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INSTITUTUL GEOLOGIC AL ROMÂNIEI
BUCUREŞTI
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SOCIETATEA ACADEMICĂ DIN ROMÂNIA

SOCIETATEA ACADEMICĂ DIN ROMÂNIA alcătuiește o bază de date în vederea editării, până la sfârșitul acestui an, a unui ***CATALOG AL EXPERȚILOR*** din România.

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DAN PATRULIUS
O PREZENŢĂ DE AUTORITATE ÎN PALEONTOLOGIA ROMÂNEASCĂ

În istoria fiecărei ştiinţe există oameni care, prin activitatea lor deosebită, marchează o treaptă de cunoaştere. Pentru geologie în general şi pentru cea românească în special, perioada anilor 1950-1980 a fost puternic influenţată de aportul de cunoaştere pe care i l-a adus doctorul Dan Constantin Patrulius, medic şi mai apoi geolog stratigraf şi paleontolog de renume, a cărui comemorare a 75 ani de la naştere a fost anul acesta serbată la Academia Română şi de la moartea căruia s-au împlinit deja 15 ani.

Doctorul Dan Patrulius s-a născut la 5 martie 1921 în Bucureşti, ca fiu al publicistului Radu Patrulius şi al Olimpiei Patrulius. După încheierea studiilor liceale şi absolvirea bacalaureatului, cu rezultate de excepţie, din 1940 devine student al Facultăţii de Medicină din Bucureşti pe care o absolvă în 1946. În 1949 obţine Diploma de Doctor în Medicină şi Chirurgie cu calificativul maxim, "Magna cum laude". Paralel cu studiile de medicină este pasionat de Zoologie şi Biologie generală care îl îndeamnă să urmeze o serie de cursuri de profil la Facultatea de Ştiinţe Naturale.

Deşi, cum am văzut, obţinuse calificarea pentru o meserie pe cât de frumoasă pe atât de nobilă, cea de medic, pasiunea sa ieşită din comun pentru studiul fosilelor, manifestată încă de pe băncile liceului, îl determină să se dedice în întregime acestora şi astfel, ca un caz unic în geologia românească, devine geolog autodidact, studiind faunele mezozoice din Masivul Bucegi.

Norocul face să fie remarcat prin această pasiune de către două mari personalităţi ale geologiei româneşti, Acad. prof. Gh. Macovei şi Acad. prof. G. Murgeanu care îi creiază toate condiţiile pentru a continua şi dezvolta aceste studii în cadrul Institutului Geologic al României.

Aşa se face că din 1948 devine colaborator al acestei instituţii de excelenţă a cercetărilor geologice româneşti, iar în 1949 este numit geolog asistent provizoriu. Această activitate este continuată după 1950, până în 1958, şi în cadrul unei unităţi nou create după reorganizarea activităţii geologice din România: Întreprinderea de Prospecţiuni a Comitetului Geologic. Competenţa şi pasiunea, manifestate în activitatea sa, îl fac să fie primit mai târziu la Institutul de Geologie al Academiei Române. În 1960, revine în cadrul noului Institut de Geologie şi Geofizică unde va activa până la trecerea sa prematură în eternitate.

Pentru a căpăta un statut şi o poziţie definitivă în viaţa geologică românească, între 1959-1964 face o a doua facultate, cea de Geologie la Universitatea din Bucureşti, de la care obţine în 1965 diploma de licenţă cu un subiect privind geologia părţii centrale a Munţilor Pădurea Craiului şi a bauxitelor asociate. Lucrarea este apreciată de comisia Examenului de Stat drept excepţională. Continuâdu-şi atestarea pregătirii sale de excepţie, în 1972, sub conducerea Prof. N. Macarovici de la Universitatea din Iaşi, obţine titlul de Doctor în geologie. Subiectul tezei sale de doctorat este monografia intitulată "Geologia Masivului Bucegi şi a Culoarului Dâmbovicioara", publicată la Editura Academiei Române. Aceasta este ultima atestare oficială a calităţilor de excepţie ale Dr. Dan Patrulius, care îi va permite să se bucure de toate drepturile acordate unui specialist geolog.

Dar calităţile sale excepţionale de paleontolog-stratigraf au făcut să fie chemat şi în învăţământul geologic ingineresc. Aşa se face că între 1950-1959 activează ca asistent la Institutul de Mine din Bucureşti, calitate în care reuşeşte prin pregătirea sa şi pasiune să capteze pentru ştiinţele paleontologice o serie de tineri care, după absolvire, vor deveni colaboratorii săi apropiaţi. Lipsa însă a unei diplome de geologie ca act oficial, îl obligă să părăsească în 1959 învăţământul. După obţinerea acestui act oficial, din nefericire, din motive ce nu ţineau de pregătirea sa, nu mai este reprimit, văduvind serii de tineri ingineri geologi de a se înfrupta din pasiunea sa mistuitoare pentru geologie în general şi paleontologie în special.

Activitatea sa de paleontolog rămâne să se desfăşoare din plin, cu influenţe benefice, în cadrul Institutului Geologic până în 1982 la 22 noiembrie, când trece în nefiinţă.

Munca sa de geolog acoperă toate domeniile de cercetare legate de formaţiunile sedimentare de pe teritoriul ţării noastre, dar cu precădere cele de paleontologie, bio- şi cronostratigrafie în care a adus contribuţii deosebit de valoroase. Studiile sale abordează cu aceeaşi uşurinţă şi competenţă formaţiuni şi faune aparţinând Paleozoicului, Mezozoicului şi Neozoicului. Nimic din ceea ce însemnă grup de fosile nu-i era străin. Excepţionala sa pregătire naturalistică, conjugată fericit cu o pasiune deosebită de savant şi sprijinită de cunoaşterea a trei limbi de circulaţie internaţională (engleza, franceza şi germana), au făcut din Dr. D. Patrulius unul dintre cei mai proeminenţi paleontologi români din ultimii 50 de ani. Pasiunea sa ieşită din comun îl făcea ca nimic din ceea ce este nou, modern în studiul formaţiunilor sedimentare să nu-i fie străin. Alături de mentorul său spiritual, Acad. G. Murgeanu şi înconjurat de un grup de tineri pasionaţi,

încă din anii '60 introduce Sedimentologia ca un domeniu de viitor ce oferă noi posibilităţi de descifrare a structurilor şi evoluţiei geologice a diverselor unităţi structurale ale pământului românesc. El este primul care pe baza acestor studii simplifică până la normal structura geologică a Masivului Bucegi, unde aplică pentru prima dată aceste studii. Aşa se face că în 1961, la cel de al V-lea Congres Carpato-Balcanic ţinut în România, Dr. D. Patrulius, în scris şi pe teren, introduce noţiunea de "olistolite" şi de "wildfliş". Ca orice noutate, şi acestea au fost la început privite cu suspiciune. Ele suprimau interpretarea complicată, cu numeroase falii şi pânze suprapuse, a succesiunilor sedimentare din Munţii Bucegi, înlocuind-o cu o alta, arătând sedimentarea normală: totul devenea acum, în concepţia wildflişului, o masă de sedimente în care sunt prinse blocuri imense de formaţiuni mai vechi (în cazul Bucegilor, triasice sau jurasice). Astăzi problema olistolitelor este unanim acceptată, ca un fenomen firesc, logic. Şcoala de Sedimentologie românească, iniţiată la începutul anilor '60 de către Acad. G. Murgeanu şi Dr. D. Patrulius, din care făceau parte tinerii absolvenţi L. Contescu, D. Jipa, N. Mihăilescu, N. Panin, este astăzi pe deplin formată şi recunoscută în lumea specialiştilor din ţară şi străinătate.

Un alt domeniu al cercetării geologice în care D. Patrulius a adus contribuţii valoroase este cel al microfaciesurilor, în special al rocelor carbonatate. În acest domeniu studiile sale privind algele calcaroase aduc date importante. Demonstrativă este în acest domeniu lucrarea sa publicată în 1965 şi intitulată "Inventar sumar al algelor calcaroase neojurasice şi eocretacice din Carpaţii româneşti şi din platforma precarpatică".

Tot cu caracter prioritar, de deschizător de drum, sunt şi studiile sale (unice până acum la noi) privind resturile fosile de decapode întâlnite în calcarele titonice şi neocomiene din Carpaţii româneşti şi polonezi occidentali.

Grupul de fosile însă care l-a pasionat încă din tinereţe şi pe care nu l-a părăsit toată viaţa, a fost cel al cefalopodelor, cu precădere al amoniţilor. Ca nimeni altul până la el, D. Patrulius a recoltat şi studiat cu o pasiune de invidiat şi cu o competenţă greu de egalat, resturile de amoniţi din întreg Mezozoicul din România. Monografiile sale privind depozitele triasice din Apuseni, Orientali sau Dobrogea de Nord, în care se prezintă o bio- şi cronostratigrafie la zi a acestora, au la bază cunoaşterea în mare detaliu a faunelor de ceratiţi întâlnite. Pe aceiaşi direcţie se înscriu şi studiile sale (singur sau în colaborare) privind faunele de amoniţi din Liasic, Dogger, Malm sau Cretacic inferior din zonele clasice sau nou descoperite de el, în care conţinutul paleontologic este redat integral, dar amoniţilor li se acordă rolul principal în descifrarea unei bio- şi cronostratigrafii de detaliu. Aici se înscriu lucrări cum sunt: *Contribuţii la studiul depozitelor albiene de la Giurgiu* (1960); *Faunele mezozoice din Masivul Bucegi* (1964); *Afinităţi provinciale şi căi de migraţie a câtorva faune jurasice din Carpaţii româneşti şi avant-pays-ul carpatic* (Coloq. Juras. Luxemburg, 1964); *Zonele de amoniţi din Jurasicul inferior şi mediu din Carpaţii româneşti* (Coloq. Juras. Medit., 1969, Budapesta); *Cefalopodele stratelor de Carhaga (Tithonic superior-Barremian inferior*, 1976); *Amoniţii heteromorfi şi alte Parkinsonide din Bathonian-Callovianul inferior de la Vadul Crişului* (publicată în acest volum).

Una din lucrările monografice fundamentale de geologie regională şi paleontologie-biostratigrafie este teza sa de doctorat referitoare la Masivul Bucegi şi Culoarul Dâmbovicioara. În această lucrare, pe lângă clarificarea din punct de vedere sedimentologic a blocurilor mari de calcare jurasic medii şi superioare prinse în masa grosieră a depozitelor Cretacicului inferior, se reia în viziune modernă biostratigrafia calcarelor, a depozitelor de fliş cretacic şi, mai ales, a depozitelor marnoase cu amoniţi cretacic-inferioare din bazinul Dâmbovicioarei care, de la I. Simionescu şi Popovici-Haţeg (sfârşitul secolului XIX), nu mai fuseseră abordate prin prisma conţinutului lor paleontologic; pentru toate aceste depozite a fost prezentată o biostratigrafie modernă, valabilă şi azi, bazată pe asociaţii de calpionele, alge calcaroase, etc. şi mai ales de amoniţi, ultimele de o bogăţie unică în aria Carpaţilor româneşti.

Pregătirea sa de excepţie i-a permis să abordeze cu aceiaşi competenţă şi alte grupe de organisme fosile, nevertebrate şi vertebrate. Dovadă stau lucrările sale privind: *Thecideidele triasice sau cretacice* (în colaborare cu D. Pajaud); *Contribuţii la studiul faunei neojurasice din Valea Casimcea* (în colaborare cu T. Orghidan); *Prezenţa placodermilor şi ostracodermilor din Devonianul Platformei Moesice* (în colaborare cu M. Iordan); *Dinosaurienii ornithopozi din bauxitele neocomiene* (în colaborare cu Fl. Marinescu); sau *Prezenţa antracotheridului Prominotherium dalmatinum în depozitele paleogene de la Săcel*, ş. a.

Dr. Dan Patrulius este printre primii geologi români care, pe baze paleontologice, demonstrează prezenţa Dinantianului în fundamentul Câmpiei Române (1963). Se ocupă apoi de Permianul autohtonului de Bihor şi realizează o lucrare de sinteză asupra Paleozoicului din Platforma Moesică.

Contribuţiile sale au fost remarcabile şi în realizarea atlaselor litofaciale ale Triasicului, Jurasicului şi Cretacicului. În aceeaşi ordine de idei se cuvine a aminti contribuţia sa deosebită la realizarea unor foi ale Hărţii Geologice a României, scara 1:200.000, atât în ceea ce priveşte partea cartografică precum şi a textului

explicativ al respectivelor foi (9 foi). Şi pentru noua ediţie a Hărţii Geologice a României la scara 1:50.000, a lucrat până în ultimul moment al vieţii sale, contribuind la realizarea a 5 foi.

Activitatea sa prodigioasă în cunoaşterea şi dezvoltarea cu precădere a ştiinţelor paleontologice şi stratigrafice româneşti a avut un puternic ecou şi în rândul specialiştilor europeni. Personalitatea şi profesionalismul său au făcut să fie ales membru în diverse comitete sau al unor societăţi de profil: membru al Asociaţiei Internaţionale a Sedimentologilor, membru al Societăţii Geologice a Franţei, membru al Subcomisiilor pentru Stratigrafia Triasicului şi Jurasicului din cadrul Comisiei Internaţionale de Stratigrafie, membru în Comisia de Stratigrafie şi Paleontologie a Asociaţiei Carpato-Balcanice, ş. a. În această calitate participă ca reprezentant al geologiei româneşti la numeroase conferinţe, reuniuni sau congrese internaţionale. Numele său apare la loc de cinste în: Dictionary of International Biography (1978), Men of Achivement (1978), Directory of Paleotologists of the World (1968), ş. a.

În scurta sa viaţă de geolog, între 1950-1982, Dan Patrulius a reuşit să publice 133 de articole, monografii şi hărţi geologice ce au intrat în fondul de bază al bibliografiei geologice româneşti, lucrări care-i permit prin contribuţiile originale şi conţinutul lor să fie trecut în galeria marilor personalităţi ale geologiei noastre.

Michel Durand-Delga, o mare personalitate a geologiei franceze şi europene, scria la moartea sa (Geochronique 1984, p. 11):

"D'une extrême sensibilité et d'une étonnante culture, sachant charmer, amoureux de la nature dans laquelle il avait, disait-il,≪semé un peu partout des petits bouts d'âme≫, D. Patrulius se réfugiait dans la recherche≪avec le sentiment que, par son imprévu, par la diversité des images qu'il vous offre, par les exigences qu'il impose à votre raisonnement, il n'y a pas de plus beau métier que celui de géologue alpin≫. De ce géologue de qualité, que la Société géologique de France choisit comme Associé Etranger (1974), les événements firent un savant solitaire quoique indispensable, à qui la chance ne fut pas offerte de devenir le chef d'école exceptionnel qu'il eut pu devenir".

Iată deci în puţine cuvinte dar foarte calde de ce aprecieri se bucura în lumea specialiştilor europeni, geologul român Dan Patrulius.

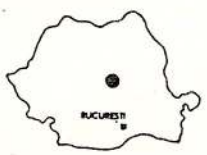
Desigur, cele câteva rânduri prin care am încercat readucerea în memorie a celui care a fost doctorul Dan Patrulius nu pot evoca îndeajuns complexitatea personalităţii sale şi marea sa pasiune pentru geologie şi, în special, pentru studiul fosilelor. Noi, toţi cei care l-am cunoscut şi admirat ca om, ca prieten şi ca mare paleontolog şi care am regretat profund stingerea sa în plină putere intelectuală, ne întoarcem cu pioşenie către opera sa în care şi acum, după 15 ani de când nu mai este printre noi, găsim exemplu şi îndrumare.

Profesor doctor Theodor Neagu
Membru corespondent al Academiei Române

Mem. Inst. Geol. Rom., 36, p. 3–12, Bucureşti, 1996

LA FAUNE DU RHAETIEN SUPÉRIEUR DES MONTS PERŞANI (CARPATES ORIENTALES)

Dan PATRULIUS



Key words: Paleontology. New species. Brachiopods. Bivalves. Rhaetian. Perşani Mts. Romania.

Abstract: *The Upper Rhaetian fauna from the Perşani Mountains (East Carpathians).* From an olistolithe in the left bank of the Vârghiş Valley, downstream the Mereşti Gorges, a faunal assemblage has been identified, attesting the presence of the Uppermost Triassic (Upper Rhaetian) in the Perşani Mts. 18 brachiopod species are described and figured, 10 of which are new species, as well as 14 bivalve species, six of which are new species.

Dans l'un de nombreux olistolithes englobés dans la formation de Wildflysch d'âge barrémien-aptien inférieur du secteur nord des Monts Perşani, Ileana Popescu a récolté une riche faune qui contient, en principal, des Bivalves et des Brachiopodes. Cet olistolithe, appartenant à la "Série" d'Olt (Patrulius, dans ce volume) est situé dans la rive gauche de la vallée du Vârghiş, en aval des gorges de Mereşti. Il est constitué de calcaire encrinitique gris et blanc, épais seulement de 3 m, qui a fourni une association faunique remarquable par le nombre d'espèces et d'exemplaires.

Loin d'être complète, l'inventaire paléontologique comprend des Brachiopodes, tels quels: *Fissirhynchia fissicostata* (SUESS), de nouvelles espèces de *Fissirhynchia (ageri, euxinelliformis, fissicostata* var. allongée), *Cirpa (sibliki, C.* sp. ex gr. *sibliki* n. sp. indet.), *Furcirhyncia (F.* n. sp. indet.), *Fimbriothyris (zapfei), Lepismatina, Laballa*, ainsi que *Zeilleria norica* (SUESS), *Z. elliptica* (ZUGMAYER), *Z. moisseievi* DAGYS, *Z.* aff. *austriaca* (ZUGMAYER), *Aulacothyris ruedti* BITTNER et des formes apparentées (*A. ruedti persanensis* n. sp.).

Quant aux Bivalves, on y a trouvé les espèces suivantes: *Oxytoma inaequivalvis* (J.SOWERBY) (très nombreuses), *Antiquillima succinta* (SCHLOTHEIM), *A.* sp. ex gr. *A. succinta* (SCHLOTHEIM), *A. ctenostreiforme* n. sp., *Pseudolimea drnavensis* (KOCHANOVA), *P.* cf. *hettangiensis* (TERQUEM), et de nouvelles espèces de *Pseudolimea (P. gaetani* et *P. subaequilatera), Plagiostoma* sp. ex gr. *P. giganteum* (J. SOWERBY), *Pleuronectites* sp. et de nouvelles espèces de *Praechlamys [Chlamys (Praechlamys) guexi], Entolioides* n. sp. indet., *Filopecten* n. sp. indet. et également *Gryphaea.*

Cette association est déroutante, car elle contient des formes soit uniquement du Trias terminal *(Pseudolimea drnavensis* et *Zeilleria norica, Z. elliptica, Z. austriaca, Z. moisseievi)*, soit uniquement du Jurassique inférieur *(Antiquilima succinta, Pseudolimea hettangiensis*, les espèces de *Furcirhynchia* et *Cirpa*), quelques exemplaires de Spiripheridae à habitus jurassique ainsi que des formes communes aux deux intervalles stratigraphiques *(Oxytoma inaequivalvis).*

Dans la "Série" d'Olt, cette faune est plus récente que la faune du calcaire rouge encrinitique de la Klippe de Meghieş (Sévatien), mais plus ancienne que la faune du calcaire d'Adneth du toit (Sinémurien inférieur). La faune décrite et, le plus probablement, d'âge rhaetien supérieur.

Description paléontologique

Brachiopoda

Fissirhynchia euxinelliformis n. sp.
Fig.1; Pl. I, fig.1 a–d

Holotype: No. 17239, collection du Musée de Géologie, Bucarest

Paratype: No. 17240, même collection

Locus typicus: rive gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du Trias terminal.

Derivatio nominis: de la ressemblance extérieure aux petites espèces d'*Euxinella.*

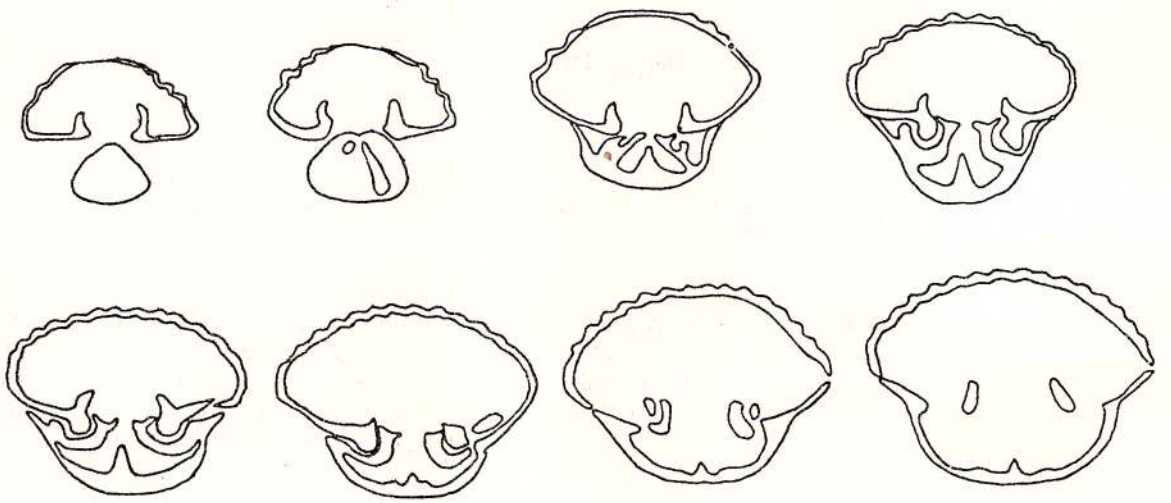


Fig. 1 – Sections sériées à travers *Fissirhynchia euxinelliformis* n. sp.

Matériel examiné: 5 exemplaires.
Dimensions:

	10,0	1a	é
1H	13,0	14,0	10,0
2P	10,6	12,0	8,5
3T	12,0	11,5	8,5
4T	10,0	10,5	5,5

Diagnose: *Fissirhynchia* de petite taille à contour subpéntagonal à subcirculaire, à valve pédonculaire peu deprimée vers le côté antérieur, à convexité régulière de la valve brachiale sans lobe médian, à peine ébauchée, à côtes peu aiguës en nombre de 14 à 18, à dents articulaires massives, simples, logées dans des alvéoles profondes. Le septum médian s'étend sur au moins un tiers de la longuer de la valve brachiale. Ressemble à *Euxiniella anatolica* dont elle se distingue extérieurement par le contour plus large, étant moins aigu au côté postérieur.

Fissirhynchia ageri n. sp.
Fig. 2; Pl. I, fig. 2 a–d

Holotype: No. 17242 (à 16 côtes), collection du Musée de Géologie, Bucarest.

Paratype: No 17243 (à 11 côtes), même collection.

Locus typicus: versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du sommet du Trias.

Derivatio nominis: dédiée à mon ami Victor Derek Ager, éminent spécialiste dans l'étude des Brachiopodes mésozoïques.

Matériel examiné: environ 50 exemplaires, dont 11 intégralement conservés.

Dimensions:

	10,0	1a	é
holotype 1	19,0	21,7	13,5
paratype 2	17,5	20,0	14,0
3	12,5	12,0	7,5
4	16,0	17,0	9,0
5	18,0	18,0	12,2
6	18,5	20,5	14,0
7	18,5	21,7	14,0
8	18,5	22,5	14,0
9	19,2	19,5	14,0
10	19,2	21,0	–
11	19,2	21,5	13,0

Diagnose: *Fissirhynchia* de taille moyenne, à contour subpéntagonal, à valve pédonculaire fortement déprimée vers le côté antérieur, à lobe médian peu saillant, à 10-16 côtes aiguës, pour la plupart non divisées, dont 5-6 sur le lobe médian. Vu du côté antérieur, le contour ventral se présente rectiligne à légèrement excavé, vue du côté latérale la valve pédonculaire n'est visible que vers l'extrémité postérieure et même là-bas elle n'est que peu convexe.

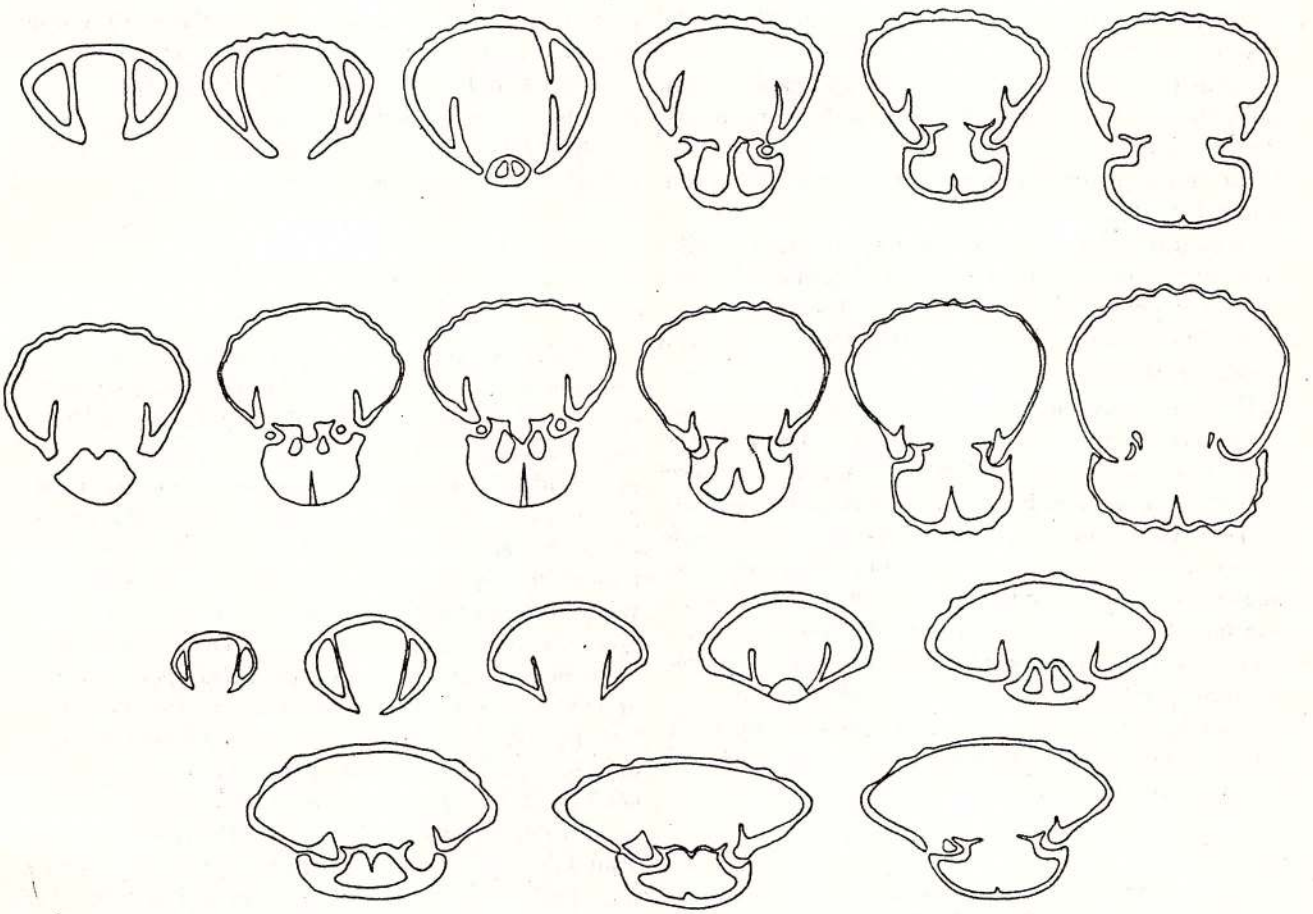


Fig. 2 – Sections sériées à travers *Fissyrhynchia ageri* n. sp.

Se distingue du type *F. fissicostata* (Suess, 1854; pl. IV, fig. 1 a-c) par le nombre plus réduit des côtes dont la plupart se détachent juste de l'apex de la valve et également par la valve pédonculaire plus déprimée vers le côté intérieur et corrélativement un lobe médian plus nettement individualisé. Plus proches de *F. ageri* sont les exemplaires de *F. fissicostata* figurés par Pearson (1977, pl. 6, fig. 4, 5, 8, 9) et par Zugmayer (1880, pl. 4, fig. 13).

Fissirhynchia cf. *fissicostata* (Suess, 1854)
Pl. I, fig. 3

Six exemplaires fragmentaires semblent bien appartenir à cette espèce telle qu'elle est représentée par le spécimen type figuré par Suess (1854, pl. IV, fig. 1 a-c). Le plus complet est une valve pédonculaire à intér-aires ventrales bien définies, à convexité modérée, à dépression faiblement exprimée, à 21 côtes dont 7 dans la dépression médiane. Aucun des exemplaires examinés ne montre une dichotomie évidente des côtes.

Fissirhynchia fissicostata (Suess, 1854) variant allongé
Pl.I, fig. 4 a–d

Cinq exemplaires se distinguent du type *F. fissicostata* par leur forme allongée pyriforme. Leur valve brachiale porte 10 à 14 côtes dont quelques unes présentent une dichotomie tardive. Se distinguent de *F. ageri* par leur valve pédonculaire un peu plus convexe et la valve brachiale dépourvue de lobe médian.

Le contour est identique à celui de *F. fissicostata* var. *longirostris* Zugmayer dont le spécimen type est reproduit par Pearson (1977, pl. 6, fig. 7).

Cirpa sibliki n. sp.
Pl. I, fig. 5 a–d

Holotype: No. 17250, collection du Musée de Géologie, Bucarest.

Locus typicus: olistolithe sur le versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du sommet du Trias.

Derivatio nominis: dédié au docteur Miloš Siblik, éminent spécialiste dans l'étude des Brachiopodes triasiques et jurassiques des Carpathes slovaques.

Matériel examiné: 4 exemplaires, dont deux valves brachiales isolées.

Dimensions de l'holotype: 10 = 21, 1a =22, é = 15,5.

Diagnose: *Cirpa* de taille moyenne, à crochet fortement recourbé, à lobe médian peu saillant, à surface frontale relativement large, à lobe médian peu saillant de la valve brachiale, à côtes robustes, tectiformes à subtectiformes, dont quatre sur le lobe médian et trois-quatre d'une part et de l'autre. Les côtes se multiplient par bifurcation près de la pointe des valves. Sur la valve brachiale l'aire de bifurcation des côtes est recouverte par le crochet de la valve pédonculaire.

Cette espèce se distingue de *Cirpa langi ageri* en premier lieu par son épaisseur plus réduite et par le lobe médian peu saillant.

Cirpa sp. ex gr. *sibliki* PATRULIUS
Pl. I, fig. 6

Matériel examiné: 2 valves brachiales, 2 valves pédonculaires.

Certains exemplaires se distinguent de *C. sibliki* par leur lobe médian très peu saillant jusqu'à nul et par l'exiguité de leur surface frontale plate. La plus grande des valves brachiales (10 = 22,5, 1a = 23) possède un lobe médian à peine individualisé, pourvu de quatre grosses côtes subtectiformes. Il y a, d'une part et de l'autre, six-sept côtes moins robustes. La plus grosse des valves pédonculaires (10 = 22) est uniformément convexe sur toute son étendue, sans ébauche d'une dépression médiane. Elle porte onze côtes tectiformes.

Cirpa n. sp. indet.
Pl. I, fig. 7 a-d

Un exemplaire complet est remarquable par son contour subtrigonal, fortement allongé, 10 = 15, 1a = 12, é = 9. La partie frontale, abruptement tronquée, est caractéristique du genre. Le rostre est subdressé, très légèrement recourbé. La valve brachiale possède un lobe médian peu saillant. Les côtes sont robustes, tectiformes, différenciées à partir de la pointe des valves. Il y en a trois sur le lobe médian, une ou deux d'une part et de l'autre. Une valve pédonculaire, 19 mm de longue et portant cinq côtes dans sa légère dépression médiane semble appartenir à la même espèce. Ces exemplaires se distinguent nettement de *C. fronto* (QUENSTEDT) par leur contour plus allongé et leur épaisseur beaucoup plus réduite.

Furcirhynchia n. sp. indet.
Pl. I, fig. 8 a, c, d

Un seul exemplaire incomplet est remarquable par son ornamentation à côtes très fines au côté postérieur; environ 40 capillae bien plus fines que celles de *Rimirhynchopsis* dont *Furcirhynchia* se distingue aussi par sa coquille plus mince. Cet exemplaire, à contour subpentagonal, est 14 mm de long. Son rostre est petit et presque droit, ce qui le fait se distinguer nettement des représentants du genre *Rimirhynchia*. La valve brachiale porte un lobe médian peu saillant et pourvu de trois grosses côtes qui occupent environ un quart de sa longueur. Deux autres côtes peu saillantes ornent les flancs. Il y a environ cinq capillae sur le lobe médian. La valve pédonculaire est peu convexe dans sa moitié postérieure. Par sa taille et son aspect général cet exemplaire est comparable à *Furcirhynchia cotteswoldiae* (UPTON) et à *F. striata* (QUENSTEDT). Toutefois, à défaut d'une étude des caractères internes, son attribution au genre *Furcirhynchia* ne peut être que provisoire.

Fimbriothyris zapfei n. sp.
Pl. I, fig. 13 a–d

Holotype: No. 17268, collection du Musée de Géologie, Bucarest.

Locus typicus: olistholite sur le versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du sommet du Trias.

Derivatio nominis: dédiée au professeur Helmut Zapfe, éminent stratigraphe et paléontologue autrichien.

Nombre d'exemplaire: 4

Dimensions:

	10,0	1a	é
holotype	24,5	20,0	14,5
topotype	21,0	17,5	10,0
topotype	20,0	16,0	10,5
topotype (valve pédon.)	18,0	13,5	–

Diagnose: *Fimbriothyris* de grande taille, à contour subpentagonal à nettement éliptique, à épaisseurs tout-à-fait variables, à côtes bien irrégulières qui s'individualisent à partir d'une longueur de 14-21 mm. L'holotype porte treize côtes, dont sept sur la partie médiane de la valve brachiale.

L'holotype et un autre exemplaire de dimensions plus petites sont comparables surtout aux exemplaires de *F. guerangeri* (Deslong, Champs, 1856), figurés par Delance (1974) en tant que variété pentagonale (pl. 6, fig. 2) et forme intermédiaire (pl. 6, fig. 5), mais généralement chez *F. guerangeri* les côtes commencent à s'individualiser plus tôt.

Zeilleria norica (SUESS)
Pl. I, fig. 14 b, d

Les exemplaires adultes représentant cette espèce sont rares et fragmentaires; le plus grand est environ 28 mm de long. Un autre est remarquable par sa partie antérieure nettement bilobée.

Zeilleria aff. *austriaca* (ZUGMAYER)
Pl. I, fig. 15

Trente exemplaires se distinguent des autres espèces de *Zeilleria* du même endroit par leur contour subcirculaire à elliptique et leurs bords tranchants. Le bord antérieur est régulièrement arrondi à rectiligne, la commissure frontale est droite, rarement un peu infléchie, vers la partie dorsale. Chez *Z. austriaca* cette inflexion est plus accusée et la coquille présente des lignes d'accroissement bien marquées.

Dimensions:

	10,0	1a	é
1	6,5	6,0	2,5
2	9,2	9,2	4,0
3	9,5	7,5	3,7
4	9,5	8,5	3,5
5	9,7	8,5	3,7
6	9,7	8,2	4,2
7	9,5	8,5	4,0
8	12,0	10,0	5,2
9	14,5	11,5	5,2
10	15,0	12,5	5,2
11	15,5	13,5	6,2
12	15,5	14,0	6,0
13	19,0	16,0	8,5
14	22,0	15,7	(8)
15	24,0	20,0	11,2
16	26,0	20,5	11,5

Zeilleria elliptica (ZUGMAYER)
Pl. I, fig. 16 b, c

Deux exemplaires de grande taille (plus de 20 mm de long) sont comparables, par leur contour elliptique, leur bord antérieur arrondi ou subtronqué, à commissure droite, à l'exemplaire allongé de *Z. elliptica* figuré par Zugmayer (1880, pl.II, fig. 8). Le rostre subdressé expose un delthyrium isocèle. Le septum dorsal n'atteint pas la demi-longueur de la valve brachiale.

Zeilleria moisseievi DAGYS
Pl. I, fig. 17 a-d

C'est l'espèce la plus abondante dans l'association de Brachiopodes du niveau considéré: 140 d'exemplaires récoltés. La longueur de la plupart des spécimens est de 12 à 16 mm. Le contour varie d'une forme nettement pentagonale à une forme subtrigonale. Chez un grand nombre d'exemplaires les bords latéraux sont subparallèles à la partie antérieure de la coquille. Le bord antérieur est droit ou légèrement excavé. La commissure frontale est le plus souvent un peu aiguë à concavité dirigée vers la valve brachiale. Le crochet subdressé expose un petit delthyrium. À partir d'une longueur d'environ 12 mm, s'individualisent deux variants, différenciés par leur épaisseur.

Dimensions:

	10,0	1a	é
1	10,0	9,0	4,0
2	10,0	9,5	4,0
3	10,5	9,0	4,0
4	11,0	9,7	4,2
5	11,0	10,0	4,0
6	11,2	10,0	5,0
7	11,5	9,5	4,5
8	12,5	10,0	5,5
9	12,5	11,2	5,5
10	13,0	11,0	6,0
11	13,5	11,0	6,2
12	13,5	13,0	6,5
13	13,5	11,5	6,7
14	14,0	11,0	6,7
15	14,0	12,0	6,5
16	14,5	12,5	6,7
17	14,7	11,2	6,5
18	15,0	12,0	7,5
19	15,5	12,0	7,5
20	12,0	11,0	6,2
21	12,2	11,0	7,5
22	12,5	10,5	6,5
23	12,5	11,0	6,5

24	12,7	10,2	6,5
25	12,5	10,5	7,0
26	13,0	11,0	7,2
27	13,0	11,5	7,2
28	13,7	12,0	7,2
29	13,7	11,5	7,7
30	14,0	11,5	7,0
31	14,0	11,5	7,5
32	14,2	11,2	7,0
33	14,5	12,2	7,0
34	15,2	12,7	7,2
35	15,7	13,0	8,5
36	15,5	12,5	8,2
37	15,7	12,5	8,5
38	17,5	14,2	9,0

Zeilleria sp. ex gr. *Z. moisseievi* DAGYS
Pl. I, fig. 18 b, d

Quatre exemplaires se distinguent du reste par l'absence d'un sinus médian sur la valve brachiale. Leurs dimensions sont:

10,0	1a	é
13,5	10,0	7,2
14,0	11,2	6,5
14,0	11,0	27,0
15,5	11,5	7,0

Leur appartenance à l'espèce de Dagys (1963) est discutable. Ils semblent représenter des exemplaires juvéniles de *Z. norica* (SUESS).

Zeilleria sp.
Pl. I, fig. 19 b, c

Deux exemplaires de petite taille (10 = 14 mm) sont remarquables par leur forte épaisseur (é ≈ 8 mm). Les commissures latérales sont légèrement infléchies, le bord antérieur est droit. Chez l'un d'eux, la valve brachiale est une peu déprimée à la partie antérieure. Ce caractère rapproche les exemplaires décrits de *Z. moisseievi* DAGYS, dont ils pourraient représenter un variant extrême.

Aulacothyris ruedti persanensis n. ssp.
Pl. I, fig. 20 a–d

Holotype: No. 17264, collection du Musée de Géologie, Bucarest.
Paratype: No. 17265, même collection.
Locus typicus: olistolithe sur le versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.
Stratum typicum: calcaire encrinitique gris-blanc du sommet du Trias.
Derivatio nominis: des Monts Perşani.
Nombre d'exemplaires: 5.
Dimensions:

	10,0	1a	é
holotype	18,0	14,5	10,0
paratype	18,5	12,5	11,0
topotype	17,0	13,5	9,7
topotype (juvénile)	10,0	8,5	4,0

Diagnose: *Aulacothyris* de grande taille, épaisse, à contour pentagonal allongé, à valve brachiale fortement déprimée du côté antérieur, à valve pédonculaire légèrement déprimée près des commissures latérales, à la moitié postérieure.

Les exemplaires décrits, surtout les plus jeunes, sont comparables à *Aulacothyris ruedti* BITTNER des calcaires à *Koninckina telleri* BITTNER de l'Oberseeland. Les exemplaires adultes se distinguent par la taille plus forte et le sinus de la commissure frontale bien plus profond. On doit remarquer toutefois que l'espèce *A. ruedti* est fondée sur un seul exemplaire qui pourrait être immature. Jusqu'à la documentation plus ample sur l'espèce de Bittner, l'attribution des exemplaires décrits en haut à une sous-espèce nouvelle n'est justifiée que par l'âge beaucoup plus récent du gisement des Mont Perşani.

Discinisca sp. A
Pl. I, fig. 21 a, c

Un exemplaire de 19,5 mm de long et de 15 mm de large présente une forme conique surbaissée très excentrique, avec l'apex au tiers postérieur. L'ornementation consiste en anneaux concentriques représentant le bord des lamelles retroussées vers l'apex. Il y en a une vingtaine en 5 mm de rayon. Au côté postérieur s'observe aussi une ornementation radiale peu évidente.

Discinisca sp. B
Pl. I, fig. 22 a, c

Un exemplaire de 21,5 mm de long et de 16,5 mm de large se distingue du précédent par sa forme générale à l'apex plus élevé et moins excentrique. Du côté postérieur s'observe à jour un sillon à pein ébauché, situé à gauche du plan de symmétrie et légèrement

arqué. L'ornementation consiste exclusivement en anneaux concentriques en forme de bourrelets séparés par de très fines rayures. Il y en a environ 15 par 5 mm de rayon.

Il s'agit très probablement d'espèces nouvelles qui se distinguent de *Discinisca* sp. figuré par Suess (1854, pl. IV, fig. 24) des couches de Kössen de Schobergraben près d'Adnet, par leur forme plus franchement elliptique et non pas ovoïde et par l'absence d'une ornementation radiale nette.

