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Palaeogeographical distribution of early Bathonian ammonites of the *Asphinctites–Polysphinctites* group

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(With 4 figures and 2 plates)

The study of ammonites representing the dimorphic pair *Asphinctites tenuiplicatus* (BRAUNS) – *Polysphinctites secundus* (WETZEL) in the Tenuiplicatus Zone of Lower Bathonian in Central Poland, reveals their abnormal large sizes when compared with those occurring in other areas of Europe. The biogeographic distribution of the discussed ammonites, as well as older representatives of *Asphinctites* and *Polysphinctites* shows a general decrease in size of both forms towards south from the Submediterranean Province to the Mediterranean Province, and to the general disappearance of *Polysphinctites* in the Mediterranean Province. The phenomena may be related to changing environmental conditions which influenced the development of the discussed ammonites. We suggest that the ammonites inhabiting more distant areas from the Mediterranean Province, at the periphery of geographic range of the species, could have reached larger sizes due to prolonged time of maturation.

Introduction

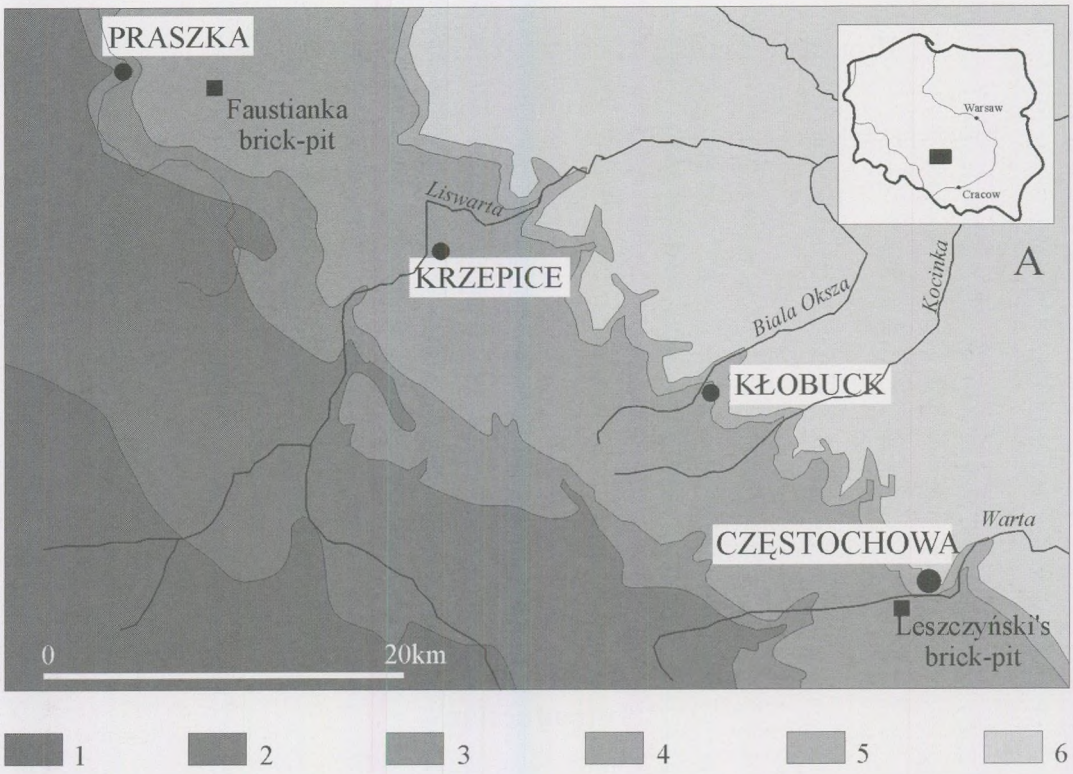
The uppermost Bajocian and Bathonian deposits distinguished in the Częstochowa and Wieluń areas in Central Poland as the Ore Bearing Częstochowa Clay Formation (cf. KOPIK 1998) became famous since the XIX. century due to wealth of well–preserved ammonites. Detailed biostratigraphical study of these deposits were undertaken by REHBINDER (1913) who introduced here for the first time the standard Tenuiplicatus Zone at the top of the Lower Bathonian. This zone was defined by common occurrence of the species *"Perisphinctes" tenuiplicatus* = *Asphinctites tenuiplicatus* (BRAUNS). Common occurrence of this species in the Częstochowa and Wieluń areas has not been, however, the subject of any detailed palaeontological study for long time, beside the unpublished M.Sc. thesis of POTOCKI (1972) where the geological section of the Leszczyński's brick–pit at Częstochowa and a short palaeontological description and illustrations of the collected specimens of *Asphinctites tenuiplicatus* were given. The ammonites *Asphinctites* and *Polysphinctites* were reported also from Kromołów near Zawiercie (KOPIK 1998), and in the cores in the Bełchatów area west of Wieluń (KOPIK 1979).

A palaeontological study of ammonites from the uppermost Bajocian and Lower Bathonian exposed in brick–pits between Częstochowa and Wieluń carried out recently (MATYJA & WIERZBOWSKI 2000a) provided the basis for the standard biostratigraphical subdivision of these deposits. The common occurrence of *Asphinctites tenuiplicatus* (BRAUNS) and *Polysphinctites secundus* (WETZEL) indicative of the Tenuiplicatus Zone has been recognised in the Leszczyński's brick–pit at Częstochowa and in the Faustianka brick–pit about 20 km south of Wieluń (Fig. 1). These ammonites representing the dimorphic pair occur in profusion in this Zone, where, on the other hand, a marked impoverishment in other ammonite groups, abundantly occurring in older deposits of the Macrescens and Yeovilensis subzones of the Zigzag Zone in the area of study, is recognised. This impoverishment may be attributed to a change in environment which promoted from the beginning of the Tenuiplicatus Chron, high endemism and led to development of the special *Asphinctites – Polysphinctites* fauna (MATYJA & WIERZBOWSKI 2000a).

Although the general description of rich collection of *Asphinctites tenuiplicatus* (BRAUNS) and *Polysphinctites secundus* (WETZEL) consisting of more than 90 well–preserved specimens has been presented previously (MATYJA & WIERZBOWSKI, 2000a), its more detailed palaeontological study is given only nowadays. It is also a time to discuss the palaeogeographical distribution of all representatives of the two forms in Europe, as well as its comparison to that of an older fauna of *Asphinctites–Polysphinctites* (see also MATYJA & WIERZBOWSKI 2000b).

