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THE MIDDLE OXFORDIAN PERISPHINCTIDAE OF ZAWODZIE  
NEAR CZĘSTOCHOWA (POLAND)

Contents

	Page
Abstract . . . . .	167
Introduction . . . . .	167
Acknowledgements . . . . .	169
Stratigraphic remarks . . . . .	169
Material, working methods and terminology . . . . .	171
Foundations of the classification of the Perisphinctidae . . . . .	173
Palaeoecological and palaeogeographical conclusions . . . . .	174
Systematic description . . . . .	177
Genus <i>Perisphinctes</i> Waagen, 1869 . . . . .	177
Subgenus <i>Perisphinctes</i> ( <i>Arisphinctes</i> ) Buckman, 1924 . . . . .	177
Subgenus <i>Perisphinctes</i> ( <i>Dichotomosphinctes</i> ) Buckman, 1926 . . . . .	185
Subgenus <i>Perisphinctes</i> ( <i>Kranaosphinctes</i> ) Buckman, 1921 . . . . .	190
Subgenus <i>Perisphinctes</i> ( <i>Liosphinctes</i> ) Buckman, 1925 . . . . .	193
Subgenus <i>Perisphinctes</i> ( <i>Perisphinctes</i> ) Waagen, 1869 . . . . .	195
Genus <i>Lithacoceras</i> Hyatt, 1900 . . . . .	114
Subgenus <i>Lithacoceras</i> ( <i>Progeronia</i> ) Arkell, 1953 . . . . .	214
Subgenus <i>Lithacoceras</i> ( <i>Subdiscosphinctes</i> ) n.subgen. . . . .	217
References . . . . .	228

*Abstract.* — Ammonites of the family Perisphinctidae from the Middle Oxfordian of Zawodzie (Częstochowa) have been elaborated. Within the genus *Lithacoceras*, the new subgenus *Subdiscosphinctes* is distinguished. Included in this subgenus are some of the species hitherto assigned to the subgenus *Discosphinctes*; such are: *L.(S.) mindowe* (Siemiradzki) and *L.(S.) kreutzii* (Siemiradzki). Are also described five new species: *Perisphinctes* (*Perisphinctes*) *alatiformis* n.sp., *P.(P.) enayi* n.sp., *P.(P.) multicostratus* n.sp., *P.(P.) swidzinskii* n.sp. and *Lithacoceras* (*Subdiscosphinctes*) *boreale* n.sp. The directions of their migration and their palaeobiogeographical relationships have been elucidated.

INTRODUCTION

The fauna of the Middle Oxfordian deposits of Zawodzie (Częstochowa) (Text-fig. 1), famous for large ammonites of the family Perisphinctidae, has not until now been accurately elaborated palaeontologically. World

War II was the main cause of this fact. S. Z. Różycki's and K. Kaznowski's collections accumulated for many years from the area of the Częstochowa Jurassic were almost completely destroyed. Their remains, rescued from the ruins of the State Geological Institute's Museum in Warsaw and later enriched by other collectors, now make up a valuable collection of the Middle Oxfordian ammonites, which may serve faunal correlations with the Jurassic of England, France and Germany.

The representatives of the family Perisphinctidae are the main Oxfordian ammonites of Zawodzie. Due to their sometimes impressive



Fig. 1. — Localization of the outcrop of the Middle Oxfordian deposits at Zawodzie near Częstochowa.

dimensions and accumulation, the outcrop at Zawodzie may be considered as one of the most important in this respect in Europe.

The present paper has been prepared at the Palaeozoological Laboratory of the Stratigraphic Department, Geological Institute. The specimens of ammonites are housed at the Geological Institute's Museum in Warsaw, abbreviated as IG.

## ACKNOWLEDGEMENTS

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## STRATIGRAPHIC REMARKS

The limestones outcropped at Zawodzie were studied by many authors (Zejszner, 1884, 1869; Bukowski, 1887; Koroniewicz & Rehbindler, 1913; Siemiradzki, 1922; Wiśniewska, 1932; Premik, 1933; Różycki, 1948, 1953; Malinowska, 1963). Różycki (*l.c.*) assigns them to the Upper Argovian. It has recently been shown by Brochwicz-Lewiński (1970) that the limestones from Zawodzie are of Middle and Upper Oxfordian age.

In the present paper, a particular attention is called to the ammonites of the family Perisphinctidae characteristic of the Middle Oxfordian. As follows from a series of hitherto published papers, only few ammonites of the family Perisphinctidae were cited or described from the Middle Oxfordian deposits of Zawodzie. These are: *Perisphinctes lucigensis* Favre, *P. promiscuus* Bukowski, *P. dunikowskii* Siemiradzki, *P. wartae* Bukowski, *P. plicatilis* (Sowerby), *P. martelli* (Oppel), *P. convolutus* (Quenstedt). Also known were the species: *Peltoceras transversarium* (Quenstedt), *Euaspidoceras oegir* (Oppel), *E. babeau* (d'Orbigny), *Ochetoceras canaliculatum* (Buch), *Trimarginites arolicus* (Oppel), *Taramelliceras callicerum* (Oppel), *Phylloceras* sp. and *Cardioceras alternans* (Buch)<sup>1</sup>.

Poland's Middle Oxfordian deposits are on the whole developed in the carbonate and siltstone-marly facies (Malinowska, 1966, 1967, 1968, 1971). A stratigraphic division, based in the case of the carbonate facies on

<sup>1</sup> Specific designations are here given in the same form in which they were used in former papers.

Table 1  
Stratigraphic range of the described species of the family Perisphinctidae

Stratigraphy Species	Middle Oxfordian	
	<i>Perisphinctes chloroolithicus</i> and <i>Cardioceras tenuiserratum</i> Zone	<i>Perisphinctes wartae</i> and <i>Amoeboceras alternans</i> Zone
<i>Perisphinctes</i> ( <i>Arisphinctes</i> ) cf. <i>cotovui</i> Simionescu	+	—
<i>P.</i> ( <i>Kranaosphinctes</i> ) <i>cyrilli</i> Neumann	+	—
<i>P.</i> ( <i>K.</i> ) <i>methodii</i> Neumann	+	—
<i>P.</i> ( <i>A.</i> ) cf. <i>helenae</i> Riaz	+	+
<i>P.</i> ( <i>A.</i> ) <i>maximus</i> (Young & Bird)	+	+
<i>P.</i> ( <i>Dichotomosphinctes</i> ) <i>buckmani</i> Arkell	+	+
<i>P.</i> ( <i>Perisphinctes</i> ) <i>andelotensis</i> Enay	+	+
<i>P.</i> ( <i>P.</i> ) <i>pumilus</i> Enay	+	+
<i>P.</i> ( <i>A.</i> ) <i>plicatilis</i> (Sowerby)	—	+
<i>P.</i> ( <i>D.</i> ) cf. <i>elisabethaeformis</i> Burckhardt	—	+
<i>P.</i> ( <i>D.</i> ) <i>wartae bedoensis</i> Collignon	—	+
<i>P.</i> ( <i>Liosphinctes</i> ) sp. <i>A</i>	—	+
<i>P.</i> ( <i>P.</i> ) <i>alatiformis</i> n.sp.	—	+
<i>P.</i> ( <i>P.</i> ) <i>cuneicostatus</i> Arkell	—	+
<i>P.</i> ( <i>P.</i> ) <i>enayi</i> n.sp.	—	+
<i>P.</i> ( <i>P.</i> ) <i>multicostatus</i> n.sp.	—	+
<i>P.</i> ( <i>P.</i> ) <i>swidzinskii</i> n.sp.	—	+
<i>P.</i> ( <i>P.</i> ) sp. <i>A</i>	—	+
<i>P.</i> ( <i>P.</i> ) sp. <i>B</i>	—	+
<i>P. berlieri</i> Loriol	—	+
<i>Lithaceras</i> (? <i>Progeronia</i> ) <i>choffati</i> (Riaz)	—	+
<i>L.</i> (? <i>P.</i> ) sp. <i>A</i>	—	+
<i>L.</i> ( <i>Subdiscosphinctes</i> ) <i>boreale</i> n.sp.	—	+
<i>L.</i> ( <i>S.</i> ) <i>kreutzi</i> (Siemiradzki)	—	+
<i>L.</i> ( <i>S.</i> ) <i>mindowe</i> (Siemiradzki)	—	+
<i>L. aeneas plana</i> (Siemiradzki)	—	+

ammonites of the family Perisphinctidae and in the case of the siltstone-marly facies on those of the family Cardioceratidae, was prepared by the present writer. A uniform division, suggested by her, was postulated in her previous paper (1968). Two zones of the Middle Oxfordian, the upper one with *Perisphinctes wartae* and *Amoeboceras alternans* and the lower one with *Perisphinctes chloroolithicus* and *Cardioceras tenuiserratum* are represented at Zawodzie.

Within the Middle Oxfordian deposits, the ammonites of the family Perisphinctidae are mostly grouped in the upper zone with *Perisphinctes wartae* and *Amoeboceras alternans*. In addition, there are species with a more extensive range of occurrence, including both the upper and lower

zone of the Middle Oxfordian. Furthermore, there are also species whose range is restricted to the lower zone only, that is that with *Perispinctes chloroolithicus* and *Cardioceras tenuiserratum* (Table 1).

#### MATERIAL, WORKING METHODS AND TERMINOLOGY

The collection of large ammonites from Zawodzie includes several scores of specimens, many of which are suitable for elaboration. All the specimens available to the writer are preserved in the form of calcareous internal moulds. Both the development of ribbing, beginning with inner whorls, and the shape of sutures may be traced in them. The analysis of change in ribbing in the course of the ammonites ontogenetic development is of a great importance to their taxonomy. It is particularly in the genera of the family Perispinctidae, in which these changes sometimes take place abruptly, and make up fundamental taxonomic characters.

Most of the ammonites from Zawodzie correspond to the gerontic stage, although an indisputable evidence in the form of an ultimately developed shell aperture, which might confirm this, is still lacking. The determination of the gerontic stage of particular specimens was based on a detailed analysis of the remaining features characteristic of the individuals whose growth had already been completed. According to Makowski (1963), to determine a gerontic stage, one should analyze sutures, the shape of aperture, the development of ornamentation on whorls and the muscle scars. Having at her disposal specimens preserved in the form of internal molds, the writer could take into account in her considerations only the development of sutures and the ribbing of the gerontic body chamber.

As shown by observations, in most specimens in the gerontic stage, the sutures concentrate towards the end of septate part. Sometimes, the sutures are so closely concentrated and tangled that it is almost impossible to trace a single continuous line. In some other cases, the concentration of particular elements of sutures is so small that it is difficult to estimate correctly to which stage individual specimens correspond. The ornamentation of specimens in the gerontic stage is examined primarily in the gerontic body chamber, where the ribbing is subject to far-reaching changes. The picture of the gerontic body chamber varies depending on the subgenus to which a specimen belongs (Table 2).

Constrictions, numerous occurring in inner whorls, do not occur or occur very rarely on the gerontic body chamber of some of the subgenera.

The method of a "rib-curve" (Text-fig. 2) allowing one for a graphical presentation of the development of ribbing on whorls turned out to be very helpful in determining species and genera of the family Perispinct-

Table 2  
Ornamentation of the gerontic body chamber

Genus	Subgenera	Gerontic body chamber
<i>Perisphinctes</i>	<i>Perisphinctes</i> s. str.	the first cuneiform ridges already in the septate part, distances between primary ribs smaller and smaller, primary ribs becoming straight towards the end of the body chamber
	<i>Arisphinctes</i>	ribs, at first thick and convex, never cuneiform, towards the end passing into straight and more concentrated ones
	<i>Kranaosphinctes</i>	ribs thick, widely spaced, decreasing towards the end
	<i>Dichotomosphinctes</i>	primary ribs more strongly inclined anteriorly
	<i>Liosphinctes</i>	primary ribs convex, widely spaced
<i>Lithacoceras</i>	<i>Progeronia</i>	primary ribs convex, particularly so in the lower and central part of whorl, widely spaced
	<i>Subdiscosphinctes</i>	primary ribs gradually swelling, widely spaced, trifurcate, frequently dischizotomous

tidae. The coincidence of particular rib-curves with the holotype provided a basis for a correct determination of a species.

Among the many characters allowing one for a correct specific assignment, very important are the shape of the primary ribs and the manner of their furcation. In the present work, we have to do with

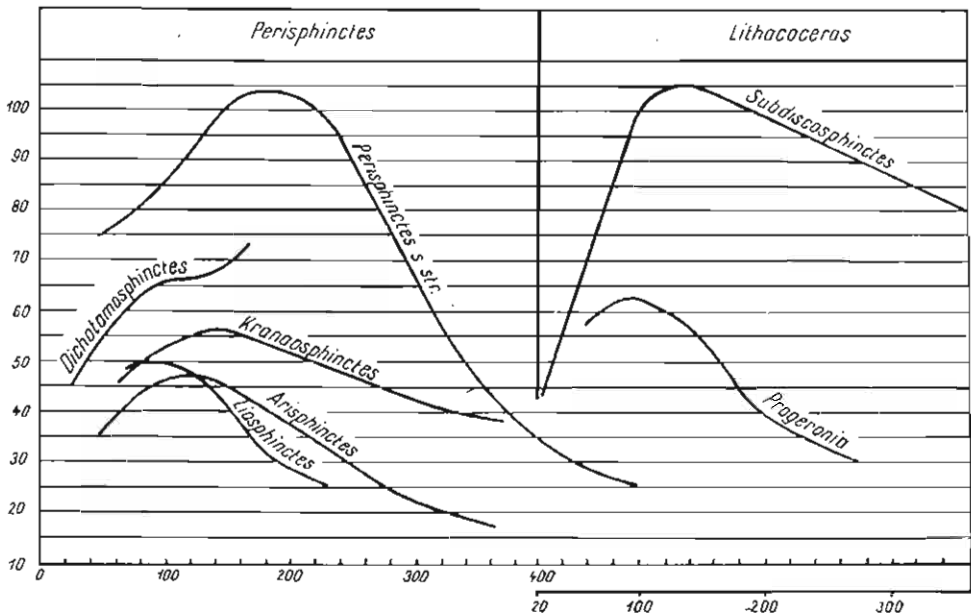


Fig. 2. — Rib-curves characteristic of selected subgenera of the genera *Perisphinctes* and *Lithacoceras*.

the species in which the monoschizotomous type of the furcation of primaries is predominant and in which the dischizotomous type occurs subordinately. The monoschizotomous type is represented by bi-, tri- and quadrifurcate ribs, while the dischizotomous type is marked by a polygyrate division.

Due to their varying degree of preservation, a detailed observation of sutures is very difficult. In most cases, the sutures are secondarily deformed by corrosion and consequently particular elements of these lines are more rounded than they were originally. In general, attention has been paid to the development of the external, the first lateral and the umbilical lobe.

In the descriptions and specific determinations, attention has been paid to:

D — diameter of shell (in mm)

H — height of the last whorl in relation to the diameter of shell

Th — width of the last whorl in relation to the diameter of shell

U — diameters of umbilicus in relation to the diameter of shell

Chl — body chamber

Chg — gerontic body chamber

Ph — septate portion

Ph/Chl — contacting place of the septate portion with the body chamber

Ph/Chg — contacting place of the septate portion with the gerontic body chamber

R — number of primary ribs in a whorl with a corresponding diameter

Th<sub>a</sub> — width of the last whorl between the ridges in relation to the diameter of shell

Th<sub>b</sub> — width of the last whorl on the ridges in relation to the diameter of shell

#### FOUNDATIONS OF THE CLASSIFICATION OF THE PERISPHINCTIDAE

Two trends may be observed in the development of views on the classification of the Perisphinctidae. According to the first of them, the authors attach a considerable importance to the sutures as taxonomic criterion and according to the second, ribbing should be a basis for classification.

Neumann (1907), Buckman (1924) and Schindewolf (1925) base their considerations on a considerable suitability of sutures for taxonomic purposes on the statement that the sutures inside the shell contacted their

environment to a smaller extent and could develop independently of it. Pfaff (1911), on the other hand, believes that the suture is precisely a perfect example of the effect of the external pressure of water and, consequently, of an influence exerted by the environment.

Klebelberg (1912) and Spath (1931) maintain that ribbing is more important to taxonomy. According to Arkell (1935—1948), the character of sutures and ribbing should be studied in all stages of ontogenetic development and the shaping of the first few septa behind the protoconch should be observed. As follows from his later works, in the taxonomy of the Perisphinctidae this author attaches most importance to the development of ribbing during the neanic, ephebic and gerontic development stages. To the best of his possibilities, Arkell analyzes the sutures, confronting them with a pattern typical of individual subgenera.

As found by Makowski (1963), particularly important to taxonomy is undoubtedly a detailed analysis of all characters in gerontic individuals. This is closely connected with the sexual dimorphism studied by this author in the ammonites.

The separation of particular subgenera on the basis of the ornamentation of shell in the gerontic stage has already been criticized by Beurlen (1926), who supports the opinion of the authors paying attention to inner whorls. Beurlen's standpoint does not, however, seem to be practical, since the inner whorls are mostly difficult to observe accurately.

Most convincing is the reasoning of Arkell, who believes that the sudden change in ribbing, observed in some of the Perisphinctidae had to be connected with physiological changes in an animal's body and that it is not characteristic of the body chamber only, but it begins as early as in the septate part at one-quarter of a whorl. Arkell considers this fact, along with the lack of data on thick or resorbed ribs on inner whorls, as evidence that the change in ribbing took place only once in an animal's life-time, that is, in the gerontic stage.

Hence, accepting Arkell's views, the present writer pays most attention to the change in ribbing in the course of the ontogenetic development and only to a smaller extent to the development of sutures which, as mentioned above, were in our specimens fully preserved in few cases only.

In the diagnoses of individual subgenera the writer takes into account, more extensively than it has ever been done before, the character of ribbing.

#### PALAEOECOLOGICAL AND PALAEOGEOGRAPHICAL CONCLUSIONS

The Middle Oxfordian deposits of Poland, excepting the Carpathian Mountains, are strongly differentiated facially. On the whole, the following



facies may be distinguished: the facies of spongyferous limestones, locally biohermal, predominating in Eastern Poland; the facies of platy limestones, including Central Poland and the siltstone-marly facies occurring in North-Western Poland. Faunal differences are found depending on the variable conditions of the formation of deposits, which, among other factors, is determined by the depth of a basin. Thus, for instance, the fauna of pelecypods, gastropods and brachiopods predominates in the facies of spongy limestones, of ammonites of the family Perisphinctidae in the facies of platy limestones and of ammonites of the family *Cardioceratidae* in the siltstone-marly facies.

The Middle Oxfordian deposits of Zawodzie represent the facies of platy limestones including the Miechów-Łódź Depression, southern part of the Mogilno Depression and the Cracow-Wieluń Jura Chain. The fauna of the limestones under study abounds in ammonites which mostly belong to the family Perisphinctidae, with a considerable smaller part of the representatives of the families *Oppeliidae*, *Haploceratidae* and *Aspidoceratidae*.

The Middle Oxfordian Perisphinctidae reach very large dimensions, sometimes to 480 mm in diameter. They have a very diversified ornamentation of whorls in the form of ridges, swellings and thick ribs. This considerable accumulation of ammonites, along with their morphology, give evidence that the environment they lived in was favourable to their development. As shown by hitherto conducted studies, the ammonites of the family Perisphinctidae had the best development conditions in a shelf sea, at a depth of 150 to 200 m.

The question whether the ammonites with a considerably varied ornamentation of whorls led a bottom mode of life or were nectonic forms, to which most ammonites are assigned, is open to discussion. Some of the authors (Kovacs, 1956) maintain that the evolute species, having ornamentation in the form of ridges and thick ribs, with low but thick whorls and with widely spaced air chambers, may be considered as benthonic forms. Various authors expressed their opinions on the palaeoecological conditions and their effects on the development of particular families and even genera (Scott, 1940; Ziegler, 1963, 1967; Malinowska, 1967 and others).

The Perisphinctidae from the Zawodzie deposits have a very wide range of geographical distribution (Table 3). The analysis of the occurrence of individual species allows one to find that the marine basin, in which these deposits were formed, was connected with the surrounding seas. In the south and south-east, this basin was connected through the Moravian and Przemyśl gates, with the Tethys Sea. As shown by similarities in the fauna of ammonites, its connection with the North-German and English basins during the Middle Oxfordian period was surely quite easy.

Geographical distribution of the species of the family Perisphinctidae

Table 3

Europe						Regions										
Southern area			North-western area	Eastern area	Extra-European areas											
Portugal and Spain	Switzerland	Southern France	Southern Germany	Czechoslovakia	Rumania		Crimea and Caucasus	England	Northern France	Northern Germany	Donets Basin	Turkmenistan	Mexico	Madagascar	Turkey	
																<i>P.(A.) cf. cotovui</i> Simionescu
																<i>P.(A.) cf. helenae</i> Riaz
																<i>P.(A.) plicatilis</i> (Sowerby)
																<i>P.(D.) buckmani</i> Arkell
																<i>P.(D.) cf. elisabethae-formis</i> Buckman
																<i>P.(D.) wartae bedoensis</i> Collignon
																<i>P.(K.) cyrilli</i> Neumann
																<i>P.(K.) methodii</i> Neumann
																<i>P.(P.) alatifformis</i> n.sp.
																<i>P.(P.) andelotensis</i> Enay
																<i>P.(P.) cuneicostatus</i> Arkell
																<i>P.(P.) enayi</i> n.sp.
																<i>P.(P.) pumilus</i> Enay
																<i>P. berlieri</i> Loriol
																<i>P.(P?) choffati</i> (Riaz)
																<i>L.(S.) kreutzii</i> (Siemiradzki)
																<i>L.(S.) mindowe</i> (Siemiradzki)
																<i>L. aeneas plana</i> (Siemiradzki)

## SYSTEMATIC DESCRIPTION

**Cephalopoda** Leach, 1817Order **Ammonoidea** Zittel, 1884Superfamily **Perisphinctacea** Steinmann, 1890Family **Perisphinctidae** Steinmann, 1890Genus *Perisphinctes* Waagen, 1869

*Type species*: The first designation: *Ammonites bplex* Sowerby (Sowerby, 1821, Vol. III, Pl. 193, Figs. 1—2; Buckman, 1920, Vol. III, pp. 26—27). Subsequently reproduced by Healey (1904, Pl. 10, Figs. 1—2) and by Arkell (1947, p. 362, Text-fig. 126); the second designation: *Ammonites variocostatus* Buckland (Buckland, 1836, Pl. 43, Fig. 7), suggested by Arkell and accepted by I.C.Z.N. (1954, opinion 303), reproduced by Healey (1904, Pl. 11; 1905, Pl. 56) and by Arkell (1947, Pl. 76, Fig. 4; 1956, Pl. 39, Fig. 3). According to Arkell (1936, p. 53), *Perisphinctes bplex* and *P. variocostatus* are synonyms.

Subgenus *Perisphinctes* (*Arisphinctes*) Buckman, 1924

*Type species*: *Arisphinctes ariprepes* Buckman, 1924 (= *Perisphinctes cotovui* Simionescu, 1907).

*Synonym*: *Toxosphinctes* Buckman, 1923.

*Species assigned*: *Perisphinctes* (*A.*) cf. *cotovui* Simionescu, *P.* (*A.*) cf. *helenae* Riaz, *P.* (*A.*) *maximus* (Young & Bird), *P.* (*A.*) *plicatilis* (Sowerby).

