

REVISION OF FOSSIL HOLOTHUROIDEA FAMILY PRISCOPE DATIDAE FRIZZELL AND EXLINE, 1955 AND SOME NEW GENERA FROM KUTCH, INDIA

K. S. SOODAN

Institute of Petroleum Exploration, Oil and Natural Gas Commission, Dehra Dun

ABSTRACT

Fossil holothurian sclerites of family Priscopeditidae Frizzell and Exline (1955) are regrouped under ten genera. *Feddenella*, *Fletcherina* and *Sastriella* are the new genera with *Feddenella jumaraensis* sp. nov., *Fletcherina giganta* sp. nov. and *Sastriella jumaraensis* sp. nov. as their type species respectively. *Fletcherina acuta* sp. nov., *Fletcherina bifurcata* sp. nov., *Sastriella imperfecta* sp. nov., *Sastriella thornicus* sp. nov. and *Sastriella wynnei* sp. nov. are the other species illustrated and systematically described. This suite has been recorded from Jhurio Formation of Bathonian-Calloviaian age (BISWAS, 1971) and exposed at Jumara Dome, Kutch, India.

Genus *Priscopeditus* Schlumberger, 1890 emend. Frizzell & Exline (1955) is considered to include tables with circular, subcircular, hexagonal, subhexagonal, irregular disc and always with four central perforations. Genus *Priscolongatus* Hanna (1969) is considered to include tables with solid radiating arms, plane or concavo-convex disc with stirrup and or spire but always four central perforations.

Priscopeditus normani Schlumberger (1890), *Priscopeditus plenus* Deflandre-Rigaud (1962) and *Priscopeditus normannus* Deflandre-Rigaud (1962) are placed under a new genus *Clarkina*. *Priscolongatus* sp. 1 Hanna (1969) is placed under a new genus *Hannaina* and redesignated *Hannaina polandica* Soodan.

The reasons for revision and advantage of the proposed classification are discussed. Key to the genera and the systematic position of the species so far described under family Priscopeditidae is given as per the proposed classification.

INTRODUCTION

The author has examined in detail the fossil sclerites recorded from Jumara dome, Kutch. The sclerites in the form of tables with spire and or stirrup and perforated disc are placed in the family Priscopeditidae. The sclerites recorded from Kutch are different from the known genera of the family. After going through the work of FRIZZELL AND EXLINE (1955, 1966), DEFLANDRE-RIGAUD (1946, 1952, 1959 and 1962), HANNA (1969), MOSTLER (1967, 1968), SCHUMBERGER (1890) and ZANKLE (1966), the author felt it necessary to erect three new genera i.e. *Feddenella*, *Fletcherina* and *Sastriella* and regroup the other sclerites of the family Priscopeditidae. A new classification is proposed and discussed in this paper.

DISCUSSIONS

FRIZZELL AND EXLINE (1955) erected a new family Priscopeditidae to receive all the sclerites which were in the form of tables with stirrup and spire and perforated disc. The authors took the characters of the central perforation as "...frequently with four central perforations..." (p. 100). Under the diagnostic characters (p. 101) of the only genus (known at that time) *Priscopeditus* Schlumberger, 1890 emend. Frizzell & Exline (1955) the authors write "...typically with four central holes surrounded by concentric rows of perforations.....". Later in 1966 they further modified the characters of the genus as "...cross bar or stirrup of four branches mounted above a large opening or making four pillars rising from the disc...". While describing *Priscopeditus pyramidalis*

the type species of the genus the authors write (p. 108-109) "...pierced by a single large perforation..." but in Pl. 6, Fig. 1, there are clearly shown four central perforations. It is, therefore, suggested that the sclerite illustrated in Pl. 6, Fig. 1 only should be taken as the type species of the genus *Priscopedatus*. Thus the present author feels that the sclerites with four central perforations and circular, subcircular, hexagonal, subhexagonal, irregular disc should be included in the genus *Priscopedatus* Schlumberger, 1890 emend. Frizzell & Exline (1955).

In the description of *Priscopedatus anceps* Schlumberger (1890) it is stated that there is only one central perforation but the figure clearly shows four central perforations (pp. 102-103; pl. 5, fig. 2). *Priscopedatus multiforis* Schlumberger (1890) (p. 107; pl. 5, figs. 15 & 19) and *Priscopedatus crassus* Schlumberger (1890) (pp. 104-105; pl. 5, fig. 11) also show only one central hole. The description and illustrations of *Priscopedatus aspergillum* Schlumberger (1890) (p. 103; pl. 5, fig. 5) and *Priscopedatus pinguis* Deflandre-Rigaud (1946) (p. 108; pl. 5, fig. 22) are stated to have only one central hole, but Pl. 5, Figs. 5 & 22 show four central holes. *Priscopedatus bartensteini* (Deflandre-Rigaud, 1952) has imperforate central part of the sclerite (pp. 103-104; pl. 5, figs. 4, 6-9). *Priscopedatus normani* Schlumberger (1890) and *Priscopedatus normannus* Deflandre-Rigaud (1962) too have imperforate central part of the sclerites.

