A CONTRIBUTION TO THE STUDY OF THE EOCENE IN WESTERN PAKISTAN AND WESTERN INDIA

C. THE DESCRIPTION OF THE SCAPHOPODA AND GASTROPODA FROM STANDARD SECTIONS IN THE RAKHI NALA AND ZINDA PIR AREAS OF THE WESTERN PUNJAB AND IN THE KOHAT DISTRICT

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The Scaphopoda here described comprise three new species.

The Gastropoda here recorded or described comprise 138 forms, 117 of which have received specific names. Of the 23 previously named species, two had not been recorded from Pakistan or India before. Largely owing to the nature of some of the beds from which collections were made, 96 of the species described are new. Four new genera and five new subgenera are proposed, and also one new generic name to replace a pre-employed name.

The fauna recorded, together with the Lamellibranchia previously described, forms part of the material constituting the basis for the consideration of the classification and correlation of the Eocene of western Pakistan and western India, which the writer has published elsewhere.

Introduction

In this paper are described the Scaphopoda and Gastropoda collected from standard sections in the Eocene of the Rakhi Nala and Zinda Pir areas of the western Punjab and of the Kohat District. The writer has described the geology of the standard sections (B 1951*b*), in which paper will be found full details of the geological successions and of the stratigraphical horizons of the fossil beds. This paper forms a continuation of the writer's work in which the Lamellibranchia are described (Eames 1951).

The classification here adopted is a compromise of those of Dr A. M. Davies (B 1935), Thiele (B 1929–31, B 1934) and Wenz (1939). All specimens for which registered numbers are given have been deposited in the Geological Department of the British Museum (Natural History).

Text. Under the subheadings 'Material', the numbers in italics following the commas after the fossil-bed numbers refer to the number of individuals collected. References, the dates of which are preceded by the letter B, are listed only in the Bibliography of my earlier paper on the Lamellibranchia.

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Class SCAPHOPODA

Family Dentaliidae

Genus *DENTALIUM* Linné, 1758

(*Syst. nat.* 10th ed. p. 785)

Type species. *Dentalium elephantinum* Linné, Recent; Montfort, 1810.

DENTALIUM SORIENSE n.sp.

(Figures 1*a*, *b*, plate 1)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2680, *2*); Ghazij Shales (local subzone 3*b*) (FB. F. 2678, the holotype, Reg. No. G. 68000, and 13 topotypes, Reg. No. G. 68001–6; FB. F. 2676, *6*).

DESCRIPTION. Shell moderately small, gently arcuate, gradually increasing in diameter, subcircular in cross-section when not crushed, ornamented with seven sharp longitudinal carinae, the intervals between which are smooth and moderately concave. Shell fairly thick.

DIMENSIONS. Holotype (broken): length 3·0 mm.; diameter of narrow end 0·75 mm.; wider end, which is somewhat crushed, measuring 1·1 by 0·84 mm. Largest fragment 4·9 mm. long.

REMARKS. *Dentalium abbreviatum* Deshayes (B 1861, p. 199, Pl. 3, figs. 5–7), from the Lower Sands and Calcaire Grossier of France and Belgium, also has seven sharp longitudinal carinae, but the apex is said to be smooth, the ribs are sometimes twisted, and the apertural end is distinctly more thick-shelled and more broadly conic. Even the smallest specimens of *D. soriense* have sharp carinae. *D. bironense* Douvillé & O'Gorman (1929, p. 374, Pl. 32, fig. 1), from the Sparnacian of France, also has seven principal longitudinal threads, but these tend to become less sharp with age, and as many as five or six intercalary threads appear. *D. marthae* Cossmann & Pissarro (1902, p. 179, Pl. 31, fig. 45), from the Eocene of the Cotentin, is very similar but has nine longitudinal carinae.

Subgenus *LAEVIDENTALIUM* Cossmann, 1888

(*Ann. Soc. malac. Belg.* **23**, Mém. p. 7)

TYPE SPECIES. *Dentalium incertum* Deshayes, Eocene; original designation.

DENTALIUM (*LAEVIDENTALIUM*) *RAKHIENSE* n.sp.

(Figures 2*a*, *b*, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68007, and a large number of topotypes, Reg. No. G. 68008–13; FB. F. 1995, *10*+; FB. F. 1987, *10*+; FB. F. 1996, *4*); Upper Chocolate Clays (upper part, local zone 14) (FB. F. 2756, *2*; FB. F. 2758, *1*; FB. F. 1991, *10*+).

DESCRIPTION. Shell rather small, tubular, gently arcuate, degree of curvature less near the larger end. Where the shell is preserved, it is seen to be quite smooth and not very thick. Narrow end circular in cross-section, the outline slightly but distinctly constricted a little way from it. Larger end in many specimens apparently oval in cross-section; this is probably due to crushing, as other mature specimens show a circular cross-section.

DIMENSIONS. Holotype: length 5·8 mm.; diameter of narrow end 0·3 mm.; dimensions of larger end 1·05 by 0·9 mm.

REMARKS. *Dentalium* (*Laevidentalium*) *hannonicum* Briart & Cornet as figured by Cossmann (1915, p. 7, Pl. 1, figs. 10, 11), from the Montian of Belgium, is rather more rapidly expanding and of larger size. *D.* (*L.*) *acicula* Deshayes as figured by Cossmann & Pissarro (B 1907–13, Pl. 1, figs. 1–4), from the Lutetian of the Paris Basin, is more strongly curved.

D. (*L.*) *incertum* Deshayes as figured by Cossmann (1902, p. 107, Pl. 10, figs. 21, 22), from the Eocene of France, is more slender and rather more strongly curved; the same species as figured by Cossmann & Pissarro (B 1907–13, Pl. 1, figs. 1–3), from the Lutetian of the Paris Basin and from the Cuisian, is larger and tapers less rapidly. The constriction near the narrow end of the Rakhi Nala moulds seems to be characteristic.

DENTALIUM (*LAEVIDENTALIUM*) *PSEUDORAKHIENSE* n.sp.

(Figures 3*a*, *b*, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68014, and 2 topotypes, Reg. No. G. 68015–16).

DESCRIPTION. The moulds are of tubular shells of moderately small size, tapering, very slightly curved, circular in section at both the narrow and large ends. No trace of any ornament or constriction.

DIMENSIONS. Holotype: length 6·0 mm.; diameter of narrow end 0·37 mm.; diameter of large end 0·75 mm.

REMARKS. This species is less rapidly tapering, less strongly curved, and the moulds lack the constriction near the narrow end, as compared with *Dentalium* (*Laevidentalium*) *rakhiense*. *D.* (*L.*) *acicula* Deshayes as figured by Cossmann & Pissarro (B 1907–13, Pl. 1, figs. 1–4), from the Lutetian of the Paris Basin, is more strongly curved, larger, and more rapidly tapering; although Checchia-Rispoli's illustrations of Deshayes's species from the Eocene of Sicily are of a somewhat larger and more strongly curved form, they are distinctly less stout than Cossmann & Pissarro's illustrations of Deshayes's species. *D.* (*Lobantale*) *duplex* Defrance as figured by Cossmann & Pissarro (B 1907–13, Pl. 1, figs. 1–6), from the Lutetian of the Paris Basin, is larger, compressed, and has internal ribs. *D. sulculosum* von Koenen (B 1892, p. 270, Pl. 15, fig. 12), from the Lower Tertiary (Borloche Schichten) near Berlin, is larger and more strongly curved. *D. parallelum* Boettger as figured by Zinndorf (B 1928, p. 38, Pl. 1, fig. 8), from the Oligocene of Germany, is evidently very similar and of about the same size, but is a little more curved (especially at the narrow end), although tapering in a similar manner. *D.* (*Laevidentalium*) *incertum* Deshayes as figured by Cossmann (1902, p. 107, Pl. 10, figs. 21, 22), from the Eocene of France, and by Cossmann & Pissarro (B 1907–13, Pl. 1, figs. 1–3), from the Lutetian, is more strongly curved and more rapidly tapering.

Class GASTROPODA

Subclass PROSOBRANCHIA

Order ARCHAEOGASTROPODA

Superfamily TROCHACEA

Family TROCHIDAE

Genus *TROCHUS* Linné, 1758

(*Syst. nat.* 10th ed. p. 756)

TYPE SPECIES. *Trochus maculatus* Linné, Recent; Iredale, 1912.

SYNONYM. *Pyramidea* Swainson, 1840 (*Treat. Malacol.* pp. 224, 350); type species: *Trochus niloticus* Linné, Recent; Gray, 1847 (as a synonym of *Trochus*).

REMARKS. Montfort (1810) designated *Trochus niloticus* Linné as the type species of *Trochus*, but this species is not in the original list. Children (1822) gave *T. imperialis* Lamarck = *T. imperialis* Gmelin as the type species, but this also is not in the original list. Gray (1847) also gave *T. niloticus* as the type species. Anton (1839) designated type species for thirteen groups of *Trochus*, so that none of them can be regarded as valid.

'*TROCHUS*' sp. A

(Figure 4, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68017, and 7 topotypes, Reg. No. G. 68018–24).

DESCRIPTION. Shell small, trochoid, with a conical spire forming at least four-elevenths of the height. Protoconch not seen distinctly on any of the specimens, possibly consisting of two smooth, convex whorls. There were two or perhaps three spire whorls which, owing to a certain amount of decortication, are moderately convex in outline and are separated by deep, rather channelled sutures. Indications of three distinct, fine, widely spaced spiral threads, but no indication of axial ornament. Body whorl fairly ample, its base being imperforate, gently convex in its upper part, slightly excavated medially, and flattened in its lower portion; its greatest width corresponds with the middle spiral thread, and it is there subcarinate. Aperture oval-subquadrate. No columellar folds. Columellar lip thin.

DIMENSIONS. Holotype: height (slightly incomplete) 3·1 mm.; width 2·25 mm.; height of spire (a little incomplete) 1·1 mm.

REMARKS. *Trochus gottardi* Vinassa de Regny (B 1898, p. 154, Pl. 19, figs. 5*a*, *b*), from the Eocene of northern Italy, is somewhat similar, but has a relatively higher spire. There is a superficial resemblance to *Danilia neozelanica* Laws (1935, p. 30, Pl. 5, fig. 2), from the Tertiary of New Zealand, but the Pakistan form does not have the columellar fold nor, apparently, the flaring aperture of a *Danilia*.

Genus *CALLIOSTOMA* Swainson, 1840

(*Treat. Malac.* pp. 218, 351)

TYPE SPECIES. '*Calliostoma conula* Mart.' Swainson, Recent = *Trochus conulus* Linné; Herrmannsen, 1846.

SYNONYMS. *Conulus* Nardo, 1841 (*Atti* 2 *Riun. Sci. Ital.* p. 244) *non* Rafinesque, 1815 (Moll.) *nec* Fitzinger, 1833 (Moll.); type species: *Conulus typus* Nardo, Recent = *Trochus conulus auct.*; absolute tautonymy.

Ziziphinus Gray (1840, *nomen nudum*, *Syn. Cont. Br. Mus.* 42nd ed. p. 147), in Dieffenbach, 1843 (*Trav. N. Zealand*, **2**, 237); type species: *Z. annulatus* (Martyn), Recent; here designated.

Callistoma Agassiz, 1846 (*Nomen. Zool. Index Univ.*) (*em.*).

Zizyphinus Souverbie, 1875 (*J. Conchyl.* **23**, 40) (*err.*).

Jacinthinus Monterosato, 1889 (*Bull. Soc. malac. Ital.* **14**, 79); type species: *Ziziphinus hyacinthinus* (Renier), Recent; virtual tautonymy.

REMARKS. No type species appears to have been designated for *Ziziphinus* Gray, in Dieffenbach, 1843. Of the six Recent species in the original list, *Z. cunninghami* Gray is conspecific with *Z. selectus* (Chemnitz) which is the type species of *Calotropis* Thiele, 1929, by monotypy; *Ziziphinus tigris* (Martyn) is the type species of *Maurea* Oliver, 1926, by original designation; and *Ziziphinus punctulatus* (Martyn) is a *Mauriella* (Oliver, 1926). The designation of *Ziziphinus annulatus* as type species retains *Ziziphinus* as a synonym of *Calliostoma*, where it has usually been placed.

CALLIOSTOMA sp. A

(Figures 5*a*, *b*, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 4) (FB. F. 1843, the holotype, Reg. No. G. 68025, and 1 topotype, Reg. No. G. 68026); *Zinda Pir section*: Ghazij Shales (local subzone 3*b*) (FB. F. 2675, *1*).

DESCRIPTION. Shell of moderate size, appearing slightly wider than high. Spire apically narrowly conic, later more broadly conic, the extraconic appearance, however, probably being rather accentuated by crushing. Protoconch not seen. About three and a half spire whorls preserved on the holotype; there were probably little more than four in the complete shell. Spire forming about one-third of the height of the shell. Sutures linear. Whorls flat-sided, ornamented with three strong, crenulated spiral threads. Body whorl large, bicarinate at the edge by two of the strong spiral threads; base abruptly flattened and excavated medially, ornamented with at least three rather widely spaced, crenulated spiral threads, apparently imperforate. Aperture crushed, apparently obliquely subquadrate.

REMARKS. Although no closely comparable form has been described from the Tertiaries of Pakistan, India, or Burma, this form is not named specifically on account of its being insufficiently well preserved.

Family ANGARIIDAE

Genus *ANGARIA* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 71)

TYPE SPECIES. *Angaria delphinus* Bolten, Recent = *Turbo delphinus* Linné; Iredale, 1915.

SYNONYMS. *Cochlus* (Humphrey, 1797) (not binomial).

Delphinula Lamarck, 1804 (*Ann. Mus. Hist. nat. Paris*, **4**, no. 20, 108); type species: *D. laciniata* Lamarck, Recent = *Turbo delphinus* Linné; Anton, 1839.

Delphinulus Montfort, 1810 (*Conch. Syst.* **2**, 130); type species: *D. spinosus* Montfort, Recent = *Turbo delphinus* Linné; original designation and monotypy.

Praxidice Rafinesque, 1815 (*Analyse*, p. 144) (*em. pro Delphinula*).

Scalator Gistl, 1847 (*Handb. Naturgesch.* 1850, p. 556) (*em. pro Delphinula*).

Angarus Gray, 1857 (*Guide Syst. Distrib. Moll. Brit. Mus.* **1**, 156 (=*Angaria*).

ANGARIA PAKISTANICA n.sp.

(Figures 6*a*, *b*, *c*, plate 1)

MATERIAL. *Kohat area* (*Gada Khel*): Middle Shekhan Limestone (local zone 3) (FB. F. 2104, the holotype, Reg. No. G. 68027).

DESCRIPTION. Shell of moderate size, subturbinate, with a very low spire which forms only about one-fourteenth of the height. Spiral angle very obtuse. Protoconch not observed. One or two spire whorls above the body whorl. Sutures distinct. Ornament ill-preserved. Body whorl very large and ample, with a wide, almost flat, gently sloping surface between the shoulder and the suture, suddenly becoming subvertical and gently convex on the flank, the shoulder itself carrying spines. The gently convex flank rapidly passes into the basal region which is gently convex, with an excavated median umbilicus. On the body whorl the ornament consists of a posterior row of flat, rectangular nodes by the suture, with a crenulated spiral thread between it and the row of spines on the shoulder, and of crenulated spiral threads on the flanks and base. Posterior nodes having their longer axis radial; they are flattened and appear to be double on account of a median axial groove, and are separated by intervals somewhat narrower than themselves; there are seven in the last half whorl. The crenulated spiral thread between them and the shoulder is perhaps slightly more distant from the shoulder, and there appear to be six crenulations opposite two adjoining nodes above them. Six spines on the shoulder of the last half whorl; they are straight, curved slightly upwards, but neither forward nor backward, and are less spinose and less widely spaced farther back from the aperture. Five strongly crenulated, equidistant spiral threads anterior to the spinose shoulder, the intervals between them being about half as wide again as the threads themselves. Fifth spiral thread perhaps slightly stronger than the others, forming the external margin of the moderately wide umbilicus within which traces of three more spiral threads can be seen. Growth lines not observed. Aperture subcircular, oblique, the outer lip appearing to be straight and distinctly antecurrent.

DIMENSIONS. Holotype: height 8·0 mm.; width 14·1 mm.

REMARKS. This species shows considerable resemblance to *Delphinula calcar* Lamarck as figured by Dainelli (B 1915, p. 512, Pl. 50, figs. 9, 10), from the Eocene of Italy, by Cossmann & Pissarro (1902, p. 164, Pl. 29, figs. 29, 30), from the Eocene of the Cotentin, by Vasseur (B 1917, Pl. 9, figs. 1–3), from the Eocene of Bois-Gouët, by Cossmann (1902, p. 89, Pl. 8 (13), figs. 21, 22), from the Eocene of Bois-Gouët, by Deshayes (1832*c*, p. 203, Pl. 23, figs. 11, 12), from the Eocene of the Paris Basin, and by Cossmann & Pissarro (B 1907–13, Pl. 3, fig. 17–2), from the Lutetian. The row of strong nodes posteriorly by the suture is not present in *Angaria calcar*, and the spiral threads on the base of Lamarck's species are finer and more numerous, the thread limiting the umbilicus being less prominent. The spire of *A. calcar* is also distinctly flatter. Although Dainelli's illustration shows a form with slightly fewer spines on the body whorl, the form illustrated by Cossmann & Pissarro from Chaussy has more numerous spines, but it is larger and has a somewhat disjunct body whorl. The ornament on the base is more regular than is shown in Cossmann & Pissarro's illustration of their form from Fresville. The spines do not appear to have been claw-shaped or to have pointed back away from the aperture as illustrated by Deshayes. In spite of the variation shown by *A. calcar*, the Pakistan form appears to be distinct. *Delphinula capelliniana* Vinassa de Regny (B 1897, p. 164, Pl. 21 (4), figs. 9*a*, *b*, *c*), from the Eocene of Italy, is larger, its body whorl is more transverse posteriorly, the spines are not so long, and the spiral threads on the base are less distinctly granular. *Angaria cordieri* (d'Archiac & Haime) (B 1854, p. 287, Pl. 26, figs. 11, 12), from the Upper Ranikot

of Western Pakistan, has a much higher spire, more regular and more numerous spiral threads, a sharply carinate shoulder, and lacks spines.

Family CYCLOSTREMATIDAE

Genus *CIRCULUS* Jeffreys, 1865

(*Brit. Conch.* **3**, 315)

TYPE SPECIES. *Delphinula duminyi* Requien, Recent ? = *Valvata striata* Philippi = '*Solarium*' *philippi* Cantraine; monotypy.

SYNONYM. '*Adeorbis* Wood', Cossmann 1918, *et auct.*; type species: *Valvata striata* Philippi, Recent.

CIRCULUS RAKHIENSIS n.sp.

(Figures 7*a*, *b*, *c*, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68028, and 6 topotypes, Reg. No. G. 68029–32).

DESCRIPTION. Shell small, depressed, with a low, slightly extraconic spire forming slightly less than one-quarter of the height. Protoconch not seen. Whorls gently to moderately convex, ornamented with fine spiral threads which are of about the same width as their intervals; there appear to be about 17 threads between the suture and the edge of the umbilicus on the body whorl. Sutures linear, distinct. There appear to be two to three spire whorls. Near the aperture the flank of the body whorl is sharply and regularly rounded, but in its earlier part, as well as on earlier whorls, it tends to be subcarinate. Base of body whorl convex like its upper surface, with a wide and deep umbilicus occupying two-fifths of the maximum diameter. Aperture subcircular, oblique. Growth lines gently convex, antecurrent, perpendicular at the posterior suture. Although most of the specimens are partially decorticated, it can be seen that they were fairly thin-shelled.

DIMENSIONS. Holotype: height 1·0 mm.; width 1·75 mm.

REMARKS. *Adeorbis tenuiliratus* Cossmann (1915, p. 60, Pl. 4, figs. 17–19), from the Montian of Belgium, has rather widely canaliculate sutures, and the spiral threads appear to be still more numerous. *A. similis* Deshayes as figured by Cossmann (1902, p. 19, Pl. 2, figs. 26–28), from the Eocene of Bois-Gouët, is more transverse; Cossmann & Pissarro's illustrations (B 1907–13, Pl. 8, figs. 59–12) of the same species from the Lutetian of the Paris Basin and from the Cuisian are of a form which also has a still lower spire.

INCERTAE SEDIS

Genus *PAKISTANIA* n.gen.

TYPE SPECIES. *Pakistania antirotata* n.sp., Lower Eocene.

GENERIC CHARACTERS. Apparently marine, small, sinistral, flattened above, convex below, apparently smooth, base with narrow and deep umbilicus, periphery carinated, aperture kite-shaped, base most convex near umbilicus.

REMARKS. This genus is provisionally placed as a flattened, sinistral member of the Cyclostrematidae. There is no umbilical thickening as in most members of the Skeneidae.

PAKISTANIA ANTIROTATA n.sp.

(Figures 50*a* to *c*, 51*a* to *c*, plate 2)

MATERIAL. *Rakhi Nala section*: Rubbly Limestones (local zone 6) (FB. F. 2057, *1*); Shales with Alabaster (local zone 6) (FB. F. 2060, the holotype, Reg. No. G. 68035); *Zinda Pir section*: Ghazij Shales (local subzone 3*c*) (MF. 439, *5*, Reg. No. G. 68037–41; MF. 436, *1*).

DESCRIPTION. Sinistral, discoidal, apparently smooth, dorsal surface flat, periphery with a rounded keel, base flattened, but shelving downwards towards a small, deep, median umbilicus the margin of which is formed by a tumid surface. Protoconch not seen. About one and a half rather rapidly increasing spire whorls, which have a gently convex dorsal surface in the earlier stages, but becoming flat on the body whorl. Sutures linear, not very deeply incised. Body whorl having a sharply rounded periphery, its base only slightly convex, almost flat, but forming a rounded swelling at the margin of the very small but deep umbilicus. Aperture subrhombic, the most acute angle being at the periphery. Growth lines not seen, the last whorl dorsally terminating in an apparently thin outer lip which is almost straight and moderately antecurrent.

DIMENSIONS. Holotype: height 0·3 mm.; width 0·88 mm.

REMARKS. The specimens are all moulds; the peculiar form seems to be characteristic.

Family LIOTIIDAE

Genus *LIOTIA* Gray, 1847

(*Proc. Zool. Soc. Lond.* **15**, 145)

TYPE SPECIES. *Delphinula cancellata* Gray, Recent; original designation and monotypy.

REMARKS. Gray's earlier references (1840, 1842) to *Liotia* are *nomina nuda.*

Subgenus *LIOTINA* Munier-Chalmas, in Fischer, 1885

(*Man. Conch.* p. 831)

TYPE SPECIES. *Delphinula gervillei* Defrance, Eocene; Cossmann, 1918.

LIOTIA (*LIOTINA*) ? sp. A

(Figures 8*a*, *b*, plate 1)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*b*) (FB. F. 2676, the holotype, Reg. No. G. 68042).

DESCRIPTION. Small, the whole anterior part of the last whorl broken away. Upper part of shell subturbinate in outline. Protoconch, rather depressed, consisting of about one and a quarter whorls which are gently convex and have rather excavate and broad sutures. About one and a quarter spire whorls preserved; they are rather high, with a subangular shoulder and gently convex flanks. Ornament consisting of four rather strong spiral threads of about the same width as their intervals; these are crossed by axial ribs which are 14 in number on the last whorl. Ribs slightly concave forward, slightly antecurrent, a little narrower than their intervals, forming distinct rounded crenulations

where they cross the spiral threads, not appearing to be varicose on that part of the shell which is preserved. Suture probably linear, the surface between it and the first spiral thread being oblique and slightly concave.

DIMENSIONS. Holotype: height (incomplete) 0·75 mm.; width 1·1 mm.

REMARKS. *Liotia* (*Liotina*) *fimbriata* (Deshayes) as figured by Cossmann & Pissarro (1902, p. 163, Pl. 30, figs. 7, 8), from the Eocene of the Cotentin, and by Cossmann & Pissarro (B 1907–13, Pl. 3, fig. 19–2), from the Bartonian of the Paris Basin, has sharper and less strongly beaded ribs, and the shell is distinctly larger than the fragment here described. *L.* (*L.*) *warni* (Defrance) as figured by Cossmann (1902, p. 87, Pl. 8 (13), figs. 15, 16), from the Eocene of the Cotentin, and by Cossmann & Pissarro (B 1907–13, Pl. 3, fig. 19–3), from the Lutetian of the Paris Basin and from the Bartonian, has a shorter and less noticeably stepped spire, the ribs are less strongly beaded, sharper, and with wider intervals, and the shell is larger than the incomplete Zinda Pir specimen. *L.* (*L.*) *heberti* Vasseur as figured by Cossmann (1902, p. 88, Pl. 8 (13), figs. 19, 20), from the Eocene of the Cotentin, shows similar differences. *L.*? (*L.*) *coultardi* (d'Archiac & Haime) (B 1854, p. 288, Pl. 26, figs. 22*a*, *b*, *c*), from the Upper Ranikot (zone 4) of Sind and from the Dhak Pass Beds of the Salt Range, does not show any shouldering of the whorls, the ribbing is much less distinct, and the two or three most posterior spiral threads are more strongly beaded.

Superfamily NERITACEA

Family NERITIDAE

Genus *VELATES* Montfort, 1810

(*Conch. Syst.* **2**, 355)

TYPE SPECIES. *Velates conoideus* (Lamarck), Eocene = *V. perversus* (Gmelin) = *Neritina schmiedeliana* (Chemnitz); original designation and monotypy.

VELATES PERVERSUS (Gmelin), 1791

REFERENCES. *Nerita schmideliana sinistrorsa, fossilis* Chemnitz, 1786 (p. 130, Pl. 114, figs. 975, 976) (not binomial).

Nerita perversa Gmelin, 1791 (p. 3686); Parkinson, 1811 (Pl. 6, figs. 4, 5); Blainville, 1825*a* (p. 477); Blainville, 1825*b* (p. 445, Pl. 36 bis, fig. 3); Bronn, B 1831 (p. 74); Bellardi, B 1852 (pp. 212, 291).

Nerita Schmidel, 1793 (p. 41, Pl. 23, figs. 1–3).

Nerita conoidea Lamarck, 1804*c* (p. 93); Deshayes, 1832*c* (p. 149, Pl. 18, figs. 1–8); Leymerie, B 1846 (p. 343); Stache, 1864 (p. 88); Reuss, 1868–9 (p. 137); E. Pavay, B 1871 (pp. 362, 424); von Hantken, B 1872 (pp. 74, 115); A. von Pavay, B 1874 (p. 412); Leymerie, 1878–81 (pp. 805, 526, 538, 623, Pl. Z′, fig. 3).

Velates conoideus (Lamarck) Montfort, 1810 (pp. 354–355).

Neritina perversa (Gmelin) Lamarck, 1822*a* (p. 183).

Nerida conoidea Lamarck, Brongniart, B 1823 (pp. 60, 18, Pl. 2, figs. 22*a*, *b*, *c*).

Neritina grandis J. de C. Sowerby, B 1839 (p. 328, Pl. 24, fig. 9); Carter, B 1854 (p. 252).

Neritina conoidea Deshayes, Leymerie, B 1846 (pp. 370, 347, 350, 351, 353, 354, 356); d'Archiac, B 1850*b* (**3**, 280, 304*j*, 33, 37, 38, 63, 114, 118, 119, 168, 197, 198, 205, 209, 223); von Hantken, B 1872 (p. 41); d'Archiac & Haime, B 1854 (pp. 80, 168, 169); Dainelli, 1901 (pp. 237, 241).

Velates schmidelianus (Chemnitz) Bronn, B 1848*b* (p. 1349); Oppenheim, B 1896*b* (pp. 102, 123, 125, 128, 130); Oppenheim, B 1896*a* (p. 168); Oppenheim, 1899 (pp. 107, 110, 113); Zittel, 1900 (p. 454, fig. 857); Oppenheim, B 1901*a* (pp. 182, 323); Oppenheim, B 1901*b* (pp. 153, 254, 189, 190); Oppenheim, B 1902 (p. 272); Dainelli, B 1904 (pp. 155, 161); Fabiani, B 1905 (p. 146); Dainelli, 1905 (p. 14); Fabiani, B 1908 (pp. 147, 52, 56, 58, 59); Taeger, B 1908 (pp. 74, 76, 85); Kranz, B 1910 (p. 229); Oppenheim, B 1915 (p. 89); Fabiani, B 1915 (pp. 12, 22, 25, 26, etc.); Dainelli, B 1915 (pp. 529, 79, 88, 100, 114, 118, 121, 124, 129, 135); Oppenheim, B 1923 (pp. 94, 7); Cossmann, 1925 (p. 229, Pl. 6, fig. 9; Pl. 7, figs. 22, 23); Gočev, B 1926 (p. 88); Gočev, B 1930 (p. 34); Gočev, B 1933*a* (pp. 39, 73, 10, 17, 63, 67); Kühn, 1934 (p. 172); Pieragnoli, B 1935 (p. 175); Socin, 1936 (p. 28); Raj Nath & Chiplonker, 1937 (p. 247); Socin, 1939 (pp. 101, 107, 112); Szots, B 1939 (p. 180); Chavan, 1947 (p. 43); Kühn, 1948 (p. 54).

Nerita grandis (J. de C. Sowerby), Bellardi, B 1852 (p. 212).

Nerita schmideliana Chemnitz, d'Archiac & Haime, B 1854 (pars) (pp. 278, 241, 279, 315, 349, 359, 368, Pl. 25, figs. 3, 5; Pl. 27, figs. 1*b*, *c non* Pl. 25, fig. 4 = *Velates noorpoorensis* (d'Archiac & Haime)); d'Archiac, B 1859*a* (pp. 308, 311, 314); von Hantken, B 1875 (pp. 367, 342, 346, 351, 363, Pl. 18, fig. 2); Marinoni, B 1877 (p. 14); Mallada, B 1878 (pp. 317, 320, 323, 325, 326, 406); Mallada, 1879 (Pl. 2, figs. 17, 18; Pl. 3, figs. 1, 2); Blanford, B 1880 (pp. 7, 14, 119, 127, 144, 150, 152, 154, 48); Wynne, B 1880 (p. 84); Maureta & Thos y Codina, B 1881 (pp. 322, 327); Mallada, B 1890 (p. 117); Mariani, B 1892 (p. 26); Koch, B 1894 (p. 215); Papp, 1897*a* (p. 432); Papp, 1897*b* (p. 479); Fabiani, B 1908 (p. 54); Dainelli, B 1915 (p. 500); Krishnan, B 1943 (p. 429).

Nertina schmideliana Chemnitz, d'Archiac & Haime, B 1854 (p. 360).

Nerita schmidelliana Chemnitz, Carter, B 1854 (p. 252); Maureta & Thos y Codina, B 1881 (pp. 323, 324, 326).

Neritina schmideliana (Chemnitz) d'Archiac, B 1859*a* (pp. 301, 304, 310, 313, 341, 296, 299); Taramelli, 1869 (p. 9); Fuchs, B 1870 (p. 142); Taramelli, B 1870 (p. 46); Fischer, 1871*b* (pp. 1393, 1394); Pirona, 1877 (p. 6); Marinoni, 1878 (p. 12); Taramelli, B 1881 (p. 102).

? *Nerita haliotis* d'Archiac & Haime var. d'Archiac, B 1859*a* (p. 313).

Diceras arietina Schafhäutl, B 1863 (p. 160, Pl. 37, fig. 1).

Nerita schmiedeliana Chemnitz, Deshayes, 1864 (p. 118); Tournouer, 1870 (p. 504); Zittel, B 1883 (p. 93); Cya, B 1883 (p. 56); Garde, B 1911 (p. 95).

Velates schmidelianus Bronn, von Schauroth, B 1865 (p. 225).

Nerita (*Velates*) *schmideliana* Chemnitz, Blanford, B 1869 (p. 3); Duncan, B 1880 (pp. 7, 9); Blanford, B 1880 (p. 40); Fedden, B 1880 (pars) (p. 205); Koch, B 1894 (pp. 223, 227, 229, 278, 286); Newton, 1905*b* (p. 84).

Velates schmideliana (Chemnitz), Suess, 1868 (pp. 271, 272); Penecke, 1885 (pp. 360, 393, 343); Noetling, 1894 (pp. 104, 105, 106, 107, 108, Pl. 2, figs. 1, 2, 7); de Gregorio, B 1894*b* (p. 31, Pl. 6, fig. 181); Noetling, B 1895 (pp. 2, 5); Noetling, 1895*b* (p. 63);

V. de Regny, B 1896*a* (pp. 218, 247, 212, 229); de Gregorio, B 1896 (p. 54, Pl. 6, figs. 1–3; Pl. 7, figs. 1–6); Marinelli, 1896 (p. 60); Noetling, B 1901 (p. 6); Vredenburg, 1901 (p. 261); Marinelli, 1902 (p. 206); Hayden, 1907 (pp. 53, 54, 67); Dalton, B 1908 (pp. 641, 644); Pilgrim, B 1908 (p. 20); Cotter, B 1912 (pp. 225, 226, 237, 238); Zittel, 1913 (p. 535, fig. 906); Holland & Tipper, 1913 (p. 24); Dainelli, B 1915 (p. 64); Lorenthey, 1917 (p. 9); de Cisneros, 1917 (p. 115); Stamp, 1922 (p. 490); Trechmann, B 1923 (p. 347, Pl. 15, figs. 1–3); Pilgrim, 1923 (p. 918); Holland, 1926 (pp. 43, 181); Chhibber, B 1934 (p. 226); Tomor-Thirring, B 1935 (pp. 5, 6); Pinard, 1936 (p. 100); Clegg, B 1938 (p. 254); Krishnan, B 1943 (p. 448).

Nerita schmiedeli Chemnitz, Tournouer (Bayan in), B 1872*a* (p. 519).

Nerita schmedeliana Chemnitz, Blanford, B 1876 (pp. 12, 13); Medlicott & Blanford, B 1879*b* (pp. 458, 459, Pl. 15, figs. 2, 2*a*).

Velates schmideli (Chemnitz), K. Mayer-Eymar, B 1877 (p. 85); Frauscher, B 1886 (p. 39); C. Mayer-Eymar, B 1887 (p. 107); Cossmann, 1888 (p. 88); Harris & Burrows, B 1891 (pp. 13, 53, 79); Doncieux, B 1903 (pp. 358, 337, 185, 187, 190, 196, 199, 205, 212, Pl. 5, figs. 9*a*, 9*b*); Doncieux, B 1905 (pp. 60, 10, 12, 19, 23, 25); Cossmann & Pissarro, B 1907–13 (Pl. 6, fig. 40–1); Fabiani, B 1908 (pp. 51, 55, 56); Doncieux, 1908 (p. 232); Cossmann & Pissarro, 1909 (p. 77); Holland, 1909 (p. 25); Stuart, 1912 (p. 253); Checchia-Rispoli, B 1912 (pp. 95, 78); Pilgrim & Cotter, 1916 (pp. 43, 44); Douvillé, B 1920*a* (pp. 113, 123, 168, 154); Nuttall, 1925 (pp. 426, 431); Bourcart & Keller, 1929 (p. 1560); Douvillé & O'Gorman, 1929 (pp. 374, 339, 346, 347, Pl. 31, figs. 12, 12*a*); Pérébaskine, B 1932 (pp. 108, 54, 55, 58, 59, 60, 61, 62, 117); L. & J. Morellet, 1935 (pp. 501, 507); Clegg, B 1938 (p. 142); Leriche, B 1939*b* (p. B. 248).

Nerita conoida Lamarck, Leymerie, 1878–81 (p. 540).

Nerita (*Velates*) *schmedeliana* Chemnitz, Medlicott & Blanford, B 1879*b* (p. 453).

Velates schmidelliana (Chemnitz), Carez, B 1881 (pp. 172, 173, etc.); Maureta & Thos y Codina, B 1881 (p. 323).

Velates schinidelliana (Chemnitz), Maureta & Thos y Codina, B 1881 (p. 316).

Velates schmiedelianus (Chemnitz), Zittel, B 1883 (pp. 98, 99, 105, 108, 112, 113, 116); Dainelli, B 1904 (pp. 145, 150); Oppenheim, B 1906*a* (p. 226); Boussac, B 1911*a* (pp. 269, 422); Pascoe, B 1912 (p. 13); Vogl, B 1912 (pp. 94, 109, 112); Schlosser, B 1925*a* (pp. 82, 175, 178); Schlosser, B 1925*b* (pp. 31, 47); Abrard, B 1925*a* (p. 98); Abrard, 1927 (pp. 564, 565, 566); Cuvillier, B 1930 (pp. 150, 52, 78, etc.); Meffert, B 1931*a* (p. 42); Isaeva, 1933 (pp. 11, 62, 57, Pl. 1, figs. 13, 14); Pieragnoli, B 1935 (p. 161); Loss, B 1940 (pp. 54, 6, 70).

Velates schmidelii (Chemnitz), Frauscher, 1884 (p. 60); Dainelli, B 1919 (p. 10).

Velates schmiedeliana (Chemnitz), Penecke, 1885 (p. 342); V. de Regny, B 1897 (pp. 168, 152); V. de Regny, B 1898 (pp. 170, 163); Fourtau, 1901 (p. 170); Garde, B 1911 (p. 93); Tomor-Thirring, B 1935 (p. 4); Trechmann (on L. M. Davies), B 1943 (p. 78).

Nerita (*Velates*) *schmideli* Chemnitz, Mallada, B 1892 (p. 204).

Provelates grandis (J. de C. Sowerby), Noetling, 1894 (pp. 104, 107, 108, Pl. 2, figs. 3–6).

Neritina schmiedeliana (Chemnitz), Oppenheim, B 1894 (p. 444).

Velates schmideliana (Chemnitz) var. *antemarginata* de Gregorio, B 1896 (Pl. 7, figs. 7, 8).

Velates balkanicus Bontscheff, 1897 (pp. 380, 322, 323, 324, 354, Pl. 6, figs. 1–6); Furon, B 1941 (p. 320).

Nerita cf. *equina* Bezancon, Marinelli, 1902 (p. 205).

Velates sp. Cossmann & Pissarro, 1909 (p. 77); Chhibber, B 1934 (p. 230).

Nerita (*Velates*) *schmiedeliana* Chemnitz, Garde, B 1911 (p. 94).

Velates schmiedeli (Chemnitz), Cotter, 1914 (pp. 164, 165); Douvillé, B 1916 (pp. 25, 2, 17, figs. 10, 11); Douvillé, 1919 (pp. 20, 21, 22); Douvillé, B 1920*b* (p. 156); Blanckenhorn, B 1921 (pp. 78, 82, 85, 87, 89); Guillaume, 1924 (p. 291); Abrard, B 1925*a* (pp. 59, 92, 327, 346, 347, 348, 366); Farchad, B 1936 (p. 57); Furon, B 1941 (pp. 314, 315, 316, 320, 328, 323, 329, 331, 340); Furon & Soyer, B 1947 (pp. 24, 60, 105, Pl. 6, fig. 40–1).

Velates? *schmiedeli* (Chemnitz) var. Cotter, 1915 (pp. 260, 269).

Velates tibeticus Douvillé, B 1916 (pp. 25, 30, 45, figs. 12, 13, Pl. 8, figs. 1*a*, *b*, 2*a*, *b*, 3*a*, *b*); Hayden, 1916 (p. 17).

Velates orientalis Vredenburg, 1922 (p. 364); Stamp, 1922 (pp. 490, 494, 495); Pilgrim, 1923 (p. 918); Cox, B 1931*a* (p. 37); Chhibber, B 1934 (p. 228); Clegg, B 1938 (pp. 205, 211).

Velates sp. cf. *schmideli* (Chemnitz), Cotter, B 1923 (p. 1).

Velates cf. *schmideliana* (Chemnitz), L. M. Davies, B 1925 (pp. 213, 216, 219).

Velates affinis (d'Archiac & Haime), Cotter, B 1926 (pars) (pp. 412, 413, 415).

Velates schmideliana? (Chemnitz), L. M. Davies, B 1926*b* (pp. 199, 203, 205).

Velates schmiedelii (Chemnitz), Cuvillier, 1927 (p. 522).

Velates perversus (Gmelin), Cox, B 1930*a* (p. 139); Cox, B 1931*a* (pp. 36, 28, 32, 33); Brown, B 1931 (p. 267); Cotter, B 1933 (p. 97); Cox, in L. M. Davies & Pinfold, B 1937 (pp. 5, 7, 8, 11, 71); Heron, B 1937 (p. 22); Cotter, B 1938 (pp. 64, 65, 68, 70); Evans & Sansom, 1941 (p. 330); Krishnan, B 1943 (pp. 435, 442, 448).

Velates noetlingi Cossmann & Pissarro, Cox, B 1931*a* (pars) (p. 37).

Velates schmiedeli Deshayes, Farchad, B 1936 (p. 75).

DOUBTFUL RECORDS. *Nerita schmideliana*? Chemnitz, T. Oldham, B 1875 (p. 179).

MATERIAL. *Kohat area* (*Panoba section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2293, *1*); Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2294, *2*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *4*; FB. F. 2290, *1*; FB. F. 2291, *3*); *Kohat area* (*Shekhan Nala section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2366, *1*; FB. F. 2377, *1*; FB. F. 2368, *1*); Middle Shekhan Limestone (local subzone 3*a*) (FB. F. 2370, *2*; FB. F. 2371, *1*).

FURTHER DISTRIBUTION IN INDIA AND PAKISTAN. Dhak Pass Beds of the Salt Range; Khairabad Limestone of the Salt Range; Patala Shales of the Salt Range; Upper Ranikot of Leilan, Tatta and the Kotri-Jherruck area; Meting Shales near △ 293 near Meting and in the Mukli Hills (Tatta-Jungshahi road); Ghazij Shales of Western Pakistan; Sakesar Limestone of the Salt Range; Lower Shekhan Limestone of Kohat and Bahadur Khel; Laki Limestone of Jhimpir and Kharguzani Hill (Laki Range); Kohat Shales of Kohat; Upper Middle Khirthar of Western Pakistan; Khirthar of Saindak, Wage-ke Pudda in Cutch (type locality for *Neritina grandis*), Maliri, the Laki Valley, Kharguzani Hill, the Baran River, Truk in Kohistan, the 'Alore Hills', the Mari Hills and Kund (3 miles south-west of Kotkai); Eocene of Karundi, and the Soh Mountains. Oldham's doubtful

record refers to an occurrence in the Prang Limestone (Middle Eocene) of the Khasi Hills in Assam.

FURTHER DISTRIBUTION. The species has a very wide geographical distribution, and ranges throughout the Eocene. The following is a very brief summary of its other occurrences: *Operculina* Limestone north-north-east of Tuna (Tibet), and the north bank of Kampa stream (Tibet); Gastropod Limestone north-east of Tuna (Tibet), and from Kampa (north-north-east of Kampa Dzong, Tibet); Lower Libyan of Egypt; Ypresian or Montian of Persia; Thanetian of France; Cuisian of France; Ypresian of Anatolia; Sparnacian of France; Lower Eocene of Somaliland, the Pyrenees and the Sudan; Khirthar of Persia; Lower Lutetian of France, Italy and Anatolia; Middle Lutetian of Italy; Mokattam of Egypt; Lutetian of Italy, the southern Alps, Persia, France, Hungary, north-east Bulgaria (type locality for *Velates balkanicus*), Jamaica, Iraq, Spain, the Bavarian Alps, Madagascar, Nigeria and Somaliland; Auversian or Lutetian of Armenia; Auversian of Italy (Ronca is the type locality for the variety *antemarginata*); Lower Bartonian of Switzerland and Hungary; Yaw Stage of numerous localities in Burma; Upper Eocene of the Bavarian Alps and Egypt; Priabonian of Italy, the French Alps and Spain; Eocene of Istria, Austria, Albania, Carinthia, Dalmatia, Croatia, the country between the Niger and Tchad, Sicily, the Sahara, the Arabian Desert and Russia.

REMARKS. Furon's (B 1941) record from the Meting Limestone of Meting cannot be substantiated. The records of the species from the 'Khirthar', Middle Eocene and Bassein Series of Burma all seem to apply to localities which are in the Yaw Stage, and the writer can find no undoubted record of the species from any horizon below the Yaw Stage (uppermost Eocene) in Burma. Vredenburg's type of *V. orientalis*, which is only an immature form of *V. perversus* and occurs together with it in large numbers showing complete intergradation, came from near Ngape, and is almost certainly from Kyetubok or some place close by on the Yaw Stage outcrop. Kranz (B 1910) placed the Vicentin Priabonian record as Oligocene, and Boussac (B 1911*a*) and Abrard (1927) placed the Trinita (Castelgomberto) Priabonian record as Oligocene. As in the case of *Cepatia cepacea*, the writer considers that some doubt attaches to this opinion. The specimens have not been illustrated and seem likely to be poorly preserved, and they may in reality belong to some other Oligocene species which should be placed in another genus in the Neritidae. While admitting the possibility that a few common Eocene species may have survived as a relict fauna in association with Oligocene forms in Oligocene times in a restricted area, it is difficult to comprehend why just a few species should do so when most of the Eocene fauna became extinct. On the other hand, if the identifications are correct, it would seem better to regard the beds as of Priabonian age and transitional between beds yielding a true Eocene fauna and those yielding a true Oligocene fauna. Such horizons and faunas are known to exist between the Oligocene and the Miocene in Burma. Such an interpretation is believed by the writer to be more likely, and is the view adopted in giving the distribution of the species above.

Order MESOGASTROPODA

Superfamily ARCHITAENIOGLOSSA

Family PILIDAE

Genus *PSEUDOCERATODES* Wenz, 1928

(*Senckenbergiana*, **10**, 121)

TYPE SPECIES. *Planorbis mammuth* Blanckenhorn, Oligocene/Upper Eocene; original designation.

PSEUDOCERATODES KOHATICUS n.sp.

(Figures 52*a*, *b*, *c*, plate 2)

MATERIAL. *Kohat area* (*Panoba section*): Lower Chharat (*Planorbis* Bed, local zone?) (FB. F. 2239, *7*, Reg. No. G. 86487–92); *Kohat area* (*Shekhan Nala section*): Lower Chharat (*Planorbis* Bed, local zone?) (FB. F. 2381, the holotype, Reg. No. G. 68043, and 8 topotypes, Reg. No. G. 68044–9; FB. F. 2382, *1*, Reg. No. G. 68486).

DESCRIPTION. Fairly large, sinistral, relatively thick and high, planorbiform. Shell not preserved on any of the specimens, and no remnant of ornament has been seen. Dorsally, about two-fifths of the width of the shell is occupied by the exposed portion of the spire. About four whorls previous to the body whorl. Dorsal and ventral surfaces of body whorl gently convex, appearing more steeply sloping (i.e. more nearly vertical) in young specimens. Median portion of body whorl distinctly more sharply rounded than the dorsal and ventral surfaces, presenting a subcarinate appearance. Umbilicus moderately wide and deep, occupying about half the width of the base on the holotype. Although some weathered and distorted specimens develop an angulation close to the suture, and the suture itself is more channelled, this appearance is not developed in the umbilical region, where the curvature of the wall, although more sharply convex at the margin of the umbilical region, does not become subcarinate. Aperture, on account of the sharp curvature of the median portion of the body whorl, broadly subtriangular.

DIMENSIONS. Holotype: height 12·7 mm.; width 32·3 mm.

REMARKS. This species is very close to *Planorbis mammuth* Blanckenhorn as figured by Oppenheim (B 1906*a*, p. 343, Pl. 27, figs. 5, 6), from the Oligocene or Upper Eocene of Egypt, but is not quite so large and the whorls in normally preserved specimens do not seem to be subcarinate near the posterior suture, the posterior slope of the whorls being less steep. Blanckenhorn's species is a *Pseudoceratodes*, and the illustration of it by Cox under this generic name (1933, p. 331, Pl. 4, figs. 4*a–c*), from the Oligocene or possibly Upper Eocene of Egypt, is of a thicker form with a wider umbilicus and exposed portion of spire; while having a rounded carination close to the posterior suture, it does not possess any indication of carination in the median portion of the whorl, the aperture being correspondingly narrower.

The discovery of this genus, until now only known from beds of possible Eocene age in Egypt, the Sudan and Algeria, in beds probably of Middle Eocene age in Western Pakistan,

is of very great interest. The species does not have the wide open basal umbilicus of a *Planorbis*, and there is no trace of any carination of the surface around the umbilicus; such carination, when present in members of the Planorbidae, appears to be farther removed from the central portion of the base than could have been the case in the Pakistan form even if it had existed but had been removed by weathering. Compared with *Indoplanorbis*, the axis of the aperture is not oblique, the aperture is more transversely rhombic or triangular, and the body whorl is medially subcarinate. The writer can find no reason why *kohaticus* should be regarded as a member of the Planorbidae rather than a *Pseudoceratodes*, and it is accordingly placed in the latter genus.

Pseudoceratodes is related to the genus *Lanistes*. The study of the soft parts of this genus have shown that it is to be regarded as an ultra-dextral (hyperstrophic) rather than a sinistral form. The soft parts of the genus *Pseudoceratodes* are not known as it has only been found fossil, but should the orientation of the shell be similar to that of *Lanistes*, then the description of *Pseudoceratodes kohaticus* given above would have to be amended to conform with the shell being hyperstrophic.

Superfamily VALVATACEA

Family VALVATIDAE

Genus *VALVATA* Müller, 1774

(*Verm.* **2**, 198)

TYPE SPECIES. *Valvata cristata* Müller, Recent; monotypy.

SYNONYMS. *Valvearius* Duméril, 1806 (*Zool. Anal.* p. 164) (name without species).

Gyrorbis Fitzinger, 1833 (*Beitr. Landesk. Oesterr. Enns* (*Ver. Vaterl. Gesch. Wien*), **3**, 117); type species: *Gyrorbis planorbis* Fitzinger, Recent=*Valvata cristata* Müller; Gray 1847 (as a synonym of *Valvata*—the date 1838 may be taken as a misprint for 1833).

Planella Schlüter, 1838 (*Kurzg. syst. Verz. Conch.* p. 13); type species: *Planella cristata* Müller, Recent; monotypy.

Volvata Berge, 1847 (*Conch. Buch.* pp. 17, 20, 26) (err.).

Planorbitina Betta, 1870 (*Mem. Accad. Verona*, **47**, 127) (*teste* Thiele, 1931).

Pachystoma Sandberger, 1875 (*Land- u. Süssw.-Conch. Vorwelt*, p. 711) *non* Guilding, 1828 (Moll.) *nec* Gray, 1840 (Moll.) *nec* Albers, 1850 (Moll.) *nec* Lioy, 1864 (Dipt.); type species: *Valvata* (*Pachystoma*) *marginata* Michaud, Pliocene; monotypy.

Stiphrostoma Oppenheim, 1892 (*Z. dtsch. geol. Ges.* **44**, 776) (=*Pachystoma* Sandberger).

Oncostoma Brusina, 1893 (*J. Conchyliol.* **41**, 185) (=*Pachystoma* Sandberger).

VALVATA? sp. A

(Figure 53, plate 2)

MATERIAL. *Rakhi Nala section*: Lower Chocolate Clays (local zone 9) (FB. F. 2071, the holotype, Reg. No. G. 68050).

DESCRIPTION. Very small, of depressed turbinate form. There is between a half and one spire whorl preserved, but it hardly shows at all in apertural view. Sutures linear, appearing channelled on the mould. Whorls almost subcircular in section, the body whorl

being more sharply convex on the flank than above or below. There is no trace of ornament preserved. Base of body whorl gently to moderately convex, with a deep median umbilicus occupying about a quarter of the diameter. Aperture subcircular, slightly drawn out obliquely anteriorly and to the right. Outline of the region of the outer lip, which may not be natural, practically straight, very slightly convex, distinctly antecurrent to the suture.

DIMENSIONS. Holotype: height 0·37 mm.; width 0·75 mm.

REMARKS. The single specimen available is a mould, and the attribution of it to the genus *Valvata* is tentative. *V.? planibasis* Cossmann (1899, p. 349, fig. 5), from the Eocene of Bois-Gouët, is more transverse and it has a wider umbilicus. Cossmann's later illustration of *V. planibasis* (1921*d*, p. 119, Pl. 4, figs. 40, 41) is a photographic reproduction differing essentially from his earlier sketch; it has a rapidly opening body whorl in basal view, seems a little *less* transverse than the Pakistan form, and the flank of the body whorl is flattened and posteriorly subcarinate. *V. inflexa* Deshayes as figured by Cossmann & Pissarro (B 1907–13, Pl. 13, fig. 84–2), from the Sparnacian of the Paris Basin, has a more widely open umbilicus and the spire appears flatter.

Superfamily RISSOACEA

Family RISSOIDAE

Genus *RISSOA* Fréminville, 1813

(*J. Mines*, no. 200; *N. Bull. Sci. Soc. philom. Paris*, **3**, no. 72, p. 341)

TYPE SPECIES. *Rissoa ventricosa* Fréminville, Recent; Fischer, 1885.

SYNONYMS. *Loxostoma* Bivona-Bernardi, 1838 (*Giorn. Sci. Lett. Sicilia*, **41**, 218) (*vide* Thiele 1929, p. 164).

Rissoia Bronn, 1848 (*Ind. Pal.* **2**, 1090) (*em.*).

Apanthausa Gistel, 1848 (*Nat. Thierr.* p. x) (*em.*).

Anatasia Gistel, 1848 (*Nat. Thierr.* p. 169) (*em.*).

REMARKS. Anton in 1839 designated *Rissoa tuberculata* as the type species, and Gray in 1847 designated *Helix labiosa* as the type species of *Rissoa*, but neither species is in the original list.

RISSOA PAKISTANICA n.sp.

(Figure 9, plate 1)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, *2*); Ghazij Shales (local subzone 3*b*) (FB. F. 2678, *6*; FB. F. 2676, the holotype, Reg. No. G. 68051, and 6 topotypes, Reg. No. G. 68052–7; FB. F. 2675, *2*).

DESCRIPTION. Shell small, oval-conic, aperture incomplete anteriorly in all available specimens. Protoconch not distinctly seen, evidently small, and of not more than two or three smooth, gently convex whorls. Four spire whorls, the height of which is about two-fifths of their width; they are flat-sided, with a tendency to being slightly convex in the early stages. Spire occupying approximately half the height of the shell, conic, some specimens showing a slight extra-conic appearance in the very early whorls and a slight conoidal appearance in later whorls. No spiral ornament. Axial ornament consisting of

moderately thick, distinct, straight, vertical ribs of about the same width as their intervals; 18 to 19 such ribs on the body whorl of the holotype. Sutures rather deeply incised, somewhat wavy at the posterior terminations of the ribs. Body whorl short, the flanks rather subcylindrical, flat or very slightly convex, the edge of the base sharply rounded or subcarinate, the base itself flattened. Ribs not extending over the periphery, the base being ornamented with about five rather fine spiral threads with intervals a little wider than themselves. Aperture not well preserved, apparently more or less oval, the columellar lip apparently rather callous. Base imperforate. Growth lines not distinctly seen, apparently following the same course as the ribs. No varices.

DIMENSIONS. Holotype: height 3·0 mm.; width 1·75 mm.

REMARKS. *Rissoa nana* (Lamarck) as figured by Deshayes (B 1861, p. 409, Pl. 24, figs. 10–12), from the Calcaire Grossier and Middle Sands of the Paris Basin, is less slender, shows no trace of being conoidal, does have the edge of the base subcarinate, and the base itself is smooth. The Pakistan species somewhat resembles the early whorls of *Mitra* (*Turricula*) *crebricosta* Lamarck and *M.* (*T.*) *zigni* de Gregorio as figured by de Gregorio (1880, p. 83, Pl. 6, figs. 16*a*, *b*, 17, Pl. 6, fig. 18, and Pl. 7, fig. 46), from the Eocene of Italy, but the spire seems less acute and the whorls are not stepped.

Family RISSOINIDAE

Genus *RISSOINA* d'Orbigny, 1840

(*Voy. dans l'Amér. mérid.* **5** (Moll.), p. 394 (52))

TYPE SPECIES. *R. inca* d'Orbigny, Recent; monotypy.

RISSOINA RAKHIENSIS n.sp.

(Figures 10, 11, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68058, and 10 topotypes, Reg. No. G. 68059–64; FB. F. 1995, *10*+).

DESCRIPTION. None of the specimens is complete, four spire whorls being the maximum number observed; protoconch not seen, and outer lip in most cases broken. Shell rather narrowly turriculate, regularly conic, with distinct linear sutures and gently convex whorls. The latter are about twice as wide as high, and are ornamented with axial ribs but show no trace of spiral ornament. Ribs thin, prominent, distinct, about the same width as their intervals, gently concave on the apertural side, retrocurrent as a whole, more or less perpendicular at the posterior suture, and distinctly retrocurrent at the anterior suture since they swing forward to it; there are 19 ribs on a whorl $\frac{3}{4}$ mm. in width. Body whorl evidently forming very approximately half the height of the shell; edge of base tends to be subangular, a feature which is accentuated on broken specimens. Neck not excavated except on broken specimens, fairly short, and ending anteriorly in a sub-notched beak. A small topotype shows the presence of about 12 very fine, closely spaced spiral threads on the base. Ribs dying out soon after passing the subcarinate edge of the base. No varices. Details of aperture are not well preserved; it appears subrhombic in

the specimens available, and probably had a gutter posteriorly. Columellar lip evidently only gently excavated. No columellar folds. Outer lip only preserved intact in one juvenile specimen, so that the labial varix of the adult is not seen; it follows the same direction as the ribs, and is distinctly prominent at and immediately anterior to the subcarinate edge of the base of the whorls.

DIMENSIONS. Holotype: height (incomplete) 2·8 mm.; width 1·25 mm.

REMARKS. *Rissoina exornata* Briart & Cornet as figured by Cossmann (1924, p. 17, Pl. 5, figs. 67, 68), from the Montian of Belgium, has less obliquely curved and rather less solid ribs. *R. biarritzensis* Boussac (B 1911*b*, p. 48, Pl. 11, figs. 3*a*, *b*), from the Bartonian of southern France, has much less sinuous ribs. *R. raincourti* Cossmann as figured by Cossmann & Pissarro (B 1907–13, Pl. 15, fig. 100–2), from the Bartonian of the Paris Basin, has higher whorls and the base of the body whorl is not subcarinate at the edge. There is a very close superficial resemblance in form and character of ribbing to *Dientomochilus* (*Varicospira*) *pakistanicus*, described later in this paper, and occurring at the same horizon, but the latter species, apart from having slightly coarser ornament which is especially noticeable on larger specimens, can be distinguished by its strong varices.

Superfamily CLAVACEA

Family TURRITELLIDAE

Genus *TURRITELLA* Lamarck, 1799

(*Mém. Soc. Hist. nat. Paris*, p. 74)

TYPE SPECIES. *Turbo terebra* Linné, Recent; monotypy.

SYNONYMS. *Turritellus* Montfort, 1810 (*Conch. Syst.* **2**, 210); type species: *Tur(r)itellus terebratus* Montfort, Recent = *Turritella terebra* Lamarck; original designation.

Proto Defrance, in Blainville, 1824 (*Dict. Sci. nat.* **32**, 228) *non* Leach, 1814 (Crust.); type species: *P. terebralis* Defrance, Recent; monotypy.

REMARKS. Fischer (B 1885) gave the type species of *Proto* as being *P. maraschini* Defrance, Recent, but this is not in the original list.

TURRITELLA RAKHIENSIS n.sp.

(Figures 54*a*, *b*, plate 2)

MATERIAL. *Rakhi Nala section*: Lower Chocolate Clays (local zone 10) (FB. F. 1966, *2*; FB. F. 1967, the holotype, Reg. No. G. 68065, and 28 topotypes, Reg. No. G. 68066–71; FB. F. 1963, *2*); *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2571, *6*; FB. F. 2558, *1*; FB. F. 2562, *2*).

DESCRIPTION. Shell of medium size for the genus, moderately narrowly turriculate. Early whorls not preserved, and apertural region broken on all available specimens. Whorls gently and distinctly convex in outline, the convexity being most marked at about one-third of their height so that the posterior portion of the whorls is flatter than the anterior. On later whorls this flattening of the posterior portion is accentuated, and in some cases this portion of the adult whorls may even be slightly concave. Sutures linear.

Height of whorls about eight-elevenths of their width. Ornament consisting of spiral threads of which three on the anterior half of the whorls are distinctly stronger than the remainder. Of these three threads the lowermost is a little stronger than the other two, and the space between it and the one above is a little wider than that between the other two. Of the second order of threads, there is one at the anterior suture, one midway between it and the lowermost strong thread, one between each pair of strong threads, and five on the posterior slope; of the latter, the second one above the most posterior strong thread is slightly stronger than the remainder. Interval between the most anterior strong thread and the anterior suture, which often tends to be more noticeably concave than the remaining intervals, carrying about four very fine tertiary threads on each side of the secondary thread. The secondary thread between the two anterior strong threads is slightly closer to the posterior strong thread, and the intervals between the three strong threads carry fine tertiary threads similar to those described above. All the intervals between the secondary threads on the posterior slope, from the most posterior strong thread to the posterior suture, carry one median tertiary thread, each one of which has two or three very fine threads of a fourth order both above and below it. All threads are, on well-preserved specimens, minutely granular, the granules being developed where the growth lines cross the spiral ornament. On the earlier whorls the distinction between the ornament on the upper and lower parts is not quite so noticeable, and the posterior portion of the whorls forms a more continuous curve with the anterior portion; that portion of the whorls anterior to the anterior strong thread is, however, still noticeably concave. Body whorl moderately high for the genus on account of the rather loose coiling, subangular at the edge of the base. Ornament on base not clearly seen, but there were at least four distinct spiral threads with three or four fine spirals in each interval, all threads being finely granular as on the spire. Aperture subcircular, slightly drawn out antero-laterally. No siphonal fasciole. Growth lines antecurrent at an angle of about 45° at the posterior suture, swinging backwards even more obliquely before forming a fairly deep and broadly rounded sinus, the apex of which lies close to the posterior side of the median strong spiral thread, then swinging forward obliquely on the anterior portion of the whorls, finally curving back again from the anterior strong thread to meet the anterior suture perpendicularly.

Dimensions. Holotype: height (incomplete) 43·2 mm.; width 13·2 mm.

Remarks. Compared with specimens of *Turritella sulcifera* Deshayes in the British Museum (Natural History), the sutural region is more deeply incised, the spiral threads are finer and sharper, and the anterior portion of the whorls is distinctly keeled. The form of the growth lines is very closely comparable to that observed in specimens of *T. terebellata* Lamarck. Compared with *T. sandbergeri* Mayer-Eymar as figured by Wolff (B 1897, p. 266, Pl. 25, fig. 24), from the Oligocene of southern Bavaria, the sutural region is more deeply excavated and some of the anterior spiral threads are stronger.

TURRITELLA SORIENSIS n.sp.

(Figure 55, plate 2)

Material. *Zinda Pir section*: Upper Chocolate Clays (lower part, local zone 12) (FB. F. 2540, the holotype, Reg. No. G. 68072, and 10 topotypes, Reg. No. G. 68073–8).

DESCRIPTION. Shell moderately acutely turreted, sometimes appearing somewhat stouter since the degree of elongation appears to be a little variable. Early whorls not preserved, and apertural region broken in the specimens available. Whorls rather loosely coiled and distinctly convex in outline, the greatest convexity being at about half their height. Sutures fine and linear, the sutural region being distinctly excavated. Height of whorls about seven-elevenths of their width. The shell appears to have been rather thin. Ornament consisting of six fine, distinct, but not prominent, relatively widely spaced, spiral threads or carinae, which are quite smooth and are separated by smooth intervals. These threads are equally spaced between the two sutures except for the most posterior thread, which is situated only one-third of the distance from the adjacent thread to the posterior suture. The three anterior threads are the strongest, and the most posterior thread is a little weaker than the two anterior to it, but the difference in strength of the threads is, on the whole, not very marked. The third thread from the anterior suture tends to give a vague angulation to the outline of the whorl. Ornament on the base not preserved. Form of growth lines not very clear, but they were apparently antecurrent posteriorly, then later curving to become vertical near the third spiral thread from the anterior suture, anterior to which they are very slightly concave forwards, meeting the anterior suture in a slightly retrocurrent direction.

DIMENSIONS. Holotype: height (incomplete) 31·5 mm.; width (slightly increased by crushing) 14·2 mm.

REMARKS. *Turritella rodensis* Carez (B 1881, p. 314, Pl. 4, figs. 13, 14), from the Eocene of Spain, is more elongate, has eight spiral threads, and the whorls are less convex, so that the sutural region is less excavated. *T. sulcifera* Deshayes as figured by Doncieux (1908, p. 198, Pl. 11, fig. 5), from the Lower Lutetian of the southern Corbières, is more turreted, has less inflated whorls, and more numerous and less widely spaced spiral threads. *T. conilhacensis* Doncieux (1908, p. 199, Pl. 11, figs. 6*a*, 6*b*), from the Lower Lutetian, differs in a similar manner.

Subgenus *STIRACOLPUS* Finlay, 1926

(*Trans. N. Z. Inst.* **57**, 389).

TYPE SPECIES. *Turritella symmetrica* Hutton, Recent; original designation.

TURRITELLA (*STIRACOLPUS*) *PAKISTANICA* n.sp.

(Figure 12, plate 1)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68079, and 5 topotypes, Reg. No. G. 68080–4).

DESCRIPTION. Shell small, turriculate, moderately slender. Protoconch consisting of about one smooth, sharply convex whorl which has a linear but deeply incised suture. The first one and a half spire whorls are strongly bicarinate on account of the presence of two strong, smooth, prominent, projecting spiral threads or keels, the anterior one of which is the stronger and more flange-like. The largest specimen available has about six whorls beyond the bicarinate stage, and they are characterized by the appearance and persistence of a third spiral keel posterior to the first two. In the bicarinate stage, the posterior thread

is considerably more removed from the posterior suture than the anterior thread is removed from the anterior suture. In the tricarinate stage, the three keels are more or less equidistantly spaced on the whorls, with the exception that the interval between the posterior thread and the posterior suture is only about half the width of the remaining intervals. Posterior thread never attaining the same prominence as the two anterior threads or keels. In later whorls, a low spiral thread appears close to the anterior suture from beneath which it emerges. Whorls, apart from the spiral keels, basically gently convex, with their greatest width at about half their height. Height of whorls about four-sevenths of their width. Ornament on the base not seen. Aperture subcircular, slightly drawn out antero-laterally. Growth lines not clearly seen, apparently antecurrent posteriorly, arching round to become vertical at about the position of the middle of the three primary spiral keels, and then curving slightly forward to meet the anterior suture in a slightly retrocurrent direction.

DIMENSIONS. Holotype: height 4·1 mm.; width 1·3 mm.

REMARKS. *Turritella* (*Haustator*) *mayombica* E. Vincent (B 1913, p. 15, Pl. 1, fig. 17), from the Palaeocene of the Belgian Congo, is fairly similar, but has the anterior primary thread at the greatest width of the whorls and forming an angulation, and there is a fine thread anterior to it. *T. aegyptiaca* Mayer-Eymar as figured by Oppenheim (B 1906*a*, p. 247, Pl. 23, figs. 14, 15), from the Libyan of Egypt, has a superficial resemblance to *T.* (*S.*) *pakistanica*, but has more cylindrical whorls and is larger; *T. aegyptiaca*, however, belongs to the genus *Mesalia*, and is a synonym of *M.* (*Sigmesalia*) *fasciata* Lamarck.

TURRITELLA (*STIRACOLPUS*) *HARNAIENSIS* Cox, 1931

(Figure 13, plate 1)

REFERENCES. *Turritella harnaiensis* Cox, B 1931*a* (pp. 48, 27, 33, Pl. 1, figs. 4, 5).

MATERIAL. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 4) (FB. F. 1850, *18*, Reg. No. G. 68085–90; FB. F. 2022, *4*; FB. F. 1855, *1*); *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2681, *10*+; FB. F. 2680, *10*+; FB. F. 2679, *28*, Reg. No. G. 68091–6); Ghazij Shales (local subzone 3*b*) (FB. F. 2678, *2*; FB. F. 2675, *2*).

DESCRIPTION. The adult shell has been described by Cox. The protoconch and early whorls, which were not known to Cox, are preserved in some of the Zinda Pir specimens, and the ornament of stages up to the size of the smallest whorl known to Cox is preserved on specimens from both Zinda Pir and Rakhi Nala. Protoconch consisting of about one smooth, convex, laxly coiled whorl with a deep suture. The next one and a half whorls are bicarinate, the posterior keel being more in the nature of a spiral thread, the anterior keel being considerably more projecting and flange-like, and fairly anterior in position. From this stage onwards a third spiral thread occurs posterior to the other two. The threads appear to be faintly beaded. Whorls gently convex in outline, about half as high as wide, their greatest width at the anterior keel. Sutures fine and linear, and up to the sixth spire whorl the anterior keel gives an imbricate appearance to the outline. One additional spiral keel well out towards the margin of the base of the body whorl, the remainder of the basal surface smooth. No siphonal fasciole. The rather imbricate outline of the whorls causes the aperture to be subrectangular rather than suboval in shape.

At a later stage, the shell is still turriculate, not very elongate, conic, with a not very acute spiral angle. The whorls have become flat-sided and cylindrical, and later still become fundamentally gently convex. The fundamental pattern of three spiral keels is present, the middle one being at the greatest width of the whorls. These keels carry numerous closely spaced, but not touching, rounded crenulations which, although not very strong, give them rather a beaded appearance; there are three crenulations in a distance of $\frac{3}{4}$ mm. on a whorl 3·4 mm. in width. Sutures linear, although the sutural region is rather deeply excavated, as are the intervals between all the spiral cordons. Base of body whorl carrying a second spiral keel a little anterior to the first; it is not so strong as the first, and is somewhat removed from the anterior region. Aperture more suboval in shape on account of the imbricate outline of the whorls having been lost. Some specimens show traces of microscopic spiral threads as well as the keels. Growth lines not distinctly seen, but are antecurrent posteriorly, become vertical at a position close to the middle spiral cordon, and then curve forward and are gently but definitely retrocurrent at the anterior suture. From this stage, which matches the smallest whorl of the specimens figured by Cox, and has been compared with them, the description as given by Cox completes the account of the known characters of the species.

DIMENSIONS. One small specimen: height 2·5 mm.; width 1·1 mm.: second (larger) specimen: height (a small portion of the apex missing) 11·6 mm.; width 4·25 mm.

FURTHER DISTRIBUTION IN PAKISTAN. Lower Ghazij Shales of Harnai (type locality).

REMARKS. The specimens described above have been compared with each other and with Cox's holotype and paratype of *Turritella harnaiensis*. There is no doubt that they all belong to one species. In spite of the tricarinate appearance being to a certain extent masked in the later whorls described by Cox, it is nevertheless apparent. The growth lines seem to agree well with those the writer has seen on specimens of *T. symmetrica* Hutton, the type species of *Stiracolpus*, and to form too shallow a sinus for *Haustator* or *Turritella sensu stricto*.

Subgenus *HAUSTATOR* Montfort, 1810

(*Conch. Syst.* **2**, 182, 183)

TYPE SPECIES. *Haustator gallicus* Montfort, Eocene = *Turritella imbricataria* Lamarck; monotypy and original designation.

SYNONYM. *Peyrotia* Cossmann, 1912 (*Ess. Pal. Comp.* **9**, 109, 119); type species: *Turritella desmarestina* Basterot, Miocene; original designation.

Gazameda Iredale, 1924 (*Proc. Linn. Soc. N.S. Wales*, **49**, 183, 247); type species: *Turritella gunnii* Reeve, Recent; monotypy.

REMARKS. In spite of the heavier shell and more granular ornament, there seems to be no really significant difference between *Haustator* and *Peyrotia*; they are here regarded as synonymous, an opinion which has been shared by other writers.

