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Inoceramid stratigraphy of the Turonian and Coniacian strata in the environs of Opole (Southern Poland)

ABSTRACT: The large quarries of the Cement Industry in the environs of Opole, Southern Poland, provide an opportunity for detailed studies and faunal collecting in the Turonian and Lower Coniacian interval of the Opole Cretaceous sequence. Basing on the rich paleontological material 10 well defined, inoceramid zones are recognized. Their correspondance to the zones established elswhere and their correlation with the international ammonite standard division is presented.

INTRODUCTION

The purpose of this report is to present the inoceramid stratigraphy of the Turonian and Lower Coniacian deposits exposed in the environs of Opole, Southern Poland (Text-fig. 1). This section, known since over a century, has never been carefully studied as concerns its biostratigraphy and the first reports of ROEMER (1870) and LEONHARD (1897) have little been supplemented. The last papers devoted to this area (BIERNAT 1960; ALEXANDROWICZ & RADWAN 1973; ALEXANDROWICZ 1974, 1979) deal mainly with the general geology and succession placing the rough stratigraphic statements at the substage level without any discussion.

REGIONAL SETTING

The exposures near Opole constitute the best surficial occurrences of the mainly subsurface Cenomanian to Coniacian deposits of the so-called Opole Cretaceous. This structural unit, being an outlier of the Polish Lowland Upper Cretaceous sequence, stretches nearly NW – SE along the Oder River from around Wrocław to the north, and it extends southeastwardly into the territory of Czechoslovakia (Text-fig. 1). The Cretaceous deposits overlie various Precambrian, Paleozoic and Mesozoic rocks, and they are covered with

Tertiary and Quaternary sediments. The tectonic structure of the Opole Cretaceous is poorly recognized. In the model proposed by OBERC (1978), the Cretaceous sequence is enclosed into two parallel synclines and one anticline with their axis running WNW – SSE, and with the superimposed fault system. In such a case the investigated strata in the environs of Opole, which display younger and younger deposits appearing to the west (Text-fig. 1), would represent the northern limb of the most northeastwardly placed Brzeg Syncline (*see* OBERC 1978).

Near Opole the Cretaceous strata are exposed in the large quarries of the Cement Industry. The accessible profile comprises the Middle and the low-Upper Turonian exposed in the huge quarries Groszowice, Bolko and Odra east of the Oder River, and the uppermost Turonian to Lower Coniacian exposed in the Folwark quarry west of the Oder River. An observational gap

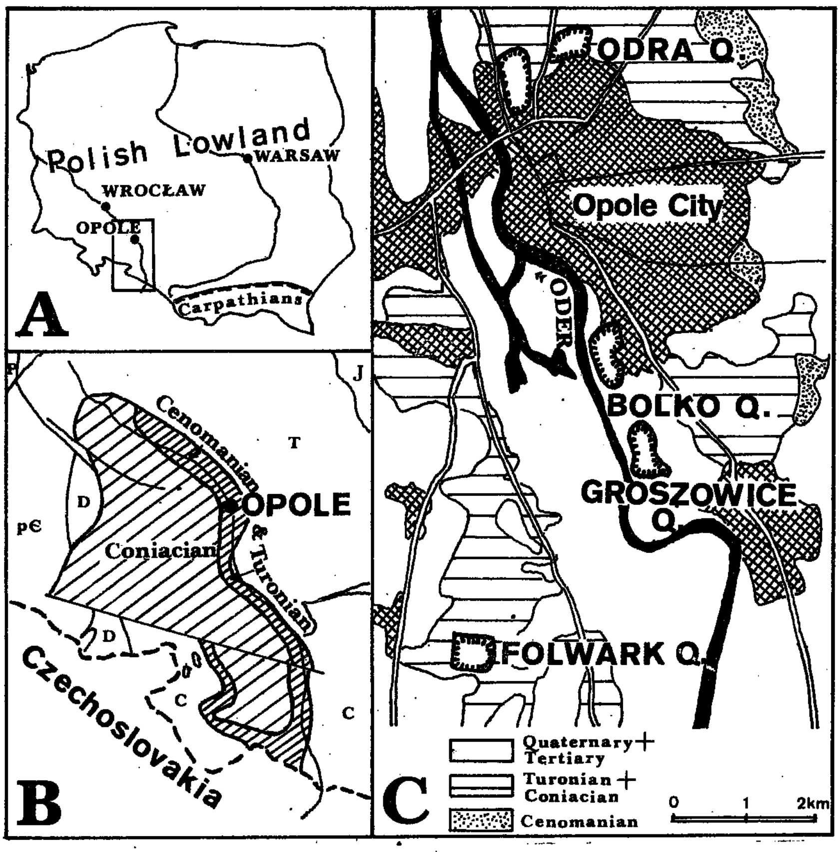


Fig. 1. Geologic setting of the Opole region

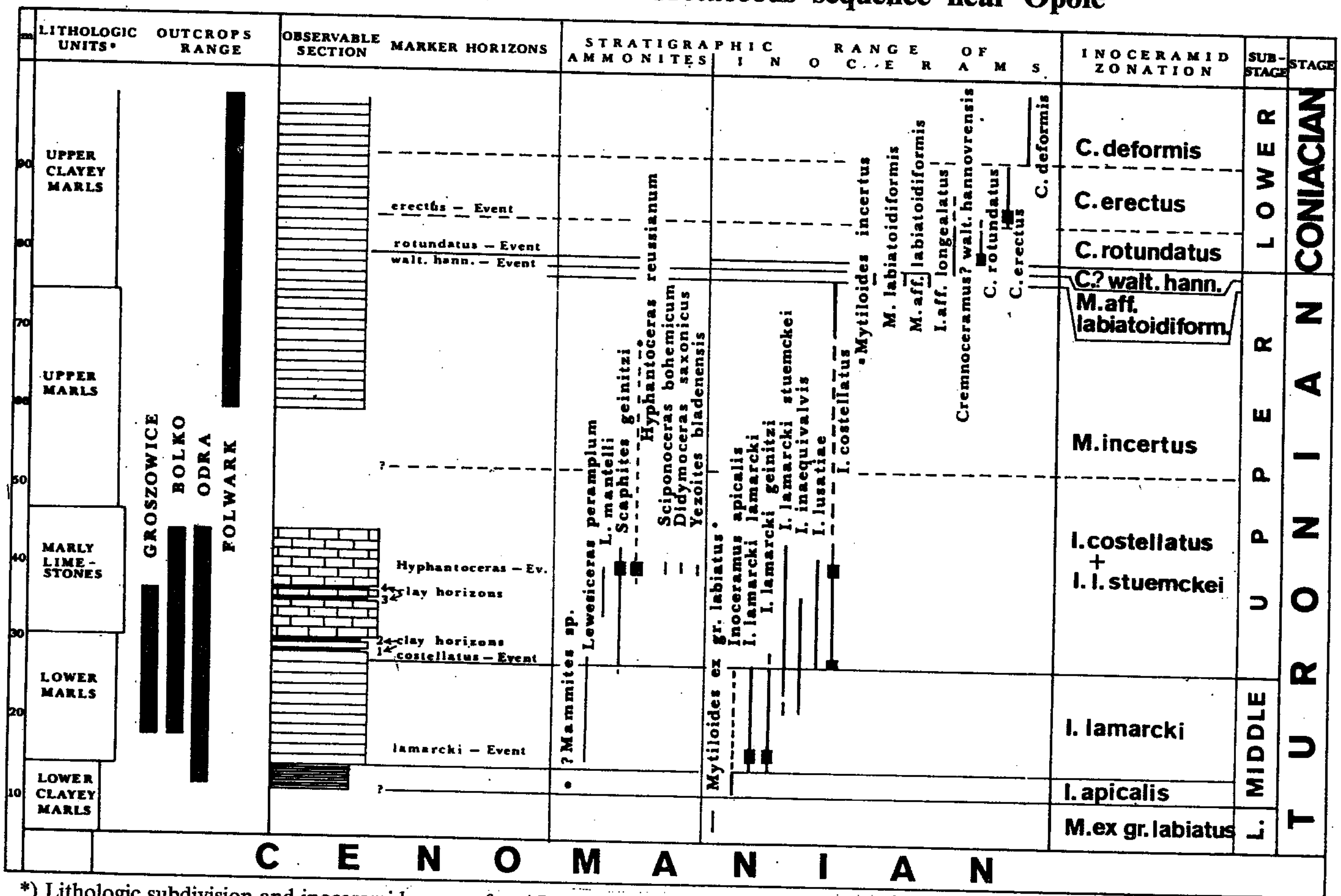
A – Location of the Opole Cretaceous in Poland