*Stratigraphic and geographical range*: Middle Oxfordian—Europe, Eastern Asia, Asia Minor, Japan, South and Central America.

*Diagnosis*.—Shell evolute, 500 mm in maximum diameter. Ribbing gradually changing. Ribs convex, thick (never cuneiform); turning in the gerontic body chamber into straight ones, less widely spaced. Transverse section of whorls mostly rectangular or subsquare. Ventral side rounded and smooth. Suture according to the formula  $EL = L > N$ . Rib-curve moderately bent, maximum curvature with a diameter of 100 to 140 mm.

*Remarks*.—The subgenera *Toxosphinctes* and *Arisphinctes*, distinguished by Buckman (1924), are considered by Geyer (1961, p. 16) as synonyms of the subgenus *Kranaosphinctes*. Enay (1966, p. 405) believes that only the subgenus *Toxosphinctes* is a synonym of *Arisphinctes*.

*Perisphinctes* (*Arisphinctes*) cf. *cotovui* Simionescu, 1907

(Pl. I, Figs. 1, 2; Text-figs. 3, 4)

1907. *Perisphinctes cotovui* Simionescu; I. Simionescu, *Studi Geologice* ..., p. 151, Pl. 4, Fig. 3; Pl. 7, Fig. 1 (lectotype).

1912. *Perisphinctes cristatus* Klebelsberg; R. Klebelsberg, *Die Perisphincten* ..., p. 192, Pl. 18, Fig. 3.

- 1902—1930. *Arisphinctes ariprepes* Buckman; S. S. Buckman, Type ammonites..., Vol. V, Pl. 511, A, B, C.
1930. *Perisphinctes plicatilis* Dorn (non Sowerby); P. Dorn, Die Ammonitenfauna ..., p. 146, Pl. 6, Fig. 1.
- 1935—1948. *Perisphinctes (Arisphinctes) cotovui* Simionescu; W. J. Arkell, Corallian Beds ..., p. 126, Pl. 24, Figs. 1—5; Pl. 25, Figs. 1—3; Pl. A, Figs. 1 a, b, 4; Text-figs. 39—43 (with earlier synonymy).
1959. *Arisphinctes cotovui* Simionescu; M. Collignon, Atlas des fossiles ..., Pl. 86, Fig. 344.

*Material.* — Two specimens, one of which (IG.1246.II.13) with a crushed gerontic body chamber. Measurements taken in the undeformed part.

Dimensions (in mm):

	IG.1246.II.16		IG.1246.II.13
	Ph	Chl	Chg
D .....	140	210	250
H .....	0.27	0.23	0.25
Th .....	0.20	0.26	0.20
U .....	0.46	0.52	0.56

Rib-curve:

	D	50	100	120	150	190	210	250
IG.1246.II.13	R			46		46	46	45
IG.1246.II.16		54	58		62		60	

*Description.* — Shell evolute, with an umbilical width varying from 0.40 mm with a diameter of 50 mm to 0.59 mm with a diameter of 50 mm to 0.59 mm with a diameter of 210 mm. Transverse section of whorls in the septate part rectangular, with flat sides. In part of the body chamber, the width of whorls considerably increasing (Text-fig. 3). In inner whorls, the primary ribs start on the umbilical margin and, in the form of a slight curve, through the side of whorl. They are directed slightly anteriorly. The bifurcation is observed up to the specimen's diameter of about 140 mm. With larger diameters, the bifurcation becomes a rule. Three constrictions clearly marked on the last whorl are surrounded on the one side by a single rib and, on the other, by a dischizotomous rib. Sutures being poorly visible, no detailed discussion is possible.

*Remarks.* — In its general outline, the rib-curve drawn for the specimen from Zawodzie IG.1246.II.16 (Text-fig. 4) is most comparable with that drawn for *Perisphinctes cristatus* Klebelsberg, considered by (cf. Arkell, 1939, p. 126, Fig. 42). The ornamentation of the specimen from Arkell (1939, p. 126) as a synonym of *Perisphinctes cotovui* Simionescu

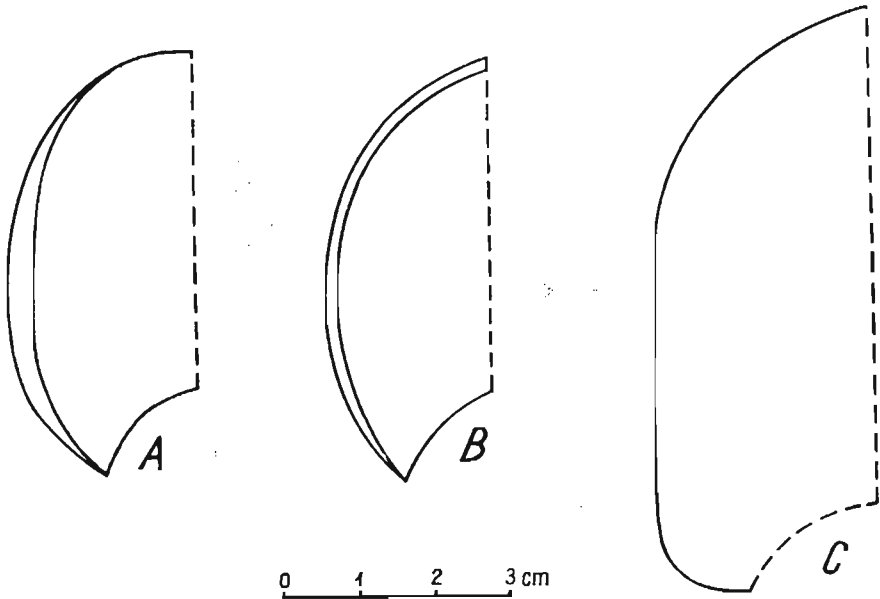


Fig. 3. — Transverse section of the last whorls in: A — *Perisphinctes* (*Arisphinctes*) cf. *cotovui* Simionescu, with a diameter of 210 mm, IG.1246.II.16; B — *P.* (*Dichotomosphinctes*) cf. *elisabethaeformis* Burckhardt, with a diameter of 200 mm, IG.1246.II.25; C — *P.* (*A.*) *plicatilis* (Sowerby) with a diameter of 285 mm, IG.1246.II.2; all figures nat.size.

Zawodzie (IG.1246.II.16) is similar to that of Dorn's (1930, p. 146) specimen. On the other hand, the rib-curve drawn for the specimen IG.1246.II.13 is more similar in its curvature to that of the lectotype (Simionescu, 1907, Pl. 7, Fig. 1) and of *Perisphinctes ariprepes* Buckman, also included in the synonymy of *P.* (*A.*) *cotovui* Simionescu.

Attention is called by Arkell (1939) to a specimen from Poland housed in the Palaeontological Museum in Berlin and which might belong to *P.* (*A.*) *cotovui* Simionescu. This specimen seems, however, to be less densely ribbed.

*P.* (*A.*) *cotovui* Simionescu displays a considerable similarity to *P.* (*A.*) *pickeringius* (Young & Bird). If the specimens are poorly preserved, it is almost impossible to distinguish the two species. The rib-curves of *P.* (*A.*) *cotovui* Simionescu and *P.* (*A.*) *pickeringius* (Young & Bird) are almost identical with each other. The species assigned to the synonymy of *P.* (*A.*) *cotovui* Simionescu include such ones as, for instance, *Perisphinctes cristatus* Klebelsberg, in which the rib-curve has the characters of the curves of *P.* (*A.*) *pickeringius* (Young & Bird), at least in initial whorls (Arkell, 1939, pp. 130 and 138).

A good deal of thought was given for a long time to a possibility of combining *P.* (*A.*) *cotovui* Simionescu with *P.* (*A.*) *pickeringius* (Young & Bird) under a common priority name of "*pickeringius*". If the rib-curves

cannot be a safe criterion of dividing the two species from each other, the remaining characters can provide a basis for such a presentation of the problem. The differences observed between two typical representatives of both species concern the height of whorls at a diameter of about 220 mm, the diameter of umbilicus and the thickness of whorls.

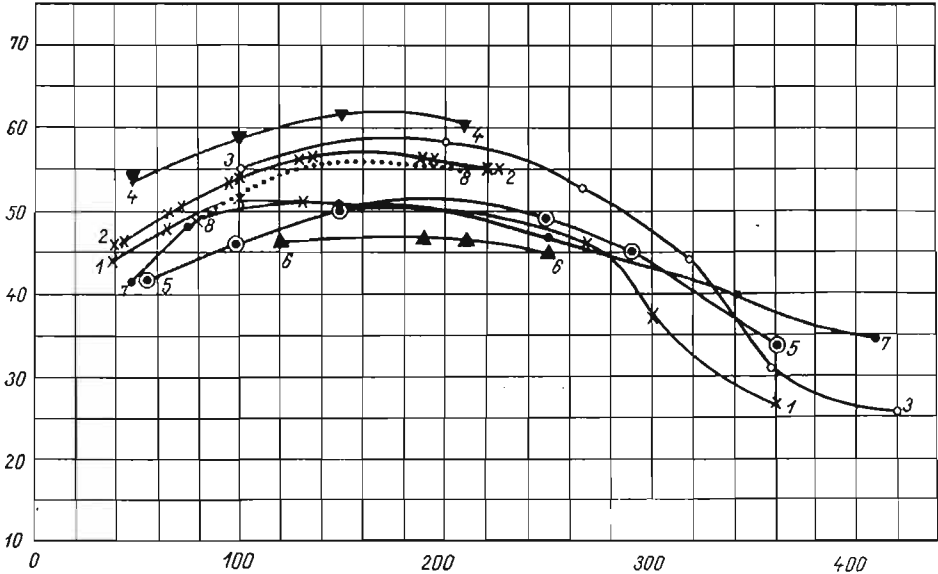


Fig. 4. — Rib-curves of *Perisphinctes (Arisphinctes) cotovui* Simionescu: 1 lectotype, Simionescu, 1907, p. 151, Pl. 7, Fig. 1; 2 syntype Simionescu, 1907, p. 151; *P. cristatus* Klebelsberg: 3 holotype, Klebelsberg, 1912, Pl. 18, Fig. 3; 4 Zawodzie, IG.1246.II.16; 5 specimen from Busko(?), Geological Museum in Berlin; 6 Zawodzie, IG.1246.II.13; *P. ariprepes* Buckman: 7 Britleton Barn Quarry, Horspath, No. 47543 (after Arkell, 1939, p. 127); *Perisphinctes (Arisphinctes) pickeringius* (Young & Bird): 8 holotype (after Arkell, 1939, p. 134).

*Perisphinctes (A.) cotovui* Simionescu is a form having lower whorls, larger diameter of umbilicus and smaller thickness of whorls. Slight differences are observed in the type of ribbing, in particular in the manner of furcation. In *P.(A.) pickeringius* (Young & Bird), the number of the intercalatories is greater, the secondaries are slimmer and thinner and the points of furcation are marked by a slender convexity.

Due to a poor state of preservation of the specimens from Zawodzie, as well as their small number, it is difficult to determine their completely sure specific assignment, the more so as both specimens somewhat differ from each other, in particular in their rib-curves.

**Occurrence.** — Rumania: Cekirgea; England: Wiltshire, Berkshire, Oxfordshire, Cowley, Cambridgeshire, Yorkshire; France: Boulonnais, Normandy; North-Western Germany: Hildesheim, Heersum; Southern Germany: Franconia; Madagascar: Ankazoabo; Poland: Zawodzie.

*Perisphinctes (Arisphinctes) cf. helenae* Riaz, 1898

(Pl. II; Text-fig. 5)

1898. *Perisphinctes helenae* Riaz; A. Riaz, Description..., p. 15, Pl. 8, Fig. 1 (lectotype).
- 1935—1948. *Perisphinctes (Arisphinctes) helenae* de Riaz; W. J. Arkell, Corallian Beds ..., p. 149, Pl. 30, Figs. 7, 8; Pl. 31, Figs. 1—3, Text-figs. 48, 49.
1966. *Perisphinctes (Arisphinctes) helenae* Riaz; R. Enay, L'Oxfordien ..., p. 413, Pl. 20, Figs. 1—4, Text-figs. 118—119.
1972. *Perisphinctes (Arisphinctes) cf. helenae* Riaz; L. Malinowska, Środkowy i górny oksford ..., p. 16, Pl. 4, Fig. 1.

*Material.* — One specimen (septate part).

*Dimensions* (in mm):

IG.1246.II.32	
Ph	
D	220
H	0.24
Th	—
U	0.58

*Rib-curve:*

D	180	200	220
R	62	59	55

*Description.* — Shell evolute, composed of the whorls of the septate part, with a wide umbilicus and whorls overlap at one-third of the height. Width of umbilicus varying from 0.45 mm at a diameter of 60 mm to 0.59 mm at a diameter of 220 mm. Transverse section of whorls subrectangular, only slightly widened on the umbilical margin. The primary ribs start on the periphery of umbilicus passing onto the sides of whorls and turning slightly anteriorly. They furcate high up, on the margin of the venter. The manner of furcation unknown. The rib-curves (Text-fig. 5) ascend suddenly and, at a diameter of 120 mm, descend considerably. Sutures, although visible, are difficult to reproduce completely.

*Remarks.* — This species has already been described earlier in the present writer's paper from 1971. The then description concerned the gerontic body chamber. In its morphological details, the specimen from Zawodzie (IG.1246.II.32) displays a considerable similarity to that from Scarborough, Yorks., England (Arkell, 1939, Pl. 30, No. 3842), whereas its rib-curve seems to be similar to that of a specimen from Trept, Isère (Enay, 1966, Text-figs. 118—119).

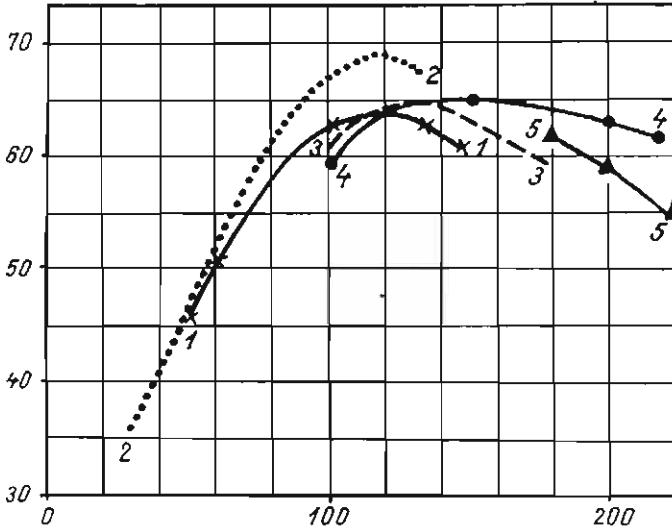


Fig. 5. — Rib-curves of *Perisphinctes (Arisphinctes) helenae* Riaz: 1 lectotype (Riaz, 1898, Pl. 8, Fig. 1), Trept, Lyon, 12774, 2 La Cluse (Gaufre), Fac. Sc. Besançon; 3 Trept, Coll. Riaz, Lyon, 75, 130, 4 Scarborough, Yorks, Sedgewick Museum, No. 3842, 5 Zawodzie, IG.1246.II.32.

*Occurrence.* — France: Trept, Isère and Doubs; Portugal: Cabaco Beds; North-Western Germany: Heersum, Langerberg; England: Oxfordshire, Wiltshire, Beckley, Yorkshire; Madagascar; Poland: Zawodzie.

*Perisphinctes (Arisphinctes) maximus* (Young & Bird, 1828).  
(Pl. III; Text-figs. 6, 7)

cf. 1935—1948. *Perisphinctes (Arisphinctes) maximus* (Young & Bird); W. J. Arkell, Corallian beds ..., p. 113, Text-fig. 35.

1972. *Perisphinctes (Arisphinctes) maximus* (Young & Bird); L. Malinowska, Śródkowy i górny oksford, p. 17, Pl. 1, Fig. 1, Text-fig. 2.

*Material.* — A specimen in the gerontic stage, with the last whorl slightly deformed.

Dimensions (in mm):

IG.1246.II.27		
	Ph	Chg
D	310	430
H	0.19	0.25
Th	0.32	0.24
U	0.65	0.65



## Rib-curve:

D	210	240	280	330	370	430
R	36	30	25	20	17	16

*Remarks.*— This species has been described in detail in a previous writer's paper (Malinowska, 1972). The diameter of the then described specimen amounted to 450 mm. Particularly accurate was the observation of the development of ribbing in both inner and outer whorls, reflected

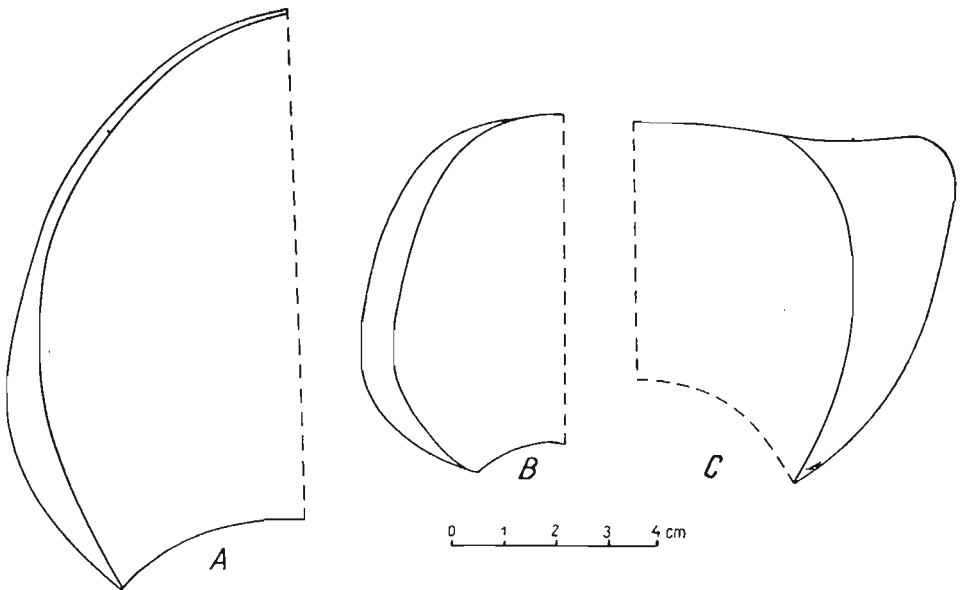


Fig. 6. — Transverse sections of the last whorls in: A — *Perisphinctes* (*Arisphinctes*) *maximus* (Young & Bird), with a diameter of 430 mm, IG.1246.II.27; B — *P.* (*Kranosphinctes*) *cyrilli* Neumann, with a diameter of 340 mm, IG.1246.II.26; C — *P.* (*Perisphinctes*) *alatiformis* n.sp., with a diameter of 270 mm, IG.1246.II.12.

in the rib-curve (Text-fig. 7). The transverse section of the specimen from Zawodzie (IG.1246.II.27) is shown in Text-fig. 6. The specimen from Wieluń, housed in the Palaeontological Museum in Berlin and which has been mentioned by Arkell (1939, p. 113, Text-fig. 35), is somewhat more densely ribbed and has more rounded whorls.

*Occurrence.* — England: Dorsetshire, Wiltshire, Berkshire, Oxforshire, Cambridgeshire, Yorkshire; France: Trept, Isère; North-western Germany: Heersum, Mönkeberg; Poland: Zawodzie.

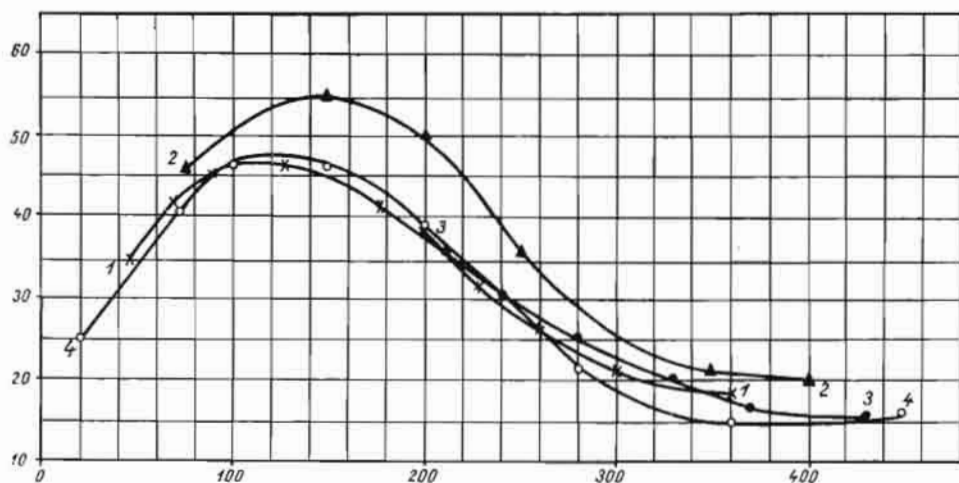


Fig. 7. — Rib-curves of *Perisphinctes (Arisphinctes) maximus* (Young & Bird): 1 Headington, Oxford, Univ. Museum (after Arkell, 1939, Text-fig. 35); 2 Wieluń, Palaeontol. Museum in Berlin (after Arkell, 1939, Text-fig. 35); 3 Zawodzie, IG.1246.II.27; 4 Smugi, IG.1185.II.1.

*Perisphinctes (Arisphinctes) plicatilis* (Sowerby, 1817)

(Pl. IV, Figs. 1, 2; Text-figs. 3, 8, 27)

1812—1846. *Ammonites plicatilis* Sowerby; J. Sowerby, *Conchologie ...*, Vol. II, p. 149, p. 166.

1972. *Perisphinctes (Arisphinctes) plicatilis* (Sowerby); L. Malinowska, *Środkowy i górny oksford ...*, p. 18, Pl. 5, Fig. 1, Text-fig. 2.

*Material.* — A specimen in the gerontic stage.

Dimensions (in mm):

	IG.1246.II.2	IG.1185.II.12
	CHg	Chg
D . . . . .	285	320
H . . . . .	0.26	0.29
Th . . . . .	0.20	0.21
U . . . . .	0.50	0.55

Rib-curve:

D	50	100	150	200	250	285
R	50	63	69	71	70	68

*Remarks.* — This species has previously been described by the writer (Malinowska, 1972). The diameter of the then described specimen amounted to 320 mm. It was undoubtedly a specimen in the gerontic stage. The specimen from Zawodzie (IG.1246.II.2), having a smaller diameter of shell, does not supply new data concerning dimensions, but it allows one to supplement the rib-curve for inner whorls (Text-fig. 8) and illustrate the transverse section of whorl (Text-fig. 3).

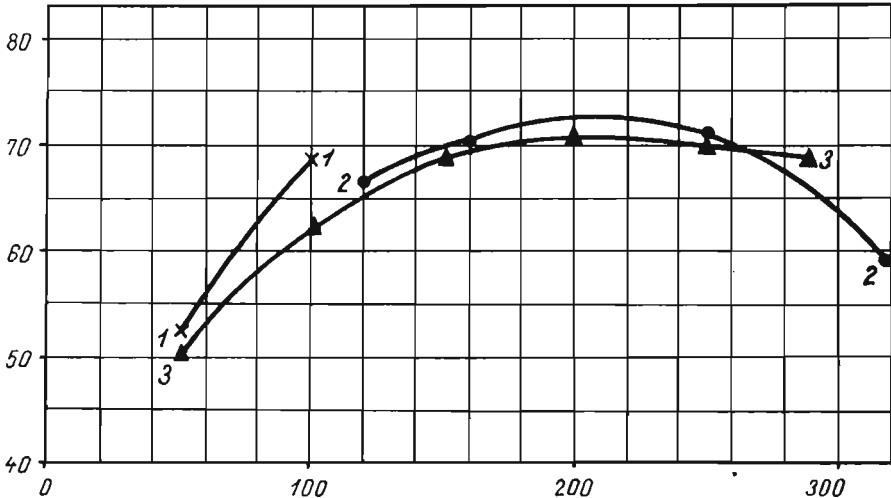


Fig. 8. — Rib-curves of *Perisphinctes (Arisphinctes) plicatilis* (Sowerby): 1 holotype, Oxford Univ. Museum (after Arkell, 1939, p. 145); 2 Biała Dolna, ZD.1185.II.12; 3 Zawodzie, IG.1246.II.2.