HANNA (1969) described a new genus *Priscolongatus* having an elongated concavo-convex sclerite with two or four solid radiating arms and a conical elevation in the centre mostly surrounded by four perforations. It is suggested that sclerites with solid radiating arms, plane or concavo-convex disc having spire and or stirrup but always four central perforations be included in this genus.

In view of the observations stated above it is felt necessary to regroup the fossil sclerites of family Priscopedatidae. This classification, however, may not be useful from purely zoological point of view but seems quite useful and practicable in its applied aspects. The advantage is that even partly broken sclerites can be systematically placed in their proper positions within this classification. In evolving this new classification the author has given main importance to the central perforations, shape and outline of the disc and the presence or absence of the additional perforations in the disc.

KEY TO THE GENERA

The sclerites in the form of tables can be systematically placed if examined in ventral view (to see number of central perforations) and the following points are properly seen.

1. If the sclerite is in the form of a table see.....(1)
2. (1) If the sclerite is with one central perforation see.....(2)
 - If the sclerite is with three central perforations see.....(4)
 - If the sclerite is with four central perforations see.....(5)
 - If the sclerite is with five central perforations see.....(6)
 - If the sclerite is with no central perforation see.....(7)
3. (2) If the disc is in the form of radiating arms see.....(3)
 - If the disc is circular, subcircular, hexagonal, irregular with or without additional perforations.....*Feddenella* gen. nov.
4. (3) If the arms are solid, circular, subcircular or elliptical in cross section.....
 - *Fletcherina* gen. nov.
 - If the arms are perforate, rectangular or subangular in cross section.....
 - *Sastriella* gen. nov.

5. (4) If the disc is circular, subcircular, irregular and with additional perforations
..... *Prisculatrites* Deflandre-Rigaud (1962)
6. (5) If the disc is in the form of solid radiating arms; arms in one plane or concavo-convex
..... *Priscolongatus* Hanna (1969)
If the disc is circular, subcircular, hexagonal, subhexagonal or irregular and with additional perforations..... *Priscopedatus* Schlumberger, 1890 emend.
..... Frizzell & Exline (1955)
7. (6) If the disc is in the form of solid radiating arms..... *Hannaina* gen. nov.
8. (7) If the disc is trilobus, three large holes covering the entire disc and controlling the trilobus character of the sclerite.... *Dictyothurites* Deflandre-Rigaud (1962)
If the disc is cruciform and perforations covering the entire arms.....
..... *Staurocumites* Deflandre-Rigaud (1962)
If the disc is circular, subcircular, irregular and generally with four large and additional perforations varying in number..... *Clarkina* gen. nov.
All these genera are illustrated in text-figs. 1-24.

The fossil sclerites of family Priscopedatidae are regrouped in the proposed classification as follows:

Feddenella gen. nov.