B – Geologic sketch-map of the Opole Cretaceous (without Tertiary and Quaternary deposits); pC – Precambrian, D – Devonian, C – Carboniferous, P – Permian, T – Triassic, J – Jurassic

C – Geologic sketch-map for the area near the city of Opole (*after* BIERNAT 1960)

I. WALASZCZYK, FIG. 2

Inoceramid zonation of the Cretaceous sequence near Opole



*) Lithologic subdivision and inoceramid range *after* ALEXANDROWICZ & RADWAN (1973)

encompasses the Cenomanian, the Lower and the mid-Upper Turonian intervals (*see* Text-figs 1–2).

The lithostratigraphical division of the studied sequence, established earlier by ALEXANDROWICZ & RADWAN (1973; *see also* ALEXANDROWICZ 1974, 1979) is here applied being well recognizable in the field. Similarly, the characteristics of the inaccessible intervals is given here after these authors.

LITHOLOGY AND STRATIGRAPHY

CENOMANIAN

The Cretaceous sequence near Opole starts with the silty to marly sands and sandstones, containing i.a. *Turrilites costatus* LAMARCK and *Acanthoceras rhotomagense* (BRONGNIART) (*see* ROEMER 1870, LEONHARD 1897), and thus dating the base of the sequence at least for the Middle Cenomanian.

TURONIAN

Overlying the Cenomanian there is a series of marly and limy units of the Turonian and Lower Coniacian age (Text-fig. 2). The lowermost Turonian unit, 8–14m thick (Lower Clayey Marls Unit), is composed of dark grey, sandy at the bottom, massive marls with rare pyritic concretions and glauconite. At places the marls are underlayed by a thin horizon of gaizes (JERZYKIEWICZ 1970).

The uppermost part of these marls is observed in the Odra quarry (Text-fig. 2 and Pl. 1, Figs 1–2). Massive when fresh, the marls reveal primary bedding and pass gradually upwards into marls of the Lower Marls Unit (Pl. 1, Fig. 2). The scarse recorded fauna contains small terebratulids, oysters, echinoid spines and subordinate inoceramids, represented exclusively by *Inoceramus apicalis* WOODS, found in a very low number (Pl. 3, Figs 2–3). At the base of the exposed sequence a badly preserved ammonite specimen (? *Mammites* sp.) with its upper surface encrusted by large oysters is present.

Among the stratigraphically diagnostic fauna from the Lower Clayey Marls, ALEXANDROWICZ & RADWAN (1973) reported *Inoceramus* ex gr. *labiatus* SCHLOTHEIM, documenting the presence of the *Mytiloides* ex gr. *labiatus* Zone of the Lower Turonian (Text-fig. 2). The uppermost part of the unit belongs however, at least in the range observable in the Odra quarry, to the *Inoceramus apicalis* Zone what is indicated by the presence of the index species. This zone corresponds to the unit *17* of TRÖGER (1981) and to the *I. apicalis* + *I. cuvieri* Zone of KELLER (1982), ERNST & *al.* (1983), and WOOD & *al.* (1984). It represents already the Middle Turonian.

Above the Lower Clayey Marls there is a 15m thick succession of grey, moderately hard, layered marls with a well discernible rhythmicity of the Lower Marls (Text-fig. 2 and Pl. 1, Figs 1, 3). The rhythmicity, clearly visible on the weathered walls, is caused by discrete difference in the carbonate content. The particular rhythms are not very regular, and they vary in thickness from about 30 to 100cm. In the uppermost part of the unit there occur two well individualized clay horizons (*Cl 1* and *Cl 2*) containing small terebratulids recognized already by GÜRICH (1890). The rhythmicity pattern and the clay horizons are stable allover the studied area.

Upwardly from the base of the unit there is a moderately rapid increase of the faunal diversity marked by the appearance of relatively common inoceramids, oysters (the latter being limited almost entirely to the lower 1–2m of the succession), brachiopods, echinoids, ammonites and much less common nautiloids, spondylids and other bivalves. The characteristic for the Opole Cretaceous sponges occur here rather rarely. About 2–3m above the bottom there is an inoceramid acme with the rich assemblage of *Inoceramus* ex gr. *lamarcki* PARKINSON, dominated by *Inoceramus lamarcki lamarcki* PARKINSON and *Inceramus lamarcki geinitzi* TRÖGER, marking the *lamarcki* Event (Text-fig. 2; Pl. 3, Figs 1, 4–6; Pl. 4, Fig. 2). The first appearance of these forms coincides with the base of the Lower Marls Unit (Text-fig. 2), and thus the lower boundary of the *Inoceramus lamarcki* Zone is herein placed. The *I. lamarcki* Zone is an equivalent of units *18*, *19* and *20* of TRÖGER (1981) as also the *I. lamarcki* + *I. cuvieri* Zone of ERNST & *al.* (1983). In the same age range as given in this paper the *I. lamarcki* Zone was distinguished earlier by KELLER (1982). Almost throughout the whole zone the inoceramid fauna, though decreasing upwards in number, is more or less uniform, with the exception of its upper part where relatively common becomes *Inoceramus inaequivalvis* SCHLÜTER. The associated ammonites are represented by *Lewesiceras peramplum* (MANTELL) (*see* Pl. 4, Fig. 3), *Allocrioceras* sp., and sparse *Scaphites geinitzi* d' ORBIGNY (two specimens from the uppermost part of the zone) which do not allow for any more precise stratigraphic statements, but their occurrence do not stand in opposition to the inoceramid based conclusions.