*Occurrence.* — Great Britain: Berkshire, Oxfordshire, Yorkshire and Scotland; France: Jura Mountains, Poitou, Ain, Isère, La Faucille, Chezery; North-Western Germany: Hildesheim, Vorholz; Czechoslovakia: Četechovice, Moravia; The U.S.S.R.: Donets Basin, Turkmenistan; Mexico: Cerro Volcán; Poland: Zawodzie.

#### Subgenus *Perisphinctes (Dichotomosphinctes)* Buckman, 1926

*Type species:* *Perisphinctes antecedens* Salfeld, 1914 (= *P. cf. wartae* Bukowski mut. *antededens* Salfeld, 1914).

*Species assigned:* *Perisphinctes (D.) buckmani* Arkell; *P.(D.) cf. elisabethaeformis* Burckhardt, *P.(D.) wartae bedoensis* Collignon.

*Stratigraphic and geographical range:* The Lower and Middle Oxfordian: Europe, East and North Africa, Indonesia, South and Central America.

*Diagnosis.* — Shell evolute, 250 mm in maximum diameter. Ribbing does not change in the course of ontogenetic development. It is only in the gerontic stage, that the ribs are slightly strongly extended

anteriorly in the terminal part of body chamber. The gerontic chambers occupies three-quarters of the whorl. Two or three systems of trifurcate, monoschizotomous ribs happen to occur in the last section of the gerontic chamber. Suture developed according to the formul  $EL=L=N$ . Rib-curve runs on the whole from SW to NE.

*Perisphinctes (Dichotomosphinctes) buckmani* Arkell, 1936  
(Pl. V; Text-fig. 9)

- 1935—1948. *Perisphinctes (Dichotomosphinctes) buckmani* Arkell; W. J. Arkell, Corallian beds ..., p. 79, Pl. 14, Figs. 1—4; Pl. 17, Figs. 3, 13; Text-fig. 19.  
1966. *Perisphinctes (Dichotomosphinctes) buckmani* Arkell; R. Enay, L'Oxfordien ..., p. 478, Pl. 28, Fig. 5; Pl. 29, Figs. 1, 2; Text-figs. 140, 144.

*Material.* — A specimen with a septate part and a fragment of the body chamber.

Dimensions (in mm):

IG.1246.II.8	
Chl	
D . . . . .	160
H . . . . .	0.22
Th . . . . .	—
U . . . . .	0.58

Rib-curve:

D	30	40	60	80	100	120	140	160
R	40	41	44	49	52	52	53	56

*Description.* — Shell medium-sized, evolute, with whorls overlapping each other to a small extent. The outline of the transverse section of whorls with flattened sides. Occupying the entire whorl, the body chamber is exceptionally long. It starts with a diameter of 120 mm. The primary ribs are observed on the body chamber. Constrictions are numerous, furcate, high up on the margin of outer side, into two secondary ribs. The point of furcation is marked by a small thickening. Intercalatory ribs are observed on the body chamber. Constructions are numerous, deep and limited by a rib which furcate on the periphery of umbilicus. Sutures indistinctly preserved. Rib-curve (Text-fig. 9) descends with a specimen's diameter of about 100 mm.

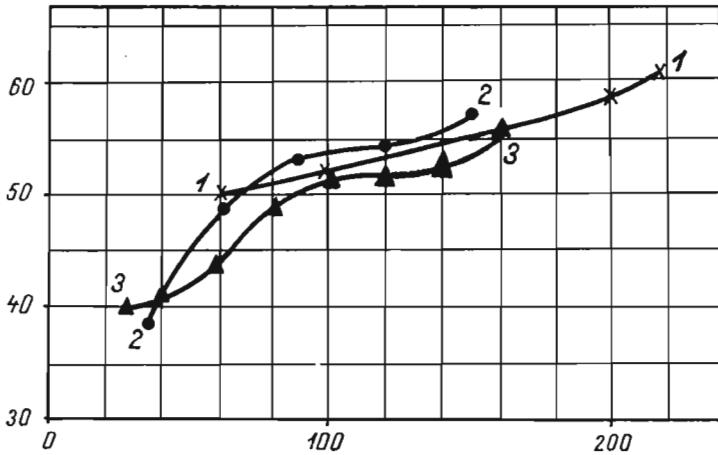


Fig. 9. — Rib-curves of *Perisphinctes (Dichotomosphinctes) buckmani* Arkell: 1 holotype, Headington, No. 47844, 2 Chaumont (Jura), Lyon, 75218, 3 Zawodzie, IG.1246.II.8.

*Remarks.* — *Perisphinctes (D.) buckmani* Arkell displays a similarity to *P.(D.) antecedens* Salfeld, although the details allow one to separate the two species. A similarity is also observed of the species under study to *Perisphinctes (D.) martini* Collignon (1959, Pl. 62, Fig. 283), although the ribbing of the latter is somewhat closer.

*Occurrence.* — Great Britain: Oxfordshire, Cambridgeshire and Scotland; France: Trept (Isère), Poitou, Ain, Jura; North-Western Germany: Heersum; Poland: Zawodzie.

*Perisphinctes (Dichotomosphinctes) cf. elisabethaeformis* Burckhardt, 1912  
(Pl. IX; Text-fig. 3)

1912. *Perisphinctes elisabethaeformis* Burckhardt; C. Burckhardt, Faunes jurassiques ..., p. 31, Pl. 6, Figs. 1—5.

1966. *Perisphinctes (Dichotomosphinctes) cf. elisabethae* Burckhardt; R. Enay, L'Oxfordien ..., p. 493, Text-fig. 150.

*Material.* — A fragmentary body (gerontic?) chamber; inner whorls destroyed.

Dimensions (in mm):

I.G.1246.II.25	
Chg (?)	
D . . . . .	200
H . . . . .	0.27
Th . . . . .	0.18
U . . . . .	0.54

*Description.*—The fragment of the body (gerontic?) chamber gives evidence that the shell was evolute. The transverse section of the whorl (Text-fig. 3) is both at the beginning and end of this chamber, oval. Ribs, covering the sides of the body (gerontic?) chamber are straight, fairly strongly inclined anteriorly and mostly bifurcated. Frequent single ribs occur independently of constrictions.

*Remarks.*—The species under study differs from *Perisphinctes (D.) elisabethae* Riaz in a higher degree of evoluteness. In addition, the thickness of its whorls seems to be smaller.

*Occurrence.*—Mexico: Cerro del Volcán; France: Longe-Combe, Tenay (Ain); Poland: Zawodzie.

*Perisphinctes (Dichotomosphinctes) wartae bedoensis* Collignon, 1959  
(Pl. IX; Text-fig. 10)

1898. *Perisphinctes wartae* Bukowski; A. Riaz, *Description ...*, p. 17, Pl. 11, Fig. 1.

1959. *Dichotomosphinctes wartae* Buk. var. *bedoensis* (type) Collignon; M. Collignon, *Atlas des fossiles ...*, Pl. 41, Fig. 281.

1953. *Perisphinctes (Dichotomosphinctes) wartae* Bukowski; P. Siegfried, *Die Heer-sumer Schichten ...*, Pl. 1, Fig. 2, Text-fig. 8.

*Material.*—A specimen in the gerontic stage

Dimensions (in mm):

IG.1246.II.21		
Ph/Chg		Chg
D . . . . .	160	250
H . . . . .	0.26	0.34
Th . . . . .	—	—
U . . . . .	0.49	0.48

Rib-curve:

D	50	60	80	100	120	140	160	180	220	250
R	46	47	53	60	65	72	79	88	95	98

*Description.*—Shell evolute, with whorls overlapping each other at one-third of the height. The transverse section of whorls oval. The septate part terminates with a diameter of 160 mm. In the same place, the so far straight and sharp ribs gradually become blunter and turn more anteriorly. The furcation of ribs near the ventral margin is emphasized by a slight convexity. A general outline of suture is typical of the subgenus *Dichotomosphinctes*.

*Remarks.*—In contrast to the nominal species *Perisphinctes* (*D.*) *wartae*, described by Bukowski from the Częstochowa Jurassic, a variety “*bedoensis*” was distinguished by Collignon (1959). A short description, given by this author, as well as his later mentions, concerning the variety “*bedoensis*”, induce the writer to a more detailed discussion of the development of ribbing on the whorls and of the differences between the variety “*bedoensis*” and the nominal species. Ribbing is the main distinguishing character which may be clearly observed comparing rib-curves (Text-fig. 10). Even if we assume the possibility of a considerable variability within the species, it seems that the main outline of rib-curves should be similar. The variety “*bedoensis*” is among less densely ribbed forms. Differences in rib-curves, presented by Enay (1966) are fairly large. The rib-curve for the nominal species *P.*(*D.*) *wartae* Bukowski

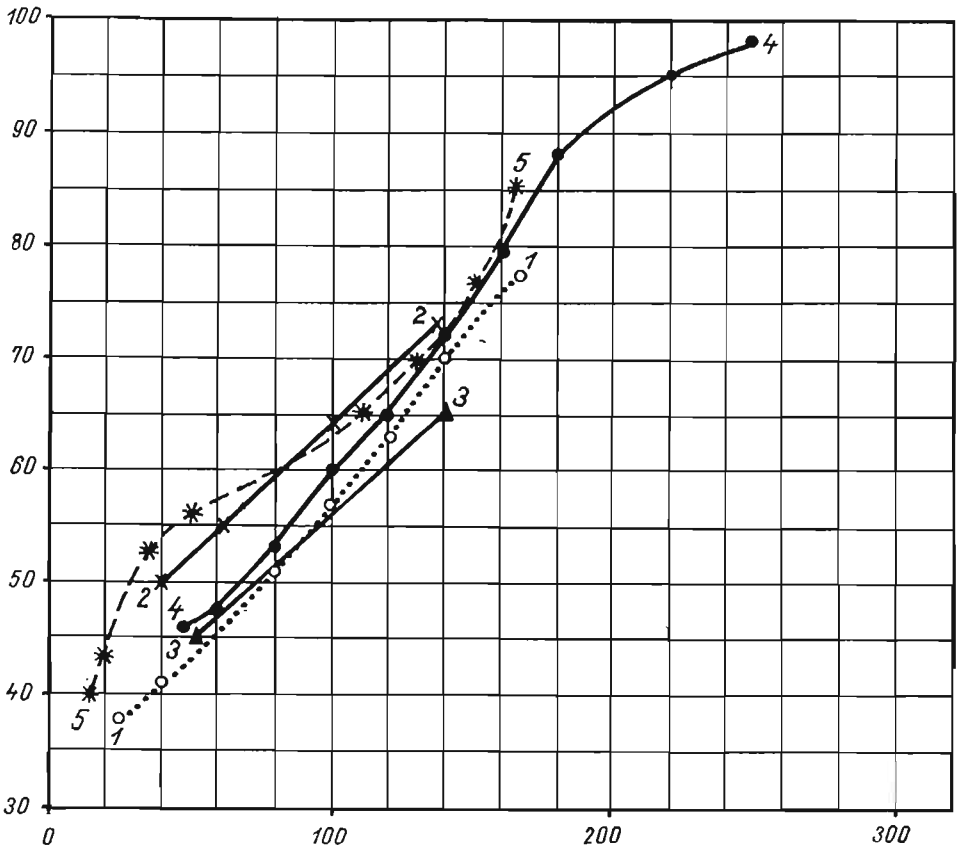


Fig. 10. — Rib-curves of *Perisphinctes* (*Dichotomosphinctes*) *wartae* *bedoensis* Collignon: 1 var. *bedoensis* Collignon, 1959, Pl. 61, Fig. 281, Bedoa, Madagascar, Hirz's collection; 2 Trept, Isère, Riaz's collection, Lyon, 12789 (after Riaz, 1898, Pl. 11, Fig. 1); 3 Listringer Bruch (No. 7b), Siegfried, 1952, Pl. 1, Fig. 2; 4 — Zawodzie, IG.1246.II.21; *Perisphinctes* (*Dichotomosphinctes*) *wartae* Bukowski: 5 holotype (after Enay, 1966, p. 485, Fig. 146).

is represented by a wavy line, whereas in the variety "*bedoensis*" it is an almost straight SW-NR line. Consequently, the separation of the variety "*bedoensis*" seems to be correct. More or less densely ribbed forms are also distinguished in Siegfried's (1953) work, but they are called by a common name of *P.(D.) wartae* Bukowski. In the present writer's opinion, specimen No. 76, assigned by Siegfried to extremely sparsely ribbed forms, should be also considered as the variety "*bedoensis*". In addition, according to Bukowski (1887), in *P.(D.) wartae* frequent constrictions occur on inner whorls, while they are almost indistinct or lacking at all in the variety "*bedoensis*". On the body chamber of the holotype of the nominal species, numerous constrictions are limited by single wavy ribs. In the variety "*bedoensis*", the number of constrictions on the body chamber is lower, without dischizotomous ribs. The specimen IG.1246.II.21 described from the Częstochowa is the largest of the specimens of the subgenus *Dichotomosphinctes* known thus far.

*Occurrence.* — Madagascar: Bedoa; France: Trept (Isère); North-western Germany: Listringer Bruch; Poland: Zawodzie.

#### Subgenus *Perisphinctes* (*Kranaosphinctes*) Buckman, 1921

*Type species:* *Kranaosphinctes kranaus* Buckman, 1921.

*Synonyms:* *Cymathosphinctes* Buckman, 1923; *Pachyplanulites* Spath, 1930; *Germanosphinctes* Arkell, 1935.

*Species assigned:* *Perisphinctes* (*K.*) *cyrilli* Neumann, *P.(K.) methodii* Neumann.

*Stratigraphical and geographical range:* Lower and Middle Oxfordian; Europe, East Africa, Central part of the U.S.S.R., Japan, Indonesia, New Guinea.

*Diagnosis.* — Shell evolute, reaching large dimensions. The transverse section in inner whorls very thick and flattened in outer whorls rounding. Changes in ribbing gradual. Thick ribs widely spaced, to the end of the gerontic body chamber, gradually become denser and denser. A smooth, siphonal band, formed as a result of a gap in ribbing, is a characteristic feature of the subgenus. Two to four deep constrictions on the whorl are surrounded by a single rib. Suture shaped according to the formula  $N > EL > L$ . Rib-curve moderately bent, with a maximum curvature with a diameter of 100 to 160 mm.

#### *Perisphinctes* (*Kranaosphinctes*) *cyrilli* Neumann, 1907

(Pl. VIII, Figs. 1, 2; Text-figs. 6, 11)

1907. *Perisphinctes* *Cyrilli* Neumann; J. Neumann, Oxfordfauna ..., p. 39, Pl. 4, Fig. 12.

1972. *Perisphinctes* (*Kranaosphinctes*) cf. *cyrilli* Neumann; L. Malinowska, Srodkowy i górny oksford ..., p. 24, Pl. 11, Fig. 4, Text-fig. 3.



*Material.* — A specimen in the gerontic stage.

Dimensions (in mm):

IG. 1246.II.26		
Ph		Chg
D . . . . .	240	340
H . . . . .	0.22	0.19
Th <sub>a</sub> . . . . .	0.21	0.17
Th <sub>b</sub> . . . . .	0.23	0.20
U . . . . .	0.64	0.63

Rib-curve:

D	90	120	160	200
R	48	53	54	52

*Description.* — This species has been previously described by the writer (Malinowska, 1972). But that description concerned inner whorls only on a specimen 90 mm in diameter. The specimen from Zawodzie (IG.1246.II.26), 340 mm in diameter, allows one to observe the development of ribbing on the gerontic body chamber. Despite the deformation of its inner whorls, the development of ribbing and number of the primary ribs may on the whole be observed. Rib-curve drawn on the basis of the number of ribs up to 200 mm of the specimen's diameter is identical with that in the holotype. An incipient part of gerontic body chamber is observed with a diameter of 240 mm. It covers the almost entire last whorl. This is also the place, in which the transverse section of whorls is subsquare and rounded on the ventral and umbilical margins (Text-fig. 6). The primary ribs, covering the sides of whorls, are straight and only slightly directed anteriorly. They furcate high up on the rounded ventral margin. Since the ribs are obliterated, it is impossible to observe the manner of furcation over the entire length of whorl. A trifurcation of the primary ribs to form the secondary ribs may be noted only in the initial part, of the gerontic body chamber. On this chamber, the spaces between the primary ribs gradually increase and the ribs themselves become considerably more convex. Constrictions are deep, wide and limited by a dischizotomous rib. Rib-curve shown in Text-fig. 11.

*Remarks.* — Two species: *P.(K.) bullingdonensis* and *P.(K.) crassisimus*, displaying a certain slight similarity to *P.(K.) cyrilli* Neumann, may be distinguished among British species, described by Arkell (1935—1948) and assigned by him to the subgenus *Kranaosphinctes*. Differences are, however, observed in dimensions and details of ribbing. In *P.(K.) crassisimus*

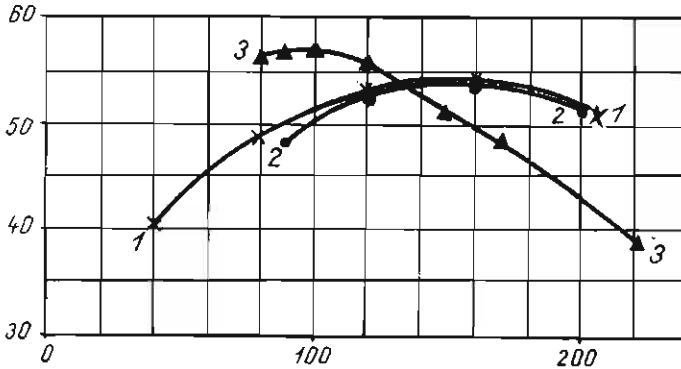


Fig. 11. — Rib-curves of *Perisphinctes (Kraenaosphinctes) cyrilli* Neumann: 1 holotype (after Enay, 1966, p. 434, Fig. 124); 2 Zawodzie, IG.1246.II.26; *Perisphinctes (Kraenaosphinctes) methodii* Neumann: 3 Zawodzie, IG.1246.II.35.

Arkell, the primary ribs are strongly bent anteriorly and in *P.(K.) bullingdonensis* Arkell the inner whorls are not so closely spaced which is depicted by the rib-curve.

*Occurrence.* — Czechoslovakia: Četechovice, Moravia; Poland: Zawodzie.

*Perisphinctes (Kraenaosphinctes) methodii* Neumann, 1907  
(Pl. IX, Figs. 1, 2; Text-fig. 11)

1907. *Perisphinctes Methodii* Neumann; J. Neumann, Oxfordfauna ..., p. 40, Pl. 6, Fig. 15.

*Material.* — A specimen with a septate portion and a fragmentary gerontic body chamber.

Dimensions (in mm):

IG.1246.II.35		
	Ph	Chg
D . . . . .	180	220
H . . . . .	0.29	0.29
Th . . . . .	0.24	—
U . . . . .	0.48	0.52

Rib-curve:

D	80	90	100	120	150	170	220
R	56	57	57	56	52	48	39

*Description.* — Shell evolute, medium-sized, with whorls slightly overlapping each other. The outline of the transverse section of inner whorls higher than wide, considerably increasing in its height together with growth. Up to the specimen's diameter of 90 mm, ribbing is somewhat chaotic. Predominant are the primary ribs which furcate high up on a rounded ventral margin. In addition, there appear ribs which furcate at various levels of the side of whorl, that is, on the umbilical margin or in the middle of the side. The manner of furcation of the primary ribs may be observed only with the specimen's diameter of about 140 mm. Near the ventral margin, the primaries bi- or trifurcate to form the secondary ribs which are much less strongly developed than the primary ribs. On the gerontic body chamber, the primary ribs are considerably more convex and the spaces between them gradually increase. Two deep constrictions occur on each whorl. A maximum curvature of the rib-curve (Text-fig. 11) occurs with a diameter of 90 to 100 mm.

*Remarks.* — Due to a characteristic ornamentation of its sides on inner whorls, *Perisphinctes (K.) methodii* Neumann is easily distinguished among the species of the subgenus *Kranaosphinctes*.

*Occurrence.* — Czechoslovakia: Četechovice, Moravia; Poland: Zawodzie.

#### Subgenus *Perisphinctes (Liosphinctes)* Buckman, 1925

*Type species:* *Liosphinctes apolipon* Buckman (1909—1930); illustrated once again by Arkell (1935—1948).

*Species assigned:* *Perisphinctes (L.)* sp.A.

*Stratigraphic and geographical range:* The Middle Oxfordian of Europe and East Africa.

*Diagnosis.* — Shell evolute, to 300 mm in maximum diameter. At one-quarter of the length of whorl, ribs furcate into considerably less strongly developed secondary ribs forming three- or fourfold bundles. The furcation is fully monoschizotomous, except, sometimes, for fourfold bundles which represent the dischizotomous type. According to Callomon (personal communication), in shells 80 mm in diameter by maximum rib curvature the number of ribs barely exceeds 30.

*Remarks.* — The discussion of the independence of subgenus *Liosphinctes* (Arkell, 1935—1948) was preliminarily summed up by Callomon (1960), who believes that a considerable number of characters common for a certain group of species allows one to maintain the separate subgenus *Liosphinctes* within the genus *Perisphinctes*. Geyer (1961) expresses the opinion that *Liosphinctes* may be a synonym of the subgenus *Kranaosphinctes*.

*Perisphinctes (Liosphinctes) sp.A*

(Pl. XII; Text-fig. 23)

*Material.* — A specimen with a septate portion and a fragmentary body chamber.

Dimensions (in mm):

IG.1246.II.31	
Chl	
D . . . . .	230
H . . . . .	0.28
G . . . . .	—
U . . . . .	0.49

Rib-curve:

D	75	100	120	150	170	200	230
R	49	50	48	39	36	30	27

*Description.* — Shell evolute, with whorls overlapping each other at one-third of the height. The outline of the transverse section of whorls has not been observed. Body chamber begins at a diameter of about 170 mm. Ribbing is subject to three, gradual changes, each of them preceded by a constriction. Up to the second constriction, inner whorls display a similar ribbing as that in the subgenus *Kranaosphinctes*. Later, an increase is recorded in the spaces between the primary ribs. The latter become convex over their entire length. At one-third of the height of whorl, they furcate into three or four bundles of the secondaries. Due to the specimen's poor state of preservation, the number of the intercalatories could not be found. The ornamentation of the body chamber is on the whole similar to that of the preceding whorls, except for the primary ribs which are more strongly marked, with proportionally larger spaces between them. The primary ribs are furcated into bundles, the fourfold ones predominating among them. Sutures are hardly distinguishable. Rib-curve shown in Text-fig. 23.