TURRITELLA (*HAUSTATOR*) *IMBRICATARIA* Lamarck, 1804

(Figure 14, plate 1; figure 57, plate 2)

REFERENCES. *Turritella imbricataria* Lamarck, 1804*b* (p. 216); Lamarck, 1806*c* (p. 79, Pl. 37, figs. 7*a*, *b*); Brongniart, B 1823 (pp. 54, 18, 31); Defrance, 1828 (p. 156); Bronn,

B 1831 (p. 53); Deshayes, 1832*c* (p. 271, Pl. 35, figs. 1, 2); Lyell, 1833 (App. p. 26, Pl. 3, fig. 6); Galeotti, B 1837 (p. 143); Pusch, 1837 (p. 104); Verneuil, 1838 (p. 21); Morris, B 1843 (p. 166); Deshayes, 1843 (p. 264); Potiez & Michaud, B 1844 (p. 282); Nyst, B 1845 (p. 396); Leymerie, B 1846 (pp. 371, 343, 346, 348, 349, 351, 353, 356); d'Archiac, B 1850*b* (pars) (**3**, 285, 37, 38, 63, 118, 209, 223); Dixon, B 1850 (pp. 21, 25); Studer, 1851 (p. 48); Bellardi, B 1852 (pp. 209, 291); Sismonda, B 1852 (p. 325); Lyell, 1852 (p. 354); Studer, B 1853 (pp. 105, 108); Hébert & Renévier, B 1854 (pp. 172, 216); Deshayes, B 1861 (p. 311); von Schauroth, B 1865 (p. 248); Lowry, B 1866 (p. 402); Taramelli, B 1870 (p. 42); E. Pavay, B 1871 (pp. 362, 424); Tournouer, B 1872*a* (pp. 500, 509); Tournouer, B 1872*b* (p. 716); Stukenberg, B 1873 (pp. 243, 253); A. von Pavay, B 1874 (p. 412); Vieillard & Dollfus, B 1875 (p. 98); Pirona, 1877 (p. 46); K. Mayer-Eymar, B 1877 (p. 84); Marinoni, 1878 (pp. 649, 652); Mallada, B 1878 (pp. 317, 320, 321, 323, 405); Carez, B 1881 (pp. 40, 60, 217); Maureta & Thos y Codina, B 1881 (pp. 322, 332); Cya, B 1883 (p. 56); Mallada, B 1883 (p. 56); Cossmann & Lambert, B 1884 (p. 4); C. Mayer-Eymar, B 1887 (p. 105); Cossmann, 1888 (p. 296); Newton, B 1891 (p. 206); Harris & Burrows, B 1891 (pp. 18, 87); Mallada, B 1892 (p. 204); Oppenheim, B 1894 (p. 441); de Gregorio, B 1894*a* (p. 32); Koch, B 1894 (pp. 223, 226, 241, 243, 244, 278, 296, 302, 210); Netschaew, B 1897 (p. 245); Papp, 1897*a* (p. 435); Vinassa de Regny, B 1898 (pars) (pp. 188, 180, Pl. 20, fig. 21); Radkewitsch, B 1900 (p. 341); Oppenheim, B 1901*a* (p. 306); C. Mayer-Eymar, B 1902 (p. 389); Archangelsky, B 1904 (pp. 10, 23); Boussac, B 1908 (p. 242); Dollfus, B 1909 (table opp. p. 24); Cossmann & Pissarro, B 1907–13 (Pl. 20, fig. 125–5); Boussac, B 1911*b* (pp. 35, 36); Boussac, B 1911*a* (pars) (pp. 319, 428, Pl. 19, figs. 34, 37); Fabiani, B 1915 (pp. 120, 122, 142, 147, 254); Dainelli, B 1915 (pp. 535, 79, 88, 100, 109, 110, 124, 135); Dainelli, B 1919 (pp. 19, 8, 13); Guillaume, 1924 (pp. 281, 282, etc., 294, 425, 426, figs. 2, 11; Pl. 11, figs. 1–4); Dukooizen, B 1924 (p. 19); Schlosser, B 1925*a* (pp. 92, 162, 178, Pl. 2, fig. 18); Schlosser, B 1925*b* (pp. 33, 47, 49, 51, Pl. 8, figs. 3, 23); Abrard, B 1925*a* (pp. 223, 78, etc.); Lukovitch, B 1926 (p. 30); Douvillé, B 1929 (pp. 54, 55, 57); Zöller & Böhm, 1929 (p. 473); Cuvillier, B 1930 (pars) (pp. 152, 194, 196, 247; *non* Pl. 3, figs. 13, 14); Robert, B 1932 (p. 34); Isaeva, 1933 (p. 56); Burton, B 1933 (pp. 144, 148, 159); Reina, B 1934 (p. 13); Wrigley, B 1934 (p. 11); Blanckenhorn, B 1935 (p. 157); Léonov, B 1936 (p. 310); Davis, B 1936 (p. 333); L. & J. Morellet, B 1936 (p. 302); Coulon, B 1936 (p. 43); Alimen, B 1936 (p. 181); Heron, B 1938 (p. 82); Socin, 1939 (pars) (pp. 82, 102, 106); Loss, B 1940 (pp. 57, 74, 77, 79); Curry, B 1942 (pp. 90, 93, 96, 98); Furon & Soyer, B 1947 (p. 113, Pl. 13, fig. 125–5); L. & J. Morellet, B 1948 (p. 187).

Haustator gallicus Montfort, 1810 (p. 183, fig.).

Turritella elongata J. Sowerby, B 1814 (**1**, 110, Pl. 51, fig. 2); Dixon, B 1850 (p. 101); Abrard, B 1925*b* (p. 23).

Turritella conoidea J. Sowerby, B 1814 (**1**, 110, Pl. 51, figs. 1, 4, 5); Dixon, B 1850 (pp. 100, 181, Pl. 5, figs. 6, 10).

Turritella imbricataria Lamarck var. *c* Deshayes, 1832*c* (pp. 271, 272, Pl. 37, figs. 9, 10).

Turritella imbricataria Lamarck var. *d* Deshayes, 1832*c* (pp. 271, 272, Pl. 38, figs. 1, 2).

Turritella carinifera Deshayes, 1832*c* *non* Lamarck, 1822 (p. 273, Pl. 36, figs. 1, 2); Deshayes, 1843 (p. 269); d'Archiac, B 1846 (p. 215); d'Archiac, B 1850*a* (pars) (pp. 445,

455); d'Orbigny, B 1850 (p. 310); Studer, B 1853 (p. 93); Deshayes, B 1861 (p. 311); Coquand, B 1862 (pp. 311, 111, 118, 122); Zittel, 1863 (pp. 385, 359, 362); K. Mayer, B 1869 (pp. 360, 361, 362, 369); K. Mayer-Eymar, B 1877 (p. 84); Carez, B 1881 (p. 185); Abich, B 1882 (pp. 286, 326, Pl. 1, fig. 4); Zittel, B 1883 (pp. 93, 127); Frauscher, 1884 (p. 60); C. Mayer-Eymar, B 1887 (p. 105 (pars)); Cossmann, 1888 (p. 300 (pars)); Newton, B 1891 (p. 205); Harris & Burrows, B 1891 (pp. 18, 87 (pars)); Mallada, B 1892 (p. 204); Koch, B 1894 (pp. 226, 278, 296); de Gregorio, B 1894*a* (p. 32); de Gregorio, 1895 (pp. 13, 4); de Gregorio, B 1896 (pp. 61, 10, 13, 128); Marinelli, 1896 (p. 60); Cossmann, B 1901*b* (p. 181, Pl. 2, figs. 5, 6); Marinelli, 1902 (p. 206); C. Mayer-Eymar, 1902 (p. 388); Oppenheim, B 1906*a* (p. 248); Cossmann & Pissarro, B 1911–13 (Pl. 20, fig. 125–4) (pars); Boussac, B 1911*a* (Pl. 19, figs. 32, 33, 35, 36, 40, 41); Newton, 1912 (pp. 81, 72, 83, 85); Vogl, B 1912 (pp. 94, 108, 110); Dainelli, B 1915 (pp. 100, 118, 121, 124, 133, 503, 536, 79, 88); Fabiani, B 1915 (pp. 110, 142, 254, table opp. p. 178); Dainelli, B 1919 (pp. 20, 8, 13); Blanckenhorn, B 1921 (pp. 86, 87, 91, 94); Guillaume, 1924 (pp. 284, 302, 425, 427; Pl. 11, fig. 5); Schlosser, B 1925*a* (pp. 93, 178 (pars), Pl. 2, fig. 27); Abrard, B 1925*b* (p. 28); Abrard, B 1925*a* (pp. 87, 88, 97, etc.); Jackson, B 1926 (p. 366); Robert, B 1932 (p. 34); Gočev, B 1933*b* (pp. 191, 207, 187, 194, 195, 196, 198, 199, 205, 210, Pl. 7, fig. 9); Coulon, B 1936 (p. 33); Deb, 1938 (pp. 9, 25, 27); Abrard, 1938 (p. 134); Furon & Soyer, B 1947 (pars) (pp. 66, 113, 158, *non* Pl. 13, fig. 125–4).

Turritella imbricataria Lamarck?, d'Archiac, B 1846 (p. 215); d'Archiac, B 1850*a* (p. 455).

Turritella rouyana d'Orbigny, B 1850 (p. 341).

Turritella bicincta J. Sowerby, in Dixon, B 1850 *non* Wood 1842 (pp. 100, 180, Pl. 6, fig. 19).

Turritella contracta J. Sowerby, in Dixon, B 1850 (pp. 101, 181, Pl. 7, fig. 42); Wrigley, 1934 (p. 11).

Turritella conoidea J. Sowerby var. *elongata* J. Sowerby, Dixon, B 1850 (pp. 101, 181, Pl. 5, fig. 10).

Turritella conoidea? J. Sowerby, Rouault, B 1850 (p. 477).

Turritella bipartita Schafhäutl, B 1863 (p. 187, Pl. 48, fig. 6).

Turritella asperula Brongniart, Taramelli, B 1870 (p. 42 (pars)); Pirona, 1877 (p. 46 (pars)); Taramelli, B 1881 (p. 102 (pars)); Mariani, B 1892 (p. 28 (pars)).

Turritella edita J. Sowerby, Taramelli, B 1870 (p. 42); Taramelli, B 1881 (p. 102); Mariani, B 1892 (p. 28 (pars)).

Turritella hybrida Deshayes, Taramelli, B 1870 (p. 42 (pars)); Mariani, B 1892 (p. 28 (pars)).

Turritella carinata Deshayes, von Hantken, B 1872 (pp. 49, 69, 112).

Turritella carinifera Deshayes var. Rouault, de Bouillé, B 1873 (p. 446).

Turritella carinifera Deshayes var. B, Rouault, de Bouillé, B 1873 (p. 433).

Turritella carinifera d'Archiac var. de Bouillé, B 1873 (p. 443).

Turritella asperulata Brongniart, Marinoni, B 1877 (p. 14 (pars)).

Turritella imbricata Lamarck, Mallada, 1879 (Pl. 2, figs. 26, 27); Papp, 1897*a* (p. 482).

Turritella granulosa Deshayes, Renévier, B 1890 (p. 399).

Turritella turris Basterot, Mariani, B 1892 (p. 28 (pars)).

Turritella imbricataria Lamarck var.? de Gregorio, B 1896 (p. 61).

Turritella imbricataria Lamarck var. *planulata* Vinassa de Regny, B 1898 (pp. 188, 180).

Turritella carinifer Deshayes, Blanckenhorn, B 1900 (pp. 406, 437, 446).

Turritella terebellata Lamarck, Deninger, B 1901 (p. 236).

Turritella cf. *imbricataria* Lamarck, Marinelli, 1902 (p. 206).

Turritella imbricataria Lamarck var. *carinifera* Deshayes, Boussac, B 1908 (p. 242); Boussac, B 1911*b* (p. 35); Bourcart, B 1922 (p. 76); Guillaume, 1924 (p. 293); Cuvillier, B 1930 (pp. 152, 247, 318, 117, 122, etc., Pl. 19, fig. 19); Reina, B 1933 (p. 839); Flandrin, B 1938 (pp. 114, 142, 147, Pl. 13, fig. 12); Loss, B 1940 (p. 77).

Turritella oppenheimi Newton, 1912 (p. 81, Pl. 3, fig. 5); Cossmann, 1913*b* (p. 61); Oppenheim, 1914 (p. 196); L. & J. Morellet, B 1936 (p. 302); L. & J. Morellet, 1938 (p. 302); L. & J. Morellet, B 1948 (pp. 30, 130, 276, 331).

Turritella (*Haustator*) *imbricataria* Lamarck, Cossmann, 1912 (p. 114, Pl. 8, figs. 10, 11); Cossmann, B 1913 (p. 158); Böhm, 1929 (p. 455); Glibert, B 1933 (p. 45 (pars) *non* Pl. 2, fig. 17); Heron, B 1937 (p. 23).

Turritella (*Haustator*) *carinifera* Deshayes, Cossmann, 1912 (p. 117); di Stefano, B 1920 (p. 37 (pars), Pl. 11, figs. 3, 4); Glibert, B 1933 (pp. 45 (pars), 193, Pl. 2, fig. 16).

Turritella (*Haustator*) *oppenheimi* Newton, Cossmann, B 1913 (p. 158 (pars)); Isaeva, 1933 (pars) (pp. 21, 65, 57, Pl. 2, figs. 17–21).

Turritella imbricataria Lamarck var. Bourcart, B 1922 (p. 70).

Turitella carinifera Deshayes, Socin, 1936 (p. 27).

Turitella imbricataria Lamarck, Socin, 1936 (p. 27).

REFERENCES EXCLUDED. *Turritella imbricataria* Lamarck, Nyst, B 1843 (Pl. 37, fig. 4); Nyst, B 1845 (p. 396); Grateloup, 1847 (Pl. 16, fig. 17); d'Archiac, B 1850 (pars) *b* (**3**, 285, 37, etc.); Leymerie, 1878–81 (pp. 804, 828, Pl. W, fig. 12 = *T. leymeriei* Netschaew, 1897); Maureta & Thos y Codina, B 1881 (p. 375); Cya, B 1883 (p. 60); Mallada, B 1883 (p. 60); Mallada, B 1890 (pp. 123, 124, 128); Blanckenhorn, 1890 (p. 356, Pl. 19, fig. 10 = *T. biserialis* Eichwald, 1868 *sec.* Netschaew, 1897); Mallada, B 1892 (p. 221); Cuvillier, B 1935 (p. 37, Pl. 3, figs. 13, 14).

Turritella imbricataria Lamarck var. *β* Nyst, B 1843 (Pl. 37, fig. 5); Nyst, B 1845 (p. 397).

Turritella (*Haustator*) *imbricataria* Lamarck, Glibert, B 1933 (p. 45 (pars), Pl. 2, fig. 17); Socin, 1939 (p. 111, Pl. 1, figs. 2–5).

Turritella imbricataria Lamarck var. *b* Deshayes, 1832*c* (pp. 271, 272, Pl. 36, figs. 7, 8 = *T. edita* J. Sowerby, 1814).

Turritella carinifera Deshayes, Rouault, B 1850 (p. 477, Pl. 15, figs. 13, 14 = *T. pseudo-elegans* Cossmann, 1923); K. Mayer-Eymar, B 1883 (p. 76, Pl. 23 (1), fig. 8); Furon & Soyer, B 1947 (p. 66, Pl. 13, fig. 125–4 = *T. dixoni* Deshayes).

Turritella carinifera Deshayes var. *subnova* de Gregorio, B 1894*a* (pp. 32, 8, Pl. 5, fig. 125).

Turritella imbricataria Lamarck var. *carinifera* Deshayes, Belmustakov, B 1949 (pp. 45, 53, Pl. 2, fig. 4).

MATERIAL. *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2561, *1*); Upper Chocolate Clays (lower part, local zone 12) (FB. F. 2541, *2*; FB. F. 2521, *81*, Reg. No. G. 68478–83); Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520,

50+, Reg. No. G. 68097–102; FB. F. 2519, *1*); Upper Chocolate Clays (upper part, local zone 14) (FB. F. 2738, *50*+); *Kohat area* (*Panoba section*): Upper Kohat Shales (local subzone 4*a*) (FB. F. 2257, *1*); *Kohat area* (*Shekhan Nala section*): Upper Kohat Shales (local subzone 4*a*) (FB. F. 2341, *5*; FB. F. 2342, *2*).

DESCRIPTION. In spite of the widespread geographical distribution and the long time that this commonly occurring species has been known, there does not appear to be any description of the early whorls. In some of the softer, shalier horizons in western Pakistan the early stages and adult forms, obviously conspecific, occur in the same fossil beds; both are illustrated, and the early stages are now described.

A fragment 2·6 mm. high is 1·0 mm. wide and consists of about eight whorls. Protoconch minute, smooth, and of about one convex whorl, with a deep suture. First spire whorl bluntly unicarinate. All subsequent whorls until the eighth are conic, imbricate, with a distinct, sharp keel at about one-quarter of their height, flat-sided above the keel, and with two distinct, regularly spaced spiral threads above the keel. Sutures linear. Whorls about twice as wide as high. Although the adult shells occurring in the same bed are of the normal *imbricataria* type, the early stages are more like the adult of *carinifera* Deshayes.

FURTHER DISTRIBUTION IN PAKISTAN. Upper Khirthar Shales 1 mile north-east of Nili Kach (south of Gumal); Khirthar $1\frac{1}{4}$ miles north of Sambaza.

FURTHER DISTRIBUTION. This well-known and widely distributed species has a range, according to the above interpretation, from Middle Eocene to Priabonian, and the following is a summary of the distribution: Lower Mokattam of Egypt; Bruxellian of Belgium; Bracklesham Beds of England; Lutetian of Italy, France, England, Constantine and southern Algeria; Middle Eocene of the Bavarian Alps, Switzerland and the Arabian Desert; Auversian of France, Italy and Akhaltsikh; Lower Bartonian of France and Switzerland; Bartonian of England; Upper Mokattam of Egypt; Upper Eocene of the Balkans, Armenia, the Bavarian Alps, Syria and the Arabian Desert; Priabonian of France, Italy, the Alps and southern Bulgaria; Eocene of the Aral Sea area, the Crimea, Hungary, Spain, Angola, Podolia, Croatia, the Isle of Rhodes and Siebenburg.

REMARKS. While following Boussac in regarding the '*imbricataria*' Lamarck and '*carinifera*' Deshayes groups as belonging to one variable species, the writer can find no satisfactory record from below the Middle Eocene that falls within the variation of this group. Cuvillier's (B 1935) illustrations of a form from the Ypresian of Egypt, which he referred to *Turritella imbricataria*, seem to be different from that species; his fig. 13 is much more strongly carinate, and the resemblance of his fig. 14 (which shows a few of the earlier whorls) to *T. imbricataria* is probably fortuitous. *T. dixoni* Deshayes, which was regarded as a synonym of the *imbricataria-carinifera* group by Boussac, appears to be a distinctive Lower Eocene species characterized by its regular imbricate appearance and the regular, strong and distinct, rather widely spaced spiral threads; the form illustrated by Furon & Soyer (B 1947) as *T. carinifera* belongs to this species. Of other forms, that illustrated by Glibert (B 1933) as *T.* (*Haustator*) *imbricataria*, from the Bruxellian of Belgium, appears to differ in its coarser and more widely spaced spiral threads. The form illustrated by K. Mayer-Eymar in B 1883 as *T. carinifera* Deshayes is much too strongly granular to belong to that species. di Stefano (B 1920) was incorrect in including the Coniacian

species *T.* (*H.*) *ramsis* Greco in the synonymy of *T.* (*H.*) *carinifera* Deshayes, the resemblance between these two forms being merely superficial.

TURRITELLA (*HAUSTATOR*?) *PUNJABENSIS* n.sp.

(Figure 56, plate 2)

MATERIAL. *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2556, the holotype, Reg. No. G. 68103).

DESCRIPTION. Shell of moderate size, rather slender, conic, the early whorls being missing and the aperture broken on the single available specimen. Sutures linear. Height of whorls about five-sixths of their width. Whorls with two distinct spiral threads forming blunt carinations, the upper one at about half the height of the whorl, the lower one about half-way between the upper one and the anterior suture. The keels are of about the same strength, and the posterior shelving slope of the whorl is rather high. The broken base shows a third spiral thread emerging from close beneath the suture. Surface of whorl anterior to the anterior keel sloping inwards towards the suture, the whorls being sub-imbricate. Shell rather loosely coiled.

DIMENSIONS. Holotype: height (apex and aperture missing) 21·0 mm.; width (a little increased by crushing) 7·8 mm.

REMARKS. *Turritella desertica* Cuvillier (B 1930, p. 318, Pl. 19, fig. 21), from the Bartonian of Egypt, is less turreted and the anterior spiral keel is closer to the anterior suture. *T. uniangularis* Lamarck var. A. Rouault (B 1850, p. 478, Pl. 15, fig. 19), from the Eocene near Pau, is distinctly less slender.

Genus *MOTYRIS* n.nom.

TYPE SPECIES. *Turritella* (*Tomyris*) *aralica* Michailovski, Eocene; here designated.

SYNONYM. *Tomyris* Michailovski, 1912 (*S.B. naturf. Ges. Jurjew*, **21**, 125, 134) *non* Eichwald, 1831 (Rept.) *nec* Chapuis, in Lacordaire, 1874 (Col.) *nec* Druce, 1890 (Lep.); type species: *Tomyris arabica* (*err. pro aralica*) (Michailovski), Eocene; Wenz, 1939.

REMARKS. Wenz, by mistake, gave the name of Michailovski's species as *arabica* instead of *aralica*, and he also regarded it as of Oligocene instead of Eocene age.

MOTYRIS PSEUDOARALICA n.sp.

(Figure 15, plate 1; figures 58*a*, *b*, plate 2)

MATERIAL. Domanda, Dera Ismail Khan District; high in Eocene (the holotype, Reg. No. G. 68510, and 3 topotypes, Reg. No. G. 68511–13); *Zinda Pir section*: Upper Chocolate Clays (lower part, local zone 12) (FB. F. 2522, *6*; FB. F. 2521, *2*); Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, *36*, Reg. No. G. 68104–10).

DESCRIPTION. Shell of moderate size, somewhat variable in degree of elongation, moderately turreted but often more broadly conic, early stages often conoidal. Protoconch consisting of one smooth, rather flatly coiled whorl with a deep suture. Whorls flat-sided, giving a regular conic appearance to the mode of growth. Sutures linear. First two spire whorls strongly imbricate, with a prominent keel a little removed from the anterior suture. A thin upturned flange rapidly develops on the posterior part of the whorl at a slightly

shorter distance from the posterior suture compared with the position of the anterior keel relative to the anterior suture. The suture line is thus at the bottom of a deep V-shaped depression. On adult whorls the flange is considerably upturned, but is often broken as it becomes rather thin at the edge; the anterior keel is a prominent rounded thread. Height of whorls about three-sevenths of their width. Ornament often eroded, but there are two fine, closely spaced spiral threads just posterior to the anterior keel, and the surface of the whorl midway between the posterior thread and the posterior suture is gently subangular. Ornament anterior to the anterior keel variable, there being sometimes one strong median thread, and sometimes two or three threads of varying size. A strong thread partially emerges from beneath the anterior suture. Whole surface covered with microscopic spiral threads. On the base there are at least four primary spiral threads, the interval between the two anterior ones being considerably wider than the remaining intervals, and there are also numerous, irregular, fine spiral threads in the intervals. Growth lines gently but distinctly arcuate, antecurrent posteriorly, retrocurrent anteriorly, the apex of the curvature being between the vague angulation of the whorl and the posterior of the two spiral threads above the anterior keel.

DIMENSIONS. Holotype: height (incomplete) 27·9 mm.; width 15·5 mm.

REMARKS. *Turritella* (*Tomyris*) *aralica* Michailovski (B 1912, pp. 123, 125, 133, 135, figs. 4–6), from the upper part of the Eocene of the Aral Sea area, has a distinctly more stepped outline and more convex whorls, and also differs in the details of the ornament, in not being conoidal, and in the early whorls not having the sutures sunk in deep V-shaped excavations. *T.* (*T.*) *ukrainae* Michailovski (B 1912, pp. 123, 125, 133, 135, fig. 3), from the same beds, differs in a similar manner, and is still less turreted.

Wenz (1939, p. 652) gives the age as Oligocene, but Lukovitch (B 1926, pp. 19–82) has shown that the Eocene molluscan fauna of the Aral Sea, Termembes, and Lake Chalkar area falls within the limits Upper Lutetian and Lower Ludian, and the Pakistan form apparently occurs well within these limits. Wenz regards *Tomyris* Michailovski, here renamed *Motyris*, as a genus; its range appears to be restricted to the upper part of the Eocene, and its geographical distribution to Pakistan and the southern part of central Asia.

Genus *MESALIA* Gray (1840), 1847

(*Proc. Zool. Soc. Lond.* pt. 15, p. 155)

TYPE SPECIES. *Cerithium mesal* Adanson, Recent = *Turritella mesal* Deshayes = *T. brevialis* Lamarck; original designation.

REMARKS. Gray's record of the name *Mesalia* in 1840 (*Syn. Cont. Brit. Mus.* 42nd ed., p. 147) is a *nomen nudum*. Although Wenz places *Arcotia* Stoliczka, 1868 in the synonymy of *Mesalia*, Cossmann records that its growth lines are straight, and Merriam excludes it from the Turritellidae; it is accordingly omitted here.

Subgenus *SIGMESALIA* Finlay & Marwick, 1937

(*Palaeont. Bull. N.Z.* no. 15, p. 43)

TYPE SPECIES. *Turritella sulcata* Lamarck, Eocene; original designation.

REMARKS. Finlay & Marwick placed this form as a new genus in a family Pareoridae, based on the deep sinuosity of the outer lip and on the characters of the columella and

anterior part of the aperture. The writer feels, however, that it would be better to retain *Sigmesalia* merely as a subgenus of *Mesalia* in the family Turritellidae, where it has always been classified, the differences not appearing to be sufficiently marked to warrant placing it in a different family. Wenz tentatively placed *Sigmesalia* in the Trichotropidae, but it seems out of place and unrelated to other genera in that family.

MESALIA (SIGMESALIA) FASCIATA (Lamarck), 1804

REFERENCES. *Turritella fasciata* Lamarck, 1804*b* (p. 217); Lamarck, 1818*b* (p. 562); Deshayes, 1832*c* (p. 284, Pl. 38, figs. 13, 14, 17, 18; Pl. 39, figs. 1–20); Morris, B 1843 (p. 166); Dixon, B 1850 (p. 101, Pl. 7, fig. 5); d'Archiac & Haime, B 1854 (p. 297); Deshayes, B 1861 (p. 326); Vieillard & Dollfus, B 1875 (p. 98); Maureta & Thos y Codina, B 1881 (p. 322); Mallada, B 1883 (p. 56); Cya, B 1883 (p. 56); Mallada, B 1892 (p. 204); Papp, 1897*a* (p. 436); Noetling, B 1901 (pp. 55, 276); Dollfus, B 1915 (p. 34); Vidal, 1920 (p. 125); Guillaume, 1924 (p. 302).

Turritella uniangularis Lamarck, Rouault, B 1850 (p. 478, Pl. 15, fig. 19).

Turritella sp. Meneghini, 1857 (p. 349, Pl. F, fig. 15*d*).

Turritella (Mesalia) fasciata Lamarck, C. Mayer-Eymar, B 1887 (p. 106); Papp, 1897*a* (p. 429); Taeger, B 1908 (p. 78); Garde, B 1911 (p. 96).

Mesalia fasciata (Lamarck), Cossmann, 1888 (p. 303); Newton, B 1891 (p. 207); Harris & Burrows, B 1891 (pp. 48, 86); Cossmann, 1898 (p. 182, Pl. 8, figs. 10, 11); Cossmann, B 1901*b* (p. 183, Pl. 2, fig. 18); Douvillé, in de Morgan, 1904 (p. 329, Pl. 47, figs. 23–27); Oppenheim, B 1906*a* (p. 252, Pl. 23, fig. 23); Oppenheim, B 1908 (pp. 335, 317); Cossmann & Pissarro, 1909 (p. 62); Cossmann & Pissarro, B 1907–13 (Pl. 21, figs. 126–9); Cossmann, 1912 (pp. 126, 127); Oppenheim, B 1915 (pp. 93, 89); Fabiani, B 1915 (p. 254); Dainelli, B 1915 (pars) (pp. 541, 79, 100, 133—*non* Pl. 51, figs. 12, 13 = ? *Tympanotonos* sp.); Douvillé, B 1920*a* (p. 119); Blanckenhorn, B 1921 (pp. 91, 94); Cottreau, 1922 (p. 60, Pl. 15, fig. 2); Dukooizen, B 1924 (pp. 10, 44); Abrard, B 1925*a* (pp. 223, 56, 72, etc.); L. & J. Morellet, 1927 (p. 213); Vredenburg, B 1928*a* (pp. 59, 60); Douvillé, B 1928 (pp. 16, 7, 24, 25, Pl. 4, figs. 1–4); Cox, B 1930*a* (pp. 157, 132, 133, 136, 137, 141, 142, Pl. 18, figs. 1–5); Cuvillier, B 1930 (pp. 191, 193, 194, 205, 216, 223, 224, 226, 227); Robert, B 1932 (p. 34); L. & J. Morellet, 1932 (p. 450); Basse, B 1933 (p. 203, Pl. 12, figs. 24–52); Burton, B 1933 (p. 136); Vialov, B 1934*a* (p. 144); Wrigley, B 1934 (p. 11); Ruzin, B 1935 (p. 51); L. & J. Morellet, B 1936 (p. 302); Coulon, B 1936 (pp. 34, 36); Cox, in L. M. Davies & Pinfold, B 1937 (p. 8); Chavan & Dupuis, B 1938 (p. 531); Krishnan, B 1943 (pp. 435, 438); Guaitani, 1947 (p. 43); Furon & Soyer, B 1947 (pp. 113, 159); L. & J. Morellet, B 1948 (pp. 30, 94, 273, 276, 331, 343).

Turritella obruta Locard, B 1889 (p. 22, Pl. 7, fig. 17—*non* Conrad, 1833).

Mesalia hofana C. Mayer-Eymar, 1895 (p. 42, Pl. 2, fig. 3); Cossmann, B 1901*b* (p. 184, Pl. 2, fig. 3); Oppenheim, B 1906*a* (p. 249, Pl. 22, figs. 20, 21); Cossmann, 1912 (p. 127); Blanckenhorn, B 1921 (pp. 84, 86, 87, 92, 93, 94); Stefanini, B 1921*a* (p. 114); Stefanini, B 1921*b* (p. 147); Cuvillier, B 1930 (pp. 108, 116, 117, 152, 192, 199, 204, 210, 216, 224, 230, 247); Cuvillier, B 1933 (p. 33, Pl. 6, figs. 9, 10, 17, 18); Pieragnoli, B 1935 (p. 176); Alberici, 1939 (pp. 359, 365); Rossi, B 1942 (p. 118).

Mesalia locardi Cossmann, B 1901*b* (p. 183, Pl. 2, figs. 7, 8); Oppenheim, B 1906*a* (p. 250, Pl. 22, figs. 33, 33*a*); Cossmann & Pissarro, 1909 (p. 62); Cossmann, 1912 (p. 127); Fourtau, 1912 (p. 1117); von Klebelsberg, B 1913 (pp. 374, 375, 378, 379); di Stefano, B 1920 (p. 38); Blanckenhorn, B 1921 (pp. 87, 90, 94, 96, 99, 105); Cuvillier, B 1930 (pp. 153, 187, 192, 197, 208, 210, 214, 216, 218, 219, 220, 228, 247); Cuvillier, B 1933 (p. 32, Pl. 7, figs. 1, 2, 3, 4); Flandrin, B 1938 (pp. 112, 142, 146, 147, Pl. 13, figs. 9, 10); Alberici, 1939 (pp. 359, 360).

Mesalia obruta (Locard) C. Mayer-Eymar, 1902 (p. 391); Cossmann & Pissarro, 1909 (p. 62).

Mesalia bilirata C. Mayer-Eymar, 1902 (p. 391).

Mesalia electa Locard, C. Mayer-Eymar, 1902 (p. 8).

Mesalia plurilirata C. Mayer-Eymar, 1902 (p. 392).

? *Mesalia terebriformis* C. Mayer-Eymar, 1902 (p. 392, Pl. 22, fig. 11).

Turritella (*Torcula*) *overwegi* Quaas, 1902 (p. 253, Pl. 26, figs. 13, 14).

Mesalia farafrensis Oppenheim, B 1906*a* (p. 251, Pl. 20, fig. 34); Oppenheim, B 1915 (pp. 37, 68, 70, 89, Pl. 2, figs. 15–16).

Mesalia hildeverti Doncieux, 1908 (p. 186, Pl. 10, fig. 9).

Mesalia mecquenemi Cossmann & Pissarro, 1909 (p. 61, Pl. 5, figs. 22, 23); Holland, 1909 (p. 25); L. M. Davies, 1927*b* (pp. 263, 264); Vredenburg, B 1928*a* (p. 59); Furon, B 1941 (pp. 313, 340).

Mesalia cf. *fasciata* (Lamarck), Garde, B 1911 (p. 93).

Turritella fasciata d'Archiac, Garde, B 1911 (pp. 96, 98, 99); Pérébaskine, B 1932 (p. 47).

Mesalia fasciata (Lamarck) var. Douvillé, B 1920*a* (p. 153, Pl. 3, fig. 3).

Mesalia fasciata (Lamarck) mut. *praeteniata* Douvillé, B 1929 (p. 57, Pl. 9, figs. 17–20); Guaitani, 1947 (p. 44).

Mesalia fasciata (Lamarck) var. *fasciata* (Lamarck), Vialov & Solun, 1936 (p. 192).

Mesalia (*Sigmesalia*) *fasciata* (Lamarck), Chavan & Dupuis, B 1938 (p. 534).

MATERIAL. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 4) (FB. F. 1842, *10*+; FB. F. 1843, *69*, Reg. No. G. 68111–6; FB. F. 1845, *2*; FB. F. 1848, *4*; FB. F. 1850, *10*+; FB. F. 2021, *1*; FB. F. 1854, *2*; FB. F. 2022, *10*+; FB. F. 1855, *2*; FB. F. 1856, *1*; FB. F. 1857, *1*; FB. F. 1859, *1*); Green and Nodular Shales (local zone 5) (FB. F. 1871, *1*; FB. F. 1873, *4*); Rubbly Limestones (local zone 6) (FB. F. 1915, *1*); Lower Chocolate Clays (local zone 10) (FB. F. 1966, *4*); Lower Chocolate Clays (local zone 11/10) (FB. F. 1962, *1*); *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, *10*+); Ghazij Shales (local subzone 3*b*) (FB. F. 2678, *2*; FB. F. 2677, *6*; FB. F. 2676, *6*; FB. F. 2675, *10*+); Upper Chocolate Clays (lower part, local zone 12) (FB. F. 2536, *2*); *Kohat area* (*Tarkhobi section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *2*); *Kohat area* (*Panoba section*): Upper Kohat Shales (local subzone 4*a*) (FB. F. 2257, *1*); *Kohat area* (*Shekhan Nala section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2313, *1*); ?Gypsiferous Beds (just above local zone 3) (FB. F. 2374, *1*); Upper Kohat Shales (local subzone 4*a*) (FB. F. 2341, *1*).

FURTHER DISTRIBUTION IN PAKISTAN. *Cardita beaumonti* beds of Kasanen Chapar (Baluchistan), and west of Ranikot (type locality for mut. *praeteniata*); Hangu Shales of Hangu; Patala Shales of the Salt Range; Upper Ranikot (zone 1) of Western Pakistan;

Upper Ranikot (zone 2, lower part) 3 miles east of Leilan coal-pit; Upper Ranikot (zone 3) of Jherruck; Upper Ranikot (zone 4) of Jherruck, and the hilly ground north-east of Petiani (north-west of Kotri); Upper Ranikot of Thal; Laki of Western Pakistan; Khirthar of Western Pakistan.

FURTHER DISTRIBUTION. The species has a long vertical range and a wide geographical distribution, the following being a summary of the available information: Upper Cretaceous of Libya and Madagascar; Danian of Persia; Eocene or Maestrichtian of West Africa; Lower Lutetian of Constantine, Algeria and French Morocco; Alaian (Middle Eocene) of Ferghana; Lower Mokattam of Egypt; Bracklesham Beds of England; Lutetian of France (Grignon is the type locality) and Italy; Middle Eocene of Egypt, Hungary and Spain; Upper Mokattam of Egypt; Lower Bartonian of France, Switzerland and England; Eocene of Sardinia, Cyrenaica, eastern Soudan, Togo, Bosnia, the Aral Sea area, Casakstan, Somaliland and Libya.

MESALIA (*SIGMESALIA*) *RAKHIENSIS* n.sp.

(Figures 59*a*, *b*, plate 2)

MATERIAL. *Rakhi Nala section*: *Venericardia* Shales (local zone 1) (FB. F. 1836, the holotype, Reg. No. G. 68117).

DESCRIPTION. Early whorls missing and aperture broken on the single available specimen which consists of about two and three-quarter whorls. Shell turreted, rather broadly conic, only moderately elongate. Sutures linear, rather deeply sunk on account of the shape of the whorls. Whorls convex, greatest convexity at about one-third of their height, the posterior slope being less convex than the remainder of the surface, the anterior portion of the surface rather abruptly turned in towards the suture. Height of whorls about four-sevenths of their width. Principal ornament consisting of six strong, rounded spiral threads of which the two anterior are the weakest. Intervals between the spiral threads of fairly uniform width, although those above and below the posterior thread are greater than the remainder. Whole surface covered with very fine, closely spaced, incised spiral lines. Base of last whorl well rounded at the edge and tending to be slightly concave medially; there is an indication of one additional spiral thread near the margin. Growth lines fairly regularly and rather deeply arcuate, antecurrent posteriorly, meeting the anterior suture in a retrocurrent direction, the apex of curvature approximately at the second spiral thread from the posterior suture.

DIMENSIONS. Holotype: height (incomplete) 13·8 mm.; width (slightly increased by crushing) 9·1 mm.

REMARKS. This species is somewhat similar to *Turritella quinquecarinata* Doncieux (1908, p. 188, Pl. 10, figs. 11*a*–11*c*), from the Sparnacian of the southern Corbières, which differs in having only five primary spiral threads or keels, in having no fine spiral incised lines, in being more acicular, and in having the spiral ornament somewhat differently arranged in detail.

MESALIA (*SIGMESALIA*) *SORIENSIS* n.sp.

(Figure 16, plate 1)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*b*) (FB. F. 2678, the holotype, Reg. No. G. 68118, and 7 topotypes, Reg. No. G. 68119–5).

DESCRIPTION. Shell small, moderately turreted but not elongate, conic, with linear sutures and regularly and moderately strongly convex whorls, which are about half as high as wide, and which have their greatest convexity at about half their height. Protoconch, while present on some of the specimens, not clearly seen, evidently small, not high, smooth, little more than one whorl, and gently convex. Ornament on spire whorls consisting of seven or eight fine spiral threads of about the same width as their intervals. Growth lines apparently moderately deeply excavated, antecurrent posteriorly, meeting the anterior suture in a retrocurrent direction, the apex of the concave curve being a little below the middle of the whorls. Aperture broken, and whorls appearing subcircular in section. Even on small specimens the base is not well preserved and the extent to which the spiral ornament spreads on to it cannot be determined.

DIMENSIONS. Holotype: height (a little incomplete) 1·9 mm.; width 1·0 mm.

REMARKS. *Mesalia multisulcata* (Lamarck) as figured by Cossmann & Pissarro (B 1907–13, Pl. 21, fig. 126–11), from the Lutetian of the Paris Basin, is larger and more slender and has somewhat wider intervals between the spiral threads. The same species as figured by Glibert (B 1933, p. 48, Pl. 3, fig. 2), from the Bruxellian of Belgium, is much larger and has less regularly convex whorls. *M. regularis* (Deshayes) as figured by Cossmann & Pissarro (B 1907–13, Pl. 21, fig. 126–1), from the Lutetian of the Paris Basin, is larger, narrower, and has relatively wider and less convex whorls. *M. ecki* de Laub as figured by Cossmann & Pissarro (B 1907–13, Pl. 21, fig. 126–2), from the Lutetian of the Paris Basin, differs in a similar manner. *M. consobrina* (Deshayes) as figured by Cossmann & Pissarro (B 1907–13, Pl. 21, fig. 126–12), from the Lutetian of the Paris Basin, is larger, more slender, and the whorls are not so high. *M. solida* (Deshayes) as figured by Cossmann & Pissarro (B 1907–13, Pl. 21, fig. 126–10), from the Bartonian of the Paris Basin, also has less convex and wider whorls, is larger, and has relatively wider intervals between the spiral threads. *Turritella dumasi* Cossmann (1899, p. 317, Pl. 23 (2), figs. 4–5), from the Eocene of the Lower Loire, is also rather similar and has seven or eight spiral threads, but its whorls are less convex and its spire is more acute.

Family ARCHITECTONICIDAE

Genus *ARCHITECTONICA* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 78)

TYPE SPECIES. *Architectonica perspectiva* (Linné), Recent; Gray, 1847.

SYNONYMS. *Solarium* Lamarck, 1799 (*Mém. Soc. Hist. nat. Paris*, **1**, 74); type species: *Trochus perspectivus* Linné, Recent; monotypy.

Architectoma Gray, 1847 (*Proc. Zool. Soc. Lond.* **15**, 151) (*error*).

Subgenus *SOLARIAXIS* Dall, 1892

(*Trans. Wagner Inst. Sci. Philad.* **3**, part 2, p. 323)

TYPE SPECIES. *Solarium elaboratum* Conrad, Eocene; original designation.

SYNONYM. *Granosolarium* Sacco, 1892 (*I Moll. terr. terz. Piem. e Lig.* **12**, 59); type species: *Solarium millegranum* Lamarck, Pliocene; original designation.

ARCHITECTONICA (SOLARIAXIS) RAKHIENSIS n.sp.

(Figures 60*a*, *b*, plate 2)

MATERIAL. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 4) (FB. F. 1843, the holotype, Reg. No. G. 68126).

DESCRIPTION. Shell of moderate size, conic, with a very flat spire and a very obtuse apical angle, sharply carinate at the margin, the base flattened and umbilicate. Protoconch is not seen. At least four spire whorls. Upper surface of last whorl carrying seven spiral threads behind the keeled margin. The third thread from the anterior side is stronger than the others and is situated distinctly below the middle of the whorl; the most posterior thread, which borders the suture, is also somewhat stronger than the remainder, but is not so strong as the third thread. Traces of fine intercalary threads on the last half of the last whorl between the second and third, and between the fourth and fifth, spiral threads. All spiral threads bear distinct, rounded crenulations of which there are four in a distance of $\frac{3}{4}$ mm. in the adult shell. These crenulations may be a little wider than, of the same width as, or narrower than their intervals, and are stronger and more prominent on the stronger threads. Fine, distinctly antecurrent raised threads join the crenulations. Sutures linear. Carinate margin of body whorl crenulated like the spiral threads. Umbilicus, the interior of which is masked by matrix, occupying about half the width of the base. Base with four strong, crenulated spiral threads, the innermost one of which, forming the margin of the umbilicus, is coarser, and carries heavier, more widely spaced, and more wedge-shaped crenulations. Aperture crushed.

DIMENSIONS. Holotype (crushed): height 2·25 mm.; width 7·5 mm.

REMARKS. The solitary specimen is crushed, but shows the ornament on the upper surface and on the base quite well. *Solarium taramellii* Dainelli (B 1915, p. 533, Pl. 51, figs. 3, 4), from the Eocene of Italy, has less regular dorsal ornament, and the ornament on the base is also distinctly less regular. The stronger thread just below the middle of the whorls distinguishes *Architectonica (Solariaxis) rakhiensis* from Eocene species from the Paris Basin.

ARCHITECTONICA (SOLARIAXIS) PUNJABENSIS n.sp.

(Figures 17*a*, *b*, *c*, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, *2*; FB. F. 1995, the holotype, Reg. No. G. 68127, and 4 topotypes, Reg. No. G. 68128–31); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *2*).

DESCRIPTION. Shell rather small, solarioid, with a flatly conic, gently conoidal spire. Protoconch, as seen on a topotype, consisting of about two smooth, convex whorls, planorbiform, with deep sutures, and with its early part slightly obliquely placed. About one and a quarter spire whorls on the holotype. Sutures linear, distinct. Body whorl sharply carinate, carrying a crenulated cord on the carination. Posterior to this cord there is one slightly finer crenulated spiral cord behind which there are three ribbon-like, flat bands separated by fine, linear, rather shallow grooves. Ribbons split up into raised, axially directed, elongate crenulations, rather rectangular in shape, and with intervals

which may attain twice the width of the crenulations. Surface of whorls slightly convex; anterior band worn on the specimens available, but it can be accepted that the spiral thread anterior to the three bands was quite distinct from them. On the marginal keel the crenulations are closely spaced, the intervals being narrower, there being four crenulations in a distance of $\frac{3}{4}$ mm. The slightly convex base has an umbilicus occupying about seven-eighteenths of its width, and it carries four spiral threads or bands, the innermost one of which borders the umbilicus. These increase in size and thickness towards the umbilicus, the outside one being fine (but nevertheless prominent), the next more distinct, the two inner ones appearing rather ribbon-like with rather rectangular beading. Beads elongated in a radial direction, separated by rather narrower intervals; those on the margin of the umbilicus become wedge-shaped. On the holotype, the band outside that which limits the umbilicus splits into two unequal parts near the aperture; the two parts are separated by a fine incised line, and the outer part is only about one-third the width of the inner part. This feature is not seen on any of the topotypes, which are, however, smaller. Aperture subrhombic.

DIMENSIONS. Holotype: height 1·2 mm.; width 3·4 mm.

REMARKS. *Solarium bonneti* Cossmann (B 1901*a*, Pl. 3, figs. 16, 17), from the Eocene of the Paris Basin, is a little larger, has one less spiral band dorsally, and more numerous and more granular spiral threads on the base. The ornament is characteristic, and distinguishes it from other Eocene species from the Paris Basin.

Genus *PSEUDOMALAXIS* Fischer, 1885

(*Man. Conch.* p. 714)

TYPE SPECIES. *Pseudomalaxis zanclaea* (Philippi), Pliocene-Recent; monotypy.

SYNONYM. *Orbis* Lea, 1883 (*Contrib. to Geol.* p. 123)—*non* Mueller, 1767 (Pisces) *nec* Schroeter, 1776 (Moll.) *nec* (Lacépède) F. von Waldheim, 1813 (Pisces) *nec* Blainville, 1825 (Moll.); type species: *O. rotella* Lea, Eocene; monotypy.

REMARKS. Wenz places *Discosolis* Dall, 1892 in synonymy, but while the type species, '*Omalaxis*' *nobilis* Verrill, Recent, has a very similar shell, the operculum is very different and is trochoid. Since differences in the nature of the operculum are apparently of considerable significance in the Gastropoda, *Discosolis* is not here regarded as a synonym of *Pseudomalaxis* which has a torinioid operculum.

PSEUDOMALAXIS PUNJABENSIS n.sp.

(Figures 61*a*, *b*, plate 2)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68132).

DESCRIPTION. Shell very small, flattened, discoidal, smooth except for the two marginal carinae. Protoconch planorbiform, consisting of two smooth, convex whorls with well-marked sutures. Adult shell consisting of between one-quarter and half a whorl, transversely and narrowly rectangular in section. Upper and lower surfaces similar, sloping inwards towards the distinct suture line. Flank perfectly straight and vertical, forming a distinct sharp edge above and below, where it meets the upper and lower surfaces.

Aperture transversely rectangular, rather wide. Distinction between the smooth, convex-whorled protoconch and the sharply bicarinate adult shell very noticeable.

DIMENSIONS. Holotype: height 0·25 mm.; width 0·9 mm.

REMARKS. *Discohelix arabicum* Cuvillier (B 1930, p. 330, Pl. 20, fig. 21), from the Upper Mokattam of Egypt, has two similar marginal keels, but is larger and has a distinct circumsutural thread.

INCERTAE SEDIS

Genus *PUNJABIA* n.gen.

TYPE SPECIES. *Punjabia marginostriata* n.gen. et sp., Lower Eocene.

GENERIC CHARACTERS. Small, discoidal, flat above, convex and carinate below; protoconch smooth, planorbiform, large, of at least two whorls, separated from brephic stage by a transverse, raised ridge; upper surface with a sutural and a peripheral row of nodes which are joined by axial ribs; lateral margin with fine spiral threads between the peripheral row of nodes above and the row of nodes limiting the moderately wide umbilicus below; axial ribs run into the umbilicus from the row of nodes limiting it; whorl section pentangular.

REMARKS. This species is provisionally placed in the Architectonicidae on account of its general similarity to such forms as *Awarua* Mestayer, 1930 and *Calodiscus* Rehder, 1935. Such forms as *Munditia* Finlay, 1927 and *Pseudoliotina* Cossmann, 1925, which belong to the Liotiidae, do not seem to be so closely related.

PUNJABIA MARGINOSTRIATA n.sp.

(Figures 62*a*, *b*, *c*, plate 2)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68133).

DESCRIPTION. Shell very small, discoidal, flat or slightly concave above, rather convex and carinate below, with a wide umbilicus, dextral. Protoconch large, planorbiform, smooth, its periphery sharply rounded, its upper and lower surfaces convex, not very rapidly increasing in size; its earlier portion is obscure, but it seems to have consisted of about two whorls, and is shallowly umbilicate above and below. Junction of protoconch with the commencement of the first post-nuclear whorl marked by a sharp raised axial rib at right angles to the suture. The quarter post-nuclear whorl that is preserved shows the form and ornament well. It is flattened above in contradistinction to the convex upper surface of the whorls of the protoconch, and carries a row of not very conspicuous nodes by the suture; on the upper margin of the periphery there is a fine, sharp, upwardly turned spiral thread or fine carina which carries similar nodes; raised ribs, which are moderately coarse and slightly wider than their intervals, join the two rows of nodes, the ribs being slightly convex forwards and moderately antecurrent, and being so distributed that every alternate rib joining a node on the suture is formed by the fusion of two ribs arising on the periphery. Periphery itself bounded above by the outer noded thread, and below by a similar, distinctly noded thread, the intervening surface being moderately convex, a little receding downwards, and ornamented with five fine, simple, spiral threads of about the same width as their intervals. The strongly noded band forming the outer

margin of the umbilicus gives a subcarinate appearance to the median portion of the whorls in basal view. Umbilicus occupying about two-fifths of the width of the base, its margin not very well defined; that portion of the base between the margin and the lower noded carination is flat or even vaguely concave and is ornamented with simple, unbifid, rather antecurrent ribs which are a little narrower than their intervals and which connect with the nodes on the lower noded carination. Growth lines not clearly seen, apparently following the same course as the ribs. Whorl section pentagonal.

DIMENSIONS. Holotype: height 0·37 mm.; width 0·95 mm.

REMARKS. The form and ornament appear to be characteristic.

Family POTAMIDIDAE

Genus *PYRAZUS* Montfort, 1810

(*Conch. Syst.* **2**, 458–459)

TYPE SPECIES. *Pyrazus baudini* Montfort, Recent = *Cerithium ebeninum* Bruguière; original designation and monotypy.

SYNONYM. *Kleistopyrazus* Sacco, 1895 (*I Moll. terr. terz. Piem. e Lig.* **17**, 56); type species: *K. monstrosus* (Grateloup), Oligocene; original designation.

REMARKS. The peristome is more developed than usual in *Kleistopyrazus*, but it does not seem worth while retaining it as a subgenus. Wenz also places it in synonymy.

PYRAZUS INDICUS Cox, 1931

REFERENCES. *Pyrazus indicus* Cox, B 1931*a* (pp. 45, 27, 33, Pl. 1, figs. 12, 15).

MATERIAL. *Rakhi Nala section*: Shales with Alabaster (local zone 7) (FB. F. 1930, *1*; FB. F. 1932, *6*, Reg. No. G. 68134–9; FB. F. 1934, *2*; FB. F. 1935, *10*+; FB. F. 1941, *4*; FB. F. 1948, *10*+).

FURTHER DISTRIBUTION IN PAKISTAN. Ghazij Shales of Hindu Bagh (type locality).

REMARKS. Although the Rakhi Nala specimens are all moulds and are not very well preserved, there is sufficient left of the ornamentation and of the form to leave no doubt in the writer's mind that they belong to *P. indicus*. The two strong spiral keels on the edge of the body whorl, the general appearance, the apical angle, and the number, inclination and spacing of the ribs are all of the type found in Cox's species.

Family DIASTOMIDAE

Genus *DIASTOMA* Deshayes, 1850

(*Traité élém. Conch., Atlas*, p. 46)

TYPE SPECIES. *Diastoma costellata* Deshayes, Eocene = *Melania costellata* Lamarck; monotypy.

DIASTOMA RAKHIENSIS n.sp.

(Figures 18, 19, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68140, and 6 topotypes, Reg. No. G. 68141–6).

DESCRIPTION. Shell small, moderately turriculate. Early whorls missing and aperture broken on all available specimens. Whorls moderately convex, their height about two-thirds of their width. Sutures linear. Ornament consisting of axial ribs and spiral threads. Ribs well developed, distinct, almost vertical, tending to be very slightly retrocurrent as a whole, gently concave forwards, of about the same width as or very slightly narrower than their intervals. On the holotype strong varices are developed on the broken margin of the aperture and at positions 180°, a little more than 360°, and at 630° back from the aperture. Spiral ornament not very well preserved, but there are two primary spiral threads with intercalary finer threads on each whorl. All spiral threads cross over the ribs. A third strong spiral thread partially emerges from the anterior suture. Ornament extending on to the base, but is considerably fainter on broken specimens. Base declivous, slightly convex, appearing concave on broken specimens. Aperture apparently suboval, not canaliculate anteriorly. Growth lines subvertical as a whole, gently excavated posteriorly, gently prominent anteriorly.

DIMENSIONS. Holotype (broken): height (incomplete) 2·6 mm.; width 1·75 mm.

REMARKS. *Diastoma variculosum* Deshayes as figured by Dainelli (B 1919, p. 24, Pl. 1, fig. 4), from the Eocene of Italy, has more numerous spiral threads and more prominent varices. *D. hispanicum* Cossmann (1906*b*, p. 142, Pl. C, figs. 15, 16, 17), from the Eocene of Catalonia, and also figured by Cossmann & Pissarro (B 1907–13, Pl. 26, fig. 138–4), from the Cuisian of the Paris Basin, is less slender, larger, and has finer ornament. The small number of primary spiral threads, which with the ribs forms rather a coarse pattern, appears to be characteristic.

Family CLAVIDAE

Subfamily CAMPANILINAE

Genus *CAMPANILE* Bayle, in Fischer, 1884

(*Man. Conch.* p. 680)

TYPE SPECIES. *Cerithium giganteum* Lamarck, Eocene; Cossmann, 1889.

SYNONYMS. ?*Cerites* De Lamétherie, 1807 (*J. Physiol. Path. gen.* **65**, 411); type species: *cerites gigas* Lamarck, Eocene (*nomen dubium*).

Ceratoptilus Bouvier, 1887 (*Bull. Soc. philom. Paris*, (7), **11**, 36); type species: *Ceratoptilus laevis* (Quoy & Gaimard), Recent; monotypy.

Campanilopa Iredale, 1917 (*Proc. Malac. Soc. Lond.* **12**, 322, 325); type species: *Cerithium giganteum* Lamarck, Eocene; monotypy and original designation.

REMARKS. The name *cerites* was used by de Lamétherie with a small initial letter, and the species was insufficiently characterized. *Campanilopa* was proposed by Iredale on the basis that the type species of *Campanile* was not *Cerithium giganteum*.

CAMPANILE GIGANTEUM (Lamarck), 1804

REFERENCES. *Cerithium giganteum* Lamarck, 1804*a* (p. 439); Lamarck, B 1806*a* (Pl. 14, fig. 1); J. Sowerby, B 1818 (**2**, 199, Pl. 188, fig. 2); Deshayes, 1833 (p. 300, Pl. 42, figs. 1, 2); Verneuil, 1838 (p. 21); Nyst, B 1843 (p. 534 (pars)); Leymerie, B 1846 (p. 356); Bronn, B 1848*a* (p. 268); d'Archiac, B 1850*b* (pars) (**3**, 287, 112, 118, 174, 178); Dixon,

B 1850 (pp. 26, 101, Pl. 6, fig. 10); Bellardi, B 1852 (p. 225); Stache, B 1864 (p. 107); Deshayes, 1864 (p. 115); Zivic, 1868 (p. 4); Suess, 1868 (pp. 271, 273); K. Mayer, B 1869 (p. 367); Fuchs, B 1870 (p. 142); E. Pavay, B 1871 (p. 424); Stukenberg, B 1873 (pp. 249, 254, 263, 264); K. Mayer-Eymar, B 1877 (p. 87); Mallada, B 1878 (pp. 317, 321, 323, 406); Duncan, B 1880 (pp. 32, 58); Blanford, B 1880 (p. 140); Carez, B 1881 (pp. 36, 60, 165); Maureta & Thos y Codina, B 1881 (pp. 321, 324, 326); Zittel, B 1883 (p. 103); Mallada, B 1883 (p. 56); Carez, 1883 (pp. 162, 163); Cya, B 1883 (p. 56); Harris & Burrows, B 1891 (pp. 8, 16, 18); Mallada, B 1892 (p. 205); Oppenheim, B 1894 (p. 444); de Gregorio, B 1894*b* (pp. 18, 4, 7, Pl. 2, figs. 64, 65); de Gregorio, B 1896 (pp. 74, 24, 129); Oppenheim, B 1900*a* (pp. 5, 7); Oppenheim, B 1901*a* (p. 186); Oppenheim, B 1901*b* (p. 189); Marinelli, 1902 (p. 209); Dainelli, B 1904 (p. 145); Newton, B 1905 (p. 155); Taeger, B 1908 (p. 87); Popescu-Voitesti, 1911 (p. 304); Boussac, 1912 (pp. 19, 24, 25, 27); Fabiani, B 1915 (pp. 109, 142, 146); Dainelli, B 1915 (pp. 118, 122, 125, 134); Abrard, B 1925*a* (pp. 224, 41, 44, 45, 46, etc.); L. M. Davies, B 1926*a* (p. 367); Vredenburg, 1927 (p. 11); Leriche, 1929 (pp. 68 (pars), 70, 71, 73); Cuvillier, B 1930 (pp. 88, 105, 127); Robert, B 1932 (p. 35); Reina, B 1933 (p. 840); Reina, B 1934 (p. 53); Tomor-Thirring, B 1935 (p. 6); Pinard, 1936 (p. 102); Coulon, B 1936 (pp. 33, 46); Farchad, B 1936 (p. 30); Leriche, 1937 (pp. 95, 96); Stefanini, B 1938 (p. 13); Leriche, B 1939*b* (pp. B. 214, B. 215, B. 217, etc.).

Cerithium cornucopiae Lamarck, Taramelli, 1869 (p. 9 (pars)); Taramelli, B 1870 (p. 43); Pirona, 1877 (p. 46); Marinoni, B 1877 (p. 14 (pars)).

Cerithium cf. *incomptum* Dixon, Bayan, B 1870 (p. 458).

Cerithium giganteum Lamarck var. *claudiopolitanum* E. Pavay, B 1871 (p. 360).

Cerithium giganteum Deshayes, A. von Pavay, B 1874 (pp. 362, 412, 415).

Cerithium vicetinum Bayan, Marinoni, 1878 (p. 6); Taramelli, B 1881 (p. 102 (pars)); Mariani, B 1892 (p. 32 (pars)); Marinelli, 1902 (p. 210).

Cerithium cf. *giganteum* Lamarck, Medlicott & Blanford, B 1879*b* (p. 459); Duncan, B 1880 (p. 9).

Cerythium giganteum Lamarck, Maureta & Thos y Codina, B 1881 (p. 330).

Cerithium (*Campanile*) *giganteum* Lamarck, Cossmann, 1889 (p. 26); Harris & Burrows, B 1891 (p. 88); Oppenheim, B 1896*a* (pars) (pp. 183, 217, 218, Pl. 12, figs. 5, 5*a*); Fabiani, B 1905 (p. 146); Cossmann, 1906*c* (p. 71); Dollfus & Chédeville, in Dollfus, B 1909 (p. 18, table opp. p. 24); Fabiani, B 1915 (p. 254); Dainelli, B 1915 (pp. 584, 500, 80, Pl. 52, fig. 11); Oppenheim, B 1923 (p. 77); Abrard, B 1925*a* (p. 245); Leriche, B 1939*b* (p. B. 219); Furon & Soyer, B 1947 (p. 115).

Cerithium cf. *giganteum* Defrance, Munier-Chalmas, B 1891 (p. 46).

Campanile giganteum (Lamarck), Newton, B 1891 (p. 188); Cossmann, 1906*c* (Pl. 1, figs. 1, 2; Pl. 2, fig. 1); Cossmann & Pissarro, B 1907–13 (Pl. 25, fig. 137–45); Boussac, 1912 (pp. 20, 23, 24, 32, 86, 87, Pl. 10, fig. 24); Oppenheim, B 1923 (p. 95); Gočev, B 1926 (pp. 88, 89); Douvillé, B 1928 (p. 9); Gočev, B 1933*a* (pp. 39, 73, 10, 11, 17, 63, 67); Stefanini, B 1938 (pp. 24, 32); Leriche, B 1939*b* (p. B. 237); Wrigley, 1940*b* (p. 104, figs. 9, 10, 11).

Cerithium giganteum Lamarck var. *propemarginatum* de Gregorio, B 1894*b* (pp. 18, 7, Pl. 2, figs. 66, 67).

Cerithium sp. Marinelli, 1896 (p. 61 (pars)); Marinelli, 1902 (p. 211).

'Large *Cerithium*' L. M. Davies, B 1925 (p. 213).

Campanile ('*Cerithium giganteum*') Wrigley, B 1934 (p. 4).

MATERIAL. *Kohat area* (*Shekhan Nala section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2377, *1*, Reg. No. G. 68148; FB. F. 2310, *4*; FB. F. 2366, *2*; FB. F. 2368, *3*); Middle Shekhan Limestone (local subzone 3*a*) (FB. F. 2370, *3*; FB. F. 2372, *1*, Reg. No. G. 68147; FB. F. 2371, *2*); *Kohat area* (*Gada Khel*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2102, *1*, Reg. No. G. 68149).

FURTHER DISTRIBUTION IN PAKISTAN. Lower Shekhan Limestone of the Kohat area; recorded from the Shekhan Limestone near Jutana (Salt Range), but there is no Shekhan Limestone in the Salt Range—it seems possible that it was intended to refer to Sakesar Limestone; Khirthar of the Hala Pass.

FURTHER DISTRIBUTION. This well-known species has a wide geographical distribution, and the following is a summary of the information as to its range and distribution: Libyan of Egypt; Bracklesham Beds of England; Parisian of Hungary; Lutetian of Italy, France, north-eastern Bulgaria and the Isle of Rhodes; Middle Eocene of Egypt; Auversian of Italy; Barton Beds of England; Bartonian of the Isle of Rhodes; Eocene of Switzerland, Spain, Herzegovina, Somaliland and the Crimea.

REMARKS. Although the forms here recorded are mostly moulds, there seems to be no doubt that they belong to the common and widely distributed species *Cerithium giganteum* rather than to the less common and less widely distributed species *C. auversiense* or *C. vicetinum*. *C. auversiense*, which seems to be the most closely related species, does not have quite such a slender spire as in *C. giganteum*, and the spiral bands are less numerous. According to Leriche (B 1939*b*), the horizon, which is apparently just above the top of the Sables de Glennes and which has yielded *C. giganteum*, is the oldest horizon from which the species has been recorded. This horizon is apparently of lower Lutetian age, however, and the Egyptian and Pakistan occurrences include horizons of Lower Eocene age.

Records of *C. giganteum* Lamarck by Nyst (B 1845 (pars), p. 534) refer to *Campanile auversiense*, by Leymerie (B 1846, p. 367, Pl. 16, fig. 2) refer to *Cerithium* (*Campanile*) *incomptum* Dixon, 1850 *sec* Schlosser, 1925 = *Cerithium* (*Campanile*) *leymeriei* Bellardi, 1852, and by de Gregorio (B 1894*b*, p. 18, Pl. 2, figs. 64, 65) refer to *Campanile vicetinum* (Bayan). Bellardi's (B 1852, pp. 225, 292) record of *Cerithium giganteum* from the Eocene of Belgium and Fallot's (1895, p. 283) record from the Oligocene of Langon are omitted.

Genus *CHONDROCERITHIUM* Monterosato, in Cossmann, 1906

(*Ess. Pal. Comp.* **7**, 82)

TYPE SPECIES. *Cerithium calculosum* Basterot, Miocene; original designation.

CHONDROCERITHIUM PAKISTANICUM n.sp.

(Figures 20 to 23, plate 1; figure 63, plate 2)

MATERIAL. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 4) (FB. F. 2011, *2*; FB. F. 2014, *2*; FB. F. 1850, *6*, Reg. No. G. 68157–62; FB. F. 1852, *1*; FB. F. 2021, *1*;

FB. F. 2022, *2*; FB. F. 1855, *2*; FB. F. 1860, *1*); *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2680, *2*; FB. F. 2679, *10*+); Ghazij Shales (local subzone 3*b*) (FB. F. 2678, the holotype, Reg. No. G. 68150, and 17 topotypes, Reg. No. G. 68151–6; FB. F. 2676, *1*).

DESCRIPTION. Shell rather small, conic, turreted, rather broad. Protoconch not well preserved, apparently small and consisting of not more than two smooth, convex whorls. On a specimen 4·1 mm. high there were not more than five or six spire whorls. Early spire whorls carinate; there is one spiral thread on the shelving shoulder, one forming the shoulder itself, one half-way between the shoulder and the anterior suture, and one partly emerging from the anterior suture. These spiral threads cross, and form small crenulations on, the axial ribs, which are subvertical as a whole, gently concave forwards, and a little narrower than their intervals. Spiral threads themselves slightly narrower than their intervals, so that the crenulated reticulate pattern is rather coarse-meshed in spite of the strength of the ribs and threads. Sutures not well seen, apparently linear. On later whorls the sharpness of the shoulder is lost, the whorls being regularly and gently convex, about two and a quarter times as wide as high, and having their widest diameter almost at half their height. Four equally spaced spiral threads, with a secondary thread in each interval. Approximately 17 ribs on the body whorl of the holotype. Apertural region of all specimens either broken or obscured by matrix. There was a thick, prominent labial varix, another very thick varix about five-eights of a whorl behind it, and there are a few irregularly spaced, considerably less prominent varices in earlier stages. Base carrying an extension of the same type of ornament as on the flanks of the whorls. Columellar lip callous, gently excavated, with a parietal fold. Growth lines gently antecurrent posteriorly, gently excavated medially, gently prominent anteriorly. There is some variation in the height of the spire, that of some of the Rakhi Nala specimens being rather more elongate; this may be due to the mode of preservation.

DIMENSIONS. Holotype: height 4·5 mm. (5·25 mm. restored); width 2·25 mm. Topotype: height 3·75 mm.; width 2·1 mm.

REMARKS. Although the general characters place this species close to *Cerithium calculosum*, the spiral threads are more widely spaced and the varices more irregularly placed, apart from the shell being of considerably smaller size. *C. Dal Lagoi* Oppenheim as figured by Fabiani (B 1905, p. 149, Pl. 3, fig. 6), from the Eocene of Italy, is considerably larger, and has much coarser and more nodular ribs. *C.* (*Vulgocerithium*?) *pratti* Rouault as figured by Dainelli (B 1919, p. 32, Pl. 1, figs. 15, 16), from the Eocene of Croatia, is much larger, has more regularly convex whorls, and has much coarser ribbing. *C. subfragile* Rouault (B 1850, p. 480, Pl. 16, fig. 8), from the Eocene near Pau, is larger, less muricate, and has less distinct ribbing. *C. chevallieri* Cossmann as figured by Cossmann (1889, Pl. 1, figs. 18, 19), from the Eocene of the Paris Basin, is larger, a little more broadly conic, with somewhat less distinct ornament and less deeply incised sutures. While there is some resemblance to *C. lamellosum* Bruguière as figured by Deshayes (1833, p. 370, Pl. 44, figs. 8, 9), from the Eocene of the Paris Basin, the ribs are less curved; Cossmann & Pissarro's illustration of *C.* (*Ptychocerithium*) *lamellosum* Lamarck (B 1907–13, Pl. 24, fig. 137–39), from the Lutetian of the Paris Basin and from the Bartonian, is of a considerably larger form with more delicate ornament. Comparison with specimens of *lamellosum* in

the British Museum (Natural History) shows that the Pakistan species is smaller, has straighter ribs, coarser spiral threads, larger and more swollen varices in the adult shell, and does not develop the strong, sharp spiral threads or keels on the base of the body whorl. The characters seem to indicate the placing of the species as a *Chondrocerithium* rather than a *Ptychocerithium*.

Genus *PTYCHOCERITHIUM* Sacco, 1895

(*I Moll. terr. terz. Piem. e Lig.* **17**, 23)

TYPE SPECIES. *Cerithium granulinum* Bonelli, Miocene; original designation.

PTYCHOCERITHIUM sp. A

(Figure 24, plate 1)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68163).

DESCRIPTION. First few whorls missing, and outer lip broken. Shell not very well preserved, moderately small, turriculate, moderately slender, practically conic in outline, with a high spire. Whorls gently convex, about half as high as wide, ornamented with axial ribs and spiral threads. The latter are four in number, equally spaced, somewhat flattened but nevertheless distinct, separated by intervals about one and a half times as wide as they are. Ribs distinct, relatively fine and sharp, subvertical, vaguely concave forwards, separated by intervals twice as wide as they are, carrying distinct crenulations where the spiral threads cross them. Body whorl gently convex, the flank passing insensibly into the short, gently convex base. Ribs even more widely spaced than on earlier whorls, and there is a fine secondary spiral thread in each of the intervals between the four primary spiral threads. Base with seven additional spiral threads anteriorly, the first and fourth being finer than the others. Ribs rapidly dying out on the base, developing into swollen varices at various places on the surface of the spire and body whorl. Columellar lip relatively fairly callous and well-excavated. Growth lines apparently more or less vertical, slightly concave forwards.

DIMENSIONS. Holotype: height (incomplete) 9·2 mm.; width 3·0 mm.

REMARKS. The general form and ornament, and the manner in which the varices are developed, seem to place this species as a *Ptychocerithium*. It is probably a new species, but the preservation is not quite good enough for it to be named. Compared with *Cerithiopsis punjabensis* this species has varices, and the outline of the whorls is more convex, the ribs also being not quite so straight. *Chondrocerithium pakistanicum* is less elongate, differs in the details of the ornament, and also develops large swollen varices.

Family CERITHIOPSIDAE

Genus *CERITHIOPSIS* Forbes & Hanley, 1851

(*Hist. Brit. Moll.* **3**, 364)

TYPE SPECIES. *Murex tubercularis* Montagu, Recent; monotypy.

SYNONYM. *Trachyschoenium* Cossmann, 1889 (*Ann. Soc. malac. Belg.* **24**, 47); type species: *Cerithium alveolatum* Deshayes, Eocene; original designation.

CERITHIOPSIS PUNJABENSIS n.sp.

(Figure 64, plate 2)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68164).

DESCRIPTION. Early whorls missing and outer lip broken. Shell moderately small, turriculate, slender, with a conic, long and high spire. Seven spire whorls preserved, the whorls being stiffly cylindrical in outline, only vaguely convex, about five-eighths as high as wide. Sutures linear, the whorls slightly stepped. Ornament consisting of ribs and spiral threads. The latter number four, are equally spaced, and are of about the same width as their intervals; a considerably finer, unbeaded spiral thread adjacent to the anterior suture. Ribs prominent, straight, vaguely retrocurrent, of about the same width as or slightly narrower than their intervals, and giving rise to distinct beads or crenulations where the spiral threads cross them. Body whorl small, short, its flank gently convex, its base slightly convex; it carries five rather smooth spiral cordons on the base anterior to the continuation of the ornament seen on the spire. On the body whorl there is one fine intercalary thread in each interval between the primary spiral threads. No varices. Columella evidently short and moderately callous, the columellar lip only gently excavate. Growth lines practically vertical, very slightly concave, very slighty retrocurrent.

DIMENSIONS. Holotype: height (incomplete) 10·5 mm.; width 3·2 mm.

REMARKS. While showing some superficial resemblance to *Cerithium plicatum* Bruguière as figured by Oppenheim (B 1896*b*, p. 111, Pl. 5, fig. 13), from the Priabonian (Muschellumachelle) of Italy, it is considerably smaller, the aperture less disjunct, and the whorls stiffer in outline. The nature of the ornament on the spire, the non-carinate edge of the base of the body whorl, and the presence of spiral ornament on the base place this species as a *Cerithiopsis* rather than a *Cerithiella*.