The top of the *I. lamarcki* Zone and the base of the succeeding *Inoceramus costellatus* + *I. lamarcki stuemckei* Zone marks the acme occurrence of *Inoceramus costellatus* WOODS in the upper half of the pronounced, hard marl layer, enplaced just beneath the clay horizon *Cl 1* (*see* Text-fig. 2 and Pl. 1, Fig. 3). The associated inoceramids comprise *Inoceramus lamarcki stuemckei* HEINZ, *Inoceramus lusatiae* ANDERT and the forms close to *Inoceramus cuvieri* SOWERBY (*see* Pl. 4, Fig. 1; Pl. 5, Fig. 8). The *I. costellatus* + *I. lamarcki stuemckei* Zone corresponds to the unit *21* of TRÖGER (1981) as well as to *I. costellatus* Zone of KELLER (1982), and *I. costellatus* + *I. cuvieri* + *I. lamarcki stuemckei* + *I. inaequivalvis* Zone of ERNST & *al.* (1983). The placement of this zone in the ammonite standard division has been variously interpreted by the inoceramid workers, and included either into the Middle or into the Upper Turonian (*see* e.g. SEIBERTZ 1979, TRÖGER 1981, KELLER 1982). However, the recent report by KELLER (1982) of *Subprionocyclus neptuni* (GEINITZ), the orthostratigraphic marker of the Upper Turonian (KENNEDY 1984, KENNEDY & *al.* 1982), with the appearance of the first representatives of *I. costellatus* proves the Late Turonian age of the *I. costellatus* + *I lamarcki stuemckei* Zone (KELLER 1982; *see also* KAPLAN 1986).

The succeeding, 14—17m thick unit (Marly Limestones Unit), commencing immediately above the clay horizon *Cl 2* (*see* Text-fig. 2) is composed of light grey to slightly yellow, hard, layered marly limestones with two clay horizons (*Cl 3* and *Cl 4*) a few meters above the bottom (Text-fig. 2; Pl. 1, Fig. 3; Pl. 2, Fig. 1). In the observable, 10—12m thick interval of this unit there occur conspicious, layered accumulations of debris of the large inoceramid shells (Pl. 2, Fig. 2), with rare complete specimens enclosed. These layers with inoceramid debris continue laterally at a distance of some tens of meters.

The marly limestones contain the richest and the most diverse fossil assemblage among the whole Opole section. However, the abundant ammonites, echinoids, sponges, brachiopods and inoceramids are confined mostly to the 1m thick horizon about 7m above the bottom of the unit, with its remaining part being characterized mainly by the large, intact or crushed inoceramids. This fossiliferous horizon with abundant *Scaphites geinitzi* d'ORBIGNY, *Hyphantoceras reussianum* (d'ORBIGNY) and associated *Sciponoceras bohemicum* (FRITSCH), *Didymoceras saxonicum* (SCHLÜTER), *Lewesiceras mantelli* WRIGHT & WRIGHT, *Yezoites bladenensis* (SCHLÜTER), *Allocrioceras* sp. (*see* Pl 5, Figs 1—5, 7) and other fauna, is well correlatable with the English Chalk Rock (WOODS 1896, 1897; WRIGHT 1979; WRIGHT & KENNEDY 1981) as also with the *reussianum*-fauna horizons in northern Germany marking the *Hyphantoceras* Event described by ERNST & *al.* (1983) and DAHMER & ERNST (1986). The inoceramids are here represented by *I. costellatus* (Pl. 5, Fig. 6) and the forms close to *I. inaequivalvis*. The Marly Limestones Unit belongs, similarly as the uppermost part of the preceding one, to the *I. costellatus* + *I. lamarcki stuemckei* Zone (Text-fig. 2), and to the Upper Turonian *Subprionocyclus neptuni* Zone in the ammonite standard division.

The upper part of the Cretaceous strata near Opole is exposed in the large Folwark quarry, west of the Oder River (Text-fig. 1). It is represented by an about 40 m thick succession of grey, rhythmically bedded marls and clayey marls, dipping markedly to the west. At the bed junction, diverse burrows with common *Thalassinoides* and *Chondrites* types are observed.

Referring to the complete profile of the Cretaceous sequence near Opole (*see* ALEXANDROWICZ & RADWAN 1973) the observational gap between the sections observed in the quarries east of the Oder River and that accessible in the Folwark quarry comprises an about 15m interval of the uppermost part of the Marly Limestones and lowermost part of the Upper Marls units (*see* Text-fig. 2). Judging from the thickness measurements given by ALEXANDROWICZ & RADWAN (1973), the upper part of the Upper Marls and Upper Clayey Marls units should be present in the Folwark quarry. In this exposure, however, they are not recognizable and thus not distinguished in the present paper (*see* Text-fig. 2).

The lower part of the succession (about 18m) is poorly fossiliferous and it contains single *Mytiloides incertus* (JIMBO) [= *Inoceramus fiegei fiegei* TRÖGER; *see* NODA 1985], *I. costellatus* WOODS, sponges, echinoids and extremely rare ammonites (? *Hyphantoceras* sp.), and is included temporarily into the *M. incertus* Zone.

The succeeding 2m interval is marked by a relatively rapid increase of the inoceramid diversity combined with their rising frequency. The recorded assemblage is characterized by delicate, alate forms (Pl. 6, Figs 7–10) represented by *Inoceramus* aff. *longealatus* TRÖGER, *Mytiloides labiatoidiformis* (TRÖGER), and *Mytiloides* aff. *labiatoidiformis* (TRÖGER). This latter form (Pl. 6, Figs 8–9) displays the greatest resemblance to the forms reported from the Sudetes and ascribed incorrectly to *Inoceramus glatziae* FLEGEL by RADWAŃSKA (1963). In contrary to *M. labiatoidiformis* it has flared posterior wing with outwardly incurved concentric rings on its surface. Moreover, it posseses also distinct sculpture pattern with a clear gap against the specimens belonging to the TRÖGER's species. Whether it represents a distinct species or simply an extreme form within the variability range of *M. labiatoidiformis* may be proved when elaboration of the larger collection will be undertaken.

Similar assemblage in the same stratigraphic position was stated by the author in the Middle Vistula key section (WALASZCZYK, *in prep.*) and also was reported by SCOTT & *al.* (1986) and COBBAN (1986) from the Western Interior of the United States. Judging from the discussion presented by ERNST & *al.* (1983), WOOD & *al.* (1984), and the faunal list given by SZASZ (1986a), one may expect this assemblage also in Germany and Romania. This interval is included here into a distinct zone *M.* aff. *labiatoidiformis* (Text-fig. 2). It corresponds to the uppermost part (lower *Didymotis* Event) of the *Inoceramus* aff. *frechi* Zone of ERNST & *al.* (1983).

Overlying 1.2 m thick succession is characterized by the flood occurrence of *Cremnoceramus*? *waltersdorfensis hannovrensis* (HEINZ) (*see* Pl. 6, Figs 4–6), with subordinate other forms, as e.g. *Mytiloides striatoconcentricus* aff. *carpathicus* (SIMIONESCU) (*see* Pl. 6, Figs 1–3) marking the *waltersdorfensis hannovrensis* Event. This part of the section up to the first occurrence of *Cremnoceramus rotundatus* (FIEGE) represents the *C.*? *waltersdorfensis hannovrensis* Zone, which is the uppermost Turonian zone in the Opole Cretaceous (Text-fig. 2).

