

## THE HISTORY OF ECHINODERMOLOGY OF THE INDIAN OCEAN\*

D. B. JAMES

*Central Marine Fisheries Research Institute, Cochin-682 018*

### ABSTRACT

Napoleon's scientific contingent made one of the first collections of echinoderms of the Indian Ocean when they visited the Gulf of Suez and the north-western coast of the Red Sea. Our knowledge of the echinoderms of the Indian Ocean is mainly due to the various expeditions, starting with the Challenger Expedition (1873-1874) to the recent International Indian Ocean Expedition (1961-1965) organised with the co-operation of several nations. Apart from these expeditions small vessels engaged in marine survey notably the R.I.M.S. Investigator and the vessels belonging to the Union of South African Fisheries and Marine Biological Survey have collected many echinoderms from the Indian and South African waters respectively. Numerous individual workers who collected the echinoderms from various parts of the Indian Ocean have also significantly contributed to our knowledge of the echinoderms of the Indian Ocean. This paper reviews a history of the echinodermology of the Indian Ocean.

### INTRODUCTION

THE echinoderms of the Indian Ocean are known since very ancient times. Plancus and Gaultire reported some echinoderms from Goa (west coast of India) as early as 1743. Napoleon's scientific contingent made one of the first collections of echinoderms of the Indian Ocean when they visited the Gulf of Suez and the northern Red Sea. Our knowledge of the echinoderms of the Indian Ocean is mainly due to various expeditions such as Challenger Expedition (1873-1874), Deutchen Tiefsee Expedition, 1902-1903 (Gauss), Percy Sladen Trust Expedition, 1904 (Sealark), Willebrod Snellius Expedition (1929), John Murray Expedition, 1933-1934 (Mabahiss), Swedish Deep Sea Expedition, 1947-1948 (Albatross) and the Danish Deep Sea Expedition, 1950-1951 (Galathea). The recent International Indian Ocean Expedition (1961-1965) organised with the co-operation of several nations is bound to bring several echinoderms to light. A. M. Clark and Rowe (1971) have brought out a monograph on the shallow water Indo-West Pacific echinoderms dealing with all the species of Indian Ocean upto a depth of 20 metres.

Apart from the various expeditions mentioned above small vessels engaged in marine survey notably the R.I.M.S. Investigator and the vessels belonging to the Union of South African Fisheries and Marine Biological Survey have collected several echinoderms from the Indian and South African waters respectively. A large number of naturalists and scientists who collected echinoderms from various places in the Indian Ocean have also significantly contributed to our knowledge of the echinoderms of the Indian Ocean.

\* Presented at the Symposium on 'Indian Ocean and Adjacent Seas—Their Origin, Science and Resources' held by the Marine Biological Association of India, at Cochin from January 12 to 18, 1971.

In addition to the expedition reports and other papers published on the echinoderms from several places along the Indian Ocean a number of Indian Ocean species find place in monographs, catalogues, revisional works and other general papers which deal material on a global basis. Among monographs mention may be made of the works of A. H. Clark (1915-1950) and A. H. Clark and A. M. Clark (1967) on the living Comatulids and Mortensen (1928-1951) on the echinoids. Revisional works by A. Agassiz (1872-1874) on the echinoidea, A. M. Clark and A. H. Clark (1954) on the genus *Tethyaster*, Duncan (1889) on echinoidea, Döderlein (1915) on the genus *Anthenea* and Fell (1962) on the Family Amphiuroidae deal with the echinoderms of the Indian Ocean. General works by Müller and Troschel (1842) on asteroids and ophiuroids, Gray (1840, 1866), Perrier (1875), John (1948, 1950), A. M. Clark (1951, 1953) and Madsen (1955) on asteroids, Ludwig (1882), Mitsukuri (1912) and Panning (1929-1935) on holothurians and Koehler (1907) and Matsumoto (1915, 1917) on ophiuroids have made references to the material from the Indian Ocean.

The catalogues of Ramsay (1885) on the echinoids of the Australian Museum, H. B. Clark (1925) on the echinoids of the British Museum, Downey (1969) on the types of echinoids and ophiuroids of the American Museums and James (1969) on the echinoderms of the reference collection of the Central Marine Fisheries Research Institute have listed echinoderms belonging to the Indian Ocean.

The Challenger Expedition made some collections in the southern Indian Ocean. The Challenger Expedition Reports are very important in that they not only include material collected from the Indian Ocean but summarise data on all the species known at the time of writing. A. Agassiz (1879, 1881) on echinoids, Carpenter (1884, 1888) on crinoids, Lyman (1878-1882) on ophiuroids, Sladen (1882, 1883) on asteroids and Theel (1882, 1886) on holothurians published the Challenger reports.

