A MAGYAR ÁLLAMI FÖLDTANI INTÉZET ÉVKÖNYVE

ANNALES

INSTITUTI GEOLOGICI PUBLICI HUNGARICI

ЕЖЕГОДНИК ВЕНГЕРСКОГО ГЕОЛОГИЧЕСКОГО ИНСТИТУТА
ANNALES DE L'INSTITUT GÉOLOGIQUE DE HONGRIE
ANNALS OF THE HUNGARIAN GEOLOGICAL INSTITUTE
JAHRBUCH DER UNGARISCHEN GEOLOGISCHEN ANSTALT

VOL. LIV., FASC. 2.

100-YEAR CELEBRATIONS OF THE HUNGARIAN GEOLOGICAL INSTITUTE

COLLOQUE DU JURASSIQUE MÉDITERRANÉEN
Budapest, 3—8. IX., 1969

КОЛЛОКВИУМ ПО ЮРСКОЙ СИСТЕМЕ СРЕДИЗЕМНОМОРСКОЙ ОБЛАСТИ
Будапешт, 3–8. IX., 1969 г.

MŰSZAKI KÖNYVKIADÓ, BUDAPEST

1971. január

LOWER AND MIDDLE JURASSIC AMMONITE ZONES IN THE ROUMANIAN CARPATHIANS

by

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Since the first conference held in Budapest (1959) on the Mediterranean Mesozoic, our knowledge on zonal stratigraphy of the Carpathian Jurassic has considerably improved by systematic listing of the faunas discovered in the meantime, and a revision of the assemblages from some classical localities such as Strunga in the East Carpathians (Bathonian), Svinița in the South Carpathians (Bathonian), Vad in the Apuseni Mountains (Upper Bathonian–Lower Callovian), and the Olt Defile in the Perșani Mountains (Lower Jurassic), has been made.

Lower Jurassic

The Lower Jurassic of the Roumanian Carpathians displays two quite different facies: *(1)* red nodular limestones of Adneth-type in the East Carpathians (Transylvanian Nappe); *(2)* sandstones, limestones and marls with Gresten-type fauna in the East Carpathians, South Carpathians and Apuseni Mountains.

The Adnethian limestones are commonly outcropping as small isolated olistoliths. Their condensed stratigraphic interval ranges at least from the Liasicus to the Jamesoni Zone. In some places these limestones are crowded with ammonites. *Phylloceratids* and *Juraphyllitids* are very abundant (*Dasyceras*, *Paradasyceras*, *Geyeroceras*, *Juraphyllites*, in the Hettangian-Lower Sinemurian; *Geyeroceras*, *Paradasyceras*, *Zetoceras*, *Calliphylloceras*, *Harpophylloceras*, *Meneghiniceras*, *Partschiceras* in the Upper Sinemurian-Lower Carixian). Some Lytoceratids proper to the Mediterranean province, such as *Analytoceras*, *Peltolytoceras*, *Ectocentrites*, *Cosmolytoceras*, also are represented.

Planorbis Zone (?). This is indicated by a single species recorded by E. VADÁSZ (1908), namely *Caloceras johnstoni* (SOW.) (Curmătura, in the Hăghimaș Massif).

Liasicus Zone. The poor ammonite assemblage of the Liasicus Zone, contains only some rare specimens of *Whaeneroceras* (*W. portlocki* group), *Megastomoceras* (*M. anisophyllum* group) and *Franziceras* sp. aff. *ruidum* BUCKMAN (Tepei Valley, near Racoș, in the Perșani Mountains).

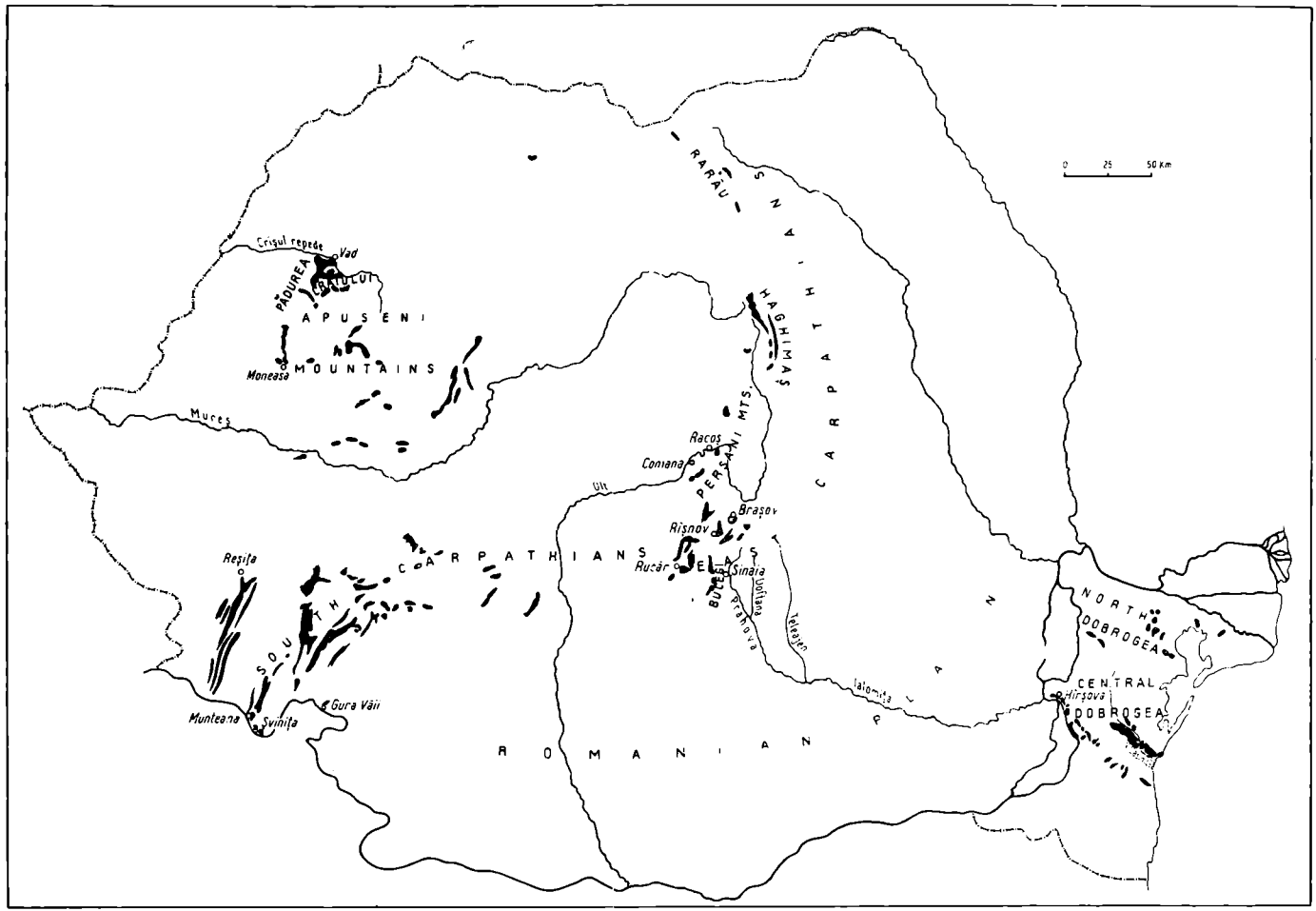

Fig. 1. Jurassic outcrops on Romania's territory

A n g u l a t a Z o n e . A rich assemblage of the Angulata Zone has been found in condensed beds of a small olistolith from the Perşani Mountains (Tepei Valley) which also yielded some species of the Lower Sinemurian. The Upper Hettangian species listed by D. PATRULIUS, are: *Schlotheimia montana* (WÄHNER) (new subspecies), *S.* sp. aff. *extranodosa* (WÄHNER), *S.* sp. ex gr. *S. stenorhyncha* LANGE, *S. (Charmasseiceras) marmorea* (OPPEL).

B u c k l a n d i , S e m i c o s t a t u m a n d T u r n e r i Z o n e s . Because of condensation there are no sharp boundaries between these zones in the Adnethian limestones. Throughout the whole interval *Arnioceras* is most abundant.

It is necessary to lay stress on the early occurrence of the genus and its several species which have been found together with *Metophioceras* sp. and *Paracaloceras centauroides* (SAVI et MENEG.), just above the level with *S. (Charmasseiceras) marmorea* (Tepei Valley).

The Bucklandi Zone has also yielded some species of *Coroniceras* among which *C. lyra* (HYATT) (Dealul Negru in the Perşani Mountains) occurs. The *Semicostatum Zone* is indicated by *Agassiceras scipionianum* (D'ORB.) recorded by E. VADÁSZ (1915) and by species of *Euagassiceras*, found in several olistoliths of the Perşani Mountains (Tepei Valley); the Turneri Zone by *Caenisites* (fragmentary specimens).

O b t u s u m Z o n e . Several species of *Asteroceras*, such as *A.* cf. *suevicum* (QUENST.) have been found in loose blocks of the Adnethian limestone, south of the Olt Defile.

O x y n o t u m Z o n e . This zone has been recognized only in one olistolith of the Rarău syncline whose red limestones have yielded *Gleviceras guibalianum* (D'ORB.) specimens (recorded by V. UHLIG, 1900).

R a r i c o s t a t u m Z o n e . A more varied ammonite assemblage of the Raricostatum Zone has been found in the Perşani Mountains (Pietrele Albe, north of the Olt Defile). The following Ammonites have been listed by the authors:

Echioceras raricostatum (ZIETEN), *E.* aff. *rhodanicum* (DUM.), *Paltechioceras* sp. aff. *aplanatum* (HYATT), *Leptechioceras* sp., *Epideroceras* sp. aff. *lorioli* HUG., *Zetoceras bonarelli* OOSTER, *Partschiceras* cf. *tenuistriatum* (MENEGHINI), *Phylloceras meneghinii* GEMM., *Calliphylloceras anatolicum* MEIST., *C. bicicolae* (MGH.), *C.* cf. *emeryi* (BETTONI), *Paradasyceras planispira* (REYNÈS), *Meneghiniceras libertus* (GEMM.).

J a m e s o n i Z o n e . Typical specimens of *Uptonia jamesoni* (SOW.) have been found together with a lot of *Phylloceratids* in some olistoliths outcropping on the eastern slope of the Tepei Valley.

The fauna of the Gresten facies includes only few ammonites. The Phylloceratids are extremely rare (one specimen of *Phylloceras* found in the Domerian of Pădurea Craiului–Northern Apuseni Mountains).

The Bucklandi Zone has yielded badly preserved specimens of *Arietites* or *Coroniceras* (Pădurea Craiului; Moneasa in the Codru Mountains), the Jamesoni Zone—large specimens of *Uptonia jamesoni* (SOW.) (Pădurea Craiului).

I b e x Z o n e . The only ammonites of the Roumanian Carpathians, to the Ibex Zone, are: one specimen of *Liparoceras* sp. figured by E. JEKELIUS

(1916) and one specimen of *Androgynoceras* sp. aff. *hybrida* (D'ORB.) (Hăghimaş Massif), identified by D. PATRULIUS.

