Acta Geologica Polonica, Vol. 50 (2000), No. 2, pp. 191-209

Ammonites and stratigraphy of the uppermost Bajocian and Lower Bathonian between Częstochowa and Wieluń, Central Poland

BRONISŁAW ANDRZEJ MATYJA & ANDRZEJ WIERZBOWSKI

Institute of Geology, University of Warsaw, Al. Żwirki i Wigury 93, 02-089 Warszawa, Poland.
E-mail: bam@geo.uw.edu.pl, awzw@geo.uw.edu.pl

ABSTRACT:

MATYJA, B. A. & WIERZBOWSKI, A. 2000. Ammonites and stratigraphy of the uppermost Bajocian and Lower Bathonian between Częstochowa and Wieluń, Central Poland. *Acta Geologica Polonica*, **50** (2), 191-209 Warszawa.

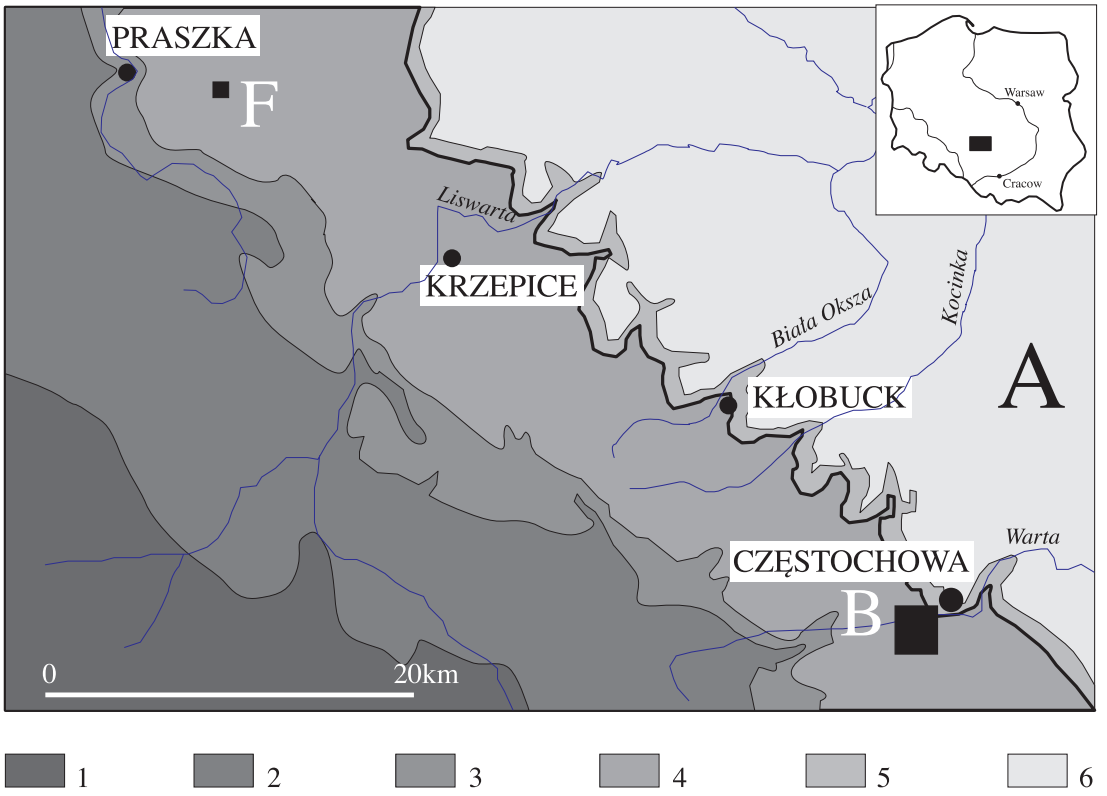
A detailed biostratigraphical study of the black clays and siltstones with ironstone nodules of the Ore Bearing Częstochowa Clay Formation in the brick-pits at Częstochowa and Wieluń resulted in recognition of the following standard ammonite zones and subzones: the Parkinsoni and Bomfordi subzones of the Parkinsoni Zone of the uppermost Bajocian; the Convergens, Macrescens and Yeovilensis subzones of the Zigzag Zone, and the Tenuiplicatus Zone of the Lower Bathonian. The ammonite faunas are of Submediterranean character, although markedly impoverished when compared with those of the most classic areas of the province. This impoverishment is especially well seen in the uppermost Bajocian – lowermost Bathonian part of the succession, where the only numerous ammonites are these of the genus *Parkinsonia*, together with rare representatives of *Cadomites*; and in the uppermost part of the Lower Bathonian, where representatives of the corresponding macro- and microconchs – *Asphinctites tenuiplicatus* (BRAUNS), and *Polysphinctites secundus* (WETZEL) – predominate. In the palaeontological part of the paper 14 species belonging to the genera *Oxycerites*, *Parkinsonia*, *Cadomites*, *Wagnericeras*, *Asphinctites* and *Polysphinctites* are described. Of these, particular attention is paid to a form referred to as *Parkinsonia* (*Parkinsonia*) aff. *dorni* ARKELL from the uppermost Bajocian, represented by several specimens of various growth stages, which may be tentatively compared with the poorly diagnostic small, incomplete type-specimens of *P. dorni*.

Key words: Jurassic, Bajocian, Bathonian, Central Poland, Ammonites, Biostratigraphy, Biogeography, Palaeontology.

INTRODUCTION

The classic area of occurrence of Upper Bajocian and Bathonian deposits in Poland lies in the Upper Warta Depression, west of the Częstochowa Upland, and in the Krzepice Depression, west of the Wieluń Upland. The deposits are black clays and siltstones with abundant ironstone (mostly siderite) concretions, known in the Polish geological literature as the Ore Bearing Częstochowa Clay Formation. Some levels of the ironstones were exploited in this area in iron-mines that were active up to the early 1980s. These deposits are currently exposed in several brick-pits.

The deposits became famous due to a wealth of well preserved ammonites that was known since the nineteenth century. Detailed biostratigraphical studies of these deposits were undertaken by REHBINDER (1913), who introduced here for the first time the standard



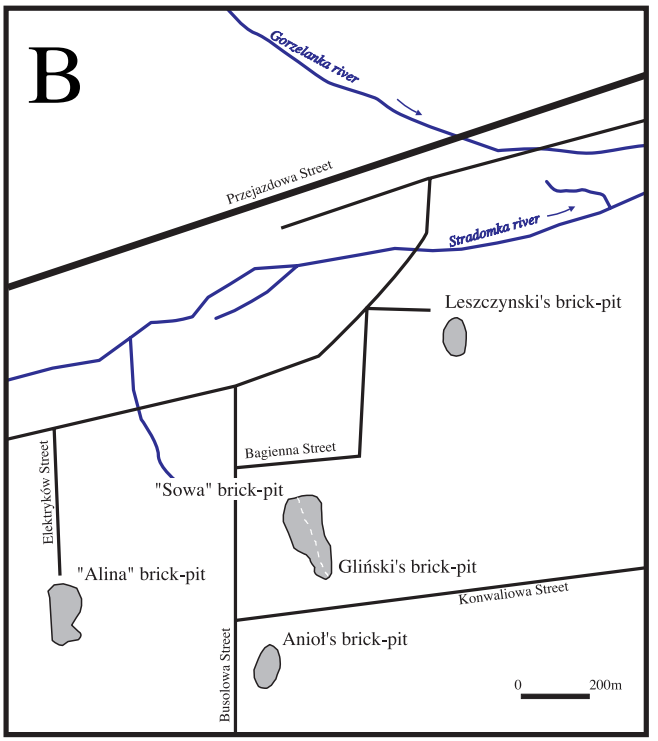


Fig. 1A. Geological map of the study area showing location of the sections: F – Faustianka brick-pit, B – Częstochowa; area. **1 –** Upper Triassic, **2 –** Lower Jurassic**, 3 –** Middle Jurassic: Kościelisko Beds, **4 –** Middle Jurassic: Ore Bearing Częstochowa Clay Formation, **5 –** Middle Jurassic: sandy limestones, **6 –** Upper Jurassic; Fig. 1B. Location of the studied sections in the south-western part of Częstochowa

Tenuiplicatus Zone at the top of the Lower Bathonian; and by PREMIK (1934). Both of these authors recognised the general ammonite succession but, with the exception of illustrations of some specimens, mostly of the genus *Parkinsonia*, given by PREMIK (1934), they presented very few data on the ammonite systematics.

A part of the older collections, supplemented by new bed-by-bed collections, were studied by RÓŻYCKI (1953), who modified the zonation of these deposits. However, that study was also devoid of palaeontological documentation, because the collections, as well as descriptions of the ammonites that had previously been prepared by that author, were destroyed during the Second World War. The zonal scheme proposed by RÓŻYCKI (1953), with some later modifications introduced mostly by ZNOSKO (1957), and KOPIK (1974, 1979), has been used until now in papers prepared by the geologists of the Polish Geological Institute (see DADLEZ & *al*. 1998). It differs markedly from the standard zonal scheme for the Upper Bajocian and Bathonian used in the present paper, and is discussed below in the stratigraphical part of this study. It should be remembered, however, that a zonal scheme comparable with the standard one was introduced recently by KOPIK (1998).

The detailed studies of the Ore Bearing Częstochowa Clay Formation that were carried out after the war concentrated mostly on analysis of cores, which did not yield many of the well preserved ammonites that are required for zonal purposes. Because of this, and because of the poor documentation in the earlier literature, the Upper Bajocian and Bathonian ammonites from the outcrops in the Częstochowa and Wieluń area are relatively poorly known. The only detailed study of the ammonite fauna that has been published more recently is that of KOPIK (1974) on the representatives of the genus *Cadomites*. In addition, several illustrations of ammonites, representing some genera occurring in the Polish Upper Bajocian and Bathonian were presented by DAYCZAK-CALIKOWSKA & *al*. (1988), and quite recently by KOPIK (1998), but without palaeontological descriptions. In addition, the stratigraphy of the Bathonian in brick-pits in Częstochowa, together with descriptions of some of the ammonites, was given in an unpublished M.Sc. thesis by POTOCKI (1972).

The present paper is the first of a planned series dealing with successive Upper Bajocian and Bathonian ammonite faunas in the Częstochowa and Wieluń areas. It gives the biostratigraphy of the uppermost Bajocian and Lower Bathonian successions, together with description of ammonites, that are exposed in currently active brick-pits in Częstochowa and in the vicinity of Wieluń.

During the field work, stratigraphically precisely located samples were collected for dinoflagellate studies. This has resulted in an integration of the ammonite zonation with a refined dinoflagellate cyst zonation (POULSEN 1998).

GEOLOGICAL SETTING

The sections studied (Text-fig. 1) expose part of the Ore Bearing Częstochowa Clay Formation. The formation is underlain by sandstones of the so-called Kościelisko Beds of Early Bajocian age, and is overlain by sandy limestones of Callovian age (KOPIK 1998). The total thickness of the formation is about 140 m at Częstochowa, but it gradually increases northwards, attaining 170 m at the village of Faustianka in the Wieluń area (ZNOSKO 1954).

The so-called "ore levels" have been distinguished within the Ore Bearing Częstochowa Clay Formation as the main mining levels. The "bottom ore level" occurs almost directly above the Kościelisko Beds, the "middle (or top) ore level" occurs about 65 m and about 70 m above the base of the formation in the vicinity of Częstochowa, and at Faustianka, respectively.

The studied interval of the Ore Bearing Częstochowa Clay Formation at Częstochowa lies between 36 m and 83 m above the base of the unit (Text-fig. 2), whereas that from the Faustianka clay pit at Wieluń– between 79 and 87 m, respectively.

DESCRIPTION OF THE SECTIONS

The sections studied are located in the south-western part of Częstochowa (in the Gnaszyn Górny and Kawodrza Górna districts), as well as at the village of Faustianka, about 20 km south of Wieluń. Their precise locations are shown by coordinates on maps at a scale of 1:25000: sheet no. 511.44 – Częstochowa Południe and sheet no. 511.12 – Jaworzno. The brick-pits have not been described in detail in the geological literature, except for the unpublished M.Sc. thesis of POTOCKI (1972). This later paper, however, described the sections at Kawodrza Górna in Częstochowa when they were less fully exposed than nowadays, and they are consequently not exactly comparable with the sections described in the present paper.

The lithologies consist of silty clays with ironstone nodules. The latter usually form well marked horizons which can be traced at least throughout brick pits that are situated close together. The ironstones are mostly siderites, but no chemical analyses of them have been

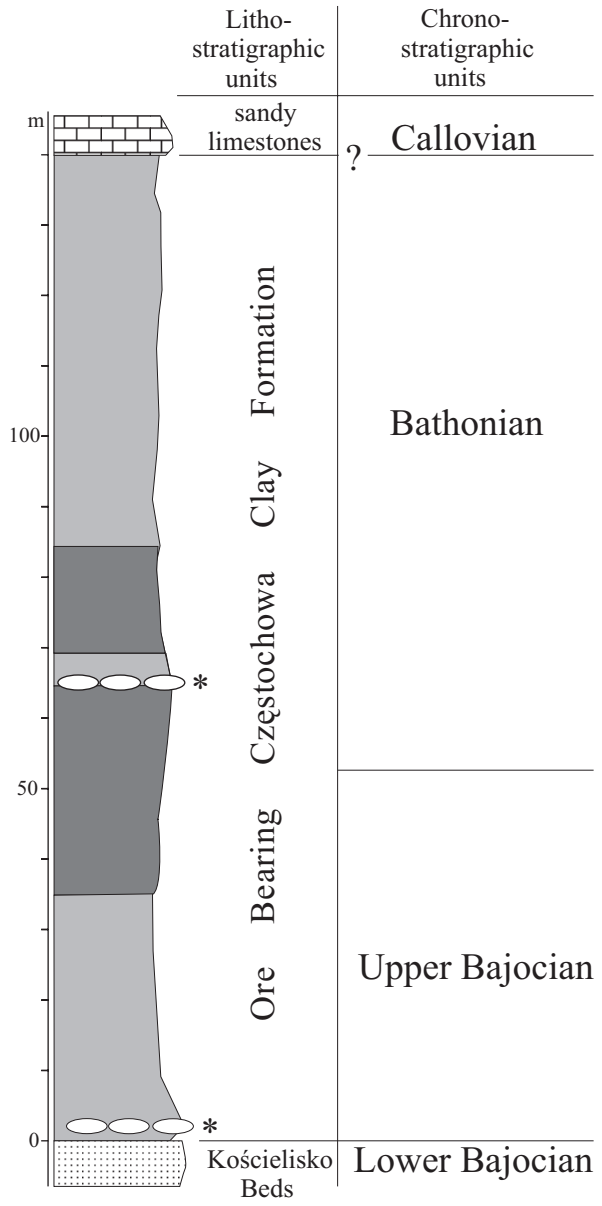


Fig. 2. Stratigraphical log of the Middle Jurassic deposits showing the studied part of the Ore Bearing Częstochowa Clay Formation (in dark grey; see also Text-Fig. 3); the asterisks indicate the bottom and the top ore levels

undertaken. The ammonites have been recorded bed by bed. These coming from the ironstone nodules are usually well preserved, whereas those from the clays are strongly flattened and difficult to determine.