Genus *TRYPANAXIS* Cossmann, 1889

(*Ann. Soc. Roy. malac. Belg.* **24**, 60)

TYPE SPECIES. *Cerithium umbilicatum* Lamarck, Eocene; original designation.

TRYPANAXIS? *DAVIESI* Cox, 1938

REFERENCES. *Trypanaxis*? *daviesi* Cox, B 1938*b* (p. 173, Pl. 8, figs. 1, 3, 4, 5).

MATERIAL. *Rakhi Nala section*: Shales with Alabaster (local zone 7) (FB. F. 1952, *2*, Reg. No. G. 68165–6).

FURTHER DISTRIBUTION IN PAKISTAN. Lower Chharat of Barbara Banda (35 miles south-south-west of Kohat)—the type locality.

REMARKS. The Rakhi Nala specimens, although not well preserved, agree well with Cox's illustrations in the general shape of the shell and in the proportions of the whorls. The Rakhi Nala occurrence is evidently slightly lower than the Barbara Banda one.

Family TRIFORIDAE

Genus *TRIPHORA* Blainville, 1828

(*Dict. Sci. nat.* **54**, 344)

TYPE SPECIES. *Triphora gemmata* Blainville, Recent = *Cerithium tristoma* Blainville; monotypy.

SYNONYM. *Biforina* Bucquoy, Dollfus & Dautzenberg, 1884 (*Moll. mar. Roussillon*, **1**, 209); type species: *Triforis perversus* (Linné), Oligocene-Recent; monotypy.

REMARKS. The name *Tristoma* (Blainville, 1828, *Dict. Sci. nat.* **55**, 368; and Deshayes, 1832, *Encycl. Méth.* (*Vers*), **3**, 1053), *non* Cuvier, 1817 (Verm.), was not intended as a generic name and was quoted in error; it actually refers to *Triforis* Deshayes, 1834, not to *Triphora*. Menke's 1830 quotation (*Syn. méth. Moll.* 2nd ed., p. 57) of *Tristoma* Deshayes seems to fall into the same category.

TRIPHORA RAKHIENSIS n.sp.

(Figure 25, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68167, and 1 topotype, Reg. No. G. 68168).

DESCRIPTION. Shell small, turriculate, sinistral, early whorls missing and aperture broken on the available specimens. Sutures linear, distinct, moderately incised. Whorls, apart from the effect of the spiral threads, cylindrical in outline, about half as high as wide. Ornament consisting of three spiral threads, together with axial riblets which are beaded at their intersection with the spiral threads. The topotype shows that the earlier whorls had two strong spiral cordons, one adjacent to each suture, and that in later whorls a finer thread develops in between them at about two-thirds the height of the whorl. On earlier whorls the median portion is more excavated than later on. Ribs not coarse, about half the width of their intervals, distinctly antecurrent except anterior to the anterior cordon, where they are more vertical; the beads developed where they intersect the two primary spiral threads do not correspond, one on the lower thread being below the interval between two beads on the upper thread. The intercalary spiral thread does not affect the direction of the ribs, but merely produces an additional crenulation upon them two-thirds of the way up from the anterior thread. Base of last whorl sharply carinate at the edge, almost smooth and flattened beneath, this appearance probably being due to breakage. Aperture subcircular to subquadrate, evidently with a short, narrow, oblique anterior canal. Growth lines not observed.

DIMENSIONS. Holotype: height (broken, only three whorls) 2·6 mm.; width 1·5 mm.

REMARKS. *Triforis* cf. *inversus* Deshayes as figured by Oppenheim (B 1901*a*, p. 207, Pl. 18, fig. 11), from the Priabonian of northern Italy, is somewhat similar, but the median row of nodes is still less developed. Oppenheim's illustration, incidentally, shows a form which is much less cylindrical than *T. inversus* as figured by Cossmann & Pissarro. *Ogivia singularis* (Deshayes) as figured by Cossmann & Pissarro (B 1907–13, Pl. 27, fig. 146 *bis*–1), from the Lutetian of the Paris Basin and from the Bartonian, has a less stiffly turreted outline and the ornament differs in detail. The high, turreted, cylindrical form, conic

spire, nature of ornament, and nodes not in vertical alignment place this species as a *Triphora sensu stricto* rather than in the subgenus *Ogivia*. The details of the ornament appear to be characteristic of the species.

Subgenus *EOCAUTOR* n.subg.

TYPE SPECIES. *Triphora* (*Eocautor*) *soriensis* n.subg. et sp., Upper Eocene.

SUBGENERIC CHARACTERS. Small, sinistral, with three spiral threads developing crenulations where they intersect the retrocurrent axial riblets; moderately turreted, outline regularly conic; protoconch consisting of one smooth, convex whorl followed by four whorls carrying two prominent, regularly spaced, thick and rounded spiral keels.

REMARKS. This form shows some resemblance to *Cautor* Finlay, 1927, and *Hypotriphora* Cotton & Godfrey, 1931, from the Recent faunas of Australia, which appear to be the only named genera or subgenera with spiral keels on the protoconch. *Cautor* differs in having a protoconch of three whorls only, the first smooth and swollen, the second and third with two spiral keels. *Hypotriphora* has a protoconch of three and a half whorls, the first whorl having two smooth, high, narrow, anteriorly placed keels, the remainder with a small extra keel by the suture.

TRIPHORA (*EOCAUTOR*) *SORIENSIS* n.sp.

(Figure 65, plate 2)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68169).

DESCRIPTION. Shell small, turreted, with a high spire which is strictly conic in outline, sinistral. Protoconch consisting of five whorls, high and tectiform, the first whorl small, moderately convex, and smooth, the remainder with two regularly spaced, prominent, rounded carinae. The first spire whorl carries two crenulated spiral cordons which are the continuation of the smooth carinae of the later whorls of the protoconch. Later whorls on the adult shell develop a third crenulated spiral cordon between the upper cordon and the posterior suture. Axial ornament consisting of moderately fine but distinct, straight, retrocurrent riblets which develop crenulations where they meet the spiral cordons. Whorls themselves flat-sided, about twice as wide as high. Holotype with three whorls after the protoconch, later whorls evidently being broken off. Last whorl preserved with an extra fourth smooth spiral cordon anteriorly, which forms a marginal angulation, and limits the flattened, smooth base. Aperture evidently subcircular to subquadrate. Growth lines not seen.

DIMENSIONS. Holotype: height 1·4 mm.; width 0·55 mm.

REMARKS. Although there is only one specimen available, it is so well preserved and the characters of the protoconch are so distinctive that it merits naming. The outline of the whorls and the straightness of the ribbing easily distinguish it from *Triphora rakhiensis*. The species evidently belongs to a little known group of eastern shells, which includes *Cautor* Finlay and *Hypotriphora* Cotton & Godfrey, characterized by the development of spiral keels on the protoconch.

Superfamily PTENOGLOSSA

Family SCALIDAE

Subfamily SCALINAE

Genus *SCALA* Bruguière, 1792

(*Enc. Méth.* (*Text*). *Vers I*, Fasc. 2, p. 532)

TYPE SPECIES. *S.* (*S.*) *scalaris* (Linné), Recent; Thiele, 1929.

SYNONYMS. *Epitonium* Bolten, in Röding, 1798 (*Mus. Bolt.* part 2, p. 91); type species: *Turbo scalaris* Linné, Recent=*Scalaria pretiosa* Lamarck; Suter, 1913.

Cyclostoma Lamarck, 1799 (*Mém. Soc. Hist. nat. Paris*, p. 74); type species: *Turbo scalaris* Linné, Recent; monotypy.

Scalaria Lamarck, 1801 (*Syst. Anim.* p. 88); type species: *Scalaria conica* Lamarck, Recent= *Turbo scalaris*, Linné; monotypy.

Scalatarius Duméril, 1806 (*Zool. Anal.* p. 164) (name without species——=*Scalaria*).

Scalarus Montfort, 1810 (*Conch. Syst.* **2**, 294); type species: *Scalarus scalatus* Montfort, Recent= *Turbo scalaris* Linné; monotypy and original designation.

Aciona Leach, 1815 (*Zool. Miscell.* **2**, 79); type species: *Aciona scalaris* Leach, Recent = *Turbo scalaris* Linné; monotypy.

REMARKS. Thiele's use in 1929 of the name *Scala* Bruguière, 1792 is the first that the writer can find; since the International Rules of Zoological Nomenclature now recognize names established in the manner of those proposed by Bruguière, and since *S.* (*S.*) *scalaris* (Linné), Recent is the only species mentioned by Thiele under *Scala sensu stricto*, this species automatically becomes the type species by monotypy.

Subgenus *CRISPOSCALA* de Boury, 1886

(*Monogr. Scalidae Viv. Foss.* **1**, part 1, p. 1)

TYPE SPECIES. *Crisposcala* (*Scalaria*) *crispa* (Lamarck), Eocene; original designation.

SCALA (*CRISPOSCALA*) *RAKHIENSIS* n.sp.

(Figures 26*a*, *b*, 27, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (lower part, local zone 12) (FB. F. 1975, the holotype, Reg. No. G. 68170, and 1 topotype, Reg. No. G. 68171); Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, *1*); Upper Chocolate Clays (upper part, local zone 14) (FB. F. 1990, *1*); *Zinda Pir section*: White Marl Band (local zone 11) (FB. F. 2548, *1*); Upper Chocolate Clays (lower part, local zone 12) (FB. F. 2528, *1*).

DESCRIPTION. Shell of moderate size, moderately turreted, not very high, spire regularly conic in outline, spiral angle evidently somewhat variable. Protoconch and early spire whorls missing. Whorls gently convex in outline, except where slightly shouldered posteriorly by the subspinous development of the ribs, about twice as wide as high. Ornament consisting of straight, antecurrent, thick ribs which are curved over away from

the aperture like the crest of a wave, the forward side being convex, the other side concave with a sharp edge at the top; on account of the turning over, the ribs appear distinctly wider than their intervals, but in early whorls the amount of turning over is less and the ribs are distinctly narrower than their intervals. Whole surface covered by a fine raised network formed of oblique, microscopic threads running in a retrocurrent direction, and of oblique, antecurrent, microscopic threads in the intervals, the resulting network being rather square, or rectangular with the longer side in the antecurrent direction. Approximately 15 microscopic retrocurrent threads in $\frac{3}{4}$ mm. Beneath the microscopic network in the intervals between the ribs there are moderately thick and flat spiral threads which are rather narrower than their intervals; on a whorl 3·0 mm. in width there are five threads in $\frac{3}{4}$ mm. Ribs occasionally developing into large, prominent, swollen varices. Body whorl gently convex on the flanks, not very high, base declivous and slightly to gently convex, with a distinct raised spiral cordon separating off the basal disk over which the ribs continue. Ribs subspiny where they cross the spiral cordon. Aperture circular, developing a siphonal fasciole close to and bordering the basal disk. Outer lip strongly varicose, gently antecurrent, straight, and forming a moderately wide surface in the plane of the aperture, a surface which carries a vague depression close to its thin inner margin. External margin of outer lip where it forms the anterior end of the aperture bluntly pointed. Umbilicus evidently very small, obscured by matrix.

Dimensions. Holotype: height (incomplete) 8·25 mm.; width 4·5 mm.

Remarks. *Epitonium* (*Crisposcala*) *tenuilamellum* (Deshayes), from the Eocene of Europe and from the Upper Ranikot of Western Pakistan, and *E.* (*C.*) *subtenuilamellum* (d'Archiac & Haime), from the Gaj of Western Pakistan, both have very much more shouldered whorls, the surface of the whorl posterior to the shoulder in most cases forming a wide, flat platform. *Scala* (*Crisposcala*) *morgani* Vasseur as figured by Cossmann (1902, p. 21, Pl. 3, figs. 1, 2), from the Eocene of the Lower Loire, does not have the ribs subspinose posteriorly, its whorls are more regularly convex, and the intervals between its ribs are broader. *S.* (*C.*) *mediana* de Boury as figured by Cossmann (1902, p. 25, Pl. 3, fig. 10), from the Eocene of the Lower Loire, differs in a similar manner, and its ribs are also more delicate. The combination of the rather vague shouldering of the whorls, the moderately deep sutures, the apical angle, and the strength and frequency of the ribbing distinguish the Pakistan form from Paris Basin species.

Genus *GYROSCALA* de Boury, 1887

(*Étude Sous-Genres Scalidae Bassin de Paris*, p. 15)

Type species. *Gyroscala* (*Scalaria*) *commutata* (Monterosato), Recent; original designation.

GYROSCALA? *PUNJABENSIS* n.sp.

(Figure 28, plate 1)

Material. *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2733, the holotype, Reg. No. G. 68172).

Description. Shell small, not very turriculate, rather stout, conic. Protoconch missing and aperture broken, the specimen consisting of four whorls, the first and second being

poorly preserved. Whorls rather strongly convex, vaguely shouldered posteriorly, their height about three-fifths of their width. Sutures deeply sunk. Ornament consisting of thin, sharp, distinct, fairly straight and vertical axial ribs, which are separated by wide intervals, and which number about eight on the last half whorl, together with fine incised spiral lines in the intervals. These incised lines are faint, narrower than the spaces between them (although becoming more widely spaced on the last whorl), and number about six on the penultimate whorl. There are no varices. Last whorl relatively large, its basal disk limited by a spiral thread on which the axial ribs, which pass over it and over the basal disk itself, form minute spines. Growth lines not observed.

DIMENSIONS. Holotype: height (incomplete) 1·75 mm.; width 0·75 mm.

REMARKS. This species is only tentatively assigned to *Gyroscala* on account of the presence of spiral ornament, although it is realized that *Gyroscala* does sometimes have faint spiral ornament. The nature of the ribbing, and the basal disk limited by a thread over which the axial ribs pass, seem to suggest association with *Gyroscala. Scalaria* (*Gyroscala*) *stueri* (de Boury) as figured by Cossmann (B 1891*a*, p. 48, Pl. 3, fig. 12), from the Lignite Stage of the Paris Basin, is more turreted, and does not have the small prickles where the ribs pass over the spiral thread limiting the basal disk. The French species was also recorded as *Scala* (*Cirsotrema*) *stueri* Cossmann by Cossmann & Pissarro (B 1907–13, Pl. 8, fig. 52–47), from the Sparnacian of the Paris Basin. *Scala* (*Gyroscala*) *tunioti* Cossmann (B 1901*a*, p. 33, Pl. 6, fig. 30), from the Sparnacian Lignites of the Paris Basin, has thicker and less numerous ribs; Cossmann & Pissarro's illustration of the species (B 1907–13, Pl. 8, fig. 52–48), from the same locality, is of a somewhat larger form.

Genus *CIRSOTREMA* Moerch, 1852

(*Cat. Conch. Yoldi*, p. 49)

TYPE SPECIES. *Scalaria varicosa* Lamarck, Recent; monotypy.

SYNONYM. *Caloscala* Tate, 1885 (*South. Sci. Rec.* Jan. 1885, **2**, 3); type species: *Scalaria mariae* Tate, Recent; quoted in Cossmann (1912).

REMARKS. Although Wenz places *Pseudosthenorytis* Sacco, 1891 (*I Moll. terr. terz. Piem. e Lig.* **9**, 43—type species: *Cirsotrema sthenorytoides* Sacco, Miocene; monotypy) in the synonymy of *Cirsotrema*, it seems to belong more properly to the *Sthenorytis* group of shells where Cossmann provisionally placed it as a synonym. Cossmann in 1912 (*Ess. Pal. Comp.* **9**, 49) misspelt the name as *Pseudostenorhytis*.

CIRSOTREMA DIVERSIFORMIS n.sp.

(Figures 29*a*, *b*, plate 1; figure 66, plate 2)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68173, and 15 topotypes, Reg. No. G. 68174–9).

DESCRIPTION. Shell of moderately small to moderate size, turriculate, slender, with a long, high spire, strictly conic in outline. Protoconch not preserved, evidently very small. On a small topotype one smooth, sharply convex whorl, with a deeply sunk suture on account of the loose coiling, may belong to the protoconch. On this topotype, the next

five spire whorls are bicarinate, there being two strong spiral threads, the anterior of which is situated closer to the anterior suture than the posterior one is to the posterior suture. On the fourth whorl an intercalary thread develops midway between the posterior primary thread and the posterior suture, and on the next whorl an intercalary thread develops in between the two primary threads. These spiral threads cross over straight, vertical axial riblets which are distinctly narrower than their intervals and which develop small crenulations at the points of intersection with the spiral ornament. On the first two whorls or so, the posterior primary spiral thread is a little more prominent than the anterior one. Sutures fine and linear, well sunk in a V-shaped depression on account of the outline of the whorls. From the sixth whorl, varices are irregularly developed. The holotype is a larger specimen on the earlier stages of which the early bicarinate appearance is still exhibited; the later whorls, however, have lost the bicarinate appearance and are gently and regularly convex, with rather channelled and wavy sutures on account of the stronger ornament. On the penultimate whorl there are six primary spiral threads with a fine secondary thread in each interval except the most posterior. One of these primary threads has developed anterior to the continuation of the thread forming the anterior keel on the earliest whorls. Varices, where developed, are very strong, broad and bulging. Twelve ribs on the last whorl preserved, inclusive of two varices. The holotype seems to have an average of about two varices per whorl. A second topotype shows that the ribbing dies out rather rapidly on the base, which is moderately convex in outline and carries, anterior to the continuation of the ornament of the spire whorls, two strong spiral threads, each with a fine spiral thread above it, followed by at least four more threads, of which the first and third are stronger than the other two. Basal disk therefore practically non-existent. Aperture not preserved intact, apparently suboval. Growth lines subvertical as a whole, slightly concave forwards. Columellar lip with a fairly good layer of callus.

Dimensions. Holotype: height (incomplete, $4\frac{1}{2}$ whorls only) 5·25 mm.; width 2·6 mm. A small topotype: height 2·45 mm.; width 1·0 mm.

Remarks. The ornament is beautifully preserved on the specimens available, and the form and details of the ornament, combined with the change from bicarinate to gently convex whorls, appears to be quite characteristic.

CIRSOTREMA? *DUBIOSA* n.sp.

(Figures 30*a*, *b*, plate 1)

Material. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 4) (FB. F. 1850, the holotype, Reg. No. G. 68180).

Description. Early whorls missing and aperture broken on the only specimen available. The four whorls preserved are moderately strongly convex in outline, about twice as wide as high. Sutures distinctly sunk. Ornament consisting of spiral threads and axial ribs. Ribs fairly coarse, separated by intervals somewhat wider than themselves, almost straight, vaguely concave forwards, numbering 14 on the last whorl. Apparently no varices developed on the whorls preserved. Spiral ornament on spire whorls consisting of four distinct spiral threads separated by intervals about twice as wide as themselves; they are fairly uniformly spaced, and cross over the ribs, the development of crenulations

at the points of intersection not being marked. The two sets of ornament form a rectangular network with the longer axis parallel to the sutures. Body whorl moderately high, edge of base rounded, the base itself is gently convex. One extra, crenulated spiral thread anteriorly, and at least one finer thread anterior to that. As preserved, the aperture appears to be suboval, and the columellar lip somewhat angulated medially and moderately callous. Growth lines not seen.

DIMENSIONS. Holotype: height (incomplete) 2·25 mm.; width 1·1 mm.

REMARKS. In spite of the apparent absence of varices, which may only have been developed on later whorls, *Cirsotrema* seems to be the best genus in which to place this species. *Scalaria libyca* Cuvillier (B 1933, p. 31, Pl. 5, figs. 20, 21), from the base of the Upper Mokattam of Egypt, has much more deeply incised sutures.

Subfamily ACRILLINAE

Genus *ACRILLA* H. Adams, 1860

(*Proc. Zool. Soc. Lond.* **28**, 241)

TYPE SPECIES. *Aclis acuminata* H. & A. Adams, Recent=*Scalaria acuminata* Sowerby; original designation.

SYNONYMS. *Textiscala* de Boury, 1911 (*J. Conchyliol.* **58**, 216, 218, 222); type species: *Scalaria decussata* Lamarck, Recent; original designation.

Abyssiscala de Boury, 1911 (*J. Conchyliol.* **58**, 212); type species: *Scala folini* Dautzenberg & de Boury, Recent; original designation.

REMARKS. *Textiscala* seems to be merely an *Acrilla* with rather coarser ornament than usual. *Adiscoacrilla* Sacco, 1891 (*I Moll. terr. terz. Piem. e Lig.* **9**, 67—type species: *Acrilla coppii* de Boury, Pliocene; Cossmann 1912) seems to differ in having a very indistinct basal disc, although it is placed in synonymy by Cossmann and by Wenz.

Subgenus *FERMINOSCALA* Dall, 1908

(*Bull. Mus. Comp. Zool. Harvard*, **43**, no. 6, p. 315)

TYPE SPECIES. *Epitonium* (*Ferminoscala*) *ferminiana* Dall, Recent; original designation.

ACRILLA (*FERMINOSCALA*) *PAKISTANICA* n.sp.

(Figures 31*a*, *b*, plate 1)

MATERIAL. From a coral bed in the Eocene of the Litra Nala, Kasrani, Dera Ghazi Khan District, Punjab, the holotype, Reg. No. G. 66975. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1995, *2*, Reg. No. G. 68181–2); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *1*).

DESCRIPTION. Early whorls missing and aperture broken on the available specimens. About six and a half whorls preserved on the holotype. Shell of moderate size, turreted, with a fairly high spire. Whorls very strongly convex, their height about three-fifths of their width. Sutures linear, deeply sunk on account of the convexity of the whorls. Spiral ornament consisting of four strong and distinct, but widely spaced spiral threads which

occupy the anterior three-fifths of the whorls, and two finer spiral threads on the posterior two-fifths of the whorls. The two finer threads are sometimes not well developed. Of the four principal threads, the second from the posterior suture is at about the middle of the whorl and is somewhat stronger than the others; this is especially noticeable on the early whorls which have a vague subcarinate appearance which is practically lost on later whorls. Intervals between the third and fourth primary threads and between the fourth thread and the anterior suture a little narrower than the intervals between the first and second and the second and third primaries. Axial ornament consisting of very numerous, fine, sharp, distinct, closely spaced axial riblets which are straight and noticeably antecurrent; they cross over the spiral threads, forming slight crenulations at the points of intersection, and the rectangular network so formed has the longer axis of the components directed axially. Sixty riblets on the last whorl of the holotype. Body whorl not high, its base gently convex, and with an additional, still stronger, sharp spiral thread or carina anteriorly which limits a distinct, flattened, slightly concave basal disk over which the axial ornament passes. No varices developed. Direction of growth lines apparently coinciding with that of the riblets. The two paratypes are smaller specimens with their bases broken, and show faint spiral ornament on the basal disc; this, however, is not the natural ornament of the adult shell, and is exhibited where later whorls are broken off.

DIMENSIONS. Holotype: height (incomplete) 9·75 mm.; width 3·4 mm.

REMARKS. The well-preserved holotype is in the E. S. Pinfold Collection, British Museum (Natural History). *Scalaria pellati* de Raincourt & Munier-Chalmas as figured by Boussac (B 1911*b*, p. 83, Pl. 21, figs. 14*a*, 16, 17*a*), from the Oligocene of Biarritz, has the whorls less high, is larger, and the axial riblets are less oblique. The details of the ornament seem to be characteristic, and there does not appear to be any closely comparable Paris Basin species. There is a superficial resemblance to *Tenuiscala laubrieri* de Boury as figured by Cossmann & Pissarro (B 1907–13, Pl. 8, fig. 54–1), from the Lutetian of the Paris Basin and from the Cuisian, but the riblets continue over the basal disk and the spiral ornament is coarser.

Subgenus *UNDISCALA* de Boury, 1909

(*J. Conchyliol.* **57**, 256)

TYPE SPECIES. *Scalaria undosa* Sowerby, Upper Eocene; monotypy.

REMARKS. The writer follows Wenz in regarding *Undiscala* as related to *Acrilla* and other similar subgenera. Wenz places *Acrilla* as a subgenus of *Amaea*, but the writer regards the latter form—which has obsolete axial ornament, no basal disk, and a columellar bulge—as generically distinct.

ACRILLA (*UNDISCALA*)? *SORIENSIS* n.sp.

(Figure 32, plate 1)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68183).

DESCRIPTION. The single specimen consists of the protoconch and three spire whorls, the later whorls being missing. The protoconch has its tip broken off, and although only two

whorls are left, there were probably at least three whorls altogether; it is rather high and subcylindrical, the whorls are gently convex, and the sutures linear; the last whorl is more convex than the others, its anterior suture being distinctly sunk and the protoconch as a whole well separated off from the remainder of the shell. Spire whorls strongly and sharply convex, the sutures deeply sunk. Axial ornament consisting of moderately fine but distinct, fairly widely spaced ribs which are continuous from whorl to whorl, and which are slightly concave on their forward side if they are not straight; they are about half the width of their intervals, and there are 16 on the third whorl. Spiral ornament consisting of rather vague, fine, flat spiral ribbons of the same width as their intervals; they cover the whole of the space between the ribs and rise up the flanks of the ribs themselves; about six threads on the last whorl preserved. No traces of varices. Last whorl much like the first two, its base is gently convex, with a strong anterior spiral keel limiting a gently concave disk which, however, is not a basal disk, but the remains of a later whorl which has been almost entirely broken away. Growth lines not seen, presumably parallel to the ribs.

DIMENSIONS. Holotype: height (incomplete) 1·5 mm.; width 0·75 mm.

REMARKS. This species is only tentatively referred to *Undiscala*, since the basal disk is not preserved. While superficially resembling *Gyroscala*? *punjabensis*, the spire is distinctly more acute, the whorls distinctly wider, and the ribs not quite so fine. *Scala* (*Acrilla*) *jogjacartensis* Martin (B 1931, p. 43, Pl. 6, fig. 7), from the Upper Eocene of Java, has higher whorls, develops secondary spiral threads, and is larger. *Scalaria bryozophila* Oppenheim (B 1901*a*, p. 187, Pl. 16, figs. 13, 13*a*), from the Priabonian of Italy, is very similar in outline and general appearance, but is larger; at a size comparable to that of the Pakistan form the ribs, judging from the illustration, are more closely spaced. Oppenheim's species, moreover, develops spiral threads of a second order on the last whorl, although this is admittedly at a distinctly later stage than is represented in the Pakistan specimen. *S. bouillei* Tournouer as figured by Boussac (B 1911*b*, p. 52, Pl. 7, figs. 13, 14, 14*a*), from the Auversian near Biarritz, has higher and less convex whorls, and is larger. *S.* (*Acrilla*) *praedecussata* de Boury as figured by Cossmann & Pissarro (B 1907–13, Pl. 64, fig. 52–50), from the Cuisian of the Paris Basin, is much larger and has somewhat coarser and more distinct spiral ornament. *Scala* (*Acrilla*) *cuisensis* de Boury as figured by Cossmann & Pissarro (B 1907–13, Pl. 8, fig. 52–36), from the Cuisian of the Paris Basin, is larger, stouter, has less regularly convex whorls and less sunken sutures (especially in the early stages); Glibert's figure of *Acrilla cuisensis* de Boury (B 1933, p. 20, Pl. 1, fig. 10), from the Bruxellian of Belgium, is also of a larger and stouter form.

Superfamily AGLOSSA

Family MELANELLIDAE

Genus *MELANELLA* (Dufresne) Bowdich, 1822

(*Elem. of Conch.* **1**, 27)

TYPE SPECIES. *Melanella dufresnii* Bowdich, Recent; monotypy.

SYNONYMS. *Eulima* Risso, 1826 (*Hist. nat. Eur. mérid.* **4**, 123); type species *Helix polita* (Linné), Recent = *Turbo politus* Linné = *Eulima elegantissima* Risso; Gray 1847.

Pasithea Lea, 1833 (pars) (*Contrib. to Geol.* pp. 99, 207) *non* Oken, 1807 (Verm.).
Melaniella Fischer, 1887 (*J. Conchyliol.* **35**, 198) *non* Pfeiffer, 1859 (*em.*).

Subgenus *POLYGIREULIMA* Sacco, 1892

(*I Moll. terr. terz. Piem. e Lig.* **11**, 10)

TYPE SPECIES. *Eulima spina* Grateloup, Miocene-Pliocene; original designation.

SYNONYMS. *Acicularia* Monterosato, 1884 (*Nomencl. Conch. medit.* p. 102); *non* d'Archiac, 1837 (?Spong.) *nec* d'Archiac, 1843 (Coel.) *nec* Carus & Gerstaecker, 1875 (Moll.) *nec* Langerhans, 1878 (Verm.); type species: *Eulima intermedia* Cantraine, Recent; Sacco, 1892.

Polygyreulima Cossmann, 1894 (*Annuaire Géol. Univ.* **9**, 796) (*em.*).

REMARKS. Cossmann gave the type of *Polygyreulima* as *Eulima intermedia* Cantraine, Recent, but Sacco established the name *Polygireulima* with *Eulima spina* Grateloup as type species. The writer does not consider that Sacco's name can be regarded unequivocably as a misprint for *Polygyreulima*.

MELANELLA (*POLYGIREULIMA*) *PUNJABENSIS* n.sp.

(Figures 67, 68, plate 2)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68184, and 1 topotype, Reg. No. G. 68185).

DESCRIPTION. Shell small, smooth and polished, with a very small protoconch not differentiated from the remainder of the shell, turreted, acicular. Spire not curved, high, regularly conic. Whorls perfectly flat-sided, height about two-thirds of their width. Sutures linear, flush with the surface of the whorls. Body whorl moderately high, subcarinate at the edge of the base, declivous and slightly convex anteriorly. Aperture oval. Columellar lip gently excavated, without folds.

DIMENSIONS. Holotype: height (incomplete) 1·4 mm.; width 0·55 mm. Topotype: height 1·1 mm.; width 0·375 mm.

REMARKS. *Eulima naumanni* von Koenen as figured by Cossmann & Lambert (B 1884, p. 114, Pl. 3, fig. 21), from the Oligocene of the Paris Basin, has a distinctly higher body whorl. Grateloup's (1847, Pl. 1 (4)) illustrations of *Melania lactea* Lamarck from Recent faunas (figs. 12, 13) and from France (fig. 11) are of somewhat similar forms which, however, have the edge of the base strongly carinate. *Eulima* (*Subularia*) *goniophora* Cossmann (1902, p. 35, Pl. 4 (9), figs. 9, 10), from the Eocene of the Lower Loire, also recorded by Cossmann & Pissarro (B 1907–13, Pl. 7, fig. 49–5) from the Lutetian of the Paris Basin and from the Cuisian, is larger, less slender, and has a higher body whorl; Cossmann's earlier illustrations (1888, p. 17, Pl. 4, figs. 55, 56) of this form from the Eocene of the Paris Basin, and from Barton, are of a form which displays similar differences, the base being noticeably more steeply descendent. *E.* (*S.*) *pupoides* (Cossmann) as figured by Cossmann (1902, p. 35, Pl. 4 (9), figs. 6, 7), from the Eocene of the Lower Loire, is more drawn out anteriorly. The body whorl of the Zinda Pir species is evidently not so high as

in the Paris Basin species. Although the subangular edge of the base is more like that of *Melanella sensu stricto*, the straight spire and acicular form with indefinite sutures suggest that the species is best placed in the subgenus *Polygireulima*.

MELANELLA (POLYGIREULIMA)? RAKHIENSIS n.sp.

(Figure 33, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68186).

DESCRIPTION. Shell small, oval-conic, moderately turreted, smooth. Protoconch and one or two spire whorls missing. Spire conic, nearly four whorls preserved. Whorls flat-sided, apparently slightly stepped, their height a little more than half their width. Sutures linear. Body whorl high, evidently forming about half the height of the shell; its flanks are very slightly convex, almost flat, the periphery gently rounded, and the base slightly convex and imperforate. Aperture suboval, posteriorly narrow, pointed, and a little drawn out, anteriorly rounded and holostome. Inner lip gently convex posteriorly, gently concave anteriorly, apparently not very callous, and without any evidence of folds. Outer lip broken. Growth lines slightly antecurrent as a whole, very vaguely concave posteriorly, vaguely convex anteriorly, receding on the base of the body whorl.

DIMENSIONS. Holotype: height (incomplete) 2·75 mm.; width 1·1 mm.

REMARKS. Owing to the absence of the protoconch and early whorls, this species is only provisionally placed as a *Polygireulima*, for which subgenus the growth lines scarcely seem convex enough anteriorly. On the other hand, the high body whorl is not very characteristic of *Eulimella*, although it is possible the species might belong to this genus. *Eulima (Subularia) planispira* Cossmann (1915, p. 58, Pl. 4, figs. 5–8), from the Montian of Belgium, shows some resemblance, but is more turreted. The high body whorl and rather stepped sutural region are characteristic of the species.

MELANELLA (POLYGIREULIMA)? PAKISTANICA n.sp.

(Figure 34, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68187, and 15 topotypes, Reg. No. G. 68188–93; FB. F. 1995, *10*+).

DESCRIPTION. Shell fairly small, smooth, oval-turreted. Protoconch not seen, apparently fairly small, with no indication of having been heterostrophic. Spire conic in outline, forming almost half the height of the shell. Four and a half spire whorls on the holotype, a normal specimen evidently having had about five and a half whorls. Whorls gently to moderately convex, rather high and loosely coiled, their height being at least five-eights of their width. Sutures linear and distinct, well incised. Body whorl elongate-oval, with convex flanks, the base declivous and slightly convex, imperforate. Aperture oval, apparently holostome. Inner lip thin, apparently without callus or folds, regularly excavated on its median and anterior portions. Outer lip thin, almost straight, slightly parasigmoidal, slightly retrocurrent as a whole.

DIMENSIONS. Holotype: height 3·75 mm.; width 1·5 mm.

REMARKS. This species is provisionally placed as a *Polygireulima* on account of its general appearance, although the whorls are rather convex, the body whorl rather high, and the outer lip evidently not strongly prominent anteriorly. Although somewhat resembling certain forms of *Hydrobia* (*Parhydrobia*), it has no umbilicus, and is, moreover, definitely a typical marine form. In spite of its relatively simple appearance, there does not seem to be any very closely related Eocene form.

Family PLOTIIDAE

Genus *ODOSTOMIA* Fleming, 1813

(*Brewster's Edin. Ency.* **7**, part 1, p. 76)

TYPE SPECIES. *Turbo plicatus* Montagu, Recent = *Turbo plicata* Montagu; Dall & Bartsch, 1907.

SYNONYMS. *Odontostoma* Turton, in Carrington, 1830 (*Teignmouth Guide*, part 2, sign G. 1) (*em.*).

Odontostomia Jeffreys, 1839 (*Mal. and Conch. Mag.* part 2, p. 34) (*em.*).

Monoptaxis (Clark) Jeffreys, 1867 (*Brit. Conch.* **4**, 109) (name without species).

Ptychostomon Locard, 1886 (*Prodr. Malac. Franc. Moll. mar.* **2**, 228, 571); type species: *P. plicatum* (Montagu), Recent; here designated.

Turritodostomia Sacco, 1892 (*Mem. Accad. Sci. Torino* (2), **42**, 623); type species; *Turritodostomia plicata* (Montagu), Recent = *Turbo plicata* Montagu; Cossmann, 1921.

'*Turridostomia* Sacco', Wenz, 1940 (*Handb. Paläozool.* **6**, Teil 4, p. 857) (*err.*).

REMARKS. Sacco gave the type species of *Odostomia* as *Turbo conoideus* Brocchi, Pliocene, but this species is not in the original list, and is a *Megastomia*.

ODOSTOMIA PAKISTANICA n.sp.

(Figure 35, plate 1)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68194, and 1 topotype, Reg. No. G. 68195).

DESCRIPTION. Shell small, ovoid-conic, the spire occupying about three-sevenths of the total height, regularly conic in outline, smooth. Protoconch small, smooth, a minute sinistral spiral the axis of which is at right angles to that of the adult shell, the last whorl of which curves loosely round to join the post-embryonic stages, apex sunk. Whorls slightly to gently convex in the early stages, becoming rather flatter-sided in the adult, their height about half their width, slightly stepped at the suture in later whorls. Four spire whorls. Sutures linear and distinct. Body whorl moderately high, edge of base vaguely subangular, the base itself declivous, not very short, slightly convex. Aperture oval. Columellar lip with its anterior half moderately thick, with one strong, transverse, median columellar fold. Base imperforate, although a very small area just behind the columellar fold is depressed. Growth lines subvertical as a whole, vaguely excavated posteriorly. Interior of outer lip not seen.

DIMENSIONS. Holotype: height 1·7 mm.; width 1·1 mm.

REMARKS. *Odontostomia Van-Dijki* Martin (B 1931, p. 43, Pl. 6, fig. 8), from the Upper Eocene of Java, has the edge of the base less subcarinate, the base is more prolonged vertically, the whorls are flatter-sided, and the sutural region is not stepped. *O. acuminata* Deshayes as figured by Cossmann & Lambert (B 1884, p. 116, Pl. 5, figs. 14*a*, *b*), from the Oligocene of the Paris Basin, has a higher body whorl, and the edge of the base is less subcarinate. *O. primaeva* Deshayes as figured by Farchad (B 1936, p. 57, Pl. 3, figs. 16*a*, 16*b*), from the Thanetian of the Paris Basin, has the edge of the base rounded, and the spire is rather conoidal; Cossmann & Pissarro's illustrations of this species (B 1907–13, Pls. 6, 63, fig. 44–15), from the Thanetian of the Paris Basin, have less stepped whorls and a higher spire. *Odostomia gravesi* Deshayes (1862*b*, p. 562, Pl. 19, figs. 29, 30), from the Lower Sands of the Paris Basin, also figured by Cossmann & Pissarro (B 1907–13, Pl. 6, fig. 44–11), has more convex whorls which are not stepped. *O. consobrina* Staadt as figured by Cossmann & Pissarro (B 1907–13, Pl. 63, fig. 44–27), from the Thanetian of the Paris Basin, has less stepped whorls and a higher body whorl. *O. pyramis* Deshayes (1862*b*, p. 560, Pl. 18, figs. 7, 8), from the Calcaire Grossier of the Paris Basin, has three lirae inside the outer lip, is a little larger, has more convex whorls which are not stepped, and the edge of the base is not subcarinate; the same species as figured by Cossmann & Pissarro (B 1907–13, Pl. 6, fig. 44–5), from the Lutetian of the Paris Basin and from the Bartonian, is also rather more broadly conic.

Subgenus *MEGASTOMIA* Monterosato, 1884

(*Nomencl. Conch. médit.* p. 94)

TYPE SPECIES. *Odostomia conspicua* Alder, Recent; original designation and monotypy.

SYNONYM. *Stomega* Dall & Bartsch, 1904 (*Proc. Biol. Soc. Wash.* **17**, 13); type species: *Odostomia conspicua* Alder, Recent; original designation and monotypy.

ODOSTOMIA (MEGASTOMIA) INFRASUBCARINATA n.sp.

(Figure 36, plate 1)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68196, and 2 topotypes, Reg. No. G. 68197–8); Ghazij Shales (local subzone 3*b*) (FB. F. 2676, *2*, Reg. No. G. 68199–200).

DESCRIPTION. Shell small, smooth, ovoid-conic, height of body whorl a little more than height of spire, outline conic. Protoconch helicoid, sinistral, smooth, with convex whorls, of moderately large size, its axis at right angles to that of the adult shell. Two spire whorls, flat-sided or very slightly convex, their height about three-fifths or four-ninths of their width. Sutures distinct, linear. Body whorl sharply rounded or vaguely subcarinate at the edge of the base which is declivous and slightly convex. There is a slight median depression on the base close to the columellar lip, but no umbilicus. Aperture suboval, the parietal region not being callous. Columella little thickened, with a strong, rather horizontal fold near its posteror end. Outer lip internally with five or six long lirae. Growth lines not distinctly seen, subvertical.

DIMENSIONS. Holotype: height 1·4 mm.; width 0·9 mm. A syntype: height 1·6 mm.; width 0·95 mm.

REMARKS. *Odostomia pyramis* Deshayes (1862*b*, p. 560, Pl. 18, figs. 7, 8), from the Calcaire Grossier of the Paris Basin, also figured as *Odontostomia pyramis* (Deshayes) by Cossmann & Pissarro (B 1907–13, Pl. 6, fig. 44–5), from the Lutetian of the Paris Basin and from the Bartonian, has three lirae inside the outer lip, is larger, and the edge of the base is more rounded. *Odostomia medianum* Deshayes (1862*b*, p. 559, Pl. 19, figs. 17–19 (*media*)), from the Middle Sands of the Paris Basin, also figured as *Odontostomia mediania* (Deshayes) by Cossmann & Pissarro (B 1907–13, Pl. 6, fig. 44–14), from the Bartonian of the Paris Basin, is larger, has a higher body whorl, and has a more steeply declivous base. *O. primaeva* (Deshayes) as figured by Cossmann & Pissarro (B 1907–13, Pl. 6, fig. 44–15; Pl. 63, fig. 44–15), from the Thanetian of the Paris Basin, is larger and less conic, the edge of the base is more rounded, and the body whorl is not so produced anteriorly. *O. primaeva* (Deshayes) var. *consobrina* Staadt as figured by Cossmann (B 1913, p. 124, Pl. 2, fig. 44–15), from the Thanetian of the Paris Basin, has more whorls and the base is more produced anteriorly; Cossmann & Pissarro's later figure of *O. consobrina* Staadt (B 1907–13, Pl. 63, fig. 44–27), from the Thanetian of the Paris Basin, has a higher body whorl and more numerous spire whorls.

Genus *TURBONILLA* Leach, in Risso, 1826

(*Hist. Nat. Eur. merid.* **4**, 224)

TYPE SPECIES. *Turbonilla typica* Dall & Bartsch, Recent = *Turbonilla plicatula* Risso, 1826 *non Turbo plicatulus* Brocchi, 1814; Dall & Bartsch, 1909.

REMARKS. Dall & Bartsch (1909, *U.S. Nat. Mus. Bull.* no. 68, p. 29) referred to Risso's and Brocchi's species as *plicata* by mistake, but it is quite evident what they meant. Bucquoy, Dollfus & Dautzenberg (1883) designated the type species as *Turbo lacteus* Linné, Recent, and Gray (1847) gave the type species as *T. elegantissimus* Montagu. Recent, but neither of these species is in the original list.

Subgenus *CHEMNITZIA* d'Orbigny, in Webb & Berthelot, 1839

(*Canaries* (*Moll.*), p. 77)

TYPE SPECIES. *Chemnitzia campanellae* (Philippi), Recent = *Melania campanellae* Philippi; monotypy.

REMARKS. The groups of *Turbonilla* and *Chemnitzia* (i.e. 'A' or 'B') considered here are the same as described by Laws (1937).

TURBONILLA (*CHEMNITZIA*—A) *SORIENSIS* n.sp.

(Figure 69, plate 3)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, the holotype, Reg. No. G. 68201).

DESCRIPTION. Shell small, ribbed, turreted, slender, subcylindrical. Protoconch a smooth, helicoid spiral the axis of which is at right angles to that of the adult whorls, of

moderately large size, distinctly projecting, its last whorl considerably larger than the earlier ones. Five spire whorls, the height of which is about two-thirds of their width. First two or three whorls slightly convex, later whorls flat-sided, all being ornamented with relatively strong, perfectly straight and vertical axial ribs of the same width as their intervals. 15 ribs on the penultimate whorl. Sutures linear, distinct, moderately well incised. Spire occupying about eight-thirteenths of the total height. Body whorl of moderate height for the genus, its base gently convex and imperforate, the periphery well rounded. Ribs not extending on to the base, as they die out rapidly near the periphery. Aperture subrhombic, the columellar lip not callous but carrying one weak median fold. Growth lines practically straight and vertical.

DIMENSIONS. Holotype: height 2·5 mm.; width 0·56 mm.

REMARKS. *Turbonilla notata* Deshayes as figured by Wrigley (B 1934, p. 10, figs. 1–3), from the Lutetian of Southampton Docks, has relatively wider whorls, more solid ribs, and the protoconch is more steeply conic; Cossmann & Pissarro's illustration of this species (B 1907–13, Pl. 7, fig. 48–4), from the Bartonian of the Paris Basin and from the Lutetian, is conoidal in the early stages and does not resemble the Pakistan species very closely, and Deshayes's original illustration of the species (1862*b*, p. 568, Pl. 27, figs. 7, 8), from the Calcaire Grossier of the Paris Basin, is of a form with distinctly less high whorls and with rather curved ribs. *T. heberti* Deshayes (1862*b*, p. 566, Pl. 21, figs. 11–13), from the Fontainebleau Sands of the Paris Basin, is less slender, somewhat conoid in the early stages, and has gently and regularly convex whorls. *T. compta* Deshayes as figured by Cossmann & Pissarro (B 1907–13, Pl. 7, fig. 48–1), from the Bartonian of the Paris Basin, is distinctly less slender, and has slightly wider and definitely more convex whorls.

Subgenus *TEREBRONILLA* n.subg.

TYPE SPECIES. *Turbonilla* (*Terebronilla*) *terebriformis* n.subg. et sp., Upper Eocene.

SUBGENERIC CHARACTERS. Turriculate; protoconch heterostrophic, helicoid, with small nucleus and large second whorl, obliquely inserted with the horizontal axis of the second whorl in dorsal view at an angle of about 30° to the vertical; whorls convex, slightly stepped, with a circumsutural cord followed anteriorly by a concave area, the remaining two-thirds of the whorls being convex; sutures deeply incised; ribs moderately fine, about the same width as or slightly narrower than their intervals, forming small nodes on the circumsutural cord, weaker on the concave band; spiral ornament feeble; columella with one feeble fold.

TURBONILLA (*TEREBRONILLA*) *TEREBRIFORMIS* n.subg. et sp.

(Figure 70, plate 3)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1995, the holotype, Reg. No. G. 68202); Upper Chocolate Clays (upper part, local zone 14) (FB. F. 1989, *1*).

DESCRIPTION. Shell small, turriculate, ribbed, with a circumsutural band. Protoconch heterostrophic, of moderately large size, smooth, helicoid, consisting of about two whorls, the nucleus very small, the last whorl large; it is obliquely inserted in the apex, the

horizontal axis of the last whorl in dorsal view being at an angle of about 30° to the vertical. About three spire whorls preserved on the holotype, the remainder of the shell being missing; the last whorl on this fragment occupies a little more than half the height. Whorls moderately convex in outline, with a circumsutural cord or collar which is followed anteriorly by a concave band, these two features not occupying more than one-third the height of the whorl. Height of whorls about half their width; they are slightly stepped, and the linear sutures are deeply incised. Ribs forming small nodes on the circumsutural cord, a little weaker over the concave band, stronger again over the main convex portion of the whorl; they are fairly fine, of about the same width as or slightly narrower than their intervals, slightly retrocurrent as a whole, gently convex anteriorly, vaguely concave posteriorly, and number 17 on the last whorl preserved. Spiral ornament apparently almost completely absent, there being only a few traces of very fine, closely spaced spiral lines on the flank of the last whorl.

Last whorl preserved only moderately high, the periphery subcarinate on account of the presence of a false basal disk which owes its presence to the fact that later whorls have been broken off. The ribs, over the remainder of the whorl, similar to those of the spire whorls, continue as obscure ridges over this basal area. Base of body whorl, represented by the basal disk, declivous and flattened. Aperture apparently oval, the inner lip gently excavated, and a low columellar fold present.

DIMENSIONS. Holotype: height 1·1 mm.; width 0·5 mm.

REMARKS. The characters of this species, as described above, seem to be unique.

Genus *EULIMELLA* Forbes & McAndrew, 1846 (*em.* Forbes, in Jeffreys, 1847)

(*Athenaeum*, 1846, p. 1027)

TYPE SPECIES. *Erilimella m'andrei* Forbes & McAndrew, Recent; original designation and monotypy.

SYNONYMS. *Erilimella* Forbes & McAndrew, 1846 (*Athenaeum*, 1846, p. 1027) (*err. typ.*).

Eulimella (Forbes) Jeffreys, 1847 (*Ann. Mag. Nat. Hist.* **19**, 311); type species: *E. crassula* (Jeffreys), Recent = *E. macandrei* (Forbes) = *E. scillae* (Scacchi); Palmer, 1938.

REMARKS. The original reference to *Erilimella* is an obvious misprint for *Eulimella*, as it was intended to be a diminutive of *Eulima*. Cossmann (1921) gave the type species of *Eulimella* Jeffreys as *Turbonilla scillai* (Scacchi), Recent, without giving the synonymy of the species.

Subgenus *BELONIDIUM* Cossmann, 1892

(*J. Conchyliol.* **40**, 350)

TYPE SPECIES. *Aciculina gracilis* Deshayes, Eocene; monotypy.

SYNONYMS. *Aciculina* Deshayes, 1862 (*Descr. An. s. Vert. Bassin Paris*, **2**, 530) *non* Adams, 1853 (Moll.); type species: *A. gracilis* Deshayes, Eocene; here designated.

Baudonia Bayan, 1873 (*Bull. Soc. géol. France*, (3) **1**, 235) *non* Mabille, 1868 (Moll.) (replacement name).

Rhaphium Bayan, 1873 (*Étud. Coll. École Mines*, Fasc. 2, p. 106) *non* (Dejean) White, 1885 (Col.) *nec* Meigen, 1883 (Dipt.) (replacement name).

Raphium auct. (*err.*).

'*Anisocycla* Monterosato, 1884', Cossmann, 1888 (*Ann. Soc. malac. Belg.* **23**, Mém., p. 108) *non* Monterosato, 1880.

EULIMELLA (*BELONIDIUM*) *LAXISPIRATA* n.sp.

(Figure 71, plate 3)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68203, and 1 topotype, Reg. No. G. 68204).

DESCRIPTION. Shell small, smooth, high, elongate-cylindrical, loosely coiled. Protoconch relatively large and projecting, helicoid, smooth, sinistral, its axis of coiling at right angles to that of the adult shell, consisting of about three whorls of which the first is very small. Three spire whorls which are distinctly and gently convex, their height about four-fifths of their width. Sutures linear, rather incised. Body whorl moderately high, the edge of the base rounded, the base itself rather short, slightly convex. Aperture suboval. Columellar lip thin, without folds. No umbilicus. Growth lines not seen.

DIMENSIONS. Holotype: height 1·5 mm.; width 0·37 mm.

REMARKS. *Belondium polygyratum* (Deshayes) as figured by Wrigley (B 1934, p. 10, figs. 1–5), from the Lutetian of Southampton Docks, also recorded by Cossmann & Pissarro (B 1907–13, Pl. 7, fig. 45 *bis*-2), from the Lutetian of the Paris Basin and from the Bartonian, and recorded as *Aciculina polygyrata* by Deshayes (1862*a*, p. 532, Pl. 25, figs. 32, 33), from the Calcaire Grossier and Middle Sands of the Paris Basin, has less convex and less high whorls, its sutures are less oblique, the shell is less narrowly cylindrical, and the helicoid protoconch is less flatly coiled. *Turbonilla fragilis* Deshayes (1862*b*, p. 570, Pl. 20, figs. 11, 12), from the Calcaire Grossier of the Paris Basin, also figured as *Belonidium fragile* (Deshayes) by Cossmann (1902, p. 43, Lower Pl. 4 (9), figs. 27–29), from the Eocene of the Lower Loire, and by Cossmann & Pissarro (B 1907–13, Pl. 7, fig. 45 *bis*–4), from the Lutetian of the Paris Basin and from the Bartonian, is larger, has less convex and less high whorls, and its sutures are less sunk. *Aciculina gracilis* Deshayes (1862*a*, p. 531, Pl. 25, figs. 23, 24), from the Calcaire Grossier of the Paris Basin, also recorded as *Belonidium gracile* (Deshayes) by Cossmann & Pissarro (B 1907–13, Pl. 7, fig. 45 *bis*–1), from the Lutetian of the Paris Basin, is closely related to the Pakistan species, but the whorls are not so high. *B. morleti* (Cossmann) as figured by Cossmann & Pissarro (B 1907–13, Pl. 7, fig. 5), from the Bartonian of the Paris Basin, has the whorls relatively wider. *B. scalarinum* (Deshayes) as figured by Cossmann & Pissarro (B 1907–13, Pl. 7, fig. 45 *bis*–3), from the Cuisian of the Paris Basin, has the whorls less convex anteriorly and relatively wider, the sutures less oblique, and the apertural region more produced anteriorly.

Superfamily STROMBACEA

Family STROMBIDAE

Genus *PRESTROMBUS* H. Douvillé, 1929

(*Pal. Indica*, N.S., **10**, Mem. no. 3, p. 39)

TYPE SPECIES. *Prestrombus vredenburgi* H. Douvillé, *Cardita beaumonti* beds; monotypy.

PRESTROMBUS ROCKEI Cox, 1931

REFERENCES. *Prestrombus rockei* Cox, B 1931*a* (pp. 52, 33, Pl. 2, figs. 6*a*, *b*).

MATERIAL. *Rakhi Nala section.* Rubbly Limestones (local zone 6) (FB. F. 1906, *1*, Reg. No. G. 68205).

FURTHER DISTRIBUTION IN PAKISTAN. Laki of Hyderabad (Sind) (the type locality).

REMARKS. Although the Rakhi Nala specimen is a somewhat flattened mould, its identity with Cox's species is evident.

Genus *LAMBIS* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 61)

TYPE SPECIES. *Lambis lambis* Bolten, Recent=*Strombus lambis* Linné; by absolute tautonymy.

SYNONYMS. *Aporrhais* Aldrovande, 1618 (not binomial) *non* Da Costa, 1778.

Pterocera Lamarck, 1799 (*Mém. Soc. Hist. nat. Paris*, p. 72); type species: *Strombus lambis* Linné, Recent; monotypy.

Heptadactylus (Klein, 1753) Mörch, 1852 (*Cat. Yoldi*, **1**, 60); type species: *Pterocera lambis* (Linné), Recent; here designated.

LAMBIS GONIOPHORA (Bellardi), 1852

REFERENCES. *Rostellaria goniophora* Bellardi, B 1852 (pp. 219, 292, Pl. 13, figs. 18, 19); Bellardi, B 1854 (p. 180, Pl. 1, fig. 6); K. Mayer, B 1869 (pp. 362, 369); E. Pavay, B 1871 (pp. 364, 424); A. von Pavay, B 1874 (p. 412); Mallada, B 1878 (pp. 318, 406); Maureta & Thos y Codina, B 1881 (p. 321); Mallada, B 1892 (p. 207); Koch, B 1894 (pp. 263, 277, 296); Oppenheim, 1899 (p. 110); Oppenheim, B 1901*a* (pp. 210, 291, Pl. 14, fig. 7); Oppenheim, B 1901*b* (p. 271); Oppenheim, 1903*c* (p. 295); Dainelli, B 1904 (p. 150); Cossmann & Pissarro, 1909 (p. 52); Boussac, B 1911*a* (pp. 311, 426, Pl. 19, figs. 1, 4, 6*a*, 8–10, 17, 25, 26); Oppenheim, B 1915 (p. 87); Fabiani, B 1915 (p. 264); Schlosser, B 1922 (p. 287); Oppenheim, B 1923 (pp. 83, 96); Schlosser, B 1925*a* (p. 190); Schlosser, B 1925*b* (pp. 35, 47, 49, 50, 51, 56, 57); Vredenburg, B 1928*a* (p. 51); Cuvillier, B 1930 (pp. 198, 210, 253); Gočev, B 1930 (p. 35); Negri, 1934*b* (pp. 149, 134); Pieragnoli, B 1935 (p. 179); Deb, 1938 (pp. 25, 27); Loss, B 1940 (pp. 59, 7, 74, 76, 79, Pl. 5, figs. 3, 3*a*).

Rostellaria digona Bellardi, B 1854 (p. 180 (pars), Pl. 1, fig. 6).

?*Rostellaria* indet. d'Archiac, in Tchihatcheff, B 1866 (p. 111).

Pteroceras goniophorum (Bellardi), C. Mayer-Eymar, B 1887 (p. 113, Pl. 6, fig. 3).

Pleurotoma filosa Lamarck, Renévier, B 1890 (p. 399).

?*Rostellaria* cf. *goniophora* Bellardi, Bontscheff, 1897 (p. 382).

Tritonium flandricum (de Koninck), Deninger, B 1901 (p. 228).

Rostellaria (*Sulcogladius*) *goniophora* Bellardi, Cossmann, 1904 (p. 20, Pl. 2, fig. 7); Meffert, B 1931*a* (pp. 44, 47, 58, 59, Pl. 8, fig. 3).

Rostellaria cf. *goniophora* Bellardi, Newton, 1905*b* (p. 90, Pl. 5, fig. 1); Lemoine, 1909 (p. 104, Pl. 2, figs. 2*a*, *b*).

Chenopus (*Maussenetia*) *dimorphospira* Cossmann & Pissarro, 1909 (p. 51, Pl. 4, figs. 26–28; Pl. 8, figs. 4, 4*a*); Douvillé, B 1920*a* (pp. 152, 122, 123, Pl. 1, figs. 6, 6*a*, 7); Pérébaskine, B 1932 (pp. 58, 111, Pl. 5, figs. 2*a*, *b*).

Chenopus dimorphospira Cossmann & Pissarro, Holland, 1909 (p. 25); Cotter, B 1926 (pp. 415, 413); Pérébaskine, B 1932 (pp. 54, 55, 59, 60, 61, 62, 117).

Chenopus tibeticus Douvillé, B 1916 (pp. 22, 45, Pl. 8, figs. 5*a*, *b*); Cotter, B 1926 (pp. 411, 413).

Pterocera? *dimorphospira* (Cossmann & Pissarro), Vredenburg, B 1928*a* (p. 50).

Lambis goniophora (Bellardi), Cox, B 1930*a* (pp. 162, 132, 137, 140, 141, Pl. 18, figs. 8*a–c*, 9–11); Cox, B 1931*a* (p. 50); Cox, in L. M. Davies & Pinfold, B 1937 (p. 71).

Aporrhais lakiensis Raj Nath & Chiplonker, 1937 (pp. 235, 245, Pl. 16, fig. 5).

INCORRECT REFERENCES. *Rostellaria goniophora* Dell., Cya, B 1883 (p. 61).

MATERIAL. *Rakhi Nala section*: Rubbly Limestones (local zone 6) (FB. F. 1910, *1*; FB. F. 1918, *1*, Reg. No. G. 68206); *Zinda Pir section*: Zinda Pir Limestones (lower part, local zone 1) (FB. F. 2712, *2*).

FURTHER DISTRIBUTION IN PAKISTAN. Hangu Shales of Hangu; Upper Ranikot (zone 3) of Jherruck; Upper Ranikot (zone 4) of Sind; Laki Limestone; Upper Middle Khirthar of the Laki dome (type locality for '*lakiensis*').

FURTHER DISTRIBUTION. This species has a long geological range and a wide geographical distribution, the following being a summary of the records: Gastropod Limestone (Ranikot) north-north-east of Kampa Dzong (Tibet); Lower Eocene of eastern Sudan; Middle Eocene of Italy, the Alps, the Balkans and Sudan; Auversian or Lutetian of Armenia; Auversian of Italy (La Palarea is the type locality), France, the Alps and Dalmatia; Upper Mokattam of Egypt; Upper Eocene of the Balkans and the Bavarian Alps; Eocene of Hungary, Spain, Nigeria, Herzegovina and Asia Minor; Priabonian of Italy and France.

REMARKS. Cya's record from the Neogene of Spain is to be neglected. There seems to be no doubt that *Aporrhais lakiensis* Raj Nath & Chiplonker is a *Lambis goniophora*; the ornament on the body whorl, as described by Raj Nath & Chiplonker, is the same as that found on the better preserved specimens of *L. goniophora*.

Genus *TIBIA* Bolten, in Röding, 1798

(*Mus. Bolt.* **2**, 123)

TYPE SPECIES. *Murex fusus* Linné, Recent = *Rostellaria curvirostra* Lamarck; Dall, 1906 (The name *Murex fusus* is listed both under *Tibia insulae chorab* and *Tibia indiarum* by Bolten.)

SYNONYMS. *Rostellaria* Lamarck, 1799 (*Mém. Soc. Hist. nat. Paris*, p. 72); type species: *Strombus fusus* Linné, Recent; monotypy.

Rostellum Montfort, 1810 (*Conch. Syst.* **2**, 518); type species: *Strombus fusus* Linné, Recent; original designation.

Gladius (Klein, 1753) Mörch, 1852 (*Cat. Yoldi*, **1**, 63); type species: *Rostellaria fusus* (Linné), Recent = *Rostellaria rectirostris* Lamarck; monotypy.

Platyoptera Conrad, 1855 (*Proc. Acad. Nat. Sci. Philad.* **7**, 260); type species: *Aporrhais* (*Platyoptera*) *extenta* Conrad, Eocene; monotypy.

TIBIA PSEUDOMOKATTAMENSIS n.sp.

(Figure 72, plate 3)

MATERIAL. *Kohat area* (*Sirki Paila*): Sirki Shale/Kohat Limestone (local subzone 4*d*) (FB. F. 2114, the holotype, Reg. No. G. 68207, and 1 topotype, Reg. No. G. 68208).

DESCRIPTION. Shell large, rather stoutly fusiform in shape, the anterior part of the columella missing. Five spire whorls are preserved, and there were probably a few more at the apex between the first whorl preserved and the protoconch. No trace of any ornament. Whorls practically flat-sided, very slightly convex, a little stepped at the suture, approximately half as high as they are wide. Sutures linear. Body whorl, which occupies about half the height of the shell in the holotype, moderately large for the genus, rather flattened on its upper part, medially vaguely subcarinate, the base gently convex and then gently concave near the commencement of the columellar region. Aperture rather narrowly oval, the anterior canal being broken. Growth lines not observed.

DIMENSIONS. Holotype: height 92·3 mm. (incomplete); width 43·0 mm.

REMARKS. The specimens are all moulds. There seem to be few closely comparable Eogene species. *Rostellaria mokattamensis* Cuvillier (B 1930, p. 47, Pl. 6, figs. 1, 2), from the Upper Lutetian of Egypt, has the angulation on the body whorl situated lower down, and the region between the parietal lip and the neck carries five or six strong spiral threads. *R. fidelis* Cuvillier (B 1935, p. 324, Pl. 20, fig. 14), from the Bartonian of Egypt, has higher whorls, its body whorl is less ample and less convex, and the neck is less excavated. *R. maxima* Rouault (B 1850, p. 496, Pl. 18, fig. 6), from the Eocene near Pau, has the early whorls distinctly ornamented, the spire is less slender, the whorls appear less stepped, and the flank of the body whorl is not flattened.

Subgenus *TIBIOCHILUS* n.subg.

TYPE SPECIES. *Tibia* (*Tibiochilus*) *rakhiensis* n.subg. et sp., *Cardita beaumonti* beds.

SUBGENERIC CHARACTERS. Size moderate; ovoid-conic, rostellariiform, spire only moderately high; relatively thin-shelled; ornament consisting of fine, relatively widely spaced, incised spiral lines which, on the base of the body whorl, become gradually more conspicuous and attain the same width as their intervals; gutter posteriorly curving upwards and gently backwards over the penultimate and penepenultimate whorls.

REMARKS. The subgenus differs from *Tibia* in lacking axial ornament and in its rather shorter spire, and in the presence of spiral ornament on the later whorls. While the posterior gutter is rather like that of *Dientomochilus*, the form is more like that of a *Tibia*, and there is no axial ornament.

TIBIA (*TIBIOCHILUS*) *RAKHIENSIS* n.subg. et sp.

(Figures 37*a*, *b*, plate 1)

MATERIAL. *Rakhi Nala section*: *Venericardia* Shales (local zone 1) (FB. F. 1836, the holotype, Reg. No. G. 68209, and 1 topotype, Reg. No. G. 68210; FB. F. 1838, *4*).

DESCRIPTION. Shell of moderate size, ovoid-conic, rostellariiform, apparently relatively thin-shelled, the spire being only moderately high, equal to or slightly less than half the

height of the shell. Protoconch not seen. There are five gently to moderately convex whorls on the holotype, their height being about half their width, the missing apical portion being small. Sutures linear and rather deeply sunk. Ornament, apparently only preserved on the later whorls, consisting of fine, widely spaced, incised spiral lines which are about $\frac{1}{2}$ mm. apart; there seem to be about nine or ten on the penultimate whorl. Body whorl broadly oval, anterior rostrum broken, the base gently convex; posteriorly and on the flanks it carries the same type of ornament as on the penultimate whorl, but anteriorly the grooves deepen and widen until they are of the same width as their intervals and separate off low, raised spiral ribbons. Aperture narrowly oval, and there are indications that the posterior gutter curved upwards and gently backwards to the posterior margin of the penultimate whorl. Columellar lip on the holotype only gently excavated. Growth lines not seen.

DIMENSIONS. Holotype: height (incomplete) 24·9 mm.; width 12·1 mm.

REMARKS. This species shows some resemblance in form to *Cyclomolops vredenburgi* Douvillé (B 1929, pp. 47, 71, Pl. 8, figs. 1–10), from the *Cardita beaumonti* beds of Sind, but the body whorl is less inflated and the spire whorls more convex. The gutter of Douvillé's species, incidentally, curves over on to the penultimate whorl, and does not ascend straight up the spire to near the apex as in *Cyclomolops*; although the sutures are visible as in *Cyclomolops*, the writer considers that the species is probably a *Calyptraphorus* since all Douvillé's illustrations appear to be of moulds, it being probable that the layer of callus covering the spire whorls has been removed.

Genus *HIPPOCHRENES* Montfort, 1810

(*Conch. Syst.* **2**, 522)

TYPE SPECIES. *Hippochrenes macropterus* (Lamarck), Eocene=*Rostellaria macroptera* Lamarck; original designation.

SYNONYMS. *Hippocrene* Oken, 1817 (*Isis*, **1**, 1168) (*em.*).

Hippocrena Schweigger, 1820 (*Handb. Naturg.* p. 724) (*err.*).

Hippocrenes Bronn, 1824 (*Syst. d. Urwelt. Konchylien*, p. 13) (*err.*).

HIPPOCHRENES AMPLUS (Solander, in Brander), 1766

REFERENCES. *Strombus amplus* Solander, in Brander, B 1766 (p. 34, fig. 76); Burtin, 1784 (Pl. 15, figs. A, B).

Rostellaria macroptera Lamarck, J. Sowerby, B 1821 (**3**, 177, Pl. 298, figs. 1–5; Pl. 300); Abrard, B 1925*a* (p. 335 (pars)).

Rostellaria ampla (Brander), Nyst, B 1843 (Pl. 43, fig. 5); Bronn, B 1848*b* (p. 1096); Fuchs, B 1869 (pp. 73, 90, Pl. 3, fig. 1).

Rostellaria ampla (Solander), Dixon, B 1850 (p. 105 (pars)); K. Mayer, B 1869 (p. 372); Vincent & Rutot, B 1879 (p. 138); Vincent & Rutot, 1879*b* (p. XIII); Vincent & Rutot, in Mourlon, B 1881 (p. 183); Lefèvre, 1881 (pp. XXX, XXVI, text-fig.); Vincent & Rutot, B 1883 (p. 197); C. Mayer-Eymar, B 1887 (p. 112); Sokolow, B 1893 (pp. 154, 185); Oppenheim, B 1896*b* (p. 138); Kranz, B 1910 (pp. 184, 198); Lukovitch, B 1921; Oppenheim, B 1922 (p. 98); Dukooizen, B 1924 (pp. 10, 19); Lukovitch, B 1926 (p. 30);

Jackson, B 1926 (p. 359 (pars)); E. Vincent, 1927 (pp. 40, 42); Gočev, B 1933*b* (pp. 191, 208, 199, 210, Pl. 7, fig. 1).

Rostellaria ampla Nyst, Bellardi, B 1852 (pp. 218, 291).

Rostellaria columbaria? Lamarck, d'Archiac & Haime, B 1854 (pp. 314, 315, 359, 370, Pl. 30, figs. 12, 12*a*, ?13).

Rostellaria columbaria Lamarck, Le Hon, B 1862 (p. 826 (pars)); Nyst, in Dewalque, B 1868 (p. 401); G. Vincent & Lefèvre, B 1872 (p. 70); Fedden, B 1880 (p. 208 (pars)); Cossmann & Pissarro, 1909 (pp. 44, 45); Abrard, B 1925*a* (p. 347).

Rostellaria (*Hippochrenes*) *ampla* (Solander), Edwards, in Lowry, B 1866 (p. 477, Pl. 3).

Hippochrenes amplus (Solander), Newton, B 1891 (p. 95 (pars)); Jackson, B 1926 (p. 359 (pars)); Burton, B 1933 (pp. 136, 144, 148, 150, 157, 163); Wrigley, 1938 (p. 75, figs. 27–31, 34, 36); Curry, B 1942 (p. 94).

Rostellaria ampla (Solander, in Brander), Boussac, B 1911*a* (pars) (pp. 313 (pars), 426 (pars), Pl. 19, fig. 2—*non* fig. 31 = *H. baylei* (Deshayes)).

Chenopus (*Hippocrene*) *columbarius* (Lamarck?), Douvillé, B 1916 (pp. 23, 45, Pl. 8, figs. 7, 7*a*—?*non* fig. 8).

Rostellaria (*Hippocrene*) *ampla* (Solander), Dukooizen, B 1924 (p. 46).

Chenopus (*Hippocrene*) *columbarius* d'Archiac & Haime, Cotter, B 1926 (pp. 412, 413).

Hippochrenes cf. *amplus* (Solander), Cox, B 1931*a* (pp. 49, 29, 32, 33, Pl. 1, fig. 20); Cox, B 1931*c* (p. 235); Cox, in B. Thomas, B 1932 (p. 364); Cotter, B 1933 (p. 97); Cox, in L. M. Davies & Pinfold, B 1937 (p. 71); Krishnan, B 1943 (p. 442).

Rostellaria (*Hippochrene*) *ampla* (Solander), Meffert, B 1931*a* (pp. 44, 58, Pl. 8, fig. 1).

Hippochrenes (*Hippochrenes*) *amplus* (Solander), Glibert, 1938 (pp. 62, 161, 166, figs. 25, 26; Pl. 2, fig. 8).

DOUBTFUL REFERENCES. *Rostellaria ampla* (Brander), Fuchs, B 1870 (pp. 186, 211, 140 ? = *Hippochrenes oligocaenica* (Lefèvre)); Oppenheim, B 1896*c* (p. 279 ? = *H. oligocaenica* (Lefèvre)).

Rostellaria ampla (Solander), Oppenheim, B 1900*c* (pp. 250, 258, 306 ? = *Hippochrenes oligocaenica* (Lefèvre)); Fabiani, B 1915 (p. 267 ? = *H. oligocaenica* (Lefèvre)).

Hippochrenes amplus (Solander), Jackson, B 1926 (p. 359 (pars) ? = *H. oligocaenica* (Lefèvre)).

Pugnellus sindensis Noetling, B 1905 (p. 137—*nomen nudum*).

INCORRECT REFERENCES. *Rostellaria ampla* (Brander), Nyst, B 1845 (p. 556 = *Hippochrenes robusta* (Rutot)).

Rostellaria (*Hippocrenes*) *ampla* (Solander), Albrecht & Valk, B 1943 (p. 52, Pl. 2, figs. 38, 39 = *Hippochrenes oligocaenica* (Lefèvre)).

Rostellaria ampla (Solander), Albrecht & Valk, B 1943 (pp. 146, 148, 150, 151, 153 = *Hippochrenes oligocaenica* (Lefèvre)).

MATERIAL. *Rakhi Nala section*: Shales with Alabaster (local zone 7) (FB. F. 1948, *2*, Reg. No. G. 68211–2); *Zinda Pir section*: White Marl Band (local zone 11) (FB. F. 2547, *1*); *Kohat area* (*Tarkhobi section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *2*; FB. F. 2173, *7*); *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2230, *1*; FB. F. 2287, *1*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *9*; FB. F. 2291, *15*+); Kaladhand Limestone (local subzone 4*a*) (FB. F. 2295, *1*).

FURTHER DISTRIBUTION IN PAKISTAN. ?Ranikot of the Salt Range; Laki of the Salt Range, and the 'Hala Range'; Kohat Shales of Kohat, possibly from shales of Laki age above the Laki Limestone in the Dharan anticline, referred to as 'Ghazij Shales' (*Pugnellus sindensis*).