Bivalvia

Oxytoma inaequivalvis (J. SOWERBY)
Pl. II, fig. 1

C'est le Bivalve le plus fréquent du gisement en question: environ 100 exemplaires récoltés, dont seulement 25 valves droites. L'ornementation en est assez variable. La valve gauche porte sur la voûte umbonale 11-13 côtes radiales de premier ordre. Les côtes de deuxième ordre, situées au milieu des espaces intercostaux, sont rarement présentes. Les côtes fines, filiformes, de troisième ordre, en nombre de 4-6 entre deux côtes principales, ne sont visibles que sur la coquille. Dans un cas exceptionnel de coquille bien conservée, celle-ci porte sur l'oreillette antérieure, qui est fortement convexe, six côtes principales séparées par des côtes intercalaires filiformes. De vagues côtes filiformes s'observent également sur l'oreillette postérieure aliforme. Les moules internes des valves droites sont habituellement lisses. Sur les mêmes valves la coquille de l'adulte porte sur le côté antérieur cinq-six rayures radiales qui n'atteignent pas la région umbonale.

Antiquilima succinta (SCHLOTHEIM, 1813)
Pl. II, fig. 2

Cette espèce, signalée jusqu'à présent seulement dans l'Hettangien du domaine celto-souabe, est relativement fréquente: 17 exemplaires dont 10 plus ou moins complets, les autres très fragmentaires.

Dimensions:

	H	L	H/L
1	(44)	30	1,46
2	36	27	1,33
3	29,5	22,5	1,31
4	25,5	19	1,34

Dans le plus grand des exemplaires examinés (1), représenté par une valve droite, l'ornementation est identique à celle du spécimen figuré par Quenstedt (1856) et reproduit par Cox et Hertlein in Moore (1969): entre deux côtes de premier ordre, légèrement sinueuses, s'intercalent 2-3 côtes de second ordre. Sur le côté postérieur il y a aussi des lignes d'accroissement bien marquées. Une valve droite de taille moyenne (3), à ornementation plus grossière met en évidence les caractères spécifiques de l'oreillette antérieure qui est à peine décalée par rapport à la voûte umbonale, faiblement convexe et pourvue de stries de croissance profondes, courbes, parallèles au bord antérieur qui est légèrement concave. Dans l'échantillon no. 4 l'oreillette postérieure n'est qu'une expansion plate de la voûte umbonale, couverte de côtes radiales jusqu'au bord cardinal. Des lignes d'accroissement fortement marquées, à partir d'une hauteur de 13 mm, dévient la direction des côtes radiales.

Sur de gros fragments à coquille bien conservée on remarque aussi de fines lamelles de croissance mieux marquées sur les côtes que dans les espaces intercostaux.

Antiquilima sp. ex gr. *A. succinta* (SCHLOTHEIM)
Pl. II, fig. 3

Deux valves gauches se distinguent sensiblement de ceux attribuables à *A. succinta* (von SCHLOTHEIM) par leur ornementation constituée de côtes très fines et aussi par leur oreillette antérieure qui est plus fortement décalée par rapport à la voûte umbonale et dont l'ornementation est à peine distincte. Le plus complet de ces exemplaires est 20,5 mm de haut et 15 mm de long (H/L = 1,36).

Antiquilima ctenostreiformis n. sp.
Pl. II, fig. 4

Holotype: No. 17284, collection du Musée de Géologie, Bucarest.

Locus typicus: olistolithe du versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du sommet du Trias.

Derivatio nominis: de l'ornementation semblable à celle du genre *Ctenostreon*.

L'impression externe un peu endommagée d'une valve gauche peu convexe haute de 26 mm est particullièrement remarquable par son ornementation très semblable à celle du genre *Ctenostreon*. Toutefois le contour de cette valve, mis en évidence par les lamelles d'accroissement, est ovale-oblique et la hauteur l'emporte nettement sur la lonqueur (H/L = 1,19). La partie médiane de la coquille porte 10 côtes,

bien individualisées, à partir de la pointe de l'umbo, légèrement sinueuses, qui s'élargissent régulièrement vers le bord ventral. À partir de 144 mm de hauteur, les côtes sont entrecroisées par des lamelles d'accroissement qui sur leur faîte dessinent des festons à convexité dirigée vers le côté dorsal. L'oreillette postérieure, nettement délimitée par rapport à la voûte umbonale porte des stries d'accroissement profondes et courbes. La première côte antérieure marque une discrète carène umbonale. La surface lunulaire, très étroite, porte de fines stries d'accroissement.

Pseudolimea drnavensis (M. KOCHANOVA, 1973)
Pl. II, fig. 5

Un exemplaire de notre collection est bien comparable à l'holotype de *Lima drnavensis* n. sp., figuré par Kochanova (pl. VA, fig. 3). C'est une valve gauche subéquilatérale, 23 mm de haut et 20 mm de long (H/L = 1,15). La longueur maximale se trouve dans le tiers ventral. Au côté antérieur, la voûte umbonale tombe à pic sur la commissure, mais il n'y a pas de carène distincte. Au côté postérieur, l'inclinaison est plus réduite. La partie médiane de la voûte umbonale est pourvue de 15 côtes grosses, arrondies au côté dorsal, tectiformes dans le tiers ventral, où s'observe aussi de fines stries de croissance. Entre deux grosses côtes il y a une costule filiforme qui commence à s'individualiser à partir du tiers moyen de la hauteur. À part les grosses côtes médianes, il y a de chaque côté sept côtes plus fines.

Jusqu'à une information plus ample sur la région cardinale, l'attribution de cette espèce au genre *Pseudolimea*, basée principalement sur les caractères de l'ornementation, doit être considérée provisoire. Le caractère subéquilatéral de la coquille suggère l'appartenance au genre *Limatula*, mais chez le dernier, la longueur maximale se trouve à mi-hauteur et au côté postérieur il y a un secteur dépourvu de côtes radiales.

Pseudolimea subaequilaterala n. sp.
Pl. II, fig. 6

Holotype: No. 17286, collection du Musée de Géologie, Bucarest.

Locus typicus: olistolithe sur le versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du Trias terminal.

Derivatio nominis: de la forme presque orbiculaire du contour.

Matériel examiné: 4 exemplaires.

Dimensions:

	H	L	H/L
holotype (valve droite)	15,5	16,0	0,97

Diagnose: *Pseudolimea* de petite taille, à contour subcirculaire, très peu oblique, à inclinaison de la voûte umbonale un peu plus accusée au côté antérieur qu'à celui postérieur, à oreillettes petites, égales, à ornementation faite d'environ 20 côtes arrondies à subtectiformes et de costules filiformes logées dans les espaces intercostaux. Il n'y a pas de côtes sur les flancs de la voûte umbonale.

Se distingue de *P. drnavensis* (KOCHANOVA) par sa convexité plus faible et ses côtes médianes plus nombreuses et moins robustes.

Pseudolimea cf. *hettangiensis* (TERQUEM)
Pl. II, fig. 7

Quatre exemplaires plus ou moins endommagés se font remarquer par leur forme ovale-oblique et leur ornementation constituée de côtes robustes tectiformes, qui apparaissent individualisées sur le moules internes à quelques millimètres de la pointe de l'umbo. Le plus petit de ces exemplaires a environ 16,5 mm de haut et 15,5 mm de long (H/L = 1,06); il est orné de 20 côtes arrondies à subtectiformes. Les espaces intercostaux abritent des costules filiformes précocement individualisées. Le plus grand a 26 mm de haut, 23 mm de long (H/L = 1,13) et porte environ 20 côtes tectiformes. Des costules intercalaires s'observent seulement à la partie postérieure de la coquille. L'oreillette postérieure, qui semble être sensiblement plus développée que l'antérieure, porte de fines stries d'accroissement.

Pseudolimea gaetanii n. sp.
Pl. II, fig. 8

Holotype: No. 17289, collection du Musée de Géologie, Bucarest.

Paratype: No. 17290, même collection.

Locus typicus: olistolithe sur le versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du Trias terminal.

Derivatio nominis: dédié au professeur Maurizio Gaetani, éminent spécialiste dans l'étude du Trias et du Jurassique inférieur de la Lombardie.

Nombre d'exemplaires: neuf valves droites et deux valves gauches.

Dimensions:

	H	L	H/L
1 holotype	22,0	20,5	1,07
2 paratype	13,5	13,5	1,00
3 topotype	9,5	9,0	1,05

Diagnose: *Pseudolimea* de taille moyenne, inéquilatérale, à convexité modérée, à oreillettes petites et subégales, à côtes peu saillantes, subarrondies à arrondies et qui jusqu'à 12-14mm de hauteur se distinguent à peine sur le moule interne.

L'holotype (1) est une valve droite à coquille exfoliée ornée d'environ 19 côtes arrondies de premier ordre entre lesquelles s'intercalent des côtes un peu moins larges et moins saillantes. L'oreillette postérieure est très petite, l'antérieure n'est pas visible.

Le paratype (2) est une valve gauche ayant conservée partiellement sa coquille qui porte 19 côtes peu saillantes, arrondies et dont les espaces intercostaux sont dépourvus de côtes intercalaires; le moule interne en est lisse jusqu'à 11 mm de hauteur. Les oreillettes sont très petites. La pointe de l'umbo se trouve au milieu de la ligne cardinale. La région cardinale est dépourvue de dents.

Le plus petit des exemplaires est une valve droite à coquille conservée dans la partie antéroventrale. Le moule interne est lisse. Les côtes sont plus étroites et plus saillantes que celles du paratype, séparées par des espaces égaux en largeur.

En général, les exemplaires attribués à *P. gaetanii* n. sp. se distinguent de *P. hettangiensis* (TERQUEM) dont ils ont les proportions [H/L = 1,04 chez l'exemplaire figuré par von Bistram (1903) et reproduit par Cox et Harleim in Moore (1969)], par leurs côtes moins saillantes et qui ne laissent pas de trace sur la partie dorsale du moule interne. Mais il n'est pas exclu que ces différences soient contrôlées par des conditions écologiques réglant la croissance de la coquille et que tous les exemplaires de *Pseudolimea* à contour ovale-oblique du gisement des Monts Perşani appartiennent à titre de variants à l'éspèce de Terquem.

Plagiostoma sp. ex gr. *P. giganteum* (J. SOWERBY)
Pl. II, fig. 9

Matériel examiné: 8 valves gauches et 6 valves droites.

Dimensions:

	H	L	H/L
1	9,5	11,5	0,82
2	12,5	13,0	0,96
3	16,7	17,5	0,95
4	18,5	21,5	0,86
5	20,0	21,5	0,93
6	30,0	(31)	0,96
7	(42)	42,0	1,00

C'est un *Plagiostoma* de taille moyenne, à longueur sensiblement égale à la hauteur chez l'adulte, à lunule profondément excavée, à oreillette postérieure courte, à coquille très mince, ornée de stries très fines et denses, visibles près du bord ventral chez les exemplaires de taille plus forte.

Se rapproche de *Plagiostoma subpunctatum* (D'ORBIGNY) et de *P. nudum* (PARONA) par la forme du contour. Se distingue de *Plagiostomum giganteum* (J. SOWERBY) par sa forme plus développée en hauteur chez l'adulte et son angle apical moins obtus: 85^0 chez un autre plus gros, tandis que chez les exemplaires adultes de *P. giganteum* il dépasse 100^0.

Chlamys (Praechlamys) guexi n. sp.
Pl. II, fig. 10, a, b

Holotype: No. 17294, collection du Musée de Géologie, Bucarest.

Paratype (valve gauche): No. 17295, même collection.

Locus typicus: olistolithe sur le versant gauche de la vallée du Vârghiş, en aval des gorges de Mereşti, Monts Perşani.

Stratum typicum: calcaire encrinitique gris-blanc du sommet du Trias.

Derivatio nominis: dédié au profeseur Jean Guex de l'Université de Lausanne, éminent spécialiste dans l'étude des Ammonites du Trias et du Jurassique inférieur.

Matériel examiné: 6 valves droites, 8 valves gauches et de nombreux fragments.

Dimensions:

	H	L	H/L
1(s)	13,5	11,0	1,2
2(d)	13,5	11,5	1,1
3(s)	13,5	11,5	1,1
4(d)	15,5	13,5	1,1
5(sP)	19,0	16,0	1,1
6(dH)	26,0	23,0	1,1

Diagnose: *Praechlamys* de taille moyenne à grande (les plus grands exemplaires sont 35 mm ou plus de 35 mm de long) à valves sensiblement plus hautes que longues, à l'angle apical de 80^0 à 85^0, à 20-30 côtes subarrondies à subtectiformes chez les exemplaires de taille moyenne. La valve droite est relativement plate et, au bord antérieur, faiblement concave. Sur la coquille les côtes sont habituellement groupées par deux.

L'ornementation des oreillettes est superficielle, très attenuée. La valve gauche est un peu plus convexe que la valve droite, à l'exception de la partie postérieure qui apparaît aplatie par rapport à la partie médiane. Son oreillette antérieure est beaucoup plus développée que la postérieure, pourvue d'une toute petite encoche byssale et des côtes radiaires superficielles. Les côtes de cette valve se multiplient par intercalation. Jusqu'à environ 20 mm de la hauteur, des côtes de premier ordre alternent avec des côtes intercalaires plus minces; ensuite presque toutes les côtes ont la même épaisseur. La partie postérieure, aplatie, de la valve est très peu ornée, presque lisse. Sur les deux valves, les lamelles de croissance sont peu saillantes, visibles seulement dans les espaces intercostaux (ou la coquille est conservée) qui sont aussi larges ou plus larges que les côtes.

Entolioides n. sp. indet.
Pl. II, fig. 11

Une valve gauche de taille moyenne (environ 16 mm de haut) est remarquable par ses plis marginaux internes particulièrement bien développés. Au pli postérieur correspond un sillon supérficiel de la coquille qui se poursuit tout le long du bord postérieur à partir de la pointe de l'umbo. La partie umbonale de la coquille est pourvue d'environ dix côtes radiaires fines auxquelles viennent s'ajouter ensuite quelques côtes intercalaires. L'oreillette postérieure est fortement convexe au côté externe, déprimée vers le côté interne.

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Planche I

Fig. 1 a–d — *Fissirhynchia euxinelliformis* n. sp. Holotype.

Fig. 2 a–d — *Fissirhynchia ageri* n. sp. Holotype.

Fig. 3 — *Fissirhynchia* cf. *fissicostata* (SUESS).

Fig. 4 a–d — *Fissirhynchia fissicostata* (SUESS) var. allongé.

Fig. 5 a–d — *Cirpa sibliki* n. sp. Holotype.

Fig. 6 — *Cirpa* sp. ex gr. *C. sibliki* n. sp. PATRULIUS.

Fig. 7 a–d — *Cirpa* n. sp. indet.

Fig. 8 b, c, d — *Furcirhynchia* n. sp. indet.

Fig. 9 a–d — *"Rhynchonella"* aff. *subrimosa* (SCHAFHAULT).

Fig. 10 a–d — *Piarorhynchia* n. sp.

Fig. 11 — *Lepismatina* cf. *austriaca* (SUESS).

Fig. 12 a, c — *Laballa* sp. ex gr. *L. slavini* DAGYS.

Fig. 13 a–d — *Fimbriothyris zapfei* n. sp.

Fig. 14 b, d — *Zeilleria norica* (SUESS).

Fig. 15 — *Zeilleria* aff. *austriaca* (ZUGMAYER).

Fig. 16 b, c — *Zeilleria elliptica* (ZUGMAYER).

Fig. 17 a–d — *Zeilleria moisseievi* DAGYS.

Fig. 18 b, d — *Zeilleria* sp. ex gr. *Z. moisseievi* DAGYS.

Fig. 19 b, c — *Zeilleria* sp.

Fig. 20 a–d — *Aulacothyris ruedti persanensis* n. spp. Holotype.

Fig. 21 a, c — *Discinisca* sp. A.

Fig. 22 a, c — *Discinisca* sp. B.

a, valve pédonculaire; b, valve brachiale; c, vue latérale; d, vue frontale.

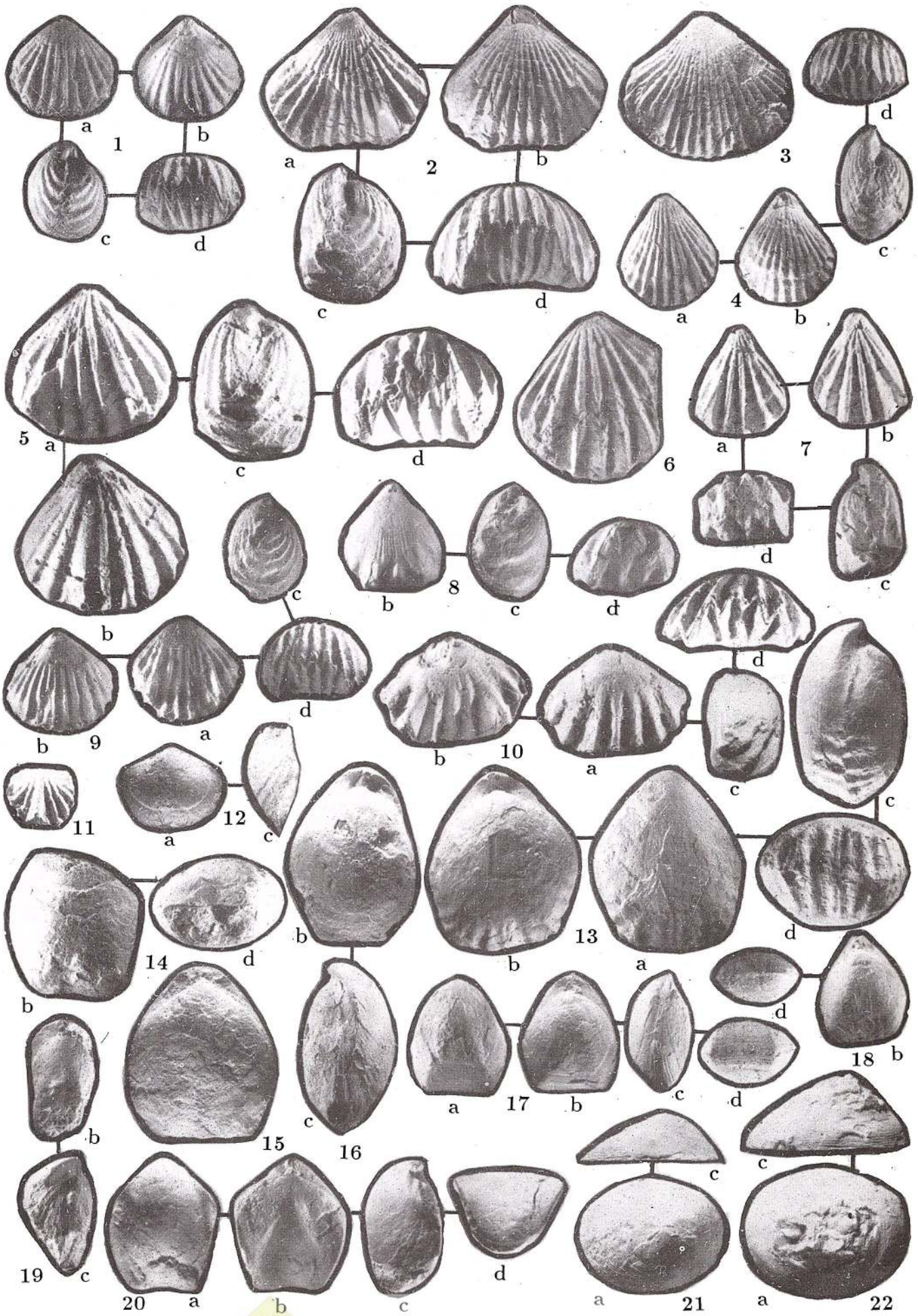


Planche II

Fig. 1 — *Oxytoma inaequivalvis* (J. SOWERBY).

Fig. 2 — *Antiquilima succinta* (SCHLOTHEIM).

Fig. 3 — *Antiquilima* sp. ex gr. *A. succinta* (SCHLOTH.).

Fig. 4 — *Antiquilima ctenostreiformis* n. sp. Holotype.

Fig. 5 — *Pseudolimea drnavensis* (M. KOCHANOVA).

Fig. 6 — *Pseudolimea subaequilatera* n. sp. Holotype.

Fig. 7 — *Pseudolimea* cf. *hettangiensis* (TERQUEM).

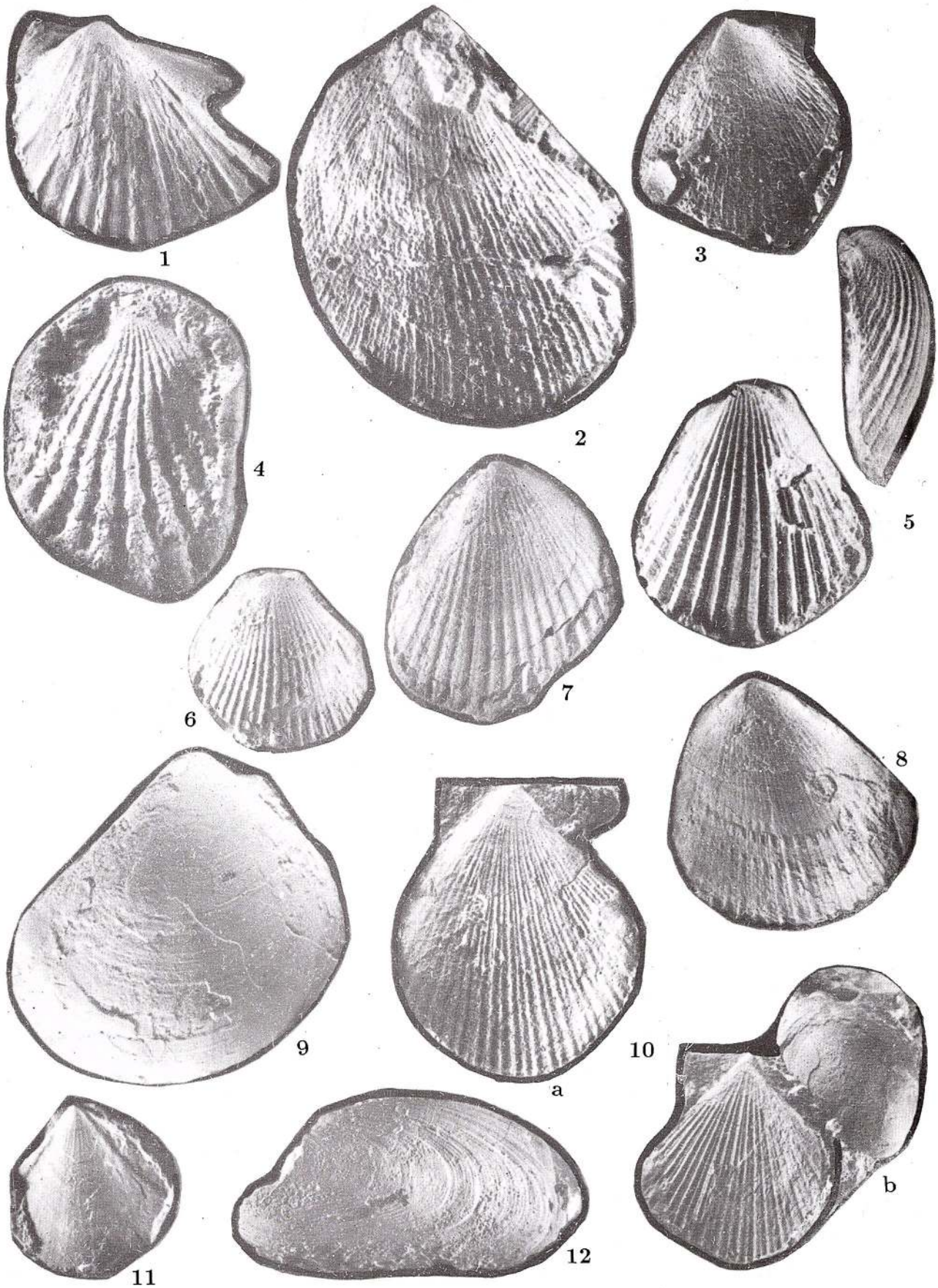
Fig. 8 — *Pseudolimea gaetanii* n. sp. Holotype.

Fig. 9 — *Plagiostoma* sp. ex gr. *P. giganteum* (J. SOWERBY).

Fig. 10 a, b — *Chlamys (Praechlamys) guexi* n. sp. a, holotype; b, paratype.

Fig. 11 — *Entolioides* n. sp. indet.

Fig. 12 — *Modiolus* sp.



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AMMONITES HÉTÉROMORPHES ET AUTRES PARKINSONIIDÉS DU BATHONIEN-CALLOVIEN INFÉRIEUR DE VADU CRIŞULUI (MONTS APUSENI - ROUMANIE)

Dan PATRULIUS

Key words: Jurassic. Bathonian. Ammonites. Taxonomy. New species. Apuseni Mountains, Romania.

Abstract: *Heteromorphic ammonites and other Parkinsoniids of the Bathonian-Lower Callovian of Vadu Crişului (Apuseni Mountains - Romania).* The Middle Jurassic fauna of Vad is one of the richest of this age in the Carpathians. Besides *Epistrenoceras, Hemigarantia, Macrocephalites, Pleurocephalites* and a lot of Perisphinctids and Oppeliids, the condensed ammonite assemblage of this locality includes several species of *Parapatoceras* and *Paracuariceras*, the latter with a new subgenus: *Lytospiroceras* [type species *Paracuariceras (Lytospiroceras) perconstrictum* n. sp.]. The only Lower Bathonian ammonite also present at Vad is *Berbericeras sekikense* ROMAN. There are also abundant slender cyrtoconic shelles of a problematic mollusc (maybe a Scaphopod): *Cyrtoconella tenuistriata* n.g. n.sp.

Introduction

Sur le territoire des Carpathes roumaines sont particulièrement remarquables, par l'abondance et la diversité de leur faune, les gisement médiojurassiques à Céphalopodes du massif de Bucegi (Carpathes Orientales), dont le célèbre gisement de Strunga, celui de Sviniţa (Carpathes Méridionales) et celui de Vad, localité située en marge du plateau karstique de Pădurea Craiului, dans la partie nord des Monts Apuseni. Tous ces gisements sont localisés dans des bancs de forte condensation, constitués de calcaires férrugineux, dont l'épaisseur est de quelques dizaines de centimètres, rarement d'un mètre. La composition des faunes d'Ammonites qui s'y trouvent représentées diffère d'un endroit à l'autre, selon la position et le nombre des zones qui ont été impliquées dans la condensation. En ensemble, l'intervalle d'où proviennent les Ammonites de ces gisements va de la Zone à Zigzag (Sous-zone à Yeovilensis et probablement aussi Macrescens, dans le Massif des Bucegi) à la Zone à Macrocephalus y comprise (Vad). C'est seulement en comparant les faunes de différentes localités qu'on peut se faire une image, très approximative d'ailleurs, de la succession des zones d'Ammonites du Bathonien ét du Callovien inférieur des Carpathes. Il y a aussi un autre inconvénient découlant de la condensation: c'est qu'on ne peut pas préciser le niveau exact d'occurrence des espèces, fort nombreuses d'ailleurs, qui n'ont pas été signalées jusqu'à présent dans les territoires extracarpathiques. Dans le cas du gisement de Vad il est souvent impossible d'affirmer si celle ou telle espèce inédite appartient au Bathonien supérieur ou au Callovien inférieur, les faunes des deux sous-étages étant intimement mélangées. C'est aussi le cas pour certaines des Ammonites déroulées qui s'y trouvent représentées.

Donées stratigraphiques

Les dépôts les plus riches en Céphalopodes du Bathonien-Callovien inférieur de Vad affleurent sur la rive gauche de Crişul Repede, à l'extrémité nord des gorges que cette rivière traverse entre les villages de Suncuiuş et de Vad. Le premier terme du Jurassique moyen y est représenté par un banc de calcaire sableux, épais de 3 m, à microconglomérat quartzitique en base et bourré de Mollusques au sommet, sur une épaisseur de 40 à 50 cm. La couleur du niveau fossilifère varie rapidement de direction, de gris foncé ou noirâtre à taches rouille, à jaunâtre ou à rouge. Le mur du banc calcaire y est constitué par des marnes du Toarcien supérieur (à *Pseudogrammoceras fallaciosum* BAYLE). Le niveau à Céphalopodes supporte, avec discontinuité lithologique, des calcaires marneux et glauconieux subnoduleux. Dans d'autres endroits de la même région les calcaires ou les marnocalcaires

du toit contiennent des faunes du Callovien moyen et de l'Oxfordien inférieur (Patrulius, Istocescu, 1967).

En comparaison avec les faunes médiojurassiques de Sviniţa et de Strunga, celle du banc à Céphalopodes de Vad a une composition bien différente. Sont à remarquer les particularités suivantes:

1. Coexistance, dans une même couches, d'espèces connues du Bathonien supérieur, telles: *Epistrenoceras subcontrarium* (BEHRESDEN), *Hemigarantia julli* (D'ORBIGNY), *Bomburites crimaciensis* (ENAY), *Rugiferites dayaicensis* (LISSAJOUS), *R. angulicostatus* (LISSAJOUS), *R. ? supersphaera* (STEPHANOV), *Paroecotraustes waageni* STEPHANOV , *Oxycerites opelli* ELMI, *Paralcida mariorae* (POPOVICI-HATZEG), *Eohecticoceras biflexuosum* (D'ORBIGNY) et de formes du Callovien inférieur, notamment: *Macrocephalites macrocephalus* (SCHLOTHEIM), *M. compressus* (QUENSTEDT), des espèces de *Pleurocephalites, Kamptokephalites* et *Jeanneticeras*. Est également à noter le présence de *Bullatimorphites bullatus* (D'ORBIGNY).

2. Abondance extraordinaire des Perisphinctidés représentés par des espèces en bonne partie inédites de *Choffatia, Subgrossouvria, Grossouvria, Siemiradzkia* (rare), *Indosphinctes, Elatmites*; par contre les Phyllocératidés y sont proportionnellement bien moins nombreux que dans les gisements de Strunga et de Sviniţa.

3. Fréquence des Ammonites déroulées appartenant aux genres *Paracuariceras* et *Parapatoceras*, qui manquent dans les gisements de Strunga et de Sviniţa.

4. Association de Céphalopodes avec une faune de Bivalves, dont *Bositra buchi* (ROEMER), Gastéropodes, rares Brachiopodes, Echinoides, Coraux ahermatypiques (*Chomatoseris*).

La plupart des Ammonites bathoniennes de Vad appartiennent à un niveau plus élevé que celui d'où proviennent les Ammonites bathoniennes les plus jeunes des gisements du Massif des Bucegi et de Sviniţa, telles que *Prohecticoceras retrocostatum* (GROSSOUVRE), *P. retrocostatum trifurcatum* STEPHANOV, *P. angulicostatum* (LOCZY) de Strunga et la sous-espèce inédite des Gorges de Tătaru. Mais, d'autre part, il faut noter, comme particulièrement remarquable, la présence dans le gisement de Vad de *Berbericeras sekikense* ROMAN, espèce réputée représentative pour le Bathonien inférieur. Toutefois l'association de Vad ne comporte pas d'autreas Morphocératidés. Manquent également les gros *Procerites* des Sous-zones à Yeovilensis et Tenuiplicatus de même que les genres caractéristiques du Bathonien moyen (Zones à Subcontractus et Morrisi), telles que *Tulites, Trolliceras (=Krumbeckia* ARKELL, non DIENER), *Morrisiceras, Lycetticeras, Holzbergia, Sphaeroptychus* pars (=*Schwandorfia* ARKELL).

PALÉONTOLOGIE

Famille **Parkinsoniidae** BUCKMAN, 1920
Sous-famille **Parapatoceratinae** BUCKMAN, 1929
Genre **Parapatoceras** SPATH, 1924
Parapatoceras tuberculatum (BAUGIER et SAUZÉ)
Pl. I, figs. 1, 17; Pl. II, figs. 1 a–c, 2 a, b

Référence type: Toxoceras ? tuberculatus BAUGIER et SAUZÉ, 1843, p. 11, pl. 4, figs., 1, 2; *Ancycloceras bispinatus* BAUGIER et SAUZÉ, ibidem, p. 12, pl. 4, figs. 6–8.

Synonimie complète: in Dietle, 1978, p. 44, 45.

Matériel: 5 fragments représentant des portions de phragmocône et d'habitacle; no. P-17181, Coll. IGG.

Description. Tous les exemplaires attribués à cette espèce sont caractérisés par la section elliptique de la coquille et l'habitacle rhabdoconique. Le plus grand d'entre eux, qui comprend la partie terminale recourbée du phragmocône et la partie initiale de l'habitacle est 36 mm de long et 6,2 mm de haute à l'extrémité aperturale. Le rapport H/E varie de la 1,10 à 1,25. Le nombre de côtes par 1 cm de longueur est de 5 pour 6–6,5 mm de hauteur, de 8 pour 3,5 mm de hauteur. Les tubercules ventraux, pointus et légèrement divergents, sont séparés par une bande siphonale relativement étroite. Les côtes, minces et saillantes sur les flancs, sont transverses, jusqu'à légèrement obliques sur le phragmocône, plus ou moins obliques sur l'habitacle, parfois attenuées mais non pas interrompues entre les tubercules latéro-ventraux et les tubercules ventraux.

La ligne suturale comporte deux lobes latéraux relativement étroits, dont le premier (L) est en général moins profond que le deuxième (U_2). Le lobe U_1 est rudimentaire, réduit aux proportions d'un lobule accessoire.

Remarques. Selon Dietl (1978) qui se base sur l'étude de certains d'exemplaires, le genre *Parapatoceras* ne comporte que deux espèces tuberculées: *P. distans* à coquille spiralée ouverte, à costulation irrégulière, à section arrondie, et *P. tuberculatum* dont les parties adultes de la coquille sont subcyrtoconiques à rhabdoconiques, les côtes obliques et la section elliptique ("hochoval"). Chez tous les exemplaires de *Parapatoceras* bituberculés de Vad la partie terminale de l'habitacle est cyrtoconique et l'habitacle rhabdoconique, tandis que les côtes sont plus ou moins obliques. En jugeant d'après ces caractères, tous les exemplaires en question appartiennent à *P. tuberculatum*, toutefois en fonction de la section de la coquille on peut les repartir dans deux groupes: à section elliptique et à section arrondie. On pourrait bein se demander si les exemplaires du deuxième groupe ne représentaient pas des stades de croissance de *Parapatoceras distans*, mais puisque jusqu'à présent le gise-

ment de Vad n'a fourni aucun exemplaire clairement spiralé rapportable à *P. distans*, je préfère les décrire comme variant de *P. tuberculatum*.

Parapatoceras aff. *tuberculatum* (BAUGIER et SAUZÉ)
Pl. I, fig. 2; pl. II, figs. 3 a–c

Matériel: 9 exemplaires fragmentaires, no. P-17182, Coll. IGG.

Description. Le plus grand des exemplaires atteint 9 mm de haut et le nombre de ses côtes est de 4 par 1 cm de long; le plus complet, légèrement recourbé et partiellement cloisonné, est 48 mm de long, 5,5 mm de haut à l'extrémité aperturale, respectivement 55 mm à l'extrémité adaperturale et porte 6 côtes par 1 cm de longueur. Un fragment de 6 mm de haut présent des côtes plus fines et plus denses que les autres. Chez tous les exemplaire la section arrondie et les côtes sont fortement proverses. L'espace compris entre les deux rangées de tubercules ventraux est relativement large et plat. Sur la partie dorsale les côtes passent sans interruption, parfois un peu attenuées ou légèrement arquées, à concavité orientée en avant.

Ces exemplaires se distinguent de ceux attribués à *Parapatoceras tuberculatum* (BAUGIER et SAUZÉ) par la section de la spire arrondie et non pas elliptique (à taille égale) de même que par le replat siphonal plus large. Des exemplaires décrits par Quenstedt (1886/1887, p. 581–583, pl. 70, figs. 20–25) sous le non de *Hamites macrocephali* et que Dietl (1978) attribue à *Parapatoceras distans* (BAUGIER et SAUZÉ) ils se distinguent par les côtes plus fortement proverses et moins saillantes.

Parapatoceras tenue (BAUGIER et SAUZÉ)
Pl. I, figs. 3, 18; pl. II, figs. 4 a-c

Référence type: Toxoceras ? tenuis BAUGIER et SAUZÉ, 1843, pl. 11, pl. 4, figs. 3–5 (synthétotype), sub *Ancyloceras tenuis* in Orbigny, 1848/1849, p. 589, figs. 1–4.

Matériel: 1 exemplaire fragmentaire représentant la partie terminale du phragmocône et l'habitacle no. P-17183, Coll. IGG.

Description. Le seul exemplaire représentant cette espèce dans le gisement de Vad est 48,5 mm de long, 7 mm de haut à l'extrémité aperturale, respectivement 5mm près de l'extrémité adaperturale. Il est bien plus fortement recourbé que l'exemplaire de *Parapatoceras* tenue du Bathonien de Niort, figuré par d'Orbigny. Toutefois il présente le même type d'ornementation et la même forme de la section: elliptique-subrectangulaire (H/E = 1,10 à 1,15). Ses côtes, en nombre de 8 par 1 cm de longueur pour 6 mm de hauteur sont peu saillantes, très obliques, interrompues au côté ventral par une bande siphonale lisse ou bien dessinant, à la proximité de l'aperture, des chevrons attenués sur la ligne médiane. L'extrémité ventrale des côtes est légèrement épaissie mais non pas tuberculée. Sur la partie terminale de l'habitacle des groupes de 2 ou 3 côtes sont séparés par des espaces intercostaux plus larges ou plus profonds que les autres. Un fragment de test conservé près de l'aperture montre que certains espaces intercostaux du moule interne correspondent en fait à des côtes du test, ces dernières étant plus minces que les épaississements internes de la coquille. La partie dorsale présente un replat médian, légèrement excavé, que les côtes non attenuées traversent en ligne droite. La ligne suturale partiellement visible est peu découpée, comparable à celle de *Parapatoceras distans* (BAUGIER et SAUZÉ), avec un lobe L rudimentaire bien plus court que le lobe U_2.

Parapatoceras vadense n.sp.
Pl. I, figs. 7, 8; pl. III, fig. 1, a-c, 2 a-c

Holotypus: l'exemplaire de la pl. I, fig. 7, pl. III, fig. 1; no. P-17184, Coll. IGG.

Derivatio nominis: d'après la localité type.

Stratum typicum: calcaire sableux, oolithique et ferrugineux du Bathonien-Callovien inférieur.

Locus typicus: versant gauche des gorges du Crişul Repede à Vadu Crişului, Pădurea Craiului-Monts Apuseni.

Matériel: sauf l'holotype, 2 fragments d'habitacle (P-17185).

Dimensions: l'holotype est 32 mm de long, 77 mm de haut à l'extrémité aperturale, respectivement 6 mm à l'extrémité adaperturale: H/E - 1 à 1,07; il porte 6 côtes par 1 cm de longueur. Le plus grand des exemplaire atteint 10,5 mm de haut et porte 4–5 côtes par 1 cm de longueur.

Diagnose. Portion terminale de la coquillle faiblement recourbée, à section elliptique-subarrondie entre les côtes, arrondie au droit des côtes. Côtes proverses, fortement saillantes et tranchantes sur les flancs, droites ou légèrement sinueuses, sans tubercules, interrompues au côté ventral par une bande siphonale relativement étroite ou bien y décrivant des chevrons anguleux plus ou moins attenués sur la ligne médiane, traversant la partie dorsale en ligne droite ou bien dessinant à la partie terminale de l'habitacle une légère boucle à convexité orientée en avant. Se distingue de *Parapatoceras tenue* (BAUGIER et SAUZÉ) par ses côtes plus saillantes et moins nombreuses, la section subarrondie à arrondie de la spire et une légère inflexion adorale des côtes sur la partie dorsale de l'habitacle.

Remarques. Chez l'holotype la distribution des côtes est inégale: quelques espaces intercostaux, plus larges

que les autres, y séparent des groupes de 4 côtes. Chez les fragments de grande taille on remarque en autre de rarea côtes, plus minces que le reste et plus rapprochées de la côtes qui les précède. La présence de chevrons anguleux ne constitue pas un caractère constant de la partie terminale de l'habitacle; chez l'un des exemplaires de grande taille, les côtes fortement proverses se rebroussent légèrement en arrière à la proximité de la bande siphonale.

Genre **Paracuariceras** SCHINDEWOLF, 1963
Paracuariceras incisum SCHINDEWOLF
Pl. I, fig. 20; pl. IV, figs. 1 a-c, 2

Référence type: Paracuariceras incisum SCHINDEWOLF, 1963, p. 127, pl. 6, fig. 8 (holotype), pl. 7, figs. 8–9, texte-fig. 3.

Matériel: 10 exemplaires fragmentaires rhabdoconiques représentant la partie terminale du phragmocône et l'habitacle ou seulement des fragments de phragmocône (P-17186).

Description. L'exemplaire le plus complet, dont le test est partiellement conservé,, est 28 mm de long et 4 mm de haut à l'extrémité aperturale, qui est légèrement comprimée, respectivement 3,5 mm à l'extrémité adaperturale. La section du phrogmocône est sistématiquement arrondie. L'ornementation varie selon qu'il s'agit du test ou du moule interne. Ce dernier est lisse ou à vagues bourrelets obliques sur les flancs. Le test est orné sur les flancs de costules faiblement saillantes et fortement proverses de même que de stries longitudinales. Sur les flancs de l'habitacle il y a des costules filiformes obliques qui deviennent plus saillantes sur la partie dorsale qu'elles traversent sans inflexion. La ligne suturale comporte deux lobes sur les flancs: L et U_2, développés de façon égale mais moins profonds que les lobes E et I; le lobe E est bifide et plus large que les autres. Les selles sont peu découpées, les deux externes étant bipartites à quadripartites au dernier stade de développement du phragmocône.

Paracuariceras elmii n.sp.
Pl. I, figs. 6, 21; pl. III, figs. 3 a-c

Holotypus: l'exemplaire figuré, no. P-17187, Coll. IGG.

Derivatio nominis: dédié à Serge Elmi, éminent spécialiste français dans l'étude des Ammonites jurassiques.

Stratum typicum: calcaire sableux, oolithique et ferrugineux du Bathonien-Callovien inférieur.

Locus typicus: versant gauche des gorges du Crişul Repede à Vadu Crişului, Pădurea Craiului-Monts Apuseni.

Matériel: 1 exemplaire (l'holotype) représentant la partie terminale du phragmocône et la partie initiale de l'habitacle, à test partiellement conservé.

Dimensions de l'holotype: 38 mm de long, 6 mm de haut à l'extrémité aperturale, 5 mm de haut à l'extrémité adaperturale.