*Remarks.* — Certain comparisons could be conducted by the present writer by courtesy of Dr. J. A. Callomon, who had supplied her with detailed descriptions and photographs of the species of the subgenus *Liosphinctes*, described in his paper from 1960. The specimen from Zawodzie (IG.1246.II.31) seems to display a considerable similarity in ornamentation to *Perisphinctes (Liosphinctes) sp.nov. E* (Callomon, OUM

3882). The rib-curve and diameter of umbilicus in the specimen from Zawodzie are, however, somewhat different.

*Occurrence.* — Poland: Zawodzie.

### Subgenus *Perisphinctes* (*Perisphinctes*) Waagen, 1869

*Type species:* *Ammonites variocostatus* Buckland, 1836 (Pl. 42, Fig. 7), suggested by Arkell and accepted by I.C.Z.N. (1954, opinion 303).

*Synonym:* *Martelliceras* Schindewolf, 1925.

*Species assigned:* *Perisphinctes* (*P.*) *alatifformis* n.sp., *P.*(*P.*) *andelotensis* Enay, *P.*(*P.*) *cuneicostatus* Arkell, *P.*(*P.*) *enayi* n.sp., *P.*(*P.*) *multicostatus* n.sp., *P.*(*P.*) *pumilus* Enay, *P.*(*P.*) *swidzinskii* n.sp., *P.*(*P.*) sp. A., *P.*(*P.*) sp. B.

*Stratigraphic and geographical range:* the Lower and Middle Oxfordian: Europe, East Africa, southern and central part of the U.S.S.R., Asia, Japan and Central America.

*Diagnosis.* — Shell evolute, to 480 mm in maximum diameter. Ribbing changes suddenly, frequently as early as at one-quarter of a whorl on the septate portion. Ribs suddenly become more or less cuneiform, free spaces occurring between particular wedges. In inner whorls, ribs are regularly bifurcate. Suture developed according to the formula  $EL=N>L$  and  $EL=L=N$ . Rib-curves display a strong curvature in the place of a sudden change inribbing.

*Remarks.* — Geyer (1961) admitted rightly that the subgenus *Martelliceras* Schindewolf was a synonym of the subgenus *Perisphinctes* s.str.

#### *Perisphinctes* (*Perisphinctes*) *alatifformis* n.sp.

(Pl. XI, Figs. 1, 2; Text-figs. 6, 12)

*Holotype:* Pl. XI, Figs. 1, 2 (IG1246.II.12).

*Type horizon:* Middle Oxfordian, *P. wartae* and *A. alternans* Zone.

*Type locality:* Zawodzie.

*Derivation of the name:* After its shape similar to that of *P.*(*P.*) *alatus* Enay.

?*Perisphinctes* (*Perisphinctes*) *alatus* Enay; R. Enay, L'Oxfordien ..., p. 344, Fig. 93 — Evosges (Ain, Lyon) 75,058 only.

*Material.* — Two specimens, one of them probably in the gerontic stage.

Dimensions (in mm):

IG.1246.II.12		IG.1246.II.18	
Ph		Ph?	
D . . . . .	270	200	
H . . . . .	0.25	0.28	
Th <sub>a</sub> . . . . .	0.30	0.27	
Th <sub>b</sub> . . . . .	0.43	—	
U . . . . .	0.51	0.52	

## Rib-curves:

	D	70	90	120	130	150	180	200	220	250	270
IG.1246.II.12	R		55		59	60	59		53	45	39
IG.12 46.II.18		45		58		60	58	54			

*Description.* — Shell evolute, with whorls overlapping each other at one-third of the height. The outline of the section of whorls transversally oval, considerably extended by the occurrence of winglike ridges on the ventral margin (Text-fig. 6). Up to a diameter of 190 mm, the primary ribs covering the sides of whorls are numerous, projecting and bifurcating at one-third of the height of whorl to form two secondaries. These secondary ribs pass, without discontinuities, over the rounded venter. Less closely spaced primary ribs, gently bent anteriorly, are observed already with a diameter of 200 mm. On the rounded ventral margin, they trifurcate, with the points of furcation emphasized by a slight convexity. A single rib, outside of which a radical change takes place, is visible with a diameter of about 230 mm. A considerable swelling of the primary ribs, larger on the ventral and smaller on the umbilical margin, is also observed. Winglike ridges are formed already at the end of the last whorl. Rib-curve shown in Text-fig. 12. Sutures only partially visible.

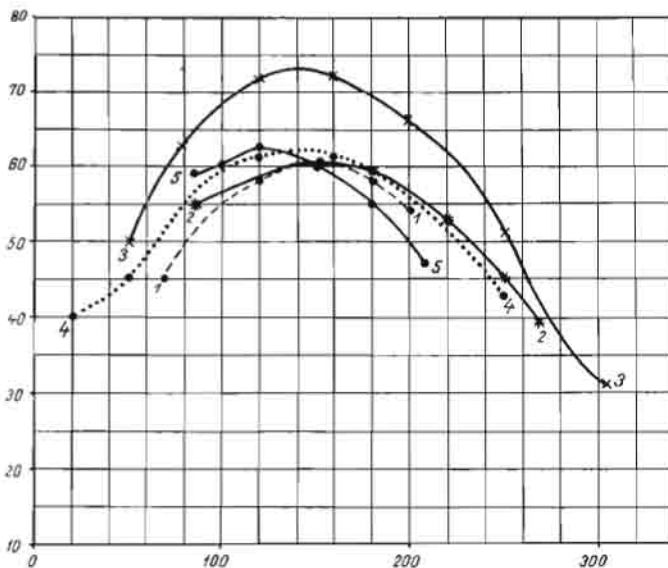


Fig. 12. — Rib-curves of *Perisphinctes* (*Perisphinctes*) *alatiformis* n.sp.: 1 Zawodzie, IG.1246.II.18, 2 Zawodzie, IG.1246.II.12; *P.*(*P.*) *alatus* Enay: 3 holotype, Vercra (Ain), Lyon, 75112, 4 ?*Evosges* (Ain), Lyon, 75058 (after Enay, 1966, Fig. 93); *Perisphinctes* (*Perisphinctes*) sp. B: 5 Zawodzie, IG.1246.II.34.

*Remarks.* — The specimens described display a similarity to one of the specimens included by Enay (1966, p. 345) in a list accompanying the description of *P.(P.) alatus* Enay. This specimen, coming from Evosges (Ain, Lyon, No. 75,058), judging by the description, considerably differs from the holotype (Lyon, No. 75,112) particularly so in rib-curves (which follows from a difference in the number of ribs, of which there are about ten). In addition, the holotype of *P.(P.) alatus* Enay is a form with a wider umbilicus. Details concerning the thickness of whorls in the specimen from Evosges and photographs being unavailable, it is impossible to assign this specimen with a complete certainty to the new species, although such an assignment seems probable.

*Occurrence.* — Poland: Zawodzie; France: Evosges (Ain).

*Perisphinctes (Perisphinctes) andelotensis* Enay, 1966  
(Pl. XII; Text-fig. 13)

1964. *Perisphinctes parandieri* Loriol; R. Enay, *Les faunes d'Ammonites ...*, p. 491.

1964. *Perisphinctes martelli* Opperl; E. Enay, *Ibid.*, p. 491.

1966. *Perisphinctes (Perisphinctes) andelotensis* Enay; R. Enay, *L'Oxfordien ...*, p. 366, Pl. 8, Figs. 1, 2; Pl. 9, Figs. 1, 2; Text-figs. 102, 103.

*Material.* — A gerontic specimen 300 mm in diameter (with the last whorl broken off).

Dimensions (in mm):

IG.1246.II.5	
Chg	
D	240
H	0.23
Th	0.27
U	0.54

Rib-curve:

D	36	50	—	170	190	210	240
R	49	53	—	51	47	40	29

*Description.* — Shell evolute; in part of the gerontic body chamber whorls are square in transverse section. Elevated ribs, covering outer whorls are distinct and gently turned anteriorly. In the septate portion, changes in ribbing take place gradually and only in the place in which the gerontic chamber begins, that is, with a diameter of 210 mm, thick

ribs suddenly appear at intervals of about 25 mm. They are more strongly turned anteriorly than the ribs of inner whorls. The points of furcation of the primary ribs may be observed only with a diameter of about 170 mm. They are marked by swellings. The trifurcation seems to be a rule. Constrictions strongly marked, particularly so in inner whorls.

*Remarks.* — Attention has been called by Enay (1966) to an interesting specimen from the locality Ceffia (Lyon, No. 75,100). This specimen display a considerable similarity to that from Zawodzie (IG.1246.II.5), although minor differences may also be observed in certain details. This is particularly true of the diameter of umbilicus, somewhat larger in the French specimen. In the specimen from Zawodzie, the rib-curve (Text-fig. 13) is almost identical with that of the holotype, in particular in the sector 160 to 240 mm in diameter.

*Occurrence.* — France: Ordonnaz (Ain); Poland: Zawodzie.

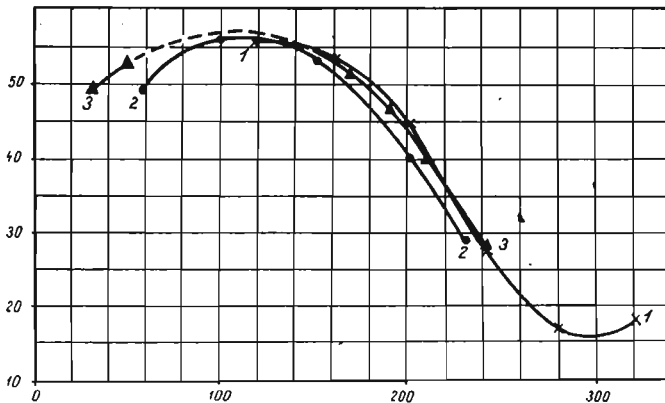


Fig. 13. — Rib-curves of *Perisphinctes (Perisphinctes) andelotensis* Enay: 1 holotype, Ordonnaz (Ain), Lyon 75108, 2 Ceffia (Jura), Lyon, 75100, Enay's collection, 3 Zawodzie, IG.1246.II.5.

*Perisphinctes (Perisphinctes) cuneicostatus* Arkell, 1956  
(Pls. XIII, XIV; Text-figs. 14, 15)

1903. *Perisphinctes biplex* Sowerby; P. Loriol, L'Oxfordien supérieur ..., p. 87, Pl. 6.  
1912. *Perisphinctes martelli* Opper; R. Klebelsberg, *Perisphincten* ..., p. 188. Pl. 18, Fig. 2.  
1935—1948. *Perisphinctes biplex* (non Sowerby); W. J. Arkell, *Corallian beds* ..., p. 13, Text-fig. 4.  
1956. *Perisphinctes cuneicostatus* (type, *P. martelli* Klebelsberg); W. J. Arkell, *Jurassic Geology* ..., p. 59.

*Material.* — Five specimens in the gerontic stage.



## Dimensions (in mm):

	IG.1246.II.6	IG.1246.II.17	IG.1246.II.3	IG.1246.II.4	IG.1246.II.33
	Chg	Chg	Chg	Chg	Ph
D	460	390	340	290	240
H	0.25	0.28	0.28	0.29	0.25
Th	0.19	0.18	0.23	0.33	—
U	0.54	0.51	0.50	0.52	0.51
Chg	340	290	250	280	—

## Rib-curves:

	D	50	70	100	120	150	180	200	220
IG.1246.II.6		48	51	57	62	68	73	74	73
IG.1246.II.17		52	55	62	70	—	—	—	—
IG.1246.II.3	R	—	—	57	60	67	73	73	67
IG.1246.II.4		—	57	63	67	74	78	—	75
IG.1246.II.33		—	47	—	—	—	—	70	68

	250	280	300	340	390	460
	67	51	—	29	19	18
	60	45	—	—	20	
	54	39	—	26		
	60	47	38			
	60					

*Description.* — Shell very large, evolute, with whorls overlapping each other at one-third of the height, beginning with inner whorls up to the gerontic chamber. The shape of the transverse section of whorls varies from subsquare in inner whorls to suboval in part of the gerontic body chamber (Text-fig. 14). Up to a diameter of about 200 mm, changes in ribbing take place gradually. Ribs thicken and spaces between them gradually increase. The primary ribs are, in this part of shell, straight, fairly sharp and slightly turned anteriorly. With a diameter of 200 mm, the primary ribs furcate on the ventral margin, into two secondary ribs (IG.1246.II.33). The same specimen display a fairly deep constriction, outside of which a few primary ribs considerably protrude on the ventral margin which is a result of the trifurcation of the ribs and the elevation, in this place, of the point of furcation. The trifurcate ribs in the form of a small arc, pass uninterruptedly onto a slightly flattened venter. The first two cuneiform ribs are already observed with a diameter of 240 mm (IG.1246.II.33). The first four wide cuneiform nodes are already observed at a diameter of 260 to 290 mm still in the septate portion (IG.1246.II.4).

The subsequent cuneiform nodes occur already on the gerontic body chamber, which in the largest specimen includes three-quarter of the last whorl. In the terminal part of this chamber, probably near the aperture, the sides of whorl are covered with single, strong and less and less widely spaced ribs. These slightly wavy ribs pass over the venter. It is only in

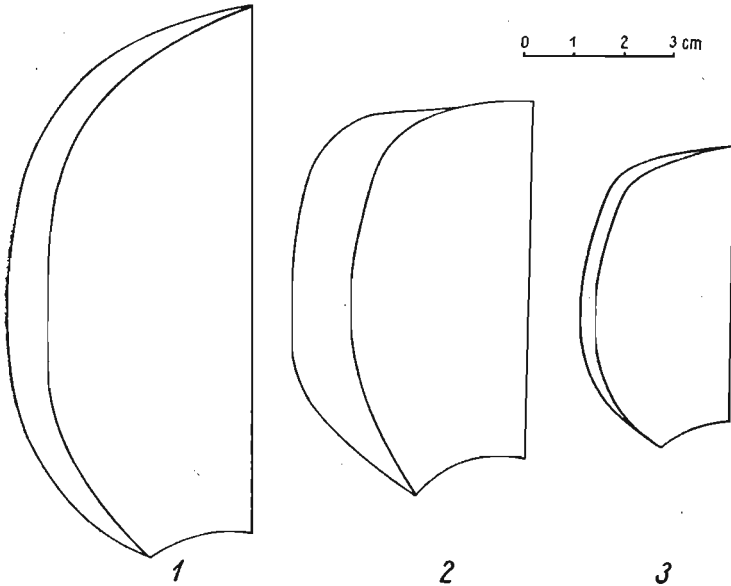


Fig. 14.—Transverse section of the last whorls of the specimens of *Perisphinctes* (*Perisphinctes*) *cuneicostatus* Arkell: 1 gerontic chamber of a specimen 390 mm in diameter, IG.1246.II.17; 2 the beginning of the gerontic chamber in a specimen 290 mm in diameter, IG.1246.II.4; 3 the septate portion of a specimen 240 mm in diameter, IG.1246.II.33.

the specimen IG.1246.II.3 that single ribs are sharper and thinner, particularly so on the left side of the shell, while on the right side, their character is typical of this species.

Rib-curves (Text-fig. 15) display a maximum curvature with a diameter of 180 to 200 mm and are on the whole in conformity with the rib-curve of the holotype.

*Remarks.* — A specimen, described by Klebelsberg (1912, Pl. 17, Fig. 2) under the name of *Perisphinctes martelli* (Oppel) is recognized by Arkell (1956, p. 59) as a holotype of *Perisphinctes cuneicostatus*. Klebelsberg's erroneous specific designation is justified by Arkell by a particularly great similarity of *P.(P.) cuneicostatus* to *P.(P.) martelli*. Such differences between shape of rib-curves, diameter of umbilicus, shape of the transverse section of whorls and ribs in the form of wide wedges, which became a basis for separating a new species, are, however, frequently emphasized in literature. *Perisphinctes bplex* Loriol (non Sowerby), having features

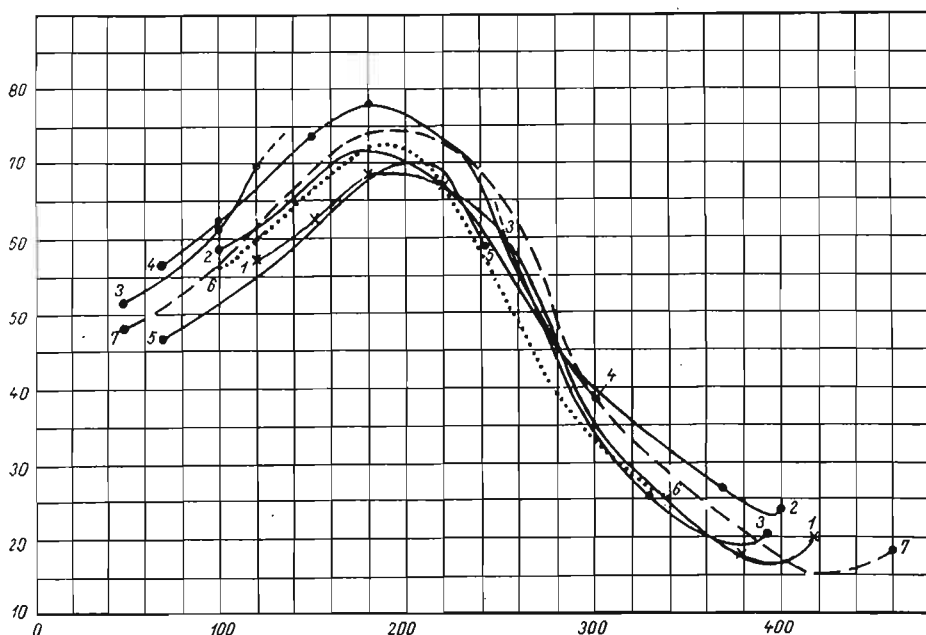


Fig. 15. — Rib-curves of *Perispinctes (Perispinctes) cuneicostatus* Arkell: 1 specimen described as *Perispinctes biplex* Loriol, 1903, Pl. 6; 2 holotype (= *Perispinctes martelli* Klebelsberg, 1912, Pl. 18, Fig. 2); 3 Zawodzie, IG.1246.II.17; 4 Zawodzie, IG.1246.II.4; 5 Zawodzie, IG.1246.II.33; 6 Zawodzie, IG.1246.II.3; 7 Zawodzie, IG.1246.II.6.

characteristic of *P.(P.) cuneicostatus* Arkell was also included in the synonymy of the latter species. Prior to describing the specimen from Zawodzie (IG.1246.II.6), Loriol's (1903, Pl. 6) specimen was considered as the largest one of the species under study.

In his remarks, concerning the species *P.(P.) cuneicostatus* Arkell, Enay (1966) mentions a specimen 330 mm in diameter, probably coming from Poland (Niegowonice) and which now is housed in Chaper's collection at the École de Mines in Paris.

*Occurrence.* — France: Haute Marne; Poland: Zawodzie and (?)Niegowonice.

*Perispinctes (Perispinctes) enayi* n.sp.

(Pl. XV; Text-figs. 16, 18)

1966. *Perispinctes (Perispinctes)* n.sp. A; R. Enay, L'Oxfordien ..., p. 341, Pl. 1, Fig. 1a, b; Text-fig. 92.

*Holotype:* Pl. XV.

*Type horizon:* Middle Oxfordian; *P. wartae* and *A. alternans* Zone.

*Type locality:* Zawodzie.

*Derivation of the name:* after the name of R. Enay, who was the first to describe a specimen of this species, but did not give it any name.

*Material.* — A specimen in the gerontic stage.

Dimensions (in mm):

IG.1246.II.14		
	Chg	Chg/Ph
D . . . . .	350	250
H . . . . .	0.30	0.29
Th . . . . .	0.24	0.19
U . . . . .	0.54	0.48

Rib-curve:

D	130	140	170	200	250	300	350
R	70	73	73	66	48	36	32

*Description.* — Shell large, evolute, with slightly overlapping whorls. The outline of the transverse section of inner whorls rectangular, sides of whorls flattened, venter with rounded margins. With a diameter of -about 240 mm, still in the septate portion, the whorls become thicker and venter-flatter (Text-fig. 16). The gerontic chamber begins with a diameter of 250 mm. Up to a diameter of 180 mm, the sides of whorls are covered with sharp, projecting ribs which furcate high up on the margin of venter. The manner of the furcation of the primary ribs in this part of shell is unknown since it is covered by the subsequent whorl. Later, the primary

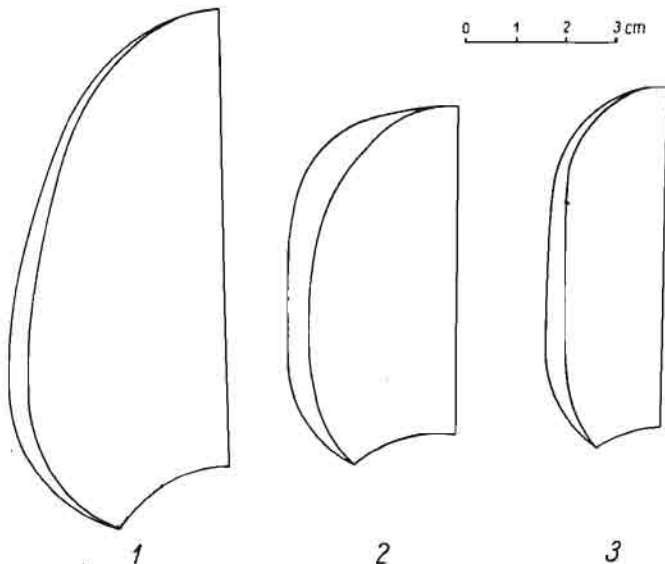


Fig. 16. — Transverse sections of the whorls of *Perisphinctes (Perisphinctes) enayi* n.sp., IG.1246.II.14: 1 gerontic chamber of a specimen 350 mm in diameter; 2 the beginning of a gerontic chamber in the same specimen but with a diameter of 250 mm; 3 part of a suture of the same specimen with a diameter of 240 mm.

ribs begin to project, at first near the wall and umbilical margin, and then on the ventral margin where they trifurcate and form bundles of the secondary ribs. The secondary ribs pass uninterruptedly through the venter with a diameter of 240 mm, still in the septate portion, the ribs become considerably thicker, which is reflected in the shape of the transverse section of whorls. At the beginning of the gerontic body chamber, the primaries take the form of slightly outlined wedges. A further part of this chamber is covered with single, thick ribs directed anteriorly which is the evidence of the proximity of aperture. Rib-curve (Text-fig. 18) within limits of specific variability.

*Remarks.* — The specimen, described by Enay (1966, p. 341, Pl. 1, Fig. 1 a, b; Text-fig. 92), represents a form which, also in the gerontic stage, is smaller than the Polish specimen. Due to its larger diameter, the specimen from Zawodzie (IG.1246.II.14), allows one to supplement the description. Describing the specimen from Montagnieu (Ain), Enay ascertains that in the places of a sudden change in ribbing the primary ribs become more widely spaced and stronger, but do not take the form of typical wedges. It seems, however, that despite the absence of a typically cuneiform shape, a larger extension of ribs on the ventral and smaller on the umbilical margin is quite obvious.

*Occurrence.* — Poland: Zawodzie; France: Montagnieu (Ain).

*Perisphinctes (Perisphinctes) multicostatus* n.sp.

(Pl. XVI, Figs. 1, 2; Text-figs. 17, 18)

*Holotype:* Pl. XVI, Figs. 1, 2.

*Type horizon:* Middle Oxfordian, *P. wartae* and *A. alternans* Zone.

*Type locality:* Zawodzie.

*Derivation of the name:* Lat. *multus* = many, *costatus* = ribbed.

*Material.* — A specimen in the gerontic stage.