FURTHER DISTRIBUTION. Gastropod Limestone (Ranikot) north-north-east of Kampa Dzong (Tibet); Lower Bracklesham Beds of England; Upper Bracklesham Beds of England; Auversian or Lutetian of Armenia; Wemmel Sands (Bartonian) of Belgium; Lower Bartonian of Switzerland; Lower Barton Beds of England; Middle Barton Beds of England; Upper Barton Beds of England; Bartonian of the Aral Sea area; Priabonian of Argens and southern Bulgaria; Eocene of Italy, Arabia and southern Russia.

REMARKS. Although the Rakhi Nala specimens are rather poorly preserved moulds, they can be matched with better preserved material the writer has seen from Eocene material in India and Western Pakistan. It seems very likely that *Pugnellus sindensis* Noetling (a *nomen nudum*) refers to this species.

The study of the references and distribution in connexion with this and related species has been very interesting. The most important contributions have been those of E. Vincent (1927), Cox (B 1931*a*), and Wrigley (1938). The application of their conclusions to the study of other records has shown that it is most probable that *Hippochrenes amplus* is restricted to the Eocene, and that Oligocene records refer to *H. oligocaenica*. The figures given by Albrecht & Valk of *Rostellaria* (*Hippocrenes*) *ampla* from the Lower Oligocene of south Limburg agree well with those of *Hippochrenes oligocaenica* and not with *H. amplus*. The record of *H. amplus* by Jackson (B 1926), from the Middle Headon Beds of England, has been referred by E. Vincent (1927) to *H. oligocaenica*. Oppenheim's (B 1900*c*, B 1896*c*) records of *Rostellaria ampla*, from the Lower Oligocene of Italy, are unaccompanied by illustrations; the writer understands from Dr L. R. Cox, that the material consists mainly of moulds, and that it is most unlikely that the wing is preserved or that the detailed characters of its upper portion where its outer margin meets the apex of the spire—one of the more important criteria for distinguishing the species of this group—is preserved. The same applies to Fabiani's (B 1915) record from the Rupelian of the Vicentin. From the available information it seems most likely that the species *Hippochrenes amplus* is restricted to the Eocene. It also appears to be the most widely distributed species of the group (Fuchs's illustration of the species from southern Russia (B 1869) is quite typical), and there seems no reason to suspect that the Pakistan forms belong to any of the other species.

The references by Negri (1934*b*, p. 152, Pl. 14, fig. 13) and Agnesotti (B 1939, p. 250) to *Rostellaria columbaria* Lamarck from the Eocene of Libya, although including d'Archiac & Haime's record of *R. columbaria*, have been omitted as the illustration is that of a mere mould with rather narrow whorls and with no flattening on the flank of the body whorl.

Genus *RIMELLA* Agassiz, in Sowerby, 1841

(*Min. Conch.* German ed. p. 137)

TYPE SPECIES. *Rostellaria* (*Rimella*) *fissurella* (Linné), Eocene=*Strombus fissurella* Linné; Herrmannsen, 1848.

SYNONYMS. ?*Isopleurus* Meek, 1864 (*Smithson. Misc. Coll.* **7**, part 8, no. 177, p. 20) *non*

Kirkby, 1837 (Col.); type species: if not yet selected, to be chosen from *I. curviliratus* (Conrad), Cretaceous and *I. meekiana* (Gabb), Cretaceous.

?*Isopleura* Meek, 1864 (*Smithson. Misc. Coll.* **7**, part 8, no. 177, p. 36) (*err.*).

RIMELLA PAKISTANICA n.sp.

(Figures 73, 74, plate 3)

MATERIAL. *Rakhi Nala section*: Green and Nodular Shales (local zone 6) (FB. F. 1900, *2*; FB. F. 1902, *1*); Rubbly Limestones (local zone 6) (FB. F. 1912, *1*); Shales with Alabaster (local zone 7) (FB. F. 1932, the holotype, Reg. No. G. 68213, and 2 topotypes, Reg. No. G. 68214–5; FB. F. 1934, 1 paratype, Reg. No. G. 68216); *Kohat area* (*Tarkhobi section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *2*; FB. F. 2173, *2*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2175, *1*); *Kohat area* (*Panoba section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2293, *1*); Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2294, *5*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *1*); Kohat Limestone (local subzone 4*b*) (FB. F. 2270, *1*).

ACCESSORY SAMPLES. *Kohat area* (*Tarkhobi*): Kohat Shales (local subzone 4*a*) (FB. F. 2183, *1*).

DESCRIPTION. Shell evidently attaining a fairly large size for the genus, diameter of the body whorl reaching 19·3 mm. Protoconch and early whorls not preserved. Shell subfusiform, not very produced anteriorly, with a moderately high spire. Whorls slightly to gently convex, their height about two-thirds of their width. Sutures on the moulds distinct and linear, moderately sunk, the whorls being occasionally slightly stepped. Body whorl oval, base not or only slightly excavated. Aperture rather narrowly oval, the inner lip on one of the syntypes being rather callous. No trace of spiral ornament remains. Axial ornament consisting of ribs which are vertical and straight or very slightly concave forwards, fine, and about the same width as or slightly narrower than their intervals on the early whorls; in large specimens they become considerably more widely spaced, are only about one-quarter the width of their intervals, and are subnodose medially. About 11 or 12 ribs on the last half of the penultimate whorl of the holotype, and about eight on the last half of the penultimate whorl of a large paratype. Moulds show indications that the posterior gutter extended straight up the spire.

DIMENSIONS. Holotype (early whorls missing): height 21·5+ mm.; width 10·5 mm. A syntype (most of spire missing): height 28·0+ mm.; width 19·3 mm.

REMARKS. Although none of the specimens is quite complete and all are moulds, sufficient can be made out from them to determine that they belong to a new species. *Rimella fusoides* (d'Archiac & Haime), from the Upper Ranikot of Western Pakistan, is rather similar to the earlier whorls of this species, but the whorls are a little more convex, the ribbing is slightly finer, and there is no indication that the spacing of the ribs becomes considerably greater in larger specimens. *R. hollandi* Cossmann & Pissarro, from the Upper Ranikot (zone 4) of Western Pakistan, is considerably stouter, and has much finer ribbing. *R. prestwichi* (d'Archiac & Haime), which is probably restricted to beds of Ranikot age, has rather coarser ribbing, and is also easily distinguished by the development of varices. *R. labrosa* Sowerby as figured by Oppenheim (B 1901*a*, p. 209, Pl. 9,

fig. 7), from the Priabonian of northern Italy, has a shorter body whorl which is more excavated anteriorly. *R. iniquicostata* Boettger (B 1875, p. 15, Pl. 2, fig. 15), also figured later by Boettger (B 1877, p. 28, Pl. 2, fig. 15), from the γ stage of the Eocene of Borneo, is similar, but has more inflated whorls. *Rostellaria? crucis* Bayan (1870*b*, p. 46, Pl. 8, figs. 5, 6), from the Eocene of Italy, has less high whorls, a more inflated body whorl, and the ribs on the body whorls do not become subnodose.

Genus *DIENTOMOCHILUS* Cossmann, 1904

(*Ess. Pal. Comp.* **6**, 38)

TYPE SPECIES. *Strombus ornatus* Deshayes, Eocene; original designation.

SYNONYM. *Dientomocheilus* Schlosser, 1925 (*Abh. bayer. Akad. Wiss. München*, **30**, part 7, p. 103) (error).

Subgenus *VARICOSPIRA* n.subg.

TYPE SPECIES. *Strombus cancellatus* Lamarck, Pliocene to Recent.

SUBGENERIC CHARACTERS. Subfusiform; gutter rising upwards and curving over backwards on to the dorsal region of the surface of the shell, not rising up to the apex as in *Rimella*; ornament consisting of axial ribs with spiral ornament consisting essentially of incised spiral lines in the intervals of the ribs; strong varices developed irregularly on the spire whorls, in addition to the labial varix.

REMARKS. The subgeneric name here proposed includes a large number of forms that have usually been placed in *Dientomochilus sensu stricto*. *Strombus ornatus* Deshayes, Eocene, which is the type of *Dientomochilus* by original designation, is, however, a short, strombiform shell with regular cancellate ornament of raised ribs and raised spiral threads which develop crenulations or small spines at their points of intersection; there is, moreover, a strong labial varix only, there being no trace of any varices elsewhere on the body whorl or on the spire whorls.

DIENTOMOCHILUS (*VARICOSPIRA*) *RAKHIENSIS* n.subg. et sp.

(Figures 38, 39, plate 1)

MATERIAL. *Rakhi Nala section*: Lower Chocolate Clays (local zone 10) (FB. F. 1967, the holotype, Reg. No. G. 68127, and 2 topotypes, Reg. No. G. 68218–9); east of Safaed, south of Tobah Kund, Dera Ghazi Khan District; Mittha Sor, Dera Ghazi Khan District; Domanda, Dera Ismail Khan District (6 specimens, Reg. No. G. 66922–8).

DESCRIPTION. Shell rather stoutly subfusiform, spire approximately half the height of the shell, regularly conic. Protoconch large, rather tectiform with a small apex, consisting of about five smooth, gently convex whorls with distinct sutures. About three and a half spire whorls on the holotype; they are slightly to gently convex in outline, about half as high as wide, and are ornamented with axial ribs. These ribs are rather fine, of about the same width as or slightly narrower than their intervals, distinctly concave forwards, a little antecurrent posteriorly, more distinctly retrocurrent anteriorly, the change in direction occurring above the middle of the whorl at about two-thirds of its height. About 33 ribs on the last whorl of the holotype. No trace of spiral ornament except on some large specimens collected by Mr Pinfold, in which the last two whorls carry fine spiral threads of the same width as their intervals; there are about 18 on a whorl 2·25 mm. high. A few

large, strong, swollen varices are irregularly developed. Sutures linear, distinct, somewhat incised. Body whorl stoutly oval, the anterior rostrum broken, its base somewhat flattened although the periphery is rounded, the ribs dying out on the periphery and giving place to about 12 or 13 incised spiral lines on the base, this appearance evidently being due to the body whorl being missing. About eight such spiral lines in $\frac{3}{4}$ mm. Body whorl carrying at least two strong, swollen varices. Aperture evidently suboval. The outer lip is broken, and the trace of the posterior gutter cannot be determined. Growth lines apparently parallel to the ribs.

DIMENSIONS. Holotype: height (incomplete) 6·25 mm.; width 3·0 mm.

REMARKS. There is no trace whatsoever of a gutter running straight up the side of the spire as in *Rimella*, and in spite of the apparent absence of spiral ornament on the spire whorls of immature specimens, the species appears to belong to the group of forms here placed in the new subgenus *Varicospira*. *Rimella subrimosa* d'Orbigny var. *narica* Vredenburg, from the Nari of Western Pakistan, *R. subrimosa* d'Orbigny, from the Gaj of Cutch, and *Rostellaria*? *sindiensis* Vredenburg, from the Nari (probably Lower Nari) of Western Pakistan, would all appear to belong to the subgenus *Varicospira* according to their illustrations and accompanying descriptions, but, in addition to other characters, can all be distinguished from the Rakhi Nala species by their distinct spiral ornament in post-nuclear stages.

DIENTOMOCHILUS (*VARICOSPIRA*) *PAKISTANICUS* n.subg. et sp.

(Figure 40, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68220, and 24 topotypes, Reg. No. G. 68221–6); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *2*).

DESCRIPTION. Shell rather small, subfusiform. None of the specimens is complete, the aperture being broken and the early whorls, in most cases, missing. One of the topotypes shows the protoconch, which was naticoid-subtectiform, consisting of about four and a half smooth, gently to moderately convex whorls with linear, distinct sutures. There are six spire whorls preserved on the holotype, and there may be one or two missing; they are gently convex, their height is about two-fifths to half their width, and they are ornamented with axial ribs. These ribs are moderately fine, distinct, solid, of about the same width as or slightly narrower than their intervals, gently concave forwards, subvertical or slightly antecurrent posteriorly, noticeably retrocurrent anteriorly; since their change of direction takes place well above the middle of the whorls at about two-thirds to three-quarters of the height of the whorls, there is a marked obliquity in their appearance, and they also seem slightly hooked posteriorly. The last whorl preserved on the holotype has about 26 ribs. Very strong, bulging varices irregularly developed, there usually being two per whorl. No spiral ornament. Sutures linear, moderately sunk. Body whorl rather stout, giving to the spire, which occupies about half the height of the shell, a rather slender appearance; its flank is rounded, the base gently excavated, the anterior rostrum distinct but not long. The ribs extend on to the base, but are replaced by rather closely spaced, incised, spiral lines on the neck and flank of the rostrum. Aperture apparently oval, with a posterior gutter ascending upwards and curving over backwards to the posterior suture of the

penultimate whorl on the dorsal surface. Growth lines not distinctly seen, apparently parallel to the ribs.

DIMENSIONS. Holotype: height (incomplete) 5·75 mm.; width 2·75 mm.

REMARKS. This species has a considerably higher and more slender spire than *Dientomochilus* (*Varicospira*) *rakhiensis*, and also rather stronger ribbing and more deeply incised sutures. The other Indian and Pakistan species of *Varicospira* which were mentioned in the discussion of *D.* (*V.*) *rakhiensis* are all distinguished from *D.* (*V.*) *pakistanicus* by the development of distinct spiral ornament between the ribs. There is a superficial resemblance between *D.* (*V.*) *pakistanicus* and *Rissoina rakhiensis* n.sp., from the same horizon, but the latter species has slightly finer ribbing, especially in the adult, and does not develop varices.

DIENTOMOCHILUS (*VARICOSPIRA*) *TENUI-INCISUS* n.subg. et sp.

(Figure 75, plate 3)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68227).

DESCRIPTION. Shell of moderate size, oval-conic, moderately turriculate, the single specimen available consisting of three and a half well-preserved whorls, the apex and part of the body whorl being missing. Whorls gently convex in outline, their greatest width at about two-fifths of their height, and their height about half their width. Sutures fine, distinct, linear. Ornament consisting of moderately strong axial ribs and of very fine incised spiral lines. Ribs narrowly rounded in section, prominent, gently retrocurrent as a whole, slightly concave on their forward side, separated by intervals from twice to three times their own width. Occasionally a rib is developed into a strong, swollen varix, there usually being about two such varices per whorl. Spiral ornament consisting of about 16 uniformly spaced, rather widely separated, fine incised spiral lines which cross over the ribs. The last whorl preserved has gently convex flanks and a declivous, slightly concave base, the anterior end being broken. Ribs stopping rather abruptly at the periphery, the base carrying at least 14 fine spiral threads which, on the upper part of the base, at any rate, are separated by relatively broad, flat intervals at least three times the width of the narrow threads. Aperture apparently moderately narrowly oval. Columellar lip gently concave, apparently rather callous. Outer lip broken, no trace of the gutter remaining. Growth lines following the same course as the ribs.

DIMENSIONS. Holotype: height (incomplete) 10·8 mm.; width 5·9 mm.

REMARKS. The form, characters of the ribbing, development of fairly strong varices, and presence of numerous fine, incised spiral lines are characteristic of the species.

Genus *TEREBELLUM* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 135)

TYPE SPECIES. *Terebellum nebulosum* Bolten, Recent = *Bulla terebellum* Linné = *Terebellum subulatum* Lamarck; by tautonymy.

SYNONYMS. *Lucis* Gistl, 1847 (*Nat. Thierr.* p. 170) (replacement name).

Artopoia Gistl, 1848 (*Nat. Thierr.* p. xi) (replacement name).

TEREBELLUM CARCASSENSE Leymerie, 1846

REFERENCES. *Terebellum carcassense* Leymerie, B 1846 (pp. 365, 371, 353, Pl. 16, figs. 9*a*, *b*); Bronn, B 1848*b* (p. 1225); Studer, B 1853 (p. 102); Mallada, B 1890 (p. 117); Mallada, B 1892 (p. 206); Vinassa de Regny, B 1896*a* (p. 259); Doncieux, B 1905 (pp. 45, 12, Pl. 2, fig. 2); Doncieux, 1908 (p. 91); Fabiani, B 1915 (pp. 255, 261); Schlosser, B 1925*a* (p. 161); Cox, B 1931*a* (pp. 51, 53, 52, Pl. 1, fig. 21); Cox, B 1936 (pp. 28, 7, Pl. 3, figs. 7–9); Furon, B 1941 (p. 335).

Terebellum obtusum J. de C. Sowerby, d'Archiac, B 1850*b* (pars) (**3**, 300); d'Archiac & Haime, B 1854 (pars) (pp. 333, 359, 371, Pl. 32, fig. 20 *non* fig. 21 = *T. subulatum* Lamarck var. *obtusum* J. de C. Sowerby); d'Archiac, B 1859*a* (p. 313); Mallada, B 1878 (pp. 320, 406); Boghdanovich, B 1890 (p. 70); Mallada, B 1892 (p. 206); Doncieux, B 1905 (pp. 44, 12, Pl. 2, fig. 4).

Terebellum carcassonnense Leymerie, Bellardi, B 1852 (pp. 217, 291).

? *Terebellum plicatum* d'Archiac & Haime, B 1854 (pars) (pp. 334, 372, Pl. 32, fig. 22 *non* figs. 17, 18 = *T.* (*Mauryna*) *plicatum* d'Archiac & Haime).

Terebellum clava Schafhäutl, B 1863 (p. 209, Pl. 47, fig. 14).

Terebellum carcassensis Leymerie, Maureta & Thos y Codina, B 1881 (p. 322).

Terebellum corcassense Leymerie, de Gregorio, B 1896 (p. 36).

Terebellum carcassonense Leymerie, Vinassa de Regny, B 1898 (p. 158); Fabiani, B 1908 (p. 165).

Terebellum cf. *carcasense* Leymerie, Schlosser, B 1925*a* (p. 103, Pl. 3, fig. 27).

Terebellum (*Seraphs*?) cf. *sopitum* Solander var. Meffert, B 1931*a* (p. 43, Pl. 8, figs. 6, 7).

MATERIAL. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 2) (FB. F. 1841, *2*); Shales with Alabaster (local zone 7) (FB. F. 1935, *2*; FB. F. 1939, *2*; FB. F. 1941, *4*); White Marl Band (local zone 11) (FB. F. 1970, *5*, Reg. No. G. 68228–32); *Pellatispira* Beds (local zone 15) (FB. F. 1981, *2*); *Zinda Pir section*: *Pellatispira* Beds (local zone 15) (FB. F. 2507, *1*); *Kohat area* (*Tarkhobi section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *2*); *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2230, *2*; FB. F. 2294, *7*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2291, *3*); Kaladhand Limestone (local subzone 4*a*) (FB. F. 2254, *2*; FB. F. 2255, *2*); Upper Kohat Shales (local subzone 4*a*) (FB. F. 2256, *1*; FB. F. 2257, *2*); Kohat Limestone (local subzone 4*b*) (FB. F. 2271, *1*); *Kohat area* (*Shekhan Nala section*): Kaladhand Limestone (local subzone 4*a*) (FB. F. 2334, *5*; FB. F. 2336, *2*); Upper Kohat Shales (local subzone 4*a*) (FB. F. 2338, *1*; FB. F. 2339, *1*; FB. F. 2341, *9*).

FURTHER DISTRIBUTION IN PAKISTAN. Laki of Sind and the Salt Range; Khirthar of the Mari Hills and the 'Alore Hills' (Sind).

FURTHER DISTRIBUTION. Lower Eocene of southern France; Lutetian of France, Italy, the Bavarian Alps and Bahrein Island; Auversian or Lutetian of Armenia; Auversian of Italy; and Eocene of Transcaspia or northern Persia, Spain, Switzerland, Italy and France (the type locality is north of Carcassonne in the Black Mountains).

REMARKS. As was the case in India, it seems that the forms which elsewhere were referred by Mallada, Boghdanovich, and Doncieux to the Neogene form *Terebellum obtusum* J. de C. Sowerby (regarded as a variety of *T. subulatum* Lamarck), but which came

from the Eocene, are best referred to *T. carcassense* Leymerie. Vinassa de Regny (B 1896*a*) placed in synonymy de Gregorio's record (1880, p. 22, Pl. 5, figs. 24, 25) of *T. fusiforme* f. 5*a retractum* de Gregorio, but the illustrations show a form which appears to be distinct on account of its higher and more slender spire and its more oblique sutures.

TEREBELLUM FUSIFORMOPSE de Gregorio, 1880

(Figures 76*a*, *b*, plate 3)

REFERENCES. *Terebellum sopitum* Brander form *fusiformopse* de Gregorio, 1880 (p. 22, Pl. 5, fig. 29).

? *Terebellum fusiforme* Lamarck, de Gregorio, B 1894*b* (p. 11, Pl. 1, fig. 21); Socin, 1939 (pars) (pp. 92, 102, 106, 111); Loss, B 1940 (pars) (pp. 62, 74, 77).

Terebellum fusiformopse de Gregorio, Oppenheim, B 1896*b* (pp. 72, 85); Oppenheim, B 1896*a* (p. 194); Oppenheim, B 1906*a* (p. 299); Fabiani, B 1915 (pp. 255, 261); Cuvillier, B 1930 (p. 253).

Terebellum (Seraphs) fusiformopse de Gregorio, Fabiani, B 1908 (pp. 164, 232).

Cerebellum fumiformopse de Gregorio, Cuvillier, B 1930 (p. 211).

INCORRECT REFERENCES. *Terebellum fusiformopse* de Gregorio, Cossmann, 1889 (p. 93, Pl. 3, figs. 3, 4); Blanckenhorn, B 1921 (p. 93); Furon & Soyer, B 1947 (p. 117).

Terebellum fusiformopsis de Gregorio, Harris & Burrows, B 1891 (p. 90).

Terebellum (Seraphs) fusiformopse de Gregorio, Cossmann & Pissarro, B 1907–13 (Pl. 31, fig. 158–3).

MATERIAL. *Zinda Pir section*: White Marl Band (local zone 11) (FB. F. 2734, *20*, Reg. No. G. 68233–8).

FURTHER DISTRIBUTION. Middle Lutetian of Italy (Gazzo); Upper Lutetian of Italy (San Giovanni Ilarione, the type locality); Lutetian of Sorne (Italy); Auversian of Italy (Fontana del Cavaliere); Upper Mokattam of Egypt; Eocene of Zovencedo and Italy (Monte Postale, Ciuppio, Valsugana and Croce grand); Priabonian of Italy (Cimome).

REMARKS. de Gregorio's (B 1894) record of *Terebellum fusiforme* Lamarck is included on the basis of Oppenheim's (B 1896*a*) opinion; de Gregorio's illustration is of a small specimen. The writer also agrees with Oppenheim (B 1896*a*) that records of *T. fusiformopse* from France are incorrect. The Paris Basin specimens referred to de Gregorio's species are considerably more slender and belong to the subgenus *Seraphs*.

'*TEREBELLUM*' *DIVERSIORNATUM* n.sp.

(Figure 77, plate 3)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*b*) (FB. F. 2675, the holotype, Reg. No. G. 68239).

DESCRIPTION. One or two of the earlier whorls are missing, and the extreme anterior portion of the body whorl is broken. Subelliptical in outline, not very elongate for the genus, with a short, slightly conoidal spire which was approximately one-seventh of the total height of the shell. Spire whorls rather flat in outline, with linear sutures, their height slightly less than half their width; there are one and three-quarter such whorls preserved. The ornament on these whorls is not very well preserved, but commences with

fine, straight, vertical axial riblets which are slightly wider than their intervals; there are ten in $\frac{3}{4}$ mm. At a later stage moderately shallow spiral grooves, of about the same width as their flat, ribbon-like intervals, appear, and the ribs gradually become obsolete. On the last spire whorl the ribs disappear completely, and there are merely about 11 spiral bands just above the termination of the outer lip. These bands themselves rapidly become obsolete, most of the body whorl being smooth. Body whorl oliviform in outline, its greatest width distinctly above the middle, the flanks gently convex. Aperture narrow and elongate, with no trace of columellar folds.

DIMENSIONS. Holotype: height (a little incomplete) 10·1 mm.; width 4·5 mm.

REMARKS. The single specimen is a mould. Although the species probably belongs to a new and undescribed subgenus of *Terebellum*, no name is suggested here for the group, since it seems advisable to await the collection of additional, better preserved material. The form and ornament appear to be unique.

Superfamily NATICACEA

Family NATICIDAE

Subfamily POLINICINAE

Genus *EUSPIRA* Agassiz, in Sowerby, 1838

(*Min. Conch.* German ed. pp. 14, 320)

TYPE SPECIES. *Natica glaucinoides* J. Sowerby, Eocene, *non* Deshayes, = *Natica labellata* Lamarck; Bucquoy, Dollfus & Dautzenberg, 1883.

SYNONYMS. *Lunatia* Gray, 1847 (*Proc. Zool. Soc. Lond.* **15**, 149); type species: *Natica ampullaria* Lamarck, Recent; original designation.

'*Naticina* Guilding' Fischer, 1885 (*Man. Conch.* p. 768) *non* Guilding, 1834.

Labellinacca Cossmann, 1919 (*Act. Soc. linn. Bordeaux*, **70**, part 3, p. 188); type species: *Natica labellata* Lamarck, Eocene; monotypy.

REMARKS. Wenz places *Lunatia* as a genus in the subfamily Polinicinae and *Labellinacca* as a genus in the subfamily Naticinae. Such separation hardly seems justified, and the writer is of the same opinion as Cox and other authors, who regard *Lunatia* as a synonym of *Euspira*.

EUSPIRA PUNJABENSIS n.sp.

(Figures 41 *a*, *b*, *c*, 42, plate 1)

MATERIAL. From so-called Khirthar beds (*Discocyclina* Shales) on the footpath from Droginda to Domanda, Dera Ismail Khan District (31° 38′: 70° 12′), the holotype, Reg. No. G. 66920, and 1 topotype, Reg. No. G. 66921; *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, *110* young specimens, Reg. No. G. 68240–5; FB. F. 1995, *10*+; FB. F. 1987, *10*+; FB. F. 1996, *1*); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, *2*; FB. F. 2519, *6*).

DESCRIPTION. Shell of moderate size, naticoid, globose, whorls growing rapidly, smooth. Although the early whorls are preserved, they are always partially decorticated

and it is not possible to tell how many constituted the protoconch. In young specimens, represented by numerous examples from FB. F. 1986, the first three whorls or so are rather flatly coiled, giving the very young stages a distinctly globose and conoidal appearance. Adult shell conic, the spire whorls moderately to distinctly convex, the sutures linear and distinctly sunk, the whorls somewhat shouldered, the body whorl globose and rounded. Aperture somewhat semicircular, narrower near the posterior suture, the columellar lip straight. Parietal callus thickened over at least the posterior half of the columellar lip, adherent to the parietal wall for only half of its length, and then tapering anteriorly where it margins the moderately sized umbilicus. Growth lines practically straight and distinctly oblique. Outer lip thin, and posterior gutter present. In adult specimens the spire forms not more than one-eleventh of the total height, and the height of the whorls is about three-tenths of their width. In dorsal view the body whorl is rather drawn out to the left and somewhat downwards.

Dimensions. Holotype: height 12·6 mm.; width 13·1 mm. A young specimen from FB. F. 1986: height 2·25 mm.; width 2·8 mm.

Remarks. *Euspira blagraveia* (Vredenburg) (B 1928*a*, p. 62), from zone 4 of the Upper Ranikot at Jherruck, is the only illustrated form from the Eogene of Pakistan or India that shows any close resemblance to this species, but it is less transverse and more ampulliniform, the aperture being less produced laterally. *Natica sultani* Martin (1914, p. 171, Pl. 6, figs. 150, 151), from the Upper Eocene of Java, does not attain the same large size; although it resembles the young stages of the Pakistan species, it has a sharper apex, the aperture is less obliquely transverse, and the sutures are less canaliculate. *N. ottiliae* Penecke (1885, p. 362, Pl. 5, fig. 1), from the Eocene of Austria, has the whorls less stepped suturally.

EUSPIRA SORIENSIS n.sp.

(Figures 78*a*, *b*, 79, plate 3)

Material. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2681, *2*; FB. F. 2680, *1*; FB. F. 2679, the holotype, Reg. No. G. 68246, and 5 topotypes, Reg. No. G. 68247–51).

Description. Shell of only moderate size, naticoid, globose, smooth, consisting of about four rapidly expanding whorls. Protoconch not distinguishable. Spire whorls gently convex, their height about one-fifth of their width, separated by linear, distinct, slightly sunken sutures. Spire occupying about one-twelfth of the height. Body whorl large, ample, globose, rounded, not shouldered. Aperture somewhat semicircular, with a distinct posterior gutter. Parietal wall covered with a thick layer of callus, which tapers rather rapidly towards the straight, oblique columellar lip, and which margins an umbilicus of moderately small size. Growth lines practically straight, slightly convex forwards, rather strongly oblique.

Dimensions. Holotype: height 6·75 mm.; width 7·1 mm.

Remarks. *Euspira blagraveia* (Vredenburg) (B 1928*a*, p. 62), from zone 4 of the Upper Ranikot at Jherruck, is the only illustrated Eogene species from Pakistan that shows any similarity to this species; it is, however, larger, has a more prominent spire, the whorls are more shouldered, and it is less globose. *Natica sultani* Martin (1914, p. 171, Pl. 6, figs. 150,

151), from the Upper Eocene of Java, is more truly globular, a little smaller, and has a somewhat less acute spire. *N.* (*Naticina*) *labellata* Lamarck as figured by Oppenheim (B 1906*a*, p. 273, Pl. 22, figs. 9*a*, *b*), from the Upper Mokattam of Egypt, and by Cossmann & Pissarro (B 1907–13, Pl. 10, fig. 61–31), from the Lutetian of the Paris Basin and from the Cuisian and the Bartonian, has the aperture more expanded antero-laterally; Cossmann & Pissarro's illustration is of a rather smaller form which also has a somewhat more acute spire. *N. ottiliae* Penecke (1885, p. 362, Pl. 5, fig. 1), from the Eocene of Carinthia, is less globose and has a more extensive parietal callus. *N. helicina* Brocchi as figured by Wolff (B 1897, p. 265, Pl. 25, fig. 15; Pl. 28, figs. 7, 8), from the Oligocene of southern Bavaria, is larger, has a more conspicuous spire, and is broader at the shoulder; this comparison has been made with Wolff's fig. 7*b*, not with his fig. 15*a*, which is of a crushed specimen; *N.* (*Sigaretopsis*) *corneti* von Koenen as figured by Cossmann (1915, p. 63, Pl. 4, figs. 34–36), from the Montian of Belgium, does not have quite such heavy parietal callus, and the aperture has its axis less obliquely directed; Cossmann's illustrations, incidentally, do not show the spiral threads of a *Sigaretopsis*. *Natica* (*Naticina*) *tenuicula* Deshayes as figured by Cossmann & Pissarro (B 1907–13, Pl. 10, fig. 61–28), from the Cuisian of the Paris Basin and from the Lutetian, and also figured by Glibert (B 1933, p. 36, Pl. 2, fig. 7) as *N.* (*Lunatia*) *tenuicula*, from the Bruxellian of Belgium, is larger, more globose, has more stepped whorls, and has a more prominent and more acute spire. *N.* (*Naticina*) *briarti* von Koenen as figured by Cossmann (1915, p. 63, Pl. 4, figs. 30–33), from the Montian of Belgium, is less inflated and a little larger; this species was figured as *N. infundibulum* Watelet var. *tenuicula* Deshayes by Briart & Cornet (1873, p. 4, Pl. 6, figs. 3*a*, *b*, *c*), from the Montian of Belgium, and the aperture of their form is more obliquely drawn out. *Euspira punjabensis* n.sp. is less globose, has a rather more distinct spire and more distinct sutures, attains a rather larger size, and the whorls are gently shouldered rather than gently convex.

Genus *CEPATIA* Gray, 1847

(*Proc. Zool. Soc. Lond.* **15**, 149)

TYPE SPECIES. *Natica cepacea* Lamarck, Eocene; monotypy and original designation.

SYNONYM. *Velainia* Munier-Chalmas, 1884 (*Ann. Malac.* **1**, 323, 335); type species: *Natica caepacea* Lamarck, Eocene; original designation and monotypy.

REMARKS. Gray's record of the name *Cepatia* in 1842 (*Syn. Cont. Brit. Mus.* 44th ed. p. 60) ranks as a *nomen nudum*, as it is a name without species or proper description.

CEPATIA CEPACEA (Lamarck), 1804

REFERENCES. *Natica cepacea* Lamarck, 1804*c* (p. 96); Lamarck, B 1806*b* (p. 387, Pl. 62, figs. 5*a*, *b*); Lamarck, 1822*b* (p. 552); Brongniart, B 1823 (pp. 60, 18); Bronn, B 1831 (p. 72); Grateloup, 1847 (key to Pl. 8, *non* vars.); Wise, 1863 (pp. 249, 247); Deshayes, 1864 (p. 59); von Schauroth, B 1865 (p. 252); K. Mayer, B 1869 (p. 367); E. Pavay, B 1871 (pp. 363, 424); A. von Pavay, B 1874 (p. 412); Zittel, B 1883 (pp. 98, 102, 108); Newton, B 1891 (p. 238); Oppenheim, B 1894 (p. 361); Koch, B 1894 (p. 286);

Oppenheim, B 1896*a* (p. 179); Oppenheim, B 1896*b* (pp. 62, 84, 151); V. de Regny, B 1896*a* (pp. 218, 249, 212, 229); V. de Regny, B 1897 (pp. 168, 152); Bontscheff, 1897 (pp. 380, 322, 323, 324, 325, 354); V. de Regny, B 1898 (pp. 155, 171, 186, 146, 163, 180); Oppenheim, 1899 (p. 109); Radkewitsch, B 1900 (p. 341); Oppenheim, B 1901*b* (p. 258); Oppenheim, B 1902 (pp. 272, 273); Dainelli, B 1904 (p. 150); Fabiani, B 1905 (p. 146); Taeger, B 1908 (pp. 264, 74, 76, 85, Pl. 10, figs. 3*a*, *b*); Boussac, B 1911*a* (p. 430); Fabiani, B 1915 (pp. 16, 25, 26, 30, 120, 122, 253, 261, 280); Douvillé, 1920*c* (p. 46); Blanckenhorn, B 1921 (p. 87); Schlosser, B 1925*b* (pp. 47, 49, 50, 51, 56); Schlosser, B 1925*a* (pp. 178, 184); Cuvillier, B 1930 (pp. 52, 79, 103, 121, 154); Cuvillier, B 1937 (p. 232); Traub, B 1938 (p. 23); Kühn, 1948 (p. 52).

Natica cepacaea Lamarck, Deshayes, B 1825 (p. 168, Pl. 22, figs. 5, 6); d'Archiac, B 1850*b* (**3**, 280, 63); Bellardi, B 1852 (pp. 212, 291); Fuchs, B 1870 (p. 142); Mallada, B 1878 (pp. 320, 406); Mallada, 1879 (Pl. 3, figs. 8, 9); Renévier, B 1890 (p. 399); Mallada, B 1892 (p. 204); Abrard, 1924 (p. 378); Abrard, B 1925*a* (pp. 79, 80, 81, 85, 89, etc.); Cuvillier, 1927 (p. 522); Robert, B 1932 (p. 31); L. & J. Morellet, 1932 (p. 450); L. & J. Morellet, B 1936 (p. 300); Coulon, B 1936 (pp. 47, 48); Loss, B 1940 (p. 6); Furon & Soyer, B 1947 (pp. 108, 154, Pl. 11, fig. 61–20; Pl. 13, fig. 61–20); L. & J. Morellet, B 1948 (pp. 29, 94, 187, 194, 275, 343); Kühn, B 1948 (p. 85).

Pitonillus cepaceus (Lamarck), Bronn, B 1848*b* (p. 983).

Natica cepacaea? Lamarck, d'Archiac & Haime, B 1854 (pp. 280, 359, 368, Pl. 25, figs. 14, 15).

Natica cepacaea Lamarck?, d'Archiac, in Tchihatcheff, B 1866 (p. 122, Pl. 3, fig. 7); Fedden, B 1880 (p. 205); Vredenburg, B 1928*a* (p. 9).

Natica caepacea Lamarck, Vieillard & Dollfus, B 1875 (pp. 76, 94); de Gregorio, 1881 (pp. 30, 51, Pl. 2, fig. 3); C. Mayer-Eymar, B 1887 (p. 108); de Gregorio, B 1894*b* (p. 29, Pl. 6, figs. 163–165); Koch, B 1894 (pp. 264, 277, 296); Socin, 1936 (p. 28).

Natica (*Neverita*) *caepacea* Lamarck, K. Mayer-Eymar, B 1877 (p. 85).

Natica caepacaea Lamarck, de Gregorio, 1881 (p. 3).

Natica coepacea Lamarck, Cya, B 1883 (p. 56).

Velainia cepacaea (Lamarck), Munier-Chalmas, 1884 (p. 336).

Natica (*Cepatia*) *cepacaea* Lamarck, Cossmann, 1888 (p. 164); Harris & Burrows, B 1891 (p. 82); Loss, B 1940 (pp. 54, 70); Kühn, B 1948 (p. 73).

Natica caepacea Lamarck var. *puerpera* de Gregorio, B 1894*b* (p. 29, Pl. 6, figs. 166–171).

Natica (*Cepatia*) *caepacea* Lamarck, de Gregorio, B 1896 (p. 56).

Natica (*Cepatia*) *caepacea* Lamarck var. *puerpera* de Gregorio, de Gregorio, B 1896 (p. 56).

Cepatia cepacaea (Lamarck), Cossmann & Pissarro, 1900 (p. 110, Pl. 24, fig. 13); Cossmann, 1902 (p. 10, Pl. 2, figs. 13, 14); Cossmann & Pissarro, 1909 (p. 69); Cossmann & Pissarro, B 1907–13 (Pl. 9, fig. 61–20); Cossmann, 1925 (pp. 140, 141, Pl. 1, figs. 27, 28, 34, 35; Pl. 2, figs. 15, 16); Socin, 1939 (pp. 84, 101–102).

Natica (*Cepatia*) *cepacea* Lamarck, Dainelli, B 1904 (pp. 156, 161); Dainelli, 1905 (p. 23); Oppenheim, B 1906*a* (p. 271); Fabiani, B 1908 (p. 148); Boussac, B 1911*a* (p. 330); Dainelli, B 1915 (pp. 551, 79); Oppenheim, B 1923 (pp. 74, 95); Schlosser, B 1925*b* (p. 32, Pl. 7, fig. 28); Schlosser, B 1925*a* (pp. 178, 184); Cuvillier, B 1930 (p. 130); Isaeva, 1933 (pp. 15, 64, 57, Pl. 1, fig. 19).

Cepatia cepacea (Lamarck), Fabiani, B 1915 (p. 142); Dainelli, B 1915 (pp. 100, 114, 121); Vasseur, B 1917 (Pl. 8, figs. 3–6); Barthoux, 1920 (p. 105); Cox, B 1931*a* (pp. 37, 28, 33, 35); Cotter, B 1933 (p. 97).

Natica capacaea Lamarck, Abrard, B 1925*a* (p. 88).

Cepacia cepacaea (Lamarck), Abrard, B 1925*a* (p. 124).

Natica cepaeca Lamarck, Abrard, B 1925*a* (p. 168).

Naticace pacaea Lamarck, Abrard, B 1925*a* (p. 240).

Helix crassa Pieragnoli, B 1935 (p. 181, Pl. 8, fig. 11).

Neverita (*Cepatia*) *cepacea* (Lamarck), Chavan & Dupuis, B 1938 (p. 534).

Cepatia caepacea (Lamarck), Socin, 1939 (p. 106).

REFERENCES OMITTED. *Natica cepacaea* Lamarck, Grateloup, B 1838 (p. 36).

Natica cepacea Lamarck, Pantanelli & Mazzetti, 1887 (p. 70); Raulin, B 1896 (p. 552).

Natica cepacea Lamarck var. *umbonata* Grateloup, 1847 (Pl. 8, fig. 15).

Natica cepacea Lamarck var. *papyracea* Grateloup, 1847 (Pl. 8, fig. 16).

Natica (*Cepatia*) *cepacaea* Lamarck, J. Noszky, 1940 (p. 11).

MATERIAL. *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2287, *1*, Reg. No. G. 68253); Kohat Limestone (local subzone 4*c*) (FB. F. 2275, *1*); *Kohat area* (*Shekhan Nala section*): Upper Kohat Shales (local subzone 4*a*) (FB. F. 2341, *2*); *Kohat area* (*Sirki Paila*): Sirki Shale (local subzone 4*d*) (FB. F. 2109, *1*).

Accessory samples: *Kohat area* (*Tarkhobi*): Kohat Shales (local subzone 4*a*) (FB. F. 2183, *1*).

FURTHER DISTRIBUTION IN PAKISTAN. Laki of the 'Hala Range'; Kohat Shales of Kohat and Bahadur Khel; Khirthar of the Mari Hills.

FURTHER DISTRIBUTION. This well-known species has a wide geographical distribution and a long geological range, of which the following is a summary: Libyan of Egypt; Lower Mokattam of Egypt; Bracklesham Beds of England; Lower Lutetian of the Isthmus of Suez; Lutetian of France (Grignon is the type locality), Italy, Istria, the Bavarian Alps, Egypt, the Balkans, Zovencedo and Asia Minor; Auversian of France, Italy, Herzegovina and Dalmatia; Lower Bartonian of France and Switzerland; Bartonian of Dalmatia, Hungary and France; Upper Eocene of the Balkans and the Bavarian Alps; Eocene of Hungary, France, Spain, Sicily, Bulgaria, Austria, Lower Tibaide and Russia (Akhaltsikh).

REMARKS. The records from the Oligocene of southern France and from the Rupelian near Budapest cannot be substantiated. None of the specimens has been illustrated, and the writer understands that the material is almost certainly poorly preserved. While not discounting the possibility of a few typical Eocene forms surviving as a relict fauna in the Oligocene, it seems more likely that the material has been incorrectly identified, and may be referable to some well-known Oligocene form which might even be a *Neverita*. According to Raulin (B 1896) Grateloup's record of *Natica cepacea* is referable to *N. hemisphaerica* d'Orbigny.

Family AMPULLOSPIRIDAE

REMARKS. It has been suggested that *Ampullospira* may be a synonym of *Amaurellina*, and that the family name Amaurellinidae may have to be adopted in place of Ampullospiridae. The type of *Amaurellina* (and of its synonym *Amauropsella*) is *Amaurellina spirata* (Lamarck) from the Eocene; this is a moderately small, thin-shelled species, with a distinct 'arête'

ascending into the umbilicus by splitting off from the columellar lip, and a distinct carination of the shoulder of the body whorl. The type of *Ampullospira* is *Euspira canaliculata* Morris & Lycett *non Natica canaliculata* Lamarck, =*Natica helicoides* Johnson, from the Bathonian; this, and other forms placed in the same genus, are of moderately large size, rather thick-shelled when well preserved, and do not display the distinct 'arête' of *Amaurellina*, although an umbilical depression is often present. There seems to be as much difference between *Amaurellina* and *Ampullospira* as there is, for example, between the thin-shelled *Crommium* and the more solid *Globularia* and *Ampullinopsis*. The forms figured by Stewart (1926) as *Amaurellina*, and which are from the Cretaceous of North America, seem to belong to *Ampullospira* rather than to *Amaurellina*. The writer accordingly prefers to retain the name *Ampullospira*, and therefore the family name Ampullospiridae.

Genus *EUSPIROCROMMIUM* Sacco, 1890

(*Boll. Mus. Zool. Anat. Comp. R. Univ. Torino*, **5**, no. 86, pp. 41, 42)

TYPE SPECIES. *Natica elongata* Michelotti *non* Hoerning, Oligocene=*Crommium* (*Euspirocrommium*) *degensis* Sacco var.; Cossmann, 1892.

EUSPIROCROMMIUM OWENI (d'Archiac & Haime), 1854

REFERENCES. *Phasianella* indet., d'Archiac, B 1850*b* (**3**, 285); Bellardi, B 1852 (p. 214, Pl. 12, figs. 14, 15).

Phasianella oweni d'Archiac & Haime, B 1854 (pp. 293, 359, 360, 369, Pl. 27, figs. 3, 3*a*, 4); d'Archiac, in Tchihatcheff, B 1866 (p. 130, Pl. 3, fig. 9); Blanford, B 1876 (p. 14); Woodward, 1879 (p. 494, Pl. 12, fig. 6); Medlicott & Blanford, B 1879*b* (p. 462); Duncan, B 1880 (p. 12); Blanford, B 1880 (pp. 52, 126); Fedden, B 1880 (p. 206); Boettger, B 1880 (p. 72, Pl. 6, fig. 4); A. M. Davies, B 1923 (p. 465).

?. de Gregorio, 1880 (Pl. 3, fig. 7).

Phasianella oweni? d'Archiac & Haime, Fedden, B 1884 (p. 49).

Phasianella superstes Rauff, 1884 (p. 81).

Natica (*Ampullina*) *syrtica* C. Mayer-Eymar, 1888 (p. 322, Pl. 14, fig. 3).

Phasianella syrtica (Mayer-Eymar), de Gregorio, B 1894*b* (pars) (p. 25, Pl. 5, figs. 135–136 *non* figs. 137, 138=?).

Phasianella oweni d'Archiac, Koch, B 1894 (p. 286).

Natica oweni (d'Archiac & Haime), Oppenheim, B 1896*a* (p. 176, Pl. 13, figs. 6, 7); Oppenheim, B 1901*a* (p. 197, Pl. 14, fig. 3).

Natica (*Euspira*) *oweni* (d'Archiac & Haime), Oppenheim, B 1906*a* (p. 265).

Natica oweni d'Archiac, Taeger, B 1908 (pp. 264, 74, 76, Pl. 10, fig. 2); Blanckenhorn, B 1921 (pp. 84, 93); Cuvillier, B 1930 (p. 121); Socin, 1936 (p. 28).

Ampullospira oweni (d'Archiac & Haime), Cossmann & Pissarro, 1909 (p. 74); Vredenburg, B 1928*a* (p. 66).

Ampullospira (*Euspirocrommium*) *oweni* (d'Archiac & Haime), Cossmann, 1925 (p. 59); Vredenburg, B 1928*b* (p. 400); Raj Nath & Chiplonker, 1937 (pp. 240, 274).

?*Ampullospira conica* Lamarck, Schlosser, B 1925*a* (p. 87, Pl. 2, fig. 13).

Euspirocrommium oweni (d'Archiac & Haime), Cox, B 1930*a* (pp. 173, 174); Cox, B 1931*a* (pp. 40, 32, 33, 35, Pl. 1, fig. 17); Cox, in L. M. Davies & Pinfold, B 1937 (p. 5).

Natica (*Euspira*) *oweni* d'Archiac, Cuvillier, B 1930 (p. 154).

REFERENCES OMITTED. *Phasinella oweni* d'Archiac, Mariani, B 1892 (p. 26).

Natica hybrida Lamarck, Marinelli, 1896 (pars) (p. 60); Marinelli, 1902 (pars) (p. 206).

Ampullina circumfossa Rauff, V. de Regny, B 1896*a* (p. 219); V. de Regny, B 1897 (p. 170).

Natica oweni d'Archiac, Fabiani, B 1905 (p. 146); Fabiani, B 1908 (pp. 149, 52, 54, 57, Pl. 3, fig. 14); Fabiani, B 1915 (pars) (pp. 54, 141, 253, 261, 263); Dainelli, B 1915 (pars) (pp. 549, 79, 100, 114, 124, 129); Socin, 1939 (p. 107).

MATERIAL. *Rakhi Nala section*: Green and Nodular Shales (local zone 6) (FB. F. 1900, *2*; FB. F. 1903, *1*, Reg. No. G. 68254); Rubbly Limestones (local zone 6) (FB. F. 1918, *1*).

FURTHER DISTRIBUTION IN INDIA, PAKISTAN AND CEYLON. Dhak Pass Beds of the Salt Range; Laki of Sind and the Salt Range; Upper Middle Khirthar of Western Pakistan; Upper Eocene of the Rajpipla Hills (Surat District); Lower Nari of Bhagothoro Hill and the 'Hala Range' (the type locality); Gaj of Gaga; Miocene of Minihagalkanda (Ceylon) and Kirimalai (Ceylon).

FURTHER DISTRIBUTION. Libyan of Egypt; Lower Mokattam of Egypt; Middle Eocene of Asia Minor, the Balkans and Italy (Sorne); Upper Mokattam of Egypt; Eocene of Italy (La Palarea is the type locality for '*superstes*') and Hungary; Tongrian of Gaas (type locality for '*syrtica*'); Lower Miocene (Burdigalian) of western Sumatra.

REMARKS. Fabiani's (B 1915) illustration of *Natica oweni* shows a form with a deep incised spiral line near the posterior suture, a feature never encountered in *Euspirocrommium oweni* (d'Archiac & Haime). Consequently this record, and therefore the others quoted above with it, should be omitted from the synonymy of the species. *Ampullina masria* Cuvillier (B 1933, p. 38, Pl. 4, figs. 13, 14), from the Upper Lutetian of Egypt, is similar in form, but has narrower whorls. *Ampullospira pharaonica* Cuvillier as figured by Alberici (1939, p. 374, Pl. 22, fig. 8), from the Eocene of Libya, is also somewhat similar, but the whorls are slightly less convex, and the body whorl is less curved anteriorly. *Natica interposita* K. Mayer-Eymar (B 1877, p. 43, Pl. 2, fig. 4), from the Eocene of Switzerland, has a slightly shorter spire and less convex spire whorls.

Genus *GLOBULARIA* Swainson, 1840

(*Treat. Malac.* p. 345)

TYPE SPECIES. *Globularia sigaretina* (Lamarck), Eocene = *Ampullaria sigaretina* (Lamarck); Herrmannsen, 1847.

SYNONYMS. '*Ampulline*' Lamarck, in Defrance, 1821 (*Dict. Sci. nat.* **20**, 446) (vernacular name only).

Ampullina Deshayes, 1830 (*Enc. Méth.* (*Vers II*), p. 36) *non* Bowdich, 1822 *nec* Férussac, 1822 (*Natica*) *nec* Blainville, 1824; type species: of *Ampullina* Lamarck, has been quoted as *Natica sigaretina* Lamarck, Eocene (e.g. by Cossmann, 1925), but the 1830 reference was a name without species.

Globulus J. de C. Sowerby, 1834 (*Index Min. Conch.* p. 246) *non* Schumacher, 1817 (Gastr.); type species: *Globulus depressus* (Lamarck), Eocene; here designated.

Anomphala (Jonas) Herrmannsen, 1846 (*Ind. Gen. Malacoz.* **1**, 61); type species: *Natica fluctuata* G. B. Sowerby, Recent; original designation.

Cernina Gray, 1847 (*Proc. Zool. Soc. Lond.* **15**, 150); type species: *Natica fluctuata* Sowerby, Recent; original designation. (*Note*: Gray's 1842 reference (*Syn. Cont. Br. Mus.*, 44th ed. p. 60) is a *nomen nudum.*)

Remarks. Gray (1847) designated *Globularia fluctuata* (Sowerby), Recent, as the type species of *Globularia.*

GLOBULARIA PSEUDOLATISPIRA n.sp.

(Figures 80*a*, *b*, plate 3)

Material. *Zinda Pir section*: White Marl Band (local zone 11) (FB. F. 2734, the holotype, Reg. No. G. 68255); Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *2*).

Description. Shell of moderate size, naticoid, imperforate, with shouldered whorls and canaliculate sutures, and with a small, conic spire. Protoconch not preserved. There are two spire whorls remaining; their flanks are cylindro-conic and gently convex, and although they are not well preserved it seems likely that they were posteriorly shouldered and canaliculate like the body whorl. Height of whorls at most one-third of their width, the spire forming about one-eighth of the height of the shell. Body whorl large, ample, not very globose, rather vertically oval; its flanks are convex, and there is a prominent, sharply rounded shoulder separating off an excavated, shelf-like area between it and the suture. On the body whorl there is a distinct spiral groove just anterior to the shoulder, giving the shoulder itself the appearance of a rounded cordon of about the same width as the groove. On the last half of the body whorl the growth lines, which are practically straight, sometimes slightly convex forwards, and gently to moderately antecurrent, are accentuated into fine, closely spaced axial riblets. Their non-appearance on earlier parts of the shell is probably due to wear. Aperture broadly suboval, narrower posteriorly, a little drawn out antero-laterally. Inner lip distinctly sinuous.

Dimensions. Holotype: height 21·5 mm.; width 20·0 mm.

Remarks. *Natica* (*Ampullina*) *latispira* Oppenheim (B 1901*a*, p. 195, Pl. 18, figs. 5, 5*a*, 6, 6*a*, 14, 14*a*, 14*b*), from the Priabonian of Italy, has a shorter spire, its body whorl is more globose, and it has fine spiral ornament in between the fine axial riblets formed by the accentuation of the growth lines.

Subgenus *AMPULLINOPSIS* Conrad, 1865

(*Amer. J. Conch.* **1**, 27)

Type species. *Natica mississippiensis* Conrad, Eocene; monotypy.

Synonym. *Megatylotus* Fischer, 1885 (*Man. Conch.* p. 766); type species: *Natica crassatina* Lamarck, Oligocene; monotypy.

GLOBULARIA (*AMPULLINOPSIS*) *ALTIVAPINCANA* n.sp.

(Figures 81*a*, *b*, plate 3)

MATERIAL. *Rakhi Nala section*: Shales with Alabaster (local zone 7) (FB. F. 1928, *10*+; FB. F. 1929, *4*; FB. F. 1931, the holotype, Reg. No. G. 68256, and 2 topotypes, Reg. No. G. 68257–8; FB. F. 1932, *10*+; FB. F. 1935, *6*; FB. F. 1938, *1*).

DESCRIPTION. Very large, remains of the test which have been replaced by crystalline calcite suggesting that the shell was very thick. Somewhat high and oval in outline rather than globular, a little drawn out antero-laterally. Protoconch not preserved. About three spire whorls preserved on the holotype, there probably being two or three small whorls missing. Spire conic, forming about one-seventh to one-eighth of the height of the shell. Whorls gently convex, with a rounded shoulder posteriorly, less convex anteriorly, their height about one-third of their width. Sutures linear, rather channelled on the moulds. Body whorl large, ample, imperforate, flanks convex, distinctly drawn out antero-laterally so that the base is only gently convex. Aperture large and ample, suboval, narrower posteriorly. Growth lines straight and gently antecurrent.

DIMENSIONS. Holotype: height 92·3 mm.; width 76·5 mm.

REMARKS. The specimens are all moulds. The large size, obliquely drawn out aperture, and high spire are characteristic. *Natica* (*Ampullina*) *vapincana* d'Orbigny as figured by Boussac (B 1911*a*, p. 327, Pl. 20, figs. 11, 11*a*, 13), from the Bartonian of France, etc., is very close to the Pakistan species, but the spire is not quite so high, the flanks of the body whorl are not quite so convex, and the posterior portion of the outline of the body whorl is distinctly flattened. *Ampullina ausonica* V. de Regny (B 1897, p. 170, Pl. 21, figs. 14*a*, *b*), from the Eocene of northern Italy, has a lower spire, is not quite so large, has more distinctly shouldered whorls, and its aperture is less obliquely drawn out. *Natica* (*Ampullina*) *suessoniensis* Deshayes as figured by Dainelli (B 1915, p. 555, Pl. 50, fig. 14), from the Eocene of Italy, has a higher spire but a broader body whorl, and its aperture is less obliquely drawn out.

Genus *AMPULLELLA* Cox, 1931

(*Trans. Roy. Soc. Edinb.* **57**, part 1, no. 2, p. 38)

TYPE SPECIES. *Ampullaria depressa* Lamarck, Middle Eocene; original designation.

SYNONYM. *Ampullina* auct. *non* Bowdich, 1822.

AMPULLELLA NUTTALLI Cox, 1931

REFERENCES. *Ampullella nuttalli* Cox, B 1931*a* (pp. 41, 27, 33, Pl. 1, figs. 14*a*, *b*).

DOUBTFUL REFERENCES. *Ampullella nuttalli* Cox, Vokes, B 1937 (p. 9).

MATERIAL. *Kohat area* (*Tarkhobi section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2166, *2*); Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *15*+; FB. F. 2172, *5*; FB. F. 2173, *15*+); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2175, *15*+); *Kohat area* (*Panoba section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2292, *2*); Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2230, *4*);

Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *15*+; FB. F. 2290, *8*; FB. F. 2291, *15*+); *Kohat area* (*Shekhan Nala section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2366, *1*, Reg. No. G. 68259; FB. F. 2377, *10*; FB. F. 2313, *5*); *Kohat area* (*Gada Khel*): Middle Shekhan Limestone (local zone 3) (FB. F. 2103, *1*, Reg. No. G. 68260).

FURTHER DISTRIBUTION IN PAKISTAN AND INDIA. Ghazij Shales of Hindu Bagh (type locality); doubtfully from the Lower Subathu (Khirthar) 5 miles north-west of Arki (21 miles north-west of Simla).

REMARKS. Since the material from the Khirthar has not been illustrated, and since there is sometimes considerable difficulty attached to the distinction between and identification of members of the Naticidae and Ampullospiridae, the writer feels that some doubt attaches to the identity of the Khirthar material, which is from a considerably younger horizon than that from which the type material was obtained.

Genus *PACHYCROMMIUM* Woodring, 1928

(*Mioc. Moll. Bowden* (*Carnegie Inst.*), **2**, 391)

TYPE SPECIES. *Amaura guppyi* Gabb, Miocene; original designation.

SYNONYM. '*Euspirocrommium* Sacco' Cossmann, 1925 (*Ess. Pal. Comp.* **13**, 58); type species: *Natica acuminata* Lamarck, Eocene; Cossmann, 1919.

PACHYCROMMIUM FLEMINGI (d'Archiac & Haime), 1854

REFERENCES. *Natica flemingi* d'Archiac & Haime, B 1854 (pp. 284, 369, Pl. 26, figs. 3, 3*a*); Blanford, B 1880 (p. 144); Fedden, B 1880 (p. 205); Cossmann & Pissarro, 1909 (p. 73).

Natica (*Ampullina*) *flemingi* d'Archiac & Haime, Boettger, B 1875 (p. 14, Pl. 1, figs. 5–7).

Natica (*Ampullina*) *flemingi* d'Archiac, Boettger, B 1877 (p. 25, Pl. 1, figs. 5, 6*a*, *b*, 7*a*, *b*).

Natica cf. *flemingi* d'Archiac & Haime, Douvillé, B 1916 (pp. 25, 45, Pl. 7, figs. 7*a*, *b*, *c*); Cotter, B 1926 (pp. 412, 413).

Ampullospira flemingi (d'Archiac & Haime), Cossmann, 1925 (p. 55).

Ampullospira cf. *flemingi* (d'Archiac) *teste* Douvillé, Cossmann, 1925 (p. 55).

Pachycrommium flemingi (d'Archiac & Haime), Cox, B 1931*a* (pp. 39, 28, 29, 33); Cox, in L. M. Davies & Pinfold, B 1937 (pp. 5, 71).

Natica flemingi d'Archiac, Van der Vlerk, B 1931 (p. 258).

DOUBTFUL REFERENCES. *Natica flemengi* d'Archiac, Chautard, B 1905 (p. 144).

Natica flemengi d'Archiac & Haime, Douvillé, B 1920*a* (p. 128).

MATERIAL. *Rakhi Nala section*: Green and Nodular Shales (local zone 6) (FB. F. 1893, *1*; FB. F. 1897, *1*; FB. F. 1899, *1*; FB. F. 1900, *2*; FB. F. 1903, *1*); Rubbly Limestones (local zone 6) (FB. F. 1908, *2*; FB. F. 1910, *1*, Reg. No. G. 68261); *Zinda Pir section*: *Pellatispira* Beds (local zone 15) (FB. F. 2507, *1*); *Kohat area* (*Tarkhobi section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2164, *1*); Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *15*+); *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2294, *1*; FB. F. 2231, *1*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *3*; FB. F. 2290, *1*; FB. F. 2291, *1*); Upper Kohat Shales (local subzone 4*a*) (FB. F. 2256, *3*); Kohat Limestone (local subzone 4*b*) (FB. F. 2271, *1*).

FURTHER DISTRIBUTION IN PAKISTAN AND INDIA. Dhak Pass Beds of the Salt Range; Upper Ranikot of Leilan (Linyan); Calcareous sandstones below alum shales (Ranikot) of the Salt Range; Ranikot between Kuttha and Moosakhail (Salt Range); Shekhan Limestone of Kohat; ?Laki of Sind; Khirthar of the 'Alore Hills' (Sind); Upper Eocene of the Rajpipla Hills (Surat District). The records by Chautard and Douvillé from the Eocene of Senegal are unaccompanied by illustrations and, in view of the doubt attaching to some identifications of Indian and Pakistan species recorded from this area, they have to be regarded as doubtful.

REMARKS. *Ampullina masria* Cuvillier (B 1933, p. 38, Pl. 4, figs. 13, 14), from the Upper Lutetian of Egypt, is similar in general outline, but the whorls are higher.

Genus *CROMMIUM* Cossmann, 1888

(*Ann. Soc. malac. Belg.* **23**, 173)

TYPE SPECIES. *Ampullina willemetii* (Deshayes), Middle Eocene; original designation.

CROMMIUM PSEUDOWILLEMETI n.sp.

(Figure 82, plate 3)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2681, *1*; FB. F. 2679, the holotype, Reg. No. G. 68262, and 18 topotypes, Reg. No. G. 68263–8).

DESCRIPTION. Shell rather small, naticoid, globose with rather compressed flanks and well-shouldered whorls, smooth. Protoconch not distinctly seen, evidently very small. Four gently convex spire whorls. Spire conic in the early stages, but the shouldering of the body whorl gives its overall aspect a gently extraconic appearance; it occupies about one-eleventh of the total height of the shell. Whorls low, about one-quarter as high as wide. Sutures linear and distinct. Body whorl large, ample, with a distinct and well-rounded shoulder posteriorly, its flank gently convex and merging insensibly into the curvature of the base which is similarly gently convex. Aperture suboval, narrower posteriorly, the parietal wall not very callous, the anterior half of the inner lip becoming progressively thicker anteriorly, the base of the body whorl with a distinct, small, umbilical depression close to and slightly anterior to the middle of the inner lip. Growth lines fairly straight and vertical, tending to being antecurrent.

DIMENSIONS. Holotype: height 8·5 mm.; width 6·8 mm.

REMARKS. *Ampullaria willemetii* Deshayes (1852*b*, p. 141, Pl. 17, figs. 11, 12), from the Eocene of the Paris Basin, also recorded as *Ampullina* (*Crommium*) *willemeti* (Deshayes) by Cossmann & Pissarro (B 1907–13, Pl. 11, fig. 64–17), from the Lutetian of the Paris Basin, and as *Natica* (*Crommium*) *willemeti* (Deshayes) by Dainelli (B 1915, p. 568, Pl. 52, fig. 8), from the Eocene of Italy, is larger, more globose, wider at the shoulder, and has a more prominent spire. *N. albasiensis* Leymerie as figured by Mallada (1879, Pl. 3, figs. 6, 7), from the Eocene of Spain, also recorded as *Ampullina* (*Crommium*) *albasiensis* (Leymerie) by Doncieux (1908, p. 221, Pl. 12, fig. 7), from the Lower Lutetian of southern France, is larger and more globose, and the umbilical depression is less well developed. *Ampullaria vulcani* Brongniart (B 1823, p. 57, Pl. 2, figs. 16*a*, *b*, *c*), from the Oligocene of Italy, is

somewhat similar in shape, but is considerably larger, a little more ventricose, and has thick callus in the umbilical region. *Natica debilis* Bayan (1870*b*, p. 26, Pl. 9, fig. 8), from the Eocene of Italy, is more globose. *Ampullina* (*Crommium*) *obtusa* Doncieux (1908, p. 222, Pl. 12, fig. 9), from the Middle Lutetian of the southern Corbières, is larger, less shouldered, the outline of the flank of the body whorl is not so stiff, and the spire is less obtuse. *Natica acutella* Leymerie (B 1846, p. 363, Pl. 15, figs. 16*a*, *b*), from the Eocene of southern France, also recorded as *N.* (*Crommium*) *acutella* Leymerie by Douvillé & O'Gorman (1929, p. 373, Pl. 31, figs. 4, 4*a*), from the Sparnacian of France, is considerably larger, has a more prominent spire, and its body whorl is less distinctly shouldered posteriorly.

Superfamily CYPRAEACEA

Family CYPRAEIDAE

Genus *CALLISTOCYPRAEA* Schilder, 1927

(*Arch. Naturgesch.* **91**, part A 10, p. 104)

TYPE SPECIES. *Callistocypraea aurantium* (Martyn) (Gmelin), Recent; original designation.

Subgenus *MIOLYNCINA* Schilder, 1932

(*Foss. Catal.* part 55, p. 131)

TYPE SPECIES. *Callistocypraea* (*Miolyncina*) *subovum* (d'Orbigny), Miocene; original designation.

CALLISTOCYPRAEA (*MIOLYNCINA*)? *SORIENSIS* n.sp.

(Figures 83*a*, *b*, *c*, plate 3)

MATERIAL. *Zinda Pir section*: White Marl Band (local zone 11) (FB. F. 2734, the holotype, Reg. No. G. 68269).

DESCRIPTION. Moderately large, suboval-subpyriform in outline, flanks pinched in anteriorly, greatest width at about half its height, ventral surface not flattened, aperture apparently little sinuous. Surface of mould smooth, apically showing two or three of the spire whorls. The detailed characters of the inner and outer lips cannot be determined.

DIMENSIONS. Holotype: height 42·0 mm.; width 27·7 mm.

REMARKS. Although a mould and not well preserved, this specimen shows no close resemblance to any of the cypraeid forms already described from the Tertiaries of India, Pakistan, Burma or Ceylon, and the writer has not discovered any similar form in the literature he has consulted. The generic placing of the form is tentative. *Callistocypraea* (*Miolyncina*) *prunum* (J. de C. Sowerby), from the Gaj of Cutch, has a somewhat similar outline which is distinctly narrower anteriorly, but the resemblance is possibly fortuitous. The species seems to be rather large for an Eocypraea.

Genus *GISORTIA* Jousseaume, 1884

(*Bull. Soc. zool. Fr.* **9**, 88)

TYPE SPECIES. *Ovula gisortiana* Valenciennes, Eocene = *Cypraea gisortiana* Passy = *Cypraea gisortiensis* Cossmann (*em.*); original designation.

GISORTIA MURCHISONI (d'Archiac & Haime), 1854

REFERENCES. *Ovula murchisoni* d'Archiac, B 1850*b* (**3**, 299) (*nomen nudum*); d'Archiac & Haime, B 1854 (pp. 329, 359, 371, Pl. 33, figs. 4, 4*a*); Fedden, B 1880 (p. 209).

Ovulum murchisoni (d'Archiac), Blanford, B 1876 (p. 13); Medlicott & Blanford, B 1879*b* (p. 459); Duncan, B 1880 (p. 9); Blanford, B 1880 (pp. 48, 127); Krishnan, B 1943 (p. 429).

Gisortia (*Vicetia*) *murchisoni* (d'Archiac), Vredenburg, 1920 (pp. 128, 147); Vredenburg, 1927 (pars) (pp. 61, 9, 10, 15, 22, 24, 25, 27, 28, 31, Pl. 16, fig. 2; Pl. 20, fig. 3; Pl. 21, fig. 1; Pl. 22, figs. 1, 2 *non* Pls. 17–19 *nec* Pl. 20, figs. 1, 2 *nec* Pl. 21, figs. 2, 3 *nec* Pl. 30, fig. 1 = *Vicetia vredenburgi* Schilder + ? *Vicetia jamesi* (Vredenburg)); Raj Nath & Chiplonker, 1937 (p. 245).

Gisortia murchisoni (d'Archiac), Schilder, 1930 (pp. 133, 136); Schilder, 1932 (p. 129).

Gisortia murchisoni (d'Archiac & Haime), Cox, B 1931*a* (pp. 54, 33).

DOUBTFUL RECORDS. *Gisortia* (*Vicetia*) *murchisoni* (d'Archiac), Vredenburg, 1927 (p. 61 (pars)).

REFERENCES EXCLUDED. *Ovula murchisoni* d'Archiac, Leymerie, 1878–81 (pp. 807, 829, Pl. Z′, fig. 4).

Cypraea murchisoni (d'Archiac), Doncieux, B 1905 (p. 37, Pl. 1, fig. 2 = *Gisortia* sp. Doncieux, 1911).

Gisortia (*Vicetia*) *murchisoni* (d'Archiac), Vredenburg, 1927 (p. 61 (pars)).

Gisortia murchisoni (d'Archiac & Haime), Cox, in B. S. Thomas, B 1931 (p. 31 = *Gisortia gisortiana* (Passy) *sec* Schilder MS.); Cox, in B. S. Thomas, B 1932 (p. 364 = *Gisortia gisortiana* (Passy) *sec* Schilder MS.).

MATERIAL. *Rakhi Nala section*: Upper Rakhi Gaj Shales (local zone 2) (FB. F. 1841, *1*, Reg. No. G. 68270); Rubbly Limestones (local zone 6) (FB. F. 1909, *1*); *Kohat area* (*Shekhan Nala section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2377, *2*); Middle Shekhan Limestone (local subzone 3*a*) (FB. F. 2370, *2*, Reg. No. G. 68033–4).

FURTHER DISTRIBUTION IN WESTERN PAKISTAN. Laki Limestone from west of Ranikot (uppermost beds), west of Ranikot (fairly high up), and 24 miles west of Kotri (entering hills on road from Jangri to Bula Khan's Thana); Upper Middle Khirthar of Western Pakistan; Khirthar of the Laki Valley and Sind. The last two records were made before the Laki Series was established, and might therefore really be of Laki age.

The doubtful records refer to specimens recorded but not illustrated by Vredenburg. Since Vredenburg evidently did not satisfactorily distinguish between this and some of the other species associated in the same beds, it seems advisable to regard these records as doubtful. Occurrences concerned are: Dunghan Limestone from north of Kats (Thal Chotiali); Upper Meting Beds (zone of *Rhynchopygus calderi*) at Meting; Laki Limestone

from west of Ranikot (fairly high horizon), the Dharan Pass (near Laki, upper beds), and west of Meting Railway Station (base).

REMARKS. Cox's records, in B. S. Thomas (B 1931, B 1932), of the species from the Middle Eocene of Wadi Dhuhair (Arabia) are omitted, since the label in the box with the specimen in the British Museum (Natural History) has a note in Schilder's handwriting that the specimen is to be referred to *Gisortia gisortiana* (Passy).

Genus *VICETIA* Fabiani, 1905

(*Atti Accad. Sci. Veneto-Trentino-Istriana*, N.S., **2**, 150)

TYPE SPECIES. *Ovula hantkeni* Lefèvre, Eocene; monotypy.

VICETIA SOWERBYI Schilder, 1930

REFERENCES. *Cypraea depressa* J. de C. Sowerby, B 1839 (p. 329, Pl. 24, fig. 12)—*non C. depressa* Linné, 1758 var. *depressa* Gray, 1824; Vickary, B 1846 (p. 267); d'Archiac & Haime, B 1854 (p. 171); Carter, B 1854 (p. 252).

Ovula depressa (J. de C. Sowerby), d'Archiac, B 1850*b* (pars) (**3**, 299, 200); d'Archiac & Haime, B 1854 (pars) (pp. 359, 329, 371 (var.)).

Ovula depressa d'Archiac, Fedden, B 1880 (p. 209).

Gisortia (*Vicetia*) *depressa* (J. de C. Sowerby), Vredenburg, 1920 (pars) (pp. 128, 143); Vredenburg, 1927 (pars) (pp. 72, 7, 9, 20, 22, 25, 31, Pl. 28, figs. 1, 2; Pl. 29, figs. 1, 2).

Vicetia sowerbyi Schilder, 1930 (pp. 132, 136); Schilder, 1932 (p. 128).

DOUBTFUL REFERENCES. *Ovula depressa* d'Archiac, Ball, B 1874 (p. 153).

Ovula bellardii Deshayes, Vredenburg, 1901 (p. 261).

Gisortia (*Vicetia*) *depressa* (J. de C. Sowerby), Vredenburg, 1927 (pars) (p. 72); Heron, B 1937 (p. 22); Raj Nath & Chiplonker, 1937 (p. 245).