The sections studied are the only uppermost Bajocian and Lower Bathonian sections in the Częstochowa – Wieluń area that are suitable for biostratigraphical purposes. The other sections of these deposits are either poor in ammonites (Pacanów – about 36 km south of Wieluń) or heavily disturbed glacitectonically (Mokrsko – about 11 km south-west from Wieluń), and hence are not included in the present paper.

Gnaszyn Górny – "Alina" brick-pit

Brick-pit located in the eastern part of Gnaszyn Górny in Elektryków Street (sheet no. 511.44 – Częstochowa Południe: coordinates: x – 24250, y – 92820).

The section exposes 12.7 m of dark grey calcareous silty clays with some small bioclasts and local bioturbation. Rows of ironstone nodules occur mostly in the middle and upper parts of the section (from about 5 to 6 m, and from 9.2 to 10.2 m above its base); these nodules are beige to brown in colour, and generally of medium size. The only row of large nodules, up to 50 cm in diameter, occurs at the base of the section: one of these nodules yielded (Pl. 3, Fig. 3) a large specimen of *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY) and *Parkinsonia* (*Durotrigensia*) sp. Another, poorly preserved specimen of *Parkinsonia* (*Durotrigensia*) sp. was found 8.6 m above the base of the section. Other ammonites found loose in the ironstone nodules include: several specimens of *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY) – see Pl. 3, Fig. 2, and a single specimen of *Parkinsonia* (*Durotrigensia*) *pseudoferruginea* NICOLESCO – see Pl. 1, Fig. 4, and *Cadomites* (*Cadomites*) *deslongchampsi* (DEFRANCE) – see Pl. 7, Fig. 1, as well as several fragmentary specimens attributable to *Parkinsonia* (*Parkinsonia*) and *P.* (*Durotrigensia*); these ammonites come from a part of the section, up to 10.2 m above the base, that contains large to medium-sized ironstone nodules.

Kawodrza Górna – Anioł's brick-pit

Brick-pit located in the western part of Kawodrza Górna in Busolowa Street (sheet no. 511.44 – Częstochowa Południe: coordinates: x – 24308, y – 92786).

The section exposes 10 m of dark grey calcareous, locally bioturbated silty clays with small bioclasts. Four distinct levels of ironstone nodules designated *A*, *B*, *C* and *D* can be seen. Fossil concentrations, a few centimetres in diameter, represented by clumps of bivalve and brachiopod shells, with an admixture of other fossils (*e.g.* small ammonites), occur commonly in the clays between the iron-stone levels *C* and *D*.

Directly below the accessible part of the section, still older deposits, now flooded, yielded a few oyster "reefs" – about 1.5 m in diameter, consisting mostly of shells of the genus *Liostrea.* Such a "reef" taken from its original position can be observed in the spoil north-east of the the exposure.

The ammonites include:

Parkinsonia (*Parkinsonia*) aff. *dorni* ARKELL, represented by three specimens, of which only two can be precisely located in the section (one from clays about 1.4 m below ironstone level *A* – see Pl. 4, Fig. 1, another from level *A* – see Pl. 4, Fig. 5),

Parkinsonia (? aff. *dorni* ARKELL), represented by two specimens (Pl. 4, Fig. 6 and Pl. 6, Fig. 1) found loose, but possibly coming from clays between ironstone levels *C* and *D* – together with some other small and immature specimens of *Parkinsonia* sp. and a single minute *Cadomites* sp.,

Parkinsonia (*Gonolkites*) *subgaleata* (BUCKMAN), represented by a single specimen (Pl. 6, Fig. 2) from ironstone level *D*.

Kawodrza Górna – "Sowa" brick-pit

Brick-pit located in the western part of Kawodrza Górna in Bagienna Street (sheet no. 511.44 – Częstochowa Południe: coordinates: x – 24314, y – 92828). It borders along a narrow spur consisting of unexploited clays with Gliński's brick-pit (described below).

The section exposes about 6 metres of dark grey calcareous, locally bioturbated silty clays. Three levels of grey ironstone nodules can be recognized. These correspond to levels *B*, *C* and *D* in Anioł's brick-pit. Small clumps of fossils consisting mostly of bivalve and brachiopod shells are encountered in the clays between ironstone levels *C* and *D*, as in Anioł's brick-pit. A fragment of *Liostrea* "reef" was found in the floor of the south-westernmost part of the brick-pit: it possibly came from the lower part of the succession.

The brick-pit yielded the following ammonites:

Parkinsonia (*Parkinsonia*) aff. *dorni* ARKELL, represented by two specimens (Pl. 4, Figs 2 and 4) found loose in the western part of the brick-pit and possibly coming from the lower part of the succession,

Parkinsonia (*Durotrigensia*) *bomfordi* ARKELL, represented by a single specimen (Pl. 5, Figs 1, 2) found around ironstone levels *C* and *D*,

Parkinsonia (*Gonolkites*) *subgaleata* (BUCKMAN), represented by a single specimen (Pl. 2, Fig. 4) found about 0.85 m above ironstone level *D*.

Kawodrza Górna – Gliński's brick-pit

Brick-pit located in the western part of Kawodrza Górna in Konwaliowa Street (sheet no. 511.44 – Częstochowa Południe: coordinates: x – 24319, y – 92830), in close proximity to the "Sowa" brick-pit, but exposing even younger deposits.

The section exposes about 15 m of dark grey calcareous clays, locally bioturbated, with levels of grey and brown ironstone nodules – from level *D* (in common with Anioł's and "Sowa" brick-pits), to still younger levels *E*, *F*, *G*, *H* and *I* (Text-fig. 3). The highest one corresponds to the lowermost part of the "top (or middle) ore level".

The ammonites include:

Parkinsonia (*Parkinsonia*) *schloenbachi* SCHLIPPE, represented by a single specimen (Pl. 3, Fig. 1) found loose on the floor of the brick-pit and possibly from ironstone level *E*,

Parkinsonia ("*Oraniceras*") sp., represented by a fragmentary involute specimen from ironstone level *I*.

In addition, a few specimens of *Parkinsonia* ("*Oraniceras*") *gyrumbilica* (QUENSTEDT) were reported by POTOCKI (1972) from the northern part of the brick-pit. All of them came from a single ironstone nodule which could be correlated with any of the levels from *F* to *I* in the present paper.

Kawodrza Górna – Leszczyński's brick-pit

Brick-pit located in northern part of Kawodrza Górna (sheet no. 511.44 – Częstochowa Południe: coordinates: x – 24362, y – 92874).

The section exposes about 15 m of dark grey calcareous silty clays. The clays are locally strongly bioturbated and contain a variable content of fine bioclasts. Levels *J* and *K,* consisting of large ironstone nodules up to 0.25 m thick, occur in the middle part of the section about 7 m and 12.5 m above the base of the section respectively. Two additional levels (*L* and *M*) of small iron-stone nodules occur in the upper part of the section.

The ammonites, together with other fossils (mostly bivalves and brachiopods), occur both in the clays, where they are commonly flattened, and in large ironstone nodules, where they are usually well preserved and undeformed.

In the lower part of the section, well below the level *J* of large nodules, ammonites of the family Oppeliidae are fairly common. Although poorly preserved, they can be safely attributed to the genus *Oxycerites*, as treated in the present paper.

Level *J* yielded a single, poorly preserved specimen referred to *Morphoceras* sp.

Level *K,* of large ironstone nodules, yielded a rich, but monotonous assemblage of ammonites consisting almost entirely of two forms that are dimorphic counterparts: *Asphinctites tenuiplicatus* (BRAUNS) and *Polysphinctites secundus* (WETZEL) – Pl. 7, Fig. 3; a single fragment of *Oxycerites* also came from this level.

Faustianka brick-pit

Brick-pit located in eastern part of the village of Faustianka (sheet no. 511.12 – Jaworzno: coordinates: x – 20812, y – 95680).

The section exposes about 8 m of grey to black silty clays with seven marked levels of ironstone nodules. These are marked as levels *O* and *I-VI* (*see* Text-fig. 3).

The ammonites occur throughout the section, but from ironstone level *II* upwards they are of Mid-Bathonian age, mostly of the genus *Procerites*, and thus beyond the scope of the present paper. The Lower Bathonian ammonites occur commonly in the lowermost part of the section, mostly in ironstone level *O* and in the directly overlying clays. This ironstone level yielded numerous specimens of *Asphinctites tenuiplicatus* (BRAUNS) – Pl. 7, Figs 4, 5 and *Polysphinctites secundus* (WETZEL), fairly common *Oxycerites* (*Oxycerites*) *limosus* (BUCKMAN) – Pl. 1, Figs 2, 3 and *Oxycerites* (*Limoxyites*) *nivernensis* (DE GROSSOUVRE) – Pl. 1, Fig. 1, and rare *Oxycerites* (*Oxycerites*) *seebachi* (WETZEL) – Pl. 2, Figs 2, 3, *Oxycerites* (*Paroecotraustes*) *formosus* (ARKELL) – Pl. 2, Fig. 1, *Wagnericeras fortecostatum* (DE GROSSOUVRE) – Pl. 7, Fig. 2. In addition, the clays up to about 2 m above level *O* yielded a few ammonites of the genera *Asphinctites* and *Polysphinctites*, as well as some representatives of the genus *Oxycerites.*

AMMONITE STRATIGRAPHY OF THE UPPERMOST BAJOCIAN AND LOWER BATHONIAN

Ammonite biostratigraphy in Poland

The definition of the Bajocian and Bathonian stages as used until quite recently in Poland differed markedly from that widely accepted in Europe, especially since the Jurassic Colloquia in Luxembourg in the early 1960s. The main difference lies in the location of the boundary between the stages and, to a lesser degree, also in details of the ammonite zonation. In western Europe, the lower boundary of the Bathonian Stage is placed at the base of the standard Zigzag Zone, whereas in Poland the lower boundary of the Bathonian has been placed either at the base of the Asphinctites tenuiplicatus Zone or at the base of the so-called "Procerites Zone". This was a consequence of the distinguishing in Poland of the Vesulian stage, replaced later by the Kuyavian stage or substage (treated as corresponding to the Upper Bajocian), which included all the ammonite zones from the "Strenoceras subfurcatum Zone" to the Parkinsonia compressa Zone = Parkinsonia wuerttembergica Zone, and sometimes even up to the Asphinctites tenuiplicatus Zone (see *e.g.* RÓŻYCKI 1953, ZNOSKO 1957, KOPIK & ZNOSKO 1968, KOPIK 1974, DAYCZAK-CALIKOWSKA & KOPIK 1976, DAYCZAK-CALIKOWSKA 1988). Such an interpretation of the Upper Bajocian = Kuyavian in Poland resulted in a totally different stratigraphical range of this substage compared with western Europe. In Poland, the Upper Bajocian (Kuyavian) has corresponded not only to the Upper Bajocian, but also to the Lower Bathonian (or a large part of it) as interpreted in the standard western European scheme.

KOPIK (1998) has recently proposed to introduce in Poland the standard ammonite zonation of the Bajocian and Bathonian, and especially to include into the Bathonian Stage the ammonite zones (or their counterparts) that were previously placed in the Upper Kuyavian. The standard ammonite zonation of the uppermost Bajocian and Lower Bathonian is also accepted in the present paper (Text-fig. 3), and the boundary between the two stages is put at the boundary between the Bomfordi Subzone of the Parkinsoni Zone, and the Convergens Subzone of the Zigzag Zone.

Ammonite succession in the sections studied

The oldest deposits exposed in the "Alina" brick-pit yielded *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY), *Parkinsonia* (*Durotrigensia*) *pseudoferruginea* NICOLESCO and *Cadomites* (*Cadomites*) *deslongchampsi* (DEFRANCE). The occurrence of these two forms of the genus *Parkinsonia* (Pl. 1, Fig. 4; Pl. 3, Figs 2, 3) is indicative of the Parkinsoni Subzone = "Densicosta" Subzone, which represents the middle part of the Parkinsoni Zone of the uppermost Bajocian (see PAVIA 1971, CALLOMON & *al*. 1987, RIOULT & *al.* 1997). As indicated by CALLOMON & *al*. (1987, p. 16), the lectotype of the subzonal index of the Densicosta Subzone does not belong (*cf.* PAVIA 1971, p. 122) to the genus *Parkinsonia*, but to the genus *Garantiana*, and consequently the use of this species as a subzonal index within the Parkinsonia Zone should be avoided. The occurrence of *Cadomites deslongchampsi* (Pl. 7, Fig. 1) is of lesser biostratigraphical importance, as this species is known to occur in both the Upper Bajocian and Lower Bathonian (see GALACZ 1980, SANDOVAL 1983). The deposits may be assigned to the Parkinsoni Zone of Polish usage (see *e.g.* RÓŻYCKI 1953, DAYCZAK-CALIKOWSKA 1988, KOPIK 1998), which corresponds approximately to the middle part of the standard Parkinsoni Zone.