Dimensions (in mm):

IG.1246.II.9		
	Chg	Chg/Ph
D . . . . .	420	320
H . . . . .	0.26	0.28
Th . . . . .	0.20	0.21
U . . . . .	0.52	0.47

Rib-curve:

D	70	100	130	180	250	320	370	420
R	74	87	104	114	108	76	51	36

*Description.*—Shell evolute, with whorls overlapping each other at one-third of the height. Inner whorls laterally compressed, subrectangular in transverse section, whose outline near the aperture becomes slightly oval (Text-fig. 17). The development of ribbing considerably variable. In inner whorls, up to a diameter of about 160 mm, the primary ribs are arranged close to each other, sharp, thin and fairly strongly directed anteriorly. Further on, the ribs maintain their previous character, except for the spaces between them which slightly increase. The primary ribs furcate on the ventral margin, but, due to the overlap by the next whorl, no data are available as to the number of the secondary ribs. At the point of furcation of the secondary ribs swellings appear which considerably thicken with an increase in the size of whorls. Near the point at which a diameter amounts to 290 mm, that is, in the terminal part of the septate portion, two ribs take the form of slender wedges. With a diameter of 320 mm, that is, already on the gerontic body chamber, ribs are thick, indistinctly cuneiform and passing further on into thick ribs which furcate above the middle of the side and form, each of them, two, also thick secondary ribs.

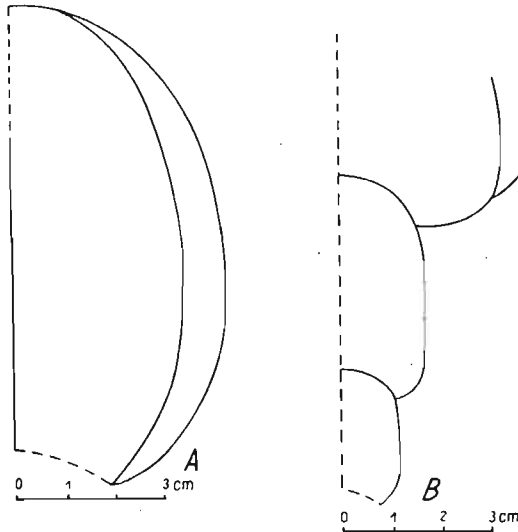


Fig. 17. — Transverse sections of the last whorls in the following species: A — *Perisphinctes (Perisphinctes) multicostatus* n.sp., with a diameter of 420 mm, IG.1246.II.9; B — *P.(P.)sp. A*, with a diameter of 250 mm, IG.1246.II.11.

*Remarks.*—The specimen described displays a slight similarity to *Perisphinctes (Perisphinctes) densecostatus* Enay, particularly so to the paratype (F. S. Lyon, No. 75,022) which, according to Enay (1966) is marked by specific morphological characters. By courtesy of Prof. R. Enay, the present writer received a photograph of the paratype and could find

great differences which, however, occur between the two specimens and which concern the manner of ribbing, especially in the gerontic body chamber. The rib-curves of the specimen from Chaumont (Jura) and that from Zawodzie are comparable, particularly so in part of their maximum curvature (Text-fig. 18). A difference is, however, observed in the manner of ribbing. As emphasized by Enay (1966). *P.(P.) densecostatus* Enay never displays cuneiform ribs, while two such ribs may be observed in the septate portion of the specimen from Zawodzie (IG.1246.II.9). In addition, the ribs on the gerontic body chamber are not as thin as those visible in the holotype and even there are thick primary ribs which bifurcate

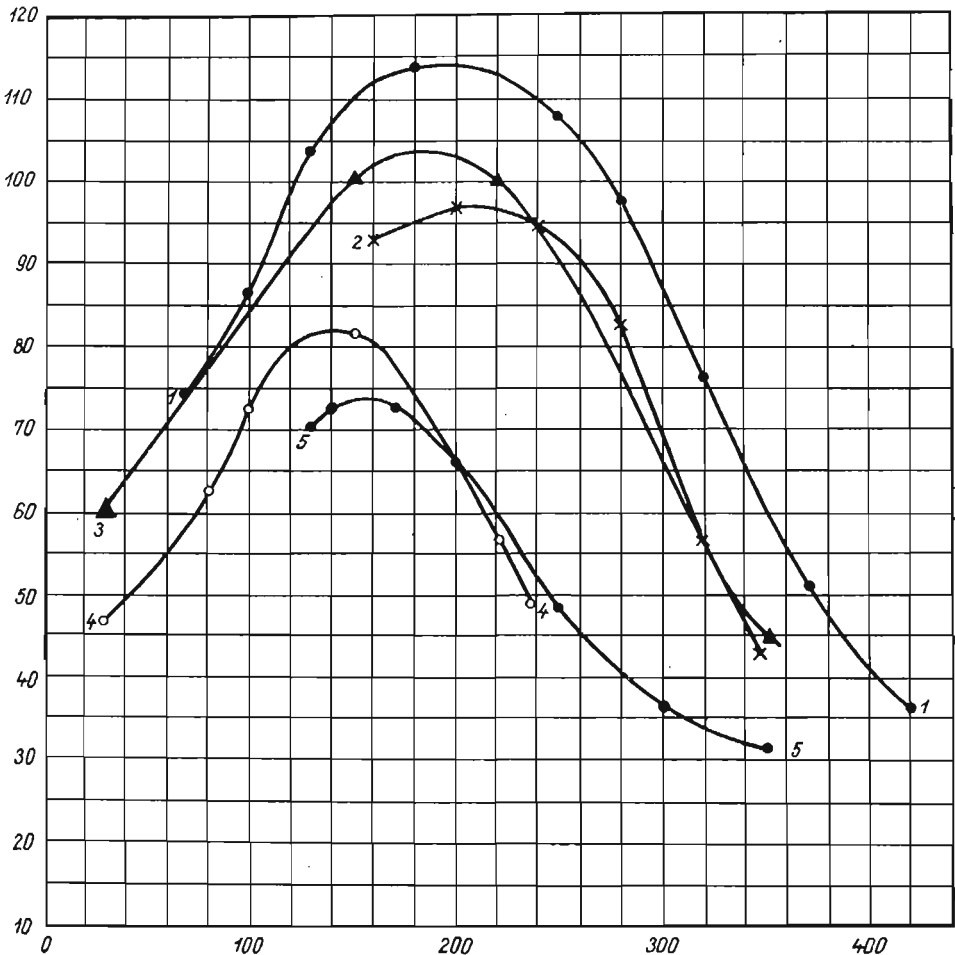


Fig. 18. — Rib-curves of *Perisphinctes (Perisphinctes) multicostatus* n.sp.: 1 holotype, Zawodzie, IG.1246.II.9; *Perisphinctes (Perisphinctes) densecostatus* Enay: 2 holotype, Lains (Jura), Lyon 75103; 3 Chaumont (Jura), Lyon 75022; *Perisphinctes (P.) enayi* n.sp.: 4 specimen described as *Perisphinctes (Perisphinctes)* sp. nov. A, Enay, 1966, Montagnieux (Ain), Lyon 75114; 5 Zawodzie, IG.1246.II.14.

to form, each of them, two thick secondary ribs. The umbilical diameter in *P.(P.) multicostatus* n.sp. is slightly smaller.

*Occurrence.* — Poland: Zawodzie.

*Perisphinctes (Perisphinctes) pumilus* Enay, 1966

(Pl. XVII; Text-figs. 19,20)

1966. *Perisphinctes (Perisphinctes) pumilus* Enay; R. Enay, L'Oxfordien ..., p. 350, Pl. 3, Figs. 1, 2; Pl. 4, Figs. 1, 3; Text-figs. 94, 96, 97.

*Material.* — A specimen, probably in the gerontic stage.

Dimensions (in mm):

IG.1246.II.30		
	Chg?	Ph
D . . . .	240	190
H . . . .	0.26	0.26
Th . . . .	—	0.21
U . . . .	0.50	0.53

Rib-curve:

D	160	200	210	• 240
R	70	55	50	39

*Description.* — Shell middle-sized, evolute, with whorls overlapping each other at one-quarter of the height of whorl. Nearly all whorls are suboval in transverse section, with a maximum width on the umbilical margin (Text-fig. 19). The gerontic body chamber(?) begins with a diameter of 190 mm. In the inner whorls, ribs numerous, straight, directed slightly anteriorly, at first thickening in the umbilical part and, at one-third of the height of whorl, furcate to form three secondary ribs. It is with a diameter of 170 mm that ribs become thicker over their entire length and this stronger prominence is marked both in the umbilical part and on the ventral margin. Constrictions clearly marked, particularly so in inner whorls. A rib, which borders a constriction, furcates on the umbilical and once again, doubly, on the ventral margin. In part of the gerontic body chamber(?) ribs are not shaped like nodes.

*Remarks.* — A considerable ontogenetic variability is observed within this species. There are specimens, in which ribbing passes from thinner to closer. The greatest similarity in the rib-curve of the specimen under



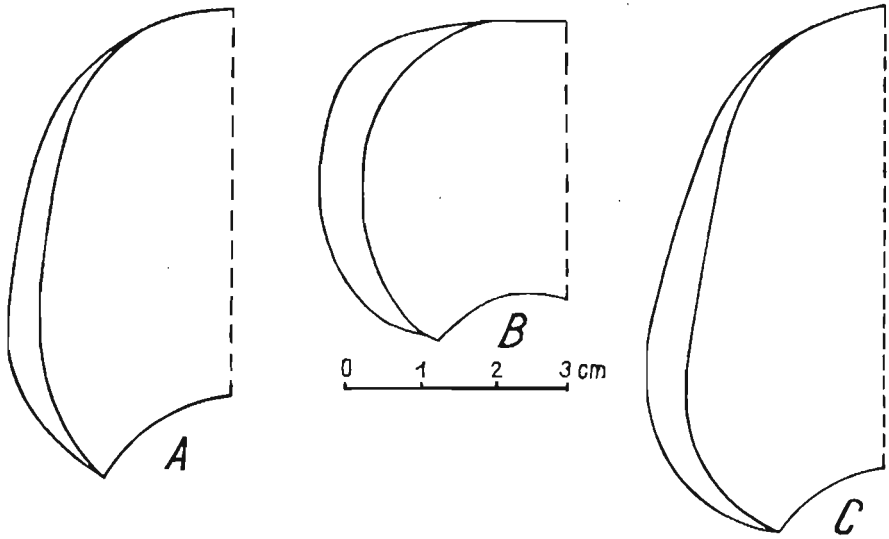


Fig. 19. — Transverse sections of the last whorls in the following species: A — *Perisphinctes (Perisphinctes) pumilus* Enay, with a diameter of 240 mm, IG.1246.II.30, nat.size; B — *Perisphinctes (P.)* sp. B, with a diameter of 210 mm, IG.1246.II.34; C — *P. berlieri* Loriol, with a diameter of 240 mm, IG.1246.II.23; all figures nat.size.

study is observed when we compare it with the specimen from Vercra, Ain (Text-fig. 20) which is very similar in transverse section of the last whorl (a diameter of 240 mm) to our holotype.

*Occurrence.* — France: Evosges (Ain),<sup>a</sup>Trept (Isère); Poland: Zawodzie.

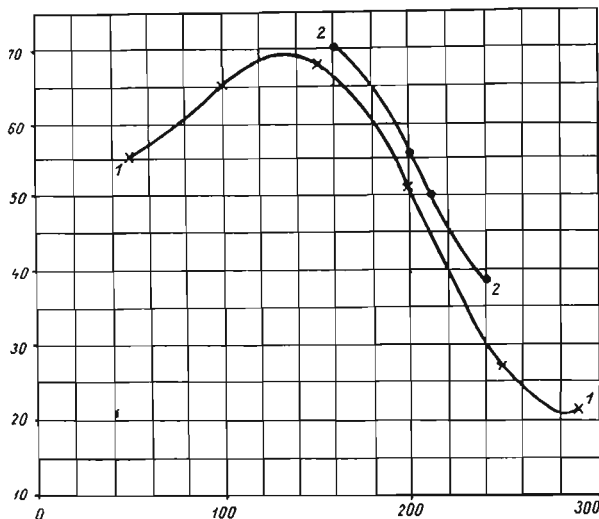


Fig. 20. — A rib-curve of *Perisphinctes (Perisphinctes) pumilus* Enay: 1 Vercra (Ain), Dominjon and Belley's collection, 2 Zawodzie, IG.1246.II.30.

*Perisphinctes (Perisphinctes) swidzinskii* n.sp.

(Pl. XVIII; XIX, Figs. 1, 2; Text-figs. 21, 22)

*Holotype*: Pl. XVIII.*Type horizon*: Middle Oxfordian, *P. wartae* and *A. alternans* Zone.*Type locality*: Zawodzie.*Derivation of the name*: in honour of the late Professor H. Świdziński, a well-known investigator of the Polish Jurassic.*Material*. — Five specimens in the gerontic stage.

Dimensions (in mm):

	IG.1246.II.36	IG.1246.II.1	IG.1246.II.22	IG.1246.II.20		IG.1246.II.29
	Chg	Chg	Chg	Chg	Ph	Ph
D . . . .	400	380	350	330	240	270
H . . . .	0.31	0.30	0.31	0.27	0.34	0.29
Th . . . .	0.26	0.29	0.20	0.20	0.21	0.27
U . . . .	0.50	0.48	0.44	0.51	0.46	0.44

Rib-curves:

	D	50	100	130	150	180	200	230	250
IG.1246.II.36	R			91	—	—	91	—	82
IG.1246.II.1		72	74	—	81	81	—	76	—
IG.1246.II.20		78	81	—	56	87	—	83	—
IG.1246.II.29					82	81	—	—	75

260	270	280	300	330	380	400
—	—	67	—	46	—	26
—	—	—	44	—	20	—
77	—	66	—	46	—	—
—	64	—	—	—	—	—

*Description*. — Shell very large, evolute, with whorls overlapping each other at one-third of the height. The shape of the transverse section of whorls varying with the growth of shell (Text-fig. 21); in inner whorls it is suboval, later, still in the septate portion and with a diameter of 270 mm, subrectangular and, in part of the gerontic chamber, once again suboval. Venter, varying depending on the transverse section of whorls, is markedly flat and wide with a diameter of about 270 mm. The development of ribbing variable, with a distinct change in the character of ribs visible already in the septate portion. Inner whorls are covered with closely spaced, straight, slightly anteriorly directed primary ribs,

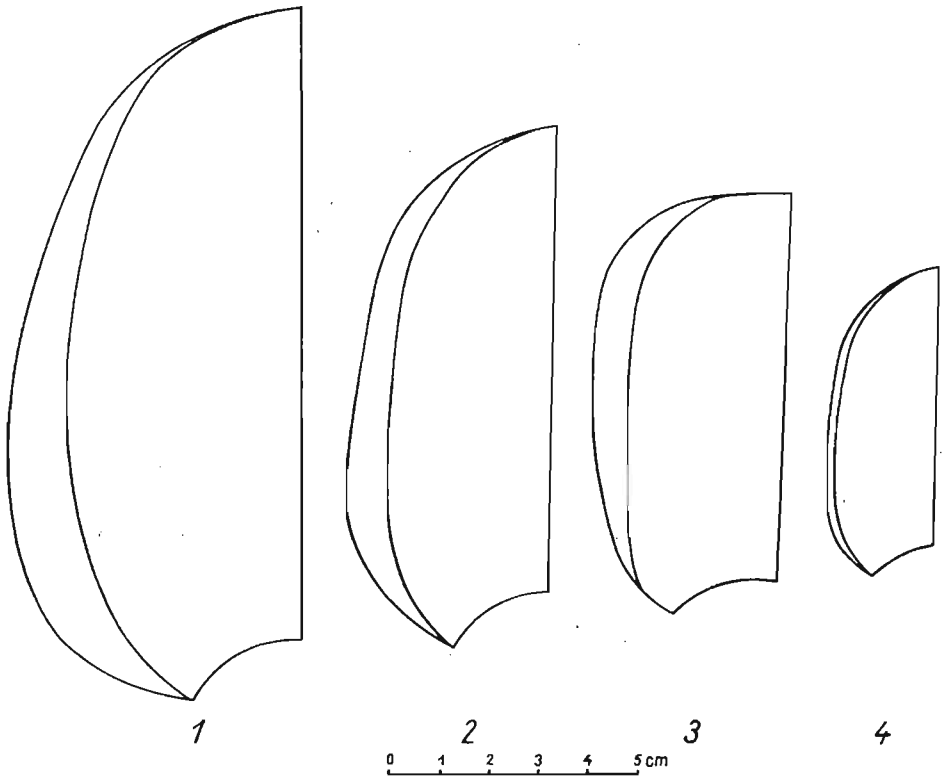


Fig. 21.—Transverse sections of the last whorls in *Perisphinctes* (*Perisphinctes*) *swidzinskii* n.sp.: 1 a gerontic chamber of a specimen 460 mm in diameter, IG.1246.II.36, 2 a gerontic chamber of a specimen 350 mm in diameter, IG.1246.II.22, 3 a septate portion of a specimen 270 mm in diameter IG.1246.II.29, 4 the same element of the same specimen with a diameter of 200 mm.

which bi- or trifurcate into secondary ribs. Since earlier whorls are covered by the subsequent ones, the furcation may be observed only with a diameter of 250 mm. The primary ribs gradually become thicker and thicker and the spaces between them also increase. Beginning with a diameter of 270 mm, the secondary ribs form bundles on the ventral margin and consequently whorls become in this place subrectangular in transverse section (Text-fig. 21). The first cuneiform rib appears still within the septate portion and subsequently develops into nodes shaped like slender wedges characteristic of this species. In the largest specimen of this species (IG.1246.II.36), with diameter larger than 330 mm the nodes considerably thicken and the width of the last cuneiform nodes on the ventral side amounts to about 7 cm. The greatest number of the primary ribs are observed with a diameter of 150 to 180 mm which is visible on rib-curves (Text-fig. 22).

*Remarks.*—None of the many species, assigned to the subgenus *P.* (*Perisphinctes*) may be considered as similar, both in sculpture and

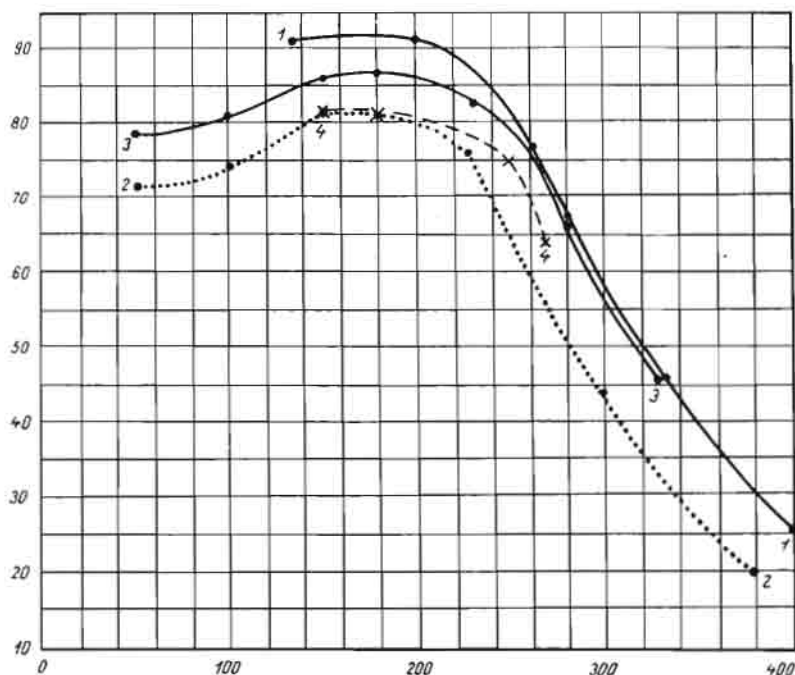


Fig. 22. — Rib-curves of *Perisphinctes (Perisphinctes) swidzinskii* n.sp.: 1 Zawodzie, holotype IG.1246.II.36; 2, 3, 4 Zawodzie, IG.1246.II.1, 20, 29.

rib-curve, to the newly erected species. Particularly interesting is the initial sector of the rib-curve drawn on the basis of the number of primary ribs between 50 and 150 mm of diameter. If the middle part of the curvature may be on the whole comparable with the curve of *P.(P.) densecostatus* Enay, its initial part is quite different.

*Occurrence.* — Poland: Zawodzie.

*Perisphinctes (Perisphinctes) sp. A*

*Material.* — A fragmentary specimen in the gerontic stage, with septate portion and body chamber.

Dimensions (in mm):

IG.1246.II.11	
D	280?
H	0.27
Th	0.32
U	—

*Description and remarks.*—This specimen undoubtedly represents the gerontic stage. Shell evolute with whorls overlapping each other at one-third of the height (Text-fig. 17). The ribbing of inner whorls of the *Perispinctes* s.str. type. In part of the gerontic body chamber, ridges are similar to those of *P.(P.) martelli* (Oppel) and *P.(P.) cuneicostatus* Arkell.

*Occurrence.*—Poland: Zawodzie.

*Perispinctes (Perispinctes) sp. B*

(Pl. XX, Figs. 1, 2; Text-figs. 12, 19)

*Material.*—A septate portion of a specimen.

Dimensions (in mm):

IG.1246.II.34	
Ph	
D . . . . .	210
H . . . . .	0.20
Th . . . . .	0.21
U . . . . .	0.57

Rib-curve:

D	85	100	120	150	180	210
R	59	60	63	60	55	47

*Description.*—Shell evolute, with very slightly overlapping whorls, which together with the outline of ribs (Text-fig. 19) are rectangular in transverse section. Venter flat. Development of ribbing gradual. At first, up to a diameter of about 110 mm, ribs are straight, fairly sharp, closely spaced. Slightly overlapping subsequent whorls do not allow one, however, to observe the manner of furcation of the primary ribs. Supposedly, the point of furcation is situated high up on the ventral margin. Spaces between primary ribs increase with the growth of whorls and an elevation is formed at the point of furcation on the neutral margin. Bifurcation may be observed in some places only. Three constrictions are bounded by a single rib and by two ribs whose point of furcation is situated on the umbilical margin.

*Remarks.*—This specimen differs from other ones of the subgenus *Perispinctes* s.str. in the shape of the transverse section of its whorls, while its rib-curve (Text-fig. 12) displays a slight similarity to those of *P.(P.) pumilus* Enay.

*Occurrence.*—Poland: Zawodzie.

*Perisphinctes berlieri* Loriol, 1903  
(Pl. XXI, Figs. 1, 2; Text-figs. 19, 23)

1903. *Perisphinctes berlieri* Loriol; P. Loriol, L'Oxfordien supérieur ..., p. 78, Pl. 12, Fig. 2 (non Pl. 9).  
 1930. *Perisphinctes berlieri* Loriol; P. Dorn, Die Ammonitenfauna ..., p. 166, Pl. 16, Fig. 1.  
 non 1953. *Perisphinctes berlieri* Loriol; P. Siegfried, Die Heersumer Schichten ..., p. 312, Pl. K, Fig. 6.  
 1966. *Perisphinctes (Liosphinctes) berlieri* Loriol; R. Enay, L'Oxfordien ..., p. 422, Pl. 21, Fig. 1; Text-figs. 120, 121.

*Material.* — A specimen in the gerontic stage.