REFERENCES APPARENTLY TO BE OMITTED. *Ovula depressa* d'Archiac, d'Archiac, B 1859*a* (p. 314).

Ovula (*Gisortia*) *depressa* (J. de C. Sowerby), C. Mayer-Eymar, 1904 (p. 36).

Cypraea depressa J. de C. Sowerby, Doncieux, B 1905 (p. 37, Pl. 1, fig. 3 = *Gisortia* sp. Doncieux, 1911).

Gisortia depressa (J. de C. Sowerby), Oppenheim, B 1906*a* (p. 305, text-fig. 33); Cuvillier, B 1930 (p. 254); Cuvillier, B 1935 (p. 52).

Ovula depressa (J. de C. Sowerby), Garde, B 1911 (p. 93); Oppenheim, B 1915 (p. 89).

Gisortia (*Vicetia*) *depressa* (J. de C. Sowerby), Negri, 1934*b* (p. 155).

MATERIAL. *Kohat area* (*Sirki Paila*): Kohat Limestone (local subzone 4*d*) (FB. F. 2113, *1*, Reg. No. G. 68271); Sirki Shale/Kohat Limestone (local subzone 4*d*) (FB. F. 2114, *5*).

FURTHER DISTRIBUTION IN PAKISTAN AND INDIA. Spintangi Limestone of Kudin (east of river, north branch of syncline); Khirthar of Baboa Hill in Cutch (the type locality); Eocene of Saindak (in the Baluchistan desert), and the north-east spur of the Sarun plateau in Sarawan (in relatively soft beds forming a ledge half way up Luddok cliff).

The doubtful records include the following occurrences: Upper Middle Khirthar probably from 8 to 9 miles south-west of Jangri (east of the Surjana Range), probably

from Sirwarzharonba in the Zhob district (argillaceous limestones and clays, zone 3), probably from west of Pudgali on the hill-slopes of the Surun in Sarawan (below the shales), probably from east of Bula Khan in the Surjana Range, probably from hilly ground about 1 mile south-east of Trak Hill, probably from the west side of the Sumbak Range 22 miles east of Arab jo Thana (white marly beds), probably from the west side of Maliri Dharmsala (south of Sehwan), and probably from the Dharan Pass (between two limestones); Spintangi Limestone probably from Gamboli in the Beji Valley, and from Kudin (east of river, south branch of syncline, base of limestone); Khirthar of Saindak, and Kund (3 miles south-west of Kotkai); Eocene of the Luni Pathan Hills, probably from the cliffs on the north-east side of Nilawan Ravine, and probably on the road from Nursingphoar to the west. Some doubt seems to attach to the localities from which many of the specimens considered by Vredenburg were obtained.

FURTHER DISTRIBUTION. Eocene of Dilwar (near Charuk Dashti, Persia).

REMARKS. The references which apparently have to be omitted concern records of the species from the Libyan of Egypt, and from the Eocene of southern France, the Soudan and North Africa.

Superfamily DOLIACEA

Family CASSIDIDAE

Genus *GALEODEA* Link, 1807

(*Beschr. Nat. Samml. Univ. Rostock*, part 3, p. 113)

TYPE SPECIES. *Galeodea echinophora* (Linné), Recent; monotypy.

SYNONYMS. *Morio* Montfort, 1810 (*Conch. Syst.* **2**, 478); type species: *Morio echinophorus* (Linné), Recent; original designation and monotypy.

'*Cassidea* Bruguière', Perry, 1811.

'*Cassidaire*' Lamarck, 1812 (vernacular name).

Echinora Schumacher, 1817 (*Ess. Vers test.* pp. 75, 249); type species: *Echinora tuberculosa* Schumacher, Recent = *Galeodea echinophora* (Linné); monotypy.

Cassidaria Lamarck, 1822 (*An. s. Vert.* **7**, 214); type species: *Cassidaria echinophora* (Linné), Recent; Gray, 1847 (as a synonym of *Morio*).

Doliopsis Conrad, 1865 (*Amer. J. Conch.* **1**, 26, 141) *non* Voigt, 1852 (Tunicata); type species: *Doliopsis quinquecostata* Conrad, Eocene; monotypy. (*Note*: the name *Doliopsis tricarinatum* Conrad on p. 26 appears to be a mistake or a *nomen nudum*.)

Galeodaria Conrad, 1865 (*Amer. J. Conch.* **1**, 26); type species: *Galeodea petersoni* Conrad, Eocene; monotypy.

REMARKS. Wenz rejects the use of *Galeodea* Link on the basis of the pre-employment of the name by Olivier in 1791, but according to Neave Olivier's name is *Galeodes*. Similarly, *Morio* Montfort is regarded as being pre-employed by Latreille in 1810, but Latreille spelt his genus '*Morion*'. *Galeodaria* was proposed for a small species in which nodes were not developed, and may accordingly be regarded as an extreme form of *Galeodea* rather than a distinct subgenus.

GALEODEA AEGYPTIACA (Oppenheim), 1906

REFERENCES. *Cassis aegyptiaca* Oppenheim, B 1906*a* (p. 307, Pl. 24, figs. 20*a*, *b*).

Cassis aegyptiaca (Oppenheim), Cuvillier, B 1930 (pp. 121, 157, 201, 254); Stefanini, B 1938 (p. 43).

Cassidea (*Semicassis*) *anteniana* Martin, B 1931 (p. 32, Pl. 5, figs. 2, 2*a*).

MATERIAL. *Rakhi Nala section*: White Marl Band (local zone 11) (FB. F. 1964, *1*, Reg. No. G. 68272); *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2294, *1*).

FURTHER DISTRIBUTION. Mokattam Stage of Egypt (including the Upper Mokattam); Upper Eocene of Kali Anten, Kali Puru and Kali Songo (all in the Nanggulan Beds); Eocene of Somaliland. The species was also represented in the Burmah Oil Company's collections from the Yaw Stage of Burma, but the specimens were unfortunately lost on account of the evacuation of Burma in 1942.

REMARKS. Martin (B 1931, p. 33) commented upon the close relationship between *anteniana* and *aegyptiaca*, pointing out that the Java form had slight crenulations on the keels and slightly more distinct growth lines. A comparison of Martin's and Oppenheim's illustrations with material from Burma and Western Pakistan, together with a consideration of their writings, has convinced the writer that there is no real specific distinction between the two forms, the slight accentuation of the ornament on Martin's specimens being, in all probability, a reflexion of the facies of the beds in which they were found. The specimen here recorded has one additional primary spiral thread on the base of the body whorl as compared with Martin's and Oppenheim's illustrations, but in the latter there is a suggestion that one of the threads on the base is stronger than the remainder.

Cassis zirpoloi Negri (1934*b*, p. 159, Pl. 14, figs. 2*a*, *b*, *c*), from the Eocene of North Africa, is closely related, but, as noted by Negri, it has a lower spire and a more inflated body whorl; the aperture also reaches higher up than in *aegyptiaca*. An unpublished species from the Lower Eocene of Western Pakistan, which was represented in the Burmah Oil Company's collections and which is almost certainly the same as an unnamed specimen No. G. 66930, from the Ghazij Shales south of Nila Kund (Dera Ghazi Khan District), in the collections of the British Museum (Natural History), is evidently closely related, but its body whorl is more inflated posteriorly and pinched in anteriorly, and there are only four primary spiral keels.

Family CYMATIIDAE

Genus *NASSARIA* Link, 1807

(*Beschr. Nat. Samml. Univ. Rostock*, part 3, p. 123)

TYPE SPECIES. *Nassaria lyrata* Link, Recent=*Buccinum niveum* Gmelin; Mörch, 1852.

SYNONYM. *Hindsia* H. & A. Adams, 1853 (*Gen. Rec. Moll.* **1**, 123); type species: *Buccinum niveum* Gmelin, Recent; Cossmann, 1901 (=*Nassaria*).

Benthindsia Iredale, 1936 *vide* Wenz.

REMARKS. Mörch in 1852 (*Proc. Zool. Soc. Lond.* 1852, p. 227) stated: 'the first species is *Nassa lyrata*, Gmel., p. 3794; Mart. IV, Figs. 1122–1123. If the first quotation of Gmelin

is right, the type is *Mangelia*; but if Martini's figures are correct, the type is *Buccinum niveum*, Gmelin. The latter, however, is not probable; and therefore the name *Nassaria* must not be used for *Hindsia* H. & A. Adams.'

First, Mörch seems to have read the wrong page in Gmelin, for on p. 3794 are recorded species of *Isis*, not of *Mangelia*. Secondly, Link misquoted Gmelin's reference (as in the case of *Anodontia*); the page number should be 3495, on which the name *Buccinum niveum* occurs together with the correct reference to Martini. It is evident that Mörch considered *Nassa lyrata* as the type (that this opinion was based upon its being the first species in Link's list is immaterial), but was in doubt as to its correct name. Furthermore, it is evident that the first condition mentioned by Mörch does not exist, and that Link's record of *N. lyrata* refers to one species only. It is therefore considered that Mörch's writing is sufficient to establish the type species of *Nassaria* Link as being *N. lyrata* Link = *Buccinum niveum* Gmelin.

The name *Hindsia* was first recorded as being the same as *Nassaria*, so that its type species must *ipso facto* be the same as that of *Nassaria*; Cossmann (1901) fortunately designated this particular species as the type species.

While both Thiele and Wenz place *Nassaria* in the Buccinidae, the writer follows Cossmann in placing it in the Cymatiidae on account of the nature of the canal and of the development of varices. Wenz gives the range of the genus as Miocene to Recent, but Vredenburg has recorded a variety of the type species from the Lower Nari (Oligocene) of Western Pakistan, and Martin has described species from the Eocene of Java.

NASSARIA PUNJABENSIS n.sp.

(Figures 84*a*, *b*, plate 3)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2680, the holotype, Reg. No. G. 68273).

DESCRIPTION. Shell oval-conic in outline, protoconch missing and aperture broken. There are four spire whorls preserved, and these were probably preceded almost immediately by the protoconch. Spire apparently about 7·0 mm. high, regularly conic. Whorls gently convex in outline, about half as high as wide, rather stepped posteriorly, ornamented with spiral threads and axial riblets. On the penultimate whorl there are four primary spiral threads which are fairly regularly spaced, the posterior one forming the slight posterior shoulder and being situated farther from the posterior suture than the anterior thread is situated from the anterior suture. The thread anterior to the shoulder is rather finer than the other three threads; there is a finer thread between it and the shoulder, and a still finer thread between the two anterior primary threads. Three fine, delicate spiral threads on the shelf above the shoulder. One moderately fine spiral thread partly emerges from the anterior suture, and there is a still finer spiral thread between it and the anterior primary spiral thread. Axial riblets fine, narrow, rather ribbon-like, practically straight and vertical, about half the width of their intervals; there are about 27 on the penultimate whorl. Three moderately strong varices developed, one at the beginning of the body whorl, one on each of the last two spire whorls. Sutures linear, but rather deeply sunk on account of the stepping of the whorls. Flank of body whorl well

rounded, the base becoming flatter and even slightly concave. The varix extends on to the anterior part of the body whorl, and anterior to the continuation of the spiral ornament of the spire there are at least seven strong spiral threads with a finer thread in each interval. Over the whole surface of the shell, small, rather squarish, beads are formed where the axial riblets cross the spiral threads. Growth lines practically straight and vertical, vaguely concave. Aperture apparently suboval. Outer lip and canal broken off.

DIMENSIONS. Holotype: height (canal missing) 15·2 mm.; width 9·5 mm.

REMARKS. There does not seem to be any closely related species, the delicate nature of the ornament being apparently characteristic.

NASSARIA sp. A

(Figures 43*a*, *b*, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68274, and 1 topotype, Reg. No. G. 68275).

DESCRIPTION. Shell small, poorly preserved; neither of the two specimens can be regarded as fully grown. Form buccinoid, rather strongly inflated. Protoconch relatively large, smooth, naticoid, consisting of at least three convex whorls separated by linear, distinct sutures. The holotype has only about half a whorl developed after the protoconch, the topotype not more than one whorl. Spire seeming to form about two-ninths or a quarter of the height of the shell, moderately broadly conic. Height of whorls about two-fifths of their width. Sutures linear. Whorls distinctly convex, ornamented with spiral threads and axial ribs. The holotype carries eight major spiral threads which become a little finer on the base where they are succeeded by a small number of still finer spiral threads. These threads are relatively rather strong and coarse, ride over the axial ribs, and are of about the same width as their intervals. Axial ribs almost straight and vertical, slightly concave forwards, fairly solid, a little narrower than their intervals; there are seven in the first one-third of a whorl. The topotype has developed a strong varix which must be at about the end of the first spire whorl. Growth lines not distinctly seen, probably following the same course as the ribs. Aperture oval, with a distinct, rather strongly oblique canal of moderate length. No distinct siphonal fasciole developed, possibly because the specimens are not adult.

DIMENSIONS. Holotype: height 2·25 mm.; width 1·5 mm. Topotype: height 3·0 mm.

REMARKS. *Hindsia nanggulanensis* Martin (1914, p. 152, Pl. 4, figs. 114, 114*a*, 115, 116, 116*a*), from the Upper Eocene of Java, is short, small, and of two whorls only, and the general form and ornament are somewhat similar; the whorls appear, however, to be less stepped, and the anterior canal is relatively longer.

NASSARIA? sp. B.

(Figure 44, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68276).

DESCRIPTION. Shell small, oval-conic to subfusiform. Protoconch broken, the apex missing; it was evidently of relatively large size, with gently convex whorls and linear

sutures, smooth except for traces of vague, straight, vertical axial riblets on the last quarter whorl, the intervals between the riblets being nearly twice the width of the ornament. The one post-nuclear whorl preserved constitutes the body whorl; it is slightly to gently convex in outline, has a well excavated base, and is produced anteriorly into a short canal, the straight, vertical neck forming about half the height of the body whorl. There is a vague indication of a siphonal fasciole. Height of whorls probably about three-eighths of their width. Ornament consisting of a strong circumsutural thread, finer spiral threads anteriorly, strong axial ribs, and microscopic frosted spiral ornament covering the whole surface. Circumsutural thread rather ribbon-like, carrying four frosted spirals. Apparently three spiral threads per whorl, the anterior one just emerging from the suture; they are rather fine and sharp, and are separated by intervals about three times their own width. Each thread is constituted of two frosted spirals with a very fine, narrow groove between them. Five or six additional spiral threads on the base of the body whorl. Ribs, over which the spiral ornament passes, moderately thick, of about the same width as their intervals, straight, slightly retrocurrent to almost vertical, numbering about 14 on the body whorl, on the base of which they rapidly become obsolete. Growth lines fairly well accentuated, straight and almost vertical. Aperture oval, with a very short, straight, and slightly oblique anterior canal. Outer lip broken.

DIMENSIONS. Holotype: height (incomplete) 2·6 mm.; width 1·75 mm.

REMARKS. This form is only tentatively referred to the genus *Nassaria*. While somewhat resembling certain forms of *Crassispira*, the perfectly straight and almost vertical growth lines preclude reference to that genus. The distinct microscopic frosted spirals, combined with its general form, distinguish it from other fossil gastropoda from the Eocene of Pakistan, India, and Burma.

Order STENOGLOSSA

Superfamily MURICACEA

Family MURICIDAE

Subfamily MURICINAE

Genus *MURICOPSIS* Bucquoy, Dollfus & Dautzenberg, 1882

(*Moll. mar. Roussillon*, **1**, 16, 19)

TYPE SPECIES. *Murex blainvillei* Payraudeau, Recent = *Murex cristatus* Brocchi; monotypy.

SYNONYMS. '*Muricidea* Swainson' Mörch, 1852 (*Cat. Yoldi*, **1**, 95) *non* Swainson, 1840.

'*Jania* Bellardi' Cossmann, 1892 *non* Bellardi, 1873 (Moll.) *nec* M'Coy, 1844 (Coel.).

MURICOPSIS? *BULBOSINUCLEUS* n.sp.

(Figure 85, plate 3)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68277, and 1 topotype, Reg. No. G. 68278).

DESCRIPTION. Shell rather fusiform in outline, although the aperture is broken and the anterior part of the columella is missing; it is not of very large size. Protoconch large and bulbous, of two naticoid whorls, the apex rather blunt and loosely coiled, the whorls

smooth and distinctly convex, the sutures linear and distinct. It is rather immersed in the circumsutural region of the first spire whorl. The three and a half whorls preserved on the holotype are all spire whorls, and their height is about two-fifths of their width. They are gently to moderately convex in the early stages, rapidly becoming strongly convex as the nodose character of the axial ornament becomes more markedly developed, with a distinct posterior circumsutural thread and a rather concave band occupying the posterior third of the whorls. Sutures linear and noticeably wavy. Ornament consisting of spiral threads riding over nodose axial ribs. Two strong, primary spiral threads, the posterior one situated along the middle of the whorl, the anterior one half way to the anterior suture; a third partially emerges from the anterior suture. Circumsutural thread a little removed from the posterior suture, being separated from it by a narrow, flat, shelving area. There is a fine spiral thread two-thirds of the way from the circumsutural thread towards the posterior primary spiral thread, a very fine thread between this one and the circumsutural thread, and another very fine thread between the anterior primary spiral thread and the anterior suture. For about the first quarter whorl, or less, the ribbing is very fine, the two primary spiral threads and the circumsutural thread being subequal and uniformly spaced. Ribs rapidly becoming very strong and nodular, although fainter over the concave band, merely causing the waviness of the circumsutural thread and suture line. On account of their relative fineness in the early stages there are about eleven on the first whorl, compared with only eight on the second whorl and six on the third whorl. Whole surface covered with minutely frosted growth lines which are subvertical as a whole, regularly and moderately concave forwards, the apex of the curvature being at half the height of the whorl. Major spiral threads with a tendency to splay out where they cross the ribs. Ribs strong and thick, slightly wider than their gently concave intervals.

Dimensions. Holotype: height (broken) 7·0 mm.; width 3·75 mm.

Remarks. The rather large protoconch and the general appearance of the shell suggest that *Muricopsis* is the best genus in which to place this species pending the discovery of material in which the anterior canal and aperture are preserved intact. *Fusus* (*Neptunea*) *amarus* de Gregorio (1880, p. 88, Pl. 7, fig. 50), from the Eocene of Italy, shows some resemblance, especially in the early whorls, but it has intercalary spiral threads and may, moreover, belong to quite a different genus. *Turbinella fusiopsis* Briart & Cornet (1871, p. 9, Pl. 1, figs. 5*a*,*b*,*c*; Pl. 2, figs. 1*a*,*b*), from the Montian of Belgium, has the same general type of ornament, but it is more slender (at least in the young stages), develops only one spiral thread posterior to the two primary spiral threads, and has much more deeply sunken sutures in the adult shell.

Superfamily Buccinacea

Family Pyrenidae

Genus *TETRASTOMELLA* Sacco, 1890

(*Mem. Accad. Sci. Torino*, (2), **40**, 333)

Type species. *Columbella* (*T.*) *miopedemontana* Sacco, Middle Miocene; here designated.

Remarks. *Tetrastomella* is here used for that group of shells (often previously referred to as *Atilia*) which have a distinctly defined anterior canal which is, however, not so long as

in the subgenus *Macrurella* Bellardi, in Bellardi & Sacco 1890 (*Mem. Accad. Sci. Torino*, ser. 2, **40**, 338). *Mitrella* is distinguished from the above two forms by its much shorter canal and by the outer lip swinging round in a regular curve (with no indentation) to the tip of the canal. *Columbellopsis* Bucquoy, Dollfus & Dautzenberg, 1882, of which Wenz regards *Tetrastomella* a synonym, seems closer to *Mitrella* Risso, 1826.

TETRASTOMELLA? *PSEUDOHUMILIS* n.sp.

(Figures 86*a*, *b*, 87, plate 3)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68279, and 1 topotype, Reg. No. G. 68280).

DESCRIPTION. Shell evidently oval-subfusiform, of moderate size, smooth except for a few incised spiral lines on the anterior part of the neck. Protoconch missing. Spire conic; on the holotype crushing gives it a slightly extraconic appearance, and it is 8·2 mm. high. Six spire whorls apparently about half as high as wide, very vaguely convex, becoming very slightly shouldered on later whorls. Sutures linear, becoming more distinct on later whorls. Body whorl apparently not very convex.

The fragmentary topotype shows the remains of four fine incised spiral lines on the anterior part of the neck, the four lines occupying a distance of $\frac{3}{4}$ mm. Outer lip apparently thin and internally smooth. No trace of folds or wrinkles on the columella, although that portion of it preserved is possibly too anterior to exhibit them.

DIMENSIONS. Holotype: height (incomplete) 13·5 mm.; width (average of two diameters of the crushed specimen) 7·6 mm.

REMARKS. The holotype is crushed and has the anterior part of the body whorl missing, and the topotype consists of a fragment of the anterior part of the columellar region. *Columbella* (*Atilia*) *humilis* E. Vincent (B 1913, p. 23, Pl. 2, fig. 12), from the Palaeocene of the Belgian Congo, has higher whorls. *Mitra cryptoconopsis* de Gregorio (1880, p. 85, Pl. 7, fig. 45), from the Eocene of Italy, has a slightly more acute spire and its sutures are not stepped; although somewhat similar in form, it differs in possessing four good columellar folds. *Atilia hordeola* (Cossmann) as figured by Cossmann (1921*d*, p. 82, Pl. 2, figs. 22, 23), from the Eocene of the Lower Loire, is smaller, the whorls are more convex and less subimbricate, and the sutural region is not stepped.

The absence of a labial varix and of crenulations or lirae on the internal surface of the outer lip on the topotype may be due to its being an immature specimen.

Family BUCCINIDAE

Subfamily PISANIINAE

Genus *CELATOCONUS* Conrad, 1862

(*Proc. Acad. Nat. Sci. Philad.* 1862, p. 566)

TYPE SPECIES: *Buccinum protractum* Conrad, Miocene; monotypy.

CELATOCONUS? *PUNJABENSIS* n.sp.

(Figures 45*a*, *b*, plate 1)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68281).

DESCRIPTION. Shell of moderate size, oval-biconic, with a rather short spire; ornament mainly spiral. Protoconch a prominent, smooth, naticoid projection of about two and a half slightly to gently convex whorls. Spire conic, forming about one-sixth the height of the shell, and consisting of about three and a half slightly convex whorls which appear to be slightly stepped. Whorls about twice as wide as high, ornamented with six prominent spiral ribbons of about the same width as or slightly wider than their intervals. The second ribbon from the posterior suture is a little less prominent, so that the third ribbon appears to be a little more prominent and to make a slight projection on the outline of the whorls. Intervals between the ribbons rather deep and squarely cut; the ribbons themselves carry obscure, coarse crenulations. Sutures apparently linear.

The body whorl is crushed, but was evidently moderately narrowly oval, a little produced anteriorly, its base being declivous and fairly straight, ending in a point anteriorly. Ornament of the same type as on the spire whorls, there being 21 spiral bands in all. The most posterior 10 bands are separated from the remainder by an extra-deep interval, twice the normal width, which leads round to the posterior termination of the aperture. The next five bands are separated by intervals which are wider than the posterior intervals, but which are not quite so wide as the interval anterior to the tenth band. The most anterior 6 spiral bands are relatively fine threads which are disposed on the region of the siphonal fasciole, which is vague. Crenulations on the spiral bands are still less noticeable and practically obsolete on the middle and anterior portions of the body whorl. The aperture, although crushed, appears to have been rather narrowly oval and to have terminated anteriorly in an ill-differentiated, short, and moderately notched canal. Growth lines fairly straight and vertical as a whole, their posterior half being gently concave; posteriorly they appear to be slightly antecurrent to the suture.

DIMENSIONS. Holotype: height 9·0 mm.; width 4·5 mm. in one direction (increased by crushing) and 2·8 mm. in apertural view (reduced by crushing).

REMARKS. The form and ornament seem to be characteristic. On account of the extent to which the specimen is crushed, the generic determination has to be regarded as provisional.

Family STREPSIDURIDAE

Genus *STREPSIDURA* Swainson, 1840

(*Treat. Malacol.* pp. 90, 308)

TYPE SPECIES. *Strepsidura costata* Swainson, Eocene = *Fusus ficulneus* Lamarck = *Murex turgidus* Solander; monotypy.

SYNONYMS. *Strepsura* Agassiz, 1846 (*Nomen. Zool. Index Univ.*) (*em.*).

Streptura Herrmannsen, 1849 (*Ind. Gen. Malac.* **2**, 507) (*em.*).

STREPSIDURA sp. A

(Figures 46*a*, *b*, 47, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68282, and 2 topotypes, Reg. No. G. 68283–4).

DESCRIPTION. Shell moderately small, piriform. Protoconch rather large and naticoid, consisting of about two smooth, gently convex whorls with linear sutures; the internal filling of the shell shows that there was an internal constriction where the end of the protoconch adjoins the beginning of the first post-nuclear whorl. The holotype has about three-quarters of a whorl preserved after the protoconch, and one of the topotypes, which is less well preserved, has about one and three-quarters such whorls. On the holotype, which is 3·0 mm. high, the spire is 0·37 mm. high, and on one of the topotypes, which is 5·25 mm. high, the spire is 1·1 mm. high. Spire low and obtusely conic. Spire whorls gently convex in outline, their height about two-fifths of their width, ornamented with axial riblets and spiral threads. About 24 spiral threads on the last whorl of the holotype. On the flanks and anteriorly these threads appear rather ribbon-like, with intervals only about half the width of the threads, but on larger specimens they are finer and more widely spaced. The most posterior spiral thread is coarser and more rounded than the remainder, forming a kind of circumsutural collar; the next anterior thread is considerably finer than the remainder, so that the interval between the first and third threads forms a concave band which is slightly wider than usual and carries a fine thread in it. These threads cross over the axial riblets and form small rounded crenulations on them. Approximately 18 axial riblets on the first half of the holotype, but they evidently do not increase much in spacing as there seem to be considerably more per whorl on the larger topotype. Riblets almost straight and vertical, on the whole appearing to be rather fine and sharp with intervals about twice their own width, although near the end of the holotype they appear to be somewhat stronger and with narrower intervals. Sutures evidently linear and moderately deep.

Body whorl large, ample, moderately convex, moderately produced anteriorly, the base distinctly and gently excavated, the anterior portion with a moderately bulging siphonal fasciole. Aperture obliquely and rather narrowly oval, with a gutter posteriorly, and an oblique anterior canal of moderate length. Outer lip broken. Growth lines practically straight and vertical. Columellar lip not well displayed, but there are indications of callus on its anterior part, and it is distinctly twisted at the commencement of the canal.

DIMENSIONS. Holotype: height 3·0 mm.; width 2·25 mm. A topotype: height 5·25 mm.

REMARKS. *Strepsidura cossmanni* Vredenburg, from zone 1 of the Upper Ranikot of Sind, has coarser ornament forming a coarser mesh, the circumsutural furrow is better defined, and the shell is more globose. *S. indica* Cossmann & Pissarro, from zone 4 of the Upper Ranikot of Jherruck, also recorded from the Basal Laungshe Shales (Ranikot) of Burma, differs in having a noticeably extraconic and higher spire, a much more twisted and deflected siphonal fasciole, and it also differs in the details of the ornament. *S. scobina* Cox, from the Hangu Shales (Ranikot) of Hangu, has much finer ornament, the ribs in particular being much less distinct, and the shell is also more globose. *S. tipperi* Cox, from the Hangu Shales (Ranikot) of Hangu, has the spiral ornament obsolete on the flanks of the whorls, the only strong spiral ornament apart from the circumsutural collar being on the neck, and the circumsutural thread is more distinctly beaded. *S. nanggulanensis* Martin (1914, p. 139, Pl. 3, figs. 81, 82, 82*a*, 82*b*), from the Upper Eocene of Java, has carinate early whorls, and the spiral groove just anterior to the circumsutural thread is less well defined.

Although the form under consideration probably represents a new species, it is not named here since it seems advisable to obtain additional better-preserved material.

Family VOLEMIDAE

Genus *VOLEMA* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 57)

TYPE SPECIES. *Volema paradisiaca* Bolten, Recent; Iredale, 1917.

SYNONYMS. *Galeodes* Bolten, in Röding, 1798 (*Mus. Bolt.* part 2, p. 53) *non* Olivier, 1791 (Arachn.); type species: *Galeodes melongena* (Linné), Recent; monotypy, and Dall, 1901.

Melongena Schumacher, 1817 (*Ess. Vers. test.* pp. 64, 212); type species: *Melongena fasciata* Schumacher, Recent = *Murex melongena* Linné, Recent; monotypy and tautonymy.

Myristica Swainson, 1840 (*Treat. Malacol.* pp. 86, 307); type species: *Myristica hippocastanea* (Born), Recent = *Murex hippocastanum* Born; Gray, 1847.

Cassidulus (Humphrey, 1797) Gray, 1847 (*Proc. Zool. Soc. Lond.* **15**, 135) *non* Lamarck, 1801 (Echin.) *nec* Berthold, 1827 (Moll.) *nec* Beck, 1838 (Moll.); type species: *Murex melongena* Linné, Recent; original designation and monotypy.

Osteodes Paetel, 1887 (*Cat. Conch.* 4th ed. **1**, 35) *non* Conrad, 1855 (Moll.) *nec* Guenée, 1857 (Lepid.) (= *Galeodes* Bolten).

Subgenus *PUGILINA* Schumacher, 1817

(*Ess. Vers test.* pp. 65, 216)

TYPE SPECIES. *Pugilina morio* (Linné), Recent = *P. fasciata* Schumacher; Sacco, 1904.

REMARKS. Gray (B1847) designated *Murex morio* Linné as the type species of *Pugilina β* Schumacher, and *Murex pyrum* Linné as the type species of *Pugilina α* Schumacher. Apart from the fact that the latter species is not mentioned by Schumacher, the designation of two type species under the name *Pugilina* invalidates both; that of Sacco is therefore adopted.

VOLEMA (PUGILINA) SUPERSPINOSA n.sp.

(Figures 88*a*, *b*, plate 4)

MATERIAL. *Rakhi Nala section*: Lower Chocolate Clays (local zone 10) (FB. F. 1967, the holotype, Reg. No. G. 68285).

DESCRIPTION. Shell fairly large, protoconch and tip of columella missing, outer lip broken off. Fundamentally biconic, with strong spines developed on the whorls. Five spire whorls preserved, there being not more than one or two missing apically. Early whorls bluntly carinate at or just above the middle, ornamented with axial ribs and spiral threads. As the shell grows, the ribs become rapidly more spinose, and on the last two whorls they form tongue-like protrusions; the whorls also become more distinctly carinate, and the carina moves forward to a position a little anterior to the middle of the whorls. In the early stages the height of the whorls is about half their width, but in later stages, owing to the development of the spines, the height is only about one-third of the

width. About nine ribs on the first whorl preserved, and seven on the last whorl, the slight reduction being on account of the increase in size of the spines developed from them. They are distinctly narrower than their intervals in the early whorls, and become very wide-spaced on later whorls, where they tend to become obsolete or less noticeable on account of the large, conspicuous spines. Shelving shoulder posterior to the keel gently convex except in the neighbourhood of the spines, where it splays out and becomes concave. The larger spines have their upper surfaces more or less horizontal and their tips narrowly rounded, so that when viewed from above their outline is rather tongue-like; on the body whorl they shelve inwards below, forming a gentle concavity before meeting the gently convex flank of the whorl. Spiral ornament not well preserved; on the shelving shoulder there are numerous, fine, rather V-shaped, spiral threads with intervals of about the same width as, or slightly wider than, themselves. Anterior to the spines there are spiral threads of at least two orders, moderately closely spaced, those of the first order being fairly strong.

Body whorl occupying about two-thirds the height of the shell. Flank and anterior part ornamented similarly to the anterior portion of the spire whorls, although the ribs are here obsolete. Siphonal fasciole narrow and ridge-like, prominent, with a steep, abrupt drop on its columellar side. Aperture broadly oval, with a gently oblique anterior canal of moderate length. Columellar lip with a relatively thin layer of callus, moderately strongly and regularly excavated medially, and with a relatively sharp but rounded bend at the commencement of the canal. No columellar folds. Growth lines practically straight and vertical, showing a trace of parasigmoidal curvature.

Dimensions. Holotype: height (incomplete) 61·6 mm.; width (possibly somewhat incomplete on account of breakage of spines) 54·8 mm.

Remarks. *Melongena* (*Pugilina*) *brevispina* Martin (B 1931, p. 22, Pl. 3, fig. 12), from the Upper Eocene of Java—*non Murex brevispina* Lamarck, 1822—is similar in general form, but is smaller, and at the same stage of growth the spines are not so long. *Volema* (*Pugilina*) *lainei* (Basterot) (1825, p. 67, Pl. 7, fig. 8), from the Middle Miocene of Europe, has a shorter spire and is less spinose on the body whorl. *Galeodes* (*Pugilina*) *vincenti* Glibert (1938, p. 98, Pl. 3, fig. 11), from the Wemmel Sands (Bartonian) of Belgium, is considerably less spinose.

Family Fusinidae

Genus *FUSINUS* Rafinesque, 1815

(*Analyse*, p. 145)

Type species. *Murex colus* Linné, Recent; monotypy.

Synonyms. *Colus* (Humphrey, 1797) (not binomial).

Fusus (Bruguière, 1792) Lamarck, 1799 (*Mém. Soc. Hist. nat. Paris*, p. 73) *non* Helbling, 1779 (Moll.); type species: *Murex colus* Linné, Recent; monotypy.

Remarks. The type species of *Fusinus* must be the same as that of *Fusus* Lamarck as it is a replacement name. *Exilifusus* Gabb, 1877 (*Proc. Acad. Nat. Sci. Philad.* 1876, p. 278—type species: *Fusus* (*E.*) *kerri* Gabb, Cretaceous) with its curved canal, *Falsifusus* Grabau, 1904 (*Smithson. Misc. Coll.* **44**, no. 1417, p. 80—type species: *Fusus meyeri* Aldrich, Eocene=*F. ottonis* Aldrich) with its keeled whorls and last one to two whorls of the proto-

conch ribbed and keeled, and *Pseudofusus* Monterosato, 1884 (*Nomencl. Conch. medit.* p. 117—exemplified by *Murex rostratus* (Olivi), Recent) which appears to be related to *Aptysis* Troschel, 1868, are here excluded from *Fusinus*, although Wenz places *Exilifusus* Gabb, 1877 (*non* Conrad, 1865) and *Pseudofusus* in synonymy.

FUSINUS sp. A

(Figure 48, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68286).

DESCRIPTION. The single specimen available is small and consists of about two and a half whorls, the early whorls being missing, and the outer lip and anterior portion of the canal broken; it is fusiform and very slender, the spire having been very high and the spiral angle very acute. Whorls rather loosely coiled, their height about three-fifths of their width, moderately convex in outline, the greatest convexity being at about half their height. Sutures fine and linear. Whorls ornamented with axial ribs and spiral threads. Ribs fairly straight, slightly concave forwards, gently retrocurrent as a whole although vertical posteriorly, solid and continuous, not nodose or spinose, rather narrower than their intervals; they number about 11 on the last whorl preserved. About seven fairly distinct spiral threads per whorl; they are a little narrower than their intervals, and rise up and cross over the ribs. Body whorl moderately high, its base gently excavated, the anterior portion broken off; in spite of a certain amount of decortication, it can be seen that the ornament was of a similar nature to that on the spire whorls, and extended on to the base. Aperture apparently rather broadly oval; much of the canal is missing. Growth lines not seen, but probably parallel to the ribs.

DIMENSIONS. Holotype: height (incomplete) 2·8 mm.; width 1·1 mm.

REMARKS. *Fusus propeaciculatus* de Gregorio (1880, p. 87, Pl. 7, fig. 34), from the Parisian of Italy, is larger, less slender, and has relatively wider whorls and less oblique sutures. *F. erbreichi* Oppenheim (B 1901 *b*, p. 273, Pl. 15, fig. 20), from the Eocene of the Balkans, is also slender, but is much larger, the ribbing is blunter, and the greatest width of the whorls is more posteriorly situated. *F. subpentagonus* Rouault (B 1850, p. 490, Pl. 17, fig. 10), from the Eocene near Pau, has less distinct ribs, the spiral ornament is relatively stronger, and the sutures are less oblique. *F. porrectus* Solander as figured by Cossmann (1897, p. 297, Pl. 5, fig. 1), from the Eocene of the Lower Loire, and by Cossmann & Pissarro (B 1907–13, Pl. 41, fig. 201–1), from the Lutetian of the Paris Basin, has more deeply incised sutures and less regularly distributed spiral threads.

The slender form, loose coiling and rather oblique sutures, high whorls, and rather strong and gently retrocurrent ribs seem to be characteristic, but the species is not named since it would be advisable to await the collection of better preserved material.

Genus *EUTHRIOFUSUS* Cossmann, 1901

(*Ess. Pal. Comp.* **4**, 27)

TYPE SPECIES. *Fusus burdigalensis* Basterot, Miocene; original designation.

REMARKS. *Falsifusus* Grabau, 1904, with its high spire, long straight canal, lack of

columellar folds, carinated whorls, and last two whorls of protoconch ribbed and keeled, is not regarded as synonymous (compare Cossmann's opinion).

EUTHRIOFUSUS? *MALCOMSONI* (d'Archiac & Haime), 1854

REFERENCES. *Fusus malcomsoni* d'Archiac & Haime, B 1854 (pp. 308, 309, 370, Pl. 29, figs. 17, 18); Medlicott & Blanford, B 1879*b* (p. 531); Dollfus, B 1915 (p. 29).

Euthriofusus? *malcomsoni* (d'Archiac & Haime), Vredenburg, 1923*b* (p. 57).

REFERENCES OMITTED. *Fusus malcomsoni* d'Archiac, E. Pavay, B 1871 (pp. 362, 424); A. von Pavay, B 1874 (p. 412).

MATERIAL. *Rakhi Nala section*: Shales with Alabaster (local zone 7) (FB. F. 1928, *2*; FB. F. 1929, *2*, Reg. No. G. 68287–8; FB. F. 1930, *1*; FB. F. 1935, *1*; FB. F. 1940, *1*); Lower Chocolate Clays (local zone 10) (FB. F. 1966, *2*); *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2554, *1*); *Kohat area* (*Panoba section*): Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *3*; FB. F. 2291, *6*).

FURTHER DISTRIBUTION IN INDIA. Subathu Beds of Subathu (type locality).

REMARKS. The old and unsubstantiated records by A. von Pavay and by E. Pavay, from the Eocene of Hungary, may be disregarded.

Genus *STREPTOCHETUS* Cossmann, 1889

(*Ann. Soc. malac. Belg.* **24**, 170)

TYPE SPECIES. *Fusus intortus* Lamarck, Eocene; original designation.

STREPTOCHETUS/*EUTHRIOFUSUS*? sp. A

(Figure 89, plate 4)

MATERIAL. *Rakhi Nala Section*: Green and Nodular Shales (local zone 6) (F.B. F. 1902, the holotype, Reg. No. G. 68289).

DESCRIPTION. Shell apparently fusoid and of moderately large size, with a spire of moderate height and a large body whorl. Ornament of subnodular radial ribs and spiral threads. There are eight ribs on the body whorl, the ribs being strong, rather widely spaced, about half as wide as their intervals, and subnodular at the shoulder. Spiral threads not well preserved, consisting of distinct, rather broad and flattened ribbons with intervals of the same width as or slightly narrower than the threads; there are 13 preserved on the body whorl between the shoulder and the broken anterior end, some of those on and posterior to the shoulder being somewhat finer. Flanks of body whorl gently convex, base gently excavated. There is a relatively narrow, shelving posterior area separated off by a somewhat indistinct rounded shoulder. Aperture apparently rather narrowly oval.

DIMENSIONS. Holotype: height (incomplete) 30·0 mm.; width 19·3 mm.

REMARKS. The single specimen available is a mould which consists of about one and a half whorls, the outer lip, anterior portion of the columella, and the early whorls being missing, but it does not seem to agree with any described species from India, Pakistan or Burma. *Turricula lakiensis* Raj Nath & Chiplonker (1937, p. 233, Pl. 16, fig. 1), from the Khirthar of the Laki Dome—which incidentally does not seem to belong to the Turridae—

is similar in general form, but the spiral ornament consists of threads of two orders and is evidently not so simple. *Euthriofusus? mixtus* (d'Archiac & Haime) is evidently a Gaj fossil, and its ribs are apparently more spinose posteriorly, and the shoulder is wider.

Superfamily VOLUTACEA

Family OLIVIDAE

Subfamily ANCILLINAE

Genus *ANCILLA* Lamarck, 1799

(*Mém. Soc. Hist. nat. Paris*, p. 70)

TYPE SPECIES. *Voluta* (*basi constricti*, etc.) Martini, Recent = *V. ampla* Gmelin = *Ancillaria candida* Lamarck; monotypy.

SYNONYMS. *Anaulax* Roissy, 1805 (*Sonnini's Buffon, Moll.* **5**, 430); type species: *A. cinnamomea* (Lamarck), Recent; here designated.

Ancillaria Lamarck, 1811 (*Ann. Mus. Hist. nat. Paris*, **16**, no. 94, p. 302); type species: *A. cinnamomea* Lamarck, Recent; Children, 1823.

Sparellina Fischer, 1883 (*Man. Conch.* p. 600); type species: *Ancilla candida* Lamarck, Recent; monotypy.

REMARKS. Cossmann (1899) gave the type as *Ancilla buccinoides* Lamarck, but this species is not in the original list.

Subgenus *ANCILLUS* Montfort, 1810

(*Conch. Syst.* **2**, 382)

TYPE SPECIES. *Ancillus buccinoides* (Roissy), Recent; monotypy.

SYNONYMS. *Amalda* H. & A. Adams, 1853 (*Gen. Rec. Moll.* **1**, 148); type species: *Dipsaccus* (*Amalda*) *tankervillianus* (Sowerby), Recent; here designated.

Sandella Gray, 1857 (*Guide Syst. Distrib. Moll. Br. Mus.* p. 26); type species: *S. tankervillii* (Sowerby), Recent; monotypy.

? *Ancillista* Iredale, 1936 *teste* Wenz.

Spirancilla Vokes, 1936 *teste* Wenz.

REMARKS. Cossmann (1899) stated that H. & A. Adams took *Amalda tankervillei* as the type of *Amalda*, but this is incorrect; H. & A. Adams listed five species under *Amalda* and did not mention which was the type.

ANCILLA (*ANCILLUS*) *PSEUDONANA* n.sp.

(Figure 90, plate 4)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68290, and 1 topotype, Reg. No. G. 68291).

DESCRIPTION. Shell moderately small, slenderly barrel-shaped, smooth, and with a moderately conoidal spire forming about four-elevenths of the height of the shell.

Protoconch an obtuse, smooth apical button not easily distinguishable from the rest of the spire. Spire covered with a thin layer of callus which obscures the sutures. Apparently about three spire whorls the height of which was about two-thirds of their width. Body whorl fairly large and high, slenderly barrel-shaped, its base flattened or even slightly concave. Terminal zone of accretions a little worn; the anterior two-thirds of it appear to carry four spiral folds which become weaker anteriorly. Aperture narrowly oval, with a deep anterior notch. Inner lip gently to moderately concave, straighter anteriorly, with a twisted anterior termination, the layer of callus quite thick posteriorly. Outer lip broken, but the infilling of matrix close to it had no incised spiral lines, indicating that the outer lip had no internal lirae. On the body whorl, posterior to the terminal zone of accretions, there are two moderately closely spaced incised spiral lines curving in towards the posterior part of the columellar lip; there are indications of a third fine spiral incised line curving in towards the posterior termination of the aperture, situated about as far posterior to the pair of lines as the pair of lines are posterior to the margin of the terminal zone of accretions. Growth lines not distinctly seen.

Dimensions. Holotype: height 8·25 mm.; width 3·2 mm.

Remarks. *Ancillaria nana* Rouault (B 1850, p. 502, Pl. 18, figs. 24, 24*a*), from the Eocene of France, is of about the same size and has a somewhat similar form, but the columella is more angularly excavated and the body whorl seems slightly more inflated. The same species figured as *Ancilla* (*Sparella*) *nana* Rouault by Douvillé & O'Gorman (1929, p. 356, Pl. 29, fig. 13), from the Sparnacian of France, is more inflated; as figured by Cossmann in O'Gorman (B 1923, p. 128, Pl. 8, figs. 7, 8), from the Cuisian of the Basses-Pyrenees, however, it is more slender, but has the angularly excavated parietal region, and possesses five or six nearly vertical folds on the anterior part of the columella. Cossmann, however, mentions that Rouault's illustrations exaggerate the stoutness of the form he was describing. *A. pinoides* (de Gregorio) as figured by Dainelli (B 1915, p. 676, Pl. 56, fig. 3), from the Eocene of Italy, has a distinctly lower spire and higher aperture, and the body whorl is more inflated. *Ancillaria studeri* Hébert & Renévier (B 1854, p. 190, Pl. 1, fig. 10), from the Upper Nummulitic of France, has a higher aperture, the columellar lip is less excavated, and the neck is less steeply descendent. *Ancilla* sp.? E. Vincent (1930*b*, p. 52, Pl. 2, fig. 13), from the Palaeocene of Belgium, has a less conoidal spire, and the neck is more obliquely descendent. *Ancillaria fusiformis* J. Sowerby, in Dixon (B 1850, pp. 189, 108, Pl. 8, fig. 16), from the Eocene of Bracklesham, is less slender. *A. spissa* Rouault (B 1850, p. 501, Pl. 18, figs. 23*a*), from the Eocene of France, is a little stouter, a little larger, and has a rather shorter spire. This latter species was figured as *Ancilla spissa* (Rouault) by Boussac (B 1911*b*, p. 62, Pl. 13, figs. 14, 14*a*), from the Lutetian near Pau, and his illustrations are also of a stouter form with a rather shorter spire. *A.* (*Sparella*) *ripaudi* (Vasseur) in Vasseur (B 1917, Pl. 2, figs. 23, 24), from the Eocene of the Lower Loire, also figured as *A. ripaudi* Vasseur by Cossmann (1896, p. 219, Pl. 8, fig. 14; Pl. 9, fig. 6), from the same locality, has a distinctly lower spire, and the aperture is relatively higher. *A.* (*Sparella*) *wrigleyi* Chavan & Fischer (1939, p. 230, Pl. 7, figs. 8, 9), from the Auversian of France, is rather similar, but the columella is inflected to the left, and the neck is less vertical; there are also minor differences in the details of the folds on the terminal zone of accretions. *A. priabonensis* Boussac (B 1911*b*, p. 62, Pl. 13, figs. 1, 1*a*, 2,

2*a*, 10, 10*a*, 11, 11*a*), from the Bartonian of southern France, is stouter and has a relatively lower spire. *A.* (*Sparella*) *arenaria* Cossmann as figured by Cossmann & Pissarro (B 1907–13, Pl. 47, fig. 211–7), from the Cuisian of the Paris Basin, has a less conoidal spire, and the base of the body whorl is much less steeply descendent.

Subgenus *SPARELLA* Gray, 1857

(*Guide Syst. Distrib. Moll. Brit. Mus.* p. 26)

TYPE SPECIES. *Ancillaria ventricosa* Lamarck, Recent; Cossmann, 1889.

ANCILLA (*SPARELLA*) *RAKHIENSIS* n.sp.

(Figure 49, plate 1)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68292, and 35 topotypes, Reg. No. G. 68293–8; FB. F. 1995, *10*+); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *2*).

DESCRIPTION. Shell rather small, oval-biconic, rather buccinoid, smooth, the spire forming about two-sevenths of the total height, conic in the adult. Young specimens considerably more globose and rounded, with a rather conoidal spire. A film of callus spreads over the spire, but decorticated specimens show that there were two or three spire whorls the height of which is about half their width. Some of the young specimens show the protoconch, which consists of about one and a half smooth, slightly convex-whorls, and forms an obtuse apical button. Body whorl large, high, oval, moderately inflated, its flank distinctly convex and giving it rather a barrel-shaped appearance, its greatest width at a position slightly below the middle of the shell at about three-sevenths of the total height. Base of body whorl declivous, not excavated. Terminal zone of accretions moderately swollen, carrying four rather fine longitudinal threads or folds. There is a spiral incised line on the body whorl, curving in to the posterior end of the aperture, and a second one half-way between it and the margin of the terminal zone of accretions. Growth lines on the whole fairly straight and vertical, but they have a small but distinct pointed projection at the posterior spiral incised line, the point being projected forwards. Aperture narrowly oval, rather pinched in posteriorly, deeply notched anteriorly. Columellar lip moderately excavated medially, straighter anteriorly and posteriorly.

DIMENSIONS. Holotype: height 5·25 mm.; width 2·25 mm.

REMARKS. *Ancilla* (*Sparella*) *birmanica* Vredenburg, from the Lower Nari (Oligocene) of Western Pakistan and the Padaung Stage (Oligocene) of Burma, is considerably larger, and its flanks are not so convex. *A. decipiens* Martin (B 1931, p. 12, Pl. 2, fig. 7), from the Upper Eocene of Java, has a similar general outline, but has only three folds on the terminal zone of accretions which itself is less projecting. *A. propinqua* Zittel as figured by Gočev (B 1933*b*, p. 184, Pl. 5, figs. 14, 14*a*, 15, 15*a*), from the Palaeogene of southern Bulgaria, is not so slender and has a lower spire. *A. buccinoides* (Lamarck) as figured by Glibert (1938, p. 111, Pl. 4, fig. 4), from the Wemmel Sands (Bartonian) of Belgium, is somewhat similar in outline, but is considerably larger, the aperture seems not quite so

short, and the inner ends of the columellar folds bifurcate. *A.* (*Sparella*) *arenaria* Cossmann as figured by Cossmann & Pissarro (B 1907–13, Pl. 47, fig. 211–7), from the Cuisian of the Paris Basin, is also very similar, but is a little larger, the body whorl is a little less inflated, and the spire is higher. The rather slender form and short aperture are characteristic features.

Family Mitridae

Genus *PYRENOMITRA* n.gen.

Type species. *Pyrenomitra anachis* n.gen et sp., Upper Eocene.

Generic characters. Oval-biconic; protoconch large, subtectiform, of four smooth, gently convex whorls; axial ribs strong in early stages, obsolete in adult; circumsutural thread more apparent in early whorls; whorls a little stepped; siphonal fasciole weak; imperforate; four columellar folds; spiral ornament on base; aperture narrowly oval; columellar callus not extensive, narrow anteriorly.

Remarks. *Pyrenomitra* seems to be a form near *Thala*, *Proximitra*, *Parvimitra* and *Vexillitra*, but differs from them in its general form and type of ornament.

PYRENOMITRA ANACHIS n.gen. et sp.

(Figures 102, 103, plate 5)

Material. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68299, and 5 topotypes, Reg. No. G. 68300–4; FB. F. 1995, 7).

Description. Shell small, oval-conic to subfusiform, the form somewhat resembling that of an *Anachis*. Protoconch subtectiform, consisting of four smooth, gently convex whorls, of relatively large size. The largest specimen obtained, the holotype, has about two spire whorls, which are almost flat-sided, slightly convex, with a circumsutural collar which is only moderately distinct; they are rather narrow, their height not appearing to be much more than two-sevenths of their width. Apart from the circumsutural thread and a spiral furrow of the same width just anterior to it, there is no other spiral ornament. Axial ornament consisting of distinct ribs which are practically straight, slightly concave forwards (especially on their anterior portion), of about the same width as or a little narrower than their intervals, and almost vertical; there are 14 on the first post-nuclear whorl, and they fade out over the furrow anterior to the circumsutural thread, but reappear as beads on the circumsutural thread. The first few ribs are more distinctly curved. Holotype worn and appearing relatively smoother, but displaying the apertural characters. Spire forming about three-elevenths of the height of the shell, regularly conic. Later whorls tend to be slightly stepped behind the circumsutural thread. Sutures linear and distinct.

Body whorl relatively large, oval-conic, slightly shouldered posteriorly, the flanks gently convex, the base gently excavated, produced anteriorly into a short, straight, oblique, vague canal. There is a weak siphonal fasciole, but no umbilicus. Axial ornament, which is obsolete on the holotype, apparently of the same general type as on the earlier spire

whorls and dying out on the concavity of the base. On the excavated base and on the siphonal fasciole there are eight spiral threads; on the siphonal fasciole itself these are of about the same width as their intervals and are rounded, but posteriorly they become wider, flatter, and more ribbon-like, and are separated by distinct intervals only about half as wide as the ribbons. Aperture narrowly oval. Columellar lip little sinuous, carrying four columellar folds, not appearing to be strongly callous, the columellar callus becoming a little detached anteriorly. Growth lines vertical as a whole, showing a distinct gentle concavity posteriorly and a distinct gentle convexity anteriorly on the body whorl. Outer lip broken, but the surface of the infilling of the body whorl shows some incised spiral lines which indicate that the outer lip was probably internally lirate.

DIMENSIONS. Holotype: 3·1 mm. (restored slightly); width 1·9 mm.

REMARKS. Although showing some superficial similarity to certain species of *Turricula* (*Fusimitra*) figured by Boussac (B 1911 *b*) from the Nummulitic of Biarritz, the form and ornament of the Pakistan form readily distinguish it on close comparison. The species described by Boussac, incidentally, are not closely comparable to *Mitra mellingtoni* Conrad, Eocene, the type species of *Fusimitra* Conrad, 1855, and belong to a different group altogether.

Family HARPIDAE

Genus *HARPA* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 149)

TYPE SPECIES. *Harpa nobilis* Bolten, Recent = *Buccinum harpa* Linné (pars); tautonymy, and Winckworth, 1945.

SYNONYMS. *Harpalis* Link, 1807 (*Beschr. Nat. Samml. Univ. Rostock*, part 3, p. 114); type species: *H. nobilis* Link, Recent; here designated.

Harparia Rafinesque, 1815 (*Analyse*, p. 145) (*em.*).

Cithara (Klein, 1753) Herrmannsen, 1847 (*Ind. Gen. Malacaz.* **1**, 239) (= *Harpa* Rhumphius, 1705 = *Harpa* Lamarck, 1799).

REMARKS. According to Winckworth (1945, p. 140) the record of *Harpa* by Pallas, 1774 is not valid, and that by Walch, 1771 falls into the same category.

HARPA? SORIENSIS n.sp.

(Figure 91, plate 4)

MATERIAL. *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2556, the holotype, Reg. No. G. 68305).

DESCRIPTION. Shell buccinoid and inflated, moderately large, with a small, conic spire constituting about two-elevenths of the height of the shell. Protoconch and about one spire whorl missing, there being about two spire whorls remaining. Whorls rather flattened on the flanks, with a rounded posterior shoulder, their height about five-thirteenths of their width. Axial ornament consisting of prominent, rounded, straight, slightly retrocurrent ribs with intervals of nearly twice their width; there are nine ribs on the last whorl. Sutures not distinctly seen. Spiral ornament not preserved. Body whorl

large, ample, its flanks slightly to gently convex, the edge of the base more sharply rounded, the base itself distinctly excavated, and the anterior end a little produced. Apertural characters not seen.

DIMENSIONS. Holotype: height 22·0 mm.; width 17·1 mm.

REMARKS. The single specimen available is a mould with its apertural face attached to a lamellibranch shell, but the form and axial ornament are sufficiently well displayed for description. *Harpa mutica* Lamarck as figured by Deshayes (1835, p. 642, Pl. 86, figs. 14, 15), from the Eocene of the Paris Basin, also figured as *H.* (*Eocithara*) *mutica* Lamarck by Cossmann & Pissarro (1901, p. 33, Pl. 10, fig. 7), by Cossmann & Pissarro (B 1907–13, Pl. 46, fig. 209–1), and by Cossmann (1896, p. 232, Pl. 9, figs. 7–9), has sharper and less coarse ribbing, the flank of the body whorl more convex, and the whorls less distinctly shouldered. *H. mutica* Lamarck var. *hilarionis* de Gregorio (1880, p. 42, Pl. 5, figs. 43*a*, *b*), from the Eocene of Italy, has a higher body whorl, the flanks especially being more elevated, and the ribs on the earlier whorls are not so widely spaced. The subgenus to which the Zinda Pir specimen should be assigned must remain doubtful pending the discovery of specimens exhibiting the apertural characters.

Family VOLUTIDAE

Genus *LYRIA* Gray, 1847

(*Proc. Zool. Soc. Lond.* **15**, 141)

TYPE SPECIES. *Voluta nucleus* Lamarck, Recent; original designation.

LYRIA PUNJABENSIS n.sp.

(Figures 92*a*, *b*, plate 4)

MATERIAL. *Zinda Pir section*: White Marl Band (local zone 11) (FB. F. 2734, the holotype, Reg. No. G. 68306).

DESCRIPTION. Shell of moderate size, ovoid-elliptical in outline, narrower anteriorly, greatest width at about two-thirds of the height. Protoconch and one or two spire whorls missing. Spire very short, probably slightly less than one-ninth of the total height, obtusely conic. The two spire whorls remaining are very gently convex, not shouldered, their height about two-fifths of their width. Axial ornament consisting of ribs which are almost straight and vertical, rather slender, about half the width of their intervals on the earlier whorls, but gradually becoming a little more widely spaced; there are about 15 or 16 on the last spire whorl and about the same number on the body whorl. Sutures not well preserved but apparently linear. There is no indication that the ribs were nodose or subspinose posteriorly. Spiral ornament not preserved. Body whorl large, ample, oval, narrower anteriorly, rather inflated posteriorly; its flank is distinctly convex, its base declivous, fairly straight, with hardly any indication of a concavity, with a vague swelling in the region of the siphonal fasciole, which is worn. Aperture high, regularly arched externally, its inner margin gently excavated, with a gutter posteriorly. Inner lip apparently callous, details of the columellar and parietal folds and of the anterior notch

not preserved. Outer lip not preserved intact, but the growth lines appear to be straight and vertical.

DIMENSIONS. Holotype: height (slightly incomplete) 25·1 mm.; width 16·6 mm.

REMARKS. *'Lyria' browni* Vokes, from the Lower Subathu (Khirthar) 5 miles north-west of Arki (21 miles north-west of Simla), has more numerous ribs and a considerably higher spire. *L. samanaensis* Cox, from the Hangu Shales (Ranikot) of Hangu, has coarser ribbing on the body whorl, and the whorls themselves are shouldered. *Lyria feddeni* Vredenburg, from zone 3 of the Upper Ranikot, north of Leilan coal-pit and zone 4 of the Upper Ranikot of Jherruck, has the whorls distinctly shouldered, is more produced anteriorly, and the ribs are more closely spaced in the early stages, but more widely spaced later on; at the same stage of growth the whorls also appear to be flatter-sided.

Genus *VOLUTOCORBIS* Dall, 1890

(*Trans. Wagner Inst. Philad.* **3**, part 1, p. 75)

TYPE SPECIES. *Volutilithes* (*Volutocorbis*) *limopsis* Conrad, Eocene; original designation.

SYNONYM. *Volutilithopsis* Petho, 1896 (*M. Kir. Földtani Intezet* (*Exp. Millen. Hung., Inst. Geol.*) p. 32) *teste* Petho, 1906 (*Palaeontographica*, **52**, 177).

VOLUTOCORBIS PAKISTANICA n.sp.

(Figures 93*a*, *b*, 94*a*, *b*, plate 4)

MATERIAL. Lower Chocolate Clays east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab (the holotype, Reg. No. G. 66932, and 14 topotypes, Reg. No. G. 66933–7); *Rakhi Nala section*: Lower Chocolate Clays (local zone 10) (FB. F. 1967, *2*, Reg. No. G. 68307–8); *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2571, *19*, Reg. No. G. 68309–14).

DESCRIPTION. Shell of moderate size, biconic, with a moderately short spire and a large body whorl the flanks of which are subcylindrical. Protoconch not well preserved on the few specimens which still retain it, but apparently small and constituted of not more than one or two whorls. Spire fairly short and conic, a little less than one-quarter of the height of the shell. There are four spire whorls which are subcylindrical in outline, almost flat-sided, markedly stepped posteriorly, and with a circumsutural shelf; their height is a little more than half their width. Spiral ornament consisting of five spiral ribbons which are twice the width of their intervals; the interval between the two posterior ribbons being a little deeper and a little narrower than the others, the posterior ribbon, which forms the shoulder of the whorl, being not quite so projecting as the remainder, the whorl being wider across the zone on which the four anterior threads are placed. All these ribbons form beads where they cross the axial ornament, the beads being sharp-edged on their upper side and shelving anteriorly. Axial ornament consisting of rather fine ribbon-like ribs of the same size as the spiral ribbons, and also about twice the width of their intervals; they are practically straight and slightly retrocurrent, and number 24 on the last spire whorl. Between the suture and the posterior spiral ribbon there is a circumsutural band which is horizontal as a whole, distinctly concave, about twice the normal width between

the spiral ribbons, and over which the vertical grooves between the ribs are continued with less distinctiveness in a direction which is mainly a little retrocurrent but curves forward near the suture to meet it at right angles. This concave circumsutural band carries no other ornament except for growth lines. Sutures fine and linear, slightly wavy.

Body whorl high, rather subtriangular, its flanks subcylindrical, the base moderately or slightly excavated (a variable feature), and produced anteriorly into a pointed beak. Ornament of exactly the same type as on the spire whorls, there being 18 spiral ribbons which are followed anteriorly by four or five finer spiral threads in the region of the siphonal fasciole, which is not bulging. Aperture narrow, almost parallel-sided, with a small posterior gutter, and a moderately shallow anterior notch. Inner lip callous, the layer of callus being wide and moderately thick posteriorly, narrower and carrying five columellar folds on its anterior half. These columellar folds are strong, rounded, prominent, oblique, and decrease in strength anteriorly. Outer lip not preserved intact, but the internal filling of the body whorl near the aperture shows a number of incised spiral grooves indicating that the outer lip was lirate internally; these lirae, however, although spaced at about the same distance as the spiral grooves of the external ornament, do not always correspond with them. Growth lines straight and vertical as a whole, gently receding anteriorly, slightly retrocurrent on their posterior half, distinctly retrocurrent on the circumsutural depression, although meeting the suture at right angles.

Dimensions. Holotype: height 25·0 mm.; width 10·0 mm.

Remarks. The type material has been selected from Mr Pinfold's collections presented to the British Museum (Natural History) on account of their good preservation. *Volutocorbis harnaiensis* Cox, from the Lower Ghazij Shales of Harnai, has a shorter spire and less stepped whorls. *V. burtoni* (Vredenburg), from zone 1 of the Upper Ranikot of Sind and probably also from the Basal Laungshe Shales (Ranikot) of Burma, is considerably broader, the ornament is more scabrose, and the whorls are less stepped. *V. daviesi* (Cox), from the Hangu Shales (Ranikot) of Hangu, has coarser ornament and the whorls are less stepped. *V. eugeniae* (Vredenburg), from zones 1, 2, 3 and 4 of the Upper Ranikot of Sind and probably also from the Basal Laungshe Shales (Ranikot) of Burma, has coarser ornament, the whorls are less stepped, and the body whorl is not flattened on the flanks. *V. victoriae* (Vredenburg), from zone 1 of the Upper Ranikot on the underscarp of Jakhmari peak, has considerably coarser and more scabrose ornament, the whorls are not stepped so much, and the shell is a little stouter. The slender form, subcylindrical and rather flattened flank of the body whorl, delicate ornament, and well-marked circumsutural concave band causing a definite stepping of the spire whorls, are characteristic of *V. pakistanica*.

VOLUTOCORBIS SORIENSIS n.sp.

(Figures 95*a*, *b*, plate 4)

Material. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68315).

Description. Shell of moderate size, not very large, oval-biconic to subfusiform, with a moderately short, conic spire which forms about two-sevenths of the height. Protoconch not well preserved, consisting of at most two smooth whorls, evidently quite small. Four

spire whorls, subcylindrical to slightly convex in outline, with a sharp shoulder posteriorly which limits a circumsutural band, the whorls thus appearing distinctly stepped. Height of whorls appearing to be about half their width. Sutures linear. Spiral ornament consisting of three spiral threads which are a little narrower than their intervals and forming short, scabrous spines where they cross the axial ornament; the posterior thread is on the shoulder, and on it the small spines are a little more distinct and more noticeably upturned. Axial ribs of about the same width as their intervals, straight, slightly retrocurrent, scabrose, and numbering 17 on the last spire whorl. Circumsutural band sloping very slightly upwards towards the suture, appearing concave on account of the upturned prickles on its outer edge, and carrying subrectangular raised wrinkles corresponding to the continuation of the ribs.

Body whorl crushed on the holotype, which is the only available specimen, but evidently oval-conic; it carries about 17 spiral bands followed anteriorly by four or five spiral threads in the region of the siphonal fasciole, which is not raised. Interval between the two posterior spiral bands a little wider than the remaining intervals. Anterior notch shallow. Indications of at least three strong, oblique columellar folds; remaining apertural characters are not determinable on account of the crushing of the shell. Growth lines fairly straight and vertical, a little retrocurrent in their posterior half, slightly sinuous near the posterior suture.

Dimensions. Holotype: height 15·6 mm.; width 8·25 mm. (the maximum, which is probably a little accentuated by crushing).

Remarks. *Volutocorbis pakistanica*, n.sp., has a higher spire, the flanks of the body whorl are more cylindrical, the circumsutural band is distinctly wider, and the beads on the posterior spiral band are not developed into small upturned prickles. *V. burtoni* (Vredenburg), from zone 1 of the Upper Ranikot of Sind and probably also from the Basal Laungshe Shales (Ranikot) of Burma, is stouter, has coarser ornament, and the prickles on the shoulder are less upturned. *V. daviesi* (Cox), from the Hangu Shales (Ranikot) of Hangu, has a higher spire, is less prickly, and the circumsutural band is less well-marked. *V. eugeniae* (Vredenburg), from zones 1, 2, 3, and 4 of the Upper Ranikot of Sind and probably from the Basal Laungshe Shales (Ranikot) of Burma, has considerably coarser ornament, and the spire is higher. *V. harnaiensis* Cox, from the Lower Ghazij Shales of Harnai, has considerably coarser ribs, and lacks a well-marked circumsutural band; the spiral ornament is distinctly coarser, and there are four spiral bands on the spire whorls instead of three. *V. victoriae* (Vredenburg), from zone 1 of the Upper Ranikot on the underscarp of Jakhmari peak, has a higher spire, and the prickles on the shoulder are less upturned. *Athleta* (*Volutocorbis*) *scabricula* (Solander) as figured by Cossmann & Pissarro (B 1907–13, Pl. 43, fig. 205–1), from the Bartonian of the Paris Basin, has a shorter spire with less distinctly stepped whorls, and is less scabrose.

Genus *VOLUTOSPINA* R. B. Newton, 1906

(*Proc. Malac. Soc. Lond.* **7**, 102, 103)

Type species. *Conus spinosus* Lamarck, Eocene; original designation.

Synonyms. '*Plejona* Bolten, 1798', Dall, 1906 *non* Bolten, 1798.

Volutilithes Swainson, 1840 (*Treat. Malac.* part 2, p. 318) *non* Swainson, 1821; type species: *Voluta spinosa* Lamarck, Eocene; Gray, 1847.

VOLUTOSPINA KOHATICA n.sp.

(Figures 96*a*, *b*, 97, plate 4)

MATERIAL. *Rakhi Nala section*: Rubbly Limestones (local zone 6) (FB. F. 1906, the holotype, Reg. No. G. 68316); *Kohat area* (*Tarkhobi section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2173, *1*); *Kohat area* (*Panoba section*): Lower Shekhan Limestone (local subzone 3*a*) (FB. F. 2292, *1* paratype, Reg. No. G. 68317); Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2294, *9* paratypes, Reg. No. G. 68318–23); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2291, *5*).

DESCRIPTION. The specimens, while exhibiting considerable variation according to their mode and state of preservation, are all oval-biconic and volutiform in outline. Protoconch not preserved. Evidently about four spire whorls which are gently convex, shouldered posteriorly, their height at least half their width. On worn specimens the sutural region is deeply channelled. Body whorl large, oval-conic, tapering anteriorly, shouldered posteriorly. Ornament consisting of axial ribs and spiral threads; this type of ornament evidently was present on the spire whorls also, but the spiral ornament is not preserved there. 13 to 15 ribs on the last whorl; they fade out anteriorly in the region of the neck, are subspinose posteriorly on the shoulder, and are, on the whole, noticeably retrocurrent posteriorly, the intervals between them being from one and a half to two times as wide as the ribs. When not too poorly preserved, the body whorl carries numerous fine, incised, spiral lines. On the specimen from FB. F. 2292 there are three incised lines in a distance of $2\frac{1}{4}$ mm.; the specimen from FB. F. 1906 shows that, anteriorly and in the apertural region, they become more obliquely incised so that the intervals appear rather as sharp, raised threads shelving anteriorly.

DIMENSIONS. Holotype: height 46·2 mm.; width 29·5 mm. A paratype from FB. F. 2292: height (incomplete) 45·0 mm.; width (possibly a little accentuated by crushing) 28·0 mm. A paratype from FB. F. 2294: height (incomplete) 35·5 mm.; width 21·5 mm.

REMARKS. The specimens are all moulds. The species does not agree with any of the known volutids described from the Nummulitic of India, Pakistan or Burma. *Volutospina sihesurensis* (d'Archiac & Haime), from the Ranikot of the Salt Range, has a distinctly broader shoulder which contributes towards a much more triangular outline of the body whorl. *Voluta spinosa* (Linné) as figured by Briart & Cornet (1871, p. 63, Pl. 5, figs. 1*a*, *b*), from the Montian of Belgium, has more widely spaced ribs which do not become retrocurrent posteriorly.

Genus *VOLUTILITHES* Swainson, 1831

(*Zool. Illust.* (2), **2**, part 12, Plate 53)

TYPE SPECIES. *Voluta muricina* Lamarck, Eocene; Newton, 1906.

SYNONYMS. *Eopsephaea* Fischer, 1883 (*Man. Conch.* p. 607); type species: *Voluta muricina* Lamarck, Eocene; monotypy.

Eopsephia G. F. Harris, 1897 (*Cat. Tert. Moll. Brit. Mus.* **1**, 115) (*err.*).

VOLUTILITHES? *RAKHIENSIS* n.sp.

(Figure 98, plate 4)

MATERIAL. *Rakhi Nala section*: Shales with Alabaster (local zone 7) (FB. F. 1933, *1*; FB. F. 1942, the holotype, Reg. No. G. 68324).

DESCRIPTION. High and subcylindrical in outline, with a moderately short spire and a high body whorl, apparently smooth except for some spiral threads on the anterior third of the body whorl in the columellar region. Protoconch and early spire whorls missing. The one and a half spire whorls preserved are stiffly cylindrical, with a sharp posterior shoulder limiting a slightly concave and slightly upward sloping circumsutural area; their height is about one-half their width. Body whorl almost perfectly cylindrical, a little narrowed anteriorly; its anterior end is broken off, but the outline is slightly concave just behind the break; shoulder a little better developed than on the spire whorls. Aperture narrow, high, elongate, almost parallel-sided. Inner lip apparently slightly excavated two-fifths of the way up. No trace can be seen of any columellar folds. Growth lines not seen.

DIMENSIONS. Holotype: height (incomplete) 45·2 mm.; width 20·5 mm.

REMARKS. The specimens are both external moulds. The species is almost certainly not a *Volutilithes*, and may belong to a new genus. The whorls are too stepped for a *Volutilithes*, quite apart from the absence of axial ornament. The apparent absence of columellar folds precludes reference to *Gosavia*. The presence of spiral threads on the anterior portion of the columellar region indicates that the specimen is an external and not an internal mould, so that the absence of axial ornament seems to be real and not apparent. The writer has found no closely comparable form in any literature with which he is acquainted. The species is provisionally placed in the genus *Volutilithes* pending the discovery of better material, although it is realized that it is probably out of place.

Genus *CYMBIUM* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 151)

TYPE SPECIES. *Cymbium jacobinum* Bolten, Recent = *Voluta cymbium* Linné; tautonymy.

SYNONYMS. *Yetus* Bowdich, 1822 (*Elem. Conch.* **1**, descr. to Plate 13); type species: *Buccinum persicum* Lister, Recent; monotypy.