At Poşta in North Dobrogea (foreland of the Carpathians), Lower Jurassic sandstones have yielded a small assemblage including *Tropidoceras* species, such as *T. masseanum* (D'ORB.) occur.

Davoei Zone. Some small specimens of *Androgynoceras* with simple capricorn ribbing have been found at Vadu Crişului in Pădurea Craiului (D. PATRULIUS) and near Munteana (South Carpathians) together with *Becheiceras bechei* (SOW.) (GR. RĂILEANU, 1953).

Margaritatus Zone. This zone, as well as the Spinatum Zone, has been identified in the surroundings of Braşov (East Carpathians), in Pădurea Craiului and in Banat near Munteana. The identified ammonites of the Margaritatus Zone are:

Amaltheus margaritatus (MONT.), *A. stokesi* (J. C. DE SOWERBY) (marking a distinct subzone in Pădurea Craiului, *Amaltheus gloriosus* HYATT from Munteana, figured and described by E. TIETZE (1872) as *Ammonites margaritatus* var. *muntjanae* (pl. 2/5), *Protogrammoceras* sp. from Munteana (*Ammonites normannianus* D'ORB., according to TIETZE).

Spinatum Zone. The most common species of this zone, found in the above mentioned areas, as well as in the Perşani Mountains (autochtonous Upper Pliensbachian in the surroundings of Comana), is *Pleuroceras solare* PHILL. (figured as *Ammonites spinatus* by TIETZE, 1872, pl. 2/6). In Pădurea Craiului the fauna of the same zone also includes rare specimens of *Pleuroceras spinatum* (BRUG.).

In the Roumanian Carpathians *two facies* of the Toarcian are developed: *(1)* a marly facies with interbedded marly (partly oolitic) limestones, covering large areas (Bihor Autochtonous—Northern Apuseni Mountains); Bucovinian unit—East Carpathians; olistoliths derived from the Transylvanian Nappe—East Carpathians; Reşiţa zone—South Carpathians); and *(2)* a more restricted gratty facies (surroundings of Braşov—East Carpathians; Danubian Autochtonous—South Carpathians).

The rocks of the marly facies have yielded rich assemblages of Ammonites, corresponding to the Tenuicostatum, Serpentinum, Bifrons, Variabilis, Bingmanni and Thouarsense zones, but no ammonites of the Levesquei and Aalensis zones are found. The much poorer fauna of the gratty facies includes species of the Tenuicostatum, Bifrons, Bingmanni and Levesquei zones. The listed assemblages are of pure NW-European type, without *Phylloceratids*.

Tenuicostatum Zone. This zone has been identified in Pădurea Craiului and the surroundings of Braşov. The following species have been listed by ELENA POPA: *Dactylioceras tenuicostatum* (Y. et B.), *D.* aff. *crassulosum* SIMP., *D.* cf. *semicelatum* SIMP., *D.* cf. *helianthoides* YOK.

Serpentinum Zone (= Falcifer Zone). Ammonite assemblages of the Serpentinum Zone have been found in Pădurea Craiului, Remeţi Graben (Northern Apuseni Mountains) and in a loose block from Miocene conglomerates (Teleajen Valley—East Carpathians).

Exaratum Subzone. This subzone has been identified only in Pădurea Craiului (Valea Mnerii). Its fauna listed by D. PATRULIUS includes: *Harpoceras* sp., *Harpoceratoides alternatus* (SIMPSON), large *Transicoeloceras* (one species similar to *Stephanoceras raquinianum* D'ORB., in T. WRIGHT (1884, pl. 87/4 exd.), coarse ribbed

Dactylioceras akin to *D. athleticum* (SIMP.), and in addition *Dactylioceras (Orthodactylites) semicelatum* (SIMP.).

F a l c i f e r S u b z o n e . In Pădurea Craiului and Remeţi Graben typical *Harpoceras falcifer* (SOW.) can be found with *Hildoceras sublevisoni* (FUCINI) wich is very abundant in the upper part of the subzone. Associated species are: *Harpoceras mulgravium* (Y. et B.) and *Dactylioceras athleticum* (SIMPSON). *Harpoceras mulgravium* has also been found in the Teleajen Valley together with *Hildoceras sublevisoni.*

B i f r o n s Z o n e . Rich assemblages of this zone have been found in Pădurea Craiului, Remeţi Graben and Central Bihor Mountains but so far no characteristic species of the Commune Subzone could be identified. Throughout the whole zone typical *Hildoceras bifrons* (BRUG.) is represented only by scarcer, small-sized specimens.

F i b u l a t u m S u b z o n e . Scarce specimens of *Peronoceras* sp. aff. *fibulatum* (J. C. DE SOW.) indicate the Peronoceras Subzone, whose assemblage also includes small specimens of *Dactylioceras* sp. aff. *annulatum* (SOW.).

B r a u n i a n u s S u b z o n e . In Pădurea Craiului typical *Zugodactylites braunianus* (D'ORB.) and specimens transitional to *Z. sapunovi* GÉCZY have been found in the uppermost part of the Bifrons Zone, together with *Peronoceras annuliferum* (SIMPSON).

V a r i a b i l i s Z o n e . Badly preserved specimens of *Haugia*, whose body chamber tends to become smooth, have been found in Pădurea Craiului just above the Bifrons Zone. In the same area the base of the overlying marls has also yielded: *Brodieia* sp. aff. *clausum* MERLA (listed by ELENA POPA).

B i n g m a n n i Z o n e . In Pădurea Craiului (Valea Mnierii) this zone has yielded a most interesting assemblage including the following species listed by D. PATRULIUS: *Pseudogrammoceras struckmanni* (DENK.), *P.* aff. *muelleri* (DENK.), *P.* sp. ex gr. *P. saemanni* (DUM.), *Subcollina yeovilensis* SPATH (abundant).

T h o u a r s e n s e Z o n e . The richest assemblages of the Thouarsense Zone have been found in Pădurea Craiului (Poniciori; East of Bratca) and in the southern part of the Perşani Mountains (surroundings of Comana). In both areas *Grammoceras thouarsense* is most abundant in the lower part of the zone whose fauna also includes scarce *Phymatoceras* species. In the upper part of the zone (Fallaciosum Subzone), *G. thouarsense* is still present but far outnumbered by *Pseudogrammoceras* species.

In Pădurea Craiului the assemblage of the upper subzone, listed by D. PATRULIUS, includes: *Pseudogrammoceras cotteswoldiae* (BUCK), *P. quadratum* (QUENST.), *P. expeditum* (BUCK.), *P. subfallaciosum* (BUCK.), *Polyplectus apenninicus* HAAS. In the Perşani Mountains (near Comana) the same species of *Pseudogrammoceras* (listed by ELENA POPA, 1967) and in addition *P. fallaciosum* BAYLE, *Polyplectus discoides* (ZIETEN), *Pseudolioceras compactile* (SIMPSON) and *Hammatoceras* sp. have been found.

L e v e s q u e i Z o n e . From the surroundings of Braşov *Hammatoceras insigne* (ZIETEN) and *Dumortieria* cf. *levesquei* (D'ORB.) have been recorded by E. JEKELIUS (1938).

Middle Jurassic

In large areas of the Roumanian Carpathians the Middle Jurassic beds especially the Bathonian-Callovian ones, are condensed, a fact which, in many case, makes the zonal correlation extremely difficult. The faunas of the Alenian and of the Lower and Middle Bajocian are of almost pure NW-European type, with only some very scarce *Phylloceratids* added. Larger assemblages have been found in Pădurea Craiului (Opalinum-Concavum) and in the Perșani Mountains, near Comana (Opalinum-Murchisonae) in beds which do not exceed several metres in thickness. The Ammonite assemblages of the Lower and Middle Bajocian are poor ones, and the existence of Upper Bajocian Ammonites is not yet confirmed in the Roumanian Carpathians.

In the Bathonian-Callovian, *Phylloceratids* are much more abundant and varied, but a regress in frequency has to be noted with regard to the Upper Callovian.

Opalinum Zone. In tde Pădurea Craiului the assemblage of the Opalinum Zone listed by D. PATRULIUS, includes: *Leicoeras* cf. *opalinum* (QUENST.), *L. comptum* (REIN.), *L. bifidatum* BUCK., *Pseudammatoceras subinsigne* (OPPEL), *Pseudammatoceras* sp.: (ex. gr. *P. mouterdei* ELMI); in addition *Rhabdobelus exilis* (D'ORB.). In the same marly horizon *Dumortieria* sp. ex. gr. *D. munieri* HAUG has been found, but no *Pleydellia*. In the Perșăni Mountains the fauna of the Lower Aalenian is to a certain extent different, including, beside *Leioceras comptum* (REIN.), *Tmetoceras scissum* (BEN.), *Hudlestonia affinis* (SEEB.) and *Costileioceras* sp. (D. PATRULIUS et al. 1966).

Murchisonae and Concavum Zones. In Pădurea Craiului both zones are observable in condensed beds wich seldom exceed 1 m in thickness. Some species of *Ludwigia*. e.g. *L. murchisonae* (SOW.), furthermore *Brasilia* and several *Graphoceras* have been identified. In the Perșani Mountains a larger assemblage of the Murchisonae Zone has been found including many species of *Ludwigia* and *Brasilia*. At this level the *Phylloceratids* reappear after the Domerian-Lower Aalenian hiatus.

Sowerbyi Zone. In the Roumanian Carpathians the Sowerbyi Zone has been identified in one locality only [Valea Mnierei in Pădurea Craiului (D. PATRULIUS 1956)]. There is a distinct Discites Subzone represented by a several cm thick horizon crowded with small specimens of: *Darellella* sp., *Darellia* sp. aff. *dorsetensis* (BUCK.) and aff. *curva* (BUCK.), *Reynesella* sp. ex. gr. *R. lineata* (BUCK.). This assemblage also includes a large species of *Chondroceras*, marking the first occurrence of *Stephanoceratacea*e in our stratigraphic column. The overlying beds have yielded rare specimens of a large *Sonninia* species.

Sauzei Zone. In the same locality the next bed has yielded a small assemblage of the Sauzei Zone including *Otoites sauzei* (D'ORB.), *Emileia polyschides* WAGEN, *Chondroceras* sp. aff. *gervillei* (SOW.) in BAYLE.

Humphresianum Zone. This zone has been identified in several localites namely in Pădurea Craiului, the South Carpathians (Banat), the East Carpathians (exotic rocks in the Rarău Syncline). In Pădurea Craiului a single find of *Stemmatoceras* cf. *pingue* QUENST. indicates this zone. In the Rarău Syncline *Stephanoceras* sp. aff. *nodosum* (QUENST.) has been found, together with a smooth species of *Dorsetensia*.