Diagnose. Partie terminale de la coquille légèrement recourbée, à section elliptique, ornée sur l'habitacle de bourrelets peu proéminents proverses qui traversent sans interruption la partie ventrale mais s'attenuent jusqu'à la disparition du côté dorsal; test orné de costules filiformes longitudinale (au moins sur la partie dorsale); ligne suturale à selles relativement longues, à lobe U_2 bien plus profond que le lobe L.

Remarques. Paracuariceras elmii n. sp. se distingue de *P. incisum* SCH. par la taille bien plus forte, la courbure de l'habitacle, l'ornementation plus saillante.

Sous-genre **Lytospiroceras** n. subgen.
Sous-générotype *Lytospiroceras perconstrictum* n.sp.

Diagnose. Le même que pour l'espèce type.

Paracuariceras (Lytospiroceras) perconstrictum n. sp.
Pl. I, figs. 4, 5, 19; pl. III, figs. 4, 5

Holotypus: pl. III, fig. 4; no. P-17188, Coll. IGG.
Paratypus: pl. III, fig. 5; no. P-17189, Coll. IGG.
Derivatio nominis: d'après les constrictions multiples.

Stratum typicum: calcaire sableux, oolithique et ferrugineux du Bathonien-Callovien inférieur.

Locus typicus: versant gauche des gorges du Crişul Repede à Vadu Crişului, Pădurea Craiului-Monts Apuseni.

Matériel: sauf l'holotype, 3 exemplaires fragmentaires; l'holotype représente le moule interne de l'habitacle (en calcaire noir dans une gangue de calcaire jaunâtre), détaché du phragmocône au niveau de la dernière cloison; le paratype, de taille bien plus réduite (un peu plus de la moitié) et plus fortement recourbé, représente la partie terminale du phragmocône et la partie initiale de l'habitacle.

Dimensions: l'holotype est 34,5 mm de long, 8,3 mm de haut à l'extrémité aperturale, 6,5 mm à l'extrémité adaperturale au niveau de la dernière cloison.

Diagnose. Partie terminale de la coquillle recourbée, à section elliptique, à constrictions proverses bordées de 1 ou 2 bourrelets, traversant en ligne droite la partie ventrale. Test lisse. Ligne suturale peu divisée: E bifide, L séparant les selles bipartites relativement grêles, U_2 situé au milieu du flanc, aussi développé que L, U_1 rudimentaire, sous forme de lobule accessoire.

Remarques. Cette forme est très différente de toutes les autres Ammonites déroulées signalées jusqu'à

présent dans le Jurassique moyen. Les constrictions de l'habitacle rappellent les Nannolytocératidés. La ligne suturale de *P. (L.) perconstrictum* est toutefois bien moins évoluée que celle des Nannolytocératidés.

Outre les caractères constants signalés dans la diagnose, sont encore à noter quelques traits morphologiques variables. Chez l'holotype, les deux premières constrictions sur la partie initiale de l'habitacle ont des versants symmétriques et sont bordées, chacune, par deux bourrelets dont le postérieur, un peu plus développé que l'antérieur, est précédé par une gouttière superficielle limitée aux flancs. Chez les constrictions suivantes seul le bourrelet postérieur est présent sur les flancs et la gouttière qui le précède est presque aussi profonde que la constriction. Chez les plus grands exemplaires examinés les segments de l'habitacle séparés par les constriction ont un profil légèrement concave vers le côté ventral où une gouttière superficielle se dessine parfois, décrivant une boucle à convexité orientée en avant. Vers le côté dorsale le profil est, par contre, convexe et chez l'holotype l'on y remarque aussi un faible bourrelet plus rapproché de la constriction qui le précède.

Sous famille **Parkinsoniinae** BUCKMAN

Genre **Epistrenoceras** BENTZ, 1928

Epistrenoceras subcontrarium apusenicum n. subsp.

Pl. I, figs. 9 a-b, 10; pl. IV, figs. 3 a-c, 4 a-b, 5 a-b, 6 a-b

Holotypus: pl. I, fig. 9; pl. IV, fig. 3, no. P-17193, Coll. IGG.

Derivatio nominis: de la position géographique sur le territoire des Monts Apuseni.

Stratum typicum: calcaire sableux, oolithique et ferrugineux du Bathonien-Callovien inférieur.

Locus typicus: versant gauche des gorges du Crişul Repede à Vadu Crişului, Pădurea Craiului-Monts Apuseni.

Matériel: sauf l'holotype, 6 exemplaires (P-17194)

Dimensions de l'holotype: D=22,5 mm, H=7; E=8; O=9,5. h=3,2; e=2,3; 31 côtes internes, 53 côtes externes.

Diagnose. Spire de taille moyenne (D=18,5–23,5) à involution modérée, à croissance plus ou moins rapide en hauteur (h=2,5–3,1), à flancs modérément convexes, ornée d'une trentaine de côtes primaires rétroflexes sur le tiers externe du phragmocône et du segment proximal de l'habitacle, geniculées sur le milieu des flancs dans le segment distale de l'habitacle où les côtes traversent ininterrompues la partie ventrale de la coquille en décrivant des chevrons arrondis. Ligne suturale peu divisée, à lobe E aussi profond que le lobe L.

Du type d'*Epistrenoceras subcontrarium* (Behrendsen, 1886, pl. 2, figs 1 a-d) se distingue par le nombre plus élevé des côtes et la division plus fréquente des côtes primaires, qui, sur le phragmocône au moins, a lieu dans le tiers externe des flancs.

Remarques. Entre les exemplaires d*Epistrenoceras* fournis par le gisement de Vad et le type d'*Ammonites subcontrarius* BEHRENDSEN provenant de Lechstedt les différences d'ornementation sont si considérables qu'on serait tenté, à première vue, d'en faire une espèce distincte. Toutefois il faut tenir compte du fait, signalé par Douvillé (1915) et par Sturani (1966), qu'*Epistrenoceras subcontrarium* est une espèce très variable. Les variants de Saint Marc et de Chaudon, que ces auteurs ont figuré, sont eux-aussi bien différents par rapport au type de Lechstedt, mais en général possèdent moins de côtes que les exemplaires de Vad.

Un caractère inconstant, tant chez les exemplaires de France que chez ceux de la sous-espèce des Monts Apuseni, est une forte atténuation des côtes à l'extérieur du tubercule latéral et dans ce cas les côtes externes semblent complètement détachées par rapport aux côtes internes, surtout où il y a de bifurcation.

Genre **Hemigarantia** SPATH, 1920

Hemigarantia julii (D'ORBIGNY)

Pl. I, figs. 11–14; Pl. IV, figs. 7 a–b; pl. V, figs. 1 a-b, 2 a–c, 3 a–b

Référence type: Ammonites julii D'ORBIGNY 1842–1849, p. 420, pl. 145, figs. 6, 7; du Bathonien de Niort.

Matériel: 10 exemplaires (P-17190).

Description. Le diamètre des exemplaires provenant de Vad varie de 11 à 28 mm. Le plus grand de ces exemplaires présente une contraction notable de la partie terminale de l'habitacle. Par contre, les exemplaires de taille moyenne ne sont pas bullatiformes. L'un d'eux, à péristome entièrement conservé, présente des oreillettes à position médiolatérale, luinguiformes, courtes, convexes, légèrement divergentes. Le nombre des côtes internes varie de 20 à 40. Chez les exemplaires à ornementation plus dense il y a de nombreuses côtes simples, alternant avec celles qui bifurquent à partir du tubercule latéral. Les côtes traversent sans interruption la partie ventrale des tours.

Remarques. Chez les exemplaires de Vad les tours sont habituellement plus déprimés que chez le type figuré par d'Orbigny, mais la population de Vad montre que la forme de la section des tours est assez variable chez cette espèce.

La position systématique d'*Hemigarantia* reste incertaine. Un rapprochement de *Garantiana*, à titre de

microconque, ne se justifie pas. Il faut préciser que le gisement de Vad n'a fourni aucun Parkinsoniidé comparable à *Garantiana* ou à *Parkinsonia* et les formes alliées.

Hemigarantia granulifera n. sp.
Pl. I, figs. 15, 16; Pl. V, figs. 4 a–c, 5 a–b, 6 a–c

Holotypus: pl. V, fig. 4; no. P-17191, Coll. IGG.
Derivatio nominis: d'après les rangées de très petits tubercules qui ornent les côtes sur la partie ventrale des tours.
Stratum typicum: calcaire sableux, oolithique et ferrugineux du Bathonien-Callovien inférieur (banc polyzonal).
Locus typicus: versant gauche des gorges du Crişul Repede à Vadu Crişului, Pădurea Craiului-Monts Apuseni.
Matériel: sauf l'hòlotype, 18 exemplaires (P-17192).
Dimensions de l'holotype: D=20; H=6,5; E=8; h=3,0; e=2,5; o=2,6; 45 côtes internes.
Diagnose. Coquille nettement bullatiforme, tant contractée que retractée dans la portion terminale de l'habitacle, à section coronatiforme déprimée des tours, avec quatre rangées de minuscules tubercules sur la partie ventrale de la spire, avec nombreuses côtes primaires (30–45), fines, proverses et arquées, ornées d'un petit tubercule médiolatéral, simples ou bifurquées parfois aussi trifurquées, à côtes externes fines, serrées (il y a environ 86 sur le dernier tour de l'holotype). Péristome précédé par une constriction large et peu profonde, pourvu d'oreillettes linguiformes courtes , convexes. Ligne suturale peu divisée.
Se distingue d'*Hemigarantia julii* (D'ORBIGNY) par sa forme nettement bullatiforme, la section des tours plus déprimée, la costulation externe plus dense.

Famille **Morphoceratidae** HYATT, 1900
Genre **Berbericeras** ROMAN, 1933
Berbericeras sekikense ROMAN
Pl. V, figs. 7 a–c

Référence type: Berbericeras sekikense ROMAN, 1933, p. 67–69, texte-fig. 3, pl. 2, figs. 15 a–b (holotype); du Bathonien de Djebeles-Sekika (Algérie).
Matériel: 2 exemplaires (P-17195).
Description. Le plus grand des exemplaires récoltés à Vad (D=17 mm) est une copie fidèle de l'holotype figuré par Roman. Il a exactement les mêmes proportions (h=2,8; e=2,0; o=2,6) et porte une cinquantaine de côtes proverses sur la moitié interne des flancs, mais qui se redressent ensuite. Les côtes sont simples ou bifurquées, plus rarement trifurquées (chez l'exemplaire de taille plus petite). Sur la partie ventrale de l'habitacle un sillon médian filiforme attenue les côtes sans en interrompre la continuité.

Remarques. Je considère utile de figurer les exemplaires de Vad pour enlever tout doute en ce qui concerne leur appartenence à l'espèce de Roman. A mon avis il ne peut être question dans ce cas d'une convergence. On peut se demander en échange si *Berbericeras sekikense* n'était pas une espèce plus persistante qu'on le croyait jusqu'à présent.

? Classe **Scaphopoda**
Cyrtoconella n. gen.
Générotype: *Cyrtoconella tenuistriata* n. sp.

Diagnose: la même que pour l'espèce type.

Cyrtoconella tenuistriata n. sp.
Pl. V, figs. 8, 9

Holotypus: pl. V, fig. 9; no. P-17196, Coll. IGG.
Paratypus: pl. V, fig. 8; no. P-17197, Coll. IGG.
Derivatio nominis: d'après l'ornementation faite de stries de croissance très fines.
Stratum typicum: calcaire sableux, oolithique et ferrugineux du Bathonien-Callovien inférieur.
Locus typicus: versant gauche des gorges du Crişul Repede à Vadu Crişului, Pădurea Craiului-Monts Apuseni.
Matériel: sauf l'holotype, 19 exemplaires plus ou moins fragmentaires (P-17197).
Dimensions: l'holotype est 28 mm de long et 2,5 en diamètre à l'extrémité aperturale, 1,5 mm à l'extrémité adaperturale; les dimensions du paratype, qui est plus fortement recourbé que l'holotype, sont respectivement 17–2,5–1,2 mm.
Diagnose. Coquille grêle cyrtoconique dans la partie adaperturale, rhabdoconique au reste, à test relativement épais, luisant, souvent noirâtre, orné de stries très fines, regulières, légèrement retroverses (orientées obliquement derrière le côté convexe), en nombre d'environ 100 par 1 cm de longueur.
Remarques. De même que dans le cas de l'association *Acuariceras acuarium* (QUENSTEDT) – *Acuarites ornatus* (QUENSTEDT), une confusion est possible entre les fragments rhabdoconiques de *Cyrtoconella tenuistriata* n. sp. et l'habitacle de *Paracuariceras incisum* SCHINDEWOLF avec lequel cette espèce se trouve associée. C'est l'ornementation qui permet de faire la distinction: à éléments retroverses chez *Cyrtoconella*, proverses chez *Paracuariceras*.

Conclusions

Le gisement polyzonal de Vadu Crişului est caractérisé entre autres par la présence d'Ammonites déroulées (sous-famille des Parapatoceratinés), qui

n'ont jamais été signalées jusqu'à présent dans d'autre gisements du Jurassique moyen des Carpathes. L'inventaire de ces formes comporte, outre des espéces connues du Bathonien supérieur: *Parapatoceras tenue* (B. et S.), du Bathonien supérieur et du Callovien inférieur et moyen: *P. tuberculatum* (B. et S.), ou seulement du Callovien inférieur et moyen: *Paracuariceras incisum* SCHINDEWOLF, trois espèces nouvelles, notamment: *Parapatoceras vadense* n. sp., *Paracuariceras elmii* n. sp. et *P. (lytospiroceras) perconstrictum*, représentant un nouveau sous-genre, dont le niveau d'apparition est probablement le Bathonien supérieur. La présence de Parapatoceratinés dans le gisement de Vad relève non seulement un certain intervalle stratigraphique, mais, certainement aussi, des conditions écologiques spéciales, car les marnes à Posidonies et Céphalopodes du même âge, largement répandues dans certains secteurs des Carpathes roumaines, ne contiennent pas d'Ammonites déroulées.

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Planche I

Section du tour de:

Fig. 1 — *Parapatoceras tuberculatum* (BAUGIER et SAUZÉ).

Fig. 2 — *Parapatoceras* aff. *tuberculatum* (BAUGIER et SAUZÉ).

Fig. 3 — *Parapatoceras tenue* (BAUGIER et SAUZÉ).

Figs. 4, 5 — *Paracuariceras (Lytospiroceras) perconstrictum* n. subg., n. sp. PATRULIUS.

Fig. 6 — *Paracuariceras elmii* n. sp. PATRULIUS.

Figs. 7, 8 — *Parapatoceras vadense* n. sp. PATRULIUS.

Figs. 9 a-b, 10 — *Epistenoceras subcontrarium apusenicum* n. subsp. PATRULIUS.

Figs. 11–14 — *Hemigarantia julii* (D'ORBIGNY).

Figs. 15, 16 — *Hemigarantia granulifera* n. sp. PATRULIUS.

Ligne suturale de:

Fig. 17 — *Parapatoceras tuberculatum* (BAUGIER et SAUZÉ.

Fig. 18 — *Parapatoceras tenue* (D'ORBIGNY).

Fig. 19 — *Paracuariceras (Lytospiroceras) perconstrictum* n. subg., n. sp. PATRULIUS.

Fig. 20 — *Paracuariceras incisum* SCHINDEWOLF.

Fig. 21 — *Paracuariceras elmii* n. sp. PATRULIUS.

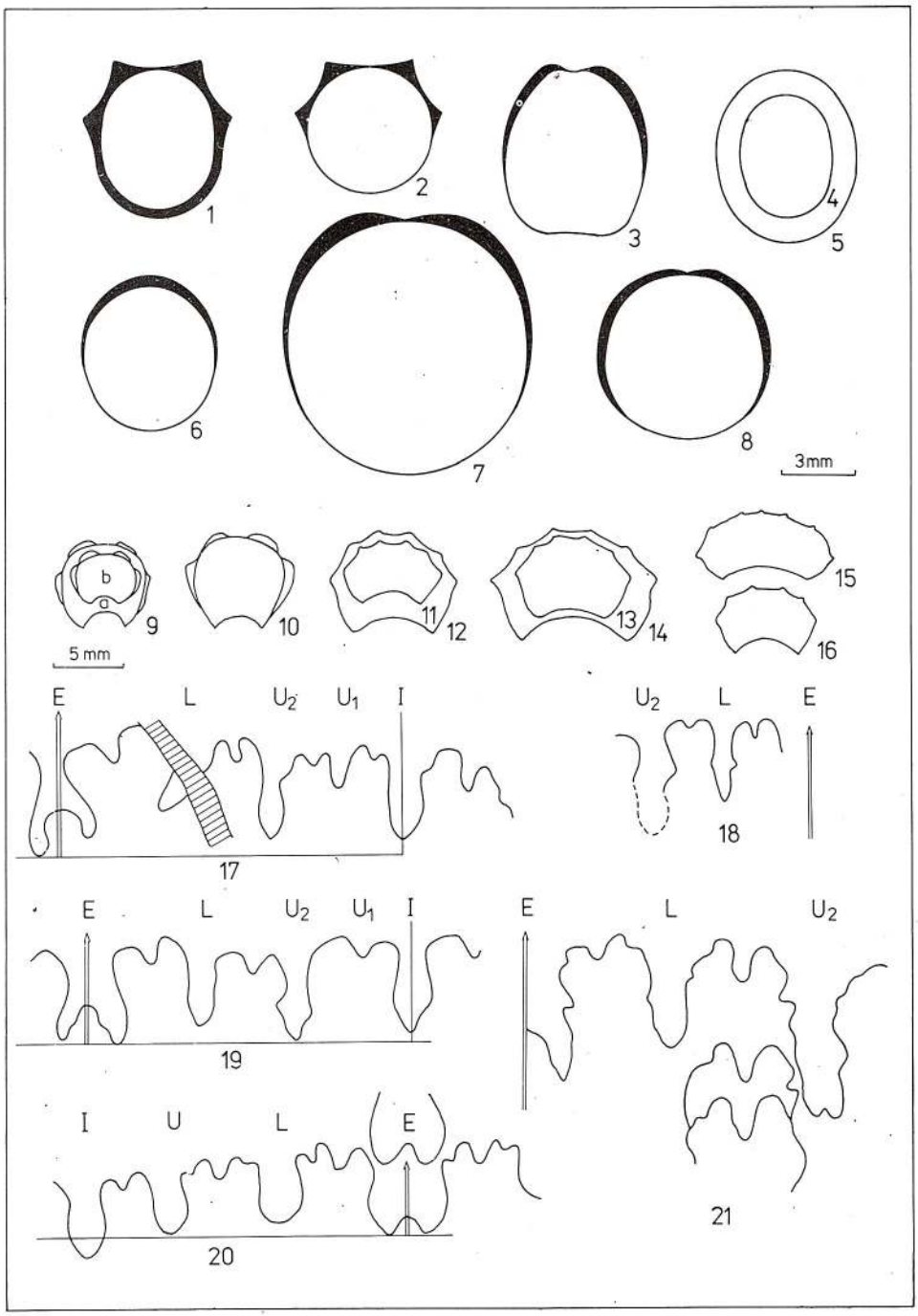


Planche II

Figs. 1 a–c, 2 a–b — *Parapatoceras tuberculatum* (BAUGIER et SAUZÉ).

Fig. 3 a–c — *Parapatoceras* aff. *tuberculatum* (BAUGIER et SAUZÉ).

Fig. 4 a–c — *Parapatoceras tenue* (BAUGIER et SAUZÉ).

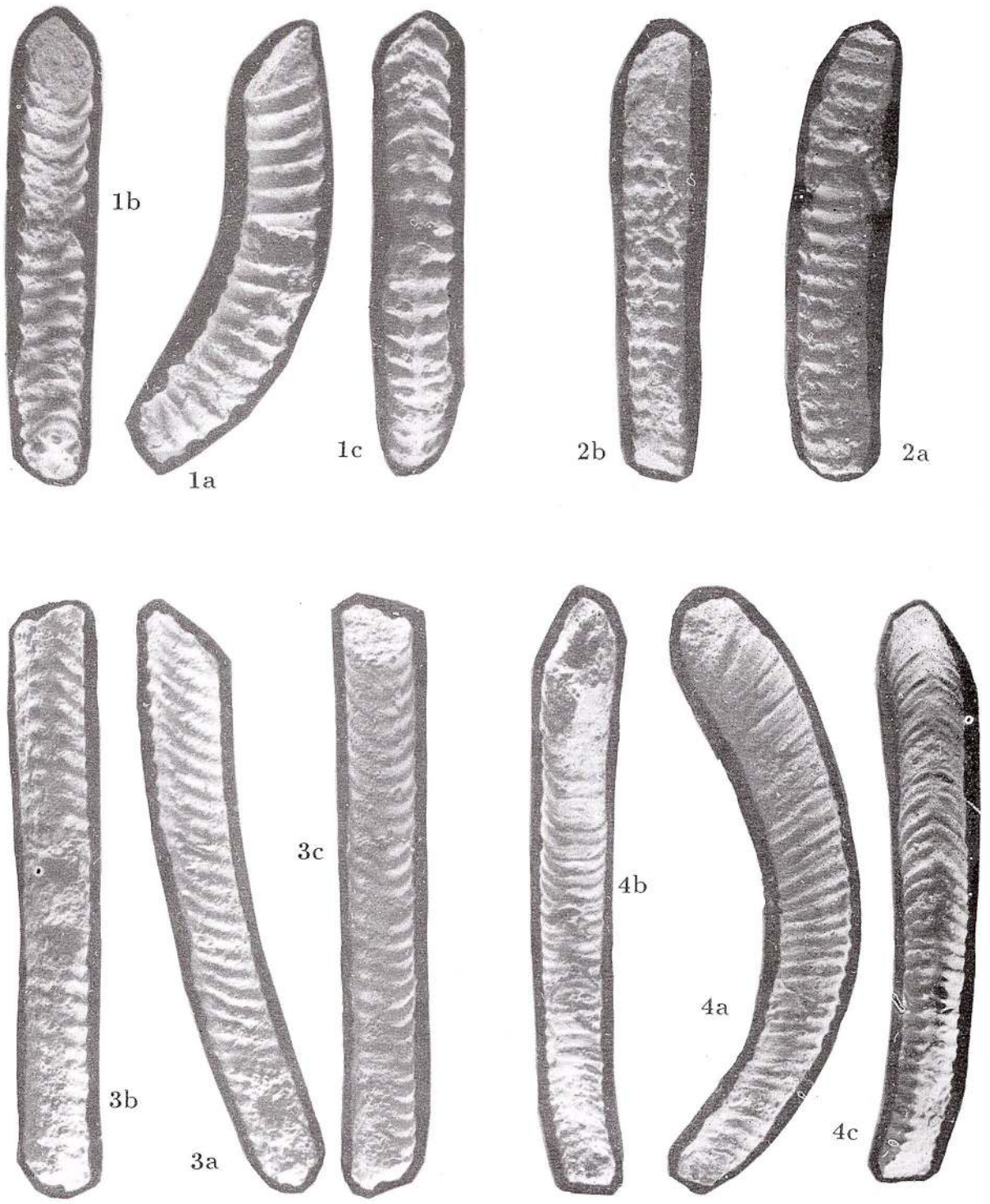


Planche III

Figs. 1 a–c, 2 a–c — *Parapatoceras vadense* n. sp. PATRULIUS. 1, holotype.

Fig. 3 a–c — *Paracuariceras elmii* n. sp.

Figs. 4 a–c, 5 — *Paracuariceras (Lytospiroceras) perconstrictum* n. subg., n. sp. PATRULIUS. 4, holotype.

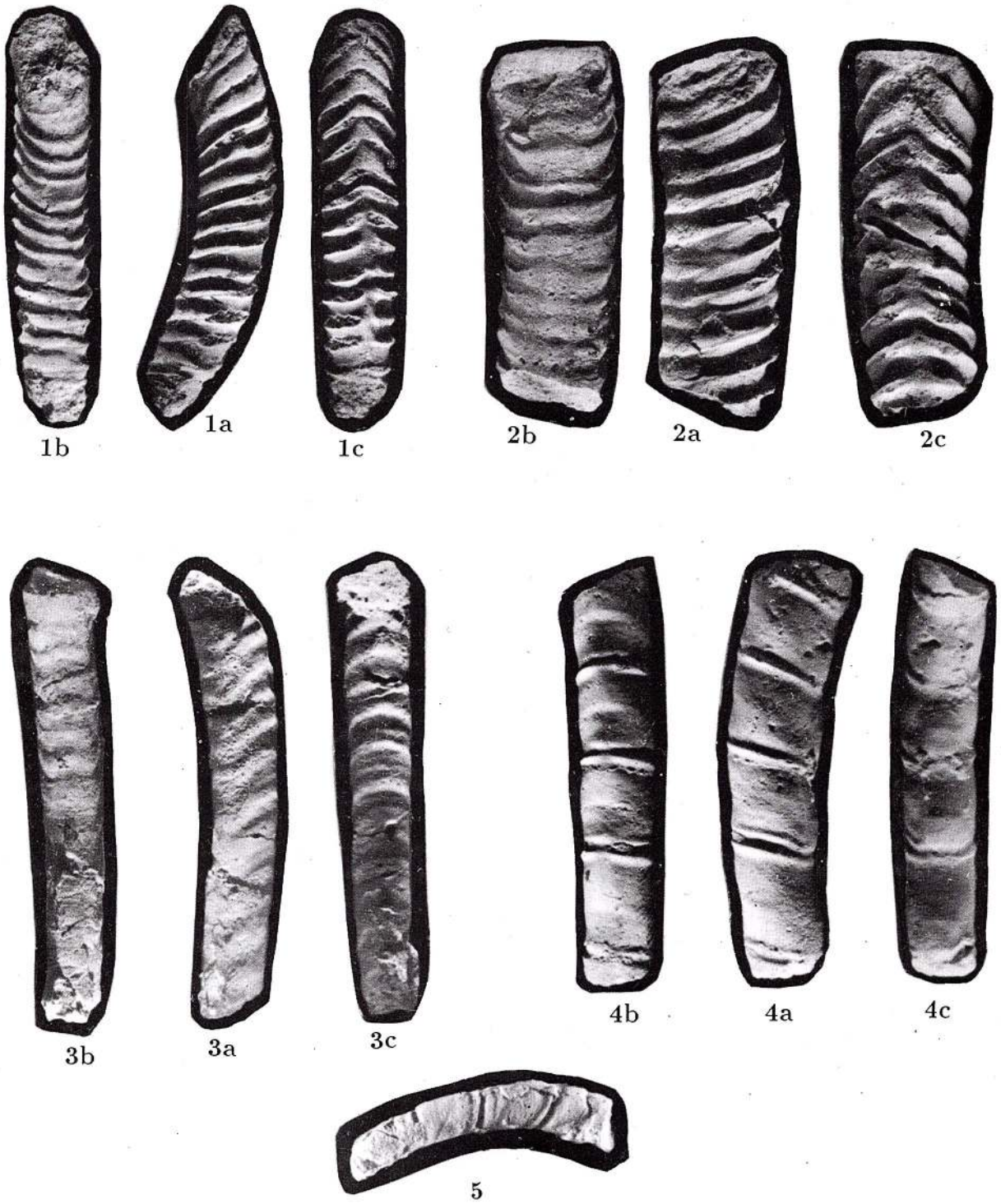


Planche IV

Figs. 1 a–c, 2 — *Paracuariceras incisum* SCHINDEWOLF.

Figs. 3 a–c, 4 a–b, 5 a–b, 6 a–b — *Epistrenoceras subcontrarium apusenicum* n. subsp. PATRULIUS. 3, holotype.

Fig. 7 a–b — *Hemigarantia julii* (D'ORBIGNY).

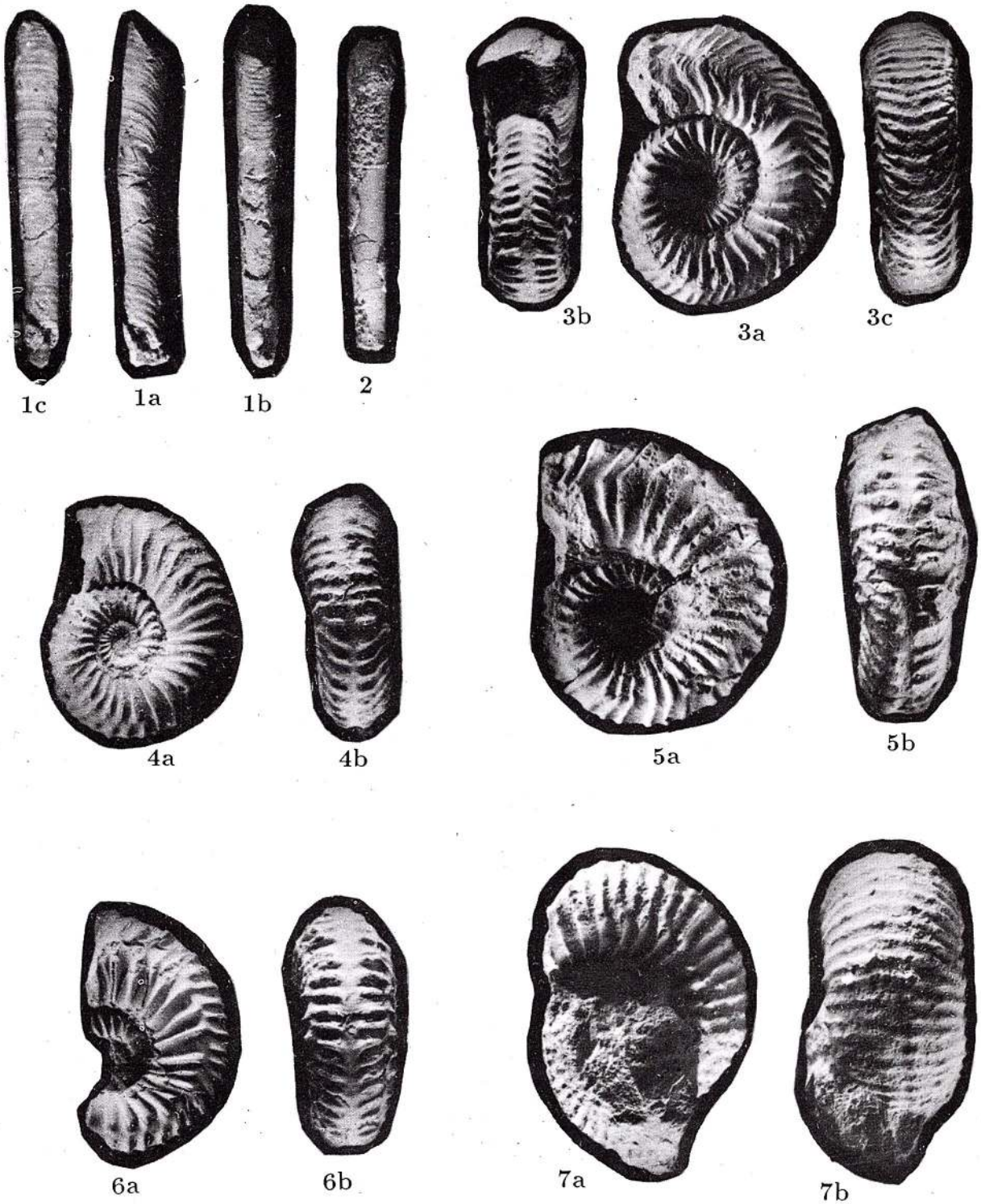


Planche V

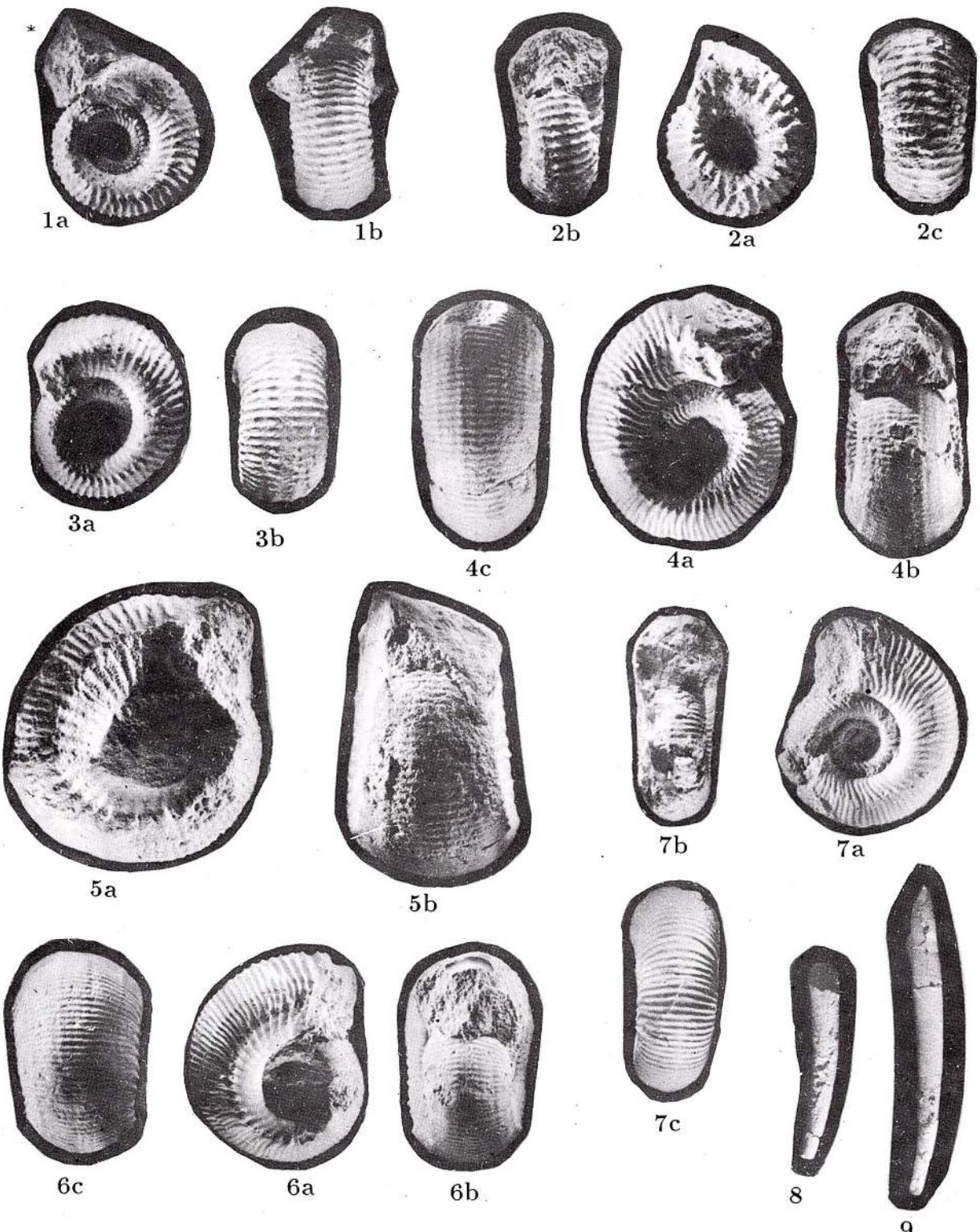
Figs. 1 a–b, 2 a–c, 3 a–b — *Hemigarantia julii* D'ORBIGNY.

Figs. 4 a–c, 5 a–b, 6 a–c — *Hemigarantia granulifera* n. sp. PATRULIUS. 4, holotype.

Fig. 7 a–c — *Herbericeras sekikense* ROMAN.

Figs. 8, 9 — *Cyrtoconella tenuistriata* n. gen., n. sp. PATRULIUS. 9, holotype.

Tous les exemplaires grossi 2 foix; tous proviennent de la collection de l'auteur.



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THE TRIASSIC AND LOWER JURASSIC FORMATIONS OF THE TRANSYLVANIAN NAPPE SYSTEM (EAST CARPATHIANS–ROMANIA)

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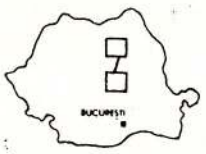

Key words: Stratigraphy. Triassic. Lower Jurassic. Bivalves. Cephalopods. Brachiopods. Conodonts. Forams. Algae. Transylvanian Nappes. Romania.

Zusammenfassung: *Einheiten des transylvanischen Deckensystems aus den rumänischen Ostkarpaten.* Aus den rumänischen Ostkarpaten konnten vier Einheiten des transylvanischen Deckensystems nachgewiesen werden die aus triassischen und unterjurassischen Formationen bestehen: 1. Die Gruppe der unteren Klippen des Rarău Gebirges, mit der Zimbru Schichtenfolge deren charakteristische Gesteine ladinische Radiolarite, obernorische Mergel mit *Monotis* und dunkle Kalke des Rhät und des Unterjura sind; 2. Die Olt Decke mit der Olt Schichtenfolge die mitteltriassische bazische und alkaline Vulkanite oder ladinische, karnische und norische Hallstätterkalke, sowie den Adneter-Kalk umfasst; 3. Die Perşani Decke mit der Lupşa Schichtenfolge deren charakteristische Schreyeralmer- und Steinalmerkalke von detritischen Kalken und Mergeln des Unterjura überlagert sind; 4. Die Hăghimaş Decke (obere Klippen des Rarău Gebirges) mit der Hăghimaş Schichtenfolge die der triassisch-unterjurassischen Schichtenfolge der Bukowinischen Decken ähnlich ist.

Introduction

The Transylvanian Nappe, as first defined by Uhlig (1907), is a collection of klippen scattered over the vast area of the Rarău and Hăghimaş synclines, each klippe being composed of only one or two, seldom three formations. Uhlig especially emphasized for its definition the difference in facies between the massive Upper Jurassic limestones of the Transylvanian Nappe and the corresponding *Aptychus* Beds of the Bucovinian Nappe. The historical career of the concept "Transylvanian Nappe" has been a rather agitated one, with changes in our knowledge since 1950 (Table). Uhlig's views on the nappe structure of the inner East Carpathian zones have been strongly opposed by Macovei (1927). In the Rarău area Kräutner (1930) recognized the trail of some sort of a "ghost" nappe, strewn by boulders of exotic rocks (p. 56), but in the Hăghimaş syncline no nappe has been identified either by Atanasiu (1927) or by Băncilă (1941). Much later the concept of a Transylvanian Nappe has been revived by Ilie (1953, 1954), but it regarded a structural unit he discovered far away from the area investigated by Uhlig, namely at the southern end of the East Carpathians. He called it the Perşani Nappe, although the rocks he assigned to this unit do not differ from the ones Uhlig considered to be characteristic of the Transylvanian Nappe. On the other hand, Ilie (1957) advanced the opinion that the klippen of the Rarău area are not exotic with respect to the normal sedimentary cover of the underlying crystalline basement, but represent the final products of an extrusive diapiric process which affected the axial zone of the Rarău Syncline. It might be the reason why he ignored the prioritary name "Transylvanian Nappe" instituted by Uhlig and introduced a new name to designate the tectonic unit in the overlier of the Bucovinian Nappe. In fact, except for the Urgonian limestones, the klippen of the Rarău syncline are composed of the same exotic rocks (Popescu, Patrulius, 1964) that build up most of the klippen of the Perşani Mts. It is for this reason that Patrulius et al. (1966) considered the Perşani Nappe to be only a southern extension of Uhlig's Transylvanian Nappe.

The fact that in the Hăghimaş Syncline there are as well huge klippen of allochthonous rocks, as assumed by Uhlig, was partially first demostrated by Ciocârdel & Patrulius (1960). Later on Săndulescu (1967) recognized the inposing Upper Jurassic, Neocomian and Urgonian limestone mass of the Hăghimaş Mts to represent a detachment nappe. He called it the Hăghimaş

Table
Nappes and olistoliths of the inner East Carpathians according to different authors

Uhlig 1907	Transylvanian Nappe, in the Rarău and Hăghimaş Mts only (Lower Triassic-Upper Jurassic)
Ilie 1953–54	Perşani Nappe, in the Perşani Mts only (Lower Triassic–Upper Jurassic)
Patrulius et al. 1966	Transylvanian Nappe, from the Rarău syncline to the Perşani Mts Upper slice (Campilian-Anisian, Lower Jurassic) — Lower slice (Ladinian-Norian, Lower Jurassic)
Patrulius 1967 Patrulius et al. 1971	Transylvanian "Series" 1. Group of upper klippen: Campilian and Anisian, Lower Jurassic 2. Group of lower klippen: Ladinian-Norian, Lower Jurassic (Adnet)
	Rarău "Series" 1. Klippen of Creasta Hăghinişului and Rarău Summit (upper klippen): Seisian-Anisian 2. Klippen of Piatra Zimbrului and Popii Rarăului (lower klippen): Ladinian-Rhaetian
Săndulescu 1974, 1975a,b	Transylvanian Nappe System 1. Perşani Nappe (Perşani Series) including the serpentinites of the Rarău syncline: Werfenian-Lower Jurassic (Adnet) 2. Hăghimaş Nappe, including the Mereşti klippen (Hăghimaş-Rarău Series): Werfenian-Norian (=Rarău "Series", Patrulius 1967), Lower Jurassic (Adnet), Kimmeridgian-Neocomian and unconformable Urgonian limestones.
Patrulius, Popescu, Mirăuţă, Gheorghian, 1989	Perşani Mts 1. Olt Nappe (Olt "Series"): Spathian shales and Anisian limestones, ? Anisian-Ladinian volcanics, Upper Ladinian-Norian Limestones, Lower Jurassic (Adnet) 2. Perşani Nappe (Lupşa "Series"): Spathian-Ladinian, Lower Jurassic (Racila Formation) 3. Olistoliths of Norian cherty limestones and shales, and Rhaetian limestones, presumably derived from the Zimbru "Series" *4. Sheet-olistoliths of Callovian, Upper Jurassic and Neocomian carbonate rocks (Carhaga Formation) 5. Mereşti klippen (olistoliths in Upper Bedoulian-Gargasian conglomerates): Upper Jurassic massive limestones
	Hăghimaş syncline 1. Olistoliths with rocks of the Olt "Series": Spathian shales? basalts, serpentinites, Hallstatt Limestones, Adnet Limestone 2. Hăghimaş Nappe, (Hăghimaş "Series"): Middle Jurassic-Hauterivian, unconformable Upper Barremian limestones *3. Criminiş Klippe: Anisian dolomites, "*Aptychus* Beds"
	Rarău syncline 1. Olistoliths with rocks of the Olt "Series": mafic volcanics, porphyries, jaspers, Ladinian-Norian Hallstatt Limestones, white Carnian-Norian limestones, Adnet Lms. 2. Olistoliths with rocks of the Lupşa "Series": Spathian shales; Anisian and Ladinian limestones (Botuş Klippen) 3. Olistoliths with rocks of the Zimbru "Series": Lower Ladinian-Rhaetian, ? grey Lower Jurassic limestones (lower olistoliths of the Mts Rarău, Popii Rarăului) 4. Hăghiniş Nappe and derived olistoliths; Hăghiniş "Series": Spathian and/or Lower Anisian sandstones and red shales, Anisian and Ladinian dolomites and limestones, Lower Jurassic red limestone, in addition Upper Barremian?-Lower Bedoulian limestones, marls, shales 5. Breaza Nappe: serpentinites.

