Genus ***Posttornoceras*** Wedekind, 1910

Type species: *Posttornoceras balvei* Wedekind, 1910 from the mid Famennian *Platyclymenia annulata* Zone of the Rhenisch Slate Mountains.

Diagnosis. — Suture with pointed flank lobe and angular or pointed dorsolateral lobe.

Remarks. — Becker (1993b) proposed *Exotornoceras* for the most primitive members of the lineage with a relatively shallow dorsolateral lobe. The difference seems too minor and continuity too apparent to make this taxonomical subdivision practical. Becker (2002) suggested that this lineage was rooted in *Gundolficeras*, which is supported by the data from the Holy Cross Mountains.

The suture of *Posttornoceras* is similar to that of *Sporadoceras*, but these end-members of unrelated lineages differ rather significantly in the geometry of the septum (Becker 1993b; Korn 1999). In *Posttornoceras* the parts of the whorl in contact with the preceding whorl are much less extensive, the dorsolateral saddle is much shorter and of a somewhat angular appearance. This is obviously a reflection of the difference in the whorl expansion rate between the tornoceratids and cheiloceratids.

Posttornoceras superstes (Wedekind, 1908)
(Figs 154A and 159)

Type horizon and locality: Early Famennian at Nehden-Schurbusch, Rhenish Slate Mountains (Becker 1993b).

Diagnosis. — Suture with pointed tip of the flank lobe and roundedly angulate dorsolateral lobe.

Remarks. — *Gephyroceras niedzwiedzkii* of Dybczyński (1913) from Sieklucki's brickpit was represented by a specimen (probably lost) significantly larger than those described by Becker (1993b). The difference in proportions of suture seem to result from this ontogenetic difference, that is mostly from increase of the whorl compression with growth.

Distribution. — Reworked at Sieklucki's brickpit in Kielce.

Posttornoceras balvei Wedekind, 1910? (or *Sporadoceras* sp.)
(Figs 154B, C and 159)

Type horizon and locality: Mid Famennian at Beul near Balve, Rhenish Slate Mountains.

Material. — Three specimens.

Diagnosis. — Suture with tips of all lobes pointed and a narrow ventrolateral saddle.

Remarks. — Serial internal thickenings of the conch developed probably parallel to the aperture, with typically tornoceratid auricles. Despite the inferred form of aperture, the specimens studied may actualy belong to *Sporadoceras*, although restriction of shell thickenings to the venter make it different from species of that genus. Original specimens of both *P. balvei* (Wedekind 1918, pl. 17: 5) and the probably related *P. sodalis* Becker, 1995 (Bogoslovsky 1971, pl. 4: 8) show a high whorl expansion rate, much higher than in the Łagów specimens. This may be related to their early ontogenetic age but is not completely consistent with this identification.

Distribution. — Probably the *C. marginifera* and *P. trachytera* zones at Łagów-Dule.

Posttornoceras fallax Korn *in* Korn *et* Ziegler, 2002
(Figs 154D–F and 159)

Type horizon and locality: Enkeberg, Rhenish Slate Mountains (Becker 1995).

Material. — Ten specimens.

Diagnosis. — Suture with wide, convex ventrolateral saddle.

Distribution. — Probably the *P. jugosus* and *D. trigonica* zones at Kowala; reworked at Sieklucki's brickpit in Kielce.

Posttornoceras (or *Xenosporadoceras*) *posthumum* (Wedekind, 1918)
(Figs 155A–E, 157, and 159)

Type horizon and locality: Lower *Clymenia* Stufe at Hoevel near Balve in the Rhenish Slate Mountains.

Material. — Ten specimens.

Diagnosis. — Suture with wide, convex ventrolateral saddle and acute lateral saddle.

Remarks. — The original drawing of the suture by Wedekind (1918, fig. 47k) does not show the characteristic, advanced appearance of the lateral saddle, but its tracing on the holotype photograph (Wedekind

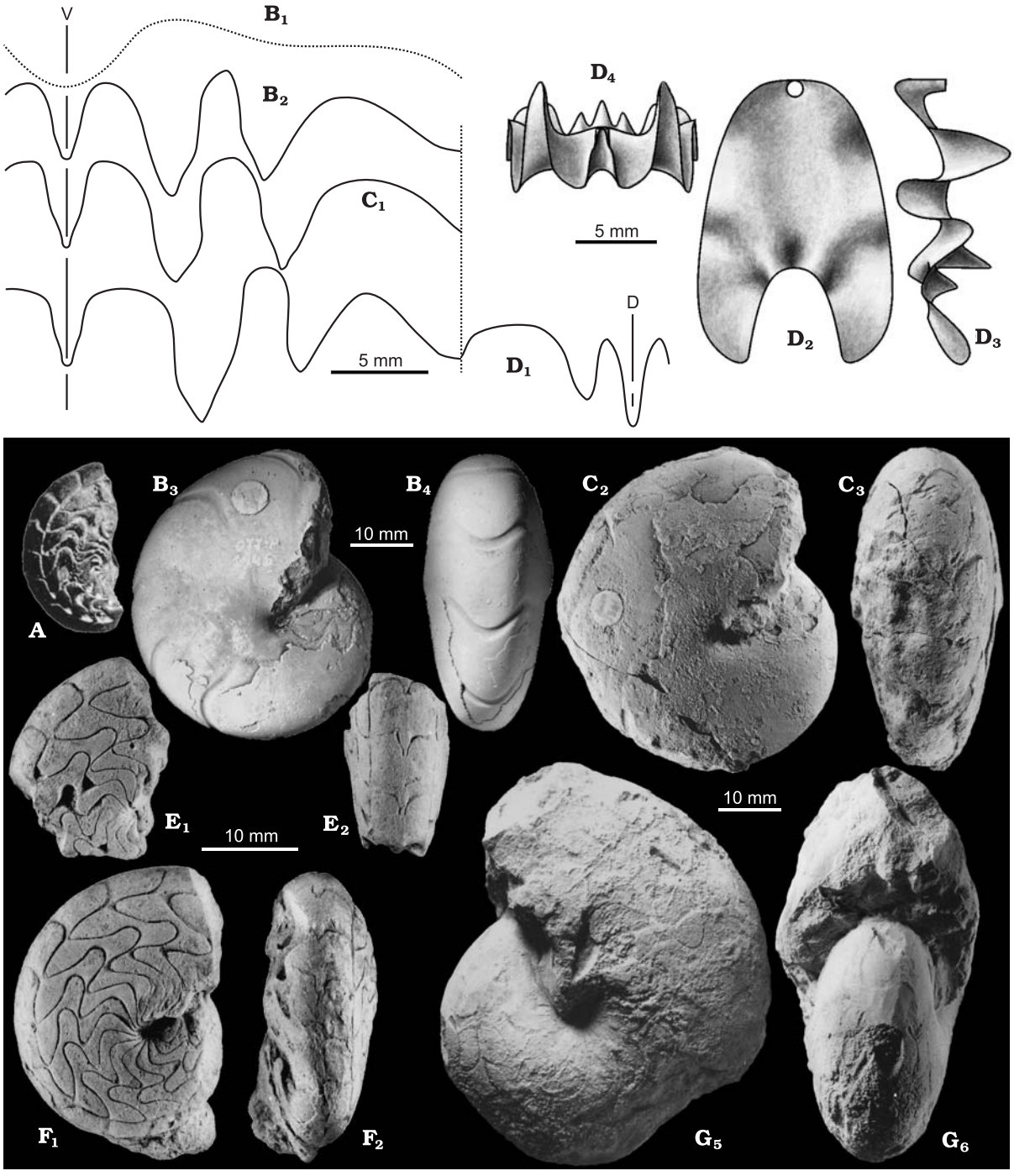


Fig. 154. Advanced tornoceratid *Posttornoceras* from the Holy Cross Mountains and Sudetes. **A**. *Posttornoceras superstes* (Wedekind, 1908) from Sieklucki's brickpit at Kielce (reproduced from Dybczyński 1913, pl. 2: 14; holotype of his *Gephyroceras niedzwiedzkii*, probably lost). **B**, **C**. *Posttornoceras balvei* Wedekind, 1910? (or *Sporadoceras* sp.) from Łagów; internal constriction (probably following the aperture) similar to those of *Sporadoceras* (see Fig. 175) but restricted to the venter, suture and views of specimen ZPAL AmVII/661 (B; black limestone suggestive of the *P. trachytera* Zone); suture and views of specimen ZPAL AmVII/1561 (C; rock matrix suggests the *C. marginifera* Zone). **D**–**F**. *Posttornoceras fallax* Korn, 2002 from the *D. trigonica* Zone at Kowala; suture and septum of unnumbered specimen from Czarnocki's collection (D; dorsal part of suture based on specimen IG 284.II.881); views of specimens IG 284.II.861 (E) and ZPAL AmVII/953. **G**. Probable *Posttornoceras* from the *P. jugosus* Zone at Dzikowiec, the Sudetes; specimen Uwr 2342 (original of *Sporadoceras muensteri* of Tietze 1870 and Frech 1902, pl. 4: 13); diagnostic growth lines not preserved.

1918, pl. 18: 13) rather closely approaches the Kowala specimens. Becker (1997) proposed a neotype for this species and illustrated its suture as well as the specimen (Becker 2002, pl. 2: 11, 12). The conch ornamenta-

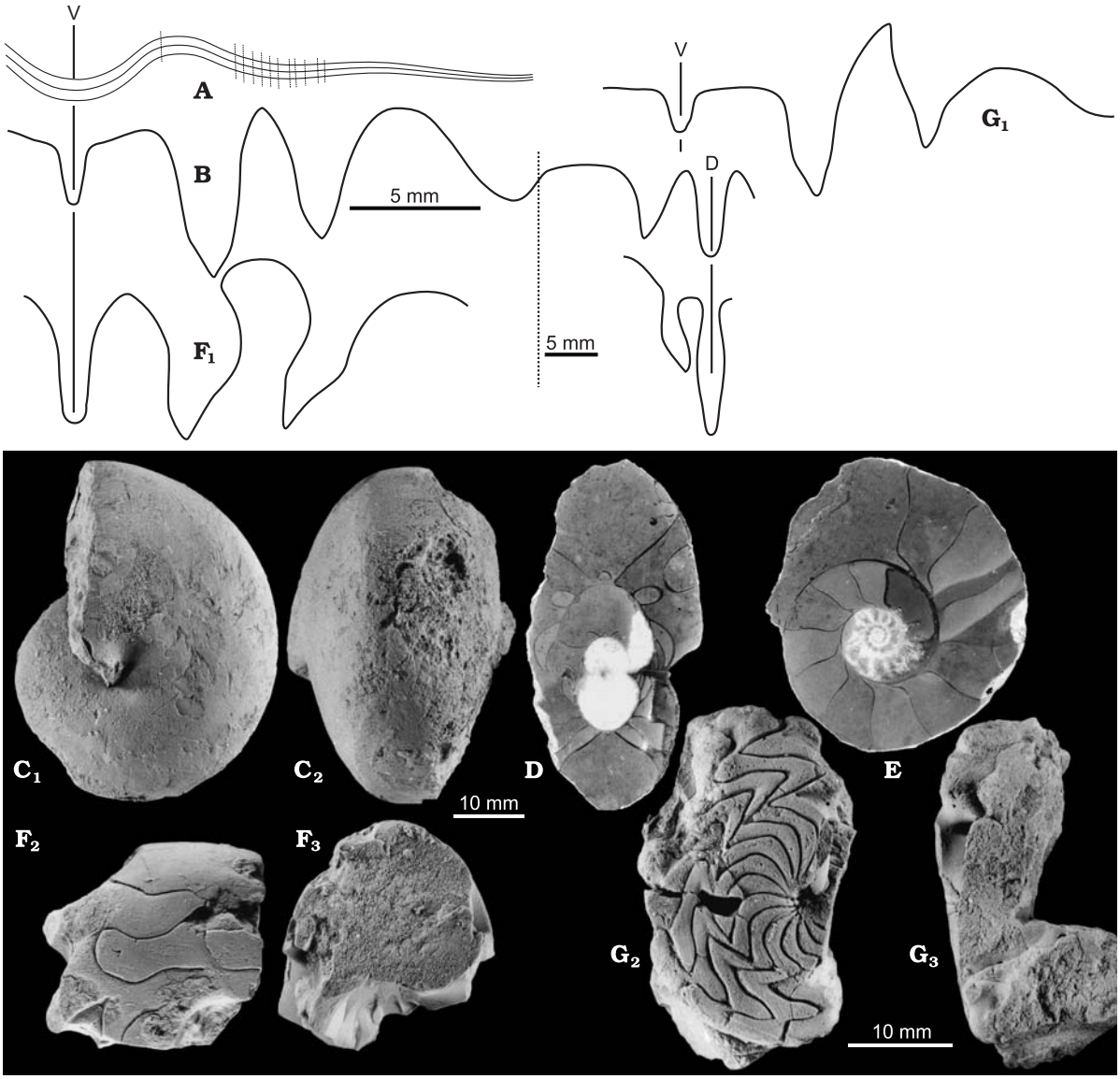


Fig. 155. Various species of *Posttornoceras* from Kowala in the Holy Cross Mountains. **A**–**E**. *Posttornoceras* (or *Xenosporadoceras*) *posthumum* (Wedekind, 1918) from the *D. trigonica* Zone; growth lines and longitudinal striation of specimen IG 284.II.926; suture of specimens IG 284.II.950 (external) and IG 284.II.953 (internal part; B); views of specimen IG 284.II.926 (C); polished transverse section of specimen IG 284.II.933 (D); medial section of IG 284.II.931 (E). **F**. *Posttornoceras*? *cornwallensis* (Selwood, 1960) probably from the *D. trigonica* Zone; suture and views of fragmentary specimen IG 284.II.880. **G**. *Posttornoceras* aff. *contiguum* (Münster, 1832) from the *P. jugosus* Zone; suture and views of specimen ZPAL AmVII/946.

tion, visible in specimen IG 284.II.926 shows small auricles and probably shallow ventral sinus associated with longitudinal striae, features typical of *Xenosporadoceras ademmeri* Korn, 2002 from the *P. annulata* fauna at Kattensiepen (Korn 2002, fig. 17). The main difference is in a more flattened conch and less derived suture in the mid Famennian species. Whether this is the same lineage characterized by longitudinally striated conchs or rather a case of convergence has to be settled out.

Distribution. — The *D. trigonica* Zone at Kowala.

Posttornoceras? *cornwallensis* (Selwood, 1960)
(Figs 155F and 159)

Type horizon and locality: *Wocklumeria* Zone Stourscombe Beds at Stourscombe, Cornwall.

Material. — One specimen.

Diagnosis. — Pointed ventrolateral saddle of the suture.

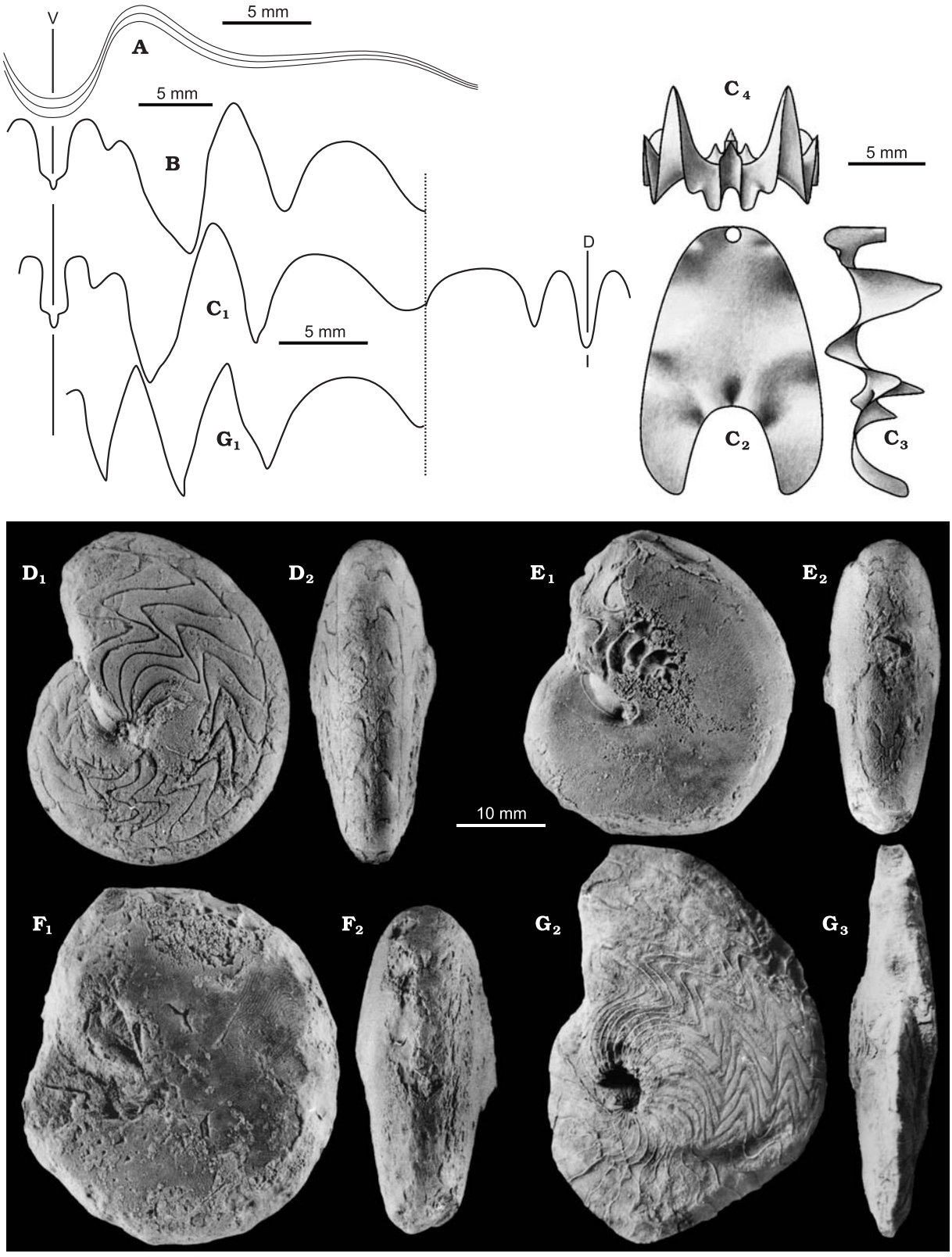


Fig. 156. Species of the most advanced tornoceratid *Discoclymenia* probably from the *D. trigonica* Zone at Kowala and Jabłonna (B) in the Holy Cross Mountains. **A**–**E**. *Discoclymenia cucullata* (von Buch, 1839); growth lines of specimen IG 284.II.284 (A), suture of specimens ZPAL AmVII/597 (B; bed 30 at Jabłonna), suture and septum of specimen UTü Ce 1012/39 (C), and views of specimens IG 284.II.855, 857, and 858 (D–F). **G**. *Discoclymenia zigzag* (Becker, 2002); suture and views of MB.C. 3433 (illustrated earlier by Schindewolf 1944, 1959 and Becker 2002).

Remarks. — This fragment of a large phragmocone shows very characteristic suture matching rather well that of the holotype and the specimen from the *Kamptoclymenia endogona* Subzone at Oberröding-hausen. If the specimen with growth lines was correctly identified by Selwood (1960), this is *Posttornoceras* and not a species of *Sporadoceras* (on this basis Becker 2002 proposed the separate genus *Selwoodites* for the Cornwall species). *Discoclymenia* differs in having one more lobe in its suture.

Distribution. — Probably the *D. trigonica* Zone at Kowala.

Posttornoceras aff. *contiguum* (Münster, 1832)
(Figs 155G and 159)

Material. — One specimen.

Remarks. — This incomplete specimen shows pointed lobes and saddles like *Discoclymenia*. However, the ventrolateral saddle, although incompletely preserved, seems to be subquadrate and undivided. This is a situation transitional between *P. contiguum*, as interpreted by Korn and Ziegler (2002), and *D. cucullata*. Becker (1993b) proposed the neotype for *Goniatites contiguus* Münster, 1832, claiming that this is a species of *Sporadoceras*, not *Posttornoceras*. Although the neotype does not show generically diagnostic growth lines, he later changed his mind and transferred the species back to *Posttornoceras* (Becker 1995; the action extensively discussed in Becker 2002) as was earlier done by Sobolew (1912) and Bogoslovsky (1971). For the sake of taxonomic stability it is probably reasonable to stop these shifts and assume that the second interpretation is correct.

Distribution. — The *P. jugosus* (possibly the late *L. styriacus*) Zone at Kowala.

Genus ***Discoclymenia*** Hyatt, 1884

Type species: *Goniatites Haueri* Münster, 1840 from the late Famennian of Franconia.

Diagnosis. — Suture with minute ventrolateral lobe and pointed tips of dorsolateral lobe and lateral saddle.

Remarks. — *Alpinites* Bogoslovsky, 1971, with *Wedekindoceras kayseri* Schindewolf, 1923 as the type species, and *Discoclymenia* represent (together with *Gundolficeras*, *Exotornoceras*, and *Posttornoceras*) successive grades in the probably monospecific lineage. Until more coeval (thus biological) species are recognized a moderately conservative approach to its taxonomy is thus proposed.

Discoclymenia cucullata (von Buch, 1839)
(Figs 156A–F, 157, and 159)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — 33 specimens.

Diagnosis. — Suture with small lobe at the tip of narrow ventrolateral saddle.

Remarks. — Some of the specimen from the red limestone at Kowala bear well preserved growth lines, regularly distributed over the conch surface and showing somewhat poined auricles.

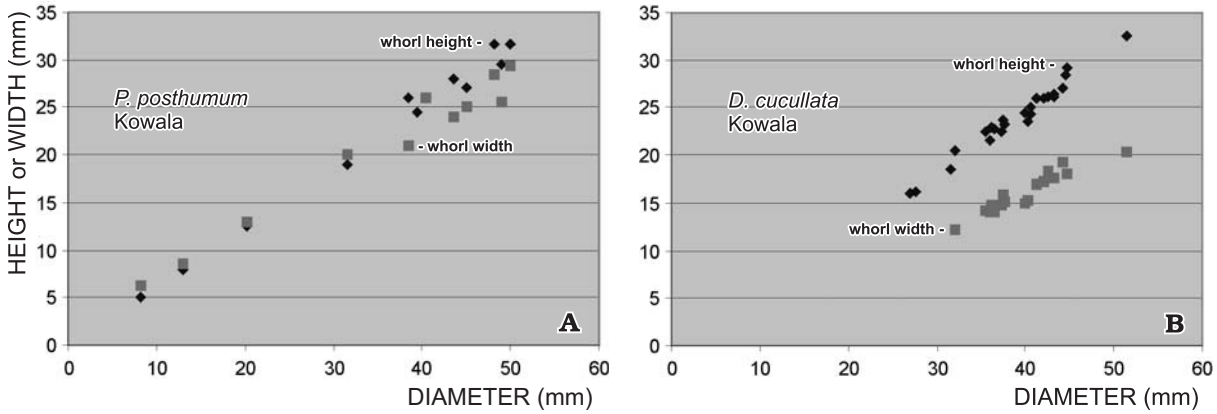


Fig. 157. Variability of conch dimensions of the most advanced tornoceratids from the *D. trigonica* Zone at Kowala. **A**. *Posttornoceras* (or *Xenosporadoceras*) *posthumum* (Wedekind, 1918). **B**. *Discoclymenia cucullata* (von Buch, 1839).

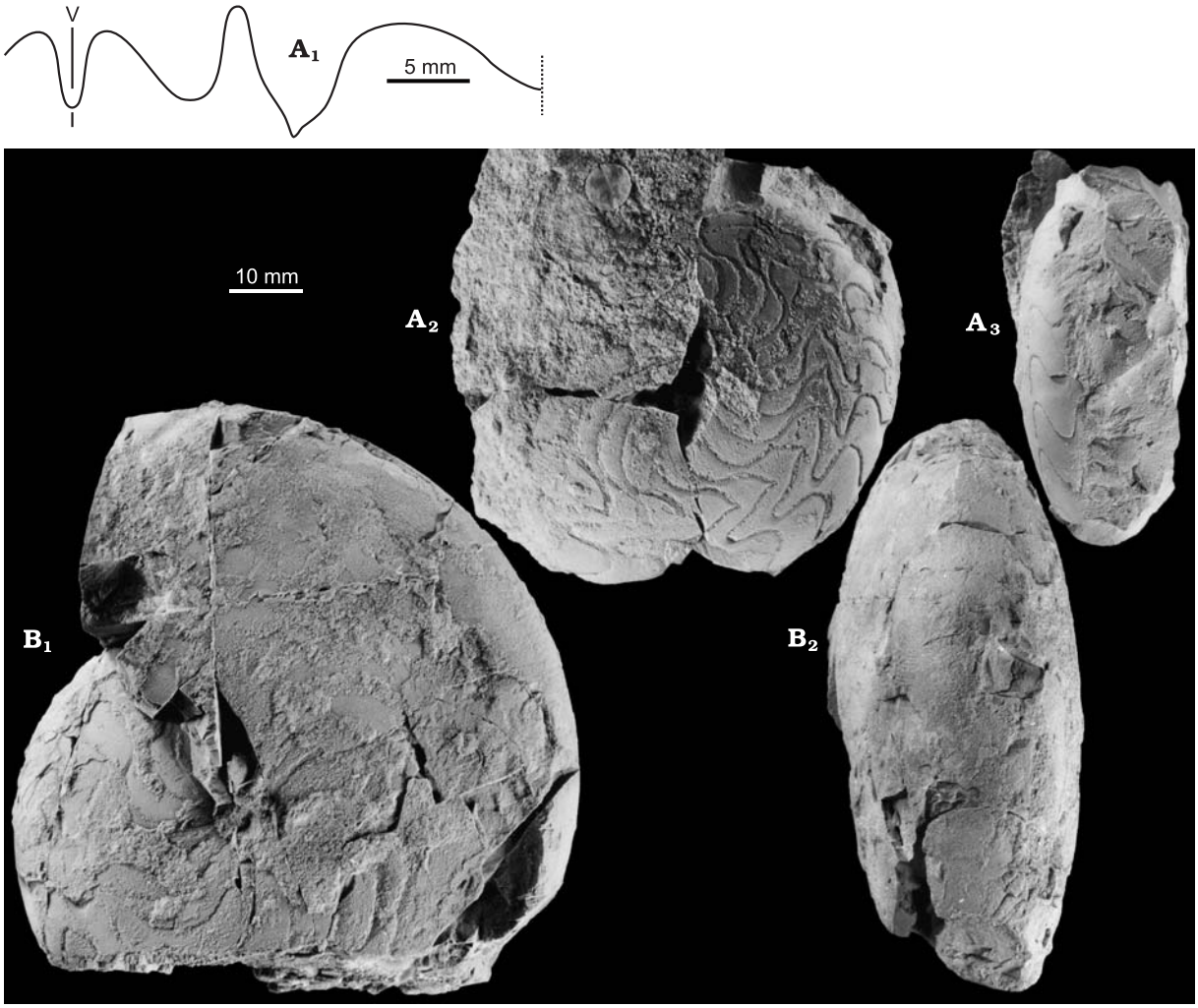


Fig. 158. Probable advanced tornoceratid (or early sporadoceratid) *Maeneceras lagoviense* Gürich, 1896 from the *C. quadrantinodosa* Zone at Łagów (locality Słupecka 73, sample ŁSŁ73-3) in the Holy Cross Mountains; suture and views of specimens ZPAL AmVII/1021 (A) and views of ZPAL AmVII/1022 (B).

Distribution. — The latest *P. jugosus* and *D. trigonica* zones at Kowala, Jabłonna (bed 30), Gałęzice (between Stokówka and Besówka hill), and at Dzikowiec (von Buch, 1839).

Discoclymenia zigzag (Becker, 2002)
(Figs 156G and 159)

Type horizon and locality: *Clymenia* Stufe age Fezzou Shale at Tourart, Morocco.

Material. — One specimen.

Diagnosis. — Thin discoidal conch with acute venter; pointed tips of all lobes and saddles of the suture, the middle flank lobe being the deepest.

Remarks. — The only specimen from Kowala has been already illustrated by Schindewolf (1944, 1959; as *Discoclymenia kayseri*) and Becker (2002). Stratigraphic distribution of other members of the group (classified by him in *Alpinites*) suggest that this was a lineage evolving towards more and more oxyconic conch.

Distribution. — Probably the *D. trigonica* Zone at Kowala.

Genus ?***Maeneceras*** Hyatt, 1884

Type species: *Goniatites acutolateralis* Sandberger et Sandberger, 1851 from the late Famennian of Franconia.

Diagnosis. — Suture with a single set of pointed flank lobes and shallow and wide ventrolateral lobe.

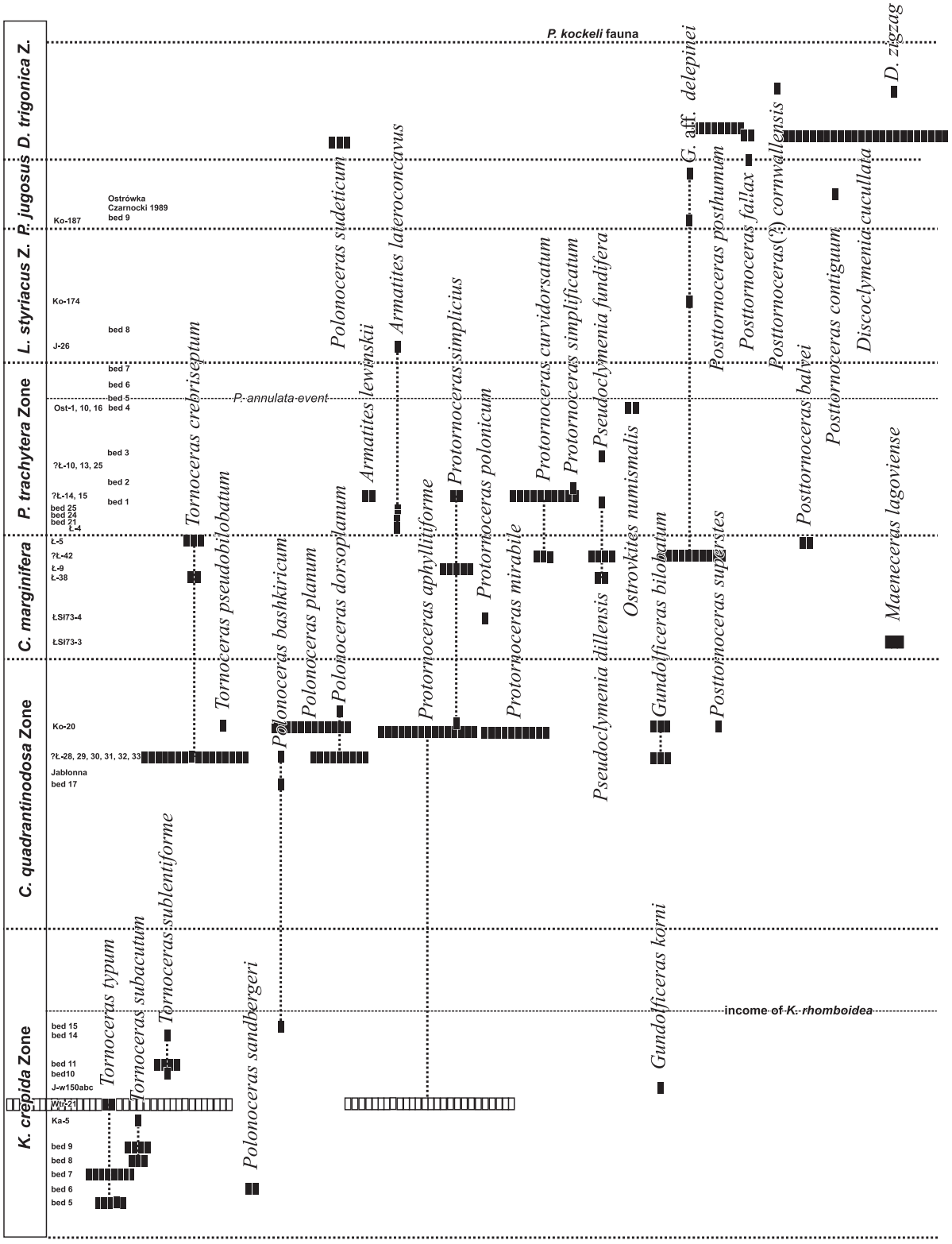


Fig. 159. Stratigraphic distribution of species of Tornoceratidae in the Polish Famennian. Black boxes denote specimens identified in particular sample; blank boxes refer to uncertain identification. Position of samples not included in Figs. 2 and 3 on the geochronological scale is hypothetical.

Remarks. — Complication of septal geometry proceeding from near the venter differs this lineage from the posttornoceratids and makes it similar rather to the sporadoceratids. However, the prominent ventrolateral auricles make *Maeneceras* unsimilar to the cheiloceratid clade and suggest that it is rather a homeomorph of

Felisporadoceras. To prove this a connecting link with either of the lineages has to be looked for. Acutely discoidal *Araneites falcatus* Bogoslovsky, 1971 is probably the end member of this lineage.

Maeneceras lagoviense Gürich, 1896
(Figs 158 and 159)

Type horizon and locality: Early Famennian Upper Łagów Beds at Łagów Dule, Holy Cross Mountains.

Material. — Three specimens.

Diagnosis. — Large conch, suture with asymmetric ventrolateral lobe of parabolic contour.

Remarks. — The holotype (Gürich 1896, pl. 13, 2a–c) is a fragmentary juvenile specimen from the "Sacculus Bank" at Łagów-Dule, with the suture closely similar to that in newly collected larger specimens. Some uncertainty remains, because in slightly younger strata at Łagów-Dule *Felisporadoceras subvaricatum* (Sobolew, 1914) occurs with closely similar suture. The main difference between advanced tornoceratids and cheiloceratids with complex suture is their conch expansion rate, which is expressed in much more extensive dorsolateral saddle in *Felisporadoceras*. The drawings in Gürich (1896) show this saddle to be relatively small, which suggests that this is truly *Maeneceras*.

Maeneceras acutolaterale (Sandberger *et* Sandberger, 1851) may be a closely related member of the same lineage, more advanced in having acute tips of the ventrolateral saddles. Mature conch of the holotype, illustrated by Becker (1993b, fig. 96) is about 160 mm in diameter. Specimens from Łagów are all juveniles but still they are among the largest goniatites from the Famennian of the Holy Cross Mountains. Growth lines are not recognizable on the conch surface but there are serial internal thickenings visible on the venter. They probably parallel aperture, showing a deep ventral sinus and apparently ventrolateral auricles. Similar is the course of internal thickenings in *M. pompeckji* (Wedekind, 1918) as illustrated by Bogoslovsky (1971, pl. 13: 5).

Distribution. — The *C. marginifera* Zone at Łagów Słupecka 73 locality (sample ŁSł73-3) and probably Łagów-Dule; reworked at Sieklucki's brickpit in Kielce.

Family **Cheiloceratidae** Frech, 1897

Diagnosis. — Conch aperture with obliquely convex profile, lacking auricles; relatively low whorl expansion rate; simple septum with weakly developed lateral vaultings.

Genus ***Nehdenites*** Korn *in* Korn *et* Ziegler, 2002

Type species: *Goniatites circumflexus* Sandberger, 1851 from the early Famennian of Nehden in the Rhenish Slate Mountains.

Diagnosis. — Simple, *Tornoceras*-like suture with rounded flank lobe and gently rounded dorsal lobe; conch involute throughout ontogeny.

Remarks. — Because of reasons presented in Korn and Ziegler (2002, p. 462) this generic name is preferred in respect to *Compactoceras* Becker, 2002.

Nehdenites verneuili (Münster, 1839)
(Figs 160A and 181)

Type horizon and locality: Unspecified horizon at Gattendorf in Franconia (Becker 1993b).

Material. — Eight specimens.

Diagnosis. — Internal thickening of the conch parallel to aperture, well developed only ventrally; discoidal, relatively flat conch with gently rounded venter; suture almost straight ventrally.

Remarks. — Sobolew's (1914) Oma-monomeroceras (*Cheiloceras*) *discoidale* (labeled *discoideum* on plate 1), O. (*Ch.*) *depressum*, and O. (*Ch.*) *lenticulare*, from the Lower Łagów Beds probably also belong here, but pyritic specimens from Sieklucki's brickpit attributed to the same species by Sobolew (1914) may rather represent a species of *Tornoceras*.

Distribution. — The *K. crepida* Zone at Kadzielnia, probably also at Łagów-Dule.

Nehdenites circumflexus (Sandberger *et* Sandberger, 1851)
(Figs 160B and 181)

Type horizon and locality: Early Famennian of Nehden, Rhenish Slate Mountains (Becker 1993b).

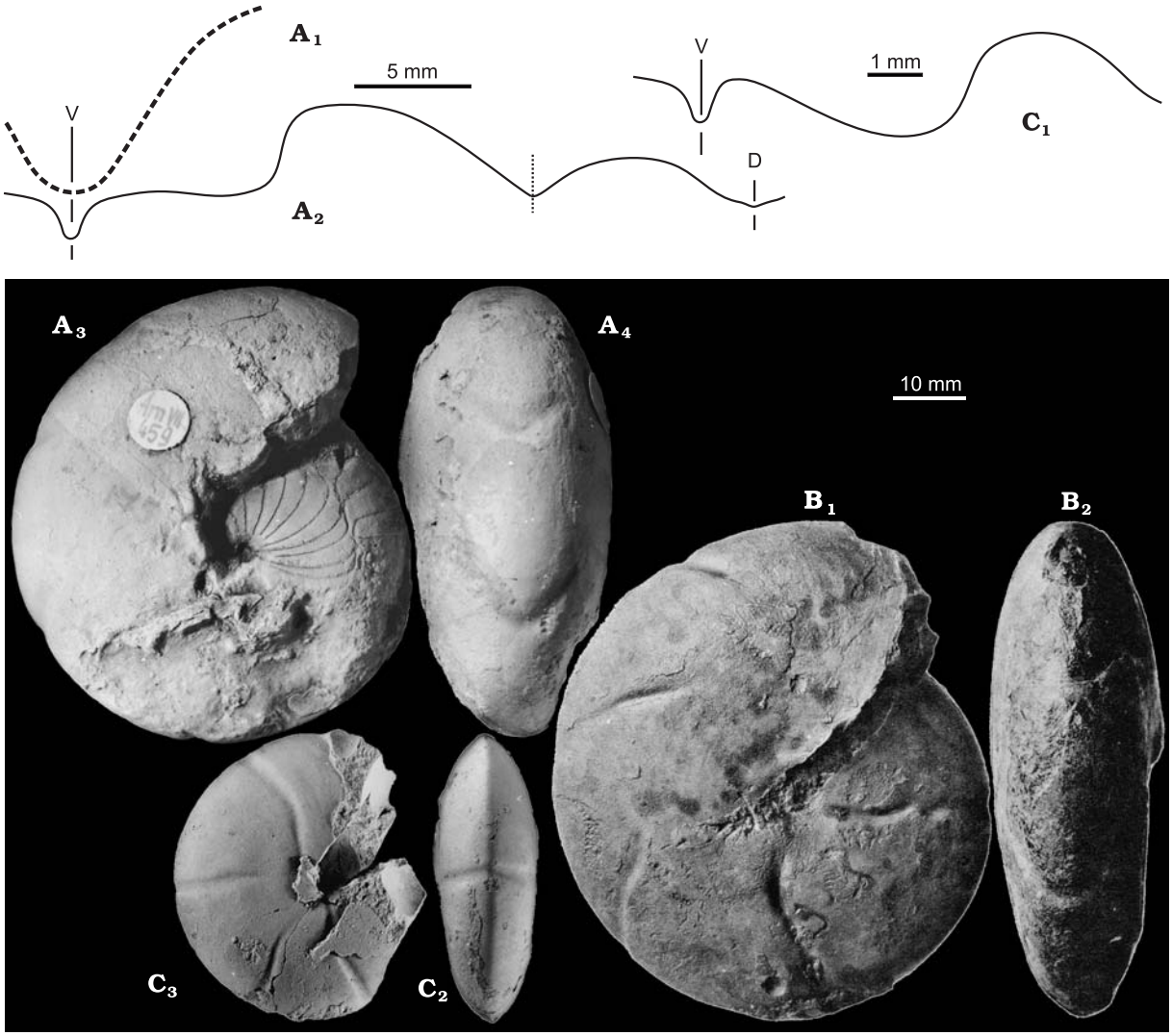


Fig. 160. Species of the ancestral cheiloceratid *Nehdenites* from the early Famennian of the Holy Cross Mountains. **A**. *N. verneuili* (Münster, 1839) from the *K. crepida* Zone at Kadzielnia; internal thickening, suture, and views of specimen ZPAL AmVII/459. **B**. *N. circumflexus* (Sandberger *et* Sandberger, 1851), from the Lower Łagów Beds (probably the late *K. crepida* Zone) at Łagów-Dule; views of the holotype of *Cheiloceras tenue* reproduced from Sobolew (1914, pl. 7: 8 and 8: 1). **C**. *N. praelentiformis* (Sobolew, 1914) from the *C. quadrantinodosa* Zone probably at Łagów-Dule (sample Mak-4); suture and views of specimen ZPAL AmVII/1861.

Diagnosis. — Internal thickenings of the conch parallel to aperture, may extend to flanks; flat conch with parabolic venter; relatively deep, rounded flank lobe of the suture.

Remarks. — Sobolew's (1914) Oma-monomeroceras (*Cheiloceras*) *praepolonicum*, and O. (*Ch.*) *tenue* from the Lower Łagów Beds probably also belong here. Unfortunately, the original specimens of Sobolew (1914) are probably lost and no more material has been collected from the type locality or coeval strata in the Holy Cross Mountains.

Distribution. — The latest *K. crepida* or *C. quadrantinodosa* Zone at Łagów-Dule.

Nehdenites praelentiformis (Sobolew, 1914)
(Figs 160C and 181)

Type horizon and locality: Early Famennian Lower Łagów Beds at Łagów Dule, Holy Cross Mountains.

Material. — One specimen.

Diagnosis. — Flat conch with acute venter; relatively deep, rounded flank lobe of the suture.

Remarks. — Becker (1993b) confirmed validity of the species and illustrated its specimen from the Rhenish Slate Mountains. The only specimen available to me lacks suture and its provenance is not clear (it comes from material discarded by Henryk Makowski, probably from Łagów, sample Mak-4).

Distribution. — The *C. quadrantinodosa* Zone at Łagów-Dule.

Genus ***Cheiloceras*** Frech, 1897

Type species: *Goniatites subpartitus* Münster, 1839 from the early Famennian of Franconia.

Diagnosis. — Suture running transversely in ventral part of the whorl with pointed narrow flank lobe of various depth; transverse internal thickenings of the conch do not following the course of aperture; conch involute except for the earliest few whorls in advanced species.

Remarks. — The concept of the genus has been extensively discused by Becker (1993) who applied much importance to evolute early whorls of the type species and exclude completely involute early species from the genus.

Cheiloceras pompeckji (Wedekind, 1908)
(Figs 161A–E and 181)

Type horizon and locality: Early Famennian of Nehden, Rhenish Slate Mountains (Becker 1993b).

Material. — 23 specimens.

Diagnosis. — Transverse internal thickenings of the conch virtually parallel to aperture, may be somewhat more acute ventrally, suture with a minute blunt indentation in the flank lobe with almost straight ventral slope.

Remarks. — The specimens from Kadzielnia are similar to those of *Nehdenites verneuili* from the same locality (but probably not the same stratum) having a somewhat more globose appearance and indented flank lobe of the suture. The lectotype of the species (Becker 1993b, pl. 20: 1, 2) is of a more discoidal appearance. The topotype specimen considered by Becker (1993b, pl. 20: 5, 6) to be within the range of variability fits the morphology of juvenile specimens from Jabłonna better than the lectotype. Oma-monomeroceras (*Nehdenites*) *verneuili*, O. (*Ch*.) *avaricatum*, and O. (*Ch*.) *avaricatum* from the Lower Łagów Beds of Sobolew (1914) may also belong to this species.

Distribution. — The *K. crepida* Zone at Kadzielnia and Jabłonna (wells W150b, c dug by Żakowa *et al*. 1984), possibly also Łagów-Dule.

Cheiloceras amblylobum (Sandberger *et* Sandberger, 1851)
(Figs 161F, G and 181)

Type horizon and locality: Early Famennian of Nehden, Rhenish Slate Mountains (Becker 1993b).

Material. — 11 specimens.

Diagnosis. — Radially running internal thickenings of the conch; *Tornoceras*-like suture; relatively globose conch.

Remarks. — Sobolew's (1914) Oma-monomeroceras (*Cheiloceras*) *globulare* from the Lower Łagów Beds may belong here.

Distribution. — The *K. crepida* Zone at Jabłonna (bed 5).

Cheiloceras inversum (Sobolew, 1912)
(Figs 161H–P and 181)

Type horizon and locality: Early Famennian Upper Łagów Beds at Łagów Dule, Holy Cross Mountains (Sobolew 1912b).

Material. — 34 specimens.

Diagnosis. — Internal thickenings of the conch tending to develop ventral saddle; suture with variously developed blunt indentation in the flank lobe; relatively globose conch.

Remarks. — Sobolew (1914) considered the presence and course of internal thickenings to be of much taxonomic importance. His view has not been generally accepted and the distribution of thickenings is known to be variable even within a single specimen. It is difficult to estimate the range of variability of the species because the material in my disposal may be heterogenous as it was collected mostly from loose blocks. In the collection of Otto Schindewolf housed at the Museum für Naturkunde in Berlin there is a sample probably coming from the same bed (his "Schicht 4" definitely do not corresponding to bed 4 of Sobolew

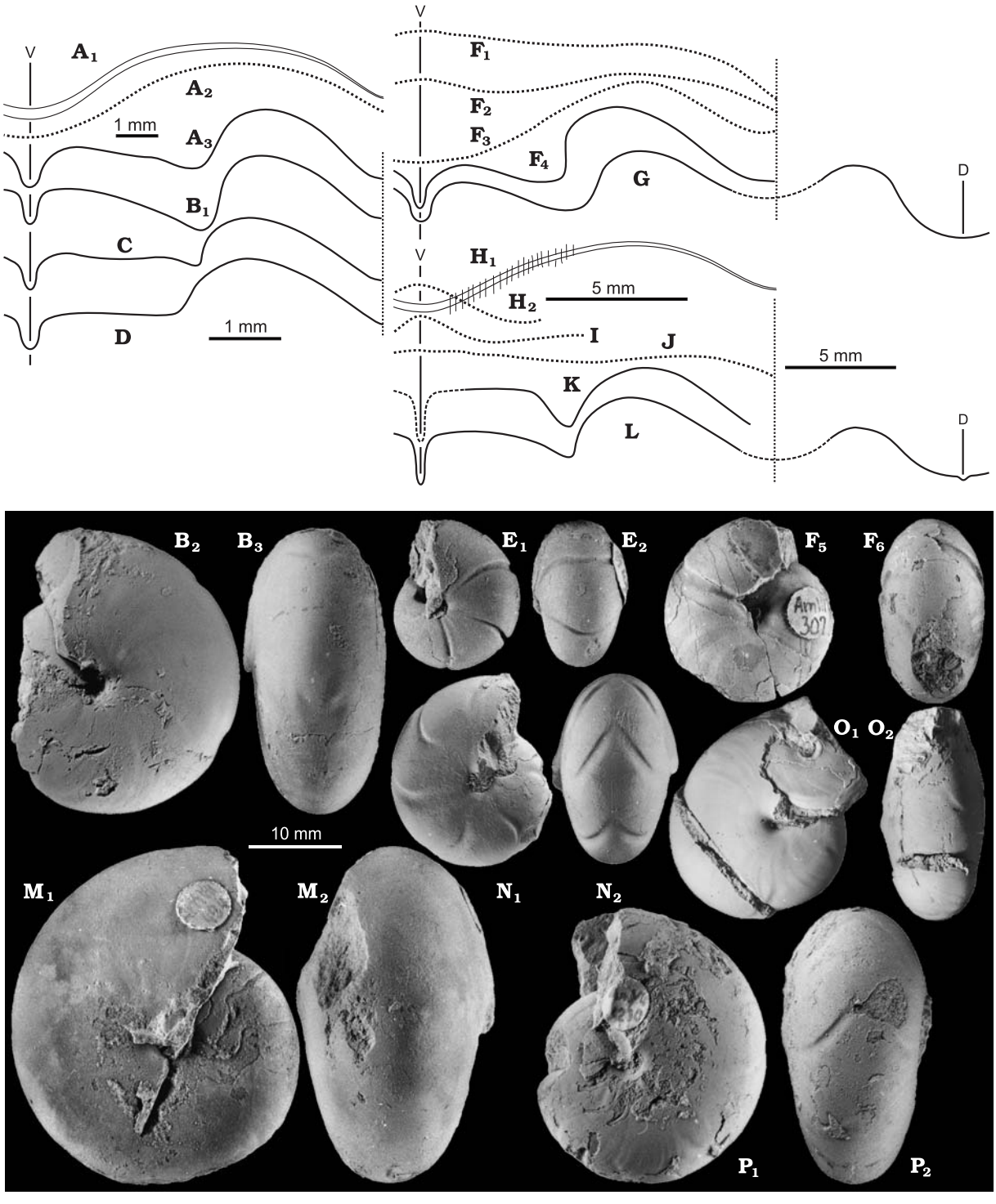


Fig. 161. Species of *Cheiloceras* with globose conch from the early Famennian of the Holy Cross Mountains. **A**–**E**. *Ch. pompeckji* (Wedekind, 1908) from the *K. crepida* Zone at Jabłonna (A, C–E; well w150c of Żakowa *et al*. 1984) and Kadzielnia (B); growth lines, internal thickening, suture and views of specimen ZPAL AmVII/319 (A); suture and views of specimen ZPAL AmVII/363 (B); and sutures of specimens ZPAL AmVII/326 and 315 (D, E). **F**, **G**. *Ch. amblylobum* (Sandberger *et* Sandberger, 1851) from the *K. crepida* Zone at Jabłonna; internal constrictions, suture and views of specimen ZPAL AmVII/307 (F, bed 5); suture of specimen ZPAL AmVII/312 (G, bed 8). **H**–**P**. *Ch. inversum* (Sobolew, 1912), from the *C. marginifera* Zone at Łagów-Dule; growth lines and internal thickening of specimen ZPAL AmVII/514 (H); thickenings of specimens IG.J.87b and ZPAL AmVII/306 (I, J); sutures of specimens ZPAL AmVII/362 and 509 (K, L, latter from sample Ł-5) and views of specimens ZPAL AmVII/494, 1235, and 351 (see also Fig. 146E for associated *Polonoceras dorsoplanum*), and 1230 (M–P).

1912b). There are 37 discoidal specimens probably representing *Ch. lagoviense* among them, 39 specimens with the ventral sinus of the internal thickening resembling what is here classified in *Ch. pompeckji*, 3 specimens with asymmetric course of thickenings, 17 with transverse thickenings, 19 specimens with a ventral saddle of the thickenings, and 29 specimens without thickenings. This is not consistent, however, with results of my collecting. In particular blocks specimens with clearly demarkated ventral saddle dominate, which seems to support taxonomic value of this character.

Distribution. — The *C. quadrantinodosa* and *C. marginifera* zones at Łagów-Dule (samples Ł-5, 28, and 29, Mak-4).

Cheiloceras subpartitum (Münster, 1839) *sensu* Becker, 1993
(Figs 162A, 181)

Type horizon and locality: Bed 4 at Gattendorf in Franconia (Becker 1993b).

Material. — One specimen.

Diagnosis. — Discoidal, relatively thick conch with transverse thickenings well developed also on flanks.

Remarks. — The neotype of the species selected by Becker (1993b) shows proportions of the conch and suture similar to the specimen from Jabłonna, without any pointing of the flank lobe. Perhaps Sobolew's (1914) Oma-monomeroceras (*Cheiloceras*) *disco-transversale* from the Upper Łagów Beds represents the same lineage. O. (*Ch.*) *tenue* from the clymeniid limestone at Łagów Dule may be a surprisingly late member of the lineage.

Distribution. —The *K. crepida* Zone at Jabłonna (bed 8).

Cheiloceras angustivaricatum (Sobolew, 1914)
(Figs 162B, C and 181)

Type horizon and locality: Early Famennian Lower Łagów Beds at Łagów Dule, Holy Cross Mountains.

Material. — Two specimens.

Diagnosis. — Minute conch with flat flanks and radially running sinuous internal thickenings; suture with angular flank lobe.

Remarks. — Sobolew's (1914) Oma-monomeroceras (*Cheiloceras*) *subpartitum* Münst. *angustivaricatum* from the Lower Łagów Beds and O. (*Ch.*) *s. lativaricatum*, from both the Lower (the holotype) and Upper Łagów Beds apparently represent morphotypes of the same species. Becker's (1993b) denomination of the neotype of *Ch. subpartitum* changed its traditional meaning and one of the names used by Sobolew (1914) offers a replacement. Perhaps also his Oma-monomeroceras (*Aganides*) *atavum* from Sieklucki's brickpit belongs here or to *Ch. discoidale*.