Still higher, in the lower and middle parts of Anioł's brick-pit section, from about 2 m, up to about 8.5 m

above its base, the only known form is *Parkinsonia* (*Parkinsonia*) aff. *dorni* ARKELL (Pl. 4, Figs 1, 3, 5). The same form is recognised in strictly coeval beds in the lowermost part of the "Sowa" brick-pit section (Pl. 4, Figs 2, 4). This form seems very close to the species *Parkinsonia* (*Parkinsonia*) *dorni* ARKELL, which, however, is poorly known due to the incompletely preserved type-material (see also remarks in the palaeontological part of the paper). The precise biostratigraphical position of *P. dorni* in southern Germany, whence all of the previously illustrated specimens have come, is unknown, but it is well above the range of *Parkinsonia parkinsoni* (SOWERBY) and below the appearance of the *Parkinsonia* ("*Oraniceras*") *wuerttembergica* group: it possibly lies in the Upper Bajocian (DORN 1927, p. 232; HAHN 1970, DIETL & *al*. 1978, p. 12). On the other hand, the close similarity of the specimens recognised here as *Parkinsonia* aff. *dorni* ARKELL to *Parkinsonia complanata* NICOLESCO and to some *Parkinsonia* cf. *bomfordi* ARKELL of ZANY & *al*. (1995; see also the palaeontological description of *P.* aff. *dorni* in the present paper) also suggests that the level of occurrence of the species in ques-

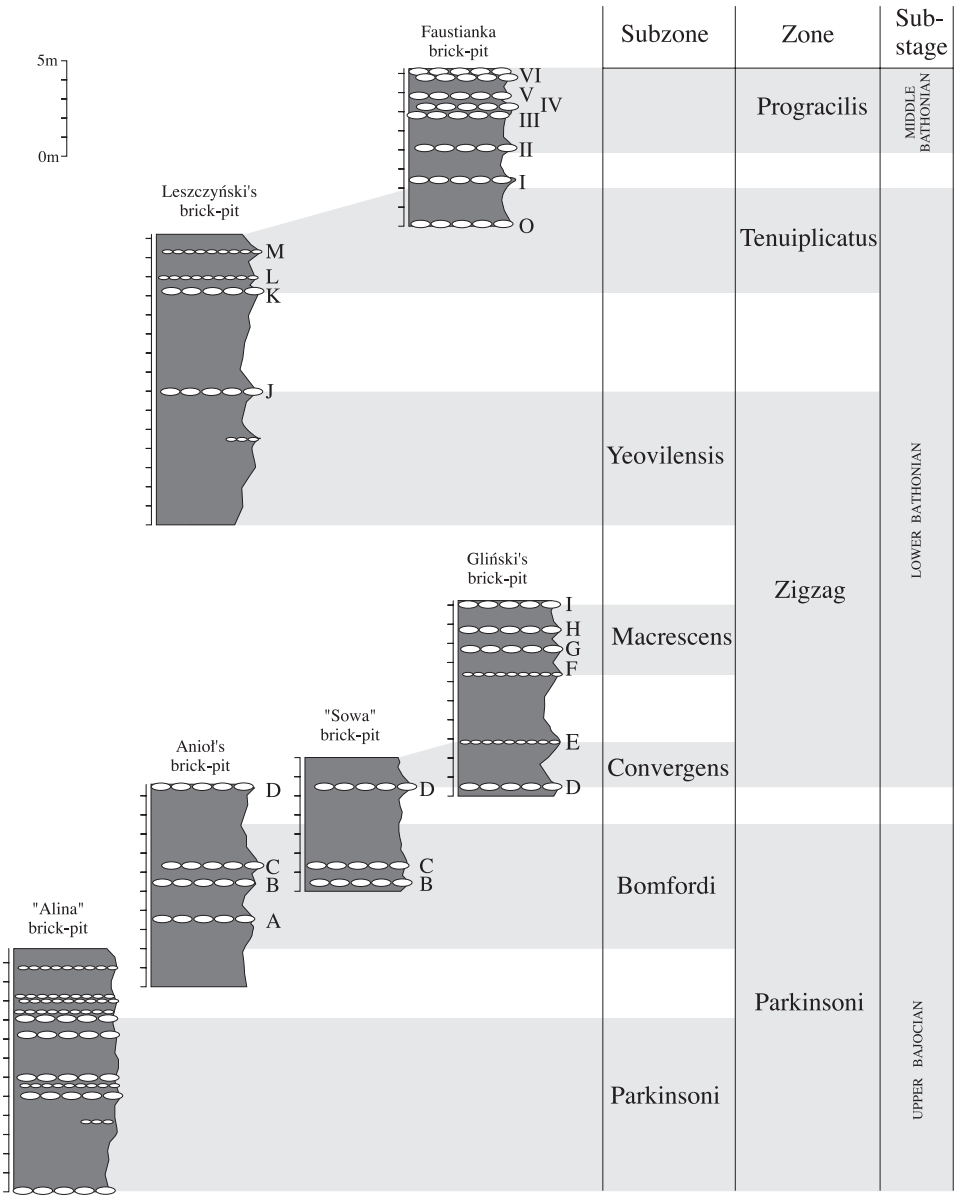


Fig. 3. Biostratigraphical interpretation of the sections studied in the Częstochowa and Wieluń areas; white stripes indicate an unexposed part of the succession and those parts that are poorly documented biostratigraphically

tion lies in the uppermost Bajocian Bomfordi Subzone of the Parkinsoni Zone (*cf.* ZANY & *al.* 1995, RIOULT & *al.* 1997). It should also be noted that the specimens referred to as "*Parkinsonia ferruginea* OPP. var. *dorni"* by RÓŻYCKI (1955) and compared by him with type specimens of *Parkinsonia dorni,* were reported from the upper part of his Parkinsoni Zone, *i.e.* still from the Upper Bajocian. The occurrence of a large specimen (Pl. 5, Figs 1, 2) of *Parkinsonia* (*Durotrigensia*) *bomfordi* ARKELL in somewhat younger beds of the succession studied – around ironstone levels *C* or *D* in the "Sowa" brick-pit and near the level of appearance of the first representatives of the subgenus *Gonolkites* – *Parkinsonia* (*Gonolkites*) *subgaleata* (BUCKMAN) – can be interpreted as indicative of the top of the Bomfordi Subzone, *i.e.* the top of the Bajocian (cf. RIOULT & *al.* 1997).

The species *P.* (*G.*) *subgaleata* characterises ironstone level *D* and the directly overlying clays in both Anioł's brick-pit and the "Sowa" brick-pit (Pl. 2, Fig. 4; Pl. 6, Fig. 2), whereas the specimen of the corresponding microconch – *Parkinsonia* (*Parkinsonia*) *schloenbachi* SCHLIPPE – possibly comes from the slightly higher ironstone level *E* in Gliński's brick-pit (Pl. 3, Fig. 1; see also Text-fig. 3). These ammonites are already indicative of the lowermost Bathonian – the Convergens Subzone of the Zigzag Zone (ARKELL 1951, 1956; STURANI 1966, MANGOLD & RIOULT 1997). The boundary of the Bajocian and Bathonian should therefore be placed close to ironstone level *D* in the sections studied (see Text-fig. 3). The Schloenbachi Zone as used in Poland (see *e.g.* RÓŻYCKI 1953, DAYCZAK-CALIKOWSKA 1988) should, according to the stratigraphical range of the species (RIOULT & *al.* 1997, MANGOLD & RIOULT 1997), be correlated approximately with the Bomfordi Subzone of the Parkinsoni Zone and the Convergens Subzone of the Zigzag Zone, *i.e.* with the uppermost Bajocian and lowermost Bathonian of the standard scheme.

The younger part of the succession studied includes ironstone levels *F-I* in Gliński's brick-pit. The ironstones yielded several involute representatives of the genus *Parkinsonia* – such as *Parkinsonia* ("*Oraniceras*") sp., as well as *Parkinsonia* ("*Oraniceras*") *gyrumbilica* (QUENSTEDT), associated with *Procerites* cf. *stephanovi* HAHN, as reported by POTOCKI (1972). The occurrence of these ammonites of the genus *Parkinsonia* is indicative of the Macrescens Subzone of the Zigzag Zone (see STURANI 1966, HAHN 1970). However, the occurrence of a single large, incomplete specimen of "*Procerites* cf. *stephanovi*" at the same level is of limited biostratigraphical value. It does not necessarily prove the Yeovilensis Subzone as interpreted by POTOCKI (1972), but it may still indicate the presence of an older part of the Bathonian, as shown *e.g.* by CALLOMON & *al.* (1987), who reported large specimens of *Procerites* in the Convergens and Macrescens subzones in the Sengenthal section of the Franconian Alb.

The unexposed part of the succession directly above the previously discussed ammonite assemblage is about 3-4 m thick and it occupies the area between Gliński's brick-pit and Leszczyński's brick-pit (see Text-fig. 3). These deposits, penetrated by boreholes in the area between Wręczyca and Krzepice, about 10 to 30 km north-west of Częstochowa, yielded ammonites treated as indicative of the "Parkinsonia compressa Zone" (ZNOSKO 1954, DECZKOWSKI 1959). They included:

- the last Parkinsoniidae, referred to as *Parkinsonia* cf. *ferruginea* (OPPEL) and *Parkinsonia* cf. *compressa* (QUENSTEDT) – both names were recognised by HAHN (1970) as synonyms of *Parkinsonia* ("*Oraniceras*") *wuerttembergica* (OPPEL), which is indicative of the Macrescens Subzone,
- Oppeliidae, represented by the species "*Ochetoceras*" *fuscus* (QUENSTEDT) = *Oxycerites* (*Paroecotraustes*) *fuscus* (QUENSTEDT) ranging from the upper Macrescens Subzone to the end of the Lower Bathonian (HAHN 1968),
- Morphoceratidae, represented by *Ebrayiceras* cf. *filicosta* WETZEL occurring in the Zigzag Zone,
- Perisphinctidae, represented by the species *Procerites* (*Siemiradzkia*) *aurigera* (OPPEL) ranging from the upper part of the Macrescens Subzone, at least up to the end of the Lower Bathonian (HAHN 1969, MANGOLD & RIOULT 1997).

The occurrence of all these species is thus indicative of the upper part of the Macrescens Subzone of the Zigzag Zone. The appearance at this level of ammonites of the families Oppeliidae and Morphoceratidae, together with more abundant Perisphinctidae, the latter already known at a somewhat lower stratigraphical level, is an ecological phenomenon that may prove useful in local correlations.

Still younger deposits, without Parkinsoniidae, but yielding abundant, albeit poorly preserved Oppeliidae and *Morphoceras* sp., are the dark grey silty clays exposed in the lower part of Leszczyński's brick-pit section at Kawodrza Górna. They may correspond to the Yeovilensis Subzone of the Zigzag Zone.

The occurrence of abundant specimens of *Asphinctites tenuiplicatus* (BRAUNS) and *Polysphinctites secundus* (WETZEL) is indicative of the Tenuiplicatus Zone, which was first distinguished in the study area by REHBINDER (1913). This zone is recognised in the uppermost part of the section in Leszczyński's brick-pit (from level *K* upwards – see Text-fig. 3), and in the lowermost part of the Faustianka brick-pit section (in level *O*, and in the 2 m of overlying black clays). In the latter section the ammonites in question are associated with fairly common *Oxycerites* (*Oxycerites*) *limosus* (BUCKMAN) and *Oxycerites* (*Limoxyites*) *nivernensis* (DE GROSSOUVRE), as well as rare *Oxycerites* (*Oxycerites*) *seebachi*

(WETZEL), *Oxycerites* (*Paroecotraustes*) *formosus* (ARKELL) and *Wagnericeras fortecostatum* (DE GROSSOUVRE).

Palaeoecological and palaeobiogeographical constraints on the distribution of the ammonite faunas in the succession studied

The uppermost Bajocian and Lower Bathonian ammonite faunas in the succession studied are generally of Submediterranean character, albeit devoid, especially in the lower part of the succession, of many of the groups of ammonites that are typical of the Submediterranean Province itself, and showing different frequencies of occurrence of other groups compared with those in the most classic areas of the province. On the other hand, no single taxon has been recognised in the faunas studied that is not known in the Submediterranean Province. It should be remembered that similar ammonite faunas from England, eastern France and Germany are often distinguished as representing the North-East European Province, also called the Subboreal Province (see *e.g.* MANGOLD & RIOULT 1997). However, this latter name does not seem appropriate for the faunas in question (see *e.g.* DAYCZAK-CALIKOWSKA 1988). The Subboreal Province included the areas inhabited by special groups of ammonites that were generally partly in common with those of the Boreal Province, and totally different from those of the Submediterranean Province, such as the Kosmoceratidae in the Bathonian and Callovian (CALLOMON 1985) and the Aulacostephanidae in the Oxfordian and Kimmeridgian (see *e.g.* BIRKELUND & CALLOMON 1985).

The ammonite faunas of the uppermost Bajocian Parkinsoni Zone and the lowermost Bathonian Convergens Subzone in the succession studied are very monotonous, consisting mostly of successive assemblages of the genus *Parkinsonia*, accompanied by rare *Cadomites* (*cf*. KOPIK 1974, 1998). A change in faunal composition takes place in the Macrescens Subzone, especially in its upper part, where representatives of the Oppeliidae – *Oxycerites* (*Paroecotraustes*), Perisphinctidae – *Procerites* (*Procerites, Siemiradzkia*) and Morphoceratidae – *Ebrayiceras*, appear for the first time.

The appearance of all of these taxa, together with the still existing Parkinsoniidae, in the Early Bathonian Macrescens Subzone was possibly related to a transgression that brought the new groups of ammonites into the formerly partly restricted Polish epicontinental Basin. This was already suggested by ZNOSKO (1954, 1957), who recognised the more diversified composition of the faunas of the Ferruginea & Compressa zones in Poland (corresponding to the Macrescens Subzone according to the scheme used in the present paper), compared with older faunas attributed by him to the Parkinsoni and Schloenbachi zones. This transgression was also revealed by a study of the depositional successions by FELDMAN-OLSZEWSKA (1997, see also older papers cited therein), who distinguished it as the beginning of the J3-III trangressive-regressive cycle in the Middle Jurassic of the Polish epicontinental Basin.

Still higher in the Lower Bathonian succession studied, the ammonite fauna of the Yeovilensis Subzone, although poorly recognised, and devoid of Parkinsoniidae, seems similar to that of the Macrescens Subzone in the abundance of Oppeliidae (as noted in Leszczyński's brick-pit in Częstochowa). The fauna of this subzone is better recognised in the cores from the Bełchatów area, east of Wieluń (KOPIK 1979), where it consists of Oppeliidae – *Oxycerites,* as well as Morphoceratidae – *Polysphinctites* and Perisphinctidae, thus showing a fairly high diversity.

The next major change occurred in the Tenuiplicatus Chron at the end of the Early Bathonian. The two forms of the family Morphoceratidae, *i.e. Asphinctites tenuiplicatus* (BRAUNS*)* and *Polysphinctites secundus* (WETZEL), representing the dimorphic pair, predominate in the ammonite fauna of this age in the succession studied. They occur in profusion at a single level in Leszczyński's brick-pit in Częstochowa, being practically the only ammonites recognised there, except for a rare representative of the Oppeliidae. Farther north-west, in the Faustianka brick-pit near Wieluń, representatives of the *Asphinctites-Polysphinctites* group are still found in large numbers, but with some associated Oppeliidae of the genus *Oxycerites* (*Oxycerites*, *Limoxyites*, *Paroecotraustes*), and even a single representative of the Perisphinctidae (*Wagnericeras*). A similar ammonite assemblage, consisting of *Asphinctites-Polysphinctites*, together with some Oppeliidae (*Oxycerites*), was recognised in cores in the Bełchatów area, east of Wieluń, by KOPIK (1979).