Yet (Adanson, 1757) Berthold, in Latreille, 1827 (*Nat. Fam. Thierreichs*, p. 181); type species: *Voluta neptuni*, Lamarck, Recent; monotypy.

REMARKS. The name *Cymbium* as recorded by Da Costa in 1776 (*Elem. Conch.* p. 182) is applied to the Paper Nautilus, but the name is not valid as the work is not strictly binomial. *Melo* Broderip, in Sowerby, 1826 (*Gen. Shells* (28); type species: *M. aethiopicus* Sowerby, Recent; Gray, 1847), although placed in synonymy by Wenz, differs in its spiny apex and polygyrate, non-scaphelloid protoconch.

CYMBIUM EOCENICUM Cox, 1931

REFERENCES. *Cymbium eocenicum* Cox, B 1931*a* (pp. 56, 33, Pl. 2, fig. 1).

MATERIAL. *Kohat area* (*Shekhan Nala section*): Lower Shekhan Limestones (local subzone 3*a*) (FB. F. 2369, *1*, Reg. No. G. 68325).

FURTHER DISTRIBUTION IN WESTERN PAKISTAN. Laki of Hyderabad (Sind) (type locality).

REMARKS. The specimen from FB. F. 2369 is slightly broken anteriorly, and agrees well with Cox's illustration although it is of much larger size; the incomplete height is 160·5 mm., width of body whorl 135·0 mm., and the width a quarter of a whorl back from the outer lip is about 80·5 mm.

Genus *GOSAVIA* Stoliczka, 1866

(*S.B. Akad. Wiss. Wien*, Math.-naturw. Kl., **52**, part 1, 1865, p. 179)

TYPE SPECIES. *Voluta squamosa* Zekeli, Turonian; original designation.

REMARKS. *Gosavia* has been included in the Conidae by some authors. Since, however, well-preserved specimens of *Gosavia humberti* from Burma have a large bulbous protoconch, it would appear to be more suitably placed in the Volutidae. Wenz also places it in the latter family.

GOSAVIA HUMBERTI (d'Archiac & Haime), 1854

REFERENCES. *Voluta humberti* d'Archiac & Haime, B 1854 (pp. 327, 323, 328, 359, 371, Pl. 34, fig. 9); Fedden, B 1880 (p. 209).

? *Voluta salsensis* d'Archiac & Haime, B 1854 (pp. 328, 323, 371, Pl. 34, figs. 10–11); Fedden, B 1880 (p. 209); Raj Nath & Chiplonker, 1937 (p. 244).

Voluta (?) *birmanica* Dalton, B 1908 (pp. 632, 608, 618, Pl. 57, fig. 10).

Cassis cf. *cornuta* Linné, Dalton, B 1908 (p. 615).

Gosavia birmanica (Dalton), Cotter, 1915 (p. 269); Hayden, 1916 (p. 16); Pilgrim & Cotter, 1916 (p. 44); Pilgrim, 1923 (p. 918); Chhibber, B 1934 (p. 226); Krishnan, B 1943 (p. 448).

Gosavia salsensis (d'Archiac & Haime), Douvillé, B 1916 (pp. 21, 45, Pl. 8, figs. 4*a*, *b*); Douvillé, B 1920*b* (p. 156); Cotter, B 1926 (pp. 411, 413); Douvillé, B 1929 (p. 34).

Volutoconus birmanicus (Dalton), Stamp, 1922 (p. 495); Pascoe, 1924 (**3**, 39, 42).

Aulica birmanica (Dalton), Vredenburg, 1923*a* (pp. 268, 267); Chhibber, B 1934 (p. 226).

Aulica humberti (d'Archiac & Haime), Vredenburg, 1923*a* (p. 267).

? *Aulica salsensis* (d'Archiac & Haime), Vredenburg, 1923*a* (p. 267).

Gosavia humberti (d'Archiac & Haime), Douvillé, B 1929 (p. 34); Cox, B 1931*a* (pp. 57, 33, 58, 59, Pl. 1, fig. 18); Clegg, 1932 (p. 252); Cox, in L. M. Davies & Pinfold, B 1937 (p. 71); Vokes, B 1937 (p. 5, fig. 7); Cotter, B 1938 (pp. 39, 41, 61, 63, 67, 70, 71); Clegg, B 1938 (p. 213); Krishnan, B 1943 (p. 442).

Volutoconus birmanica (Dalton), Clegg, B 1938 (pp. 206, 214, 231).

MATERIAL. *Rakhi Nala section*: Green and Nodular Shales (local zone 6) (FB. F. 1899, *2*; FB. F. 1901, *1*); Rubbly Limestones (local zone 6) (FB. F. 1911, *1*; FB. F. 1914, *1*, Reg. No. G. 68326); Shales with Alabaster (local zone 7) (FB. F. 1931, *1*; FB. F. 1932, *4*; FB. F. 1933, *1*; FB. F. 1935, *4*; FB. F. 1936, *4*; FB. F. 1938, *2*; FB. F. 1948, *4*); Lower Chocolate Clays (local zone 10) (FB. F. 1966, *2*; FB. F. 1967, *1*, Reg. No. G. 68327); Upper Chocolate Clays (lower part, local zone 12) (FB. F. 1978, *2*); *Zinda Pir section*: Upper Chocolate Clays (lower part, local zone 12) (FB. F. 2522, *1*); Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, *1*); *Kohat area* (*Tarkhobi section*): Middle

Shekhan Limestone (local subzone 3*b*) (FB. F. 2173, *7*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2175, *4*); *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2294, *15*+); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *7*); Lower Kohat Shales (local subzone 4*a*) (FB. F. 2253, *1*); Kaladhand Limestone (local subzone 4*a*) (FB. F. 2254, *3*; FB. F. 2255, *2*; FB. F. 2295, *2*); Upper Kohat Shales (local subzone 4*a*) (FB. F. 2257, *1*); *Kohat area* (*Shekhan Nala section*): Upper Kohat Shales (local subzone 4*a*) (FB. F. 2341, *8*; FB. F. 2342, *1*); *Kohat area* (*Sirki Paila*): Kohat Limestone (local subzone 4*d*) (FB. F. 2113, *1*); Sirki Shale (local subzone 4*d*) (FB. F. 2107, *2*); Sirki Shale/Kohat Limestone (local subzone 4*d*) (FB. F. 2114, *2*).

Accessory samples. *Kohat area* (*Tarkhobi*): Kohat Shales (local subzone 4*a*) (FB. F. 2183, *5*; FB. F. 2184, *2*).

Further distribution in Western Pakistan and western India. ?Ranikot of the Salt Range; 'Ghazij Shales' of the Nilawan Ravine; Laki Limestone of Western Pakistan; Laki of Sind, and the Salt Range; Lower Subathu (Khirthar) 5 miles north-west of Arki (21 miles north-west of Simla); Kohat Shales of Kohat; Upper Middle Khirthar of Western Pakistan; Khirthar of the 'Alore Hills' (Sind), and the Mari Hills. (The type locality for '*humberti*' is in the 'Hala Range', and for '*salsensis*' is in the Salt Range.)

Further distribution. Gastropod Bed (Bed 12, upper part) (Ranikot) behind Tuna (Tibet); Yaw Stage of numerous localities in Burma (the Letpan Chaung is the type locality for '*birmanica*').

Remarks. Vredenburg's record of the species from the Middle Eocene of the Salt Range (1923*a*) must be a mistake, as there is no Middle Eocene (Khirthar) in the area; the species is known to occur in the Lower Eocene (Laki) of the region. There seems to be very little doubt that *salsensis* is a mere variant of *humberti*.

Dalton recorded *Conus avaenis* from the Letpan Chaung (the locality being of Yaw Stage age) and *Voluta*? *birmanica* (=*Gosavia humberti*) from the Yenanine Chaung, near Banbyin (the locality being of transitional Oligo-Miocene or younger age). Dalton's type of *Voluta*? *birmanica* really is a *Gosavia*, and Dr Cox has remarked that its matrix is very similar to that of Dalton's specimen of *Natica gibberosa* (=*Globularia* (*Ampullinopsis*) *birmanica*) from Letpan Chaung, the locality of the latter being really in the Yaw Stage. The writer feels convinced that sometime between collecting the specimens and publishing his paper Dalton mixed up the labels and specimens of *Voluta*? *birmanica* and *Conus avaensis*. The most likely form for the *Conus* to have been is *Conus* (*Lithoconus*) *odengensis* Martin of which *Conus avaensis* Noetling is a synonym.

GOSAVIA MULTIDENTATA (d'Archiac & Haime), 1854

References. *Acteonella*? *multidentata* d'Archiac, B 1850*b* (*nomen nudum*) (**3**, 283).

Voluta multidentata (d'Archiac), d'Archiac & Haime, B 1854 (pp. 326, 323, 359, 371, Pl. 32, figs. 1, 1*a*); Fedden, B 1880 (p. 209); Raj Nath & Chiplonker, 1937 (p. 244).

Voluta multidentata? (d'Archiac), Medlicott & Blanford, B 1879*b* (p. 531).

Aulica multidentata (d'Archiac), Vredenburg, 1923*a* (p. 267).

Gosavia multidentata (d'Archiac), Douvillé, B 1929 (p. 34); Cox, B 1931*a* (pp. 58, 33).

Material. *Rakhi Nala section*: Green and Nodular Shales (local zone 6) (FB. F. 1900, *1*); Rubbly Limestones (local zone 6) (FB. F. 1908, *1*; FB. F. 1913, *1*, Reg. No. G. 68328);

Shales with Alabaster (local zone 7) (FB. F. 1928, *1*; FB. F. 1932, *2*; FB. F. 1935, *1*; FB. F. 1937, *1*; FB. F. 1939, *2*; FB. F. 1938, *1*); *Kohat area* (*Tarkhobi section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *2*; FB. F. 2173, *2*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2175, *4*); *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2294, *5*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2289, *2*; FB. F. 2291, *3*); *Kohat area* (*Sirki Paila*): Kohat Limestone (local subzone 4*d*) (FB. F. 2113, *1*).

FURTHER DISTRIBUTION IN WESTERN PAKISTAN AND WESTERN INDIA. Laki Limestone of Western Pakistan; Laki of Sind (type locality); Upper Middle Khirthar of Western Pakistan; Khirthar of Subathu.

REMARKS. Vredenburg's (1923*a*) record from the Middle Eocene seems to be a mistake for Lower Eocene.

Genus *INVOLUTA* Cox, 1931

(*Trans. Roy. Soc. Edinb.* **57**, part 1, no. 2, pp. 28, 33, 53, 58)

TYPE SPECIES. *Involuta daviesi* Cox, Eocene; monotypy.

REMARKS. Cox suggested that this genus might belong to the Volutidae or perhaps to the Conidae. On the basis of its form and numerous columellar folds it is here included in the Volutidae.

INVOLUTA DAVIESI Cox, 1931

REFERENCES. *Involuta daviesi* Cox, B 1931*a* (pp. 58, 28, 33, Pl. 2, figs. 2*a*?, 2*b*?, 2*c*?, 4); Cotter, B 1933 (p. 98); Heron, B 1937 (p. 22).

MATERIAL. *Kohat area* (*Panoba section*): Upper Kohat Shales (local subzone 4*a*) (FB. F. 2257, *1*, Reg. No. G. 68329).

FURTHER DISTRIBUTION IN WESTERN PAKISTAN. Kohat Shales of Kohat, and Bahadur Khel (the type locality); Khirthar of Kund (3 miles south-west of Kotkai), and probably the Mari Hills.

REMARKS. The specimen from FB. F. 2257 agrees quite well with Cox's fig. 4, although it is not quite so broad across the top.

Family CANCELLARIIDAE

Subfamily CANCELLARIINAE

Genus *CANCELLARIA* Lamarck, 1799

(*Mém. Soc. Hist. nat. Paris*, p. 71)

TYPE SPECIES. *Voluta reticulata* Linné, Recent; monotypy.

SYNONYMS. *Cancellarius* Montfort, 1810 (*Conch. Syst.* **2**, 562); type species: *Cancellarius reticulatus* (Linné), Recent; original designation and monotypy.

Buccinella Perry, 1811 (*Conchology*, Pl. 27); type species: *B. canulata* Perry, Recent; here designated.

Plicaria Fabricius, 1823 (*Fortegnelse*, p. 74); type species: *P. reticulata* (Linné), Recent; here designated.

?*Bivetia* Jousseaume, 1887 (*Le Naturaliste* (2), Year 9, p. 163); type species: *B. mariei* Jousseaume, Recent; monotypy.

Remarks. *Exechoptychia* Cossmann, 1903 (*Ess. Pal. Comp.* **5**, 189–190), type species *Cancellaria conradiana* Dall, Pliocene by original designation, is placed in synonymy by Wenz, but appears to differ in its bifid posterior fold and in the parietal wall being less callous.

'*CANCELLARIA*' *SORIENSIS* n.sp.

(Figures 104, 105, plate 5)

Material. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68330, and 1 topotype, Reg. No. G. 68331).

Description. Shell ovoid-conic, with a moderately acute spire for the genus. Protoconch consisting of two smooth, naticoid whorls which are moderately convex and have distinct, linear sutures; it is rather obtuse, but of fairly large size, and the last quarter whorl develops an anterior angulation corresponding with the most anterior of the three spiral threads in the early post-nuclear stages. Spire conic, there being two whorls preserved on the holotype. Whorls slightly convex, somewhat parallel-sided, with a small rounded shoulder posteriorly, their height slightly less than half their width. Sutures linear, slightly wavy, and set back a little behind the shoulder. Ornament consisting of axial ribs and spiral threads. On the first half whorl there are three equally spaced spiral threads or fine ribbons, which are of equal strength, and have intervals from one and a half to twice as wide as themselves; they cross over the ribs and form small crenulations at the points of intersection, a feature which rapidly becomes obsolete on later whorls. An intercalary thread soon develops between each pair of threads, and between the posterior thread and the posterior suture, and between the anterior thread and the anterior suture, making seven in all; there is occasionally a trace of an additional thread emerging from the anterior suture. These threads are of the same width as their intervals, but on the body whorl of a larger specimen they are slightly narrower than their intervals, and a little irregular in disposition on account of the development of additional intercalaries which appear to be more numerous on and close to the shoulder. Ribs straight and vertical, crossed by the spiral ornament; in the early stages they are rather more widely spaced, being about half the width of their intervals, whereas later they are more solid and rounded and little wider than their intervals. On the first spire whorl there are 10 ribs, the first three not being so strong as the remainder, and there are 11 ribs on the second whorl. No varices. Growth lines apparently fairly straight and vertical.

Dimensions. Holotype: 2·25 mm. (incomplete); width 1·7 mm.

Remarks. This species is only provisionally referred to the genus *Cancellaria* since the details of the aperture have not been observed. *C. sandbergeri* Tournouer (B 1879, p. 470, Pl. 10, fig. 2*a*, *b*), from the Tongrian of Brittany, has more widely spaced spiral threads and the spire seems a little less acute. The form and ornament distinguish '*C.*' *soriensis* from other species of the Cancellariidae recorded from the Tertiary of Pakistan, India and Burma.

Subfamily TRIGONOSTOMINAE

Genus *TRIGONOSTOMA* Blainville, 1825

(*Man. de Malac. et de Conch.* p. 652)

TYPE SPECIES. *Dauphinule trigonostoma* Lamarck, Recent; monotypy and tautonymy.

SYNONYMS. *Trigona* Perry, 1811 (*Conchology*, Pl. 51) *non* M. von Mühlfeldt, 1811 (Lam.) *nec* Jurine, 1807 (Hym.); type species: *Trigona pellucida* Perry, Recent = *Trigonostoma trigonostoma* (Lamarck); monotypy.

Trigonaphera Iredale, 1936 *teste* Wenz.

TRIGONOSTOMA PAKISTANICUM n.sp.

(Figure 99, plate 4)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68332).

DESCRIPTION. Shell ovoid-conic, with a moderately high and moderately narrow, conic spire. Protoconch not clearly seen, of fairly large size, consisting of a smooth, conoidal, dome-shaped apex, of about two slightly convex whorls with indistinct linear sutures. The four spire whorls are almost flat-sided, subcylindrical, with a sharply convex shoulder separating a narrow band close to the posterior suture, their height being a little less than half their width. Ribs projecting upwards a little on the shoulder, giving it a subspinose appearance, the circumsutural band in consequence somewhat channelled and giving a distinctly stepped appearance to the spire. Sutures linear and rather wavy. Ornament consisting of axial ribs and spiral threads. Nine spiral threads on each whorl, intercalary threads appearing on the body whorl; they are of about the same width as their intervals in the early whorls, but a little more widely spaced later on before the intercalary threads appear, and they always cross over the ribs, splaying out a little as they do so. Ribs fairly straight and vertical, a little more solid and rounded in the early stages than on the body whorl, of about the same width as, or slightly narrower than, their intervals on the first few whorls, but separated by intervals twice their width on the body whorl; there are eleven on the first whorl and nine on the body whorl. These ribs form a wavy, subspinose collar to the posterior part of the whorls. Anterior part of body whorl missing, and apertural characters not seen. Growth lines straight and vertical.

DIMENSIONS. Holotype: height (incomplete) 15·0 mm.; width 10·6 mm. (possibly slightly increased by crushing).

REMARKS. *Trigonostoma indicum* Vredenburg, from the Lower Nari of Bhagothoro Hill, has much less stepped whorls with a less distinct circumsutural collar on which the ribs are less subspiny; the ribbing is also not so noticeably stronger than the spiral ornament. *Cancellaria umbilicaris* Brocchi var. *subcanaliculata* Grateloup (1847, Pl. 25, fig. 14), from the Oligocene of southern France, has a less acute spire, and the spiral ornament is weaker and more widely spaced.

Subfamily ADMETINAE

Genus *COPTOSTOMA* Cossmann, 1899

(*Ess. Pal. Comp.* **3**, 34)

TYPE SPECIES. *Cancellaria quadrata* Sowerby, Eocene; original designation.

COPTOSTOMA? RAKHIENSE n.sp.

(Figure 100, plate 4)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (lower part, local zone 12) (FB. F. 1982, the holotype, Reg. No. G. 68333); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, *2*; FB. F. 2519, *2*).

DESCRIPTION. Shell oval-conic to subfusiform, not produced much anteriorly, moderately small. Spire conic, forming about one-third of the height. Protoconch and one or two spire whorls missing. Whorls regularly and gently convex, their height being about two-fifths of their width. Sutures linear. Ornament consisting of a very delicate network of fine axial ribbons and fine spiral ribbons of the same strength, both being little elevated, rather flattened, and about half the width of their intervals. There are vague crenulations where the two types of ornament intersect, and the ornament forms a series of small, slightly depressed squares. Nine spiral ribbons on each whorl, and 44 axial ribbons on the penultimate whorl. No varices. Body whorl rather large, inflated, the flanks rounded, the base declivous and slightly produced into a small beak. Aperture appearing relatively small and narrowly oval. Growth lines, which follow the same course as the ribs, practically straight, perhaps very slightly concave on their forward side, slightly retrocurrent.

DIMENSIONS. Holotype: height (incomplete) 8·6 mm.; width 4·75 mm.

REMARKS. This species shows no similarity to any Tertiary form described from Pakistan, India or Burma, and seems best placed provisionally as a *Coptostoma* on the basis of the form and ornament. *Digitolabrum? zigni* (de Gregorio), from the Kohat Shales of Kohat and from the Middle and Upper Eocene of Europe, while having somewhat similar ornament, has carinate whorls. *Coptostoma quadratum* (J. Sowerby) as figured by Wrigley (1935, p. 357, figs. 1, 46), from the Lower Barton Beds of England, is less turreted. ?*Cyrtochetus* sp. indet. of Traub (B 1938, p. 83, Pl. 7, figs. 3*a*, *b*), from the Palaeocene of Austria, has somewhat similar ornament, but is larger, and its body whorl is less rapidly constricted anteriorly.

COPTOSTOMA? PUNJABENSE n.sp.

(Figures 106, 107*a*, *b*, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, *3*, Reg. No. G. 68336–8; FB. F. 1995, the holotype, Reg. No. G. 68334, and 1 topotype, Reg. No. G. 68335); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *2*).

DESCRIPTION. Shell oval-conic to subfusiform, with a fairly slender, conic spire of at least four whorls on the holotype. Protoconch and one or two early spire whorls missing,

but the spire evidently occupied about one-half to two-fifths of the height of the shell. Whorls gently to moderately convex, their height from four-ninths to a half of their width; sutures linear. Ornament consisting of very delicate, distinct, spiral threads and axial riblets. The seven uniformly distributed and relatively widely spaced spiral threads on each whorl develop minute crenulations where the axial riblets cross them. Axial riblets on the whole a little finer than the spiral threads, numbering about 60 on the last whorl of the holotype; they are straight or slightly concave forwards, vertical or slightly retrocurrent, and form with the spiral threads a rectangular network which has the long axis of the rectangles in a vertical direction. No varices. Body whorl fairly large, convex on the flanks, its base declivous and gently excavated, ending anteriorly in a subrostrate beak. Beak broken on the holotype, the aperture of which therefore appears more semicircular than the oval aperture of the topotype. Spiral ornament persisting all over the base, but axial ornament soon becoming obsolete after reaching the periphery. Since both specimens from FB. F. 1995 are moulds, their apertural characters cannot be ascertained; a specimen from FB. F. 1986, however, although not well preserved and not showing any columellar folds, has a gently to moderately excavated columellar lip with a sharp bend at the beginning of a short anterior canal.

Dimensions. Holotype: height (incomplete) 5·4 mm.; width 2·8 mm. Topotype: height (restored) 3·75 mm.; width 1·75 mm.

Remarks. This species has a more acute spire than *Coptostoma? rakhiense*, and the network formed by the intersection of the axial and spiral ornament, instead of being square, is rectangular with the long axis in a vertical direction; the ornament itself is also a little more delicate. The species is placed tentatively as a *Coptostoma* on account of the form and the nature of the ornament. *Dientomochilus ickei* Martin (1914, p. 159, Pl. 5, figs. 124, 124*a*, 124*b*), from the Upper Eocene of Java, while showing a superficial similarity, has the spiral threads more closely spaced than the axial ribs, the spiral threads number 14 per whorl, and the anterior part of the shell has a strombiform rostrum.

Family Marginellidae

Genus *MARGINELLA* Lamarck, 1799

(*Mém. Soc. Hist. nat. Paris*, p. 70)

Type species. *Voluta glabella* Linné, Recent; monotypy.

Synonyms. *Marginellarius* Froriep, in Duméril, 1806 (*Analyt. Zool.* p. 338) (name without species).

Marginellus Montfort, 1810 (*Conch. Syst.* **2**, 558); type species: *Marginellus glabellus* (Linné), Recent; original designation and monotypy.

Phaenospira Hinds, 1844 (*Voy.* '*Sulphur*', *Zool.* p. 44); type species: *Marginella noduta* Hinds, Recent; Gray, 1847.

Porcellana auct. non Müller, 1766 (Moll.) *nec* Lamarck, 1801 (Crust.).

Pseudomarginella Maltzan, 1880 (*NachBl. dtsch. malak. Ges.* **12**, 108) *vide* Cook, 1922.

Simplicoglabella Sacco, 1890 (*Mem. Accad. Sci. Torino* (2), **40**, 313); type species: *Marginella* (*G.*) *taurinensis* Michelotti, M. Miocene; here designated.

Subgenus *PRUNUM* Herrmannsen, 1852

(*Indicis Gen. Malac. Suppl.* pp. 113–114)

TYPE SPECIES. *Voluta prunum* Gmelin, Recent; monotypy.

SYNONYMS. *Egouena* Jousseaume, 1875 (*Rev. Mag. Zool.* (3), **3**, 167, 209); type species: *Porcellana egouen* Adanson, Recent = *Marginella amygdala* Kiener; by tautonymy.

Egouana Jousseaume, 1875 (*Rev. Mag. Zool.* (3), **3**, 207) (*err.*).

MARGINELLA (PRUNUM) PSEUDO-ORIENTALIS n.sp.

(Figures 108*a*, *b*, plate 5)

MATERIAL. *Rakhi Nala section*: Lower Chocolate Clays (local zone 10) (FB. F. 1967, the holotype, Reg. No. G. 68339, and 1 topotype, Reg. No. G. 68340); Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, *6*; FB. F. 1995, *4*); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, *1*; FB. F. 2519, *1*).

DESCRIPTION. Shell elongate-elliptical in shape, rather like a torpedo or bullet, greatest width at about two-thirds of the height. Protoconch not clearly seen, a low, obtuse, smooth, fairly small button. Spire conic, very short, occupying only about one-fourteenth of the height of the shell, and apparently consisting of about two whorls. Sutures linear, very vaguely defined. Whorls flat-sided, their height only one-third or slightly less than one-third of their width. Shell smooth; body whorl very high, its anterior part a little narrower than its posterior part. Aperture very narrow, almost linear posteriorly where there is a narrow gutter, shallowly emarginate anteriorly, slightly constricted medially by a wide, gentle thickening of the outer lip. Only the anterior quarter of the inner lip has any callus, and there the layer is thin and carries four strong, spiral, columellar folds, the anterior one terminal. Outer lip strongly varicose, subvertical as a whole, slightly convex forwards, seemingly smooth internally.

DIMENSIONS. Holotype: height 7·1 mm.; width 3·25 mm.

REMARKS. *Marginella orientalis* Vredenburg, from the Yaw Stage (Upper Eocene) and Padaung Stage (Oligocene) of Burma, is larger, has a distinct concave circumsutural band, and the whorls are rather convex in outline; the aperture is also less constricted posteriorly.

MARGINELLA (PRUNUM) UNISTRIATA n.sp.

(Figures 110, 111, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68341, and 6 topotypes, Reg. No. G. 68342–7; FB. F. 1995, *2*); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2518, *6*).

DESCRIPTION. Shell elongate-oval in outline, greatest width above the middle line at about seven-tenths of the height. Protoconch a small, smooth, indistinct button. The holotype has about one post-nuclear whorl, but a fragmentary topotype has at least two spire whorls. These spire whorls are gently convex in outline, their height is about one-third of their width, and they are smooth except for one fine, spiral, incised line close to the posterior suture. Sutures linear. Body whorl very large, since the obtusely conic spire

occupies less than one-thirteenth of the height in the holotype, although it probably reaches a higher proportion in larger specimens. Outline well rounded at the greatest width, and somewhat flattened above, forming a vague shoulder. Aperture narrowly oval, distinctly narrower posteriorly where there is a gutter with a shallow notch anteriorly. Inner lip with four spiral columellar folds on its anterior half, the anterior fold terminal. Those specimens available on which the outer lip is preserved show no varex, the lip being thin probably on account of youth; it is practically straight and vertical, slightly receding anteriorly, slightly retrocurrent above the shoulder.

DIMENSIONS. Holotype: height 2·5 mm.; width 1·5 mm. A topotype attains a width of 2·4 mm.

REMARKS. *Marginella perkeo* Oppenheim (B 1901*a*, p. 223, Pl. 21, figs. 11, 11*a*, 11*b*), from the Priabonian of northern Italy, is a similar small form which, however, is distinctly less piriform and lacks a circumsutural incised line. *M. phaseola* Brongniart as figured by Socin (1939, p. 97, Pl. 2, fig. 3), from the Eocene of Italy, is less piriform and is larger. The form and single circumsutural incised line appear to be characteristic.

MARGINELLA (*PRUNUM*) *SORIENSIS* n.sp.

(Figure 101, plate 4)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68348, and 1 topotype, Reg. No. G. 68349).

DESCRIPTION. Shell cigar-shaped, spire bluntly conic and rather callous, smooth, rather sharply rounded at its greatest width which is situated at at least nine-fourteenths of the total height, anterior end stiffly conic and tapering. Protoconch an obtuse, indistinct, small, smooth button. Spire obtusely conic, very small, occupying less than one-twentieth of the height of the shell, consisting of about two whorls. Sutures indistinct, not incised. Inner lip not callous; both specimens available have the anterior part of the columella missing, but show three strong, spiral, columellar folds; there were probably four such folds in the complete shell, the anterior one being terminal. Aperture very narrow and parallel-sided, with a well-developed gutter posteriorly. Outer lip broken. Growth lines obscure, appearing to be fairly straight and vertical. Gutter posteriorly rising upwards somewhat on to the penultimate whorl.

DIMENSIONS. Holotype: height (incomplete) 5·6 mm.; width 3·75 mm.

REMARKS. The stiff outline, blunt spire, and blunt bullet-headed appearance seem to be characteristic.

Subgenus *SERRATA* Jousseaume, 1875

(*Revue et Magasin de Zool.* (3), **3**, 167, 230–232)

TYPE SPECIES. *Marginella serrata* Gaskoin, Recent; tautonymy.

MARGINELLA (*SERRATA*) *PAKISTANICA* n.sp.

(Figures 112, 113, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68350, and 16 topotypes, Reg. No. G. 68351–6;

FB. F. 1996, *4*); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *2*).

DESCRIPTION. Rather narrowly oval-conic, greatest width slightly above the middle, smooth, young shells more broadly oval. Protoconch not well differentiated, consisting of one and a half to two smooth, gently convex whorls with indefinite sutures, and constituting an obtuse naticoid button. Spire conic, consisting of three or four smooth, practically flat-sided whorls which are a little stepped posteriorly; their height is about two-fifths of their width. Sutures linear and distinct. Body whorl oval-conic, base not excavated, outer margin very faintly swollen anteriorly near the tip. Aperture narrow, almost parallel-sided, anteriorly emarginate, posteriorly with a vaguely differentiated gutter. Columellar lip with four columellar folds, the anterior one forming the anterior twisted end of the columella. Outer lip varicose, the varix passing round most of the anterior emargination. Interior of outer lip crenulated. Growth lines straight and vertical, vaguely sinuous posteriorly.

DIMENSIONS. Holotype: height 4·12 mm. (apex broken), or 4·5 mm. (restored); width 1·87 mm.

REMARKS. Paris Basin Eocene forms which are comparable in outline have the outer lip internally smooth and externally flattened in the plane of the aperture; they belong to the subgenus *Stazzania*.

Subgenus *NUDIFABA* n.subg.

TYPE SPECIES. *Marginella* (*Nudifaba*) *rakhiensis* n.subg. et sp., Upper Eocene.

SUBGENERIC CHARACTERS. Shell of very small size, smooth, ovoid-conic to subpiriform in outline, almost conic on account of the very flat spire which is visible and consists of about one and a half to two whorls; body whorl very large, broad posteriorly, narrow anteriorly; columella with four folds; no parietal folds; outer lip strongly varicose, vertical as a whole, gently convex, evidently not strongly crenulated internally.

REMARKS. This subgenus is very similar to *Glabella* Swainson, 1840 (type species: *Voluta faba* Linné, Recent; Gray, 1847) of which *Faba* Fischer, 1833 is an absolute synonym, but it lacks costules, the columellar lip is more callous, and the outer lip is not oblique.

MARGINELLA (*NUDIFABA*) *RAKHIENSIS* n.subg. et sp.

(Figures 109*a*, *b*, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68357, and 12 topotypes, Reg. No. G. 68358–63).

DESCRIPTION. Shell very small, smooth, ovoid-conic to subpiriform in outline, almost conic on account of the very low and obtuse spire. Protoconch minute. Spire short, obtusely conic, appearing extraconic on account of the widening out of the shell at the shoulder of the body whorl, forming only a very small proportion of the total height of the shell, and consisting of about one and a half to two slightly convex whorls with linear sutures. Whorls narrow, their height being not much more than two-sevenths of their width. Body whorl relatively very large, broadly conic in outline, with a well-rounded shoulder situated high up near the suture; on the apertural side of the shell the shoulder

is still more sharply rounded where the varicose outer lip passes over it. Aperture very narrow, long, and parallel-sided, with a narrow, rounded, well-channelled gutter posteriorly, and with a shallow emargination anteriorly. Columellar lip with a callous limb carrying four distinct folds, the anterior one of which is terminal, the posterior one being weaker. Outer lip very strongly varicose, the varix extending round the gutter and the anterior emargination, vertical as a whole, gently convex in outline. Parietal wall posteriorly with a broad, vertically-disposed swelling limiting the posterior end of the aperture by the gutter.

DIMENSIONS. Holotype: height 1·35 mm.; width 1·1 mm.

REMARKS. *Cryptospira masria* Cuvillier (B 1933, p. 66, Pl. 7, fig. 28), from the Upper Mokattam of Egypt, is larger and less piriform. *Marginella* (*Egouena*) *dichotomoptycha* Cossmann (1896, p. 227, Pl. 7, figs. 5, 6 *non* figs. 9, 10), from the Eocene of the Lower Loire, is similar but has a higher spire. *Cryptospira* (*Gibberula*) *cossmanni* (Morlet) as figured by Cossmann & Pissarro (B 1907–13, Pl. 46, fig. 208 *bis*–5), from the Lutetian of the Paris Basin and from the Bartonian, is not so broad at the shoulder and is larger. The rather similar general appearance of these three forms does not necessarily indicate a close relationship.

Genus *PERSICULA* Schumacher, 1817

(*Ess. Vers test.* pp. 71, 235)

TYPE SPECIES. *Persicula variabilis* Schumacher, Recent = *Volvaria persicula* Linné; by tautonymy.

SYNONYM. *Persicola* Swainson, 1840 (*Treat. Malac.* p. 323) (*err.*).

PERSICULA? sp. A

(Figures 135*a*, *b*, plate 6)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, the holotype, Reg. No. G. 68364, and 1 topotype, Reg. No. G. 68365).

DESCRIPTION. Shell moderately large, ovoid-conic, piriform, spire extremely obtuse and hidden under a layer of callus. Body whorl very large, sharply rounded at the shoulder which is situated high up, appearing slightly concave above the shoulder, the concave band carrying about five obscure spiral threads. Suture of body whorl fine and linear, sometimes appearing to be raised on a cordon. Aperture almost parallel-sided, moderately narrow, a little curved inwards posteriorly. Inner lip with at least seven evenly distributed columellar folds. Outer lip broken. Growth lines practically straight and vertical. There was evidently a shallow anterior emargination rather than a notch.

DIMENSIONS. Holotype: height 13·9 mm.; width (probably a little increased by crushing) 10·0 mm.

REMARKS. This form is placed tentatively in *Persicula* on account of its general form and number of columellar folds, although the presence of spiral ornament above the shoulder on the body whorl is atypical.

Superfamily TOXOGLOSSA

Family TURRIDAE

Subfamily TURRINAE

Genus *TURRIS* Bolten, in Röding, 1798

(*Mus. Bolt.* part 2, p. 123)

TYPE SPECIES. *Turris babylonica* Bolten, Recent = *Murex babylonicus* Linné; Meek, 1876.

SYNONYMS. *Fusus* (Helbling, 1779) (*Abh. Privatges. Böhmen*, **4**, 116) (pars).

Pleurotoma Lamarck, 1799 (*Mém. Soc. Hist. nat. Paris*, p. 73); type species: *Murex babylonius* Linné, Recent; monotypy.

Subgenus *GEMMULA* Weinkauff, 1875

(*Jahrb. dtsch. malak. Ges.* **2**, 285)

TYPE SPECIES. *Pleurotoma* (*Gemmula*) *gemmata* Hinds, Recent; Cossmann, 1896.

TURRIS (*GEMMULA*) *PAKISTANICA* n.sp.

(Figure 116, plate 5)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68366, and 2 topotypes, Reg. No. G. 68367–8).

DESCRIPTION. Shell moderately small, fusoid, with a spire of moderate height. Protoconch tectiform, consisting of about five gently convex whorls whose greatest width is anterior to the middle, which are vaguely excavated posteriorly and carry a fine posterior circumsutural thread, and which are separated by fine linear sutures; first two whorls small and smooth, succeeding ones ornamented with fine axial riblets which are fairly straight and vertical but tend to curve forwards anteriorly. These riblets on the protoconch are fine and sharp, about half the width of their intervals in the early stages, becoming twice as widely spaced later on. About four spire whorls on the holotype, forming a regularly conic, moderately broad spire about 3·0 mm. in height. Sutures distinct and linear. Height of whorls about two-fifths of their width, although the ratio tends to decrease in maturity. Outline of whorls steeply sloping and gently concave over their posterior half, subcylindrical anteriorly. Ornament consisting of spiral threads, and of axial crenulations on a band whose upper margin is at half the height of the whorls, and corresponds with the change from subcylindrical to concave outline. One fine, but distinct and sharp, spiral thread adjacent to the posterior suture. On the earlier whorls there is one spiral thread in the middle of the interval between the posterior strong thread and the crenulated band; on later whorls there is a still finer thread on each side of this median thread, and also traces of a very fine thread anterior to the group. The crenulated band is a raised ribbon which occupies one-third the height of the anterior subcylindrical part of the whorls; anterior to it there are two distinct spiral threads, the anterior of which is close to the anterior suture, the posterior one separated from the anterior side of the

crenulated band by an interval twice its own width, the space between the two threads being at least three times their width. The crenulations on the crenulated band, while tending to be rather rounded in the first few whorls, are elongated on later whorls, being about twice as high as wide; they are slightly antecurrent, are separated by intervals about twice their own width, and number 24 on the last whorl preserved on the holotype. Whole surface also covered by microscopic frosted growth lines which are antecurrent at an angle of about 45° posteriorly, form a rectangular-ended anal sinus on the crenulated band, and, on the body whorl, can be seen to swing forward anteriorly in a prominent convex bulge.

Body whorl moderately large, the columella and canal being broken off, the outer lip broken. Anterior to the continuation of the spiral ornament seen on the spire whorls, the two anterior threads of which form distinct keels, there is one fine spiral thread followed by a spiral thread which is a little stronger than the two posterior strong ones, and these in turn are followed by one fine thread, one stronger thread, one fine thread and another stronger thread; anterior to this there are two moderately widely spaced spiral threads on the outer side of the stump of the broken canal. Flank of body whorl subcylindrical and gently convex, the base gently excavated. Aperture oval. Where the outer lip is broken away the infilling of the whorl shows three strong incised spiral grooves which do not correspond with the external ornament, and which indicate that the outer lip was internally lirate.

Dimensions. Holotype: height (incomplete) 6·75 mm.; width 3·4 mm.

Remarks. *Pleurotoma* (*Gemmula*) *sindiensis* Vredenburg, from the Lower Nari of Bhagothoro Hill (Sind), has a higher spire and differs in the details of its ornament. *P.* (*Hemipleurotoma*) *bonneti* Cossmann var. *bhagothorensis* Vredenburg, which is from the Lower Nari of Bhagothoro Hill (Sind) and which also appears to belong to the subgenus *Gemmula* on account of the ribbed character of the later whorls of the protoconch, has a higher spire and more crenulated spiral ornament. *Pleurotoma tricincta* Martin (1935, p. 113, Pl. 2, figs. 2, 2*a*), from the Neogene of Buton, is more broadly conic and differs in the details of the ornament (for example, there are only two spiral threads posterior to the anal fasciole). *P. badensis* Hoernes & Auinger as figured by Oppenheim (B 1922, p. 69, Pl. 7, fig. 18), from the Oligocene of Czechoslovakia, has a noticeably higher spire and a practically smooth posterior concave band on the whorls. *P.* (*Hemipleurotoma*) *uniserialis* Deshayes as figured by Glibert (B 1933, p. 103, Pl. 6, fig. 10), from the Bruxellian of Belgium, appears generally similar but is less broadly conic, and the crenulated band is less accentuated by a posterior concave band, there being a distinct circumsutural keel which masks the concave band. *P. subcarinata* Rouault (B 1850, p. 484, Pl. 16, fig. 23), from the Eocene near Pau, has a more acute spire and a more distinct concave band. *P. laticlavia* Beyrich as figured by Cossmann & Lambert (B 1884, p. 168, Pl. 5, fig. 21), from the Oligocene of the Paris Basin, has a more acute spire, and the spiral threads on that part of the whorl anterior to the crenulated band are less distinct. *P. odontella* Edwards as figured by Boussac (B 1911*a*, p. 369, Pl. 22, figs. 7*a*, ?9), from the Priabonian and Lattorfian of the Alps, has a higher spire and the crenulated band is distinctly wider; the same species as figured by Boussac (B 1911*b*, p. 57, Pl. 12, figs. 19–21*a*), from the Bartonian of southern France, and by Oppenheim (B 1901*a*, p. 244, Pl. 20, fig. 6), from

the Priabonian of Italy, also has a more acute spire, and that part of the whorls anterior to the crenulated band is excavated rather than stiffly cylindrical.

TURRIS (GEMMULA) SORIENSIS n.sp.

(Figure 114, plate 5)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68369).

DESCRIPTION. Shell moderately small, fusiform, with a conic spire occupying a little more than one-third the height of the shell. Protoconch tectiform, consisting of about $4\frac{1}{2}$ to 5 whorls, the first two conic, the next producing a general conoidal appearance, the last rather pinched in; first two whorls very small, rather flattened, and smooth, the remainder gently convex and ornamented with axial riblets which are fine, sharp, slender, a little narrower than their intervals (except on the last half whorl or so where they become a little more widely spaced), and which are fairly straight and vertical with a tendency to a slight forward curve anteriorly. About 27 riblets on the last whorl of the protoconch. Spire moderately acutely conic, consisting of about four and a half whorls which have a strong, prominent, V-shaped circumsutural thread and a swollen crenulated band slightly anterior to the middle of that part of the whorl anterior to the circumsutural thread; whorl surface above and below the crenulated band, especially above, being gently concave. Sutures linear. Apart from the circumsutural thread and the crenulated band there appears to be no other spiral ornament on the spire whorls. Crenulations on anal fasciole rather blunt, a little longer along their axial diameter, slightly antecurrent, sometimes vaguely concave on their forward side, separated by intervals little more than their own width. Height of spire whorls two-fifths of their width.

Body whorl fairly convex on the flanks, the base moderately well excavated, the neck produced straight downward alongside the canal. No siphonal fasciole. Anterior to the crenulated band, there are on the body whorl eight strong, sharp, V-shaped spiral threads or small keels, with a subsidiary finer keel between the most posterior one and the crenulated band; these keels appear to be spaced well apart and to have smooth intervals. Aperture rather narrowly oval, produced anteriorly into a gently oblique canal the length of which is about equal to the height of the aperture. Inner lip covered with a moderately thick but not very wide layer of callus which becomes gradually narrower anteriorly. No columellar folds, the inner lip being gently arched at the commencement of the canal, and gently excavated posteriorly. Outer lip broken. Growth lines antecurrent at an angle of about 45° posteriorly, forming a rectangular-ended sinus on the anal fasciole, and then swinging well forward in a prominent convex curve.

DIMENSIONS. Holotype: height 7·9 mm.; width 3·0 mm.

REMARKS. *Pleurotoma (Gemmula) sindiensis* Vredenburg, from the Lower Nari of Bhagothoro Hill (Sind), has a higher spire and differs in the details of the ornament, there being, in particular, considerably more numerous spiral threads on the anterior part of the body whorl. *Turris (Gemmula) pakistanica* n.sp., has a noticeably more broadly conic spire, a relatively narrower and more projecting crenulated band, and different spacing of the spiral threads anterior to the anal fasciole on the body whorl.

Genus *CRASSISPIRA* Swainson, 1840

(*Treat. Malac.* pp. 152, 313)

TYPE SPECIES. *Pleurotoma bottae* Valenciennes *auct.*, Recent=*Pl. incrassata* Sowerby *non* Defrance=*P. fasciata* Swainson; monotypy.

CRASSISPIRA? sp. A

(Figure 117, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1995, the holotype, Reg. No. G. 68370, and 1 topotype, Reg. No. G. 68371).

DESCRIPTION. Shell moderately small, turriculate-subfusiform, with a fairly high spire occupying two-fifths of the total height of the shell. Protoconch missing, evidently small. Five spire whorls preserved, evidently not more than one or two being missing at the apex; their height is about four-ninths of their width. A strong circumsutural cord is followed anteriorly by a shallow spiral groove, each occupying nearly one-fifth the height of the whorl; anterior three-fifths or so of whorl surface slightly convex in outline. Sutures evidently fine and linear. Circumsutural cord appearing to consist of a thick posterior portion separated by a fine incised line from a narrow anterior portion, but this appearance may be due to weathering. No other spiral ornament is preserved on the spire whorls. Axial ornament consisting of numerous, sharp, closely spaced riblets which are of the same width as, or slightly narrower than, their intervals, and are noticeably retrocurrent; there are five in $\frac{3}{4}$ mm. on the penultimate whorl.

Body whorl with slightly to gently convex flanks, a gently excavated base, and a moderately long and straight neck. The absence of any trace of a siphonal fasciole may be due to the fact that the later whorls are missing. Indications of about ten spiral threads on the neck. Aperture oval and, possibly due to breakage, apparently with a slightly oblique anterior canal of about the same length as the height of the aperture. Outer lip broken. Growth lines, while not clearly seen, generally prominent on the anterior part of the whorls, and with a deep U-shaped sinus in the concave band.

DIMENSIONS. Holotype: height (slightly incomplete) 6·6 mm.; width 2·25 mm.

REMARKS. This interesting form is unique among turrid forms described from the Eocene of Pakistan, India and Burma in its ornament. The rather slender form and closely spaced oblique and retrocurrent ribs relate it to the Neogene forms *Drillia* (*Crassispira*) *tittabweensis* Vredenburg from the Obogon Alternations (Middle Miocene) of Kyaungon, Myaukmigon, Thanga, and Tittabwe and the Kyaukkok Sandstones (Lower Miocene) of Dalabe, *Drillia* (*Crassispira*) *iravadica* Vredenburg from the Obogon Alternations of Myaukmigon, and *Drillia* (*Crassispira*) *birmanica* Vredenburg from the Obogon Alternations of Tittabwe, all from Burma. The first species is the most closely related to *Crassispira*? sp. A, but it has more widely spaced riblets. The Rakhi Nala form is almost certainly a new species, but the naming of it is left in abeyance until better preserved specimens showing the spiral ornament are obtained.

Genus *BRACHYTOMA* Swainson, 1840

(*Treat. Malakol.* pp. 154, 314)

TYPE SPECIES. *Pleurotoma strombiformis* Sowerby, Recent; Herrmannsen, 1846.

SYNONYMS. *Brachitoma* Sowerby, 1842 (*Conch. Man.* 2nd ed. p. 46) (*err.*).

Brachystoma Gray, 1847 (*Proc. Zool. Soc. Lond.* **15**, 134) (*err.*).

Ptychobela Thiele, 1925 (*Wiss. Ergebn. dtsch. Tief-See Exped.* **17**, part 2, *Gastr.* 2, p. 181 (215)); type species: *Pleurotoma crenularis* (Lamarck), Recent; original designation.

REMARKS. *Inquisitor* Hedley, 1918 (type species: *Pleurotoma sterrha* Watson, Recent; original designation) is placed in synonymy by both Thiele and Wenz, but the aperture apparently has no notch.

BRACHYTOMA sp. A

(Figure 118, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68372, and 5 topotypes, Reg. No. G. 68373–7; FB. F. 1995, *4*).

DESCRIPTION. Shell of moderate size, fusiform, with a moderately acute and fairly high spire which, on one of the topotypes, forms about one-third of the total height. Protoconch apparently consisting of about three slightly convex whorls which form a subtectiform embryonic shell; last half whorl of what appears to be the protoconch with delicate curved riblets of a different type from the ribs of the post-nuclear whorls. The holotype has four spire whorls preserved, only one or two being missing at the apex; they have a strong circumsutural thread followed anteriorly by an outwardly-shelving, flat or vaguely concave band anterior to which they are slightly convex and recede a little to the anterior suture. Greatest width of whorls at the anterior side of the slightly concave band which is at about three-fifths of the height of the whorls. Height of whorls about half their width. Ornament consisting of axial ribs and spiral threads which cross them. Ribs solid and subnodular, especially at the anterior side of the concave band posterior to which position they do not pass, of about the same width as their intervals, practically straight, and distinctly retrocurrent. 12 or 13 ribs on the penultimate whorl. The anterior three-fifths of the whorls carries about five moderately strong spiral threads of about half the width of their intervals; these threads cross over the ribs, and the interval between the two most anterior threads is a little greater than the width of the remaining intervals.

Body whorl with convex flanks, an excavated base, and a moderately long, straight and vertical neck. Siphonal fasciole extremely feeble, possibly because the specimens are not adult. Ribs dying out on the base, which is ornamented with spiral threads only. Aperture oval, with a distinct, moderately oblique, straight anterior canal, the length of which is a little less than the height of the aperture, and the anterior end of which is shallowly emarginate. Inner lip gently excavated, slightly bent at the start of the canal, apparently rather callous. Apparently no columellar folds. Outer lip broken on available specimens. Growth lines prominent and forwardly arched over most of their course, with a deep U-shaped sinus in the concave band.

DIMENSIONS. Holotype: height (incomplete) 4·0 mm.; width 1·9 mm. A topotype: height 3·25 mm.; width 1·35 mm.

REMARKS. No closely comparable form has been described from the Eocene of Pakistan, India or Burma. *Drillia* (*Brachytoma*) *pinfoldi* Vredenburg, from the Okhmintaung Sandstones (Upper Oligocene) of Mindegyi in Burma, is stouter and has less numerous ribs. The species is apparently new, but is not named pending the discovery of material with the spiral ornament and body whorl better preserved.

Subfamily CLAVATULINAE

Genus *TURRICULA* Schumacher, 1817

(*Ess. Vers test.* pp. 66, 217)

TYPE SPECIES. *Turricula flammea* Schumacher, Recent = *Murex tornatus* Dillwyn = *M. javanus* Chemnitz *non* Linné; monotypy.

SYNONYMS. *Surcula* H. & A. Adams, 1853 (*Gen. Rec. Moll.* **1**, 88); type species: *Pleurotoma javana* Linné, Recent = *Pleurotoma nodifera* Lamarck; Cossmann, 1896.

Surgula Weinkauff, 1876 (*Jb. dtsch. malak. Ges.* **3**, 2) (*err.*).

REMARKS. Although *Surcula* is treated separately from *Turricula* by Wenz, there seems to be gradation between the two extreme forms as far as subgeneric characters are concerned. *Protosurcula* Casey, 1904 (type species: *Surcula gabbi* Conrad, Eocene; original designation) is placed in synonymy by Wenz, but the ribbed last whorl of the protoconch, the absence of axial ornament in the post-nuclear stages, and the relatively short spire seem to be distinctive.

TURRICULA PRAEPROMENSIS n.sp.

(Figures 136, 137, plate 6)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68378, and 16 topotypes, Reg. No. G. 68379–84; FB. F. 1995, *10*+); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *2*).

DESCRIPTION. Shell moderately small, biconic-subfusiform, with a conic spire which, on one of the topotypes, forms one-third the height of the shell. Protoconch small, consisting of nearly three smooth, gently convex whorls separated by linear, shallow sutures; it is naticoid in form, but rather high. Whorls with a thick circumsutural cord which is followed anteriorly by a wide and gently concave band at least twice the width of the circumsutural band, the two together occupying the upper half of the height of the whorls; anterior half of whorls swollen and slightly to gently convex in outline. In the earlier whorls the concave band is relatively narrower and the convex anterior part of the whorl higher. On the earliest spire whorls, the circumsutural thread is composed of two raised threads, the posterior one being the larger, separated by a narrow, linear interval; on later whorls the anterior one is more projecting than the posterior one. Apart from the circumsutural thread, the ornament consists of axial ribs and fine spiral threads. Four spiral threads on the concave band, the threads appearing somewhat like narrow ribbons since they are

separated by fine, not very deeply incised spiral lines. Four spiral threads also on the anterior convex portion of the whorls, these appearing stronger since they cross the ribs and are separated by rather deeper intervals of about the same width as themselves. Ribs confined to the anterior convex portion of the whorls, short, about half the width of their intervals, tending to be more nodular anteriorly and sharper posteriorly, and distinctly retrocurrent, being a little curved and still more oblique posteriorly. Sutures distinct and linear.

Body whorl convex on the flanks, excavated on the base, and with an anteriorly prolonged, almost straight and vertical neck of moderate length. Siphonal fasciole very feeble. Ribs very faint anterior to the periphery; spiral ornament continuing all over the base, there being about 14 spiral threads anterior to the swollen portion of the ribs on one of the small topotypes. Aperture moderately narrowly oval, produced anteriorly into a straight, distinctly oblique canal which is of about the same length as the height of the aperture, and which has its distal end shallowly emarginate. Inner lip gently excavated, with a distinct bend at the commencement of the canal, apparently with a well-defined but not very thick layer of callus which narrows alongside the canal; no columellar folds. Outer lip broken. Growth lines convex and prominent anteriorly, with a deep U-shaped sinus on the concave band, the upper arm of which soon swings upwards to meet the posterior suture at right angles.

Dimensions. Holotype: height (incomplete) 3·0 mm.; width 2·6 mm. A topotype: height 2·8 mm.; width 1·1 mm.

Remarks. No closely comparable form seems to have been described from the Eogene of Pakistan, India, or Burma. *Surcula promensis* Vredenburg, from the Obogon Alternations (Middle Miocene) of Kyaungon, Myaukmigon, and Thanga in Burma, and also represented in the Burmah Oil Company's collections from Lower Miocene horizons, is obviously closely related. Vredenburg's species differs, however, in its more numerous and finely crenulated spiral threads, in the relatively greater height and concavity of the concave band, and by the axial ribs not curving more strongly backwards posteriorly.

TURRICULA sp. A

(Figures 119, 120, plate 5)

Material. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, *1*; FB. F. 1995, the holotype, Reg. No. G. 68385, and 6 topotypes, Reg. No. G. 68386–91); *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, *1*).

Description. Shell biconic, fusiform, with a conic spire occupying one-third of the height of the shell, attaining a moderate size. Protoconch not seen, a topotype having four spire whorls. There is a strong circumsutural cord anterior to which there is an excavated band of about the same width, these two structures forming about a half, or slightly less than half, the height of the whorls; remaining anterior portion of the whorls distinctly swollen and convex. Circumsutural cord carrying strong crenulations which correspond with the ribs on the anterior portion of the whorl; on the early whorls these crenulations are rather rounded, but on larger specimens they are elongate-rectangular

in shape, rather sharp, distinctly antecurrent in disposition, and only about half the width of their intervals. Circumsutural cord on which they are placed also consisting of three distinct spiral threads separated by intervals of about the same width. On the largest specimen the crenulated band forming the anterior part of the whorls carries three spiral threads anterior to which there are at least twelve spiral threads covering the base as far as the broken end of the columellar region, these latter threads appearing to be somewhat serrated and about half the width of their intervals. Apart from the circumsutural thread, the spiral ornament on the early whorls is not preserved. Ribs on early whorls tending to be more nodular than later on, only partly interrupted on the concave band. Approximately 24 short, straight, prominent, slightly retrocurrent axial ribs on the body whorl anterior to the concave band, the intervals being from one and a half to two times the width of the ribs.

Body whorl with convex flanks, a well excavated base, and a moderately long, straight and vertical neck anteriorly. Siphonal fasciole weak. Aperture broadly oval to subcircular, more strongly arched along its outer margin, produced anteriorly into a straight, moderately oblique canal, the length of which is about the same as the height of the aperture and the tip of which is shallowly emarginate. Outer lip broken. Growth lines convexly arched anteriorly, with a deep U-shaped sinus in the concave band, swinging backwards to meet the posterior suture in a gently antecurrent to vertical direction. The infilling of the body whorl near the aperture displays at least two prominent incised spiral grooves, showing that the interior of the outer whorl walls was lirate. Inner lip not well preserved; it was excavated in its posterior part, bent at the commencement of the canal, and apparently had no folds.

Dimensions. Holotype: height 4·5 mm.; width 1·9 mm. A paratype: width 3·0 mm.

Remarks. This species is readily distinguishable from *Turricula praepromensis* n.sp. by the crenulations on the circumsutural band. *Pleurotoma* (*Epalxis*) *cavasana* Oppenheim (B 1901*a*, p. 239, Pl. 19, figs. 5, 5*a*), from the Priabonian of northern Italy, is somewhat similar, but is considerably larger and the ribs are less numerous, the nodes on the circumsutural cord also being fewer, more widely spaced, and round.

Subgenus *PLEUROFUSIA* de Gregorio, 1890

(*Ann. Géol. Pal.* no. 7, p. 33)

Type species. *Pleurotoma longirostropsis* de Gregorio, Eocene; original designation.

Synonyms. *Tropisurcula* Casey, 1904 (*Trans. Acad. Sci. St Louis*, **14**, no. 5, p. 153); type species: *Drillia caseyi* Aldrich, Eocene-Oligocene; Cossmann, 1906.

Tropidosurcula Cossmann, 1906 (*Ess. Pal. Comp.* **7**, 222) (*em.*).

Remarks. The slight differences in type of ornament do not seem to warrant the separation of *Tropisurcula* which has the same general form and type of protoconch.

TURRICULA (*PLEUROFUSIA*) *OBLIQUINODOSA* n.sp.

(Figure 138, plate 6)

Material. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68392, and 1 topotype, Reg. No. G. 68393).

DESCRIPTION. Shell small, oval-biconic, anterior canal broken off; evidently rather fusiform, with a moderately short spire giving it a rather stout appearance. Spire regularly conic in outline, consisting of about three and a half whorls on the holotype, one or two apical whorls being missing. About the uppermost quarter of the whorls is occupied by a circumsutural thread or band which is followed anteriorly by a shelving, gently concave band at least twice the width of the band behind it. The anterior three-quarters of the whorls is subcylindrical in outline and gently convex. Height of whorls about half their width. Circumsutural thread smooth and not nodose, not strongly projecting. Anterior three-quarters of the whorls ornamented with axial ribs and spiral threads which cross over them. Four equally spaced spiral threads which are slightly narrower than their intervals, and, a little further removed, traces of a fifth fine thread emerging from the anterior suture. Ribs subnodular, forming a vague shoulder at the anterior termination of the concave band where they cease, prominent, straight, of about the same width as their intervals, rather strongly retrocurrent; about 13 ribs on the last whorl of the holotype. Body whorl not well preserved, apparently rather stout. Growth lines evidently arched forward anteriorly, and with a U-shaped sinus in the concave band. Anterior canal broken off.

DIMENSIONS. Holotype: height (incomplete) 3·2 mm.; width 1·9 mm.

REMARKS. *Brachytoma* sp. A is somewhat similar to this species in general appearance, but is considerably more slender and has less solid and less nodular ribs; it also appears to have a strong spiral thread near the anterior suture rather than a fine one which is further removed from the threads above it. *Turricula lakiensis* Raj Nath & Chiplonker, which may be a *Pleurofusia*, from the Upper Middle Khirthar of the Laki dome in Western Pakistan, is larger, the ribs are not oblique and become considerably more widely spaced, and the whorls are more nodose. *Surcula textiliosa* Deshayes as figured by Dareste de la Chavanne (B 1910*a*, p. 30, Pl. 4, fig. 13), from the Eocene of Spain, has higher whorls the widest part of which is situated more anteriorly.

TURRICULA (*PLEUROFUSIA*) *PSEUDOSCALA* n.sp.

(Figures 139*a*, *b*, plate 6)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68394, and 1 topotype, Reg. No. G. 68395).

DESCRIPTION. Shell small, oval-conic, fusiform, with a moderately short, conic spire which, on the topotype, forms about three-tenths of the height of the shell. The small topotype has a spire of about two and a half whorls. Protoconch not seen, evidently small. The whorls, the height of which is about half their width, have a shelving, gently concave band posteriorly, which occupies about a quarter of the whorl height, the remaining anterior portion of the whorls being subcylindrical, gently convex, a little receding anteriorly. There is apparently no circumsutural thread. Ornament consisting of spiral threads and axial ribs. Four spiral threads, strong, sharp, about half the width of their intervals, and restricted to that portion of the whorls anterior to the concave band. On the body whorl there are six or seven additional threads anteriorly, covering the base as far as the broken end of the canal. Axial ribs strong, nodular, straight, vertical or slightly

retrocurrent, of about the same width as their intervals on the earlier whorls, becoming more widely spaced on later whorls where they are little more than half the width of their intervals; there are nine ribs on the last whorl of the holotype. These ribs in the early whorls cross the concave band almost unmodified, but on later whorls they are obsolete there, although the surface of the concave band is undulate. Junction between the concave band and the anterior portion of the whorls in the later part of the shell very sharply rounded and even subangular on account of the rather abrupt fading out of the ribs and change in disposition of the whorl surface.

Body whorl oval-conic in outline, gently convex and receding anteriorly, well-shouldered posteriorly, the base being quite well excavated, the neck straight, vertical, and of moderate length. Ribs continuing on to the base, but dying out by the time they reach the beginning of the neck. Aperture moderately narrowly oval, produced anteriorly into a distinctly oblique canal the length of which is about the same as the height of the aperture. Inner lip gently concave over its posterior half, gently bent at the commencement of the canal, apparently smooth. Outer lip broken. Growth lines convex and prominent over most of the anterior surface of the whorls, with a U-shaped sinus in the concave band.

Dimensions. Holotype: height (incomplete) 1·9 mm.; width 1·3 mm. The topotype: height 1·9 mm.; width 0·94 mm.

Remarks. The outline and rather strong ornament appear to be characteristic. *Turricula* (*Pleurofusia*) *scala* (Vredenburg), from the Obogon Alternations (Middle Miocene) of Tittabwe in Burma, is much more carinate, the widest portion of the whorls being at the carination rather than slightly anterior to the shoulder. *T.* (*Pleurofusia*) *scala* (Vredenburg) var.?, from the Obogon Alternations of Myauktin in Burma, is more like the Pakistan species, but has more nodular ribs and weaker and more numerous spiral threads. *T.* (*Pleurofusia*) *polycesta* (Bayan), from zone 2 of the Upper Ranikot 3 miles east of the old Coal-pit near Leilan, from zone 4 of the Upper Ranikot at Jherruck, and from the Eocene of the Paris Basin, is somewhat similar in form, but has rather more conspicuous ribs, and distinctly finer, more closely spaced, and more numerous spiral threads.

Subfamily Cytharinae

Genus *PYRENOTURRIS* n.gen.

Type species. *Pyrenoturris soriensis* n.gen. et sp., Lower Eocene.

Generic characters. Subfusiform, with conic spire; whorls stepped, with a circumsutural band, with axial and spiral ornament developing beads or crenulations, especially on the posterior part of the whorls where they tend to be scabrous, and where the ribs tend to be foliaceous; base excavated; growth lines gently to moderately convex anteriorly, with a distinct, broadly U-shaped sinus posteriorly, antecurrent at the suture.

Remarks. This genus is provisionally placed in the subfamily Cytharinae on the basis of its general appearance, pending the discovery of specimens exhibiting the characters of the aperture. The form, combination of ornament, and growth lines as developed in the two species here described, seem to be unique.

PYRENOTURRIS SORIENSIS n.gen. et sp.

(Figure 141, plate 6)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2681, *2*; FB. F. 2679, the holotype, Reg. No. G. 68396).

DESCRIPTION. Shell moderately large, subfusiform, with a moderately high, conic spire which is 8·6 mm. high on the holotype. Protoconch almost entirely worn off, small, the last half whorl possibly with fine fixial riblets. There are nearly six spire whorls preserved, separated by linear sutures that are rather wavy on account of the axial ribbing, and set fairly well back on account of the stepping of the whorls. This stepping of the whorls is quite distinct, there being a narrow flattened shelf between the suture and the flank of the whorls. There is a deep, distinct, moderately narrow, incised spiral line at about four-fifths the height of the whorls, separating off a narrow circumsutural band. There are also about three raised, thin, spiral threads on the anterior portion of the whorls, separated by intervals twice as wide as the threads. Axial ornament consisting of strong, solid, moderately sharp-topped ribs with intervals that appear to be distinctly wider than the ribs but which are actually not much wider, the false impression being given by the bluntly V-shaped section of the ribs; they are vague where they cross the narrow, deep posterior groove, form prominent, rather thin, antecurrent nodes on the posterior circumsutural band, are distinctly concave on their forward side, and meet the anterior suture in a retrocurrent trend that is steeper than their posterior termination. On the earlier whorls they appear to be straighter.

Body whorl moderately large, like the spire whorls in its outline and ornament, the edge of the base a little more sharply rounded than the flank, the base itself slightly and gently excavated; the anterior part of the columellar region and the outer lip are broken. Ribs continuing on to the base and crossed by 11 spiral threads between the circumsutural thread and the broken anterior end. These threads are rather ribbon-like, of about the same width as their intervals posteriorly, but become narrower anteriorly where they may be only half as wide as their intervals; they form small, distinct crenulations or beads where they cross the ribs. Aperture oval. Parietal lip not very callous, apparently without columellar folds. Upper half of each whorl without spiral threads and appearing somewhat callous; this zone corresponds with the maximum curvature of the ribs, which in this region become a little foliaceous, especially posteriorly. Growth lines parallel to the ribs.

DIMENSIONS. Holotype: height 17·3 mm. (incomplete); width 7·9 mm.

REMARKS. This pretty species is somewhat similar in appearance to *Clavatula headonensis*? (Edwards) as figured by Albrecht & Valk (B 1943, p. 80, Pl. 19, figs. 742–745), from the Lower Oligocene of southern Limburg, but is much larger and less turreted.

PYRENOTURRIS PUNJABENSIS n.gen. et sp.

(Figure 121, plate 5)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2679, the holotype, Reg. No. G. 68397).

DESCRIPTION. Shell of moderate size, subfusiform, fairly slender, with a moderately high spire. Protoconch and anterior part of columella broken off, and outer lip broken. Spire

6·4 mm. high on the holotype, regularly conic, there being five whorls preserved; not more than one or two spire whorls appear to be missing. Whorls flat-sided and cylindro-conic in outline, rather stepped at the suture in the early whorls, and distinctly so on later whorls. A distinct, deep, spiral furrow at about four-fifths the height of the whorls, separating off a circumsutural band. This band is not quite so projecting as the remainder of the whorl surface. Anterior to the spiral furrow there are three moderately distinct spiral threads which appear to be noticeably narrower than their intervals, and which form small crenulations where they cross the ribs. Axial ornament comprised of ribs which tend to be V-shaped in section and rather narrower than their intervals, are straight and slightly retrocurrent on the flanks of the early whorls, but become gently concave on later whorls. They are obsolete where they cross the circumsutural furrow, but cross it in a noticeably antecurrent direction to form nodes on the circumsutural band, opposite the nodes it forms on the posterior spiral thread limiting the circumsutural furrow. Height of whorls about four-ninths of their width.

Body whorl moderately high, the flank gently to moderately convex, the base excavated, the anterior canal broken off. Ornament of the same type as on the spire whorls, there being nine spiral threads between the circumsutural furrow and the broken end of the columella; these threads are separated by intervals which are fairly uniformly about twice as wide as the threads. Aperture oval. Columellar lip not callous, apparently without columellar folds. Outer lip broken, but the smooth filling of the body whorl shows no traces of incised lines formed by the impression of internal lirae. Growth lines following the same course as the ribs.

Dimensions. Holotype: height (incomplete) 12·4 mm.; width 5·6 mm.

Remarks. In spite of the close resemblance of this species to *Pyrenoturris soriensis* it is evidently a different species. The spire is more slender, the spiral ornament more evenly distributed and with wider intervals, the whorls are less distinctly stepped, the beading is more prominent, and there is no smooth, callous-looking band at the apex of the labial sinus. It is somewhat similar to *Clavatula headonensis*? (Edwards) as figured by Albrecht & Valk (B 1943, p. 80, Pl. 19, figs. 742–745), from the Lower Oligocene of southern Limburg, but is larger and less turreted.

Family Conidae

Genus *CONUS* Linné, 1758

(*Syst. Nat.* 10th ed. p. 712)

Type species. *Conus marmoreus* Linné, Recent; Children, 1823.

Synonyms. *Cucullus* Bolten, in Röding, 1798 (*Mus. Bolt.* part 2, p. 37); type species: *Conus marmoreus* α Bolten, Recent; Winckworth, 1945.

Rhombus Montfort, 1810 (*Conch. Syst.* **2**, 402) *non* Walbaum, 1792 (Pisces) *nec* Lacépède, 1800 (Pisces); type species: *R. imperialis* (Linné), Recent; Montfort, 1810.

Coronaxis Swainson, 1840 (*Treat. Malacol.* pp. 147, 311); type species: *Conus bandanus* Lamarck, Recent: monotypy.

Remarks. Montfort's (1810) designation of *Conus fulgurans* Montfort, Recent=*C. generalis* Linné as the type of *Conus* is invalid as the species is not in the original list.

Subgenus *LITHOCONUS* Mörch, 1852

(*Cat. Yoldi*, **1**, 66)

TYPE SPECIES. *Conus millepunctatus* Lamarck, Recent=*C. literatus* Linné *var.*; Cossmann, 1896.

SYNONYM. '*Conus* Linné' Swainson, 1840 (*Treat. Malacol.* p. 311); *Conus litteratus* Linné, Recent, is one of the species in Swainson's list, most of which seem to belong to *Lithoconus*.

CONUS (*LITHOCONUS*) *COLOSSUS* n.sp.

(Figures 140*a*, *b*, plate 6)

MATERIAL. *Rakhi Nala section*: White Marl Band (local zone 11) (FB. F. 1964, the holotype, Reg. No. G. 68398).

DESCRIPTION. Specimen poorly preserved but extremely large, conic in shape, with an almost flat, slightly convex spire; anterior portion of body whorl missing, but flanks of that part which remains stiffly subcylindrical. The number of spire whorls cannot be determined. Width of spire is 168 mm., and width of body whorl above the shoulder near the aperture 68 mm. Spire whorls showing on the mould a slightly convex upper surface except on the later part of the body whorl where the inner part is more convex and the outer part gently concave. This latter feature, as well as the considerably sharper shoulder at this point, are probably due to distortion. Shoulder near beginning of body whorl rounded, but sharper in the middle and later stages. The slight upturning of the sutural region of the body whorl near the aperture also seems to be due to the same distortion. Aperture apparently almost parallel-sided. The broken basal section shows that there were no columellar folds.

DIMENSIONS. Holotype: height (incomplete) 81·0 mm.; width (apertural view) 168·0 mm.; width (at right angles to apertural view) 114·0 mm.

REMARKS. The specimen is a mould. In spite of the poor preservation the species merits naming since it is very considerably larger than any Eocene form with which the writer is acquainted. Although represented in these collections by only one specimen, it was represented in the Burmah Oil Company's collections of fossils, lost during the evacuation of Burma in 1942, from similar horizons in the Khirthar of Western Pakistan. *Conus planus* von Schauroth (B 1865, p. 229, Pl. 25, fig. 1), from the Lower Tertiary of Italy, is somewhat similar in form, but has an absolutely flat spire, less parallel flanks to the body whorl, and is considerably smaller. *Conus pyramidalis* Münster as figured by Schafhäutl (B 1863, p. 211, Pl. 52, fig. 7), from the Eocene of Kressenberg, is considerably smaller and its flanks are less parallel. The rather high and stiffly conic outline, almost flat spire, and exceedingly large size are characters which, taken together, are typical of the Pakistan form.

Subgenus *LEPTOCONUS* Swainson, 1840

(*Treat. Malacol.* p. 312)

TYPE SPECIES. *Conus amadis* Martini, Recent; Herrmannsen, 1847.

SYNONYM. *Rhizoconus* Mörch, 1852 (*pars*) (*Cat. Yoldi*, part 1, p. 68).

CONUS (*LEPTOCONUS*) *SAFAEDENSIS* n.sp.

(Figures 142*a*, *b*, 143, plate 6)

MATERIAL. Eocene of Domanda (1 paratype, Reg. No. G. 68403). Lower Chocolate Clays east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab (the holotype, Reg. No. G. 68399, and 3 topotypes, Reg. No. G. 68400–2). *Zinda Pir section*: Lower Chocolate Clays (local zone 10) (FB. F. 2558, *1*, Reg. No. G. 68404; FB. F. 2730, *1*).