Distribution. — The *K. crepida* Zone at Jabłonna (bed 10), Kadzielnia (sample Ka-5), and Łagów-Dule (Sobolew 1914).

Cheiloceras discoidale (Sobolew, 1914)
(Figs 162D–M, 164, and 181)

Type horizon and locality: Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains.

Material. — 220 specimens.

Diagnosis. — Suture with acutely pointed shallow flank lobe; minute conch with flat flanks and radially running sinuous internal thickenings.

Remarks. — There is a variation in development of the flank lobe, ranging from an angulation similar to that in *Ch. angustivaricatum* to a quite apparent, narrow, acutely pointed lobe. This may be an expression of the evolutionary change towards a more elaborate suture. Even more variable is the course of internal thickenings.

Distribution. — The *C. quadrantinodosa* and *C. marginifera* zones at Łagów-Dule (samples Ł-5, 11, 28, and 29), reworked at Sieklucki's brickpit in Kielce.

Cheiloceras cf. *praecursor* (Frech, 1902)
(Figs 163A and 181)

Type horizon and locality: Early Famennian at Bleiwäsche in the Rhenisch Slate Mountains (Becker 1993b).

Material. — Six specimens.

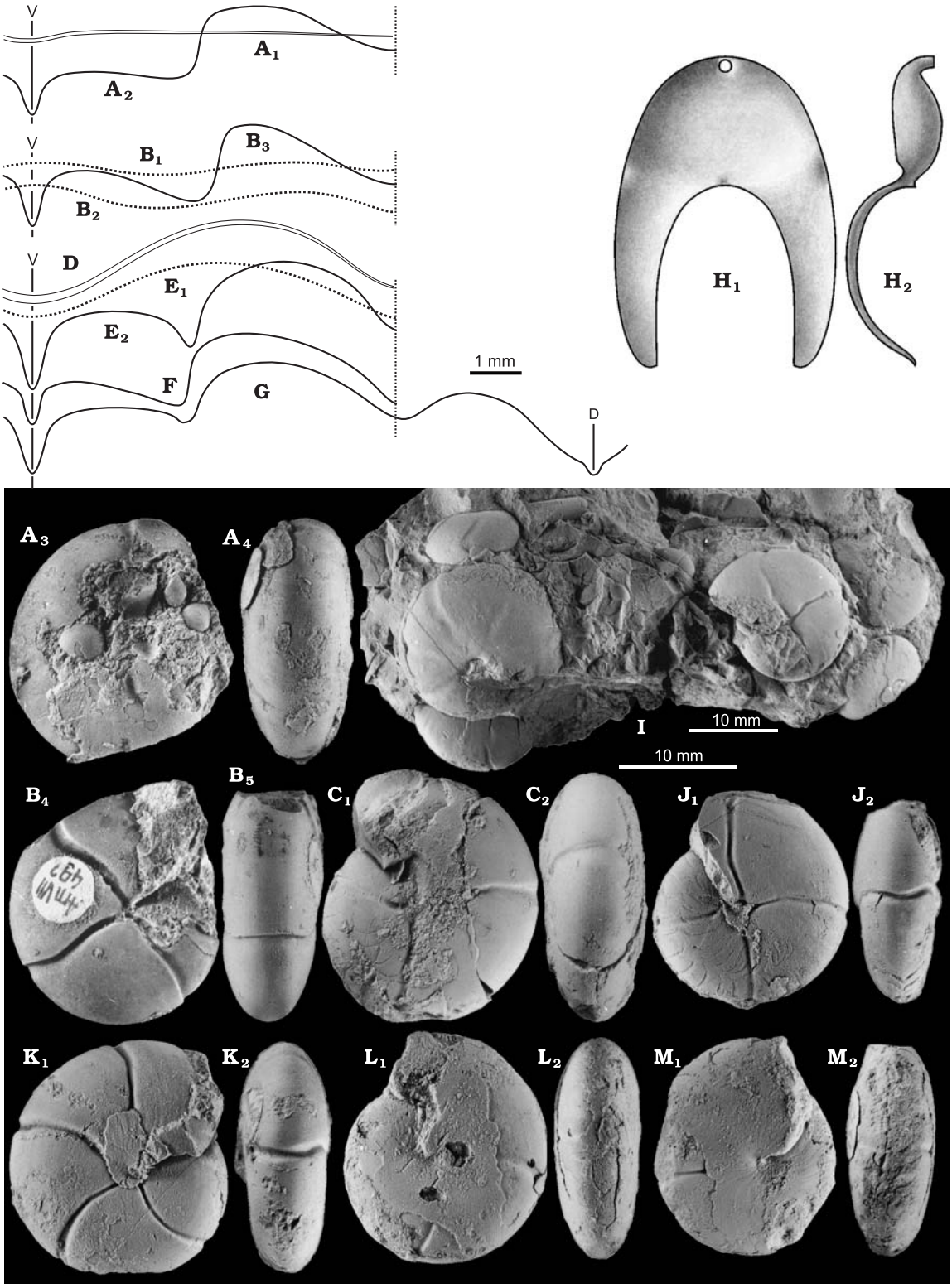


Fig. 162. Typical species of the *Cheiloceras* lineage from the Holy Cross Mountains. **A**. *Ch. subpartitum* (Münster, 1839) *sensu* Becker, 1993 from the *K. crepida* Zone at Jabłonna (bed 8); growth lines, suture and views of specimen ZPAL AmVII/310. **B**, **C**. *Ch. angustivaricatum* (Sobolew, 1914) from the *K. crepida* Zone at Jabłonna (B, bed 10) and Kadzielnia (C, sample Ka-5); internal thickenings and views of specimen ZPAL AmVII/310. **D**–**M**. *Ch. discoidale* (Sobolew, 1914) from Łagów-Dule, growth lines of specimen ZPAL AmVII/515 (D, sample Ł-5, the *C. marginifera* Zone), internal thickening and suture of specimen ZPAL AmVII/516 (E, sample Ł-11); sutures of specimens ZPAL AmVII/1336 and 1335 (F, G, sample Ł-29, the *C. quadrantinodosa* Zone); septum of specimen ZPAL AmVII/1334 (H, sample Ł-29); slab ZPAL AmVII/1228 with mass occurrence of the species (I); views of specimens ZPAL AmVII/1218, 1245, 1261, and 1331 (J–M, sample Ł-29).

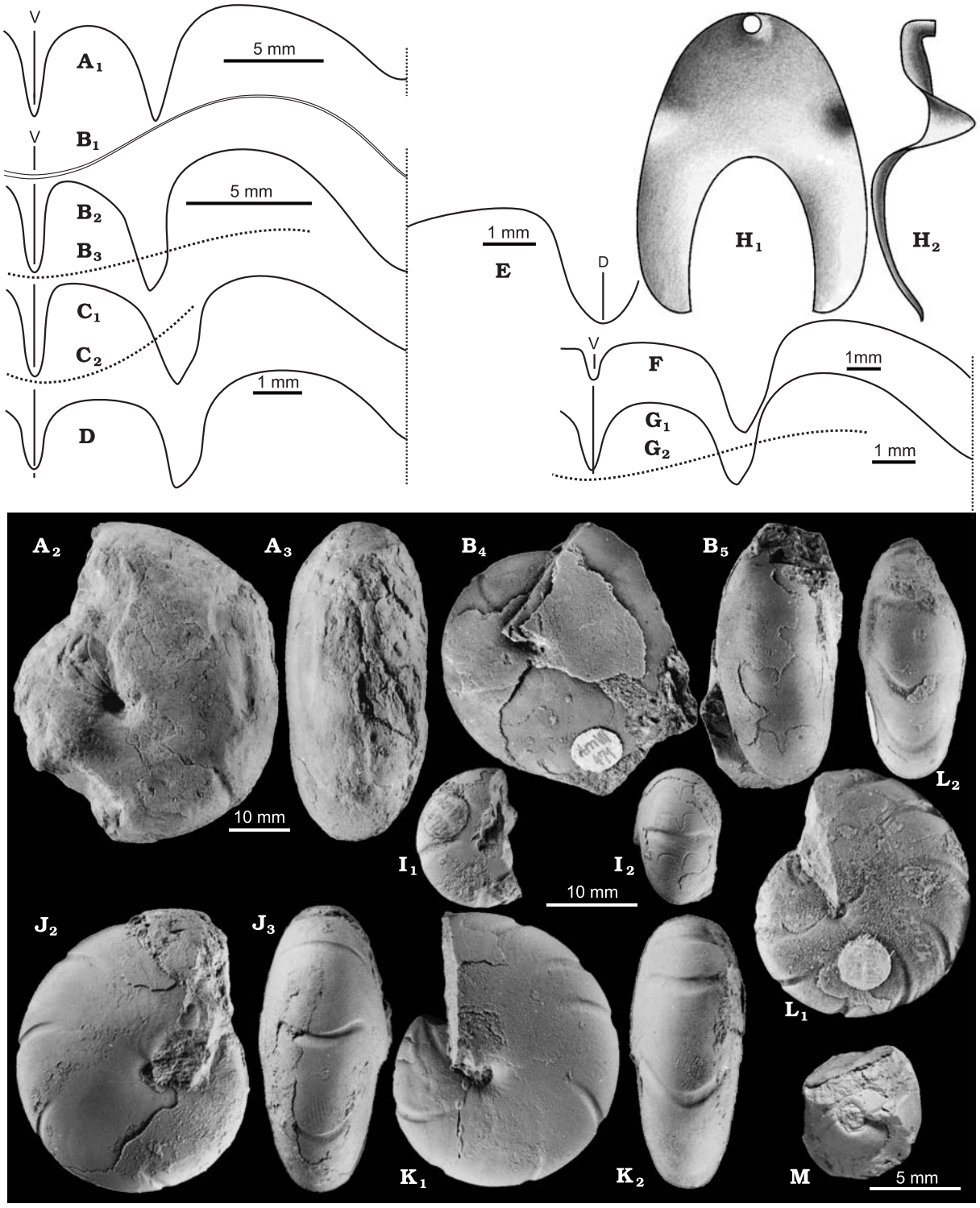


Fig. 163. Species of *Cheiloceras* with compressed conch and acute lobe of suture from the Famennian of the Holy Cross Mountains. **A**. *Ch. praecursor* (Frech, 1902) from the late *K. crepida* or early *C. quadrantinodosa* Zone at Kadzielnia; suture and views of specimen IG 175.II.7 collected by H. Makowski in 1949. **B**–**L**. *Ch. lagoviense* (Gürich, 1901) from the *C. quadrantinodosa* Zone at Łagów-Dule and Jabłonna (E); growth lines, suture, internal thickening, and views of specimen ZPAL AmVII/471 (B, sample Ł-12); sutures and internal thickenings of specimens ZPAL AmVII/475, 1445, 650, 1122 and 478 (C, sample Ł-21; D, sample Ł-33; E, well w150a at Jabłonna; F, sample Ł-34; G, loose from Łagów-Dule); septum reconstruction based on specimen ZPAL AmVII/657 (H); views of specimens ZPAL AmVII/478, 1449, 1122, and 469 (I, sample Ł-12; J, sample Ł-33; K, sample Ł-34; L, loose from Łagów-Dule). **M**. Juvenile cheiloceratid, possibly *Ch. praecursor*, from the *C. quadrantinodosa* Zone at Jabłonna (borehole IG-1 depth 67.6–68.00 m); specimen ZPAL AmVII/336.

Diagnosis. — Suture with acutely pointed, deep flank lobe and rounded ventrolateral saddle; medium-size thick discoidal conch with rare internal thickenings following the course of aperture.

Remarks. — From the geologically younger *Ch. lagoviense* the species differs in a more robust conch appearance and the shape of ventrolateral saddle of the suture. The two juvenile specimens illustrated by Becker (1993b) differ in prominence of the ventrolateral saddle. The suture of the neotype proposed by him is close to that shown by the specimen from Kadzielnia.

From the earliest species of *Dimeroceras* the species differs in the narrow juvenile umbilicus of about 1 mm width and the weak periumbonal lobe.

Distribution. — Late *K. crepida* or *C. quadrantinodosa* Zone at Kadzielnia as suggested by the marly matrix.

Cheiloceras lagoviense (Gürich, 1901)
(Figs 163B–L, 164, and 181)

Type horizon and locality: Early Famennian Upper Łagów Beds at Łagów Dule, Holy Cross Mountains.

Material. — 37 specimens.

Diagnosis. — Suture with acutely pointed, relatively deep flank lobe and trapezoidal ventrolateral saddle; medium-size discoidal conch with numerous internal thickenings following the course of aperture.

Remarks. — Among Gürich's (1901, pl. 14: 4a–c) specimens only the lectotype represents this species. The paratype (Gürich 1901, pl. 14: 5a, b) with radially arranged internal thickenings best visible on flanks and a more globose conch represents another cheiloceratid, possibly *Ch. amblylobum*. Sobolew's (1914) *Ch. sublagoviense* and *Ch. longilobum*, probably from the same stratum, may be conspecific. The latter species probably corresponds to more globose variants deviating from the main trajectory of the *Ch. lagoviense* ontogeny (Fig. 164B). This deviation is strong enough to suspect that a separate species is represented in the sample. Unquestionably homogenous natural assemblage is necessary to prove this.

Distribution. — *C. quadrantinodosa* and *C. marginifera* zones at Łagów-Dule (samples Ł-5, 12, 21, 28, 29, 30, 31, 33, 34, and Mak-3), possibly also at Jabłonna (well w150a of Żakowa *et al*. 1986).

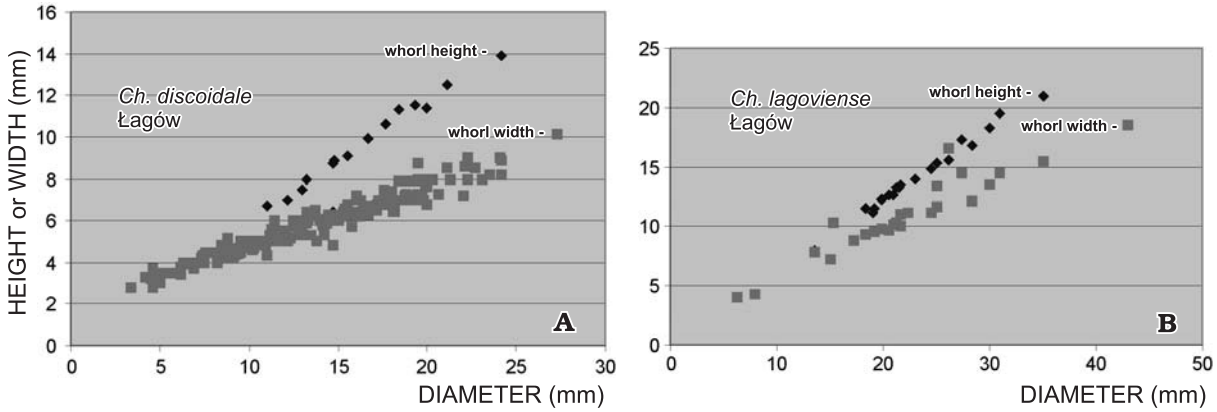


Fig. 164. Variability of conch dimensions of *Cheiloceras* species with compressed conchs from the *C. quadrantinodosa* Zone at Łagów-Dule. **A**. *Ch. discoidale* (Sobolew, 1914). **B**. *Cheiloceras lagoviense* (Gürich, 1901).

Family **Prolobitidae** Wedekind, 1913

Diagnosis. — Modified terminal conch aperture delimited by constriction or thickening; simplified suture; internal shell thickening only near aperture.

Genus ***Raymondiceras*** Schindewolf, 1934

Type species: *Prolobites simplex* Raymond, 1909 from the Three Forks Shale at Three Forks, Montana.

Diagnosis. — Regularly spiral conch with narrow or closed umbilicus.

Remarks. — Korn (2002) introduced genus *Roinghites* for prolobitids with simple suture, but its distinction in respect to *Raymondiceras* has to be confirmed by findings of mature specimens of the latter.

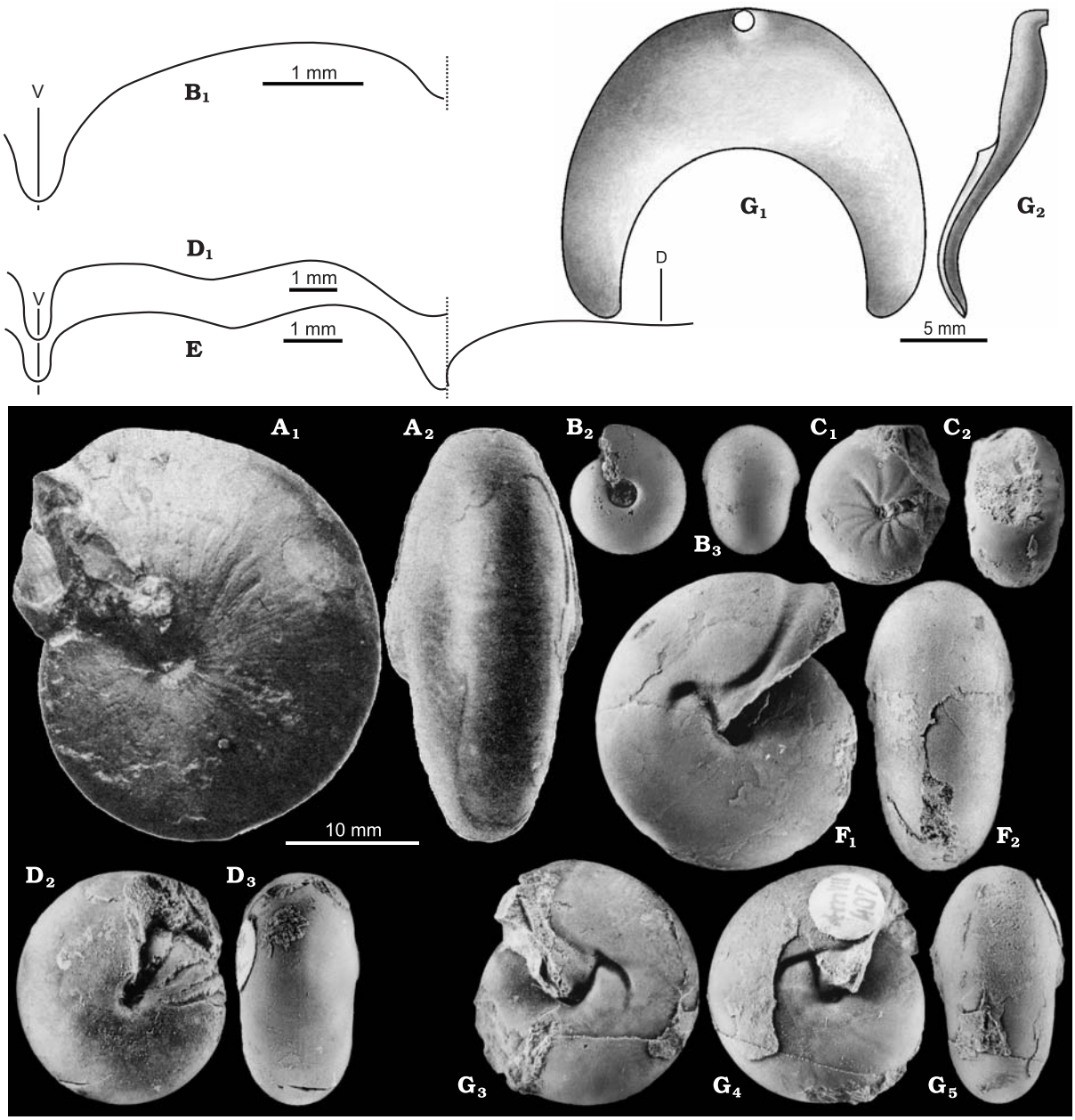


Fig. 165. Species of the prolobitid *Raymondiceras* from the Famennian of the Holy Cross Mountains. **A**. *R.*? *praelagoviense* (Sobolew, 1914) probably from the *C. quadrantinodosa* Zone at Łagów-Dule (reproduced from Sobolew 1914, pl.1: 3). **B**. *R. umbilicatum* (Sobolew, 1914) from the mid *C. marginifera* Zone at Kowala; suture and views of specimen ZPAL AmVII/1005. **C**. Possible *Raymondiceras* from Jabłonna (trench 123a of Żakowa *et al*. 1986); views of specimen ZPAL AmVII/613. **D–G**. *R. korni* sp. n. from the *P. trachytera* Zone at Łagów (D, G) and Ostrówka (E, F); suture and views of specimen ZPAL AmVII/407 (D); suture of views of specimen ZPAL AmVII/1070 (E, sample Ost-14); views of specimen IG 175.II.85 collected by J. Czarnocki (F); restored septum and views of the holotype ZPAL AmVII/407 (G).

Raymondiceras? *praelagowiense* (Sobolew, 1914)
(Figs 165A and 181)

Type horizon and locality: Early Famennian Lower Łagów Beds at Łagów Dule, Holy Cross Mountains.

Diagnosis. — Discoidal conchs with almost straight transverse profile of aperture and simplified suture with weak flank lobe.

Remarks. — Seven pyritized specimens from Sieklucki's brickpit of probably this species are represented in the collection of Dybczyński at Lvov (MD 13044). This confirms validity of the species, although photograph of the type specimen remains the only source of information on the conch morphology.

Distribution. — Probably the *C. quadrantinodosa* Zone at Łagów-Dule; reworked at Sieklucki's brickpit in Kielce.

Raymondiceras umbilicatum (Sobolew, 1914)
(Figs 165B and 181)

Type horizon and locality: Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains.

Material. — One specimen.

Diagnosis. — Extremely simplified suture and open umbilicus.

Remarks. — The figures provided by Sobolew (1914) to his Oma-re-protomeroceras *umbilicatum* are not especially informative. However, the wide, V-shaped ventral lobe seems to identify this species rather convincingly. Moreover, most of the material represented in Sieklucki's brickpit seems to come from strata of the same age as the horizon with pyritized ammonoids at Kowala. The specimen is actually indistinguishable from corresponding ontogenetic stages of *Prolobites delphinus* but cannot be attributed there because of its significantly older geological age. Becker *et al*. (2002) placed this species with reservation in their *Afrolobites*.

Distribution. — The mid *C. marginifera* Zone at Kowala.

Raymondiceras korni sp. n.
(Figs 165D–G and 181)

Holotype: Specimen IG 284.II.85 (Fig. 165G).

Type horizon and locality: Black clymenoid limestone at Łagów, Holy Cross Mountains.

Material. — 33 specimens.

Diagnosis. —Discoidal conchs of simple geometry with £-shaped internal thickening near aperture; suture with shallow flank lobe; umbilicus closed at juvenile stages.

Remarks. — *Roinghites bottkei* Korn, 2002 from the *Platyclymenia annulata* black shale at Kattensiepen is a closely related species different in a somewhat larger mature size, more discoidal conch, and less prominent internal shell thickenings (Korn 2002).

The single specimen from Jabłonna attributed here does not show suture and bears numerous serial conch constrictions or thickenings on flanks. Its taxonomic identification is highly tentative.

Distribution. — The *P. trachytera* Zone at Ostrówka (samples Ost-14 and 15), Besówka, and Łagów-Dule (sample Mak-2), possibly also Jabłonna (trench 123a of Żakowa *et al*. 1986; Fig. 165C).

Genus ***Prolobites*** Karpinsky, 1886

Type species: *Goniatites bifer* var. *delphinus* Sandberger *et* Sandberger, 1850 from the Rhenish Slate Mountains.

Diagnosis. — Mature living chamber with hood-like apertural part delimited by whorl constriction and internal shell thickening.

Remarks. — A troublesome aspect of the taxonomy within this genus is the tremendous difference in size of mature specimens co-occurring in the same bed. It remains unclear whether these are different species, different sexual morphs within the same species, or just a very wide population variability. It is noteworthy that in the most prolific *Prolobites* sample known in literature, from the locality Kara Dzhar in the southern Urals (Bogoslovsky 1969, p. 52) more than 600 specimens of *P. delphinus* are associated with 350 specimens of minute *P. nanus*. This suggests the sexual dimorphism but in the very rich sample from Kattensiepen in the Rhenish Slate Mountains minute prolobitids are apparently missing (Korn 2000). Rare associated specimens classified in four other species differ from each other in more or less ovoid shape of the last chamber and extension to maturity of the juvenile characters, that is open umbo and simplified suture. These may represent end-members of the populations variability of *P. delphinus*. The material available to me is too small to decide on this.

Prolobites delphinus (Sandberger *et* Sandberger, 1850)
(Figs 166A–D and 181)

Type horizon and locality: the Rhenish Slate Mountains.

Material. — 15 specimens.

Diagnosis. — Mature specimens reaching about 30 mm in diameter; suture with rounded deep lobe; evolute juvenile conch.

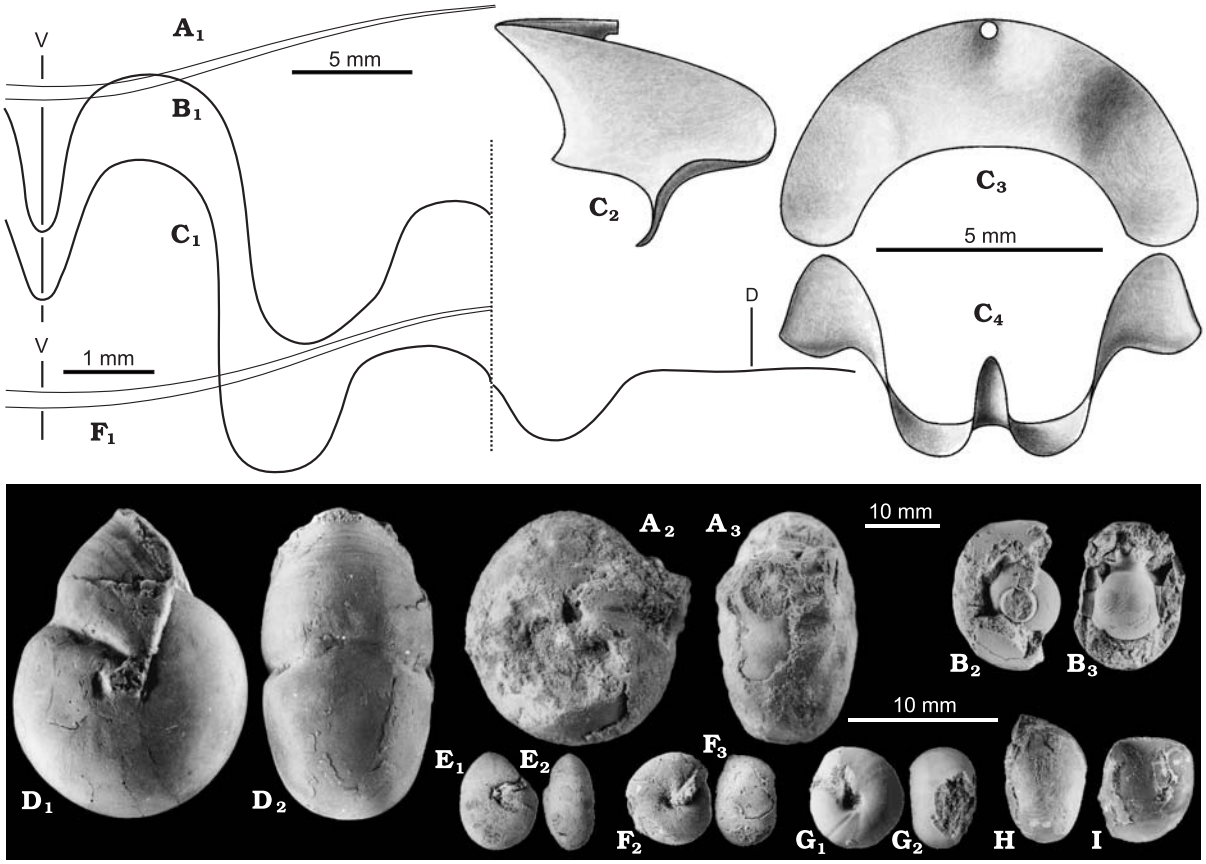


Fig. 166. Species of *Prolobites* from the Famennian of the Holy Cross Mountains. **A**–**D**. *Prolobites delphinus* (Sandberger *et* Sandberger, 1850) from the *P. trachytera* Zone at Ostrówka; growth lines and views of specimen ZPAL AmVII/200 with grey-green marly limestone matrix (A); suture and views of incomplete specimen IG 175.II.41 (B); suture and restored septum of specimen IG 175.II.49 (C); views of complete specimen IG 175.II.40 colected by J. Czarnocki (D). **E**–**I**. Possible *Prolobites nanus* (Perna, 1914) and related forms from Jabłonna; views of mature ovoid specimen ZPAL AmVII/623 (E, trench rIVc and f of Żakowa *et al*. 1986); growth lines and views of specimen ZPAL AmVII/621 (F, same trench); views of specimen ZPAL AmVII/620 (G, trench rIVf); fragmentary specimens ZPAL AmVII/145 and 121 (H, I; bed 24).

Remarks. — Suture has been traced only in two specimens and they differ significantly in shape of the flank lobe, subcircular in one, and parabolic in the other. I am thus skeptical regarding taxonomic value of this character in distinguishing species of the genus. In fact, data presented by Bogoslovsky (1969) show that virtually all characters of the species are extremely variable, with possible exception of the apertural modifications (see Korn *et al*. 1984; Korn 2002). The specimen with well preserved shell (Fig. 166A) shows coarse growth lines characteristic of the species but most specimens from the Państwowy Instytut Geologiczny in Warsaw collection are devoid of the external shell layer.

Distribution. — The *P. trachytera* Zone at Ostrówka (beds 2 and 3 of Czarnocki 1989). Specimens from Czarnocki's collection are preserved in black limestone, similar to that with *R. korni* sp. n. (well represented also in my material). The only specimen collected by myself at the locality from the scree is preserved, however, in a greyish-green marly limestone. This suggests that *R. korni* (occurring alone at Łagów) and *P. delphinus* did not come from the same bed.

Prolobites nanus (Perna, 1914)
(Figs 166E–I and 181)

Type horizon and locality: Locality 839 near Kirsy, the southern Urals.

Material. — Five specimens.

Remarks. — A few extremely small mature prolobitid conchs have been recovered from a not precisely defined horizons at Jabłonna. They are of size from 8 to 11 mm and may, with some difficulty, be fit in the range of variability of *P. nanus* (Perna, 1914) (ranging from 7 to 16 mm; Bogoslovsky 1969, p. 186).

Distribution. — The *P. trachytera* (bed 24) and *L. styriacus* (trenches rIVc and f of Żakowa *et al*. 1986) zones at Jabłonna.

Family **Dimeroceratidae** Hyatt, 1884

Diagnosis. — Suture with umbonal lobe and trifid dorsal lobe; evolute juvenile conch; conch aperture with oblique convex profile; relatively low whorl expansion rate.

Genus ***Dimeroceras*** Hyatt, 1884

Type species: *Goniatites mamillifer* Sandberger *et* Sandberger, 1850 from Enkeberg in the Rhenish Slate Mountains (Becker 1993b).

Diagnosis. — Suture with incipient dorsolateral lobe; mature conch discoidal.

Dimeroceras kontkiewiczi Dybczyński, 1913
(Figs 167 and 181)

Type horizon and locality: Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains.

Material. — Five specimens.

Diagnosis. — Juvenile conch discoidal with open umbo about 3 mm wide; at the venter internal thickenings parallel to the aperture.

Remarks. — An angulation of the dorsolateral saddle marks an incipient dorsolateral lobe of the same kind as in *D. globosoides*. The difference between these species consists in a less globose conch shape and internal thickenings parallel to aperture in the Jabłonna population, which seems also to be stratigraphically older that that at Łagów.

Early stages of the ontogeny and the conch form indistinguishable from typical species of *Cheiloceras* make this species a good connecting link between families, as already pointed out by Becker (1993b), who included it in his genus *Praemeroceras*.

The holotype of the species is a juvenile 17 mm in diameter with well exposed suture (Dybczyński 1913, pl. 2: 16), rather poorly preserved but the conch globosity and narrow umbo at such ontogentic stage fits that of the Jabłonna specimens, making it unlike more advanced species of *Dimeroceras*. In Otto Schindewolf 's sample "Schicht 4", mentioned above in connection with *Cheiloceras inversum*, there are specimens with a depressed area surrounding the closed umbo and probably representing a button-like internal thickening. Such specimens were classified by Sobolev (1914) in his *C. depressum*.

Distribution. — Probably early part of the *C. marginifera* Zone at Jabłonna (well w86b of Żakowa *et al*. 1986); reworked at Sieklucki's brickpit in Kielce.

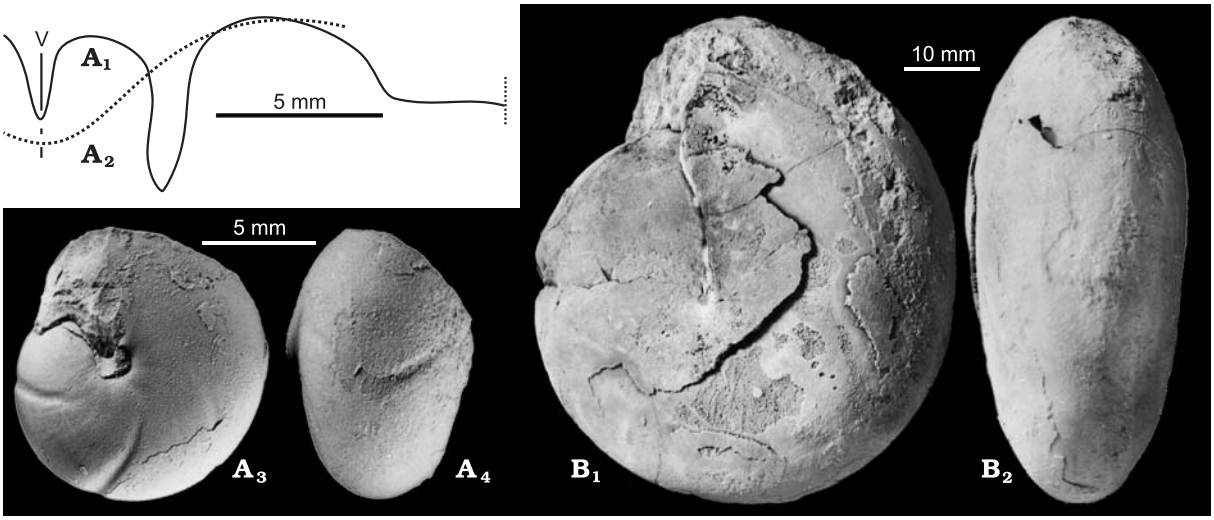


Fig. 167. *Dimeroceras kontkiewiczi* Dybczyński, 1913 from the *C. marginifera* Zone of the Holy Cross Mountains; suture, internal thickening and views of specimen ZPAL AmVII/728 from Jabłonna (A, well w86b of Żakowa *et al*. 1986); complete mature specimen MfN, unnambered, from coeval strata at Łagów-Dule (B; O. Schindewolf collection, his "Schicht 4") possibly belonging to this species (suture not exposed).

Dimeroceras globosoides (Sobolew, 1914)
(Figs 168 and 181)

Type horizon and locality: Early Famennian Upper Łagów Beds at Łagów Dule, the Holy Cross Mountains.

Material. — 18 specimens.

Diagnosis. — Suture with incipient umbonal lobe; juvenile conch globose with umbo about 3 mm wide; internal shell thickenings, if present, of radial course.

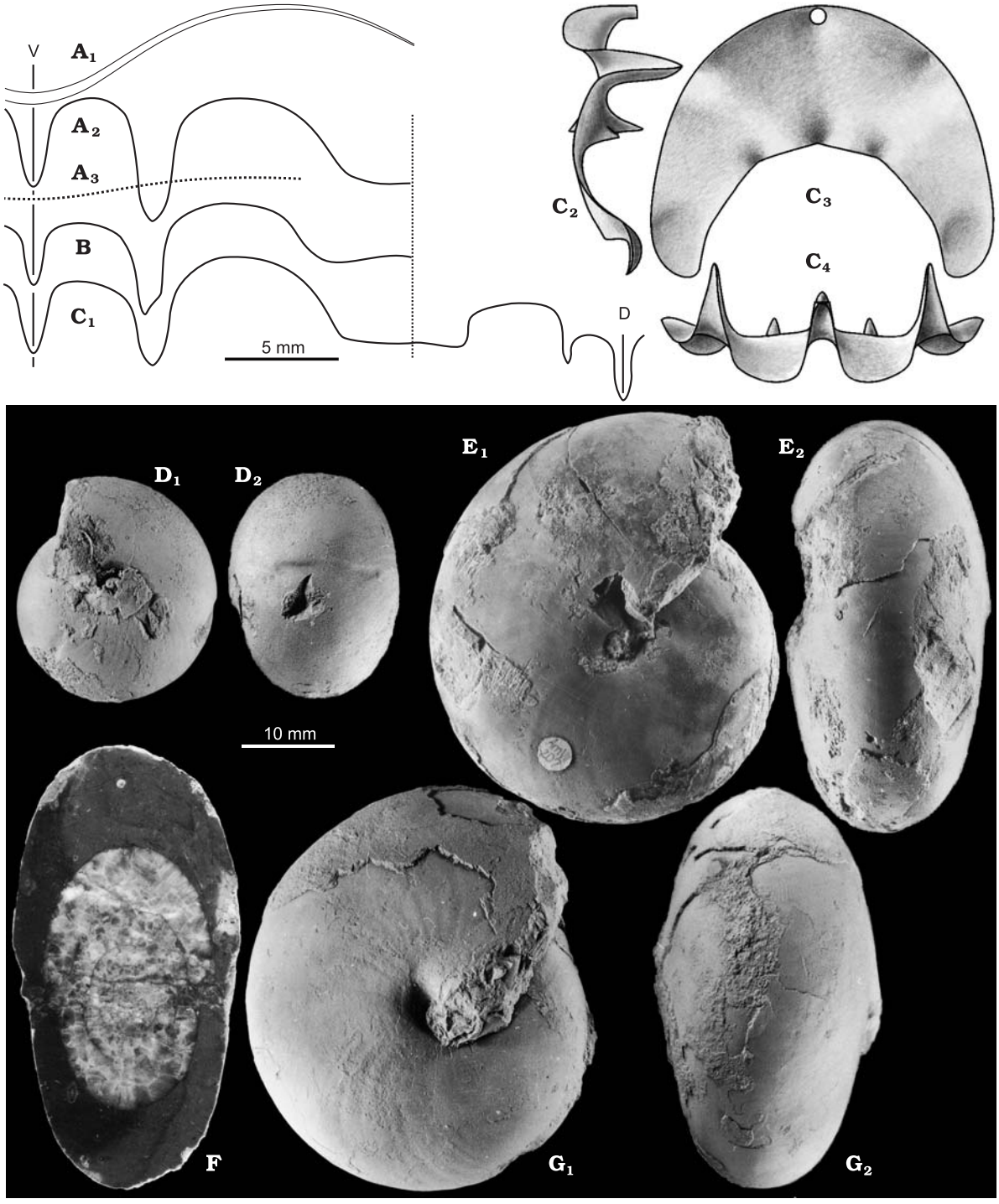


Fig. 168. *Dimeroceras globosoides* (Sobolew, 1914) from the late *C. marginifera* Zone at Łagów in the Holy Cross Mountains; growth lines, suture, and internal thickening of specimen ZPAL, unnambered (A, sample Ł-33); suture of specimen ZPAL AmVII/071 (B); suture and restored septum of specimen ZPAL AmVII/216 (C); views of specimens ZPAL AmVII/1441, 207, 1437, and 205 (D–G, D and G from sample Ł-33).

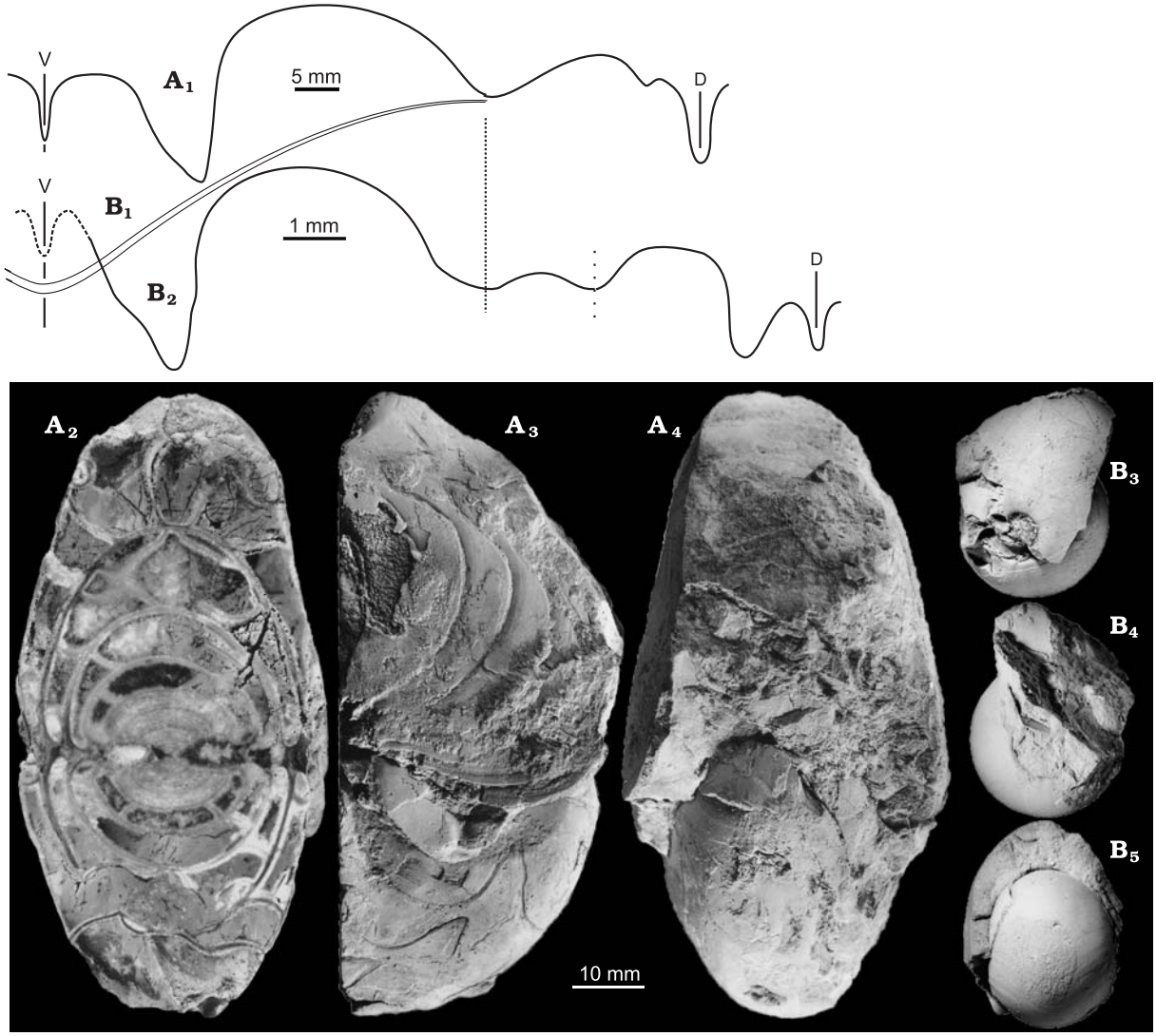


Fig. 169. Species of *Dimeroceras* with wide juvenile umbilicus from the Famennian of the Holy Cross Mountains. **A**. *D.* cf. *petterae* Petersen, 1975, probably from the *C. quadrantinodosa* Zone at Kadzielnia; suture, and views of specimen ZPAL AmVII/1856. **B**. *Dimeroceras umbilicatum* Sobolew, 1914, probably from the *P. trachytera* Zone at Łagów-Dule; growth lines, suture and views of specimen ZPAL AmVII/451.

Remarks. — This is a relatively long-ranging lineage, in the *P. trachytera* Zone represented by Sobolew's (1914) Oma-monomeroceras (*Cheiloceras*) *globosum* and possibly O. (*Ch.*) *praeglobosum*. The problematic O. (*Ch.*) *umbiliferum* has a better developed umbonal lobe and more evolute juvenile conch. An unnambered Otto Schindewolf 's mature specimen from his "Schicht 2", do not exposing suture but possibly belonging to this species, shows gradually opening umbilicus in the last half-whorl, reaching 85 mm in diameter.

Distribution. — The late *C. marginifera* to *P. trachytera* zones at Łagów-Dule (samples Ł-5 and 33).

Dimeroceras cf. *petterae* Petersen, 1975
(Figs 169A and 181)

Type horizon and locality: Middle Virgin Hills Formation, Canning Basin of western Australia.

Material. — One specimen.

Diagnosis. — Suture with very weak umbonal lobe; large discoidal mature conch with globose juvenile stage.

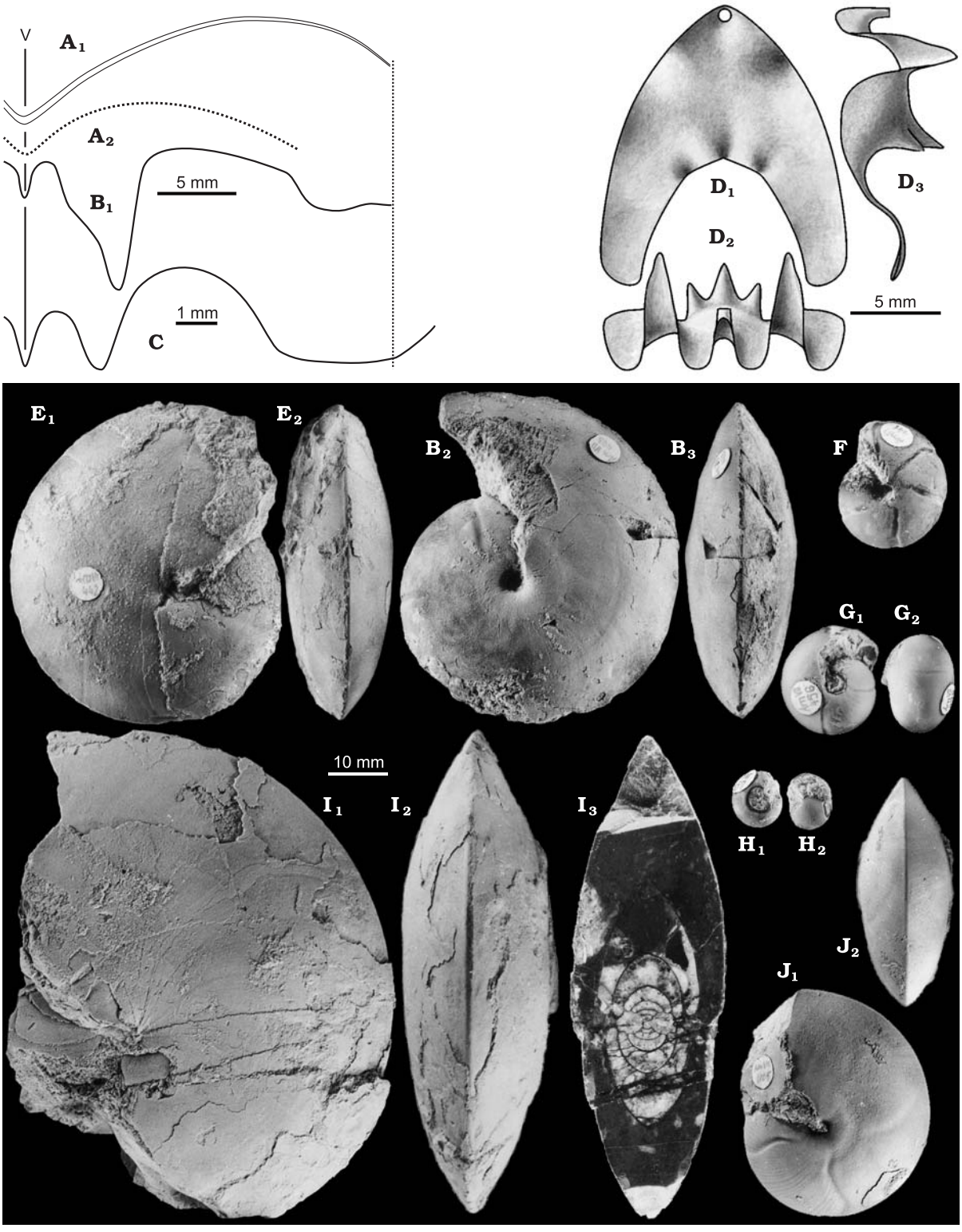


Fig. 170. *Dimeroceras polonicum* (Gürich, 1896) from the late *C. marginifera* Zone at Łagów-Dule in the Holy Cross Mountains; growth lines and internal thickening of specimen ZPAL AmVII/453 (A); suture and views of specimen ZPAL AmVII/443 (B); suture of specimen ZPAL AmVII/440 (C); restoration of septum based on specimen ZPAL AmVII/1101 (D); views of specimens ZPAL AmVII/442, 441, 456, 444, 1076, and 1105 (E–J).

Remarks. — The only specimen was found in the scree from a Famennian marl at the Kadzielnia quarry in Kielce. Specimen of *Conditolepis falcata* extracted from a piece of the specimen is the only basis for its precise dating. The most unusual aspect of the species is very wide whorl cross section at early ontogenetic

stages, exceeding that of *D. petterae* but closely approaching that of the specimen attributed to *D*. cf. *D. bredelarense* from the same stratum (Petersen 1975, text-fig. 12). The species was identified also at Enkeberg by Becker (1993b).

Distribution. — The *C. quadrantinodosa* or younger Zone at Kadzielnia.

Dimeroceras umbilicatum Sobolew, 1914
(Figs 169B and 181)

Type horizon and locality: Black clymeniid limestone at Łagów Dule, the Holy Cross Mountains.

Material. — One specimen.

Diagnosis. — Juvenile umbo reaching about 8 mm diameter; suture with shallow and relatively wide umbonal lobe.

Remarks. — An angular aperture suggests acutely discoidal mature conch shape although only juveniles are known.

Distribution. — Łagów-Dule; black limestone matrix suggests the *P. trachytera* Zone.

Dimeroceras polonicum (Gürich, 1896)
(Figs 170 and 181)

Type horizon and locality: Early Famennian Upper Łagów Beds at Łagów Dule, the Holy Cross Mountains.

Material. — 41 specimens.

Diagnosis. — Acute venter of mature conch.

Remarks. — *D. polonicum* differs from other species of *Dimeroceras* in its acute venter. It is a matter of convenience whether an oxyconic conch form is anough to separate a species at generic level or not. *Paratornoceras* Hyatt, 1900 with *Goniatites lentiformis* Sandberger, 1857 from Enkeberg in the Rhenish Slate Mountains as its type species, is available for this purpose. The suture of the latter species, illustrated by Ebbinghausen *et al*. (2002, text-fig. 13: 3), is closely similar to that of the Łagów specimens. Its conch, described by Becker (1993b) as *Paratornoceras acutum* (Münster, 1840) (considered *nomen dubium* by Ebbinghausen *et al*. 2002), is much more compressed and thus derived.

Gürich (1901) referred to this species as *Brancoceras lentiforme*. *Tornoceras acutiforme* Gürich, 1896 is probably based on a juvenile specimen of the same species from the same stratum.

Distribution. — The *C. marginifera* Zone at Łagów-Dule (samples Ł-5, 21, 30, 32, 34, and Mak-3, all probably from the same single fossiliferous limestone lens).

Family **Praeglyphioceratidae** Ruzhentcev, 1957

Diagnosis. — Suture with trifid ventral lobe; conch aperture with obliquely convex profile; relatively low whorl expansion rate.

Genus ***Lagowites*** Bogoslovsky, 1957

Type species: α-Oma-dimeroceras (*Praeglyphioceras*) *niwae* Sobolew, 1914 from Łagów in the Holy Cross Mountains.

Diagnosis. — Suture with shallow additional ventral lobes.

Lagowites niwae (Sobolew, 1914)
(Figs 171A–E and 181)

Type horizon and locality: Black clymeniid limestone at Łagów Dule, the Holy Cross Mountains.

Material. — 12 specimens.

Diagnosis. — Globose conch with radially running internal constrictions and almost transverse aperture; weak spiral striation.

Remarks. — α-Oma-dimeroceras (*Praeglyphioceras*) *lagowiense* Sobolew, 1914 from the same bed seems to be conspecific.

Distribution. — The *C. marginifera* (sample Ł-38) and *P. trachytera* (samples Ł-8, 9, and 14) zones at Łagów-Dule and Jabłonna (beds 22 and 24).

Genus ***Erfoudites*** Korn, 1999

Type species: *Erfoudites zizensis* Korn, 1999 from the *Platyclymenia annulata* Zone in the Tafilalt, Morocco.

Diagnosis. — Conch aperture transverse or with very weak ventrolateral auricles, with longitudinal (spiral) striation; suture with additional ventral lobes in the middle of ventrolateral saddle.