The echinoderms of South Africa were brought to light mainly due to the exploration conducted by the vessels belonging to the Union of South African Fisheries and Marine Biological Survey. The South African echinoderms were well treated by Bell (1888-1905), Mortensen (1925-1935), H. L. Clark (1923) and A. M. Clark (1952). In addition to the above reports Gislén (1931) and A. H. Clark (1952) on crinoids, Deichmann (1944, 1948) and Cherbonnier (1952) on holothurians and Balinsky (1962) on ophiuroids published accounts from South African waters. Other papers from this region include those of Britten (1910), Heding (1937, 1938), John (1939), Gilchrist (1920), A. H. Clark and A. M. Clark (1952) and A. M. Clark and Courtman-Stock (1976).

The East African echinoderms from places like Zanzibar are well reported by Peters (1851), Peffer (1895) and Bell (1903). Other works for the same region are those of Sladen (1879), Perrier (1875-1893), Bianconi (1865), Von Martens (1886), Lampert (1895), Ludwig (1899) and John (1937).

Among the Islands such as Mauritius, Reunion, Rodriguez, Seychelles and Kerguelen the echinoderms of Mauritius are well known. This is chiefly due to the efforts of Robillard who collected the material and de Loriol who reported on the same. The works from Mauritius include those of de Loriol (1883-1885), Bell (1889-1892), Cherbonnier (1953) and James (1969). Mortensen (1934) reported on the echinoderms of Madagascar while Hoffman (1874) and Decary (1921-1950) on the echinoids of Madagascar and Reunion Islands. E. A. Smith (1876) reported on the echinoderms of Rodriguez Island, Kerguelen Island which is situated far

south in the Indian Ocean also received some attention. Koehler (1910) and E. A. Smith (1876, 1879) reported on the echinoderms of the Island.

The echinoderms of the Red Sea are fairly well known due to the efforts of many who made collections from that area. The echinoderms from the Gulf of Aqaba were collected mainly by the 'Manihini Expedition'. The echinoderms of the Suez Canal were brought to light by the Cambridge Expedition. Napoleon's scientific contingent made one of the first collections in the Red Sea when they visited the Gulf of Suez and the northern coast of the Red Sea. The collections made by them were beautifully figured by Savignyi (1809-1817). Later Audouin (1826) gave captions to the figures. The classical work '*System der Asteriden*' by Müller and Troschel (1942) also includes several echinoderms from Red Sea collected by Ehrenberg. Since then Gray (1872), Boutan (1892), Russo (1893-1939), Mazzetti (1895), Herouard (1893), Leopoldt (1895), Fourtau (1903, 1904), Chadwick (1908), A. H. Clark (1909), Helfer (1912), Erwe (1919), Burnfield (1926), Tortonese (1932-1960), A. H. Clark and Bowen (1949), A. H. Clark (1952), Cherbonnier (1954-1967), Tsurumal and Marder (1966), Magnus (1967) and Achituv (1969) have reported on the echinoderms of the Red Sea. A. M. Clark (1967) has summarised the known echinoderms except holothurians from the Red Sea. James (1969) and James and Pearse (1971) have reported on some echinoderms from the Gulf of Suez and the northern Red Sea.

The echinoderms of the Persian Gulf are known largely due to the efforts of the Danish investigations. As a result of the Danish investigations the works of Gislén (1940) on crinoids, Heding (1940) on holothurians and Mortensen (1940) on asteroids, ophiuroids and echinoids have come out. A. Agassiz (1872) in his revision of the echini and H. L. Clark (1912) in his work on the Hawaiian echini mentioned a few echinoids from the Persian Gulf. R.I.M.S. Investigator did some trawling in the Persian Gulf and the echinoderms dredged by it are reported by Koehler (1900-1927), Koehler and Vanoy (1905) and A. H. Clark (1912).

Stanley Gardiner carried out an extensive survey in the Maldives and Minicoy Island, the southern most of the Laccadive group of Islands. Echinoderms other than holothurians collected by Gardiner were reported by Bell (1902). The holothurians of this collection were dealt in a cursory manner by Pearson (1913, 1914) in his studies on the holothurians of the Indian Ocean. A. H. Clark (1929) reported a few crinoids. In recent years A. M. Clark and Davies (1965) have reported some echinoderms from Maldives. They have also pointed out the misidentifications of Bell. James (1969) has recorded about 40 species of echinoderms from the various Islands of the Laccadive Archipelago.

The Percy Sladen Trust Expedition (1905) made some collections in the Chagos Archipelago. Bell (1909) reported on all the echinoderms except holothurians and Pearson (1913, 1914) mentioned the holothurians collected by this expedition.

The echinoderms of Ceylon are fairly well known due to the efforts of Professor Herdman who collected the echinoderms for his reports to the Government of Ceylon on the Pearl Oyster Fisheries. The notable contributions on the echinoderms of Ceylon are those of Pearson (1903) on holothurians, Herdman and Herdman (1904) on asteroids, ophiuroids and echinoids, Chadwick (1904) on crinoids and H. L. Clark (1915) on all groups of echinoderms. Other publications from this region are those of Collier (1830), E. A. Smith (1878), Bell (1882-1887), Sarasin and Sarasin (1885, 1886), Walter (1885), Ludwig (1887-1891), Döderlein (1888) and Sarasin (1887).