The ammonites of the *Asphinctites – Polysphinctites* group are essentially the forms occurring along the northern margin of the Tethys – both in wide areas of its northern shelf constituting the Submediterranean Province, and in northern

part of the Mediterranean Province: from Portugal and Spain, through France and southern England, northern Austria, Germany and Poland to Rumania, and even further east up to northern and central Iran. The boundary between the Mediterranean and Submediterraean provinces corresponds generally to a marked increase in numerical abundance of deep–water phylloceratids (CARIOU et al. 1985), but it seems to be also recognizable in changes in other ammonite groups including that of *Asphinctites – Polysphinctites.*



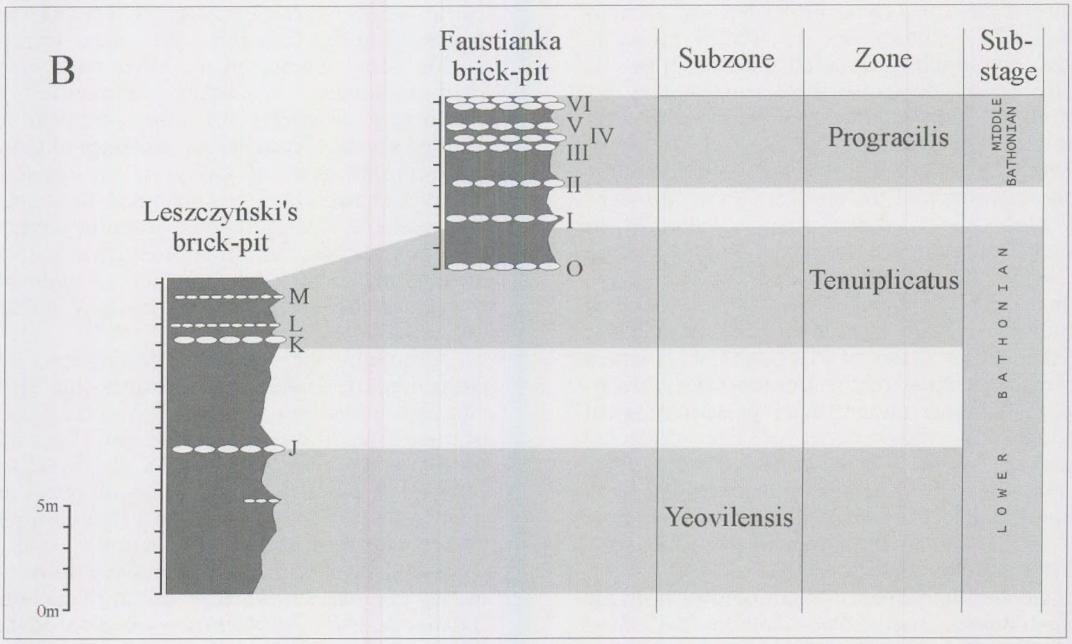


Fig. 1 A. Geological map of the area between Częstochowa and Praszka showing the locations of the studied sections.
1 – Upper Triassic, 2 – Lower Jurassic, 3 – Middle Jurassic Kościelisko Beds, 4 – Middle Jurassic Ore Bearing Częstochowa Clay Formation, 5 – Middle Jurassic sandy limestones, 6 – Upper Jurassic,

B. Detailed sections of Leszczyński's brick–pit at Częstochowa and Faustianka brick–pit, and their biostratigraphical interpretation: numbers and letters denote the ironstone levels according to MATYJA & WIERZBOWSKI (2000a).

Asphinctites tenuiplicatus – Polysphinctites secundus ammonite fauna from central Poland

This dimorphic pair of the family Morphoceratidae are represented in the studied material studied by large number of fully–grown and completely preserved specimens. This gives the basis for better understanding of their ontogeny.

The fully–grown specimens of *Asphinctites tenuiplicatus* are generally of large sizes (Pls. 1–2; Fig. 2). They range in final diameter from 72.0 mm to 119.5 mm, with a median final diameter of 103.1 mm as calculated for 30 specimens. The body–chamber is from 7/8 to $1^1/_{16}$ to $1^1/_8$ whorl long; the specimens of smallest final diameter show the shortest body–chambers, whereas of the largest diameter – generally the longest body–chambers. The final diameter of phragmocone is from 38.9 mm to 57.0 mm (the median value for 21 specimens is 47.2 mm)

The fully grown specimens of *Polysphinctites secundus* are fairly large as for this form (Pl. 2; Fig. 2). The final diameters range from 24.5 mm to 34.5 mm, with a median value 27.6 mm calculated for 12 specimens. The body–chamber is 7/8 whorl long. The final diameter of phragmocone is from 14.0 mm to 27 mm (the median value for 9 specimens is 19.7 mm).

The specimens are well–preserved what enables the recognition of particular phases of shell development from the ammonitella stage in both dimorphic forms. The ammonitella itself is about 1.2 mm in diameter. The ornamentation becomes clearly visible from about 12 mm in shell diameter. Initially, the ribs are swollen in periumbilical part of the whorls, showing the palmate type division into 4–5 secondary ribs about mid–height of whorl. This type of ribbing in *P secundus* continues up to about 20 mm diameter, then a slight rursiradiate course of ribs at their division appears what is a typical feature of the last stage of ornamentation in this form; moreover, the last 2–3 secondary ribs in *P. secundus* become sharpened at the ventrolateral and ventral parts of whorl, and the aperture shows the presence of lappets. In *A. tenuiplicatus* the palmate type of rib–division occurs up to about 30–40 mm diameter, being replaced there by the polyplocoid and virgatotome ones; the ribs are blunt, fairly thick and cross the ventral side of whorls without any weakening. The coiling is markedly evolute especially in *P. secundus* and inner whorls of *A. tenuiplicatus*. Close to the final diameter of *A. tenuiplicatus* the whorl–height diminishes markedly up to the final aperture which is simple. The outer half–whorl both in *P. secundus* and *A. tenuiplicatus* tends to coil more loosely. The constrictions in both forms are weakly developed, shallow and not numerous.

The median total length of a shell is about 5 and a half whorl in *P. secundus*, and about 7 and a half whorl in *A. tenuiplicatus*. The septal density as recognised in a few specimens changes over a small interval from 11 to 17 septa per whorl. At smallest diameters, up to about 9 mm (what corresponds to about 4 whorls) the septal density seems somewhat larger (17 septa per whorl) than at larger diameter, where it becomes nearly constant and equals 11 to 13 septa per whorl (but a few last crowded septa at the end of phragmocones).