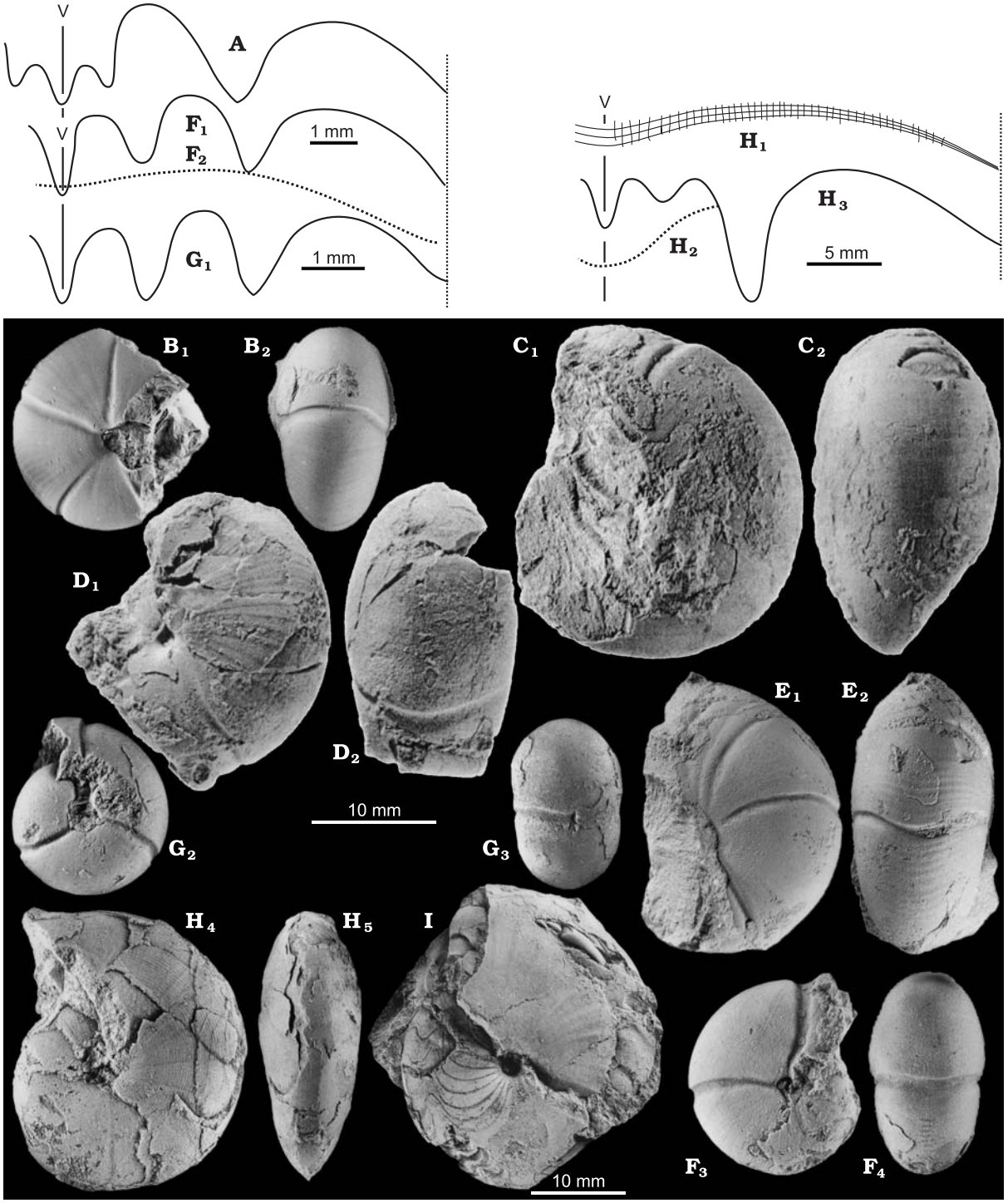


Fig. 171. Praeglyphioceratids from the Holy Cross Mountains. **A**–**E**. *Lagowites niwae* (Sobolew, 1914); suture and views of specimens ZPAL AmVII/867 and 719 from the *P. trachytera* Zone at Jabłonna (A, bed 24; E, bed 22), views of specimens ZPAL AmVII/306, 1809, and 1804 from the *C. marginifera* Zone at Łagów-Dule (B–D; C, D from sample Ł-38). **F**–**I**. *Erfoudites ungeri* (Münster, 1840) probably from the *P. trachytera* Zone at Besówka (collected by J. Czarnocki); growth lines, internal thickening and views of juvenile specimen IG 284.II205b (F); suture and views of specimen IG 284.II205c (G); growth lines, internal thickening, suture and views of specimen IG 284.II205a (H); view of specimen IG 284.II205d (I).

Remarks. — Korn (2002) introduced the subfamily Xenosporadoceratidae to include longitudinally striated sporadoceratids with transeverse apperture bearing incipient auricles. This implies that the auriculate (biconvex) aperture is of secondary origin. Quite well also the complex suture may be a homeomorphy in respect to the sporadoceratids and these may have been praeglyphioceratids with a discoidal, auriculate tornoceratid conch morphology.

Erfoudites ungeri (Münster, 1840)
(Figs 171F–I and 181)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald?

Material. — Five specimens.

Diagnosis. — Discoidal minute conch with almost transverse aperture and dense longitudinal (spiral) striation; suture with additional ventral lobe in the middle of ventrolateral saddle.

Remarks. — The ventral part of the phragmocone in the only available specimen from Jabłonna is crushed, but it is not likely that additional ventral lobes were originally represented.

Praeglyphioceras moravicus of Rzehak (1910) found in a loose block of bituminous limestone (possibly Hády Limestone) at Líšeň in Moravia seems to be conspecific with the Holy Cross Mountains material. Becker *et al.* (2004) synonymized it with *E. ungeri*. *Xenosporadoceras ademmeri* Korn, 2002 has a closely similar suture, spiral striation and conch proportions. It differs only in having small auricles of the aperture. It cannot be excluded that this is a case of evolutionary reversal and that these are close relatives.

Distribution. — Probably the *P. trachytera* Zone at Besówka near Gałęzice (lower *P. annulata* beds according to Czarnocki's label) and the *L. styriacus* Zone at Jabłonna (trench rIVc of Żakowa *et al*. 1986).

Family **Sporadoceratidae** Miller *et* Furnish, 1957

Diagnosis. — Suture with additional ventral lobes developing in the middle of ventrolateral saddle; convex profile of the conch aperture; relatively low whorl expansion rate.

Genus ***Felisporadoceras*** Korn, 2002

Type species: *Prionocears felix* Korn, 1992 from *Platyclymenia annulata* Zone at Kattensiepen in the Rhenish Slate Mountains.

Diagnosis. — Suture with additional ventral lobes shallower than the flank lobes.

Felisporadoceras kowalense sp. n.
(Figs 172 and 181)

Holotype: ZPAL AmVII/815 (Fig. 172C)

Type horizon and locality: Black shale of the mid *C. marginifera* Zone at Kowala, Holy Cross Mountains.

Material. — Five specimens.

Diagnosis. — Suture with shallow additional ventral lobe asymmetrically subdividing the ventral saddle and located closer to ventral than to flank lobe.

Remarks. — Gürich (1901, p. 351, pl. 14: 6) illustrated, as *Sporadoceras subbilobatum* (Münster, 1839), the suture of a specimen from the Sacculus Bank at Łagów-Dule, that is from the Upper Łagów Beds, which fits that of the Kowala specimens. *Goniatites subbilobatus* Münster, 1839 is now interpreted as a species of *Acutimitoceras* (Korn 1984) so this name cannot be used in the meaning given to it by Gürich (1901). From some reason Sobolew (1914), while referring to the same specimen, suggested that it may come from the clymeniid limestone. This seems to be contradicted by the new Kowala findings. Specimen ZPAL AmVII/562 from Łagów shows growth lines of *Sporadoceras* and suture closely similar to that of the holotype. Judging from its rock matrix it is from the latest *C. marginifera* Zone.

Sporadoceras rotundum Wedekind, 1908 is similar but the drawing of the suture in the type specimen (Wedekind 1908, pl. 39: 210) shows a symmetrical appearance of the additional ventral lobe.

Distribution. — The mid *C. marginifera* Zone at Kowala and Łagów-Dule (Gürich 1901).

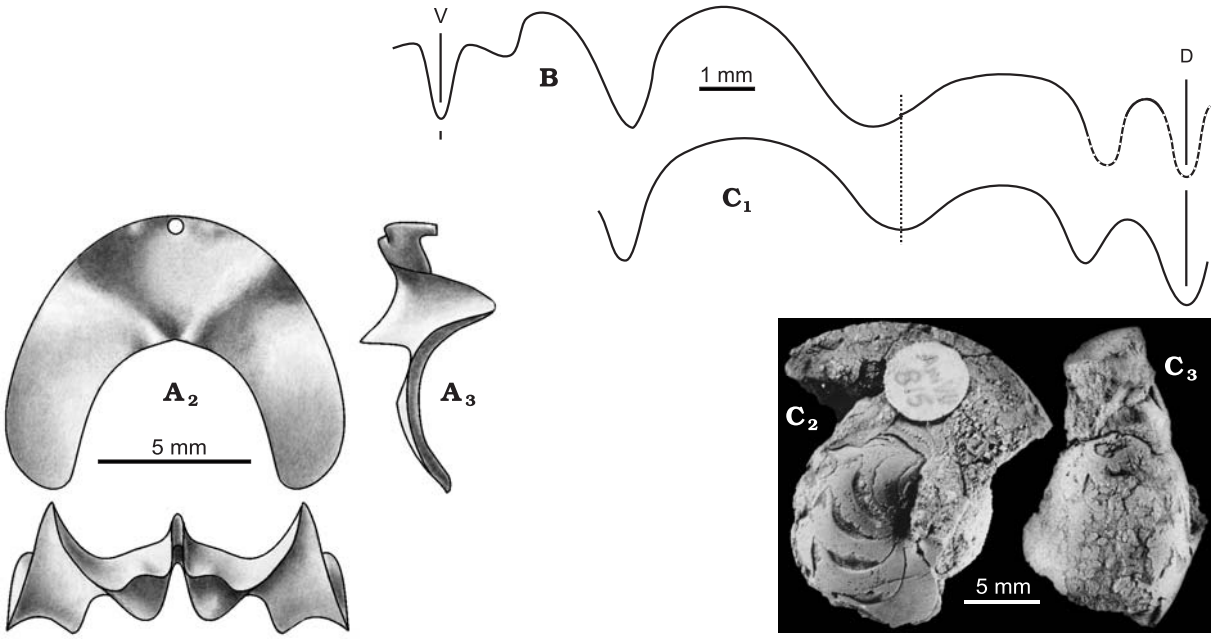


Fig. 172. The least derived sporadoceratid, *Felisporadoceras kowalense* sp. n. from the mid *C. marginifera* Zone at Kowala in the Holy Cross Mountains; restoration of septum based on specimen ZPAL AmVII/1019 (A); suture of ZPAL AmVII/177 (B); suture and views of the holotype ZPAL AmVII/815 (C).

Felisporadoceras subvaricatum (Sobolew, 1914)
(Figs 173A, B and 181)

Type horizon and locality: Black clymeniid limestone at Łagów-Dule, Holy Cross Mountains.

Material. — Eight specimens.

Diagnosis. — Suture with shallow additional ventral lobes asymmetrically subdividing the ventral saddle and located closer to ventral than to flank lobe.

Remarks. — Bockwinkel *et al*. (2002, p. 291) noticed that Sobolew (1914) used the name of his α-Oma-dimeroceras (*Sporadoceras*) *subvaricatum* to two different species and choose the lectotype that allegedly is a *Maeneceras*. Oma-dimeroceras (*Sporadoceras*) *polonicum* of Sobolew (1914) from Sieklucki's brickpit probably belongs to this species.

Distribution. — The *C. marginifera* (sample Ł-9) and *P. trachytera* (sample Ł-14) zones at Łagów-Dule, reworked at Sieklucki's brickpit in Kielce.

Felisporadoceras kielcense (Sobolew, 1914)
(Figs 173C–F and 181)

Type horizon and locality: Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains.

Material. — Eight specimens.

Diagnosis. — Suture with deep additional ventral lobes asymmetrically subdividing the ventral saddle and located closer to ventral than to flank lobe.

Remarks. — Bogoslovsky (1971) attributed specimens of this morphology to *Sporadoceras biferum* (Phillips, 1841). Wedekind (1908) illustration of the suture of the species interpreted by him as *S. biferum* shows a symmetrical appearance of the additional ventral lobe.

Admittedly, the similarity between sutures of *Maeneceras lagoviense* and *F. kielcense* is striking. It is possible that these are actually members of the same lineage and the difference in the profile of aperture is of secondary importance in disclosing phylogenetic affinities.

Distribution. — The mid *C. marginifera* Zone at Kowala, reworked at Sieklucki's brickpit in Kielce.

Genus ***Sporadoceras*** Hyatt, 1884

Type species: *Ammonites Münsteri* von Buch, 1832 probably from the Rhenish Slate Mountains (Becker 1993b).

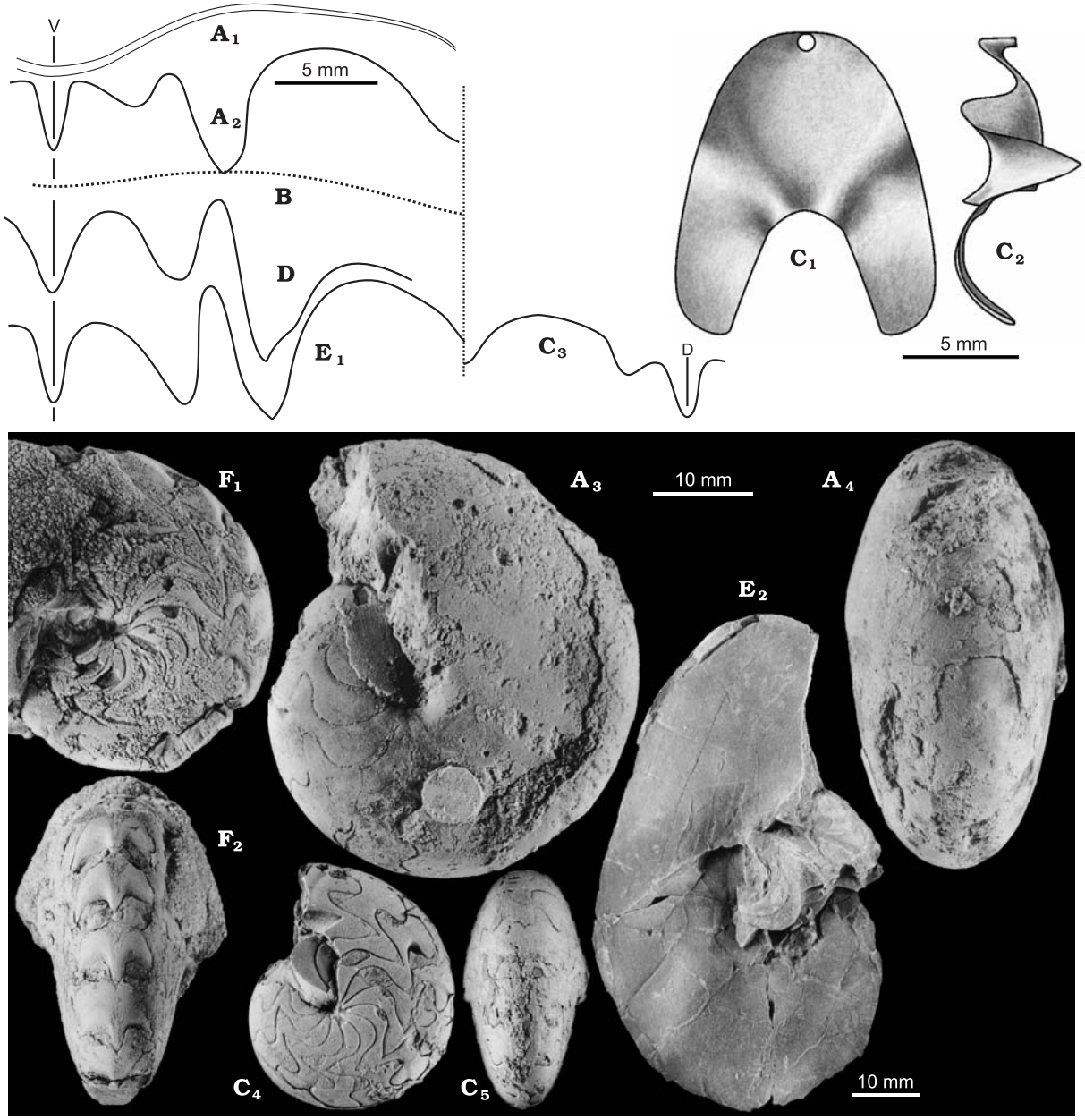


Fig. 173. Species of *Felisporadoceras* from the Holy Cross Mountains. **A**, **B**. *F. subvaricatum* (Sobolew, 1914) from the *C. marginifera* Zone at Łagów-Dule; growth lines, suture and views of specimen ZPAL AmVII/562 (A); internal thickening of specimen ZPAL AmVII/211 (B, sample Ł-9). **C**–**F**. *F. kielcense* (Sobolew, 1914) from the mid *C. marginifera* Zone at Kowala; restoration of septum, suture and views of specimen ZPAL AmVII/1003 (C); suture of specimen ZPAL AmVII182 (D); suture and view of specimen ZPAL AmVII/6 (E); views of specimen ZPAL AmVII/1842 (F).

Diagnosis. — Suture with acutely pointed additional ventral lobe of dept similar to that of the flank lobe.

Sporadoceras lagowiense (Sobolew, 1914)
(Figs 174 and 181)

Type horizon and locality: Black clymeniid limestone at Łagów Dule, Holy Cross Mountains.

Material. — Nine specimens.

Diagnosis. — Suture with the additional ventral lobe of the same depth as the flank lobe and with narrow ventral saddles; conch discoidal; internal thickenings usually weakly developed, a few per whorl.

Distribution. — The mid *C. marginifera* Zone at Kowala, late *C. marginifera* Zone at Łagów-Dule, reworked at Sieklucki's brickpit in Kielce.

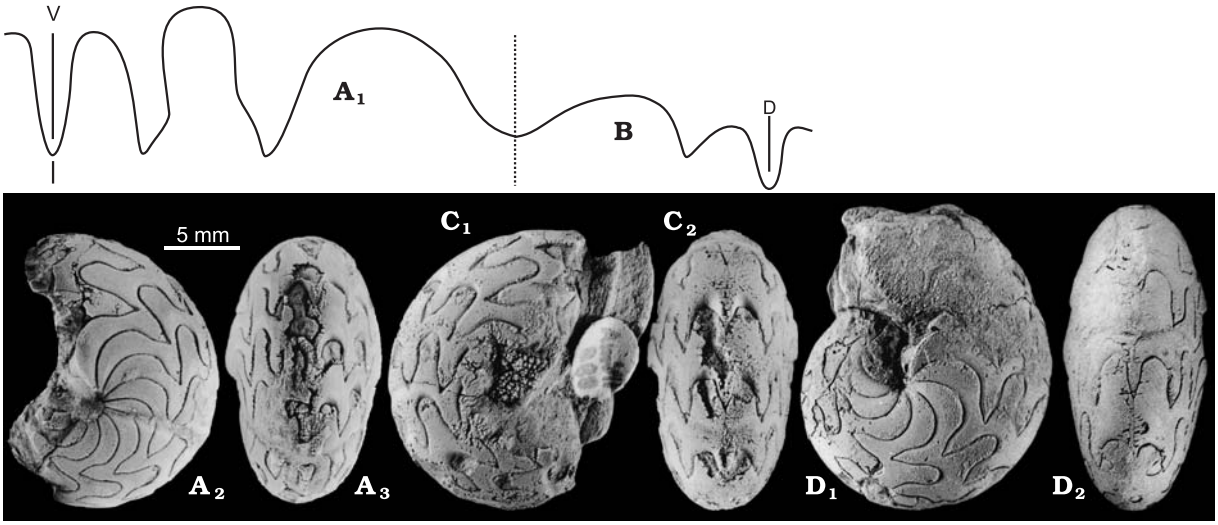


Fig. 174. Discoidal *Sporadoceras lagowiense* (Sobolew, 1914) from the mid *C. marginifera* Zone at Kowala in the Holy Cross Mountains; external suture and views of specimens ZPAL AmVII/82 (A); internal suture of specimen ZPAL AmVII/872 (B); views of specimens ZPAL AmVII/888 and 1002 (C, D).

Sporadoceras varicatum Wedekind, 1908.
(Figs 175 and 181)

Type horizon and locality: Bed 12 with *Prolobites delphinus* and *Clymenia involuta* at Enkeberg, Rhenish Slate Mountains.

Material. — 49 specimens.

Diagnosis. — Internal thickenings usually well developed on conch flanks, about six per whorl; conch discoidal in shape; suture with additional ventral lobe deeper than flank lobe and with wide ventral saddles.

Remarks. — From the type species of the genus this one differs in regularly distributed internal constrictions of the shell. In the Ostrówka sample, large specimens show ventral sinus of the internal conch thickening deeper than it is in juveniles. This suggests that small specimens from other localities represent the same species. The difference between *S. varicatum* and *S. lagoviense* is thus mostly in the morphology of suture. Growth lines are visible only in juvenile specimen ZPAL AmVII/672 from Łagów, of questionable affiliation.

Distribution. — The *P. trachytera* Zone at Łagów-Dule (sample Ł-10 and 13), Jabłonna (beds 23 and 24; trench rIVf), and Ostrówka (samples Ost-10, 11, 14, 15); the *L. styriacus* Zone at Kowala.

Sporadoceras nux (Sobolew, 1914)
(Figs 176A and 181)

Type horizon and locality: Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains.

Material. — Four specimens.

Diagnosis. — Globose conch; suture with narrow additional ventral and flank lobes of subequal depth.

Distribution. — The mid *C. marginifera* Zone at Kowala and the *P. trachytera* Zone at Jabłonna (bed 24); reworked at Sieklucki's brickpit in Kielce.

Sporadoceras terminus sp. n.
(Figs 176B–G and 181)

Holotype: Specimen ZPAL AmVII/3 (Fig. 176G)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Derivation of name: Referring to its terminal position in the *Sporadoceras* lineage.

Material. — Ten specimens.

Diagnosis. — Suture with bulbous lobes and saddles, additional ventral and flank lobes of subequal depth; rather globose conch.

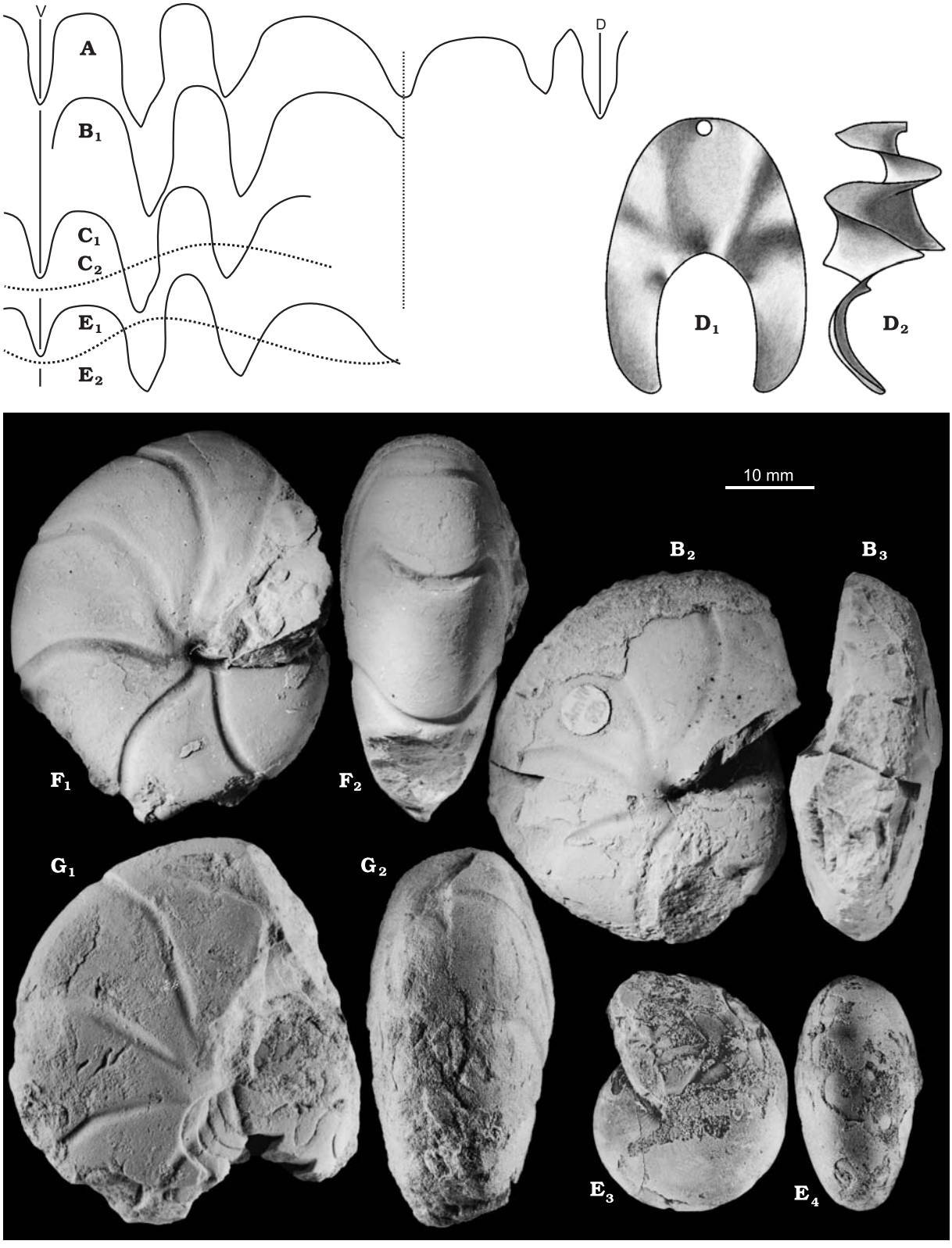


Fig. 175. Discoidal *Sporadoceras varicatum* Wedekind, 1908 from the *P. trachytera* Zone at Ostrówka (A, D, F), Jabłonna (B), Łagów-Dule (C, E), and the *L. styriacus* Zone at Kowala (G) in the Holy Cross Mountains; suture of specimen ZPAL AmVII/1063 (A, sample Ost-14); suture and internal thickening of specimen ZPAL AmVII/596 (C); restoration of septum (D) based on specimens ZPAL AmVII/1084 (sample Ost-15) and 602 (bed 24 at Jabłonna); suture, internal thickening and views of specimen ZPAL AmVII/667 (E); views of specimens ZPAL AmVII/92 and 1621 (F).

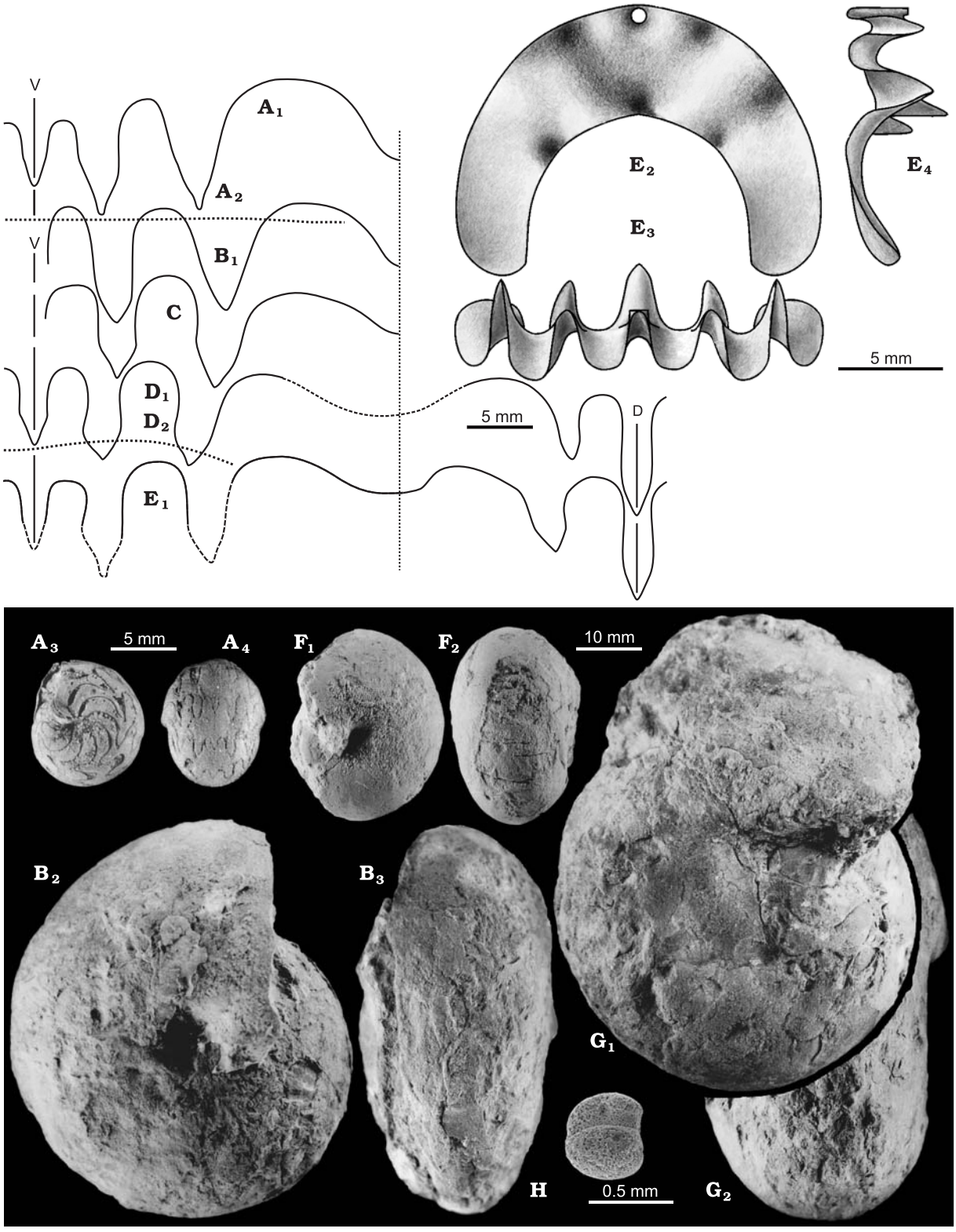


Fig. 176. Globose species of *Sporadoceras* from the Holy Cross Mountains and protoconch of a non-prionoceratid goniatite from *D. trigonica* Zone at Dzikowiec in the Sudetes. **A**. *S. nux* (Sobolew, 1914) from the mid *C. marginifera* Zone at Kowala, suture, internal thickening, and views of specimen ZPAL AmVII/813. **B–G**. *S. terminus* sp. n. from the *P. jugosus* Zone at Dzikowiec (B, C, G) and Kowala (D–F); sutures of specimen ZPAL AmVII/4 and 242 (B, C); suture and internal thickening of specimen IG 284.II.892 (D); suture and restoration of septum of specimen IG 284.II.956 (E, also ZPAL AmVII/1862); views of specimens IG 284.II.956 (F) and holotype ZPAL AmVII/3 (G). **H**. Possible sporadoceratid, specimen ZPAL AmVII/1825 (sample Dz-7).

Remarks. — *Sporadoceras orbiculare* (Münster, 1832) as interpreted by Korn (1999; Korn and Klug 2002) may represent a connecting link between *S. nux* and *S. terminus* sp. n., being intermedioate in its geological age and in the inferred conch globosity at comparable stages of the ontogeny.

Distribution. — The *P. jugosus* (possibly also *D. trigonica*) Zone at Kowala and Dzikowiec.

Family **Prionoceratidae** Hyatt, 1884

Diagnosis. — Large protoconch 0.7 to 1.0 mm in width; suture with pointed lateral and trifid dorsal lobes; conch aperture with oblique convex profile; relatively low whorl expansion rate.

Remarks. — *Cheiloceras polonicum* Sobolew, 1912 from the black clymeniid limestone at Łagów-Dule (Sobolew 1914b; *P. trachytera* Zone; see Fig. 180C) shows rare internal thickenings and the external part of its suture of *Prionoceras* morphology. It is stratigraphically transitional between the lowest occurrence of the true *Prionoceras* and the typical cheiloceratids. Unfortunately, the internal part of its suture remains unknown and no other specimen has been collected.

The characteristic barrel-shaped protoconch of unusually large size emerged together with first conchs of the *Prionoceras* morphology at Jabłonna (Fig 178K-I) to continue into the Carboniferous (Dzik 1997). Probably this is the most characteristic evolutionary novelty (synapomorphy) do define the family, although its knowledge if far from being satisfactory.

Genus ***Prionoceras*** Hyatt, 1884

Type species: *Goniatites divisus* Münster, 1832 from Schübelhammer in Franconia.

Diagnosis. — Minute more or less globose conch with closed umbilicus at all stages; internal shell thickenings correspond to external constrictions, expressed mostly on the conch flanks and are regularly distributed, usually three per whorl.

Remarks. — Korn (1988, 1994) proposed to separate advanced members of the *Prionoceras* branch into his genus *Mimimitoceras*, basing distinctions on slight differences in the shape of aperture and the course of constrictions. Perhaps subgeneric rank would be more appropriate for this taxon.

Prionoceras frechi (Wedekind, 1913)
(Figs 177A–C and 181)

Type horizon and locality: *Platyclymenia annulata* Zone at Beul near Balve in the Rhenish Slate Mountains.

Material. — One specimen.

Diagnosis. — Compressed mature conch with diameter exceeding the whorl thickness more than two times; oblique profile of the conch aperture with a rather deep ventral sinus.

Distribution. — Early *L. styriacus* Zone (bed 26) at Jabłonna. The specimen from Dzikowiec, MB.C. 4657, may also belong to this species, which would require its ranging to much younger strata (at least *P. jugosus* Zone).

Prionoceras divisum (Münster, 1832)
(Figs 177D–H and 181)

Type horizon and locality: Probably *Platyclymenia annulata* Zone at Schübelhammer in Franconia (Korn 1994, 2002).

Material. — 21 specimens.

Diagnosis. — Globose mature conch with diameter exceeding whorl thickness about 1.5 times.

Remarks. — The specimens from Jabłonna are crushed, but some of them show the original conch globosity and irregularities on the conch surface corresponding to the thickening underneath.

Distribution. — *L. styriacus* Zone (trench rIVc of Żakowa *et al*. 1984) at Jabłonna.

Prionoceras lineare (Münster, 1832)?
(Figs 177I–O and 181)

Type horizon and locality: Probably *Clymenia* Stufe at Schübelhammer in Franconia (Korn 1994).

Material. — 36 specimens.

Remarks. — Actually, the only basis for identification of this species is its geological age (see Korn 1994) as the distinctions in the conch shape and course of internal thickenings are hardly significant. Speci-

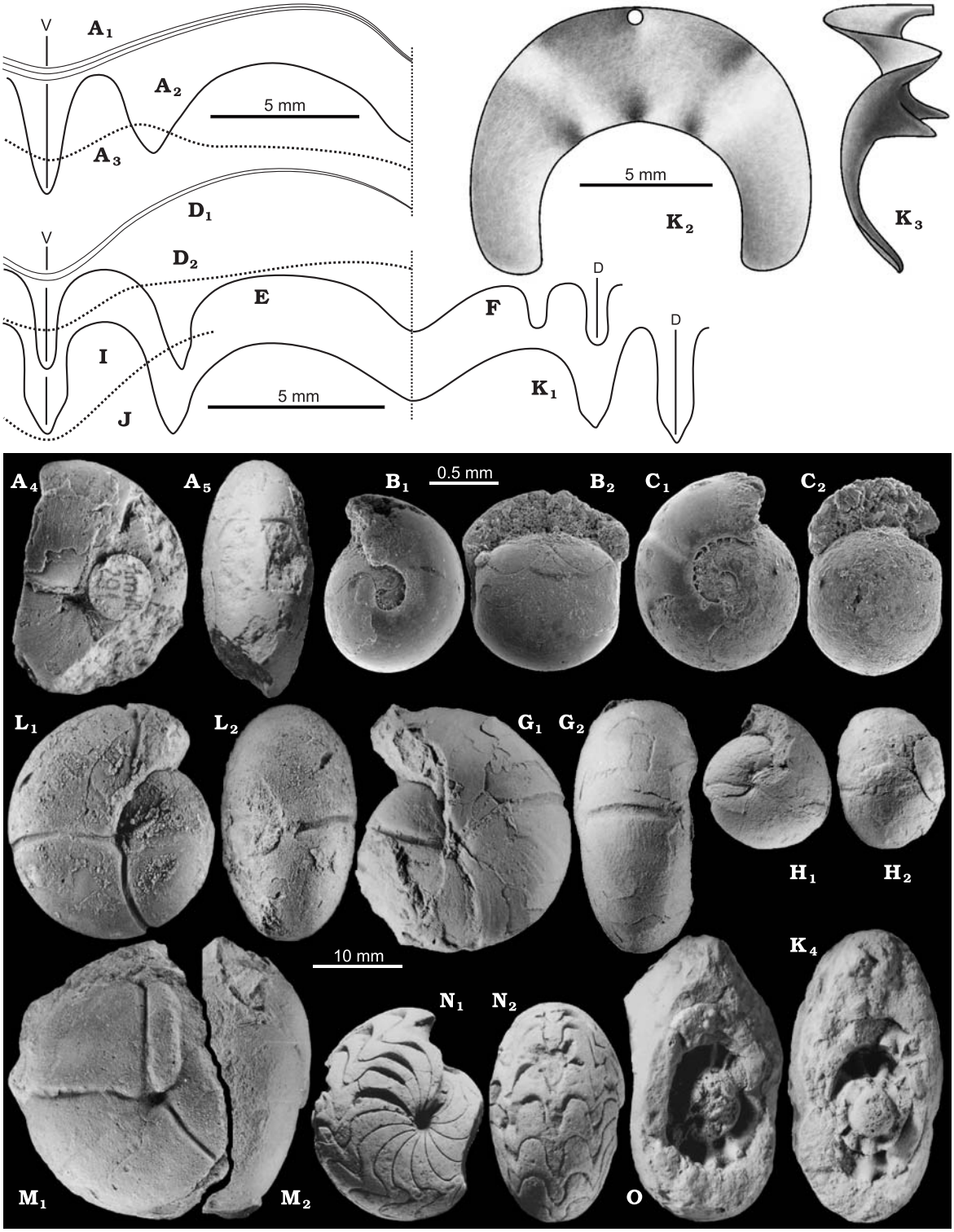


Fig. 177. Early species of *Prionoceras* from the Holy Cross Mountains. **A**-**C**. *P. frechi* (Wedekind, 1913) from the *L. styriacus* Zone at Jabłonna; growth lines, suture, internal thickening, and views of specimen ZPAL AmVII/291 (A, bed 26); larval (or embryonic) conchs ZPAL AmVII/1827 (B, bed 24) and 1838 (C, sample J-35). **D**–**H**. *Prionoceras divisum* (Münster, 1832) from the *L. styriacus* Zone (trench rIVc of Żakowa *et al*. 1984)) at Jabłonna; suture and internal thickening of specimen ZPAL AmVII/722 (D); external and internal parts of suture of specimens ZPAL AmVII/727 and 736 (E, F); views of specimens ZPAL AmVII/726 and 742 (G, H). **I**–**O**. *P. lineare* (Münster, 1832)? from the early *P. jugosus* Zone at Kowala; external suture of specimen ZPAL AmVII/1057 (I); internal thickening of specimen ZPAL AmVII/1623 (J, with unusually deep ventral sinus); internal suture, restoration of septum, and view of specimen ZPAL AmVII/102 (K); views of specimens ZPAL AmVII/1039, 939, Uwr 2183 (collected by M. Schwarzbach), and ZPAL AmVII/101 (L–O).

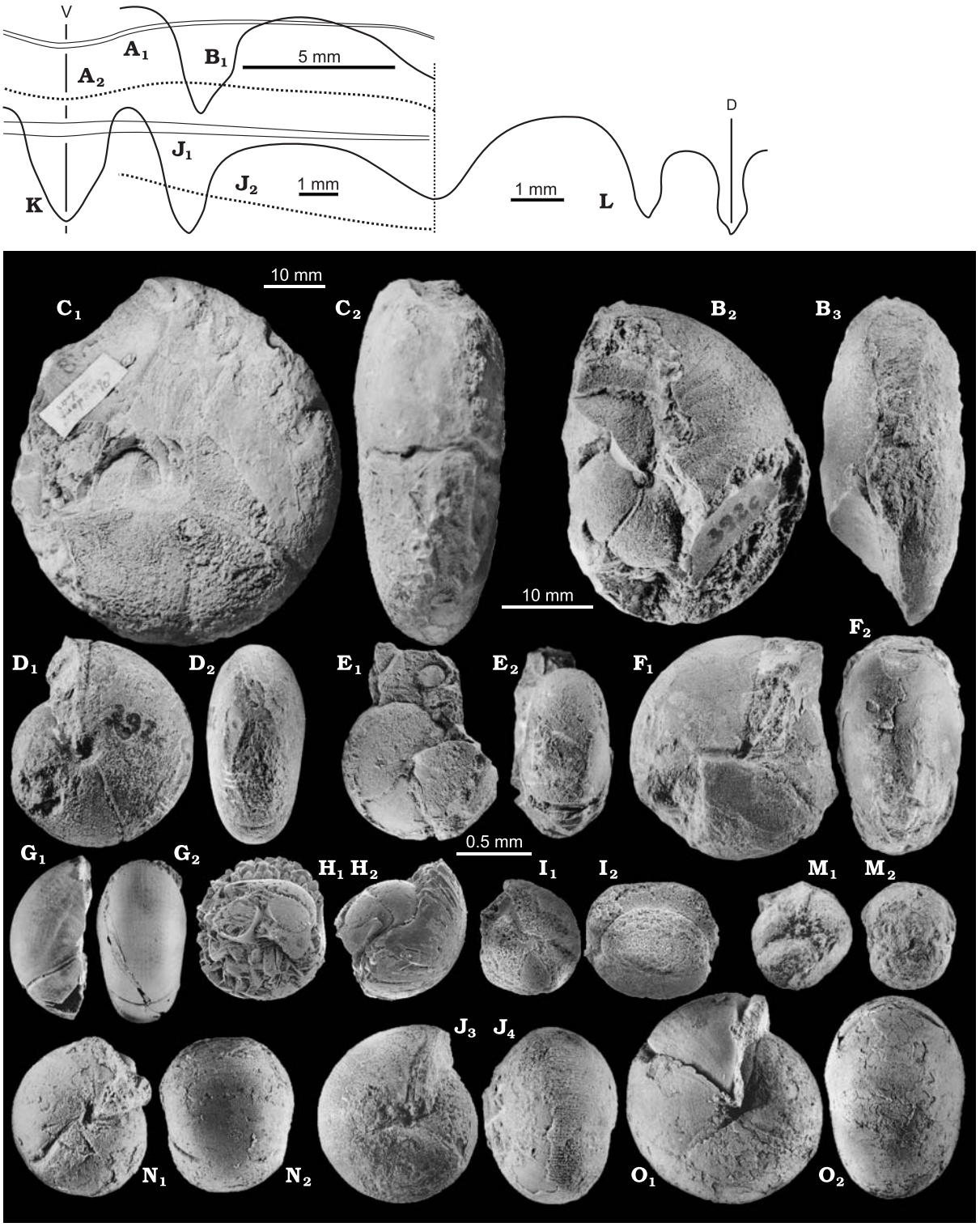


Fig. 178. Late species of *Prionoceras* from the *P. jugosus* Zone of the Sudetes and the Holy Cross Mountains. **A**–**G**. *P. fuerstenbergi* (Korn, 1992) from Dzikowiec; growth lines and conch constriction of specimen ZPAL AmVII/153 (A, also 149), suture and views of specimen ZPAL AmVII/162 (B, inside a clymeniid), probably mature specimen MB.C. 4672 (C), views of specimens ZPAL AmVII/154, 1030, 149, and 937 (D–G; the latter from sample Dz-180 associated with *Parawocklumeria*). **H**, **I**. Larval (or embryonic) conchs probably representing the same species; specimens ZPAL AmVII/1835 and 1823 from Kowala (I, sample Ko-187) and Dzikowiec (J, sample Dz-4). **J**–**O**. *P. lentum* (Korn, 1992) from Dzikowiec (J–M), Ostrówka (N), and exposure between Besówka and Stokówka near Gałęzice (O), growth lines, conch constriction, and views of specimen ZPAL AmVII/153 (J), external and internal parts of suture of specimens ZPAL AmVII/32 and 39 (K, L), and views of specimens ZPAL AmVII/446, IG 284.II.762, and 333 (M–O).

mens from Kowala do not not have the original shell preserved, so features of shell ornamentation cannot be taken into accout.

Distribution. — The *P. jugosus* Zone at Kowala.

Prionoceras fuerstenbergi (Korn, 1992)
(Figs 178A–G and 181)

Type horizon and locality: *Parawocklumeria paradoxa* Zone (bed 28 in trench 1) at Müssenberg, Rhenish Slate Mountains.

Material. — 30 specimens.

Diagnosis. — Globose mature conch with diameter exceeding whorl thickness about 1.3 times, transverse conch aperture.

Distribution. — The *P. jugosus* and *D. trigonica* zones at Dzikowiec, Jabłonna (bed 30), and Kowala.

Prionoceras lentum (Korn, 1992)
(Figs 178J–O and 181)

Type horizon and locality: Late *Parawocklumeria paradoxa* Zone (bed 1 in the street section) at Ober-Rödinghausen, Rhenish Slate Mountains.

Material. — 23 specimens.

Diagnosis. — Compressed mature conch with diameter exceeding whorl thickness almost 2 times, transverse conch aperture with small ventral sinus.

Distribution. — The *P. jugosus* and *D. trigonica* zones at Dzikowiec and Kowala.

Genus ***Balvia*** Lange, 1929

Type species: *Gattendorfia globularis* Schmidt, 1924 from the *Wocklumeria* Stufe at Ober-Rödinghausen, Rhenish Slate Mountains.

Diagnosis. — Minute conch with internal shell thickenings and corresponding external constrictions forming anteriorly oriented saddle; umbilicus open at early growth stages.

Balvia prima sp. n.
(Figs 179A and 181)

Holotype: ZPAL AmVII/26 (Fig. 179A).

Type horizon and locality: *Lagovignathus styriacus* Zone at Ostrówka (sample Ost-7) in the Holy Cross Mountains.

Material. — Two specimens.

Diagnosis. — Relatively large mature conch with very narrow ventral protrusion of the shell thickening.

Remarks. — Probably also specimen IG 284.II.343 of diameter about 27 mm, collected by Czarnocki in a grey limestone (labelled as *Gonioclymenia* beds) belongs to the species. This is a good connecting link between the *Prionoceras* and *Balvia* lineages.

Distribution. — The *L. styriacus* Zone at Ostrówka (sample Ost-7).

Balvia minutula Korn, 1992?
(Figs 179B–G and 181)

Type horizon and locality: Early *Parawocklumeria paradoxa* Zone at at Dasberg (bed 1 in southern trench), Rhenish Slate Mountains.

Material. — 15 specimens.

Diagnosis. — Mature conch with shell thickening showing a narrow ventral saddle.

Remarks. — The only specimen from Ostrówka is more globose at corresponding ontogenetic stage than those from Dzikowiec.

Distribution. — The *P. jugosus* Zone at Dzikowiec (samples Dz-2a, 4a, and 7) and Ostrówka (red *Gonioclymenia* limestone).

Balvia biformis (Schindewolf, 1937
(Figs 179H and 181)

Type horizon and locality: *Wocklumeria* Stufe at Ober-Rödinghausen, Rhenish Slate Mountains.

Material. — One specimen.

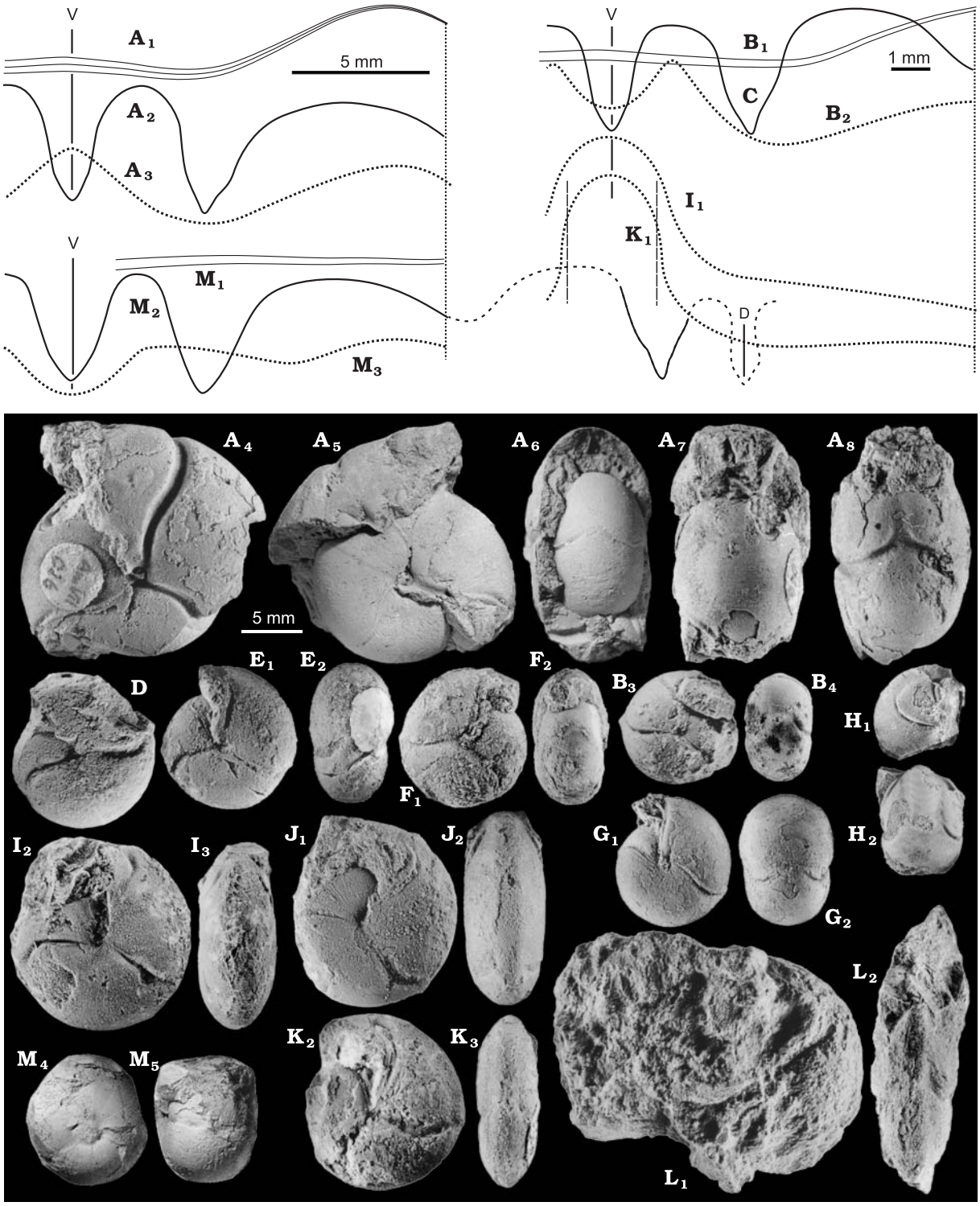


Fig. 179. Species of the derived prionoceratid *Balvia* from the *L. styriacus* Zone at Ostrówka in the Holy Cross Mountains (A), the *P. jugosus* Zone at exposure between Besówka and Stokówka near Gałęzice (G) and probably the *D. trigonica* Zone at Dzikowiec in the Sudetes (B–F, I–M). **A**. *B. prima* sp. n.; growth lines, suture, conch constriction, and views of the holotype ZPAL AmVII/26 (sample Ost-7). **B**–**G**. *B. minutula* Korn, 1992? growth lines, conch constriction, and views of specimen ZPAL AmVII/31 (B); suture of specimen ZPAL AmVII/1048 (C); views of specimen ZPAL AmVII/1041, 801, 113, and IG 284.II.334 (D–G). **H**. *B. biformis* (Schindewolf, 1937); views of specimen ZPAL AmVII/941 (sample Dz-180; associated with *Parawocklumeria paradoxa*). **I**, **J**. *B. falx* Korn, 1992; conch constriction and views of specimens ZPAL AmVII/172 and 1028. **K**, **L**. *B. lens* Korn, 1992; conch constriction and views of specimens ZPAL AmVII/235 and 227. **M**. *Balvia globularis* (Schmidt, 1924); growth lines, suture, conch constriction, and views of specimen ZPAL AmVII/252.

Diagnosis. — Mature conch with ventral saddle of the shell thickening delimited by longitudinal furrows.
Remarks. — In *Balvia nucleus* the area delimited by longitudinal furrows is much wider (see Korn 1994).
Distribution. — The *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec (sample Dz-180).