Zigzag Zone. An assemblage, characteristic of the Convergens Subzone, has recently been identified by S. NĂSTĂSEANU (personal communication) in the South Carpathians (Banat). An assemblage of the Yeovilensis Subzone, found in the East Carpathians (Mount Grohotisu-Bucegi Massif), includes the following species listed by D. PATRULIUS (1969):

Oxycerites yeovilensis ROLL. (very abundant), *O. pygmaeus* ARKELL, *Paroecotraustes (Nodiferites) subfuscus* (WAGEN), *Lissoceras psilodiscus* (SCHLOEN.) (finely ribbed new subspecies), *Asphinctites transylvanicus* (SIM.), *Morphoceras* sp. (ex. gr. *M. macrescens* BUCK.), *Nannolytoceras* n. sp. quite similar to the new species figured by C. STURANI (1966) from Bas Auran, and several *Phylloceratids* e.g. *Partschiceras viator* (D'ORB.).

Condensed Progracilis ? – Rertocostatum Zones. In the classical localities of Strunga (Bucegi Massif—East Carpathians) and Sviniţa (Banat—South Carpathians), as well as in some other places of the Bucegi Mountains (Tătaru Gorges, Horoaba Valley), owing to strong condensation, no zonal subdivision is possible.

Older zones than the Retrocostatum Zone are indicated by the occurrence of *Schwandorfia marginata* ARKELL and *Bullatimorphites costatus* ARKELL. A large part of the assemblage including *Prohecticoceras retrocostatum* (GROSS.), *P. retrocostatum trifurcatum* STEPHANOV, as well as large *Procerites*, belongs to the Retrocostatum Zone. Several *Siemiradzkia* (non. *S. aurigera*, erroneously listed by POPOVICI–HATZEG) and *Wagnericeras* species, as well as *Eohecticoceras? haugi* (POP.-HATZEG) might belong to the same zone.

The Sviniţă assemblage seems to cover a similar interval. Among the still unlisted species of this locality, identified by D. PATRULIUS, are to be noted: *Bullatimorphites* aff. *costatus* ARKELL and *Prohecticoceras retrocostatum trifurcatum* STEPHANOV.

It should be emphasized that both in Strunga and Sviniţă no characteristic species of the Wagneri Zone such as *Oxycerites oppeli* ELMI (=*O. aspidoides* auct.) and *Epistrenoceras subcontrarium* (BEHR.) have been found, neither *Hemigarantia julii* D'ORB., nor *Parapatoceras* species occur. In the light of this fact, the occurrence of scarce and small, but unmistakable specimens of *Macrocephalites*, in the same bed which yielded the above mentioned assemblage of the Retrocostatum and older zones of the Bathonian (Tătaru Georges—Bucegi Massif), is quite unexpected.

Condensed Wagneri—Calloviense Zones. The richest, most varied and certainly the most interesting Middle Jurassic fauna of the Carpathians is the one from Vad (or Vadul Crişului)—Northern Apuseni Mountains. The assemblage found in one bed of only 30—40 cm thickness and listed by D. PATRULIUS, includes such Bathonian forms as follows:

Oxycerites oppeli ELMI, *Paralcidia mariorae* (POP.–HATZ.), *Eohecticoceras biflexuosum* (D'ORB.), *Epistrenoceras subcontratium* (BEHR.), *Hemigarantia julii* (D'ORB.), *Treptoceras crimaeensis* ENAY, *Rugiferites angulicostatus* (LISS.), *R. davaicensis* (LISS), *R.* (?) *supersphaera* (STEPHANOV)*, *Oecotraustes waageni* STEPHANOV.

In addition can be found: a lot other *Oppelids* and *Hecticoceratids* among which an undescribed *Prohecticoceras* quite different from *R. retro-*

* On preserved body-chamber of larger specimens no tendency to contraction could be traced.

costatum, several species of *Oecostrautes* with Callovian affinities and *Jeanneticeras* species, very abundant species of *Choffatia*, *Indosphinctes*, *Grossouvria*, *Subgrossouvria*, several species of *Parapatoceras*, *Acuariceras*, as well as underscribed species belonging to allied genera of unrolled ammonites, typical *Macrocephalites macrocephalus*, as well as *M. compressus* (QUENST.), *Pleurocephalites pila* (NIK.), *P. paronai* B. et P., very rare *Reineckeids*, *Bomburites* sp. and *Bullatimorphites* closely resembling *B. bullatus* (D'ORB.), but with ribbing completely fading out on the body-chamber.

Discus Zone. A pure assemblage of this zone including *Clydoniceras discus* (SOW.), *C. hollandi* (BUCK.) and *Delecticeras* sp. has been found only in the Reşiţa Zone (South Carpathians) where the Upper Bathonian is developed in marly facies (GR. RĂILEANU et al. 1964).

Macrocephalites and Calloviense Zones. Both zones have been identified by D. PATRULIUS (1964) in the Tătaru Gorges (Bucegi Massif), above the bed with abundant Bathonian fauna and scarce specimens of *Macrocephalites*. The assemblage of the Macrocephalites Zone includes *M. macrocephalus*, *Bomburites* sp. aff. *devauxi* (GROSS.), *Grossouvria leptoides* (TILL); the Calloviense Zone is indicated by a new species of *Proplanulites* (akin to *P. koenigi*), being a so far unique find in the Carpathian area. Small ammonite assemblages of the Macrocephalus Zone have also been recorded from the South Carpathians (Reşiţa Zone; according to S. NĂSTĂSEANU, 1963; Gura Văii, according to AL. CODARCEA et al., 1962).

Anceps Zone. Two ammonite assemblages of the Roumanian Carpathians correspond to this zone. The older one (Mount Lespezi—Bucegi Massif) listed by D. PATRULIUS (1964) includes several *Lunuloceras* (sensu ELMI 1967) and *Putealiceras* species, as well as *Indocephalites*, *Indosphictes*, *Grossouvria* and *Subgrossouvria* species, but no *Reineckeids*. A similar assemblage has been found in the Reşiţa Zone (GR. RĂILEANU et al., 1964). In the younger assamblage, known from Pădurea Craiului (D. PATRULIUS, 1956), beside *Lunuloceras* and *Putealiceras*, *Reineckeids* are abundant with *Reineckeia anceps* (REIN.) among them.

Upper Callovian

In the area of the Roumanian Carpathians, *Peltoceratids* are extremely rare in the Callovian and no *Quenstedtoceras* has been found. Thus, zonal correlation can only relay on *Kosmoceratids*, late boreal immigrants in this territory. Beside *Kosmoceras mrazeci* described by I. SIMIONESCU (1899), several other Upper Callovian *Kosmoceras* have been lately identified, among which *Kosmoceras spinosum* (J. C. DE SOWERBY) and *K.* sp., of the *duncani* group, in the Reşiţa Zone; species of the later group also occur in the Hatzeg Basin, together with an early representative of *Paraspidoceras*.

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PLATE I

HETTANGIAN–LOWER PLIENSBACHIAN INDEX AMMONITES

1. *Schlotheimia montana* (WAECHNER). — Perşani Mts. (Valea Tepeia). Col.: D. PATRULIUS
2. *Coroniceras lyra* HYATT. — Perşan Mts. (Dealu Negru). Col.: D. PATRULIUS
3. *Echioceras* aff. *rhodanicum* (DUM.) — Perşani Mts. (Pietrele Albe). Col.: D. PATRULIUS
4. *Androgynoceras* sp. — Pădurea Craiului (Vadu Crişului). Col.: D. PATRULIUS
5. *Tropidoceras masseanum* (D'ORBIGNY). — North Dobrogea. Col.: G. MACOVEI
6. *Uptonia* sp. aff. *U. jamesoni* (J. C. DE SOWERBY). — Perşani Mts. (Dealu Negru). Col.: D. PATRULIUS

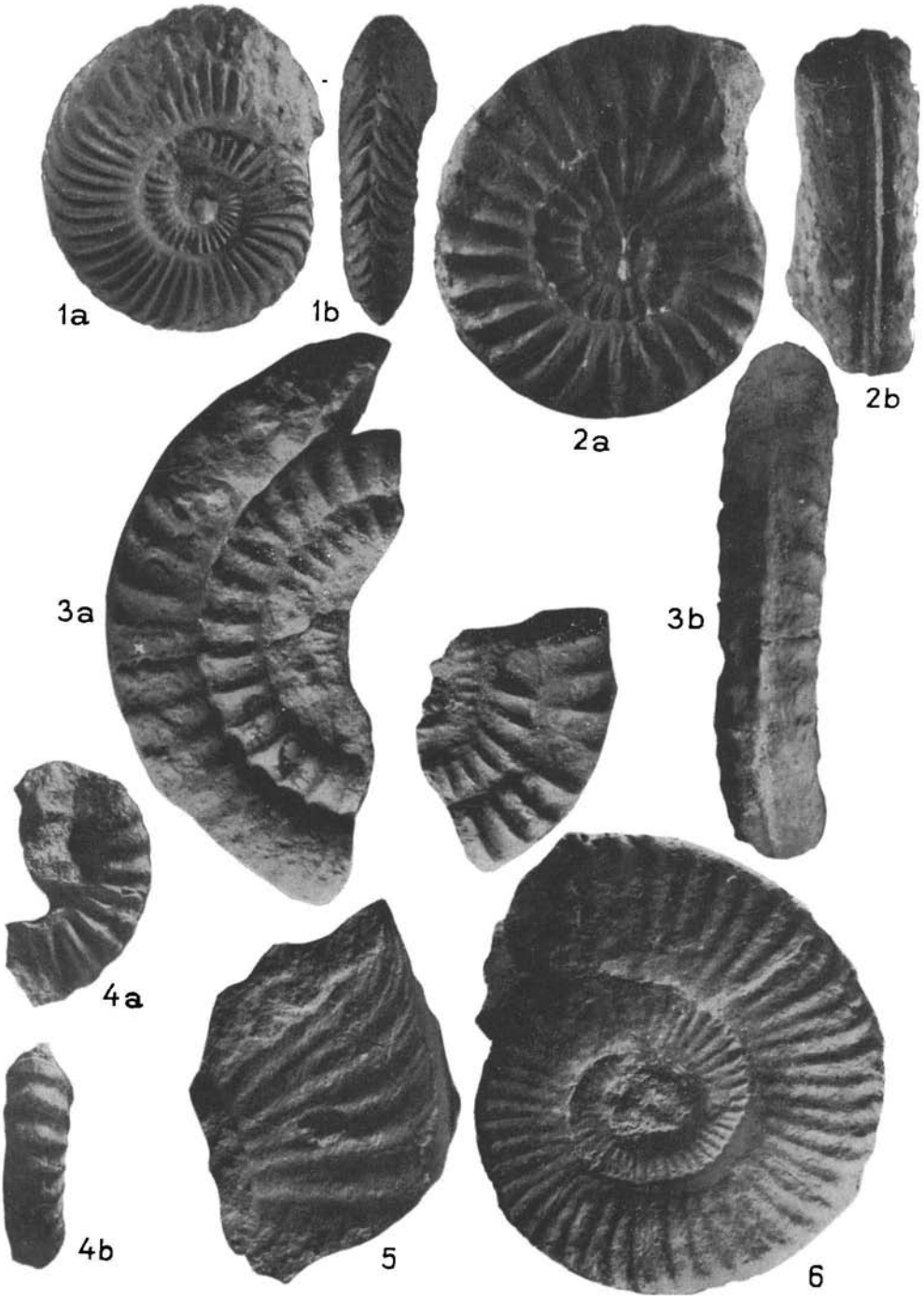
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PLATE II