The echinoderms of the Indian Coast were poorly known till the present author took up the study of this group from the Indian Seas a few years ago. As a result of his efforts the echinoderms of Gulf of Mannar, Palk Bay and Andaman and Nicobar Islands are now well known (James MS.). Echinoderms from Laccadives, Jamnagar, Bombay, Karwar, Cochin, Vizhinjam, Cape Comerin, Tuticorin, Mandapam, Waltair and Puri were also collected, studied and reported in the following publications (James, 1967, 1968a, 1968b, 1969, 1971a, 1971b, 1973a, 1973b, 1978). Plancus and Gaultier (1743) from Goa, Thurston (1889) from Rameswaram, Bell (1888) from Tuticorin, Gravely (1927) from Krusadai Island and the neighbouring places, Kuriyan (1950) from Krusadai Island, Aiyar (1938), Gravely (1941) and Nair (1946) from Madras, Kurian (1953) from Travancore, Patil (1953) from Karwar, Sanne and Chhapgar (1962) from Bombay, Rao (1968) from Waltair and Gopalakrishnan (1969) from Port Okha have published short accounts of echinoderms collected by them.

The echinoderms from the seas around India (Bay of Bengal) are fairly well known because of the extensive dredging done by R.I.M.S. Investigator in the littoral and beyond the shelf region. About 800 species are now known from the Indian Seas. Ludwig (1878, 1879), Bell (1880-1889), Wood-Mason and Alcock (1891), Tull-Walsh (1891), Alcock (1893-1902), Anderson (1894), Alcock and Anderson (1895), Koehler (1898-1927), Koehler and Vaney (1905-1910), Döderlein (1906, 1912), A. H. Clark (1912-1936), Pearson (1913), Bomford (1913), Hertz (1927) Setna (1930), Liberkind (1932), Ludwig and Heding (1935), Macan (1938), H. L. Clark (1939, 1948), Mortensen (1939) and Heding (1940) have published accounts of the echinoderms of the Indian Seas.

The first collections of echinoderms from the Andaman and Nicobar Islands came as a result of the efforts made by Dr. John Anderson who created interest in Col. Cadell who was stationed at Port Blair. Mr. Booley also made lot of collections for the Indian Museum from Port Blair. Bell (1887) reported on the echinoderms from Andaman Island. Anderson (1907) and James (1966) have reported an echinoid from Port Blair. The personnel of R.I.M.S. Investigator also have made collections at Port Blair and other places in the Andaman and Nicobar Islands when the vessel called at various places. The echinoderms collected by them find mention in the various reports of the Investigator. Lütken (1865, 1872), Theel (1886) and Marktanner (1887) listed some asteroids, ophiuroids and holothurians respectively from Nicobar. The present author first visited Andaman and Nicobar Islands in January-February, 1965 and again during 1975-78 and made extensive collections of echinoderms from the intertidal region. The echinoderms collected are included in the catalogue published by the author in 1969. Bedford (1900) published an account of the echinoderms from Singapore and Malacca Straits.

The echinoderms of Mergui Archipelago are fairly well known through the publications of Bell (1886), Duncan (1887), Carpenter (1889), Sladen (1889) and Duncan and Sladen (1889). Rudmose Brown collected echinoderms from Mergui Archipelago and lower Burma. Asteroids and echinoids from these places were described by Brown (1910) while the holothurians were described by Pearson (1910).

The echinoderms of the East Indian region which is perhaps the richest ground for echinoderms in the world is well known through the efforts of the Siboga Expedition. The holothurians by Sluiter (1901), echinoids by Meijere (1904), ophiuroids by Koehler (1904, 1905), crinoids by Döderlein (1907) and A. H. Clark (1912, 1918)

and asteroids by Döderlein (1917-1936) have been well reported. Engel (1933, 1938) has reported on the holothurians, asteroids and ophiuroids of the East Indian region.

Fisher (1934) reported a starfish from Christmas Island and A. H. Clark (1950) reported on some echinoderms from the Cocos-Keeling Islands. Bell (1884) has reported several echinoderms from the Indo-Pacific collected by H.M.S. Alert. A. H. Clark (1954) has listed a number of echinoderms occurring in the Indo-Pacific region.

The echinoderms occurring in the Western Australian region bordering the Indian Ocean have been well reported by H. L. Clark (1913-1946) in his several reports. Livingstone (1930-1934) recorded a few asteroids from the western Australian region. Marsh (1976) reported on the asteroids known since H. L. Clark.