Balvia falx Korn, 1992
(Figs 179I, J and 181)

Type horizon and locality: Early *Parawocklumeria paradoxa* Zone (bed 12 in the street section) at Ober-Rödinghausen, Rhenish Slate Mountains.

Material. — Ten specimens.
Diagnosis. — Discoidal mature conch with parabolic profile of the venter.
Distribution. — The *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec (samples Dz-4a and 7).

Balvia lens Korn, 1992
(Figs 179K, L and 181)

Type horizon and locality: Late *Gonioclymenia subarmata* Zone at Effenberg (bed T), Rhenish Slate Mountains.

Material. — Three specimens.
Diagnosis. — Discoidal mature conch with the ventral area bordered by longitudinal depressions.
Remarks. —All the specimens come from a single block collected near the southern end of the quarry; they are thus apparently of different geological age (younger?) than specimens of *B. falx* found at the northern end of the quarry.
Distribution. — The *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec.

Balvia globularis (Schmidt, 1924)
(Figs 179M and 181)

Type horizon and locality: *Wocklumeria* Stufe at Ober-Rödinghausen, Rhenish Slate Mountains.

Material. — One specimen.
Diagnosis. — Globose mature conch with umbilicus open at ealy stages.
Distribution. — The *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec in the Sudetes.

Genus ***Acutimitoceras*** Librovich, 1957

Type species: *Imitoceras acutum* Schindewolf, 1923 from the *Gattendorfia* Stufe at Gattendorf in Franconia.

Diagnosis. — Discoidal conch without thickenings or constrictions and more or less acute venter.

Acutimitoceras guerichi (Frech, 1902)
(Figs 180A and 181)

Type horizon and locality: *Wocklumeria* Stufe at Ober-Rödinghausen, Rhenish Slate Mountains.

Material. — Two specimens.
Diagnosis. — Large mature conch with parabolic venter in cross section.
Remarks. — The holotype does not show any traces of growth increments and only its large size makes it different from other Dzikowiec prionoceratids. The discoidal conch shape suggests that this is a member of the lineage leading to acute Tournaisian species, as alredy pointed out by Korn (1994).
Distribution. — The *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec.

Acutimitoceras prorsum (Schmidt, 1925)
(Figs 180B and 181)

Type horizon and locality: Stockum Limestone near Stockum, Rhenish Slate Mountains (Korn 1994).

Material. — Numerous crushed and fragmentary specimens covering slabs of tuffite.
Diagnosis. — Conch aperture with radially running lateral margins and gentle ventral sinus; rounded conch venter with no signs of angulation.
Remarks. — The species does not fit the diagnostic character of the genus in respect to the conch form but the shape of aperture resembles that in the type species and this supports its ancestral position within the lineage. Apparently on this basis Korn (1981, 1994) classified it in *Acutimitoceras*. All specimens from

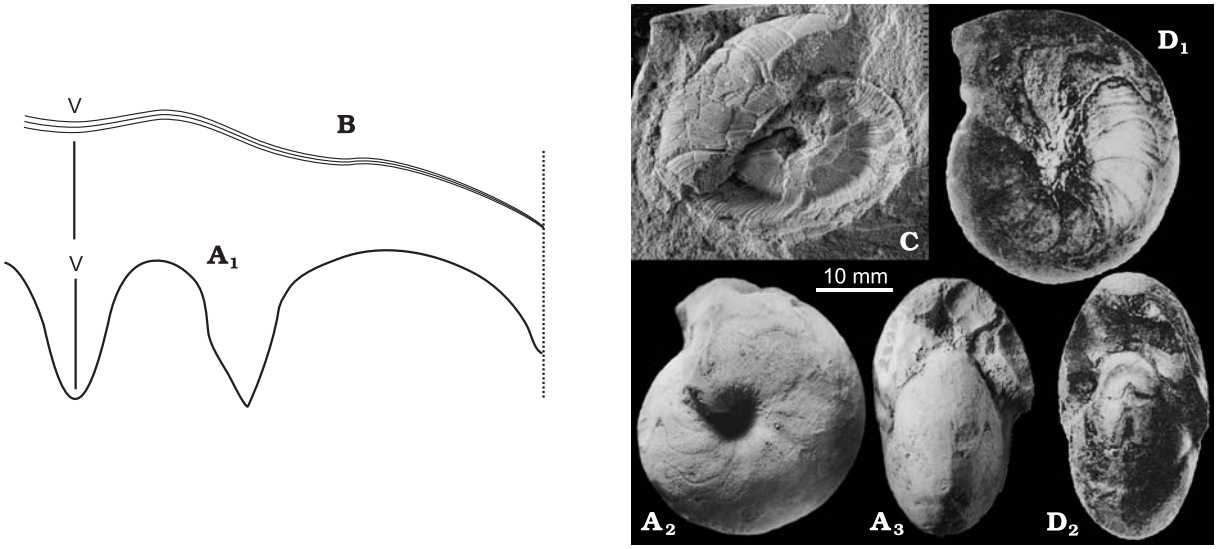


Fig. 180. Famennian prionoceratids. **A**. *Acutimitoceras guerichi* (Frech, 1902) probably from the *D. trigonica* Zone at Dzikowiec in the Sudetes; suture and views of of the holotype Uwr 23337. **B**. *Acutimitoceras prorsum* (Schmidt, 1925) from the *Protognathodus kockeli* horizon at Kowala in the Holy Cross Mountains; growth lines and crushed conch ZPAL AmVII/1855 in tuffite (sample Ko-52, see Dzik 1997). **C**. "*Cheiloceras*" *polonicum* Sobolew, 1914 from the *P. trachytera* Zone at Łagów-Dule, possibly the ancestral *Prionoceras* (reproduced after Sobolew 1914).

Kowala (illustrated earlier in Dzik 1997, fig. 27) are flattened and fragmentary but some show the original geometry leaving little doubt that this is a generalized prionoceratid with an oval whorl cross section. The distinct growth lines are not so apparent in the German material illustrated by Korn (1981, 1994) but this may be due to exfoliation of the conch surface.

Distribution. — The *P. kockeli* horizon at Kowala.

Order **CLYMENIIDA** Hyatt, 1884

Remarks. — The only character that distinguishes the earliest clymenias from the co-occurring or slightly older protornoceratid goniatites is the dorsal location of their siphuncle. All other conch and septal morphology characters are virtually identical. This was the basis for indication of the tornoceratids as the clymenias' ancestors by House (1970). Exquisitely preserved material of the oldest clymenias from the Urals (Bogoslovsky 1976, 1981) shows that in the larval conch the siphuncle perforated the first septum near the protoconch venter, centrally in the second, and centrodorsally in the third septum. Thus, not before the metamorphosis an early clymenia developed the diagnostic dorsal location of its siphuncle. This looks like a recapitulation of phylogeny in the early ontogeny and points towards *Kirsoceras rotundatum* (Perna, 1914) from the *Cheiloceras* Stufe of the Urals, having the siphuncle significantly departing from the venter in adult specimens, as the probable ancestor of the clymenias.

However, the typical members of the Tornoceratidae and the clymenias differ fundamentally from each other in their larval (ammonitella) conch organization. The difference between the *Tornoceras* and clymeniid suture ontogeny was the main argument against any close relationship between these ammonoids (reviewed by Bogoslovsky 1981). If *K. rotundatum* is truly a connecting link between evolute tornoceratids and the earliest clymenias, then its protoconch morphology has to be also transitional. *Kirsoceras* is known after only four specimens from locality 839 of Perna (1914) near the village Spasskiy, possibly representing the range of variability within the same species (suggested by the labile conch morphology of probably related protornoceratids from the Holy Cross Mountains) and there is little chance for a new material, as it was not available to Bogoslovsky (1981). The crucial evidence has to be thus looked for in the Holy Cross Mountains material of evolute tornoceratids. Such data are available and have been presented above. The advanced tornoceratids do not differ substantially in their larval conch internal structure from the stratigraphically proximal clymenias.

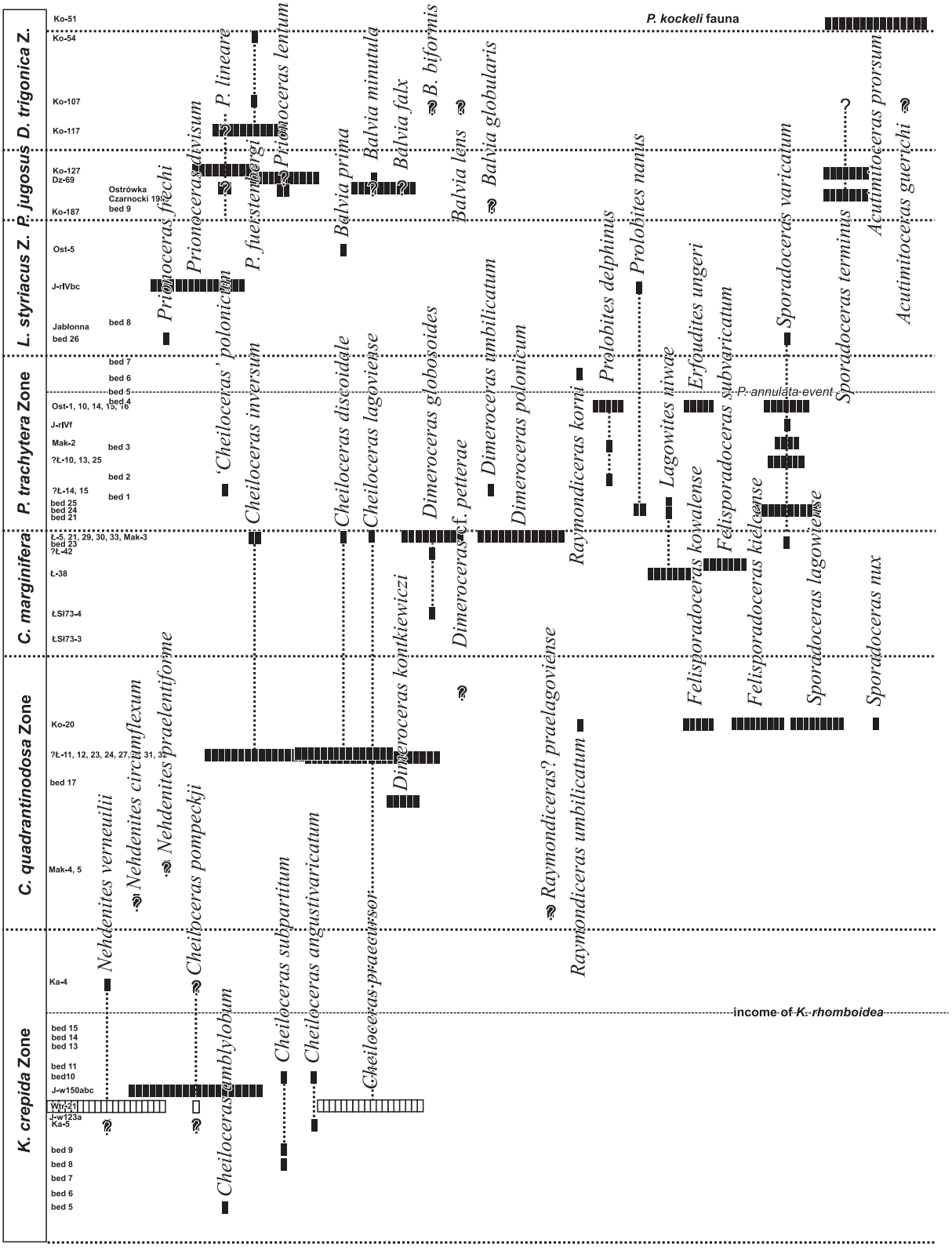


Fig. 181. Stratigraphic distribution of species of Cheiloceratidae, Praeglyphioceratidae, Sporadoceratidae, and Prionoceratidae in the Polish Famennian. Position of samples not included in Figs 2 and 3 on the geochronological scale is hypothetical.

The origin of clymenias from the tornoceratid goniatites implies that the ancestral forms were of a rather complex morphology, with a relatively involute conchs and marginally vaulted septum. This conch morphol-

ogy continued, with a somewhat more complicated septum, in the most long-ranging lineage of *Cymaclymenia* (Korn 1981, 1991; Korn *et al*. 2004). The vaulting of the septum in the evolute *Clymenia* and *Kosmoclymenia* is apparently rooted in this ancestral status. Also the lineages ending in the highly sophisticated septal morphologies of *Dimeroclymenia* and *Gonioclymenia* are rooted, idependently of each other, in the early vaulted cymaclymeniids. In the lineage of *Cyrtoclymenia*, the ancestral involute conch geometry with open umbilicus was preserved, but with a simplified (balloon-type) septum. A more evolute conch combined with simple septum characterize *Platyclymenia*. In the wocklumeriids, a complication of suture morphology developed *de novo* from a rather simple septal morphology.

The dorsal location of siphuncle makes its length significantly shorter in respect to the phragmocone than in goniatites. Some clymeniids (Biloclymeniidae) show unusually wide siphuncle (Bogoslovsky 1981, p. 17), proposed by Gottobrio and Saunders (2005) to be an adaptation to preserve the area of contact of the siphonal tissue with the cameral liquid similar to that in goniatites. Interestingly, they show also extremely long septal necks (Bogoslovsky 1981, p. 16), a feature undoubtedly limiting fluid and gas exchange between the sipho and phragmocone chambers (like in the Tertiary nautiloid *Aturia* with dorsally located siphuncle, but also in the endoceratid nautiloids, having similarly wide siphuncle).

Family **Cymaclymeniidae** Hyatt, 1884

Diagnosis. — Septum with marginal vaulting in the middle of its height, expressed in suture as a tongue-like pointed flank lobe; moderately evolute conch with rounded trapezoidal whorl cross section.

Remarks. — Bogoslovsky (1979) introduced genera *Ornatoclymenia*, *Kazakhoclymenia*, and *Loganoclymenia* based mostly on differences in their whorl cross section and resulting complications of the ventral part of suture. Their septal topology seems to be identical with *Cymaclymenia*.

Genus ***Genuclymenia*** Wedekind, 1908

Type species: *Clymenia frechi* Wedekind, 1908 from *Prolobites* beds at Enkeberg, Rhenish Slate Mountains.

Diagnosis. — Suture with deep rounded flank lobe and shallow ventrolateral lobe; moderately evolute conch.

Remarks. — The type species of the genus is closely similar to early *Cymaclymenia*, being different only in a shallower flank lobe of its suture. The Polish species show a even more ancestral, tornoceratid-like appearance in having a somewhat narrower umbilicus and more rounded whorl cross section.

Genuclymenia humboldti (Pusch, 1837)
(Figs 182A–F, 186A and 196)

Type horizon and locality: Bituminous calcareous shale exposed at the foot of Kadzielnia hill in Kielce, Holy Cross Mountains.

Material. — 26 specimens.

Diagnosis. — Umbo covering about one third of the conch diameter; slopes of the flank lobe merging approximately at right angle, the ventral one obliquely crossing the conch flanks.

Remarks. — Probably *Ammonites humboldtii* Pusch, 1837, based on a pyritized specimen from bituminous calcareous shale exposed at the foot of Kadzielnia hill in Kielce, is the first reference to this species, but Pusch (1837) was uncertain whether the siphuncle is ventral or dorsal. Roemer (1866, p. 675, pl. 13: 1) illustrated a specimen of probable *Protornoceras* from apparently the same exposure, suggesting that Pusch's *A. humboldti* and *A. buchi* represent variants of the same goniatite species (which seems highly unlikely). Gürich (1896, p. 329) used his collection of specimens, considered by him conspecific and coming probably from the same stratum exposed between Kadzielnia and Psiarnia hills, to prove that this was a clymeniid and transferred the species to *Cyrtoclymenia*. Although the original Pusch's collection has not survived to our days, one of the specimens studied by Gürich (1896) was illustrated by Frech (1902, pl. 4: 5). This emendation of the first reviser should thus be binding, so more that it was accepted by Sobolew (1914, p. 64) who distinguished two varieties within Gomi-monomeroclymenia *humboldti*. The variety G. *h. genulobata*, based on the material from Sieklucki's brickpit, with pointed flank lobe of the suture seems to fit within the range of the species, as suggested by additional material assembled by Czarnocki (1989) and myself. However, Czarnocki (1989, p. 64) preferred to abandon Pusch's species name and to replace it with his *Flexiclymenia*

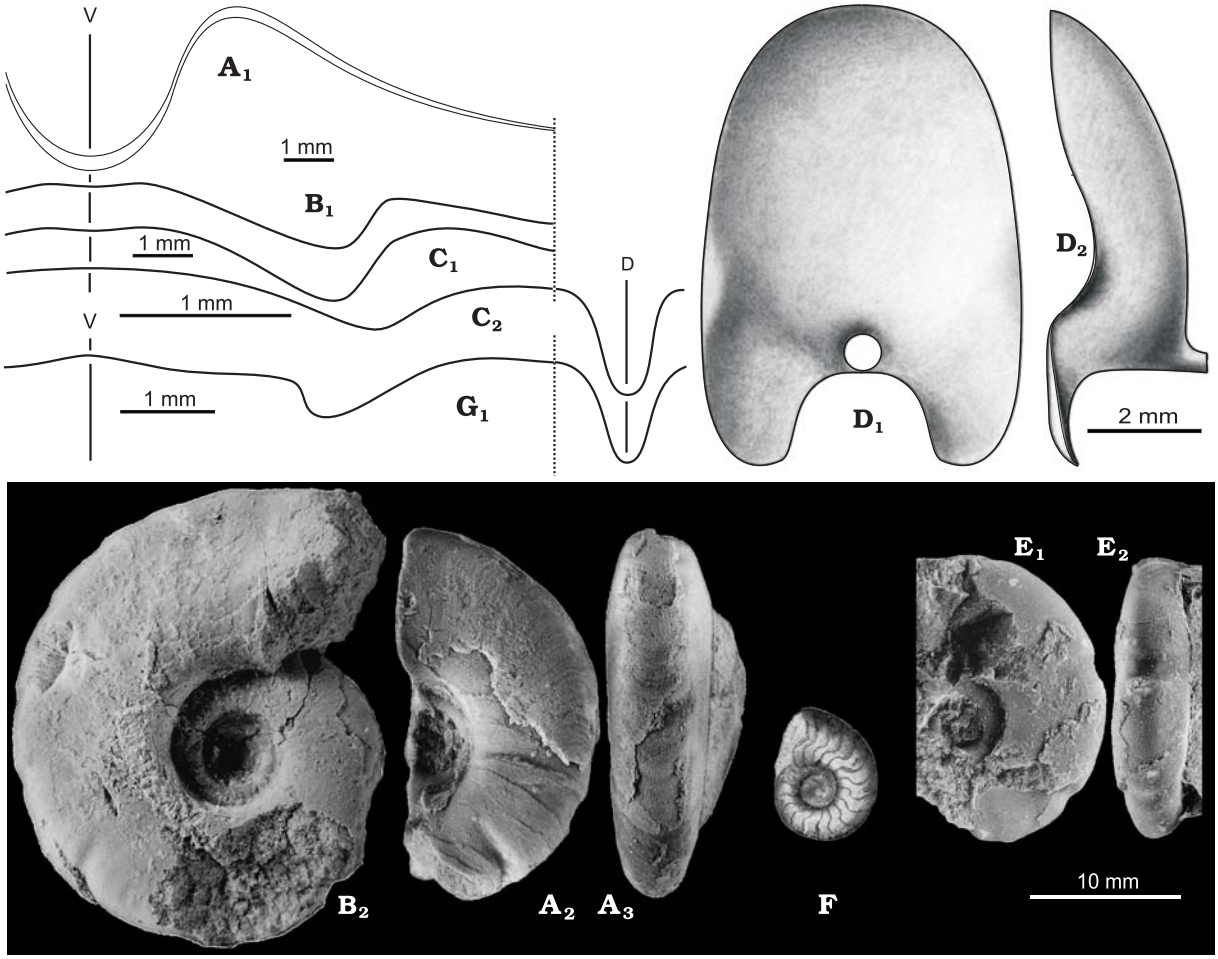


Fig. 182. Early tornoceratid-like clymenia *Genuclymenia humboldti* (Pusch, 1837) from the *P. trachytera* (bed 24) and early *L. styriacus* (beds 25 and 26) zones at Jabłonna (A–E) and Kadzielnia (F) in the Holy Cross Mountains; growth lines and views of specimen ZPAL AmVII/714 (A, bed 24); suture and view of ZPAL AmVII/700 (B, bed 26); two stages in development of suture of ZPAL AmVII/639 (C, bed 26); reconstructed septum of ZPAL AmVII/851 (D, bed 25); views of ZPAL AmVII/168 (E, bed 25); original specimen of Gürich (1896; reproduced from Frech 1902, pl. 5: 5).

puschi. He proposed the holotype collected at Ostrówka from the *Prolobites* Zone strata (thus his beds 1–3) which seems to represent another Sobolew's species, here referred to as *Praeflexiclymenia curvidorsata*. I believe that *Flexiclymenia tempestiva* Czarnocki, 1989, *F. staszici* Czarnocki, 1989 and *F. simosa* Czarnocki, 1989 are conspecific with *G. humboldti*.

Distribution. — The *P. trachytera* (bed 24) to the early *L. styriacus* (beds 25 and 26) zones at Jabłonna; probably the *L. styriacus* Zone at Ostrówka (upper *Platyclymenia* beds of Czarnocki 1989); black shale at Kadzielnia and reworked to Quaternary sediments at Sieklucki's brickpit in Kielce.

Genus ***Cymaclymenia*** Hyatt, 1884

Type species: *Planulites striatus* Münster, 1832 from Schübelhammer near Heinersreuth in Frankenwald (Korn 1981).

Diagnosis. — *Aturia*-like flank lobe with sinous dorsal slope in the middle of conch flanks; relatively involute conch.

Remarks. — The type species of *Genuclymenia*, *G. frechi* from Enkeberg in the Rhenish Slate Mountains is almost exactly transitional in the conch form, its ornamentation, and suture between *G. humboldti* and this species. Its stratigraphic position also fits the chronomorphocline. The early part of the lineage of Cymaclymenia seems thus relatively well documented.

The course and prominence of growth increments and the shape of the flank lobe of the suture are considered to be the most important diagnostic character of species within this genus (e.g., Korn 1981). However

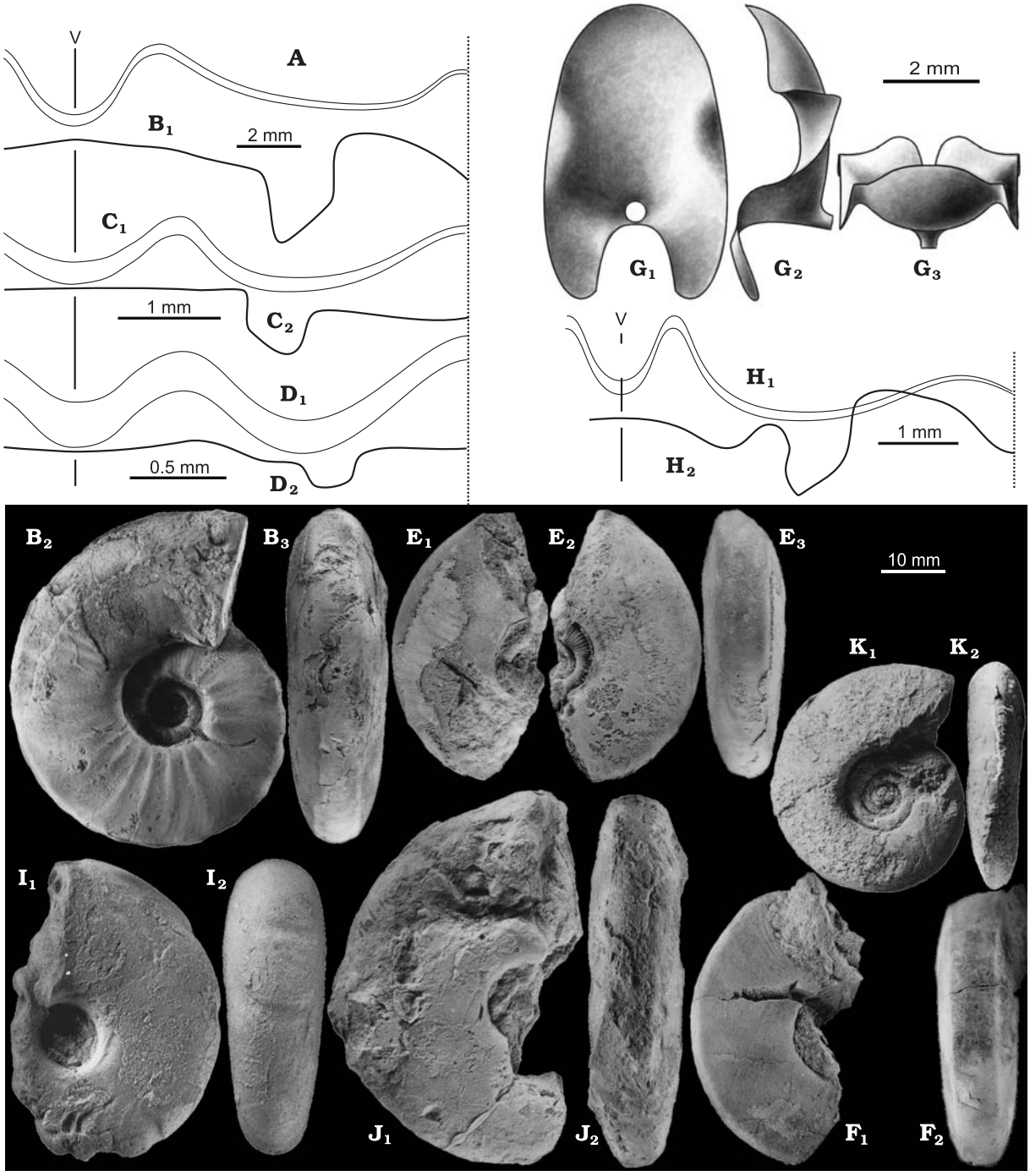


Fig. 183. Early and last *Cymaclymenia*. **A–F**. *C. inflata* Czarnocki, 1989 from the *P. trachytera* Zone at Ostrówka (B) and the early *L. styriacus* Zone at Jabłonna (A, C–F; trench rIVc of Żakowa *et al*. 1984) in the Holy Cross Mountains; growth lines of specimen ZPAL AmVII/435 (A); suture and views of the holotype IG 284.II.142 (B; also Czarnocki 1989, pl. 26: 10); two stages in the development of suture and growth lines of ZPAL AmVII/393 and 394 (C, D); views of ZPAL AmVII/698 and 699 (E, F). **G–J**. *Cymaclymenia* sp. n. from the early *P. jugosus* Zone at Kowala in the Holy Cross Mountains; restoration of septum based on ZPAL AmVII/948 (G); growth lines and suture of ZPAL AmVII/013 (H), and views of ZPAL AmVII/1099 (I, sample Ko-63) and 1616 (J; 30 cm below the black shale). **K**. *C. evoluta* (Schmidt, 1924)? from Dzikowiec in the Sudetes; specimen MB.C. 4083.2.

both these traits show significant variation even within the same specimen (Fig. 184B). It is difficult to match the Holy Cross Mountains material with the topotype German specimens of earlier introduced species. either they tend to be endemic or this is due to differences between local populations representing the same species. Their actual number may thus appear smaller than now estimated.

Cymaclymenia inflata Czarnocki, 1989
(Figs 183A–F, 186B, and 196)

Type horizon and locality: Grey crinoid limestone, lower part of *Platyclymenia* Stufe at Ostrówka, Holy Cross Mountains.

Material. — Ten specimens.

Diagnosis. — Flank lobe of the suture with a blunt tip.

Remarks. — The ancestral position of this species in respect to more advanced cymaclymeniids was noticed by Czarnocki (1989). Probably his report of *C. striata* in bed 7 in the description of the Ostrówka section refers to this species.

Distribution. — The late *P. trachytera* Zone at Ostrówka (samples Ost-7 and 10) and the *L. styriacus* Zone at Jabłonna (trench rIVc of Żakowa *et al*. 1986).

Cymaclymenia sp. n.
(Figs 183G–J and 196)

Material. — 16 specimens from near the Epinette Event black shale and 45 specimens from around sample Ko-116.

Remarks. — The most specific aspect of the *Cymaclymenia* specimens from the upper part of the *Clymenia* Stufe grey limestone and the basal part of the reddish limestone at Kowala is a rounded conch venter and prominent acute auricles in aperture. A similar growth lines and suture characterize the much younger geologically *C. warsteinensis* Korn, 1979, but its conch is more evolute (Korn 1981). In fact, most specimens are internal moulds offering no data on the course of growth lines and only rarely well preserved suture can be traced. It seems that specimens from the lower part of the range of this form have a little tabulate venter, which is the primitive feature in the lineage

Distribution. — Most specimens from the lower part of the range were collected from the scree and they probably come from the fossiliferous strata with *Clymenia* about 2 m below the black shale horizon, that is the late *L. styriacus* and early *P. jugosus* zones. A few specimens can be rather safely determined as coming from near the black shale; a large sample of rather poorly preserved specimens have been derived from the nodular bed of sample Ko-116.

Cymaclymenia costellata (Münster, 1832)
(Figs 184A–E, 186C, and 196)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald (Korn 1981).

Material. — 23 specimens.

Diagnosis. — Aperture with somewhat angular convexity on flanks and relatively sharply delimited deep ventral sinus; umbo covering one fourth of the conch diameter in adult conchs.

Remarks. — Specimens from the same strata classified by Czarnocki (1989) in *C. compressa* (Münster, 1832) belong here. According to Korn (1981) the type specimen of this species is too poorly preserved to be identifiable. Czarnocki's specimens come from the red marly limestone and have unusully well preserved, as for the locality, shells. No similar material has been encountered later, which may mean that they occurred in a lens of restricted extend. The sample seems thus homogenous and shows the actual range of variability (Fig. 186C). It is expressed not only in the conch proportion, but also in the shape of aperture, believed to be of high diagnostic value. The course of growth lines may dramatically differ even in different parts of the same conch (Fig. 184B).

Distribution. — The *D. trigonica* Zone at Kowala.

Cymaclymenia sp. aff. *C. striata* (Münster, 1832)
(Figs 184F and 196)

Material. — One specimen.

Remarks. — In the presence of pointed auricles and gently concave flanks of the aperture, the specimen from Jabłonna resembles those of *C. striata* (see Korn 1981) but the straight course of suture across the venter makes it different from all other species of the genus. This may be an expression of the population variability but my material does not allow to determine its range in species of the genus.

Distribution. — The *P. jugosus* Zone at Jabłonna.

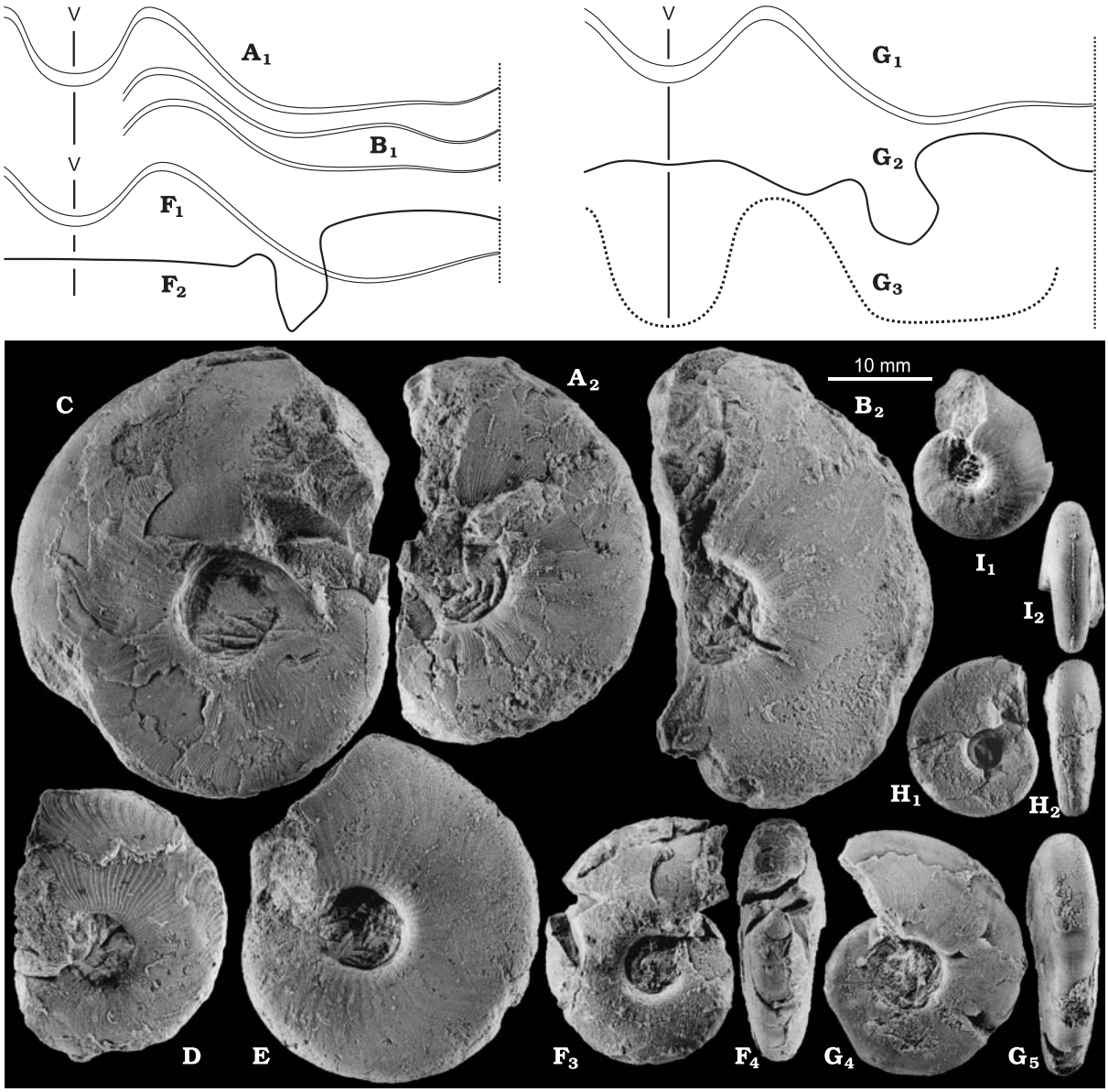


Fig. 184. Advanced *Cymaclymenia*. **A–E**. *C. costellata* (Münster, 1832) from the *D. trigonica* Zone at Kowala in the Holy Cross Mountains; growth lines and view of specimen IG 284.II.1070 (A); variability of growth lines and view of IG 284.II.1044 (B); views of IG 284.II.1057, 1070, and 1040 (C–E). **F**. *C.* sp. aff. *C. striata* (Münster, 1832) from the mid *P. jugosus* Zone at Jabłonna in the Holy Cross Mountains; growth lines, suture and views of ZPAL AmVII/382. **G–I**. *C.* sp. aff. *C. evoluta* (Schmidt, 1924) from the late *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec in the Sudetes; growth lines, suture, internal shell thickening, and views of ZPAL AmVII/150 (G); views of ZPAL AmVII/1604 and 386 (H, I, the latter of problematic affinity, may represent *C. silesiaca*).

Cymaclymenia sp. aff. *C. evoluta* (Schmidt, 1924
(Figs 184G–I and 196)

Material. — Five specimens.

Remarks. — In a rather acute apertural auricles and evolute compressed conch the species resembles remotely *Postclymenia evoluta* Schmidt, 1924 (see Price and Korn 1989; Korn *et al*. 2004) but its bizarre, almost symmetrical, obliquely oriented flank lobe looks rather like that of *C. fundilobata* Czarnocki, 1989.

Distribution. — Probably the late *P. jugosus* at Dzikowiec.

Cymaclymenia evoluta (Schmidt, 1924)?
(Figs 183K and 196)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

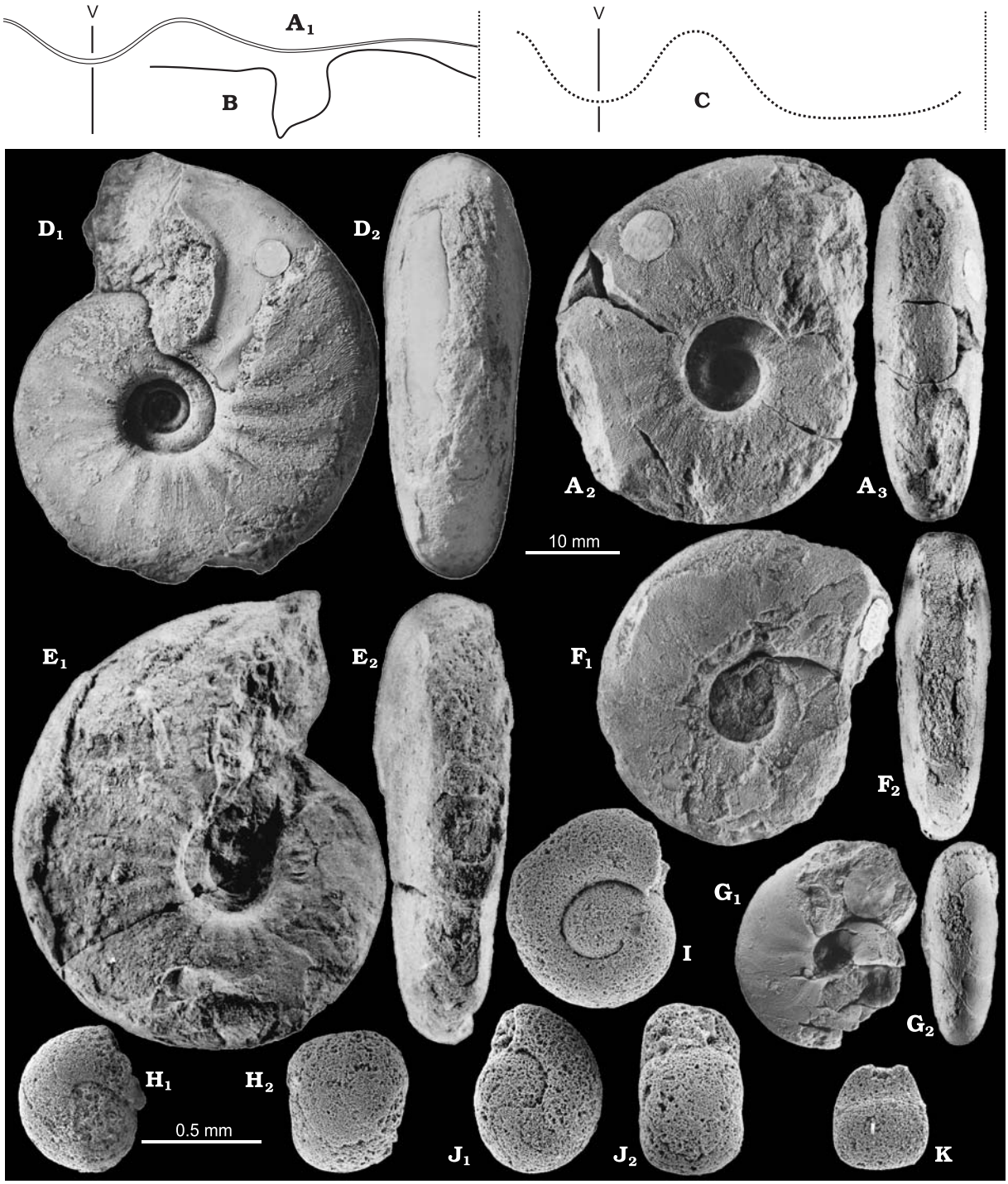


Fig. 185. **A–G**. *Cymaclymenia silesiaca* (Renz, 1913) from the late *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec in the Sudetes; growth lines and views of ZPAL AmVII/171 (A); suture of ZPAL AmVII/62 (B); internal shell thickening of ZPAL AmVII/388 (C); views of MB.C. 4167 (D, also Frech 1902, pl. 5: 1), ZPAL AmVII/157, 57, and 1592 (E–G). **H–K**. Larval conchs with two septa of generalized clymenias (*Cymaclymenia* and/or *Kosmoclymenia*) from Dzikowiec in the Sudetes; ZPAL AmVII/1822 and 1821 (H, I, sample Dz-4, the late *P. jugosus* Zone; living chamber incomplete in H) and ZPAL AmVII/1826 and 1824 (J, K, sample Dz-7, the *D. trigonica* Zone; only embryonic part preserved in K).

Material. — One specimen.

Diagnosis. — Relatively evolute conch.

Remarks. — The single specimen MB.C. 4083.2 labeled *Cymaclymenia cordata* may belong to this species, as suggested by the evolute conch. It comes from a light yellowish-pink limestone occurring near the top

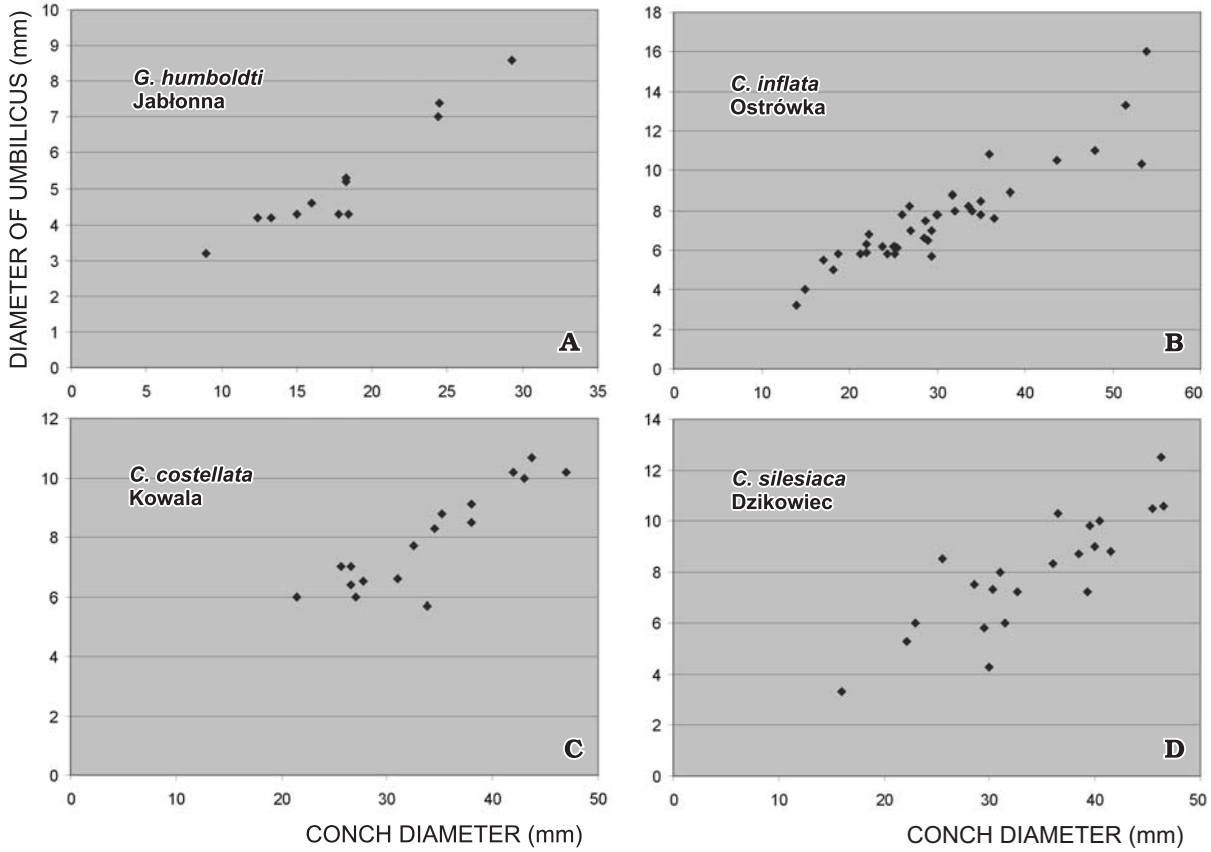


Fig. 186. Variability of umbilical width in species of the Cymaclymeniidae. **A**. *Genuclymenia humboldti* (Pusch, 1837) from the *P. trachytera* to early *L. styriacus* zones at Jabłonna in the Holy Cross Mountains. **B**. *Cymaclymenia inflata* Czarnocki, 1989 from the *P. trachytera* Zone at Ostrówka. **C**. *C. costellata* (Münster, 1832) from the late *P. jugosus* Zone at Kowala. **D**. *Cymaclymenia silesiaca* (Renz, 1913) from the late *P. jugosus* (or *D. trigonica*) Zone at Dzikowiec in the Sudetes.

of the Dzikowiec succession (Korn et al. 2005, fig. 2). Two more specimens derived from a similar rock (MB.C. 4083.1 and 4180) differ in a somewhat narrower umbo. All are compressed and have a rather rounded whorl cross section. Possibly a lineage of *Cymaclymenia* independent of *C. silesiaca* (occuring in dark purple limestone) is represented at Dzikowiec, but stratigraphic evidence is too poor to prove this.

The species was originally classified in the separate genus *Postclymenia*, the view revived by Korn *et al*. (2004).

Distribution. — Probably *D. trigonica* Zone (perhaps the *P. kockeli* fauna) at Dzikowiec.

Cymaclymenia silesiaca (Renz, 1913)
(Figs 185, 186D, and 196)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — 24 specimens.

Diagnosis. — Aperture with low auricles and shallow ventral sinus; rounded conch venter.

Remarks. — This is a rather generalized conch morphology and the preservation of specimens is not always good enough to allow determination of crucial characters. It is possible that also other species of *Cymaclymenia* are represented in the material from Dzikowiec.

Distribution. — The *P. jugosus* Zone at Dzikowiec.

Family **Clymeniidae** Edwards, 1849

Diagnosis. — Evolute conchs; septum with marginal lateral vaulting expressed in suture as more or less acute lobe with gentle dorsal slope.

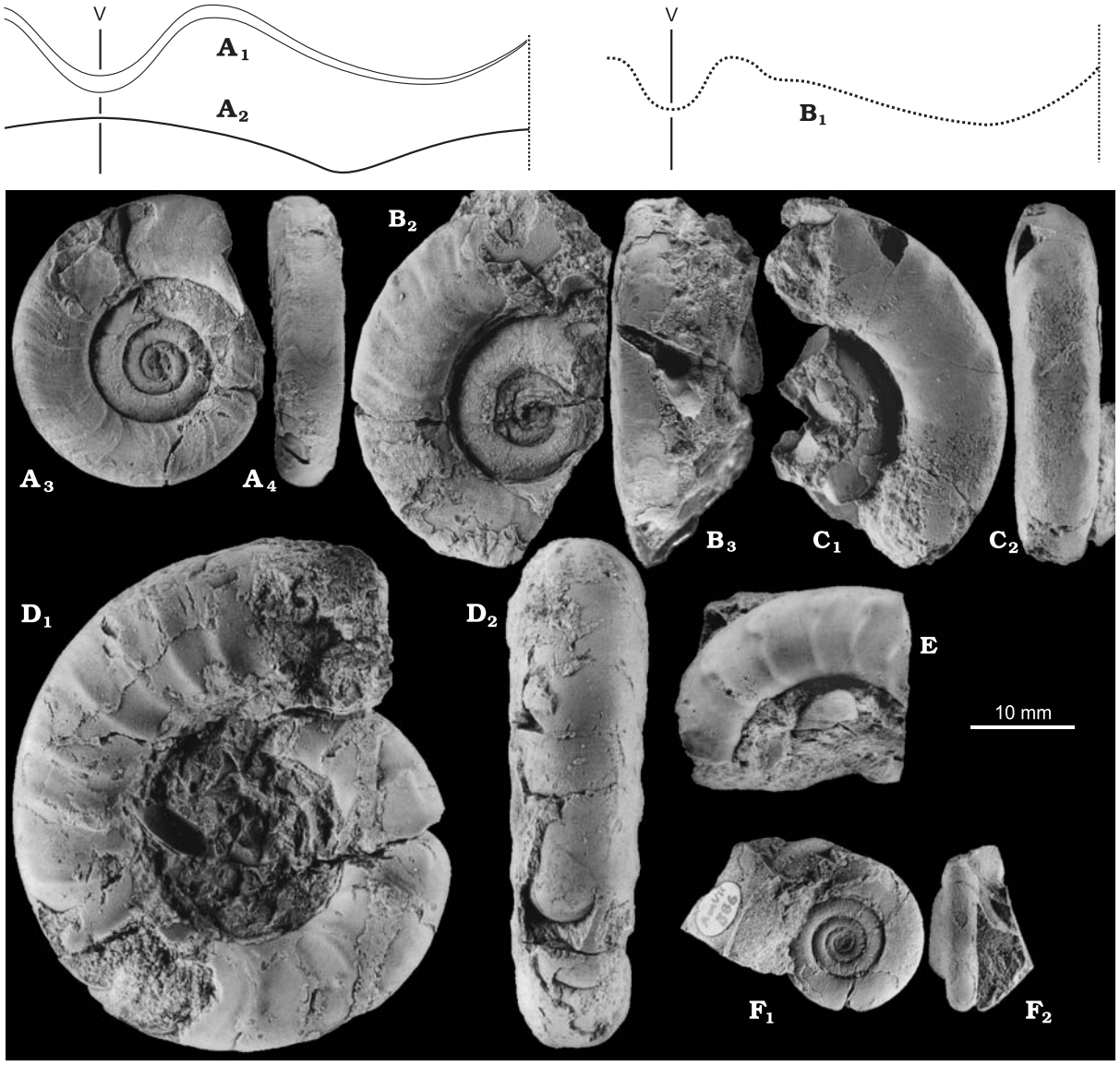


Fig. 187. Species of *Trigonoclymenia* from the *P. trachytera* Zone of the Holy Cross Mountains. **A**, **B**, **F**. *T. glabra* (Czarnocki, 1989) from Ostrówka; growth lines, suture, and views of IG 284.II.164 (A); internal shell thickening and views of IG 284.II.234 (B); views of juvenile specimen ZPAL AmVII/886 from Jabłonna probably belonging to this species (F; bed 25). **C**–**E**. *T. spinosa* (Münster, 1842); views of ZPAL AmVII/27 from Ostrówka (C, sample Ost-7), IG 284.II.155 from the same locality (D, bed 4 of Czarnocki 1989), and ZPAL AmVII/222 from Besówka (E).

Remarks. — Korn and Price (1987) suggested that the lineage of *Kosmoclymenia* originated from *Platyclymenia* with simple baloon-like septum. The new evidence on the earliest clymenias from the Holy Cross Mountains suggests rather that the marginal vaulting of the septum is an ancestral character inherited after the tornoceratids and that *Clymenia* and its probable successor *Kosmoclymenia* are less derived in this respect than *Platyclymenia*.

Genus ***Trigonoclymenia*** Schindewolf, 1934

Type species: *Clymenia spinosa* Münster, 1842 from Frankenwald.

Diagnosis. — Periodic expansions of the shell aperture produced funnel-like blades or ventrolateral parabolic nodes; septum with minute lateral vaulting; conch evolute.

Remarks. — The type species shows a simple septum and morphology closely similar to that in the species of *Platyclymenia*. Its affinities to *Clymenia* are suggested by the septal morphology and ornamentation of *T. glabra* (Czarnocki, 1989), that is, morphologically transitional rather between *Aktuboclymenia* and

Clymenia. The simple suture of advanced *Trigonoclymenia* may thus be an effect of simplification parallel to that at the origin of the *Platyclymenia* lineage, which may be otherwise closely related. *Spinoclymenia aculeata* Bogoslovsky, 1962, with its ventrolateral spines (Bogoslovsky 1962) may also represent this clade.

Trigonoclymenia glabra (Czarnocki, 1989)
(Figs 187A, B, F?, and 196)

Type horizon and locality: Lower part of *Platyclymenia* Stufe at Ostrówka (bed 4 of Czarnocki 1989), Holy Cross Mountains.

Material. — Two specimens.

Diagnosis. — Periodic blade-like expansion of the aperture.

Remarks. — Czarnocki (1989) classified this species in *Platyclymenia* but the septal morphology makes it close rather to *Clymenia*. An apparent tendency towards developing parabolic nodes points out its probable affinity to *Trigonoclymenia spinosa*.

Distribution. —Probably the early *P. trachytera* at Ostrówka (bed 4 of Czarnocki 1989).

Trigonoclymenia spinosa (Münster, 1842)
(Figs 187C–E and 196)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald?

Material. — Two specimens.

Diagnosis. — Ventrolateral parabolic nodes expressed on conch internal moulds as more or less apparent tubercles.

Remarks. — Czarnocki's (1989) *Platyclymenia unisulcata*, showing prominent ventrolateral tubercles, may belong here. Specimen ZPAL AmVII/027 from sample Ost-7 at Ostrówka shows a *Clymenia*-like septal morphology, although the suture is not suitable to prepare a camera lucida drawing. In fact, as the shell surface is not preserved, it cannot be excluded that this is a morph of *Nodosoclymenia distincta* Czarnocki, 1989.