UPPER PLIENSBACHIAN AND TOARCIAN INDEX AMMONITES

1. *Amaltheus stokesi* (J. SOWERBY). — Pădurea Craiului (Vadu Crişului). Col.: D. PATRULIUS
2. *Amaltheus margaritatus* (MONTF.). — Pădurea Craiului (Vadu Crişului). Col.: TH. KRÄUTNER
3. *Pleuroceras solare* (PHILLIPS). — Pădurea Craiului (Vadu Crişului). Col.: D. PATRULIUS
4. *Pleuroceras spinatum* (BRUGUIÈRE). — Pădurea Craiului (Valea Neagră). Col.: FL. MARINESCU
5. *Harpoceras* sp. — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
6. *Hildoceras bifrons* (BRUGUIÈRE). — Pădurea Craiului (Valea Pregusului). Col.: S. şi JOSEFINA BORDEA
7. *Grammoceras thouarsense* (D'ORBIGNY). — Perşani Mts. (Valea Sărăţii). Col.: ELENA POPA
8. *Dactylioceras tenuicostatum* (Y. et B.) — Postăvaru Mts. (Cristian-Braşov). Col.: ELENA POPA

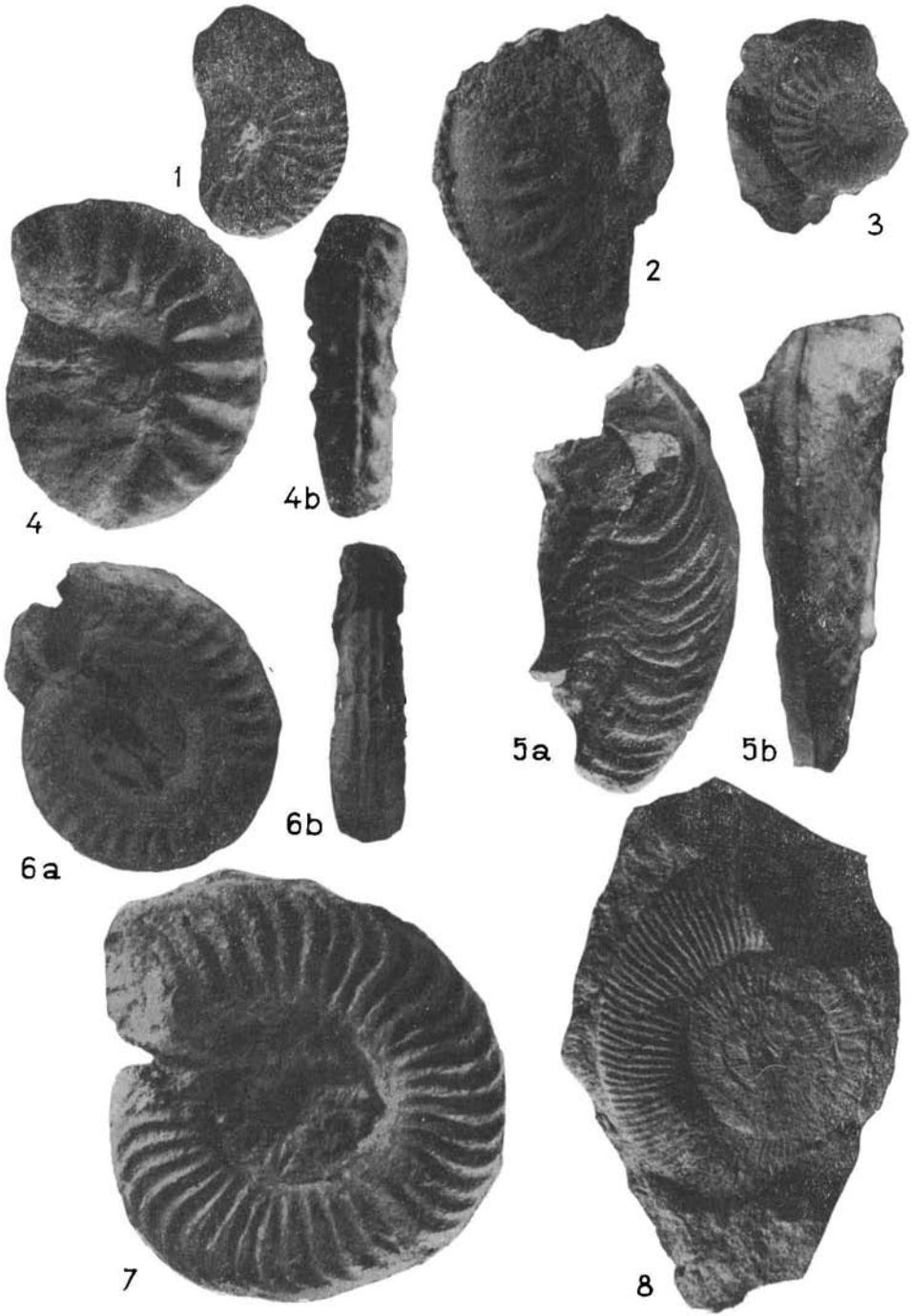
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PLATE III

AALENIAN—MIDDLE BATHONIAN INDEX AMMONITES

1. *Leioceras comptum* (REINECKE). Pădurea Craiului. Col.: D. PATRULIUS
2ab *Tmetoceras scissum* (BENECKE). — Perşani Mts. (Valea Sărăţii). Col.: D. PATRULIUS
3ab *Emileia polyschides* WAAGEN. — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
4. *Darellia* sp. [aff. *dorsetensis* (BUCK)]. — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
5. *Ludwigia murchisonae* (J. C. DE SOWERBY). — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
6. *Schwandorfia marginata* (ARKELL). — Bucegi Massif (Strunga Pass). Col.: POPOVICI-HATZEG
7ab *Asphinctites transsylvanicus* (SIMIONESCU). — Bucegi Massif (Mt. Grohotişu). Col.: D. PATRULIUS
8ab *Schwandorfia marginata* (ARKELL). — Bucegi Massif (Horoaba). Col.: D. PATRULIUS

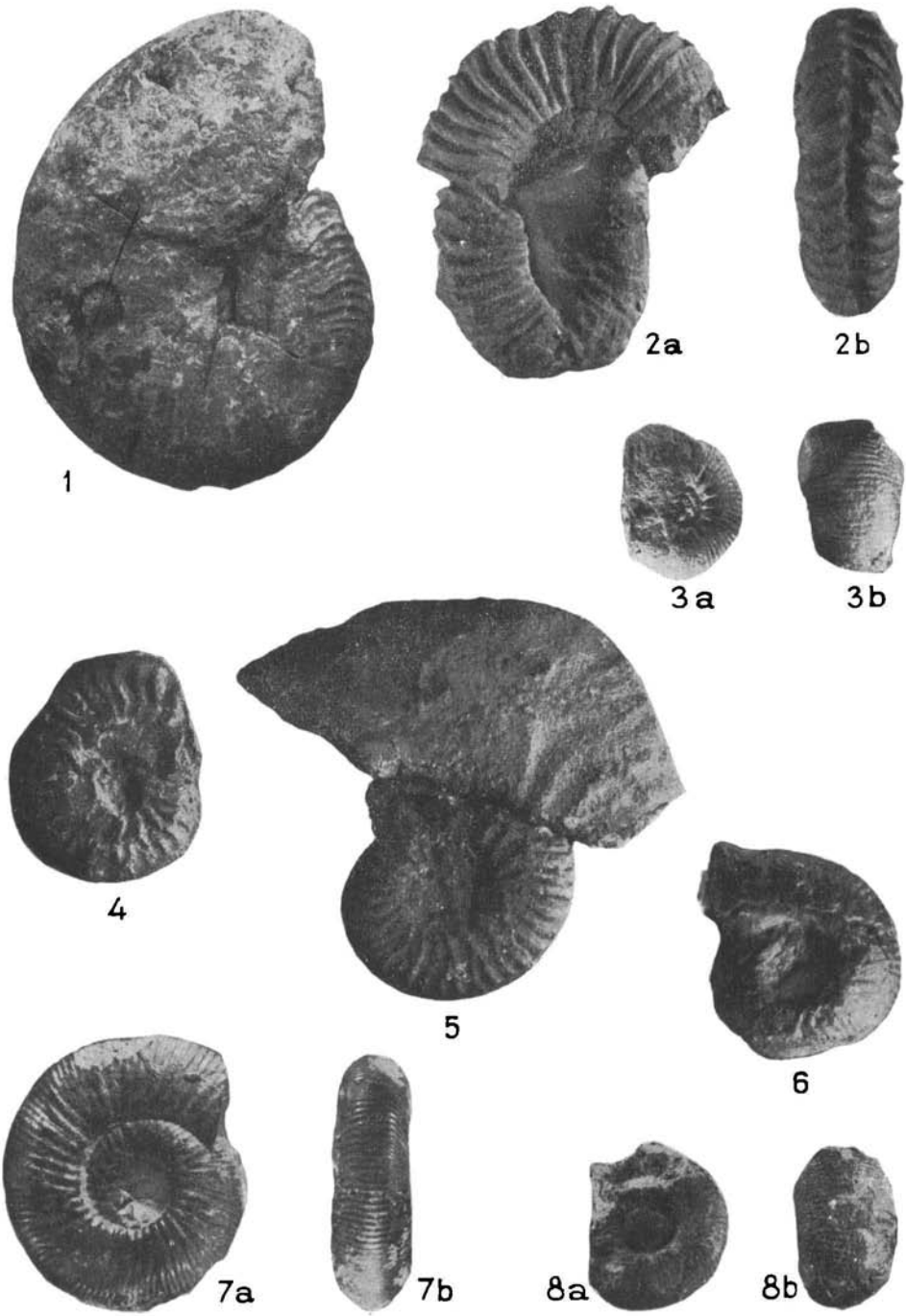
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PLATE IV

UPPER BATHONIAN–CALLOVIAN INDEX AMMONITES

1. *Clydoniceras discus* (J. SOWERBY). — Reşiţa Area. Col.: GR. RĂILEĂNU
2. *Macrocephalites macrocephalus* (SCHLOTHEIM). — Gura Văii. Col.: FL. MARINESCU
3. *Reineckeia anceps* (REINECKE). — Pădurea Craiului (Chicera Tarbii). D. PATRULIUS
4. *Kosmoceras ornatum* (SCHLOTHEIM). — Reşiţa Area. Col.: AURELIA NĂSTĂSEANU

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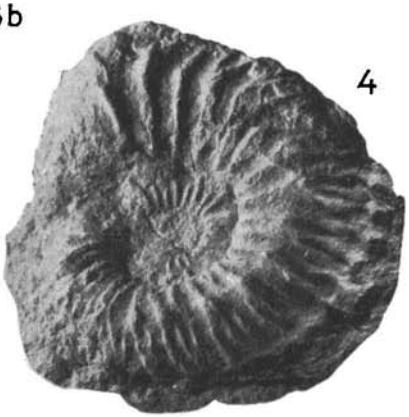

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ANNALES

INSTITUTI GEOLOGICI PUBLICI HUNGARICI

ЕЖЕГОДНИК ВЕНГЕРСКОГО ГЕОЛОГИЧЕСКОГО ИНСТИТУТА
ANNALES DE L'INSTITUT GÉOLOGIQUE DE HONGRIE
ANNALS OF THE HUNGARIAN GEOLOGICAL INSTITUTE
JAHRBUCH DER UNGARISCHEN GEOLOGISCHEN ANSTALT

VOL. LIV., FASC. 2.