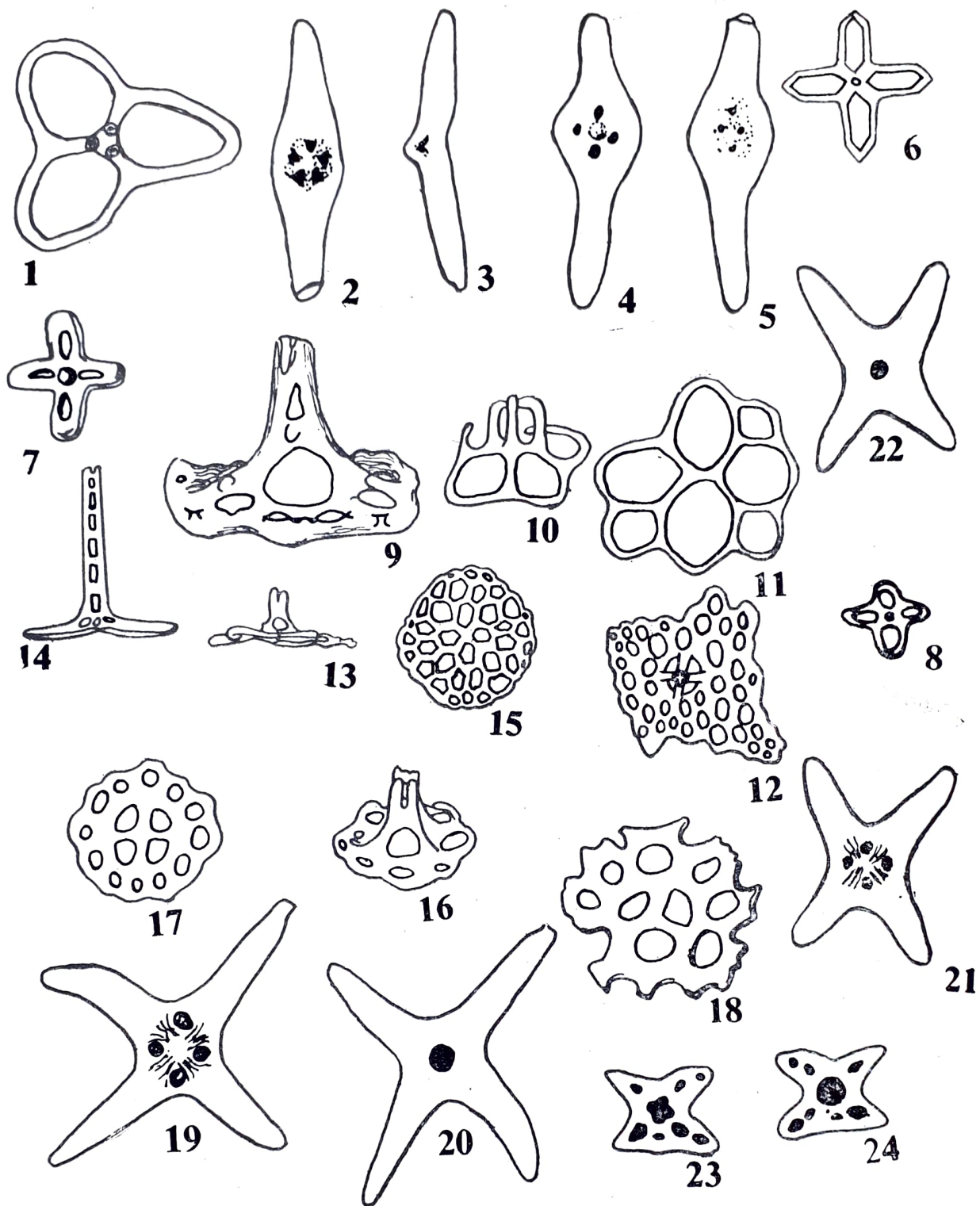
1. *Feddenella asymmetricus* (Deflandre-Rigaud) comb. nov. (= *Priscopedatus asymmetricus* Deflandre-Rigaud, 1962; p. 70; pl. 2, fig. 6, text-figs. 79-80).
2. *Feddenella bolkoviensis* (Hanna) comb. nov. (= *Priscopedatus bolkoviensis* Hanna, 1969; p. 371; pl. 70, fig. 6).
3. *Feddenella conspicuus* (Defl.-Rigaud) comb. nov. (= *Priscopedatus conspicuus* Deflandre-Rigaud, 1959; p. 193; pl. 1, fig. 7; pl. 2, fig. 12; pl. 3, fig. 6).
4. *Feddenella crassus* (Schlumberger) comb. nov. (= *Priscopedatus crassus* Schlumberger, 1890; p. 204; text-fig. 39; Frizzell & Exline, 1955; p. 104, pl. 5, fig. 11).
5. *Feddenella heteropurus* (Deflandre-Rigaud) comb. nov. (= *Priscopedatus heteropurus* Deflandre-Rigaud, 1962; p. 72; pl. 2, fig. 5, text-figs. 89-90).
6. *Feddenella multiforis* (Schlumberger) comb. nov. (= *Priscopedatus multiforis* Schlumberger, 1890; p. 202; text-figs. 31-32; Frizzell & Exline, 1955; p. 107, pl. 5, figs. 15-19).
7. *Feddenella propinquus* (Schlumberger) comb. nov. (= *Priscopedatus propinquus* Schlumberger, 1890; p. 201, text-fig. 30; Frizzell & Exline, 1955; p. 108, pl. 5, fig. 20).
8. *Feddenella pseudoaffinis* (Deflandre-Rigaud) comb. nov. (= *Priscopedatus pseudoaffinis* Deflandre-Rigaud, 1962; p. 73; fig. 107).

Fletcherina gen. nov.

9. *Fletcherina crux* (Deflandre-Rigaud) comb. nov. (= *Priscopedatus crux* Deflandre-Rigaud, 1962; p. 72, figs. 83, 84).
10. *Fletcherina exlineae* (Said & Barakat) comb. nov. (= *Priscopedatus exlineae* Said & Barakat, 1958; p. 268, pl. 6, fig. 11).

Sastriella gen. nov.

11. *Sastriella bathoniensis* (Hanna) comb. nov. (= *Priscopedatus bathoniensis* Hanna, 1969; p. 369, pl. 71, fig. 7).



Text-figs. 1-24—1, *Dictyothurites corbisema* Deflandre-Rigaud, Holotype $\times 160$; 2, 3, *Hannaina polandica* Soodan, Holotype, 2, Dorsal and 3, ventral views $\times 55$; 4, 5, *Priscolongatus quadriperforata* Hanna, Paratype, 4, Dorsal and 5, ventral views $\times 60$; 6-8, *Staucumites bartensteini* Deflandre-Rigaud, 6, Holotype $\times 50$, 7, Paratype $\times 90$, 8, Paratype $\times 50$; All dorsal views 9, *Prisculatrites deflandreae* (Frizzell and Exline, 1955), Holotype dorso-lateral view $\times 411$; 10, 11, *Clarkina normanni* (Schlumberger, 1890), 10, Dorsolateral view $\times 50$, 11, ventral view $\times 194$; 12, 13, *Feddenella multiforis* (Schlumberger, 1890), Holotype, 12, Dorsal and 13, ventral views $\times 100$; 14, 15, *Priscopedatus eiffeli* (Schlumberger, 1890), Holotype, 14, Lateral view $\times 183$, 15, ventral view $\times 210$; 16, 17, *Priscopedatus pyramidalis* Schlumberger, 1890, Holotype, 16, Dorsolateral view $\times 191$, 17, ventral view $\times 210$; 18, *Prisculatrites schlumbergeri* Deflandre-Rigaud, 1946, Holotype, ventral view $\times 400$; 19, 20, *Fletcherina gigantea* gen. et sp. nov. Genoholotype No. I. P. E./A04/04/158, 19, Dorsal view $\times 93$, 20, ventral view $\times 85$; 21, 22, *Fletcherina acuta* sp. nov. Holotype No. I. P. E./H04/04/159, 21, Dorsal and 22, ventral views $\times 92$; 23, 24, *Sastriella jumaraensis* gen. et sp. nov. Genoholotype No. I. P. E./A04/04/157; 23, Dorsal view $\times 114$; 24, ventral view $\times 114$.