These differences in the ammonite faunas of the Tenuiplicatus Zone between the vicinity of Częstochowa and the Wieluń (Faustianka) and Bełchatów area could possibly be explained in one of two ways:

- by a general change in ammonite faunas from an older fauna, recognised in the vicinity of Częstochowa, to a younger one in the Wieluń area (Faustianka section) – see Text-figs. 3,

- by the original position of the faunas within the basin, with the more peripheral and more central positions showing smaller or larger number of deeper water Oppeliidae respectively.

Nevertheless, the general character of the youngest Early Bathonian ammonite fauna is one of very low

diversity and high density, as shown in the the sections between Częstochowa and Wieluń. The replacement of the older, more diversified fauna of the Macrescens and Yeovilensis Subchrons by this younger impoverished fauna may be attributable to a change in the palaeoenvironment that promoted high endemism and lead to the development of the special *Asphinctites-Polysphinctites* assemblage (*e.g.* BAYER & MCGHEE 1985).

DESCRIPTIONS OF AMMONITES

The collections of ammonites consists of 98 specimens. They are housed in the Museum of Geology, University of Warsaw (collections numbers IGPUW/A/37, IGPUW/A/38). In addition, 33 specimens collected in the brick-pit in Faustianka, and described in the present paper, come from the private collection of Krzysztof Dembicz and Tomasz Praszkier and that of Dr. M. Machalski of the Institute of Palaeobiology, Polish Academy of Sciences.

The following abbreviations are used in the descriptions of the ammonites: D – diameter of specimen in mm, Wh – whorl height as percentages of D, Wt – whorl thickness as percentages of D, Ud – umbilical diameter as percentages of D, PR – number of primary ribs per whorl, SR/PR – ratio of secondary to primary ribs (calculated for 5-10 primary ribs at given diameter).

Family Oppeliidae DOUVILLÉ, 1890
Genus *Oxycerites* ROLLIER, 1909

The genus as treated here includes both the macroconchs – traditionally placed in the subgenus *Oxycerites*, as well as their corresponding microconchs, attributed to the subgenera *Paroecotraustes* SPATH, 1928 and *Limoxyites* WESTERMANN, 1958. Such a classification agrees with the proposals of HAHN & *al.* (1990, p. 36), and differs from the widely accepted opinion according to which all the microconch taxa corresponding to several macroconch genera of the Bajocian and Bathonian Oppeliidae have been placed in the single genus *Oecotraustes* WAAGEN, 1869. In the material studied two groups of corresponding macro- and microconchs are recognised:

1. *Oxycerites* (*Oxycerites*) *limosus* (BUCKMAN) – *Oxycerites* (*Limoxyites*) *nivernensis* (DE GROSSOUVRE), characterised by large size, strongly involute coiling, fine ribbing, and the development of tertiary riblets at the ventral side of the inner whorls; this last feature is seen in the ancestral *Oppelia,* and it is also encountered in the typical *Oecotraustes* (see HAHN & *al.* 1990),

2. *Oxycerites* (*Oxycerites*) *seebachi* (WETZEL) – *Oxycerites* (*Paroecotraustes*) *formosus* (ARKELL), characterised by fairly small size, moderately involute coiling, strong, rursiradiate ribbing in the ventrolateral part of the whorls, and the general absence of tertiary riblets.

Oxycerites (*Oxycerites*) *limosus* (BUCKMAN)
(Pl. 1, Figs 2, 3)

1951. *Oppelia* (*Oxycerites*) *limosa* (BUCKMAN); ARKELL, pp. 60-61, Pl. 5, Figs 7ab (holotype) and 8ab.

1968. *Oxycerites limosus* (BUCKMAN); HAHN, pp. 33-36, Text-figs 6b-d and 7e; Pl. 2, Fig. 7; Pl. 5, Fig. 8, with given synonymy.

MATERIAL: Five specimens attaining about 110-160 mm in diameter. The specimens are septate to 70-125 mm, with their body chambers occupying two-thirds of the last whorl; the aperture is only incompletely preserved.

DESCRIPTION: The coiling is strongly involute: Wh = 58-61%, and Ud = 7-10%, at D = 75-130 mm, corresponding to the initial part of the body chamber. The ribbing is generally fine; on the innermost whorls the ribs are falcate with strongly prorsiradiate tertiary riblets at the venter; on the middle and outer whorls the ribbing becomes very weak on the inner, and much more stronger on the outer part of the whorls, well above the distinctly raised spiral band, and the tertiary riblets almost completely disappear. At the end of the last whorl the ribbing consists of faint falcate riblets on the flank.

The whorl section of the phragmocone is lanceolate with a raised keel bordered by the narrow ventrolateral edges; the venter becomes gradually rounded on the body chamber.

OCCURRENCE: Faustianka brick-pit, level *O*.

Oxycerites (*Limoxyites*) *nivernensis* (DE GROSSOUVRE)
(Pl. 1, Fig. 1)

1919. *Oppelia nivernensis* DE GROSSOUVRE; DE GROSSOUVRE, p. 407, Pl. 14, Fig. 1ab (holotype).

1958. *Oxycerites* (*Limoxyites*) *nivernensis* (DE GROSSOUVRE); WESTERMANN, p. 46, Pl. 9, Figs 2-4; Pl. 10, Fig. 1, ?2.

1968. *Oecotraustes* (*Oecotraustes*) *nivernensis* (DE GROSSOUVRE); HAHN, pp. 41-43, Text-fig. 8ab; Pl. 3, Figs 7-9, with given synonymy.

MATERIAL: Four fully grown specimens about 70-75 mm in diameter. Specimens are septate to about 45 mm, with the body chamber two-thirds of a whorl long. The final aperture is nowhere completely preserved; only one specimen shows the sinous final constriction.

DESCRIPTION: The coiling is strongly involute: Wh = 52.3-54.5%, and Ud = 10-11.8%, at the end of phragmocone. The ribbing is generally fine on the inner whorls, but becomes more differentiated on the outer whorl, where it consists of fine prorsiradiate riblets on the inner part of the whorl, and much stronger rursiradiate concave ribs (sometimes composed of riblet sets) on the outer part of the whorl; the raised spiral band occurs about mid-flank. The fine riblets become strongly sinuously bent close to the aperture, which suggest the presence of lappets.

The whorl section at the end of phragmocone and beginning of the body chamber is lanceolate, with a raised keel bordered by narrow and poorly marked ventrolateral edges; the venter becomes more rounded towards the aperture.

REMARKS: This species is very similar to *Oxycerites limosus,* differing mostly in smaller size, and the aperture possessing lappets. The two species are consequently treated as corresponding micro and macroconchs (HAHN 1968, p. 40).

OCCURRENCE: Faustianka brick-pit, level *O*.

Oxycerites (*Oxycerites*) *seebachi* (WETZEL)
(Pl. 2, Figs 2, 3)

1958. *Oxycerites* (*Pleuroxyites*) *seebachi* (WETZEL); WESTERMANN, p. 49, Pl. 10, Figs 5ab (holotype).
1968. *Oxycerites seebachi* (WETZEL); HAHN, pp. 37-39, Text-fig. 7d; Pl. 2, Figs 5-6, with given synonymy.

MATERIAL: Two specimens, about 45-50 mm in diameter, septate till 30-35 mm diameter, and with the body chamber occupying about half a whorl.

DESCRIPTION: The coiling is moderately involute on the last part of the phragmocone (Ud = 17-22%), but it becomes more involute from the phragmocone/body chamber boundary (Ud = 15-17%). The ornamentation consists of falcate ribs which are fairly strong, especially on the outer part of whorls. On the phragmocone the strongly prorsiradiate primary ribs are represented by sets of fine riblets; such primaries split about mid-flank into 2-3 markedly rursiradiate, strong secondaries. On the body chamber the ribs become fainter: the secondary ribs are more concave and less inclined backward, whereas the primary ribs gradually disappear, being replaced by feeble striae at the end of the shell.

The whorl section is compressed, with slightly convex flanks, and very narrow lanceolate venter. Very fine, strongly prorsiradiate riblets are developed at the prolongation of secondary ribs on the venter.

OCCURRENCE: Faustianka brick-pit, level *O*.

Oxycerites (*Paroecotraustes*) *formosus* (ARKELL)
(Pl. 2, Fig. 1)

1951. *Oecotraustes* (*Paroecotraustes*) *formosus* ARKELL; ARKELL, pp. 71-72, Text-figs 18.2 (holotype), and 18.3 (paratype); Pl. 7, Figs 8-10.
1968. *Oecotraustes* (*Paroecotraustes*) *formosus* ARKELL; HAHN, pp. 56-57, Text-fig. 9d; Pl. 4, Figs 7-9, with given synonymy.

MATERIAL: A single specimen, 17 mm in diameter. It is septate to 12 mm with the preserved part of the body chamber about half a whorl long.

DESCRIPTION: The coiling is moderately involute: Wh = 48%, and Ud = 31.2%, at the end of phragmocone. The ribs are falcate on the outer whorl; they consist of rather faint and markedly prorsiradiate primaries which split about mid-flank into two fairly strong, concave, slightly rursiradiate secondaries . The number of primaries per half whorl equals 12, whereas that of secondaries is about 22 at D = 15 mm. The spiral groove on the outer whorl is fairly conspicuous; the fine riblets crossing the spiral groove at the end of the body chamber are strongly sinuously bent towards the aperture, which indicates the presence of lappets.

The whorl section at the end of the phragmocone – beginning of body chamber is lanceolate, with a raised keel.

REMARKS: Although small and incomplete, the specimen in question agrees well with specimens attributed to *O. formosus* by HAHN (1968). This species is very similar to *O.* (*Paroecotraustes*) *fuscus* (QUENSTEDT), which differs mostly in the more strongly developed primary ribs. It seems, however, that these differences are of low taxonomic rank, *i.e.* of subspecific rather than specific character (SCHLEGELMILCH 1985). The dimorphic relation between *O.* (*P.*) *fuscus* (QUENSTEDT) and *O.* (*P.*) *seebachi* (WETZEL) was indicated by HAHN (1968, p. 40).

OCCURRENCE: Faustianka brick-pit, level *O*.

Family Stephanoceratidae NEUMAYR, 1875
Genus *Cadomites* MUNIER-CHALMAS, 1892

Cadomites (*Cadomites) deslongchampsi* (DEFRANCE)
(Pl. 7, Fig. 1)

1983. *Cadomites* (*Cadomites*) *deslongchampsi* (DEFRANCE in D'ORBIGNY); SANDOVAL, pp.269-272, Text-figs 101B, 102A; Pl. 18, Fig. 2; Pl. 21, Fig. 8, with given synonymy.
1994. *Cadomites deslongchampsi* (DEFRANCE); RIOULT, MANGOLD & GAUTHIER, pp. 125-126, Pl. 46, Fig.1a-c (holotype); Pl. 46, Fig. 2a-b.

MATERIAL: A single, fully grown specimen, 105 mm in diameter, with collared peristome preserved.

DESCRIPTION: The specimen is septate to 73 mm, with the body chamber occupying half a whorl. The coiling of the phragmocone is evolute (Wh = 35.4% and Ud = 37%, at the end of phragmocone – at D = 65 mm); it becomes even more evolute on the body chamber (Wh = 33.2% and Ud = 39.8% at D = 98 mm). The ribbing is fairly dense (45-50 PR on the last whorl). It consists of almost rectiradiate primary ribs which become somewhat prorsiradiate and concave at the end of the body chamber; the primaries split into 2-3 secondary ribs about mid-flank, but some free secondary ribs also occur in the upper part of the flank : the secondary/primary rib ratio equals 3.0 at D=85 mm, and 2.7 at D=95 mm; the secondary ribs are always slightly prorsiradiate. The points of division of the ribs are marked by distinct tubercles. The whorl section is depressed and coronate, with flattened flanks and a broadly arched venter. The whorl thickness attains smaller values on the body chamber (Wt=43% at D = 93 mm) than on the phragmocone (Wt = 54.3% at D = 70 mm).

REMARKS: When compared with the holotype, the phragmocone of the specimen studied shows a somewhat slender whorl section; however, this is comparable with that of some other specimens attributed to this species (*e.g.* GALACZ 1980, SANDOVAL 1983).

OCCURRENCE: Gnaszyn Górny, "Alina" brick-pit; loose.

Family Parkinsoniidae BUCKMAN, 1920
Genus *Parkinsonia* BAYLE, 1878

REMARKS: The following subgenera: *Parkinsonia* BAYLE, 1878, *Durotrigensia* BUCKMAN, 1928 and *Gonolkites* BUCKMAN, 1925 are recognised in the collection studied; the youngest, strongly involute representatives of this genus, traditionally attributed to the subgenus *Oraniceras* FLAMAND, 1911, are poorly represented in the collection and hence are not discussed in this chapter.

The subgenus *Parkinsonia* includes isocostate forms which sometimes, especially in medium-sized specimens up to 150 mm diameter, show the aperture with small lappets; these specimens have been interpreted as the typical microconchs (see *e.g.* GALACZ 1980, RIOULT & *al.* 1994, PAVIA 1994). This has been the case with the following specimens: *Parkinsonia subarietis* WETZEL illustrated by WETZEL (1911, Pl. 15, Fig. 1), *Parkinsonia rarecostata* (BUCKMAN) illustrated by D'ORBIGNY (1842-1851, Pl. 122, Fig. 1) as " *Ammonites parkinsoni* Sow. "(see also RIOULT & *al.* 1994, Pl. 48, Fig. 4a), *Parkinsonia* (*Parkinsonia*) *complanata* NICOLESCO, and *Parkinsonia* (*Parkinsonia*) cf. *bomfordi* ARKELL – both specimens illustrated by ZANY & *al*. (1995, Pl. 1, Fig. 2; Pl. 2, Fig. 1), as well as *Parkinsonia* (*Parkinsonia*) sp. (m.) illustrated by PAVIA (1994, Pl. 3, Figs 1 – 2); the small lappets can also be observed in the specimen of *Parkinsonia* (*Parkinsonia*) *schloenbachi* SCHLIPPE shown in Pl. 3, Fig. 1 of the present paper. The status of other forms where the lappets are not known became somewhat unclear (see HAHN 1970, GALACZ 1980). It is highly probable, however, that even the absence of lappets, especially in larger specimens of the subgenus *Parkinsonia*, does not preclude the interpretation of these forms as microconchs. Such an opinion is supported by, for example, the case of the Middle Oxfordian representatives of the genus *Perisphinctes*, where the observed disappearance of lappets in the single lineage strictly corresponds to the increasing end-size of the microconchs, which takes place at diameters of 180-200 mm (BROCHWICZ-LEWIŃSKI & RÓŻAK 1975). It seems thus highly probable that all of the isocostate representatives of the genus *Parkinsonia* should be treated as microconchs.