Distribution. — Black limestone of probably the *P. trachytera* Zone at Ostrówka (bed 4) and Besówka, and grey limestone of the *L. styriacus* Zone (sample Ost-7).

Genus ***Clymenia*** Münster, 1834

Type species: *Planulites laevigatus* Münster, 1832 from Schübelhammer near Heinersreuth in Frankenwald?

Diagnosis. — Very evolute conch; septum with incipient lateral vaulting expressed in angulation of flank lobe of the suture, dorsal slope of which is more or less concave and ventral convex.

Clymenia primaeva (Czarnocki, 1989)
(Figs 189A and 196)

Type horizon and locality: Lower part of the *Platyclymenia* beds at Ostrówka, Holy Cross Mountains.

Material. — Three specimens.

Diagnosis. — Suture with relatively deep and angulate flank lobe; compressed whorls with tabulate venter.

Remarks. — *C. primaeva* was proposed by Czarnocki (1989) to be the type species of his genus *Eokosmoclymenia*. It is transitional between *Aktuboclymenia* and *Protoxyclymenia* and apparently represents a stage in the continuous lineage. One may doubt if so detailed subdivision is necessary.

From the same stratum the types of Czarnocki's (1989) *Eokosmoclymenia subacuta* originated, defined as developing ventrolateral furrows in mature stages, and *E. transitoria*, with slighly more acute venter. Their status seems questionable.

Distribution. — Probably the *P. trachytera* Zone at Jabłonna (well w52d dug by Żakowa *et al*. 1984) and Ostrówka (Czarnocki 1989).

Clymenia laevigata (Münster, 1839)
(Figs 188 and 196)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald?

Material. — Three specimens from Jabłonna, 23 specimens from Kowala, one from Ostrówka.

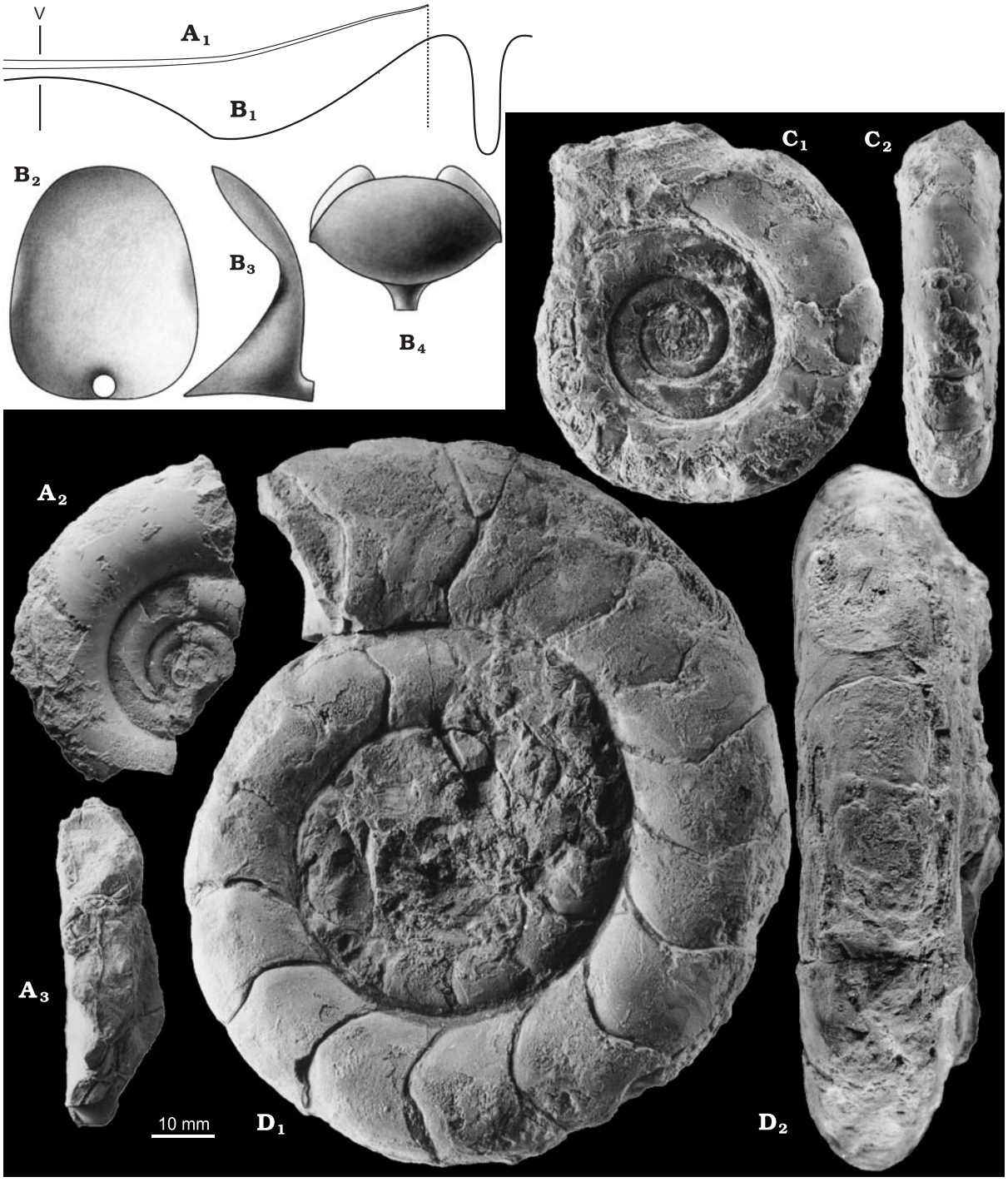


Fig. 188. *Clymenia laevigata* (Münster, 1839) from the early *P. jugosus* Zone of the Holy Cross Mountains; growth lines and views of ZPAL AmVII/303 from Jabłonna (A, sample J-51); suture and restoration of septum based on unnambered fragmentary specimens from Kowala (B); views of ZPAL AmVII/107 and IG 284.II.787 from Jabłonna (C, bed 28; D, beds with *Costaclymenia*).

Diagnosis. — Slight flank lobe angulation in the suture; aperture without ventral sinus.

Distribution. — The late *L. styriacus* Zone at Ostrówka (sample Ost-9) and Kowala, the early *P. jugosus* Zone at Jabłonna (bed 28 and sample J-51).

Genus ***Aktuboclymenia*** Bogoslovsky, 1979

Type species: *A. ancestralis* Bogoslovsky, 1979 from the Egedin Formation of the Urals.

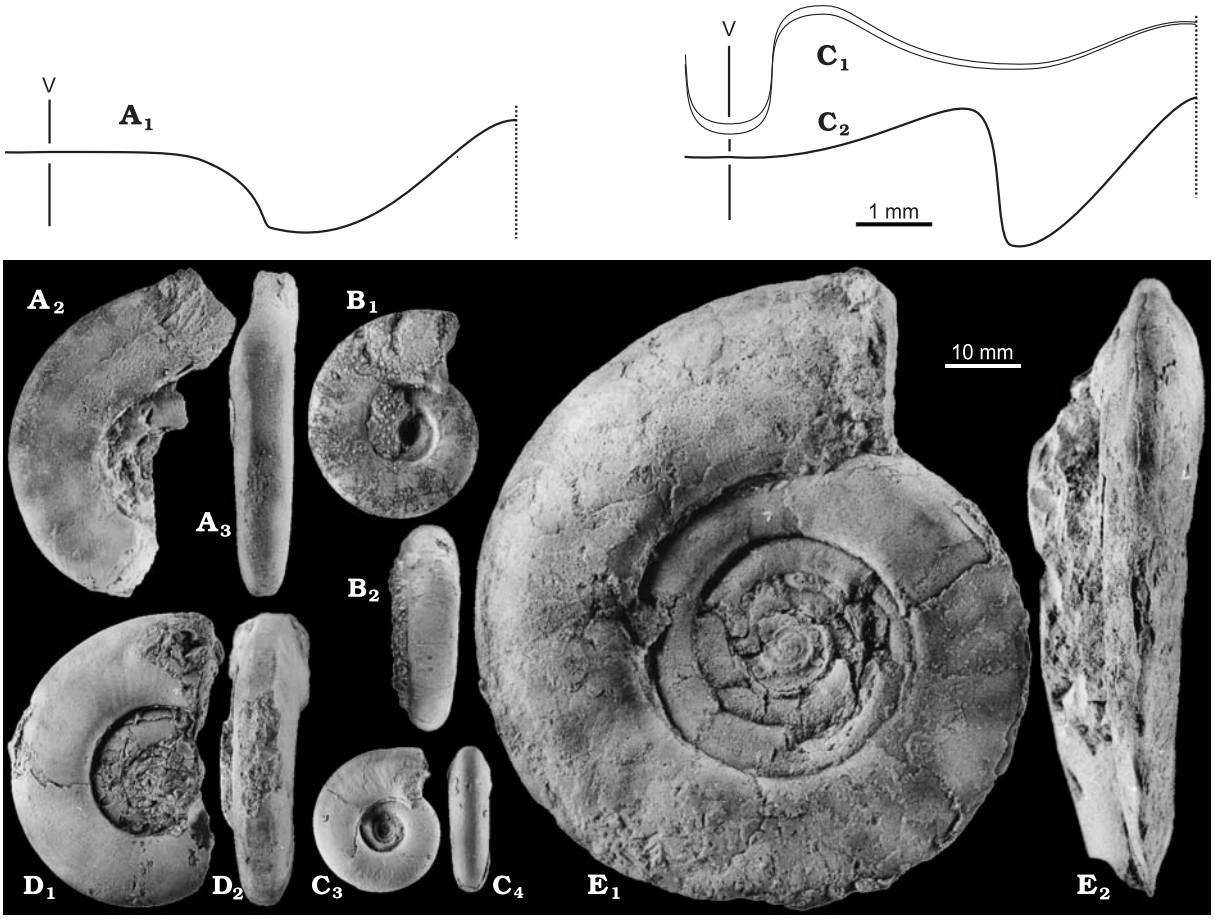


Fig. 189. Clymeniids from the *P. trachytera* Zone at Ostrówka in the Holy Cross Mountains. **A**. *Clymenia primaeva* Czarnocki, 1989; suture and views of ZPAL AmVII/708 from Jabłonna (well w52d of Żakowa *et al*. 1984). **B**. *Aktuboclymenia ancestralis* Bogoslovsky, 1979 from Sieklucki's brickpit in Kielce; suture and views of pyritic internal mould IG 284.II.182 (also Czarnocki 1989, pl. 21: 20). **C**, **D**. *Protoxyclymenia galezicensis* Czarnocki, 1989, growth lines, suture, and views of ZPAL AmVII/1117 (B, sample Ost-16); views of IG 284.II.219 (C, *Nodosoclymenia* bed). **E**. *Protoxyclymenia serpentina* (Münster, 1832); views of IG 284.II.216 (holotype of *Kosmoclymenia prima* Czarnocki, 1989; *Nodosoclymenia* bed).

Diagnosis. — Incipient septal vaulting expressed as an asymmetric angulation of the flank lobe, relatively involute conch with subtrapezoidal whorl cross section.

Remarks.— Bogoslovsky (1979) considered the type species of the genus ancestral to the branch of the Clymeniidae because its evolute conch and shallow flank lobe of the suture. The Polish species supports this interpretation. The incipient marginal vaulting of the septum seems to be inherited after a tornoceratid ancestor, preserved in the Cymaclymeniidae but apparently lost in the lineage of *Clymenia*.

Aktuboclymenia ancestralis Bogoslovsky, 1979
(Figs 189B, and 196)

Type horizon and locality: Egedin Formation at Kara Dzhar in the southern Urals.

Remarks. — The single pyritized specimen representing juvenile portion of the phragmocone and made the type of Czarnocki's *Flexiclymenia fundifera* shows conch evoluteness and suture making it indistinguishable from those of *A. ancestralis*. Obviously, until mature conchs are found in the Holy Cross Mountains, this species identification remains tentative.

Despite its small size, a true vaulting near the margin of the septum is developed, with the tip of the flank lobe extending significantly deeper than the nearby area of the septum. In this respect the species is transitional between *A. humboldti* and species of *Cymaclymenia*.

Distribution. — Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce.

Genus ***Protoxyclymenia*** Schindewolf, 1923

Type species: *Clymenia dunkeri* Münster, 1839 from Kirch-Gattendorf in Oberfranken.

Diagnosis. — Septum with lateral vaulting expressed in angulation of the flank lobe of the suture, the dorsal slope of which is almost straight and the ventral slightly angulated.

Protoxyclymenia galezicensis Czarnocki, 1989
(Figs 189C, D and 196)

Type horizon and locality: Lower part of the *Platyclymenia* beds at Ostrówka, Holy Cross Mountains.

Material. — Three specimens.

Diagnosis. — Ventral slope of the flank lobe of the suture almost parallel to the venter, delimited with slightly rounded angulation from the wide ventral lobe.

Remarks. — The septum is of almost hemispherical shape ventrally of the flank lobe, which makes tracing its contact with conch wall difficult.

Distribution. — The *P. trachytera* Zone at Ostrówka (sample Ost-16).

Protoxyclymenia serpentina (Münster, 1832)
(Figs 189E and 196)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald (Korn and Price 1987).

Remarks. — The only identifiable specimen collected by Czarnocki (1989) was made by him the type of *Kosmoclymenia prima*, although suture cannot be traced and generic affiliation remains uncertain. Restudy of the type material by Korn and Price (1987) removed objections against the proposed here identification of the specimen, although its preservation makes any determination tentative.

Distribution. — Probably the *P. trachytera* Zone at Ostrówka (lower *Platyclymenia* beds of Czarnocki 1989).

Genus ***Kosmoclymenia*** Schindewolf, 1949

Type species: *Planulites undulatus* Münster, 1832 from Försterei Reigern near Balve, Rhenish Slate Mountains (Korn and Price 1987).

Diagnosis. — Pointed flank lobe of the suture delimited ventrally by a narrow saddle giving it a zigzag appearance.

Remarks. — A great number of *Kosmoclymenia* species has been proposed and its taxonomy is rather complex (Korn and Price 1987). The differences between species result mostly from maturation of their conchs at various size. It remains to be determined with biometrics of large samples how strict was the control of ontogeny and how much variation is allowed for a species and its particular populations.

Kosmoclymenia kowalensis Czarnocki, 1989
(Figs 190 and 196)

Type horizon and locality: Lower part of the *Wocklumeria* beds at Kowala, Holy Cross Mountains (Czarnocki 1989).

Material. — 17 specimens.

Diagnosis. — Conch of generalized morphology and longiconic appearance at juvenile stages, developing ventrolateral furrows at diameter of 40–45 mm; delicate irregular growth lines.

Remarks. — The species shows much similarity to *K. bisulcata* (Münster, 1832), lacking its diagnostic lateral furrows at maturity (see Korn and Price 1987) and to *K. ademmeri* Korn *et* Price, 1987, but lacks any spiral ornament.

The holotype of *K. kowalensis* is a juvenile specimen, unidentifiable at the species level if taken alone. Probably the oldest true *Kosmoclymenia* in the Holy Cross Mountains occurs at Kowala in the grey limestone below the black Epinette Event shale. Along with several internal moulds collected by myself from there, two specimens with preserved shell showing growth lines were found and they fit the morphology of both the Czarnocki's type specimens of *K. kowalensis* from Ostrówka and those from the red limestone classified by him in *K. sedgwicki*. However, the lectotype of *Clymenia sedgwicki* Münster, 1840 has appeared to represent the tornoceratid *Pseudoclymenia* (Korn and Price 1987, p. 33).

Protoxyclymenia tenuissima Czarnocki, 1989 was based on a minute specimen considered mature by Czarnocki (1989) because of apertural modification of one specimen from Kowala (possible preservational artefact).

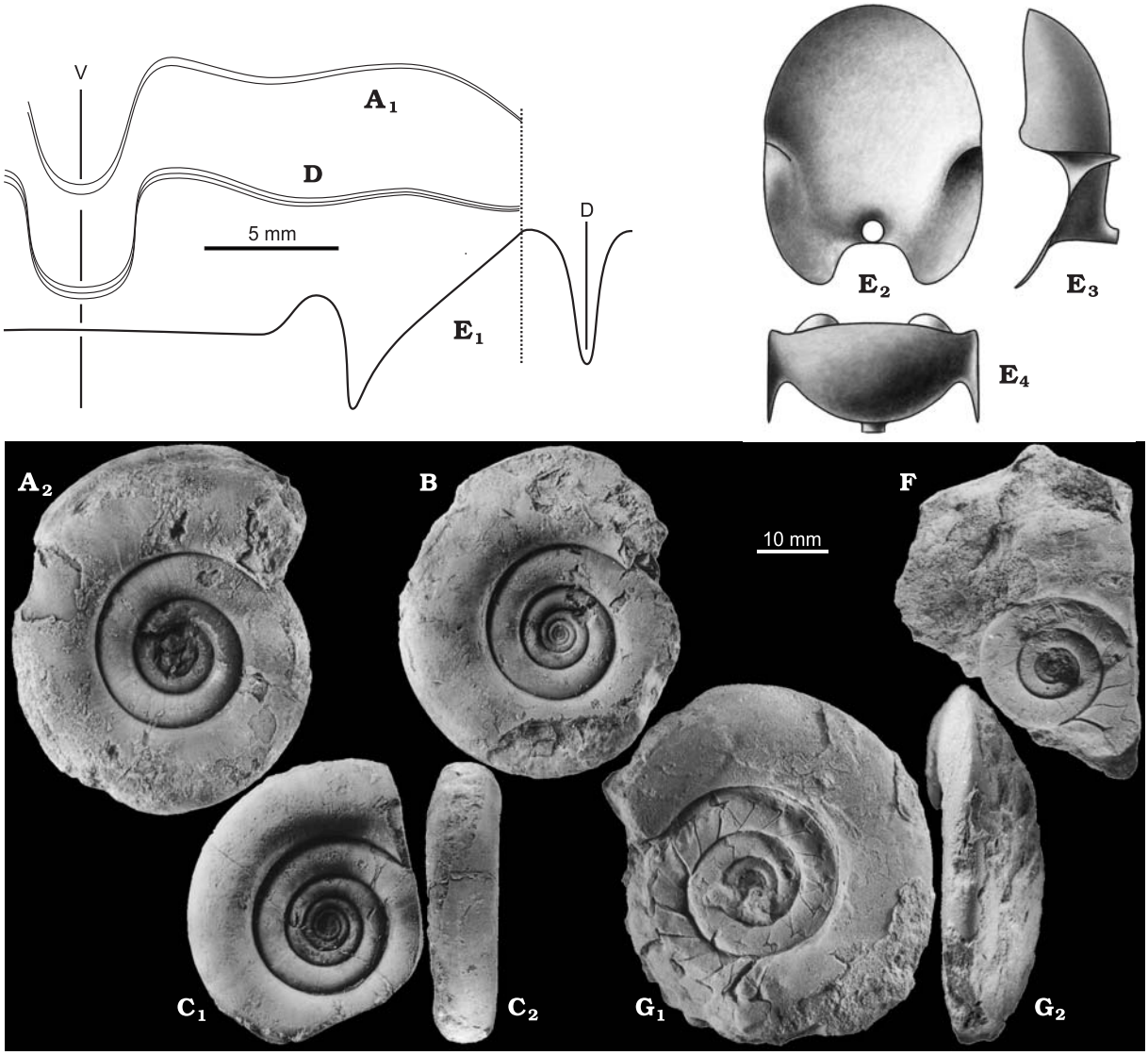


Fig. 190. *Kosmoclymenia kowalensis* Czarnocki, 1989 from Kowala in the Holy Cross Mountains; growth lines and views of mature specimens IG 284.II.457 and 457a, and juvenile specimen IG 284.II.465 from red limestone (A–C, *D. trigonica* Zone); suture growth lines of ZPAL AmVII/783, suture and restoration of septum based on unnambered specimens, and views of ZPAL AmVII/950 and 1615 from grey limestone immediately above the strata with *Clymenia* (D–G, *P. jugosus* Zone).

Distribution. — The *P. jugosus* and *D. trigonica* zones at Kowala and Ostrówka and Dzikowiec.

Kosmoclymenia sp. aff. *K. bisulcata* (Münster, 1832)
(Figs 191 and 196)

Material. — 36 specimens.

Diagnosis. — Conch of generalized morphology developing ventrolateral furrows at diameter of about 40 mm or later, ornamented with dense distinct growth lines.

Remarks. — The species is similar to *K. bisulcata* in general conch form but differs in underived shape of mature aperture and the lack of lateral furrows; probably also in distinctness of growth lines, a feature dependant on preservation. *K. adammeri* Korn *et* Price, 1987 is even more similar to the Dzikowiec form than that species in low whorl expansion rate, but its diagnostic character is a longitudinal striation. Such a striation sometimes developed in the Dzikowiec *Kosmoclymenia*, but rather on specimens of juvenile morphology resembling *K. undulata*.

Distribution. — The *D. trigonica* and possibly the late *P. jugosus* zones at Dzikowiec.

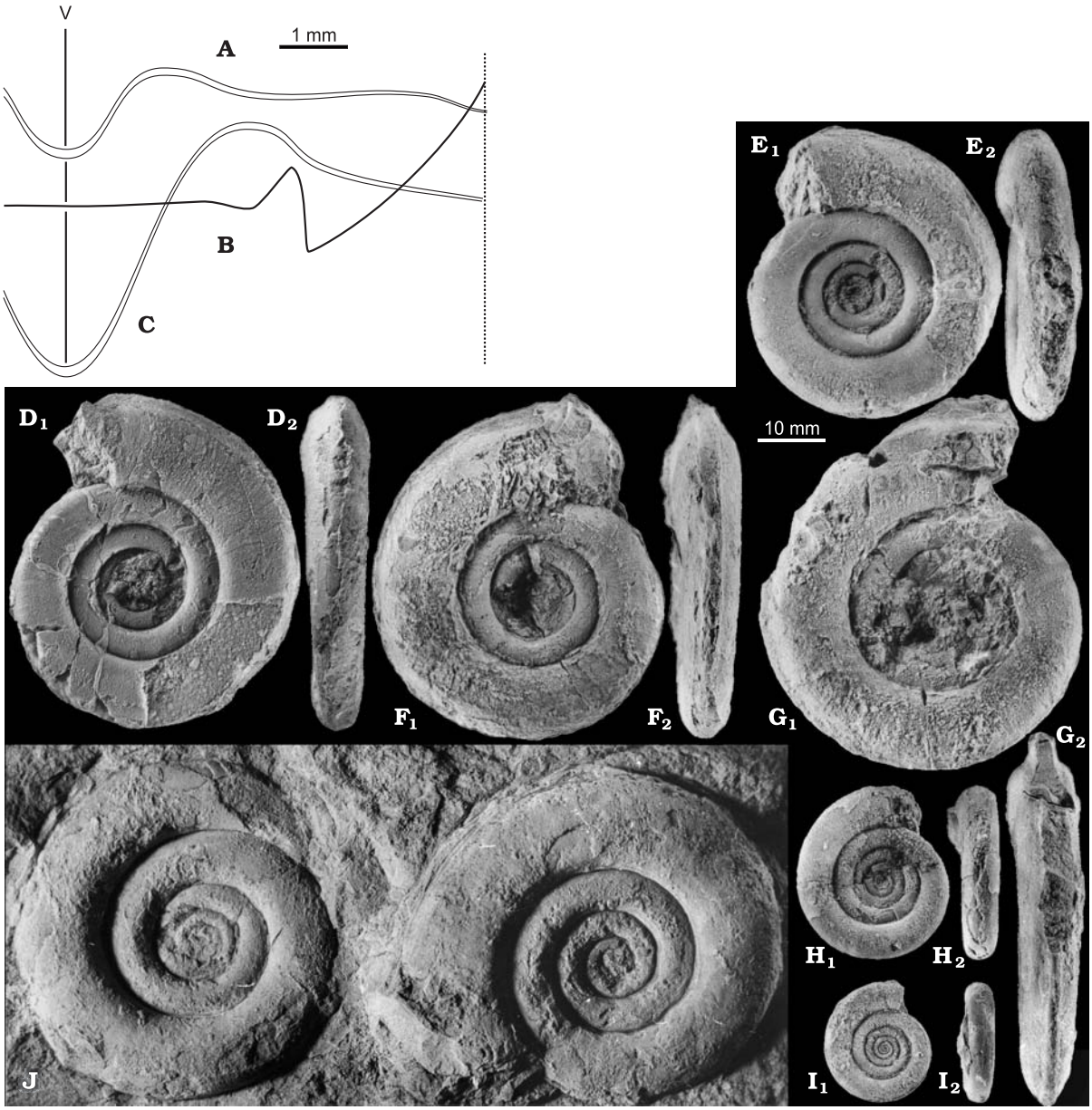


Fig. 191. *Kosmoclymenia* sp. aff. *K. bisulcata* (Münster, 1832) from the *D. trigonica* and the late *P. jugosus* zones at Dzikowiec in the Sudetes; growth lines of subadult specimen ZPAL AmVII/71 (A); suture of ZPAL AmVII/74 (B); growth lines of mature specimens ZPAL AmVII/156 (C); views of ZPAL AmVII/174, 163, 175, 153, 1029, and 170 (D–I), and Uwr 1776 (J).

Kosmoclymenia galeata (Wedekind, 1914)
(Figs 192 and 196)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes (Korn and Price 1987).

Material. — Two specimens.

Diagnosis. — Conch of generalized morphology developing ventrolateral furrows at diameter of about 70 mm, ornamented with regularly and densely distributed distinct growth lines.

Remarks. — The lectotype has poorly preserved growth lines and shows a rather early development of ventrolateral furrows, indicating conch maturity (Korn and Price 1987) but its evolute appearance suggests affinities to the topotype specimens included here in the same species. *K.* sp. aff. *K. bisulcata* shares a similar ornamentation and occurs at the same locality but not necessarily in the same stratum. *K. galeata* is distinct from it in ontogenetically later development of the ventrolateral furrows, but a somewhat higher growth expansion rate at earlier stages. The apertural lappets of the type specimen of *K. parundulata* Korn *et* Price, 1987 from Effenberg project forward, unlike the discussed specimens from Dzikowiec.

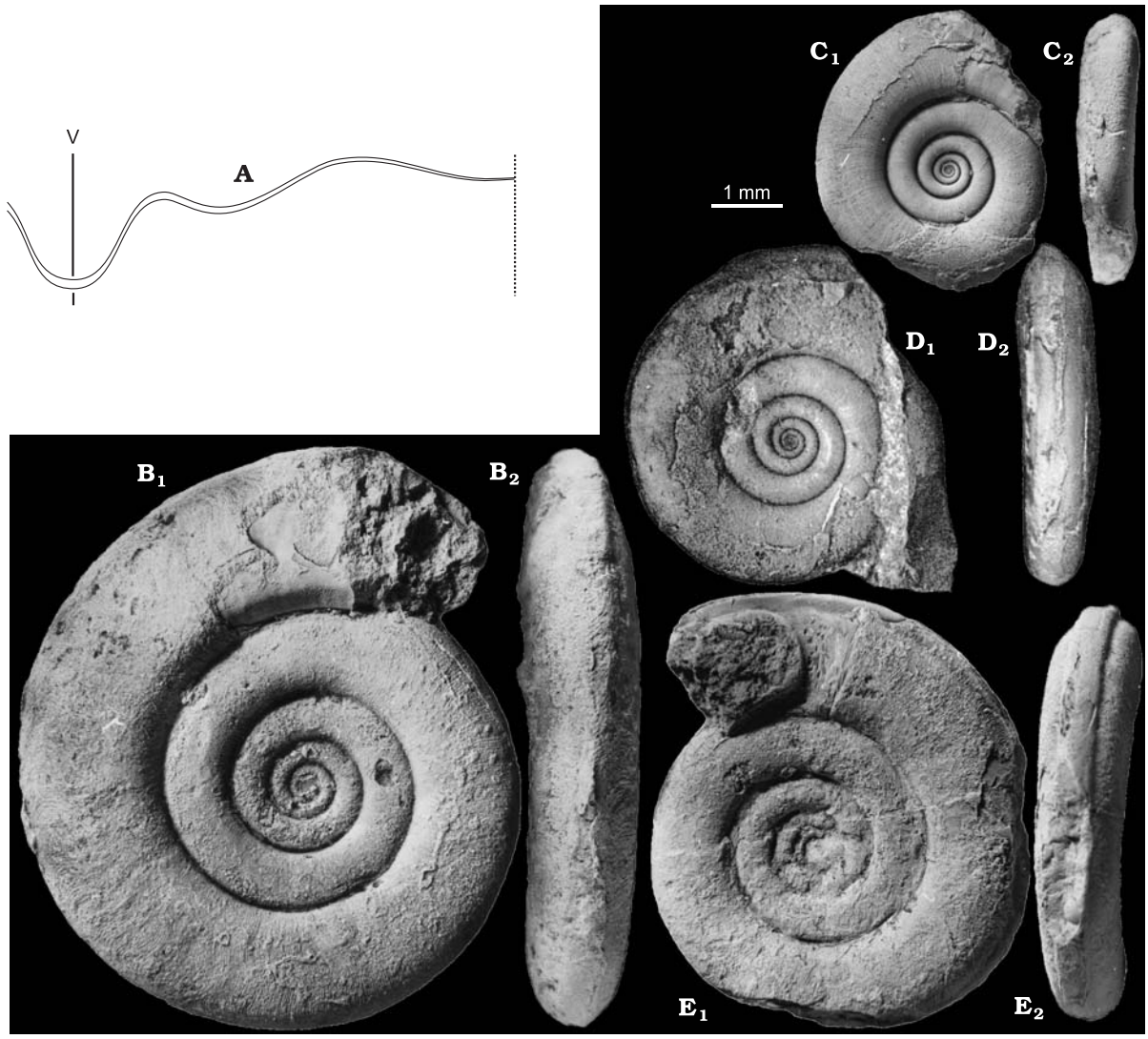


Fig. 192. *Kosmoclymenia galeata* (Wedekind, 1914) from the late *P. jugosus* zones at Dzikowiec in the Sudetes; suture of MB.C. 4285 (A), views of large immature specimen MB.C. 4046 and juvenile 4062 (B, C), the lectotype (D) reproduced from Korn and Price (1987), and small mature specimen MB.C. 4093 (E; note internal thickening near the aperture, similar to that in *Cymaclymenia silesiaca* on Fig. 185D).

Distribution. — Probably the late *P. jugosus* Zone at Dzikowiec.

Kosmoclymenia dzikowiecensis (Korn *et* Price, 1987)
(Figs 193A–E and 196)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes (Korn and Price 1987).

Material. — Three specimens.

Diagnosis. — Conch of generalized morphology and relatively breviconic appearance, developing ventrolateral furrows at diameter of about 25 mm, ornamented with regularly and densely distributed distinct growth lines.

Remarks. — The maturity at rather small conch size suggests that this species is ancestral to *K. similis*, occurring also at the same locality. No evidence on their stratigraphic relationship is available, however.

Distribution. — Probably the *P. jugosus* Zone at Dzikowiec.

Kosmoclymenia similis (Münster, 1832)
(Figs 193F–I and 196)

Type horizon and locality: Kirch-Gattendorf in Frankenwald (Korn and Price 1987).

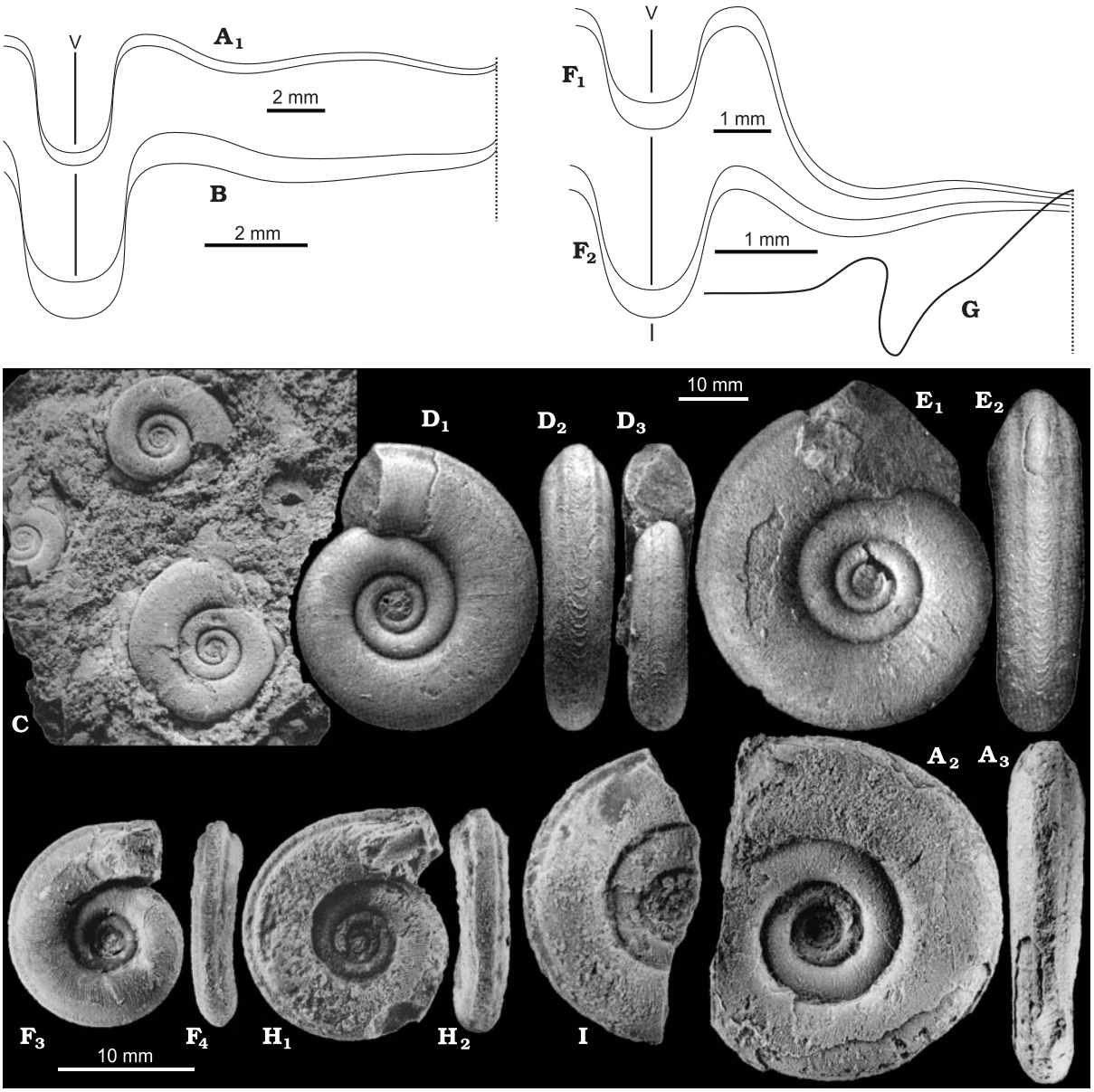


Fig. 193. Small size advanced *Kosmoclymenia* from Dzikowiec in the Sudetes. **A–E**. *Kosmoclymenia dzikowiecensis* (Korn *et* Price, 1987) probably from the late *P. jugosus* Zone; growth lines and views of specimen ZPAL AmVII/1026 (A); growth lines of ZPAL AmVII/1026 (B); view of specimen MB.C. 4043 (C); views of paratype and holotype (D, E, both reproduced from Korn and Price 1987, pl. 8: 58, 59). **F–I**. *Kosmoclymenia similis* (Münster, 1832) from the *D. trigonica* Zone; growth lines at maturity and prior to developing ventrolateral furrows and views of specimen ZPAL AmVII/117 (F); suture of ZPAL AmVII/43 (G); views of ZPAL AmVII/424 and 164 (H, I).

Material. — 23 specimens.

Diagnosis. — Minute conch developing ventrolateral furrows at diameter of about 12 mm.

Remarks. — This is probably the most characteristic and easy to determine species of *Kosmoclymenia* owing to its minute size at maturity.

Distribution. — The *D. trigonica* Zone at Kowala (sample Ko-107) and Dzikowiec (sample Dz-7 and loose blocks).

Kosmoclymenia xenostriata Korn *et* Price, 1987
(Figs 194 and 196)

Type horizon and locality: Probably Schübelhammer in Franconia (Korn and Price 1987).

Material. — 12 specimens.

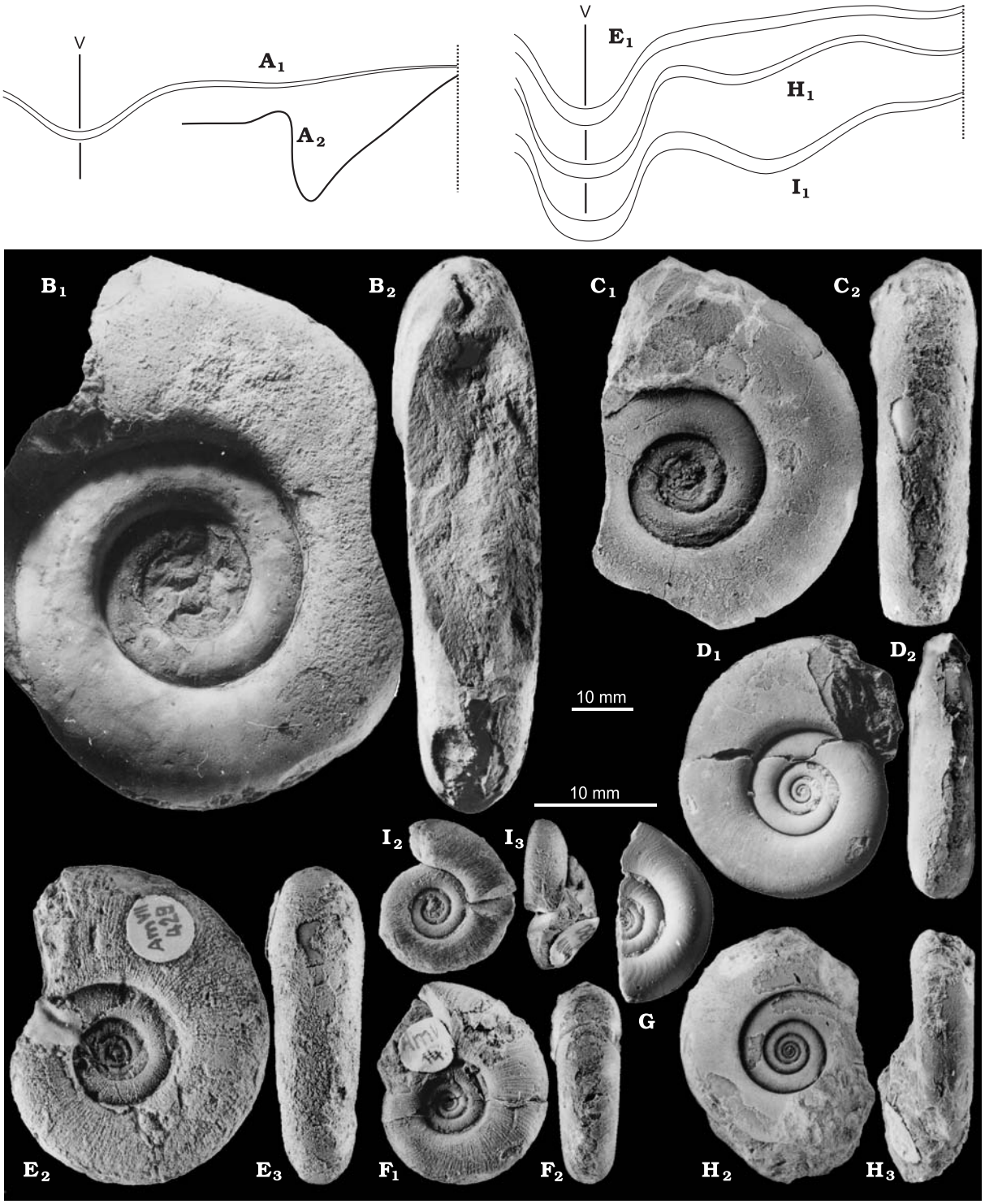


Fig. 194. *Kosmoclymenia xenostriata* Korn *et* Price, 1987 from the late *P. jugosus* Zone at Dzikowiec in the Sudetes (A–H) and Jabłonna in the Holy Cross Mountains (I); growth lines and suture of specimen ZPAL AmVII/428 (A); views of UWr 1769, ZPAL AmVII, 165, MB.C. 4076 (B–D); growth lines and views of of ZPAL AmVII/429 (E); views of ZPAL AmVII/143 and UWr 1760 (F, G); growth lines and views of of ZPAL AmVII/167 and 430 (H, I).

Diagnosis. — Oblique aperture of the conch with usually prominent growth lines and relatively breviconic appearance, umbonal wall rounded in profile.

Remarks. — The holotype is a juvenile specimen (Korn and Price 1987), but its oblique aperture profile is consistent with that of the Dzikowiec specimens at comparable stages of their ontogeny. In this respect

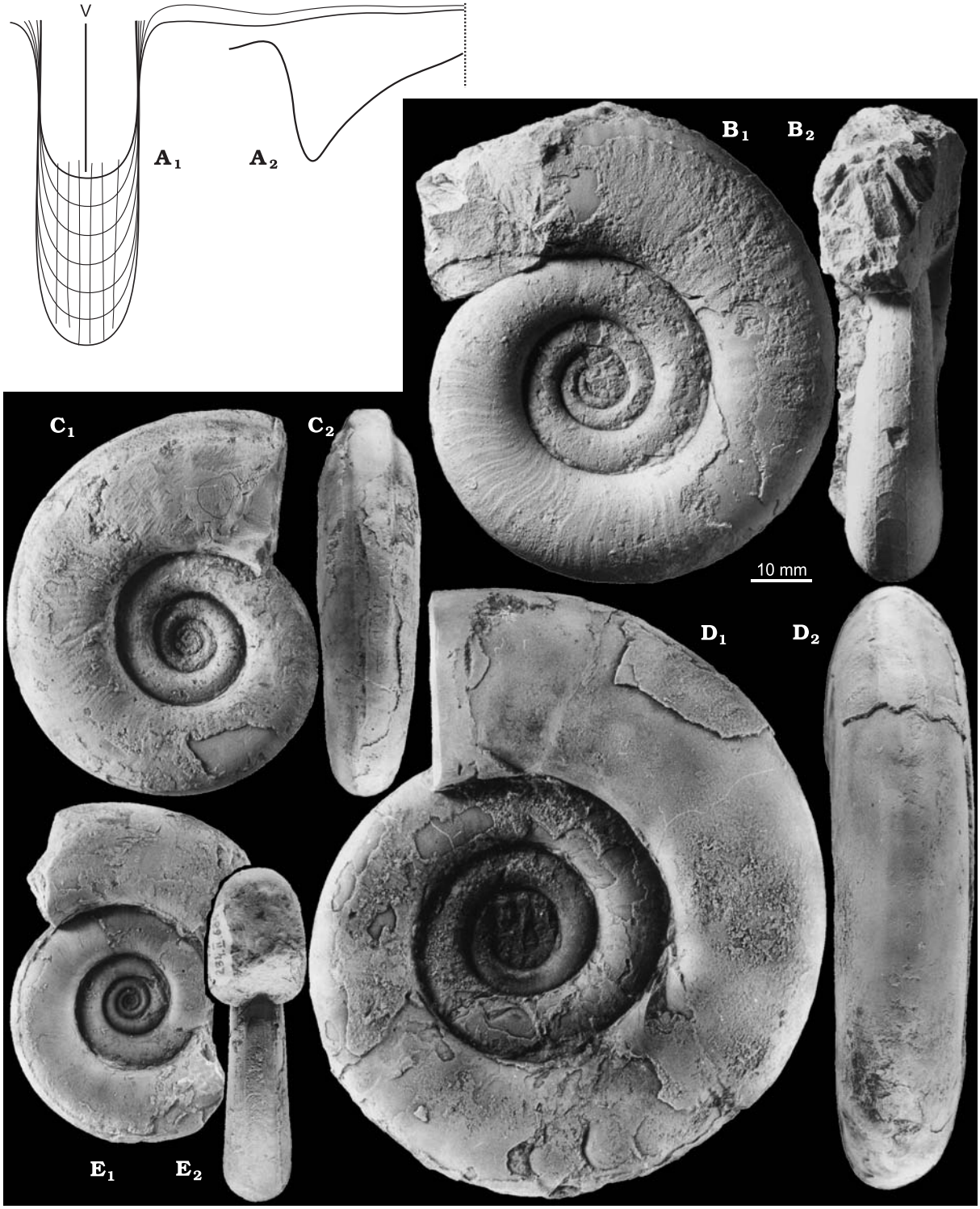


Fig. 195. *Kosmoclymenia undulata* (Münster, 1832) from the late *P. jugosus* Zone at Dzikowiec in the Sudetes (A, B) and at between Stokówka and Besówka in the Holy Cross Mountains (C–E); growth lines and suture of specimen ZPAL AmVII/416 (A); views of unnambered specimen Uwr (B), IG 284.II.367 (C; holotype of *K. venusta* Czarnocki, 1989), IG 284.II.363 (D), and 685 (E, paratype of *Eokosmoclymenia subacuta* Czarnocki, 1989).

they also resemble the lectotype of *Kosmoclymenia wocklumeri* (Wedekind, 1914) from the *P. paradoxa* Zone at Ense in Kellerwald, proposed by Korn and Price (1987), which differs, however, in an angular profile of the umbonal part of its umbo and in mature whorl lacking ventrolateral furrows despite the large conch size.

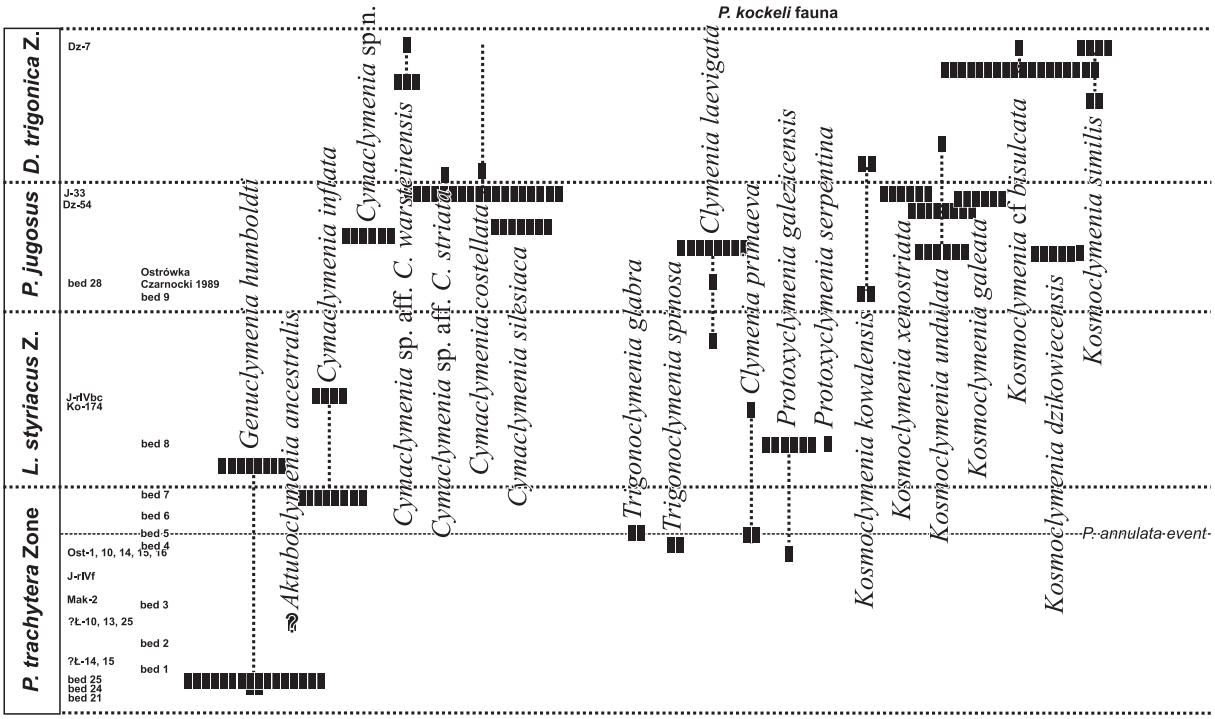


Fig. 196. Stratigraphic distribution of species of the Cymaclymeniidae and Clymeniidae in the Polish Famennian. Position of samples not included in Figs. 2 and 3 on the geochronological scale is hypothetical.

There is much variation in the prominence and regularity in distribution of growth lines among the Dzikowiec specimens showing their sinuous appearance. In a few specimens with prominent growth lines, lateral sinuses are not developed. They are thus more derived than *K. xenostriata* in this respect, which may place them within the range of variability of *K. wocklumeri*.

Distribution. — The late *P. jugosus* Zone at Dzikowiec and Jabłonna.

Kosmoclymenia undulata (Münster, 1832)
(Figs 195 and 196)

Type horizon and locality: Försterei Reigern near Balve, Rhenish Slate Mountains (Korn and Price 1987).

Material. — 12 specimens.

Diagnosis. — Serially distributed blade-like transverse expansions of the aperture ventrally prominent; deep infundibular sinus of the aperture; nearly circular whorl cross section until conch maturity.

Remarks. — The large specimen from Kowala attributed to *K. wocklumeri* by Czarnocki (1989) because of its angular umbo, is here transferred to *K. undulata*, as this is rather the character of this species. Also the material of *K. venusta* Czarnocki, 1989 from the locality between Besówka and Stokówka probably represents this species, as suggested by the appearance of fragmentarily preserved growth lines on one specimen (Czarnocki 1989, pl. 34: 7).

Distribution. — Red limestone of the late *P. jugosus* Zone at Ostrówka and grey limestone of probably the *D. trigonica* Zone at Kowala and Dzikowiec.

Family **Carinoclymeniidae** Bogoslovsky, 1975

Diagnosis. — Suture with clearly delimited semicircular flank lobe; more or less involute conch tending to develop acute venter.

Remarks. — Bogoslovsky (1975) introduced this family for clymenias with deeply involute conchs and acute venter. Advanced members of the clade developed periodic narrow "horns" along the ventral keel (Bogoslovsky 1982). Among species from the Holy Cross Mountains introduced by Czarnocki (1989), sev-

eral are transitional between such forms and *Costaclymenia*. To preserve clarity of classification it seems necessary to extend the range of this family to encompass also those ancestral forms that are provisionally classified here in *Nanoclymenia*. It is only a matter of convenience whether to separate this clade from the family Costaclymeniidae, here restricted to forms with a tabulate venter, or not. An acute venter alone is a poor diagnostic character for high rank ammonoid taxa, and this feature appeared independently several times in the evolution of clymenias.

Genus ***Nanoclymenia*** Korn, 2002

Type species: *Clymenia nana* Münster, 1842 probably from the lower part of *Platyclymenia* Stufe at Schübelhammer near Heinersreuth in Frankenwald (Korn 2004b).

Diagnosis. — Suture with rounded flank lobe with gently sinuous dorsal and more steep ventral slope; moderately evolute conch with rounded subtrapezoidal whorl cross section.

Remarks. — This is a connecting link between early clymenias with angular flank lobe and *Costaclymenia* with distinctly developed semicircular lobe of the suture. It is assumed here that the specimens of *N. nana* described by Korn (2004b) and Korn and Klug (2002) are juveniles.

Nanoclymenia? *intermedia* (Czarnocki, 1989)
(Figs 197A–D and 218)

Type horizon and locality: *Prolobites* beds at Ostrówka, Holy Cross Mountains (Czarnocki 1989).

Remarks. — Suture of the species remains unknown. Czarnocki (1989) classified it in *Rectoclymenia* together with *Nanoclymenia retrusa*, although both lack the generically diagnostic ventral keel. He referred to some similarity in conch morphology, especially the shape of internal shell thickenings. In fact, the earliest keeled clymenia in the Ostrówka section, *Kiaclymenia polonica* (Czarnocki, 1989) occurs immediately above and shows much similarity in conch morphology to *N.*? *intermedia*. Another possible affinity of the species is among involute species of *Pleuroclymenia*.

Distribution. — The *P. trachytera* Zone, grey limestone of *Prolobites* beds at Ostrówka (bed 3? of Czarnocki 1989); several juvenile specimens from Jabłonna (trench rIVb dug by Żakowa *et al*. 1984) may also belong here.

Nanoclymenia retrusa (Czarnocki, 1989)
(Figs 197I, J and 218)

Type horizon and locality: Lower part of *Platyclymenia* beds at Ostrówka, Holy Cross Mountains.

Remarks. — Obliquely transverse internal shell thickenings make the species similar to *Pleuroclymenia intermedia* (Czarnocki, 1989) which may be ancestral both to it and the *Cteroclymenia* lineage of clymenias with acute venter but its exact evolutionary position remains questionable because of unknown suture.

Distribution. — Early *L. styriacus* Zone, lower part of the *Clymenia* beds (*Nodosoclymenia* bed) at Ostrówka (bed 8 of Czarnocki 1989) and probably the *P. trachytera* Zone at Jabłonna (bed 24).