12. *Sastriella denticulata* (Hanna) comb. nov. (= *Priscopedatus denticulata* Hanna, 1969; p. 371, pl. 74, fig. 1).
13. *Sastriella jaworznicensis* (Hanna) comb. nov. (= *Priscopedatus jaworznicensis* Hanna, 1969; p. 369, pl. 73, fig. 1).
14. *Sastriella octoperforata* (Hanna) comb. nov. (= *Priscopedatus octoperforata* Hanna, 1969; p. 372, pl. 74, fig. 5).
15. *Sastriella pentaradiatus* (Hanna) comb. nov. (= *Priscopedatus pentaradiatus* Hanna, 1969; p. 370, pl. 73, fig. 9).
16. *Sastriella triangularis* (Hanna) comb. nov. (= *Priscopedatus triangularis* Hanna, 1969; p. 368, pl. 71, fig. 5).

Prisculatrites Deflandre-Rigaud, 1962

17. *Prisculatrites deflandreae* (Frizzell & Exline) comb. nov. (= *Prisculatrites deflandreae*. Frizzell & Exline, 1955; p. 105, pl. 5, fig. 14).
18. *Prisculatrites schlumbergeri* (Deflandre-Rigaud) comb. nov. (= *Priscopedatus schlumbergeri* Deflandre-Rigaud, 1946; p. 512, text-fig. 10; 1962; p. 76, text-fig. 112; Frizzell & Exline, 1955; p. 105, pl. 5, fig. 14).
19. *Prisculatrites triceratium* Deflandre-Rigaud 1962; p. 77, pl. 2, fig. 4, text-fig. 118.

Priscolongatus Hanna, 1969

20. *Priscolongatus obliquobrachiatus* Hanna, 1969 (Hanna, 1969; p. 374; pl. 75, fig. 13).
21. *Priscolongatus quadriperforatus* Hanna, 1969 (Hanna, 1969; p. 373; pl. 75, fig. 7).
22. *Priscolongatus* sp. 2 Hanna, 1969; (p. 374, pl. 76, figs. 5-6).

Priscopedatus Schlumberger, 1890 emend. Frizzell & Exline, 1955

23. *Priscopedatus affinis* Deflandre-Rigaud, 1946 (Deflandre-Rigaud, 1946; p. 954, text-fig. 16; 1962; p. 68, figs. 67-68; Frizzell & Exline, 1955; p. 102, pl. 5, fig. 1).
24. *Priscopedatus anguliferus* Zankl. 1966 (Zankl, 1966; p. 75; table 5; figs. 7a-c).
25. *Priscopedatus apertus* Deflandre-Rigaud, 1962 (p. 69; fig. 77).
26. *Priscopedatus corolla* Schlumberger, 1890 (Schlumberger, 1890; p. 202, text-fig. 34; Frizzell & Exline, 1955; p. 104, pl. 5, fig. 10).
27. *Priscopedatus cribellum* Schlumberger, 1890 (Schlumberger, 1890; p. 205, text-fig. 43; Frizzell & Exline, 1955; p. 105, pl. 5, fig. 13).
28. *Priscopedatus echinatus* Schlumberger, 1890, (Schlumberger, 1890; p. 203, text-fig. 38; Frizzell & Exline, 1955; p. 106, pl. 5, fig. 12).
29. *Priscopedatus eiffeli* Schlumberger, 1890 (Schlumberger, 1890; p. 203; text-figs. 35-37; Frizzell & Exline, 1955; p. 106, pl. 5, figs. 17-18).
30. *Priscopedatus spectabilis* Deflandre-Rigaud, 1962 (Deflandre-Rigaud, 1962; p. 74, figs. 122-123).
31. *Priscopedatus spiniferus* Deflandre-Rigaud, 1962 (Deflandre-Rigaud, 1962; p. 75, figs. 116-117).
32. *Priscopedatus pyramidalis* Schlumberger, 1890 (Schlumberger, 1890; p. 201, figs. 26-29; Frizzell & Exline, 1955; p. 108, pl. 6, figs. 1-3).
33. *Priscopedatus* spp. 'b' and 'c' Mostler, 1967; (p. 184, figs. 2-3).
34. *Priscopedatus* sp. Zankl. 1966; (p. 76, table 5, fig. 6).