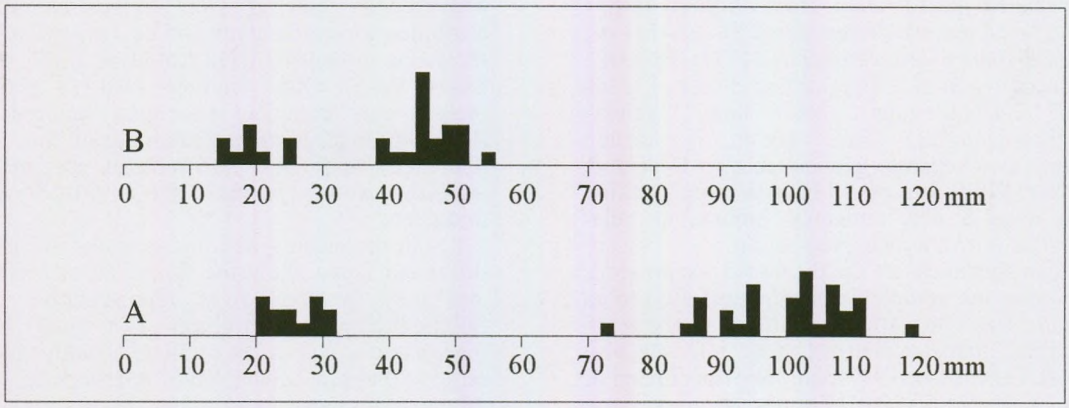


Fig. 2. Final diameters of shells (A) and final phragmocone diameters (B) of – *Asphinctites tenuiplicatus* (grey) and *Polysphinctites secundus* (black) from Central Poland.

Palaeogeographic distribution of *Asphinctites – Polysphinctites* ammonite faunas

Two ammonite faunas consisting of *Asphinctites* and *Polysphinctites* may be recognised in the Lower Bathonian in Europe (see e.g. MANGOLD 1970; PAGE 1996; DIETZE et al. 1997; DIETZE & CHANDLER 1997): (1) an older fauna of *Asphinctites pinguis* (DE GROSSOUVRE)/ *Asphinctites replictum* (BUCKMAN) (M) – *Polysphinctites polysphinctus* BUCKMAN (m) and allied forms in the Zigzag Zone, as well as (2) a younger fauna of *Asphinctites tenuiplicatus* (BRAUNS)/ *Asphinctites patrulii* HAHN (M) – *Polysphinctites secundus* (WETZEL) (m) and allied forms in the Tenuiplicatus Zone. These two ammonite faunas show a special palaeogeographic distribution depending on type of a shell (macro– and microconchs), as well as on final size of the specimens belonging to the same morph (see also MATYJA & WIERZBOWSKI 2000 b). The detailed analysis of the distribution of the two faunas is presented and discussed below (see Fig. 3).

Fauna of *Asphinctites pinguis* (DE GROSSOUVRE)/ *Asphinctites replictum* (BUCKMAN) – *Polysphinctites polysphinctus* BUCKMAN and allied forms

This fauna is poorly known in Poland, including a specimen referred to as "*Morphoceras pinguis* (DE GROSSOUVRE)" reported (but not illustrated) together with *Zigzagiceras zigzag* (D'ORBIGNY) and *Morphoceras polymorphum* (D'ORBIGNY) = *M. multiforme* ARKELL by RÓŻYCKI (1953, p. 105) from the Rudniki section south of Częstochowa, and a specimen of *Polysphinctites polysphinctus* (BUCKMAN) from the vicinity of Częstochowa (KOPIK 1998, p. 85). The fauna itself is, however, widely known from different parts of Europe, and even outside of it (Iran).

The macroconchs include *Asphinctites pinguis* (DE GROSOUVRE 1919) as based on original illustration of DE GROSSOUVRE (1919, pl. 14, fig. 7ab – holotype; refigured in ARKELL 1955, Text–fig. 49, left), and a very close if not conspecific *Asphinctites replictum* (BUCKMAN 1922), see also ARKELL (1955, pl. 16, fig. 9ab; 10ab – refigured holotype). The relation of the two forms were discussed recently by PAGE (1996) and DIETZE et al. (1997); see also synonymy of *A. pinguis* in MANGOLD (1970) and SANDOVAL (1983). For full synonymy of microconch *Polysphinctites polysphinctus* see e.g. HAHN (1970, p.56) with some corrections by DIETZE et al. (1997, p. 14).

The macroconchs as well as microconchs of the discussed ammonite fauna are distinguished from those of a younger *Asphinctites – Polysphinctites* fauna by presence of strong constrictions, and the macroconchs themselves additionally by more involute middle whorls. The discussed macroconchs (*A. pinguis/A. replictum*) as well as closely related macroconchs from northern Iran – such as *Pseudodimorphinites komsi* SEYED–EMAMI and *Pseudodimorphinites foersteri* SEYED–EMAMI – were placed by SEYED–EMAMI (in: SEYED–EMAMI et al. 1989) in his new genus– *Pseudodimorphinites*. This taxon is treated sometimes as a separate genus (see also DIETZE & CHANDLER 1997), but possibly it is more justified to treat it as a new subgenus embracing older *Asphinctites* forms, as accepted herein.

English specimens of the discussed *Asphinctites* include only one complete specimen referred to as *A. pinguis* (DE GROSSOUVRE) attaining about 45 mm in final diameter (DIETZE pers. inf., see also DIETZE & CHANDLER 1997), and two specimens of *A. replictum* (BUCKMAN) – about 64 mm , and about 70 mm in final diameters, respectively (ARKELL 1955, pl. 16, figs 9ab; DIETZE pers. inf., see also DIETZE & CHANDLER 1997). The maximum diameters of two fully–grown English specimens of *Polysphinctites polysphinctus* BUCKMAN range from 34 (MANGOLD 1970, pl. 7, fig. 21) to 39.5 mm (ARKELL 1955, pl. 16, fig. 8), whereas the corresponding end–diameters of phragmocones in both specimens equal about 22 mm. Other English specimens of *P. polysphinctus* and *A. replictum*, including the holotypes of the two forms (see ARKELL 1955, pl. 16, figs 7 and 10, respectively) are either incomplete or not fully–grown.