CONIACIAN

The entry of *Cremnoceramus rotundatus* (FIEGE) (*see* Pl. 7, Figs 1—6) is accepted here as the base of the Coniacian stage (Text-fig. 2). The use of this species for the definition of the Turonian/Coniacian boundary results from its coincident appearance level with *Forresteria petrocoriensis* (COQUAND) stated in many areas (KAUFFMAN & *al.* 1978, BAILEY & *al.* 1983, MATSUMOTO 1984, SZASZ 1986b). This ammonite species is commonly regarded as the indicator of the lower boundary of the Coniacian in the international standard division (KENNEDY 1984, BIRKELUND & *al.* 1984).

The Turonian/Coniacian boundary was widely debated in the last years (*e.g.* KAUFFMAN *in* HERM & *al.* 1979, TRÖGER 1981, SEIBERTZ 1979, SZASZ 1986a, b). Besides ammonite and inoceramid fauna, often quoted (IMLAY 1955, KAUFFMAN *in* HERM & *al.* 1979, SZASZ 1986b, c) as a good marker of the base of the Coniacian stage is also the bivalve genus *Didymotis*. Recently, however, *Didymotis* was found in the indisputable Upper Turonian deposits in northern Germany (ERNST & *al.* 1983) and in the unquestionably Upper Turonian sediments it occurs also in the Middle Vistula key section (WALASZCZYK, *in prep.*). ERNST & *al.* (1983) recognizing its appearance in two thin horizons (*Didymotis* Event *I* and *II*) proposed the upper one as the base of the Coniacian stage. However, the same mode of occurrence (in two acme horizons) was stated in Romania (SZASZ 1986b, c) with both horizons exclusively within the Coniacian. Moreover, in the Middle Vistula section *Didymotis* occurs more or less continuously from the uppermost Turonian to the almost top of the *Cremnoceramus rotundatus* Zone. It is therefore appearant that the *Didymotis* Events distinguished in Germany are of local importance only. In the Opole section the representatives of the genus *Didymotis* were not found.

Above the *C. rotundatus* Zone, two other inoceramid complexes are recognizable, one with *Cremnoceramus erectus* (MEEK) (*see* Pl. 8, Figs 3—4), and the overlying one with *Cremnoceramus deformis* (MEEK) (*see* Pl. 8, Figs 1—2), and the intervals of the section containing them are included here into *C. erectus* and *C. deformis* zones respectively (Text-fig. 2).

FINAL REMARKS

The detailed faunal collecting in the Turonian — Coniacian interval of the Cretaceous sequence exposed in the vicinity of Opole allows the inoceramid succession to be recognized, and ten inoceramid zones to be distinguished. The zonal scheme here applied is very close to the one recently worked out in northern Germany (ERNST & *al.* 1983) what makes possible detailed correlation of these sections. Of a special importance is also a high correlative potential of some events established in Germany (ERNST & *al.* 1983) and recognized also in the Opole region. Further testing of these events, being very good marker horizons within the established zonal scheme, is needed to recognize their geographic extent.

The stratigraphic range of the Cretaceous sequence in the whole Opole region at this moment can not be definitely stated. In the studied area the section encompasses the interval from the Middle Cenomanian up to the Lower Coniacian, the youngest Lower Coniacian *Cremnoceramus deformis* Zone including (Text-fig. 2). The unquestionably younger deposits were reported by RADWAŃSKA (1969) from the borehole Sady *IG-1*, west of the studied area, with *Peroniceras tricarinatum* (d'ORBIGNY) and *Inoceramus involutus* SOWERBY, representing the Middle Coniacian. Which part of the Coniacian is represented in the section exposed in Gracze in the western part of the Opole region, basing on the foraminifers reported therefrom (ALEXANDROWICZ & BIRKENMAJER 1973), it can hardly be estimated. Moreover, a riddle at this moment is the report of the belemnites *Gonioteuthis westfalica* SCHLÜTER and *G. granulata* (BLAINVILLE) once reported by WEGNER (1913) from the karst deposits in the Bolko quarry. Concluding, the Cretaceous deposits of the Opole region which are well documented paleontologically represent the Middle Cenomanian to Middle Coniacian, though the presence of any younger deposits may also be taken into account. In the light of the regional paleogeography, the existence of the Cretaceous basin in this area up to the Santonian seems to be very probable.

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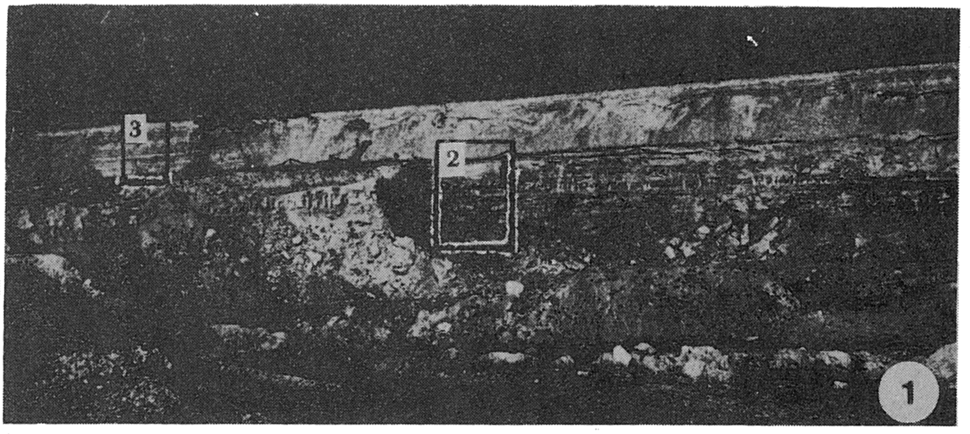
I. WALASZCZYK

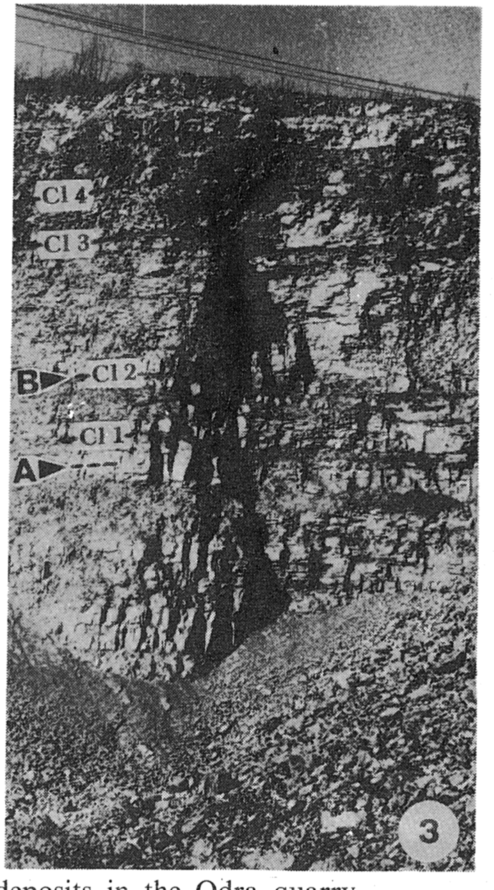
STRATYGRAFIA INOCERAMOWA OSADÓW TURONU I KONIAKU OKOLIC OPOLA

(Streszczenie)

Przedmiotem pracy jest ustalenie schematu stratygraficznego dla utworów turonu i koniaku okolic Opola. Badania oparto na faunie inoceramowej, zbieranej w dużych kamieniołomach (Groszowice, Bolko, Odra i Folwark) znajdujących się na obszare miasta Opola i w jego najbliższej okolicy (*patrz* fig. 1 oraz pl. 1–2).