#### REFERENCES\*

- AGASSIZ, A. 1872. A revision of the echini. *Illus. Cat. Mus. Comp. Zool. Harv.*, Pts. 1 & 2 : 1-378.
- . 1873. A revision of the echini. *Ibid.*, Pt. 3 : 383-628.
- . 1879. Preliminary report on the *Challenger* echini. *Proc. Am. Acad. Arts. Soc.*, 14 : 190-212.
- . 1881. On the echinoidea dredged by H.M.S. Challenger during the years, 1873-1876. *Rep. Sci. Res. Challenger (Zool.)*, 3 (9) : 1-321.
- ALCOCK, A. 1893. Natural History Notes from H.M. Indian Marine Survey Steamer, Investigator Commander C. F. Oldham, R.N. Commanding. An account of the collection of Deep Sea Asteroidea. *Ann. Mag. nat. Hist.*, (6) 11 : 73-121.
- . 1902. *A naturalist in the Indian Seas*. 328 pp. London.
- BELL, F. J. 1884. Echinodermata. In : *Report on the zoological collections made in the Indo-Pacific Ocean during the voyage of H.M.S. Alert*. 117-177 ; 509-512. London.
- . 1902. The actinogonidiate echinoderms of the Maldive and Laccadive Islands. In : Gardiner, J. S. (Ed.). *The Fauna and geography of the Maldive and Laccadive Archipelagoes*. Cambridge University Press, Cambridge, 1 : 223-233.
- . 1909. Report on the echinoderms (other than holothurians) collected by Mr. J. Stanley Gardiner in the western parts of the Indian Ocean. *Trans. Linn. Soc. Lond. (Zool.)*, 13 : 17-22.
- CARPENTER, P. H. 1884. Report on the Crinoidea collected during the voyage of H.M.S. *Challenger* during the years 1873-1876. I. Stalked Crinoids. *Rep. Sci. Res. Challenger (Zool.)*, 11 (2) : 1-442.
- . 1888. Report on the Crinoidea collected during the voyage of H.M.S. *Challenger* during the years 1873-1876. II. The Comatulac. *Ibid.*, 26 (1) : 1-399.
- CHERBONNIER, G. 1952. Holothuries de l' Institute Royal des Sciences Naturelle de Belgique. *Mem. Inst. r. Sci. nat. Belg.*, 41 (2) : 1-68.

\* Only very important papers, monographs and expedition reports are cited here. For a full list of references please see James and Lal Mohan (1969).

- CHERBONNIER, G. 1952. Contribution a la connaissance des holothuries de l' Afrique du Sud. *Trans. R. Soc. S. Afr.*, 33 : 469-501.
- . 1955. Les holothuries de la mer Rouge. *Ann. Inst. Oceanogr (n.s.)*, 30 : 129-183.
- CLARK, A. H. 1912. *Echinoderma of the Indian Museum*. Part VIII. Crinoidea. The crinoidea of the Indian Ocean. 325 pp. Calcutta.
- . 1915. Die Crinoiden der Antarktis. *Dt. Sudpol. Exped.*, 16 : 101-210.
- . 1915. A monograph of the existing crinoids. The Comatulids. Part 1. *Bull. U.S. natn. Mus.*, 82 : 1-406.
- . 1918. The unstalked crinoids of the Siboga Exped., 42b : 1-300.
- . 1921. A monograph of the existing crinoids. I. The Comatulids. Part 2. *Bull. U.S. natn. Mus.*, 82 : 1-795.
- . 1931. A monograph of the existing crinoids. The Comatulids. Super family Comasterida. Part 3. *Ibid.*, 82 (1) : 1-816.
- . 1932. On a collection of crinoids from the Indian Ocean and the Bay of Bengal. *Rec. Indian Mus.*, 34 : 551-566.
- . 1937. Crinoidea. *Sci. Rep. John Murray Exped.*, 4 (1) : 87-108.
- . 1937. Crinoidea. *Sci. Res. Austral. Ant. Exped.*, 8 (4) : 5-18.
- . 1941. A monograph of the existing crinoids. I. The Comatulids. Part 4a. Super family Mariametridae (Except the family Colobometridae). *Bull. U.S. nat. Mus.*, 82 : 1-603.
- . 1947. A monograph of the existing crinoids. I. The Comatulids. Part 4b. Super family Mariametrida (concluded—The family Colobometridae and Super family Tropiometrida except the families Thalassometridae and Charitometridae). *Ibid.*, 82 : 1-473.
- . 1950. A monograph of the existing crinoids. I. The Comatulids. Part 4c. Super family Tropiometrida. (The families Thalassometridae and Charitometridae). *Ibid.*, 82 : 1-383.
- . 1954. Records of Indo-Pacific Echinoderms. *Pacif. Sci.*, 8 (3) : 243-263.
- . AND A. M. CLARK 1967. A monograph of the existing crinoids. 1. The Comatulids. Part 5. Suborders Oligophreata (concluded) and Macrophreata. *Bull. U.S. natn. Mus.*, 82 : 1-860.
- CLARK, A. M. 1952. The Manihine Expedition to the Gulf of Aqaba. VII. Echinodermata. *Bull. Br. Mus. nat. Hist.*, 1 : 203-214.
- . 1953. A revision of the genus *Ophioneris*. *Proc. zool. Soc. Lond.*, 123 : 65-94.
- . 1966. Echinoderms from the Red Sea. Part 2. (Crinoids, ophiuroids, echinoids and more asteroids). *Bull. Sea Fish. Res. Stn. Israel*, 41 : 26-58.
- . 1967. Notes on asteroids in the British Museum (Natural History) *Nardoa* and some Ophiasterids. *Bull. Br. Mus. nat. Hist.*, 15 (4) : 167-198.
- . 1968. Notes on some tropical Indo-Pacific Ophiotrichids (Ophiuroidea). *Bull. Br. Mus. nat. Hist.*, 16 (7) : 275-322.