100-YEAR CELEBRATIONS OF THE HUNGARIAN GEOLOGICAL INSTITUTE

COLLOQUE DU JURASSIQUE MÉDITERRANÉEN
Budapest, 3—8. IX., 1969

КОЛЛОКВИУМ ПО ЮРСКОЙ СИСТЕМЕ СРЕДИЗЕМНОМОРСКОЙ ОБЛАСТИ
Будапешт, 3–8. IX., 1969 г.

MŰSZAKI KÖNYVKIADÓ, BUDAPEST

1971. január

LOWER AND MIDDLE JURASSIC AMMONITE ZONES IN THE ROUMANIAN CARPATHIANS

by

D. PATRULIUS—E. POPA

Since the first conference held in Budapest (1959) on the Mediterranean Mesozoic, our knowledge on zonal stratigraphy of the Carpathian Jurassic has considerably improved by systematic listing of the faunas discovered in the meantime, and a revision of the assemblages from some classical localities such as Strunga in the East Carpathians (Bathonian), Svinița in the South Carpathians (Bathonian), Vad in the Apuseni Mountains (Upper Bathonian–Lower Callovian), and the Olt Defile in the Perșani Mountains (Lower Jurassic), has been made.

Lower Jurassic

The Lower Jurassic of the Roumanian Carpathians displays two quite different facies: *(1)* red nodular limestones of Adneth-type in the East Carpathians (Transylvanian Nappe); *(2)* sandstones, limestones and marls with Gresten-type fauna in the East Carpathians, South Carpathians and Apuseni Mountains.

The Adnethian limestones are commonly outcropping as small isolated olistoliths. Their condensed stratigraphic interval ranges at least from the Liasicus to the Jamesoni Zone. In some places these limestones are crowded with ammonites. *Phylloceratids* and *Juraphyllitids* are very abundant (*Dasyceras*, *Paradasyceras*, *Geyeroceras*, *Juraphyllites*, in the Hettangian-Lower Sinemurian; *Geyeroceras*, *Paradasyceras*, *Zetoceras*, *Calliphylloceras*, *Harpophylloceras*, *Meneghiniceras*, *Partschiceras* in the Upper Sinemurian-Lower Carixian). Some Lytoceratids proper to the Mediterranean province, such as *Analytoceras*, *Peltolytoceras*, *Ectocentrites*, *Cosmolytoceras*, also are represented.

Planorbis Zone (?). This is indicated by a single species recorded by E. VADÁSZ (1908), namely *Caloceras johnstoni* (SOW.) (Curmătura, in the Hăghimaș Massif).

Liasicus Zone. The poor ammonite assemblage of the Liasicus Zone, contains only some rare specimens of *Whaeneroceras* (*W. portlocki* group), *Megastomoceras* (*M. anisophyllum* group) and *Franziceras* sp. aff. *ruidum* BUCKMAN (Tepei Valley, near Racoș, in the Perșani Mountains).

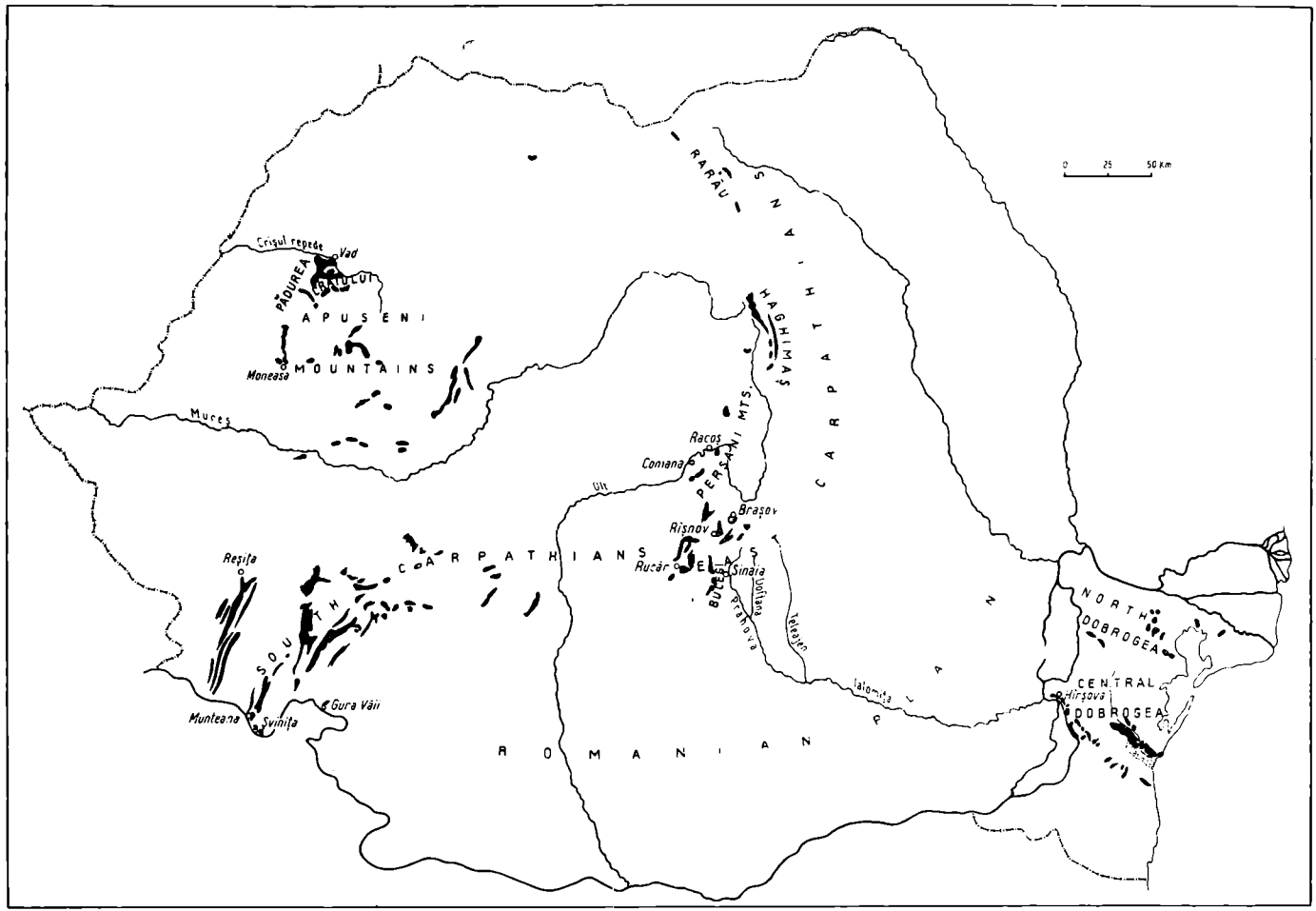

Fig. 1. Jurassic outcrops on Romania's territory

A n g u l a t a Z o n e . A rich assemblage of the Angulata Zone has been found in condensed beds of a small olistolith from the Perşani Mountains (Tepei Valley) which also yielded some species of the Lower Sinemurian. The Upper Hettangian species listed by D. PATRULIUS, are: *Schlotheimia montana* (WÄHNER) (new subspecies), *S.* sp. aff. *extranodosa* (WÄHNER), *S.* sp. ex gr. *S. stenorhyncha* LANGE, *S. (Charmasseiceras) marmorea* (OPPEL).

B u c k l a n d i , S e m i c o s t a t u m a n d T u r n e r i Z o n e s . Because of condensation there are no sharp boundaries between these zones in the Adnethian limestones. Throughout the whole interval *Arnioceras* is most abundant.

It is necessary to lay stress on the early occurrence of the genus and its several species which have been found together with *Metophioceras* sp. and *Paracaloceras centauroides* (SAVI et MENEG.), just above the level with *S. (Charmasseiceras) marmorea* (Tepei Valley).

The Bucklandi Zone has also yielded some species of *Coroniceras* among which *C. lyra* (HYATT) (Dealul Negru in the Perşani Mountains) occurs. The *Semicostatum Zone* is indicated by *Agassiceras scipionianum* (D'ORB.) recorded by E. VADÁSZ (1915) and by species of *Euagassiceras*, found in several olistoliths of the Perşani Mountains (Tepei Valley); the Turneri Zone by *Caenisites* (fragmentary specimens).

O b t u s u m Z o n e . Several species of *Asteroceras*, such as *A.* cf. *suevicum* (QUENST.) have been found in loose blocks of the Adnethian limestone, south of the Olt Defile.

O x y n o t u m Z o n e . This zone has been recognized only in one olistolith of the Rarău syncline whose red limestones have yielded *Gleviceras guibalianum* (D'ORB.) specimens (recorded by V. UHLIG, 1900).

R a r i c o s t a t u m Z o n e . A more varied ammonite assemblage of the Raricostatum Zone has been found in the Perşani Mountains (Pietrele Albe, north of the Olt Defile). The following Ammonites have been listed by the authors:

Echioceras raricostatum (ZIETEN), *E.* aff. *rhodanicum* (DUM.), *Paltechioceras* sp. aff. *aplanatum* (HYATT), *Leptechioceras* sp., *Epideroceras* sp. aff. *lorioli* HUG., *Zetoceras bonarelli* OOSTER, *Partschiceras* cf. *tenuistriatum* (MENEGHINI), *Phylloceras meneghinii* GEMM., *Calliphylloceras anatolicum* MEIST., *C. bicicolae* (MGH.), *C.* cf. *emeryi* (BETTONI), *Paradasyceras planispira* (REYNÈS), *Meneghiniceras libertus* (GEMM.).

J a m e s o n i Z o n e . Typical specimens of *Uptonia jamesoni* (SOW.) have been found together with a lot of *Phylloceratids* in some olistoliths outcropping on the eastern slope of the Tepei Valley.

The fauna of the Gresten facies includes only few ammonites. The Phylloceratids are extremely rare (one specimen of *Phylloceras* found in the Domerian of Pădurea Craiului–Northern Apuseni Mountains).

The Bucklandi Zone has yielded badly preserved specimens of *Arietites* or *Coroniceras* (Pădurea Craiului; Moneasa in the Codru Mountains), the Jamesoni Zone—large specimens of *Uptonia jamesoni* (SOW.) (Pădurea Craiului).

I b e x Z o n e . The only ammonites of the Roumanian Carpathians, to the Ibex Zone, are: one specimen of *Liparoceras* sp. figured by E. JEKELIUS

(1916) and one specimen of *Androgynoceras* sp. aff. *hybrida* (D'ORB.) (Hăghimaş Massif), identified by D. PATRULIUS.