Zebrany materiał inoceramowy (*patrz* pl. 3–8) pozwolił na wydzielenie w badanych profilach 10 poziomów biostratygraficznych, reprezentujących cały turon i dolny koniak w standardowym schemacie stratygraficznym górnej kredy (*patrz* fig. 2). Towarzysząca fauna amonitowa, chociaż reprezentowana przez zespół stosunkowo zróżnicowany taksonomicznie (*patrz* pl. 4–5), nie daje podstaw do bardziej precyzyjnych wydzieleń. Ustalone następstwo stratygraficzne pozwala natomiast na korelację badanego profilu z innymi obszarami Polski i Europy. Istotnym jest również stwierdzenie kilku rozpoznanych na obszarze Niemiec bio-zdarzeń (*patrz* ERNST & *al.* 1983), które występują tu w identycznej pozycji stratygraficznej, co daje dodatkową możliwość korelacji regionalnej w obrębie ustalonych poziomów biostratygraficznych (*patrz* fig. 2).



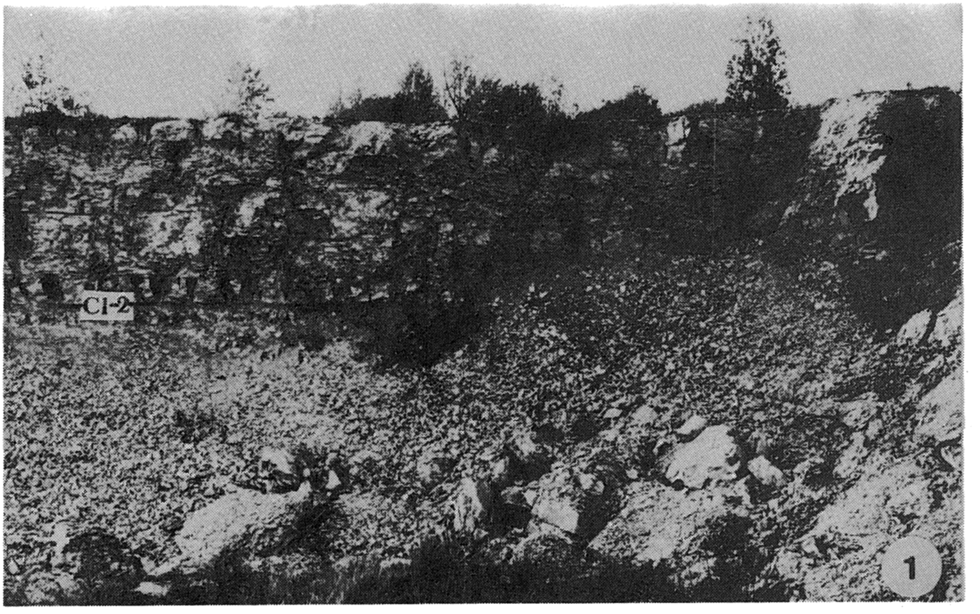


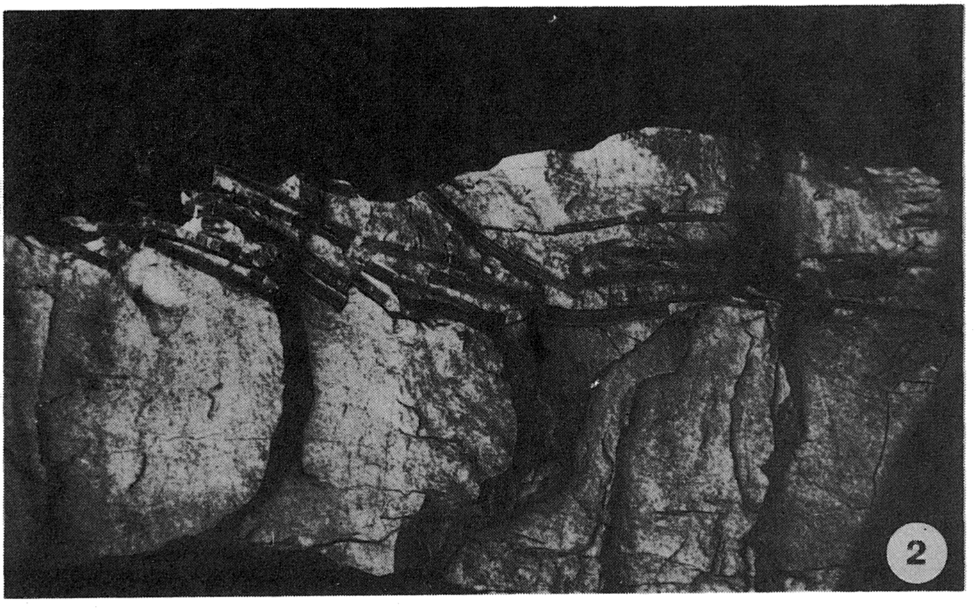
Middle to Upper Turonian deposits in the Odra quarry

1 – General view of the northern side of the quarry (rectangled are the fragments presented in Figs 2 and 3)

2 – Lower part of the Middle Turonian strata with the boundary (**A**) between the topmost part of the Lower Clayey Marls Unit (*I. apicalis* Zone) and the Lower Marls Unit (*I. lamarcki* Zone)

