected by the S. African government Fisheries and Marine Biological Survey. *Union of South Africa, Fisheries and Marine Biological Survey, Annual Rep.*, no. 3, *special rep.* no. 11, 19 p., 1 pl. [Short faunal description from 9 dredge samples off the coast of South Africa.]

C9 CHAPMAN, F. 1941. Report on foraminiferal soundings and dredgings of the F.I.S. 'Endeavour' along the continental shelf of the south-east coast of Australia. *Trans. Roy. Soc. South Australia*, **65** (2): 145-211, pl. 7-9. [Foraminiferal taxonomy and distribution, also including Kerguelen area.]

C10 CHAPMAN, F. and PARR, W. J. 1935. Foraminifera and Ostracoda from soundings made by the trawler 'Bonthorpe' in the Great Australian Bight. *Jour. Roy. Soc. Western Australia*, **21**: 1-7, pl. 1. [List of 112 species.]

C11 CHAPMAN, F. and PARR, W. J. 1937. Foraminifera.—*Australian Antarctic Expedition* 1911-14, ser. C, **1** (2): 1-190, 4 pl., 4 tab. [Major faunal description (planktonic and benthic), 30 new species, SE part of Indian Ocean.]

C12 CHATTERJEE, B. P. and GURURAJA, M. N. 1968. Foraminifera off Mangalore coast, south India. *Bull. Nat. Inst. Sci., India*, **38**: 393-397, 3 text-fig., 3 tab. (Proc. Symp. Indian Ocean, New Delhi, 1967). [8 samples from 8-10 fathoms depth, species not identified.]

C13 CHAUDHURI, A. and BISWAS, B. 1954. Recent perforate foraminifera from Juhu Beach, Bombay. *The Micropaleontologist*, **8** (4): 30-32. [12 species.]

C14 CONOLLY, J. R. 1967. Postglacial-glacial change in climate in the Indian Ocean. *Nature*, **214**: 873-875, text-fig. 1-3. [Frequency distribution of planktonic species in 5 deep sea cores off the southern coast of Western Australia.]

C15 CRESPIN, I. 1955. A bibliography of Australian foraminifera. *Micropaleontology*, **1** (2): 172-188.

C16 CRESPIN, I. 1960. Some Recent Foraminifera from Vestfold Hills, Antarctica. *Tohoku Univ. Sci. Rep.*, 2 ser. (Geology), Spec. Vol. no. 4 (Hanzawa Mem. Vol.), Sendai: 19-31, 3 pl., 1 text-fig. [23 recent species from former fjord area.]

C17 CUSHMAN, J. A. 1946. The species of foraminifera named and figured by Fichtel and Moll in 1798 and 1803. *Cushman Lab. Foram. Research, Special Publ.*, **17**: 1-16, 4 pl. [Includes recent species from the Red Sea.]

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D2 *DANIEL, C. J. 1949. Encrusting Foraminifera of Krusadai Island. *J. Madras Univ.*, Ser. B., **18**: 27-37.

D3 DURRAND, A. 1898. On Anchor Mud from the Malay Archipelago. *Roy. Soc., Microsp. J.*, 1898, p. 255-257. [Locations of the material of the study of Millett (1898-1904).]

E1 EARLAND, A. 1902. On *Cymbalopora bulloides* (D'Orbigny) and its internal structures. *J. Quekett Microsp. Club*, ser. 2, **8** (51): 309-322, pl. 16, 1 text-fig. [Beach samples; Southern Australia.]

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E4 EMERY, K. O. 1964. Sediments of Gulf of Aqaba (Eilat). Papers in Marine Geology; *In*: R. L. Miller, (ed.) *Shepard Commemor. Vol.*, Macmillan Co., London-New York, p. 257-273, 5 text-fig., 2 tab. [Refers to foraminiferal components of organic debris; Red Sea.]

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F4 FRERICHS, W. E. 1970. Distribution and ecology of benthonic foraminifera in the sediments of the Andaman Sea. *Contr. Cushman Found. Foram. Res.*, **21** (4): 123-147, 15 text-fig., 7 tab. [Five faunal provinces, based on ecological factors.]

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H3 HERMAN, Y. 1963. Cretaceous, Paleocene, and Pleistocene sediments from the Indian Ocean. *Science*, **140**, (3573) : 1316-1317, 1 text-fig. [Planktonic species from 2 cores SE of Cape Town.]

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H5 HERMAN, Y. 1968. Evidence of climatic changes in Red Sea Cores. *In* : R. B. Morrison and H. E. Wright, Jr., (ed.) *Means of Correlation of Quaternary Successions*, Univ. Utah Press, **8** : 325-348, 1 pl., 6 text-fig., 5 tab. [Planktonic foraminifera and pteropods from 7 cores and 6 plankton tows.]

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M4 MORIN, R. W., THEYER, F., and VINCENT, E. 1970. Pleistocene climates in Atlantic and Pacific Oceans : a reevaluated comparison based on deep-sea sediments. *Science*, **169** : 365-366, 2 text-fig. [Variation in frequency distribution of some planktonic species in two cores from the Mozambique Channel.]

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M9 MURRAY, J. W. 1965. The Foraminiferida of the Persian Gulf. Part 2. The Abu Dhabi Region. *Palaeogeography, Palaeoclimatol., Palaeoecol.*, **1** : 307-332, 4 text-fig., 5 tab. [Shallow water faunas from lagoon to delta facies.]

M10 MURRAY, J. W. 1966. The Foraminiferida of the Persian Gulf. Part 3. The Halat al Bahrani Region. *Ibid.*, **2** : 59-68, 3 text-fig., 1 tab. [Shallow water carbonate environment.]

M11 MURRAY, J. W. 1966. The Foraminiferida of the Persian Gulf. Part 4. Khor al Bazam. *Ibid.*, **2** : 153-169, 14 text-fig. [Distribution patterns in lagoonal inlet.]

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P3 PARR, W. J. 1932. Victorian and South Australian shallow-water Foraminifera ; Part I. *Proc. Roy. Soc. Victoria*, new ser., **44** (1) : 1-14, pl. 1, 1 text-fig., Part II. *Ibid.*, **44** (2) : 218-234, pl. 21-22, 1 text-fig. [Taxonomic study of 45 species.]

P4 PARR, W. J. 1933. Notes on Australian and New Zealand foraminifera ; No. 2 : The genus *Pavonina* and its relationships. *Ibid.*, **45** (1) : 28-31, pl. 7.

P5 PARR, W. J. 1945. Recent foraminifera from Barwon Heads, Victoria. *Ibid.*, **56** (2) : 189-218, pl. 7-12, 2 text-fig. [Description of 142 species from shore gatherings ; SW of Melbourne, Australia.]

P6 PARR, W. J. 1950. Foraminifera. *B.A.N.Z. Antarctic Res. Exped.* 1929-31. Rept. Ser. B., **5** (6) : 233-392, pl. 3-15, 8 text-fig. [34 bottom samples from the Southern Indian Ocean (off the Antarctic Continent from lat. 49°E ; Kerguelen Islands; South Coast of Australia).]

P7 PARR, W. 1950. Foraminifera. Appendix II. *In* : R. W. Fairbridge, The geology and geomorphology of Point Peron, Western Australia. *J. Roy. Soc. Western Australia*, **34** : 70-72.—[List of recent and subfossil littoral species from 12 samples.]

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