*Dimensions* (in mm):

IG.1246.II.23	
Chg	
D	240
H	0.29
Th	0.25
U	0.49

*Rib-curve:*

D	70	100	130	160	180	200	240
R	68	73	66	54	44	36	24

*Description.* — Shell evolute, with whorls overlapping each other at one-third of the height. Whorls oval in transverse section, slightly extended near the umbilical margin (Text-fig. 19). Gerontic body chamber begins with a diameter of 200 mm. Ribbing considerably variable. Up to a diameter of about 130 mm, inner whorls are covered with many, thin ribs, directed slightly anteriorly. Spaces between ribs slightly increase with the growth of whorls. Due of its being overlapped by the subsequent whorl, the point of furcation of the primary ribs remains invisible. A constriction, behind which there occurs a change in ribbing, is visible with a diameter of 130 mm. In this part of shell, the primary ribs swell on the umbilical margin and, subsequently, form bundles of three to four secondary ribs in the upper part of the side of whorl. A slightly marked dischizotomous furcation is visible locally. The ornamentation of the gerontic body chamber considerably differs from that of the remaining parts. The primary ribs, prominent on the umbilical margin, are fairly widely spaced. Halfway the side of whorl, these ribs slightly decrease their convexity. The point of furcation of these ribs

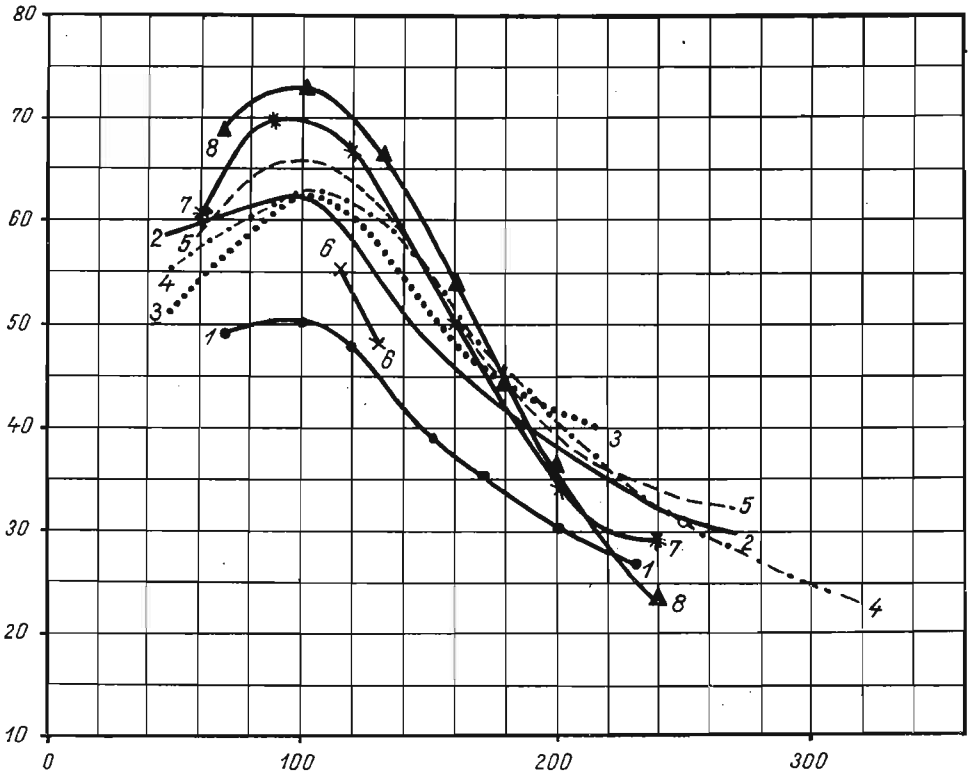


Fig. 23. — Rib-curves of *Perisphinctes* (*Liosphinctes*) sp. A: 1 Zawodzie, IG.1246.II.31; *Lithacoceras* (?*Progeronia*) *choffati* (Riaz): 2 Zawodzie, IG.1246.II.24; 3 Zawodzie, IG.1246.II.7; *Lithacoceras* (?*Progeronia*) sp. A: Zawodzie, IG.1246.II.38; *Perisphinctes* *berlieri* Loriol: 6 lectotype (after Loriol, 1903, Pl. 12, Fig. 2), 7 topotype, Lyon 75038, Enay, 1966, p. 422, 8 Zawodzie, IG.1246.II.23.

on a rounded ventral margin is poorly visible. A constriction, observed in the place of a sudden change in ribbing is bordered by a single rib. Sutures strongly furcated and, therefore, difficult to decipher.

*Remarks.* — The rib-curve of the specimen from Zawodzie (Text-fig. 23) is almost completely in conformity with that drawn for Enay's specimen (Enay, 1966, No. Lyon 75,038). Due to its somewhat different ribbing, another of Loriol's specimens (1903, Pl. 9) cannot be assigned to this species. Siegfried (1953, p. 312) calls attention to the fact that the specimens he describes correspond to Loriol's descriptions, but are differently ribbed in inner whorls. *Perisphinctes berlieri* Loriol is assigned by Enay (1966) to the subgenus *P.(Liosphinctes)*. On the basis of comparative materials (texts and photographs) sent in by Dr. J. H. Calomon and due to this author's penetrating analysis of particular species of the subgenus *P.(Liosphinctes)*, the present writer was able to find that *P. berlieri* cannot be assigned to this subgenus. Such an assignment

is impossible primarily due to the rib-curve, which differs from those observed in the representatives of the subgenus *P.(Liosphinctes)*. Callo-mon's paper (1960) and photographs reveal that the ornamentation of the gerontic body chamber in the species of *Liosphinctes* somewhat differs from that in *P. berlieri* Loriol in the shape of the primary ribs, which, thickened in the umbilical part, are slightly slimmer in the last-named species. In addition, *P. berlieri* Loriol is a form with a wider umbilicus. Due to the fact of only one specimen being available to her and the difficulties of comparing it with other species, the present writer is now still unable to assign this species to an appropriate subgenus.

*Occurrence.* — Switzerland: Bourau; France: Trept (Isère); Southern Germany: Franconia; the U.S.S.R.: Donets Basin; Poland: Zawodzie.

### Genus *Lithacoceras* Hyatt, 1900

*Type species:* *Ammonites ulmensis* Oppel (1858, p. 771; 1862, p. 261, Pl. 74, Fig. 1), designated by Hyatt (1900, p. 581).

### Subgenus *Lithacoceras (Progeronia)* Arkell, 1953

*Type species:* *Perisphinctes progeron* Ammon (1875), designated by Arkell (1953, p. 38).

*Synonym:* *Ammonia* Ilovaisky & Florensky (1941).

*Species assigned:* *Lithacoceras (P.?) choffati* (Riaz), *Lithacoceras (P?) sp. A*.

*Stratigraphic and geographical range:* Middle(?) Oxfordian and Kimmeridgian of Europe, Southern part of the U.S.S.R., North Africa.

*Diagnosis.* — Shell large, evolute. Whorls high-oval to oval in transverse section. Ornamentation consisting of many ribs in inner whorls and widely spaced ribs in outer whorls. Ribbing double and triplicate, in outer whorls sometimes irregular and of the "ataxioidal" type. Early swelling of ribs in the umbilical part.

*Remarks.* — According to Arkell (1953), *Progeronia* descends from *Arisphinctes*, as indicated by ribbing.

### *Lithacoceras (?Progeronia) choffati* (Riaz, 1898)

(Pls. XXII, XXIII; Text-figs. 23, 24)

1898. *Perisphinctes choffati* Riaz; A. Riaz, Description ..., p. 33, Pl. 11, Fig. 3.

1946. *Perisphinctes (Arisphinctes?) choffati* Riaz; W. J. Arkell, A revision ..., p. 132.

1966. *Progeronia (?) choffati* (Riaz); Gygi R., Über das zeitliche ..., p. 938.

1969. *Progeronia (?) choffati* (Riaz); R. A. Gygi, Zur Stratigraphie ..., Pl. 17.

*Material.* — Three specimens, one of which is preserved together with a fragment of gerontic body chamber, the other with an almost complete gerontic chamber and the third only with the septate portion preserved.



## Dimensions (in mm):

	IG.1246.II.7	IG.1246.II.24	IG.1246.II.37
	Chg	Chg	Ph
D . . . .	320	270	220
H . . . .	0.27	0.27	0.27
Th . . . .	0.25	0.21	0.25
U . . . .	0.50	0.55	0.52
Chg . . . .	310	230	—

## Rib-curves:

	D	50	70	100	130	140	150	170	200
IG.1246.II.7		55	59	63		58			41
IG.1246.II.24	R	58	60	63	55			44	
IG.1246.II.37		51	57	63			52	46	41

	220	230	250	270	300	320
		34		29	25	24
40		34	31	30		

*Description.*—Shell evolute, with whorls overlapping each other at one-third of the height. In the septate portion and in part of the gerontic body chamber, whorls (Fig. 24) are high-oval in transverse section with a maximum extension in the umbilical part, which is caused by a considerable prominence of the primary ribs in this part of whorl. Changes in ribbing gradual. The secondary ribs are considerably less strongly developed than the primaries, which is already observed in earlier whorls and which makes up a characteristic feature. In earlier whorls, the primary ribs are straight, sharp and slightly inclined anteriorly. In addition to constrictions, slightly prominent points of furcation of the primary ribs are already visible beginning with a diameter of about 100 mm, although the secondary ribs themselves and the manner of furcation are invisible. The tri- and quadrifurcating secondary ribs are visible only with a diameter of about 150 mm. With such a diameter the primary ribs become more prominent on or near the umbilical margin and, consequently, the whorl has a transverse section illustrated in Text-fig. 24. In the largest specimen, the gerontic body chamber begins with a diameter of 310 mm. The ornamentation of the body chamber is poorly preserved. The thick primary ribs are visible, along with considerably less distinct secondary ribs. Spaces between primary ribs reach 3 cm. Constrictions are visible particularly in inner whorls. Sutures strongly furcate, difficult to decipher.

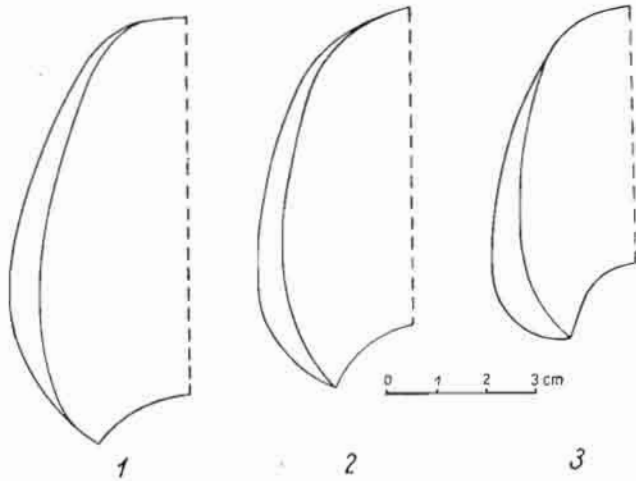


Fig. 24. — Transverse sections of the last whorls in specimens of *Lithacoceras* (?*Progeronia*) *choffati* (Riaz): 1 a gerontic chamber of a specimen 320 mm in diameter, IG.1246.II.7; 2 a gerontic chamber of a specimen with a diameter of 270 mm, IG.1246.II.24; 3 a septate part of a specimen, with a diameter of 220 mm, IG.1246.II.37.

Rib-curves display their maximum curvatures with a diameter of 100 mm (Text-fig. 23).

*Remarks.* — According to Siemiradzki (1899, p. 342), *Perisphinctes choffati* Riaz (1898, Pl. 11, Fig. 3 — not 4, 5) should be recognized as a separate species, strongly related to *Perisphinctes* cf. *Pagri* nob. (Siemiradzki's designation). This suggestion has not been undertaken by later investigators. An appropriate assignment of *P. choffati* Riaz to a genus or subgenus poses many problems. Arkell (1946, p. 32) believes that it should be assigned to the subgenus *P.* (*Arisphinctes*), while Gygi (1966, 1969) maintains, with some probability, that this species belongs to the genus *Progeronia*.

*Occurrence.* — France: Trept (Isère); Switzerland: Eisengraben near Mönthäl; Poland: Zawodzie.

*Lithacoceras* (?*Progeronia*) sp. A  
(Pl. XXIV; Text-fig. 23)

*Material.* — A specimen with a septate portion, and a fragmentary gerontic body chamber.

Dimensions (in mm):

IG.1246.II.38	
D	270
H	0.25
Th	0.23
U	0.52

Rib-curve:

D	60	70	100	150	180	200	220	270
R	59	61	66(?)	55	45	39	37	33

*Description.* — Shell middle-sized, evolute, with slightly overlapping whorls. Whorls oval in transverse section, with a fairly wide venter. Changes in ribbing gradual. Up to a diameter of about 120 mm, the primary ribs are straight, sharp and slightly inclined anteriorly. With larger diameters, the secondary ribs become more prominent. The point of furcation of the primary ribs, covered by the last whorl and, consequently, invisible. With a diameter of about 200 mm, a constriction is visible, behind which the primary ribs become more prominent. In this part of shell, the manner of furcation may be observed. The primary ribs tri- or quadrifurcate into the secondary ribs almost exactly on a rounded ventral margin. The gerontic body chamber, which begins with a diameter of 190 mm, is covered with prominent ribs furcating at one-third of the height of whorl and forming three and four secondary ribs. Intercalary ribs are visible between the latter. Sutures invisible. Rib-curve with a maximum curvature displayed with a diameter of 100(?) mm (Text-fig. 23).

*Remarks.* — The rib-curve, shown in Text-fig. 23, displays characters of a curve transitional between *Lithacoceras* (?*Progeronia*) *choffati* (Riaz) and *Perisphinctes berlieri* Loriol.

*Occurrence.* — Poland: Zawodzie.

#### Subgenus *L.*(*Subdiscosphinctes*) n.subgen.

*Type species:* *Lithacoceras* (*S.*) *kreutzii* (Siemiradzki).

*Species assigned:* *Lithacoceras* (*S.*) *kreutzii* (Siemiradzki), *L.*(*S.*) *mindowe* (Siemiradzki) and *L.*(*S.*) *boreale* n.sp.

*Stratigraphic and geographical range:* Middle Oxfordian of Europe, West Asia, Japan(?).

*Diagnosis.* — Shell evolute, with a maximum diameter to 380 mm. Ribbing gradually changes with the ontogenetic development. In inner whorls, ribs are very numerous, sharp, thin and inclined anteriorly to a varying extent, on the umbilical margin fairly strongly bent. In this part of shell, ribs are mostly bifurcated and passing, without interruptions, onto the venter. Already with a diameter of about 150 mm, in part of the gerontic body chamber, ribs become thicker and thicker over their entire length, spaces between them increase gradually and the point of their furcation is located at one-third or three-thirds of the height of whorl. Predominant in this place are trifurcate, frequently dischizotomous.

slender ribs. Intercalations of single and, sometimes, double ribs are observed in some of the species of this subgenus. Constrictions shallow. Rib-curve with a maximum curvature reached with a diameter of 100 to 150 mm. Due to the preservation of specimens in the form of internal molds sutures cannot be observed in detail.

*Remarks.* — *L.(Subdiscosphinctes)* n.subgen. displays a similarity to the subgenus *L.(Discosphinctes)* Dacqué, 1914, but only in inner whorls. Erecting the genus *Discosphinctes*, Dacqué believed, that *Perisphinctes arussiorum* Dacqué, an involute form with high whorls, was its typical representative. The following species were also supposed to belong to this taxon: *Perisphinctes fraasi* Dacqué, *P. aeneas* Choffat (non Gemmelaro), *P. rhodanicus* Dumortier.

*Discosphinctes* Dacqué was included by Schindewolf (1925) and Spath (1930) to the genus *Lithacoceras* Hyatt, which has been maintained up to the present. Arkell (1937) believed that some of the specimens, among them, *Perisphinctes kreutzii* Siemiradzki (1891, Pl. 1, Fig. 4) and *P. kreutzii* Siemiradzki (Ronchadze, 1917, p. 35, Pl. 4, Figs. 30, 31) had been erroneously assigned by Spath (1931, p. 450) to the genus *Lithacoceras* and subgenus *Discosphinctes*. In his opinion, those forms might represent the inner whorls of the representatives of species of the subgenus *Arisphinctes*. Ronchadze (1917, p. 35) also considers his specimens as transitional forms between species of the subgenera *Arisphinctes* and *Discosphinctes*.

According to Enay (1966), the subgenus *L.(Discosphinctes)* Dacqué groups "micro-conch" forms whose ribbing is of the isocostate type.

Most forms hitherto assigned to the subgenus *L.(Discosphinctes)* Dacqué differed from the type species *Perisphinctes arussiorum* Dacqué (1905, p. 45, Pl. 17, Fig. 4) primarily in a larger evoluteness, as well as in the height of whorls. Attention has already been called to this fact by Spath (1931), who generally distinguished a group of species of the "*lucingensis-aeneas*" type differing from those which should correspond to type species of the subgenus *L.(Discosphinctes)* Dacqué. The lack of complete specimens in the gerontic stage was, however, a considerable obstruction in separating a new subgenus. Specimens in a certain development stage being only available, various authors were unable to classify them correctly. It was only Siemiradzki (1899) who, describing the species *Perisphinctes lucingensis*, called attention to the ornamentation of the body chamber. The manner of ribbing does not on the whole differ from that observed in the subgenus *L.(Subdiscosphinctes)*. This specimen is illustrated in Dorn's work (1930, Pl. 7, Fig. 2). According to Enay (1966), Siemiradzki's specimen cannot be assigned to the *L.(Discosphinctes)* *lucingae* (Favre). The specimens in the gerontic stage, found at Zawodzie, allowed one to trace the development of ribbing typical of the subgenus *L.(Subdiscosphinctes)* n.subgen.

*Lithacoceras (Subdiscosphinctes) boreale* n.sp.

(Pl. XXV; Pl. XXVI, Figs. 1, 2; Text-figs. 25, 26)

*Holotype*: Pl. XXV; Pl. XXVI, Figs. 1, 2.*Type horizon*: Middle Oxfordian, *P. wartae* and *A. alternans* Zone.*Type locality*: Zawodzie.*Derivation of the name*: *Lat.borealis* — occurring in boreal regions.*Material*. — A specimen in the gerontic stage.

Dimensions (in mm):

IG.1246.II.15			
	Chg	Ph	
D . . . . .	330	250	100
H . . . . .	0.22	0.26	0.39
Th . . . . .	0.20	0.20	—
U . . . . .	0.51	0.42	—

Rib-curve:

D	80	100	120	150	170	200	250	270	300	330
R	108	116	123	117	111	99	81	77	71	66

*Description*. — Shell large, evolute, with whorls overlapping each other at one-third of the height. The transverse section of whorls is shown in Text-fig. 25. The septate portion ends with a diameter of 250 mm. Up to

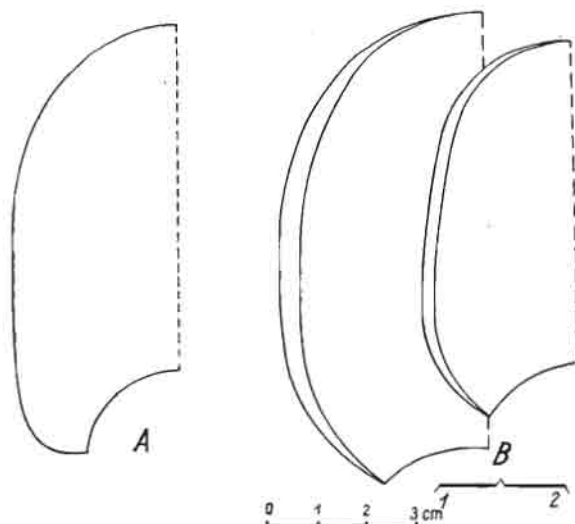


Fig. 25. — Transverse sections of the last whorls in: *A* — *Lithacoceras (Subdiscosphinctes) boreale* n.sp., with a diameter of 330 mm, IG.1246.II.15; *B* — *L.(S.) kreutzii* (Siemiradzki): 1 a gerontic chamber with a specimen's diameter of 380 mm, IG.1246.II.10; 2 the chamber with a diameter of 250 mm, IG.1246.II.19.

a diameter of 120 mm, inner whorls are covered with fine, closely spaced, sharp ribs which begin in the umbilical side and slightly bend on the umbilical margin. On the sides of shell, these ribs are slightly inclined anteriorly. The points of furcation of the primary ribs are invisible, being covered by subsequent whorls.

On the left side of the specimen, the manner of ribbing is already clearly visible. Mostly trifurcate, frequently dischizotomous, as well as double ribs and single intercalatories are observed. The fact that the primary ribs are swollen already halfway the whorl and the secondary ribs are slender, is a characteristic feature of this manner of furcating.

In part of the gerontic body chamber, the primary ribs grow thicker and thicker already in the umbilical area. These ribs furcate dischizotomously in the upper one-third of the whorl, forming three or four secondary ribs. Poorly visible constriction do not differ in appearance from

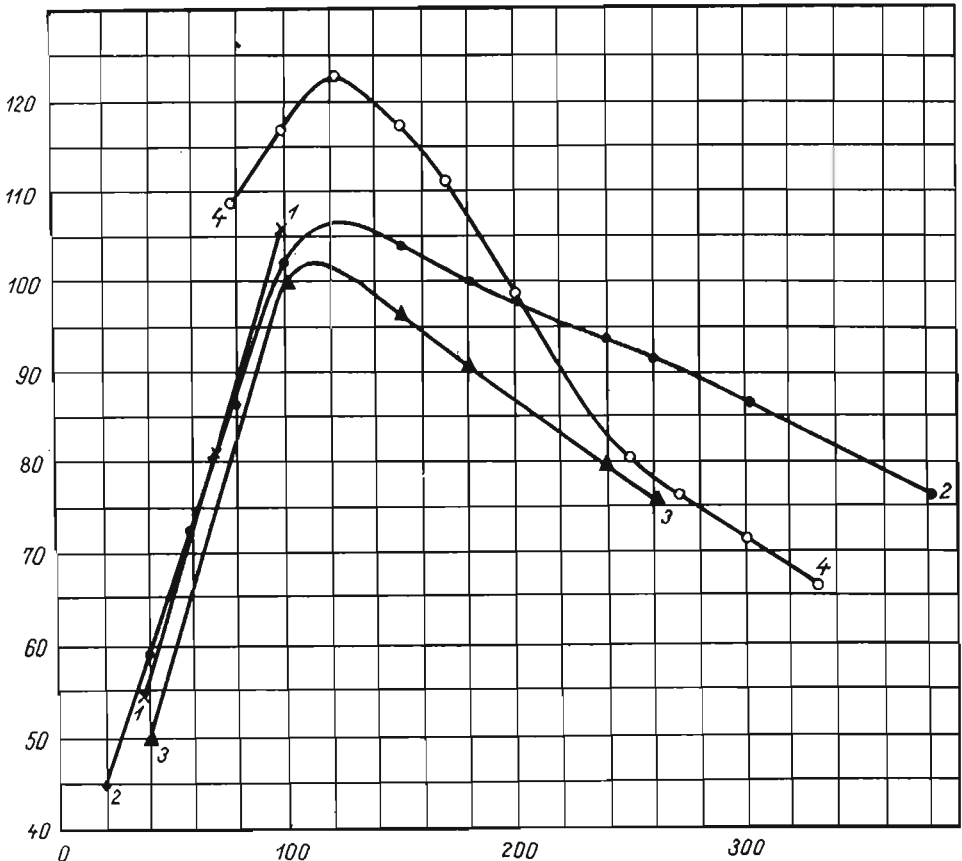


Fig. 26. — Rib-curves of *Lithacoceras* (*Subdiscosphinctes*) *kreutzii* (Siemiradzki): 1 holotype, Museum of the Inst. of Geol. Sci., Polish Academy of Sciences, Cracow, 2 Zawodzie, IG.1246.II.10, 3 Zawodzie, IG.1246.II.19; *Lithacoceras* (*Subdiscosphinctes*) *boreale* n.sp.: 4 Zawodzie, IG.1246.II. 15.

inter-costal gap. It is shallow and its presence is revealed rather by the prominence of rib with an irregular furcation. The rib-curve (Text-fig. 26) reaches its maximum curvature with the specimen's diameter of 120 mm.