Genus ***Cteroclymenia*** Bogoslovsky, 1979

Type species: *C. rozmanae* Bogoslovsky, 1979 from the Egedin Formation of Kara Dzhar in the southern Urals (Bogoslovsky 1979).

Diagnosis. — Conch with small umbilicus and parabolic venter developing a sharp keel at late ontogenetic stages; suture with small flank lobe located near umbilicus.

Cteroclymenia sp. n.
(Figs 197E, F and 218)

Remarks. — The species was determined by Czarnocki (1989) as *Rectoclymenia* aff. *arietina* (Sandberger, 1853) but the conch shape points rather to *Cteroclymenia rozmanae* Bogoslovsky, 1979 as its closest relative. The Polish species is less involute, which suggests its underived status. Unfortunately, the available evidence on suture and growth lines is insufficient to determine more precisely its relationships and to define new species.

Distribution. — The *P. trachytera* Zone, upper *Prolobites* beds at Ostrówka (bed 4? of Czarnocki 1989), juvenile specimen found in sample Ost-15.

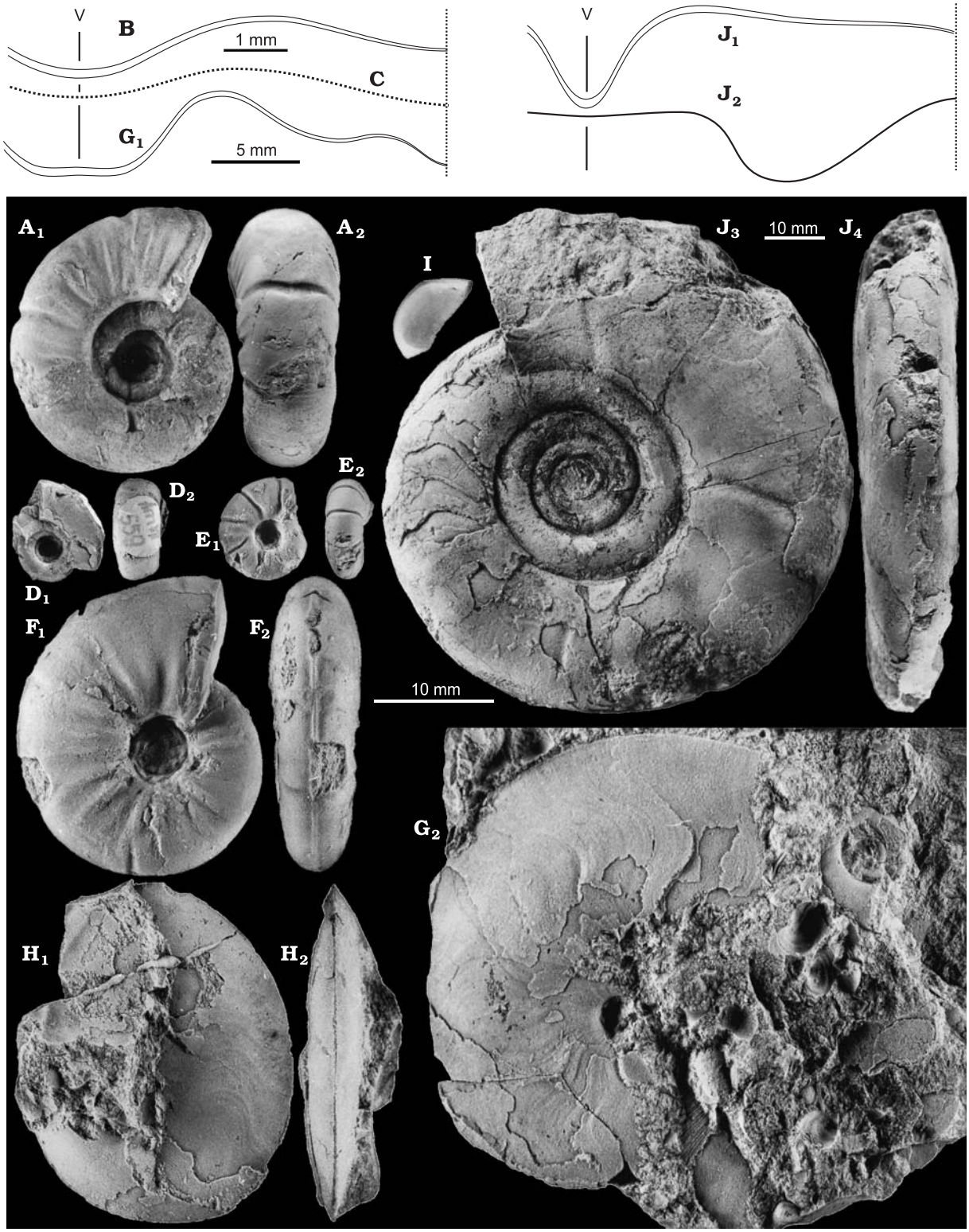


Fig. 197. Carinoclymeniids from the *P. trachytera* Zone of the Holy Cross Mountains. **A**–**E**. *Nanoclymenia*? *intermedia* (Czarnocki, 1989) from Ostrówka (A) and Jabłonna (B–D); views of specimen IG 284.II.39 (A, bed 1 of Czarnocki 1989); growth lines of ZPAL AmVII/557, internal thickening of 532, and views of 559 (B–D; trench rIVb of Żakowa *et al*. 1984). **E**, **F**. *Cteroclymenia* sp. n. from Ostrówka; views of specimen ZPAL AmVII/1677 (E, sample Ost-15) and IG 284.II.23 (F). **G**, **H**. *Carinoclymenia beulensis* (Lange, 1929) from the *P. trachytera* Zone at Ostrówka (lower *P. annulata* Zone according to label written in 1936 by Jan Czarnocki); growth lines and view of specimen IG 284.II.206 (G) and 206a (H). **I**, **J**. *Nanoclymenia retrusa* (Czarnocki, 1989) from Jabłonna (I, bed 24) and Ostrówka (J, *Nodosoclymenia* bed); a piece of the living chamber ZPAL AmVII/846 (I); growth lines, suture and views of IG 286.II.233 (J).

Genus ***Carinoclymenia*** Bogoslovsky, 1965

Type species: *?Tornoceras beulense* Lange, 1929 from the *P. annulata* Zone at Beul, in the Rhenish Slate Mountains.

Diagnosis. — Flat involute conch with a very sharp ventral keel.

Carinoclymenia beulensis (Lange, 1929).
(Figs 197G, H and 218)

Material. — Two specimens.

Remarks. — Growth lines reaching the margin of the ventral keel give it a characteristic serrated appearance (Müller 1956). Suture is not preserved; identification of the species as a clymenia is thus due only to data by Bogoslovsky (1965). *Clymenia subflexuosa* var. *acuta* of Perna (1914) with a wider umbilicus and less compressed conch may be the ancestor of this species.

Distribution. — The *P. trachytera* Zone, black crinoidal limestone with *Guerichia* of the lower *P. annulata* beds at Ostrówka (bed 5? of Czarnocki 1989).

Family **Costaclymeniidae** Schindewolf, 1920

Diagnosis. — Suture with flank lobe bordered by narrow saddles; evolute conch with more or less tabulate venter.

Genus ***Costaclymenia*** Schindewolf, 1920

Type species: *Goniatites binodosus* Münster, 1832.

Diagnosis. — Almost semicircular flank lobe dorsally delimited by distinct saddle and ventrally by angulation of the whorl.

Costaclymenia binodosa (Münster, 1832)
(Figs 198 and 218)

Material. — Three specimens.

Remarks. — Ventral and umbonal lobes of the suture are shallow; juvenile conch bears subventral tubercles. Czarnocki (1989) created species *C. limata* for the single large specimen from the red limestone of probable *Clymenia* Stufe strata at Ostrówka, referring to the completely smooth conch surface as the diagnostic character. Actually the conch shows indistinct tubercles, which usually disappear at the stage when the whorls increase their height (see Bogoslovsly 1981, pl. 3: 2b). I find thus this evidence insufficient to define a separate species.

Distribution. — Red limestone of the *Clymenia* beds at Ostrówka (bed 16 of Czarnocki 1989) and the earliest *P. jugosus* Zone at Jabłonna (bed 27), coeval strata at Kowala.

Genus ***Trochoclymenia*** Schindewolf, 1929

Type species: *Clymenia wysogorskii* Frech, 1902 from the clymeniid limestone at Dzikowiec, the Sudetes.

Diagnosis. — Very longiconic smooth evolute conch with shallow flank lobe of the suture.

Trochoclymenia wysogorskii (Frech, 1902)
(Figs 216A–C and 218)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — Three specimens.

Remarks. — The original from Dzikowiec is poorly preserved and offers little information on the conch morphology but its overall shape and suture (Frech 1902, fig. 3) strongly suggest species identity with the specimen from Kowala described by Czarnocki (1989). Among juvenile specimens from Dzikowiec there is one with a wide tabulate venter which potentially may also belong here. The suture, weel represented in the Kowala specimen, shows a pointed saddle on flanks without any correspondence to the whorl section. This is a feature of the *Costaclymenia* lineage.

Distribution. — The *D. trigonica* Zone at Kowala (lower *Wocklumeria* beds of Czarnocki 1989) and Dzikowiec (the highest clymeniid limestone according to Frech 1902, p. 33).

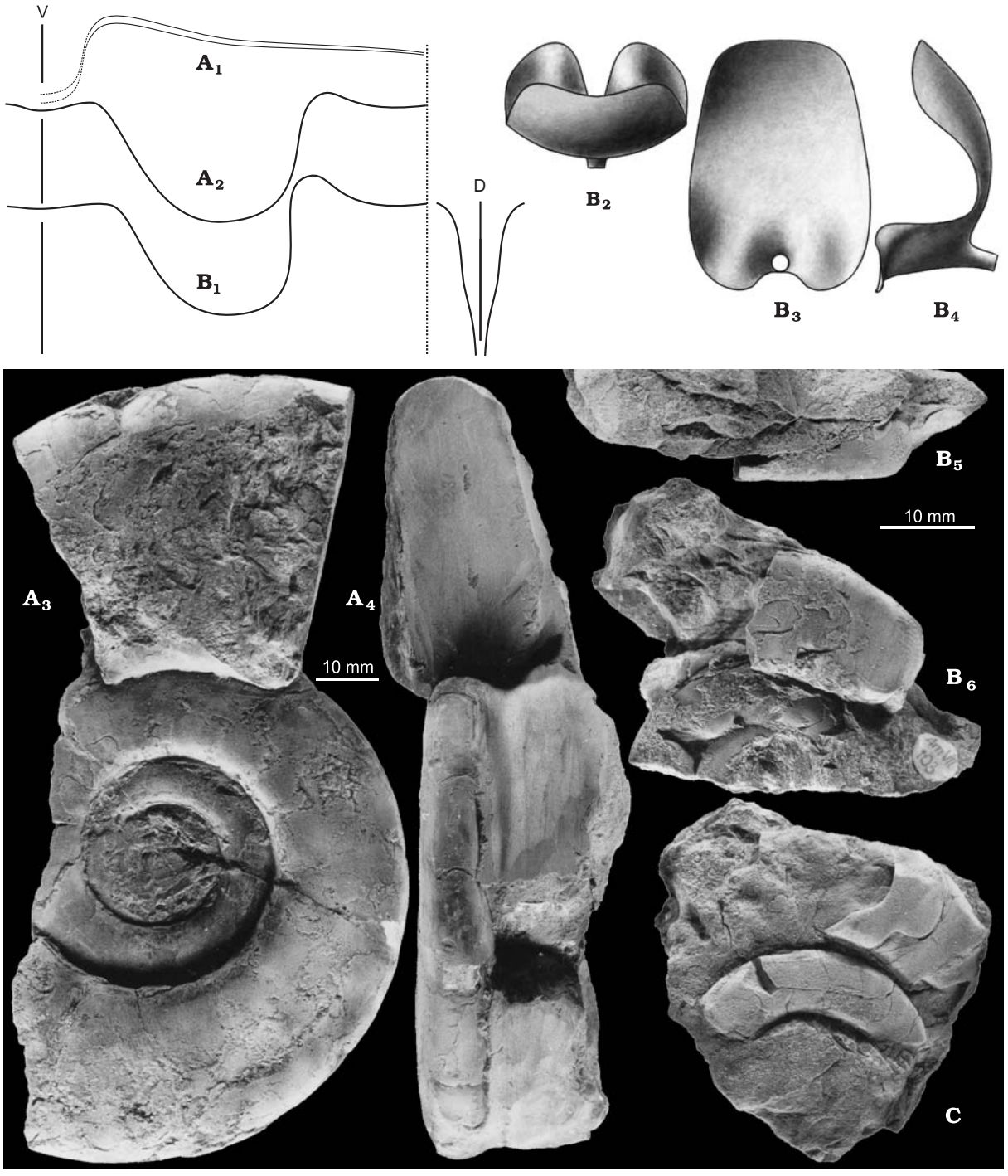


Fig. 198. *Costaclymenia binodosa* (Münster, 1832) from the Holy Cross Mountains; growth lines, suture, and views of specimen IG 284.II.231, from Ostrówka (A, probably the early *P. jugosus* Zone); suture, restored septum, and views of ZPAL AmVII/103 from the earliest *P. jugosus* Zone at Jabłonna (B, bed 27); view of ZPAL AmVII/945 from the early *P. jugosus* Zone at Kowala (C).

Family **Gonioclymeniidae** Hyatt, 1884

Diagnosis. — Suture with flank lobe bordered by narrow saddles; evolute conch with flat venter.

Remarks. — Probable ancestor of the gonioclymeniids is *Mesoclymenia nalivkinae* Bogoslovsky, 1981 from Kazakhstan, with acute ventral and flank lobes. Subsequent deepening of the umbonal lobe and subdivision of ventrolateral saddle apparently gave the situation known in *Gonioclymenia* (Bogoslovsky 1981).

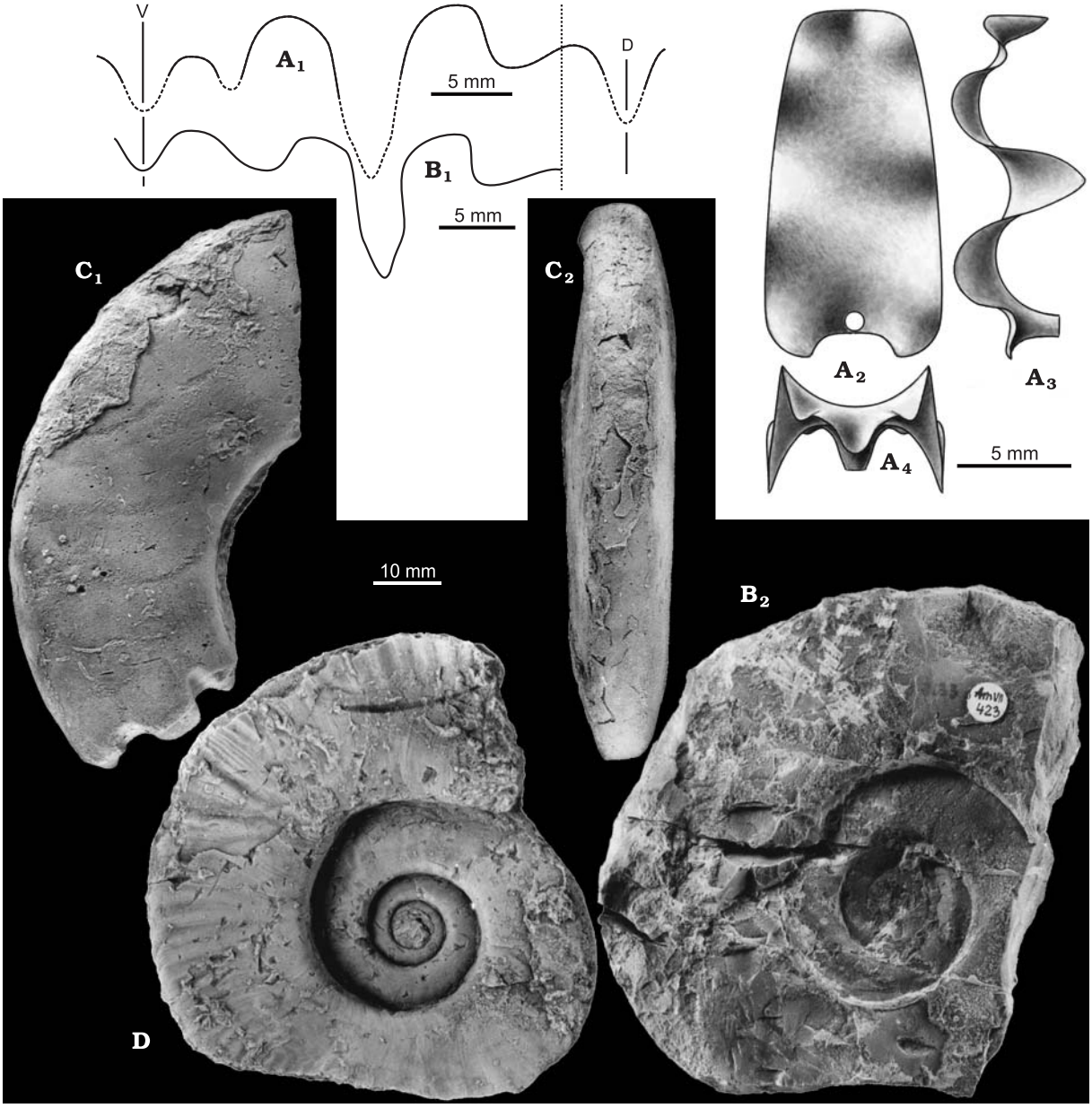


Fig. 199. *Finiclymenia wocklumensis* (Lange, 1929) from the *P. jugosus* Zone of the Holy Cross Mountains; suture, and restored septum of specimen IG 284.II.272, from Kowala (A); suture and view of ZPAL AmVII/423 from Jabłonna (B, C; bed 33); views of specimens IG 284.II. 852 and 635 from Kowala (C, D; D reproduced from Czarnocki 1989, pl. 4: 4).

Genus ***Finiclymenia*** Price *et* Korn, 1989

Type species: *Gonioclymenia (Kalloclymenia) wocklumensis* Lange, 1929 from *P. paradoxa* Zone, Burg near Balve, Rhenish Slate Mountains (Price and Korn 1989).

Diagnosis. — Suture with shallow rounded umbonal lobe; high trapezoidal whorls of the conch; ventrolateral tubercles.

Remarks. — Price and Korn (1989) defined their subgenus *Finiclymenia* of *Gonioclymenia*, on the V-shaped apperance of the flank lobe in the only available specimen. The specimens from Kowala (Czarnocki 1989) and Jabłonna, otherwise indistinguishable from the holotype, show a narrow flank lobe similar to that in species of *Kalloclymenia*. Otherwise the suture is significantly less derived in other lobes are shallow and round. This suggests that the lineage of *F. wocklumensis* is rooted deep in the branch of the Gonioclymeniidae being possibly transitional between *Costaclymenia* and *Kalloclymenia*. Future findings in strata older than the type horizon are predicted.

Finiclymenia wocklumensis (Lange, 1929)
(Figs 199 and 218)

Type horizon and locality: *P. paradoxa* Zone, Burg near Balve, Rhenish Slate Mountains (Price and Korn 1989)

Material. — One specimen.

Remarks. — The conch from Jabłonna is only partially exposed on a hard limestone block, but sections across ventrolateral spines (or tubercles) are visible in juvenile part up to about 10 mm diameter. At later stages the conch is virtually smooth, although in the probably conspecific specimen from Kowala described by Czarnocki (1989) numerous transverse riblets are developed near the venter. Suture is unexpectedly underived, which may suggest that the conch morphology is also primitive for the lineage, despite its stratigraphic location. The only other species of similar morphology are the more evolute *K. kozhimensis* Bogoslovsky *et* Kuzina, 1980 from the polar Urals (Bogoslovsky and Kuzina 1980; Bogoslovsky 1981) and K glabra Bogoslovsky, 1981 from the northern Urals.

Distribution. — The *P. jugosus* Zone at Jabłonna (bed 33) and Kowala (Czarnocki 1989).

Genus ***Kalloclymenia*** Wedekind, 1914

Type species: *Goniatites subarmatus* Münster, 1832 from Schübelhammer near Heinersreuth in Frankenwald (Price and Korn 1989).

Diagnosis. — Ventrolateral spines restricted to juvenile stages, convex venter of the conch.

Remarks. — The species of the genus differ mostly in the course of their ontogeny, with juvenile parabolic nodes or spines being replaced with ribs or ventrolateral tubercles and finally the whorls smoothen reaching maturity. Too little is known about their population variability to be sure of taxonomic identifications proposed below.

Kalloclymenia subarmata (Münster, 1832)
(Figs 200F, G and 218)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald (Price and Korn 1989).

Material. — Two specimens.

Diagnosis. — Somewhat compressed subquadrate whorls; laterally oriented parabolic nodes change into thick ribs terminating with robust ventrolateral tubercles at about 50 mm diameter.

Remarks. — Massive spines are preserved on inner whorls of specimen ZPAL Am VII/1075 from Dzikowiec. Immature, somewhat deformed specimen MB.C. 5462 from the same locality is about 20 cm in diameter.

Distribution. — The *P. jugosus* Zone at Dzikowiec and Ostrówka.

Kalloclymenia uhligi (Frech, 1902)
(Figs 200D and 218)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

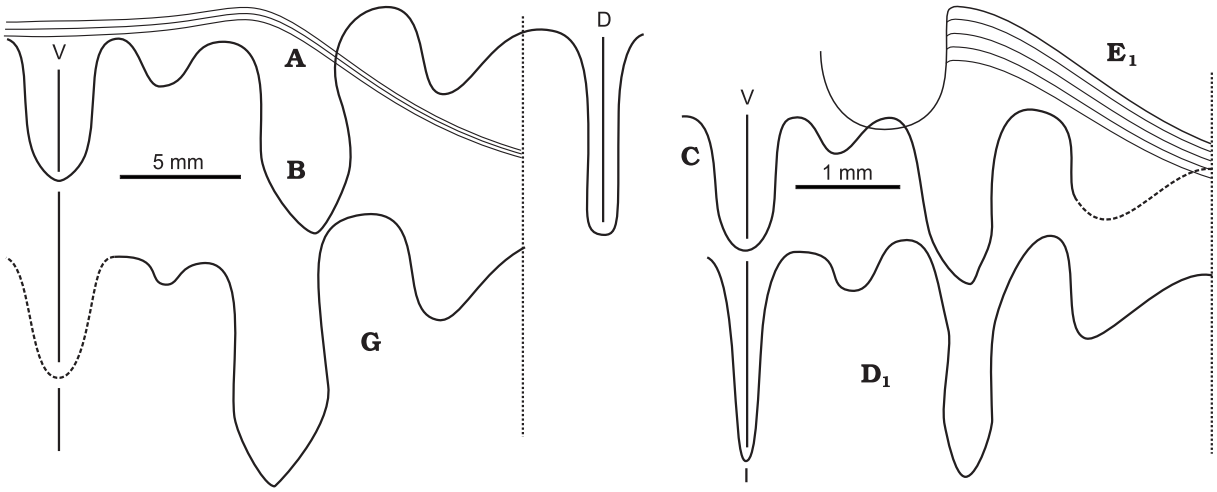
Material. — One specimen.

Diagnosis. — Lateraly oriented parabolic spines continue to at least 60 mm diameter; robust conch with high whorl expansion rate.

Remarks. — Korn and Price (1989, fig. 5f, g) gave wrong magnification of the lectotype picture, and this obliterated the difference in respect to *K. subarmata*. Whether this difference reflects only the population variability or species distinction remains to be determined.

Distribution. — Probably the late *P. jugosus* Zone at Dzikowiec.

Fig. 200. Underived species of *Kalloclymenia* from the *P. jugosus* Zone. **A–C**. *K. biimpressa* (von Buch, 1839); growth lines of subadult specimen ZPAL AmVII/224 (A); suture of IG 284.II.917 (B, for septum see Fig. 201A), ZPAL AmVII/223 (C, for views see Fig. 201E), and 1075 (D, for views see Fig. 201B) from Dzikowiec in the Sudetes. **D**. *Kalloclymenia uhligi* (Frech, 1902) from the late *P. jugosus* or *D. trigonica* Zone at Dzikowiec in the Sudetes; suture (from Price and Korn 1989) and views of the lectotype MB.C. 550. **E**. Undetermined juvenile of *Kalloclymenia* from Kowala in the Holy Cross Mountains (possibly the *D. trigonica* Zone); growth lines with parabolic node and views of specimen IG.284.II.851. **F**. *K. subarmata* (Münster, 1832); views of mature MD 16649 (5327) from Gałęzice in the Holy Cross Mountains (F, probably Ostrówka; collected by Jan Czarnocki) and suture of ZPAL Am VII/1075 from Dzikowiec (G). →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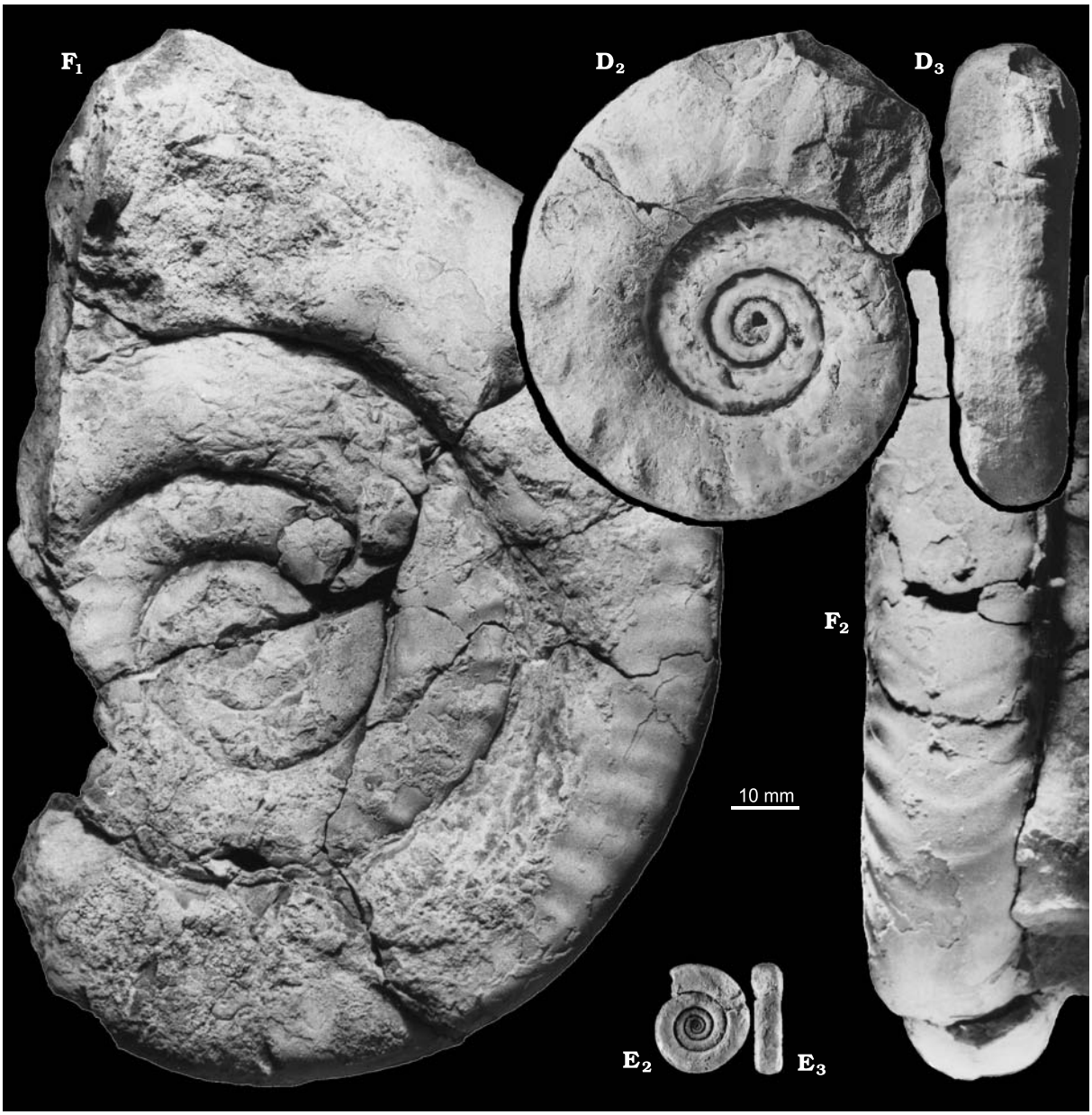
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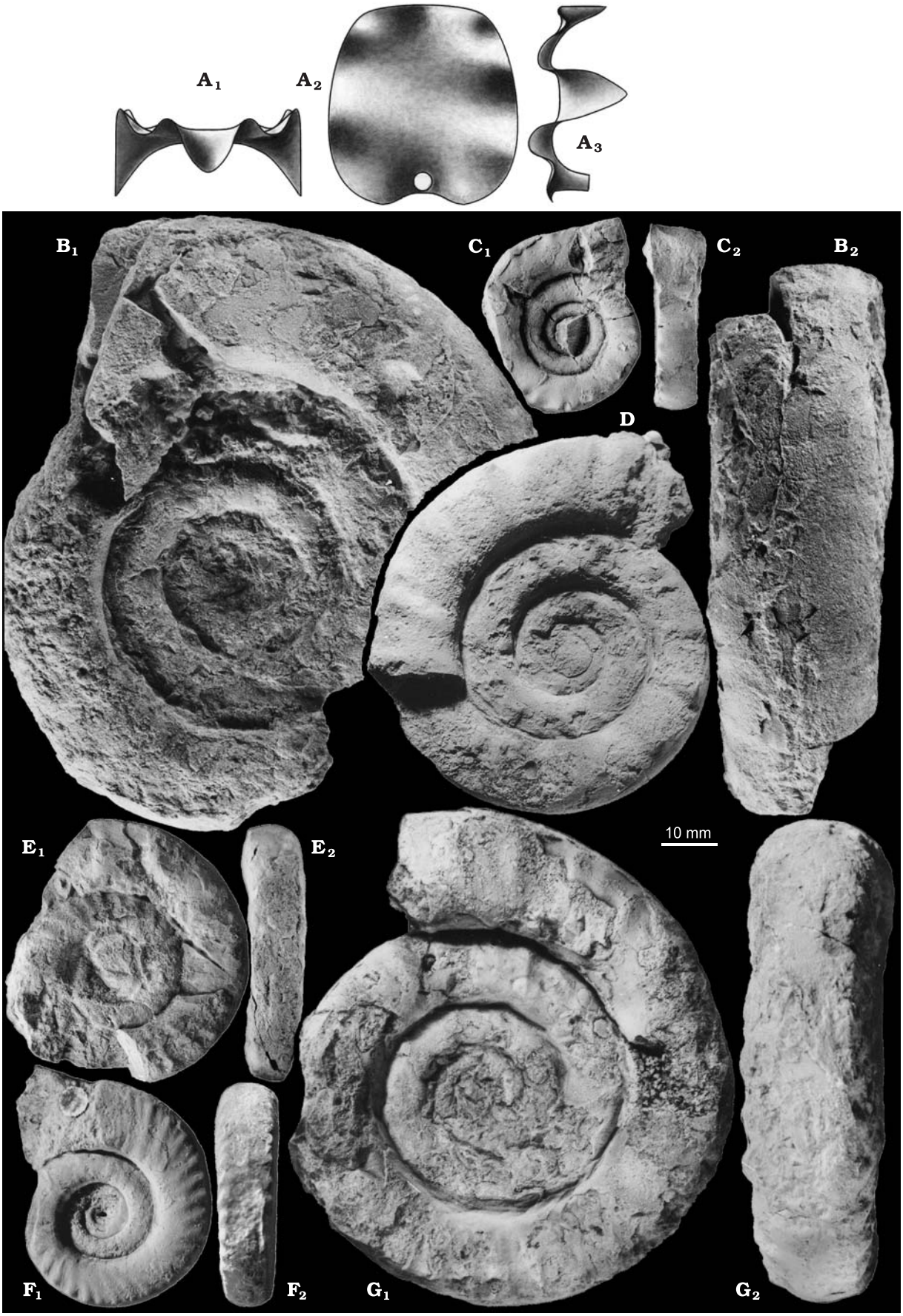
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Kalloclymenia biimpressa (von Buch, 1839)
(Figs 200A–C, 201, and 218)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — Six specimens.

Diagnosis. — Somewhat depressed subquadrate whorls, ribs parallel to aperture with ventrolateral tubercles disappearing gradually from about 50 mm diameter, laterally oriented parabolic nodes at juvenile stages.

Remarks. — The species differs from *K. subarmata* in somewhat more densely distributed and less massive ribs and wider whorl cross section. Probably it is more advanced. Parabolic nodes or massive spines are preserved on inner whorls of specimen ZPAL Am VII/224 from Dzikowiec and in ZPAL Am VII/1075.

Distribution. — The early *P. jugosus* Zone at Dzikowiec (sample Dz-9).

Kalloclymenia pessoides (von Buch, 1839)
(Figs 202A–E and 218)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — Eight specimens.

Diagnosis. — Compressed subquadrate whorls with smooth flanks; ribbing disappears at about 30 mm diameter.

Remarks. — The species is unique among those of *Kalloclymenia* in its virtually smooth adult conch. The parabolic nodes at juvenile stages disclose the close affinity to *K. subarmata*.

Distribution. — The *P. jugosus* Zone at Dzikowiec.

Kalloclymenia frechi (Lange, 1929)
(Figs 202F–H and 218)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — Two specimens.

Diagnosis. — Compressed subquadrate whorls with smooth flanks, ventrolaterally oriented spines disappearing at about 20 mm diameter.

Remarks. — In the conch form the species is closely similar to *K. pessoides* but prominent spines impressed in the umbonal wall of the successive whorls make it similar rather to *Sphenoclymenia*.

Distribution. — The early *P. jugosus* Zone at Dzikowiec.

Genus ***Gonioclymenia*** Hyatt, 1884

Type species: *Goniatites speciosus* Münster, 1831 from Schübelhammer near Heinersreuth in Frankenwald (Price and Korn 1989).

Diagnosis. — V-shaped lateral, umbonal, and subventral lobes of the suture, more or less concave venter with high trapezoidal whorls of the conch with smooth flanks.

Gonioclymenia speciosa (Münster, 1832)
(Figs 203 and 218)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald (Price and Korn 1989).

Material. — Four specimens.

Remarks. — These were probably the largest Famennian ammonoids as shown by an unlabeled IG exhibition specimens collected by Jan Czarnocki at Ostrówka, which is more than 30 cm in diameter.

Distribution. — The *P. jugosus* Zone at Kowala and Ostrówka (sample Ost-185).

Genus ***Sphenoclymenia*** Schindewolf, 1920

Type species: *Goniatites maximus* Münster, 1832 from Schübelhammer near Heinersreuth in Frankenwald (Price and Korn 1989).

← Fig. 201. *K. biimpressa* (von Buch, 1839) from the *P. jugosus* Zone at Dzikowiec in the Sudetes; septum of IG 284.II.917 (A, for suture see Fig. 200B); views of ZPAL AmVII/ 1075 (B, for suture see Fig. 200D); views of ZPAL AmVII/224 (C), Uwr 1768 (D), ZPAL AmVII/223 (E, for suture see Fig 200C), Uwr 1768 (F), and MB.C. 3216 (G).

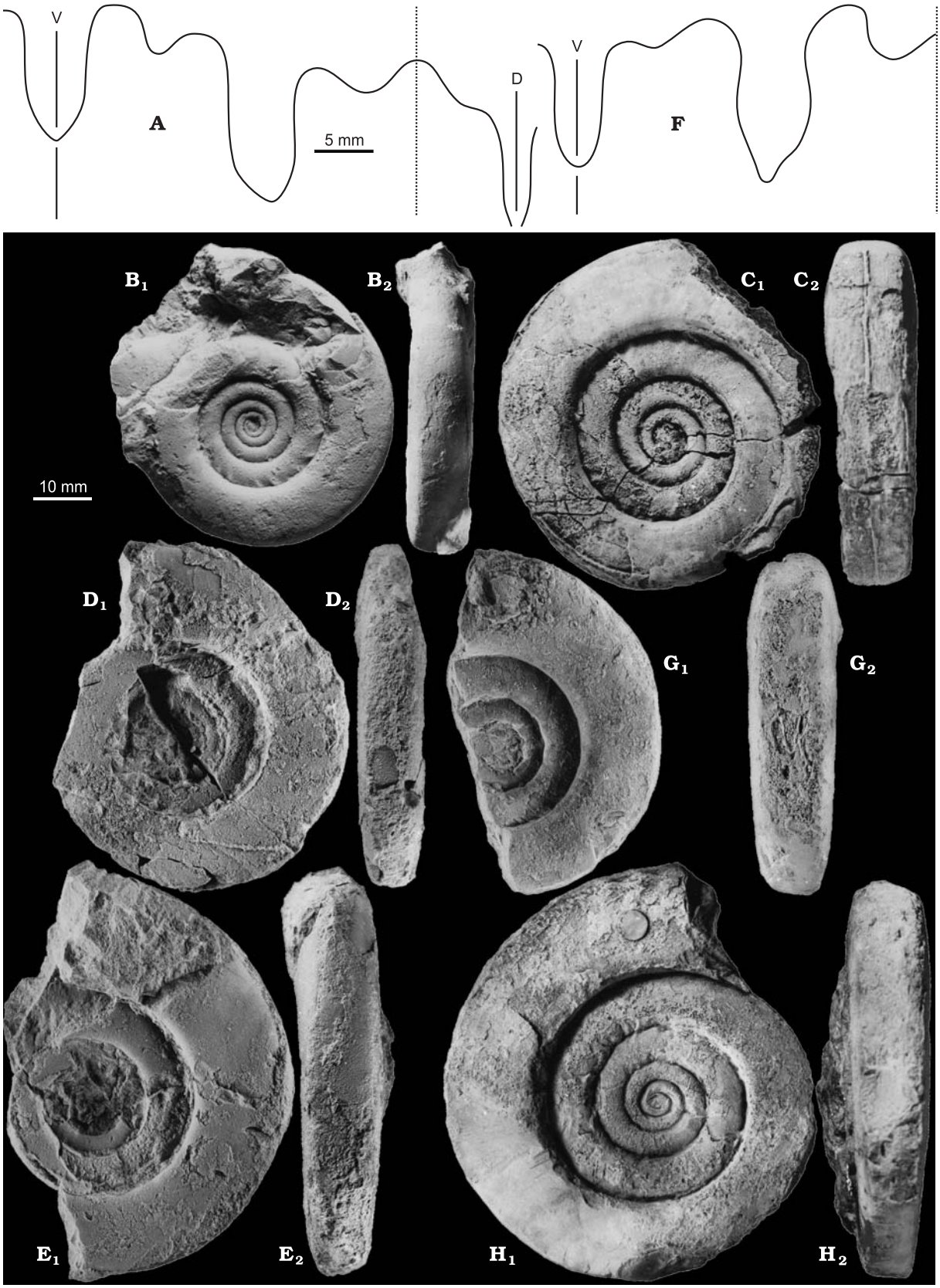


Fig. 202. Species of *Kalloclymenia* with tabulate venter from the *P. jugosus* Zone. **A**–**E**. *K. pessoides* (von Buch, 1839) from Kowala in the Holy Cross Mountains (A) and Dzikowiec in the Sudetes (B–E); suture of ZPAL AmVII/225 (A); views of UWR 2122s (B), MB.C. 4016 (C), ZPAL AmVII/1027, and 1584 (D, E). **F**–**H**. *K. frechi* (Lange, 1929) from Kowala (F, G) and Dzikowiec (H); suture of specimen IG.284.II.914 (F); views of 853 (G) and the holotype MB.C. 4029 (H).

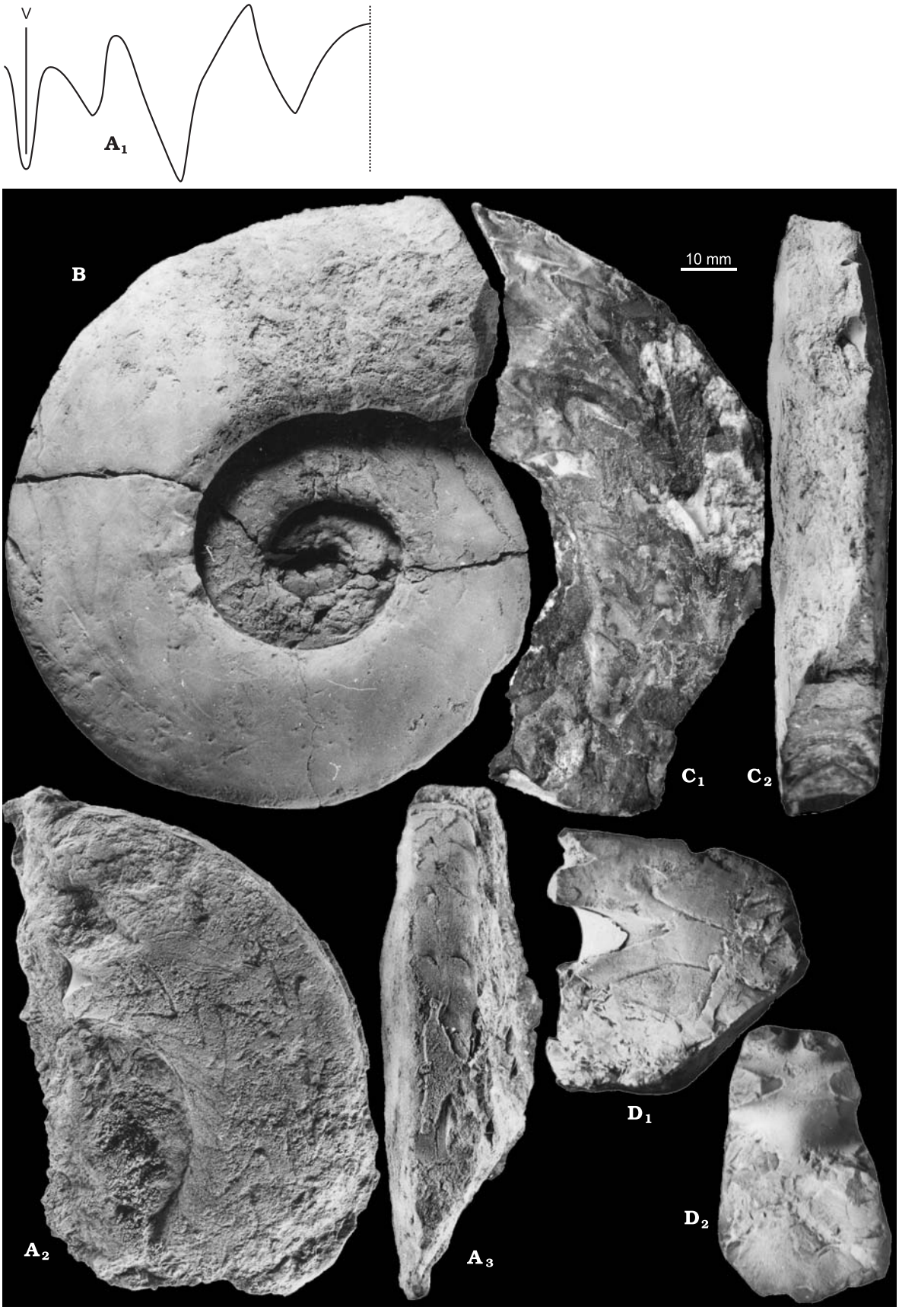


Fig. 203. *Gonioclymenia speciosa* (Münster, 1832) from the *P. jugosus* Zone at Ostrówka ina the Holy Cross Mountains (A) and Dzikowiec in the Sudetes (B–D); suture and views of ZPAL AmVII/185 (A); views of Uwr 1765 (B) and MB.C. 4021 (C, D).

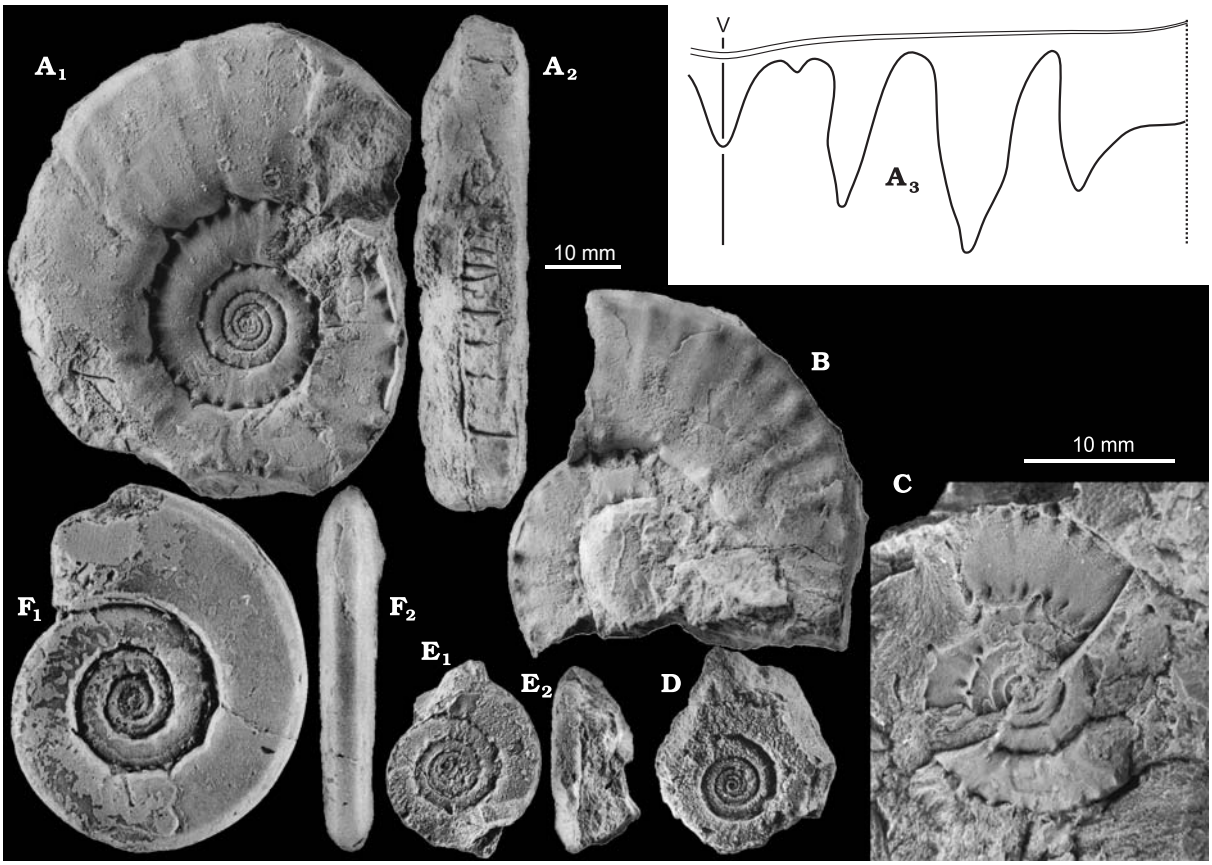


Fig. 204. Species of *Sphenoclymenia* from the *P. jugosus* Zone. **A**. *S. erinacea* Price *et* Korn, 1989 from Kowala in the Holy Cross Mountains; views and suture of specimen IG.284.II.772. **B–E**. *S. brevispina* (Lange, 1929) from Dzikowiec in the Sudetes; views of specimen ZPAL AmVII/194 (B), MB.C. 916 (C, also Frech 1902, pl. 2: 3a and Price and Korn 1989, fig. 5c, i, p), ZPAL AmVII/415, and 1581 (D, E). **F**. *S. plana* Bogoslovsky, 1981 from beds with *Gonioclymenia* between Besówka and Stokówka in the Holy Cross Mountains; views of specimen IG.284.II.381.

Diagnosis. — Two subventral lobes of the suture; compressed conch with ventrolaterally oriented spines at juvenile stages.

Remarks. — The suture of *Sphenoclymenia* is even more advanced in its subdivision than that in *Gonioclymenia*. On this basis Korn (1992) proposed to separate the genus in his family Sphenoclymeniidae.

Sphenoclymenia erinacea Price *et* Korn, 1989
(Figs 204A and 218)

Type horizon and locality: Base of bed 0 at Dasberg, Rhenish Slate Mountains (Price and Korn 1989).

Material. — One specimen.

Diagnosis. — The second subventral lobe incipient, at the tip of subventral saddle; spines dissappear at diameter about 20 mm, venter of mature specimens rounded.

Distribution. — Red limestone of the *D. trigonica* Zone at Kowala.

Sphenoclymenia brevispina (Lange, 1929)
(Figs 204B–E and 218)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — Four specimens.

Diagnosis. — The second subventral lobe deep and narrow; umbonal and ventrolateral tubercles occur up to late ontogenetic stages.

Remarks. — Suture has been traced by Korn and Price (1989) in a specimen from the Rhenish Slate Mountains.

Distribution. — Probably the *D. trigonica* Zone at Dzikowiec.

Sphenoclymenia plana Bogoslovsky, 1981
(Figs 204F and 218)

Type horizon and locality: Kia formation on the Kia River in the southern Urals (Bogoslovsly 1981)

Material. — One specimen.

Diagnosis. — Smooth conch with shallow ventrolateral furrows and spines disappering at diameter of about 20 mm.

Distribution. — Red limestone of the *Gonioclymenia* beds between Besówka and Stokówka in the Holy Cross Mountains, as labeled by Jan Czarnocki.

Family **Biloclymeniidae** Hyatt, 1884

Diagnosis. — Gently sinuous suture complicating ventrally in the course of evolution. Tendency to develop wide siphuncle and long septal necks reaching the preceding septum.

Remarks. — It is suggested here that families of the Devonian ammonoids represent clades in which gradual complication of septum geometry proceeds from the beginning of their emergence. In the case of the *Biloclymenia* clade, its evolution started from development of a wide ventral lobe. Therefore Pachyclymeniidae Korn, 1992 are included in the family. Both genera share also the higly unusual structure of siphuncle (Bogoslovsky 1981, p. 16, 17), analogous to that in *Aturia*.

Genus ***Pachyclymenia*** Schindewolf, 1937

Type species: *Pachyclymenia abeli* Schindewolf, 1937.

Diagnosis. — Moderately involute conch with rounded venter; suture with relatively narrow, rounded flank lobe and wide ventral lobe.

Remarks. — Despite some complication, the septum geometry was probably inherited by *Pachyclymenia* after the earliest *Protornoceras*-like clymenias. *P. kozlowskii*, with its internal shell constrictions and discoidal conch seems to be close to the ancestral condition.

Pachyclymenia kozlowskii (Czarnocki, 1989)
(Figs 205A and 218)

Type horizon and locality: Bed 16 of red limestone with *Costaclymenia* at Jabłonna, Holy Cross Mountains (Czarnocki 1989).

Diagnosis. — Moderately evolute conch with internal shell thickenings parallel to the aperture.

Remarks. — In the original description of the species the drawing of suture was reversed and this was probably the main basis to erect the genus *Borkowia* and compare it with *Kiaclymenia*. The morphologically closest species of *Pachyclymenia* seems to be *P. intermedia* Bogoslovsky, 1977 (Bogoslovsky 1977, 1981) which differs in a somewhat more involute conch with oblique internal thickenings. In the distribution of thickenings, *P. kozlowskii* resembles the more involute and discoidal *P. sinuconstricta* Bogoslovsky, 1977 from the *Clymenia–Gonioclymenia* Zone of the southern Urals. It seems that *P. kozlowskii* is the least derived of all species of the genus. Its ancestry is apparently within *Uraloclymenia* from the late *Prolobites–Platyclymenia* Zone of the southern Urals (Bogoslovsky 1977, 1981), which has the umbonal saddle restricted to the umbilicus. In fact this is hardly a generic level distinction.

Distribution. — Probably the early *P. jugosus* Zone at Jabłonna.