* Questionable "Transylvanian" origin

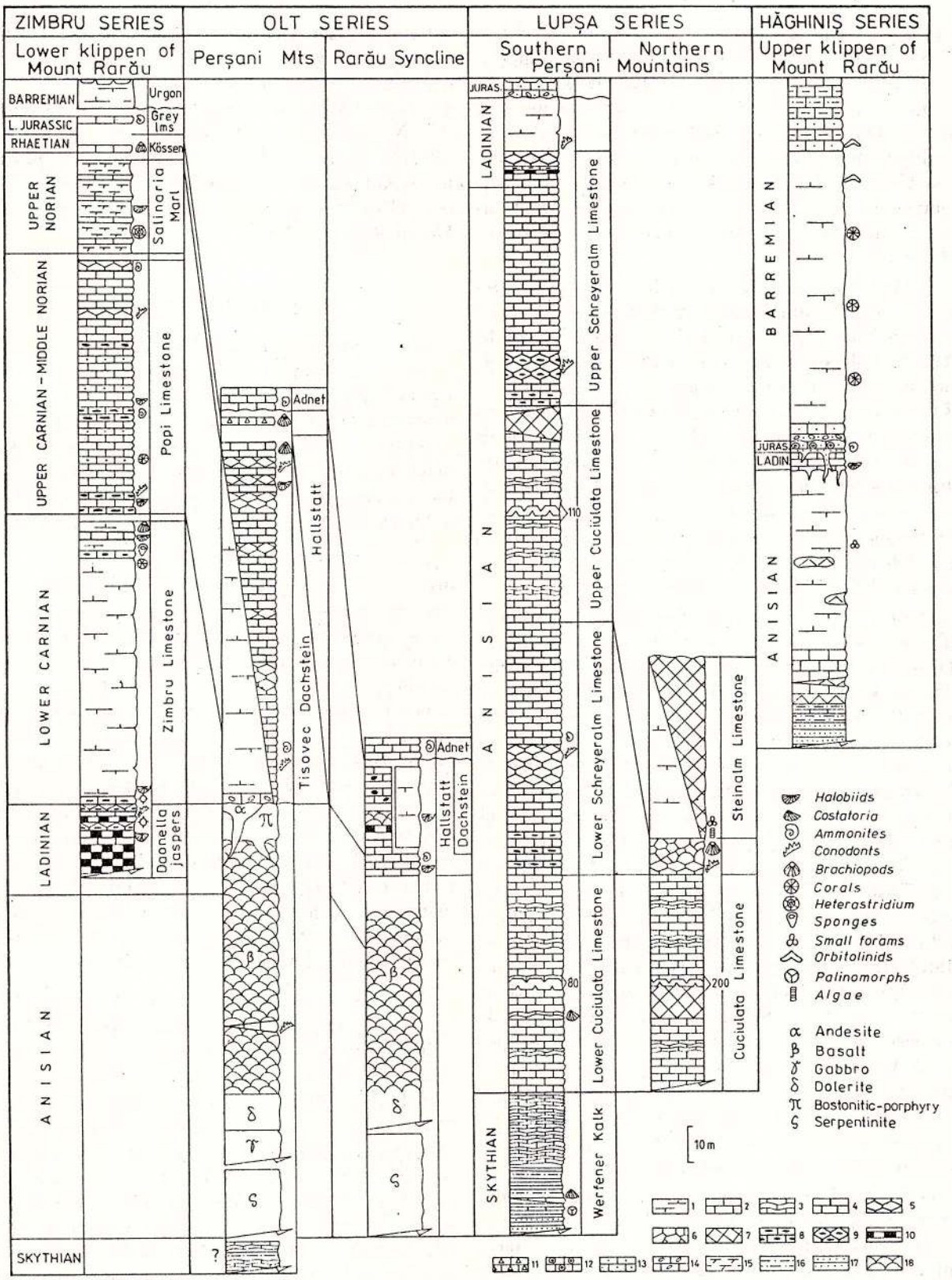

Fig. – Triassic and Lower Jurassic formations of the Transylvanian Nappes and Klippen.
1, reefoid limestone; 2, bedded limestone; 3, thin bedded dark limestone; 4, red Platten and Bankkalk; 5, red Knolenkalk; 6, limestone breccia; 7, dolomite; 8, 8, red cherty limestone; 9, red cherty Knolenkalk; 10, red jasper; 11, crinoidal limestone; 12, oolitic and pisolitic limestone; 13, sandy limestone; 14, conglomeratic limestone; 15, marl; 16, silty shale; 17, sandstone; 18, pillow lava.

Nappe, developing Uhlig's original views. According to Săndulescu (1975 a, b), the Hăghimaş Nappe is also represented in the Perşani Mts, namely by the group of the Mereşti klippen which are composed by thick-bedded to massive light coloured Upper Jurassic limestones. This structural correlation is questionable since the Mereşti klippen do not include Urgonian limestones and their emplacement occurred earlier, during the Aptian and not in the course of the Albian.

Neither Uhlig nor Ilie did include in the rock sequence of the Transylvanian, respectively the Perşani Nappe, Triassic igneous rocks. Ilie assumed that the mafic and ultramafic rocks of the Perşani Mts are Cretaceous in age. That most, if not all, of the pillow-lavas of the Perşani Mts are in fact Triassic in age has been demonstrated by Patrulius (1960): "des éruptions de diabases ont certainement eu lieu dans les Carpates Orientales pendant le Trias, car dans les Monts Perşani il y a des calcaires carniens rouges... qui contiennent des fragments de diabases et sont intimement associés à de telles roches". This discovery opened new horizons for the interpretation of the origin of klippen.

Another fact which complicated the structural classification of the klippen was the discovery in the Rarău area of several Triassic allochthonous rocks, such as Anisian massive Steinalm-like limestones, or *Daonella* jasper beds, and marls with *Monotis salinaria* (Popescu & Patrulius, 1964) which did not fit into the rock-sequence firstly assigned either to the Transylvanian or to the Perşani Nappe. Consequently the rocks in question were listed under the label :"Rarău Series" (Patrulius, 1967). This name ought to be abandoned since it has been proved that in the "Rarău Series" two separate rock-sequences have been artificially linked together, namely the Hăghiniş and the Zimbru series, the former being Lower (?) and Middle Triassic in age with a cap of Hettangian limestone, the latter, Ladinian to Rhaetian in age, with an assumed cap of grey Sinemurian limestone. The rock-sequence first assigned to the "Transylvanian Nappe" in the Perşani Mts is also to be split into two quite distinct "series" as originally suggested by Patrulius et al. (1966): the Lupşa "Series" proper to the Perşani Nappe *stricto sensu* and the Olt "Series" proper to the Olt Nappe (Patrulius in Patrulius et al., 1979).

As "Transylvanian Nappe" there is no particular group of klippen (there are four distinct ones in the Rarău Syncline) for which the name can be retained, but we can still use it for designating the uppermost nappe system of the East Carpathians.

In fact each of the four Triassic rock sequences originally grouped two by two into the restored "Transylvanian" and "Rarău Series" is capped by a different Lower Jurassic formation. Each comes from a different zone as concerns both the facies and the tectono-magmatic evolution and consequently represents an independent "series" (Figure) namely: the Zimbru "Series" (lower klippen of Mount Rarău), the Olt "Series" (Olt Nappe including the lower klippen of the Perşani Mts), the Lupşa "Series" (Perşani Nappe including the upper klippen of the Perşani Mts), the Hăghiniş "Series" (Hăghiniş Nappe, including the upper klippen of Mount Rarău).

Zimbru "Series"

With some minor exceptions, the characteristic rocks of the Zimbru Series are concentrated in the Rarău Syncline. Their restored sequence includes, in ascending order: *Daonella jasper* beds, the Zimbru Limestone, the Popi Limestone, the *Salinaria* Marls, black Rhaetian limestones with Kössen fauna, Sinemurian grey limestones. The last two types of rocks occur only as large boulders.

1. *The Daonella jasper Beds*, some 20 m thick, are divisible into two members. The lower one (13 m) consists of hematitic jaspers and dark grey-greenish or variegated radiolarites interbedded with centimetric beds of limestones. Both the radiolarites and the limestones contain *Daonella pichleri* (GÜMBEL). The upper member (7 m) is mainly composed of grey-greenish and red cherty limestones with centimetric interbeds of variegated shales. Its faunas includes: *Daonella indica* KITTL., *D. tyrolensis* KITTL., *D.* sp. ex gr. *D. reticulata*, a poor assemblage of conodonts, varied foraminifers and a rich assemblage of radiolarians with several species of Palaeoscenidiidae, Entactiniidae, Eptingiidae, Oertlisponginae and Foremanellinidae, shared in common with the *Radiolaria* assemblage proper to the Buchenstein Beds of the Vicentin Alps (Dumitrică, 1978 a, b; 1982 a, b, c).

2. *The Zimbru Limestone*, some 80 m thick, builds up the imposing mass of the Piatra Zimbrului Klippe. It is light grey in colour with some pink or reddish layers. Thick beds of micrite or pelmicrite alternate with bioclastic calcarenites which contain corals and *Colospongia*. Its base consists of a reddish cherty limestone with a connodont assemblage characteristic of the Upper Langobardian (Mirăuţă, Gheorghian, 1978) including *Metapolygnathus mungoensis* (DIEBEL), *M. mostleri* KOZUR, *Gondolella palata* BENDER, *G. foliata* (BUDUROV), *Gladigondolella tethydis* (HUCKRIEDE). Several meters higher up there are lumachelles with *Halobia vixaurita* KITTL., a species characteristic of the Lower Carnian. The top of the Piatra Zimbrului Klippe includes a thick bed of reddish limestones with *Halobia vixaurita* KITTL. and *Gondolella* cf. *polygnathiformis* BUD. & STEF.. It is overlain by bioclastic

limestone with corals, sponges, gastropods and *Curatula damesi* BITTNER. Thus most of the Zimbru Limestone is Lower Carnian (Julian) in age.

3. *The Popi Limestone* is at least 60 m thick (the Popcii Mari Klippe), decimetric to metric bedded, usually darker in colour than the Zimbru Limestone, with brown to black small chert nodules or thin bands. In several klippen the dark-coloured limestones alternate with light grey, yellowish, pink, red or violet stained and glauconitic limestones, some of them nodular. Their commonest microfacies are: (1) coarse sandy, bioclastic and to some extent also oolitic calcarenites; (2) bio- and pelmicrites. Their fauna includes the following species recorded by Patrulius et al. (1971), Baltreş (1973), Turculeţ (1976 a, b), Iordan (1978 a), Mirăuţă, Gheorghian (1978): *Halorites* spp. of the Catenaţi group, *Arcestes stenostomus* MOJS., *Stenarcestes* cf. *ptychoides* (MOJS.), *Paracladiscites diuturnus* (MOJS.), *Cladiscites* cf. *monticola* (MOJS.), *C. quadratus* (MOJS.), *Placites* aff. *polydactylus* (MOJS.), *Megaphyllites jarbasoides* KÜHN, *Rhacophyllites occultus* (MOJS.), *Halobia styriaca* (MOJS.), *H. beyrichi* (MOJS.), *H. austriaca* MOJS., *H. praesuperba* KITTL., *H. fallax* MOJS., *H. hyatti* KITTL., (together with *Halorites* spp.), *Koninckina leopoldiaustriae* BITTNER, *Neoretzia* sp. ex gr. *N. superba* (SUESS), *Zugmayerella* cf. *eurea* DAGYS, *Fissirhynchia fissicostata* (SUESS), *Oxycolpella oxycolpos* (EMMRICH), *Laballa suessi* (WINKLER), *Triadihyris gregariaeformis* ZUGMAYER), *Stromatomorpha oncescui* BALTREŞ. The conodont assemblage from the lower part of the Popi Limestone with *Gondolella polygnathiformis* BUD. & STEF., *Metapolygnathus nodosus* (HAYASHI) and *M. permicus* (HAYASHI) points out an Uppermost Carnian age, that of its upper part, with *Metapolygnathus abnepsis* (HUCKRIEDE) and *Gondolella steinbergensis* (MOSHER), a Middle to Upper Norian age.

4. *The Salinaria Marls*, which exceed 20 m in thickness, compose small olistholiths south of the Rarău Summit. They consist of marly, slightly silty shales alternating with 10–40 cm thick beds of biomicritic or sandy limestones. Apart from *Monotis salinaria* (BRONN), their poor fauna includes *Megaphyllites* and *Placites* species, as well as discoidal to globose specimens of *Heterastridium*.

5. The dark grey to black Rhaetian limestones contain a varied fauna. The following species have been listed by Mehrhart (1910), Popescu, Patrulius (1964), Mutihac (1968), Patrulius et al. (1971), Turculeţ (1971), Iordan (1978 b): *Rhaetina gregaria* (SUESS), *R. piriformis* (SUESS), *Zeilleria norica* (SUESS), *Z. elliptica* (ZUGMAYER), *Z.* cf. *austriaca* (ZUGMAYER), *Triadithyris graegarieformis* (ZUGMAYER), *Fissirhynchia fissicostata* (SUESS), *Austrirhynchia cornigera* (SCHAFHÄUTL), *Euxinella pamirensis* (DAGYS), *Sinucosta emmrichi* (SUESS), *Laballa* aff. *suessi* (WINKLER), *Zugmayerella koessenensis* (ZUGMAYER), *Pisoidea uncinata* (SCHAFHÄUTL), *Chlamys valonensis* (DEFRANCE), *Lopha haidingeriana* (EMMRICH), *Thamnasteria rectilamellosa* (WINKLER).

6. Younger than the Triassic Zimbru "Series", but assumed to belong to the same unit, are: (1) Lower Sinemurian, massive argillaceous, dark-coloured limestones, with *Euagassiceras sauzeanum* (D'ORBIGNY) and *Spiriferina alpina* (OPPEL) (Turculeţ, 1976 c); (2) Pliensbachian sandy limestones and silty marly shales with *Zeilleria waterhausi* (DAVIDSON) and *Piarorhynchia* sp. ex gr. *P. juvenis* (QUENSTEDT) (Stănoiu, 1967).

7. The youngest member of the Zimbru Unit consists of Barremian massive limestones with corals and *Palorbitolina lenticularis* (BLUM.).

Outside the Rarău Syncline scarce and minor remnants of the Zimbru "Series" are represented by: (1) Upper Norian grey sandy limestone with *"Monotis" substriata* HÖRNES and Rhaetian grey limestone with *Rhaetina gregaria* (SUESS) in the Hăghimaş Syncline; (2) Middle Norian dark grey shales associated with thin bedded grey limestones with *Halobia fallax* MOJS., as well as Rhaetian black limestones with large megalodonts in the Perşani Mts.

Olt "Series"

The restored Triassic rock-sequence of the Olt Nappe, some 200 m thick, includes in ascending order serpentinites, gabbros and dolerites, basalts, mainly as variolitic pillow lavas associated with volcanic clastics, radiolarian jaspers, argillaceous shales and red or grey nodular limestones, bostonitic porphyries and subordinate andesites (Patrulius, 1960; Cioflică et al., 1965), Hallstatt Limestones ranging in age from the Langobardian to the top of the Norian and equivalent massive light-coloured limestones and subordinate dolomites, Rhaetian encrinitic white limestones, Middle Hettangian to Lower Carixian Adnet Limestone.

In the huge klippe of Pârâul Rotund (northern Perşani Mts) the sequence of the pillow lavas includes a metric bed of red limestone whose conodont assemblage with *Gondolella* cf. *timorensis* NOGAMI, listed by Mirăuţă (in Patrulius et al., in press), points out a Lower Anisian age. The white limestones overlying the volcanics of the same klippe contain near their base a Ladinian conodont assemblage with *Gondolella trammeri* (KOZUR). In the Perşani Mts the oldest fauna of the Hallstatt Limestones, with *Joannites* and

Sirenites species, *Gondolella tadpole* HAYASHI and *G.* cf. *mostleri* KOZUR, points out a Lower Carnian age; their youngest conodont assemblage, with *Parvigondolella lata* KOZUR and *Metapolygnathus bidentatus* (MOSHER, listed by Mirăuţă, – an Upper Norian age. The Hallstatt Limestones of the Olt "Series" are rather poor in ammonites in the Perşani Mts, but rich in halobiids and monotids. The following species have been identified so far: the Upper Carnian *Halobia carnica* GRUBER associated with *Anatomites* sp., *Gondolella polygnathiformis* BUD. and STEF. and *Metapolygnathus nodosus* HAYASHI, the late Upper Carnian-Lower Norian *Halobia styriaca* (MOJS. alone or locally associated either with *H. beyrichi* MOJS. or with *H. charlyana* MOJS., *Halobia austriaca* MOJS. and a younger subspecies associated in the Meghieş Valley with *Metapolygnathus posterus* (KOZUR and MOSTLER), *M. abneptis spatulatus* (HAYASHI) and *Gondolella steinbergensis* (MOSHER) (Mirăuţă, Gheorghian, 1978), *Halobia fallax* MOJS. (=*H. superbescens* KITTL.), *Monotis rudis* (STOPPANI) and *"M": hoernesi* KITTL just below the first occurrence level of *Metapolygnathus bidentatus* (MOSHER) and in the stratigraphic range of this conodont species (Hăghimaş Valley, Vârghiş Valley), *Monotis salinaria* (BRONN) only in the Rarău Syncline.

In some klippen of the Perşani Mts the Hallstatt Limestones cover the whole interval ranging from the Lower Carnian to the Upper Norian (Hăghimaş Valley), in others these rocks underlie white massive limestones and dolomites (Tepeia Ormenişului), are interbedded with them (Pietrele lui Murgoci) or lie on top of them (Meghieş Valley and Hill).

The Hallstatt Limestone of the Meghieş Klippe is overlain by a bed of red encrinitic limestone with abundant brachiopods (Patrulius et al., 1971; Iordan, 1978 a) among which: *Oxycolpella eurycolpos* (BITTNER), *Laballa suessi* (WINKLER), *Sinucosta emmrichi* (SUESS), *S. acerrima* (BITTNER), *Fissirhynchia fissicostata* (SUESS), *Neoretzia superba* (SUESS) [(=*N. superbescens* (BITTNER)], *Aulacothyris conspicua* BITTNER. These limestones with brachiopods are directly overlain by unconformable Lower Sinemurian Adnet Limestone with *Paradasyceras uermosiensis* (HERBICH), *Arnioceras* and *Charmasseiceras* species.

Younger than the Upper Norian Hallstatt Limestone and the red encrinitic bed of the Meghieş Klippe are white-grey encrinitic calcarenites ("Drnava facies") building a small olistolith on the eastern slope of the Vârghiş Valley (northern Perşani Mts). These deserve special attention because their fauna is a mixture of forms known so far only from the Triassic or only from the Lower Jurassic: *Pseudolimea drnavensis* (KOCHANOVA), *Oxytoma inaequivalvis* (J. SOWERBY), *Zeilleria norica* (SUESS), *Z. elliptica* (ZUGMAYER), *Z.* aff. *austriaca* (ZUGMAYER), *Z. moisseievi* DAGYS, *Fissirhynchia fissicostata* (SUESS) make good company with *Antiquilina succinta* (SCHLOTHEIM), *Pseudolimea hettangiensis* (TERQUEM), *Furcirhynchia* and *Cirpa* species as well as several spiriferinids of Lower Jurassic habitus. This fauna is most probably Upper Rhaetian in age.

Besides the Ladinian conodonts recorded from their base, the white massive limestones synchronous with the Hallstatt Limestones contain the following fossils: *Poikiloporella duplicata* PIA, corals (some of them arborescent), abundant calcareous sponges, scarce medium-sized megalodonts and pectinids, occasionally also halobiids such as *Halobia praesuperba* KITTL, *H. ocevjana* KITTL and *H. austrica* MOJS. (=*H. bukovinensis* KITTL) in the Izvoru Malului Klippe (Rarău Syncline), gastropods, very scarce ammonites, such as *Lobites* (Frunzar Klippe in the Comana Valley), echinoids and crinoids, the cycloid anthropod *Cyclocarcinides* (Frunzar, Izvoru Malului), in places abundant brachiopods namely: *Costispiriferina, Pexidella* and *Rhaetina* species in the Lower Carnian limestones of Frunzar (Iordan, 1976), *Tetractinella dyactis* (BITTNER), *Anisactinella quadriplecta* (MÜNSTER), *Schwagerinella schwageri* (BITTNER) in Carnian-Lower Norian limestones near Comana de Sus, *Neoretzia fastosa* (BITTNER), *Laballa suessi* (WINKLER), *Koninckina leopoldiaustriae* BITTNER, *Amphiclina* spp., *"Rhynchonella" salinaria* BITTNER, *"Aulacothyris"* sp. ex gr. *"A." kuehni* JEKELIUS in the Norian limestones of the Surmanu Klippe (Central Perşani Mts) (Patrulius, 1967; Patrulius et al., 1971).

In the Hăghimaş Syncline the Olt Nappe has left only small olistoliths and boulders consisting of serpentinites, variolitic pillow lavas, red Upper Carnian limestone with Jovites, Middle Norian Hallstatt Limestone with *Placites, Cladiscites, Paracladiscites, Distichites* and *Halorites* species (Mojsisovics, 1873, 1893), marly limestone with *Monotis haueri* KITTL (Grasu, 1970), Hettangian and Sinemurian Adnet Limestone (Vadasz, 1915).

In the Rarău Syncline, apart from the large Breaza Outlier consisting of serpentinites (Săndulescu, 1973), the Olt "Series" is represented only by modest débris composed of dolerites, basalts and basaltic clastics, quartz syenites and anorthosites, hematitic jaspers, Hallstatt Limestones ranging in age from the Upper Ladinian to the Upper Norian, also Carnian to Upper Norian light-coloured biodetrital and bioconstructed limestones. Hematitic jaspers with *Radiolaria* outcropping on the northern slope of the Fundu Pojorâtei Valley and overlain by basalts are Carnian in age (Dumitrică, oral information). In the Măceş Stream boulders of Norian red limestone are studded with angular fragments of basalts. Thus there

are good reasons to assume that in some parts of the area from which the Olt Nappe was derived the volcanic activity persisted long after the Ladinian. The fauna of the Hallstatt Limestones includes ammonites and bivalves, characteristic of the Archelaus Zone (Paul, 1876; Kittl, 1912; Turculeţ, 1971): *Protrachyceras archelaus* (LAUBE), *Arpadites cinensis* MOJS., *Daonella pichleri* (GÜMBEL), *D. pauli* (KITTL), *D. badiotica* MOJS., *D. tripartita* KITTL, (in addition also *Metapolygnathus hungaricus* KOZUR and VEGH in the klippe of Dealul Cailor); the Aon Zone (Mojsisovics, 1879, 1882): *Trachyceras aon* (MÜNSTER), *Protrachyceras furcatum* (MÜNSTER), *Joannites johannisaustriae* (KLIP.), *Coroceras hypsocarenum* (MOJS.), *Arcestes, Megaphyllites, Cladiscites* and *Mojvarites* species in the surrounding of Pojorâta; the Magnus Zone: *Juvavites* sp., together with *Metapolygnathus abneptis spatulatus* (HAYASHI) in the Măceş Stream; the Upper Norian: *Placites myophorus* (MOJS.) and *Monotis salinaria* BRONN in the Măceş Stream (Mutihac, 1968); *Rhacophyllites despectus* MOJS. and *Megaphyllites insectus* MOJS. at the sources of the Mesteacăn Valley (Mojsisovics, 1879). The fossils of the white reefoid limestones (Kittl, 1912; Mutihac, 1968; Turculeţ, 1971; Iordan, 1978 a) are characteristic of the Upper Ladinian: *Daonella pichleri* (GÜMBEL); the Lower Carnian: *Cyclocarcinides* sp.; the Upper Carnian: *Halobia praesuperba* KITTL (sub *H. fallax* MOJS. in Mutihac , 1968); the Norian: *Sinucosta bittneri* DAGYS (klippe of Izvoru Malului); the Upper Norian-Rhaetian: *Neoretzia superba* (SUESS), *Zugmayerella koessenensis* (ZUGMAYER), *Pisoidea uncinata* (ZUGMAYER), *Zeilleria austriaca* (ZUGMAYER), (Fundu Pojorâtei Valley).

The Adnet Limestone recorded from the Rarău Syncline (Dealu Praşca) is Upper Sinemurian in age (Obtusum, Oxynotum and Raricostatum zones).

The latest volcanic products underlying the Upper Ladinian or Carnian limestones of the Olt Nappe are characteristic of insular arc volcanism. After their emplacement the volcanic complex has been subjected to intense erosion. In places Norian limestones with *Monotis* resting directly on gabbros include angular fragments from their underlying rocks (Hăghimaş Valley in the Perşani Mts). Another significant unconformity is between the Triassic rock sequence and the Adnet Limestone (Meghieş Hill).

Lupşa "Series"

The Triassic rock-sequence of the Perşani Nappe amounts to at least 500 m thickness and ranges in age from the Spathian to the Lower Ladinian. It is unconformably overlain by Upper Sinemurian and/or Lower Pliensbachian calcareous sandstones and sandy limestones. The Lupşa "Series" has its fullest development in the southern part of the Perşani Mts; in the northern part of the same area its thickness is around 300 m and its upper part consists only of Steinalm Limestone.

Where fully developed (Lupşa Outlier), the Lupşa "Series" includes in ascending order: Upper Spathian Werfen Limestone, Anisian Cuciulata Limestone with two members of Schreyeralm Limestone, Lower Ladinian white massive limestone (Pleşiţa Corbului Outlier). The Werfen Limestone consists of grey argillaceous to marly silty shales and siltstones with interbedded centimetrtic silty and sandy limestones, some of them lumachellic, with *Costatoria costata* (ZENKER), *Eumorphotis inaequicostata* (BENECKE), *E. telleri* BITTNER, *Leptochondria inequistriata* (SCHLOTHEIM) and scarce specimens of *Tirolites* sp. Its spore-pollen assemblage is characteristic of the Densoisporites nejburgii Zone (Antonescu et al., 1976). The Cuciulata Limestone, well exposed on the northern slope of the Lupşa Valley (type section) consists of submetric to metric, closely packed beds of grey pseudosparitic limestone, some of them vermiculated, alternating with decimetric to centimetric beds of darker-coloured limestones with argillaceous coatings of the uneven bedding planes. Its lower part includes a layer of centimetric beds with *Costatoria costata* (ZENKER). The lower member of Schreyeralm Limestone is composed mainly of uniform vivid, red decimetric to metric beds, some of them with red cherts, and of subordinate nodular violet and grey-greenish stained beds, with ammonites (*Balatonites* sp.), scarce brachiopods such as *Koeveskallina koeveskalyensis* (STUR), and abundant conodonts among which *Gondollela timorensis* NOGAMI, *G. bulgarica* BUDUROV, *Kamuellerella subsymmetrica* GEDIK, *Ketinella langeri* GEDIK, *Nicoraella kockeli* (TATGE) (Mirăuţă, Gheorghian, 1978). The upper part of the Cuciulata Limestone is locally replaced by dolomites. The Upper Schreyeralm Limestones have yielded *Flexoptychites* and *Gymnites* species and a poor conodont assemblage with *Gondollela excelsa* MOSHER. The base of the overlying white-grey massive limestone (Pleşiţa Corbului Outlier) contains a Ladinian assemblage of conodonts with *Gondolella transita* KOZUR and MOSTLER besides *G. acuta* KOZUR (Mirăuţă, Gheorghian, 1978).

The Lower Jurassic rocks which overlie the Triassic Lupşa "Series" compose the Racila Formation which amounts to some hundreds of meters in thickness. Its lower part consists of sandstones and sandy encrinitic limestones with *Gryphaea mcculochi* J. SOWERBY, its upper part of grey marls and limestones with Pliensbachian and Toarcian fauna.

A characteristic klippe of the Perşani Nappe with Steinalm Limestone is the one of Colţii Nadaşului. Its

rock-sequence includes in ascending order: Cuciulata Limestone (250 m), a 10 m thick breccia composed of Schreyeralm Limestone, white or pink Steinalm Limestone (30 m) replaced by dolomites along the strike. The following species of ammonites, brachiopods (Patrulius, 1960; Patrulius et al., 1971) and conodonts (Mirăuţă, Gheorghian, 1978) have been listed from the Schreyeralm Limestone: *Beyrichites* sp., *Balatonites* sp., *Mentzelia ptychitiphylla* (BITTNER), *Koeveskallina koeveskalyensis* (STUR), *Pexidella sturi* (BOECKH), *Volirhynchia* sp. ex gr. *V. volitans* (BITTNER), *Neoretzia* sp. ex gr. *N. preetziosa* (BITTNER), *Nicoraella kockeli* (TATGE), *N. germanica* (KOZUR), *Gondolella bulgarica* (BUD. and STEF.), *G. bifurcata* (BUD. and STEF.), *Kamuellerella subsymmetrica* GEDIK, *K. seymeni* GEDIK, *K. gebzeensis* GEDIK, *Ketinella langeri* (GEDIK), *K. mexicavata* GEDIK. The overlying Steinalm Limestone contains abundant *Diplopora helvetica* PIA and scarce specimens of *D. hexaster* PIA, *Oligoporella pilosa intusannulata* PIA, *Macroporella* sp. (Patrulius, 1970). The associated foraminifera are *Pilammina densa* PANTIĆ, *Meandrospira dinarica* KOCH-DEV., *Angulodiscus pragsoides* (OBERHAUSER). Further north, in the klippe of the Rica Hill, the Schreyeralm Limestone is reduced to a decimetric bed with *Meandrospira pusilla* HO, overlain by Steinalm Limestone whose base contains a similar assemblage of foraminifera and in addition *Glomospirella grandis* (SALAJ). The sequence of the Rica Hill proves beyond any doubt that *M. pusilla* persisted long after the end of the Spathian.

In the Rarău Syncline remnants of the Perşani Nappe are represented by the klippen of the Florea Valley and of the Botuş Quarry (Săndulescu, Tomescu, 1978). The Florea Klippe consists in ascending order of: (1) Cuciulata Limestone, (2) a dolomitic breccia and (3) bedded limestones with *Meandrospira dinarica* KOCH-DEV. The members of the Botuş Quarry Klippe are: (1) bedded black limestones with *Physoporella*, (2) massive grey limestone with *Turritellella mesotriassica* KOEHN.-ZAN. and *Gondolella bifurcata* BUD. and STEF. (Upper Anisian), (3) bedded black and red limestones, assumed to be Ladinian in age.

Hăghiniş "Series"

The rock sequence of the Hăghiniş Nappe, some 200 m thick, is illustrated by the Upper Klippen of Mount Rarău and its surrounding heights (Creasta Hăghimaşului, Pietrele Doamnei). Its members are: (1) coarse quartzitic sandstones, some conglomeratic; (2) red argillaceous silty shales with a local interbed of red limestone; (3) massive dolomites or dolomitic breccia with local development; (4) poorly bedded grey to almost black limestone with interbedded lenses of dolomite; (5) massive, light-coloured Steinalm-like limestones, mainly composed of bioclastic calcarenites with *Meandrospira*; (6) several meters thick, pink or light-grey micritic limestone with abundant juvenile specimens of halobiids, assumed to be Ladinian in age. The Spathian ? and Middle Triassic Hăghiniş "Series" is overlain by Upper Hettangian red, argillaceous-sandy encrinitic or oolitic to pisolitic limestones with *Schlotheimia* sp.. These rocks are filling in narrow crevices in the Triassic limestones. Next to the Triassic and Jurassic limestones comes a thick, unconformable mass of grey or pink limestones with abundant corals. These Urgonian limestones grade upwards into yellowish argillaceous limestones crowded with orbitolinids.

The Triassic-Lower Jurassic rock sequence of the Hăghiniş "Series" has close affinities to the corresponding one of the Bucovinian Nappe. So we may assume that among the Transylvanian units the Hăghiniş Nappe was closest to the area from which the Bucovinian Nappes were derived. On the other hand the Zimbru "Series" with its Wetterstein-like Zimbru Limestone, its Norian rocks with terrigenous material and especially its black Rhaetian limestones with Kössen fauna can be best compared to the rock-sequences of the Lower Codru Nappes (Apuseni Mts). These are the reasons why we assume that the original position of the Olt and Lupşa "Series" was between the western Zimbru "Series" and the eastern Hăghiniş "Series".

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THE KLIPPEN OF THE PERŞANI MOUNTAINS (EAST CARPATHIANS)

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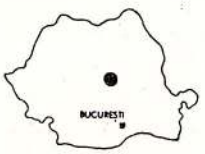

Key words: Lithostratigraphy. Biostratigraphy. Forams. Echinoids. Conodonts. Ammonites. Brachiopods. Bivalves. Algae. Palynomorphs. Tectonics. Transylvanian Nappes. Perşani Mts. Romania.

Résumé: *Les klippes des Monts Perşani (Carpathes Orientales).* Les klippes des Monts Perşani, initialement attribuées en totalité à la nappe de Perşani ou à la nappe transylvaine, constituent plusieurs groupes différents entre eux par l'intervalle stratigraphique des successions représentées, les faciès de certaines formations synchrones et partiellement aussi par l'ordre de la mise en place. A base de ce dernier critère on distingue: (1) des olistolithes constitués par les formations propres aux "séries" d'Olt (Anisien-Jurassique inférieur) de Perşani (Scythien-Jurassique inférieur) et de Zimbru (Norien-Rhétien); (2) des olistolithes formés par les roches propre à la formation de Carhaga (Callovien-Néocomien); (3) les lambeaux de la nappe d'Olt; (4) les lambeaux de la nappe de Perşani; (5) des olistolithes de calcaires jurassiques qui constituent le groupe de klippes de Mereşti et qui se trouvent situées à la base de la couverture post-nappe. Le territoire de distribution des klippes couvre deux unités structurales de formation plus récente: la nappe bucovinienne et l'unité de Vârghiş.

1. INTRODUCTION

When Uhlig (1907) first defined the Transylvanian Nappe, he grouped in one stratigraphic column Triassic and Jurassic formations from different klippen scattered within or overlying the Lower Cretaceous Wildflysch of the Rarău and Hăghimaş synclines (Uhlig's "ostkarpatische Randmulde der mesozoisch-crystalline Zone)". This column includes: Werfen Shales, Muschelkalk (Gutenstein Limestone of later authors), Ladinian and Upper Triassic Hallstatt Limestone, dark-coloured Rhaetian limestones, Adnet Limestone, nodular limestone with *Aspidoceras acanthicum*, Tithonian-Neocomian white massive limestones. Much later a similar nappe – the so-called Perşani Nappe – has been identified at the southern end of the East Carpathians (Ilie, 1953, 1954). According to the original definition, the Perşani Nappe does not differ in composition and age of emplacement from the Transylvanian Nappe. Most of its massive white limestones, initially assigned to the Ladinian, are in fact Upper Triassic in age and cannot be distinguished from the equivalent limestones of the Rarău Syncline. Consequently the Perşani Nappe has been considered to represent only a southern extension of the "Transylvanian" Nappe (Patrulius et al., 1966), but with two slices in the Perşani Mts: (1) lower klippen consisting of Ladinian mafic rocks and Upper Triassic limestones; (2) upper klippen composed of Lower Triassic shales and bedded Anisian limestones. Later on the senior author of this paper recognized a Rarău "Series", quite distinct from the Transylvanian "Series" (Patrulius, 1967, Patrulius et al., 1971), divisible into two groups of formations: (1) Ladinian radiolarites and Upper Triassic limestones building up the lower klippen of the Rarău Mountain; (2) sandstones assumed to be Lower Triassic in age and massive Anisian limestones composing the upper klippen of the same area. Thus both the "Transylvanian" and the "Rarău Series" were restored by linking a younger rock sequence (Ladinian-Upper Triassic) of one group of klippen (lower klippen) to the older sequence (Skythian-Anisian) of another group of klippen (upper klippen). These restorations were based on the concept of "diverticulation", a process in which the upper part of the Triassic cover of each of the two facies should have been first detached and earlier emplaced as nappe outlier (lower klippen) and then the lower part of the cover emplaced as upper klippen over the former slice. Further investigations proved this interpretation to be wrong.

Actually the klippen of the Perşani Mts can be classified in five groups (Fig. 1): (1) klippen of the Perşani Nappe (outliers and olistoliths), (2) klippen of the Olt Nappe (outliers and olistoliths), (3) olistoliths and boulders composed of rocks proper to the Zimbru

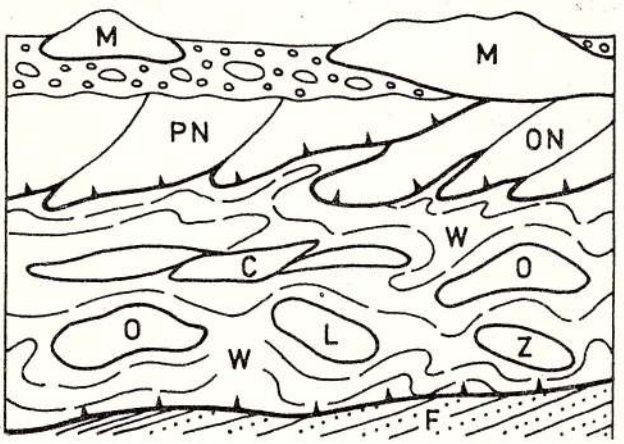

Fig. 1 – Klippen of the Perşani Mountains: F - Tithonian-Neocomian Flysch; W - Barremian-Lower Aptian Wildflysch; O, L, Z - Olistoliths composed of rocks derived from the Olt, Lupşa and Zimbru Series; C - sheet olistoliths consisting of the Carhaga Formation; PN - Perşani Nappe; ON - Olt Nappe; M - Mereşti Klippen embedded in the Aptian conglomerates at the base of the post-nappe cover.

Series (Norian and Rhaetian limestones), (4) sheet-olistoliths consisting of rocks proper to the Carhaga Formation (Callovian-Neocomian), (5) the group of the Mereşti klippen (Upper Jurassic limestones). The last group has been originally included in the Perşani Nappe as defined by Ilie (1953, 1954), respectively the "Transylvanian Nappe" sensu Patrulius et al. (1966), but we now know that their emplacement occurred later on (Upper Bedoulian-Gargasian) just before or during the deposition of the post-nappe cover, consisting of conglomerates mainly composed of Upper Jurassic limestones and crystalline schists, but apparently without pebbles of Triassic rocks. Thus we have good reasons to assume that each of the recorded groups of klippen comes from a different paleogeographic zone, consequently representing primarily independent structural zones.

Considering the principle of ill definition and original misuse, the name of "Perşani Nappe" being applied by its author to three groups of klippen differing by their origin, should be abandoned, but as it was first used for the klippen of the southern Perşani Mts, which consist of Lower and Middle Triassic carbonate rocks and as the definition does not imply either mafic rocks or Upper Triassic limestones, we may keep it for designating the outliers composed of the rocks of the Lupşa "Series".

Correlation of the allochthonous Triassic limestones of the Perşani Mts is based on the fauna and flora listed by D. Patrulius (algae and associated foraminifera, brachiopods, mollusca; partial list in Patrulius et al., 1971); E. Antonescu (spores and pollen; in Antonescu et al., 1976); D. Gheorghian (foraminifera, microechinodermata, microproblematica; in Mirăuţă & Gheorghian, 1978); E. Mirăuţă (conodonts; in Mirăuţă & Gheorghian, 1978); M. Iordan (brachiopods; 1976, 1978); E. Popa (ammonites and halobiids; in Popescu & Popa, 1976), C. Tomescu (Spathian bivalves; in Patrulius et al., 1976).

2. STRATIGRAPHY

2.1. Outliers of the Perşani Nappe and derived olistoliths

There are two sorts of outliers detached from the Perşani Nappe: (1) with Spathian shales and bedded dark-coloured Middle Triassic limestones including thick members of red Schreyeralm Limestone (southern Perşani Mts); (2) with bedded dark-coloured limestones and light-coloured dolomites, overlain by subordinate Schreyeralm Limestone and thick Steinalm Limestone (mainly in the northern Perşani Mts). Steinalm Limestone, of questionable origin, also occurs as small olistoliths in the southern Perşani Mts (Lupşa Valley).

(1) In the southern Perşani Mts, the Lupşa "Series" characteristic of the Perşani Nappe builds up three large outliers: Pleaşa Lupşei, Pleşiţa Corbului and Măgura Cuciulatei. The Pleaşa Lupşei outlier displays in turn a most complex structure at least with three imbricated slices: Lupşa, Pleaşa, Pleşa Hill (Figs. 2, 3).

The Lupşa "Series" of the large outliers extending between Comana de Sus in the south and Fântâna in the north includes in ascending order: (1) argillaceous to marly-silty shales and siltstones with interbedded centimetric to subdecimetric silty to sandy limestones, some lumachellic (Spathian) ones; (2) the lower Cuciulata Limestone, mainly thick-bedded, grey, with vermiculated beds (Lower Anisian); (3) the lower Schreyeralm Limestone, mainly red, partially grey as well, thick-bedded, with some scarce nodular and cherty beds (late Lower Anisian and Pelsonian); (4) upper Cuciulata Limestone, mainly decimetric bedded, dark grey to almost black (Pelsonian); (5) a rather thin member of light-coloured limestones with dolomitic nuclei laterally grading into dolomites (assumed late Pelsonian in age); (6) the upper Schreyeralm Limestone, red, pink and grey, decimetric-bedded, with some beds of Flaserkalk or with chert nodules and bands; in places also with jasper beds (Illyrian and Fassanian); (7) massive, pink, cream-coloured or light-grey to almost white, fine granular limestone overlain by bedded grey limestone in the Pleşiţa Corbului outlier (Ladinian, probably including the Langobardian). The Lupşa "Series" is capped by the unconformable Lower Jurassic Racila Formation.