At Poşta in North Dobrogea (foreland of the Carpathians), Lower Jurassic sandstones have yielded a small assemblage including *Tropidoceras* species, such as *T. masseanum* (D'ORB.) occur.

Davoei Zone. Some small specimens of *Androgynoceras* with simple capricorn ribbing have been found at Vadu Crişului in Pădurea Craiului (D. PATRULIUS) and near Munteana (South Carpathians) together with *Becheiceras bechei* (SOW.) (GR. RĂILEANU, 1953).

Margaritatus Zone. This zone, as well as the Spinatum Zone, has been identified in the surroundings of Braşov (East Carpathians), in Pădurea Craiului and in Banat near Munteana. The identified ammonites of the Margaritatus Zone are:

Amaltheus margaritatus (MONT.), *A. stokesi* (J. C. DE SOWERBY) (marking a distinct subzone in Pădurea Craiului, *Amaltheus gloriosus* HYATT from Munteana, figured and described by E. TIETZE (1872) as *Ammonites margaritatus* var. *muntjanae* (pl. 2/5), *Protogrammoceras* sp. from Munteana (*Ammonites normannianus* D'ORB., according to TIETZE).

Spinatum Zone. The most common species of this zone, found in the above mentioned areas, as well as in the Perşani Mountains (autochtonous Upper Pliensbachian in the surroundings of Comana), is *Pleuroceras solare* PHILL. (figured as *Ammonites spinatus* by TIETZE, 1872, pl. 2/6). In Pădurea Craiului the fauna of the same zone also includes rare specimens of *Pleuroceras spinatum* (BRUG.).

In the Roumanian Carpathians *two facies* of the Toarcian are developed: *(1)* a marly facies with interbedded marly (partly oolitic) limestones, covering large areas (Bihor Autochtonous—Northern Apuseni Mountains); Bucovinian unit—East Carpathians; olistoliths derived from the Transylvanian Nappe—East Carpathians; Reşiţa zone—South Carpathians); and *(2)* a more restricted gratty facies (surroundings of Braşov—East Carpathians; Danubian Autochtonous—South Carpathians).

The rocks of the marly facies have yielded rich assemblages of Ammonites, corresponding to the Tenuicostatum, Serpentinum, Bifrons, Variabilis, Bingmanni and Thouarsense zones, but no ammonites of the Levesquei and Aalensis zones are found. The much poorer fauna of the gratty facies includes species of the Tenuicostatum, Bifrons, Bingmanni and Levesquei zones. The listed assemblages are of pure NW-European type, without *Phylloceratids*.

Tenuicostatum Zone. This zone has been identified in Pădurea Craiului and the surroundings of Braşov. The following species have been listed by ELENA POPA: *Dactylioceras tenuicostatum* (Y. et B.), *D.* aff. *crassulosum* SIMP., *D.* cf. *semicelatum* SIMP., *D.* cf. *helianthoides* YOK.

Serpentinum Zone (= Falcifer Zone). Ammonite assemblages of the Serpentinum Zone have been found in Pădurea Craiului, Remeţi Graben (Northern Apuseni Mountains) and in a loose block from Miocene conglomerates (Teleajen Valley—East Carpathians).

Exaratum Subzone. This subzone has been identified only in Pădurea Craiului (Valea Mnerii). Its fauna listed by D. PATRULIUS includes: *Harpoceras* sp., *Harpoceratoides alternatus* (SIMPSON), large *Transicoeloceras* (one species similar to *Stephanoceras raquinianum* D'ORB., in T. WRIGHT (1884, pl. 87/4 exd.), coarse ribbed

Dactylioceras akin to *D. athleticum* (SIMP.), and in addition *Dactylioceras (Orthodactylites) semicelatum* (SIMP.).

F a l c i f e r S u b z o n e . In Pădurea Craiului and Remeţi Graben typical *Harpoceras falcifer* (SOW.) can be found with *Hildoceras sublevisoni* (FUCINI) wich is very abundant in the upper part of the subzone. Associated species are: *Harpoceras mulgravium* (Y. et B.) and *Dactylioceras athleticum* (SIMPSON). *Harpoceras mulgravium* has also been found in the Teleajen Valley together with *Hildoceras sublevisoni.*

B i f r o n s Z o n e . Rich assemblages of this zone have been found in Pădurea Craiului, Remeţi Graben and Central Bihor Mountains but so far no characteristic species of the Commune Subzone could be identified. Throughout the whole zone typical *Hildoceras bifrons* (BRUG.) is represented only by scarcer, small-sized specimens.

F i b u l a t u m S u b z o n e . Scarce specimens of *Peronoceras* sp. aff. *fibulatum* (J. C. DE SOW.) indicate the Peronoceras Subzone, whose assemblage also includes small specimens of *Dactylioceras* sp. aff. *annulatum* (SOW.).

B r a u n i a n u s S u b z o n e . In Pădurea Craiului typical *Zugodactylites braunianus* (D'ORB.) and specimens transitional to *Z. sapunovi* GÉCZY have been found in the uppermost part of the Bifrons Zone, together with *Peronoceras annuliferum* (SIMPSON).

V a r i a b i l i s Z o n e . Badly preserved specimens of *Haugia*, whose body chamber tends to become smooth, have been found in Pădurea Craiului just above the Bifrons Zone. In the same area the base of the overlying marls has also yielded: *Brodieia* sp. aff. *clausum* MERLA (listed by ELENA POPA).

B i n g m a n n i Z o n e . In Pădurea Craiului (Valea Mnierii) this zone has yielded a most interesting assemblage including the following species listed by D. PATRULIUS: *Pseudogrammoceras struckmanni* (DENK.), *P.* aff. *muelleri* (DENK.), *P.* sp. ex gr. *P. saemanni* (DUM.), *Subcollina yeovilensis* SPATH (abundant).

T h o u a r s e n s e Z o n e . The richest assemblages of the Thouarsense Zone have been found in Pădurea Craiului (Poniciori; East of Bratca) and in the southern part of the Perşani Mountains (surroundings of Comana). In both areas *Grammoceras thouarsense* is most abundant in the lower part of the zone whose fauna also includes scarce *Phymatoceras* species. In the upper part of the zone (Fallaciosum Subzone), *G. thouarsense* is still present but far outnumbered by *Pseudogrammoceras* species.

In Pădurea Craiului the assemblage of the upper subzone, listed by D. PATRULIUS, includes: *Pseudogrammoceras cotteswoldiae* (BUCK), *P. quadratum* (QUENST.), *P. expeditum* (BUCK.), *P. subfallaciosum* (BUCK.), *Polyplectus apenninicus* HAAS. In the Perşani Mountains (near Comana) the same species of *Pseudogrammoceras* (listed by ELENA POPA, 1967) and in addition *P. fallaciosum* BAYLE, *Polyplectus discoides* (ZIETEN), *Pseudolioceras compactile* (SIMPSON) and *Hammatoceras* sp. have been found.

L e v e s q u e i Z o n e . From the surroundings of Braşov *Hammatoceras insigne* (ZIETEN) and *Dumortieria* cf. *levesquei* (D'ORB.) have been recorded by E. JEKELIUS (1938).

Middle Jurassic

In large areas of the Roumanian Carpathians the Middle Jurassic beds especially the Bathonian-Callovian ones, are condensed, a fact which, in many case, makes the zonal correlation extremely difficult. The faunas of the Alenian and of the Lower and Middle Bajocian are of almost pure NW-European type, with only some very scarce *Phylloceratids* added. Larger assemblages have been found in Pădurea Craiului (Opalinum-Concavum) and in the Perșani Mountains, near Comana (Opalinum-Murchisonae) in beds which do not exceed several metres in thickness. The Ammonite assemblages of the Lower and Middle Bajocian are poor ones, and the existence of Upper Bajocian Ammonites is not yet confirmed in the Roumanian Carpathians.

In the Bathonian-Callovian, *Phylloceratids* are much more abundant and varied, but a regress in frequency has to be noted with regard to the Upper Callovian.

Opalinum Zone. In tde Pădurea Craiului the assemblage of the Opalinum Zone listed by D. PATRULIUS, includes: *Leicoeras* cf. *opalinum* (QUENST.), *L. comptum* (REIN.), *L. bifidatum* BUCK., *Pseudammatoceras subinsigne* (OPPEL), *Pseudammatoceras* sp.: (ex. gr. *P. mouterdei* ELMI); in addition *Rhabdobelus exilis* (D'ORB.). In the same marly horizon *Dumortieria* sp. ex. gr. *D. munieri* HAUG has been found, but no *Pleydellia*. In the Perșăni Mountains the fauna of the Lower Aalenian is to a certain extent different, including, beside *Leioceras comptum* (REIN.), *Tmetoceras scissum* (BEN.), *Hudlestonia affinis* (SEEB.) and *Costileioceras* sp. (D. PATRULIUS et al. 1966).

Murchisonae and Concavum Zones. In Pădurea Craiului both zones are observable in condensed beds wich seldom exceed 1 m in thickness. Some species of *Ludwigia*. e.g. *L. murchisonae* (SOW.), furthermore *Brasilia* and several *Graphoceras* have been identified. In the Perșani Mountains a larger assemblage of the Murchisonae Zone has been found including many species of *Ludwigia* and *Brasilia*. At this level the *Phylloceratids* reappear after the Domerian-Lower Aalenian hiatus.

Sowerbyi Zone. In the Roumanian Carpathians the Sowerbyi Zone has been identified in one locality only [Valea Mnierei in Pădurea Craiului (D. PATRULIUS 1956)]. There is a distinct Discites Subzone represented by a several cm thick horizon crowded with small specimens of: *Darellella* sp., *Darellia* sp. aff. *dorsetensis* (BUCK.) and aff. *curva* (BUCK.), *Reynesella* sp. ex. gr. *R. lineata* (BUCK.). This assemblage also includes a large species of *Chondroceras*, marking the first occurrence of *Stephanoceratacea*e in our stratigraphic column. The overlying beds have yielded rare specimens of a large *Sonninia* species.

Sauzei Zone. In the same locality the next bed has yielded a small assemblage of the Sauzei Zone including *Otoites sauzei* (D'ORB.), *Emileia polyschides* WAGEN, *Chondroceras* sp. aff. *gervillei* (SOW.) in BAYLE.

Humphresianum Zone. This zone has been identified in several localites namely in Pădurea Craiului, the South Carpathians (Banat), the East Carpathians (exotic rocks in the Rarău Syncline). In Pădurea Craiului a single find of *Stemmatoceras* cf. *pingue* QUENST. indicates this zone. In the Rarău Syncline *Stephanoceras* sp. aff. *nodosum* (QUENST.) has been found, together with a smooth species of *Dorsetensia*.