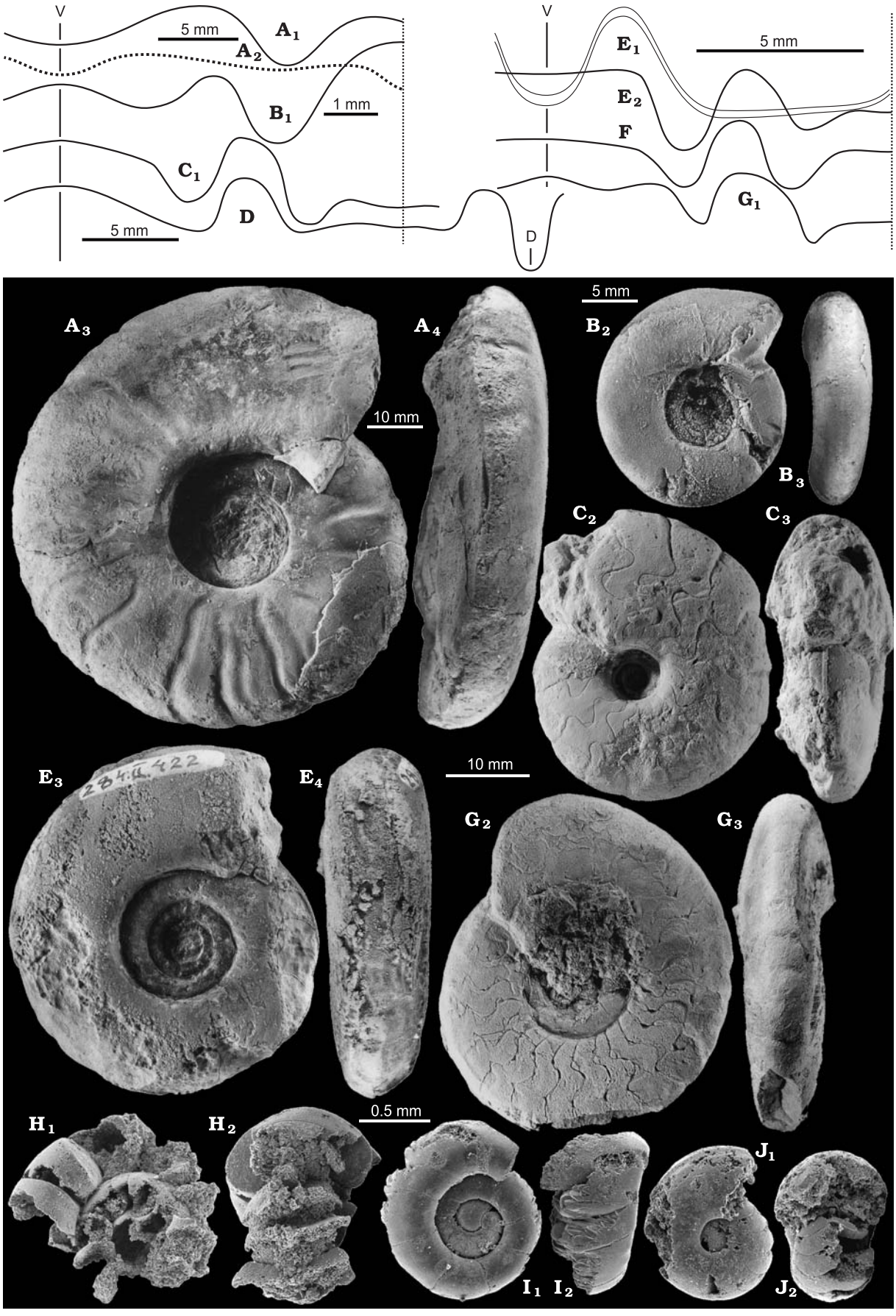
Genus ***Kiaclymenia*** Bogoslovsly, 1955

Type species: *Kiaclymenia uralica* Bogoslovsky, 1955 from the *Clymenia–Gonioclymenia* Zone at Kia, the southern Urals.

Diagnosis. — Suture with two rounded flank lobes on conch flanks and wide ventral saddle; moderately involute conch.

Kiaclymenia polonica (Czarnocki, 1989)
(Figs 205B and 218)

Type horizon and locality: *Prolobites* beds st Ostrówka (bed 5) in the Holy Cross Mountains (Czarnocki 1989).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Diagnosis. — Gently rounded lateral and high umbonal saddles of the suture.

Remarks. — The species was originally referred to *Genuclymenia*, the type species of which has a basically different appearance of the suture and subtrapezoidal whorl section, pointing towards affinity with *Cymaclymenia* rather than *Kiaclymenia polonica*. Whatever is the generic affiliation of this species, it may serve as a good connecting link between *Uraloclymenia* and *Biloclymenia*.

Distribution. — *P. trachytera* Zone at Ostrówka (bed 5 of Czarnocki 1989).

Kiaclymenia laevis (Richter, 1848)
(Figs 205C, D, H, I, J? and 218)

Type horizon and locality: Saalfeld in Thuringia.

Material. — Two specimens.

Diagnosis. — Wide lateral saddle of the suture.

Remarks. — From *K. uralica* the species differs in a less prominent and wider flank lobe and somewhat angulate medially ventral lobe, probably resulting from the shape of the venter (Petter 1960; Bogoslovsky 1981). *Biloclymenia nebulosa* and *B. accessa* of Czarnocki (1989) apparently represent this species.

Distribution. — Grey limestone of the early *P. jugosus* Zone at Kowala; lower *Wocklumeria* beds at Ostrówka, Stokówka, and Besówka (Czarnocki 1989).

Genus ***Biloclymenia*** Schindewolf, 1923

Type species: *Clymenia bilobata* Münster, 1832 from Schübelhammer near Heinersreuth in Frankenwald.

Diagnosis. — Suture with two rounded flank lobes on conch flanks and shallow wide ventral lobe.

Remarks. — Czarnocki's (1989) concept of *Biloclymenia* corresponds rather to *Kiaclymenia* whereas his *Dimeroclymenia* is roughly the same as the former genus.

Biloclymenia pristina (Czarnocki, 1989)
(Figs 205E–G and 218)

Type horizon and locality: Lower *Wocklumeria* beds at Kowala, Holy Cross Mountains (Czarnocki 1989).

Material. — One specimen.

Diagnosis. — Second umbonal lobe of the suture not developed; moderately evolute conch.

Remarks. — The three species of *Dimeroclymenia* based by Czarnocki (1989) on the material from the same horizon at Kowala are probably conspecific.

Distribution. — Red limestone of the *D. trigonica* Zone at Kowala in the Holy Cross Mountains.

Family **Cyrtoclymeniidae** Hyatt, 1884

Diagnosis. — Simple septum in mature conchs lacking any vaulted areas; generalized conch morphology ranging from moderately involute to moderately evolute.

Remarks. — The only difference between *Cyrtoclymenia* and *Platyclymenia* I have been able to disclose is a more evolute conch of the latter. There is a complete gradation between these conch geometries and the conch evoluteness is hardly a character deserving distinction at the family rank. The family Platyclymeniidae Wedekind, 1914 is therefore not used here. It may be also a matter of dispute whether acute venter is enough to define the family Rectoclymeniidae Schindewolf, 1923.

← Fig. 205. Species of the Biloclymeniidae from the Holy Cross Mountains. **A**. *Pachyclymenia kozlowskii* (Czarnocki, 1989) from Jabłonna (probably the early *P. jugosus* Zone, bed 16 of Czarnocki 1989); suture, internal shell thickening and views of holotype IG 284.II.823. **B**. *Kiaclymenia polonica* Czarnocki, 1989 from the *L. styriacus* Zone at Ostrówka; suture and views of holotype IG 284.II.30. **C**, **D**. *Kiaclymenia laevis* (Richter, 1848) from the early *P. jugosus* Zone at Kowala; suture and views of specimen ZPAL AmVII/1802 (C) and suture of 947 (D). **E–G**. *Biloclymenia pristina* (Czarnocki, 1989) from the *D. trigonica* Zone at Kowala; growth lines, suture, and views of specimen IG 284.II.422 (E); suture of IG 284.II.912 (F); suture and views of specimen ZPAL AmVII/1803 (G). **H**, **I**. Juveniles of a species of an evolute biloclymeniid, probably *K. laevis*, from the late *L. styriacus* Zone at Kowala; internal pyritic moulds ZPAL AmVII/1829 and 1828 (sample Ko-187). **J**. Juvenile of a species of an involute biloclymeniid from the same sample; specimen ZPAL AmVII/1831.

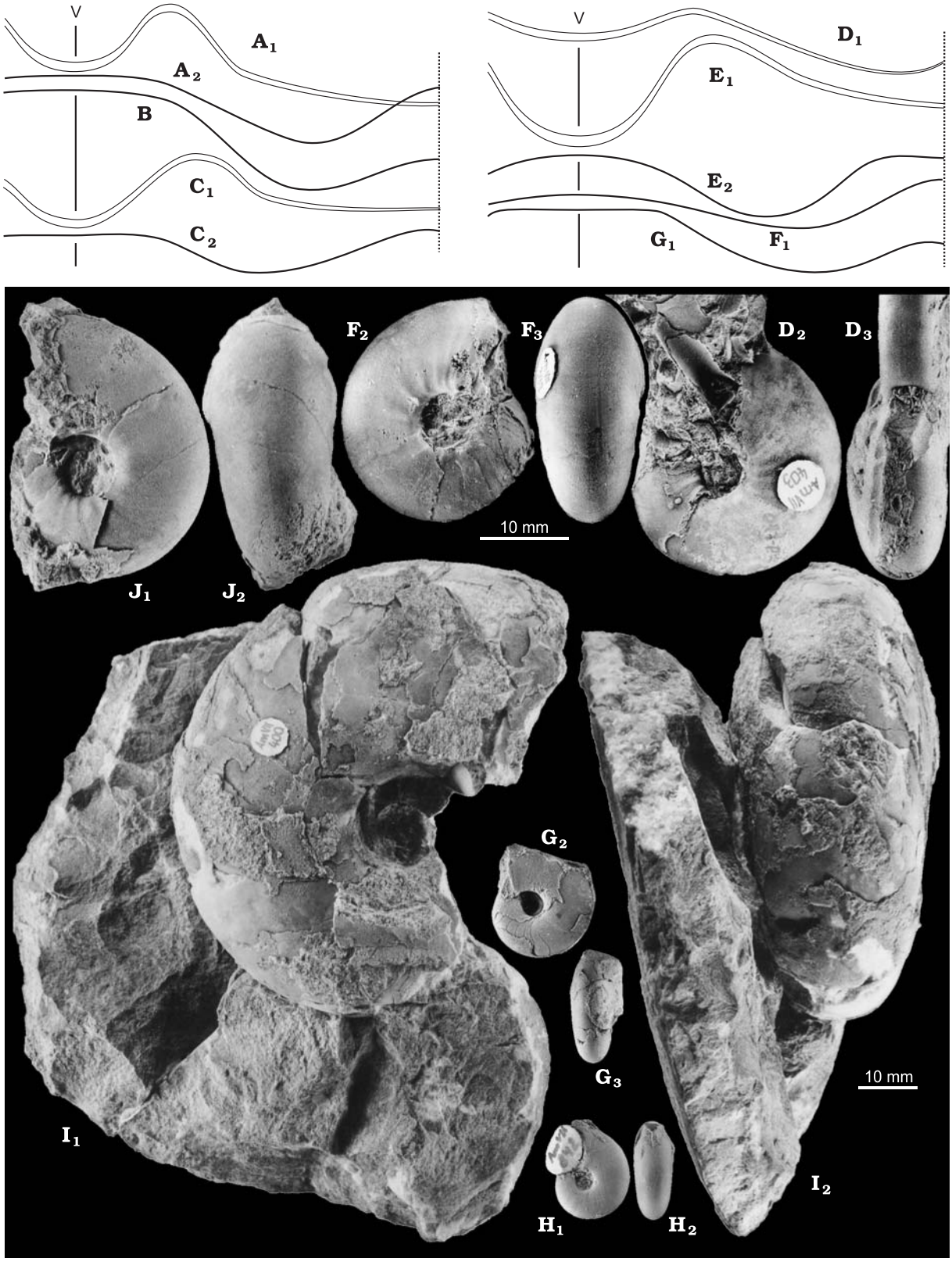

Fig. 206. *Cyrtoclymenia involuta* (Wedekind, 1908) from the Holy Cross Mountains; growth lines and sutures of specimens ZPAL AmVII/692 and 683 from Jabłonna (A, B, trench rIVc of Żakowa *et al*. 1984), and 694 (C, probably Ostrówka); suture and views of ZPAL AmVII/403 from Łagów (D); growth lines and suture of ZPAL AmVII/551 probably from Łagów (E); suture and views of ZPAL AmVII/399 from Łagów (F); suture and views of ZPAL AmVII/122 and 842 from Jabłonna (G, H, bed 24), and 400 (I, bed 27); views of ZPAL AmVII/160 from Ostrówka (J, sample Ost-7).

Genus ***Cyrtoclymenia*** Hyatt, 1884

Type species: *Planulites angustiseptatus* Münster, 1832 from Schübelhammer near Heinersreuth in Frankenwald.

Diagnosis. — Involute conch with small umbilicus and rounded venter.

Cyrtoclymenia involuta (Wedekind, 1908)
(Figs 206 and 223)

Type horizon and locality: Beds 13–10 at Enkeberg, Rhenish Slate Mountains.

Material. — 22 specimens.

Diagnosis. — Umbo covers somewhat more than one fourth of the whorl diameter, almost equal width and height of the whorl.

Remarks. — This is the oldest member of the *Cyrtoclymenia* lineage, *Praeflexiclymenia curvidorsata* being its possible relative. Sobolew's (1914) Gomi-monomeroclymenia *Humboldti subacuta*, known only from Sieklucki's brickpit, may be a connecting link between these species (or/and *C. acuta*).

Wedekind (1908) description refers to specimens showing much difference in the whorl width, exceeding that observed in the Holy Cross Mountains material. More information on the German topotype material is necessary to substantiate preliminary *Cyrtoclymenia* species identifications proposed here. Possibly, my specimens represent *Cyrtoclymenia ventriosa* Petter, 1960.

Distribution. — The *P. trachytera* to *L. styriacus* Zone at Jabłonna (beds 24, 25, 27, trenches rIVc and f dug by Żakowa *et al*. 1984) and Ostrówka (sample Ost-7); black clymeniid limestone at Łagów.

Cyrtoclymenia angustiseptata (Münster, 1832)
(Figs 207 and 223)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald.

Material. — Seven specimens.

Diagnosis. — Umbo covers almost half of the whorl diameter in mature specimens, much less in juveniles, smooth flattened flanks of the conch.

Remarks. — Distinction between this species and *C. plicata* (Münster, 1832) is rather doubtful on purely morphological grounds.

Distribution. — The late *P. jugosus* Zone at Dzikowiec, Ostrówka and Kowala (Czarnocki 1989).

Cyrtoclymenia sp.
(Figs 208A, B, E, F? and 223)

Remarks. — A single specimen in the Czarnocki's collection from a grey crinoidal limestone of his *Nodosoclymenia* beds at Ostrówka is unusual in having a parabolic section of the venter and gently curved septum also in the umbonal area. A similar specimens occur in the significantly younger strata with *Clymenia* at Kowala. Septum so steep dorsally resembles that in *Clymenia* and *Kosmoclymenia* and this may possibly be a vaulting-free member of that branch. In fact, in sample Ko-187 pyritized juvenile specimens occur closely resembling at this stage conchs of *Platyclymenia*, do not known so high in the Kowala section. They may belong to this species or to *Clymenia*.

Distribution. — Probably the early *L. styriacus* and earliest *P. jugosus* zones at Ostrówka and Kowala.

Cyrtoclymenia acuta Czarnocki, 1989
(Figs 208D and 223)

Type horizon and locality: *Prolobites* beds at Ostrówka, Holy Cross Mountains.

Remarks. — As usual in early species of *Cyrtoclymenia*, but unlike the late ones, the suture is sinuos in the umbonal area. In this respect the studied specimen differs from co-occurring *Cyrtoclymenia* sp. but resembles that from the upper *Wocklumeria* beds at Kowala classified by Czarnocki (1989) in *Falciclymenia falcifera* Münster, 1840. Because of its incomplete preservation and unexpectedly high stratigraphic origin I restrain from evaluating the phylogentic meaning of the latter.

The Czarnocki's (1989) name is a junior homonym of *Cyrtoclymenia acuta* Schmidt, 1925 but this species is now classified in the unrelated genus *Rectoclymenia* and too little material is available to make possible new name truly meaningful.

Distribution. — The *P. trachytera* and *L. styriacus* (sample Ost-7) zones, at Ostrówka.

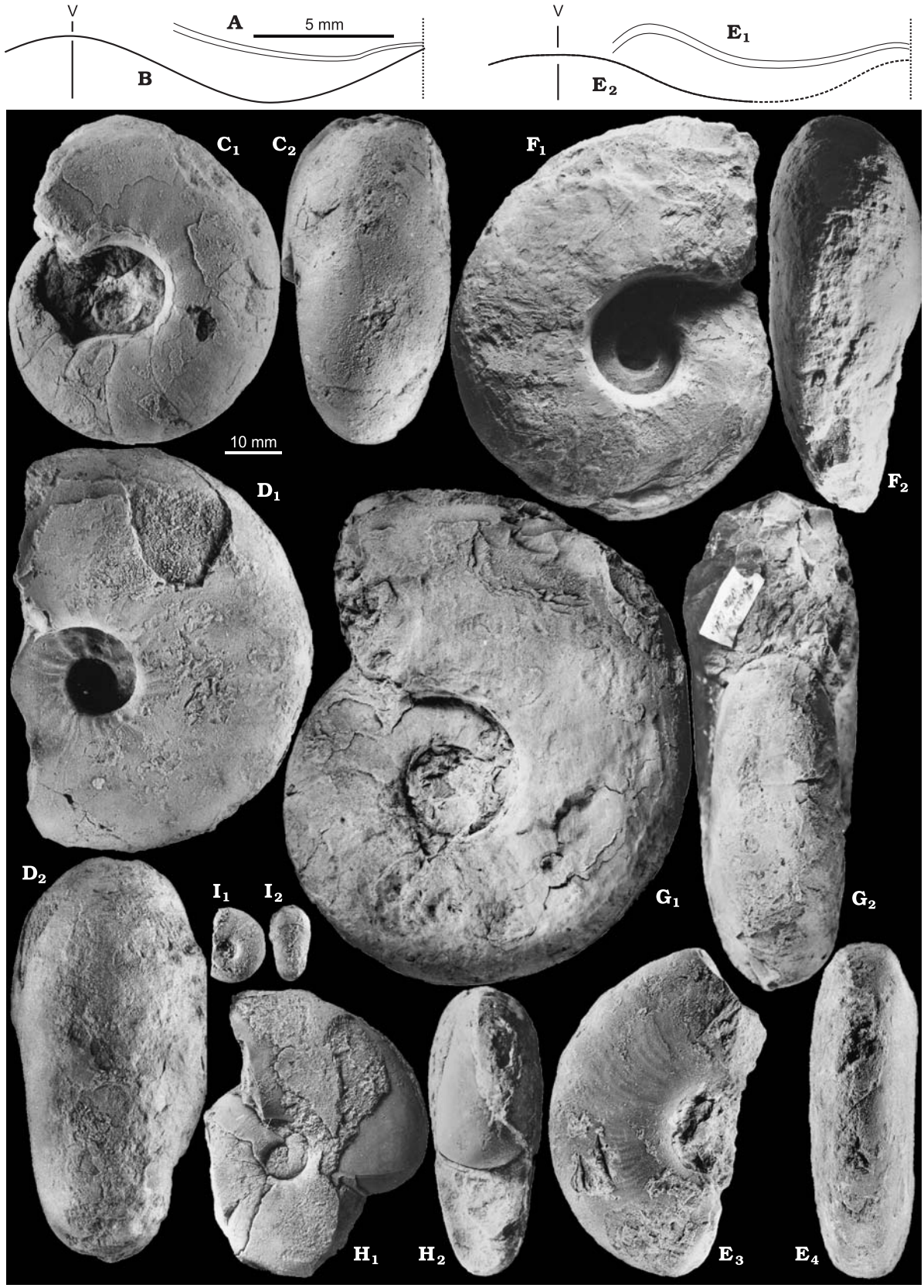

Fig. 207. *Cyrtoclymenia angustiseptata* (Münster, 1832) from the late *P. jugosus* (C) and *D. trigonica* (A, B, D) zones at Kowala (A–D) in the Holy Cross Mountains and Dzikowiec in the Sudetes (E–I); growth lines of specimen IG 284.II.982 (A); suture of 895 (B); views of ZPAL AmVII/1047 (C, sample Ko-86) and IG 284.II.868 (D); growth lines, suture, and views of ZPAL AmVII/152 (E); views of MB.C. 1761, 4209, and 4205 (F–H), and ZPAL AmVII/119 (I).

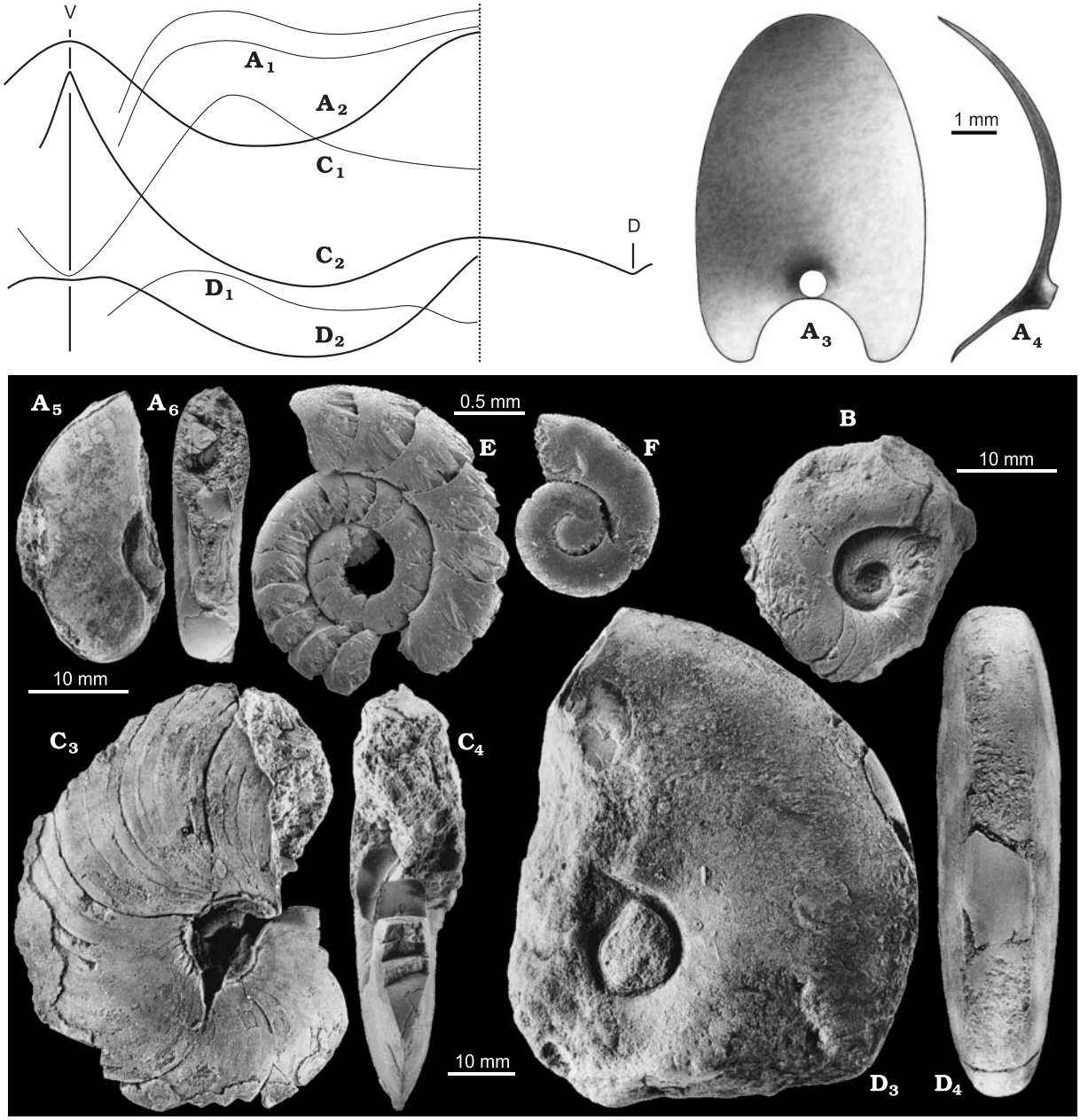

Fig. 208. Aberrant *Cyrtoclymenia* species from the Holy Cross Mountains. **A**, **B**. *Cyrtoclymenia* sp. from the early *P. jugosus* Zone at Ostrówka (A; *Nodosoclymenia* bed) and Kowala (B); growth lines, suture, restored septum, and views of specimen IG.284.II.269 (A); view of ZPAL AmVII/939 (B). **C.** *C. acuta* Czarnocki, 1989 from the *P. styriacus* Zone at Ostrówka; growth lines, suture, and views of specimens ZPAL AmVII/186 (sample Ost-7; *Nodosoclymenia* bed?). **D**. *C.*? *procera* Czarnocki, 1989 from the *P. jugosus* Zone at Kowala; growth lines, suture, and views of specimen IG 284.II.679. **E**, **F**. Juvenile *Cyrtoclymenia* or *Clymenia* from the *L. styriacus* Zone at Kowala; pyritic internal moulds ZPAL AmVII/1830 and 1832 (sample Ko-187).

Cyrtoclymenia? *procera* Czarnocki, 1989
(Figs 208E and 223)

Type horizon and locality: Upper *Wocklumeria* beds at Kowala, Holy Cross Mountains.

Remarks. — This is an enigmatic cephalopod, all specimens being too poorly preserved and fragmentary to be certain that this is actually a clymenia. The tabulate venter and thickening of the umbonal part of the conch resemble the situation in the centroceratid nautiloids (see Dzik 1984).

Distribution. — Probably the *D. trigonica* Zone at Kowala (Czarnocki 1989).

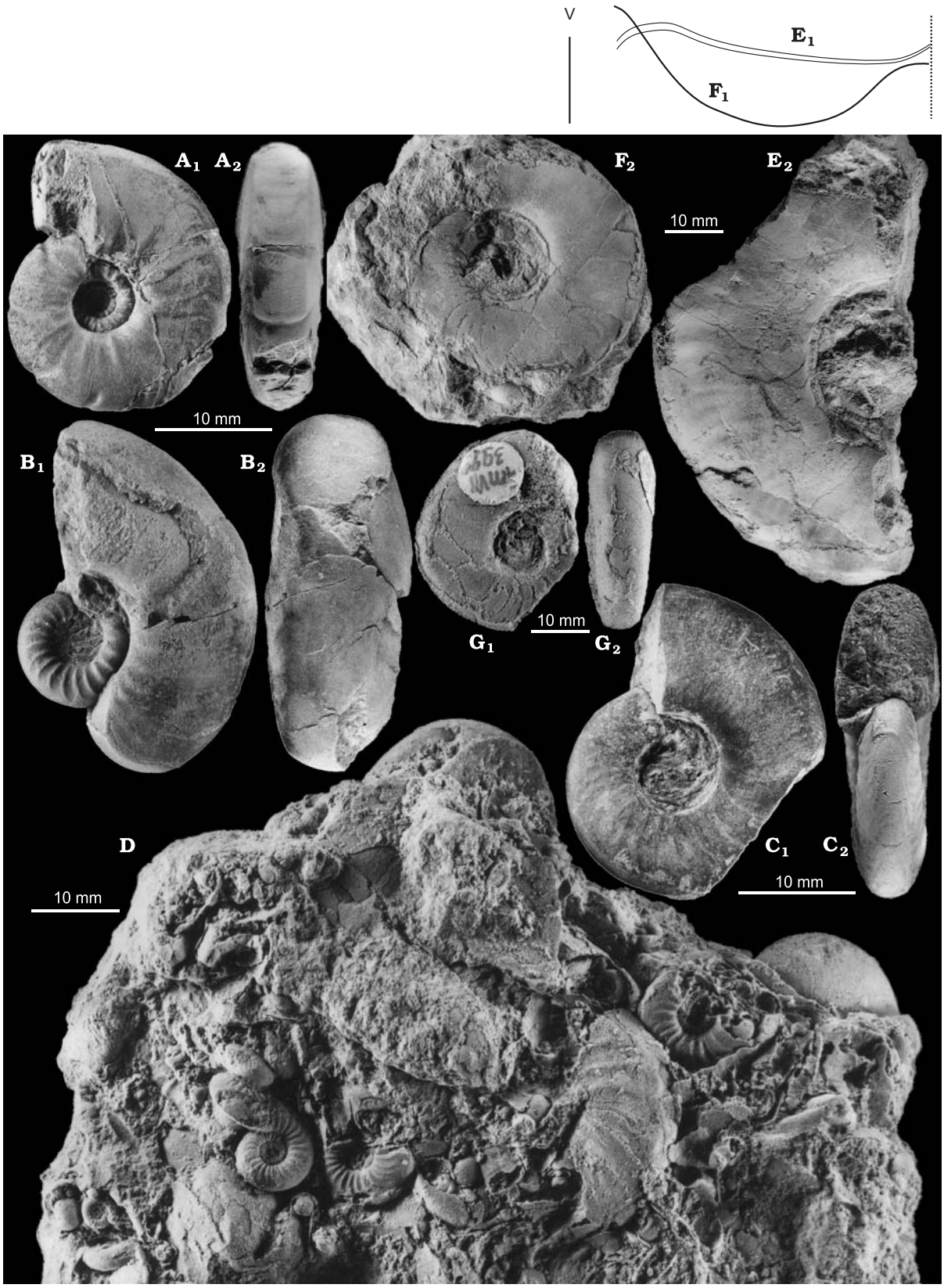

Fig. 209. Early involute *Platyclymenia* species from the *P. trachytera* Zone of the Holy Cross Mountains. **A–D**. *P. implana* (Czarnocki, 1989) from Łagów (A) and Ostrówka (B–D); views of specimens IG.284.II.5 (A) and 166 (B; holotype of *P. inflata* Czarnocki, 1989), 184 (C), and a block with mass occurrence of the species ZPAL AmVII/15 (D). **E–G**. *P. puschi* (Czarnocki, 1989) from Jabłonna (well w92b of Żakowa *et al*. 1984); growth lines (inferred from irregularities on the conch internal mould) and views of specimens ZPAL AmVII/390 (E); suture and views of 631 (F); views of 399 (G).

Genus ***Platyclymenia*** Hyatt, 1884

Type species: *Goniatites annulatus* Münster, 1832 from Kirch Gattendorf in Upper Franconia (Price and Korn 1989).

Diagnosis. — More or less evolute conchs with roundedly subquadrate whorl section.

Platyclymenia implana (Czarnocki, 1989)
(Figs 209A–D and 223)

Type horizon and locality: Lower part of the *Platyclymenia* beds at Ostrówka, Holy Cross Mountains.

Diagnosis. —Mature whorls significantly higher than wide; umbilicus covering less than one third of the conch diameter; juvenile whorls with sharp ribs on flanks.

Remarks. — Czarnocki (1989) classified this species in *Cyrtoclymenia*, but it is so close to *P. lagowiensis* that it remains uncertain whether it does not fall in the range of its population variability. *Platyclymenia inflata* Czarnocki, 1989 probably also represents this species.

Distribution. — The *P. trachytera* Zone at Łagów and Ostrówka (sample Ost-11).

Platyclymenia puschi (Czarnocki, 1989)
(Figs 209E–G and 223)

Type horizon and locality: *Prolobites* beds at Ostrówka, Holy Cross Mountains.

Material. — Four specimens.

Diagnosis. — Narrow umbilicus covering about one third of mature conch diameter, smooth surface.

Remarks. — As discussed above, Czarnocki (1989) introduced this species in replacement of *Clymenia humboldti* sensu Gürich, 1896 but I believe that his choice of holotype from Ostrówka changed the original meaning of the species and made his *Flexiclymenia puschi* a distinct species. In having a simple septum and relatively wide venter, it resembles some species of *Platyclymenia* and may be considered its earliest member, with some affinities to *Cyrtoclymenia*. Perhaps also the single specimen from the upper *Platyclymenia* beds at Ostrówka, on which *P. laxata* Czarnocki, 1989 is based, belongs also to this species.

Distribution. — The early *P. trachytera* Zone at Jabłonna (well w 92b dug by Żakowa *et al*. 1984) and Ostrówka (Czarnocki 1989).

Platyclymenia lagowiensis (Sobolew, 1912)
(Figs 210 and 223)

Type horizon and locality: Black clymeniid limestone at Łagów-Dule, Holy Cross Mountains.

Material. — 25 specimens.

Diagnosis. — Mature whorls somewhat higher than wide; umbilicus covering less than half of the conch diameter; juvenile whorls with sharp ribs on flanks.

Remarks. — From *Platyclymenia annulata* (Münster, 1832), the population variability of which was presented by Korn (2002), the Polish species differs in higher, more angular whorls and narrower umbilicus. *Cyrtoclymenia laxata* and *P. intracostata* of Czarnocki (1989) are probably mature specimens of the same species.

Distribution. — The *P. trachytera* Zone at Łagów (samples Ł-10, 13, and Mak-2), Jabłonna (beds 23 and 24), and Ostrówka (sample Ost-11).

Genus ***Nodosoclymenia*** Czarnocki, 1989

Type species: *N. distincta* Czarnocki, 1989 from Ostrówka, Holy Cross Mountains.

Diagnosis. — Subrectangular whorls tending to develop strong ribs and ventrolateral tubercles.

Nodosoclymenia distincta Czarnocki, 1989
(Figs 211 and 223)

Type horizon and locality: Lower part of the *Clymenia* beds (*Nodosoclymenia* bed) at Ostrówka, Holy Cross Mountains.

Remarks. — The material assembled by Czarnocki and split into several species of his genus *Nodosoclymenia* comes from a single bed (except for *N. variabilis* from a layer probably immediately above). It is interpreted here as representing a single very variable species. The conch surface ranges from virtually smooth to bearing irregularly distributed and variably expressed lateral ribs. In some specimens the ribs terminate

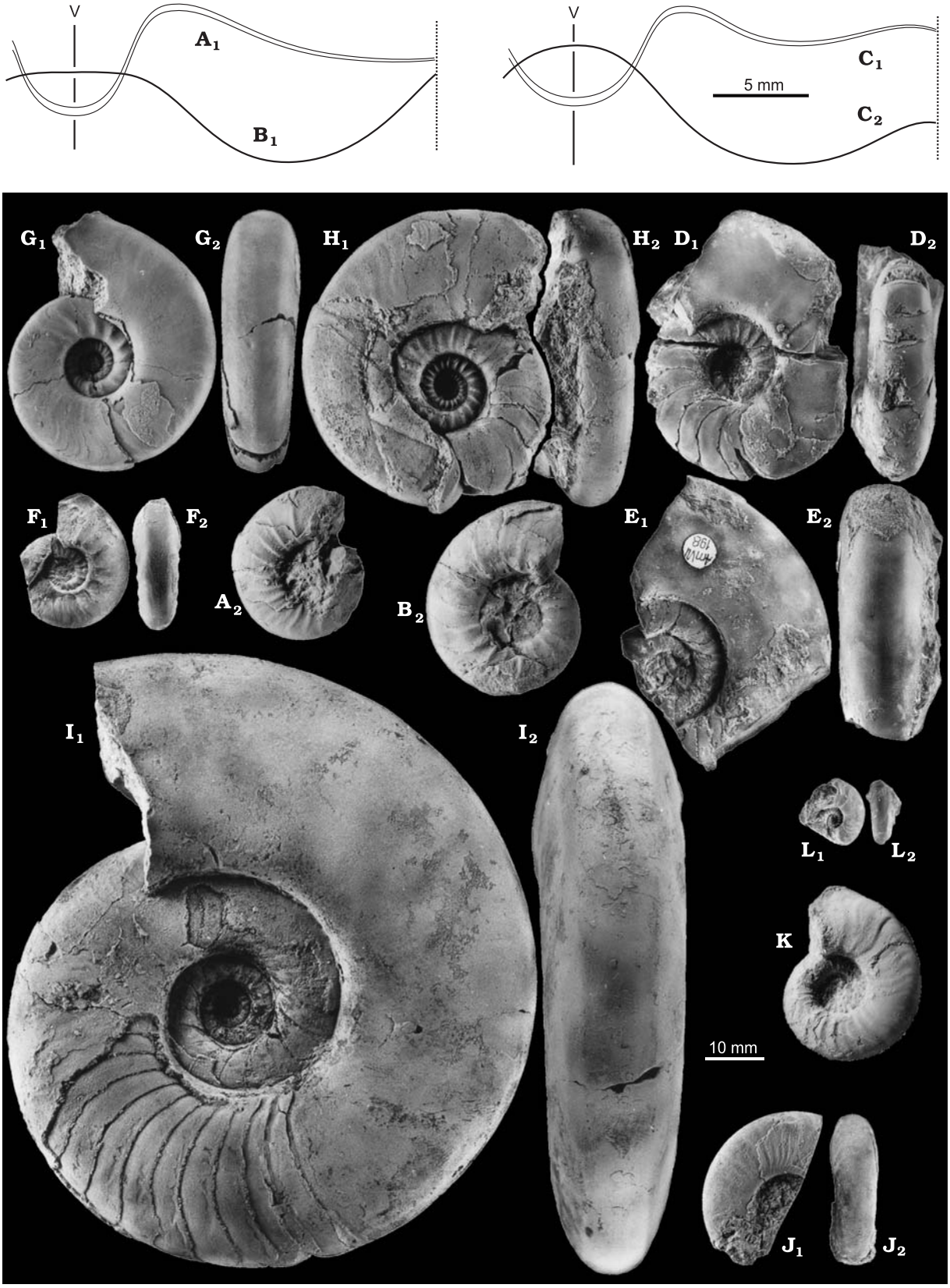

Fig. 210. *Platyclymenia lagowiensis* (Sobolew, 1912) from the *P. trachytera* Zone at Łagów (A–F), Ostrówka (G–J), and Jabłonna (K, L) in the Holy Cross Mountains; growth lines and view of specimen ZPAL AmVII/710 (A); suture and view of 715 (B); growth lines and suture of ZPAL AmVII/753 (C, sample Ł-10); views of ZPAL AmVII/196, 188, and 195 (D–F), IG.284.II.114, 62, 139 (G–I, black matrix), 134 (J, grey matrix), and ZPAL AmVII/709 and 116 (K, L, bed 24).

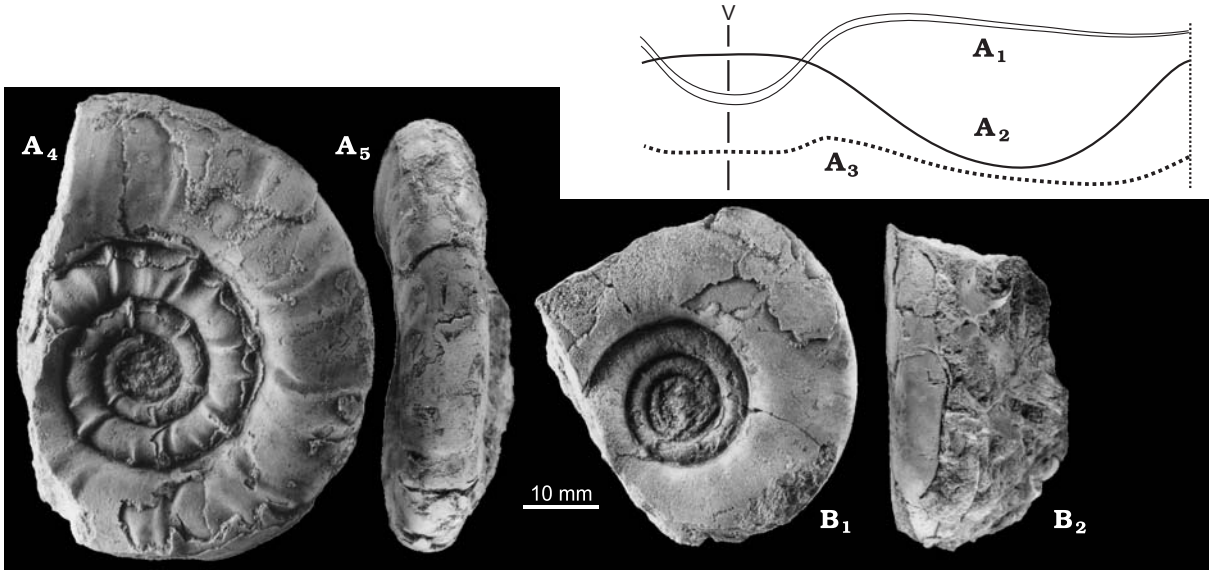

Fig. 211. *Nodosoclymenia distincta* (Czarnocki, 1989) from the *P. trachytera* (or early *L. styriacus*) Zone at Ostrówka in the Holy Cross Mountains (*Nodosoclymenia* bed of Czarnocki 1989); growth lines, suture, ribs and constrictions, and view of holotype IG.284.II.250 (A) and extreme, smooth morphotype specimen 724 (B, holotype of *Stenoclymenia elliptica* Czarnocki, 1989).

ventrally in prominent tubercles, in others flanks are almost smooth but ventrolateral tubercles of almost spinose appearance emerge. Although the variability is remarkable, it only slightly exceeds that presented by Korn (2002) for a population of *Platyclymenia annulata* (Münster, 1832) taken from a single bed at Kattensiepen. Almost smooth specimen were probably arbitrarily separated by him in *P. subnautilina* (Sandberger, 1855) to keep variability in reasonable limits.

Stenoclymenia elliptica Czarnocki, 1989 is based on a single specimen from grey crinoidal limestone of unknown stratigraphic provenace but not different from the *Nodosoclymenia* bed. It shows low massive ribs on the external whorl and fits in the population variablity of *N. distincta*. Juvenile specimen of *Nodosoclymenia* has been identified by Korn (2004b) who also pointed out synonymy of Czarnocki's (1989) *N. lupata* and *M. distincta*.

Distribution. — Probably early *L. styriacus* Zone at Ostrówka.

Genus ***Pleuroclymenia*** Schindewolf, 1934

Type species: *Platyclymenia crassissima* Schindewolf, 1955 (= *Cycloclymenia costata* Lange, 1929) from Beul in the Rhenish slate Mountains (Korn 2002).

Diagnosis. — Widely oval cross section of the conch whorls ornamented with periumbonal ribs at early stages of ontogeny.

Remarks. — Czarnocki (1989) introduced new genus *Gyroclymenia*, believing that its species are ancestral Hexaclymeniidae, being just homeomorphic to those of *Pleuroclymenia*. Becker (2000) proposed *Pleuroclymenia* to be ancestral to the lineage leading to the wocklumeriids.

Pleuroclymenia costata (Lange, 1929)
(Figs 212A–D and 223)

Type horizon and locality: *Platyclymenia annulata* Zone at Beul near Balve, Rhenish Slate Mountains (Korn 2002).

Material. — Three specimens.

Diagnosis. — Umbilicus covering about half of the conch diameter.

Remarks. — I believe that *Gyroclymenia cyclocostata* Czarnocki, 1989, the type species of *Gyroclymenia*, belongs to this species. Czarnocki's (1989) *G. angulata* and *G. evoluta* may fall in the range of its variability.

Distribution. — The *P. trachytera* Zone at Łagów Dule (sample Ł-13), Jabłonna (bed 20), and *Prolobites* beds at Ostrówka (beds 1–2 of Czarnocki 1989).

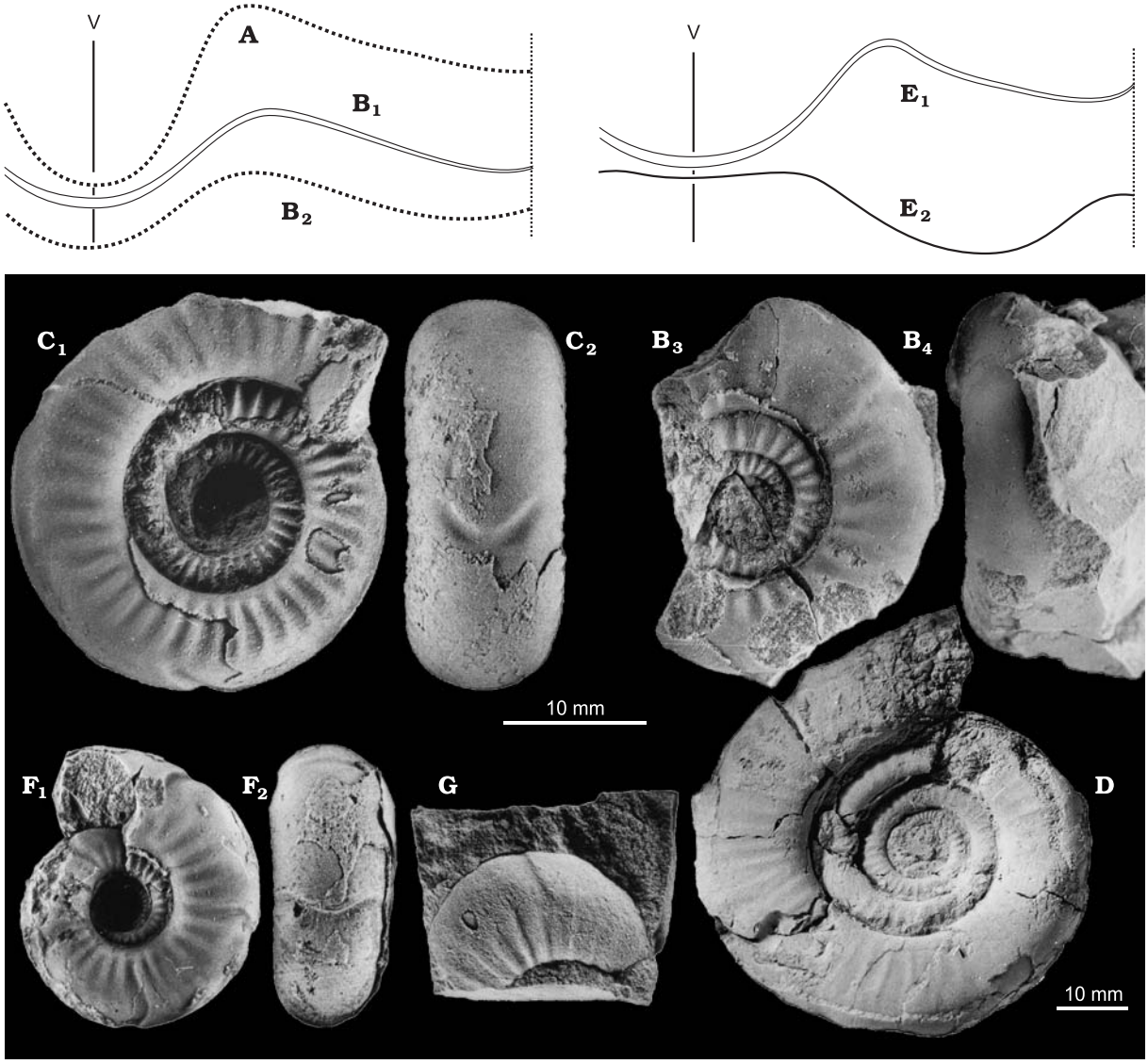

Fig. 212. Species of *Pleuroclymenia* from the Holy Cross Mountains. **A–D**. *P. costata* (Lange, 1929) from the *P. trachytera* Zone at Jabłonna (A), Łagów (B), and Ostrówka (B–D); internal thickening of specimen ZPAL AmVII/706 (A, bed 20); growth lines, internal thickening, and views of specimen 716 (B, sample Ł-13); views of IG.284.II.120 (C, bed 1? of Czarnocki 1989) and unnambered MD (D). **E–G**. *P. varicata* (Sobolew, 1914) from the early *L. styriacus* Zone ta Ostrówka (E, F) and Kowala (G); growth lines and suture of specimen ZPAL AmVII/754 (E); views of IG.284.II.188 (F, holotype of *Gyroclymenia mutabilis* Czarnocki, 1989), and ZPAL AmVII/372 (G).

Pleuroclymenia varicata (Sobolew, 1914)
(Figs 212E–G and 223)

Type horizon and locality: Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains.

Material. — One specimen.

Diagnosis. — Umbilicus covering about one third of the conch diameter.

Remarks. — The species is close to *P. costata* but seems to represent the next stage of its evolution towards more and more involute conchs. Czarnocki's (1989) *Gyroclymenia mutabilis* and *G. rotundata* seem to represent the same species, and the type of *G. sophiae* apparently is mature.

Distribution. — The early *L. styriacus* Zone, lower *Clymenia* beds (*Nodosoclymenia* bed) at Ostrówka (bed 8 of Czarnocki 1989), reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains (Sobolew 1914).

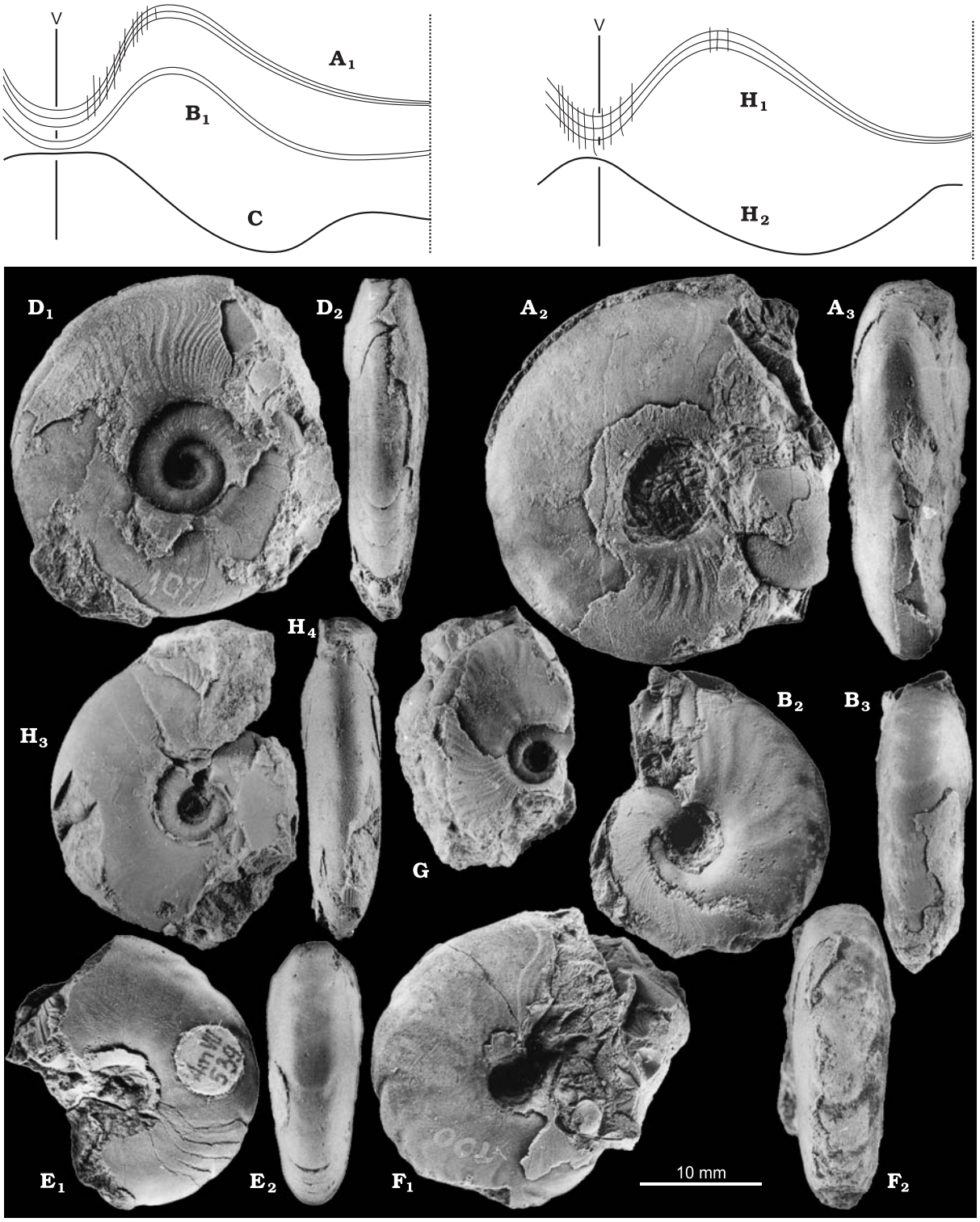

Fig. 213. *Praeflexiclymenia curvidorsata* (Sobolew, 1912) from the *P. trachytera* Zone at Łagów (A–G) and Jabłonna (H) in the Holy Cross Mountains; growth lines and views of specimens ZPAL AmVII/704 and 711 (A, B); suture of ZPAL AmVII/359 (C); views of IG.284.II.107 (D), ZPAL AmVII/539 (E), IG.284.II.100 (F), and ZPAL AmVII/705 (G); growth lines, suture and views of ZPAL AmVII/703 (H, bed 24).

Family **Hexaclymeniidae** Lange, 1929

Diagnosis. — Extremely evolute conch with tabulate venter; simple septum in mature conchs lacking any vaulted areas.

Remarks. — These are clymenias of simplified morphology, thus difficult to diagnose with any newly acquired character (synapomorphy). Despite still incomplete fossil record of their evolution, they seem to represent a rather well-defined clade changing the conch morphology towards being more and more evolute. At least in the lineage of *Soliclymenia*, some amount of paedomorphism is involved, with diminished size of mature conchs and depressed whorl cross section.

Genus ***Praeflexiclymenia*** Czarnocki, 1989

Type species: *Clymenia tenuis* Sobolew, 1912 from the clymeniid limestone at Łagów-Dule, Holy Cross Mountains.

Diagnosis. — Narrow tabulate venter of moderately evolute conch.