- CLARK, A. M. AND A. H. CLARK 1954. A revision of the seastars of the genus *Tethyaster*. *Smithson. misc. Collns.*, 122 : 1-27.
- . AND J. COURTMAN-STOCK 1976. *The Echinoderms of Southern Africa*. London, 277 pp.
- . AND P. S. DAVIES 1966. Echinoderms of the Maldive Islands. *Ann. Mag. nat. Hist.*, (13) 8 : 597-612.
- . AND F. W. E. ROWE 1971. *Monograph of shallow-water Indo-West Pacific Echinoderms*. London, 238 pp.
- CLARK, H. L. 1921. The echinoderm fauna of Torrest Strait : its composition and its origin. *Pap. Dep. mar. biol. Carnegie Instn. Wash.*, 10 : 1-223.
- . 1922. The holothurians of the genus *Stichopus*. *Bull. Mus. comp. Zool. Harv.*, 65 : 39-74.
- . 1923. The echinoderm fauna of South Africa. *Ann. S. Afr. Mus.*, 13 : 221-435.
- . 1925. *A catalogue of the recent sea-urchins (Echinoidea) in the collection of the British Museum. (Natural History)*. 250 pp. London.
- . 1938. Echinoderms from Australia. *Mem. Mus. comp. Zool. Harv.*, 55 : 1-596.
- . 1939. Ophiuroidea. *Sci. Rep. John Murray Exped.*, 6 : 29-136.
- . 1946. The echinoderm fauna of Australia, its composition and its origin. *Publ. Carnegie Instn.*, 566 : 1-568.
- . 1948. Report on the Echinoidea of the Murray Expedition. Part, II. *Sci. Rep. John Murray Exped.*, 9 (1) : 1-15.
- DODERLEIN, L. 1901. Diagnosen einiger von der Valdivia-Expedition gesamelter Seeigel-Arten aus dem Indischen Oeana. *Zool. Anz.*, 23 : 19-23.
- . 1905. Ueber Seeigel der Deutschen Tiefsee-Expedition. *Ibid.*, 28 : 621-624.
- . 1906. Die Echinoiden der Deutschen Tiefsee-Expedition. *Wiss. Ergebn. dt. Tiefsee-Exped. Valdivia.*, 5 (2) : 61-290.
- . 1907. Die gestielten Crinoiden der Siboga-Expedition. *Siboga Exped.*, 42a : 1-156.
- . 1912. Die gestielten Crinoiden der Deutschen Tiefsee-Expedition. *Wiss. Ergebn. dt. Tiefsee-Exped. Valdivia*, 17 : 1-31.
- . 1914. Echinoidea. *Die Fauna Sudwest-Australiens*, 4 : 443-492.
- . 1917. Die Asteriden der Siboga-Expedition. 1. Die Gattung *Astropecten* und ihre Stammesgeschichte. *Siboga Exped.*, 46a : 1-191.
- . 1920. Die Asteriden der Siboga-Expedition. 2. Die Gattung *Ludia* und ihre Stammesgeschichte. *Ibid.*, 46b : 193-291.
- . 1921. Die Asteriden der Siboga-Expedition. 1. Porcellanasteridae, Astropectinidae, Benthoplectinidae. *Ibid.*, 46 : 1-47.
- . 1924. Die Asteriden der Siboga-Expedition. 2. Pentagonasteridae. *Ibid.*, 46 (2) : 49-60.