(Text-figures 1-18 have been copied from the papers mentioned in the text of the paper. Types have been mentioned wherever possible.)

Hannaina gen. nov.

35. *Hannaina polandica* Soódan (= *Priscolongatus* sp. 1 Hanna, 1969; p. 374, pl. 76, fig. 4).

Dictyothurites Deflandre-Rigaud, 1959

36. *Dictyothurites corbisema* Deflandre-Rigaud, 1959 (Deflandre-Rigaud, 1959; p. 193, pl. 1, figs. 12-13; pl. 2, fig. 10).
37. *Dictyothurites spatuligerus* Deflandre-Rigaud, 1969 (Deflandre-Rigaud, 1959; p. 193, pl. 1, figs. 10-11; pl. 2, fig. 13).

Staurocumites Deflandre-Rigaud, 1952

38. *Staurocumites bartensteini* Deflandre-Rigaud, 1952 (Deflandre-Rigaud, 1952, p. 953, text-fig. 12; Frizzell & Exline, 1955; p. 103, pl. 5, figs. 4, 6-9).

Clarkina gen. nov.

39. *Clarkina aegyptiacus* (Said & Barakat) comb. nov. (= *Priscopedatus aegyptiacus* Said & Barakat, 1958; p. 268, pl. 6, figs. 24-27).
40. *Clarkina normani* (Schlumberger) comb. nov. (= *Priscopedatus normani* Schlumberger, 1890; p. 200, text-figs. 23-24; Frizzell & Exline, 1955; p. 107, pl. 5, figs. 16, 21).
41. *Clarkina normannus* (Deflandre-Rigaud) comb. nov. (= *Priscopedatus normannus* Deflandre-Rigaud, 1962; p. 72, figs. 96-97).
42. *Clarkina ovalis* (Mostler) comb. nov. (= *Priscopedatus ovalis* Mostler, 1968; p. 55, table 1, fig. 11).
43. *Clarkina plenus* (Deflandre-Rigaud) comb. nov. (= *Priscopedatus plenus* Deflandre-Rigaud, 1962; p. 73, fig. 103).

In addition to the above noted species there are some more species which require re-examination for their final placement in proper systematic position in the proposed classification. The original names of the species and genera are given within brackets. The complete details of the papers are given under references.

SYSTEMATIC DESCRIPTION

Phylum— ECHINODERMATA
Class— HOLOTHUROIDEA
Family— PRISCOPEMATIDAE Frizzell & Exline, 1955
Genus— **Feddenella** gen. nov.

Type species: *Feddenella jumaraensis* gen. et sp. nov.

Diagnosis—Sclerites in the form of tables; disc circular, subcircular, irregular, hexagonal, subhexagonal with or without additional perforations; spire and or stirrup present; only one central perforation; perforations of the disc of various shape and sizes; spire low to medium.

Stratigraphic Range—Jurassic (Oxfordian)-Oligocene.

Comparison—This genus differs from *Priscopedatus* in having only one central hole. From *Fletcherina* and *Sastriella* it differs in having circular, subcircular, irregular, hexagonal or subhexagonal disc.

Derivation of the name—Genus *Feddenella* is named after late Mr. F. Fedden, one of the geologist who worked in Kutch in the initial stages of geological work in the region.

Feddenella jumaraensis sp. nov. (Pl. 1, Figs. 9-11)

Description—Sclerites in the form of tables; disc perforate with spire and/or stirrup, subcircular in outline, perforations of the disc of various shapes arranged somewhat concentrically around the central perforation, eight large perforations in the inner circle and outer circle with 15-20 smaller perforations; spire high; stirrup four footed; central hole circular; diameter of the disc 0.15 mm.

Type Material—The specimen illustrated is Genoholotype No. I. P. E./A04/04/157.

Type Locality—Jumara Dome, Kutch, India

Distribution—Jhurio Formation (Bathonian-Callovian).

Comparison—*Feddenella jumaraensis* sp. nov. differs from *Feddenella multiformis* comb. nov. and *F. asymmetricus* comb. nov. in having subcircular outline and concentric arrangement of the perforations of the disc. *F. bolkoviensis* comb. nov. differs in having scalloped outline and very few perforations of disc.

Genus—***Fletcherina*** gen. nov.

Type species—*Fletcherina gigante* gen. et sp. nov.

Diagnosis—Sclerites in the form of tables; disc cross shaped with four radiating arms, spire and or stirrup present; arms solid in one plane, at uniform or different angles with each other, equal or unequal in length, tapering distally, circular or subcircular in cross section, sometimes elliptical in cross section; spire low to medium; one central hole, circular or subcircular in nature.

Stratigraphic Range—Jurassic (Oxfordian)-?Tertiary.

Comparison—Sclerite of *Fletcherina* gen. nov. differs from *Sastriella* in having solid radiating arms. From *Priscolongatus* it differs in having only one central hole. *Hannaina* differs in having five central holes.

Derivation of the name—This genus is named in honour of Dr. B. N. Fletcher, Institute of Geological Sciences, Leeds, England, in recognition of his contributions to the knowledge of fossil holothurian sclerites.