The variocostate representatives of the genus *Parkinsonia* occur in the same beds as the isocostate forms, usually attaining much larger sizes: those of the uppermost Bajocian and lowermost Bathonian are distinguished as the subgenera *Durotrigensia* and *Gonolkites* respectively. The two subgenera represent the macroconchs.

In the studied sections of the uppermost Bajocian and the lowermost Bathonian the following succession of representatives of the subgenus *Parkinsonia* (microconchs), and the subgenera *Durotrigensia* and *Gonolkites* (macroconchs) is recognized, in ascending order:

P. (*Parkinsonia*) *parkinsoni* (SOWERBY) – *P.* (*Durotrigensia*) *pseudoferruginea* NICOLESCO,
P. (*Parkinsonia*) aff. *dorni* ARKELL – ?
P. (*Parkinsonia*) *schloenbachi* SCHLIPPE – *P.* (*Durotrigensia*) *bomfordi* ARKELL
P. (*Parkinsonia*) *schloenbachi* SCHLIPPE – *P.* (*Gonolkites*) *subgaleata* (BUCKMAN).

Palaeontological descriptions of the particular segments of this succession that possibly represent the same lineage are given below. The general evolutionary changes include the development of the forward projection of the ribbing, as well as the accentuation and lowering of the point of division of the ribs in microconchs; on the other hand, the development of blunter ribbing, and its earlier fading is observed in the macroconchs.

Parkinsonia (*Parkinsonia*) *parkinsoni* (SOWERBY)
(Pl. 3, Figs 2, 3)

1956. *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY); ARKELL, pp. 143-144, Text-fig.53 (lectotype).
1980. *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY); GALACZ, pp. 93-95, Pl. 20, Fig. 5; Text-figs 73-74, with given synonymy.
1998. *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY); KOPIK, Pl. 5, Fig. 2.

MATERIAL: Three specimens consisting of phragmocones with body chamber preserved (length of body chamber from 4/5 to 6/7 of the last whorl), another phragmocone and a few fragments, mostly of body chambers.

DESCRIPTION: Two specimens are adult (Pl. 3, Fig. 3): their maximum diameters are 185 mm and 160 mm respectively. They show periapertural modifications of the ribbing at the end of the last whorl, such as the crowding of the last few ribs after the terminal constriction (especially well seen in the larger specimen), and the development of more massive ribs at the ventral side. The lappets are nowhere observed and it may be seriously doubted if they ever existed. The third fairly complete specimen (Pl. 3, Fig. 2), about 120 mm in diameter, does not show any modifications of ribbing at the end of the shell, and it is possibly not fully grown.

The coiling is moderately evolute at smaller diameters, becoming much more evolute at larger diameters in the body chambers of the adult specimens (at D = 150 mm, Ud = 48-52%). The ribbing is sharp, somewhat concave, projected, mostly biplicate, but with some simple ribs; the number of primary ribs per whorl gradually increases with growing diameter (from PR = 34-39 at D = 30-50 mm, through PR = 40-50 at D = 90 mm, to PR = 60-65 at D = 160-185 mm).

The whorl section is compressed (Wt = 25-30% at D = 100-130 mm), with somewhat flattened flanks , and with the rounded ventrolateral sides of the whorl passing into a narrow venter.

REMARKS: All of the specimens studied represent a homogenous assemblage from the same locality. The species *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY) may be treated as the microconch, of which the macroconch counterpart could be *Parkinsonia* (*Durotrigensia*) *pseudoferruginea* NICOLESCO.

OCCURRENCE: Gnaszyn Górny, "Alina" brick-pit, level of large nodules at the base of the section, and loose.

Parkinsonia (*Durotrigensia*) *pseudoferruginea* NICOLESCO
(Pl. 1, Fig. 4)

1928. *Parkinsonia parkinsoni* Sow. var. *pseudoferruginea* n. var.; NICOLESCO, pp. 37-39, Pl. 9, Fig. 3 (holotype).
1994. *Parkinsonia* [M.] *pesudoferruginea* NICOLESCO; PAVIA, Pl. 2, Fig. 2.

MATERIAL: One large, incomplete specimen about 210 mm in diameter, consisting of the phragmocone (which includes the penultimate whorl), and a body chamber including a half of the last whorl preserved; the boundary between the phragmocone and the body chamber lies somewhere in the missing part of the last whorl (between 120 mm and 160 mm diameter).

DESCRIPTION: The coiling of the inner whorls is moderately evolute; it becomes much more evolute at the largest diameter (at D = 210 mm, Ud = 48%). The ribbing of the inner whorls is sharp, projected, consisting of biplicate ribs with some single ribs; the number of primary ribs gradually increases from PR = 38, at D = 45 mm, to PR = about 50, at D = 110 mm.; at about 120 mm the primary ribs become thicker; on the preserved part of the last whorl the ribbing is reduced to faint umbilical swellings; there are numerous secondary ribs on the ventrolateral and ventral sides**,** whereas the rest of the whorl becomes smooth.

REMARKS: The specimen strongly resembles the only two so far known large specimens of this species (see synonymy) which attain diameters of about 200 mm. The characteristic features of all these specimens indicate their affinity to the subgenus *Durotrigensia.*

The species *Parkinsonia* (*Durotrigensia*) *neuffensis* (OPPEL) is a giant form, akin to *P. pesudoferruginea,* but still poorly known. Its holotype is a fragment of septate whorl about 85 mm in height, mostly smooth except the ventrolateral side, where the numerous secondary ribs are clearly visible (see *e.g.* SCHLEGELMILCH 1985, Pl. 34, Fig. 4). This type of ornamentation is similar to that

observed on the outer whorl of the present specimen (see Pl. 1, Fig. 4). In fact, STURANI (1966) actually treated *P. pseudoferruginea* NICOLESCO as a possible junior synonym of *P. neuffensis* (OPPEL). However, until the latter species is better understood, it is preferable to use the name *P. pseudoferruginea* for the specimen described here.

OCCURRENCE: Gnaszyn Górny, "Alina" brick-pit, loose.

Parkinsonia (*Parkinsonia*) aff. *dorni* ARKELL
(Pl. 4, Figs 1-5)

aff. 1927. *Parkinsonia ferruginea* (OPPEL); DORN, pp.231-232, Text-fig. 4; Pl. 4, Figs 5, 6ab (type specimens).
aff. 1951. *Parkinsonia dorni* sp. nov.; ARKELL, p. 9.
aff. 1956. *Parkinsonia* (*Parkinsonia*) *dorni* ARKELL; ARKELL, Text-fig. 56 (type specimens refigured).
aff. 1970. *Parkinsonia* (*Parkinsonia*) *dorni* ARKELL; HAHN, Pl. 4, Figs 4-5 (type specimens photographed).
aff. 1978. *Parkinsonia dorni* ARKELL; DIETL & *al*., Text-fig. 4ab.

TYPES: The two specimens illustrated as *P. ferruginea* by DORN (1927, Pl. 4, Fig. 5-6), were subsequently designated as type specimens of the new species *P. dorni* by ARKELL (1951); they are small, about 50 mm in diameter, consisting of phragmocones with some parts of the body chambers preserved. The final size reached by specimens of this species is unknown but, in any case, it must be larger than 50 mm; the probable signs of a still younger whorl visible in the photograph of one of the type specimens (HAHN 1970, Pl. 4, Fig. 5) suggest that it had attained a diameter of at least about 70 mm. According to HAHN (1970, p. 31) *Parkinsonia dorni* is possibly a microconch species belonging to the *P. parkinsoni* group.

MATERIAL: Five specimens of different sizes, from about 40 mm to about 130 mm in diameter The two largest specimens (Pl. 4, Figs 1, 5), 130 mm and 115 mm in diameter, are septate up to about 85-90 mm and preserve the body chambers; in the larger specimen the body chamber is possibly complete and comprises about three/quarter of a whorl; in the smaller specimen the preserved part of the body chamber is half a whorl long. Another two specimens (Pl. 4, Figs 3, 4) have diameters of about 70 mm and 80 mm; the smaller one comprises the phragmocone, with a body chamber nearly one whorl long, whereas the larger one comprises the entire phragmocone and an initial part of the body chamber. The smallest specimen, 42 mm in diameter, is wholly septate (Pl. 4, Fig. 2) and shows signs of a still younger whorl that was not preserved.

DESCRIPTION: The coiling of the inner whorls is usually moderately evolute (Ud = 44%, at D = 40-50 mm), but sometimes also strongly evolute (Pl. 4, Fig. 1 where Ud = 52.5%, at D = 40 mm). At larger diameters, on the body chamber, the coiling is always moderately evolute (Ud = 42-44%, at D = 80-125 mm).

The ribbing is sharp, the primary ribs are more or less distinctly prorsiradiate and almost straight, whereas the secondary ribs are markedly projected; this results in some twisting of the ribs at the point where they divide. The point of rib-division is always accentuated, with small tubercles developed on the phragmocone and initial part of the body chamber up to diameters of about 80-100 mm. The ribbing is biplicate, with numerous single ribs. The number of primary ribs per whorl increases gradually, from PR = about 30, at D = 20 mm, through PR = 36-46. at D = 60 mm, to PR = 48-49, at D = 120-130 mm.

The whorl section of the inner whorls is subquadrate, that of the outer whorl becomes high, somewhat trapezoidal, with flattened lateral and ventral sides. The groove on the venter is well incised.

REMARKS: The specimens in the collection studied seem very similar to German material of *Parkinsonia dorni*. However, our specimens are mostly larger and thus show a development of ornamentation which cannot be compared with the original specimens of *P. dorni.* In these circumstances, the specific position of the specimens studied cannot be unequivocally resolved until larger specimens are available from the type level of *P. dorni.*

The specimens of *P.* aff. *dorni* differ from those of *Parkinsonia parkinsoni* (SOWERBY), occurring in somewhat older beds, in the type of ribbing. In *P.* aff. *dorni* the ribs comprise prorsiradiate, almost straight primaries and markedly projected secondaries, whereas in *P. parkinsoni* the general shape of the ribs is more concave and the primaries are less prorsiradiate. Moreover, in *P.* aff. *dorni* the whorl section is more trapezoidal, and the point of rib-division is markedly accentuated with small tubercles that are visible up to large diameters. Apart from these differences, the two species are generally similar, representing fragments of the same smoothly evolving lineage of the genus *Parkinsonia.*

In the style of ribbing, the studied specimens of *P.* aff. *dorni* resemble the microconch referred to as *Parkinsonia* (*Parkinsonia*) cf. *bomfordi* ARKELL by ZANY & *al*. (1995, Pl. 2, Fig. 1), but whether or not this latter specimen belongs to the same species as the former specimens needs further study. The resemblance of the specimens of *P.* aff. *dorni* to *Parkinsonia complanata* NICOLESCO is also considerable. The holotype of the latter species (see NICOLESCO 1928, Pl. 12, Fig. 2ab) is only

about 60 mm in diameter, but it shows signs of a still younger, not preserved whorl, which indicates that it had been at least 80 mm in diameter; in the type of ribbing, and strongly evolute coiling the holotype is very similar to specimens (Pl. 4, Fig. 1) assigned to *P.* aff. *dorni*. It should be remembered, however, that the paratype of *P. complanata* is a large macroconch (see NICOLESCO 1928, Pl. 12, Fig. 3) of the *Durotrigensia* type; a very similar specimen was illustrated recently by PAVIA (1994, Pl. 2, Fig. 1) and referred to as *Parkinsonia* [*M.*] *complanata* NICOLESCO. These specimens could potentially represent the macroconchs of the group of *Parkinsonia dorni* under discussion.

OCCURRENCE: Kawodrza Górna, Anioł's and "Sowa" brick-pits; about 1.4 m below the ironstone level *A*, level *A* and about 2 m above level *C*.

Parkinsonia (*Durotrigensia*) *bomfordi* ARKELL
(Pl. 5, Figs 1, 2)

1956. *Parkinsonia* (*Parkinsonia*) *bomfordi* sp. nov.; ARKELL, p. 157, Text-fig. 55, 3ab (holotype).
1971. *Parkinsonia* (*Parkinsonia*) *bomfordi* ARKELL; PAVIA, pp. 120-121, Pl. 22, Fig. 2, with given synonymy.

MATERIAL: One large, incomplete specimen about 340 mm in diameter, mostly septate (up to about 300 mm), and with a fragment of the body chamber occupying about one-third of a whorl.

DESCRIPTION: The inner and middle whorls are moderately evolute (Wh = 35% and Ud = 40%, at D = 120 mm; Wh = 37.5% and Ud = 42.5%, at D = 160 mm), but on the last one and a half whorls the coiling becomes involute (Wh is about 40%, and Ud is about 32%, at D = 210 mm).

The ribbing of the inner whorls consists of sharp, strongly prorsiradiate, fairly numerous biplicate ribs; the point of division lies about mid-flank and is accentuated with a small tubercle. There are about 33 primary ribs at D = 120 mm. At about D = 160 mm, the primary ribs still exist although they become somewhat weaker at the point where they divide while remaining swollen at the umbilicus. The younger part of the penultimate whorl, up to 210 mm diameter, is poorly preserved, showing only the primary ribs at the umbilicus, which gradually die out; the ventral side of the whorl is not visible, consequently the character of the secondary ribs is unknown. The half of the outer whorl preserved is completely smooth. The whorl section is oval.

REMARKS: This specimen differs from the specimens attributed to *Parkinsonia* (*Gonolkites*) *subgaleata* (BUCKMAN) and found in the same brick-pits in the sharper ribbing of the inner and middle whorls, as well as in the persistence of primary ribs up to a larger diameter. These features are typical of the holotype of *Parkinsonia bomfordi* ARKELL, as illustrated by ARKELL (1956, p. 157, Text-fig. 55 – 3ab), who treated this form as an ancestral *Gonolkites*; the holotype is about 100 mm in diameter and shows evolute coiling throughout (Wh = 36% and Ud = 40% at D = 100 mm; see SCHLEGELMILCH 1985). The inner and middle whorls of the specimen studied are very similar in coiling and type of ribbing, to the holotype of *P. bomfordi.* The involute, and partly smooth outer whorl of the specimen studied has no counterparts (see *e.g.* PAVIA 1971) among most of the specimens so far attributed to the species *P. bomfordi*, apart from a single specimen interpreted by ARKELL (1956, p. 162, Text-fig. 58-right) as "*Parkinsonia* (*Durotrigensia* ?) cf. *crassa* NICOLESCO" which, according to STURANI (1966, p. 31) may be placed into synonymy of *Parkinsonia bomfordi* ARKELL. It is a large specimen, about 235 mm in diameter, generally similar to the specimen studied, although undoubtedly with a more evolute outer whorl.