- DODERLEIN, L. 1930. Die Ophiuriden der Deutschen Tiefssee-Expedition. 2. Euryalae. *Wiss. Ergebn. dt. Tiefssee-Exped. 'Valdivia'*, 22 : 347-396.
- . 1936. Die Asteriden der Siboga-Expedition. III. Oreasteridae. *Siboga-Exped.*, 46 : 71-110.
- . 1936. Die Asteriden der Siboga-Expedition. Die Unterfamilie Oreasterininae. *Ibid.*, 46c : 295-368.
- DOWNNEY, M. E. 1968. Catalogue of recent echinoid type specimens in the U.S. National Museum Smithsonian Institution and the Museum of Comparative Zoology, Harvard University. *Bull. U.S. natn. Mus.*, 264 : 1-99.
- DUNCAN, D. M. 1889. A revision of the genera and great groups of Echinoidea. *J. Linn. Soc. (Zool)*, 23 : 1-311.
- EKMAN, S. 1918. Results of Dr. E. Mjöberg's Swedish Scientific Expeditions to Australia, 1910-1913. Holothurioidea. *K. sevenask. Vetensk. Akad. Handl.*, 58 (6) : 1-70.
- . 1927. Holothurien für Deutschen Sudpolar-Expedition, 1901-1903 aus der Ostantarktis und von den Kerguelen. *Dt. Sudpol-Exped.*, 19 : 361-419.
- . 1933. Results scientifiques du voyage aux Indes orientales Néerlandaises. Holothuries. *Mem. Mus. r. Hist. nat. Belg.*, 3 (13) : 1-42.
- . 1938. Asteries et Ophiures. Results scientifiques du voyage aux Indes orientales Néerlandaises. *Ibid.*, 3 (18) : 1-31.
- FISHER, W. K. 1919. Starfishes of the Philippine seas and adjacent waters. *Bull. U.S. natn. Mus.*, 100 (3) : 1-546.
- GISLEN, T. 1938. Crinoids of South Africa. *K. Svenska Vetensk. Handl.*, (3) 17 : 1-22.
- . 1940. Crinoidea. In: Echinoderms from the Iranian Gulf. *Dan. sci. invest. Iran.*, 2 : 110-112.
- GOTO, S. 1914. A descriptive monograph of Japanese Asteroidea. Part I. *J. Coll. Sci. Imp. Univ., Tokyo*, 29 : 1-808.
- GRAY, J. E. 1840. A synopsis of the genera and species of the class Hypostomata. *Ann. Mag. nat. Hist.*, 6 : 175-184 ; 275-290.
- . 1866. *Synopsis of the species of starfish in the British Museum*. 17 pp. London.
- HANSEN, B. 1956. Scientific results of the Danish Deep-Sea Expedition round the world 1950-52. Holothurioidea from depths extending 6000 metres. *Galathea Rep.*, 2 : 33-54.
- HEDING, S. G. 1940. The holothurians of the Iranian Gulf. *Dan. sci. Invest. Iran.*, 2 : 113-137.
- . 1940. Die Holothurien der Deutschen Tiefssee-Expedition. II. Aspidochirote und Elaspode Formen. *Wiss. Ergebn. dt. Tiefssee-Exped. 'Valdivia'*, 1898-1899, 24 : 317-375.
- HERDMAN, W. A. AND J. B. HERDMAN 1904. Report on the Echinoderma collected by Professor Herdman at Ceylon in 1902. *Rep. Govt. Ceylon Pearl Oyster Fish. Gulf of Mannar*, 2 : 137-150.
- HERTZ, M. 1927. Ophiuriden der Deutschen Tiefssee-Expedition 1901-1903. *Wiss. Ergebn. dt. Tiefssee-Exped. Valdivia*, 22 : 59-122.
- JAMES, D. B. 1967. *Phyllophorus (Phyllophorella) parvipedes* Clark (Holothuroidea), a new record to the Indian Seas. *J. mar. biol. Ass. India*, 7 : 325-327.

- JAMES, D. B. 1968a. Studies on Indian Echinoderms-1. Re-description of the echinoid, *Breyntia vredenburgi* Anderson from the Andaman Sea with amended description. *Ibid.*, 8 : (1) : 76-81.
- . 1968b. Studies on Indian Echinoderms-2. The holothurian *Stolus buccalis* (Stimpson) with notes on its systematic position. *Ibid.*, 8 (2) : 285-289.
- . 1969. Catalogue of echinoderms in the reference museum of the Central Marine Fisheries Research Institute. *Bull. cent. Mar. Fish. Res. Inst.* No. 7 : 51-62.
- . 1971a. Studies on Indian Echinoderms-3. *Ophiarthrum pictum* (Müller & Tröschel), a new record from the Indian Ocean with additional notes on the species. *J. Mar. Biol. Ass. India*, 12 : 136-138.
- . 1971b. Studies on Indian Echinoderms-4. On the brittle-stars *Amphioplus graveyi* sp. nov., and *Amphioplus depressus* (Ljungman) from the Indian coasts. *Ibid.*, 12 : 139-145.
- . 1973a. *Beche-de-mer* resources of India, In : *Proc. Sym. Living Resources of the Seas around India*. pp. 706-711. Spl. Publ., Central Marine Fisheries Research Institute, Cochin.
- . 1973b. Studies on Indian Echinoderms-5. New and little known star-fishes from the Indian Seas. *J. mar. Biol. Ass. India*, 15 (2) : 883-884.
- . 1976. Studies on Indian Echinoderms-6. Re-description of two little known holothurians with a note on early juvenile of *Holothuria scabra* Jaeger from Indian Seas. *Ibid.*, 18 (1) : 55-61.
- . AND R. S. LAL MOHAN 1969. Bibliography of the echinoderms of the Indian Ocean. *Bull. cent. mar. Fish. Res. Inst.*, 15 : 1-41.
- JOHN, D. D. 1948. Notes on the asteroids in the British Museum (Natural History). I. The species of *Astropecten*. *Novit. Zool.*, 42 : 485-508.
- KOEHLER, R. 1898. Echinodermes recueillis par l' Investigator dans l'Océan Indien. II. Les ophiures littorales. *Bull. sci. Fr. Belg.*, 31 : 55-124.
- . 1898. Echinodermes recueillis par l' Investigator dans l'Océan Indien. I. Les Ophiures de mer profonde. *Annls. Sci. nat.*, 4 : 277-372.
- . 1899. *Echinoderma of the Indian Museum*. Part I. An account of the deep-sea Ophiuroidea collected by R.I.M.S. *Investigator*, 76 pp. Calcutta.
- . 1900. *Echinoderma of the Indian Museum*. Illustrations of shallow water ophiuroidea collected by R.I.M.S. *Investigator*. 4 pp. pls. xv-xxi Calcutta.
- . 1904. Ophiures de l'Expedition du Siboga. I. Ophiures de mer profonde. *Siboga Exped.*, 45a : 1-176.
- . 1905. Ophiures de l'Expedition du Siboga. II. Ophiures littorales. *Ibid.*, 46b : 1-146.
- . 1909. *Echinoderma of the Indian Museum*. Part V. An account of the deep-sea Asteroidea collected by R.I.M.S. *Investigator*. 143 pp. Calcutta.
- . 1910. Description d' Ophiures nouvelles provenant des dernières campagnes de l' Investigator, dans l' Indien Ocean. *Rec. Indian Mus.*, 5 : 83-88.