Of the most often cited French specimens is the holotype of *A. pinguis* (DE GROSSOUVRE) coming from the Niévre area at the southern border of the Paris Basin (DE GROSSOUVRE 1919, pl. 14, fig. 7ab). It is an incomplete specimen about 45 mm in diameter devoid of the body–chamber, and thus about one whorl longer when complete (MANGOLD 1970, p. 111): hence, the original diameter of this specimen may be calculated as about 65–70 mm. Other specimen of *A. pinguis* found more towards south, in the Barrême area of south–eastern France (MANGOLD 1970, pl. 3, fig. 13–14), is nearly complete (but without final peristome preserved); it is 68 mm in maximum diameter with end of phragmocone at 44 mm diameter. The corresponding microconchs *Polysphinctites polysphinctus/* cf. *polysphinctus* were reported (but not illustrated) from the Niévre area (ZANY et al. 1995, p. 50), and from the French Jura Mts.(MANGOLD 1970, p. 114). In Portugal, the ammonites in question are poorly known: beside a single specimen of *Asphinctites pinguis* 26 mm in diameter representing the inner whorls only, there have been reported, but not illustrated specifically indeterminable specimens of *Polysphinctites* (see MANGOLD 1970, p. 111; MANGOLD 1979, p. 279).

The ammonites of the discussed fauna are recognised in southern Germany (Franconian and Swabian Albs, Oberpfalz area) where a few findings of *Polysphinctites polysphinctus* BUCKMAN come from. Two illustrated specimens of this form (SCHAIRER 1994, fig. 1; DIETZE & SCHWAIGERT 2000, pl. 2, fig. 2) are 35 mm and 37 mm in final diameters, respectively. Some specimens specifically indeterminable represented by inner whorls with strongly developed constrictions coming from this area may be attributed to *Asphinctites* and/or *Polysphinctites* of the fauna in question (DIETZE et al. 1997; see also DIETL 1986). Other findings (DIETZE pers. inf.) include one complete specimen referred to as *Asphinctites* cf. *replictum* attaining 68 mm in final diameter, and two incomplete specimens of *Asphinctites* cf. *pinguis* about 50–55 mm in diameters.

Both the macro– and microconchs of the above discussed fauna show the fairly uniform character and may be treated as representative of the Submediterranean Province. The final size of macroconchs seems to oscillate usually about 60 mm to 70 mm, whereas that of microconchs – about 35 mm to 40 mm.

Quite different in character assemblage of ammonites corresponding to the discussed fauna is recognised in the Mediterranean Province. In the Digne–Barrême area of south–eastern France, beside a single fairly large specimen of *Asphinctites pinguis* attaining 68 mm in final diameter discussed above, two other fully–grown specimens are of somewhat smaller sizes: from 49 mm in final diameter (STURANI 1966, p. 37, fig. 3ab; see also TORRENS 1987, pl. 2, fig. 4ab) to about 55 mm in final diameter (TORRENS 1987, pl. 2, fig. 3). In the Betic Cordillera of southern Spain both the species *Asphinctites replictum* (BUCKMAN) and *Asphinctites pinguis* (DE GROSSOUVRE) have been recognised (SANDOVAL 1983, pp. 357–359, pl. 28, figs 3, 5, 8–9). The complete specimens of the latter range from about 45 mm to 59 mm in final

diameters (SANDOVAL 1983, p. 359, pl. 28, fig. 3); on the other hand, the specimens referred to as *A. replictum* are less complete – only a single specimen attaining about 36 mm in diameter (SANDOVAL 1983, pl. 28, fig. 8) shows a marked uncoiling of the last whorl what suggests it is mature. The smallest fully–grown specimen of *Asphinctites pinguis* was described from the Northern Limestone Alps in northern Austria (KRYSTYN 1972, pp. 264–265, pl. 8, fig. 4): it attains about 30 mm in final diameter only. None of the discussed areas yielded any well–documented (described or illustrated) specimens of *Polysphinctites*. The only possible indication on the occurrence of this forms comes from the Betic – Subbetic zones of southern Spain where a few specimens of *Polysphinctites* sp. have been recorded but not illustrated (MANGOLD 1979, p. 272; SANDOVAL 1983, p. 139).

Some representatives of *Asphinctites* were described from SE–Alborz area in northern Iran under the new genus name *Pseudodimorphinites* by SEYED–EMAMI (see SEYED–EMAMI et al. 1989; see also remarks above): these include such forms as *Asphinctites* (*Pseudodimorphinites*) *komsi* (SEYED–EMAMI) fully–grown at about 36 mm or even at somewhat smaller diameter, and showing the phragmocone/body–chamber boundary already at 20 mm diameter (SEYED–EMAMI et al. 1989, p. 85, pl. 1, figs 15–16), as well as *A.* (*P.*) *foersteri* (SEYED–EMAMI) which holotype is fully–grown at about 28 mm diameter and shows the phragmocone/body–chamber boundary at about 17 mm diameter (SEYED–EMAMI et al. 1989, pp. 85–86, pl. 1, fig. 14). Other, but incomplete specimens of *Asphinctites* represented by pyritized phragmocones were described from Central Iran, from the Tabas–Nayeband area (SEYED–EMAMI et al. 1991): the largest of them referred to as *Pseudodimorphinites pinguis* (DE GROSSOUVRE) = *Asphinctites* (*Pseudodimorphinites*) *pinguis* (DE GROSSOUVRE) is 22 mm in diameter (SEYED–EMAMI et al. 1991, pl. 4, fig. 11). It should be remembered that the only specimens referred to as *Polysphinctites* cf. *polysphinctus* BUCKMAN by SEYED–EMAMI et al. (1991, pl. 4, figs 14–15) are possibly too small for unequivocal interpretation: they attain only about 13–14 mm in diameter and they could represent the inner whorls of *Polysphinctites* and/or *Asphinctites* as well.