OCCURRENCE: Kawodrza Górna, "Sowa" brick-pit, without precise location – somewhere around levels *C* and *D*.

Parkinsonia (*Gonolkites*) *subgaleata* (BUCKMAN)
(Pl. 2, Fig. 4; Pl. 6, Fig. 2)

1956. *Parkinsonia* (*Gonolkites*) *subgaleata* (BUCKMAN); ARKELL, pp. 156-160, Text-figs 57.1 and 58-left (holotype); Pl. 18, fig. 7; Pl. 19, Figs 3-4.
1966. *Parkinsonia* (*Gonolkites*) *subgaleata* (BUCKMAN); STURANI, p. 34, Pl. 6, Fig. 6; Pl. 7, Fig. 5; Pl. 8, Fig. 1ab and 4, with synonymy.

MATERIAL: Two large, but poorly preserved and incomplete specimens: the larger one (Pl. 6, Fig. 2), 380 mm in diameter, is septate to 280 mm, and shows the body chamber, which occupies about three-quarters of a whorl; the smaller one (Pl. 2, Fig. 4), about 250 mm in diameter, is almost wholly septate, but signs of a still younger whorl, which is not preserved, indicate that the body chamber had been about six-sevenths of a whorl long, and that the maximum diameter attained by the specimens had reached about 300 mm.

DESCRIPTION: The coiling of the innermost whorls is evolute, becoming very weakly evolute or slightly involute in the middle and outer whorls (in the smaller specimen illustrated in Pl. 2, Fig. 4, Wh = 36.9%, and Ud = 35.4%,

at D = 195 mm; in the larger specimen illustrated in Pl. 6, Fig. 2, Wh = 33.3%, and Ud = 38.8%, at D = 180 mm).

The ribbing of the innermost whorls is partly visible in the smaller specimen only: it consists of strong, markedly prorsiradiate, fairly numerous primary ribs: PR = 31, at D = 25 mm; PR = 38, at D = 40 mm. In the middle whorls, the ribs become blunt and more sparsely placed; at about 110 mm diameter (in the smaller specimen) the ribbing begins to fade at mid-flank, and at about 150-160 mm in both specimens the primaries die out. There then exist only the secondary ribs high on the whorl-side, which are gradually reduced to vestigial form, and completely disappear at the end of the phragmocone, at about 200-230 mm. The last whorl, comprising the final part of the phragmocone and the body chamber, is completely smooth.

The whorl section is mostly difficult to interpret due to partial flattening of the specimens. The undeformed parts of the phragmocone and the body chamber generally show a high-oval whorl section with fairly wide venter.

DISCUSSION: Although poorly preserved, the specimens studied agree closely with the holotype of *Parkinsonia* (*Gonolkites*) *subgaleata* and with the other specimens referred to that species. As pointed out by ARKELL (1956) and STURANI (1966), several features enable the differentiation of *P. subgaleata* from the closely related *Parkinsonia* (*Gonolkites*) *convergens* (BUCKMAN); most of these features, such as the bigger size, the wider whorl section, the more evolute coiling, and the longer persistence of the primary ribs (up to 150-160 mm diameter) may also be observed in the specimens studied.

OCCURRENCE: Kawodrza Górna, Anioł's and "Sowa" brick-pits; level *D*, and 0.85 m above.

Parkinsonia (*Parkinsonia*) *schloenbachi* SCHLIPPE
(Pl. 3, Fig. 1)

1888. *Parkinsonia schloenbachi* nov. sp.; SCHLIPPE, pp. 210-211, Pl. 4, Fig. 4 (lectotype).
1966. *Parkinsonia schloenbachi* SCHLIPPE; STURANI, pp. 30-31, Pl. 7, Fig. 1ab, with given synonymy.
1998. *Parkinsonia* (*Parkinsonia*) *schloenbachi* SCHLIPPE; KOPIK, Pl. 5, Fig. 4.

MATERIAL: The cast fragmentary preserved, representing a fully grown specimen with lappets, 120 mm in diameter.

DESCRIPTION: The specimen is moderately evolute (Wh = 30%, and Ud = 43.3%, at D = 90 mm). The ribbing consists of strongly prorsiradiate primaries which split into two secondaries, somewhat above mid-flank of the outer whorl; the point of division is marked by a small tubercle, at least up to 85 mm diameter of the specimen; the ribbing is not very dense (PR = 39 at D = 120 mm).

REMARKS: In style of ribbing and type of coiling the specimen is close to the lectotype of *P. schloenbachi.* However the stout, low trapezoidal whorl section of *P. schloenbachi* cannot be readily recognised. Although the whorl section is an important feature differentiating the *P. schloenbachi* from *Parkinsonia* (*Parkinsonia*) *pachypleura* BUCKMAN, the specimen studied differs from representatives of the latter species in its less evolute coiling and smaller size (*cf.* STURANI 1966). The studied microconch shows a marked similarity in ornamentation to the inner whorls of the macroconchs referred to here as *P.* (*Durotrigensia*) *bomfordi* ARKELL and *P.* (*Gonolkites*) *subgaleata* (BUCKMAN), which indicates a possible dimorphic relation between the two groups of specimens.

OCCURRENCE: Kawodrza Górna, Gliński's brick-pit; loose – possibly level *E*.

Family Perisphinctidae STEINMANN, 1890
Genus *Wagnericeras* BUCKMAN, 1921
Wagnericeras fortecostatum (DE GROSSOUVRE)
(Pl. 7, Fig. 2)

1958. *Wagnericeras fortecostatum* (DE GROSSOUVRE); ARKELL, pp. 204-205, Text-fig. 76 (holotype); Pl. 29, Figs 2-3.
1969. *Wagnericeras fortecostatum* (DE GROSSUVRE); HAHN, p. 69, Text-fig. 8; Pl. 1, Fig. 7, with given synonymy.
1987. *Wagnericeras fortecostatum* (DE GROSSOUVRE); TORRENS, p. 100, Pl. 5, Figs 1, 3, 4.

MATERIAL: A single specimen, about 120 mm in diameter, represented by an impression and a fragment of internal cast, which is strongly flattened and filled with dark clay.

DESCRIPTION: The specimen is septate to about 105 mm, with the initial part of the body chamber preserved. The coiling at the end of phragmocone is moderately involute (Wh = 39.4%, and Ud = 27.9%, at D = 104 mm).

The ribbing is fairly dense on the innermost whorls (PR = 30, at D = 30 mm), becoming coarse on the outer whorls (PR = 19, at D = 120 mm). On the last whorl preserved, the primary ribs are thick; they split into 2-3 secondary ribs at mid-flank, and the intercalatory ribs also occur on the ventrolateral side of the

whorl (SR/PR = 3.4, at D = 100 mm; SR/PR = 3.0, at D = 120 mm). Whereas the primary ribs are weakly prorsiradiate, the secondaries are generally rectiradiate, what gives the somewhat flexuous appearance of the ribbing that is typical of the genus *Wagnericeras.*

OCCURRENCE: Faustianka brick-pit, level *O*.

Family Morphoceratidae HYATT, 1900

REMARKS: The specimens of the macroconchiate species *Asphinctites tenuiplicatus* (BRAUNS) and the corresponding microconchiate *Polysphinctites secundus* (WETZEL) are extremely abundant in the deposits studied. *Asphinctites tenuiplicatus*, although widely distributed elswhere in Europe, is represented by only small numbers of specimens and hence is generally poorly known. *Polysphinctites secundus* has so far been reported only from Germany (see *e.g.* HAHN 1970). The collections consist of more than 90 specimens, of which many are fully grown and completely preserved. A general description of the collections is presented below, but a detailed palaeontological study of the two forms will be presented elsewhere.

Genus *Asphinctites* BUCKMAN, 1924

Asphinctites tenuiplicatus (BRAUNS)
(Pl. 7, Figs 4, 5)

1970. *Asphinctites tenuiplicatus* (BRAUNS); HAHN, p. 50-53, Text-fig. 8, Pl. 7, Figs 1-5; Pl. 8, Fig. 14a,b (with synonymy).

MATERIAL: About 50 specimens in various states of preservation, including 30 complete adults.

DESCRIPTION: The coiling is markedly evolute, with a range of Ud values from 41%-51% and a median Ud value of 47%. The inner whorls are identical to those of *Polysphinctites secundus* (WETZEL). The rib-division is initially of the palmate type, subsequently, especially at the end of the phragmocone and on the body chamber, polyplocoid and virgatotome. The ribs are blunt, fairly thick and cross the venter without weakening. Close to the final diameter, the whorl-height diminishes markedly. The aperture is simple and is sometimes preceded by a final constriction. The specimens attain 119.5 mm maximum diameter; with a median final diameter for 30 fully grown specimens of 103.1 mm. The body chamber occupies from $1^1/_{16}$ to $1^1/_8$ of the last whorl. The phragmocone attains a maximum diameter of 57.0 mm (the average for 21 specimens is 47.2 mm).

REMARKS: The specimens studied are the largest ones known so far for the genus, as well as for the species. The specimens that are closest in final diameter are those described by HAHN (1970) from Germany. Constrictions in the specimens studied are either not recognised at all, or occur in small numbers (not more than 1-2 per whorl). The heavy and fairly distant ribs on the flanks distinguish *Asphinctites tenuiplicatus* (BRAUNS) from other species.

OCCURRENCE: Kawodrza Górna – Leszczyński's brick-pit, level *K*; Faustianka brick-pit, level *O*.

Genus *Polysphinctites* BUCKMAN, 1922
Polysphinctites secundus (WETZEL)
(Pl. 7, Fig. 3)

1950. *Grossouvria secunda* n.sp.; WETZEL, p. 79.
1970. *Polysphinctites secundus* (WETZEL); HAHN, p.57-59, Pl. 8, Fig. 11-13.

MATERIAL: About 40 specimens of different state of preservation, including 12 with final peristome preserved.

DESCRIPTION: The coiling is strongly evolute. The ribbing becomes clearly visible from about 12 mm diameter. The ribs are swollen in the periumbilical area, and split at about mid-flank into 4-5 secondary ribs showing the palmate-type division. A slight rursiradiate course of the primary ribs at their division is typical of the last stage of ornamentation. This feature is observed on the last half-whorl of the fully grown specimens, but it is completely unknown in young macroconch specimens of *Asphinctites tenuiplicatus* at similar diameter. The aperture shows the presence of lappets; the dorsolateral part of the aperture margin is concave backwards. The last 2-3 secondary ribs on the ventrolateral and ventral side of the whorl become markedly sharpened. The final diameter of the specimens ranges up to 34.5 mm (the median value for 12 complete specimens is 27.6 mm). The body chamber is 7/8 of a whorl long. The final diameter of the phragmocone is up to 27 mm (the median value for 9 specimens showing the last septum is 19.7 mm).

REMARKS: The stronger and more distant ribbing distinguishes the species from *Polysphinctites polysphinctus* BUCKMAN. Constrictions are not recognised in all of the specimens studied.

OCCURRENCE: Kawodrza Górna – Leszczyński's brick-pit, level *K*; Faustianka brick-pit, level *O*.

Acknowledgements

This paper is a part of the *EFP-95* Project of the Geological Survey of Denmark and Greenland (*GEUS*), and the Faculty of Geology of the University of Warsaw, financed by the Ministry of Environment and Energy of Denmark.

The autors are grateful to Professor Andreas GALACZ and Dr. Janusz KOPIK, journal referees, for valuable suggestions and comments.

The authors are also grateful to KRZYSZTOF DEMBICZ and TOMASZ PRASZKIER, students of the Faculty of Geology, University of Warsaw, as well as to Dr MARCIN MACHALSKI (Institute of Palaeobiology, Polish Academy of Sciences) for kindly loaning several of the ammonites described in the present paper.

REFERENCES

ARKELL, W.J. 1951, 1956, 1958. Monograph of the English Bathonian ammonites. *Monograph of the Palaeontographical Society,* 1951: **1** (1-46), **2** (47-72); 1956: **6** (141-162); 1958: **7** (163-208). London.

BAYER, U. & MCGHEE, G.R. 1985. Evolution in marginal epicontinental basins: the role of phylogenetic and ecological factors (ammonite replacements in the German Lower and Middle Jurassic). *In*: U.BAYER & A.SEILACHER (*Eds*), Sedimentary and Evolutionary Cycles, *Lecture Notes in Earth Sciences*, **1**, 164-220. *Springer Verlag*; Berlin-Heidelberg-New York-Tokyo.

BIRKELUND, T. & CALLOMON, J.H. 1985. The Kimmeridgian ammonite faunas of Milne Land, central East Greenland. *Grønlands Geologiske Undersøgelse Bulletin*, **153**, 1-56. København.

BROCHWICZ-LEWIŃSKI, W. & RÓŻAK, Z. 1975. Peristomal modifications of Upper Jurassic perisphinctids (Ammonoidea). *Bulletin de l'Académie Polonaise des Sciences, Série des Sciences de la Terre,* **23** (1), 53-58. Warszawa.

CALLOMON, J.H. 1985. The evolution of the Jurassic ammonite family Cardioceratidae. *Special Papers in Palaeontology,* **33**, 49-90. London.

CALLOMON, J.H., DIETL, G., GALACZ, A., GRADL, H., NIEDERHÖFER, H.-J. & ZEISS, A. 1987. Zur Stratigraphie des Mittel- und unteren Oberjuras in Sengenthal bei Neumarkt/Opf. (Fränkische Alb). *Stuttgarter Beiträge zur Naturkunde, **B***, **132**, 1-53. Stuttgart.

DADLEZ, R., FELDMAN-OLSZEWSKA, A,. GAŹDZICKA, E., IWANOW, A,. KIERSNOWSKI, H., LESZCZYŃSKI, K., MAREK, S., POKORSKI, J., WAGNER, R. & WYBRANIEC, S. 1998. Palaeogeographical Atlas of the Epicontinental Permian and Mesozoic in Poland. PAE SA; Warszawa.

DAYCZAK-CALIKOWSKA, K. 1988. Biostratigraphic correlation of the Middle Jurassic of Poland and other areas, pp. 83-88. *In*: L. MALINOWSKA (*Ed.*), Geology of Poland, III, Atlas of Guide and Characteristic Fossils, 2b, Mesozoic – Jurassic. *Wydawnictwa Geologiczne*; Warszawa.

DAYCZAK-CALIKOWSKA, K. & KOPIK, J. 1976. Middle Jurassic. The Cracow-Wieluń Upland, pp. 241-257. *In*: S. SOKOŁOWSKI (*Ed.*), Geology of Poland, I, Stratigraphy, 2, Mesozoic. *Wydawnictwa Geologiczne*; Warszawa.