Fletcherina gigante sp. nov. (Pl. 1, Figs. 3-4; Text-figs. 19-20)

Description—Sclerites in the form of tables; disc cross shaped with four solid radiating arms; arms in one plane at right angles or nearly so with respect to each other, unequal in length, tapering distally, circular to subcircular in cross section, one arm bent at the distal end; spire very short; stirrup four footed; central perforation circular; diameter 0.50 mm. along one set of arms and 0.55 mm. along the second set.

Type Material—The specimen illustrated is Cenoholotype No. I.P.E./A04/04/158.

Type Locality—Jumara Dome, Kutch, India.

Distribution—Jhurio Formation (Bathonian-Callovian).

Comparison—*Fletcherina gigante* sp. nov. differs from *F. acuta* sp. nov. in having all the arms placed at right angles or nearly so with each other. *F. bifurcata* sp. nov. differs in having bifurcated distal end of the arms.

Fletcherina acuta sp. nov. (Pl. 1, Figs. 5-6; Text-figs. 21-22).

Description—Sclerites in the form of tables; disc cross shaped with four solid radiating arms; arms in one plane and make two acute and two obtuse angles with each other, unequal, distally tapering, circular to subcircular in cross section; spire very short; stirrup four footed; central perforation circular; diameter 0.25 mm. and 0.32 mm. along two opposite pairs of arms.

Type Material—The specimen illustrated is Holotype No. I.P.E./H04/04/159.

Type Locality—Jumara Dome, Kutch, India.

Distribution—Jhurio Formation (Bothanian-Callovian).

Comparison—This new species differs from *Fletcherina acuta* sp. nov. and *F. bifurcata* sp. nov. in having one pair of acute and one pair of obtuse angles.

Fletcherina bifurcata sp. nov. (Pl. 1, Figs. 1-2)

Description—Sclerites in the form of tables; disc cross shaped with four solid radiating arms; arms in one plane, at right angles with each other (two arms broken in the specimen), arms bifurcated at the distal ends into two pointed branches, almost equal in length, circular to subcircular in cross section; spire small; stirrup four footed; central hole large and circular; diameter 0.60 mm. along the complete arms.

Type Material—The illustrated specimen is Holotype No. I.P.E./H04/04/160.

Type Locality—Jumara Dome, Kutch, India.

Distribution—Jhurio Formation (Bathonian-Callovian).

Comparison—This species differs from *F. acuta* sp. nov. and *F. gigante* sp. nov. in having bifurcating tips of the arms.

Genus Sastriella gen. nov.

Type species—*Sastriella jumaraensis* gen. et sp. nov.

Diagnosis—Sclerites in the form of tables; disc cross shaped with perforated radiating arms; arms in one plane, three, four or more in number rectangular to subrectangular in cross section equal or unequal in length; perforations of the arms of various shape and sizes; only one circular to subcircular central hole; stirrup 3-5 footed depending, perhaps, on the number of arms.

Stratigraphic Range—Jurassic-?Tertiary.

Comparison—*Sastriella* gen. nov. differs from new genera *Fletcherina* and *Feddenella* in having perforated arms and cross shaped disc respectively. Genera *Priscolongatus* and *Hannaina* gen. nov. differs in having four and five central holes respectively in place of one in *Sastriella*.

Derivation of the name—This genus is named in honour of Sri V. V. Sastri Additional Director, Institute of Petroleum Exploration, Oil and Natural Gas Commission, Dehra Dun in recognition of his services in the development of micropalaeontology and biostratigraphy in India.

Sastriella jumaraensis sp. nov. (Pl. 1, Figs. 12-13; Text-figs. 23-24)

Description—Sclerites in the form of tables; disc cross shaped with four perforated radiating arms; arms placed irregularly in one plane, unequal in length, tapering distally, rectangular or subangular in cross section, arms placed in such a manner that they form two acute and opposite angles, one obtuse angle and one angle of 180° thus placing two arms in a straight line, perforations of the arms of various shapes and sizes; stirrup broken but four footed nature is seen; central hole subcircular; diameter 0.17 mm. and 0.12 mm. if measured along the adjacent arms.

Type Material—The illustrated specimen is Genoholotype No. I.P.E./A04/04/161.

Type Locality—Jumara Dome, Kutch, India.

Distribution—Jhurio Formation (Bathonian-Callovian).

Comparison—This new species differs from *Sastriella thornicus* sp. nov. and *Sastriella wynnei* sp. nov. in having four arms of the disc.

Sastriella thornicus sp. nov. (Pl. 1, Figs. 14-15)

Description—Sclerites in the form of tables; disc triradiate perforated arm, arms placed in one plane, two arms in a straight line and the third joins at the middle making an angle of 90° and is short and triangular or thorn like, other two bluntly pointed, rectangular or subrectangular in cross section; perforations of the arms of various sizes and shapes; spire and stirrup broken but four footed nature is seen; central hole large and circular; diameter of the sclerite 0.22 mm. and 0.12 mm. if measured at right angles along the arms.