Fauna of *Asphinctites tenuiplicatus* (BRAUNS)/*Asphinctites patrulii* HAHN – *Polysphinctites secundus* (WETZEL) and allied forms

Several forms such as *Asphinctites recinctus* BUCKMAN 1924 (holotype refigured by ARKELL 1955, Text–fig.51), *Asphinctites* (= "*Morphoceras*") *transylvanicum* DE GROSSOUVRE 1919 (non SIMIONESCU 1905) – see DE GROSSOUVRE (1919, pl. 15, figs 1–2ab), *Asphinctites* (= "*Siemiradzkia*") *bajociformis* ARKELL 1951 (see ARKELL 1951, pl. 3, fig. 1ab), *Asphinctites bathonicus* WESTERMANN 1958 (see WESTERMANN 1958, pl. 46, fig.4a–c), *Asphinctites gaertneri* WESTERMANN 1958 (see WESTERMANN 1958, pl. 46, fig.3a–c), are considered as synonymous with *Asphinctites tenuiplicatus* (BRAUNS 1865) itself (see HAHN 1970; MANGOLD 1970; TORRENS 1987; PAGE 1996; DIETZE et al. 1997; see also full lists of synonymy in: HAHN 1970, p. 5; and DIETZE et al. 1997, p. 12). All the indicated specimens show markedly evolute coiling of inner and middle whorls, and relatively weakly–developed constrictions (see e.g. DIETZE et al. 1997). *Asphinctites patrulii* HAHN 1970 (see HAHN 1970, pp.53–55, pl. 8, figs 1–4, as well as the Rumanian specimen illustrated by PATRULIUS 1969, pl. 1, fig. 5ab put in synonymy of that form) is also close to *Asphinctites tenuiplicatus* but differs by having a more dense and fine ribbing (see HAHN 1970; TORRENS 1987; DIETZE et al. 1997).

Polysphinctites secundus (WETZEL 1950) the microconch counterpart of *A. tenuiplicatus* includs the vast list of formerly illustrated specimens as shown by HAHN (1970 p.57) and DIETZE et al. (1997, p.14). These specimens reveal strongly evolute coiling of whorls, and poorly marked constrictions (DIETZE et al. 1997). It should be remembered that some specimens attributed to *P. secundus*, such as those illustrated by TORRENS (1987, pl. 2, fig. 8ab), are too small for unequivocal interpretation: they do not show any modification of ribbing observed in fully–grown specimens of *Polysphinctites* (see MATYJA & WIERZBOWSKI, 2000a), and thus they could represent as well the innermost whorls of *Asphinctites*.

The largest macroconchs and microconchs of the discussed fauna are recorded from Central Poland (see MATYJA & WIERZBOWSKI, 2000 a, b; as well as the preceding chapter herein): the maximum diameter of the fully–grown macroconchs of *Asphinctites tenuiplicatus* ranges here between 72 and 119.5 mm (the median diameter is 103.1 mm), whereas that of the phragmocone is between 38.9 and 57.0 mm (the median diameter is 47.2 mm); the maximum diameter of fully–grown microconchs of *Polysphinctites secundus* ranges between 24.5 and 34.5 mm (the median diameter is 27.6 mm) whereas that of the phragmocone is between 14 and 27 mm (the median value is 19.7 mm).

In other areas of Europe the size variablity of the ammonites of the fauna is less known and could be deduced mostly from limited number of figured specimens. Nevertheless, general trends appear rather obvious.

In north–west Germany the only fully–grown specimens of *Asphinctites tenuiplicatus* (= *A. bathonicus* in: WESTERMANN 1958, p. 88, pl. 46, fig. 4a–c) is about 70 mm in close to maximum diameter, and 43 mm in phragmocone maximum diameter: all other specimens are not complete phragmocones about 35 mm in diameters, and hence not useful in general considerations on the end–size of this form. Of three fully–grown specimens of *Polysphinctites secundus* illustrated so far from north–west Germany, the largest one referred to as *P* cf. *secundus* by HAHN (1970, pl. 8, fig. 13) attains about 30 mm in final diameter, and 19 mm in maximum phragmocone diameter; two other specimens (lectotype of *P. secundus*, see SCHLOENBACH 1865, pl. 29, fig. 3ab, and specimen illustrated by WESTERMANN 1958, pl. 46, fig. 2a–c; see also HAHN 1970, p. 58) although devoid of final

part of the body–chambers, show the presence of crowded septa marking the end of phragmocone already at 13 mm diameter (HAHN 1970, p. 58).

Three fully–grown specimens of *A. tenuiplicatus* from south–western Germany (Swabian and Franconian Albs) as illustrated by HAHN (1970, pl. 7, figs 1, 4, and pl. 8, fig. 1)) are between 68 mm and 79 mm in final diameters, and show the phragmocone/body–chamber boundaries at about 35 mm to 45 mm diameters. Similar size is shown also by the fully–grown (although devoid of final peristome) specimen of *A. tenuiplicatus* (=" *Siemiradzkia* " *bajociformis*) illustrated by ARKELL (1951, p.13, pl. 3, fig. 1ab): its final size ranges about 70 mm, and the phragmocone/body–chamber boundary is at about 45 mm diameter. The specimens illustrated by DIETZE et al. (1997, pl. 2) from Oberpflaz area in south–eastern Germany are mostly incomplete, and hence they have not to be smaller when fully–grown as suggested therein, in comparison with the specimens from south–western Germany. The largest ones (DIETZE et al. 1997, pl. 2, figs 1 and 8) show a marked uncoiling of the last whorl at about 45 mm and 55 mm, but still they do not reveal any decrease in whorl–height what is typical feature of fully–grown *A. tenuiplicatus.* Another specimen about 30 mm in diameter interpreted by DIETZE et al. (1997, p. 13, pl. 3, fig. 3) as "the completely preserved form with aperture" differs in its size and type of coiling from all the other specimens of *A. tenuiplicatus* (see e.g. DIETZE et al. 1997, pl. 1) and its systematic interpretation seems somewhat unclear. A few specimens of *A. tenuiplicatus* from the north–eastern Swabian Alb show fairly large end–sizes similar to those of the Polish specimens (DIETZE, pers. inf.). The illustrated specimens of *P. secundus* from south–western Germany (HAHN 1970, figs 7–13; SCHLEGELMILCH 1985, pl. 37, figs 2–3; see also DIETZE et al. 1997) are generally small, about 18 to 25 mm when fully–grown, and show the end of phragmocone marked by crowded septa already at 11–13 to 16 mm diameters. The specimens of *P. secundus* from the Oberpfalz area of south–eastern Germany (DIETZE et al. 1997, pl. 1, figs 5–11) are from 16 to 27 mm in final diameters showing the end of phragmocone from about 10 to 16 mm diameters.