- KOEBLER, R. 1910. *Echinoderma of the Indian Museum*, Part VI. An account of the shallow-water Asteroidea. 192 pp. Calcutta.
- . 1914. *Echinoderma of the Indian Museum*. Part VIII. An account of the Echinoidea. I. 258 pp. Calcutta.
- . 1922. *Echinoderma of the Indian Museum*. Part IX. An account of the Echinoidea. 2. Clypeastridres et Cassidulides. 161 pp. Calcutta.
- . 1922. Ophiurans of the Philippine Seas and adjacent waters. *Bull. U.S. natn. Mus.*, 100 (3) : 1-486.
- . 1927. *Echinoderma of the Indian Museum*. Part X. An account of the Echinoidea. 3. Echinides Reguliers. 158 pp. Calcutta.
- AND C. VANEY 1905 *Echinoderma of the Indian Museum*. Part III. An account of the deep-sea Holothurioidea collected by the R.I.M.S. *Investigator*. 123 pp. Calcutta.
- . 1908. *Echinoderma of the Indian Museum*. Part IV. An account of the littoral Holothurioidea collected by the R.I.M.S. *Investigator*. 55 pp. Calcutta.
- LIBERKIND, I. 1932. Asteridae : Porcellanasteridae. *Wiss. Ergebn. dt. Tiefsee-Exped. Valdivia*, 21 : 273-299.
- LORIOU, P. DE. 1883. Catalogue raisonne des echinodermes recueillis par M.V. de Robillard a l'ile Maurice. I. Echinides. *Mem. Soc. Phys. Hist. nat. Geneve*, 28 (8) : 1-64.
- . 1885. Catalogue raisonne des echinodermes recueillis par M.V. de Robillard a l'ile Maurice. II. Stellerides. *Ibid.*, 29 (4) : 84.
- LUDWIG, H. AND S. G. HEDING 1935. Die Holothurien der Deutschen Tiefsee-Expedition. I. Fusslose und dendrochirote Formen. *Wiss. Ergebn. Tiefsee-Expedition Valdivia*, 24 : 121-214.
- LUTKEN, C. 1865. Kritiske Bemaerkninger om forskellige Sostjermer (Asterider), med Beskrivelse af nogle nye Arter. *Vidensk. Meddr. dansk naturh. Fosen*. 1864 : 123-169.
- . 1872. Fortsatte kritiske og beskrivende Bidrag til Kundskab om Sostjernerne (Asteriderne) *Ibid.*, 1871 : 227-304.
- LYMAN, T. 1879. Ophiuridae and Astrophytidae of the Challenger Expedition. *Bull. Mus. Comp. Zool. Harv.*, 6 (2) : 17-83.
- . 1882. Report on the Ophiuroidea dredged by H.M.S. Challenger during the years 1873-1876. *Rep. Sci. Res. Challenger (Zool.)*, 5 (1) : 1-386.
- MACAN, T. T. 1938. Asteroidea. *Sci. Rep. John Murray Exped.*, 4 : 323-435.
- MADSEN, F. J. 1951. Asteroidea. *Rep. Swed. deep Sea Exped.*, 2 (6) : 73-92.
- . 1951. Ophiuroidea. *Ibid.*, 2 (9) : 107-117.
- MARKTANNER, T. G. 1887. Beschreibung neuer Ophiuriden and Bemerkungen zu Bekannten. *Ann. naturh. Mus. Wien*. 2 : 291-316.
- MARSH, L. M. 1976. Western Australian Asteroids since H. L. Clark. *Thalassia Jugoslavica* 12 (1) : 213-225.
- MATSUMOTO, H. 1917. A monograph of Japanese Ophiuroidea arranged according to a new classification. *J. Coll. Sci. Imp. Univ. Tokyo Art.* 2, 38 : 1-408.