Type Material—The illustrated specimen is Holotype No. I.P.E./H04/04/162.

Type Locality—Jumara Dome, Kutch, India.

Distribution—Jhurio Formation (Bathonian-Callovian).

Comparison—This species differs from *Sastriella wynnei* sp. nov. in having large central hole and thorn like arm making right angle with the other two arms. *Sastriella imperfecta* sp. nov. differs in having imperfectly developed perforations of the arms and triangular out line of the disc.

Sastriella imperfecta sp. nov. (Pl. 1, Figs. 7-8)

Description—Sclerites in the form of tables; disc triradiate imperfectly perforate arms; arms placed in one plane, unequal in length, bluntly pointed distally, rectangular to subrectangular in cross section, overall outline of the disc almost triangular, arms imperfectly perforated; spire broken, stirrup partly broken, four footed; central perforation small, circular; maximum diameter 0.16 mm. minimum 0.14 mm.

Type Material—The illustrated specimen is Holotype No. I.P.E./H04/04/163.

Type Locality—Jumara Dome, Kutch, India.

Distribution—Jhurio Formation (Bathonian-Callovian).

Comparison—*Sastriella imperfecta* sp. nov. differs from *S. thornicus* sp. nov. and *S. wyneii* sp. nov. in having imperfectly developed perforations and triangular outline of the disc.

Sastriella wyneii sp. nov. (Pl. 1, Figs. 16-17)

Description—Sclerites in the form of tables; disc triradiate perforate arms; arms placed in one plane, unequal, two arms nearer to each other than the third (broken), bluntly pointed distally, rectangular to subrectangular in cross-section, perforations of the arms elliptical; spire low; stirrup four footed; central perforation large and circular; maximum diameter of the disc 0.20 mm.

Type Material—The illustrated specimen is Holotype No. I.P.E./H04/04/164.

Type Locality—Jumara Dome, Kutch, India.

Distribution—Jhurio Formation (Bathonian-Callovian).

Comparison—*Sastriella wyneii* sp. nov. differs from *Sastriella imperfecta* sp. nov. by the fact that the latter has imperfectly developed perforations and triangular outline of the disc. *Sastriella thornicus* sp. nov. differs in having one thorn like arm which makes an angle of 90° with the other two arms.

Genus—***Priscolongatus*** Hanna, 1969.

Type species—*Priscolongatus quadriperforatus* Hanna, 1969.

Remarks—The diagnostic characters given by the author of the genus are given as “an elongated, concavo-convex sclerite with two or four arms. A conical elevation, mostly surrounded by four perforations, occurs in the central part.” The present author feels that arms may be in one plane or forming a concavo-convex disc but always with four central perforations, spire or stirrup may be reduced very much in some cases.

Stratigraphic Range—Oligocene

Comparison—Genus *Priscolongatus* Hanna (1969) can be distinguished from *Priscopodatus* in having radiating arms of the disc. It can also be distinguished from *Fletcherina* in possessing four central perforations whereas *Sastriella* is differentiated in not having solid arms of the disc.

Genus—***Priscopodatus*** Schlumberger, 1890 emend. Frizzell & Exline, 1955.

Type species—*Priscopodatus pyramidalis* Schlumberger, 1890.

Remarks—The present author is of the opinion that sclerites in the form of tables with circular, subcircular, subhexagonal, hexagonal, irregular perforated disc, spire and or stirrup but always four central perforations only should be included in this genus.

Stratigraphic Range—Jurassic to Pleistocene.

Comparison—This genus can be differentiated from *Feddenella* in having four central perforations.

Genus—**Hannaina** gen. nov.

Type species—*Hannaina polandica* Soodan (= *Priscolongatus* sp. 1 Hanna, 1969; p. 374, pl. 76, fig. 4).

Diagnosis—Sclerites in the form of tables; disc consisting of radiating arms; arms solid in one plane or making concavo-convex disc; spire and or stirrup present; disc always with five central perforations.

Stratigraphic Range—Lower Rupelian (so far no other record).

Comparison—This genus can be differentiated from *Fletcherina* and *Priscolongatus* in having five central perforations.

Derivation of the name—This genus is named in honour of Dr. Gorka Hanna in recognition of his contribution to the knowledge of fossil sclerites.

Genus—**Clarkina** gen. nov.

Type species—*Priscopedatus plenus* Deflandre-Rigaud (1962; p. 73; figs. 103, 105; pl. 5, fig. 7 and reproduced here in Text-figs. 10-11).

Diagnosis—Sclerites in the form of tables; disc circular, subcircular, irregular perforated generally with four large perforations and other smaller perforations varying in numbers, arrangements regular or irregular; spire and or stirrup present; centre always imperforate.

Stratigraphic Range—Triassic-Eocene.

Comparison—*Clarkina* gen. nov. can be differentiated from *Dictyothurites* Deflandre-Rigaud, in the latter having trilobus disc. *Staurocumites* Deflandre-Rigaud, 1962 can be distinguished in having perforations covering the entire arms.

Derivation of the name—This genus is named in the honour of late Dr. A. H. Clark for his contributions to the knowledge of fossil holothurian in the initial stages.