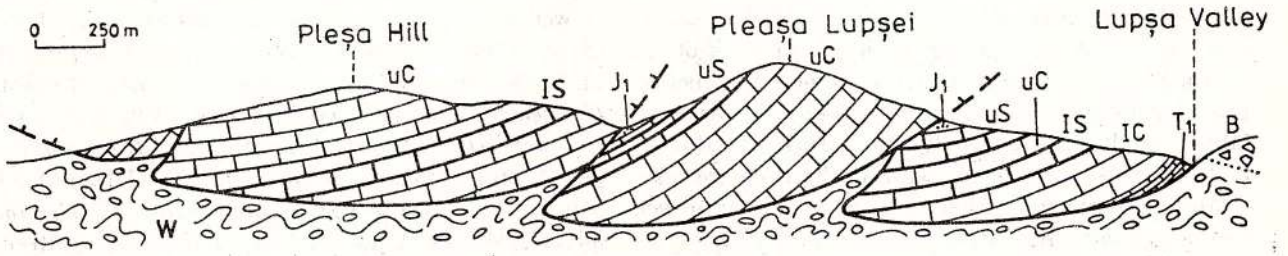

Fig. 2 – Pleaşa Outlier of the Perşani Nappe: B-Badenian breccia; W-Barremian-Lower Aptian wildflysch; T_1-Spathian formation; 1C-Lower Cuciulata Limestone (Lower Anisian); 1S-lower Schreyeralm Limestone (late Lower Anisian and Pelsonian); uC-upper Cuciulata Limestone (Pelsonian); uS-upper Schreyeralm Limestone (Illyrian and Fassanian); J_1-Racila Formation (Lower Jurassic).

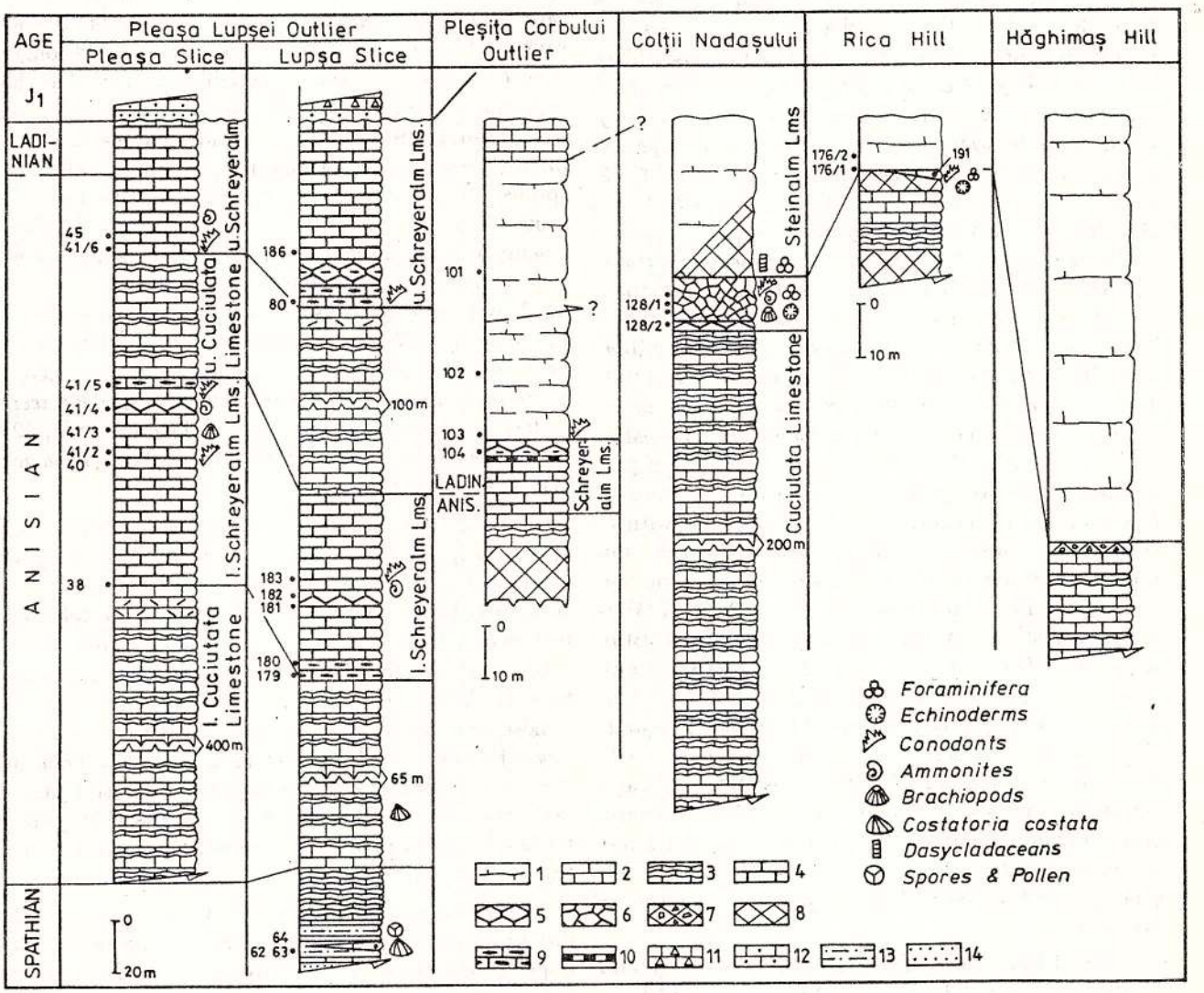

Fig. 3 – Klippen of the Perşani Nappe: 1, reefoid limestone; 2, thick-bedded dark limestone; 3, thin-bedded dark limestone; 4, red Platten - and Bankkalk; 5, red Knollenkalk; 6, red limestone breccia; 7, limestone breccia in dolomite; 8, dolomite; 9, red cherty limestone; 10, red jasper; 11, crinoidal limestone; 12, sandy limestone; 13, silty shale; 14, sandstone.

The type section of the Cuciulata Limestone is on the southern slope of the Măgura Cuciulatei Hill, down to the Lupşa Stream. The lower Cuciulata Limestone is well exposed along the northern bank of the Lupşa Stream, where it includes submetric to metric, closely packed beds of grey limestone, some vermiculated, mainly pseudosparitic, alternating with thinner and darker-coloured beds, with argillaceous greenish, reddish and orange weathering coatings of their uneven bedding planes. As a whole, the Cuciulata Limestone - recorded as Gutenstein Limestone by Herbich (1878), Wachner (1918) and Ilie (1953) - is similar to the Bucea Limestone (Patrulius in Ianovici et al., 1976) from the Bihor Unit (Apuseni Mts).

The base of the Lupşa Slice (Fig. 3), exposed along the southern border of the Lupşa Stream, consists of some 30 m of Spathian argillaceous silty shales and subordinate limestones with a spore-pollen assemblage characteristic of Densoisporites nejburgii Zone (Antonescu et al., 1976), including the index species: *Cycloverrutriletes presselensis* (SCHULTZ), *Lunatisporites acutus* (LESCHIK), *Jugasporites delasaucei* (POT. & KLAUS), *Alisporites cymbatus* VENK., BEJU & KAR., *A. landianus* BAHNE, *Platysaccus papillionis* POT. & KLAUS, as well as abundant *Veryhachium reductum* DEUNFF. The lumachellic interbedded limestones contain the following bivalves (partly listed by C. Tomescu): *Costatoria costata* (ZENKER), *"Gervillia" mytiloides* (SCHLOTHEIM), *"G." exporrecta* LEPSIUS, *Unionites fassaensis* WISSMANN, *Leptochondria inaequistriata* (SCHLOTHEIM), *Eumorphotis inaequicostata* (BENECKE), *E. telleri* BITTNER. In the western part of this slice the overlying lower Cuciulata Limestone includes a layer of centimetric bedded limestone with *C. costata*. The lower Schreyeralm Limestone of this unit, some 60 m thick, mainly consists of beds of vivid red, compact, uniform limestone (S. 181-183) with *Nicoraella* cf. *kockeli* (TATGE), *Gondolella bulgarica* (BUD. & STEF.), *Lonchodina ? posterognathus* (MOSHER), *Hindeodella pectiniformis* (HUCKRIEDE) (Pl. I). One bed of violet, grey-greenish stained bioclastic limestone contains poorly preserved ammonites (*Leiophyllites ?*). A similar limestone, north of the Lupşa Stream (Valea Gardului) has yielded *Balatonites* sp. (E. Grădinaru, oral communication). The upper Schreyeralm Limestone, some 70 m thick, contains in its base (S. 80) a poor conodont assemblage with *Gondolella excelsa* MOSHER.

In the Pleaşa Slice (Fig. 3), the lower Cuciulata Limestone seems to be extremely thick (some 650 m), but its considerable development might be only apparent, due to imbrication of secondary slices. The lower Schreyeralm Limestone, some 80 m thick and consisting of alternating red and light-grey beds, some nodular or cherty ones, has yielded rare specimens of brachiopods such as *Koeveskallina koeveskallyensis* (STUR) and *Pexidella* sp. ex gr. *P. sturi* (BOECKH), as well as rich conodont assemblages at several levels (S. 40, 41/1, 2) (Mirăuţă & Gheorghian, 1978) including such species as: *Gondolella timorensis* NOGAMI, *G. regalis* (MOSHER); *G. bulgarica* (BUD & STEF.), *Kamuellerella subsymmetrica* GEDIK, *Kefinella langeri* GEDIK, *Enantiognathus ziegleri* (DIEBEL), *E. petraeviridis* (HUCKRIEDE), *Lonchodina ? posterognathus* (MOSHER), *Ozarkodina saginata* HUCKRIEDE, *O. turgida* BENDER, *O. tortilis* TATGE, *O. kochi* HUCKRIEDE, *Hindeodella pectiniformis* (HUCKRIEDE), *H. suevica* TATGE, *Neohindeodella triassica riegeli* (MOSHER), *N. aequiramosa* KOZUR & MOSTLER, *Hibardella magnidentata* (TATGE), *Cornudina ? latidentata* KOZUR & MOSTLER, *Prioniodina latidentata* TATGE, *P. muelleri* TATGE, *P. venusta* (HUCKRIEDE) (Pl. I). *Gondolella timorensis* persists longer than *G. regalis*. Surprising enough is the fact that the concerned limestones do not display any lithological feature, suggesting reworking of older sediments to explain the coexistence of Lower Anisian and Pelsonian species. In any case, there should be emphasized the south-Tethyan, "Anatolian", stamp of these conodont assemblages, in flagrant contrast with the submediterranean character of the fauna contained in the overlying Lower Jurassic rocks of the Gresten facies (Racila Formation). The upper, more uniform and compact Schreyeralm Limestone has yielded scarce specimens of *Flexoptychites* and *Gymnites* (maybe also *Paraceratites*) and a poor conodont assemblage (S. 41/6, 42) with *Gondolella excelsa* (MOSHER) and *G. bulgarica* (BUD. & STEF.).

The northern part of the Pleşiţa Corbului outlier (Fig. 3) exposes in ascending order: (1) massive light-coloured dolomites; (2) several meters thick grey limestone; (3) 10 m thick compact red limestone followed by several meters thick red jaspers, nodular and cherty limestones (upper Schreyeralm Limestone); (4) some 80 m thick massive pink, cream-coloured, light-grey to almost white fine granular limestone with *Gondolella acuta* KOZUR and *G. transita* KOZUR & MOSTLER in the base, pointing out a Fassanian age for this member whose considerable thickness suggests that higher terms of the Ladinian could be also represented at the top of the Lupşa "Series".

The Lower Jurassic Racila Formation crops out with its full development south of Pleaşa Lupşei, along the upper course of the Racila Stream. It amounts there to some 300 m in thickness and is divisible into two members (Fig. 4): the lower one consists of yellowish weathering, coarse, limy sandstones and of crinoidal sandy limestones with *Gryphaea mcculochi* J. SOW. and *Lobothyris punctata* (J. SOWERBY), the upper one is mainly composed of grey marls and limestones with

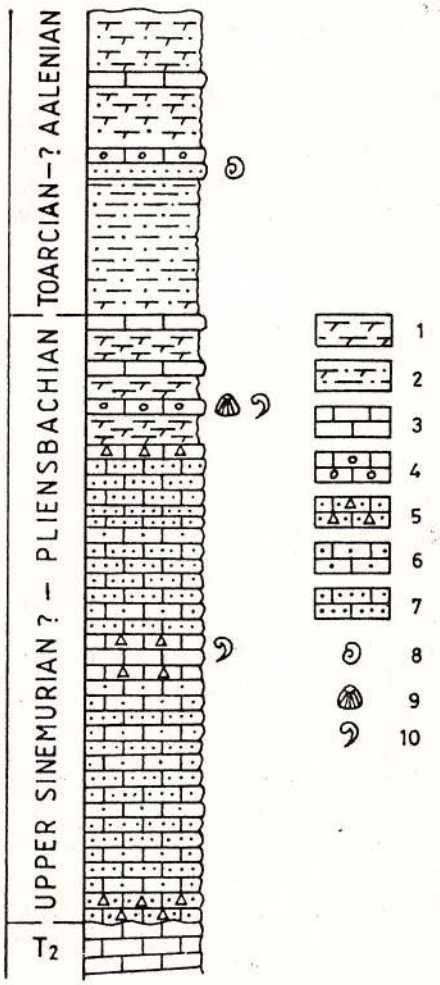

Fig. 4 – Lithological column of the Racila Formation: 1, marl; 2, marly siltstone; 3, limestone; 4, oolitic limestone; 5, crinoidal sandy limestone; 6, sandy limestone; 7, limy sandstone; 8, ammonites; 9, brachiopods; 10, *Gryphaea gigantea*.

added interbeds of violet sandy siltstone and oolitic limestone midway between base and top. The fauna in the base of the upper member includes: *Gryphaea gigantea* J. SOW., *Entolioides hehlii* (D'ORBIGNY), *Chlamys textoris* (SCHLOTHEIM), *C. bersaskensis* (TIETZE), *Spiriferina* cf. *rostrata* (ZIETHEN), *Cuneirhynchia oxynoti* QUENSTEDT, *C.* sp. aff. *C. dalmasi* (DUMORTIER); the violet marly siltstones and oolitic limestones contain an Upper Toarcian ammonite assemblage with *Hammatoceras* sp. ex gr. *H. insigne* (ZIETHEN) and *Pseudogrammoceras* spp.

(2) Characteristic klippen of the Perşani Nappe with Steinalm Limestone are those of: Colţii Nadaşului (west of Racoşul de Sus), the Rica Hill, the Hăghimaş Hill and the eastern slope of the Vârghiş Valley, midway between the Vârghiş village and the Mereşti Gorges.

The 300 m thick sequence of the Colţii Nadaşului with upright standing beds includes (Fig. 3): Cuciulata Limestone, mostly thin-bedded, with uneven bedding planes, some with bioglyphs and minute columnalia of *Isocrinus* (Lower Anisian); (2) red nodular Schreyeralm Limestone (1 m), with abundant juvenile specimens of bivalves, succeeded by a breccia up to 10 m thick, composed of reddish and grey-yellowish, violet stained limestones, some glauconitic, with abundant conodonts, foraminifera, crinoids (columnalia of *Encrinus*), brachiopods and scarce ammonites (Lower Anisian-Pelsonian); (3) dolomites and dolomitic limestones grading laterally into typical Steinalm Limestone, massive, light-grey, white or cream-coloured and pink stained, bioclastic, arenitic to ruditic, with abundant dasycladacean algae and foraminifera (Upper Anisian). The nodular limestone of member 2 (S. 128/2) contains such agglutinated foraminifera as *Gaudryna triassica* TRIFONOVA and *Gaudrynella kotlensis* TRIFONOVA and conodonts such as *Enantiognathus bitortus* (BENDER), *E. latus* KOZUR & MOSTLER, *Neohindeodella aequiramosa* (KOZUR & MOSTLER), *N. triassica triassica* (MÜLLER), *N. triassica reigeli* (MOSHER), *Hindeodella suevica* (TATGE), *H. pectiniformis* (HUCKRIEDE), *Hibardella magnidentata* (TATGE), *Ozorkodina kochi* HUCKRIEDE, *Prioniodina muelleri* (TATGE), *Diplododella meissneri* (TATGE), *Gondolella* cf. *bulgarica* (BUD. & STEF.), *Ketinella mexicavata* GEDIK, *K. langeri* GEDIK. From the limestones of the overlying breccia the following ammonites and brachiopods have been listed (Patrulius, 1960; Patrulius et al., 1971): *Beyrichites* sp., *Balatonites* sp., *Mentzelia ptychitiphila* (BITTNER), *Koeveskallina koeveskalyensis* (STUR), *Pexidella sturi* (BOECKH), *Volirhynchia* sp. ex gr. *V. volitans* (BITTNER), *Neoretzia* sp. ex gr. *N. pretziosa* (BITTNER). The rich conodont assemblage of the same limestones (S. 128/1, 128/1a-f) includes the following species: *Nicoraella kockeli* (TATGE), *N. germanica* (KOZUR), *Gondolella bulgarica* (BUD. & STEF.), *G. bifurcata* (BUD. & STEF.), *G. excelsa* (MOSHER), *Gladigondolella malayensis budurovi* KOVACS & KOZUR, *Kamuellerella subsymmetrica* GEDIK, *K. seymeni* GEDIK, *K. gebzeensis* GEDIK, *Ketinella langeri* GEDIK, *K. mexicavata* GEDIK, *Neohindeodella aequiramosa* KOZUR & MOSTLER, *N. triassica triassica* MÜLLER, *Hindeodella suevica* (TATGE), *H. pectiniformis* (HUCKRIEDE), *Hibardella magnidentata* (TATGE), *Ozarkodina tortilis* TATGE, *O. kochi* HUCKRIEDE, *Cornudina ? latidentata* KOZUR & MOSTLER, *C. tortilis* KOZUR & MOSTLER, *Enantiognathus ziegleri* (DIEBEL), *Diplododella meissneri* (TATGE), *Prioniodina venusta* (HUCKRIEDE), *P. muelleri* (TATGE), *Lonchodina ? posterognathus* (MOSHER), *Grodella delicatula* (MOSHER), *Anastrophgnathus sagittalis* BEN-

DER. Their foraminiferal assemblage is dominated by milliolids and nodosariids. The Steinalm Limestone contains abundant *Diplopora helvetica* PIA with scarce added specimens of *D. hexaster* PIA, *Oligoporella pilosa intusannulata* PIA, *Macroporella* sp. (Patrulius, 1970); the associated foraminifera are: diverse variostomatids, *Meandrospira dinarica* KOCH.-DEV. & PANTIČ, *Pilammina densa* (PANTIČ and scarce specimens of *Angulodiscus pragsoides* (OBERHAUSER).

The klippen of the Rica Hill (Fig. 3) exposes the following formations in ascending order: (1) massive light-coloured dolomite; (2) Cuciulata Limestone, decimetric bedded and darker in colour in the lower part, thick-bedded, grey, and locally vermiculated in the upper part; (3) a thin metric member of white dolomite; (4) a decimetric bed of Schreyeralm micritic limestone (S. 176/1) with scarce specimens of *Meandrospira pusilla*; a nearby block of grey limestones (S. 191) has yielded a rich Pelsonian assemblage of conodonts with: *Nicoraella kockeli* (TATGE), *N. germanica* (KOZUR), *Gondolella bulgarica* (BUD. & STEF.), *G. bifurcata* (BUD. & STEF.), *Gladigondolella malayensis budurovi* KOVÁCS & KOZUR, *Kamuellerella gebzeensis* GEDIK, *K. seymeni* GEDIK, *K. yurtseveri* GEDIK, *Ketinella mexicavata* GEDIK, *Enantiognathus insignis* (TATGE), *E. ziegleri* (DIEBEL), *Lonchodina ? posterognathus* (MOSHER), *Ozarkodina kochi* HUCKRIEDE, *O. tortilis* TATGE, *Anastrophognathus sagittalis* BENDER, *Prioniodina muelleri* (TATGE) and with scarce foraminifera and microechinodermata (Pl. V); (5) thick-bedded to massive light-coloured Steinalm Limestone (S. 176/2), pink stained in the base which is bioclastic, arenitic, with *Meandrospira dinarica* KOCH.-DEV. & PANTIČ), *Glomospirella grandis* (SALAJ), *Angulodiscus pragsoides* (OBERHAUSER), *Endothyranella* sp., *Oligoporella* sp. The first three members are Lower Anisian in age, the last two Upper Anisian (Pelsonian and maybe also Illyrian). It should be emphasized that in this section *Meandrospira pusilla* HO is still present in the Pelsonian.

In the klippe of the Hăghimaş Hill the lower member of the sequence is the Cuciulata Limestone. Its top consists of a breccia with fragments of grey limestone in a dolomite matrix. Thick Steinalm Limestone comes next.

The large klippe of Anisian limestones on the eastern slope of the Vârghiş Valley has a similar composition, but between the Cuciulata Limestone and the Steinalm Limestone there are in addition thin lenses of red Schreyeralm Limestone.

In the upper course of the Lupsa Stream there are two small olistoliths of Steinalm Limestone exposed on the northern bank just below a large klippe of Cuciulata Limestone. The eastern one consists of pink stained, rather fine-grained limestone with scarce brachiopods among which *Mentzelia mentzeli* (DUNKER), and poorly preserved ammonites; the western one is composed of white bioclastic calcarenites rich in dasycladacean algae (Patrulius, 1970) and foraminifera (listed by Patrulius) such as: *Diplopora subtilis* PIA, *Physoporella* aff. *prealpina* PIA, *P. minutula* (GÜMBEL), diverse variostomatids *Angulodiscus pragsoides* (OBERHAUSER), *Meandrospira dinarica* KOCH.-DEV. & PANTIČ, *Endothyranella wirzi* KOEHN-ZANINETTI.

2.2. Outliers of the Olt Nappe and derived olistoliths

Numerous klippen representing outliers of this nappe include in their lower part gabbros, dolerites, basalts, to a large extent as variolitic pillow-lava, and associated with basaltic clastics.

Younger are bostonitic porphyries and subordinate andesites (Cioflică et al., 1965). Isolated olistoliths of serpentinites are considered to be derived from the same nappe. In many instances only basalts compose the base of the klippen, but in the central part of the Perşani Mts (Olt Défilé) the volcanics mainly consist of bostonitic porphyries underlain in places by basalts or gabbros. In some outcrops the latter are crossed by porphyry veins. Closely associated with the basalts are red hematitic or black greenish radiolarian jaspers and argillaceous shales, as well as red or grey limestones, some nodular.

In the northern Perşani Mts. the sequence of pillow-lavas composing the klippe of Pârâul Rotund (south of Pârâul Caprei) includes a metric bed of red limestone, whose rich conodont assemblage (S. 2045) with: *Gondolella* cf. *timorensis* NOGAMI, *G. bulgarica* (BUDUROV et STEFANOV), *Hindeodella pectiniformis* (HUCKRIEDE), points out a Lower Anisian age. The foraminifera listed from the same bed are: *Trochammina almtalensis* KOEHN-ZANINETTI, *Ammobaculites parallelus* IRELAND, *Pilammina densa* PANTIČ (Pl. III).

In the same klippe the pillow-lavas are obtained by bostonitic porphyries. Next comes a volcanoclastic bed with angular fragments of porphyries in a clastic matrix of basalts, then light-grey to white bioclastic limestone with the following Ladinian assemblage of conodonts, near the base (S. 1269/5): *Gondolella excelsa* (MOSHER), *G. trammeri* KOZUR, *Enantiognathus ziegleri* (DIEBEL), *Neohindeodella triassica* (MÜLLER), *Prioniodina muelleri* (TATGE). It is the only klippe of the Perşani Mts which provided paleontological evidence that the base of the limestones overlying the volcanics of the Olt Nappe is Ladinian in age. In this respect it should be reminded that in the Rarău syncline the Olt 'Series' includes Upper Ladinian and

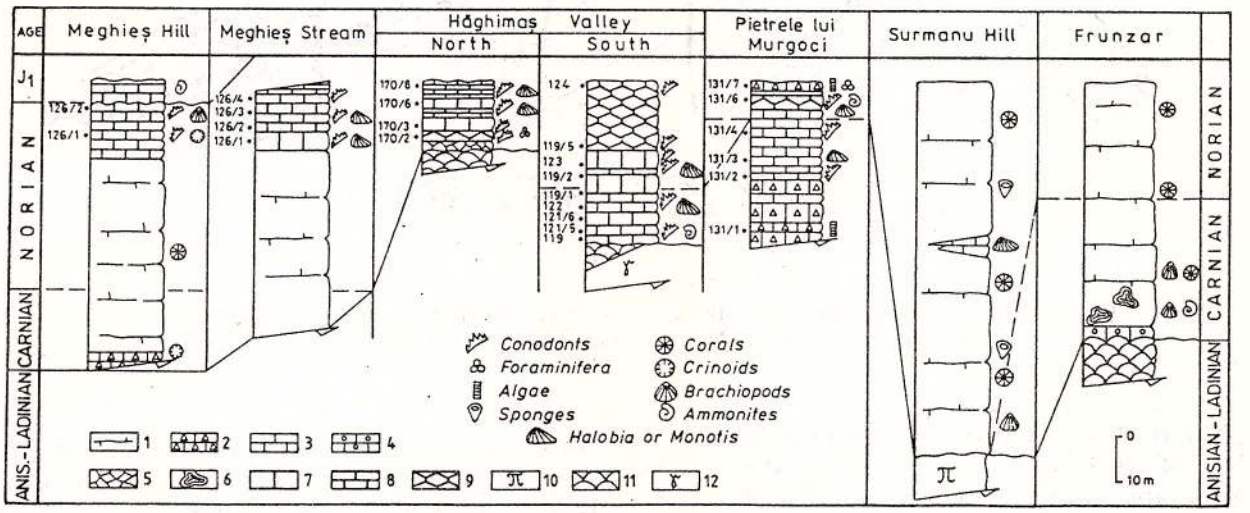

Fig. 5 – Klippen of the Olt Nappe: 1, reefold limestone; 2, calcarenite; 3, micrite & pelmicrite; 4, conglomeratic limestone; 5, limestone breccia; 6, Grossolithstruktur; 7, red Bankkalk; 8, red Plattenkalk; 9, red knolenkalk; 10, porphyry; 11, pillow lava; 12, gabbro.

Lower Carnian Hallstatt Limestones (Archelaus and Aon Zones in the olistoliths of Dealu Cailor).

According to the composition of the Upper Triassic limestones overlying the volcanics, five groups of klippen (Fig. 5) can be distinguished: (1) with Hallstatt Limestone only (Lower Carnian-Upper Norian); (2) with Hallstatt Limestone of reduced thickness above the volcanics and to the rest with massive light-coloured limestones and locally also dolomites (Carnian?-Norian); (3) with red and white Hallstatt lumachellic limestones in the middle part of the sequence, between two members of massive light-coloured bioclastic limestones (Carnian-Norian); (4) with red Hallstatt Limestone on top of light-coloured massive or thick-bedded limestones (Carnian-Middle Norian); (5) with light-coloured massive limestones and dolomites only (Upper Ladinian-Carnian, Carnian-Norian, or Norian only).

The limestones are disconformably or unconformably overlying the volcanics; in some areas they rest directly on gabbro. In two places at least the stratigraphic gap corresponding to the unconformity covers the whole of the Carnian and part of the Norian. On the northern border of the Hăghimaş Stream (west of Vârghiş) red limestone with *Monotis* includes angular fragments reworked from the underlying gabbro and further north, on the divide between the Vârghiş Valley and the Surmanu Valley, basalts are directly overlain by a late Lower Norian lumachelle with *Halobia styriaca* (MOJS.) at one end and *H. charliana* (MOJS.) at the other one. From the same limestone (S. 171/1-3) the following conodonts have been listed: *Metapolygnathus abneptis abneptis* (HUCKRIEDE), *Gondolella hallstattensis* (MOSHER) and also rich assemblage of foraminifera (Pl. II, III, IV).

If the lower part of the Olt "Series", besides volcanics and Schreyeralm Limestones, includes in addition other members, is still a matter of conjecture. We may reasonable assume that this "series" shares in common with the rock sequence of the Perşani Nappe shales with *Tirolites* and *Costatoria costata* (WINK.), maybe also Anisian thick-bedded, grey Annaberg-like limestones (Cuciulata Limestone). Such an assumption is based on the following facts: (1) in the central Perşani Mts the volcanics are in places directly underlain by Spathian shales; (2) in the southern Perşani Mts the basalts include slabs of bedded grey limestone;

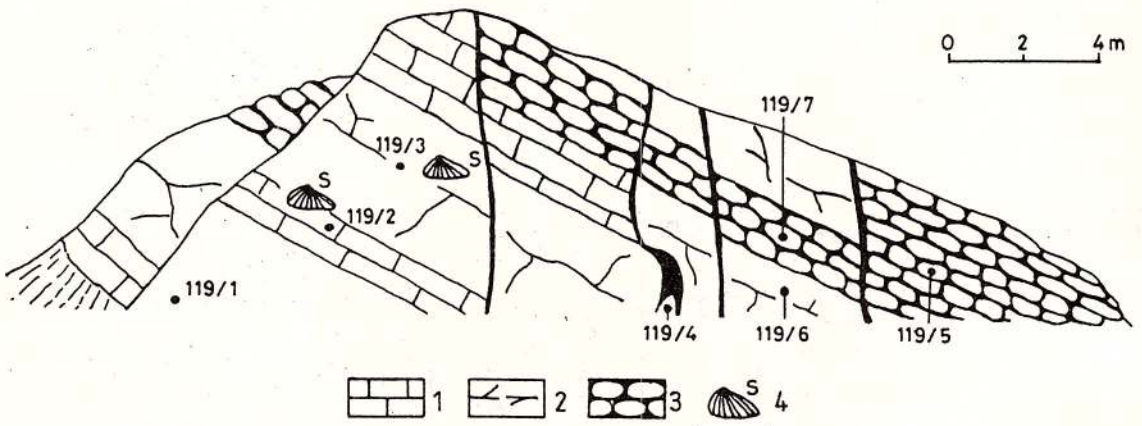

Fig. 6 – Carnian-Norian Hallstatt Limestone on the southern slope of the Hăghimaş Valley: 1, thin-bedded limestone; 2, massive limestone; 3, red nodular limestone; 4, *Halobia styriaca*.

(3) in the Comana Valley (southern Perşani Mts) the base of the Frunzar-Porţile de Piatră klippe is conglomeratic with small well rounded pebbles of grey micrite in the white Carnian limestone.

(1) Klippen of Carnian-Norian or only Norian Hallstatt Limestone overlying basalts are exposed on both sides of the Hăghimaş Stream (west of Vârghiş), as well as further north on the divide between the Hăghimaş Valley and the Surmanu Valley. On the southern slope of the Hăghimaş Valley, some 3 km west of Vârghiş, Hallstatt Limestones, 40 m thick, and underlain by pillow-lavas and gabbros, are exposed in a small quarry by the road side from Baraolt to Odorhei (Fig. 6). The lower part of this klippe, on some 15 m thickness, consists of pink, yellowish, grey, seldom red decimetric to metric bedded limestones and the upper one mainly of red nodular limestones. A slab detached from the main body of the klippe and outcropping midway between the road and the Hăghimaş Stream yielded *Ioannites* and *Sagenites* species, *Diplosphaerella radiata* K.-TOLLMANN, as well as a conodont assemblage (S. 119) with *Gondolella tadpole* HAYASHI, *Prioniodina excavata* MOSHER, *P. muelleri* (TATGE), *Enantiognathus ziegleri* (DIEBEL), *Hindeodella spengleri* (HUCKRIEDE), *H. pectiniformis* (HUCKRIEDE), *Ozarkodina tortilis* TATGE. Next to this Lower Carnian level, the base of the limestones exposed in the quarry (S. 119/1) contains such conodonts as *Gondolella noah* HAYASHI (formerly listed by Mirăuţă & Gheorghian, 1978, as *G. polygnathiformis* BUD. & STEF.), *Metapolygnathus nodosus* (HAYASHI), *M.abneptis abneptis* (HUCKRIEDE), *Prioniodina muelleri* (TATGE); in addition there are *Pseudobolivina tornata* K.-TOLLMANN and *P. globosa* K. -TOLLMANN.

Similar assemblages have also been identified at the eastern end of this klippe (SS. 121/5, 121/6, 122). Sample 121/6 contains the same species as sample 119/1 and in addition *Gondolella praeangusta* KOZUR, MIRĂUŢĂ & MOCK, and *Hindeodella suevica* (TATGE). Higher up there is a bed of grey and pink limestone with thin bands of red chert, and a lumachelle with *Halobia carnica* GRUBER and *Anatomites* sp. (top of the Upper Carnian). The assemblages of the next beds (SS. 121, 123, 119/2, 119/3, 119/6, 119/7, 119/5) are different. Their most frequent species are: *Gondolella steinbergensis* (MOSHER), *G. hallstattensis* (MOSHER) and *Metapolygnathus abneptis abneptis* (HUCKRIEDE), in addition: *Gondolella navicula* HUCKRIEDE, *Metapolygnathus abneptis spatulatus* (HAYASHI) and *M. multidentatus* (MOSHER) (119/5), *Enanthiognathus ziegleri* (DIEBEL), *Hindeodella suevica* (HUCKRIEDE), *Neohindeodella triassica* (MÜLLER), *Hibbardella magnidentata* (TATGE), *Ozarkodina tortilis* TATGE. In the lower part of this interval there is a lumachelle with *Halobia austriaca* MOJS. (121/1) and two others with *Halobia styriaca* (MOJS.) (119/2, 119/3). According to the conodonts, the interval with *Gondolella steinbergensis, G. hallstattensis* and *Metapolygnathus abneptis spatulatus* is Alaunian in age, but the *Halobia* species point out a Lower Norian age at least for its lower part. The top of the nodulár limestones is Upper Norian in age as shown by its conodont assemblage (S.124) with *Gondolella navicula* HUCKRIEDE, *G. steinbergensis* (MOSHER), *Metapolygnathus abneptis abneptis* (HUCKRIEDE), *M. posterus* (KOZUR & MOSTLER), *M. bidentatus* (MOSHER) juv.

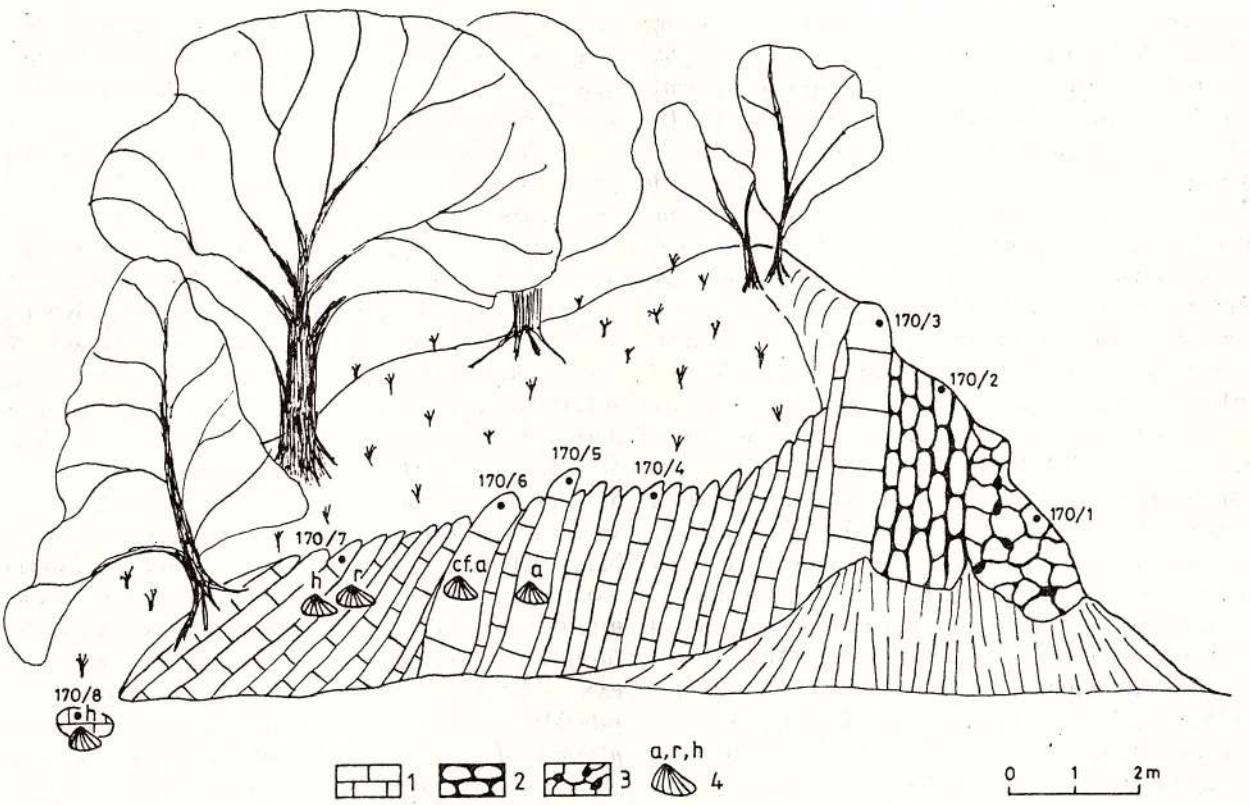

Fig. 7 – Norian Hallstatt Limestone in the Hăghimaş Valley: 1, bedded limestone; 2, red nodular limestone; 3, limestone breccia with nodules of red jaspers; 4, *Halobia* or *Monotis*: a, *Halobia austriaca*; r, *Monotis rudis*; h, *Monotis haueri*.

On the opposite side of the Hăghimaş Stream, at a lower topographic level, the 15 m thick rock of a small klippe exposes the following members (Fig. 7): (1) breccia of red limestone with reworked, scattered fragments of red jaspers; (2) nodular red limestone; (3) centimetric bedded red limestone and some submetric to metric beds of pink limestone, the upper ones with *Halobia austriaca* MOJS. (young specimens, listed by Patrulius, 1967 as *H. marmorea* KITTL) and *H.* sp. ex gr. *H. halorica* MOJS.; a large, loose block of grey and red-stained limestone standing nearby has yielded *H. fallax* MOJS. (listed as *H. tropitum* KITTL by Patrulius, 1967); (4) red and yellowish thin-bedded Flaserkalk with two lumachellic layers, the lower one with *"Monotis" hoernesi* KITTL and *M. rudis* (STOPPANI), the upper one with *Monotis haueri* KITTL. Member 2 and the base of member 3 contain scarce specimens of *Metapolygnathus abneptis abneptis* (HUCKRIEDE), foraminifera (Pl. III, IV) and microechinodermata. Higher up, to the top of member 3 (SS. 170/4, 170/5) this species is accompanied by *Metapolygnathus abneptis spatulatus* (HAYASHI), *M. posterus* (KOZUR & MOSTLER), *Gondolella navicula* HUCKRIEDE and *G. steinbergensis* MOSHER. The lumachelle with *Monotis haueri* KITTL and the overlying beds (S. 170/4) contain only *G. steinbergensis*, but a loose nearby standing block (S. 170/8), also with *Monotis haueri*, has yielded in addition *Metapolygnathus posterus* (KOZUR & MOSTLER) and *M. bidentatus* (MOSHER). Thus it seems that the interval with *M. haueri* straddles the boundary between the Middle and the Upper Norian.

(2) Klippen with Hallstatt Limestone of reduced thickness underlying massive white limestones are common in the central Perşani Mts. The Tepeia Ormenişului Hill offers a typical example of such a klippe. Its Hallstatt Limestones with poorly preserved specimens of *Cladiscites* and large species of *Arcestes* seem to be exclusively Norian in age. A lumachellic level of the overlying massive limestone, not far from the base, contains *Monotis haueri* KITTL. The massive limestones of a nearby klippe have yielded minute specimens of *Worthenia* sp. ex gr. *W. coronata* MÜNSTER.

(3) One of the rare cases of Hallstatt Limestones interfingering with white coarse-grained limestones is illustrated in the Perşani Mts by the Pietrele lui Murgoci Klippe (Fig. 5). This klippe, located on the southern slope of the Olt Défilé east of the conflu-

ence with the Tepeia Stream, exposes in ascending order the following members : (1) some 15 m of light-coloured bioclastic calcarenites and calcirudites with abundant débris of *Poikiloporella duplicata* PIA (S. 131/1) and fragments of corals, echinoderms, thick-shelled molluscs, interbedded with biomicrites with minute débris of halobiids; (2) 3 m of white biomicrite (131/2) with scattered ossicles of crinoids, juvenile specimens of halobiids and a poor conodont assemblage with *Gondolella noah* (HAYASHI) and *Enantiognathus ziegleri* (DIEBEL); (3) some 12 m of light-coloured pelmicritic limestones with a lumachellic bed with *Halobia* sp. ex gr. *H. suessi* MOJS. in the base (S. 131/3), with abundant porostromata and the following conodonts (S.131/4): *Neocavitella tatrica* (ZAWIDZKA), *Gondolella* cf. *praeangusta* KOZUR, MIRĂUŢĂ & MOCK, *G. noah* (HAYASHI), *Neohindeodella triassica triassica* (MÜLLER); (4) 2,5–3 m of compact to subnodular pink to red limestone with a rich ammonite assemblage listed by Popescu & Popa (1976) and revised by Patrulius, including *Placites placodes* (MOJS.), several arcestids among which *Arcestes* sp. ex gr. *A. acutus* (MOJS.), but no *Cladiscites* sp., *Halorites* sp. of the *Acatenati* group (transitional from *H. macer* MOJS. to *H. mitis* MOJS.), *Megaphyllites* sp.; in addition, there are halobiids at two levels: the lower one with *Halobia styriaca* (MOJS.) and *H. beyrichi* MOJS., the upper one with *H. fallax* MOJS. and *H. austriaca* MOJS. (new subspecies with sulcate auricle, identical to the specimens of the lumachelle overlying the *H. fallax* beds in the Meghieş Valley), scarce brachiopods (Iordan, 1978), among which *Austriellula dilatata* (SUESS) and *Koninckina* sp., a poor conodont assemblage with *Metapolygnathus abneptis abneptis* (HUCKRIEDE) and *Gondolella steinbergensis* (MOSHER); (5) 3 m of white bioclastic limestone with abundant algae (*Cayeuxia, Thaumatoporella, Macroporella, Gyroporella*) and such foraminifera as *Endothyra kuepperi* OBERHAUSER, *Endothyranella* cf. *wirzi* KOEHN-ZAN., *Ammobaculites* sp. and diverse variostomatids with interbeds of pink encrinitic limestones.