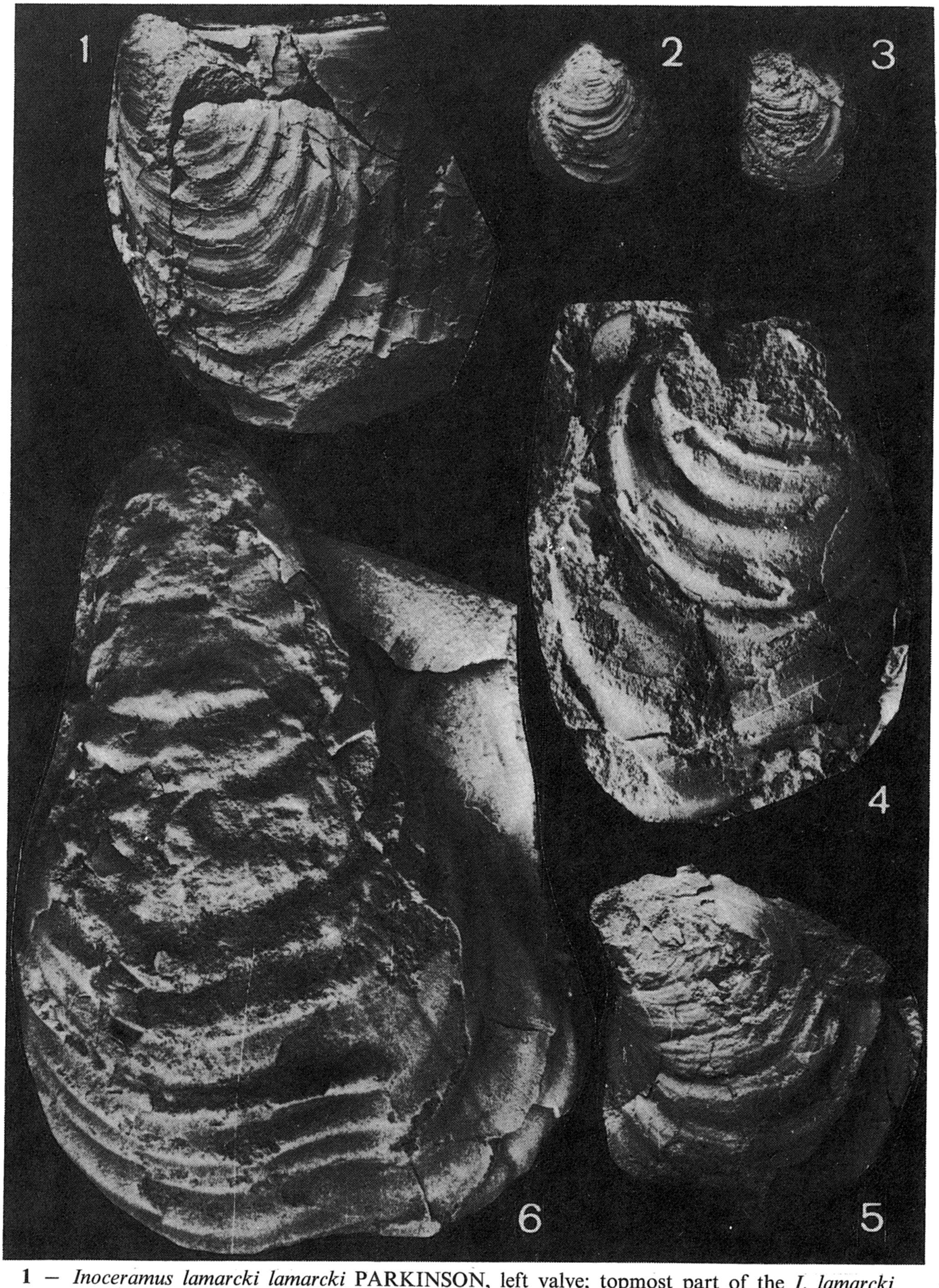
3 – Uppermost Middle and the Upper Turonian strata: **A** – boundary between the *I. lamarcki* and *I. costellatus* + *I. lamarcki stuemckei* zones; **B** – boundary between the Lower Marls and Marly Limestones units; **CL 1** – **CL 4** – clay horizons (*see* Text-fig. 2)





1 – Upper Turonian strata in the northern wall of the Bolko quarry (the fragment sketched by BIERNAT 1960, Fig. 6); **Cl 2** – clay horizon No. 2 (*see* Text-fig. 2)

2 – A fragment of the layered inoceramid debris accumulation (Marly Limestone Unit, *I. costellatus* + *I. lamarcki stuemckei* Zone; Bolko quarry)



1 — *Inoceramus lamarcki lamarcki* PARKINSON, left valve; topmost part of the *I. lamarcki* Zone; Groszowice quarry

2-3 — *Inoceramus apicalis* WOODS, *2* right and *3* left valve; *I. apicalis* Zone; Odra quarry

4-5 — *Inoceramus lamarcki geinitzi* TRÖGER, *4* right and *5* left valve; *I. lamarcki* Zone; Odra quarry

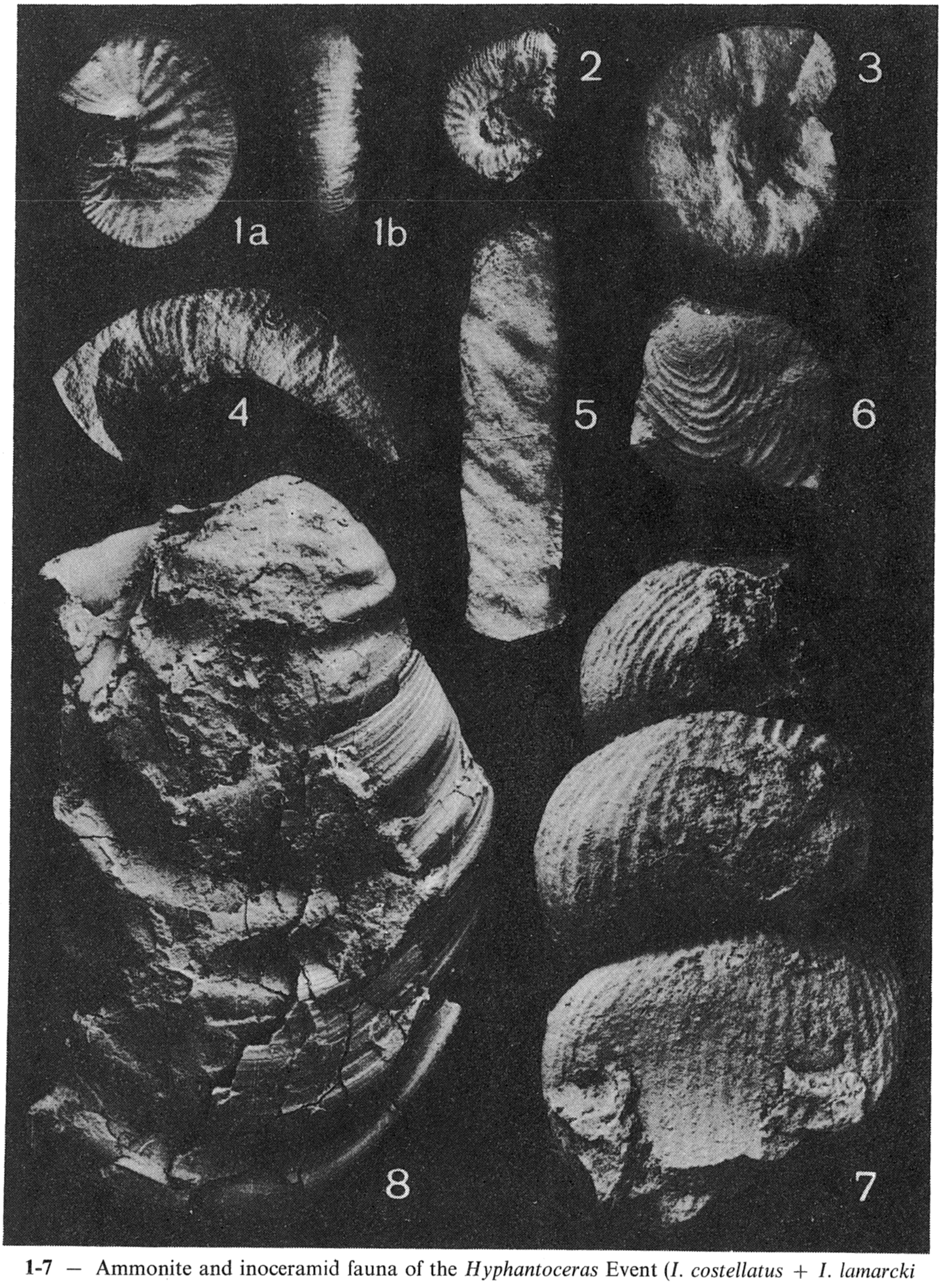
6 — *Inoceramus lamarcki lamarcki* PARKINSON, left valve; *I. lamarcki* Zone; Odra quarry