ACKNOWLEDGMENTS

The author is grateful to Sri V. V. Sastri, Additional Director, Institute of Petroleum Exploration, Oil and Natural Gas Commission, Dehra Dun, Sri L. L. Bhandari, Joint Director (Geol.) and Dr. A. K. Datta, Senior Scientific Officer for encouragements and providing facilities. The author is sincerely thankful to Dr. B. N. Fletcher, Institute of Geological Sciences, Leeds, England; Dr. R. Grill, Chief Geologist, Geological Survey, Austria; Dr. Hanna Gorka, Lidia Luszczewska, Warsa University, Poland; Dr. M. Deflandre-Rigaud, Laboratoire de Micropaleontologie, Paris, France who provided valuable literature without which this work could not have been completed. The guidance and encouragements received from Drs. M. Rioult, B. N. Fletcher and Deflandre were of great help to the author who was new to this group of fossils. The suggestions of Dr. M. Rioult, although could not be followed in the present work, are of great value. The author is thankful to his colleague Mr. M. L. Bhatia who helped in this work. Mrs. I. Kohli provided translations in English of some French publications for which the author is thankful.

REFERENCES

- BISWAS, S. K. (1971). Note on the Geology of Kutch. *Q. Jl. geol. Min. metall. Soc. India.* **43** (4): 223-235.
- DEFLANDRE-RIGAUD, M. (1946). Sur les divers types de sclerites d'holothurides Oxfordiens des marnes de Viller-sur-Mer. *Acad. Sci., Compte rendu.* **223**: 513-515.
- DEFLANDRE-RIGAUD, M. (1952). Contribution a la systematique des sclerites d'Holothurides fossiles. *Bull. Inst. Oceanogr.* **1012**: 1-12.
- DEFLANDRE-RIGAUD, M. (1959). Sur quelques sclerites d'Holothurides de l'Oligocene d'Innien, Holstein. *Rev. Micropal.* **1**: 190-200.
- DEFLANDRE-RIGAUD, M. (1962). Contribution a la Connaissance des sclerites d'Holothurides fossiles. *Mem. Mus. Natl. Nat. Hist. Now. Ser.* **11**(1): 65-78.
- FRIZZELL, D. L. & EXLINE, H. (1955). Monograph of Fossil Holothurian Sclerites. *Bull. School Min. Met. Tech. Ser.* 89, Rolla, Missouri: 1-199.
- FRIZZELL, D. L. & EXLINE, H. (1966). Holothuroidea—Fossil Records, In: *Treatise on Invertebrate Paleontology.* Univ. Kansas Press; U646-U672.
- HANNA-GORKA, & LIDIA LUSZCZEWSKA (1969). Holothurian sclerites from the Polish Jurassic and Tertiary. *Roczn. pol. Tow. geol. Annales de la Soc. Geologique de Pologne.* **39** (1-3): 361-402.
- MOSTLER, V. H. (1967). Conodonten und Holothurien sklerite aus den norischen Hallatatter-Kalken von Herstein (Niederosterreich). *Verh. geol. B. A.* **1-2**: 177-188.
- MOSTLER, V. H. (1968). Holothurien-Sklerite und Conodonten aus dem Schreyeralmkalk (Anisium) der Nordlichen Kalkalpen (Coberosterreich). *Verh. geol. B. A.* **1-2**: 54-64.
- SAID, R. & BARAKAT, M. G. (1958). Jurassic Microfossils from Gebel Maghara, Sinai, Egypt. *Micropaleontology.* **4**(3): 231-272.
- ZANKL, H. (1966). Holothurian-Sklerite aus dem Dachsteinkole (Ober Trias) der Nordlichen Kalkalpen, *Palaont. Zh.* **40**: 70-88.

EXPLANATION OF PLATE 1

All the types have been deposited in Palaeontology Laboratory, I.P.E., O.N.G. Commission, Dehra Dun, India.

- 1, 2. *Fletcherina bifurcata* sp. nov. 1. Dorsal view. $\times 120$, 2. Ventral view. $\times 118$
- 3, 4. *Fletcherina giganta* gen. et sp. nov. 3. Dorsal view. $\times 113$, 4. Ventral view. $\times 84$
- 5, 6. *Fletcherina acuta* sp. nov. 5. Dorsal view. $\times 127$. 6. Ventral view. $\times 116$
- 7, 8. *Sastriella imperfecta* sp. nov. 7. Dorsal view. $\times 124$, 8. Ventral view. $\times 124$.
- 9-11. *Feddenella jumaraensis* gen. et sp. nov. 9. side view showing spire. $\times 140$, 10. Dorsal view. $\times 167$
11. Ventral view. $\times 167$.
- 12, 13. *Sastriella jumaraensis* gen. et sp. nov. 12. Dorsal view. $\times 114$, 13. Ventral view. $\times 114$.
- 14, 15. *Sastriella thornicus* sp. nov. 14. Dorsal view. $\times 117$, 15. Ventral view. $\times 117$
- 16, 17. *Sastriella wynnei* sp. nov. 16. Dorsal view. $\times 110$, 17. Ventral view. $\times 110$