Remarks. — The type species of the genus is actually located at the extremity of the morphologic diversity of species included in it, probably related to *Stenoclymenia*. Unfortunately, there seems to be no other generic name available to encompass these early clymenias. *Hexaclymenia* Schindewolf, 1923, with widened whorl cross section but still relatively narrow tabulate venter seems to be a derivative of *Praeflexiclymenia*. Its origin from *Pleuroclymenia*, advocated by Becker (2000, p. 50), is a possible alternative.

Praeflexiclymenia curvidorsata (Sobolew, 1912)
(Figs 213 and 223)

Type horizon and locality: Black clymeniid limestone at Łagów-Dule, Holy Cross Mountains.

Material. — 23 specimens.

Diagnosis. — Relatively involute conch, frequently developing numerous internal thickenings at the venter, parallel to the apertural sinus.

Remarks. — The holotype (Sobolew 1912, pl 4: 5; Czarnocki 1989, pl 21: 12) is an internal mould of a relatively evolute conch hardly distinguishable from the holotype of *Praeflexiclymenia obliqua* Czarnocki, 1989 (Czarnocki 1989, pl. 9: 8). Typical specimens from Łagów Dule are significantly more involute (like the paratype of Sobolew 1912, pl. 4: 6) whereas another specimen included in *P. obliqua* by Czarnocki (1989, pl 21: 17; here Fig. 213F) is much more evolute. Generally, mature specimens are significantly more evolute than juveniles and some specimens show a change in conch geometry during the ontogeny. It seems thus that this is an extremely variable species both in respect to the conch evoluteness and the development of internal thickenings. The specimens from Jabłonna with extremely narrow venter are also included here.

Distribution. — The *P. trachytera* Zone at Łagów Dule (sample Ł-14 and 15) and Jabłonna (beds 20, 24, and 26).

Praeflexiclymenia tenuis (Sobolew, 1912)
(Figs 214A–C and 223)

Type horizon and locality: Black clymeniid limestone at Łagów-Dule, Holy Cross Mountains.

Material. — 14 specimens.

Diagnosis. — Small evolute conch with gently concave flank lobe of the mature, and *Clymenia*-like juvenile, suture.

Remarks. — The specimens from Jabłonna are of generally poor preservation and only the juvenile whorls, with a subcircular cross section, show sutures. They exhibit the suture angulation and minute marginal vaulting of the septum virtually undistiguishable from that in *Clymenia laevigata*. Mature whorls of the Jabłonna specimens are closely similar to those of the Łagów specimens. Probably this is a case of recapitulation of the ancestral features in the ontogeny, pointing to *Aktuboclymenia* as another close relative.

Distribution. — The *P. trachytera* Zone at Jabłonna (beds 24, 25, and 26) and black clymeniid limestone at Łagów Dule (Sobolew 1912; Czarnocki 1989).

Praeflexiclymenia flexilobata (Sobolew, 1914)
(Figs 214D and 223)

Type horizon and locality: Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce, Holy Cross Mountains.

Diagnosis. — Evolute conch with sinuous umbilical saddle of the suture.

Remarks. — Sobolew (1914b, fig. 2) illustrated a specimen from Sieklucki's brickpit closely similar to the holotype of *Flexiclymenia mariae* (Czarnocki 1989, pl. 23: 13) referring to it as "*Gomi-monomeroclymenia Humboldti flexilobota* Sob.", apparently having in mind the earlier proposal by himself [Sobolew

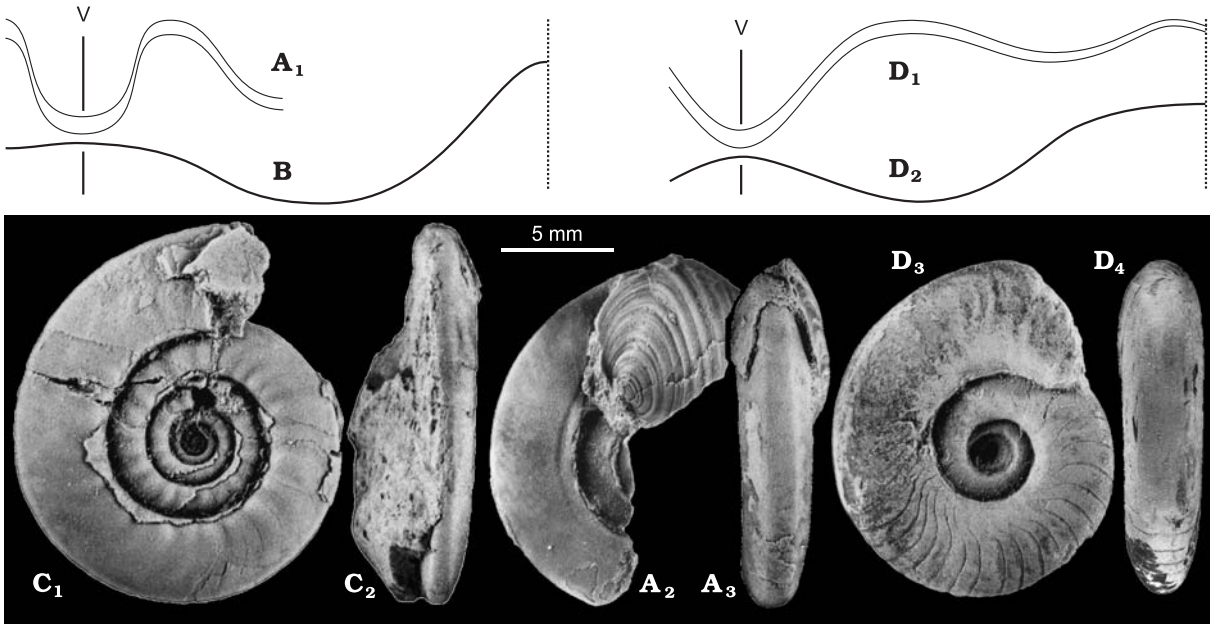

Fig. 214. Small-size species of *Praeflexiclymenia* from the Holy Cross Mountains. **A**–**C**. *P. tenuis* (Sobolew, 1912) from the *P. trachytera* Zone at Jabłonna (A, B) and Łagów-Dule (C); growth lines and views of specimen ZPAL AmVII/578 (A, bed 26); suture of ZPAL AmVII/576 (B, bed 26); views of IG.284.II.3 (C). **D**. *P. flexilobata* (Sobolew, 1914) from Sieklucki's brickpit in Kielce; growth lines (inferred from irregularities on the internal mould of the living chamber), suture, and views of IG.284.II.104, the holotype of *Flexiclymenia mariae* Czarnocki, 1989.

1914a, p. 64, spelled there "*Gomi-monomeroclymenia Humboldti* (Pusch. em. Gürich) *flexilobata* n. nom."]. The original description is followed by schematic suture drawings and photographs (Sobolew 1914a, pl. 9: 33) of two specimens with the umbilicus somewhat narrower than in Sobolew (1914b, fig. 2) and resembling rather Czarnocki's (1989) *P. obliqua* (here classified in *P. curvidorsata*). It is unclear whether all the specimens referred to by Sobolew (1914a, b) are conspecific but I propose to accept the most informative of them (Sobolew 1914b, fig. 2) as the type.

Distribution. — Reworked to Quaternary sediments at Sieklucki's brickpit in Kielce.

Genus ***Stenoclymenia*** Lange, 1929

Type species: *Platyclymenia stenomphala* Lange, 1929 from Enkenberg, Rhenish Slate Mountains.

Diagnosis. — Tabulate venter of evolute conch with sharp edges.

Stenoclymenia sandbergeri (Wedekind, 1908)
(Figs 215A–G and 223)

Type horizon and locality: Bed 12 at Enkenberg, Rhenish Slate Mountains

Material. — 19 specimens.

Remarks. — Specimens with ribs, considered typical for *S. sandbergeri*, are rare in the Holy Cross Mountains material, as pointed out by Czarnocki (1989, p. 53). The prominence and distribution of ribs is higly variable and this suggests that these are extreme morphotypes of the species. Specimens that do not bear ribs are usually classified in *Platyclymenia prorsostriata* Schindewolf, 1920. *S. stenomphala* is less evolute. Do not having enough information on the variability in the type populations I am not able to decide which of those names should be applied to the Polish material.

Distribution. — The *P. trachytera* Zone at Łagów Dule (sample Ł-10) and Jabłonna (beds 23 and 26; wells w92b and c dug by Żakowa *et al*. 1984), and Ostrówka (samples Ost-14 and 16).

Stenoclymenia? spp.
(Figs 215H, I and 223)

Material. —Two specimens.

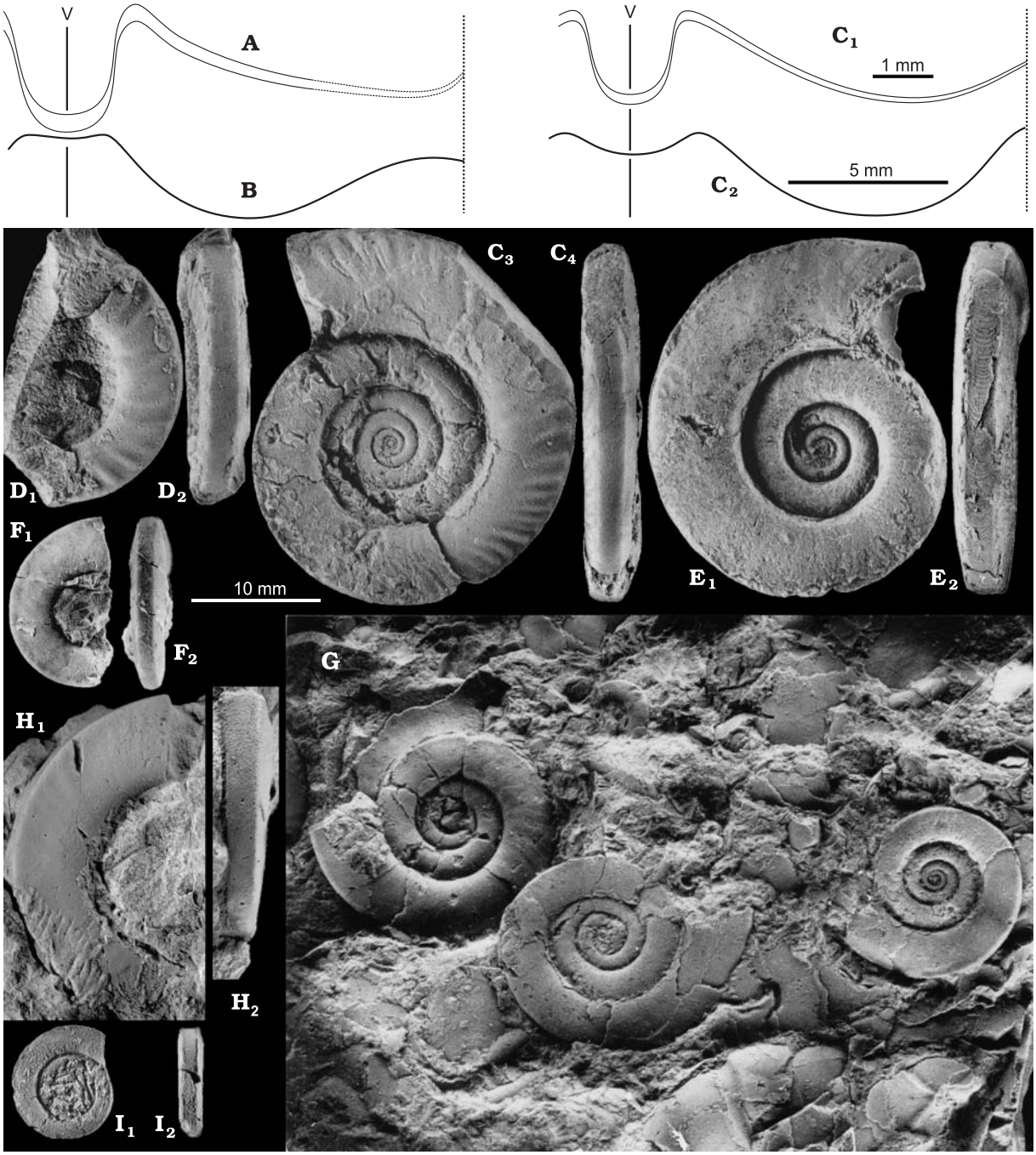

Fig. 215. Species of *Stenoclymenia*. **A–G**. *S. sandbergeri* (Wedekind, 1908) from the *P. trachytera* Zone at Ostrówka (A–E) and Jabłonna (F) in the Holy Cross Mountains; growth lines of specimen ZPAL AmVII/189 and suture of 567 (A, B); growth lines, suture and views of IG.284.II.854 (C); views of ZPAL AmVII/573 (D), IG.284.II.813 (E), ZPAL AmVII/115 (F, bed 24), and of virtually monospecific accumulation ZPAL AmVII/184 (G). **H**. *Stenoclymenia* sp. from the *P. jugosus* Zone at Kowala in the Holy Cross Mountains; views of specimen ZPAL AmVII/. **I**. *Stenoclymenia* sp. from the *D. trigonica* Zone at Dzikowiec in the Sudetes; views of specimen ZPAL AmVII/1670 (sample Dz-7).

Remarks. — Suture cannot be traced in available specimens which makes their classification only tentative. In general conch form they can be compared only with the much older *S. sandbergeri* and this may sugegst continuation of the lineage almost to the end of the Famennian. Relationship to gonioclymeniids cannot be excluded, however.

Distribution. — The early *P. jugosus* Zone at Kowala in the Holy Cross Mountains; the *D. trigonica* Zone at Dzikowiec in the Sudetes (sample Ł-7).

Genus ***Soliclymenia*** Schindewolf, 1937

Type species: *Goniatites solarioides* von Buch, 1840 from the clymeniid limestone at Dzikowiec, the Sudetes.

Diagnosis. — Very longiconic evolute conch with wide tabulate venter and ribs on flanks.

Soliclymenia aegoceras (Frech, 1902)
(Figs 216D–F and 223)

Type horizon and locality: Probably *Clymenia* Stufe at Kleiner Pal in the Carnic Alps (Price and Korn 1989).

Material. — Three specimens.

Diagnosis. — Smooth concave venter and strong regular ribs on flanks of slightly compresses subquadrate whorls.

Remarks. — Price and Korn (1989) have chosen the neotype for the type species of *Progonioclymenia*, *P. acuticostata* (Münster, 1842) with juvenile ventrolateral spines and ribbing similar to those in the gonioclymeniids. This makes it fundamentally different from *Clymenia aegoceras* Frech, 1902 (Price and Korn 1989; Korn and Klug 2002), believed to be a junior synonym of *P. acuticostata* by Bogoslovsky (1981). It is here transferred to *Soliclymenia* as the earliest member of the lineage. The specimen from the *Prolobites–Platyclymenia* Zone of the Ishikay River determined as *S. solarioides* by Bogoslovsky (1981) has been made the type of *Borisiclymenia ishikayensis* by Korn and Klug (2002), whereas that from the *Clymenia–Gonioclymenia* Zone of the Kia River section originally referred to *P. acuticostata* has been named *P. bogoslovskyi*. They may represent the same lineage.

Distribution. — The early *P. jugosus* Zone (grey *Clymenia* limestone) at Kowala.

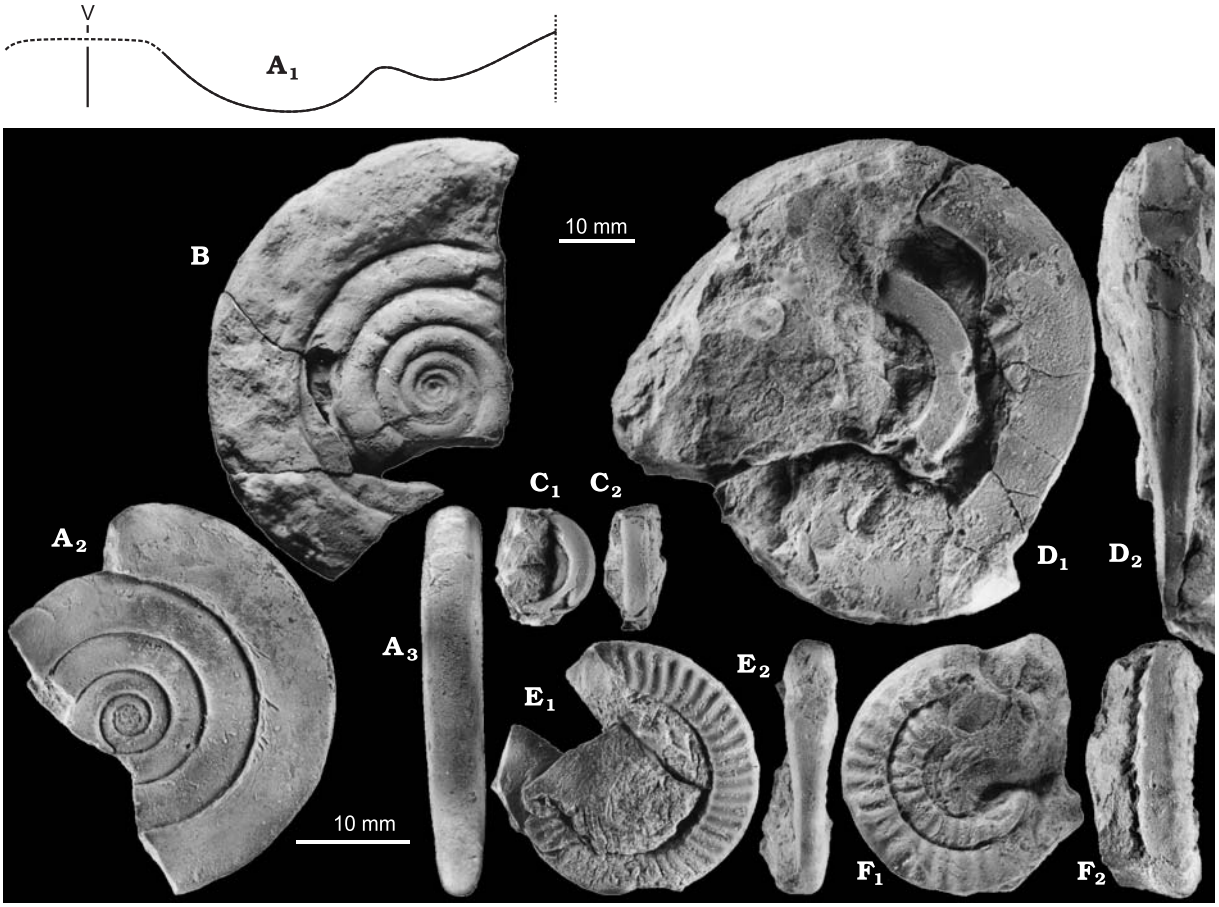

Fig. 216. Late Famennian extremely evolute clymenias. **A**–**C**. *Trochoclymenia wysogorskii* (Frech, 1902) from the early *P. jugosus* Zone at Kowala in the Holy Cross Mountains (A) and Dzikowiec in the Sudetes (B, C); suture and views of specimen IG.284.II.824 (A); views of unnambered specimen UWr (B); juvenile ZPAL AmVII/189 probably belonging to this species (C). **D**–**F**. *Soliclymenia aegoceras* (Frech, 1902) from the early *P. jugosus* Zone at Kowala in the Holy Cross Mountains; views of specimens ZPAL AmVII/10, 942 and 940.

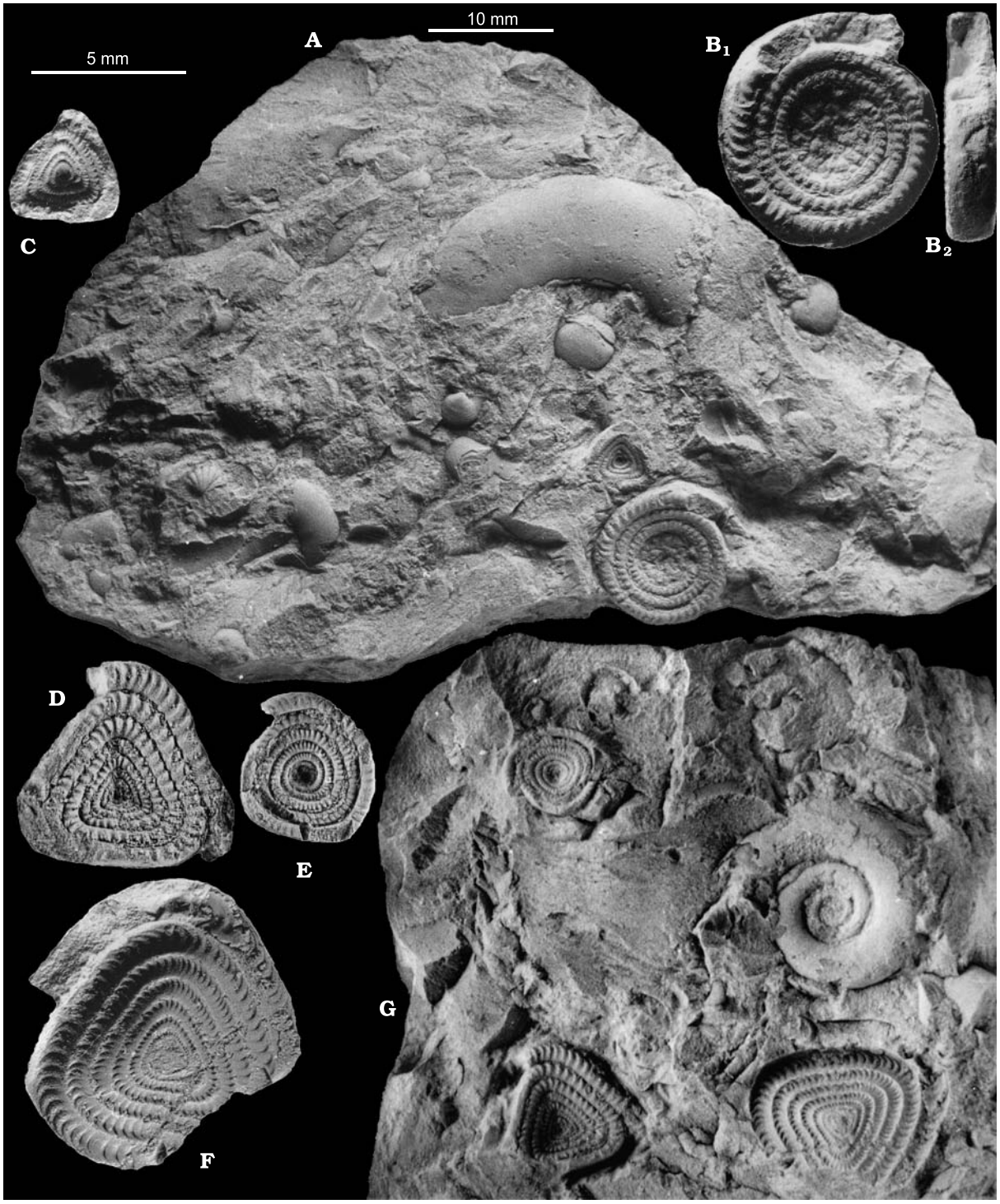

Fig. 217. Limestone blocks with associations of *Soliclymenia* from the late *P. jugosus* Zone at Dzikowiec Uwr 1760 (A) and Göttingen unnambered (G; see also Korn and Klug 2005) and magnified views of their conchs (B–F). **B**. *S. solarioides* (von Buch, 1840). **C**–**F**. *S. paradoxa* (Münster, 1839).

Soliclymenia solarioides (von Buch, 1840)
(Figs 217A, B and 223)

Type horizon and locality: Clymeniid limestone at Dzikowiec, the Sudetes.

Material. — Eight specimens.

Diagnosis. — Strongly depressed whorls with rounded flanks.

Distribution. — The late *P. jugosus* Zone at Dzikowiec (Korn *et al*. 2005).

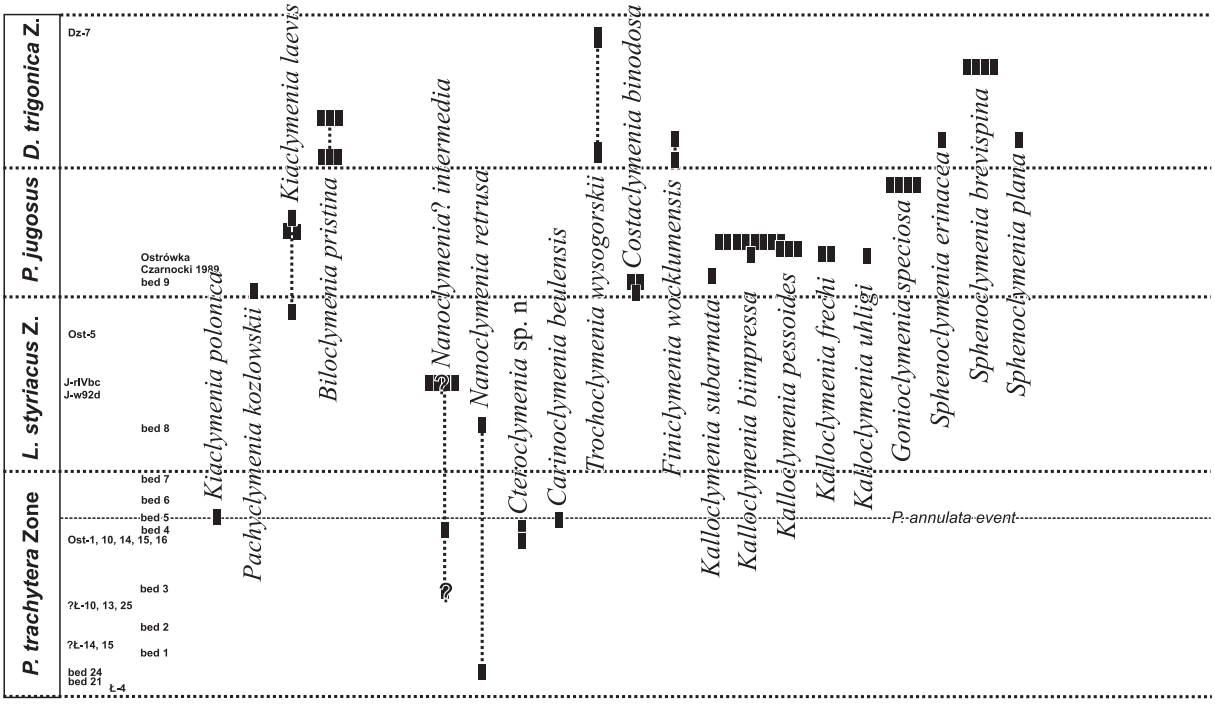

Fig. 218. Stratigraphic distribution of species of the Carinoclymeniidae, Costaclymeniidae, Gonioclymeniidae, and Biloclymeniidae in the Polish Famennian. Position of samples not included in Figs. 2 and 3 on the geochronological scale is hypothetical.

Soliclymenia paradoxa (Münster, 1839)
(Figs 217A, C–G and 223)

Type horizon and locality: Schübelhammer near Heinersreuth in Frankenwald (Schindewolf 1937).

Material. — Ten specimens.

Diagnosis. — Roundedly triangular conch outline.

Remarks. — *S. paradoxa* co-occurs with *S. solarioides* on the same bedding planes (Fig. 209A, G; Korn *et al.* 2005). There is also a great variation in the conch outline among triangular specimens found together, although the sample size is too small to enable reasonable statistics (Korn *et al*. 2005). The single more roundedly triangular specimen described by Schindewolf (1937) as his *S. semiparadoxa* (Fig. 209E) may belong to the same species as an extreme morphology. There seems to be, however, a bimodality in frequency distribution of conch morphologies covering ranges of *S. solarioides* and *S. paradoxa*; these thus seem to be biologically meaningful. Because the triangular or regularly spiral coiling starts from almost the beginning of the conch growth, it is unlikely that this is a case of sexual dimorphism.

Distribution. — The late *P. jugosus* Zone at Dzikowiec.

Family **Glatziellidae** Schindewolf, 1928

Diagnosis. — Evolute conch ribbed on flanks, with subventral furrows.

Genus ***Rhiphaeoclymenia*** Bogoslovsky, 1981

Type species: *Rhiphaeoclymenia canaliculata* Bogoslovsky, 1981 from *Kalloclymenia–Wocklumeria* Zone at Kia in the southern Urals.

Diagnosis. — Evolute conch with depressed juvenile, and furrowed mature, whorls; suture with deep subventral lobes and shallow acute flank lobes.

Remarks. — The external morphology of juvenile conch makes it similar to those of *Pleuroclymenia* (relationship proposed for the Glatziellidae by Becker 2000) or even *Soliclymenia* but suture points out rather towards *Kiaclymenia*.

Rhiphaeoclymenia canaliculata Bogoslovsky, 1981
(Figs 219A and 223)

Type horizon and locality: *Kalloclymenia–Wocklumeria* Zone of the Kia Formation at Kia in the southern Urals.

Fig. 219. Species of the Glatziellidae from Kowala (A, K, L) and Karczówka (G, I) in the Holy Cross Mountains and Dzikowiec (B–F, J) in the Sudetes. **A**. *Rhiphaeoclymenia canaliculata* Bogoslovsky, 1981 from the *P. jugosus* Zone at Kowala; photograph of lost specimen (reproduced from Czarnocki 1989, pl. 3: 11). **B**–**G**. *Glatziella helenae* (Renz, 1914) probably from the late *P. jugosus* or early *D. trigonica* Zone at Dzikowiec (B–F) and Karczówka (G); views of specimens ZPAL AmVII/806, 426, 1583, 796, and 1582 (B–F; all probably from the same level at the southern end of the quarry), and specimen IG 284.II.821a (G, in red haematitic shale). **H**, **I**. *G. minervae* (Renz, 1914) probably from the early *D. trigonica* Zone at Dzikowiec (H) and Karczówka (I); views of specimens ZPAL AmVII/161 (H) and mature conch IG 284.II.821b (I, in red haematitic shale). **J**–**L**. *G. glaucopis* (Renz, 1914) from the *D. trigonica* Zone at Dzikowiec (J) and Kowala (K, L); views of specimen ZPAL AmVII/944 (J, sample Dz-180 with *Parawocklumeria paradoxa*), 1043, and 1040 (K, L, both from a bed near sample Ko-102).

Remarks. — *Liroclymenia fundifera* Czarnocki, 1989 seems to represent this species (Becker 1997), although the single original specimen is lost and cannot be studied. The description of its suture (Czarnocki 1989, p. 47), indicating presence of two deep acute lobes on flanks, is consistent with this identification.

Distribution. — Probably the *P. jugosus* Zone at Kowala (lower *Wocklumeria* beds of Czarnocki 1989).

Genus ***Glatziella*** Renz, 1914

Type species: *Glatziella helenae* Renz, 1914 from the clymeniid limestone at Dzikowiec in the Sudetes.

Diagnosis. — Minute conch with very low whorls.

Remarks. — Suture of *Glatziella helenae* illustrated by Schindewolf (1937, fig. 15) shows two lobes on the flanks, thus a situation similar to that in *Rhiphaeoclymenia*. Lobes are, however, much shallower, which may be related to a secondary simplification in result of the paedomorphic nature of the genus.

Glatziella helenae (Renz, 1914)
(Figs 219B–G and 223)

Type horizon and locality: Clymeniid limestone at Dzikowiec in the Sudetes.

Material. — Four specimens.

Diagnosis. — Evolute conch with whorls height similar to width.

Remarks. — Each of the studied specimens is unique in the whorl cross section. No doubt that this is a highly variable species. Still, the extend of variability approaches, but does not reach the more *Rhiphaeoclymenia*-like morphology of the oldest species of the lineage, *G. lethmathensis* Becker, 1997 from the Rhenish Slate Mountains (1997). There seems to be also a gap separating this species from the equally variable *G. minervae* (Renz, 1913). A possibility remains that these are actually members of a single continuous lineage. Unfortunately, all the specimens studied were collected from the scree in blocks too small to provide conodont samples of size enabling precise age determination.

Distribution. — The early *D. trigonica* Zone at Dzikowiec and Karczówka.

Glatziella minervae (Renz, 1914)
(Figs 219H, I and 223)

Type horizon and locality: Clymeniid limestone at Dzikowiec in the Sudetes.

Material. — Three specimens.

Diagnosis. — Moderately involute conch; wide whorls with distinct ribbing on flanks.

Remarks. — Particular specimens differ from each other mostly in having more or less apparent ribbing on flanks and in the width of the umbilicus. Schindewolf (1937; also Becker 2000) introduced *G. diensti* and *G. tricincta* from the same locality, the species transitional in the conch geometry between *G. helenae* and *G. minervae*. It remains to be documented with more material whether these are stages in the evolutionary development of the lineage, end-members of population variability, or truly separate species.

Distribution. — The early *D. trigonica* Zone at Dzikowiec.

Glatziella glaucopis (Renz, 1914)
(Figs 219J–L and 223)

Type horizon and locality: Clymeniid limestone at Dzikowiec in the Sudetes.

Material. — Two specimens.

Diagnosis. — Globose, relatively involute conch; wide whorls with smooth flanks.

Remarks. — This is probably the end-member of the *Glatziella* lineage. No sign of ribbing is visible on internal moulds and also the areas with preserved shell visible in sections seem to be smooth. Suture can be traced only in the umbonal part of specimen ZPAL AmVII/1040 and septa in a section across the inner whorl of the holotype. It was apparently of simple geometry and does not differ substantially from the sutures of related species from Dzikowiec, traced by Schindewolf (1937).

Distribution. — The late *D. trigonica* Zone at Kowala, probably somewhat older stratum at Dzikowiec (Renz 1914; Schindewolf 1937).

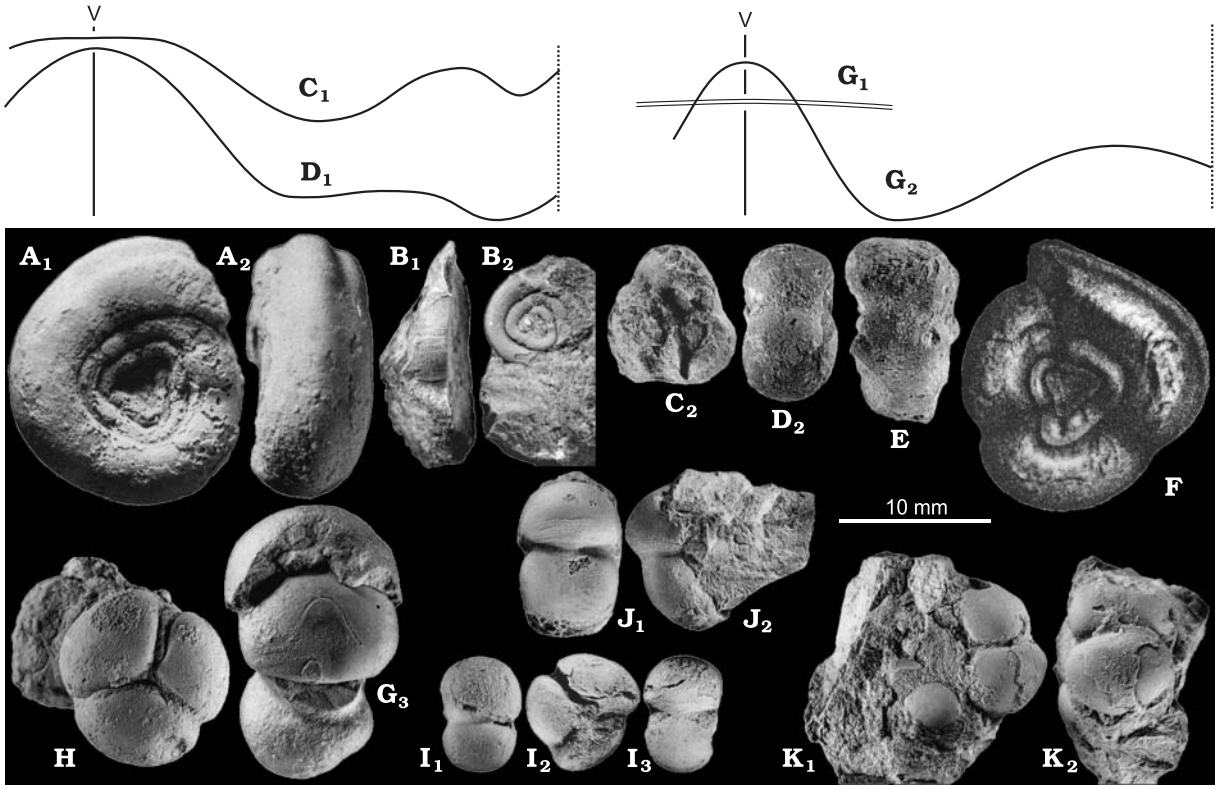

Fig. 220. Species of the *Parawocklumeria* lineage from Dzikowiec (A–F, I–L) in the Sudetes and Kowala (G, H) in the Holy Cross Mountains. **A**, **B**. *Kamptoclymenia trivaricata* Schindewolf, 1937 probably from the *P. jugosus* Zone at Dzikowiec; views of the holotype UWr 1772 (A) and unnambered MfN (B, 0.1 m below the top of the Famennian, illustrated also in Schindewolf 1937, pl. 3: 16). **C**–**F**. *Parawocklumeria distorta* (Tietze, 1870) from the late *P. jugosus* or early *D. trigonica* Zone at Dzikowiec; suture and view of specimens ZPAL AmVII/108 and 109 (C, D); view of 110 (E) and mature specimen (F, holotype of *Parawocklumeria patens*, reproduced from Schindewolf 1937, pl. 4: 5). **G**–**K**. *Parawocklumeria paradoxa* (Wedekind, 1918) from the *D. trigonica* Zone at Kowala (G, H) and Dzikowiec (I–K); growth lines, suture, and view of specimen ZPAL AmVII/954 (G); views of 1046, 800 (H, I), 936, and 938 (J, K, sample Dz-180).

Family **Wocklumeriidae** Schindewolf, 1937

Diagnosis. — Conch with three constrictions per whorl at least early in the ontogeny.

Remarks. — It was convincingly shown by Becker (2000) that, contrary to the original idea of Schindewolf (1937), the lineages of *Wocklumeria* and *Parawocklumeria* are closely related to each other, and their similarity is not a case of homeomorphy but the result of common descend. It does not seem necessary to distinguish the separate family Parawocklumeriidae Schindewolf, 1937; at the best it deserves the subfamily rank.

Genus ***Kamptoclymenia*** Schindewolf, 1937

Type species: *K. endogona* Schindewolf, 1937 from beds 7–9 at Hönnental, Rhenish Slate Mountains (Schindewolf 1937).

Diagnosis. — Evolute conch with adult stages bearing ventrolateral furrows and juvenile conch of trigonal shape.

Kamptoclymenia trivaricata Schindewolf, 1937
(Figs 220A, B and 223)

Type horizon and locality: Clymeniid limestone at Dzikowiec in the Sudetes.

Material. — Two specimens.

Diagnosis. — Trigonal conch form reaches in ontogeny the stage with ventrolateral furrow.

Remarks. — The species seems to be confined to the upper part of the clymeniid limestone at Dzikowiec (Schindewolf 1937). Also the juvenile whorls attributed by Schindewolf (1937, pl. 3: 16; here Fig. 220B) to

his *K. trigona* (the holotype being an adult conch from Hönnental) seem indistinguishable from corresponding whorls of the holotype of *K. trivaricata*.

Probable ancestor of this species is *K. endogona* from Hönnental (co-occurring there in the same beds with the closely similar *K. trigona*) which differs in a more evolute spiral conch, the trigonal appearance being restricted to early stages (Schindewolf 1937; Becker 2000).

Distribution. — The *D. trigonica* Zone at Dzikowiec (0.1 m below the top of the Famennian in the quarry according to Schindewolf 1937).

Genus ***Parawocklumeria*** Schindewolf, 1926

Type species: *Wocklumeria paradoxa* Wedekind, 1918.

Diagnosis. — More or less involute conch, with three deep constrictions on each whorl.

Parawocklumeria distorta (Tietze, 1870)
(Figs 220C–F and 223)

Type horizon and locality: Clymeniid limestone at Dzikowiec in the Sudetes.

Material. — Three specimens.

Diagnosis. — Relatively evolute conch with ventrolateral furrows on the mature living chamber.

Remarks. — The holotype of *P. patens* from the same strata (Schindewolf 1937; Becker 2000) may represent mature stage of the same species. Unfortunately, being originally housed in Wrocław, it was probably lost during World War II, together with the holotype of *P. distorta*. *P. distributa* Czarnocki, 1989 from Kowala closely resembles the Dzikowiec specimens of *P. distorta* in the conch form but differs from the specimen illustrated by Schindewolf (1937, fig. 26) in a wider and mory distinctly bilobate ventral saddle of the suture. Becker (2000) introduced the separate genus *Tardewocklumeria* for it, hypothesizing that this is the ancestral member of the Wocklumeriidae.

Distribution. — The *D. trigonica* (perhaps also the late *P. jugosus*) Zone at Dzikowiec (Schindewolf 1937), probably the late *P. jugosus* Zone at Kowala (Czarnocki 1989).

Parawocklumeria paradoxa (Wedekind, 1918)
(Figs 220G–K and 223)

Type horizon and locality: Burg near Balve in the Rhenish Slate Mountains (Wedekind, 1918).

Material. — Five specimens.

Diagnosis. — Involute conch with ventrolateral furrows on the mature living chamber.

Remarks. — The ontogeny of suture was studied by Czarnocki (1989). *P. paprothae* Korn, 1989 from Grünen Schneid in the Carnic Alps is intermediate between *P. distorta* and *P. paradoxa* in having an open umbilicus. Specimens of such morphology occur also in Dzikowiec and Kowala and it remains to be shown whether they represent a separate stage in the evolutionary development of the lineage (Becker 2000) or only an extreme in the population variability.

Distribution. — The *D. trigonica* Zone at Dzikowiec, Miedzianka and Kowala (Czarnocki, 1989).

Genus ***Epiwocklumeria*** Schindewolf, 1937

Type species: *Wocklumeria paradoxa* var. *applanata* Wedekind, 1918 from Burg near Balve in the Rhenish Slate Mountains.

Diagnosis. — Involute discoidal conch; suture with deep ventral and flank lobes, and shallow umbonal lobe.

Epiwocklumeria bohdanowiczi (Czarnocki, 1989)
(Figs 221A–D and 223)

Type horizon and locality: Burg near Balve in the Rhenish Slate Mountains (Wedekind, 1918).

Material. — One specimen.

Diagnosis. — Discoidal conch; rounded ventral and acute flank lobes of the suture.

Remarks. — The mature living chamber in this species lacks constrictions and is evolute. Its venter is acute. Czarnocki (1989) introduced genus *Kielcensia* for the species (developed further by Becker 2000) but it seems more likely to me that this is rather a connecting link between *Parawocklumeria* and the type species of *Epiwocklumeria*.

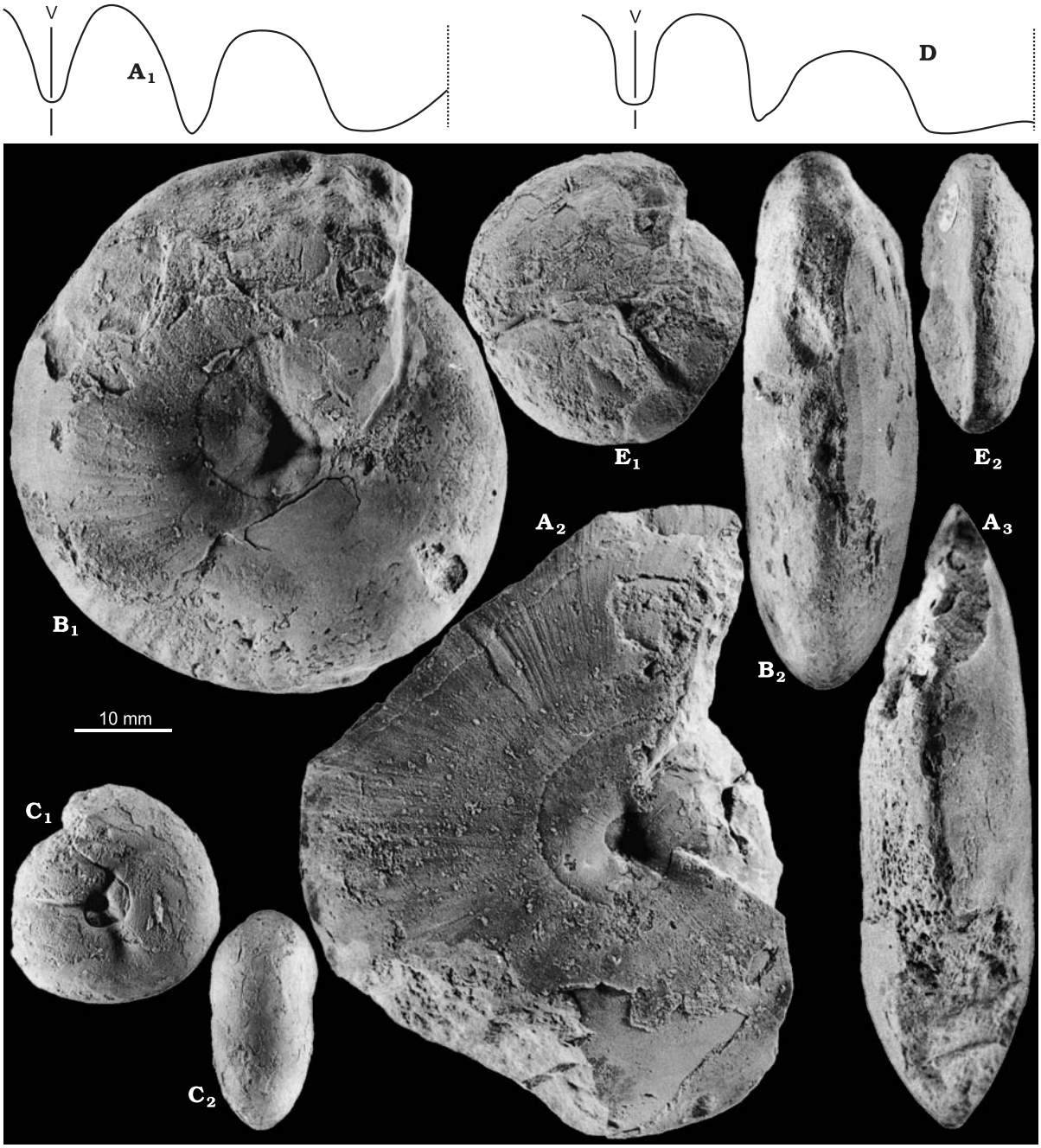

Fig. 221. Species of the *Epiwocklumeria* from Kowala in the Holy Cross Mountains. **A**–**D**. *Epiwocklumeria bohdanowiczi* (Czarnocki, 1989) probably from the *P. jugosus* Zone at Kowala (A–C) and Jabłonna (D); suture and views of mature specimen ZPAL AmVII/183 (A); views of mature IG 284.II.443 (B, trench III, bed 2 of Jan Czarnocki) and juvenile IG 284.II.431 (C); suture of ZPAL AmVII/448 (D, bed 33). **E**. *Epiwocklumeria applanata* (Wedekind, 1918) probably the *D. trigonica* Zone; views of specimen IG 284.II.875.

Distribution. — Probably the late *P. jugosus* Zone at Kowala in the Holy Cross Mountains. According to Czarnocki (1989, p. 27), *Kielcensia* occurs throughout his 5.54 m thick *Wocklumeria* beds, starting from below the red marly limestone. This is a mysterious notion as no single specimen of this clymenia was found by myself in these strata. *Epiwocklumeria* and *Wocklumeria* is reported by him from the base of 1.85 m thick upper unit of the beds. He also reports a mass occurrence of Kielcensia from the "cuboidally breaking shale" immediately below the bituminous black shale (equivelent to the Hangenberg Shale; Dzik 1997), which obviously refers to *Acutimitoceras*. It seems thus that only the report of *E. bohdanowiczi* from the stratum below the red limestone is likely to be correct.

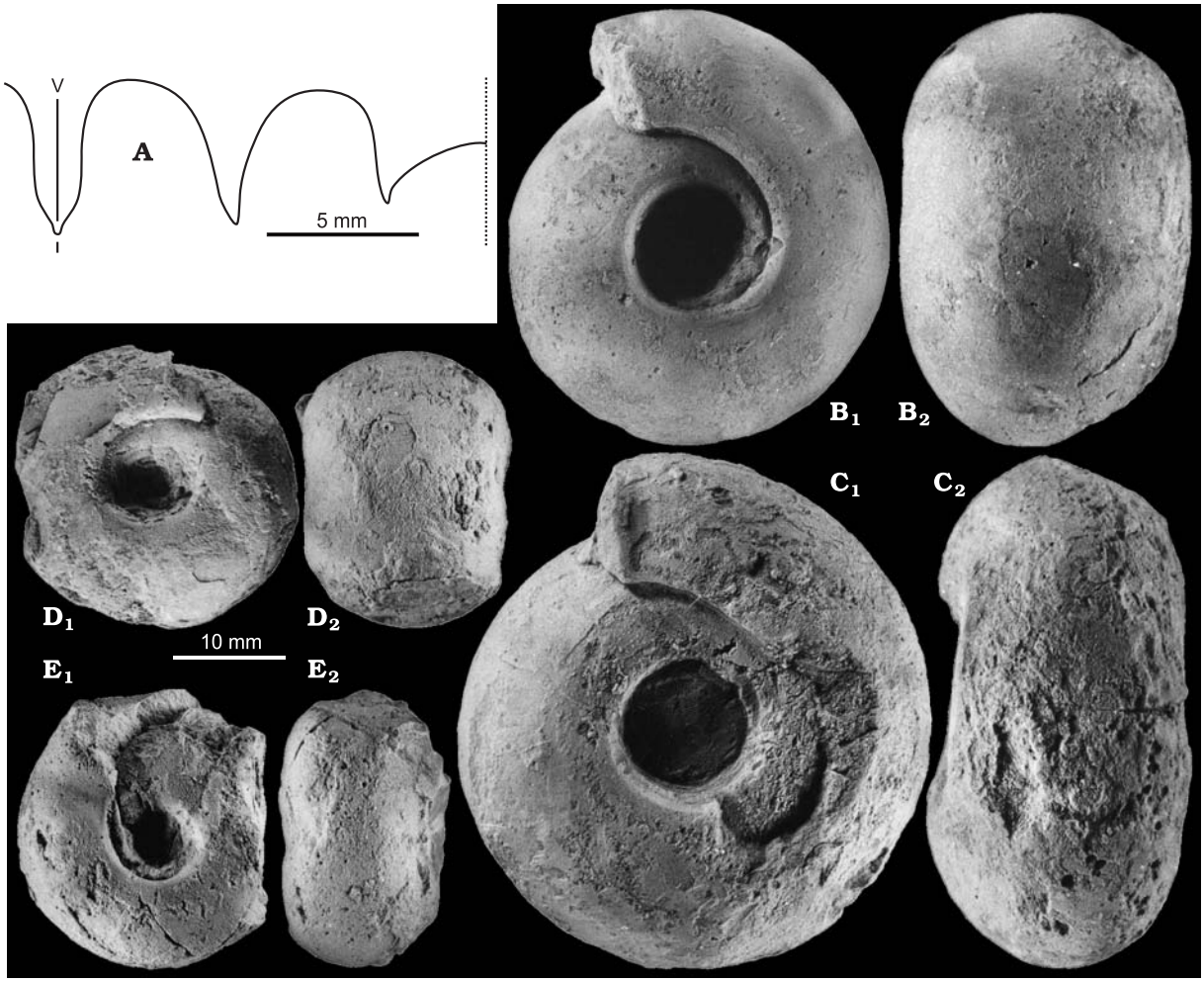

Fig. 222. W*ocklumeria sphaeroides* (Richter, 1848) probably from the *D. trigonica* Zone at Kowala in the Holy Cross Mountains; suture of specimen IG 284.II.874 (A); views of mature specimens IG 284.II.622, 775 (B, C), subadult ZPAL AmVII/1045, and 1042 (D, E).

Epiwocklumeria applanata (Wedekind, 1918)
(Figs 221E and 223)

Type horizon and locality: Burg near Balve in the Rhenish Slate Mountains (Wedekind, 1918).

Diagnosis. — Flat discoidal conch with ventrolateral furrows on the mature living chamber.

Remarks. — It is unclear whether among available specimens there are adults and whether constrictions developed truly until the maturity.

Distribution. — The *D. trigonica* Zone at Kowala in the Holy Cross Mountains (Czarnocki, 1989).

Genus ***Wocklumeria*** Wedekind, 1918

Type species: *Goniatites sphaeroides* Richter, 1848 from Bohlen near Saalfeld in Thuringia (Becker 2000).

Diagnosis. — Evolute smooth globose conch; suture with acute ventral, lateral, and umbonal lobes.

Wocklumeria sphaeroides (Richter, 1848)
(Figs 222 and 223)

Type horizon and locality: Burg near Balve, Rhenish Slate Mountains (Wedekind, 1918).

Material. — Two specimens.

Distribution. — Probably the late *D. trigonica* Zone at Kowala in the Holy Cross Mountains (Czarnocki, 1989).