Zigzag Zone. An assemblage, characteristic of the Convergens Subzone, has recently been identified by S. NĂSTĂSEANU (personal communication) in the South Carpathians (Banat). An assemblage of the Yeovilensis Subzone, found in the East Carpathians (Mount Grohotisu-Bucegi Massif), includes the following species listed by D. PATRULIUS (1969):

Oxycerites yeovilensis ROLL. (very abundant), *O. pygmaeus* ARKELL, *Paroecotraustes (Nodiferites) subfuscus* (WAGEN), *Lissoceras psilodiscus* (SCHLOEN.) (finely ribbed new subspecies), *Asphinctites transylvanicus* (SIM.), *Morphoceras* sp. (ex. gr. *M. macrescens* BUCK.), *Nannolytoceras* n. sp. quite similar to the new species figured by C. STURANI (1966) from Bas Auran, and several *Phylloceratids* e.g. *Partschiceras viator* (D'ORB.).

Condensed Progracilis ? – Rertocostatum Zones. In the classical localities of Strunga (Bucegi Massif—East Carpathians) and Sviniţa (Banat—South Carpathians), as well as in some other places of the Bucegi Mountains (Tătaru Gorges, Horoaba Valley), owing to strong condensation, no zonal subdivision is possible.

Older zones than the Retrocostatum Zone are indicated by the occurrence of *Schwandorfia marginata* ARKELL and *Bullatimorphites costatus* ARKELL. A large part of the assemblage including *Prohecticoceras retrocostatum* (GROSS.), *P. retrocostatum trifurcatum* STEPHANOV, as well as large *Procerites*, belongs to the Retrocostatum Zone. Several *Siemiradzkia* (non. *S. aurigera*, erroneously listed by POPOVICI–HATZEG) and *Wagnericeras* species, as well as *Eohecticoceras? haugi* (POP.-HATZEG) might belong to the same zone.

The Sviniţă assemblage seems to cover a similar interval. Among the still unlisted species of this locality, identified by D. PATRULIUS, are to be noted: *Bullatimorphites* aff. *costatus* ARKELL and *Prohecticoceras retrocostatum trifurcatum* STEPHANOV.

It should be emphasized that both in Strunga and Sviniţă no characteristic species of the Wagneri Zone such as *Oxycerites oppeli* ELMI (=*O. aspidoides* auct.) and *Epistrenoceras subcontrarium* (BEHR.) have been found, neither *Hemigarantia julii* D'ORB., nor *Parapatoceras* species occur. In the light of this fact, the occurrence of scarce and small, but unmistakable specimens of *Macrocephalites*, in the same bed which yielded the above mentioned assemblage of the Retrocostatum and older zones of the Bathonian (Tătaru Georges—Bucegi Massif), is quite unexpected.

Condensed Wagneri—Calloviense Zones. The richest, most varied and certainly the most interesting Middle Jurassic fauna of the Carpathians is the one from Vad (or Vadul Crişului)—Northern Apuseni Mountains. The assemblage found in one bed of only 30—40 cm thickness and listed by D. PATRULIUS, includes such Bathonian forms as follows:

Oxycerites oppeli ELMI, *Paralcidia mariorae* (POP.–HATZ.), *Eohecticoceras biflexuosum* (D'ORB.), *Epistrenoceras subcontratium* (BEHR.), *Hemigarantia julii* (D'ORB.), *Treptoceras crimaeensis* ENAY, *Rugiferites angulicostatus* (LISS.), *R. davaicensis* (LISS), *R.* (?) *supersphaera* (STEPHANOV)*, *Oecotraustes waageni* STEPHANOV.

In addition can be found: a lot other *Oppelids* and *Hecticoceratids* among which an undescribed *Prohecticoceras* quite different from *R. retro-*

* On preserved body-chamber of larger specimens no tendency to contraction could be traced.

costatum, several species of *Oecostrautes* with Callovian affinities and *Jeanneticeras* species, very abundant species of *Choffatia*, *Indosphinctes*, *Grossouvria*, *Subgrossouvria*, several species of *Parapatoceras*, *Acuariceras*, as well as underscribed species belonging to allied genera of unrolled ammonites, typical *Macrocephalites macrocephalus*, as well as *M. compressus* (QUENST.), *Pleurocephalites pila* (NIK.), *P. paronai* B. et P., very rare *Reineckeids*, *Bomburites* sp. and *Bullatimorphites* closely resembling *B. bullatus* (D'ORB.), but with ribbing completely fading out on the body-chamber.

Discus Zone. A pure assemblage of this zone including *Clydoniceras discus* (SOW.), *C. hollandi* (BUCK.) and *Delecticeras* sp. has been found only in the Reşiţa Zone (South Carpathians) where the Upper Bathonian is developed in marly facies (GR. RĂILEANU et al. 1964).

Macrocephalites and Calloviense Zones. Both zones have been identified by D. PATRULIUS (1964) in the Tătaru Gorges (Bucegi Massif), above the bed with abundant Bathonian fauna and scarce specimens of *Macrocephalites*. The assemblage of the Macrocephalites Zone includes *M. macrocephalus*, *Bomburites* sp. aff. *devauxi* (GROSS.), *Grossouvria leptoides* (TILL); the Calloviense Zone is indicated by a new species of *Proplanulites* (akin to *P. koenigi*), being a so far unique find in the Carpathian area. Small ammonite assemblages of the Macrocephalus Zone have also been recorded from the South Carpathians (Reşiţa Zone; according to S. NĂSTĂSEANU, 1963; Gura Văii, according to AL. CODARCEA et al., 1962).

Anceps Zone. Two ammonite assemblages of the Roumanian Carpathians correspond to this zone. The older one (Mount Lespezi—Bucegi Massif) listed by D. PATRULIUS (1964) includes several *Lunuloceras* (sensu ELMI 1967) and *Putealiceras* species, as well as *Indocephalites*, *Indosphictes*, *Grossouvria* and *Subgrossouvria* species, but no *Reineckeids*. A similar assemblage has been found in the Reşiţa Zone (GR. RĂILEANU et al., 1964). In the younger assamblage, known from Pădurea Craiului (D. PATRULIUS, 1956), beside *Lunuloceras* and *Putealiceras*, *Reineckeids* are abundant with *Reineckeia anceps* (REIN.) among them.

Upper Callovian

In the area of the Roumanian Carpathians, *Peltoceratids* are extremely rare in the Callovian and no *Quenstedtoceras* has been found. Thus, zonal correlation can only relay on *Kosmoceratids*, late boreal immigrants in this territory. Beside *Kosmoceras mrazeci* described by I. SIMIONESCU (1899), several other Upper Callovian *Kosmoceras* have been lately identified, among which *Kosmoceras spinosum* (J. C. DE SOWERBY) and *K.* sp., of the *duncani* group, in the Reşiţa Zone; species of the later group also occur in the Hatzeg Basin, together with an early representative of *Paraspidoceras*.

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PLATE I

HETTANGIAN–LOWER PLIENSBACHIAN INDEX AMMONITES

1. *Schlotheimia montana* (WAECHNER). — Perşani Mts. (Valea Tepeia). Col.: D. PATRULIUS
2. *Coroniceras lyra* HYATT. — Perşan Mts. (Dealu Negru). Col.: D. PATRULIUS
3. *Echioceras* aff. *rhodanicum* (DUM.) — Perşani Mts. (Pietrele Albe). Col.: D. PATRULIUS
4. *Androgynoceras* sp. — Pădurea Craiului (Vadu Crişului). Col.: D. PATRULIUS
5. *Tropidoceras masseanum* (D'ORBIGNY). — North Dobrogea. Col.: G. MACOVEI
6. *Uptonia* sp. aff. *U. jamesoni* (J. C. DE SOWERBY). — Perşani Mts. (Dealu Negru). Col.: D. PATRULIUS

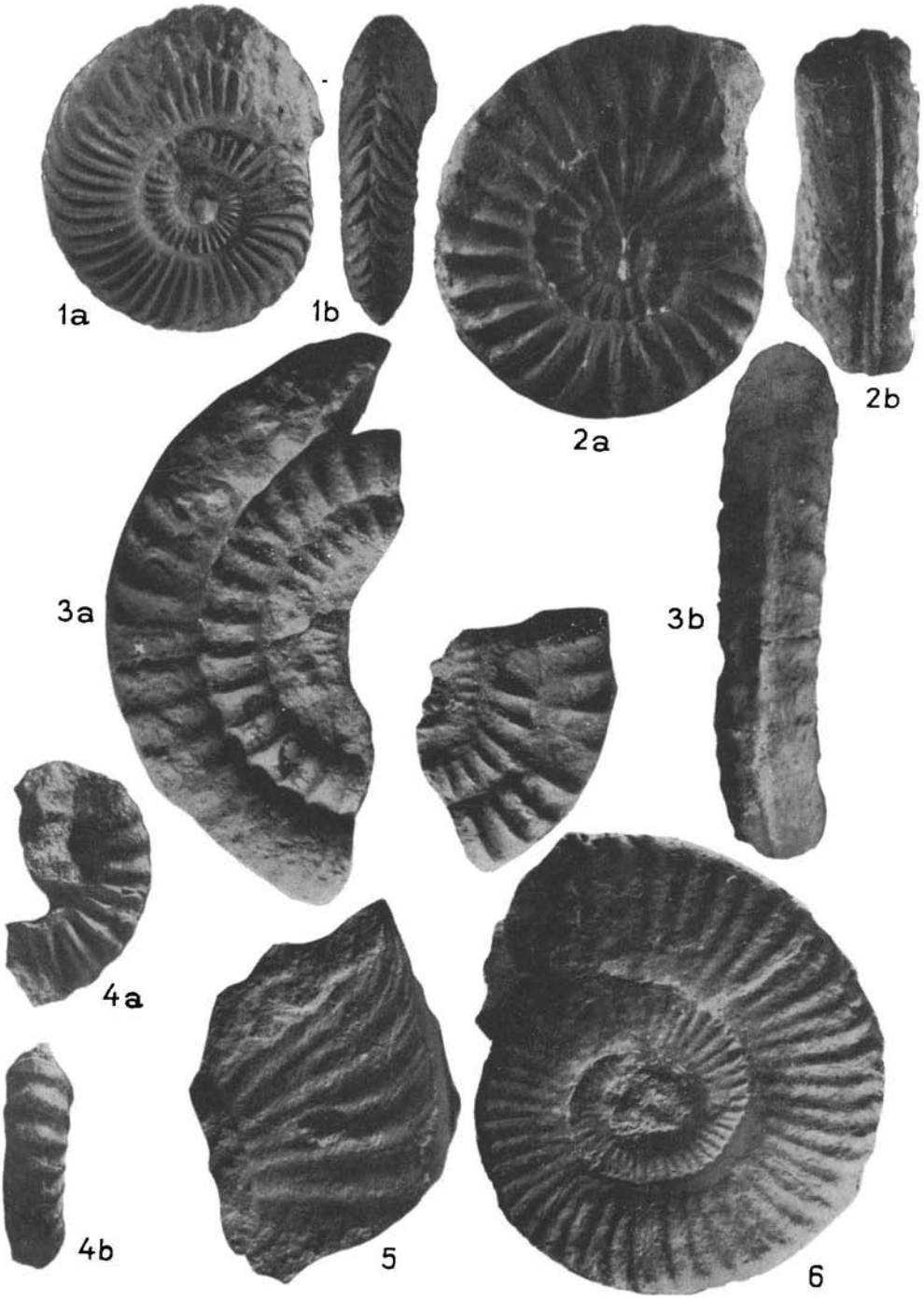
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PLATE II