From the aforegoing one may suggest that the German ammonites are in average smaller than those described from Central Poland, but nevertheless the total ranges of size variability both for macroconchs and microconchs in the two areas partly overlap. It is difficult to evaluate precisely the median end–sizes of *Asphinctites tenuiplicatus* and *Polysphinctites secundus* on the base of German material so far illustrated. It may be, however, suggested that the median value for *A. tenuiplicatus* in Germany should oscillate around 70 mm, and that for *P. secundus* about 20 mm. These values are about 30% smaller than the corresponding values recognised in Central Poland. The data enable distinguishing of the two assemblages of *Asphinctites tenuiplicatus–Polysphinctites secundus* in Submediterranean Europe differing in median sizes of macro– and microconchs – the larger–sized assemblage from central Poland, and the smaller–sized one from Germany.

The representatives of the *A. tenuiplicatus – P. secundus* fauna are also known from other Submediterranean areas of western and north–western Europe, from England and France. The English specimen of *A. tenuiplicatus* (= *A. recinctus* BUCKMAN, see ARKELL 1955, Text–fig. 51) is about 64 mm in diameter, but although fully–grown it has not preserved the final peristome – thus, it end–size could be around 70 mm. The specimen is considered as the only undoubtful evidence of the Tenuiplicatus Zone in Britain (TORRENS 1980, fide PAGE 1996, see also DIETZE & CHANDLER 1997). The specimens of *A. tenuiplicatus* (= "*Morphoceras*" *transylvanicum* of DE GROSSOUVRE 1919, pl. 15, figs 1–2) coming from the Niévre area at the southern border of the Paris Basin are from about 50 to 52 mm in diameter, and although incomplete they show uncoiling of the last whorl. Another specimen of *A. tenuiplicatus* (see MANGOLD & RIOULT 1997, pl. 16, fig. 7) from the French Jura Mts is about 50 mm in diameter but still incomplete with missing part of the last whorl. The form *Polysphinctites* cf. *secundus* has been recorded from the Nièvre area (ZANY et al. 1995) but without any description or illustration. The discussed fauna from England and France, although poorly known, in its composition and final–sizes of the specimens seems close to coeval assamblege of *A. tenuiplicatus P secundus* from Germany, as discussed above.

Quite different character of the coeval ammonite fauna is stated in areas of southern and south–eastern France corresponding to the Mediterranean Province. The fauna consists of small–sized *Asphinctites*, both *Asphinctites tenuiplicatus* (BRAUNS) and allied *Asphinctites patrulii* HAHN. It is especially well recognised in the Digne–Barrême area of south–eastern France (STURANI 1966; TORRENS 1987). These specimens referred sometimes with reservation to *A. tenuiplicatus* (= *A. recinctus* in STURANI 1966, pp. 37–38, pl. 10, fig. 2ab, pl. 11, fig. 9; see also HAHN 1970, p. 53) are complete already at about 45 mm in diameter, and have body–chambers slightly more than a whorl long, thus showing the phragmocone/body–chamber boundary at about 20 – 22 mm. Another specimen possibly related to *A. tenuiplicatus* (*A.* aff. *tenuiplicatus* of TORRENS 1987, pl. 2, fig. 7; see also DIETZE et al. 1997) is about 45 mm in (?) final diameter. The specimens referred to as *A.* aff. *patrulii* HAHN by TORRENS (1987, p. 98, pl. 2, figs 5–6, 9–12) fall within the *A. tenuiplicatus* group, and some of them (pl. 2, figs 10–12) are fully–grown as shown by their markedly uncoiled last part of the whorls attaining from about 37.5 to about 43 mm in final diameter.

Other specimen of *A. patrulii* (= *Asphinctites transsylvanicus* of PATRULIUS 1969, pl. 1, fig. 5ab and earlier illustration of this specimen indicated in HAHN 1970, p.53) comes also from the Mediterranean Province – from the Bucegi Massive in Rumanian Carpathians: it has about 40 mm in diameter and seems fully–grown, although the final peristome is not preserved. It should be remembered, however, that the form *A. patrulii* is known also from south–western Germany corresponding to the southern part of the Submediterranean Province (southern Swabian Alb; see HAHN 1970, pp. 53–55, pl. 8, fig. 1ab): the specimen is fully–grown about 43 mm in final diameter (although without final peristome) having about 2/3 whorl long body–chamber which begins at 28 mm diameter.