DAYCZAK-CALIKOWSKA, K., KOPIK, J. & MYCZYŃSKI, R. 1988. Order Ammonitida, Zittel 1884, pp. 133-159. *In*: L.MALINOWSKA (*Ed.*), Geology of Poland, III, Atlas of Guide and Characteristic Fossils, 2b, Mesozoic – Jurassic. *Wydawnictwa Geologiczne*; Warszawa.

DECZKOWSKI, Z. 1959. Dogger between Wilkowiecko and Libidza. *Biuletyn Instytutu Geologicznego*, **161**, 1-71.Warszawa.

DIETL, G., FLAIG, R. & GLÜCK, E. 1978. Zur Stratigraphie der Ober-Bajocium (Braunjura δ/ε Grenzschichten) am Plettenberg bei Balingen, Württemberg. *Stuttgarter Beiträge zur Naturkunde, **B,** **40,*** 1-16. Stuttgart.

DORN, P. 1927. Die Ammonitenfauna der Parkinsonienschichten bei Thälmassing (Frankenalb). *Jahrbuch der Preussischen Geologischen Landesanstalt*, **48**, 225-251. Berlin.

FELDMAN-OLSZEWSKA, A. 1997. Depositional architecture of the Polish epicontinental Middle Jurassic Basin. *Geological Quarterly*, **41** (4), 491-508. Warszawa.

GALACZ, A. 1980. Bajocian and Bathonian ammonites of Gyenespuszta, Bakony Mts., Hungary. *Geologica Hungarica*, *Series Palaeontologica***, 39**, 1-227. Budapest.

DE GROSSOUVRE, A. 1919. Bajocien – Bathonien dans la Nievre. *Bulletin de la Société Géologique de France*, **18**, 337-459. Paris.

HAHN, W. 1968. Die Oppeliidae Bonarelli und Haploceratidae Zittel (Ammonoidea) des Bathoniums (Brauner Jura ε) im südwestdeutschen Jura. *Jahreshefte des geologischen Landesamtes Baden-Württemberg*, **10**, 7-72. Freiburg i. Br.

— 1969. Die Perisphinctidae Steinmann (Ammonoidea) des Bathoniums (Brauner Jura ε) im süd-westdeutschen Jura. *Jahreshefte des geologischen Landesamtes Baden-Württemberg*, **11**, 29-86. Freiberg i. Br.

— 1970. Der Parkinsoniidae S.Buckman und Morphoceratidae Hyatt (Ammonoidea) des Bathoniums (Brauner Jura ε) im südwestdeutschen Jura. *Jahreshefte des Geologischen Landesamtes Baden-Württemberg*, **12,** 7-62. Freiburg i. Br.

HAHN, W., WESTERMANN, G.E.G. & JORDAN, R. 1990. Ammonite fauna of the Upper Bathonian hodsoni Zone (Middle Jurassic) at Lechstedt near Hildesheim, northwest Germany. *Geologisches Jahrbuch,* **A 121**, 21-63. Hannover.

KOPIK, J. 1974. Genus *Cadomites* Munier-Chalmas, 1892 (Ammonitina) in the Upper Bajocian and Bathonian of the Cracow-Wieluń Jurassic Range and the Góry Świętokrzyskie Mountains (southern Poland). *Biuletyn Instytutu Geologicznego*, **276**, 7-54. Warszawa.

— 1979. Stratigraphy of the Middle Jurassic of the Bełchatów Region. *Kwartalnik Geologiczny*, **23** (1), 179-194. Warszawa.

— 1998. Lower and Middle Jurassic of the north-eastern margin

of the Upper Silesian Coal Basin. *Biuletyn Instytutu Geologicznego,* **378**, 67-120. Warszawa.

KOPIK, J. & ZNOSKO, J. 1968. La limite du Bajocien et du Bathonien de même que le problème du Vésulien et du Kuyavien en Pologne (in Polish). *Przegląd Geologiczny*, **6**, 269-273. Warszawa. [*In Polish*].

MANGOLD, CH. & RIOULT, M. 1997. Bathonien, pp. 55-62. *In*: E. CARIOU & P. HANTZPERGUE (*Coord*.), Biostratigraphie du Jurassique ouest-européen et méditerranéen: zonations parralleles et distribution des invertebrés et microfossiles. *Bulletin des Centres de Recherches Exploration-Production Elf Aquitaine, Mémoire,* **17**. Pau.

NICOLESCO, C.P. 1928. Étude monographique du genre *Parkinsonia. Mémoires Société Géologique de France*, **9**, 3-84. Paris.

D'ORBIGNY, A. 1842-1851. Paléontologie française. Description zoologique et géologique de tous les animaux mollusques et rayonnés fossiles de France. Terraines oolitiques ou Jurassiques; I, 641pp. *Masson*; Paris.

PAVIA, G. 1971. Ammoniti del Baiociano superiore di Digne (Francia SE, dip. Basses-Alpes). *Bolletino della Societa Paleontologica Italiana*, **10** (2), 75-142. Modena.

— 1994. Taphonomic remarks on d'Orbigny's type – Bajocian (Bayeux, west France). *Servizio Geologico Nazionale*, *Miscellanea,* **5**, 93-111. Roma.

POTOCKI, K. 1972. Litologia i stratygrafia batonu okolic Częstochowy. *Unpublished M.Sc. thesis*, 90 pp. *Institute of Geology, University of Warsaw*; Warszawa.

POULSEN, N.E. 1998. Upper Bajocian to Callovian (Jurassic) dinoflagellate cysts from central Poland. *Acta Geologica Polonica*, **48** (3), 237-245.

PREMIK, J. 1934. Über den geologischen Bau und Geschichte der Umgegend von Częstochowa (in Polish). *Ziemia Częstochowska*, **1**, 177-266. Częstochowa. [*In Polish*].

REHBINDER, V. R. 1913. Die mitteljurassischen eisenerzführenden Tone langs dem südwestlichen Rande des Krakau-Wieluner Zuges in Polen. *Zeitschrift der Deutschen Geologischen Gesellschaft*, **65,** 181-349. Berlin.

RIOULT, M., CONTINI, D., ELMI, S., GABILLY, J. & MUTERDE R. 1997. Bajocien, pp. 41-53. *In*: E. CARIOU & P. HANTZPERGUE (*Coord*.), Biostratigraphie du Jurassique ouest-européen et méditerranéen: zonations paralleles et distribution des invertebrés et microfossiles. *Bulletin des Centres de Recherches Exploration-Production Elf Aquitaine, Mémoire,* **17**. Pau.

RIOULT, M., GAUTHIER, H. & GABILLY, J. 1994. *Parkinsonia rarecostata* (S. Buckman, 1881). *In*: J.C. FISCHER (*Ed.*), Révision critique de la Paléontologie Française d'Alcide d'Orbigny, vol. I Céphalopodes Jurassiques, pp. 107-108. *Masson*: Paris-Milan-Barcelone; *Muséum National d'Historie Naturelle*. Paris.

RIOULT, M., MANGOLD, C. & GAUTHIER, H. 1994. *Cadomites deslongchampsii* (Defrance). *In*: J.C. FISCHER (*Ed.*), Revision critique de la Paléontologie Française d'Alcide d'Orbigny, vol. I Céphalopodes Jurassiques, pp. 125-126. *Masson*: Paris-Milan-Barcelone; *Muséum National d'Historie Naturelle*. Paris.

RÓŻYCKI, S.Z. 1953. Górny dogger i dolny malm Jury Krakowsko-Częstochowskiej. *Prace Instytutu Geologicznego*, **17**, 1-412. Warszawa.

— 1955. Parkinsonie, garantiany i strenocerasy z doggeru obrzeżenia Gór Świętokrzyskich i ich znaczenie stratygraficzne. *Acta Geologica Polonica*, **5** (3), 305-341.Warszawa.

SANDOVAL, J. 1983. Bioestratigrafia y paleontologia (Stephanoceratáceae y Perisphinctaceae) del Bajocense y Bathonense en las Cordilleras Beticas. *Tesis Doctoral Universidad de Granada*, 613 pp. Granada.

SCHLEGELMILCH, R. 1985. Die Ammoniten des süddeutschen Doggers, 284 pp. *Gustav Fischer*; Stuttgart – New York.

SCHLIPPE, A.O. 1888. Die Fauna des Bathonien in oberrheinischen Tieflande. *Abhandlungen zur Geologischen Spezialkarte von Elsass-Lothringen,* **4** (4), 1-266. Strassburg.

STURANI, C. 1966. Ammonites and stratigraphy of the Bathonian in the Digne-Barrême area (south-eastern France. Dept. Basses-Alpes). *Bolletino della Societa Paleontologica Italiana,* **5** (1), 3-57. Modena.

TORRENS, H. 1987. Ammonites and stratigraphy of the Bathonian rocks in the Digne – Barrême area (South – Eastern France, Dept. Alpes de Haute Provence). *Bolletino della Societa Paleontologica Italiana*, **26** (1-2), 93-108. Torino.

WESTERMANN, G. 1958. Ammoniten-Fauna und Stratigraphie des Bathonien NW-Deutschlands. *Beihefte zum Geologischen Jabrbuch*, **32**, 1-103. Hannover.

WETZEL, W. 1911. Faunistische und stratigraphische Untersuchungen der Parkinsonienschichten des Teutoburger Waldes bei Bielefeld. *Palaeontographica*, **58** (3-4), 139-278. Stuttgart.

— 1950. Fauna und Stratigraphie der *Wuerttembergica*-Schichten insbesondere Nord-deutschland. *Palaeontographica*, **A99**, 63-120. Stuttgart.

ZANY, D., MANGOLD, CH., MARCHAND, D. & TEHOUR, M. 1995. Biostratigraphie et stratigraphie sequentielle du Bajocien supérieur – Bathonien inférieur dans le Nivernais. *Géologie de la France,* **1**, 47-61.

ZNOSKO, J. 1954. Stratygrafia iłów rudonośnych na podstawie otworów wiertniczych. *Biuletyn Instytutu Geologicznego*, **93b**, 183-284. Warszawa.

— 1957. Outline of stratigraphy of the Dogger in the Łęczyca area (Central Poland). *Biuletyn Instytutu Geologicznego,* **125,** 1-144. Warszawa.

Manuscript submitted: 14th October 1999
Revised version accepted: 4th March 2000

PLATE 1

1 – *Oxycertites* (*Limoxyites*) *nivernensis* (DE GROSSOUVRE); unregistered specimen, K. DEMBICZ & T. PRASZKIER collection, Faustianka brick-pit, level *O*

2-3 – *Oxycerites* (*Oxycerites*) *limosus* (BUCKMAN); 2 – unregistered specimen, K. DEMBICZ & T. PRASZKIER collection, inner whorls of large specimen, Faustianka brick-pit, level *O*; 3 – unregistered specimen, M. MACHALSKI's collection, Faustianka brick-pit, level *O*

4 – *Parkinsonia* (*Durotrigensia*) *pseudoferruginea* NICOLESCO; IGPUW/A/37/1, "Alina" brick-pit, loose

All specimens in natural size


2
1
3
4

PLATE 2

1 – *Oxycerites* (*Paroecotraustes*) *formosus* (ARKELL); unregistered specimen, K. DEMBICZ & T. PRASZKIER collection, Faustianka brick-pit, level *O*

2-3 – *Oxycerites* (*Oxycerites*) *seebachi* (WETZEL); unregistered specimen, K. DEMBICZ & T. PRASZKIER collection, Faustianka brick-pit, level *O*

4 – *Parkinsonia* (*Gonolkites*) *subgaleata* (BUCKMAN); IGPUW/A/37/8, "Sowa" brick-pit, 0.85 m above level *D*

All specimens in natural size

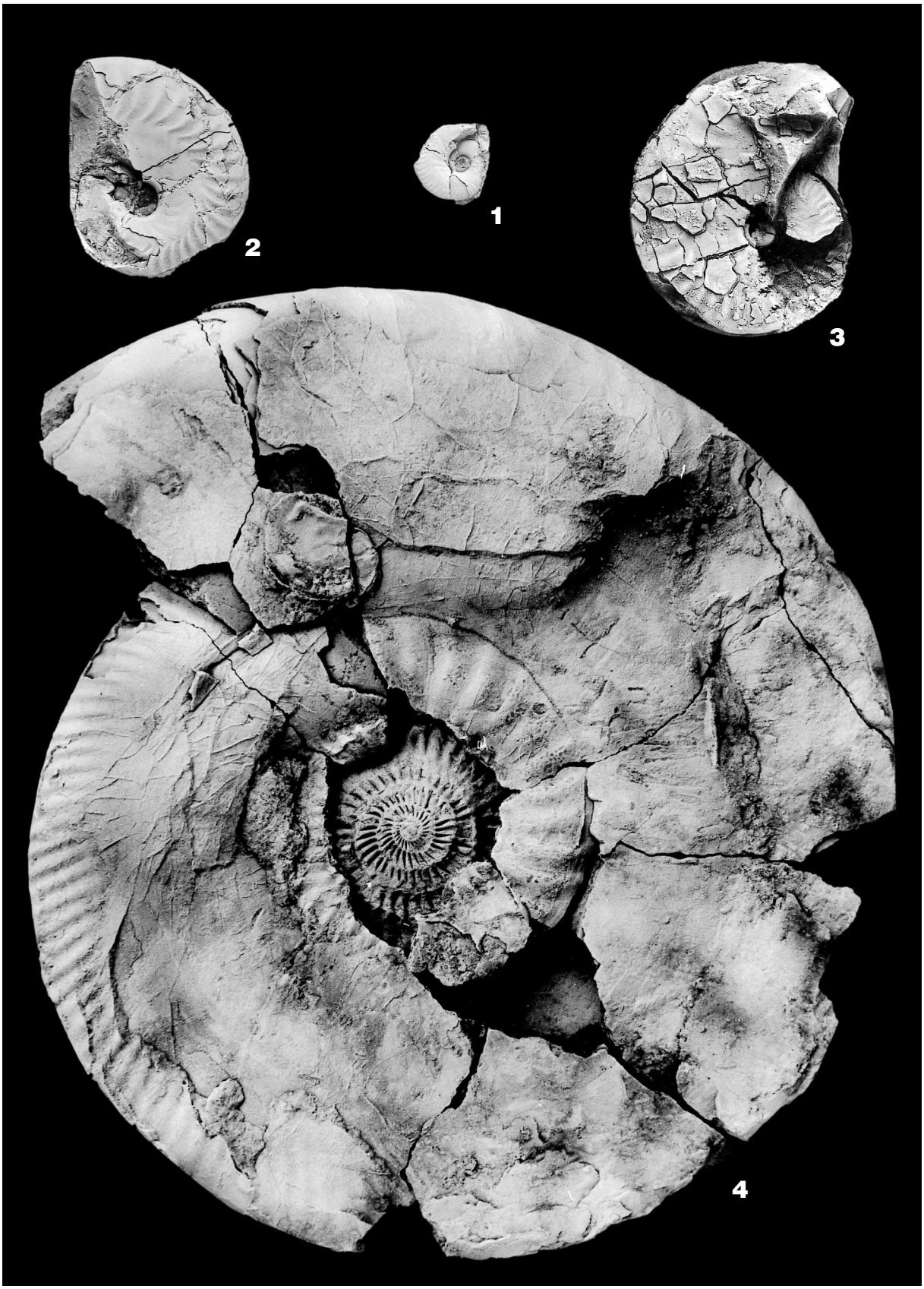

1
2
3
4

PLATE 3

1 – *Parkinsonia* (*Parkinsonia*) *schloenbachi* SCHLIPPE; IGPUW/A/37/10, Gliński's brick-pit, loose – possibly from level *E*, × 1