All figures in natural size

1 – *Inoceramus lamarcki stuemckei* HEINZ, left valve; *I. costellatus* + *I. lamarcki stuemckei* Zone; Odra quarry, × 0.45

2 – *Inoceramus lamarcki geinitzi* TRÖGER, right valve; I. *lamarcki* Zone; Odra quarry, × 1

3 – *Lewesiceras peramplum* (MANTELL); *I. lamarcki* Zone; Odra quarry, × 0.45

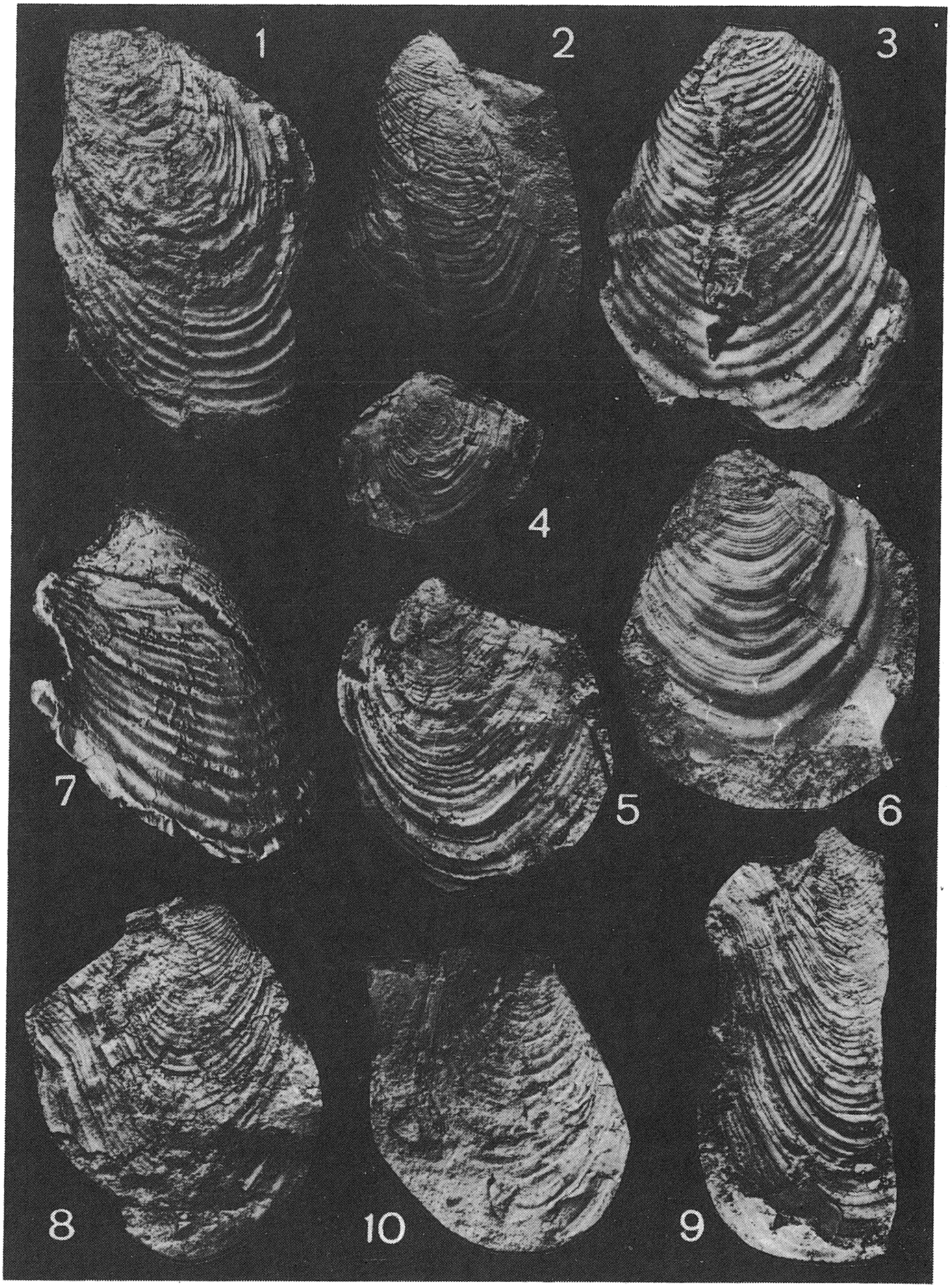


1-7 — Ammonite and inoceramid fauna of the *Hyphantoceras* Event (*I. costellatus* + *I. lamarcki stuemckei* Zone)

1 — *Scaphites geinitzi* d'ORBIGNY, 2 — *Yezoites bladenensis* (SCHLÜTER), 3 — *Lewesiceras mantelli* WRIGHT & WRIGHT, 4 — *Hyphantoceras reussianum* (d'ORBIGNY), 5 — *Sciponoceras bohemicum* (FRITSCH), 6 — *Inoceramus costellatus* WOODS, 7 — *Didymoceras saxonicum* (SCHLÜTER); 1, 2, 6 — Bolko quarry, 3-5, 7 — Odra quarry

8 — *Inoceramus lusatiae* ANDERT, right valve; *I. costellatus* + *I. lamarcki stuemckei* Zone; Odra quarry

All figures in natural size



1-3 – *Mytiloides striatoconcentricus* aff. *carpathicus* (SIMIONESCU), *1*, *2* left and *3* rigth valve; *C.*? *walt. hann.* Zone; Folwark quarry