*Remarks.* — A considerably greater number of ribs with the same diameter as compared with the remaining species of the subgenus *L. (Subdiscosphinctes)* is a main character enabling the distinction of the new species. With a diameter of 100 mm, this species has to 16 ribs more than all other species. A similarity is observed between the new species and *L. (Subdiscosphinctes) kreutzii* (Siemiradzki), but, the latter is a form having a lower number of ribs in inner whorls.

*Occurrence.* — Poland: Zawodzie.

*Lithacoceras (Subdiscosphinctes) kreutzii* (Siemiradzki, 1891)

(Pl. XXVII, Figs. 1, 2; Pl. XXVIII; Text-figs. 25, 26, 28)

1891. *Perisphinctes kreutzii* Siemiradzki; J. Siemiradzki, Fauna kopalna ..., p. 41, Pl. I, Fig. 4.
1899. *Perisphinctes trichoplocus* Gemmelaro; J. Siemiradzki, Ammonitengattung *Perisphinctes* ..., p. 273 (pars).
- non 1917. *Perisphinctes kreutzii* Siemiradzki; J. Ronchadze, *Perisphinctes* ..., p. 35, Pl. 4, Fig. 30.
- non 1917. *Perisphinctes kreutzii* Siemiradzki; J. Ronchadze, *Perisphinctes* ..., p. 29.
- non 1931. *Lithacoceras* aff. *kreutzii* Siemiradzki; Spath F. L., Cutch ..., p. 456, Pl. 87, Fig. 9.
- non 1939. *Perisphinctes kreutzii* Siemiradzki; W. J. Arkell, Corallian beds ..., p. 148.
- non 1946. *Perisphinctes (Arisphinctes) kreutzii* Siemiradzki; W. J. Arkell, A revision ..., p. 131, 134.
1966. *Lithacoceras (Discosphinctes) kreutzii* (Siemiradzki); Enay R., L'Oxfordien ..., p. 537, Pl. 37, Figs. 5, 7; Text-figs. 164, 169.

*Material.* — Two specimens in the gerontic stage.

*Description.* — Shell large, evolute, with whorls overlapping each other at one-quarter of the height of whorl. Whorls oval in transverse section (Text-fig. 25). Up to a diameter of 100 mm, inner whorls are covered with fine, sharp ribs, which begin in the umbilical side, take an arcuate form on the umbilical margin and slightly incline anteriorly on the sides of whorls. In this part of shell, the points of furcation of the primary ribs are invisible, being covered by successive whorls. Also in this part of shell, the number of the primary ribs reaches its maximum. The manner of furcation may be observed at the earliest with a diameter of 150 mm. The point of furcation is located at three-quarters of the whorl. The primary ribs bifurcate and the secondary ribs pass, without interruptions, onto the venter. The change in ribbing takes place slowly and gradually. In part

## Dimensions (in mm):

	IG.1246.II.10		IG.1246.II.19	
	Chg	Ph	Chg	Ph
D . . . . .	380	240	250	180
H . . . . .	0.25	0.31	0.28	0.30
Th . . . . .	0.21	0.22	0.23	0.26
U . . . . .	0.55	0.47	0.50	0.50
Chg . . . . .	280		200	

## Rib-curves:

	D	20	40	60	80	100	150	180
IG.1246.II.10	R	45	59	73	86	102	104	100
IG.1246.II.19			50			100	97	91

	200	240	260	300	380
	98	94 80	92 76	87	76

of the gerontic body chamber the ribs thicken and furcate at three-quarters of the height of whorl, mostly forming three secondary ribs. Nearer the aperture, the primary ribs smooth down and their points of furcation are marked by a swelling on a rounded ventral margin. Next, the secondary ribs almost completely flatten down, so that a smooth surface is visible on the venter. Rib-curve of the Text-fig. 26.

*Remarks.* — The holotype of *Lithacoceras (Subdiscosphinctes) kreutzii* (Siemiradzki) was described by Siemiradzki (1891) from the *P. transversarius* Zone of the Cracow Jurassic<sup>2</sup>. It was a small specimen, whose diameter did not exceed 100 mm. A considerably greater number of ribs (about 50) with a diameter of 15 mm and an umbilicus much wider than in other, already known species, was a characteristic feature which allowed Siemiradzki to separate this new species. According to Siemiradzki, the aperture of the specimen recognized by him as a holotype, displayed the lack of lateral lappets and the ornamentation of the body chamber did not differ at all from that of the preceding whorls. This description indicates

<sup>2</sup> Specimens from Siemiradzki's collection, described in his work from 1891, are now housed in the Museum of the Institute of Geological Sciences in Cracow, Polish Academy of Sciences.



that Siemiradzki's specimen was a young form with the shape of its aperture depending on the development stage. In its inner whorls, the specimen from Zawodzie (IG.1246.II.15) displays characters of the holotype and this fact has induced the present writer to recognize it as a gerontic form of *Lithacoceras* (*Subdiscosphinctes*) *kreutzii* (Siemiradzki).

In inner whorls, the specimen described differs from *L.(S.) mindowe* (Siemiradzki) in a lower number of ribs by a diameter of 100 mm and in less inclined primary ribs. One of the specimens, described by Ronchadzè (1917, Pl. 4, Fig. 30) is less densely ribbed than *L.(S.) kreutzii*, while another of Ronchadzè's (*l.c.*, p. 29) specimens was recognized by Enay (1966) as a new species *Perisphinctes* (*Arisphinctes*) *tenuis* Enay. A specimen described by Spath (1931, p. 456) is more involute than the holotype. It should be emphasized, however, that Spath was the first to assign correctly *P. kreutzii* Siemiradzki to the genus *Lithacoceras*. Forms, described by Arkell (1939, 1946) were assigned by this author to the subgenus *P.(Arisphinctes)*. The character of this form's suture, similar to that in *Perisphinctes* (*Arisphinctes*) *plicatilis* (Sowerby), was accepted by Arkell as a basis for this assignment.

*Occurrence.* — Poland: Rudno, Podłęże, Tenczynek, Paczołtowice (the Cracow Jurassic), Zawodzie; France: Isère, Ain; Switzerland: Siblingen, Eisengraben.

*Lithacoceras* (*Subdiscosphinctes*) *mindowe* (Siemiradzki, 1891)

(Pl. XXIX, Figs. 1, 2; Text-fig. 27)

1891. *Perisphinctes mindowe* Siemiradzki; J. Siemiradzki, Fauna kopalna ..., p. 43, Pl. 2, Fig. 1.
1893. *Perisphinctes lucingensis* Favre; P. Choffat, Faune jurassique ..., p. 41, Pl. 3, Fig. 7.
- non 1893. *Perisphinctes* n.sp. aff. *mindowe* Siemiradzki; P. Choffat, Faune jurassique ..., p. 43, Pl. 10, Fig. 3.
1899. *Perisphinctes mindowe* Siemiradzki; J. Siemiradzki, Ammonitengattung *Perisphinctes* ..., p. 186.
- non 1907. *Perisphinctes* aff. *Mindowe* Choffat; Neumann J., Oxfordfauna ..., p. 35.
1912. *Perisphinctes Mindowe* Siemiradzki; R. Klebelsberg, Die *Perisphincte* ..., p. 201.
- non 1963. *Perisphinctes* (*Discosphinctes*) aff. *aeniformis* Daqué (= *Perisphinctes* aff. *mindowe* Choffat, 1893, p. 43, Pl. 10, Fig. 3); R. Enay, L'Oxfordien ..., p. 29.
1966. *Lithacoceras* (*Discosphinctes*) *mindowe* (Siemiradzki); R. Enay, L'Oxfordien ..., p. 535, Pl. 37, Figs. 1, 4; Text-figs. 163, 169 (pars).
- non 1970. *Lithacoceras* (*Discosphinctes*) *mindowe* (Siemiradzki); W. Brochwicz-Lewiński, Biostratigraphy ..., p. 237, Pl. 6.

*Material.* — A specimen which is probably in the gerontic stage. Rib-curve: with a diameter of about 100 mm, 100 primary ribs are recorded}

Dimensions (in mm):

IG.1246.II.28		
	Chg	Ph
D . . .	215	120
H . . .	0.33	0.40
Th . . .	0.24	0.18
U . . .	0.42	0.34

*Description.* — Shell evolute, with whorls overlapping each other at one-third of the height. Up to a diameter of 120 mm, the sides of shell are quite flat, the outline of transverse section compressed, umbilicus deep and having a steep wall (Text-fig. 27). Venter narrow and rounded. Whorls covered with very thin and sharp ribs strongly inclined anteriorly. With a diameter of about 100 mm, there are 100 such ribs. The development of and change in ribbing gradual. The primary ribs grow stronger and spaces between them gradually increase. The last whorl displays the tendency to a rapid growth, which is distinctly indicated by measurements of the height of this whorl. In this part of shell, whorls are suboval in transverse section. Venter rounded, its margin not marked. The sides of whorls covered with slightly primary ribs which start to grow in the

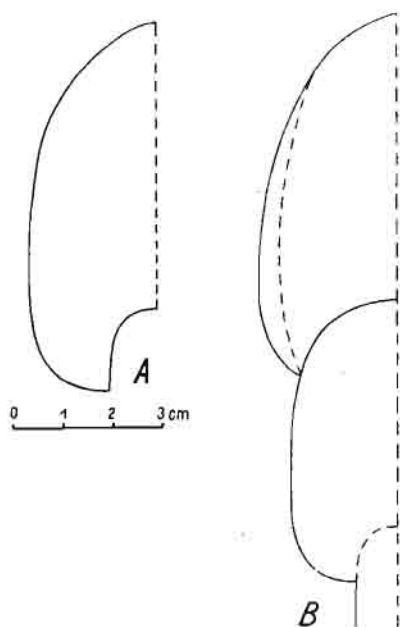


Fig. 27. — Transverse sections of the last whorls in the following species: A — *Lithacoceras (Subdiscosphinctes) mindowe* (Siemiradzki), with a diameter of 215 mm, IG.1246.II.28; B — *Lithacoceras aeneas plana* (Siemiradzki), with a diameter of 250 mm, IG.1246.II.39.

umbilical area and, taking a slight, arcuate form, pass onto the umbilical margin. The primary ribs begin to furcate already halfway the side of whorl. Trifurcate, mostly dischizotomous ribs are observed.

*Remarks.*—Specimens known so far and assigned to *Lithacoceras* (*Subdiscosphinctes*) *mindowe* (Siemiradzki) did not exceed 150 mm in diameter and were described as adult individuals, except for the fact that no individuals were known with a fully developed gerontic aperture. These specimens were only younger forms, in which the development of aperture depended on the ontogenetic stage.

In its inner whorls, the specimen described displays a similarity to *Lithacoceras* (*Subdiscosphinctes*) *kreutzii* (Siemiradzki), which, with an identical diameter, has, however, less inclined primary ribs and, in addition, their number is somewhat smaller. The specimen from Zawodzie is similar to *Lithacoceras* (*Discosphinctes*) *rhodanicus* Dumortier (1871, Pl. 3, Fig. 10), but *L.(S.) mindowe* (Siemiradzki) is more densely ribbed, its whorls overlap each other at one-third of the height and consequently its umbilicus is higher and, finally, its ribs are strongly directed anteriorly.

Due to the presence of a distinctly marked furrow, running through the middle of venter in *Perisphinctides aeneas* var. *plana* Siemiradzki (Enay, 1966, p. 535), including this species in the synonymy of *L.(S.) mindowe* (Siemiradzki) does not seem to be correct.

A specimen, described by Neumann (1907) from Četechovice (Moravia), is similar to *L.(S.) mindowe* (Siemiradzki) but has thicker whorls.

A specimen, presented by Brochowicz-Lewiński (1970) is a form less densely ribbed. A rib-curve, drawn on the basis of data taken from this author's work, may be compared with that of Choffat's (1893, Pl. 10, Fig. 3) specimen shown by Enay (1966, Fig. 163).

*Occurrence.*—Poland: Rudno (Cracow Jurassic), Zawodzie; France: Trept (Isère), Ain; Portugal: Montejunto and Cabaço Beds; Switzerland: Siblingen; Turkey: Bilecik near Ankara.

*Lithacoceras aeneas plana* (Siemiradzki, 1899)

(Pl. XXX, Figs. 1, 2; Text-figs. 27, 28)

1891. *Perisphinctes aeneas* Gemmelaro; J. Siemiradzki, Fauna kopalna..., p. 50, Pl. 4, Fig. 5.
1899. *Perisphinctes Aeneas* var. *plana* Siemiradzki; J. Siemiradzki, Ammonitengattung..., p. 184, Pl. 27, Fig. 59.
1907. *Perisphinctes Aeneas* Gemmelaro var. *plana* Siemiradzki; I. Simionescu, Studi Geologice..., p. 142.
- non 1917. *Perisphinctes aeneas* var. *plana* Siemiradzki; J. Ronchadzè, Perisphinctes..., p. 47, Pl. 5, Fig. 46.
- non 1930. *Perisphinctes Aeneas* var. *plana* Siemiradzki; P. Dorn, Die Ammonitenfauna..., p. 139, Pl. 10, Fig. 5.
- non 1960. *Perisphinctes (Discosphinctes) aeneas plana* Siemiradzki; H. Christ, Malm von Westsizilien..., p. 99.

*Material.* — A specimen in the gerontic stage.

Dimensions (in mm):

IG.1246.II.39		
	Chg	Ph
D . .	250	150
H . .	0.29	0.32
Th . .	0.20	—
U . .	0.44	0.45

Rib-curve:

D	40	60	80	110	130	160	190	220	250
R	53?	71	84	90	91	87	73	65	57

*Description.* — Shell evolute, middle-sized, with whorls overlapping each other at one-third of the height. In transverse section, a whorl looks like an oval with its vertical axis longer and sides compressed and flat, which is particularly strongly marked in inner whorls (Text-fig. 27). The septate portion terminates with a diameter of 170 mm. A change in ribbing is more conspicuous in the place in which the gerontic body chamber begins.

With a diameter of 110 mm, 90 fine, closely spaced primary ribs strongly directed anteriorly are observed in inner whorls. Since the points of furcation are covered with overlapping whorls, the manner of furcation of the primaries is in this place invisible. In the present writer's opinion, this is precisely the reason of the impossibility of observing parabolic nodes, which, according to Siemiradzki (1899), should occur on smaller specimens. With a specimen's diameter of 150 mm, the primary ribs furcate at one-third of the height of whorl or slightly lower and, in this place, on the average three secondary ribs are formed of one primary. Distinctly outlined and strongly branched sutures do not permit an accurate observation of the manner of furcation. On the whole, in this part of the specimen, a bi- and trifurcation, as well as single intercalatories may be observed. Constrictions are bordered by twofold bifurcating ribs. The trace of a furrow in the middle of venter is a characteristic feature which enables the assignment to the variety "*plana*".

A change in ribbing takes place at the point of contact of the septate portion of shell with the gerontic body chamber. The primary ribs become thicker and spaces between them gradually increase on a slightly marked umbilical margin. In the middle of the side of whorl, the primary ribs become less strongly expressed, as if obliterated and subsequently, at

one-third of the height of whorl they furcate into much weaker secondary ribs, on the average four secondary ribs being formed of each primary rib.

Sutures are strongly branched and very difficult to decipher accurately. A fragmentary whorl with a suture gives a general idea on the shape of particular elements (Pl. XXX).

*Remarks.*—The specimen from Zawodzie has the gerontic body chamber with a preserved ornamentation which enables the assignment of the species under study to the genus *Lithacoceras*. On the other hand, it is very difficult to assign this species to an appropriate subgenus. The rib-curve of the specimen from Zawodzie precludes the possibility of assigning it to the subgenera *Arisphinctes* and *Dichotomosphinctes* of the genus *Perisphinctes*, as well as to the subgenus *Subdiscosphinctes* of the genus *Lithacoceras*. The higher degree of the evoluteness of the specimen from Zawodzie does not allow one to assign it to the subgenus *Discosphinctes*. In view of only one specimen being available and the difficulty of comparing it with other species, the present writer is now unable to assign this species with a certainty to an appropriate subgenus.

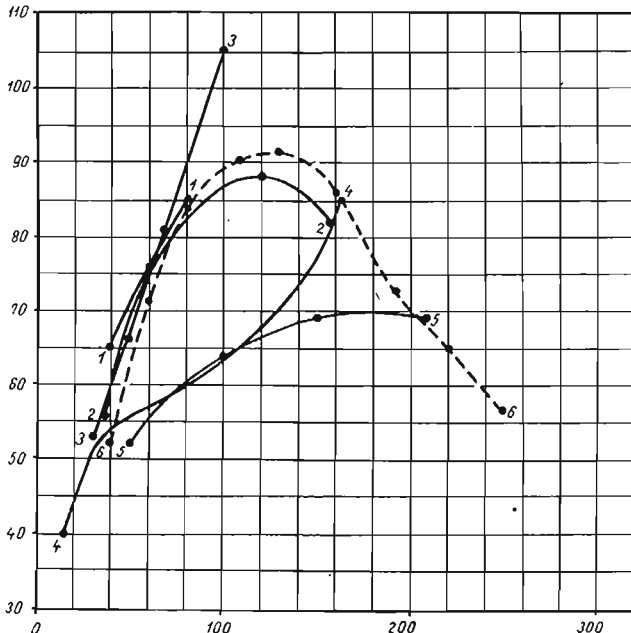


Fig. 28.—Rib-curves of *Perisphinctes* (*Discosphinctes*) *trichoplocus* Gemmelaro: 1 Evosges (Ain), Lyon 75221 (after Enay, 1966, Fig. 151); *Perisphinctes* (*Arisphinctes*) *tenuis* Enay: 2 holotype Trept (Isère), Lyon 75136 (after Enay, 1966, Fig. 117); *Lithacoceras* (*Subdiscosphinctes*) *kreutzii* (Siemiradzki): 3 holotype, Siemiradzki, 1891; *Perisphinctes* (*Dichotomosphinctes*) *wartae* Bukowski: 4 holotype (after Enay, 1966, Fig. 146); *Perisphinctes* (*Arisphinctes*) *plicatilis* (Sowerby): 5 topotype, Oxford Univ. Museum, (after Enay, 1966, Fig. 117); *Lithacoceras aeneas plana* (Siemiradzki): 6 Zawodzie, IG.1246.II.39.

Siemiradzki's subspecies displays many similarities to various species. This is particularly true of the inner whorls, especially distinct on rib-curves. (Text-fig. 28). As revealed by closer observations, certain differences do occur between particular species. *Perisphinctes (Arisphinctes) tenuis* Enay (1966, p. 407), has a very similar rib-curve, particularly its holotype (Lyon, 75136). In addition, the specimen from Lyon has only slightly overlapping, lower whorls and, consequently, a wider umbilicus. *Perisphinctes (Dichotomospinctes) trichoplocus* Gemmelaro has a similar rib-curve, but differs in the presence of constrictions in inner whorls.

Specimens described by Ronchadzè (1917, p. 47) are thicker forms, while Dorn's (1930, p. 139) specimen, despite its having such similar characters as the transverse section of whorls and a furrow in the middle of venter, is a much more closely ribbed form, much the same as *Lithacoceras (Subdiscosphinctes) kreutzii* (Siemiradzki). No photographs of the specimen he describes are presented by Christ (1960), but as follows from the measurements, this is a thicker form.

*Occurrence.* — Poland: Rudno, Filipowice (Cracow Jurassic), Zawodzie; Rumania: Cekirgea.

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LIDIA MALINOWSKA

PERISPHINCTIDAE ŚRODKOWEGO OKSFORDU ZAWODZIA  
(JURA CZĘSTOCHOWSKA)

*Streszczenie*

W niniejszej pracy opisano amonity rodziny Perisphinctidae oksfordu środkowego Zawodzia. Wyróżniono nowy podrodzaj *Subdiscosphinctes* w obrębie rodzaju *Lithacoceras*, ujmujący niektóre gatunki dotychczas zaliczane do podrodzaju *Discosphinctes*: *Lithacoceras (Subdiscosphinctes) mindowe* (Siemiradzki), *L.(S.) kreutzii* (Siemiradzki). Opisano pięć nowych gatunków: *Perisphinctes (Perisphinctes) alatiiformis* n.sp., *P.(P.) enayi* n.sp., *P.(P.) multicostatus* n.sp., *P.(P.) swidzinskii* n.sp., *Lithacoceras (Subdiscosphinctes) boreale* n.sp.

Fauna osadów środkowego oksfordu Zawodzia, słynna z dużych amonitów rodziny Perisphinctidae, nie doczekała się do dzisiejszego dnia szczegółowego, paleontologicznego opracowania. Główną przyczyną tego stanu była wojna, która dotknęła nasz kraj w latach 1939—1945. Kompletowane przez długie lata zbiory faunistyczne przez S. Z. Różyckiego i K. Kaznowskiego (Politechnika Warszawska) z obszaru Jury Częstochowskiej uległy prawie całkowitemu zniszczeniu w czasie bombardowania Warszawy w roku 1939 i Powstania Warszawskiego w roku 1944. Ocalałe resztki, wydobyte spod gruzów Muzeum Państwowego Instytutu Geologicznego w Warszawie, wzbogacone przez późniejszych zbieraczy, stanowią dzisiaj piękną kolekcję amonitów środkowego oksfordu. Zbiór ten może służyć przy korelacjach faunistycznych z jurą angielską, francuską i niemiecką.

Głównymi składnikami fauny omawianych osadów są amonity rodziny Perisphinctidae. Imponujące niekiedy ich rozmiary, a także ich nagromadzenie czynią, że odsłonięcie w Zawodziu może być uznane za jedno z ważniejszych w Europie.

Z dotychczasowych opracowań stratygraficznych wynika, że w odsłonięciu Zawodzia mamy do czynienia z osadami nie tylko środkowego, ale i górnego oksfordu.

W niniejszej pracy zwrócono szczególną uwagę na amonity rodziny *Perisphinctidae*, charakterystyczne dla oksfordu środkowego (Tab. 1). Na podstawie licznych prac autorki i innych przyjęto, że w Zawodziu reprezentowane są dwa poziomy oksfordu środkowego: górny — *Perisphinctes wartae* i *Amoeboceras alternans*, i dolny — *Perisphinctes chloroolithicus* i *Cardioceras tenuiserratum*.

Wśród okazów amonitów z Zawodzia większość jest w stadium gerontycznym, jakkolwiek brak jest na to bezspornego dowodu, jakim jest właściwie wykształcone ostateczne ujście muszli. Określenie gerontycznego stadium poszczególnych okazów nastąpiło po szczegółowej analizie pozostałych cech, charakterystycznych dla osobników, których wzrost już się zakończył. Dysponując okazami zachowanymi w postaci ośródek wapiennych, w moich rozważaniach mogłam uwzględnić tylko analizę rozwoju linii przegrodowych i analizę rozwoju żeberkowania na komorze mieszkalnej — gerontycznej. Obserwacje wykazały, że u okazów w stadium gerontycznym w większości przypadków linie przegrodowe ulegają zagęszczeniu ku końcowi części przegrodowej (*Dichotomosphinctes*). Czasami obserwuje się wprost „płatanię” tych linii i wyróżnienie ciągłej linii jest prawie niemożliwe. Niekiedy zaś zagęszczenie poszczególnych elementów linii jest tak minimalne, że ustalenie stadium, w jakim okaz się znajduje, jest niepewne.