Considering both macrofauna and conodonts the Carnian/Norian boundary likely lies near the top of member 3 and the Lower Norian/Middle Norian boundary in the probably condensed bed with ammonites, above the level with *Halobia styriaca.*

Near Pietrele lui Murgoci, medium-sized megalodonts have been found by Dimitrescu (oral information) in scattered blocks of white limestone.

(4) The best so far known example of klippen with red Hallstatt Limestone on top of light-coloured massive limestones is illustrated by the klippe of the Meghieş Valley which extends northwards on the Meghieş Hill (northern Perşani Mts). This klippe displays an imbricated structure, with three superposed slices. In the lower slice (Meghieş Valley) (Fig. 5), assumed Carnian and Lower Norian, white massive limestones are overlain by Hallstatt Limestones whose sequence is divisible into three members: (1) thick-bedded pink or red micritic limestones (S. 125/1,2) with scattered specimens of *Halobia fallax* (MOJS.) (=*H. superbescens* KITTL), *Gondolella steinbergensis* (MOSHER), *G. hallstattensis* (MOSHER), *Metapolygnathus abneptis abneptis* (HUCKRIEDE), *M. abneptis spatulatus* (HAYASHI), *M. posterus* KOZUR & MOSTLER, *Diplododella thuringensis* KOZUR & MOSTLER, *Enantiognathus ziegleri* (DIEBEL); (2) slightly argillaceous bioclastic, more or less encrinitic dark red bedded limestones (S. 125/3-5) with *Halobia austriaca* MOJS. (new subspecies with sulcate auricle), *Koninchina leopoldiaustriae* BITTNER, *"Austrielulla" halophila* (SUESS), a similar conodont assemblage including in addition *Metapolygnathus posterus* KOZUR & MOSTLER and *Gondolella navicula* HUCKRIEDE, scarce Foraminifera such as *Pseudobolivina tornata* K.-TOLLMANN and *Gaudryina kelleri* TAPPAN, holothurian sclerites such as *Tetravirga perforata* MOSTLER, *Calclamnella nuda* MOSTLER, *Theelia planorbicula* MOSTLER; (3) slightly argillaceous micritic thin-bedded red limestones. Limestones similar to the last mentioned ones are exposed further north, on the western slope of the Vârghiş Valley just below the massive Upper Jurassic limestones which compose the huge klippe of the Mereşti gorges. There they contain a lumachelle with *Monotis haueri* KITTL and such conodonts as *Metapolygnathus bidentatus* (MOSHER) and *Gondolella steinbergensis* (MOSHER). Thus we may assume that the Hallstatt Limestones of the lower slice are Alaunian and early Sevatian in age.

In the middle slice (Meghieş Hill) some 60 m of light-coloured, thick-bedded to massive limestones, with large colonies of arborescent corals in their middle part, are overlain by: (1) grey and pink micritic limestones (S. 126/1) with *Gondolella steinbergensis* (MOSHER), *Metapolygnathus abneptis abneptis* (HUCKRIEDE), *Gaudryina kelleri* TAPPAN, *Calclamnella regularis* STEFANOV, *Kuehnites slovakensis* KOZUR & MOCK, *Achistrum monochordata* HODSON, HARRIS and LAWSON, and (2) a thick bed of red bioclastic limestones (S. 126/2) with the same species of conodonts and in addition *Gondolella hallstattensis* (MOSHER), and *Metapolygnathus abneptis spatulatus* (HAYASHI) as well as abundant brachiopods among which: *Oxycolpella eurycolpos* (BITTNER), *Fissirhynchia fissicostata* (SUESS), *Neoretzia superba* (SUESS) (*N. superbescens* BITTNER) *Aulacothyris conspicua* BITTNER, *Laballa suessi* (WINKLER), *Sinucosta emmrichi* (SUESS), *S. accerima* (BITTNER) (Patrulius et al., 1971; Iordan, 1978). According to this brachiopod assemblage, the *Oxy-*

colpella limestone at the top may be early Sevatian in age. This bed with brachiopods is unconformably overlain by bedded Sinemurian Adnet Limestone with *Paradasyceras uermosiensis* (HERBICH), *Cosmolytoceras canavarii* (BONARELLI), *Arnioceras* and *Charmasseiceras* species.[1]

Younger in age than the bed with brachiopods from the Meghieş Hill is the Hallstatt Limestone of a small, tree-stump-like olistolith exposed on the eastern bank of the Vârghiş River, just south of the Mereşti Gorges. It is a dark red limestone (S. 109) crowded with ammonites that cannot be extracted from their matrix. Its conodont assemblage (Pl. II) includes such species as: *Parvigondolella lata* KOZUR, *Metapolygnathus bidentatus* (MOSHER), *Chirodella gracilis* MOSTLER, *Neohindeodella dropla* (SPASOV & GANEV), *Prioniodina muelleri* (TATGE).

Further south another small olistolith, hidden among shrubs and consisting of white-grey encrinitic limestone, has yielded a remarkable assemblage of bivalves and brachiopods (listed by Patrulius, in press), with several genera and species so far known from the latest Triassic or only from the Lower Jurassic. This assemblage includes such bivalves as: *Oxytoma inaequivalvis* (SOWERBY) (very abundant), *Antiquilina succinta* (SCHLOTHEIM), *Pseudolimea drnavensis* (KOCKANOVA), *P.* cf. *hettangiensis* (TERQUEM) and new species, *Plagiostoma* sp. ex gr. *P. giganteum* (SOWERBY), *Pleuronectites* sp., and new species of *Praechlamys, Entolioides, Filopecten* (?), also *Gryphaea*. Among the brachiopods there are: *Fissirhynchia fissicostata* (SUESS), new species of *Fissirhynchia, Cirpa, Furcirhynchia, Fimbriothyris* and *Dispiriferina, Zeilleria norica* (SUESS), *Z. elliptica* (ZUGMAYER), *Z. moisseievi* (DAGYS), *Z.*aff. *austriaca* (ZUGMAYER), *Aulacothyris ruedti* BITTNER, new subspecies, new species of *Discinisca, "Spiriferina" haueri* (SUESS) and allied forms, *Sinucosta* sp. We are still in doubt whether this assemblage belongs to the latest Triassic or to the earliest Jurassic. It should be reminded that *Oxytoma inaequivalvis* is common to both, that Suess (1854) records the group of *"Spirifer" rostratus* (SCHLOTHEIM), *"Lima" gigantea* (SOWERBY) and *"Pecten" liasinus* NYST from the Kössen beds, *"Spirifer" emmrichi* SUESS, as well as *"Spirifer" münsteri* DAVIDSON [=*Zugmayerella keossensis* (ZUGMAYER)] from the Gresten Beds, and that the genus *Gryphaea* occurs as early as the Upper Triassic.

(5) Klippen composed of massive light-coloured Upper Triassic limestones, some with dolomites added, are fairly common both in the central and southern Perşani Mts. In the central Perşani Mts a typical example is the klippe of the Surmanu Hill (some 3 km east of Racoşu de Jos). This klippe (Fig. 5) consists almost exclusively of biodetrital and bioconstructed limestones with abundant pharetrone sponges. In its western part, midway between the base and the top, a small lens of grey micritic lumachelle with *Monotis haueri* KITTL has been quarried out. Further east, near the base, the biodetrital limestone contains a rich Norian brachiopod assemblage with: *Neoretzia fastosa* (BITT.), *Laballa suessi* (WINK.), *Koninckina leopoldiaustriae* BITT., *Amphiclina* spp., *"Rhynchonella" salinaria* BITT., *Halorella amphitoma* (BRONN.), *"Aulacothyris"* sp. ex gr. *A. kuehni* JEKELIUS. That the base of these limestones is Carnian in age, as stated by Patrulius (1973), seems unlikely. Among the similar klippen of the southern Perşani Mts, the Frunzar-Porţile de Piatră Klippe (middle course of the Comana Stream (Fig. 5) is particularly remarkable as concerns the faunal assemblage of its basal part. This assemblage, pointing out a Lower Carnian age, includes abundant brachiopods (Iordan, 1976, 1978) such as *Costispiriferina* sp. ex gr. *C. terekhovi* DAGYS, *Pexidella* sp. ex gr. *P. strohmayri* (SUESS), *Rhaetina* sp. ex gr. *R. piriformis* (SUESS), a host of bivalves and gastropods, some crinoids, echinoids and ammonites among which a species of *Lobites*, rather abundant specimens of the cycloid arthropod, *Cyclocarcinides*. Some 2 km west of Frunzar, near Comana de Sus, there is a megabreccia composed of similar Carnian and maybe also Norian limestones with such species of brachiopods as: *Tetractinella dyactis* BITT., *Neoretzia schwageri* (BITT.), *Anisactinella quadriplecta* (MÜNST.) as well as probably new species of *Pexidella, Decurtella, Aulacothyris* and *Aulacothyropsis*; in addition bivalves, abundant gastropods and echinoids are present.

Apart from the Adnet Limestone capping the Upper Triassic limestones of the Meghieş Klippe, in the central Perşani Mts, there are several olistoliths of red Lower Jurassic limestones assumed to have been derived from the Olt Nappe. These limestones are of 3 types: (1) nodular with abundant argillaceous or marly matrix (Ammonitico Rosso), (2) Flaserkalk and (3) compact, decimetric to submetric bedded. Their macrofauna consists mainly of ammonites and aulacoceratids (also belemnitids in certain crinoidal limestones) and in addition of quite scarce echinoids, gastropods, bivalves and brachiopods. Among the listed ammonites, very scarce specimens of *Whaeneroceras, Megastomoceras* and *Franziceras*, recorded by Patrulius & Popa (1969), point to a Middle Hettangian age. The bulk of the listed ammonite fauna is Upper Hettangian and Sinemurian in age (Angulata, Bucklandi, Semicostatum, Turneri, Obtusum, Rari-

[1] M. Iordan also listed some species of *Crurirhynchia* and *Caucasirhynchia* but without serial grindings to support the generic position assigned to the figured specimens.

costatum Zones). Rare specimens of *Uptonia jamesoni* Sow. point out a Lower Carixian age.

To summarize, the Olt "Series", characteristic of the Olt Nappe (upper part of the former Perşani or "Transylvanian" Nappe), includes as hypothetical lower members (Patrulius et al., 1966): Spathian shales and thin-bedded limestones with *Tirolites* and *Costatoria costata* (WINKLER), maybe also Lower Anisian, medium- to thick-bedded grey limestones. Next comes a Lower Anisian to Lower Ladinian ophiolitic complex capped by bostonitic porphyries and andesites. This complex has been subjected to deformation and deep erosion before the Upper Ladinian. The Upper Triassic rock sequence (Lower Carnian-early Upper Norian) displays two facies: red Hallstatt Limestone and light-coloured massive limestones. Some klippen expose transitional sequences from one facies to the other. Differences between the Upper Triassic rock-sequences are not only due to the facies change, but also to the stratigraphic gap that covers in many klippen the Upper Ladinian-Lower Carnian and in some, also part of the Norian. The Upper Triassic limestones are unconformably overlain by Adnet Limestone. In the central Perşani Mts, the red Lower Jurassic limestones composing olistoliths assumed to have been derived from the Olt Nappe range from the Upper Hettangian to the Lower Carixian in age.

2.3. Olistoliths with rocks of the Zimbru "Series"

Apart from the Triassic Formations building up the Perşani and Olt Nappes, the Wildflysch of the Perşani Mts incorporated isolated blocks or small lenses of limestones, whose primary connection with either the Lupşa or the Olt "Series" is highly questionable. Such allochthonous rocks of uncertain origin are exposed in Valea Oalei (a southern tributary of the Lupşa Valley) and on the northern slope of the Lupşa Valley (in a ravine facing the confluence with Pârâul Băeşilor). The outcrop in the upper course of Valea Oalei (quite close to the Anisian dolomites of the Bucovinian Nappe) includes: (1) dark grey to almost black marly shales with lumachelles of a fine ribbed species of *Halobia*; (2) grey centimetric to decimetric limestone with red argillaceous coatings of the undulated bedding planes, and with *Halobia fallax* MOJS; (3) grey centimetric bedded cherty limestone with *Halobia* cf. *fallax* and a related species reminding of *H. maximiliani* KITTL. These rocks are best comparable to the Norian ones of the Zimbru "Series" (Popi Limestone and marls with *Monotis salinaria*).

In the ravine on the northern slope of the Lupşa Valley, bituminous lumachellic marls and limestones crop out (Patrulius et al., 1966). Their fauna with *Cardinia, Unionites (?), Modiolus*, and numerous small specimens of *Promathilda (Teretrina)* and *Zygopleura* points to a depositional environment of diminished salinity. This list is useless for an accurate stage correlation, but taking into account the fact that from the Lupşa Valley a black bituminous limestone with very large megalodonts has also been recorded (Preda & Ilie, 1940), we may reasonably assume that all such limestones in the concerned area are uppermost Triassic in age, and thus probably derived from the Zimbru "Series".

2.4. Allochthonous Jurassic and Neocomian rocks of uncertain origin

2.4.1. Apart from the Adnet Limestone which, in the Meghieş Klippe is connected with the Olt "Series", and from the Racila Formation, which forms the normal cover of the Lupşa "Series", in the Perşani Mts there are Middle Jurassic, Upper Jurassic and Neocomian rocks which only occur as olistoliths so that their primary position with respect to either of the mentioned "Series" is still debatable. As allochthonous Middle Jurassic rocks should be mentioned in the central Perşani Mts (southern slope of the Olt Défilé) very hard quartzitic-limy sandstones with *Entolium*, and in the southern Perşani Mts (Pârâul Băeşilor, a southern tributary of the Lupşa Stream) Upper Bathonian-Lower Callovian marly shales with *Bositra buchi* (ROEMER) and *Paroecotraustes* sp. (Patrulius et al., 1966).

2.4.2. Especially debatable is the primary paleogeographic position of the Carhaga Formation (Patrulius & Avram, 1976; Patrulius et al., 1976), which in the central Perşani Mts builds up several sheet-olistoliths with very complex structure due to intraformational shearing and faulting. The restored sequence of the Carhaga Formation (Callovian-Hauterivian) is some 100 m thick, and includes the following members (Fig. 8): (1) Callovian grey, reddish stained limestones with angular pebbles of crystalline schists, hecticoceratids, perisphinctids and abundant phylloceratids among which *Partschiceras viator* (D'ORBIGNY) (Carhaga Valley); (2) Callovian and/or Oxfordian red jaspers and limestones with radiolaria (Carhaga Valley); (3) Upper Jurassic light-grey to almost white, pink and red marls and marly limestones with spongolitic cherts and interbedded endostratic breccia, conglomerates or breccia with pebbles of crystalline schists, thin layers of benthonite (Carhaga Valley; northern slope of the Olt Défilé); (4) Tithonian light-grey or pink marls with small lenses of calcarenites and bedded white allodapic calcarenites with brown cherts; (5) Uppermost Tithonian-Berriassian greybluish marls with some glauconite and light-grey to almost white limestones with calpionellids, radiolaria,

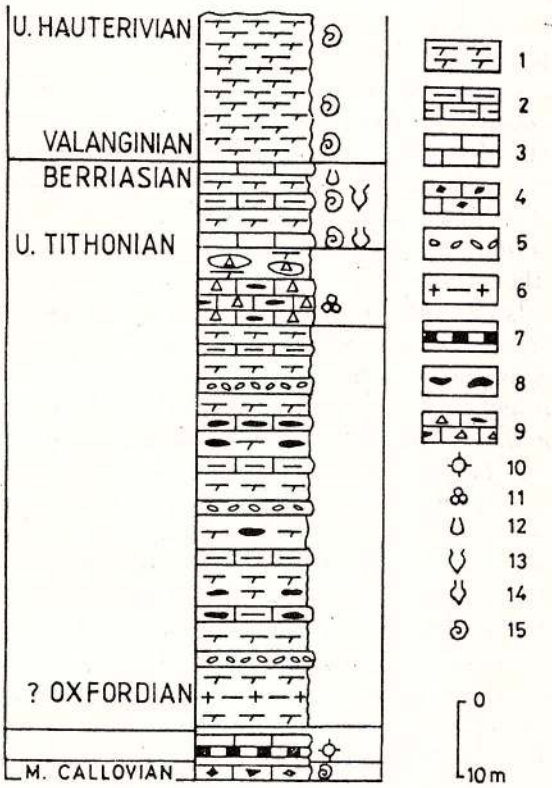

Fig. 8 – Lithological column of the Carhaga Formation: 1, marls; 2, marly limestone; 3, limestone; 4, limestone with pebbles; 5, breccia and conglomerate; 6, benthonite; 7, jasper; 8, spongolitic chert; 9, cherty calcarenite; 10, Radiolaria; 11, Foraminifera; 12, *Calpionellopsis*; 13, *Tintinopsella*; 14, *Calpionella*; 15, ammonites.

ammonites (the *Euxina*, the *Occitanica* and most probably also the Picteti-Malbasi Zones) (Carhaga Valley and Izvoru Mic): (6) Valanginian and Hauterivian soft marls with *Protancyloceras, Kilianella, Neocomites, Bochianites* species (Valanginian; Carhaga Valley, Izvoru Mic); with *Bochianites, Spitidiscus* and *Plesiospitidiscus* species, *Eleniceras transylvanicum* (JEKELIUS) (Lower Hauterivian; Chioveş Stream); with *Acrioceras (Paraspinoceras) jourdani* AST., *A. (P.) pulcherimum* (D'ORBIGNY), *A. (Protacrioceras) ornatum alpinum* SARKAR, *Crioceratites emerici* LÉVEILLÉ, *Barremites* sp. ex gr. *B. strettotoma* (UHLIG) – *B. difficile* (D'ORBIGNY), *Neolissoceras grasianum* (D'ORBIGNY) (Upper Hauterivian; Pârâul Cetăţelii).

If the Carhaga Formation was primarily linked with either the Olt or the Lupşa "Series" is quite questionable. It seems more likely that its deposition took place directly on the crystalline basement, in a rather deep water, at least in the time-span ranging from the Oxfordian to the Valanginian. According to Săndulescu (1975 a), the olistoliths composed of rocks of the Carhaga Formation are presumably derived from a swell ("ride prétransylvaine"). In our opinion, this formation represents the sediments of a starved basin bordered by a ridge. The latter supplied with crystalline schists the interbedded rudites and with white Upper Jurassic limestones the cherty allodapic calcarenites in the underlier of the Uppermost Tithonian marls.

2.4.3. Mereşti Klippen. Klippen of Upper Jurassic limestones are restricted to the northernmost part of the Perşani Mts. The largest one is cut by the Vârghiş Stream in deep gorges. South of it, on the eastern slope of the Vârghiş Valley, there are several other medium- to small-sized klippen composed of the same limestones. The base of the main klippe, well exposed on the western slope, is decimetric bedded. To the rest of limestones are thick-bedded to massive, mostly light-coloured, in places pinky-grey. The commonest varieties of these limestones are bioclastic and lithoclastic calcarenites and calcirudites, the latter unsorted, with fragmentary corals, *Cladocoropsis*, bryozoans, brachiopods, *Bacinella – Lithocodium lumps*, porostromatic nodules, thick-shelled bivalves, crinoid ossicles, minute spines of echinoids, with the interstices between the clasts filled in by pelmicrite, pelsparite to fine calcarenite and subordinate micrite. The calcarenites at the base of the main klippe contain scarce, very small, angular quartz grains. Apart from the *Bacinella-Lithocodium* growths and porostromatic nodules, the flora of these limestones includes *Thaumatoporella parvovesi culifera* RAIN., scarce dasycladaceans among which the most frequent species is *Pianella pygmaea* (GÜMBEL), and as by product of algal growth *Tubiphytes obscurus* MASLOV. Among their foraminifera the most significant species for correlation purposes are: *Protopeneroplis striata* (WEINSCHENK) *Conicospirillina basilensis* MOHLER, and *Troncholina alpina* (LEUPOLD & BIGLER). A Berriasian age for the upper part of these limestones is still to be proved.

3. POSITION AND STRUCTURE OF THE KLIPPEN

The idea that in the Perşani Mts there is more than one structural unit of Transylvanian origin was born in 1963, when we first undertook the mapping of the area crossed by the Comana and Lupşa Streams (Patrulius et al., 1966). There, quite close to the crystalline Gârbova Massif, which represents the basement of the Bucovinian Nappe, there is a large outlier of Middle Triassic basalts and Upper Triassic limestones (Olt Nappe) overthrust on the Wildflysch clays or directly on the underlying Bucovinian Upper Jurassic-Berriasian and even Middle Jurassic formations.

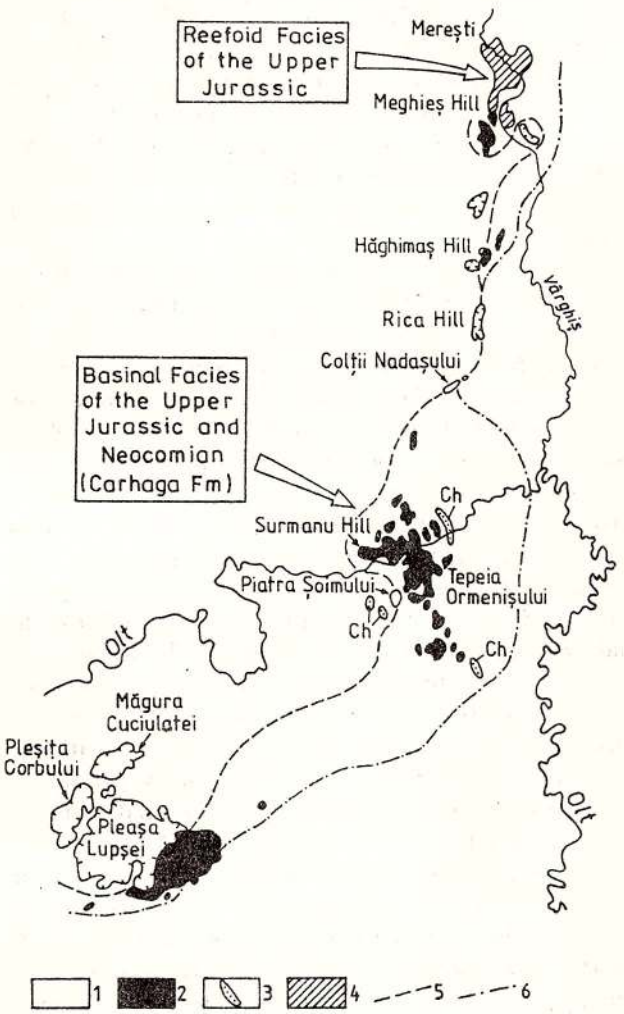

Fig. 9 – Distribution of the Klippen and olistoliths on the territory of the Perşani Mountains; 1, Perşani Nappe Klippen; 2, Olt Nappe Klippen; 3, sheet-olistoliths of the Carhaga Formation; 4, Mereşti Klippen; 5, distribution boundary of the Lupşa Series olistoliths; 6, distribution boundary of the Olt Series olistoliths.

To the west, in the upper course of the Lupşa Valley, the basalts of the Olt Nappe in their turn are overlain by Wildflysch clays and both are overthrust by klippen of Anisian limestones detached by erosion from the main body of the Perşani Nappe (Figs. 9, 10 A). The latter nappe dives westwards under the Tertiary cover of the Transylvanian Basin. The Wildflysch Formation exposed in the tectonic windows of the Perşani Nappe incorporates large slabs of Spathian shales and smaller olistoliths of Anisian limestone. In the same windows there are also huge boulders of mafic and ultramafic rocks derived from the Olt Nappe. Many of the slabs of Spathian shales, as well as the larger boulders of igneous rocks display traces of intense tectonic stress, which suggest that they were sheared off from the overriding klippen and subsequently engulfed by the plastic clays of the underlying Wildflysch.

Of particular interest is the presence of small olistoliths composed of crystalline schists (Lupşa Valley). One may suppose that these were derived from the neighbouring Gârbova Massif, but it should be noted that the Wildflysch does not contain detrital material coming from the older Mesozoic cover of the Bucovinian Nappe, although the latter, at least down to its Anisian dolomites, was uncovered by erosion before the emplacement of the Olt Nappe. This fact suggests that the Wildflysch is allochthonous, too, with respect to the present basement which it unconformably overlies. On close examination of the Wildflysch and its contact with the underlying formations of the Bucovinian Nappe one gets the firm impression that the former, detached from its original basement, has been involved in the same process of displacement as the klippen. We may even suppose that the overburden created by the klippen was one of the factors which favoured the detachment and subsequent displacement of the underlying clay mass. Thus we have good reasons to consider that the olistoliths of crystalline schists exposed in the Southern Perşani Mts have been derived from the same internal area which supplied the Wildflysch with exotic Mesozoic rocks. This means that in the source area deformation was not merely confined to the thin Mesozoic cover; it also caused the faulting of the basement. Basement tectonics offers also an explanation for the outrouting of the serpentinites.

The original low consistency, plasticity and gliding quality of the Wildflysch clayey sediments have certainly been contributing factors to the sinking, the tilting, the piling up of the overlying klippen. Local superposition of the Wildflysch clays on the nappe outliers, as in the Lupşa Valley on the western border of the Olt Nappe, does not necessarily imply a normal stratigraphic covering. We can readily imagine that clays bulging between limestone masses on the move have been pushed by the klippen in the rear over the klippen in the front, eventually resulting in tectonic wedges similar to the sedimentary flame structures. The same process of mechanical wedging may explain why the Spathian shales locally appear as slabs detached from the overlying Anisian limestones of the Perşani Nappe, with Wildflysch clays interposing between the former and the latter.

In the central Perşani Mts there is a large outlier of the Olt Nappe exposed on both sides of the Olt Défilé, dismembered by erosion into smaller klippen. As a whole this outlier is gently dipping towards the west. South of the Olt, its western border is overlain by Wildflysch clays and these, in their turn, are capped by an isolated klippe of the Perşani Nappe (Piatra

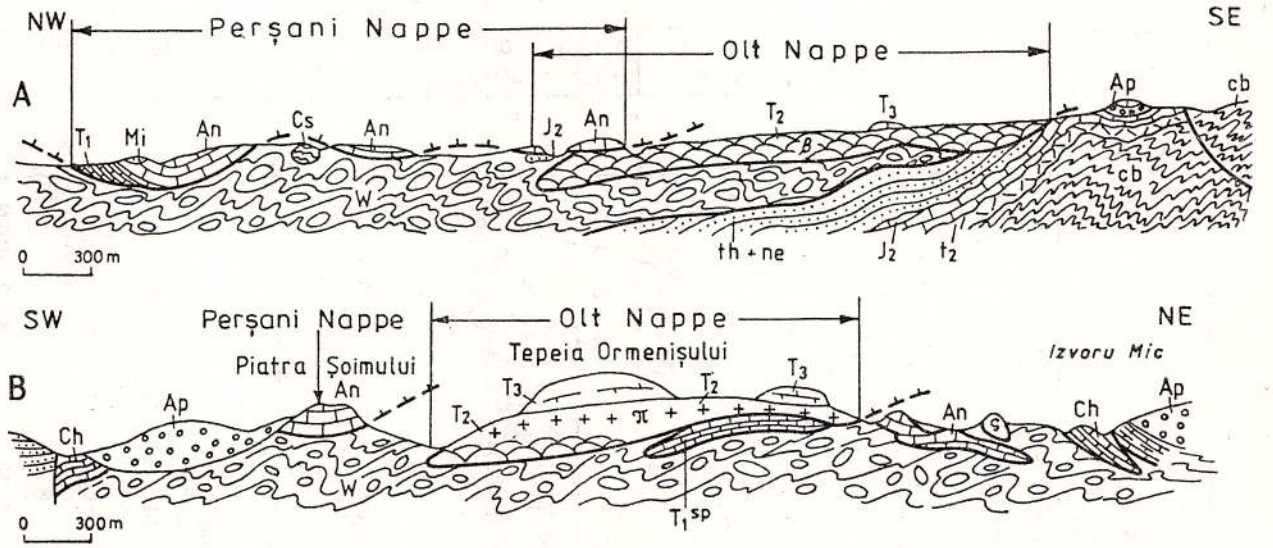

Fig. 10 – Cross sections in the Persani Mountains: A, Southern Perşani Mts; b, Central Perşani Mts. Gârbova Massif; cb, crystalline schists; t_2, Middle Triassic dolomites; j_2, Middle Jurassic limestones and sandstones; th+ne, Valea Cascadelor and Comana Formations; w, Wildflysch Formation. Olt Nappe: T_2, Middle Triassic basalts (β) and porphyries (π); T_3, Upper Triassic limestones. Perşani Nappe: T_1, Lower Triassic deposits; An, Middle Triassic limestones. Olistoliths: Cs, crystalline schists; T_1^{sp}, Spathian shales; An, Middle Triassic bedded limestones; s, serpentinites; Ch, Carhaga Formation. Post-nappe cover: Ap, Aptian conglomerates.

Şoimului), composed of red Schreyeralm Limestone and light-coloured massive Steinalm Limestone (Fig. 10 B). In this area the sole of the Olt Nappe consists mainly of bostonitic porphyries, in places underlain by basalts, basaltic breccia and gabbros. There are also klippen of serpentinites, most of them completely isolated with respect to the igneous rocks. Local contacts with either basalts or porphyries seem to be random ones. The Wildflysch underlying the Olt Nappe includes slabs of Spathian shales, some very large, as well as olistoliths of Anisian bedded limestone, basalts, gabbros, serpentinites, porphyries (rare and of small size), radiolaritic jaspers, some plastering basalts, Hallstatt and Adnet limestones (the latter rather frequent and of small size), white Upper Triassic limestones, Middle Jurassic sandstones. In addition there are blocks or small bedded slabs of Upper Jurassic and Berriasian Calpionel-limestones (Carhaga Formation), locally packed in a white marly matrix. Larger outcrops of the Callovian, Upper Jurassic and Neocomian Carhaga Formation are bordering on both sides the axial uplifted zone of the central Perşani Mts, being overlain either by a rather thin layer of tilloid conglomerates or directly by the Aptian conglomerates of the post-nappe cover. Thus the position of these outcrops suggests that the Carhaga Formation builds up sheet-olistoliths located in the uppermost part of the Wildflysch.

The exotic rocks of the Olt Défilé – except for the serpentinites – may be grouped in a single stratigraphic column with the Spathian shales at the base and the Upper Hauterivian marls of the Carhaga Formation at the top. But at closer inspection such a restoration is highly questionable. The main argument that two units with Triassic rocks are represented in the central Perşani Mts is the geometric position of the Anisian limestones of the Piatra Şoimului klippe, above the Wildflysch formation (Fig. 10 B). Of course one may infer that this klippe, sheared off from the base of the Olt Nappe, lagged behind the more rapidly advancing slice of volcanic rocks and Upper Triassic limestones. But it should be noted that the Anisian limestones capping the Wildflysch markedly differ from the ones underlying the Olt Nappe in the same area, sharing in common with the Lupşa outlier of the Perşani Nappe red Schreyeralm Limestone. On the other hand the structure of the Olt Défilé suggests that the Spathian shales outcropping here are a component part of the Olt "Series", shared in common with the Perşani "Series". In this area the slabs of Spathian shales are in many places directly underlying the volcanics of the Olt Nappe. It should be also noted that the surfaces

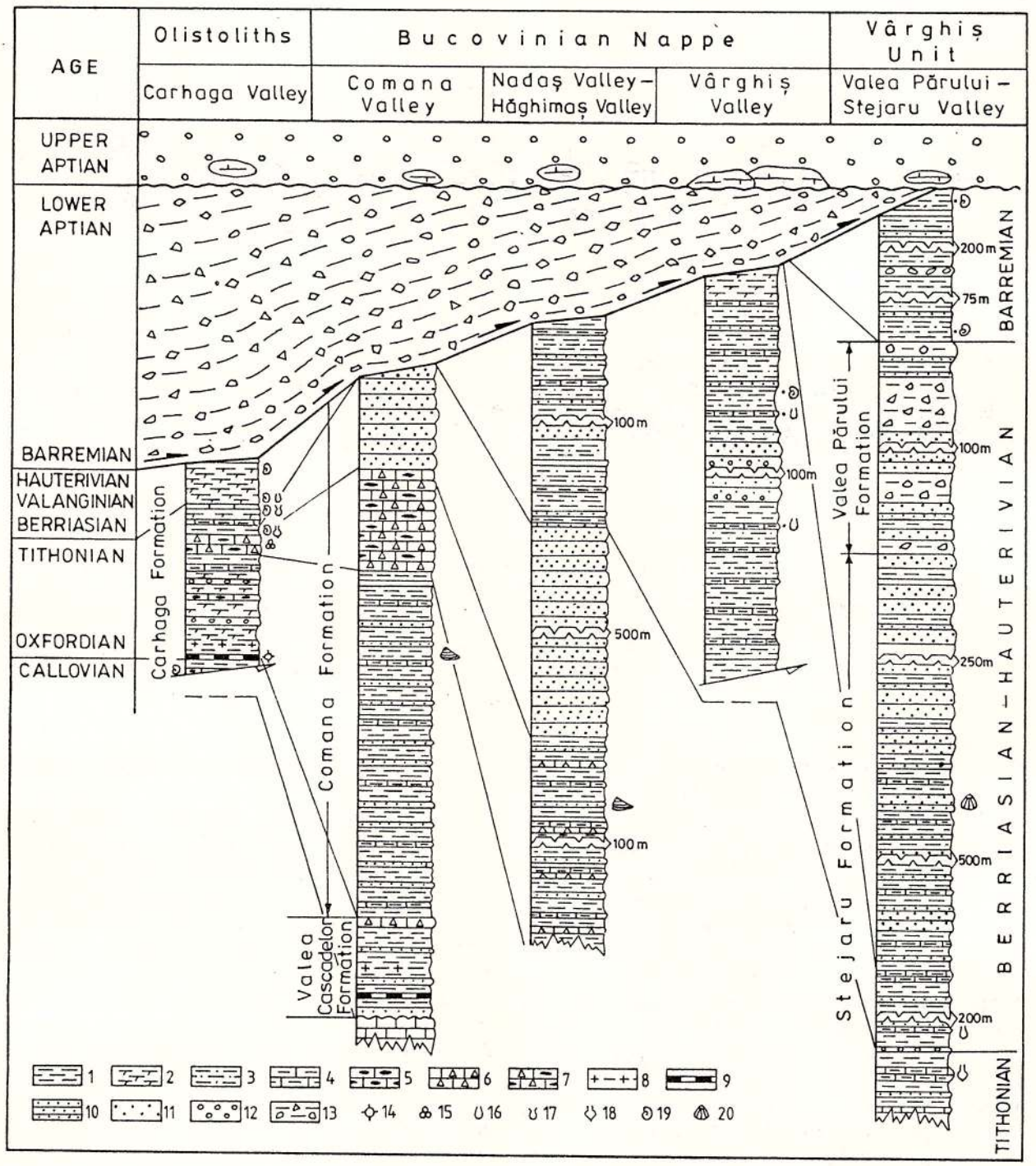

Fig. 11 – Correlated lithological columns of the Upper Jurassic and Neocomian formations in the Perşani Mountains: 1, marly and argillaceous shale; 2, marl; 3, argillaceous silty shale; 4, marly limestone; 5, cherty limestone; 6, calcarenite; 7, cherty calcarenite; 8, benthonite; 9, red jasper; 10, thin-bedded sandstone; 11, thick coarse sandstone; 12, conglomerate; 13, tilloid conglomerate with olistoliths (wildflysch); 14, Radiolaria; 15, Foraminifera; 16, *Calpionellopsis*; 17, *Tintinopsella*; 18, *Calpionella*; 19, ammonites; 20, *Peregrinella*.

covered by these shales are much larger than the ones of the olistoliths composed of bedded Anisian limestones. Thus, if the latter are also a component part of the Olt "Series", shared in common with the Perşani "Series", it is only a minor one as concerns both extension and thickness.

As we have already stated, it is debatable whether the Carhaga Formation (Callovian-Hauterivian) derives from the same area as the Triassic and Lower Jurassic rocks of the Transylvanian Nappes. Judging from the structure of the Hăghimaş Mts, where the Mesozoic exotic rocks underlying as olistoliths the Hăghimaş Nappe are Spathian shales, mafic rocks and serpentinites, Hallstatt and Adnet Limestones, one may infer that the normal stratigraphic cover of the Triassic Olt "Series" is the Jurassic-Barremian Hăghimaş "Series" (Săndulescu, 1974, 1975 a, b).

Actually the only way to approximate the original position of the Carhaga Formation is a comparison with other time equivalent formations or groups represented in the inner zones of the Carpathian Bend, such as the group of the Valea Cascadelor and Comana Formations (Patrulius et al., 1976) and the Tithonian-Neocomian Stejaru Formation (Ştefănescu & Ştefănescu, 1981) (Fig. 11). The red argillitic Valea Cascadelor Formation (Callovian-Oxfordian) overlain by the mainly pelitic flysch of the Comana Formation (Kimmeridgian-Neocomian) unconformably rests on the older Mesozoic rocks of the Bucovinian Nappe along the north-western border of the crystalline Gârbova Massif. There, the upper part of the Comana Formation includes a calcarenitic member succeeded by massive limy sandstones. The same formations reappear in the underlier of the unconformable Wildflysch formation far away to the north of Gârbova Massif, namely in the surroundings of the Vârghiş (between the Nadaş Valley and the Hăghimaş Valley). There only its upper members are exposed, represented by: (1) a mainly pelitic flysch with interbeds of white calcarenites and slightly argillaceous-silty micrites; (2) thick-bedded coarse sandstones, some 600 m thick; (3) thin-bedded flysch with fine sandstones and siltstones, some 200 m thick. Still further to the north (between the Surmanu Stream and the Vârghiş Valley) the underlier of the unconformable Wildflysch formation consists of a 250–300 m thick sequence of argillaceous to marly and silty shales with interbeds of micrites with calpionellids and also, in the middle part, with some interbeds of coarse sandstones to conglomerates. The latter, with abundant pebbles of metamorphic quartzitic rocks and only scarce pebbles of grey Upper Jurassic limestone are quite similar to the ones which compose the upper part of the Stejaru Formation. These shales are dated as Upper Berriasian by their assemblage of calpionellids. *Calpionellopsis* occurs on some 100 m thickness starting from the base. Scarce, large calpionellids are still present some 150 m higher up. In addition, the same shales contain rare aptychi. In our opinion, these shales with calpionellids and aptychi may represent the top member of the Comana Formation sheared off from its flysch substratum under the pressure generated by the clayey mass of the Wildflysch during its advance towards the east.

The Carhaga Formation shares in common with the Valea Cascadelor Formation red pelitic rocks with associated jaspers and benthonitic clays, with the tenfold thicker Comana Formation white cherty calcarenites and micritic limestones or marls with calpionellids. In comparing the Carhaga Formation with the group of the Valea Cascadelor and Comana Formations the simplest paleogeographic model to be considered is an asymmetric basin with an inner rather deep platform (Carhaga Platform) covered by pelagic mainly pelitic and carbonate sediments, and an outer strongly subsiding through supplied by flysch sediments (Comana Trough).

The Stejaru Flysch Formation belongs to a more external structural unit, the so-called "Vârghiş Unit" (Ştefănescu & Ştefănescu, 1981), which is overthrust by the Bucovinian Nappe proper. In the surroundings of Vârghiş the tectonic contact between these two units is sealed up by Upper Bedoulian-Gargasian conglomerates. The visible rock-sequence of the Vârghiş Unit is divisible into: the Stejaru Formation, the Pârâul Părului Formation and a thin-bedded Barremian flysch with abundant shales (Ştefănescu et al., 1977). The deeper visible part of the Stejaru Formation, which certainly exceeds 2000 m in thickness, consists mainly of shales and decimetric to submetric argillaceous micritic limestones; the sandstones are subordinate. They increase in frequency upwards. Where the sandstones become more abundant, scarce beds of conglomerates are added. According to Ştefănescu et al. (1977), the lower part of the Stejaru Formation contains below the lowermost visible bed of conglomerate an Upper Tithonian calpionellid assemblage with *Crassicolaria* and above it an Upper Berriasian one with *Calpionellopsis*. The upper part of the Stejaru Formation reaching some 250–300 m in thickness consists mainly of decimetric to submetric coarse, limy sandstones with rather frequent interbeds of conglomerate. Shales and argillaceous limestones are quite subordinate. The conglomerates are most characteristic, with abundant pebbles of metamorphic quartzitic rocks and scarcer pebbles to large boulders of grey Upper Jurassic limestone (micritic), fine bioclastic, pelmicritic and coarse bioclastic, with *Globochaete*, *Tubiphytes*, fragmentary shells of brachiopods and mollusca, dasycladaceans, bryozoans, corals, minute scarce quartz grains). In places there

are also, isolated or clustered, huge blocks of light-coloured limestone of the same age. The sandstone beds contain *Peregrinella multicarenata* (LAMARCK), either accumulated in lumachelles (Surmanu Stream) or as scarce loose valves, pointing to a Hauterivian age. The Stejaru Formation as a whole is similar in many respects to the Sinaia Beds of the more external Ceahlău Nappe. Actually the latter nappe mainly differs from the former only by the composition of its upper member – with breccia rich in crystalline schists – and a more prominent tectofacies. Between the Stejaru Formation and the Pârâul Părului Formation there is a gradual passage. Conglomerates with quartzitic pebbles are still present in the lower part of the latter, which to the rest consists of tilloid conglomerates and breccia. Some beds are rich in Upper Jurassic limestones with *Tubiphytes*, dasycladaceans (*Pianella), Protopeneroplis*, corals, débris of echinoderms and scarce quartz grains, whereas others, especially in the middle part of the formation, contain abundant pebbles of mafic rocks (variolitic basalts and dolerites), as well as Triassic limestones, white or red, micritic, with juvenile halobiids, crinoids and ammonites. In addition, on both sides of the Vârghiş Valley, the same formation incorporates medium-sized olistoliths composed either of mafic rocks or of Anisian dolomite and bedded grey limestone.Thus the Pârâul Părului Formation includes the first exotics of unquestionable "Transylvanian origin" to appear in the stratigraphic column, most probably in the Lower Barremian if not even in the uppermost Hauterivian, at any rate before the emplacement of the klippen subsequently incorporated as olistoliths in the Wildflysch of the Bucovinian Nappe proper. In the Pârâul Părului section (on the western slope of the Vârghiş Valley) which exposes in ascending order the Stejaru Formation, the Pârâul Părului Formation, the overthrust Neocomian shales with calpionellids considered to represent the top member of the Comana Formation and the unconformable Wildflysch formation of the Bucovinian Nappe, the latter is completely devoid of Upper Jurassic limestone pebbles or boulders. Thus it seems most likely that in time there was a turnover from a source, which during the Neocomian supplied only Upper Jurassic limestones, to a source which during the first phase of the Wildflysch deposition provided the latter with only Triassic rocks. A quite different source ought to be considered the one which towards the end of the Wildflysch deposition (assumed Lower Bedoulian) yielded sheet-olistoliths of Carhaga beds.