- MEIJERE, J. C. H. DE. 1904. Die Echinoiden der Siboga-Expedition. *Siboga Exped.*, 43 : 1-251.
- MITSUKURI, K. 1912. Studies on actinopodus Holothuroidea. *Jour. Coll. Sci. Tokyo*, 29 : 1-284.
- MORTENSEN, T. 1909. Die Echinoiden der Deutschen Sudpolar-Expedition, 1901-1903. *Deutsch. Sudpolr. Exped.*, 11 : 1-113.
- . 1928. *A monograph of the Echinoidea*. I. Cidaroida. 551 pp. Copenhagen.
- . 1935. *A monograph of the Echinoidea*. II. Bothriocidaroida, Meloechinoidea, Lepidocentroida and Stirodonta, 647 pp. Copenhagen.
- . 1939. Report on the Echinoidea of the Murray Expedition. Part I. *Sci. Rep. John Murray Exped.*, 6 : 1-28.
- . 1940. *A monograph of the echinoidea*. III. 1. Aulodonta. 370 pp. Copenhagen.
- . 1940. Echinoderms from the Iranian Gulf. Asteroidea, Ophiuroidea and Echinoidea. *Danish sci. Invest. Iran.*, 2 : 55-112.
- . 1943. *A monograph of the Echinoidea*. III. 2. Camerodonta I. 553 pp. Copenhagen.
- . 1943. *A monograph of the Echinoidea*. III. 3. Camerodonta II. 446 pp. Copenhagen.
- . 1948. *A monograph of the Echinoidea*. IV. 1. Holectypoida, Cassiduloida, 363 pp. Copenhagen.
- . 1948. *A monograph of the Echinoidea*. IV. 2. Clypeastroida, 471 pp. Copenhagen.
- . 1948. Report on the Echinoidea of the Murray Expedition. Part 2. *Sci. Rep. John Murray Exped.*, 9 : 1-15.
- . 1950. *A monograph of the Echinoidea*. V. 1. Spatangoida I. 432 pp. Copenhagen.
- . 1951. *A monograph of the Echinoidea*. V. 2. Spatangoida II. 593 pp. Copenhagen.
- PANNING, A. 1921. Die Gattung *Holothuria*. Part I. *Mitt. zool. St. Inst. Hamb.*, 44 : 91-138.
- . 1934. Die Gattung *Holothuria*. Parts II-IV. *Ibid.*, 45 : 24 ; 65-84 ; 85-107.
- . 1935. Die Gattung *Holothuria*. Part V. *Ibid.*, 46 : 1-18.
- MÜLLER, J. AND F. H. TROSCHEL. 1842. *System der Asteriden*. 134 pp. Braunschweig.
- PEARSON, J. 1913. Notes on the Holothurioidea of the Indian Ocean. I. The genus *Holothuria*. *Spolia Zeylan.*, 9 : 49-101.
- . 1914. Notes on the Holothurioidea of the Indian Ocean. II. Sub-genera *Argiodia* and *Actinopyga*. *Ibid.*, 9 : 173-190.
- FERRIER, E. 1875. *Revision de la collection de Stellerides du Museum d' Histoire Naturelle de Paris*, 384 pp. Paris. Also *Archs. Zool. exp. gen.*, 4 : 265-450 ; 5 : 1-104 ; 209-309.
- RAMSAY, E. P. 1885. *Catalogue of the Echinodermata in the Australian Museum*. Pt. 1. Echini. 54 pp.
- SELENKA, 1867. Beiträge zur Anatomie und Systematik der Holothurien. *Z. wiss. Zool.*, 17 : 291-374.

- SELENKA, 1867. Nachtrage zu den Beitragen zur Anatomie und Systematik der Holothurien. *Ibid.*, 18 : 109-118.
- SEMPER, C. 1868. Die Holothurien. *Reisen im Archipel der Philippinen*. 288 pp. Weisbaden.
- SLADEN, W. P. 1882. The Asteroidea of H.M.S. Challenger Expedition. I. Pterasteridae. *J. Linn. Soc.*, 16 : 189-246.
- . 1883. The Asteroidea of H.M.S. Challenger Expedition II. *Ibid.*, 17 : 214-269.
- . 1889. Report on the Asteroidea collected during the voyage of H.M.S. Challenger during the years 1873-1876. *Rep. Sci. Res. Challenger. (Zool.)*, 30 : 1-935.
- SLUITER, C. P. 1901. Die Holothurien der Siboga-Expedition. *Siboga-Exped.*, 44 : 1-141.
- THEEL, H. 1882. Report on the Holothurioidea dredged by H.M.S. Challenger during the years 1873-1876. Part. I. *Rep. Sci. Res. Challenger (Zool.)*, 4 : 1-176.
- . 1886. Report on the Holothurioidea dredged by H.M.S. Challenger during the years 1873-1876. Part II. *Ibid.*, 14 : 1-290.
- TULL-WALSH, J. T. 1891. Natural History notes from H.M. Indian Marine Survey Steamer 'Investigator' commander R. F. Hoskyn, R.N. commanding. No. 24. List of deep sea holothurians, collected during the seasons 1887-1891, with description of new species. *J. Astat. Soc. Beng.*, 60 : 197-204.
- WOOD-MASON, J. AND A. ALCOCK 1891. Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator' Commander R. F. Hoskyn, R.N., Commanding. On the results of deep sea dredging during the season 1890-1891. *Ann. Mag. nat. Hist.*, 8 : (6) 427-443.