Urzeźbienie okazów w stadium gerontycznym rozpatrywane jest przede wszystkim na komorze mieszkalnej — gerontycznej, gdzie żeberkowanie ulega daleko idącym zmianom. W zależności od przynależności do odpowiedniego podrodzaju obraz komory mieszkalnej — gerontycznej jest inny (Tab. 2).

Przy określaniu poszczególnych gatunków zwrócono szczególną uwagę na rozwój żeberkowania począwszy od skrętów wewnętrznych. Analiza zmian żeberkowania w ciągu rozwoju osobniczego amonitów ma ogromne znaczenie dla ich taksonomii. Szczególnie u rodzajów rodziny *Perisphinctidae*, u których zmiany te zachodzą niekiedy raptownie, pełnią one rolę podstawowego elementu taksonomicznego. Bardzo pomocną okazała się metoda „krzywej żeberkowej”, pozwalająca na graficzne przedstawienie rozwoju żeberkowania na skrętach. Zbieżność poszczególnych krzywych z holotypem była obiektywnym dowodem prawidłowego określania gatunku (Fig. 2). Także kształt żeberk głównych i ich sposób rozwidlenia jest ważną cechą, pozwalającą na prawidłowe zaszeregowanie gatunkowe. W niniejszym opracowaniu mamy do czynienia z gatunkami, u których przeważa monoschizotomiczny typ rozwidleń żeberk głównych, a podrzędnie występuje także typ dischizotomiczny. Typ monoschizotomiczny reprezentowany jest przez dwu-, trój- i czterodzielne żeberka, natomiast typ dischizotomiczny — przez dzielenie poligratyczne.

W rozwoju poglądów na klasyfikację *Perisphinctidae* dają się zauważyć dwa kierunki. Według pierwszego, autorzy przyznają dużą wagę liniom przegrodowym jako kryterium taksonomicznemu, w myśl drugiego — podstawą klasyfikacji winno być żeberkowanie (Neumann, 1907; Schindewolf, 1925; Buckman, 1924; Pfaff, 1911; Klebelsberg, 1912; Spath, 1931; Arkell, 1935—1948; Makowski, 1963; Beurlen, 1926).

Niewątpliwie doniosłe znaczenie dla taksonomii ma szczegółowa analiza wszystkich cech u osobników w stadium starczym, jak twierdzi Makowski (1962), co nie-

wątpliwie ściśle wiąże się z rozpatrywanym przez tego autora dimorfizmem płciowym u amonitów. Bardzo przekonywające są wywody Arkella, który uważa, że nagła zmiana żeberkowania u niektórych Perisphinctidae musi pozostawać w związku z fizjologią zwierzęcia i nie jest ona osobliwa jedynie dla komory mieszkalnej, lecz często zaczyna się na czwartej części skrętu jeszcze w części przegrodowej. Arkell uważa, że ten fakt, a także brak dotychczas danych o grubych zresorbowanych żebrach w skrętach wewnętrznych skłania do wniosku, że nagła zmiana żeberkowania miała miejsce tylko raz w życiu zwierzęcia, w stadium gerontycznym.

Osady oksfordu środkowego w Polsce pozakarpackiej są silnie zróżnicowane facjalnie. Generalnie można wyróżnić: fację wapieni gąbkowych, nierzadko biohermalnych, dominującą we wschodniej Polsce, fację wapieni płytowych obejmującą centralną Polskę i fację mułowcowo-ilasto-marglistą w północno-zachodniej części Polski. W zależności od zmiennych warunków tworzenia się osadów, co uwarunkowane jest między innymi głębokością zbiornika, stwierdza się odmienne występowanie poszczególnych grup zwierzęcych. I tak w facji wapieni gąbkowych dominuje fauna małżów, ślimaków i brachiopodów, w facji wapieni płytowych przeważają amonity rodziny Perisphinctidae, natomiast w facji mułowcowo-ilasto-marglistej dominują amonity rodziny Cardioceratidae.

Osady oksfordu środkowego Zawódzia stanowią integralną część utworów facji wapieni płytowych, obejmującej nieckę miechowską, łódzką, południową część niecki mogileńskiej i jurę Krakowsko-Wieluńską. Fauna omawianych wapieni obfituje w amonity, należące głównie do rodziny Perisphinctidae, przy znacznie mniejszym udziale przedstawicieli rodzin OpeIIDae, Haploceratidae i Aspidoceratidae. Amonity oksfordu środkowego należące do rodziny Perisphinctidae osiągają bardzo duże rozmiary, do 480 mm średnicy. Mają one bardzo urozmaiconą rzeźbę skrętów w postaci guzów, uwypukleń i grubych żeber. To znaczne nagromadzenie amonitów, jak również cechy budowy świadczą o tym, że środowisko, w jakim żyły te organizmy, było dla nich sprzyjające.

Dotychczasowe badania wykazały, że amonity rodziny Perisphinctidae najlepiej rozwijały się w morzu szelfowym, o głębokości 150—200 m, gdzie przewietrzanie zbiornika było dostateczne, a zasolenie normalne.

Kwestią otwartą jest, czy amonity duże, o rzeźbie skrętów bardzo urozmaiconej, prowadziły denny tryb życia, czy też były to formy nektoniczne, do których zalicza się większość amonitów? Niektórzy badacze (np. Kovacs, 1956) utrzymują, że gatunki ewolucyjne, posiadające rzeźbę w postaci guzów i grubych żeber, o niskich a grubych skrętach i o komorach powietrznych bardziej oddalonych od siebie, mogą być uważane za formy bentoniczne. Na temat warunków paleoekologicznych i wpływu ich na rozwój poszczególnych rodzin, a nawet rodzajów, wypowiedzieli się różni autorzy (Ziegler, 1963, 1967; Scott, 1940; Malinowska, 1967).

Amonity rodziny Perisphinctidae, określone z osadów zawodziańskich, mają bardzo szerokie rozprzestrzenienie geograficzne. Analiza występowania poszczególnych gatunków pozwala na stwierdzenie, że zbiornik morski, w obrębie którego tworzyły się osady zawodziańskie, miał dobre połączenie z otaczającymi go morzami.

Ku południowi i południowemu-wschodowi, przez Bramę Morawską i Przemyską, zbiornik ten łączył się z morzem Tetydy. Z basenem północno-niemieckim i angielskim w okresie środkowego oksfordu połączenie musiało być dostateczne, na co wskazuje fauna amonitowa.

ЛИДИЯ МАЛИНОВСКА

PERISPHINCTIDAE ИЗ СРЕДНЕГО ОКСФОРДА РАЙОНА ЗАВОДЗЕ  
(ЧЕНСТОХОВСКАЯ ЮРА), ПОЛЬША

Резюме

В настоящей работе представлены результаты изучения аммонитов семейства Perisphinctidae из среднего оксфорда района Заводзе. Внутри рода *Lithacoceras* установлен новый подрод *Subdiscosphinctes*, охватывающий некоторые виды, относимые до сих пор к подроду *Discosphinctes*: *Lithacoceras (Subdiscosphinctes) mindowe* (Siemiradzki), *L.(S.) kreutzii* (Siemiradzki). Описано пять новых видов: *Perisphinctes (Perisphinctes) alatiformis* n.sp., *P.(P.) enayi* n.sp., *P.(P.) multicostatus* n.sp., *P.(P.) swidzinskii* n.sp., *Lithacoceras (Subdiscosphinctes) borcale* n.sp.

Фауна среднеоксфордских отложений района Заводзе, славная своими крупными аммонитами семейства Perisphinctidae, до сих пор не получила детальной палеонтологической характеристики. Основной причиной такого состояния была война, постигшая Польшу в 1939—1945 гг. Фаунистические коллекции, в течение долгих лет собираемые на площади Ченстоховской Юры С. З. Ружицким и К. Казновским (Варшавский Политехнический институт), подверглись почти полному уничтожению во время бомбардировки Варшавы в 1939 г. и в дни Варшавского восстания в 1944 г. Уцелевшие остатки, добытые из-под развалин Музея Государственного Геологического института, были впоследствии дополнены коллекционерами и в настоящее время снова составлена прекрасная коллекция аммонитов среднего оксфорда, которую можно использовать в фаунистических корреляциях с английской, французской и германской юрой.

Основными фаунистическими компонентами рассматриваемых отложений являются аммониты семейства Perisphinctidae. Обнажение в местности Заводзе, в котором аммониты образуют большие скопления и представлены иногда крупнейшими экземплярами, вправе считаться одним из важнейших местонахождений Европы.

По данным стратиграфических исследований в обнажении Заводзе представлены породы не только среднего, но и верхнего оксфорда. В настоящей работе основное внимание обращается на аммониты семейства *Perisphinctidae*, характерные для среднего оксфорда (табл. 1). На основании многочисленных предыдущих работ автора и других исследователей принимается, что в районе Заводзе представлены два горизонта среднего оксфорда: верхний — *Perisphinctes wartae* и *Amoeboceras alternans* и нижний — *Perisphinctes chloroolithicus* и *Cardioceras tenuiserratum*.

Большинство экземпляров из местонахождения Заводзе находится в геронтической стадии, хотя это и не доказано достоверным признаком, каким является окончательно сформировавшееся устье раковины. Отнесение отдельных экземпляров к геронтической стадии основывается на детальном изучении остальных признаков, которые характеризуют завершившие уже свой рост особи. Автор располагал экземплярами, сохранными в виде известковых ядер, и поэтому сделанные заключения основываются лишь на изучении перегородочных линий и расположения ребер на жилой геронтической камере. Как показали наблюдения, у экземпляров в геронтической стадии перегородочные линии сгущаются, как правило, в конце перегородочной части раковины (*Dichotomosphinctes*). Иногда система этих линий настолько „спутана”, что почти невозможно проследить одну сплошную линию. В других же случаях отдельные элементы линий сильно разрознены и не позволяют достоверно определить стадию развития особи.

Скульптура экземпляров в геронтической стадии исследовалась, прежде всего, на жилой геронтической камере, ребра которой подверглись значительным изменениям. В зависимости от принадлежности к отдельным под родам экземпляры характеризуются разными типами жилой геронтической камеры (табл. 2).

При определении отдельных видов особое внимание обращалось на развитие ребристости, начиная с внутренних оборотов. Изучение эволюции ребер в течение всего развития особи аммонита имеет важное таксономическое значение. В частности у родов семейства *Perisphinctidae* иногда проявляются очень резкие изменения системы ребер, что может являться основным таксономическим критерием. Большую пользу оказал метод „реберной кривой”, позволяющий графически изображать развитие ребристости на оборотах. Совпадение отдельных кривых с голотипом являлось объективным доказательством правильного определения вида (фиг. 2).

Форма главных ребер и способ их ветвления представляют также важный признак, позволяющий производить достоверное видовое определение. Описанные исследования проводились на видах, характеризующихся преимущественно моношизотомическим ветвлением главных ребер. В подчиненном количестве наблюдался дишизотомический тип ветвления. Моношизотомический тип представлен двух-, трех- и четырехраздельными ребрами, дишизотомический же тип характеризуется полигиратическим ветвлением.

В эволюции взглядов на классификацию *Perisphinctidae* намечаются два направления. Странники первого направления в качестве важного таксономическо-

го критерия принимают перегородочные линии, приверженцы же второго направления считают, что в основу классификации должна быть положена система ребер (Нойманн, 1907; Шиндевольф, 1925; Бакмен, 1924; Пфафф, 1911; Клебелсберг, 1912; Спат, 1931; Аркелл, 1935—1948; Маковски, 1963; Боирлен, 1926).

Важное значение в таксономии имеет, несомненно, детальный анализ всех характерных признаков у особей в старческой стадии, как утверждает Маковски (1962), что имеет близкое отношение к изучаемому этим автором половому диморфизму у аммонитов. Весьма убедительны рассуждения Аркелла, считающего, что резкие видоизменения ребер у некоторых *Perisphinctidae* несомненно связаны с физиологией животного и характерны не только для жилой камеры, но часто появляются на четвертой части оборота, еще в перегородочной части. По мнению Аркелла, этот факт наряду с отсутствием данных относительно крупных, втянутых ребер во внутренних оборотах приводит к заключению, что резкое изменение ребристости происходило лишь один раз за весь период жизни животного — в геронтической стадии.

Отложения среднего оксфорда во внекарпатской части Польши характеризуются сильным фаціальным разнообразием. В самых общих чертах можно отметить следующие фации: фацию губковых, часто биогермовых известняков, господствующую в Восточной Польше, фацию плитняковых известняков, распространенную в Центральной Польше, и алевролито-глинисто-мергелистую фацию в северо-западной части Польши. В зависимости от условий осадконакопления, обусловленных глубиной водоема и другими факторами, по-разному представляется распределение отдельных фаунистических групп. Итак, в фации губковых известняков преобладает фауна пластинчатожаберных, брюхоногих и плеченогих, в фации плитняковых известняков — аммониты семейства *Perisphinctidae*, а в фации алевролито-глинисто-мергелистых осадков — аммониты семейства *Cardioceratidae*.

Среднеоксфордские отложения района Заводзе составляют неотъемлемую часть отложений фации плитняковых известняков, охватывающей Меховскую и Лодзинскую мульды, южную часть Могильновской мульды и Краковско-Велюньскую Юру. Фауна в этих известняках характеризуется обилием аммонитов, главным образом семейства *Perisphinctidae* и в значительно меньшем количестве представителей семейств *Oppeliidae*, *Naoloceratidae* и *Aspidoceratidae*. Среднеоксфордские аммониты семейства *Perisphinctidae* достигают очень крупных размеров, до 480 мм в диаметре. Они отличаются богатой скульптурой оборотов, которую образуют бугры, выступы и крупные ребра. Такое богатое скопление аммонитов, а также детали их строения свидетельствуют о существовании благоприятной среды для их обитания.

Как показали исследования, наиболее благоприятные условия для развития аммонитов семейства *Perisphinctidae* существовали в зоне шельфа глубиной 150—200 м, с достаточным количеством кислорода и нормальной соленостью морской воды.

До сих пор не решен вопрос о том, какой образ жизни вели крупные аммониты со сложной скульптурой оборотов: обитали ли они на дне или же, как большинство аммонитов, представляли nektonные формы. Некоторые исследователи (Ковачш, 1956 и др.) придерживаются мнения, что эволютивные виды, характеризующиеся скульптурой в виде бугров и толстых ребер, низкими, толстыми оборотами и более отдаленными друг от друга воздушными камерами, представляли bentonные формы. Относительно палеоэкологических условий и их воздействия на развитие отдельных семейств и даже родов высказывались многие авторы (Циглер, 1963, 1967; Скотт, 1940; Малиновска, 1967).

Аммониты семейства Perispinctidae, определенные в отложениях местонахождения Заводзе, характеризуются весьма широким географическим распространением. По распространению отдельных видов можно предполагать, что морской бассейн, в котором образовались рассматриваемые отложения, свободно соединялся с окружающими морями. На юге и на юго-востоке этот водоем соединялся через Моравские и Пшемьсленские Ворота с Тетисом. С северогерманским и английским бассейнами в среднем оксфорде существовало свободное сообщение, что доказывается аммонитовой фауной.

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## EXPLANATION OF PLATES

### Plate I

#### *Perispinctes (Arispinctes) cf. cotovui* Simionescu

Middle Oxfordian, *P. chloroolithicus* and *C. tenuiserratum* Zone; Zawodzie

Fig. 1. Specimen in gerontic stage; a flattened fragmentary body chamber; height of the last whorl exceeded; IG.1246.II.13;  $\times 0.43$ .

Fig. 2. Fragmentary last whorl of the same specimen, in the undeformed part; slightly magnified.

### Plate II

#### *Perispinctes (Arispinctes) cf. helenae* Riaz

Middle Oxfordian, Zawodzie

A middle-sized specimen with the septate portion, I.G.1246.II.32;  $\times 0.56$ .

### Plate III

#### *Perispinctes (Arispinctes) maximus* (Young & Bird)

Middle Oxfordian, Zawodzie

A gerontic specimen, IG.1246.II.27;  $\times 0.32$ .

## Plate IV

*Perisphinctes (Arisphinctes) plicatilis* (Sowerby)Middle Oxfordian, *P. wartae* and *A. alternans* Zone, ZawodzieFig. 1. A gerontic specimen, IG.1246.II.2;  $\times 0.44$ .

Fig. 2. A fragmentary whorl of the same specimen at the point of contact of the gerontic body chamber and septate portion; nat.size.

## Plate V

*Perisphinctes (Dichotomosphinctes) buckmani* Arkell

Middle Oxfordian, Zawodzie

Septate portion and a fragmentary body chamber; IG.1246.II.8;  $\times 0.72$ .

## Plate VI

*Perisphinctes (Dichotomosphinctes) cf. elisabethaeformis* BurckhardtMiddle Oxfordian, *P. chloroolithicus* and *C. tenuiserratum* Zone, ZawodzieA fragmentary body (?gerontic) chamber, IG.1246.II.25;  $\times 0.75$ .

## Plate VII

*Perisphinctes (Dichotomosphinctes) wartae bedoensis* CollignonMiddle Oxfordian, *P. wartae* and *A. alternans* Zone, ZawodzieA specimen in the gerontic stage; IG.1246.II.21;  $\times 0.57$ .

## Plate VIII

*Perisphinctes (Kranaosphinctes) cyrilli* NeumannMiddle Oxfordian, *P. chloroolithicus* and *C. tenuiserratum* Zone, ZawodzieFig. 1. A specimen in the gerontic stage; in the septate portion whorls pressed in; IG.1246.II.26;  $\times 0.34$ .

Fig. 2. A fragmentary gerontic chamber of the same specimen; nat.size.

## Plate IX

*Perisphinctes (Kranaosphinctes) methodii* NeumannMiddle Oxfordian, *P. chloroolithicus* and *C. tenuiserratum* Zone, ZawodzieFig. 1. A septate portion and fragmentary gerontic chamber; IG.1246.II.35;  $\times 0.61$ .

Fig. 2. A fragmentary body chamber of the same specimen; nat.size.



## Plate X

*Perisphinctes (Liosphinctes) sp. A*

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A specimen with the septate portion and fragmentary body chamber; IG.1246.II.31;  $\times 0.57$ .

## Plate XI

*Perisphinctes (Perisphinctes) alatiformis* n.sp.

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. A septate portion of a specimen probably in the gerontic stage, holotype; IG.1246.II.12;  $\times 0.48$ .

Fig. 2. A fragmentary whorl in the septate portion of the same specimen; wing-like ridges; nat.size.

## Plate XII

*Perisphinctes (Perisphinctes) andelotensis* Enay

Middle Oxfordian, Zawodzie

The left side of a specimen in the gerontic stage; IG.1246.II.5;  $\times 0.55$ .

## Plate XIII

*Perisphinctes (Perisphinctes) cuneicostatus* Arkell

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A specimen in the gerontic stage; the development of ribbing visible throughout all whorls; the first cuneiform ribs start already in the septate portion of shell; IG.1246.II.6;  $\times 0.29$ .

## Plate XIV

*Perisphinctes (Perisphinctes) cuneicostatus* Arkell

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A specimen in the gerontic stage; IG.1246.II.3;  $\times 0.40$ .

## Plate XV

*Perisphinctes (Perisphinctes) enayi* n.sp.

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

The right side of a specimen in the gerontic stage; holotype; IG.1246.II.14;  $\times 0.36$ .

## Plate XVI

*Perisphinctes (Perisphinctes) multicostatus* n.sp.

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. A specimen in the gerontic stage; holotype; IG.1246.II.9;  $\times 0.32$ .

Fig. 2. A fragment of whorl at the point of contact of the gerontic chamber and septate portion; nat.size.

## Plate XVII

*Perisphinctes (Perisphinctes) pumilus* Enay

Middle Oxfordian, Zawodzie

A specimen probably in the gerontic stage; IG.1246.II.30;  $\times 0.54$ .

## Plate XVIII

*Perisphinctes (Perisphinctes) swidzinskii* n.sp.

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A specimen in the gerontic stage; holotype; IG.1246.II.36;  $\times 0.34$ .

## Plate XIX

*Perisphinctes (Perisphinctes) swidzinskii* n.sp.

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. A specimen in the gerontic stage; IG.1246.II.1;  $\times 0.35$ .

Fig. 2. A fragmentary whorl of the same specimen with suture visible; nat.size.

## Plate XX

*Perisphinctes (Perisphinctes) sp. B*

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. A septate portion of the specimen; IG.1246.II.34;  $\times 0.62$ .

Fig. 2. A fragmentary septate portion of the same specimen; nat.size.

## Plate XXI

*Perisphinctes berlieri* Loriol

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. The right side of a specimen in the gerontic stage; IG.1246.II.23;  $\times 0.52$ .

Fig. 2. A fragmentary gerontic body chamber of the same specimen; nat.size.

## Plate XXII

*Lithacoceras* (?*Progeronia*) *choffati* (Riaz)

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A specimen in the gerontic stage; IG.1246.II.7;  $\times$  0.44.

## Plate XXIII

*Lithacoceras* (?*Progeronia*) *choffati* (Riaz)

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A septate portion of the specimen; IG.1246.II.37;  $\times$  0.60.

## Plate XXIV

*Lithacoceras* (?*Progeronia*) sp. A

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A fragmentary body chamber and septate portion of the specimen IG.1246.II.38;  $\times$  0.46.

## Plate XXV

*Lithacoceras* (*Subdiscosphinctes*) *boreale* n.sp.

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

The right side of a specimen in the gerontic stage; holotype; IG.1246.II.15;  $\times$  0.41.

## Plate XXVI

*Lithacoceras* (*Subdiscosphinctes*) *boreale* n.sp.

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. The left side of a specimen in the gerontic stage; holotype; the primary ribs and, commonly, dischizotomous, secondary ribs visible; IG.1246.II.15;  $\times$  0.41.

Fig. 2. A fragmentary whorl of the same specimen; nat.size.

## Plate XXVII

*Lithacoceras* (*Subdiscosphinctes*) *kreutzii* (Siemiradzki)

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. A specimen in the gerontic stage; IG.1246.II.10;  $\times$  0.33.

Fig. 2. A fragment of whorls of the same specimen; nat.size.

## Plate XXVIII

*Lithacoceras (Subdiscosphinctes) kreutzii* (Siemiradzki)

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

A specimen in the gerontic stage; IG.1246.II.19;  $\times 0.55$ .

## Plate XXIX

*Lithacoceras (Subdiscosphinctes) mindowe* (Siemiradzki)

Middle Oxfordian, *P. wartae* and *A. alternans* Zone, Zawodzie

Fig. 1. A sepate portion of the specimen IG.1246.II.28;  $\times 0.67$ .

Fig. 2. Inner whorls with clearly visible ribs strongly inclined anteriorly;  $\times 0.65$ .

## Plate XXX

*Lithacoceras aeneas plana* (Siemiradzki)

Middle Oxfordian, *P. wartae* and *A. alternans* Zone; Zawodzie

Fig. 1. A specimen in the gerontic stage; IG.1246.II.39;  $\times 0.52$ .

Fig. 2. A fragmentary whorl of the same specimen at the point of contact of the body chamber and septate portion; nat.size.

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