DESCRIPTION. Shell of medium size, biconic, the spire occupying about one-fifth or one-sixth of the total height. On the holotype the spire is regularly conic except for the extreme apical portion which is extraconic, the average spiral angle being about 90°. On some of the smaller topotypes the spire is more acute and is gently extraconic throughout. In side view the whorls have a height of about one-fifth of their width in the earlier stages, this ratio changing gradually to about one-seventh in the later stages. On a paratype from Domanda, the protoconch was evidently styliform; only the last whorl of it, which is smooth, gently convex, possesses shallow, linear sutures, and is not very high, is preserved. About seven spire whorls separated by distinct, linear sutures; on some specimens they are distinctly stepped, but on others the amount of stepping is negligible, the adjacent anterior portion of the previous whorl having a rounded, not very strongly projecting margin. On the paratype from Domanda the first spire whorl has a projecting median keel which carries distinct, closely spaced crenulations of which there are about nine in half a whorl. On the second spire whorl of this paratype the keel moves to an anterior position, the crenulations becoming weaker. On the later spire whorls of the syntype there are two closely spaced spiral threads adjacent to the posterior suture, the posterior thread being only about half the size of the anterior thread and almost touching both it and the suture, followed by four spiral threads separated by intervals about twice their width and which are in turn followed anteriorly by a rather smooth and rounded band forming the anterior margin of the whorls and occupying the same amount of space as about three of the spiral threads. All spiral threads finely serrated by growth lines. The ornament on the specimens from Safaed is not so clear as they are a little worn, but it appears to be of the same type, although the anterior rounded band appears to be narrower and less distinct on those specimens which have a higher spire and more stepped whorls. All the spire whorls except the first two post-nuclear whorls are gently concave.

Body whorl stiffly conic in outline, the shoulder being slightly angular and slightly upturned. Holotype with about 35 incised spiral lines of about the same width as or slightly narrower than their raised, ribbon-like intervals; they are fairly regularly spaced, although a few are finer than others. Smaller specimens show that the raised ribbons become progressively wider and wider until an intercalary incised spiral line appears on most of them, more or less simultaneously, thus almost doubling their number. The relative proportions of the raised ribbons and of the incised spiral grooves therefore vary from time to time during the growth of the shell. Spiral threads near the anterior termination of the body whorl more widely spaced. On the larger paratype from Domanda the spiral ribbons have become spiral bands which are obtusely V-shaped in section, and have intervals of about the same width as themselves; they are rather vaguely crenulated by the growth lines. Growth lines rather strongly convex, noticeably retrocurrent at the shoulder,

having a well-defined, U-shaped sinus above the shoulder, and swinging round to meet the posterior suture in an antecurrent direction. Aperture narrow and parallel-sided.

DIMENSIONS. Holotype: height 22·4 mm.; width 12·6 mm. (possibly slightly incomplete). Paratype from Domanda: width 15·3 mm.

REMARKS. *Conus vredenburgi* Raj Nath & Chiplonker, from the Upper Middle Khirthar of the Laki dome in Western Pakistan, which also appears to be a *Leptoconus*, has a higher spire, a less carinate shoulder to the body whorl, is more slender, and has much finer and more closely spaced spiral ornament on the flanks. *Conus orcagnae* Oppenheim as figured by Gočev (B 1933*b*, pp. 192, 208, Pl. 7, fig. 5), from the Palaeogene of southern Bulgaria, is somewhat similar in shape, but the incised spiral grooves are restricted to the anterior portion of the body whorl. *Conus deperditus* Lamarck as figured by Brongniart (B 1823, p. 61, Pl. 3, figs. 1*a*, *b*), from Italy, has weaker and more widely spaced spiral ornament on the body whorl, the shell is slightly narrower and less sharply shouldered, and the outline is not so stiff.

Subclass OPISTHOBRANCHIA

Order PLEUROCOELA

Superfamily CEPHALASPIDEA

Family ACTEONIDAE

Subfamily ACTEONINAE

Genus *ACTEON* Montfort, 1810

(*Conch. Syst.* **2**, 314)

TYPE SPECIES. *Acteon tornatilis* (Gmelin), Pliocene-Recent = *Voluta tornatilis* Linné; monotypy and original designation.

SYNONYMS. *Tornatella* Lamarck, 1816 (*Tabl. Enc. Méth., Vers*, Pl. 452); type species: *Tornatella fasciata* Lamarck, Recent = *Voluta tornatilis* Linné; Gray, 1847 (dated from Lamarck, 1822, as a synonym of *Acteon*).

Actaeon Goldfuss, 1820 (*Handb. Zool.* p. 681) (*em.*) *non* Oken, 1815 (Moll.).

Speo Risso, 1826 (*H.N. Europe*, **4**, 235); type species: *Speo tornatilis* Risso, Recent = *Voluta tornatilis* Linné; Gray, 1847 (as a synonym of *Acteon*).

Kanilla Sowerby, in Silvertrop, 1833 (*Edinb. Nat. Phil. J.* **15**, no. 30, p. 367) (*nomen nudum*); type species: *Kanilla gigantea* Sowerby, Tertiary (*nomen nudum*); monotypy.

Myosota (Humphrey) Gray, 1847 (*Proc. Zool. Soc. Lond.* **15**, 160); type species: *Voluta tornatilis* Linné, Recent; original designation (as a synonym of *Acteon*).

ACTEON RAKHIENSIS n.sp.

(Figure 122, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1995, the holotype, Reg. No. G. 68405, and 1 topotype, Reg. No. G. 68406).

DESCRIPTION. Shell small, rather globose, with a short spire which occupies about two-ninths of the total height. Protoconch not preserved. There are two spire whorls, there

being probably one missing apically. These whorls are not very high, their height being about four-elevenths of their width; they are gently convex on the flanks and well-shouldered posteriorly. Ornament not well preserved, but of the same type as that on the body whorl. Sutures fine and linear. Body whorl large, ample, globose, with a rounded shoulder posteriorly, its flanks only gently convex and giving the shell a vaguely compressed lateral outline, the base declivous and scarcely convex. Ornament on body whorl consisting of about 20 fine, sharp spiral threads separated by flat intervals of about twice their width. Intervals between spiral threads carrying fine serrated growth lines of about half the size and prominence of the threads, so spaced as to form a rectangular network which is either square or has its vertical axis slightly longer. Spire whorls carrying about seven such spiral threads. Aperture moderately broadly oval, narrower posteriorly, appearing subrhombic on the holotype owing to a small amount of crushing. Inner lip well excavated medially, apparently carrying one columellar fold on its anterior part. Outer lip thin, slightly retrocurrent as a whole, gently convex anteriorly, gently concave posteriorly.

Dimensions. Holotype: height 1·7 mm.; width 1·1 mm.

Remarks. There does not seem to be any closely comparable Eogene species, the rather globose form and short spire being characteristic.

ACTEON? sp. A

(Figure 115, plate 5)

Material. *Zinda Pir section*: Ghazij Shales (local subzone 3*b*) (FB. F. 2678, the holotype, Reg. No. G. 68407, and 1 topotype, Reg. No. G. 68408).

Description. Shell very small, oval-conic, with a very short, obtusely conic spire occupying about one-sixth of the total height and forming an obtuse apical button probably of little more than one whorl. There appears to be about one spire whorl which is gently convex, with a rounded shoulder posteriorly, rather cylindroconic on the flanks; its height is about one-third of its width. Sutures fine and linear. Body whorl oval, with a narrow, rounded posterior shoulder, slightly to gently convex on the subcylindrical flanks, more strongly arched at the periphery of the base which is declivous and slightly convex, the anterior portion of the shell being slightly produced. Aperture oval, narrow and pointed posteriorly. Outer lip thin, slightly retrocurrent as a whole, gently convex anteriorly, gently concave posteriorly, meeting the posterior suture almost at right angles. Details of columellar lip and ornament obscure, the ornament appearing to have consisted of extremely fine and very numerous spiral threads separated by incised spiral lines.

Dimensions. Holotype: height 1·1 mm.; width 0·75 mm.

Remarks. The small size, form, and very fine ornament seem to characterize this species which is probably new, but is not named pending the obtaining of better-preserved material.

Family Ringiculidae

Genus *RINGICULA* Deshayes, in Lamarck, 1838

(*Hist. nat. An. s. Vert.* 2nd ed. **8**, 342)

Type species. *Auricula ringens* Lamarck, Eocene; Herrmannsen, 1847.

SYNONYM. *Aptycha* Meek, 1863 (*Amer. J. Sci.* (2), **35**, 88, 93); type species: *Tornatella labiosa* Forbes, Cretaceous; original designation.

RINGICULA PUNJABENSIS n.sp.

(Figures 123*a*, *b*, plate 5)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*a*) (FB. F. 2680, *6*; FB. F. 2679, *2*); Ghazij Shales (local subzone 3*b*) (FB. F. 2678, the holotype, Reg. No. G. 68409, and 34 topotypes, Reg. No. G. 68410–5; FB. F. 2676, *2*; FB. F. 2675, *2*).

DESCRIPTION. Shell small, oval-barrel-shaped, greatest width at about half the height of the shell which is, however, rather pinched in anteriorly. Spire slightly extraconic on account of the shouldering of the body whorl, the posterior termination of the labial varix, and the rather more acute early whorls, short, occupying only about one-fifth of the total height. Protoconch not preserved on any of the specimens, evidently exceedingly small. There are two spire whorls preserved on the holotype, and the largest specimens seem to have had about three. They are shouldered posteriorly, gently convex on the flanks, rather cylindroconic in outline, and carry four spiral threads, the interval between the two posterior threads being a little wider than the threads, that between the second and third threads being of about the same width as the threads, and the interval between the two anterior threads being a little narrower than the threads. Sutures linear.

Body whorl large and ample, barrel-shaped, slightly shouldered posteriorly, its flanks moderately convex, its anterior end slightly attenuated, the margin of the outer lip projecting further downward than the end of the columella. It is ornamented with eleven distinct, moderately prominent, rather ribbon-like spiral threads, the anterior one of which margins the anterior notch. Intervals between spiral threads slightly wider than the width of the threads, the difference being a little more noticeable posteriorly. Aperture elongate, narrow, oval, its posterior half being constricted and set off from its anterior part by the parietal fold. Inner lip callous, straight and vertical over its posterior half, deeply excavated in its anterior half, the anterior termination being vertical. There is a long, straight, vertical parietal fold extending the whole length of the posterior vertical portion of the inner lip, a strong anterior columellar fold, and a second strong columellar fold about half-way up the anterior half of the aperture. There also appears to be a rounded callous knob or prominence above the columellar folds and level with the anterior termination of the parietal fold. Outer lip having a strong, thick, swollen varix, gently convex anteriorly, gently retrocurrent over most of its middle portion, slightly excavated posteriorly, meeting the suture practically at right angles. Anterior termination of shell deeply and obliquely notched.

DIMENSIONS. Holotype: height 1·75 mm.; width 1·3 mm.

REMARKS. The matrix inside the aperture of all the specimens is too hard to remove, and consequently it cannot be determined whether the outer lip is internally smooth or crenulated. If it is eventually found to be internally smooth, the species would be placed in the subgenus *Ringiculella*. *Ringicula mammosa* Martin (B 1931, p. 4, Pl. 1, figs. 4–8), from the Upper Eocene of Java, has an excavated circumsutural band, and the spiral ornament on the posterior half of the body whorl is more widely spaced. *R.* (*Ringiculella*) *hauns-*

bergensis Traub (B 1938, p. 98, Pl. 8, figs. 14*a*, *b*), from the Palaeocene of Austria, is not so broad, and has less sharp spiral threads which are more closely spaced. *R. bezançoni* Morlet as figured by Glibert (B 1933, p. 112, Pl. 7, fig. 5), from the Bruxellian of Belgium, and by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 245–4), from the Bartonian of the Paris Basin, has a distinctly narrower and higher spire.

Subgenus *RINGICULELLA* Bellardi & Sacco, 1892

(*I Moll. terr. terz. Piem. e Lig.* part 12, p. 16)

TYPE SPECIES. *Ringicula auriculata* (Ménard), Miocene-Recent; Cossmann, 1895.

RINGICULA (*RINGICULELLA*) *PAKISTANICA* n.sp.

(Figures 144*a*, *b*, plate 6)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68416, and 1 topotype, Reg. No. G. 68417).

DESCRIPTION. Shell small, oval-conic, rather globose, with a moderately short, conic spire occupying about two-ninths of the total height. Protoconch small, consisting of about one and a half rather loosely coiled whorls which are convex and separated by deep sutures. There are about one and a half spire whorls which are rather stiffly cylindroconic in outline, moderately well shouldered posteriorly, and separated by conspicuous, linear sutures; their height is about one-half their width. Penultimate whorl carrying seven fine spiral threads separated by intervals which are noticeably narrower than themselves.

Body whorl large, ample, barrel-shaped, feebly shouldered posteriorly, its greatest width slightly below the middle at about two-fifths of the height of the shell; flanks gently convex and receding a little upwards, periphery convex and rounded, the base obliquely declivous, slightly convex, and not projecting very much forwards. There are about 17 fine, rather ribbon-like spiral threads on the body whorl, the threads being separated by intervals of about the same width as or slightly narrower than the threads; the anterior thread margins the anterior notch, and the posterior thread forms the inconspicuous shoulder. In apertural view the outer lip projects laterally near its posterior end, its anterior two-thirds is obliquely declivous and descendent to the left, gently convex, and the anterior termination is moderately sharply rounded and projects distinctly further forward than the termination of the columella. Aperture very narrowly oval posteriorly, this portion being set off by the anterior termination of the parietal fold and by a median swelling on the outer lip from a slightly larger and wider, rather parallelepipedic anterior part. Columellar lip callous, especially anteriorly, a rather deeply channelled middle portion separating the subvertical parietal wall from the oblique and gently excavated anterior portion. There is a long, strong, prominent, vertical parietal fold, and there are two strong, prominent columellar folds anteriorly, the anterior one limiting the anterior portion of the columella; both columellar folds are fairly long, and extend to the outer margin of the anterior callous region. Outer lip extremely strongly varicose, the varix being very strong, prominent and thick; it is gently convex anteriorly, gently retrocurrent in its middle portion, and gently concave posteriorly where it becomes vertical, rises up to

cover the three most anterior spiral threads of the penultimate whorl, and then curves over to join the gutter which separates it from the posterior end of the parietal fold. Interior of outer lip smooth except for a median swelling above which the apertural face of the varex is slightly excavated. The very deep anterior notch is so oblique that it is not very far removed from the horizontal.

DIMENSIONS. Holotype: height 1·1 mm.; width 0·85 mm.

REMARKS. This species has the body whorl less inflated posteriorly, the spire more regularly and acutely conic, and the spiral threads finer, less prominent, more closely spaced, and more numerous than in *Ringicula punjabensis*, n.sp. *R. parva* Newton (1895, p. 328, Pl. 22, figs. 5, 6), from the Barton Beds of High Cliff and Barton, has a less globose body whorl, the outer lip does not project so far laterally, and the parietal fold is horizontally disposed; while there is some resemblance in general form, the English species is, however, a *Ringicula sensu stricto* since the outer lip is crenulated internally. *R. bezançoni* Morlet as figured by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 245–4), from the Bartonian of the Paris Basin, is a little larger, the aperture is more ample, and the outer lip does not project so far laterally; the same species as figured by Glibert (B 1933, p. 112, Pl. 7, fig. 5), from the Bruxellian of Belgium, is also rather similar in general appearance, but the labial varix extends upwards to the posterior suture of the penultimate whorl.

Family AKERIDAE

Subfamily AKERINAE

Genus *AKERA* Müller, 1776

(*Z. Dan. Prodr.* pp. xxix, 242)

TYPE SPECIES. *Akera bullata* Müller, Recent; monotypy.

SYNONYMS. *Acera* Lamarck, 1812 (*Extr. d'un cours*) (*em.*).

Eucampe Leach, 1847 (*Ann. Mag. Nat. Hist.* **20**, 268); type species: *Bulla akera* Montagu, Recent: monotypy.

REMARKS. The name *Eucampe* has been treated as a *nomen nudum*. Of the two species originally listed one—*E. donovani* Leach—was a *nomen nudum*; the other—*Bulla akera* Montagu—therefore becomes the type by monotypy.

AKERA PSEUDODESIOI n.sp.

(Figures 124*a*, *b*, plate 5)

MATERIAL. *Rakhi Nala section*: Green and Nodular Shales (local zone 6) (FB. F. 1903, the holotype, Reg. No. G. 68418); *Kohat area* (*Tarkhobi section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2171, *15*+; FB. F. 2173, *1*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2175, *1*); *Kohat area* (*Panoba section*): Middle Shekhan Limestone (local subzone 3*b*) (FB. F. 2230, *1*; FB. F. 2232, *1*); Upper Shekhan Limestone (local subzone 3*b*) (FB. F. 2291, *2*).

DESCRIPTION. Shell of medium size, subcylindrical in outline, rather rounded apically. Spire not involute, visible, only slightly projecting, consisting of about two rather narrow

whorls; there is a sharp keel at about two-thirds of the height of the whorls, anterior to which the surface is slightly convex, and posterior to which the surface is slightly concave and gently descendent inwards towards the axis. These characters form a narrow, excavated, spiral channel in dorsal view. Sutures fine and linear. Body whorl very high, occupying practically the entire height of the shell, subcylindrical in outline, although a little rounded; sutural keel continued on the body whorl close to the posterior suture, being well removed from the widest part of the shell. Aperture very narrow. Although the anterior part of the shell is missing, it can be seen from what is left that the growth lines are vertical as a whole but distinctly convex in outline, and are distinctly receding posteriorly. Traces of fine, fairly widely spaced, incised spiral lines, of which there are three in $\frac{3}{4}$ mm., can be seen near the outer lip of the holotype.

Dimensions. Holotype: height (incomplete) 17·0 mm.; width 13·3 mm.

Remarks. *Acera desioi* Negri (1934*b*, p. 166, Pl. 14, figs. 8*a*, *b*, *c*), from the Eocene of North Africa, is closely comparable but has a more canaliculate circumsutural groove, a more rapidly opening spire, and is a little larger. *A. striatella* (Lamarck) as figured by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 244–1), from the Bartonian of the Paris Basin and from the Cuisian and the Lutetian, and *A. spirata* Staadt as figured by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 244–2), from the Thanetian of the Paris Basin, both have the outer lip more rapidly receding posteriorly. *Acera* cf. *striatella* (Lamarck) as figured by Cuvillier (B 1933, p. 66, Pl. 7, figs. 22, 27, 35), from the Upper Mokattam of Egypt, is not so high.

Family Retusidae

Genus *RETUSA* Brown, 1827

(*Ill. Conch. Gr. Br. and Ir.* Pl. 38, figs. 1–6)

Type species. *Bulla obtusa* Montagu, Recent ? = *Retusa plicata* Brown, Recent ? = *R. discors* Brown, Recent ? = *Voluta alba* Kanmacher, Recent; Gray, 1847 (as a synonym of *Utriculus α* Brown).

Synonym. *Utriculus I* Brown, 1844 (*Ill. Conch. Gr. Br. and Ir.* 2nd ed. p. 58); type species: *Bulla obtusa* Montagu, Recent = *Utriculus obtusus* (Montagu); Gray, 1847 (as *Utriculus α*).

RETUSA RECTA n.sp.

(Figure 125, plate 5)

Material. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68419, and 4 topotypes, Reg. No. G. 68420–3; FB. F. 1995, *2*).

Description. Shell small, high, stiffly subcylindrical in outline, body whorl forming the whole height of the shell; spire visible, minute, mucronate. Flanks almost straight and vertical; posterior of whorl subcarinate, anterior end rounded, posterior end truncated. Shell appearing smooth except for vague traces of closely spaced, fine, incised spiral lines of which there seem to be about 14 or 15 in $\frac{3}{4}$ mm. Aperture extremely narrow, almost

linear, except anteriorly where it expands somewhat and is narrowly oval. No columellar folds are seen. Outer lip practically vertical, almost straight.

DIMENSIONS. Holotype: height 1·7 mm.; width 0·7 mm.

REMARKS. There does not seem to be any closely comparable Eogene species.

Subgenus *CYLICHNINA* Monterosato, 1884

(*Nomencl. Conch. médit.* p. 143)

TYPE SPECIES. *Bulla umbilicata* Montagu *non* Bolten, Recent = *Cylichnina umbilicata* (Jeffreys) = *Cylichna strigella* Loven; Bucquoy, Dollfus & Dautzenberg, 1886.

SYNONYM. *Acrotrema* Cossmann, 1889 (*Ann. Soc. malac. Belg.* **24**, 317 (313)); type species: *Bulla cylindroides* Deshayes, Eocene; original designation.

RETUSA (CYLICHNINA) AEQUIATTENUATA n.sp.

(Figure 145, plate 6)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68424, and 1 topotype, Reg. No. G. 68425).

DESCRIPTION. Shell small, regularly and bluntly cigar-shaped, rather pointed at the ends, anterior end only very slightly more rounded; apex involute and apparently narrowly perforated. Flank of body whorl opposite the aperture fairly regularly curved, only very slightly flattened in its middle part. Outline on the other side (that is, by the outer lip) a little more flattened medially. Ornament obscure, consisting of fine spiral ribbons, approximately twelve in $\frac{3}{4}$ mm., separated by incised spiral lines which are rather narrower than the ribbons. Aperture very long and narrow, slightly wider anteriorly, its posterior end very narrow but not surpassing the apex. Inner lip fairly regularly convex, anteriorly (in the region where a columellar fold would have been) decortication having produced a depression on the whorl infilling; there appears, however, to be no true umbilicus. Outer lip thin, apparently subvertical and gently convex in outline.

DIMENSIONS. Holotype: height 1·5 mm.; width 0·75 mm.

REMARKS. The fact that the outer lip does not apparently surpass the apex precludes reference of the species to either *Bulla* or *Cylichna*; the outer lip, in addition, is not prominent anteriorly as in *Bulla*. *Cylichna volgensis* Netschaew (B 1897, p. 193, Pl. 10, fig. 10), from the Eocene of Russia, is considerably larger and has a more rounded apex. *Bulla nitens* Sandberger as figured by Kissling (B 1896, p. 33, Pl. 3, fig. 1), from the Middle Oligocene of Switzerland, has more shouldered whorls. *B. redacta* Deshayes (1862*b*, p. 627, Pl. 39, figs. 1–3), from the Calcaire Grossier of the Paris Basin, has a less blunt apex. The form and outline appear to be characteristic.

Genus *RHIZORUS* Montfort, 1810

(*Conch. Syst.* **2**, 338)

TYPE SPECIES. *Rhizorus adelaidis* Montfort, Recent = *Nux marina minuscula* Soldani = *Bulla acuminata* Bruguière; monotypy.

SYNONYMS. *Volvula* A. Adams, in Sowerby, 1850 (*Thes. Conch.* **2**, part 11, pp. 558, 596) *non* Gistl, 1848 (Diptera); type species: *Volvula rostrata* A. Adams, Recent; Bucquoy, Dollfus & Dautzenberg, 1886.

Volvulella R. B. Newton, 1891 (*Syst. List F. E. Edw. Coll. Br. Olig. and Eoc. Moll. Br. Mus.* p. 268); type species: *Volvula rostrata* A. Adams, Recent; Bucquoy, Dollfus & Dautzenberg, 1886 (replacement name).

RHIZORUS PAKISTANICUS n.sp.

(Figures 126*a*, *b*, plate 5)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68426).

DESCRIPTION. Shell small, involute, body whorl occupying the whole height of the shell, rostrate posteriorly, a little attenuated anteriorly, stoutly barrel-shaped. Greatest width a little below the middle. Apex produced, rostrate, separated by a vaguely concave band from the main inflated part of the body whorl. On this rostrate portion and the vaguely concave part anterior to it there are seven moderately closely spaced incised spiral lines separated by slightly convex intervals of about twice their width; these incised lines are a little more conspicuous posteriorly. Flanks of body whorl quite smooth, but the base anteriorly carries at least six incised spiral lines which are more widely spaced posteriorly. Aperture gently to moderately arcuate, straighter and extremely narrow and linear posteriorly, a little expanded and oval anteriorly. Inner lip gently convex over the posterior two-thirds of its course, moderately strongly excavated anteriorly where it is distinctly callous, the outer margin of the callus becoming detached and leaving a small umbilicus. Extreme anterior portion of aperture broken, but it appears as if there may have been one weak columellar fold. Outer lip more or less straight and vertical.

DIMENSIONS. Holotype: height 2·0 mm.; width 1·1 mm.

REMARKS. *Bulla* (*Volvula*) *tournoueri* C. Mayer-Eymar (1864, p. 177, Pl. 9, fig. 6), from the Lower Tertiary of the Paris Basin, is closely related but is noticeably less inflated. *Volvulella charlesworthi* Newton (1895, p. 330, Pl. 22, figs. 13, 14), from the Barton Beds of High Cliff (the type locality) and Barton, is considerably less inflated. *V. oxyacrum* Cossmann as figured by Cossmann & Pissarro (B 1907–13, Pl. 54, fig. 238–2), from the Cuisian of the Paris Basin, is considerably less inflated anteriorly and not so narrow posteriorly. The strongly inflated form and acute posterior rostration of *Rhizorus pakistanicus* seem to be characteristic.

Family SCAPHANDRIDAE

Genus *SCAPHANDER* Montfort, 1810

(*Conch. Syst.* **2**, 334)

TYPE SPECIES. *Scaphander lignarius* Montfort, Recent=*Bulla lignaria* Linné; monotypy and original designation.

SYNONYMS. *Bulla* Linné, 1758 (*Syst. Nat.* 10th ed. p. 725) *non* Linné 1758 (*antea*, p. 425 (Orth.)); type species: *B. lignaria* Linné, Recent; Children, 1823.

'*Tricla* Retzius, 1788', Gray, 1847 (*mal. dist.*).

'*Gioenia* Bruguière, 1789', Gray, 1847 (*mal. dist.*).

Assula Schumacher, 1817 (*Ess. Vers test.* pp. 78, 258); type species: *Assula convoluta* Schumacher, Recent=*Bulla lignaria* Linné; monotypy.

SCAPHANDER sp. A

(Figure 127, plate 5)

MATERIAL. *Rakhi Nala section*: Rubbly Limestones (local zone 6) (FB. F. 1915, the holotype, Reg. No. G. 68427).

DESCRIPTION. The single specimen has the anterior part missing, but it was narrowly scaphandriform, involute, the outer lip evidently rising up a little above the top of the body whorl. Shell apparently not very expanded anteriorly, there being a vague indication of a concavity in the outline a little below the posterior end. Aperture very narrow, almost linear posteriorly. No ornament or growth lines are discernible as the specimen is a mould. There are indications of some axially directed, fine, incised lines about $\frac{3}{4}$ mm. apart, but these seem to be fortuitous rather than representatives of growth lines or axial ornament.

DIMENSIONS. Holotype: height (incomplete) 9·0 mm.; width 4·1 mm.

REMARKS. *Scaphander ickei* Martin (1914, p. 110, Pl. 1, figs. 1, 1*a*, 1*b*), from the Upper Eocene of Java, is somewhat similar but is not so narrow. The Pakistan form is not named pending the discovery of better preserved material. The very narrow, high form appears to be characteristic.

Genus *ROXANIA* Leach, in Gray, 1847

(*Proc. Zool. Soc. Lond.* **15**, 161)

TYPE SPECIES. *Bulla cranchii* Fleming, Recent=*B. utriculus* Brocchi; monotypy.

SYNONYMS. *Roxania* Leach, 1847 (*Ann. Mag. Nat. Hist.* **20**, 268) (*nomen nudum*).

Abderospira Dall, 1895 (*Proc. U.S. Nat. Mus.* **18**, 32); type species: *Bullina* (*Abderospira*) *chipolana* Dall, Miocene; original designation.

Damoniella Iredale, 1918 (*Proc. Malac. Soc. Lond.* **13**, 37); type species: *Bulla cranchii* Fleming, Recent (replacement name).

Atys auct. non Montfort, 1810.

ROXANIA PSEUDOSEMISTRIATA n.sp.

(Figures 128,129, plate 5)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2519, the holotype, Reg. No. G. 68428, and 2 topotypes, Reg. No. G. 68429–30).

DESCRIPTION. Shell moderately small, elongate-oval in outline, slightly more than twice as high as wide, involute, perforate apically, outer lip rising up a little above the spire. Although the outline is fairly regularly oval, the greatest width is at about two-fifths of the height. Anterior end apparently narrowly rounded. Aperture moderately narrow, distinctly so over the posterior two-thirds of its length, widened and narrowly oval

anteriorly, its outer margin slightly curved. Inner lip gently convex and not at all callous posteriorly and medially, well-excavated anteriorly where it has a fairly thick covering of callus the outer margin of which bounds a small umbilicus. There is no columellar fold. Outer lip fairly straight and vertical, rising up to curve over the posterior thickened rostrum. On an immature specimen there are four thin, distinct, subequal, raised threads posteriorly, the posterior thread being on the body whorl shoulder; the intervals between these threads decrease in width anteriorly, the posterior interval being twice the width of a thread, the anterior interval being about the same width as a thread. Anterior to this, after a rather deep interval, the remaining portion of the surface consists of flat, ribbon-like bands separated by fine incised spiral lines. The most posterior eight incised lines gradually increase the width of their intervals in an anterior direction as far as a position about one-third the height of the whorl, becoming progressively a little fainter at the same time; anteriorly there are at least nine or ten additional incised spiral lines which are deeper, wider, and more conspicuous, and which separate intervals which become progressively narrower anteriorly. Apically, there are at least three additional spiral threads above the shoulder. Adult shell having the finer incised spiral grooves obsolete, a band anterior to the posterior spiral threads and equal to about two-fifths of the height of the shell being quite smooth.

Dimensions. Holotype: height 3·75 mm.; width 1·75 mm.

Remarks. *Bulla semi-striata* Deshayes (1824*b*, p. 44, Pl. 5, figs. 27, 28), from the Eocene of the Paris Basin, also figured as *Roxania semistriata* (Deshayes) by Cossmann (1896, p. 181, Pl. 4, fig. 5), and by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 242–7), from the Cuisian and from the Lutetian and the Bartonian, is evidently very closely related. The Pakistan form is more elongate and the posterior threads are more distinct than in Deshayes's illustrations, it is not so regularly oval and has wider spaced posterior threads compared with Cossmann's illustration, and is a little smaller, subcylindrical rather than oval and has stronger posterior threads compared with Cossmann & Pissarro's illustration. Comparison with specimens in the British Museum (Natural History) shows that while the general form is very similar, the French species being only slightly more inflated at the widest part, the posterior spiral threads of the Pakistan species are distinct and have intervals increasing in width posteriorly, whereas the French species, although showing some variation, always has the threads becoming more closely spaced posteriorly, there being a band of closely spaced threads just below the apex. The columellar callus on the Pakistan form also seems to be a little thicker than in the French species.

Bulla semistriata Deshayes var. A. Rouault (B 1850, p. 474, Pl. 15, figs. 7*a*), from the Eocene near Pau, which was renamed *Roxania pyrenaicensis* by Cossmann in O'Gorman (B 1923, p. 179, Pl. 6, figs. 43, 44), apart from being a little narrower and less regularly oval, having the columellar lip more excavated anteriorly and the aperture wider anteriorly, has the spiral ornament spreading all over the surface, there being no smooth band. *Cylichna tenuis* Netschaew (B 1897, p. 195, Pl. 10, fig. 12), from the Eocene of the Volga region, is a little more slender. *Bulla* (*Cylichna*) *crassiplicata* C. Mayer-Eymar (1893*b*, p. 61, Pl. 2, fig. 12), from the Lower Tongrian, is a little less barrel-shaped and a little larger, has spiral furrows at both ends and no posterior threads, and the smooth zone is more medially situated. *Roxania ballui* Cossmann (1921*d*, p. 56, Pl. 1, figs. 12, 13,

57), from the Eocene of the Lower Loire, is a little more inflated, has rather more widely spaced incised spiral lines anteriorly, and has incised spiral lines rather than spiral threads posteriorly.

ROXANIA? sp. A

(Figures 130, 131, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 1986, the holotype, Reg. No. G. 68431, and 6 topotypes, Reg. No. G. 68432–7).

DESCRIPTION. Shell fairly small, involute, moderately high, oval-subcylindrical. Body whorl occupying the whole height of the shell, flank gently convex, labial outline almost straight. Curvature of the anterior portion of the flank greater than that of the posterior portion, the greatest width being at about two-fifths of the height. Outer lip ascending upwards a little above the involute spire, the growth lines showing that it was almost straight and vertical. Aperture narrow posteriorly, its anterior third being slightly expanded and narrowly oval. Inner lip gently convex over the posterior two-thirds of its course, moderately excavated anteriorly. Columellar lip not preserved, but the specimens show, on the infilling of the body whorl, a moderately small but distinct depression in the umbilical area which doubtless indicates that the specimens possessed a small umbilicus. A small specimen 2·25 mm. in height shows on the back fine, moderately widely spaced, incised spiral lines of equal strength and spacing, numbering 8 in $\frac{3}{4}$ mm.

DIMENSIONS. Holotype: height 2·75 mm.; width 1·3 mm. A topotype: height 4·75 mm.; width 1·65 mm.

REMARKS. There does not appear to be any closely comparable species. *Roxania pseudosemistriata* is somewhat similar in form, but has distinct spiral threads posteriorly. Since, however, the apparent lack of such threads on the form here considered may be due to the state of preservation, it is considered advisable not to name it.

Genus *CYLICHNA* Loven, 1846

(*Öfvers. K. VetenskAkad. Förh. Stockholm*, **3**, part 5, p. 142)

TYPE SPECIES. *Cylichna cylindracea* (Pennant), Recent = *Bullae cylindraceae* Pennant = *Bulla cylindracea* Pennant; Herrmannsen, 1852 (also Gray, 1847, as a synonym of *Bullina* Risso).

SYNONYMS. *Bullina* Risso, 1826 (*H. N. Europe*, **4**, 51) *non* Férussac, 1822 (Moll.); type species: *Bulla cylindrica* Montagu, Recent = *Bullina cylindracea* (Pennant); Gray, 1847.

Cylindrella Swainson, 1840 (*Treat. Malacol.* pp. 135, 326) *non* Swainson, 1840 (*antea*); type species: *Cylindrella alba* Swainson, Recent; monotypy.

Bullinella Newton, 1891 (*Syst. List F. E. Edw. Coll. Br. Olig. and Eoc. Moll. Br. Mus.* p. 265); type species: *Bulla cylindrica* Pennant, Recent (substitute name for *Bullina* Risso and *Cylichna* Loven).

CYLICHNA? sp. A

(Figure 132, plate 5)

MATERIAL. *Zinda Pir section*: Upper Chocolate Clays (upper part, local zone 13) (FB. F. 2520, the holotype, Reg. No. G. 68438).

DESCRIPTION. Shell small, oval, moderately strongly inflated, involute. Ornament not preserved. Outlines of the two flanks about equal and moderately strongly convex, the

greatest width of the shell being submedian. Outer lip rising up a little above the top of the body whorl in a moderately sharply rounded curve. Inner lip distinctly convex over most of its course, its anterior quarter being moderately excavated. Aperture rather narrow, fairly strongly curved, a little expanded and narrowly oval anteriorly. Columellar lip showing indications of having had one strong fold with a small umbilicus to the left of it. Indications of what may have been growth lines seem fairly straight and vertical.

DIMENSIONS. Holotype: height 3·2 mm.; width 1·9 mm.

REMARKS. The single specimen is a mould. This species is more inflated and less elongate than *Bulla semi-striata* Deshayes (1824*b*, p. 44, Pl. 5, figs. 27, 28), from the Eocene of the Paris Basin, also figured as *Roxania semistriata* (Deshayes) by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 242–7), from the Cuisian and from the Lutetian and the Bartonian. *R. pseudosemistriata* n.sp. differs in a similar manner. *Bulla turgidula* Deshayes as figured by Kissling (B 1896, p. 33, Pl. 3, figs. 2–4), from the Middle Oligocene of the Bernese Jura, is a little less inflated. *B. simplex* Fuchs (B 1870, p. 163, Pl. 1, figs. 21, 22), from the Gomberto Beds (Rupelian) of Italy, is considerably larger and has its greatest width more anteriorly situated. *B. sulcatina* Deshayes (1862*b*, p. 638, Pl. 38, figs. 23–25), from the Lower Sands of the Paris Basin, also figured as *Roxania sulcatina* (Deshayes) by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 242–3), from the Cuisian and from the Thanetian, has the aperture more expanded anteriorly. *R. cincta* (Deshayes) as figured by Cossmann & Pissarro (B 1907–13, Pl. 55, fig. 242–4), from the Thanetian of the Paris Basin, although similar in outline, is larger, and the aperture is wider anteriorly. While showing some similarity in general form to some species of *Roxania*, the species differs, apparently, in possessing a columellar fold.

Subgenus *ACROSTEMMA* Cossmann, 1889

(*Ann. Soc. malac. Belg.* **24**, 314)

TYPE SPECIES. *Bulla coronata* Lamarck, Eocene; original designation.

CYLICHNA (*ACROSTEMMA*) *PUNJABENSIS* n.sp.

(Figure 133, plate 5)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*b*) (FB. F. 2678, the holotype, Reg. No. G. 68439).

DESCRIPTION. Shell very small, elongate-oval to subelliptical in outline, involute, with a slight circum-apical swelling followed below by a vague spiral depression or constriction, these two features occupying the uppermost quarter of the body whorl. Greatest width of shell at about a quarter to a third of the height. Outer lip rising up a little above the apex of the body whorl in a moderately sharply rounded rostrum. The outer lip is crushed in against the body whorl, but it can be seen that the aperture was narrow over the posterior three-quarters of its course, and was a little expanded and narrowly oval anteriorly. Outer lip apparently fairly straight and vertical, very gently convex, especially posteriorly. There are faint indications of what were probably incised spiral lines on the base. In the apical region, especially noticeable in the concave band anterior to the

circum-apical swelling, there are numerous, fine, slightly sinuous axial riblets which are a little narrower than their intervals, and number about twelve in $\frac{3}{4}$ mm.

DIMENSIONS. Holotype: height 1·5 mm.; width 0·75 mm. (possibly slightly on the high side owing to crushing).

REMARKS. There do not appear to be any closely comparable Eogene forms.

Order PTEROPODA

Suborder THECOSOMATA

Superfamily EUTHECOSOMATA

Family SPIRATELLIDAE

Genus *SPIRATELLA* Blainville, 1817

(*Dict. Sci. nat.* **9**, 407)

TYPE SPECIES. *Clio helicina* Phipps, Recent; monotypy.

SYNONYMS. '*Les Limacines*' Cuvier, 1817 (*Le Régne anim.* **2**, 380) (vernacular name).

Limacina Lamarck, 1819 (*An. s. Vert.* **6**, part 1, p. 290); type species: *Limacina helicialis* Lamarck, Recent = *Clio helicina* Gmelin; monotypy.

Heterofusus Fleming, 1823 (*Mem. Werner Soc.* **4**, part 2, p. 500); type species: *Fusus retroversus* Fleming, Recent; Gray, 1847 (the date given—1833—may be regarded as a misprint).

Heliconoides d'Orbigny, 1836 (*Amér. mérid.* (*Moll.*), p. 174); type species: *Atlanta heliconoides* d'Orbigny, Recent; tautonymy.

Spirialis Eydoux & Souleyet, 1840 (*Rev. Zool.* (*Soc. Cuv.*), **3**, 236); type species: *Spirialis rostralis* Eydoux & Souleyet, Recent = *Atlanta inflata* d'Orbigny; here designated.

Helicophora Gray, 1842 (*Syn. Cont. Br. Mus.* 44th ed. pp. 59, 89) (*nomen nudum*).

Scaea A. Philippi, 1844 (*Enum. Moll. Siciliae*, **2**, 164); type species: *S. retroversa* (Fleming), Recent; Gray, 1847 (as a synonym of *Heterofusus*).

Protomedea O. G. Costa, 1861 (pars—auct.) (*Microdoride Medit.* p. 73) *non* Blainville, 1830 (Coel.) *nec* Rafinesque, 1815 (Verm.) (*nomen nudum*).

Embolus Jeffreys, 1869 (*Brit. Conch.* **5**, 114) *non* Selenka, 1867 (Echin.); type species: *Spirialis rostralis* Eydoux & Souleyet, Recent; monotypy.

SPIRATELLA PSEUDOPYGMAEA n.sp.

(Figures 146*a*, *b*, plate 6)

MATERIAL. *Zinda Pir section*: Ghazij Shales (local subzone 3*c*) (MF. 439, the holotype, Reg. No. G. 68440, and 2 topotypes, Reg. No. G. 68441–2).

DESCRIPTION. Very small, sinistral, very globose and naticoid, with a very low spire and an ample body whorl, a little wider than high. There are about one and a half spire whorls which appear on the moulds to be gently convex and to be separated by deep channelled sutures. Spire very slightly projecting, but forming a negligible proportion of the total height of the shell. Body whorl large and ample, expanding rapidly both above and

below towards the aperture; it is well shouldered posteriorly and moderately convex on the flanks, the form being reflected in the outline of the aperture which is moderately broadly kidney-shaped. Inner lip strongly parasigmoidal, the anterior end being straighter, subvertical, and forming the columellar region. Base narrowly arched over, strongly convex, with a very deep and rather narrow median umbilicus.

DIMENSIONS. Holotype: height 0·5 mm.; width 0·6 mm.

REMARKS. The specimens are all moulds. *Ampullaria pygmaea* Lamarck as figured by Deshayes (1825*b*, p. 141, Pl. 17, figs. 15, 16), from the Lutetian of the Paris Basin, also figured as *Spirialis pygmaea* (Lamarck) by Cossmann (B 1891*a*, p. 7, Pl. 2, figs. 26–28), and by Cossmann & Pissarro (B 1907–13, Pl. 60, fig. 1–1), has a narrower and less ample aperture. The Pakistan form is a little smaller and the aperture is less projecting anteriorly compared with Deshayes's illustrations of the shell which also appears to have a more projecting spire; compared with Cossmann's illustrations the body whorl also does not seem to be so high on the apertural side, so that the aperture is wider there. *Spirialis umbilicata* (Bornemann) as figured by Zinndorf (B 1928, p. 53, Pl. 3, fig. 4), from the Rupelian of Germany, has a narrower aperture.

Subclass PULMONATA

Order BASOMMATOPHORA

Superfamily HYGROPHILA

Family PHYSIDAE

Genus *APLEXA* Fleming, 1820

(*Brewster's Edinb. Ency.* **14**, 617)

TYPE SPECIES. *Bulla hypnorum* Linné, Recent; Gray, 1847 (dated from Fleming, 1824).

SYNONYMS. *Nauta* Leach, in Turton, 1831 (*Man. L. and F. W. Shells*, p. 129); type species: *Nauta hypnorum* Leach, Recent = *Physa hypnorum* Draparnaud; monotypy.

Aplexus Gray, in Turton, 1840 (*Man. L. and F. W. Shells*, 2nd ed. p. 255) (*em.*).

Aplecta Herrmannsen, 1846 (*Indicis Gen. Malacoz.* **1**, 64) (*em.*)—*non* Guenée, 1838 (Lep.).

APLEXA KOHATICA n.sp.

(Figure 147, plate 6)

REFERENCES. *Physa*? *nummulitica* d'Archiac & Haime, B 1854 (p. 277, Pl. 34, fig. 4 *non* figs. 3, 3*a*, 4*a* = *Physa nummulitica*).

MATERIAL. *Kohat area* (*Panoba section*): Lower Chharat (*Planorbis* Bed, local zone?) (FB. F. 2239, the holotype, Reg. No. G. 68443, and 24 topotypes, Reg. No. G. 68444–9); *Kohat area* (*Shekhan Nala section*): Lower Chharat (*Planorbis* Bed, local zone?) (FB. F. 2381, *2*; FB. F. 2382, *15*+).

DESCRIPTION. Shell smooth, moderately large, sinistral, imperforate, oval-biconic, moderately elongated, with a rather acute spire forming about one-third of the total height. Protoconch not preserved. Early spire whorls not clearly seen. There were probably about

three or four spire whorls; they are rather flat-sided, only slightly convex, and their height is about half their width. Sutures linear. Body whorl rather large but not very inflated. Aperture, which forms about half the height of the shell, suboval, more rounded anteriorly, more pointed posteriorly. Parietal wall gently convex, the columellar lip rather strongly concave.

DIMENSIONS. Holotype: height 27·2 mm.; width 13·2 mm. (possibly a little on the high side owing to crushing).

FURTHER DISTRIBUTION IN INDIA. Subathu Beds of Subathu.

REMARKS. The specimens are all moulds. d'Archiac & Haime's fig. 4 of their *Physa*? *nummulitica*, from the Subathu Beds (Khirthar) of Subathu, is considerably less inflated and has a higher spire than the form illustrated in figs. 3, 3*a* and 4*a*, and compares well with the species under consideration. *P.* (*Aplecta*) *primigenia* Deshayes as figured by Cossmann & Pissarro (B 1907–13, Pl. 56, fig. 251–3), from the Sparnacian of the Paris Basin, has wider spire whorls and a higher body whorl.

APLEXA TRANSPORTATA n.sp.

(Figure 148, plate 6)

MATERIAL. *Rakhi Nala section*: Lower Chocolate Clays (local zone 8) (FB. F. 2068, the holotype, Reg. No. G. 68450, and 12 topotypes, Reg. No. G. 68451–6; FB. F. 2069, *2*; FB. F. 2070, *10*+).

DESCRIPTION. Very small, apparently smooth. Shell sinistral, oval-biconic, with a moderately high and rather tightly wound spire, imperforate. Protoconch not preserved. Spire moderately acute, conic or even slightly extraconic, occupying about one-third or slightly more (up to nearly one-half, on large specimens) of the total height. There are three spire whorls on a specimen 0·8 mm. high and four whorls in a specimen 1·1 mm. high, the height of the whorls being about one-half of their width, and their outline distinctly convex Sutures distinct, linear, and well-channelled. Body whorl large, convexly oval. Aperture moderately broadly oval. Inner lip gently convex posteriorly and medially, well excavated anteriorly.

DIMENSIONS. Holotype: height 0·82 mm.; width 0·56 mm. A topotype: height 1·1 mm.; width 0·66 mm. Another topotype: height 1·5 mm.; width 0·82 mm.

REMARKS. The specimens are all moulds. This form seems to be referable to the genus *Aplexa*, and there appears to be no closely comparable form, the small size, rather tight coiling, and rather numerous spire whorls being characteristic. They are apparently immature forms which have drifted some distance from their original fresh-water environment and been buried in estuarine sediments.

APLEXA ROBUSTA n.sp.

(Figure 149, plate 6)

MATERIAL. *Rakhi Nala section*: Lower Chocolate Clays (local zone 9) (FB. F. 2071, the holotype, Reg. No. G. 68457, and 19 topotypes, Reg. No. G. 68458–63; FB. F. 2072, *6*; FB. F. 2073, *10*+; FB. F. 2074, *4*; FB. F. 2075, *1*; FB. F. 2076, *10*+; FB. F. 2077, *6*); Lower Chocolate Clays (local zone 10/9) (FB. F. 2078, *4*).

DESCRIPTION. Very small, sinistral, stoutly oval-biconic, apparently smooth. Protoconch not seen. About two and a half convex spire whorls whose height is about one-third of their width. Spire conic, forming about one-quarter of the height of the shell. Sutures linear, distinct, rather steeply descendent. Body whorl large and ample, imperforate, with rounded flanks, the base flattened and even slightly excavated, not very much produced. Aperture obliquely oval. Inner lip slightly convex and oblique over the posterior three-fifths of its course, then rather angulated, its anterior two-fifths being fairly straight and vertical.

DIMENSIONS. Holotype: height 0·75 mm.; width 0·66 mm.

REMARKS. The specimens are all moulds. There does not seem to be any closely comparable form. *Physa nummulitica* d'Archiac & Haime, from the Subathu Beds of Subathu, is a much larger form with a shorter and more conoidal spire and a higher and more inflated body whorl. It appears that the freshwater forms must have been floated down from some closely neighbouring source and buried in estuarine sediments. *Aplexa transportata* is a relatively higher form altogether. The angular indentation of the inner lip seems to preclude reference of the species to the genus *Isidora* Ehrenberg, 1831.

Family PLANORBIDAE

Genus *PLANORBIS* Müller, 1774

(*Verm.* **2**, 152)

TYPE SPECIES. *Planorbis purpura* Müller, Recent = *Helix cornea* Linné; Montfort, 1810.

SYNONYMS. *Planorbarius* Duméril, 1806 (*Zool. Anal.* p. 164) (name without species).

Coretus (Bruguière, 1792) Oken, 1835 (*Allg. Naturgesch.* **5**, part 2, p. 577) (name without species).

Coretus (Adanson, 1757) Gray, 1847 (*Proc. Zool. Soc. Lond.* **15**, 180); type species: *Helix cornea* Linné, Recent; monotypy and original designation.

Spirodiscus Stein, 1850 (*Schneck. Musch. Berlins*, p. 73) *non* Ehrenberg, 1830 (Prot.); type species: *Planorbis corneus* (Linné), Recent; here designated.

Planorbia J. E. S. Moore, 1901 ('*To the Mountains of the Moon*', p. 260); type species: *Planorbia albertensis* J. E. S. Moore, Recent; monotypy.

Biomphalaria Preston, 1910 (*Ann. Mag. Nat. Hist.* (8), **6**, 535); type species: *B. smithi* Preston, Recent; monotypy.

'*PLANORBIS*' *KOHATICUS* n.sp.

(Figures 150*a*, *b*, *c*, plate 6)

MATERIAL. *Kohat area* (*Panoba section*): Lower Chharat (*Planorbis* Bed, local zone?) (FB. F. 2239, *24*, Reg. No. G. 68496–502); Lower Chharat (*Ostrea* Alternations, local zone?) (FB. F. 2241, *1*, Reg. No. G. 68493); *Kohat area* (*Shekhan Nala section*): Lower Chharat (*Planorbis* Bed, local zone?) (FB. F. 2381, the holotype, Reg. No. G. 68464, and 14 topotypes, Reg. No. G. 68465–70; FB. F. 2382, *17*, Reg. No. G. 68503–9).

DESCRIPTION. Smooth, apparently sinistral. Rather flat, the spire not protruding at all, the upper and lower surfaces appearing to be about equally widely and shallowly umbilicate, and the whorls appearing to embrace to about the same amount. There seem

to have been about four or five spire whorls, although the exact number cannot be ascertained since the median portion of the upper and lower surfaces is usually poorly preserved or obscured by matrix. Whorl section, except for the impressed area, subcircular, perhaps slightly more sharply rounded on the outer margin, becoming a little more transverse in the later stages. Upper and lower surfaces of whorls gently convex, the periphery being sharply rounded. Sutures linear.

DIMENSIONS. Holotype: height 5·6 mm.; width 23·0 mm.

REMARKS. The specimens are mostly in the form of moulds. *Planorbis scabrellus* Pieragnoli (B 1935, p. 182, Pl. 8, fig. 14), from the Eocene of Egitto and Tebaide, has the last part of the body whorl opening up more rapidly. In the collection of Recent planorbids from India and Pakistan, in the British Museum (Natural History), there does not appear to be any similar species or one attaining such a large size. The most similar form seems to be the species *pseudoammonius* of Schlotheim, variously referred to *Planorbis* and *Planorbina*. *Planorbina pseudoammonius* (Schlotheim) as figured by Royo y Gomez (1929, p. 240, Pl. 17, fig. 2), from the Lutetian of Spain, is a little larger; whereas *Planorbina* is a sinistral genus with the whorls dorsally keeled, Royo y Gomez's illustration shows no carination, and the author does not intimate whether it gives a dorsal or ventral view. *Planorbina pseudammonius* (Schlotheim) as figured by Jenny (1928, p. 421, Pl. 35, figs. 1, 2, 3, 8–10), from the Middle Eocene of Switzerland, is also very similar, but is higher (cf. his fig. 10), the aperture is not so broad, and the periphery near the aperture is less narrowly rounded. *Planorbis pseudoammonius* (Schlotheim) as figured by de Lapparent (1938, p. 16, Pl. 25, fig. 24), from the Lutetian of France, also bears a close resemblance, but is slightly larger and slightly higher (it attains dimensions of 24 × 6 mm.). *P. pseudoammonius* (Schlotheim) as figured by Andreae (B 1884, p. 36, Pl. 2, figs. 9–13), from the Middle Eocene of Alsace, is similar, but is larger, and the umbilical area is more concave; Andreae's form appears to be a *P. sensu stricto*. *P. leymerii* Deshayes (1863, p. 739, Pl. 46, figs. 1–4), from the lacustrine limestone of the Paris Basin, shown by Cossmann (1889, p. 337) to be the same as *P. pseudoammonius* (Schlotheim), is not so thick, and the aperture is not so wide. *P.* (*Menetus*) *pseudoammonius* Schlotheim as figured by Cossmann & Pissarro (B 1907–13, Pl. 57, fig. 254–2), from the Lutetian, is a little larger, and has a more broadly rounded periphery.

Although the above records of forms referred to the species *P. pseudammonius* show some variety in their general appearance, the Pakistan species does not agree very well with any of them, in spite of its apparent close relationship. Since it seems possible that more than one species may be represented by the above records of *P. pseudammonius*, since the distribution of fossil freshwater gastropod species seems to be rather restricted, and since the Pakistan form can be readily recognized in those localities in which it has so far been found and requires a name, it is accordingly here named '*Planorbis*' *kohaticus*.

PLANORBIS ALIENATUS n.sp.

(Figures 134*a*, *b*, *c*, plate 5)

MATERIAL. *Rakhi Nala section*: Upper Chocolate Clays (lower part, local zone 11) (FB. F. 2091, the holotype, Reg. No. G. 68471, and 13 topotypes, Reg. No. G. 68472–7).

DESCRIPTION. Very small, sinistral, apparently smooth. Shell discoidal, rather thick, the spire a little sunk, the base deeply umbilicate, the umbilicus occupying about one-third of the diameter of the base. Protoconch not seen. About three spire whorls which are gently convex and separated by deep sutures. Body whorl large, moderately rapidly enlarging, rather strongly arched over dorsally towards the spire, with a rounded periphery and a gently convex base, turning into the umbilicus, which is rather scalariform, in a sharply rounded curve. Aperture subsemicircular in shape, somewhat drawn out laterally.

DIMENSIONS. Holotype: height 0·5 mm.; width 1·1 mm.

REMARKS. The specimens are all moulds. *Planorbis* (*Menetus*) *pygmaeus* Deshayes as figured by Cossmann & Pissarro (1900, p. 22, Pl. 1, figs. 12–14), from the Eocene of the Cotentin, is not so high; as figured by Cossmann & Pissarro (B 1907–13, Pl. 57, fig. 254–8), from the Lutetian of Septeuil, it is not only higher, but less rapidly opening. *P.* (*M.*) *spiruloides* Deshayes as figured by Cossmann & Pissarro (B 1907–13, Pl. 57, fig. 254–7), from the Audunian of the Paris Basin, differs in a similar manner. Apart from appearing to be dextral, *Menetus* also has a carination of which there is no trace in the Rakhi Nala specimens.

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Description of plates 1 to 6

Plate 1

Figures 1*a*, *b*. *Dentalium soriense* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×10; *b*, ×10. Reg. No. G. 68000. Holotype.

Figures 2*a*, *b*. *Dentalium* (*Laevidentalium*) *rakhiense* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×6¾; *b*, ×6¾. Reg. No. G. 68007. Holotype.

Figures 3*a*, *b*. *Dentalium* (*Laevidentalium*) *pseudorakhiense* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×6¾; *b*, ×6¾. Reg. No. G. 68014. Holotype.

Figure 4. '*Trochus*' sp. A. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68017.

Figures 5*a*, *b*. *Calliostoma* sp. A. Upper Rakhi Gaj Shales: Rakhi Nala section. *a*, ×2⅛; *b*, ×2⅛. Reg. No. G. 68025.

Figures 6*a*, *b*, *c*. *Angaria pakistanica* n.sp. Middle Shekhan Limestone: Gada Khel. *a*, ×1; *b*, ×1; *c*, ×1$\frac{3}{40}$. Reg. No. G. 68027. Holotype.

Figures 7*a*, *b*, *c*. *Circulus rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×10; *b*, ×10; *c*, ×10. Reg. No. G. 68028. Holotype.

Figures 8*a*, *b*. *Liotia* (*Liotina*)? sp. A. Ghazij Shales: Zinda Pir section. *a*, ×11; *b*, ×9⅝. Reg. No. G. 68042.

Figure 9. *Rissoa pakistanica* n.sp. Ghazij Shales: Zinda Pir section. ×10⅛. Reg. No. G. 68051. Holotype.

FIGURE 10. *Rissoina rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10¼. Reg. No. G. 68058. Holotype.

FIGURE 11. *Rissoina rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅜. Reg. No. G. 68059.

FIGURE 12. *Turritella* (*Stiracolpus*) *pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68079. Holotype.

FIGURE 13. *Turritella* (*Stiracolpus*) *harnaiensis* Cox. Ghazij Shales: Zinda Pir section. ×1$\frac{19}{20}$. Reg. No. G. 68091.

FIGURE 14. *Turritella* (*Haustator*) *imbricataria* Lamarck. Upper Chocolate Clays: Zinda Pir section. ×9¾. Reg. No. G. 68098.

FIGURE 15. *Motyris pseudoaralica* n.nom. et sp. Upper Chocolate Clays: Zinda Pir section. ×7$\frac{1}{10}$. Reg. No. G. 68105. Paratype.

FIGURE 16. *Mesalia* (*Sigmesalia*) *soriensis* n.sp. Ghazij Shales: Zinda Pir section. ×10. Reg. No. G. 68118. Holotype.

FIGURES 17*a*, *b*, *c*. *Architectonica* (*Solariaxis*) *punjabensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×6½; *b*, ×6½; *c*, ×6½. Reg. No. G. 68127. Holotype.

FIGURE 18. *Diastoma rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6⅞. Reg. No. G. 68140. Holotype.

FIGURE 19. *Diastoma rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅝. Reg. No. G. 68141.

FIGURE 20. *Chondrocerithium pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. ×6$\frac{19}{20}$. Reg. No. G. 68150. Holotype.

FIGURE 21. *Chondrocerithium pakistanicum* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. ×6⅞. Reg. No. G. 68158.

FIGURE 22. *Chondrocerithium pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. ×6¾. Reg. No. G. 68151.

FIGURE 23. *Chondrocerithium pakistanicum* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. ×4⅛. Reg. No. G. 68157.

FIGURE 24. *Ptychocerithium* sp. A. Ghazij Shales: Zinda Pir section. ×4⅙. Reg. No. G. 68163.

FIGURE 25. *Triphora rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7¼. Reg. No. G. 68167. Holotype.

FIGURES 26*a*, *b*. *Scala* (*Crisposcala*) *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×2; *b*, ornament on rib, enlarged. Reg. No. G. 68170. Holotype.

FIGURE 27. *Scala* (*Crisposcala*) *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×5¾. Reg. No. G. 68171.

FIGURE 28. *Gyroscala*? *punjabensis* n.sp. Lower Chocolate Clays: Zinda Pir section. ×10⅚. Reg. No. G. 68172. Holotype.

FIGURES 29*a*, *b*. *Cirsotrema diversiformis* n.sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×10; *b*, ×10⅞. Reg. No. G. 68173. Holotype.

FIGURES 30*a*, *b*. *Cirsotrema*? *dubiosa* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. *a*, ×10⅛; *b*, ×10¾. Reg. No. G. 68180. Holotype.

FIGURES 31*a*, *b*. *Acrilla* (*Ferminoscala*) *pakistanica* n.sp. Eocene: Litra Nala, Kasrani, Dera Ghazi Khan District, Punjab. *a*, ×4$\frac{1}{20}$; *b*, portion of ornament, enlarged. Reg. No. G. 66975. Holotype.

FIGURE 32. *Acrilla* (*Undiscala*)? *soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×11. Reg. No. G. 68183. Holotype.

FIGURE 33. *Melanella* (*Polygireulima*)? *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. $\times 6\frac{7}{8}$. Reg. No. G. 68186. Holotype.

FIGURE 34. *Melanella* (*Polygireulima*)? *pakistanica* n.sp. Upper Chocolate Clays: Rakhi Nala section. $\times 6\frac{9}{10}$. Reg. No. G. 68187. Holotype.

FIGURE 35. *Odostomia pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. $\times 15\frac{1}{4}$. Reg. No. G. 68194. Holotype.

FIGURE 36. *Odostomia* (*Megastomia*) *infrasubcarinata* n.sp. Ghazij Shales: Zinda Pir section. $\times 11$. Reg. No. G. 68196. Holotype.

FIGURES 37*a*, *b*. *Tibia* (*Tibiochilus*) *rakhiensis* n.subg. et sp. *Venericardia* Shales: Rakhi Nala section. *a*, $\times 1$; *b*, ornament of one whorl, $\times 3$. Reg. No. G. 68209. Holotype.

FIGURE 38. *Dientomochilus* (*Varicospira*) *rakhiensis* n.subg. et sp. Lower Chocolate Clays: Rakhi Nala section. $\times 6\frac{5}{8}$. Reg. No. G. 68217. Holotype.

FIGURE 39. *Dientomochilus* (*Varicospira*) *rakhiensis* n.subg. et sp. Lower Chocolate Clays: Domanda, Dera Ismail Khan District, Punjab. $\times 2\frac{19}{20}$. Reg. No. G. 66922.

FIGURE 40. *Dientomochilus* (*Varicospira*) *pakistanicus* n.subg. et sp. Upper Chocolate Clays: Rakhi Nala section. $\times 7$. Reg. No. G. 68220. Holotype.

FIGURES 41*a*, *b*, *c*. *Euspira punjabensis* n.sp. *Discocyclina* Shales (so-called Khirthar): footpath from Droginda to Domanda, Dera Ismail Khan District, Punjab (31° 38′: 70° 12′). *a*, $\times \frac{19}{20}$; *b*, $\times \frac{19}{20}$; *c*, $\times \frac{19}{20}$. Reg. No. G. 66920. Holotype.

FIGURE 42. *Euspira punjabensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. $\times 6\frac{5}{8}$. Reg. No. G. 68240.

FIGURES 43*a*, *b*. *Nassaria* sp. A. Upper Chocolate Clays: Rakhi Nala section. *a*, $\times 7\frac{1}{4}$; *b*, $\times 7\frac{1}{4}$. Reg. No. G. 68274.

FIGURE 44. *Nassaria*? sp. B. Upper Chocolate Clays: Rakhi Nala section. $\times 7$. Reg. No. G. 68276.

FIGURES 45*a*, *b*. *Celatoconus*? *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, $\times 2\frac{1}{2}$; *b*, $\times 2\frac{1}{2}$. Reg. No. G. 68281. Holotype.

FIGURES 46*a*, *b*. *Strepsidura* sp. A. Upper Chocolate Clays: Rakhi Nala section. *a*, $\times 6\frac{5}{6}$; *b*, ornament enlarged. Reg. No. G. 68282. Holotype.

FIGURE 47. *Strepsidura* sp. A. Upper Chocolate Clays: Rakhi Nala section. $\times 4\frac{1}{8}$. Reg. No. G. 68283.

FIGURE 48. *Fusinus* sp. A. Upper Chocolate Clays: Rakhi Nala section. $\times 8\frac{1}{8}$. Reg. No. G. 68286.

FIGURE 49. *Ancilla* (*Sparella*) *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. $\times 6\frac{5}{8}$. Reg. No. G. 68292. Holotype.

PLATE 2

FIGURES 50*a*, *b*, *c*. *Pakistania antirotata* n.gen. et sp. Shales with Alabaster: Rakhi Nala section. *a*, $\times 15$; *b*, $\times 15$; *c*, $\times 15$. Reg. No. G. 68035. Holotype.

FIGURES 51*a*, *b*, *c*. *Pakistania antirotata* n.gen. et sp. Ghazij Shales: Zinda Pir section. *a*, $\times 21$; *b*, $\times 21$; *c*, $\times 17$. Reg. No. G. 68307.

FIGURES 52*a*, *b*, *c*. *Pseudoceratodes kohaticus* n.sp. Lower Chharat (*Planorbis* Bed): Kohat area (Shekhan Nala section). *a*, $\times 1$; *b*, $\times 1$; *c*, $\times 1$. Reg. No. G. 68043. Holotype.

FIGURE 53. *Valvata*? sp. A. Lower Chocolate Clays: Rakhi Nala section. $\times 20\frac{1}{2}$. Reg. No. G. 68050.

FIGURES 54*a*, *b*. *Turritella rakhiensis* n.sp. Lower Chocolate Clays: Rakhi Nala section. *a*, $\times 2$; *b*, ornament of one whorl enlarged. Reg. No. G. 68065. Holotype.

FIGURE 55. *Turritella soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. $\times 1$. Reg. No. G. 68072. Holotype.

FIGURE 56. *Turritella* (*Haustator*?) *punjabensis* n.sp. Lower Chocolate Clays: Zinda Pir section. $\times 1$. Reg. No. G. 68103. Holotype.

FIGURE 57. *Turritella* (*Haustator*) *imbricataria* Lamarck. Upper Chocolate Clays: Zinda Pir section. ×3. Reg. No. G. 68097.

FIGURES 58*a*, *b*. *Motyris pseudoaralica* n.nom. et sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68104. Paratype.

FIGURES 59*a*, *b*. *Mesalia* (*Sigmesalia*) *rakhiensis* n.sp. *Venericardia* Shales: Rakhi Nala section. *a*, ×3; *b*, ornament on one spiral thread, enlarged. Reg. No. G. 68117. Holotype.

FIGURES 60*a*, *b*. *Architectonica* (*Solariaxis*) *rakhiensis* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. *a*, ×4½; *b*, ×4½. Reg. No. G. 68126. Holotype.

FIGURES 61*a*, *b*. *Pseudomalaxis punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×21; *b*, ×21. Reg. No. G. 68132. Holotype.

FIGURES 62*a*, *b*, *c*. *Punjabia marginostriata* n.g. et sp. Ghazij Shales: Zinda Pir section. *a*, ×15½; *b*, ×15½; *c*, ×15½. Reg. No. G. 68133. Holotype.

FIGURE 63. *Chondrocerithium pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. ×22$\frac{1}{10}$. Reg. No. G. 68151.

FIGURE 64. *Cerithiopsis punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×3$\frac{1}{10}$. Reg. No. G. 68164. Holotype.

FIGURE 65. *Triphora* (*Eocautor*) *soriensis* n.subg. et sp. Upper Chocolate Clays: Zinda Pir section. ×21¾. Reg. No. G. 68169. Holotype.

FIGURE 66. *Cirsotrema diversiformis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×21. Reg. No. G. 68174.

FIGURE 67. *Melanella* (*Polygireulima*) *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×20¾. Reg. No. G. 68185.

FIGURE 68. *Melanella* (*Polygireulima*) *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×21. Reg. No. G. 68184. Holotype.

PLATE 3

FIGURE 69. *Turbonilla* (*Chemnitzia—A*) *soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×20¾. Reg. No. G. 68021. Holotype.

FIGURE 70. *Turbonilla* (*Terebronilla*) *terebriformis* n.subg. et sp. Upper Chocolate Clays: Rakhi Nala section. ×19⅓. Reg. No. G. 68202. Holotype.

FIGURE 71. *Eulimella* (*Belonidium*) *laxispirata* n.sp. Ghazij Shales: Zinda Pir section. ×21¼. Reg. No. G. 68203. Holotype.

FIGURE 72. *Tibia pseudomokattamensis* n.sp. Sirki Shale/Kohat Limestone: Sirki Paila. ×1. Reg. No. G. 68207. Holotype.

FIGURE 73. *Rimella pakistanica* n.sp. Shales with Alabaster: Rakhi Nala section. ×1. Reg. No. G. 68213. Holotype.

FIGURE 74. *Rimella pakistanica* n.sp. Shales with Alabaster: Rakhi Nala section. ×1. Reg. No. G. 68216.

FIGURE 75. *Dientomochilus* (*Varicospira*) *tenui-incisus* n.subg. et sp. Upper Chocolate Clays: Zinda Pir section. ×2. Reg. No. G. 68227. Holotype.

FIGURES 76*a*, *b*. *Terebellum fusiformopse* de Gregorio. White Marl Band: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68233.

FIGURE 77. '*Terebellum*' *diversiornatum* n.sp. Ghazij Shales: Zinda Pir section. ×2⅕. Reg. No. G. 68239. Holotype.

FIGURES 78*a*, *b*. *Euspira soriensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×2; *b*, ×2. Reg. No. G. 68246. Holotype.

FIGURE 79. *Euspira soriensis* n.sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68247.

FIGURES 80*a*, *b*. *Globularia pseudolatispira* n.sp. White Marl Band: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68255. Holotype.

FIGURES 81*a*, *b*. *Globularia* (*Ampullinopsis*) *altivapincana* n.sp. Shales with Alabaster: Rakhi Nala section. *a*, ×½; *b*, ×½. Reg. No. G. 68256. Holotype.

FIGURE 82. *Crommium pseudowillemeti* n.sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68262. Holotype.

FIGURES 83*a*, *b*, *c*. *Callistocypraea* (*Miolyncina*)? *soriensis* n.sp. White Marl Band: Zinda Pir section. *a*, ×1; *b*, ×1; *c*, ×1. Reg. No. G. 68269. Holotype.

FIGURES 84*a*, *b*. *Nassaria punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×2; *b*, ×2. Reg. No. G. 68273. Holotype.

FIGURE 85. *Muricopsis*? *bulbosinucleus* n.sp. Upper Chocolate Clays: Zinda Pir section. ×3¼. Reg. No. G. 68277. Holotype.

FIGURES 86*a*, *b*. *Tetrastomella*? *pseudohumilis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×2; *b*, ×2. Reg. No. G. 68279. Holotype.

FIGURE 87. *Tetrastomella*? *pseudohumilis* n.sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68280.

PLATE 4

FIGURES 88*a*, *b*. *Volema* (*Pugilina*) *superspinosa* n.sp. Lower Chocolate Clays: Rakhi Nala section. *a*, ×1$\frac{1}{10}$; *b*, ×1$\frac{1}{10}$. Reg. No. G. 68285. Holotype.

FIGURE 89. *Streptochetus*/*Euthriofusus*? sp. A. Green and Nodular Shales: Rakhi Nala section. ×1. Reg. No. G. 68289.

FIGURE 90. *Ancilla* (*Ancillus*) *pseudonana* n.sp. Ghazij Shales: Zinda Pir section. ×4$\frac{1}{10}$. Reg. No. G. 68290. Holotype.

FIGURE 91. *Harpa*? *soriensis* n.sp. Lower Chocolate Clays: Zinda Pir section. ×1. Reg. No. G. 68305. Holotype.

FIGURES 92*a*, *b*. *Lyria punjabensis* n.sp. White Marl Band: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68306. Holotype.

FIGURES 93*a*, *b*. *Volutocorbis pakistanica* n.sp. Lower Chocolate Clays: east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab. *a*, ×2; *b*, ×2. Reg. No. G. 66932. Holotype.

FIGURES 94*a*, *b*. *Volutocorbis pakistanica* n.sp. Lower Chocolate Clays: east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab. *a*, ×2; *b*, ×2. Reg. No. G. 66933.

FIGURES 95*a*, *b*. *Volutocorbis soriensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×3; *b*, ×3. Reg. No. G. 68315. Holotype.

FIGURES 96*a*, *b*. *Volutospina kohatica* n.sp. Rubbly Limestones: Rakhi Nala section. *a*, ×1; *b*, ×1. Reg. No. G. 68316. Holotype.

FIGURE 97. *Volutospina kohatica* n.sp. Middle Shekhan Limestone: Kohat area (Panoba section). ×1. Reg. No. G. 68318.

FIGURE 98. *Volutilithes*? *rakhiensis* n.sp. Shales with Alabaster: Rakhi Nala section. ×1. Reg. No. G. 68324. Holotype.

FIGURE 99. *Trigonostoma pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68332. Holotype.

FIGURE 100. *Coptostoma*? *rakhiense* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6. Reg. No. G. 68333. Holotype.

FIGURE 101. *Marginella* (*Prunum*) *soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×2¼. Reg. No. G. 68348. Holotype.

PLATE 5

FIGURE 102. *Pyrenomitra anachis* n.gen et sp. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68299. Holotype.

FIGURE 103. *Pyrenomitra anachis* n.gen. et sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅝. Reg. No. G. 68300.

FIGURE 104. *'Cancellaria' soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68330. Holotype.

FIGURE 105. *'Cancellaria' soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68331.

FIGURE 106. *Coptostoma? punjabense* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68334. Holotype.

FIGURES 107*a*, *b*. *Coptostoma? punjabense* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×3⅞; *b*, ×3⅞. Reg. No. G. 68336.