2-3 – *Parkinsonia* (*Parkinsonia*) *parkinsoni* (SOWERBY): 2 – IGPUW/A/37/3, "Alina" brick-pit, loose, × 1; 3 – IGPUW/A/37/4, "Alina" brick-pit, level of large nodules at the base of the section, × 0.8

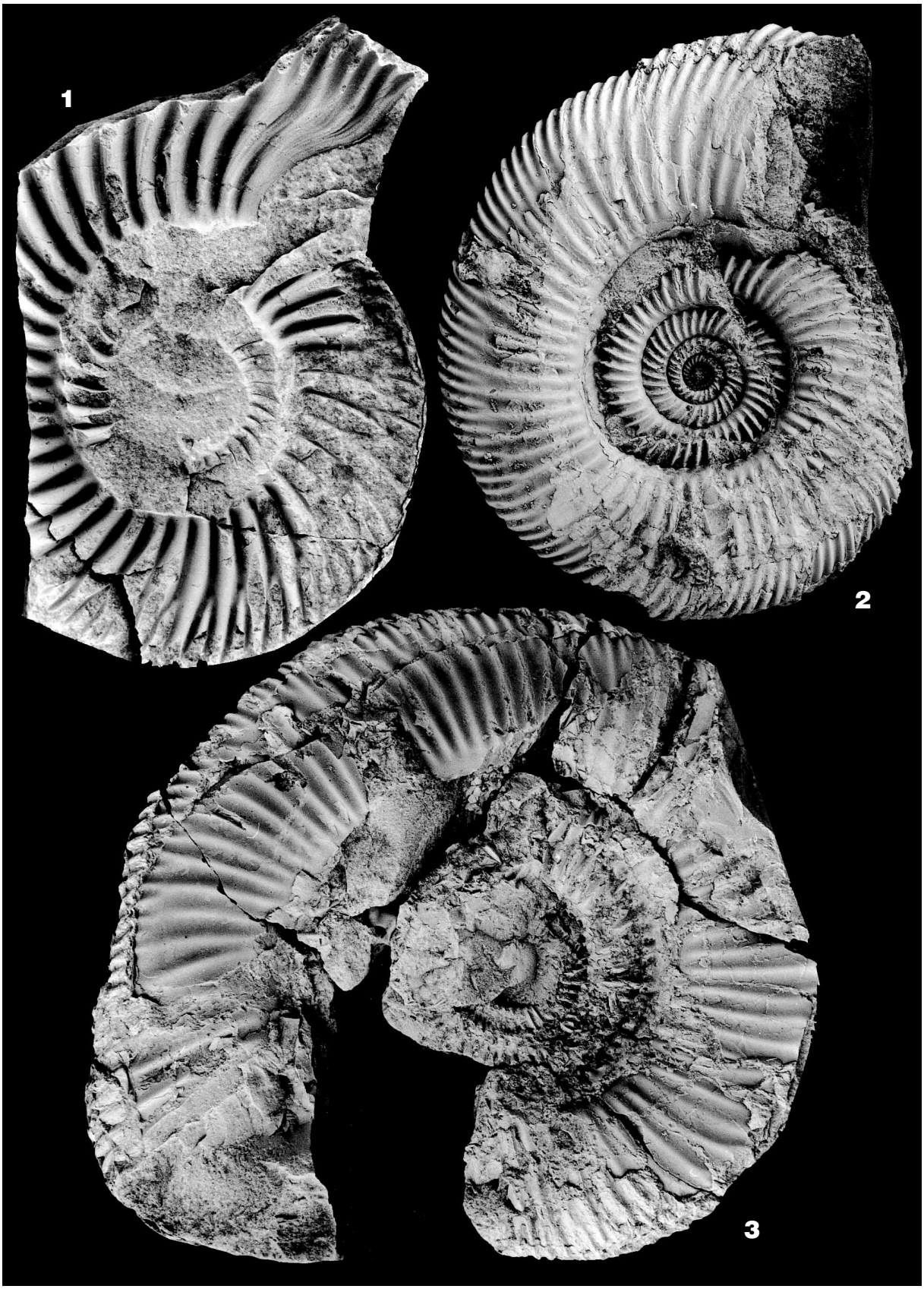

1
2
3

PLATE 4

1-5 – *Parkinsonia* (*Parkinsonia*) aff. *dorni* ARKELL; 1 – IGPUW/A/37/7, outer and inner whorls of the same specimen, Anioł's brick-pit, about 1.4 m below level *A*; 2 – IGPUW/A/37/15, "Sowa" brick-pit, loose, lower part of the section; 3 – IGPUW/A/37/5, Anioł's brick-pit, loose; 4 – unregistered specimen, K. DEMBICZ & T. PRASZKIER collection, "Sowa" brick-pit, loose, lower part of the section; 5 – IGPUW/A/37/16, Anioł's brick-pit, level *A*

6 – *Parkinsonia* (? aff. *dorni* ARKELL); IGPUW/A/37/14, Anioł's brick-pit, loose

All specimens in natural size

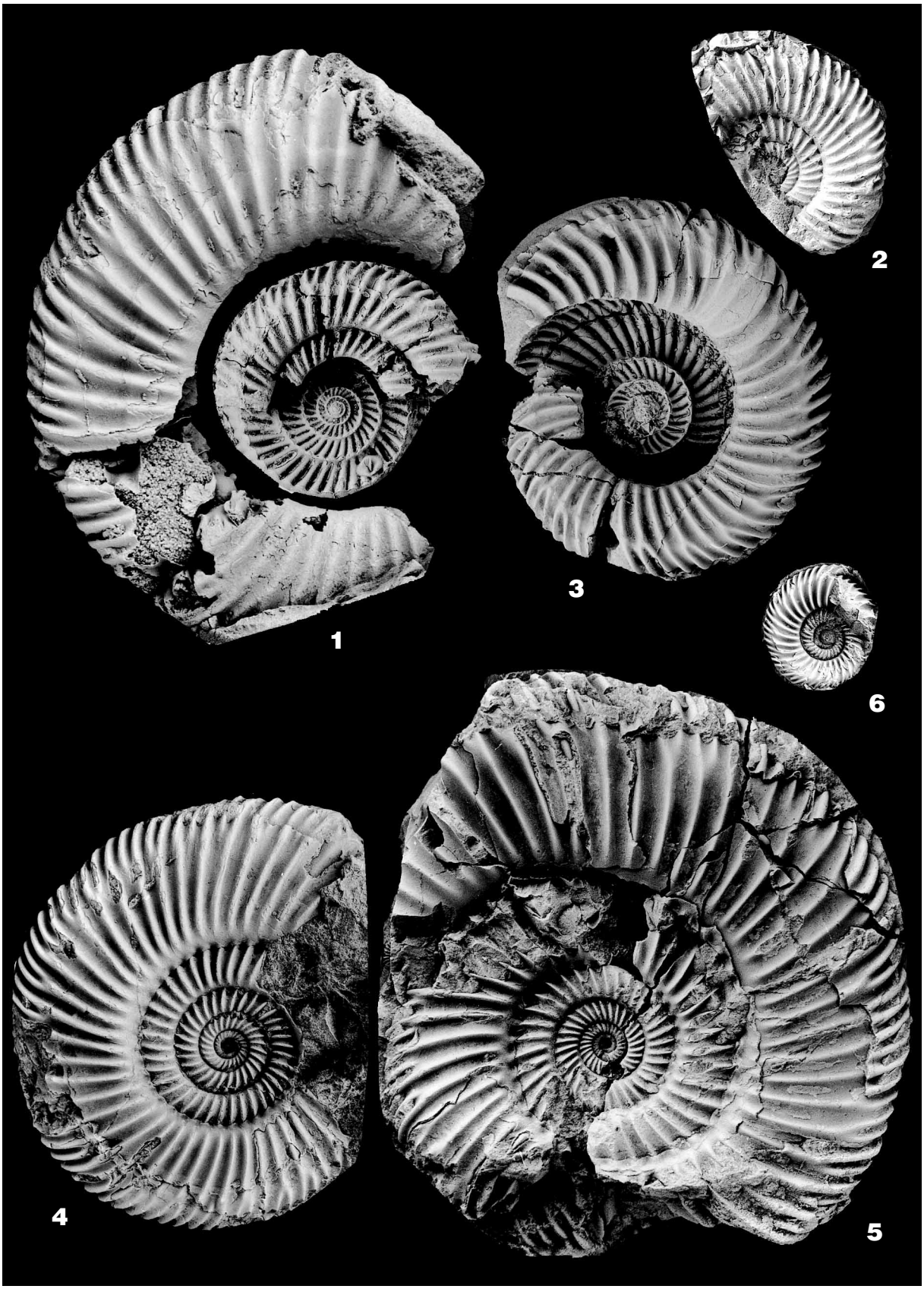

1
2
3
4
5
6

PLATE 5

1-2 – *Parkinsonia* (*Durotrigensia*) *bomfordi* ARKELL; IGPUW/A/37/17, "Sowa" brick-pit, around levels *C* or *D*, 2 – inner whorls × 1; 1 × 0.6


2
1

PLATE 6

1 – *Parkinsonia* (? aff. *dorni* ARKELL); IGPUW/A/37/13, Anioł's brick-pit, loose, × 1
2 – *Parkinsonia* (*Gonolkites*) *subgaleata* (BUCKMAN); IGPUW/A/37/9, Anioł's brick-pit, level *D*, × 0.5


1
2

PLATE 7

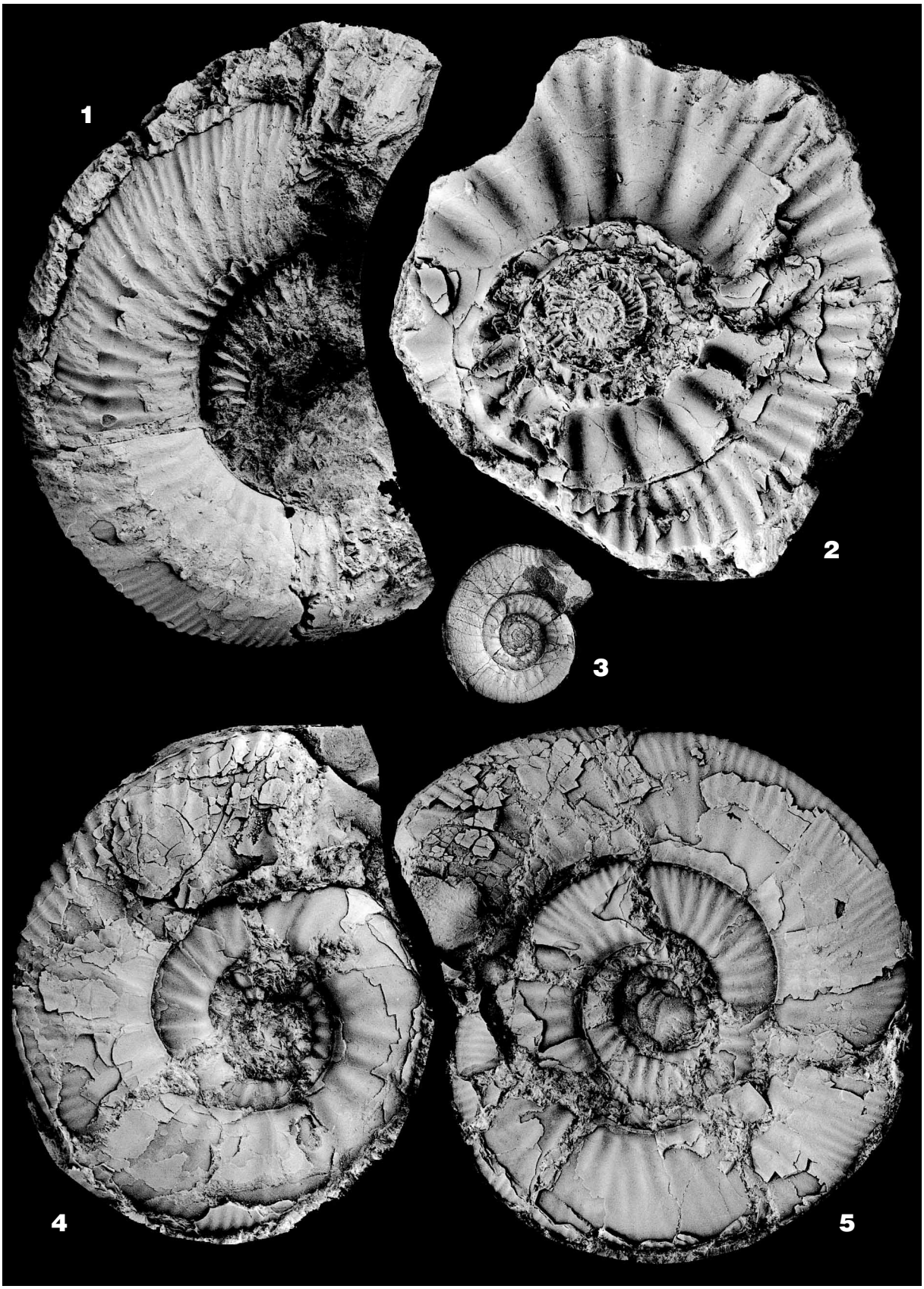
1 – *Cadomites* (*Cadomites*) *deslongchampsi* (DEFRANCE); IGPUW/A/37/33, "Alina" brick-pit, loose

2 – *Wagnericeras fortecostatum* (DE GROSSOUVRE); IGPUW/A/37/34, Faustianka brick-pit, level *O*

3 – *Polysphinctites secundus* (WETZEL); IGPUW/A/38/3, Leszczyński's brick-pit, level *K*

4-5 – *Asphinctites tenuiplicatus* (BRAUNS), unregistered specimen, K. DEMBICZ & T. PRASZKIER collection, Faustianka brick-pit, level *O*

All specimens in natural size


1
2
3
4
5