Along the narrow axial zone of the northern Perşani Mts there are scaterred klippen of both the Olt and the Perşani Nappes, and in the northernmost part of this zone also klippen of Upper Jurassic massive limestone (Mereşti Klippen). In this area, the section of

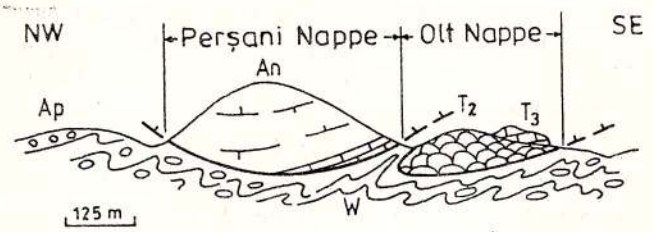

Fig. 12 – Cross-section on the southern slope of the Hăghimaş Valley: Ap, Aptian conglomerates of the post-nappe cover; w, Wildflysch Formation; Perşani Nappe: An, Anisian Cuciulata and Steinalm Limestones; Olt Nappe; T_2, Ladinian mafic rocks; T_3, Carnian-Norian Hallstatt limestones.

the Hăghimaş Valley offers another excellent example of the superposition of the Perşani Nappe on the Olt Nappe. On the southern slope of the valley a medium-sized klippe of the Olt Nappe with Carnian-Norian Hallstatt Limestone is overlain by the Anisian bedded limestones of the Hăghimaş Klippe. A narrow band of Wildflysch is wedged between the two klippen. On the opposite side of the valley the same Anisian limestones are directly overlying a large outlier of the Olt Nappe composed of basalts and Norian Hallstatt Limestone involved together in an imbricated structure (Fig. 12). The klippen of the Perşani Nappe systematically include in their upper part Steinalm Limestone. Many of these klippen are close to the outer border of the Wildflysch zone and one of them even transgresses this border, directly resting on the sandstones of the Comana Formation (Rica Klippe). Thus in the northern Perşani Mts, as opposed to the southern Perşani Mts, it seems that the klippen of the Olt Nappe have been overridden by the klippen of the Perşani Nappe. Olistoliths are not as abundant as in the southern and central Perşani Mts. Most of them consist of mafic and ultramafic rocks, a few ones of Anisian Cuciulata Limestone, Upper Triassic Hallstatt Limestone and Uppermost Triassic crinoidal limestone with abundant brachiopods.

The position of the Mereşti Klippen deserves special attention.It has been first thought that the Upper Jurassic limestones represent the normal stratigraphic overlier of the Triassic limestones assigned either to the Perşani Nappe (Ilie, 1954), or to the Transylvanian Nappe (Patrulius et al., 1966; Patrulius, 1973). This assumption resulted from the fact that on the western slope of the Vârghiş Valley the main body of Upper Jurassic limestones is directly underlain in one place by red Norian limestone with *Monotis haueri* KITTL. But on the opposite side of the valley the base of one of the klippen with Upper Jurassic limestones rests on

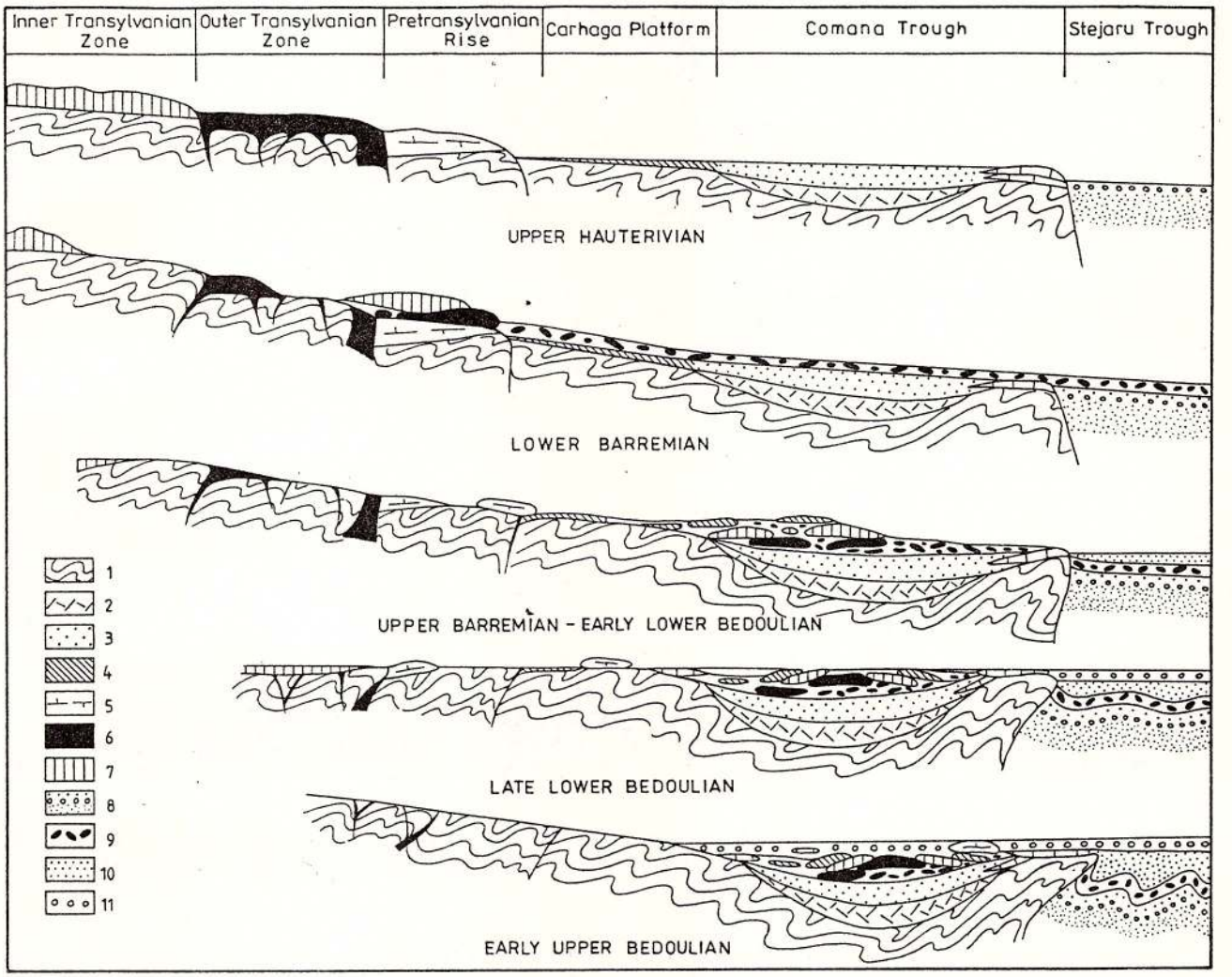

Fig. 13 – Cross sections illustrating progressive detachment and displacement of the klippen of the Perşani Mts: 1, Bucovinian basement (crystalline schists); 2, Bucovinian Triassic "Series"; 3, Comana Formation; 4, Carhaga Formation; 5, Mereşti Limestone; 6, Olt Triassic "Series"; 7, Lupşa Triassic "Series"; 8, Stejaru Formation; 9, Olistostromes (wildflysch and Pârâul Părului Formation); 10, Barremian Flysch; 11, Post-nappe cover.

a thin layer of Aptian conglomerate. On the other hand, in the surroundings of Vârghiş, the lower part of the same Aptian conglomerates includes very large boulders to small klippen of white or pink Upper Jurassic limestone. These facts prove that the emplacement of the Mereşti klippen took place after the displacement of the Transylvanian nappes came to an end in the Perşani Mts, or, in other words, during the deposition of the post-nappe conglomerates (Upper Bedoulian-Gargasian). The original paleogeographic position of the Mereşti klippen is as difficult to approximate as the one of the Carhaga Formation. The conglomerates which compose their matrix are rich in pebbles of crystalline schists and light-coloured reefoid Upper Jurassic limestones. Other significant components are "Urgonian" limestones with pachyodonts, some as huge boulders to medium-sized klippen. The "Urgonian" limestones are quite similar to the ones which compose the first member of the post-nappe cover along the borders and on top of the crystalline Gârbova Massif. Pebbles of carbonatic rocks which might be Triassic in age must be very scarce, if ever present. Thus it seems most unlikely that the Mereşti klippen have been derived from the same source area as the klippen of the Transylvanian nappes composed of Triassic and Lower Jurassic rocks.

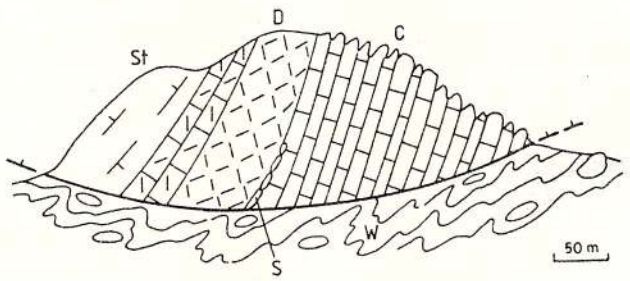

Fig. 14 – Colţii Nadaşului Klippe: w, Wildflysch Formation; C, Cuciulata Limestone; S, Schreyeralm Limestone; D, dolomites; St, Steinalm Limestone.

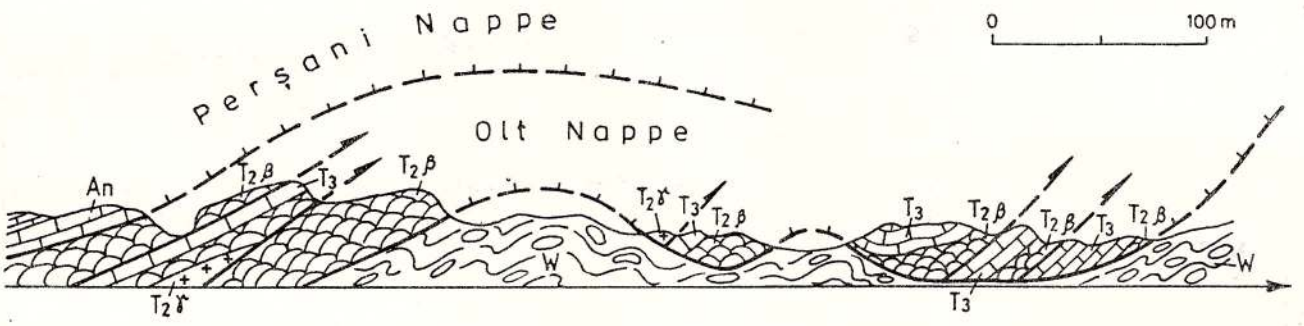

Fig. 15 – Cross section on the northern border of the Hăghimaş Valley: w, Wildflysch Formation; Olt Nappe: T_2, Ladinian basalts (β) and gabbros (π); T_3, Carnian-Norian Hallstatt Limestones; Perşani Nappe: An, Anisian Cuciulata Limestones.

In the simplest imaginable model of paleogeographic restoration, if we deploy the klippen according to the order of their present superposition, then the source area of the Mereşti klippen is the innermost one succeeded outwards by the distribution areas of the Carhaga Formation, of the Perşani Nappe, of the Olt Nappe and of the Bucovinian Mesozoic cover with the Bucovinian Triassic "Series" at the base and the Comana Formation on the top. In this model the successive upliftings which resulted in delivery of klippen occurred from the outside to the inside of the Carpathian Arc. In another more complicated model (Fig. 13), the Comana Trough is succeeded to the west by the Carhaga Platform, the source area of the Mereşti klippen (Pretransylvanian Rise or Ridge) and the zones corresponding to the Olt and the Perşani Nappes. In this model the Carhaga Platform and the Pretransylvanian Rise were uplifted and started to deliver olistoliths after being overridden by the first emplacement klippen of the Transylvanian nappes.

The klippen of the Transylvanian nappes are usually flat, lying on the Wildflysch clays. The attitude of the beds within the klippen varies from almost horizontal to vertical (Colţii Nadaşului) and even slightly reverted (western part of the Măgura Cuciulatei Outlier-Perşani Nappe). Several of the larger klippen display an inbricated structure (Lupşa Outlier and Rica Klippe of the Perşani Nappe, Meghieş Klippe and other klippen of the Olt Nappe on the northern slope of the Hăghimaş Valley).

The Lupşa Outlier is flat, lying on the Wildflysch but within each of its component slices the dips, which mainly trend towards the south-east, usually exceed 20^0 (Fig. 2). As a result of both truncation and tilting the steep Lower Jurassic beds of the lower slice come directly into contact with the Wildflysch.

The Colţii Nadaşului klippe, with its upright standing beds seems to be deeply sunken into the Wildflysch clays (Fig. 14). Smaller neighbouring klippen of Steinalm Limestone look like emerging picks of a large body buried under the clays.

In the Rica klippe the beds are dipping towards the east. In the central part of this klippe, lowered between eastwards trending faults, Steinalm Limestone

is exposed, overlain by an upper slice which consists in ascending order of Cuciulata Limestone, Schreyeralm Limestone and again Steinalm Limestone.

The northern slope of the Hăghimaş Valley (Fig. 15) exposes several rather thin imbricated slices of the Olt Nappe consisting mainly of pillow lava succeeded by bedded Norian limestones. In some gabbros it is also present in the underlier of the basalts.

South of the Meghieş Valley there is a large klippe of basalts dipping towards the north and almost completely deprived of a limestone cover. The northern part of the klippe consists of a thin slice of bostonitic porphyries overlain by a narrow band of white Carnian limestone. The basalts are overthrust on the limestones which, quite close to the tectonic contact, are bending upwards. It looks like the porphyries and the limestone cover have slipped off from their tilted basaltic substratum and, being arrested in their progress towards the north, they have been overridden by the advancing mafic rocks. The remainder of the limestone cover of this klippe might be represented by the slices which further north compose the Meghieş klippe. In this nappe there are no volcanic rocks. The lower slice is largely overlapped towards the north by the middle slice, and the latter in the same direction by the upper one.

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MICROFAUNA OF THE TRIASSIC LIMESTONES IN THE PERȘANI NAPPE

No.	MICROPALEONTOLOGICAL CONTENT	A1					A2																	
		VÂRGHIȘ VALLEY EASTERN SLOP		PLEAȘA LUPȘEI			PLEȘIȚA CORBULUI	PLEAȘA LUPȘEI		COLȚII NADAȘULUI					LUPȘA SLICE		PLEAȘA LUPȘEI		COLȚII NADAȘULUI			RÎCA HILL	
		168	164	41/1	41/2	41/3	41/4	102	40	40 bis	128/1	128/1a	128/1b	128/1c	128/1d	128/1e	182	183	41/6	42	128/2	128/2a	128/2b	191	949
1	*Neospathodus* sp.	+																							
2	*Gondolella regalis*	+	+						+	+															
3	*Neohindeodella triassica riegeli*	+								+										+		+		+	
4	*Hindeodella pectiniformis*		+							+	+	+					+			+			+		
5	*Prioniodella muelleri*		+	+					+	+	+	+	+							+		+		+	
6	*Neohindeodella aequiramosa*			+							+	+	+			+					+	+	+		
7	*Ketinella langeri*			+								+											+		
8	*Gondolella timorensis*			+	+				+	+															
9	*Gondolella bulgarica*				+			+	+	+	+	+	+	+	+	+	+			+			cf	+	
10	*Ozarkodina saginata*								+																
11	*Kamuellerella subsymmetrica*								+		+														
12	*Lonchodina ? posterognathus*								+	+	+	+			+		+							+	
13	*Enantiognathus ziegleri*								+	+	+			+					+					+	
14	*Prioniodina latidentata*									+															
15	*Enantiognathus petraeviridis*									+															
16	*Chirodella dinodoides*									+															
17	*Ozarkodina turgida*									+															
18	*Prioniodina venusta*									+	+														
19	*Cornudina ? latidentata*									+	+	+			+	+									
20	*Hindeodella suevica*									+				+								+			
21	*Hibbardella magnidentata*									+		+	+		+	+			+		+				
22	*Ozarkodina tortilis*									+	+	+	+		+	+								+	
23	*Ozarkodina kochi*									+	+	+		+		+				+	+	+		+	
24	*Nicoraella germanica*										+	+	+	+	+	+								+	
25	*Nicoraella kockeli*										+	+	+	cf	+	+		cf						+	
26	*Gondolella bifurcata*										+	+												+	
27	*Gladigondolella malayensis budurovi*										+													+	
28	*Kamuellerella seymeni*										+													+	
29	*Grodella delicatula*											+													
30	*Neohindeodella triassica triassica*											+				+					+				
31	*Diplododella meissneri*											+										+			
32	*Ketinella mexicavata*												+			+							+	+	
33	*Cornudina tortilis*														+										
34	*Gondodella excelsa*															+			+	+					
35	*Kamuellerella gebzeensis*															+								+	
36	*Anastrophognathus sagittalis*															+								+	
37	*Enantiognathus bitortus*																				+				
38	*Enantiognathus latus*																				+				
1	*Glomospira densa*	+	+				+																		
2	*Glomospirella spirillinoides*	+	+																						
3	*Trochammina* sp. 4	+					+											+							
4	*Tolypammina discoidea*	+	+																						+
5	*Gaudryinella kotlensis*	+																			+				+
6	*Gaudryina triassica*	+	+		+		+		+								+	+			+			+	+
7	*Ammosphaeroidina* sp.	+	+		+		+										+								+
8	*Gaudryina adoxa*		+																						
9	*Ammobaculites parallelus*				+				+	+															
10	*Earlandinita* sp.						+																		
11	*Pseudonosaria* sp. 2										+														
12	*Spirillina* sp.										+	+	+												
13	*? Tetrataxis inflata*										+	+	+	+	+	+									
14	*? Duostomina* sp.										+	+	+	+	+	+									
15	*Lenticulina* sp. 5										+	+		+	+	+									
16	*Frondicularia* sp. 4										+		+		+	+									
17	*Frondicularia* sp. 5										+	+	+	+	+	+									
18	*Ophthalmidium exiguum*										+	+	+	+	+	+		+							
19	*Glomospira perplexa*										+										+				
20	*Frondicularia* sp. cf. *F. lordosa*											+	+			+									
21	*Austrocolomia* sp.												+	+	+										
22	*Verneuilinoides mauritii*																							+	
1	*Fissobractites* sp. a	+		+		+				+															
2	*Fissobractites subsymetrica*			+																					
3	*Theelia immisorbicula*			+						+														+	
4	*Staurocumites bartensteini*			+						+									+					+	
5	*Tetravirga echinocucumioides*			+		+						+		+	+		+	+						+	
6	*Achistrum monochordata*									+															
7	*Priscopedatus triassicus*									+									+						
8	*Tetravirga perforata*											+	+					+						+	
9	*Praeeuphronides* sp.														+										
10	*Punctatites* sp. cf. *P. extensus*																							+	
11	*Tetravirga fordelensis*																							+	
12	*Eocaudina subhexagona*																							+	

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Plate III

Figs. 1, 2 — *Hyperamminoides* sp. (P 119/5 bis).

Figs. 3–5 — *Hyperammina sappingtonensis* GUTSKCHICK (V 110).

Figs. 6–9 — *Hyperammina casteri* CONKIN (V 110).

Fig. 10 — *Thurammina congesta* GUTSKCHICK, WEINER & YOUNG (P 122).

Figs. 11–13 — *Glomospira gordialis* (JONES & PARKER (P 171/1).

Figs. 14–15 — *Glomospirella* sp. cf. *G. spirillinoides* (GROZDILOVA & GLEBOVSKAIA) (P 170/4).

Figs. 16, 17 — *Trochamminoides* sp. cf. *T. vertens* TAPPAN (V 110).

Figs. 18, 19 — *Ammobaculites* sp. F (V 110).

Figs. 20–24 — *Ammobaculites tzankovi* (TRIFONOVA) (P 170/7).

Fig. 25 — *Placopsilina florae* TRIFONOVA (P 170/7).

Fig. 26 — *Reophax lachrymosus* (GUTSKCHICK & TRECKMAN (V 110).

Figs. 27–28 — *Spiroplectammina* sp. cf. *S. dobrudzhiana* TRIFONOVA (P 170/4).

Figs. 29–32 — *Spiroplectammina* sp. cf. *S. dobrudzhiana* TRIF. (P 119/5 bis).

Figs. 33–35 — *Pseudobolivina tornata* KRISTAN-TOLLMANN (P 119/5).

Fig. 36 — *Plagioraphe tornata* KRISTAN-TOLLMANN (P 171/1).

Figs. 37, 38 — *Plagioraphe tornata* KRISTAN-TOLLMANN (P 126).

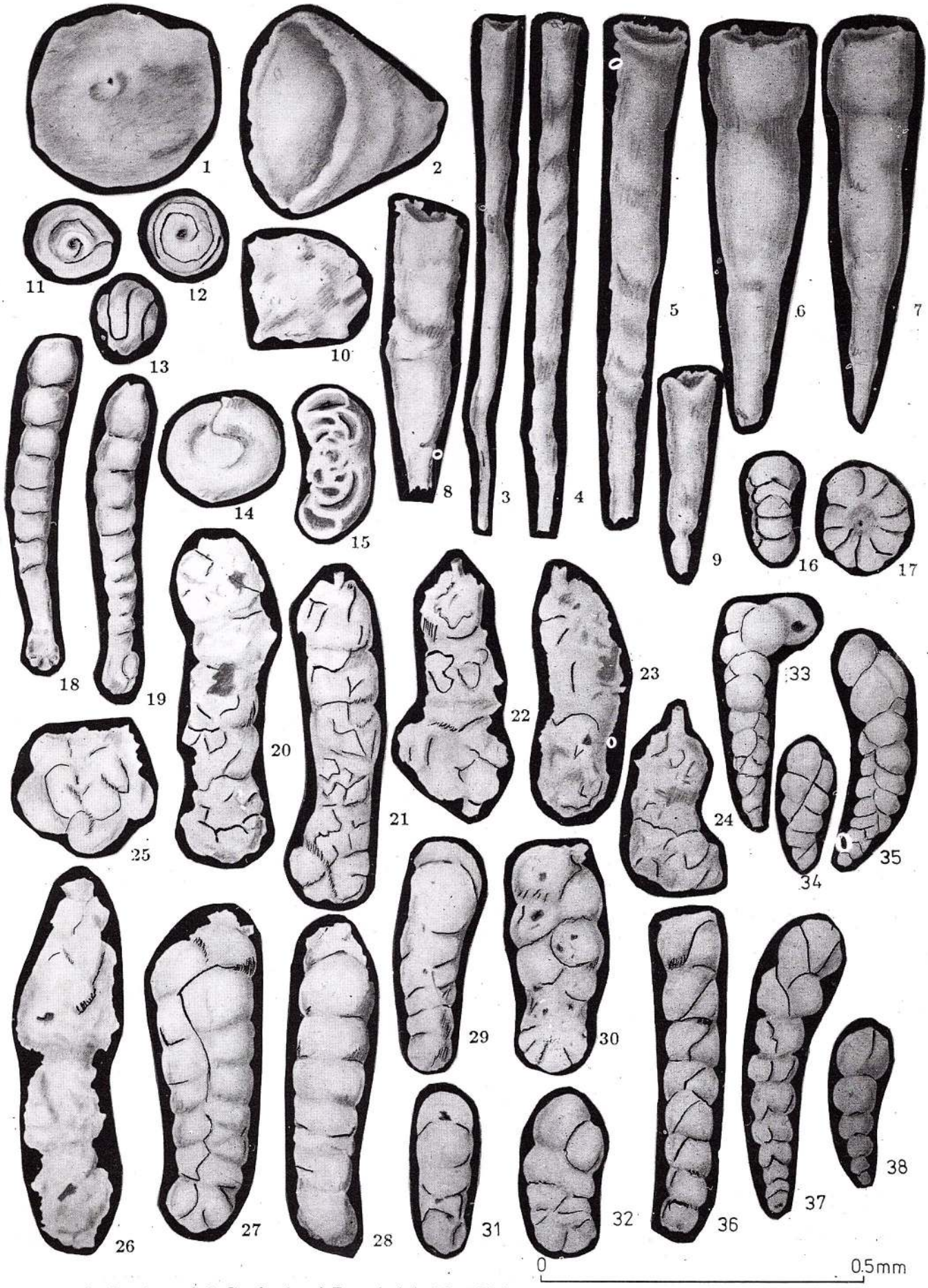

Plate IV

Figs. 1–3 — *Trochammina umbilicata* HOLZER (P 171/1).

Figs. 4–6 — *Trochammina umbilicata* HOLZER (P 119/5).

Figs. 7–9 — *Trochammina* sp. cf. *T. jaunensis* BRÖNIMANN & PAGE (P 170/7).

Figs. 10–12 — *Trochammina* sp. cf. *T. jaunensis* BRÖNIMANN & PAGE (P 119/5).

Figs. 13–15 — ? *Trochammina almtalensis* KOEHN-ZANINETTI (V 110).

Figs. 16–18 — *Trochammina alpina* KRISTAN-TOLLMANN (P 125/1).

Figs. 19–24 — *Trochammina* sp. 3 (V 110).

Figs. 25–30; 34–36 — *Trochammina* sp. 4 (2045).

Figs. 31–33 — *Trochammina* sp. 4 (P 170/1).

Figs. 37, 38 — *Endothyranella* sp. (P171/1).

Figs. 39, 40 — *Endothyranella* sp. (P 170/7).

Figs. 41, 42 — ? *Tetrataxis* sp. A (P 122).

Fig. 43 — *Gaudryina kelleri* TAPPAN (P 125/1).

Figs. 44, 45 — *Ammodiscus* sp. cf. *A. planus* (MOELLER) (P 170/4).

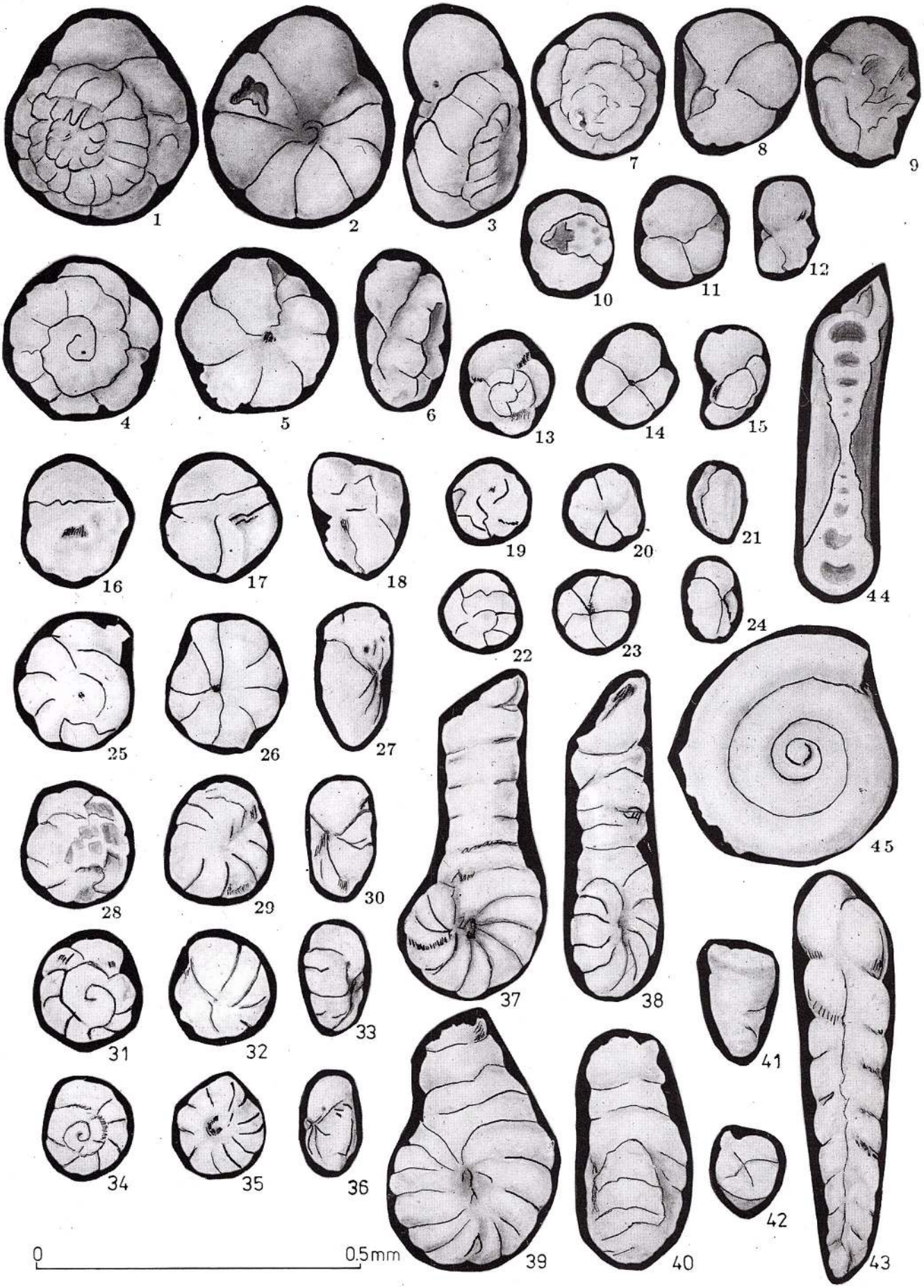

Plate V

Figs. 1–4 — *Tetravirga echinocucumioides* MOSTLER (with intermediate forms towards *T. fordelensis* (FRIZZELL & EXLIM) (P 119).

Fig. 5 — *Punctatites* sp. cf. *P. extensus* MOSTLER (P 191).

Fig. 6 — ? *Multivirga* sp. (P 191).

Figs. 7, 8 — *Acanthotheelia pseudospinera* KOZUR & MOCK (1176/7).

Figs. 9, 10 — *Theelia variabilis* ZANKL (Mereşti).

Fig. 11 — *Protocaudina rigaudae* MOSTLER (P 171/3).

Figs. 12, 13 — *Fissobractites* sp. a (P 41/1).

Figs. 14, 15 — *Staurocumites bartensteini* DEFLANDRE-RIGAUD (P 191).

Figs. 16, 17 — *Tetravirga* sp. A (P 191).

Figs. 18–20 — *Theelia planorbicula* MOSTLER (1176/7).

Fig. 21 — *Calclamnella nuda* MOSTLER (1176/7).

Fig. 22 — ? *Calclamnella* sp. cf. *C. nuda* MOSTLER (1176/7).

Fig. 23 — *Eocaudina subhexagona* GUTSCHICK, CANIS & BRILL (P 191).

Fig. 24 — Echinoids-rosette-plate (1176/7).

Fig. 25 — *Microproblematica* (1176/7).

Fig. 26 — *"Venerella" stilata* KOZUR & MOSTLER (P 41/1).

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LOWER JURASSIC AMMONITES IN THE ROMANIAN CARPATHIANS

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Key words: Biostratigraphy. Ammonite Zones. Lower Jurassic. Adnet Facies. Gresten Facies. Romanian Carpathians.

Abstract: The present review of zonal Lower Jurassic stratigraphy of the Romanian Carpathians is based on a new paleontological material studied by the authors and contained partly in archives reports. The condensed stratigraphic interval of Adnetian limestones ranges from the Liasicus to the Jamesoni Zone. The rocks of the Gresten facies have yielded rich assemblages of ammonites from the Bucklandi to the Levesquei zones.

1. INTRODUCTION

On the occasion of the International Colloquium on Mediterranean Jurassic Stratigraphy (Budapest, 1969), the authors of this study presented a paper on Lower and Middle Jurassic Ammonite zones known at that time. During the following two decades a great number of data on Lower Jurassic zone stratigraphy have been obtained, being associated with the elaboration of biostratigraphic synthesis studies of different Carpathian areas (East Carpathians - Patrulius et al., 1980, 1981; Apuseni Mountains - Patrulius et al., 1982; South Carpathians - Popa et al., 1977), the discovery of new fossiliferous sites, the revised determination of Ammonites belonging to old collections of the Geological Institute of Romania in Bucharest (Popa, 1969 b), the collection and determination in known sites. The aim of the present study is to systematize and synthesize the information contained by different published and archives reports.

The Ammonites presented and partly figured in this study come from the collections of Jekelius, Macovei, Kräutner, Preda, Răileanu, Motaş, Patrulius, Popa, Mantea to be found at the museum of the Geological Institute of Romania in Bucharest. In fact, only the specimens from the above mentioned collections are figured in the present study; as regards other citations, references to the published studies are made.

Special attention is paid to the Ammonites from Lower Jurassic deposits in Gresten facies, widely developed in the Carpathian area, in which I have taken personal interest since 1967, with respect to different Carpathian sectors (Popa, 1967, 1969 a, 1970, 1971, 1981; Popa in Popa et al., 1977; Popa in Mantea et al., 1982; Popa et al., 1985).

It should be mentioned that the chapter of the present study on Lower Jurassic in Adnet facies presents the Ammonite assemblages which I revised or specified mostly in co-operation with Patrulius (Patrulius, Popa in Patrulius et al., reports: 1980, 1981).

The Ammonite fauna has been analysed by means of the zonal scale of Dean et al. (1961), slightly adapted to other schemes (Mouterde et al., 1971) for the Lower Sinemurian-Lower Domerian interval.

The standard chronostratigraphic scale after Dean, Donovan and Howarth, adopted by the international subcommission on Jurassic stratigraphy in 1984, is very appropriate and all researchers agree on it.

2. LOWER JURASSIC FACIES

In the Romanian Carpathian area, the Lower Jurassic deposits occur in extreme facies, on the one hand (1) the Adnet facies, to be recognized only in the East Carpathians, and on the other hand (2) the Gresten facies, largely developed in all the Carpathian areas (Apuseni Mountains, South Carpathians, East Carpathians).

2.1. The Adnet Facies

In accordance with the initial definition (Hauer, 1853 and Wendt, 1969) the Adnet Beds *s.str.*

MICROFAUNA OF THE TRIASSIC LIMESTONES IN THE OLT NAPPE

No.	MICROPALEONTOLOGICAL CONTENT	A_{1-2}	L_1-L_2	C_1			C_2	C_3^3					N_2													N_2^2		N_2-N_3													
		ROTUND HILL	VALEA CAPREI	PIETRELE LUI MURGOCI		HĂGHIMAŞ VALLEY (south)										MEGHIEŞ VALLEY			HĂGHIMAŞ VALLEY (north)							HĂGHIMAŞ VALLEY (south)		MEGHIEŞ VALLEY							HĂGHIMAŞ VALLEY	HILL BETWEEN HĂGHIMAŞ V.-SURMANU S		HĂGHIMAŞ VALLEY (north)	VÂRGHIŞ VALLEY		ROTUND HILL
		2045	1269/5	131/4	131/2	119	122	119/1	121/1	121/2	121/5	121/6	119/3	119/5	119/5 bis	125/2	125/3	125/5	170/2	170/3	170/4	170/5	170/5a	170/6	170/7	119/2	119/2a	3868	1176/7	126/1	126/2	125/1	125/4	125/6	123	171/1	171/2	170/8	V109	V110	2048
1	*Gondolella timorensis*	+																																							
2	*Gondolella bulgarica*	cf																																							
3	*Gondolella excelsa*		+																																						
4	*Gondolella trammeri*		+																																						
5	*Neohindeodella triassica triassica*		+	+																																					
6	*Prioniodina muelleri*		+			+		+																															+		
7	*Enantiognathus ziegleri*		+		+	+		+				+	+			+	+									+	+			+			+								
8	*Neocavitella tatrica*			+																																					
9	*Gondolella praeangusta*			cf								+																													
10	*Gondolella noah*			+	+		+	+	+	cf	cf	cf																													
11	*Gondolella tadpole*					+																																			
12	*Prioniodina excavata*					+																																			
13	*Hindeodella spengleri*					+																																			
14	*Hindeodella pectiniformis*	+				+																																			
15	*Ozarkodina tortilis*					+									+																										
16	*Metapolygnathus nodosus*							+				+																													
17	*Metapolygnathus abneptis abneptis*							+	+			+	+	+	+	+	+	+	+	+	+	+							+	+	+		+		+		+				
18	*Gondolella oertlii*											cf																													
19	*Gondolella steinbergensis*												+		+	+	+	+			+			+	+	+	+	+	+	+	+	+	+	+	+	+	cf				
20	*Gondolella hallstattensis*												+			+						cf									+	cf		cf	+		+				
21	*Metapolygnathus abneptis spatulatus*													+	+	+	+				+								+		+	+									
22	*Metapolygnathus multidentatus*													+																											
23	"*Prioniodina prioniodellides*"													+																											
24	*Hibbardella magnidentata*														+											+	+														
25	*Gondolella navicula*																																+								
26	*Diplododella thuringensis*																+																								
27	*Metapolygnathus posterus*																					+	+										+					+			
28	*Hindeodella suevica*																									+	+														
29	*Neohindeodella triassica riegeli*																											+													
30	*Prioniodina sweeti sweeti*																																	+	+						
31	*Metapolygnathus bidentatus*																																					cf	+		
32	*Parvigondolella lata*																																						+		
33	*Chirodella gracilis*																																						+		
34	*Neohindeodella dropla*																																						+		
1	*Trochammina almtalensis*	+																																						+	
2	*Glomospira* sp. cf, *G. densa*	+																																							
3	*Ammobaculites parallelus*	+																																							
4	*Ammobaculites* sp. F.	+																																						+	
5	*Earlandinita* sp.	+																																							
6	*Trochammina* sp. 3	+																																						+	+
7	*Gaudryina triassica*	+						+	+	+	+			+	+											+	+														
8	*Trochammina* sp.	+												+	+		+								+	+	+								+						+
9	*Tolypammina discoidea*	+					+		+	+	+	+		+	+									+		+	+					+					+	+		+	
10	*Thurammina congesta*			+			+																																		
11	*Verneuilinoides mauritii*			+	+	+		+		+	+	+		+	+			+			+	+	+	+		+	+			+	+	+			+	+	+				+
12	*Frondicularia* sp. cf. *F. lordosa*					+																																			
13	*Diplosphaerella radiata*					+						+																													
14	*Hyperamminoides* sp.					+			+						+																										
15	*Glomospirella* sp. cf. *G. spirillinoides*					+		+	+		+	+									+																				
16	*Trochammina* sp. cf. *T. jaunensis*					+																																+		+	
17	*Ammodiscus* sp. cf. *A. planus*					+	+	+		+	+	+			+						+	+			+					+	+	+			+	+	+			+	
18	*Hyperammina carnica*						+																																		
19	*Ammosphaeroidea* sp.						+											+								+	+			+											
20	*Plagioraphe tornata*						+															+									+					+				+	
21	*Gaudryina adoxa*						+					+										+				+	+													+	
22	*Gaudryinella kotlensis*						+	+		+	+	+		+							+	+		+	+					+	+				+	+		+			+
23	*Pseudobolivina tornata*							+						+	+			+			+				+	+	+										+				
24	*Pseudobolivina globosa*							+																																	
25	*Glomospira gordialis*							+			+	+		+							+		+	+	+											+	+			+	+
26	*Trochammina umbilicata*													+																						+					
27	*Spiroplectammina* sp. cf. *S. dobrudzhiana*														+						+	+								+	+	+				+					
28	*Endothyranella* sp.														+						+	+			+					+					+	+	+				+
29	*Gaudryina kelleri*																	+												+	+	+			+	+	+				
30	*Trochammina alpina*																					+			+							+								+	
31	*Ammobaculites tzankovi*																							+	+												+	+		+	
32	*Placopsilina florae*																								+																
33	*Hyperammina casteri*																																				+			+	
34	*Trochamminoides* sp. cf. *T. vertens*																																				+			+	
35	*Reophax lachrymosus*																																							+	
1	"*Calclamnoidea*" *canalifera*					+		+	+	+		+																													
2	*Tetravirga gracilis*								+																																
3	*Achistrum monochordata*													+																+	+										
4	*Calclamnella nuda*													+				+											+						+						+
5	*Kuehnites inaequalis*														+																										
6	*Theelia planorbicula*																	+											+	+											
7	*Tetravirga perforata*																	+																							
8	*Calclamnella regularis*																				+									+	+										
9	? *Theelia variabilis*																												+												
10	*Theelia immisorbicula*																												+												
11	*Acanthotheelia pseudospinera*																												+												
12	*Kuehnites slovakensis*																													+											
13	*Achistrum triassicum*																													+											
14	*Calclamna consona*																															+									

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are represented by red nodular limestones bearing Cephalopods of small thickness (2-15m), developed in the Sinemurian-Lower Pliensbachian interval. They overlie discontinuously the Rhaetian reef limestones; the gap corresponds at least to the Lower Hettangian (Planorbis Zone) and the End Rhaetian. In the Adnet area (Salzburg, Austria) the sedimentation of red limestones ended during the Pliensbachian, while in other areas it went on till the Upper Aalenian (Murchisonae Zone).

The deposits in Adnet facies exhibit the following lithological types: (1) red nodular limestones with argillaceous or marly matrix (ammonitico rosso); (2) limestones of Flaserkalk type, and (3) dense limestones and decimetric to submetric layered ones.

The fauna contained by the Adnet Beds, concentrated on highly stratigraphically condensed layers, is dominated by Ammonoids; the characteristic feature consists in the abundance of phylloceratids; sparse echinoids, gastropods, bivalves, brachiopods, belemnites occur subordinately. This faunal assemblage is exclusively of Mediterranean type.