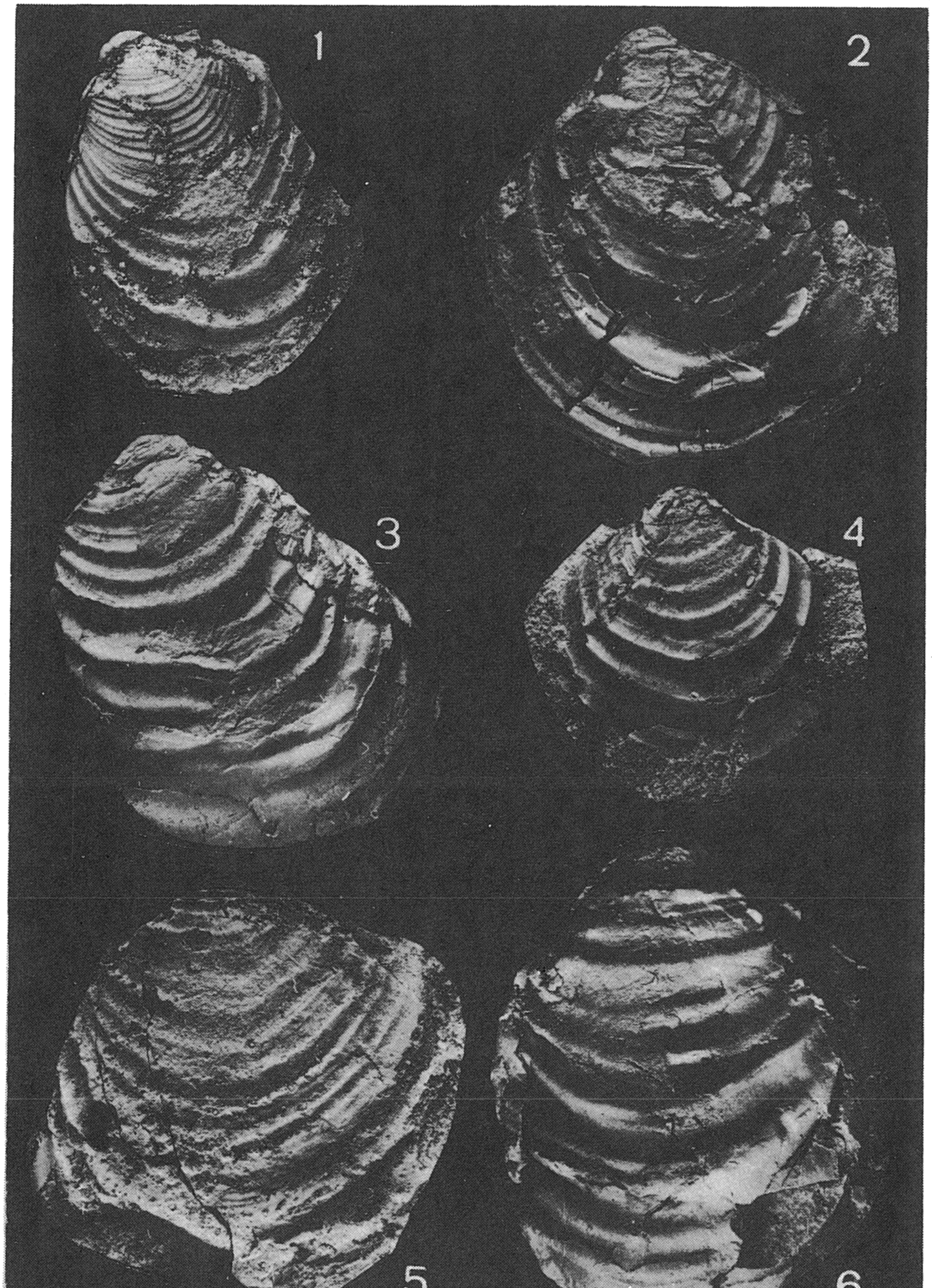
4-6 – *Cremnoceramus*? *waltersdorfensis hannovrensis* (HEINZ), left valves; *C.*? *walt. hann.* Zone; Folwark quarry

7 – *Mytiloides labiatoidiformis* (TRÖGER), rigth valve; *M.* aff. *labiatoidiformis* Zone; Folwark quarry

8-9 – *Mytiloides* aff. *labiatoidiformis* (TRÖGER), right valves; *M.* aff. *labiatoidiformis* Zone; Folwark quarry

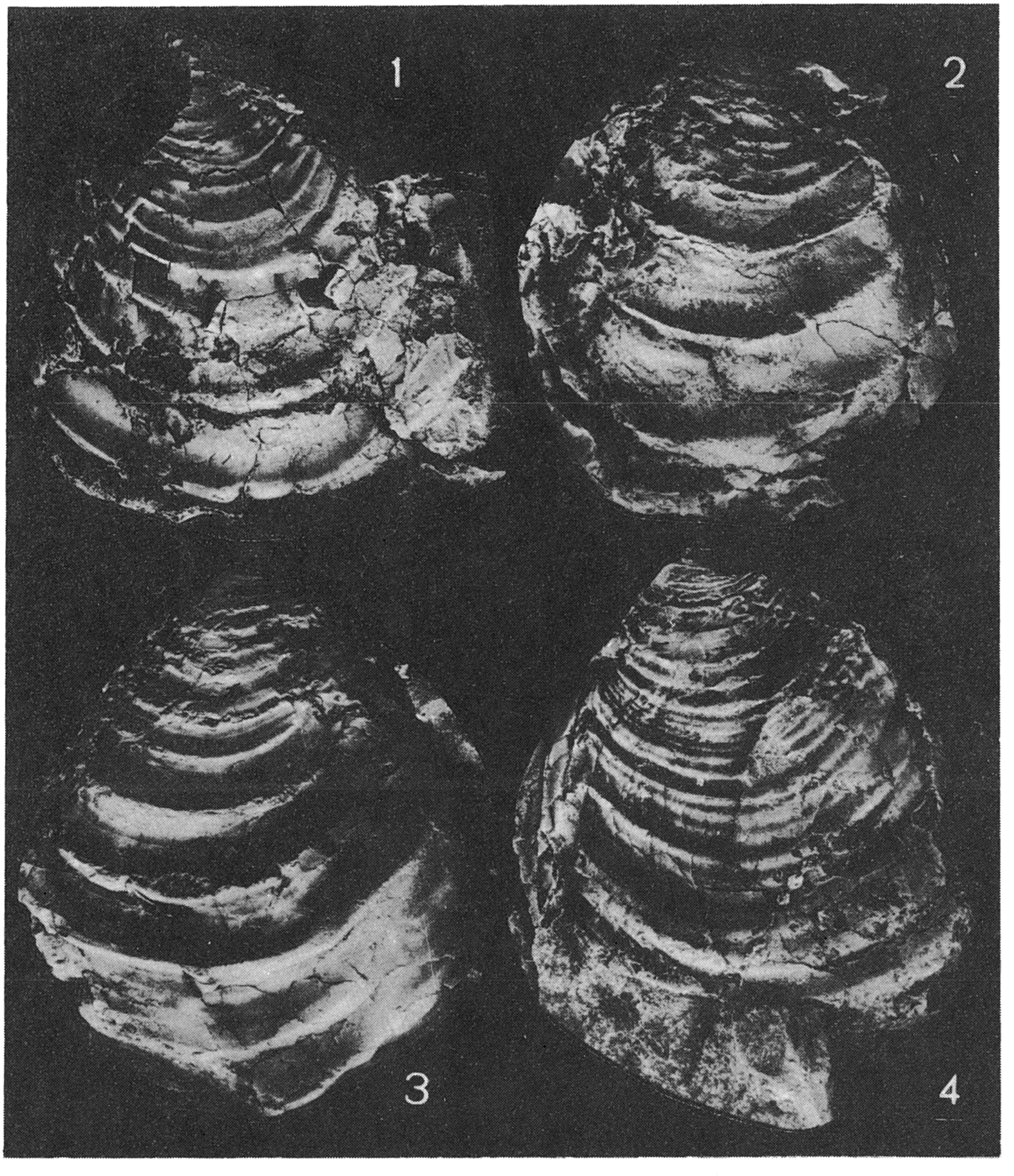
10 – *Inoceramus* aff. *longealatus* TRÖGER, right valve; *M.* aff. *labiatoidiformis* Zone; Folwark quarry

All figures in natural size



1-6 – *Cremnoceramus rotundatus* (FIEGE), 1–2, 5–6 left, 3–4 right valves; 1 and 3–5 *C. rotundatus* Zone; 2 and 6 *C. erectus* Zone; Folwark quarry

All figures in natural size



1-2 – *Cremnoceramus deformis* (MEEK), left valves; *C. deformis* Zone; Folwark quarry, × 0.5
3-4 – *Cremnoceramus erectus* (MEEK), left valves; *C. erectus* Zone; Folwark quarry, × 0.75