FIGURES 108*a*, *b*. *Marginella* (*Prunum*) *pseudo-orientalis* n.sp. Lower Chocolate Clays: Rakhi Nala section. *a*, ×10½; *b*, ×4⅛. Reg. No. G. 68339. Holotype.

FIGURES 109*a*, *b*. *Marginella* (*Nudifaba*) *rakhiensis* n.subg. et sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×10½; *b*, ×10½. Reg. No. G. 68357. Holotype.

FIGURE 110. *Marginella* (*Prunum*) *unistriata* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68341. Holotype.

FIGURE 111. *Marginella* (*Prunum*) *unistriata* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68342.

FIGURE 112. *Marginella* (*Serrata*) *pakistanica* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7½. Reg. No. G. 68350. Holotype.

FIGURE 113. *Marginella* (*Serrata*) *pakistanica* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6⅝. Reg. No. G. 68351.

FIGURE 114. *Turris* (*Gemmula*) *soriensis* n.sp. Ghazij Shales: Zinda Pir section. ×3½. Reg. No. G. 68369. Holotype.

FIGURE 115. *Acteon*? sp. A. Ghazij Shales: Zinda Pir section. ×10⅜. Reg. No. G. 68407.

FIGURE 116. *Turris* (*Gemmula*) *pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. ×6⅞. Reg. No. G. 68366. Holotype.

FIGURE 117. *Crassispira*? sp. A. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68370.

FIGURE 118. *Brachytoma* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×7$\frac{1}{20}$. Reg. No. G. 68372.

FIGURE 119. *Turricula* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68385. Holotype.

FIGURE 120. *Turricula* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×9⅜. Reg. No. G. 68386.

FIGURE 121. *Pyrenoturris punjabensis* n.gen. et sp. Ghazij Shales: Zinda Pir section. ×2½. Reg. No. G. 68397. Holotype.

FIGURE 122. *Acteon rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅛. Reg. No. G. 68405. Holotype.

FIGURES 123*a*, *b*. *Ringicula punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×10⅛; *b*, ×10⅛. Reg. No. G. 68409. Holotype.

FIGURES 124*a*, *b*. *Akera pseudodesioi* n.sp. Green and Nodular Shales: Rakhi Nala section. *a*, ×1$\frac{1}{20}$; *b*, ×$\frac{9}{10}$. Reg. No. G. 68418. Holotype.

FIGURE 125. *Retusa recta* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅝. Reg. No. G. 68419. Holotype.

FIGURES 126*a*, *b*. *Rhizorus pakistanicus* n.sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×10½; *b*, ×10⅝. Reg. No. G. 68426. Holotype.

FIGURE 127. *Scaphander* sp. A. Rubbly Limestones: Rakhi Nala section. ×2. Reg. No. G. 68427.

FIGURE 128. *Roxania pseudosemistriata* n.sp. Upper Chocolate Clays: Zinda Pir section. ×11⅛. Reg. No. G. 68428. Holotype.

FIGURE 129. *Roxania pseudosemistriata* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10½. Reg. No. G. 68429.

FIGURE 130. *Roxania*? sp. A. Upper Chocolate Clays: Rakhi Nala section. ×8¾. Reg. No. G. 68431. Holotype.

FIGURE 131. *Roxania*? sp. A. Upper Chocolate Clays: Rakhi Nala section. ×10. Reg. No. G. 68432.

FIGURE 132. *Cylichna*? sp. A. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68438.

FIGURE 133. *Cylichna* (*Acrostemma*) *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×11¾. Reg. No. G. 68439. Holotype.

FIGURES 134*a*, *b*, *c*. *Planorbis alienatus* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×10½; *b*, ×10½; *c*, ×10½. Reg. No. G. 68471. Holotype.

PLATE 6

FIGURES 135*a*, *b*. *Persicula*? sp. A. Upper Chocolate Clays: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68364.

FIGURE 136. *Turricula praepromensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×14. Reg. No. G. 68378. Holotype.

FIGURE 137. *Turricula praepromensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×19¼. Reg. No. G. 68379.

FIGURE 138. *Turricula* (*Pleurofusia*) *obliquinodosa* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×13¾. Reg. No. G. 68392. Holotype.

FIGURES 139*a*, *b*. *Turricula* (*Pleurofusia*) *pseudoscala* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×14; *b*, ×14. Reg. No. G. 68394. Holotype.

FIGURES 140*a*, *b*. *Conus* (*Lithoconus*) *colossus* n.sp. White Marl Band: Rakhi Nala section. *a*, ×½; *b*, ×½. Reg. No. G. 68398. Holotype.

FIGURE 141. *Pyrenoturris soriensis* n.gen. et sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68396. Holotype.

FIGURES 142*a*, *b*. *Conus* (*Leptoconus*) *safaedensis* n.sp. Lower Chocolate Clays: east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab. *a*, ×1; *b*, ×1½. Reg. No. G. 68399. Holotype.

FIGURE 143. *Conus* (*Leptoconus*) *safaedensis* n.sp. Eocene: Domanda. ×1. Reg. No. G. 68403.

FIGURES 144*a*, *b*. *Ringicula* (*Ringiculella*) *pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×22¼; *b*, ×22½. Reg. No. G. 68416. Holotype.

FIGURE 145. *Retusa* (*Cylichnina*) *aequiattenuata* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×21. Reg. No. G. 68424. Holotype.

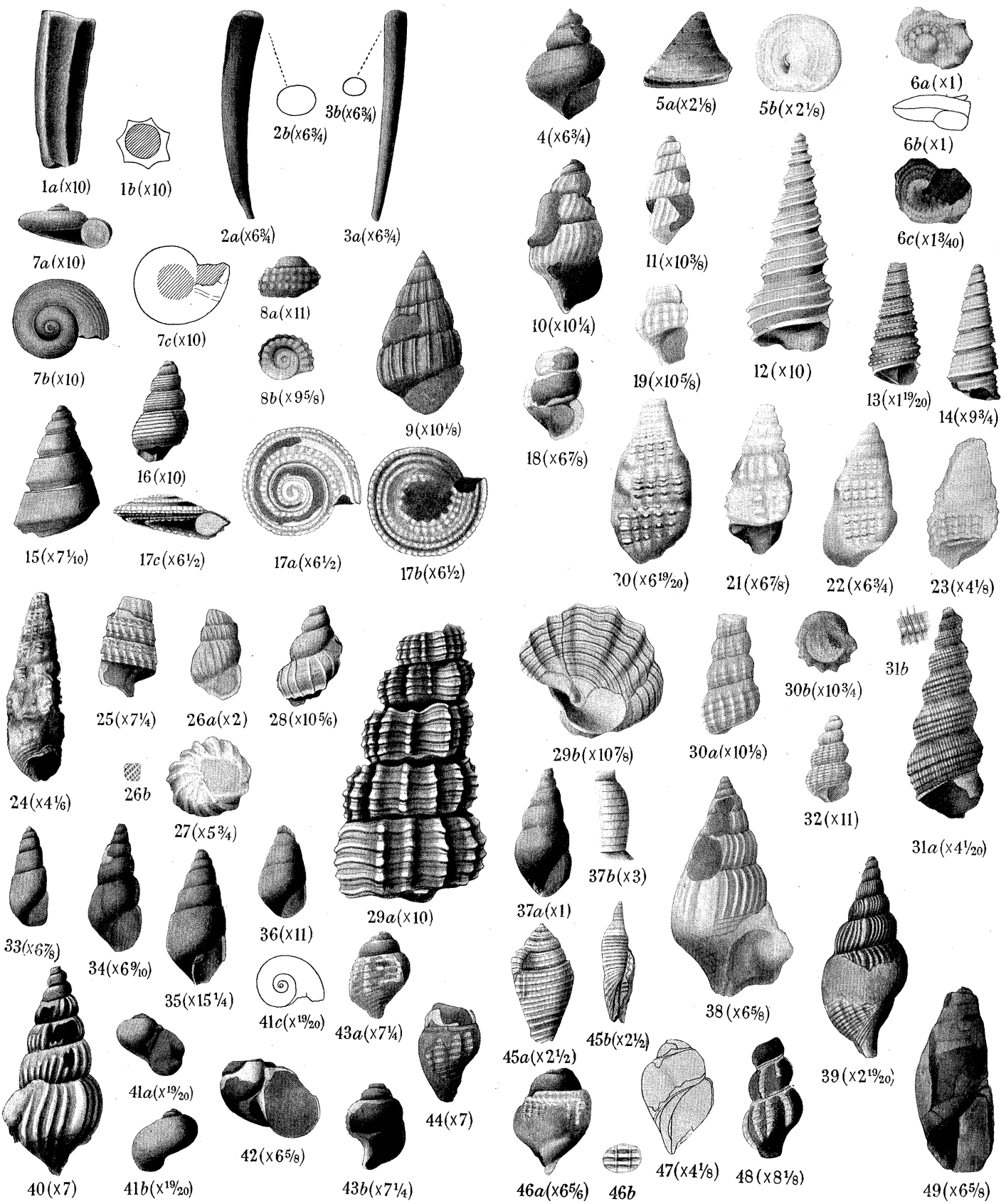
FIGURES 146*a*, *b*. *Spiratella pseudopygmaea* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×23½; *b*, ×24¼. Reg. No. G. 68440. Holotype.

FIGURE 147. *Aplexa kohatica* n.sp. Lower Chharat (*Planorbis* Bed): Kohat area (Panoba section). ×1. Reg. No. G. 68443. Holotype.

FIGURE 148. *Aplexa transportata* n.sp. Lower Chocolate Clays: Rakhi Nala section. ×21¼. Reg. No. G. 68450. Holotype.

FIGURE 149. *Aplexa robusta* n.sp. Lower Chocolate Clays: Rakhi Nala section. ×20. Reg. No. G. 68457. Holotype.

FIGURES 150*a*, *b*, *c*. '*Planorbis*' *kohaticus* n.sp. Lower Chharat (*Planorbis* Bed): Kohat area (Shekhan Nala section). *a*, ×1; *b*, ×1; *c*, ×1. Reg. No. G. 68464. Holotype.


1a(x10)
1b(x10)
2a(x6¾)
2b(x6¾)
3b(x6¾)
3a(x6¾)
4(x6¾)
5a(x2⅛)
5b(x2⅛)
6a(x1)
6b(x1)
6c(x1¾0)
7a(x10)
7b(x10)
7c(x10)
8a(x11)
8b(x9⅝)
9(x10⅛)
10(x10¼)
11(x10⅜)
12(x10)
13(x1¹⁹⁄₂₀)
14(x9¾)
15(x7⅒)
16(x10)
17a(x6½)
17b(x6½)
17c(x6½)
18(x6⅞)
19(x10⅝)
20(x6¹⁹⁄₂₀)
21(x6⅞)
22(x6¾)
23(x4⅛)
24(x4⅛)
25(x7¼)
26a(x2)
26b
27(x5¾)
28(x10⅝)
29a(x10)
29b(x10⅞)
30a(x10⅛)
30b(x10¾)
31a(x4½0)
31b
32(x11)
33(x6⅞)
34(x6⅘10)
35(x15¼)
36(x11)
37a(x1)
37b(x3)
38(x6⅝)
39(x2¹⁹⁄₂₀)
40(x7)
41a(x¹⁹⁄₂₀)
41b(x¹⁹⁄₂₀)
41c(x¹⁹⁄₂₀)
42(x6⅝)
43a(x7¼)
43b(x7¼)
44(x7)
45a(x2½)
45b(x2½)
46a(x6⅝)
46b
47(x4⅛)
48(x8⅛)
49(x6⅝)

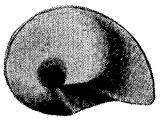
(*Facing p.* 168)

50*a* (×15)

50*b* (×15)

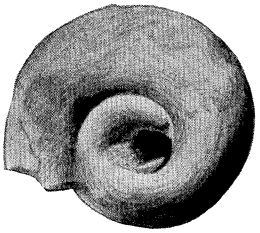
50*c* (×15)

51*a* (×21)

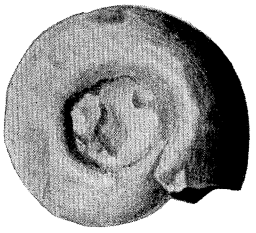


51*b* (×21)

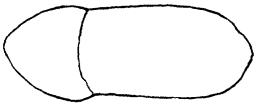
51*c* (×17)



52*a* (×1)

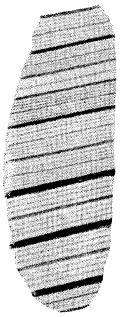


52*b* (×1)

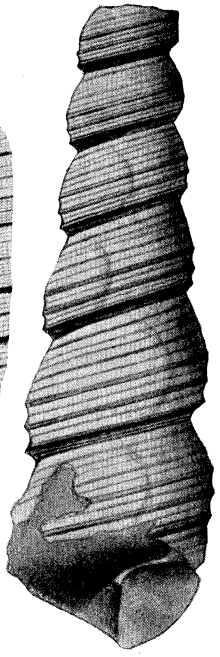


52*c* (×1)

53 (×20½)

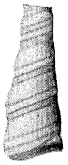


54*b*

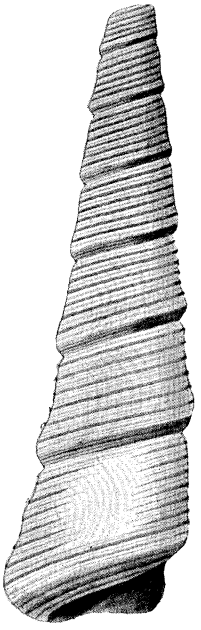


54*a* (×2)

55 (×1)



56 (×1)

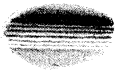


57 (×3)

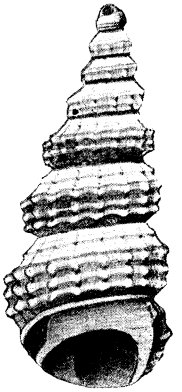
58*a* (×1)

58*b* (×1)

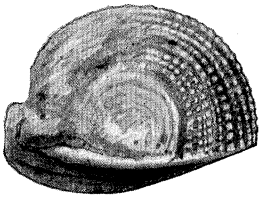
59*a* (×3)



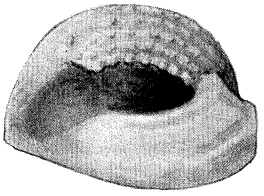
59*b*



66 (×21)



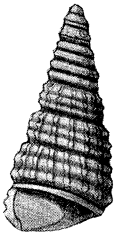
60*a* (×4½)



60*b* (×4½)

61*a* (×21)

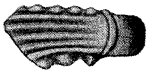
61*b* (×21)



65 (×21¾)

62*a* (×15½)

62*b* (×15½)



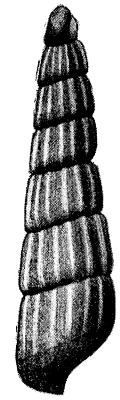
62*c* (×15½)

63 (×22 1/10)

64 (×3 1/10)

67 (×20¾)

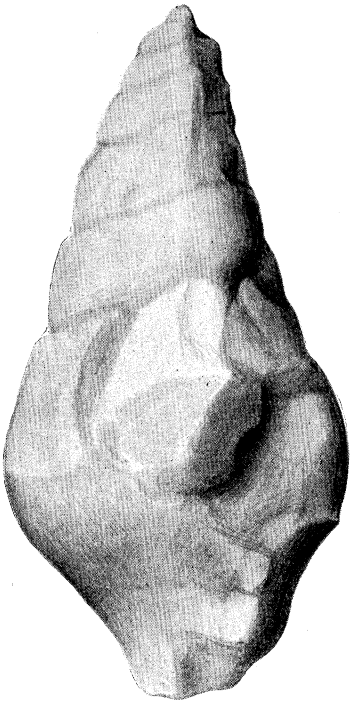
68 (×21)



69(x20¾)

70(x19⅓)

71(x21¼)

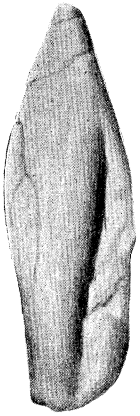


72(x1)

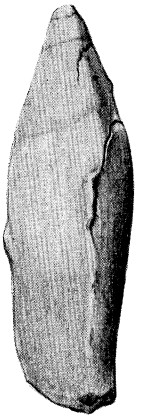
73(x1)

74(x1)

75(x2)



76a(x1)



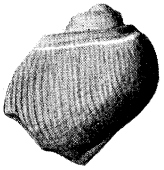
76b(x1)

77(x2⅕)

78a(x2)

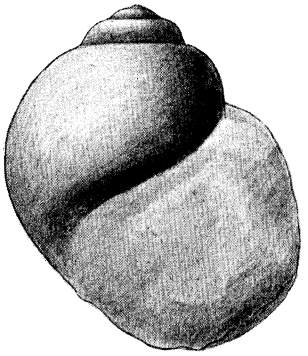
78b(x2)

79(x2)

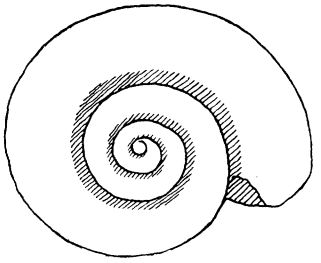


80a(x1)

80b(x1)



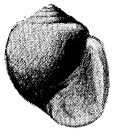
81a(x½)



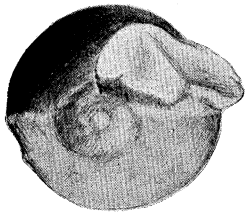
81b(x½)

84a(x2)

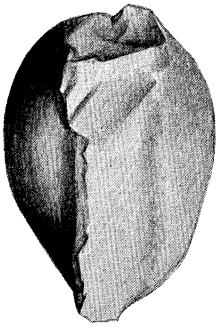
85(x3¼)



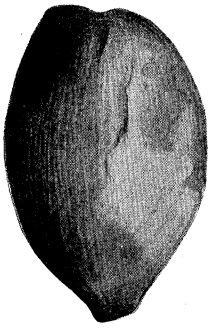
82(x2)



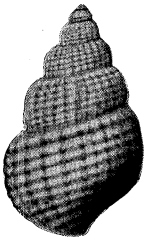
83a(x1)



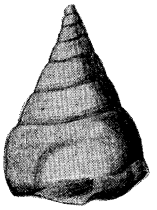
83b(x1)



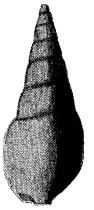
83c(x1)



84b(x2)

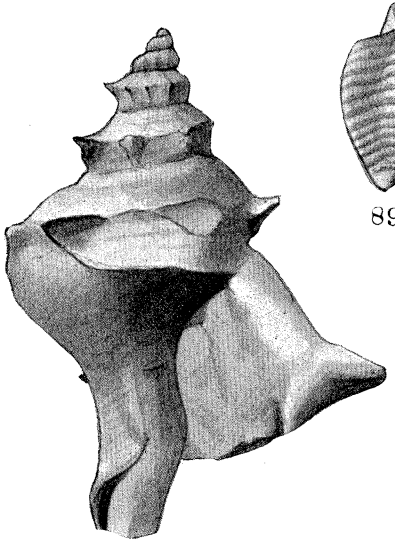


86a(x2)

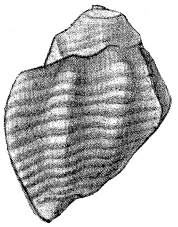


86b(x2)

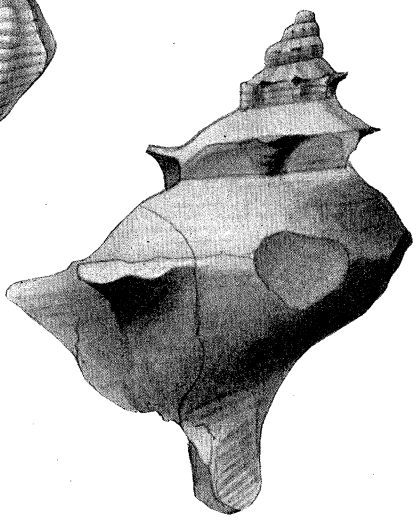
87(x2)



88*a* (×1 1/10)

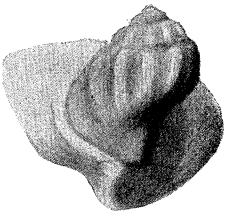


89 (×1)



88*b* (×1 1/10)

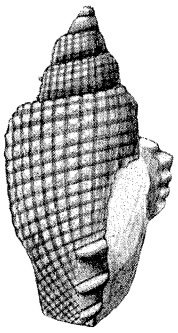
90 (×4 1/10)



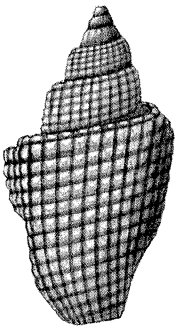
91 (×1)

92*a* (×1)

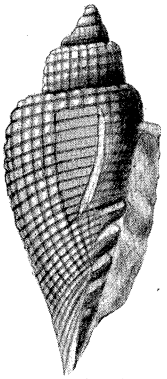
92*b* (×1)



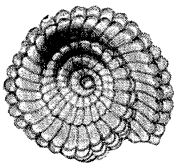
93*a* (×2)



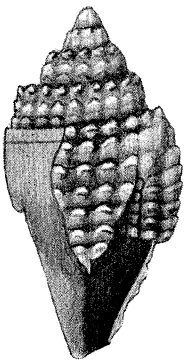
93*b* (×2)



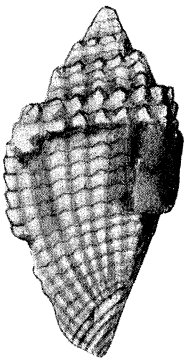
94*a* (×2)



94*b* (×2)

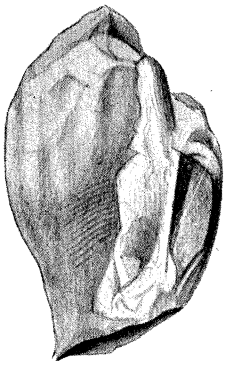


95*a* (×3)

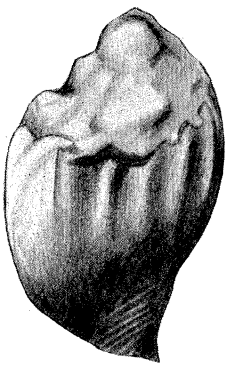


95*b* (×3)

97 (×1)



96*a* (×1)

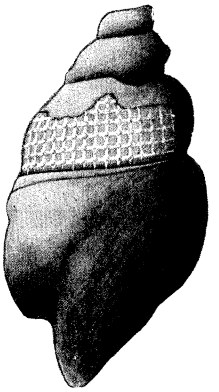


96*b* (×1)

98 (×1)

99 (×2)

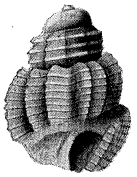
101 (×2 1/4)

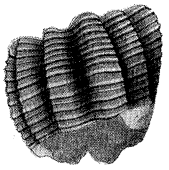


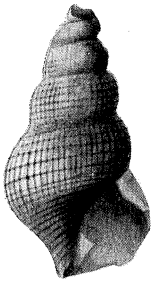
100 (×6)


102 (×7)


103 (×10⅝)


104 (×10)


105 (×10)


106 (×6¾)


107*a* (×3⅞)


107*b* (×3⅞)


108*a* (×10½)

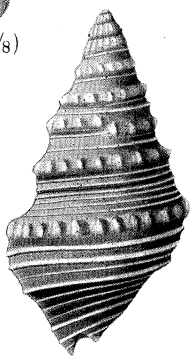

108*b* (×4⅛)


115 (×10⅜)


112 (×7½)

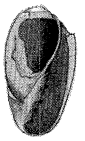

113 (×6⅝)


114 (×3½)


116 (×6⅞)


109*a* (×10½)

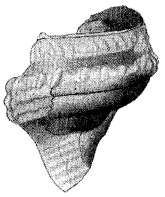

109*b* (×10½)


110 (×7)


111 (×7)


117 (×6¾)


118 (×7 1/20)


119 (×6¾)


120 (×9⅜)


121 (×2½)


122 (×10⅛)


123*a* (×10⅛)

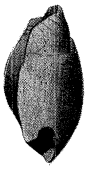

123*b* (×10⅛)


124*a* (×1 1/20)

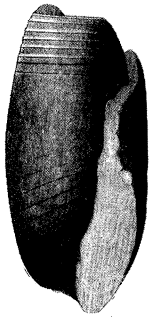

124*b* (×9/10)

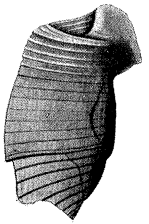

125 (×10⅝)


126*a* (×10½)


126*b* (×10⅝)

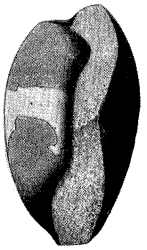

127 (×2)


128 (×11⅛)


129 (×10½)

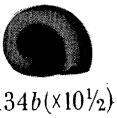

130 (×8¾)

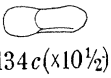

131 (×10)


132 (×10)


133 (×11¾)

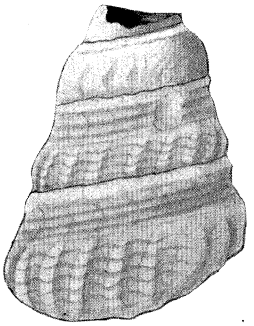

134*a* (×10½)


134*b* (×10½)

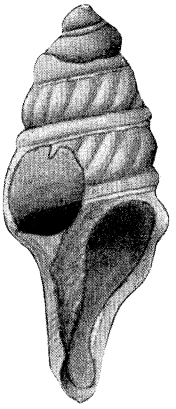

134*c* (×10½)

135*a*(×1)

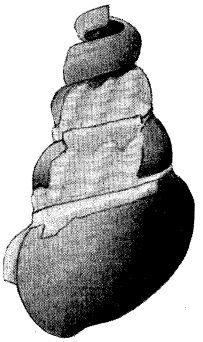
135*b*(×1)



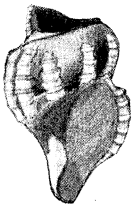
136 (×14)



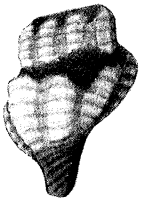
137(×19¼)



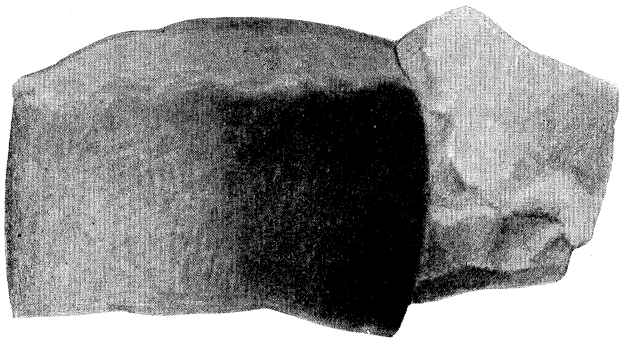
138(×13¾)



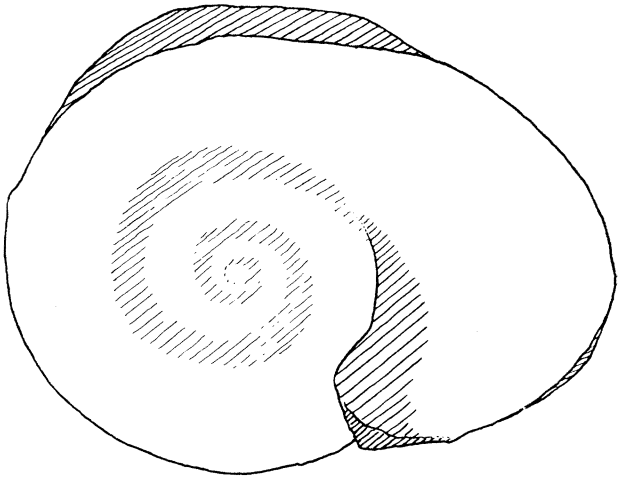
139*a*(×14)



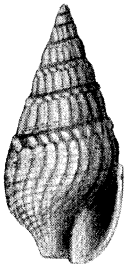
139*b*(×14)



140*a*(×½)



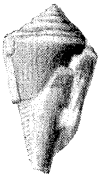
140*b* (×½)



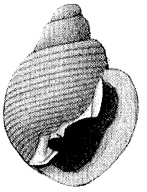
141(×2)

142*a*(×1)

142*b*(×1½)

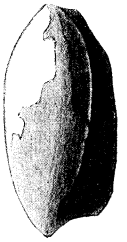


143(×1)



144*a*(×22¼)

144*b*(×22½)



145(×21)

146*a*(×23½)

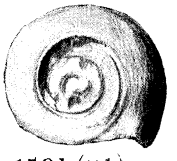
146*b*(×24¼)

147(×1)

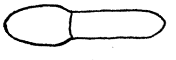
148(×21¼)

149(×20)

150*a*(×1)



150*b*(×1)



150*c*(×1)

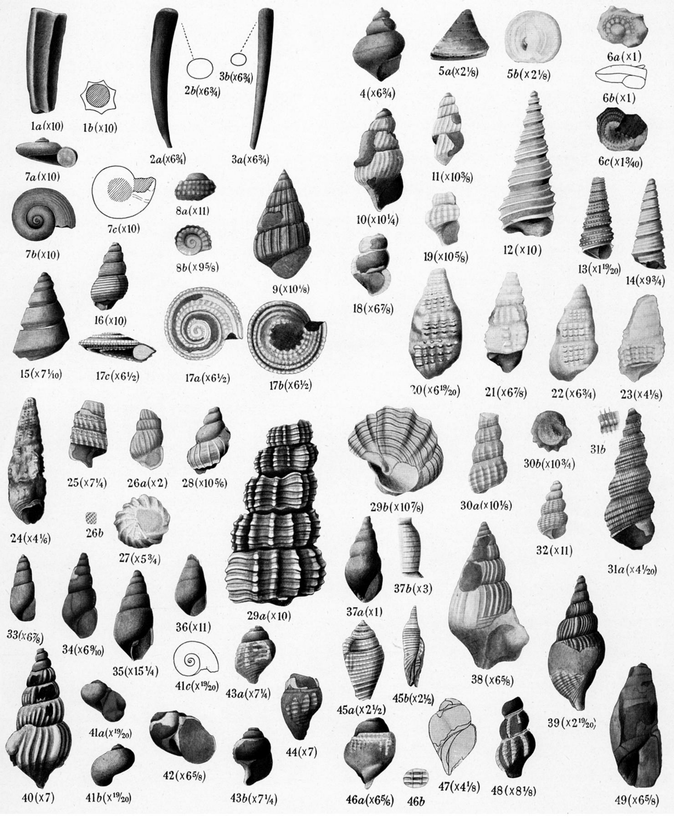


PLATE 1

FIGURES 1*a*, *b*. *Dentalium soriense* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×10; *b*, ×10. Reg. No. G. 68000. Holotype.

FIGURES 2*a*, *b*. *Dentalium* (*Laevidentalium*) *rakhiense* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×6¾; *b*, ×6¾. Reg. No. G. 68007. Holotype.

FIGURES 3*a*, *b*. *Dentalium* (*Laevidentalium*) *pseudorakhiense* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×6¾; *b*, ×6¾. Reg. No. G. 68014. Holotype.

FIGURE 4. '*Trochus*' sp. A. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68017.

FIGURES 5*a*, *b*. *Calliostoma* sp. A. Upper Rakhi Gaj Shales: Rakhi Nala section. *a*, ×2⅛; *b*, ×2⅛. Reg. No. G. 68025.

FIGURES 6*a*, *b*, *c*. *Angaria pakistanica* n.sp. Middle Shekhan Limestone: Gada Khel. *a*, ×1; *b*, ×1; *c*, ×1¾0. Reg. No. G. 68027. Holotype.

FIGURES 7*a*, *b*, *c*. *Circulus rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×10; *b*, ×10; *c*, ×10. Reg. No. G. 68028. Holotype.

FIGURES 8*a*, *b*. *Liotia* (*Liotina*)? sp. A. Ghazij Shales: Zinda Pir section. *a*, ×11; *b*, ×9⅝. Reg. No. G. 68042.

FIGURE 9. *Rissoa pakistanica* n.sp. Ghazij Shales: Zinda Pir section. ×10¼. Reg. No. G. 68051. Holotype.

FIGURE 10. *Rissoina rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10¼. Reg. No. G. 68058. Holotype.

FIGURE 11. *Rissoina rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅜. Reg. No. G. 68059.

FIGURE 12. *Turritella* (*Stiracolpus*) *pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68079. Holotype.

FIGURE 13. *Turritella* (*Stiracolpus*) *harnaiensis* Cox. Ghazij Shales: Zinda Pir section. ×1¹⁹/₂₀. Reg. No. G. 68091.

FIGURE 14. *Turritella* (*Haustator*) *imbricataria* Lamarck. Upper Chocolate Clays: Zinda Pir section. ×9¾. Reg. No. G. 68098.

FIGURE 15. *Motyris pseudoaralica* n.nom. et sp. Upper Chocolate Clays: Zinda Pir section. ×7⅛0. Reg. No. G. 68105. Paratype.

FIGURE 16. *Mesalia* (*Sigmesalia*) *soriensis* n.sp. Ghazij Shales: Zinda Pir section. ×10. Reg. No. G. 68118. Holotype.

FIGURES 17*a*, *b*, *c*. *Architectonica* (*Solariaxis*) *punjabensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×6½; *b*, ×6½; *c*, ×6½. Reg. No. G. 68127. Holotype.

FIGURE 18. *Diastoma rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6⅞. Reg. No. G. 68140. Holotype.

FIGURE 19. *Diastoma rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅝. Reg. No. G. 68141.

FIGURE 20. *Chondrocerithium pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. ×6¹⁹/₂₀. Reg. No. G. 68150. Holotype.

FIGURE 21. *Chondrocerithium pakistanicum* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. ×6⅞. Reg. No. G. 68158.

FIGURE 22. *Chondrocerithium pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. ×6¾. Reg. No. G. 68151.

FIGURE 23. *Chondrocerithium pakistanicum* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. ×4⅛. Reg. No. G. 68157.

FIGURE 24. *Ptychocerithium* sp. A. Ghazij Shales: Zinda Pir section. ×4⅛. Reg. No. G. 68163.

FIGURE 25. *Triphora rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7¼. Reg. No. G. 68167. Holotype.

FIGURES 26*a*, *b*. *Scala* (*Crisposcala*) *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×2; *b*, ornament on rib, enlarged. Reg. No. G. 68170. Holotype.

FIGURE 27. *Scala* (*Crisposcala*) *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×5¾. Reg. No. G. 68171.

FIGURE 28. *Gyroscala*? *punjabensis* n.sp. Lower Chocolate Clays: Zinda Pir section. ×10⅝. Reg. No. G. 68172. Holotype.

FIGURES 29*a*, *b*. *Cirsotrema diversiformis* n.sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×10; *b*, ×10⅞. Reg. No. G. 68173. Holotype.

FIGURES 30*a*, *b*. *Cirsotrema*? *dubiosa* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. *a*, ×10⅛; *b*, ×10⅜. Reg. No. G. 68180. Holotype.

FIGURES 31*a*, *b*. *Acrilla* (*Ferminoscala*) *pakistanica* n.sp. Eocene: Litra Nala, Kasrani, Dera Ghazi Khan District, Punjab. *a*, ×4⅛0; *b*, portion of ornament, enlarged. Reg. No. G. 66975. Holotype.

FIGURE 32. *Acrilla* (*Undiscala*)? *soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×11. Reg. No. G. 68183. Holotype.

FIGURE 33. *Melanella* (*Polygireulima*)? *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68186. Holotype.

FIGURE 34. *Melanella* (*Polygireulima*)? *pakistanica* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6⅝0. Reg. No. G. 68187. Holotype.

FIGURE 35. *Odostomia pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. ×15¼. Reg. No. G. 68194. Holotype.

FIGURE 36. *Odostomia* (*Megastomia*) *infrasubcarinata* n.sp. Ghazij Shales: Zinda Pir section. ×11. Reg. No. G. 68196. Holotype.

FIGURES 37*a*, *b*. *Tibia* (*Tibiochilus*) *rakhiensis* n.subg. et sp. *Venericardia* Shales: Rakhi Nala section. *a*, ×1; *b*, ornament of one whorl, ×3. Reg. No. G. 68209. Holotype.

FIGURE 38. *Dientomochilus* (*Varicospira*) *rakhiensis* n.subg. et sp. Lower Chocolate Clays: Rakhi Nala section. ×6⅝. Reg. No. G. 68217. Holotype.

FIGURE 39. *Dientomochilus* (*Varicospira*) *rakhiensis* n.subg. et sp. Lower Chocolate Clays: Domanda, Dera Ismail Khan District, Punjab. ×2⅛0. Reg. No. G. 66922.

FIGURE 40. *Dientomochilus* (*Varicospira*) *pakistanicus* n.subg. et sp. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68220. Holotype.

FIGURES 41*a*, *b*, *c*. *Euspira punjabensis* n.sp. *Discocyclina* Shales (so-called Khirthar): footpath from Droginda to Domanda, Dera Ismail Khan District, Punjab (31° 38′: 70° 12′). *a*, ×1⁹/₂₀; *b*, ×1⁹/₂₀; *c*, ×1⁹/₂₀. Reg. No. G. 66920. Holotype.

FIGURE 42. *Euspira punjabensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6⅝. Reg. No. G. 68240.

FIGURES 43*a*, *b*. *Nassaria* sp. A. Upper Chocolate Clays: Rakhi Nala section. *a*, ×7¼; *b*, ×7¼. Reg. No. G. 68274.

FIGURE 44. *Nassaria*? sp. B. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68276.

FIGURES 45*a*, *b*. *Celatoconus*? *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×2½; *b*, ×2½. Reg. No. G. 68281. Holotype.

FIGURES 46*a*, *b*. *Strepsidura* sp. A. Upper Chocolate Clays: Rakhi Nala section. *a*, ×6⅝; *b*, ornament enlarged. Reg. No. G. 68282. Holotype.

FIGURE 47. *Strepsidura* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×4⅛. Reg. No. G. 68283.

FIGURE 48. *Fusinus* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×8⅛. Reg. No. G. 68286.

FIGURE 49. *Ancilla* (*Sparella*) *rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6⅝. Reg. No. G. 68292. Holotype.

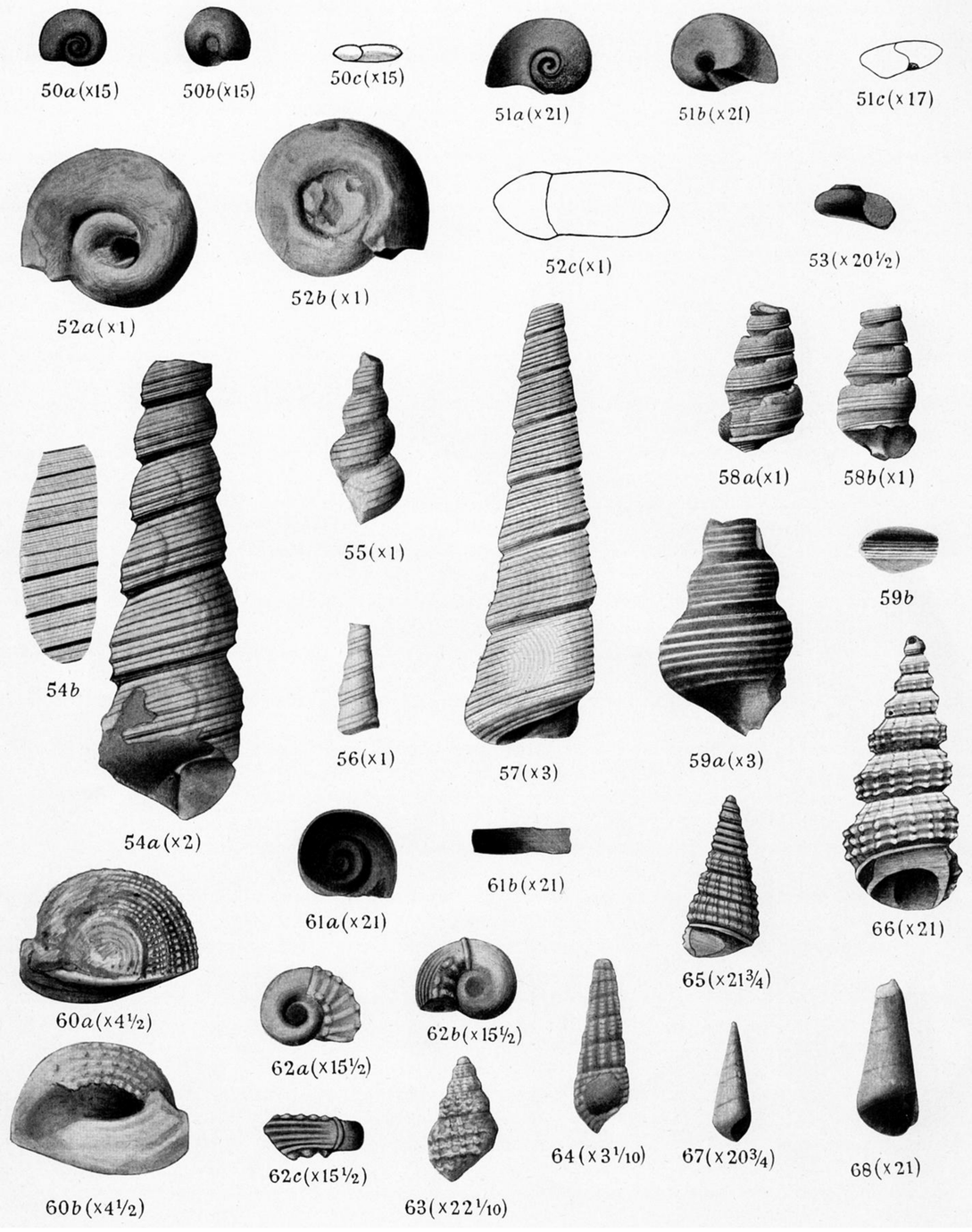


PLATE 2

FIGURES 50*a*, *b*, *c*. *Pakistania antirotata* n.gen. et sp. Shales with Alabaster: Rakhi Nala section. *a*, ×15; *b*, ×15; *c*, ×15. Reg. No. G. 68035. Holotype.

FIGURES 51*a*, *b*, *c*. *Pakistania antirotata* n.gen. et sp. Ghazij Shales: Zinda Pir section. *a*, ×21; *b*, ×21; *c*, ×17. Reg. No. G. 68307.

FIGURES 52*a*, *b*, *c*. *Pseudoceratodes kohaticus* n.sp. Lower Chharat (*Planorbis* Bed): Kohat area (Shekhan Nala section). *a*, ×1; *b*, ×1; *c*, ×1. Reg. No. G. 68043. Holotype.

FIGURE 53. *Valvata*? sp. A. Lower Chocolate Clays: Rakhi Nala section. ×20½. Reg. No. G. 68050.

FIGURES 54*a*, *b*. *Turritella rakhiensis* n.sp. Lower Chocolate Clays: Rakhi Nala section. *a*, ×2; *b*, ornament of one whorl enlarged. Reg. No. G. 68065. Holotype.

FIGURE 55. *Turritella soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×1. Reg. No. G. 68072. Holotype.

FIGURE 56. *Turritella* (*Haustator*?) *punjabensis* n.sp. Lower Chocolate Clays: Zinda Pir section. ×1. Reg. No. G. 68103. Holotype.

FIGURE 57. *Turritella* (*Haustator*) *imbricataria* Lamarck. Upper Chocolate Clays: Zinda Pir section. ×3. Reg. No. G. 68097.

FIGURES 58*a*, *b*. *Motyris pseudoaralica* n.nom. et sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68104. Paratype.

FIGURES 59*a*, *b*. *Mesalia* (*Sigmesalia*) *rakhiensis* n.sp. *Venericardia* Shales: Rakhi Nala section. *a*, ×3; *b*, ornament on one spiral thread, enlarged. Reg. No. G. 68117. Holotype.

FIGURES 60*a*, *b*. *Architectonica* (*Solariaxis*) *rakhiensis* n.sp. Upper Rakhi Gaj Shales: Rakhi Nala section. *a*, ×4½; *b*, ×4½. Reg. No. G. 68126. Holotype.

FIGURES 61*a*, *b*. *Pseudomalaxis punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×21; *b*, ×21. Reg. No. G. 68132. Holotype.

FIGURES 62*a*, *b*, *c*. *Punjabia marginostriata* n.g. et sp. Ghazij Shales: Zinda Pir section. *a*, ×15½; *b*, ×15½; *c*, ×15½. Reg. No. G. 68133. Holotype.

FIGURE 63. *Chondrocerithium pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. ×22 1/10. Reg. No. G. 68151.

FIGURE 64. *Cerithiopsis punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×3 1/10. Reg. No. G. 68164. Holotype.

FIGURE 65. *Triphora* (*Eocautor*) *soriensis* n.subg. et sp. Upper Chocolate Clays: Zinda Pir section. ×21¾. Reg. No. G. 68169. Holotype.

FIGURE 66. *Cirsotrema diversiformis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×21. Reg. No. G. 68174.

FIGURE 67. *Melanella* (*Polygireulima*) *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×20¾. Reg. No. G. 68185.

FIGURE 68. *Melanella* (*Polygireulima*) *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×21. Reg. No. G. 68184. Holotype.

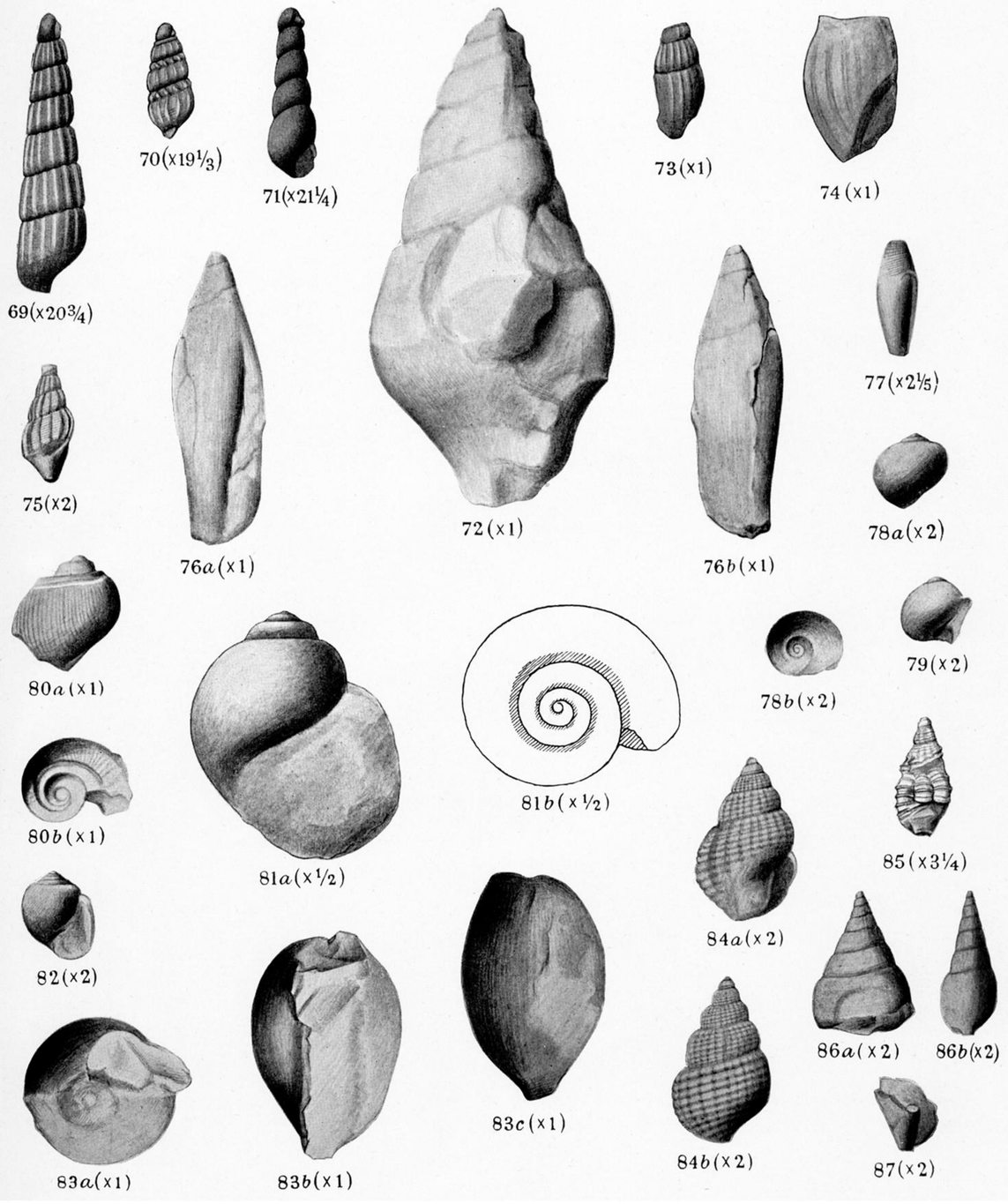


PLATE 3

FIGURE 69. *Turbonilla* (*Chemnitzia—A*) *soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×20¾. Reg. No. G. 68021. Holotype.

FIGURE 70. *Turbonilla* (*Terebronilla*) *terebriformis* n.subg. et sp. Upper Chocolate Clays: Rakhi Nala section. ×19⅓. Reg. No. G. 68202. Holotype.

FIGURE 71. *Eulimella* (*Belonidium*) *laxispirata* n.sp. Ghazij Shales: Zinda Pir section. ×21¼. Reg. No. G. 68203. Holotype.

FIGURE 72. *Tibia pseudomokattamensis* n.sp. Sirki Shale/Kohat Limestone: Sirki Paila. ×1. Reg. No. G. 68207. Holotype.

FIGURE 73. *Rimella pakistanica* n.sp. Shales with Alabaster: Rakhi Nala section. ×1. Reg. No. G. 68213. Holotype.

FIGURE 74. *Rimella pakistanica* n.sp. Shales with Alabaster: Rakhi Nala section. ×1. Reg. No. G. 68216.

FIGURE 75. *Dientomochilus* (*Varicospira*) *tenui-incisus* n.subg. et sp. Upper Chocolate Clays: Zinda Pir section. ×2. Reg. No. G. 68227. Holotype.

FIGURES 76*a*, *b*. *Terebellum fusiformopse* de Gregorio. White Marl Band: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68233.

FIGURE 77. '*Terebellum*' *diversiornatum* n.sp. Ghazij Shales: Zinda Pir section. ×2⅕. Reg. No. G. 68239. Holotype.

FIGURES 78*a*, *b*. *Euspira soriensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×2; *b*, ×2. Reg. No. G. 68246. Holotype.

FIGURE 79. *Euspira soriensis* n.sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68247.

FIGURES 80*a*, *b*. *Globularia pseudolatispira* n.sp. White Marl Band: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68255. Holotype.

FIGURES 81*a*, *b*. *Globularia* (*Ampullinopsis*) *altivapincana* n.sp. Shales with Alabaster: Rakhi Nala section. *a*, ×½; *b*, ×½. Reg. No. G. 68256. Holotype.

FIGURE 82. *Crommium pseudowillemeti* n.sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68262. Holotype.

FIGURES 83*a*, *b*, *c*. *Callistocypraea* (*Miolyncina*)? *soriensis* n.sp. White Marl Band: Zinda Pir section. *a*, ×1; *b*, ×1; *c*, ×1. Reg. No. G. 68269. Holotype.

FIGURES 84*a*, *b*. *Nassaria punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×2; *b*, ×2. Reg. No. G. 68273. Holotype.

FIGURE 85. *Muricopsis*? *bulbosinucleus* n.sp. Upper Chocolate Clays: Zinda Pir section. ×3¼. Reg. No. G. 68277. Holotype.

FIGURES 86*a*, *b*. *Tetrastomella*? *pseudohumilis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×2; *b*, ×2. Reg. No. G. 68279. Holotype.

FIGURE 87. *Tetrastomella*? *pseudohumilis* n.sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68280.

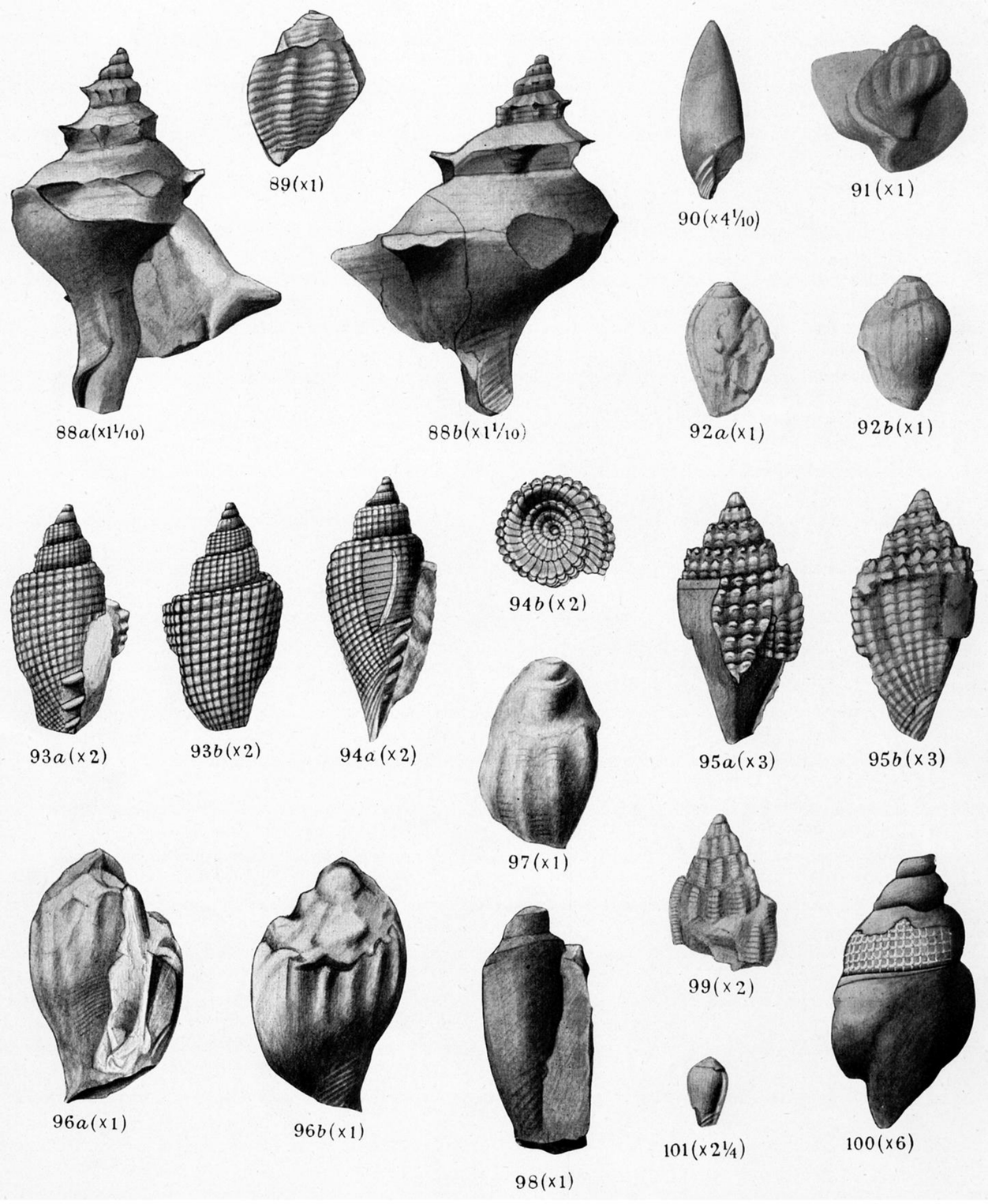


Plate 4

Figures 88*a*, *b*. *Volema* (*Pugilina*) *superspinosa* n.sp. Lower Chocolate Clays: Rakhi Nala section. *a*, $\times 1\frac{1}{10}$; *b*, $\times 1\frac{1}{10}$. Reg. No. G. 68285. Holotype.

Figure 89. *Streptochetus*/*Euthriofusus*? sp. A. Green and Nodular Shales: Rakhi Nala section. $\times 1$. Reg. No. G. 68289.

Figure 90. *Ancilla* (*Ancillus*) *pseudonana* n.sp. Ghazij Shales: Zinda Pir section. $\times 4\frac{1}{10}$. Reg. No. G. 68290. Holotype.

Figure 91. *Harpa*? *soriensis* n.sp. Lower Chocolate Clays: Zinda Pir section. $\times 1$. Reg. No. G. 68305. Holotype.

Figures 92*a*, *b*. *Lyria punjabensis* n.sp. White Marl Band: Zinda Pir section. *a*, $\times 1$; *b*, $\times 1$. Reg. No. G. 68306. Holotype.

Figures 93*a*, *b*. *Volutocorbis pakistanica* n.sp. Lower Chocolate Clays: east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab. *a*, $\times 2$; *b*, $\times 2$. Reg. No. G. 66932. Holotype.

Figures 94*a*, *b*. *Volutocorbis pakistanica* n.sp. Lower Chocolate Clays: east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab. *a*, $\times 2$; *b*, $\times 2$. Reg. No. G. 66933.

Figures 95*a*, *b*. *Volutocorbis soriensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, $\times 3$; *b*, $\times 3$. Reg. No. G. 68315. Holotype.

Figures 96*a*, *b*. *Volutospina kohatica* n.sp. Rubbly Limestones: Rakhi Nala section. *a*, $\times 1$; *b*, $\times 1$. Reg. No. G. 68316. Holotype.

Figure 97. *Volutospina kohatica* n.sp. Middle Shekhan Limestone: Kohat area (Panoba section). $\times 1$. Reg. No. G. 68318.

Figure 98. *Volutilithes*? *rakhiensis* n.sp. Shales with Alabaster: Rakhi Nala section. $\times 1$. Reg. No. G. 68324. Holotype.

Figure 99. *Trigonostoma pakistanicum* n.sp. Ghazij Shales: Zinda Pir section. $\times 2$. Reg. No. G. 68332. Holotype.

Figure 100. *Coptostoma*? *rakhiense* n.sp. Upper Chocolate Clays: Rakhi Nala section. $\times 6$. Reg. No. G. 68333. Holotype.

Figure 101. *Marginella* (*Prunum*) *soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. $\times 2\frac{1}{4}$. Reg. No. G. 68348. Holotype.

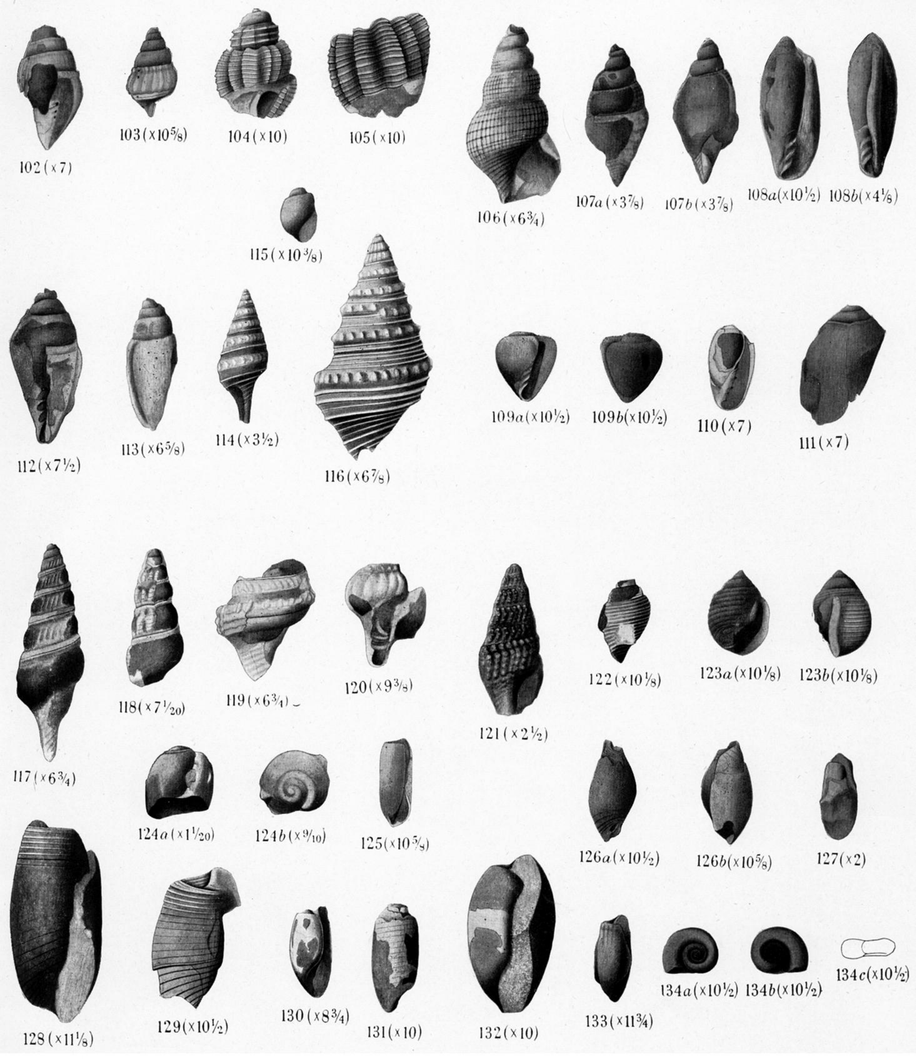


Plate 5

Figure 102. *Pyrenomitra anachis* n.gen et sp. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68299. Holotype.

Figure 103. *Pyrenomitra anachis* n.gen. et sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅝. Reg. No. G. 68300.

Figure 104. *'Cancellaria' soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68330. Holotype.

Figure 105. *'Cancellaria' soriensis* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68331.

Figure 106. *Coptostoma? punjabense* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68334. Holotype.

Figures 107*a*, *b*. *Coptostoma? punjabense* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×3⅞; *b*, ×3⅞. Reg. No. G. 68336.

Figures 108*a*, *b*. *Marginella* (*Prunum*) *pseudo-orientalis* n.sp. Lower Chocolate Clays: Rakhi Nala section. *a*, ×10½; *b*, ×4⅛. Reg. No. G. 68339. Holotype.

Figures 109*a*, *b*. *Marginella* (*Nudifaba*) *rakhiensis* n.subg. et sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×10½; *b*, ×10½. Reg. No. G. 68357. Holotype.

Figure 110. *Marginella* (*Prunum*) *unistriata* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68341. Holotype.

Figure 111. *Marginella* (*Prunum*) *unistriata* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7. Reg. No. G. 68342.

Figure 112. *Marginella* (*Serrata*) *pakistanica* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×7½. Reg. No. G. 68350. Holotype.

Figure 113. *Marginella* (*Serrata*) *pakistanica* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×6⅝. Reg. No. G. 68351.

Figure 114. *Turris* (*Gemmula*) *soriensis* n.sp. Ghazij Shales: Zinda Pir section. ×3½. Reg. No. G. 68369. Holotype.

Figure 115. *Acteon?* sp. A. Ghazij Shales: Zinda Pir section. ×10⅜. Reg. No. G. 68407.

Figure 116. *Turris* (*Gemmula*) *pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. ×6⅞. Reg. No. G. 68366. Holotype.

Figure 117. *Crassispira?* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68370.

Figure 118. *Brachytoma* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×7 1/20. Reg. No. G. 68372.

Figure 119. *Turricula* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×6¾. Reg. No. G. 68385. Holotype.

Figure 120. *Turricula* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×9⅜. Reg. No. G. 68386.

Figure 121. *Pyrenoturris punjabensis* n.gen. et sp. Ghazij Shales: Zinda Pir section. ×2½. Reg. No. G. 68397. Holotype.

Figure 122. *Acteon rakhiensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅛. Reg. No. G. 68405. Holotype.

Figures 123*a*, *b*. *Ringicula punjabensis* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×10⅛; *b*, ×10⅛. Reg. No. G. 68409. Holotype.

Figures 124*a*, *b*. *Akera pseudodesioi* n.sp. Green and Nodular Shales: Rakhi Nala section. *a*, ×1 1/20; *b*, ×9/10. Reg. No. G. 68418. Holotype.

Figure 125. *Retusa recta* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×10⅝. Reg. No. G. 68419. Holotype.

Figures 126*a*, *b*. *Rhizorus pakistanicus* n.sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×10½; *b*, ×10⅝. Reg. No. G. 68426. Holotype.

Figure 127. *Scaphander* sp. A. Rubbly Limestones: Rakhi Nala section. ×2. Reg. No. G. 68427.

Figure 128. *Roxania pseudosemistriata* n.sp. Upper Chocolate Clays: Zinda Pir section. ×11⅛. Reg. No. G. 68428. Holotype.

Figure 129. *Roxania pseudosemistriata* n.sp. Upper Chocolate Clays: Zinda Pir section. ×10½. Reg. No. G. 68429.

Figure 130. *Roxania?* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×8¾. Reg. No. G. 68431. Holotype.

Figure 131. *Roxania?* sp. A. Upper Chocolate Clays: Rakhi Nala section. ×10. Reg. No. G. 68432.

Figure 132. *Cylichna?* sp. A. Upper Chocolate Clays: Zinda Pir section. ×10. Reg. No. G. 68438.

Figure 133. *Cylichna* (*Acrostemma*) *punjabensis* n.sp. Ghazij Shales: Zinda Pir section. ×11¾. Reg. No. G. 68439. Holotype.

Figures 134*a*, *b*, *c*. *Planorbis alienatus* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×10½; *b*, ×10½; *c*, ×10½. Reg. No. G. 68471. Holotype.

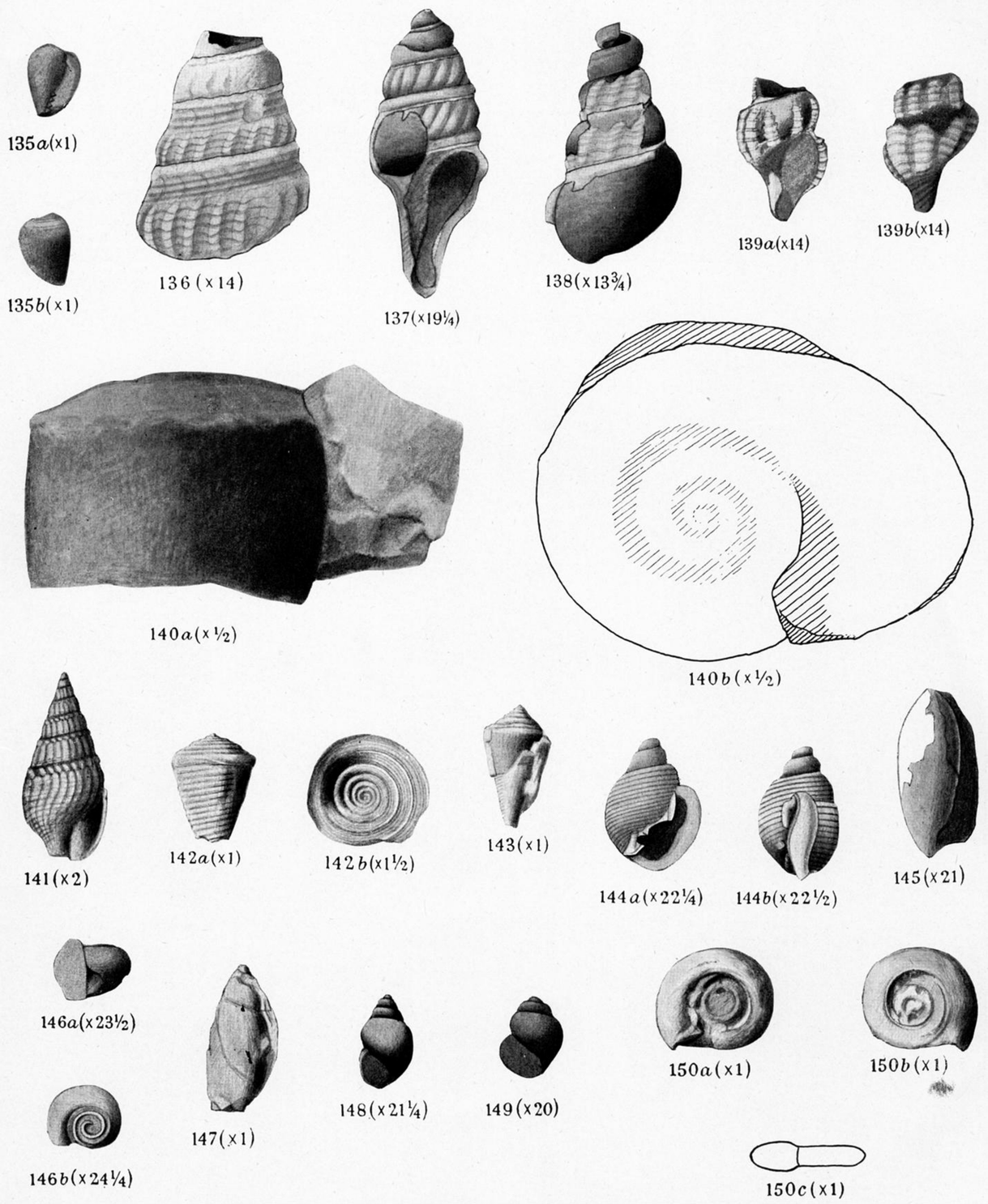


PLATE 6

FIGURES 135*a*, *b*. *Persicula*? sp. A. Upper Chocolate Clays: Zinda Pir section. *a*, ×1; *b*, ×1. Reg. No. G. 68364.

FIGURE 136. *Turricula praepromensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×14. Reg. No. G. 68378. Holotype.

FIGURE 137. *Turricula praepromensis* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×19¼. Reg. No. G. 68379.

FIGURE 138. *Turricula* (*Pleurofusia*) *obliquinodosa* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×13¾. Reg. No. G. 68392. Holotype.

FIGURES 139*a*, *b*. *Turricula* (*Pleurofusia*) *pseudoscala* n.sp. Upper Chocolate Clays: Rakhi Nala section. *a*, ×14; *b*, ×14. Reg. No. G. 68394. Holotype.

FIGURES 140*a*, *b*. *Conus* (*Lithoconus*) *colossus* n.sp. White Marl Band: Rakhi Nala section. *a*, ×½; *b*, ×½. Reg. No. G. 68398. Holotype.

FIGURE 141. *Pyrenoturris soriensis* n.gen. et sp. Ghazij Shales: Zinda Pir section. ×2. Reg. No. G. 68396. Holotype.

FIGURES 142*a*, *b*. *Conus* (*Leptoconus*) *safaedensis* n.sp. Lower Chocolate Clays: east of Safaed, south of Tobah, Dera Ghazi Khan District, Punjab. *a*, ×1; *b*, ×1½. Reg. No. G. 68399. Holotype.

FIGURE 143. *Conus* (*Leptoconus*) *safaedensis* n.sp. Eocene: Domanda. ×1. Reg. No. G. 68403.

FIGURES 144*a*, *b*. *Ringicula* (*Ringiculella*) *pakistanica* n.sp. Upper Chocolate Clays: Zinda Pir section. *a*, ×22¼; *b*, ×22½. Reg. No. G. 68416. Holotype.

FIGURE 145. *Retusa* (*Cylichnina*) *aequiattenuata* n.sp. Upper Chocolate Clays: Rakhi Nala section. ×21. Reg. No. G. 68424. Holotype.

FIGURES 146*a*, *b*. *Spiratella pseudopygmaea* n.sp. Ghazij Shales: Zinda Pir section. *a*, ×23½; *b*, ×24¼. Reg. No. G. 68440. Holotype.

FIGURE 147. *Aplexa kohatica* n.sp. Lower Chharat (*Planorbis* Bed): Kohat area (Panoba section). ×1. Reg. No. G. 68443. Holotype.

FIGURE 148. *Aplexa transportata* n.sp. Lower Chocolate Clays: Rakhi Nala section. ×21¼. Reg. No. G. 68450. Holotype.

FIGURE 149. *Aplexa robusta* n.sp. Lower Chocolate Clays: Rakhi Nala section. ×20. Reg. No. G. 68457. Holotype.

FIGURES 150*a*, *b*, *c*. '*Planorbis*' *kohaticus* n.sp. Lower Chharat (*Planorbis* Bed): Kohat area (Shekhan Nala section). *a*, ×1; *b*, ×1; *c*, ×1. Reg. No. G. 68464. Holotype.