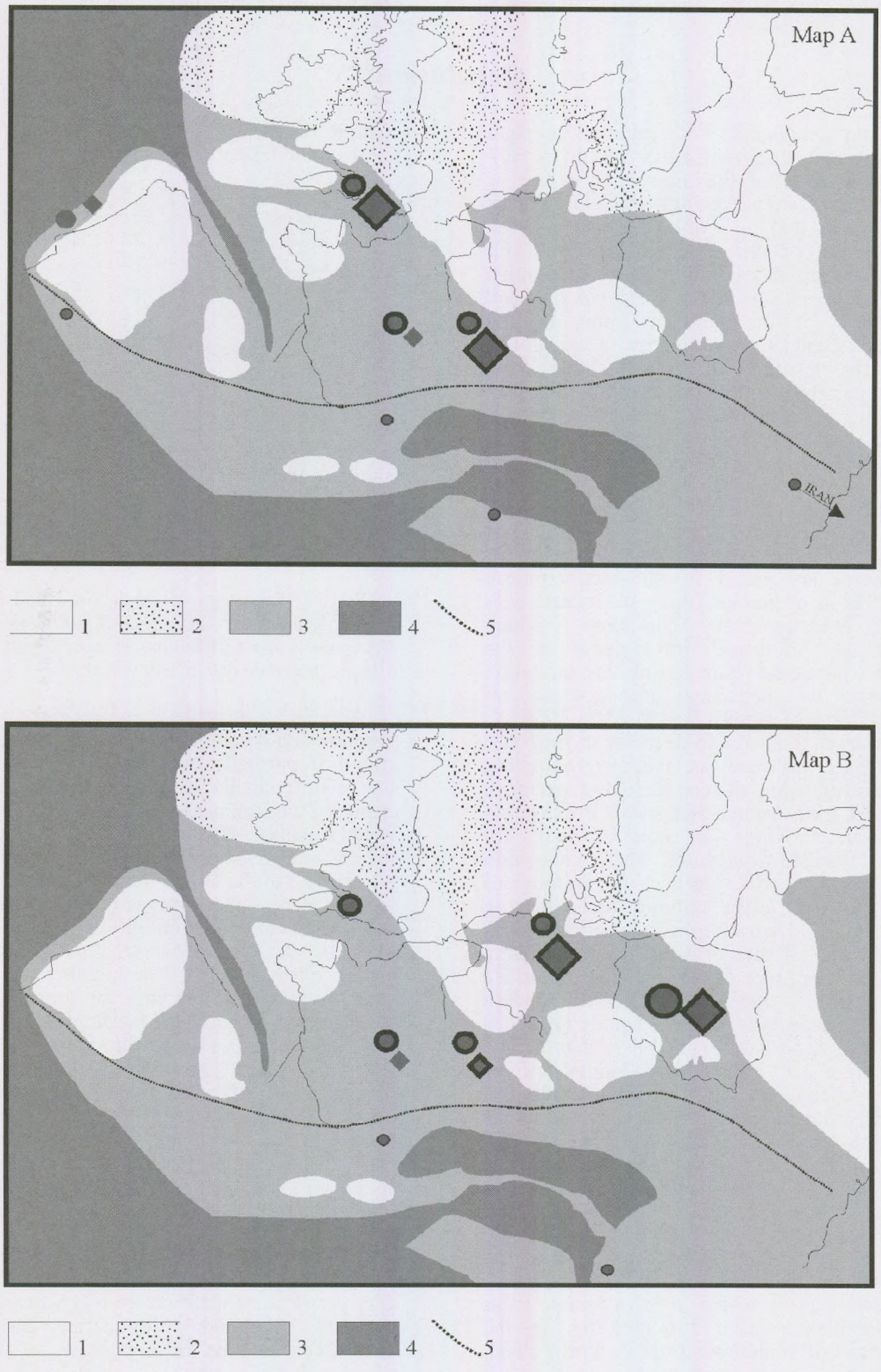


Fig. 3. Palaeogeographic maps (compiled from CARIOU et al. 1985, and GOLONKA et al., 2000; partly modified) of the distribution of the *Asphinctites* (circles) – *Polysphinctites* (diamonds) faunas during Early Bathonian. 1 – land with prevailing erosion, 2 – areas of non–marine or brackish sedimentation, 3 – epicratonic seas, 4 – ocean basins, 5 – northern boundary of the Mediterranean Province
Map A. *A. pinguis*/*A. replictum* – *P polysphinctus* and allied form fauna
Map B: *A. tenuiplicatus*/*A. patrulii* – *P secundus* and allied form fauna
Size of symbols indicates relative size of ammonites; not–framed symbols correspond to ammonites of unknown size.

From the aforegoing it becomes evident that the third discussed assemblage of the considered ammonite fauna typical of the Mediterranean Province consists of the smallest–sized macroconchs of *A. tenuiplicatus* – *A. patrulii* ranging from about 37.5 to about 45 mm in final diameters, and is completely devoid of *Polysphinctites*–type microconchs.

Conclusions

A marked geographic differentiation in final sizes of shells and occurrence either of both macro– and microconchs or of the macroconchs only is recognised within two succeeding ammonite faunas of *Asphinctites* (M) – *Polysphinctites* (m) in particular areas of the Submediterranean and Mediterranean provinces during Early Bathonian (Fig. 3). The largest specimens of *Asphinctites* and *Polysphinctites* of the younger fauna of the Tenuiplicatus Zone (*A. tenuiplicatus* – *P. secundus*) found in the territory of Poland come from peripheral, possibly highly stress–influenced, and thus showing to some degree endemic character part of the Submediterranean Province. Somewhat smaller representatives both of *Asphinctites* and *Polysphinctites* of the two ammonite faunas are widely distributed in bulk of the Submediterranean Province in Europe, whereas the smallest *Asphinctites* to the almost total absence of *Polysphinctites* are stated in the Mediterranean Province. These phenomena may be related with changing environmental conditions which influenced the ontogenic development of the ammonites what could result in time of maturation (as expressed by shell size) and existence of particular number of morphs (see MATYJA 1986).

The observed tendency to decrease in final size of *Asphinctites* macroconchs and *Polysphinctites* microconchs (including the complete disappearance of the latter) from Submediterranean Province to Mediterranean Province is more difficult for unequivocal detailed explanation. The phenomenon may be related with earlier maturation of ammonites towards lower latitudes, and replacing in that direction of two morphs by a single morph as a consequence of smaller contrast in seasonality of the environment (see MATYJA 1986). There are evidences from studies of some modern cepahalopods, especially modern squids (ZUEV et al. 1979; NESIS & NIGMATULLIN 1979), that marked difference in size of fully mature animals of the same sex, depends on environmental conditions, mostly the temperature of the sea–water. The squids from the tropical Atlantic attain their maturity at fairly small size in sea–water of higher temperature, whereas the same forms may attain maturity at larger size at the periphery of their geographic range as a consequence of delayed maturation in sea–water of lower temperature (Fig. 4). Similarly, we suggest that ammonites of the *Asphinctites*–*Polysphinctites* group which lived in remote areas of the Submediterranean Province, as in the discussed case of ammonites from Central Poland, could have reached their maturity at larger sizes due to lower temperature of sea–water.

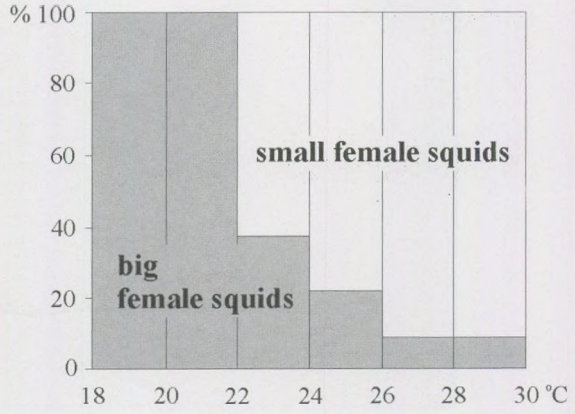


Fig. 4. Percentage of small sized and large sized mature females of the squid *Sthenoteuthis pteropus* versus sea–water temperature in eastern part of Central Atlantic (based on data of ZUEV et al. 1979)