UPPER PLIENSBACHIAN AND TOARCIAN INDEX AMMONITES

1. *Amaltheus stokesi* (J. SOWERBY). — Pădurea Craiului (Vadu Crişului). Col.: D. PATRULIUS
2. *Amaltheus margaritatus* (MONTF.). — Pădurea Craiului (Vadu Crişului). Col.: TH. KRÄUTNER
3. *Pleuroceras solare* (PHILLIPS). — Pădurea Craiului (Vadu Crişului). Col.: D. PATRULIUS
4. *Pleuroceras spinatum* (BRUGUIÈRE). — Pădurea Craiului (Valea Neagră). Col.: FL. MARINESCU
5. *Harpoceras* sp. — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
6. *Hildoceras bifrons* (BRUGUIÈRE). — Pădurea Craiului (Valea Pregusului). Col.: S. şi JOSEFINA BORDEA
7. *Grammoceras thouarsense* (D'ORBIGNY). — Perşani Mts. (Valea Sărăţii). Col.: ELENA POPA
8. *Dactylioceras tenuicostatum* (Y. et B.) — Postăvaru Mts. (Cristian-Braşov). Col.: ELENA POPA

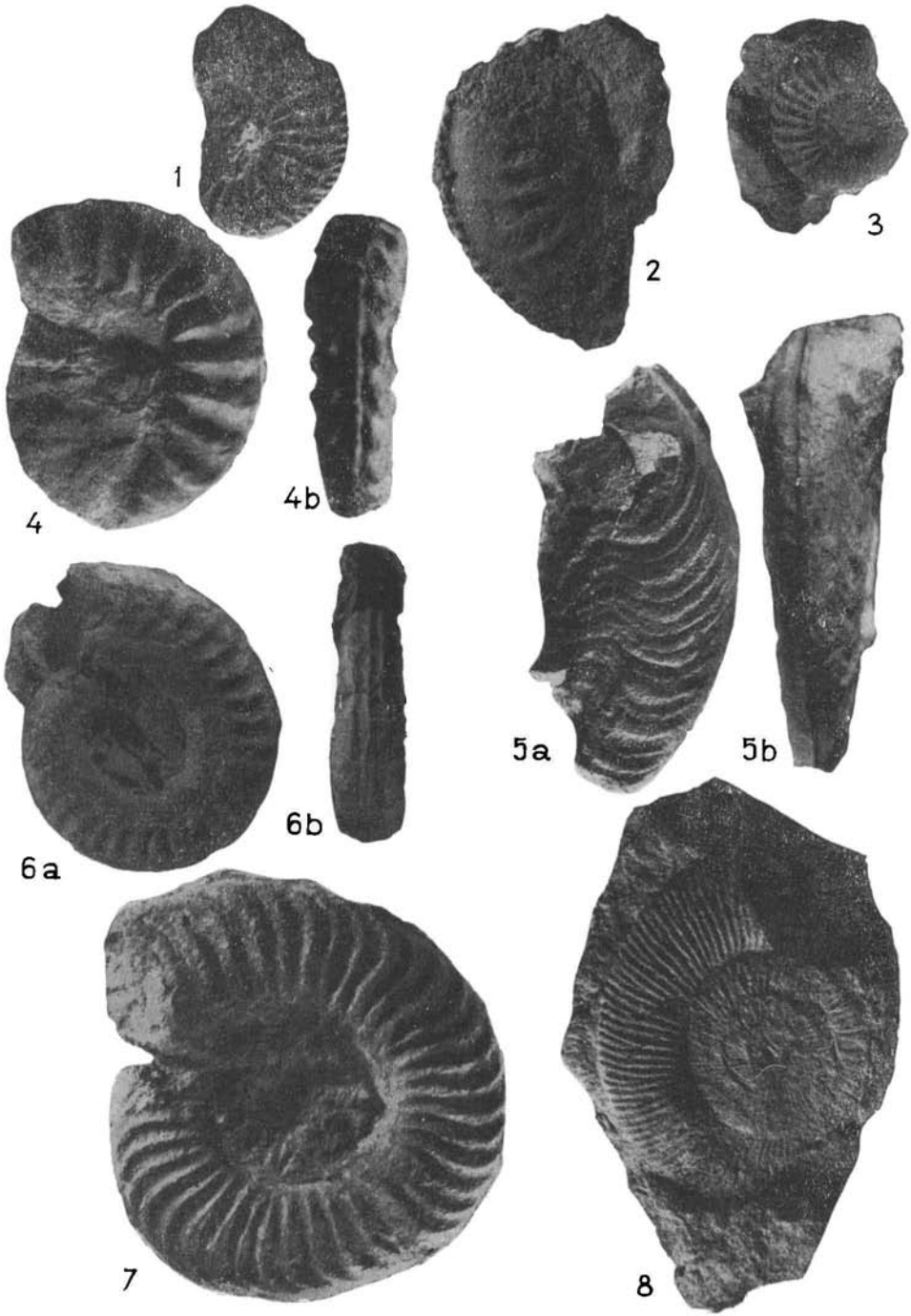
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PLATE III

AALENIAN—MIDDLE BATHONIAN INDEX AMMONITES

1. *Leioceras comptum* (REINECKE). Pădurea Craiului. Col.: D. PATRULIUS
2ab *Tmetoceras scissum* (BENECKE). — Perşani Mts. (Valea Sărăţii). Col.: D. PATRULIUS
3ab *Emileia polyschides* WAAGEN. — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
4. *Darellia* sp. [aff. *dorsetensis* (BUCK)]. — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
5. *Ludwigia murchisonae* (J. C. DE SOWERBY). — Pădurea Craiului (Valea Mnierei). Col.: D. PATRULIUS
6. *Schwandorfia marginata* (ARKELL). — Bucegi Massif (Strunga Pass). Col.: POPOVICI-HATZEG
7ab *Asphinctites transsylvanicus* (SIMIONESCU). — Bucegi Massif (Mt. Grohotişu). Col.: D. PATRULIUS
8ab *Schwandorfia marginata* (ARKELL). — Bucegi Massif (Horoaba). Col.: D. PATRULIUS

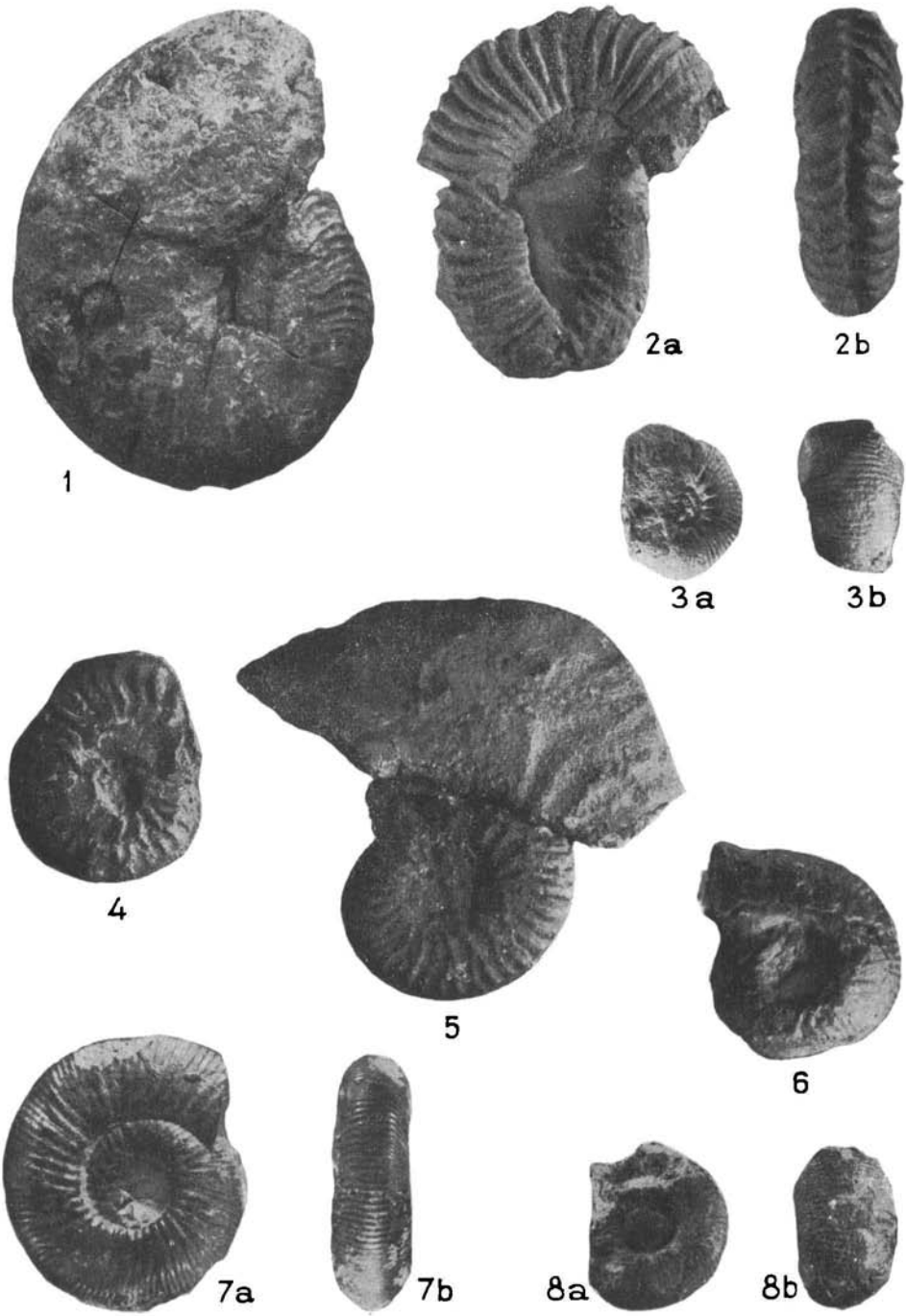
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PLATE IV

UPPER BATHONIAN–CALLOVIAN INDEX AMMONITES

1. *Clydoniceras discus* (J. SOWERBY). — Reşiţa Area. Col.: GR. RĂILEĂNU
2. *Macrocephalites macrocephalus* (SCHLOTHEIM). — Gura Văii. Col.: FL. MARINESCU
3. *Reineckeia anceps* (REINECKE). — Pădurea Craiului (Chicera Tarbii). D. PATRULIUS
4. *Kosmoceras ornatum* (SCHLOTHEIM). — Reşiţa Area. Col.: AURELIA NĂSTĂSEANU

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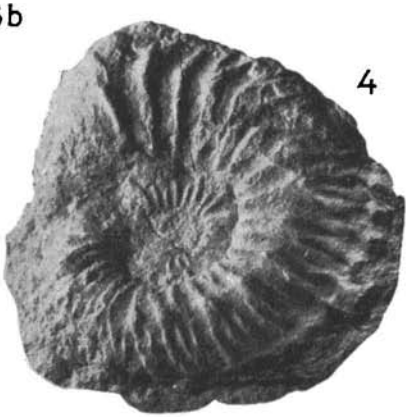

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