Another possible explanation of the phenomenon could be the difference in rate of shell growth in particular areas or even the difference in size of ammonitella, which may be also related with changing environmental conditions (cf. MATYJA & WIERZBOWSKI, 2000c). The problem cannot be solved unequivocally without recognition of the growth rate of the ammonite shell expressed e.g. by septal density during ontogeny in ample number of specimens coming from different areas (see e.g. MATYJA & WIERZBOWSKI, 2000c, and earlier papers cited therein). The number of septa per whorl is known so far only for some Polish large specimens of *Asphinctites tenuiplicatus* (BRAUNS) and *Polysphinctites secundus* (WETZEL), and for a few specimens representing the incomplete phragmocones of small–sized *Asphinctites pinguis* (DE GROSSOUVRE) and allied forms from Central Iran (Text–fig. 3); in both cases the number of septa per whorl is similar, from 11 to 13 septa per whorl at 17 mm to about 45 mm diameters in Polish specimens (see chapter on Polish fauna herein), and from 10 to 11 septa per whorl at 11 to 21.5 mm diameters in Iranian specimens illustrated by SEYED–EMAMI et al.(1989, pl. 4, figs 10, 11, 15, after personal information from G.SCHAIRER), what suggests a similar growth–rate and marked differences in time of maturation of ammonites between the two areas.

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Plates

Plate 1

Asphinctites tenuiplicatus (BRAUNS)

Figs 1–4. Inner whorls and/or immature specimens, 1– No. IGPUW/A/38/9, 2 – No. IGPUW/A/38/39, 3 – No. IGPUW/A/38/5, all from Leszczyński's brick–pit level K, 4 – No. IGPUW/A/38/40 from Faustianka brick–pit level 0.

Figs 5–8. Fully–grown specimens, collection of K. DEMBICZ and T. PRASZKIER from Faustianka brick–pit, level 0.

All specimens in natural size

Plate 1

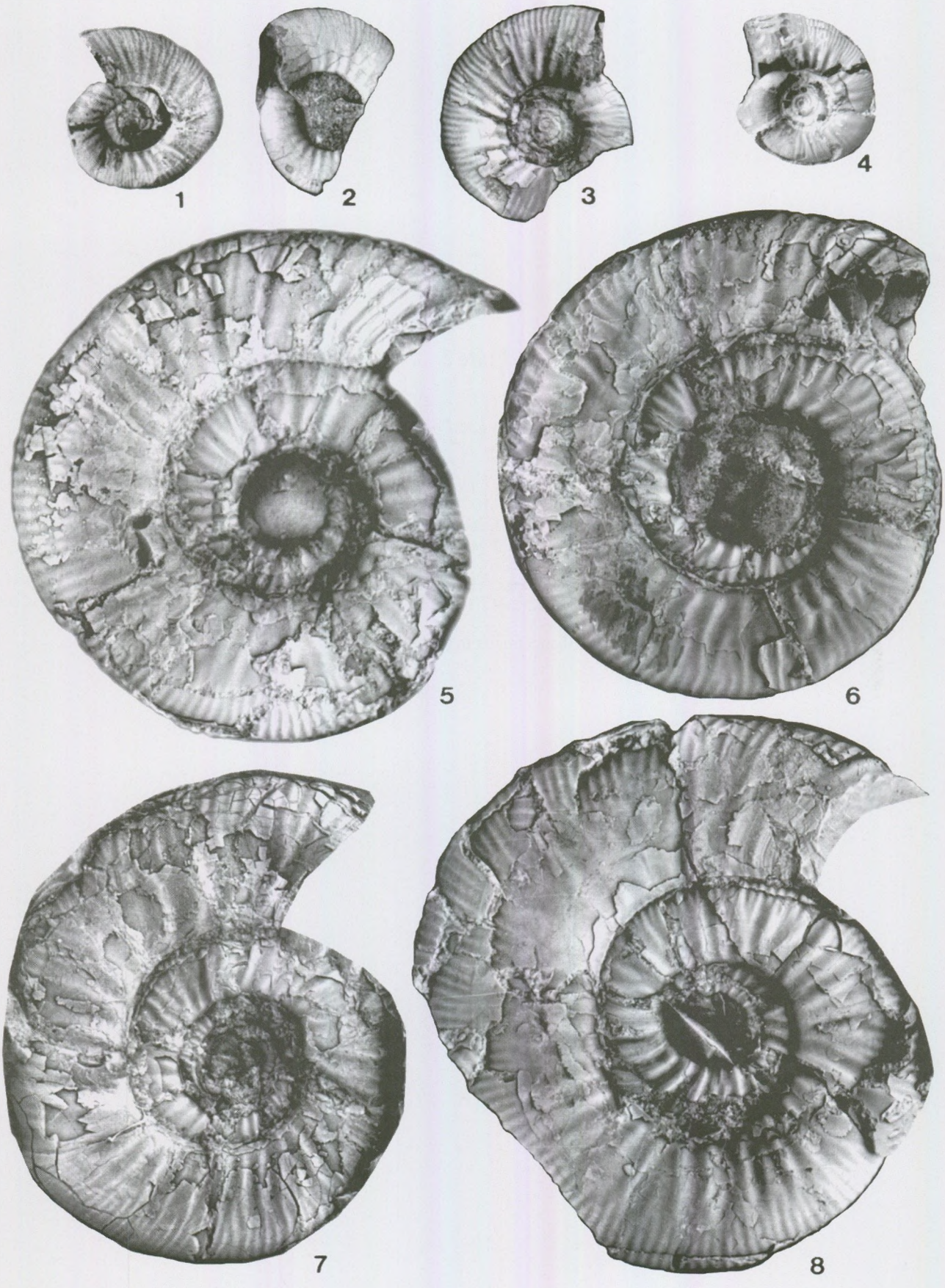

Plate 2

Asphinctites tenuiplicatus (BRAUNS) and *Polysphinctites secundus* (WETZEL)

Figs 1–3 and 6–8. *Polysphinctites secundus* (WETZEL), 1– No. IGPUW/A/38/7, 2 – No. IGPUW/A/38/13, 3 – No. IGPUW/A/38/6 and 6 – No. IGPUW/A/38/12, 7 – No. IGPUW/A/38/8a all from Leszczyński's brick–pit level K, 8 – No. IGPUW/A/38/28 from Faustianka brick–pit level 0

Figs 4, 5 and0 9, 10. *Asphinctites tenuiplicatus* (BRAUNS) fully–grown specimens, collection of K. DEMBICZ and T. PRASZKIER from Faustianka brick–pit, level 0

All specimens in natural size

Plate 2