As regards the Romanian Carpathians, the Lower Jurassic rocks in Adnet facies occur in the Olt Nappe of the Transylvanian Nappe System from the East Carpathians (1. Perşani Mts; 2. Hăghimaş Mts and 3. Rarău Mts).

The Adnet limestones are represented mostly by two types: a) nodular limestones with marly matrix and b) more or less marly, partly subnodular, plate and slab stratified limestones.

The microfacies type of these limestones consists of micrites with disseminated entroques, calcareous foraminifers, bivalve fragments, echinoids, brachiopods and belemnites. Ammonites are the prevailing group in these limestones.

2.1.1. The Perşani Mountains

In the Perşani Mts the rocks in Adnet facies constitute small olistoliths, which originate in the division into fragments of the Olt Nappe, subsequently included in the Barremian-Aptian Wildflysch Formation. The stratigraphic interval of the Liassic deposits in Adnet facies from the Perşani Mts is Middle Hettangian (Liasicus Zone)-Lower Carixian (Jamesoni Zone). In the northern Perşani Mts only, within the middle scale of the Meghieş klippen (Table 1/34) the limestones of Adnet type (Lower Sinemurian) overlie discontinuously the Hallstatt Limestones (Upper Norian), which means that the Jurassic sedimentation is resumed there after a gap corresponding to the Rhaetian-Hettangian interval.

The Adnet limestone olistoliths were noticed mainly in the central Perşani Mts, on the two sides of the Olt Gorges. On their southern slope, along the Tepei Valley (Table 1/31), 2 km upstream its confluence with the Olt river, one encounters the main fossiliferous site, explored by Herbich (1878), Vadasz (1906, 1907, 1915), Jekelius (1915 - collection of the Geological Institute of Romania in Bucharest), Preda, Răileanu (1953), Popa (in Patrulius et al., 1966). The Ammonite collections were revised by Popa (1969 b, report) and Patrulius, Popa (1969). This is a stratigraphically condensed layer belonging to the Middle Hettangian-Lower Sinemurian interval.

An alignment of small olistoliths can be traced in the right slope of the Tepei Valley along its east-side tributaries (Table 1/31) and in Dealul Negru (Table 1/35), at an altitude of about 125 m from the main river bed. North of the Olt Gorges, the Adnet limestone olistoliths occur in a small valley beneath Pietrele Albe (Table 1/33), on the southern slope of Tepea Racoşului and on a small, right tributary of the Olt river, east of the Tepei Valley.

In the southern Perşani Mts a single Adnet limestone olistolith was reported (Patrulius et al., 1966) from the Stanciului Valley (Table 1/32).

The Ammonite fauna is often concentrated in the highly stratigraphically condensed beds.

The zonal inventory (Patrulius and Popa in the report by Patrulius et al., 1980) of the fossiliferous deposits occurring in the Perşani Mts area, south and north of the Olt Gorges, is the following (after revision and determinations by Patrulius, Popa of the collections belonging to Jekelius, Preda, Răileanu, Patrulius, Popa):

Liassicus Zone

Waehneroceras toxophorum (WAEHNER), *W.* sp. ex gr. *W. portlocki* (WRIGHT), *W.* sp. ex gr. *W. anisophyllum* (WAEHNER), *Franziceras* sp. aff. *F. ruidum* BUCKMAN, in Tepeul Ormeniş Valley (Pl. XV, Fig. 1 and Table 2).

Angulata Zone

Schlotheimia montana (WAEHNER), *S. pachygaster* (SUTTNER), *S. exechoptycha* WAEHNER n. ssp., *S.* sp. aff. *S. extranodosa* (WAEHNER), *S.* sp. ex gr. *S. stenorhyncha* LANGE, *Charmasseiceras marmoreum* (OPPEL), *Ectocentrites petersi* (HAUER), *Aegolytoceras* sp. in the Tepei and Stanciului Valleys (Pl. XV, Figs. 2-7).

The olistolith in the Stanciului Valley (Comana de Sus) partly consisting of red nodular limestones with abundant marly matrix contains, in its lower part, species (identified by Patrulius and Popa) assigned to Uppermost Hettangian and to the Lower Sinemurian (Pl. XV, Figs. 2, 4, 5, 8) such as: *Calliphylloceras sylvestre* (HERBICH), *Geyeroceras cylindricum* (J. SOWERBY), *Juraphyllites gigas* (FUCINI), *Ectocentrites petersi* (HAUER), *Aegolytoceras* sp., *Arnioceras*

sp., *Schlotheimia* sp., *Charmasseiceras marmoreum* (OPPEL).

Bucklandi, Semicostatum and Turneri Zones

Paracaloceras centauroides (SAVI and MENEG.), *Metophioceras* spp., *Arnioceras* spp., in Tepeul Ormenişului Valley (Pl. XIX, Fig. 1), *Metophioceras* sp., *Coroniceras lyra* HYATT, *Euagassiceras* sp., *Arnioceras* spp. in the Dealul Negru-south deposits (Pl. XV, Fig. 9; Pl. XVIII, Fig. 2). The isolated blocks occurring in the thalweg of the Tepei Valley have yielded several specimens of the species pertaining to the genera: *Arietites, Coroniceras, Paracoroniceras, Caenisites, Arnioceras, Euagassiceras.* Vadasz (1915) mentioned the species *Agassiceras scipionianum* (ORB.) from the Semicostatum Zone.

Among the numerous Phylloceratidae, Juraphillitidae and Lytoceratidae belonging to the Middle Hettangian-Lower Sinemurian interval, which occur in the Tepei Valley within a stratigraphically condensed layer, the following species are presented (Pl. XV, Fig. 8; Pl. XVI, Pl. XVII, Pl. XVIII, Figs. 1, 3): *Juraphyllites transilvanicus* (HAUER), *J. gigas* (FUCINI), *Geyeroceras cylindricum* (SOW.), *G. leptophyllum* (HAUER), *G. persanense* (HERBICH), *G. oenotrium* (FUCINI), *G. szadeczkyi* (VADASZ), *G. hungaricum* (VADASZ), *G. prinzi* (VADASZ), *Ectocentrites alutae* (HERBICH), *Dasyceras rakosense* (HERBICH), *Paradasyceras uermoesense* (HERBICH), *P. tenuilobata* RĂILEANU, *P. lunense* (DE STEF.), *Tragolytoceras herbichi* (BON.), *T. altecinctum* (HAUER), *T.* ? *simplex* (VADASZ), *Pleuroacanthites biformis* (SOW.), *Analytoceras* sp., *Phylloceras lipoldi* (HAUER), *Calliphylloceras sylvestre* (HERB.), *C. dubium* (FUCINI).

The limestones of Adnet type which overlie discontinuously the Norian limestones in the Meghieş Hill contain a Lower Sinemurian fauna (identified by Patrulius), namely: *Paradasyceras uermoesense* (HERBICH), *Ectocentrites (Cosmolytoceras) canavarii* (BONARELLI), *Charmasseiceras* sp., *Epammonites* (?) sp., *Arnioceras* sp.

Obtusum Zone

Several *Asteroceras* species, *A.* cf. *suevicum* (QUENST.) included, were reported from the Adnet limestone blocks occurring in the Tepei Valley. It should be noted that the specimen described by Vadasz as *Asteroceras obtusum* SOW. var. *vulgaris* belongs (acc. to Patrulius) to the genus *Euagassiceras.*

Oxynotum (?) Zone

No species characteristic of the Oxynotum Zone has been identified so far in the Perşani Mts. However, as far as the whole Upper Sinemurian to Lower Carixian inclusively interval, in Adnet facies, shows no lithological change typical of discontinuity, it is highly probable that this zone is also represented.

Raricostatum Zone

An assemblage characteristic of this zone is reported from the Pietrele Albe olistolith (collected by Patrulius). The following species (Pl. XIX, Figs. 3, 4, 6; Pl. XX, XXI) have been identified by Patrulius and Popa: *Echioceras* aff. *rhodanicum* (DUM.), *E. raricostatum* (ZIETEN), *Paltechioceras* sp. aff. *P. aplanatum* (HYATT), *Leptechioceras* sp., *Epideroceras* sp. aff. *E. lorioli* (HUG.), *Zettoceras bonarelli* (BETTONI), *Partschiceras* cf. *tenuistriatum* (MENEG.), *Phylloceras meneghinii* GEMM., *Calliphylloceras anatolicum* MEISTER, *C. bicicolae* (MENEG.), *C.* cf. *emeryi* (BETTONI), *Paradasyceras planispira* (REYNES), *Meneghiniceras libertus* (GEMM.).

It is also to note here the Upper Sinemurian specimens of *Adneticeras* (?) sp. aff. *A. adnethicum* ? HAUER, identified (Pl. XVIII, Fig. 4) within an olistolith occurring on the fourth right-slope tributary of the Tepei Valley.

Jamesoni Zone

An *Uptonia jamesoni* (J de C. SOWERBY) specimen (collected by Patrulius) has been reported from the first right-slope tributary of the Tepei Valley in the thalweg. Richer fauna belonging to this zone has been found by Ileana Popescu within an olistolith lying on the third right-slope tributary of the same valley. The assemblage includes, besides *Uptonia* specimens, such as *Uptonia* sp. aff. *U. jamesoni* (J. de C. SOW.) (Pl. XIX, Fig. 5), several Phylloceratidae.

Several other Ammonite species have been described or cited by Vadasz (1908) from the Olt Gorges. It is to note the abundant *Arnioceras* species assigned to the interval of Bucklandi, Semicostatum, Turneri and Obtusum Zones, such as: *Arnioceras semicostatum propinquum* FUCINI, *A. ceras* HYATT, *A.* cf. *obliquecostatus* (ZIETEN), *A. hartmanni* (OPPEL), *A.* cf. *dimorphum* PARONA, *A. speciosum* FUCINI, *A. subrejectum* (VADASZ), *A. pseudospiralis* (VADASZ), *A. carenatus antiquus* (VADASZ), *A. semilaeva* HAUER. The species *Metarnioceras althii* (HERBICH) (described by Herbich, 1878, as *Aegoceras*) is also worth mentioning.

2.1.2. The Hăghimaş Massif

The only Adnet Beds occurring in the Hăghimaş Nappe (Săndulescu, 1967, 1975) lie at the springs of Pârâul Sec (Table 1/36) in the Curmătura saddle, between Piatra Unică and Muntele Fratele, as an olistolith hosted by the Barremian-Albian Wildflysch formation. This olistolith consists of red and green argillaceous-marly shales, marls and micrite limestones, scarcely sandy, of red colour, as well as greenish thin-bedded limestones. The macrofauna inventoried by Herbich (1878), Vadasz (1915) and Grasu

(1970) consists mainly of Ammonites, out of which the following (the taxonomic nomenclature revised by Patrulius, Popa in report by Patrulius et al., 1981) are particularly relevant for the chronostratigraphic correlation:

Lower Hettangian (Planorbis Zone) - *Caloceras johnstoni* (SOW.),

Middle Hettangian (Liasicus Zone) - *Waehneroceras (Megastomoceras)* cf. *megastoma* (GUMBEL), *W.(M.) anisophyllum* (WAEHNER).

Upper Hettangian (Angulata Zone) - *Schlotheimia angulata* (SCHLOTH.), *S.* cf. *donar* WAEHNER, *S. trapezoidalis* (SOW.), *Ectocentrites petersi* (HAUER).

Lower Sinemurian (Rotiforme, Bucklandi, Semicostatum, Turneri Zones - *Metophioceras longidomus* (QUENST.), *Charmasseiceras charmassei* (ORB.), *C. marmoreum* (OPPEL), *Paracaloceras* cf. *coregonense* (SOW.), *Arietites bisulcatus* (BRUG.), *Tmaegoceras crassiceps* POM., *Arnioceras mendex rareplicatus* FUCINI, *Euagassiceras sauseanum* (ORB.), *Promicroceras planicosta* (SOW.), *Caenisites turneri* (J. de C. SOW.).

Upper Sinemurian (Obtusum and Raricostatum Zones) - *Asteroceras* cf. *stellare* (SOW.), *Echioceras raricostatoides* VADASZ, *Paradasyceras uermoesense* (HERB.), *Juraphyllites transylvanicus* (HAUER), *Schistophylloceras lunense* (DI STEF.), *S. aulonotum* (HERB.), *Geyeroceras cylindricum complanatum* FUC., *G. cylindricum bielzii* (HERB.), *G. persanense* HERB., *G. leptophyllum* (HAUER), *Partschiceras* cf. *tenuistriatum* (MENEGH.), *Calliphylloceras dubium* (FUC.), *C. sylvestre* (HERB.), Nautilods and Coleiods.

Thus, the Curmătura sequence of red shales and limestones represents the entire Hettangian (except for its bottom) and the entire Sinemurian. Besides Cephalopods, these limestones contain sparse Gastropods, Echinoderms and Brachiopods.

2.1.3. The Rarău Massif

The Lower Jurassic deposits of Adnet type, the most typical of the Transylvanian sedimentation area, are represented in the Rarău Syncline (in the Olt Series, acc. to Patrulius et al., 1981) by isolated blocks or small olistoliths included in the Barremian-Albian Wildflysch. The largest olistolith, reported for the first time by Uhlig (1900), lies in Dealul Praşca, on its slope facing Valea Seacă. It is about 50 m long and only a few meters wide. The lithological composition of this olistolith consists of red, partly argillaceous-marly, nodular or subnodular limestones. The rich Ammonite fauna, inventoried by Uhlig (1900), includes the following species (the taxonomic nomenclature revised by Patrulius and Popa in Patrulius et al., 1981): *Partschiceras partschi* (STUR.) (as *Phylloceras), Geyeroceras persanense* (HERBICH) (as *Phylloceras), Paradasyceras planispira* (REYNES) (as *Phylloceras), Harpophylloceras bucovinicus* (UHLIG) (as *Rhacophyllites), Meneghiniceras nardii* (MENEGH.) (as *Rhacophyllites), Lytoceras* aff. *secernendum* DI STEF., *Microderoceras keindli* (EMMR.) (as *Aegoceras*), *Gleviceras* sp. aff. *G. subguibalianum* PIA (as *Oxynoticeras*), *Arnioceras* n. sp. ex gr. *A. semicostatum* (as *Arietites), Paltechioceras romanicus* (UHLIG) (as *Arietites*), *P. waehneri* (UHLIG), (as *Arietites*), *P. herbichi* (UHLIG) (as *Arietites*), *P. boesei* (UHLIG) (as *Arietites*), *P. charpentieri* (SCHAF.) (as *Arietites*), *P.* n. sp. ind. (as *Arietites*), *"Arietites"* cf. *resurgens* DUM., *"Arietites"* cf. *pluricosta* (MGH.) FUCINI, *Echioceras raricostatum* (ZIET.) (as *Arietites).* The inventory presented by Uhlig (1900) also contains: *Atractites* sp., *Spiriferina aequilobata* UHLIG.

From the same fossiliferous site, Trauth (1906) (see Patrulius, Popa, 1969; Turculeţ, 1970) reported the following assemblage (taxonomic nomenclature revised by Patrulius, 1981): *"Phylloceras"* cf. *lunense* MENEG., *"Phylloceras"* cf. *leptophyllum* HAU., *Zetoceras zetes* (ORB.), *Geyeroceras cylindricum* SOW. (as *Phylloceras*), *Oxynoticeras* cf. *oxynotum* (QUENST.), *Microderoceras* aff. *nothum* MENEG., *Tmaegophioceras laevis* (GEYER) [as *Arietites saemilevis* (HAUER) in Geyer], *Paltechioceras boesei* (UHL.), *"Arietites" falcaries* var. *ceratitoides* (QN.).

A big Ammonite, yielded by the same limestones, has been identified by Răileanu as belonging to the *Asteroceras genus* (collections of the Bucharest University).

In 1980 several Ammonite specimens have been collected and identified (Patrulius, Popa in Patrulius et al., 1981) from the limestone olistolith of Adnet type in Dealul Praşca. The following are worth mentioning: *Adnethiceras* sp. aff. *A. adnethicum* (HAUER), *Tragolytoceras* sp., *Echioceras* sp. ex gr. *E. regulare* (TRUE-W.), *Paltechioceras* sp., *Pseudasteroceras* sp., *Juraphyllites* sp. (Pl. XIX, Fig. 2).

The Ammonite assemblages identified so far show that the Adnet limestones occurring in Dealul Praşca include the entire Upper Sinemurian (Obtusum, Oxynotum, Raricostatum Zones), possibly the upper part of the Lower Sinemurian (*Arnioceras* species reported by previous authors).

Turculeţ (1970) added to the above cited inventory assemblages of Brachiopods, Foraminifers, Bivalves, Gastropods, Echinoderms, fishes.

Based on varied benthonic faunas, Turculeţ (1970) assigned the limestones in Dealul Praşca to an intermediate facies between the Adnet facies and the Hierlatz one.

The Foraminifers listed by Turculeţ in 1970 are completed with a study (Patrulius et al., 1981) of the Adnet limestones occurring in Dealul Praşca.

2.2. The Gresten Facies

The initial definition of the Gresten Beds (Hauer, 1853 in Trauth, 1909) was associated with both the Lower Jurassic formation and the Lunz Sandstone from the northern Alpine area. Later, Stur (in Trauth, 1909) limited the Gresten Beds to the Liassic deposits in littoral facies from the Austrian Prealpine area.

At Gresten, the Lower Jurassic sequence consists of (Trauth, 1909): (1) a lower complex formed of arkoses, carbonaceous and middle- and coarse-grained bituminous sandstones, and of black sandy shales with coal interlayerings (7-16 layers). Both the upper part and the bottom of the coal layers have yielded plant remnants. Spherosiderites occur subordinately. These layers belong to the lower part of Lower Jurassic (probably Planorbis Zone, possibly Rhaetian-Hettangian boundary deposits); (2) the Gresten shales, of black or black-grey colour, fossil-bearing (Pleuromya Stur beds) assigned to the Upper Hettangian (Angulata Zone)-Lower Sinemurian (lower half of Bucklandi Zone); (3) the Gresten limestones, dark-coloured, associated with quartzose and with calcareous and schistous sandstones, fossil-bearing (beds containing Terebratulas, Rhynchonelas and Pectens) - Lower Sinemurian (upper half of Bucklandi Zone)-Pliensbachian.

The Gresten facies is generally characteristic of a littoral area abounding in detrital supply, while the coal occurrences point to humid temperate climate.

The Lower Jurassic coal-bearing formation is widespread in the northern hemisphere; it occurs approximately along the 45^0N parallel, from the Alps to Crimea region (the Gresten Formation) and from the Northern Caucasus to Central Asia (the Shemshak Formation) (Dercourt et al., 1986).

The fauna yielded by the Gresten Beds consists of neritic assemblages dominated by Brachiopods, Bivalves and Cephalopods (Celtic-Suabian or Submediterranean fauna). The Phylloceratids are extremely rare.

In the Romanian Carpathians, the Lower Jurassic deposits in Gresten facies occur in (1) the northern Apuseni Mts, (2) the South Carpathians, and (3) the East Carpathians. In all these areas, the field work carried out in order to draw the geological maps, scale 1:50.000, and the biostratigraphic studies (Popa, 1967, 1969 a, 1970, 1971, 1981; Popa et al., 1977, 1985; Mantea, 1985; Mantea et al., 1982; Năstăseanu, 1979) have contributed with new data to the zonal stratigraphy based on Lower Jurassic Ammonites, from the Sinemurian onwards.

The following Ammonite Zones have been recognized:

Bucklandi Zone

A small size *Arietites bucklandi* (Sow.) specimen has been identified by Răileanu (1953) in the Cuţilor Valley, on the southern part of Pădurea Craiului Mts. This Ammonite comes from fine micaceous sandstones assigned to the Poniţa Formation (Patrulius et al., 1982) and is to be found in the collection of the Bucharest University.

From the "Moneasa black limestones" assigned to the Finiş Nappe (Codru Mts - Moneasa sector), Nedelcu (1958) has reported the species *Arietites bisulcatus* Brug., encountered in the neighbourhood of Moneasa locality. The same Moneasa limestones have yielded a *Coroniceras species* (Patrulius et al., 1972).

Semicostatum and Turneri Zones

The Semicostatum Zone has been recognized by Tomescu and Bordea (1976) based on Ammonite fauna collected from the Următ Unit (Finiş Nappe - Bihor Mts). The authors mentioned above have reported the assemblage *Arnioceras* sp. ex gr. *A. semicostatum* (Y. & B.) and *Agassiceras* sp. aff. *scipionianum* (Orb.), yielded by the black limestones occurring in the Următ Complex of the Valea Mare profile.

An Ammonite from Jekelius' collection (stored at the collections of the Geological Institute of Romania in Bucharest), which has been reported from the marine sequences synchronous with the "coal-bearing complex that contains refractory clays" at Cristian-Braşov, belongs to (rev. Popa, 1969 b) the species *Angulaticeras lacunatum* (Buckman) (Pl. I, Fig. 1) (as *"Schlotheimia" lacunata* Buchman in Jekelius' collection). This species is known from the upper part of the Lower Sinemurian (it is supposed to point to the Semicostatum or Turneri Zone).

Obtusum Zone

The organogenous detrital limestones of red and grey colour, Brachiopod-bearing oolitic ones, occurring in the Lower Jurassic sequence from Munteana-Banat (south-western Carpathians) have yielded, according to Răileanu (1953) the species *Promicroceras* cf. *planicosta* (Sow.) [as *Aegoceras (Amblycoceras)* cf. *planicosta* Sow.] (revised Popa, 1977).

Jamesoni Zone

The Jamesoni Zone has yielded large specimens of *Uptonia jamesoni* (Sow.) in the Pădurea Craiului Mts (Apuseni Mts) as follows: (a) one specimen has been yielded from the middle of the "Gryphaea-bearing limestone subformation" occurring at Poniţa, southwest of the Cuţilor Gorges (Patrulius, in Ianovici et al., 1976); (b) another specimen of *Uptonia jamesoni* (Sow.) has been reported from the western slope of Boiului Valley, from the sandy limestones assigned to the same subformation (Popa, 1981), and (c) a third

specimen of the same species has been collected by Diaconu (Patrulius et al., 1982) from the yellow limestones occurring in the Peştireului Valley (north of Dealul Crucii).

A specimen of *Acanthopleuroceras rursicosta* (BUCKMAN) assigned to the Jamesoni Zone has been reported from the top of the grey and red oolitic limestones, occurring at Munteana-Banat (from the last three meters overlying the Brachiopod-bearing lumachelle) (Popa et al., 1977).

In the western South Carpathians, the Lower Jurassic deposits in Presacina facies, more precisely the base of the Ohaba Beds occurring in the Belareca Valley, have yielded (Iliescu, 1963) the species *Platypleuroceras* cf. *brevispina* (SOW.) characteristic of the lowermost Carixian (fide Mouterde in Mouterde et al., 1971).

In Northern Dobrogea (foreland of the Carpathians), at Poşta, the Lower Jurassic sandstones have yielded a small assemblage which consists of *Uptonia* cf. *jamesoni* (SOW.) and *Tropidoceras masseanum* (ORB.) assigned to Jamesoni and Ibex Zones (Macovei' collection, see Patrulius, Popa, 1969).

Ibex Zone

The Ammonites belonging to this zone, identified so far in the Romanian Carpathians, are the following: (1) *Liparoceras* sp., specimen collected from the neighbouring area of the Braşov town and figured by Jekelius (1916); (2) *Androgynoceras* sp. aff. *hybrida* (ORB.), specimen identified by Patrulius in the Hăghimaş Massif (Patrulius, Popa, 1969); (3) *Tropidoceras masseanum* (ORB.), specimen (Pl. I, Fig. 5) yielded by the Carixian calcareous sandstones occurring at Munteana-Banat (calcareous-sandy facies) (Popa in Popa et al., 1977). Another specimen assigned to the same species (Pl. II, Fig. 1) has been collected by Bleahu and Mantea from the calcareous sandstone occurrences in the Gârda Seacă Valley (Bihor Mts).

The bioclastic sparry limestones, exhibiting yellowish, reddish or violaceous alteration, of the Vălani Unit (Northern Apuseni Mts), have yielded (Preda, 1962) a *Tropidoceras* species collected from the Dealul Tabla Buşii (Câmpani- Căbeşti window); (4) the grey sparry limestones occurring on the southern tributary of the Leşului Valley (Remeţi Graben) in the Northern Apuseni Mts have yielded (Popa, 1981) the species *Beaniceras luridum* (SIMPS.) (Pl. I, Figs. 6-9) in association with various Brachiopod species.

Davoei Zone

Some small specimens of *Aegoceras* sp. (Pl. I, Fig. 4) with simple capricorn ribbing have been found (Patrulius in Patrulius, Popa, 1969) at Vadu Crişului in the Pădurea Craiului Mts (Apuseni Mts). An *Androgynoceras* sp. ex gr. *A. hibridiforme* SPATH specimen has been identified (Popa, 1981) in the Bisericii Valley from the Remeţi Graben (Northern Apuseni), in association with *Gryphaea mccullochii mccullochii* SOW. and *G. gigantea* (SOW.) species.

From the sandy limestone outcrops in the Pârâul Suhardu and at Bâtca lui Cioflec (East Carpathians), Grasu (1971) has reported the species *Aegoceras capricornum* (SCHLOTH.). This species was mentioned by Tietze in 1872 (*Ammonites capricornus* according to Tietze) and by Popa (in Popa et al., 1977) from the sandy limestone occurrences (Munteana, Southwesthern Carpathians) (Pl. II, Fig. 2). From the same site Răileanu (1960) reported the species *Liparoceras (Becheiceras) bechei* (SOW.). The same species has been reported (Grasu and Turculeţ, 1978) from the southern part of the Hăghimaş Syncline (East Carpathians), namely from the Trotuş Valley, upstream its confluence with the Strâmba Valley (Table 1/12).

Stokesi Zone

Typical specimens of *Amaltheus stokesi* (SOW.) have been found by Jekelius (Pl. II, Fig. 3) in the grey, slightly micaceous sandy siltstones occurring in the Fabricii Valley (Schneebrich), at Cristian-Braşov (as *Amaltheus margaritatus* MONTF. according to Jekelius, in collections; rev. Popa, 1969 b), by Patrulius (in Patrulius, Popa, 1969) (Pl. II, Fig. 1) and by Popa (Pl. II, Fig. 5) in the marly layers at the bottom of the horizon bearing silexites nodules assigned to Vadu Crişului (Apuseni Mts) Domerian occurrences (Popa in Patrulius et al., 1982), as well as in the grey-greenish organogenous-sandy detrital limestone occurrences at the bottom of the Munteana (Pl. II, Fig. 4) Domerian deposits (western South Carpathians) (Popa in Popa et al., 1977).

Margaritatus Zone

This zone has been identified in the surroundings of Braşov town (East Carpathians), in Pădurea Craiului (Apuseni Mts) and at Munteana (western South Carpathians).

The identified Ammonites of the Margaritatus Zone are: (1) *Amaltheus gloriosus* HYATT from Munteana, figured and described by Tietze (1872) as *Ammonites margaritatus* var. *muntjanae*; (2) *Protogrammoceras* sp. from Munteana (*Ammonites normanianus* D'ORB. according to Tietze, rev. by Patrulius and Popa, 1969); (3) *Amaltheus margaritatus* (MONTF.) identified (Pl. III, Fig. 1) at Munteana from grey-greenish calcareous sandstones and (4) *Pseudoamaltheus* sp. reported from the same site (Popa in Popa et al., 1977). The species *Amaltheus margaritatus* (MONTF.) has also been identified in the Domerian occurrences in the Remeţi Graben (Northern Apuseni) by Kräutner

(1939) and Pauliuc (1958) (Table 1/17).

Kräutner has also reported scarce *A. margaritatus* (MONTF.) specimens (Pl. III, Fig. 3) from the Lower Jurassic deposits at Vadu Crişului (Pădurea Craiului, where Patrulius (Patrulius et al., 1982) has also cited this species. This one has been identified by Diaconu (Diaconu, Ionescu, 1970) in the grey or yellow-rusty Valea Neagră marly limestones which exhibit silex lenses of Domerian age. Besides the above cited species, the Domerian fauna in the Pădurea Craiului Mts includes the species *Phylloceras frondosum* (REYNES), represented by a unique specimen found by Popa (1981) in the western slope of Boiului Valley. According to Szontagh, the fauna yielded by this formation (in Kräutner, 1939) seems to contain the species *Meneghiniceras lariense* (MENEGHINI) (rev. Popa, 1981), too.

The Domerian occurrences at Cristian-Braşov have also yielded a *Paltarpites* sp. (Pl. II, Fig. 6), belonging to Jekelius' collection (fide Popa, 1969 b).

Spinatum Zone

The most common species of this zone is *Pleuroceras solare* (PHYLL.) which has been identified in all the Carpathian sectors.

In the Perşani Mts (Sărăţii and Cascadelor Valleys) this species (Pl. III, Figs. 5, 6) has been yielded by the yellowish and reddish, in places ooidal limestones. These limestones crop out in the middle course of the Sărăţii Valley, up- and downstream its confluence with the Măguri Brook, as well as in two sites along the upper course of the Sărăţii Valley, on its slopes and in the thalweg, 30 m upstream the Toarcian fossiliferous site and 60 m downstream the latter (Table 1/9).

In the Cascadelor Valley, the Domerian limestones were identified in 1965 (Patrulius et al., 1966) in the river bed and on its eastern slope as far as the ridge, as the filling material of a crevasse in the Triassic dolomites. The limestones are no longer seen in the river bed, as they have been covered by a newly built road.

Other specimens of *Pleuroceras solare* (Pl. III, Fig. 4) have been supplied by the sparry sandstone complex at Cristian-Braşov (collected by Săndulescu) and by the grey encrinite limestones at Munteana (Western South Carpathians) assigned to the top of the Domerian (Pl. III, Fig. 7).

The specimen of *Pleuroceras solare* (PHILLIPS) (revised by Popa) mentioned by Codarcea [as *Pleuroceras costatus nudus* (QUENST)] in 1940 (see Năstăseanu, 1979) has been yielded by the Domerian deposits assigned to the Danubian Autochthon (Western South Carpathians). This specimen was collected by Codarcea from "the Ohaba Beds" (Presacina facies) which occur on the road that links the villages of Bogâltin and Presacina across Poiana Lungă (the springs of the Bolvaşniţa Valley). This specimen, determined initially by Jekelius ,is preserved in the G.I.R. collection, no 408.

Another species which occurs frequently in the Spinatum Zone is *Pleuroceras spinatum* (BRUG.). Specimens assigned to this species have been identified by Grasu (1971) in the Domerian occurrences in Pârâul Ghilcoş (Hăghimaş) (Table 1/40).

The richest assemblages of the Spinatum Zone have been reported from the Apuseni Mts. In the Remeţi Graben (the Fruntea Crest and Leşului Valley) (acc. to Thalmann in Kräutner, 1939; Pauliuc, 1958; Popa, 1981); in the Pădurea Craiului Mts (Vadu Crişului and Cuţilor Valley) (Patrulius in Patrulius et al., 1982); in the Someşul Cald Graben (Mantea et al., 1982); in the east of the Borod Basin (Diaconu, Ionescu, 1970); in the Crişanului Valley and Gârda Seacă Valley (Bihor Mts) (Popa in Popa et al., 1985) have been identified assemblages which contain the following species: *Pleuroceras solare* (PHILLIPS), *P. spinatum* (BRUG.), *P. hawskerense* (Y. et B.), *P. gigas* HOWARTH, *Aegoceras nautiliforme* (YOK.), *Arieticeras* spp. (Pl. III, Figs. 8-15).

Tenuicostatum Zone

This zone has been identified in several sites from the Pădurea Craiului Mts (Remeţi Graben, Coasta Cailor, Poniciori, Mnierei Valley), in the Someşul Cald Graben, at Cristian-Braşov and in the Zamoniţa Valley (Banat). The following species have been recorded: *Dactylioceras tenuicostatum* (Y. et B.) (Pl. IV, Fig. 1), *D. semicelatum* (SIMP.), *D. helianthoides* (YOK.) (western slope of the Boiului Valley, fide Popa, 1981), *Dactylioceras tenuicostatum* (Y. et B.) (Pl. IV, Fig. 2) (Mnierei Valley, Patrulius in Patrulius et al., 1982), *Dactylioceras semicelatum* (SIMP.) in Dealul Crucii (Coasta Cailor) (Patrulius, 1982) as well as in the Someşul Cald Graben (Mantea et al., 1982), *Dactylioceras* sp. aff. *D. acanthus* ORB. (in the Remeţi Graben, Popa, 1981).

The assemblage of *Dactylioceras tenuicostatum* (Y. et B.), *D.* cf. *semicelatum* SIMP., *D.* cf. *helianthoides* (YOK.) and *D.* aff. *crassulosum* SIMP. has been identified (Popa, 1970) in the Căldării Valley, at Cristian (Pl. IV, Figs. 3, 4). The species *Dactylioceras (Orthodactylites) semicelatum* (SIMPSON) (Pl. IV, Figs. 5, 6) has been identified at the bottom of the rock sequence assigned to the Toarcian in the Bigăr area (Banat), along the Zamoniţa Valley (Popa et al., 1977).

Falcifer Zone

Rich assemblages of this zone have been reported from the Apuseni Mts and the Banat region (Danubian Autochthon). In the East Carpathians has been found a single Ammonite specimen assigned to this

zone, represented by the species *Harpoceras mulgravium* Y. et B. (Pl. V, Fig. 4); it has been reported, together with *Hildoceras sublevisoni*, by I. Motaş (personal commun.) from blocks of the Miocene conglomerates occurring in the Teleajen Valley (Table 1/11).

The following species have been reported from the Pădurea Craiului Mts: *Harpoceras falciferum* (Sow.) (Remeţi Graben, Popa, 1981), *Harpoceras* sp. ex gr. *H. falciferum* Sow. and *Harpoceratoides alternatus* (Simp.) (Mnierei Valley, Patrulius, 1982) (Pl. V, Fig. 3), *Nodicoeloceras crassoides* (Simp.) (Boiului Valley, Popa, 1981) (Pl. IV, Fig. 7), *Harpoceras mulgravium* (Y. et B.) (Mnierei Valley and Vadu Crişului, Patrulius in Patrulius et al., 1982).

The following Ammonites belong to the Falcifer Zone of the Danubian Autochthon: *Harpoceras mulgravium* Y. et B., *H.* cf. *falciferum* (Sow.), *H. exaratum* Y. et B., *Hildaites* sp. aff. *H. serpentiniformis urkutensis* Geczy (recognized at Munteana, Popa in Popa et al., 1977) (Pl. IV, Figs. 8, 9; Pl.V, Figs. 1, 2); *Whitbiceras* sp. (Nievrei Valley, Popa in Popa et al., 1977); *Harpoceras* sp. (Zoina Valley, east of Bogâltin, Schafarzik, 1897, in Năstăseanu, 1979).

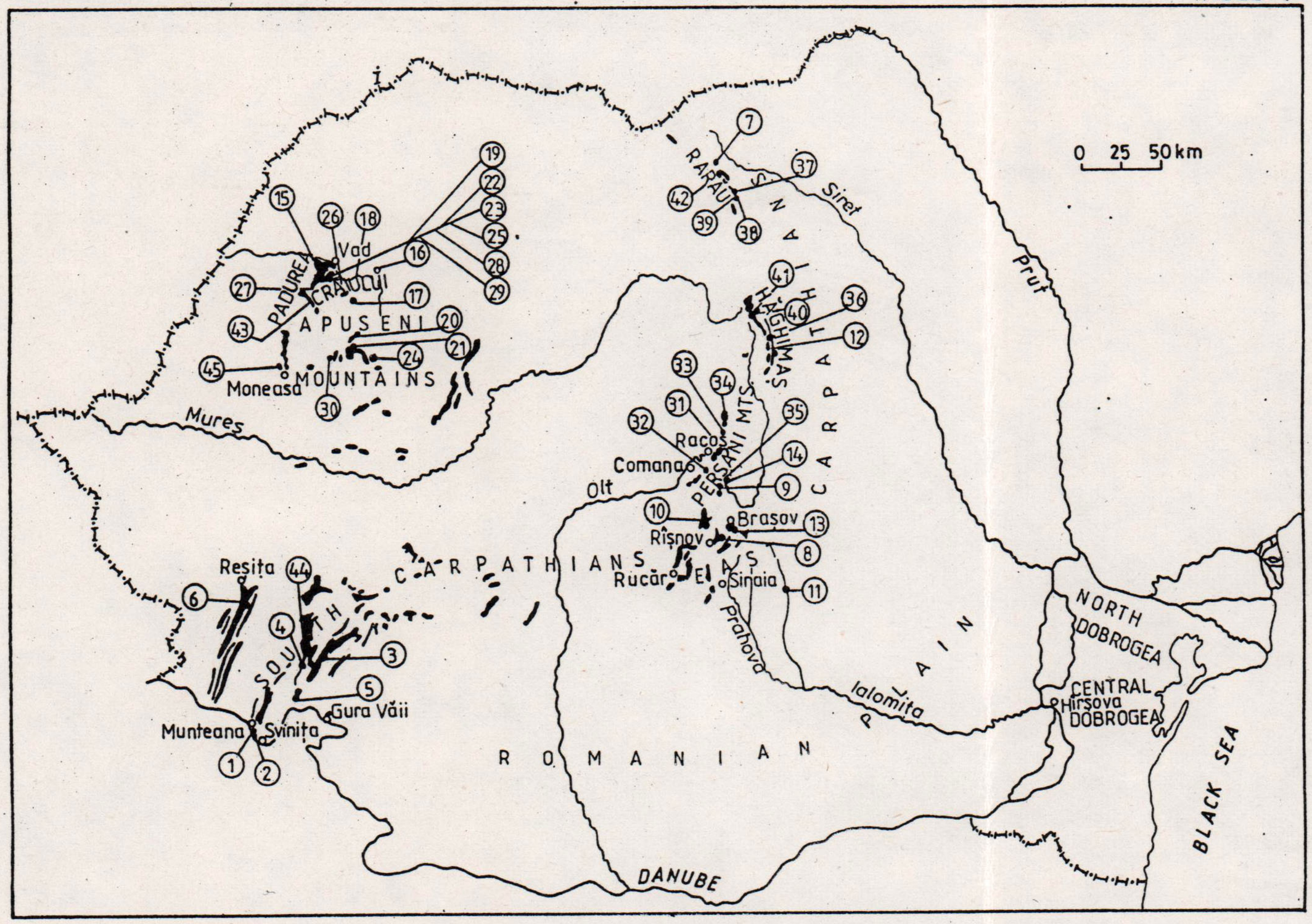
Bifrons Zone, to which are assigned: *Hildoceras bifrons* (Brug.), *H. lusitanicum* (Meister), *H. sublevisoni* (Fucini), *H. semicosta* (Buckman), *Lytoceras* sp. ex gr. *L. rhodanicum* (Monestier), *Porpoceras* sp. ex gr. *P. vortex* (Simpson), *Phymatoceras* sp. ex gr. *P. lillii* (Hauer), *Catacoeloceras* sp. ex gr. *C. jordani* (Guex) (Munteana, Pl. VII, Figs. 8, 9, 10; Pl. VIII, Figs. 1-5) (Popa in Popa et al., 1977); *Dactylioceras commune* (Sow.) and *Hildoceras* sp. (Cristian-Căldării and Cristianului Valleys) (Jekelius, 1915 and Popa, 1970), *Hildoceras sublevisoni* (Fucini) (found in blocks included in Miocene conglomerates occurring in the Teleajen Valley, collected by Motaş) (Pl. V, Fig. 6); *Hildoceras semipolitum* Buck. [as *Hildoceras bifrons* (Brug.) in Năstăseanu and Solcan, 1963, revised Patrulius, 1981] (Strâmba Valley, southernmost part of the Hăghimaş Syncline), *Peronoceras* sp. ex gr. *P. subarmatum* (Y. et B.) (Pl. V, Fig. 7) [as *Coeloceras subarmatum* (Y. et B.) in Jekelius, 1938], reported from the neighbouring areas of the Braşov town (revised Popa, 1969 b) and *Hildoceras* sp. (from Cristian, Popa, 1970); *Hildoceras sublevisoni* (Fucini), *H. bifrons* (Brug.) *H. semipolitum* Buck., *Polyplectus apenninicus* (Haas) (Remeţi Graben, Popa, 1981) (Pl. VI, Figs. 2, 3, 5, 7; Pl. VIII, Figs. 2, 3); *Hildoceras* cf. *semipolitum* Buck., *Catacoeloceras broilii* (Mitzopoulos), *Hildoceras sublevisoni* (Fucini) (Boiului Valley, Popa, 1981) (Pl. VI, Figs. 1, 6; Pl. VII, Fig. 4); *Hildoceras sublevisoni* (Fucini), *Harpoceras* sp. ex gr. *H. falciferum* (Sow.), *Dactylioceras atlethicum* (Simp.) (Mnierei Valley-Pădurea Craiului Mts, Patrulius in Patrulius et al., 1982), *H. Lusitanicum* (Meister), *Dactylioceras* sp. ex gr. *D. commune* (Sow.), *Phymatoceras* sp. (Someşul Cald Graben - Bihor Mts, Mantea et al., 1982) (Pl. VI, Figs. 10, 11; Pl. IX, Figs. 2–4); *Hildoceras lusitanicum* (Meister), *Dactylioceras atlethicum* (Simp.), *Zugodactylites* sp., *Nodicoeloceras* (?) sp. (Piatra Bulzului- Bihor Mts, Popa et al., 1985) (Pl. VII, Fig. 5; Pl. VIII, Fig. 6); *Hildoceras bifrons* (Bruguiere) (Pregusului Valley - Pădurea Craiului, Patrulius in Patrulius et al., 1982) (Pl. VI, Fig. 4); *Hildoceras sublevisoni* (Fucini), *Dactylioceras atlethicum* (Simp.), *Zugodactylites* sp., *Nodicoeloceras* sp. (Crişanului Valley - Bihor Mts, Popa et al., 1985) (Pl. VII, Figs. 6, 7), *Hildoceras semipolitum* Buck., *H. bifrons* (Brug.), *Peronoceras* sp. ex gr. *P. fibulatum* (Sow.), *Zugodactylites* sp. ex gr. *Z. braunianus* (Orb.) (Coasta Cailor - Pădurea Craiului, Patrulius in Patrulius et al., 1982) (Table 1).

Variabilis Zone to which are assigned: *Brodieia* sp. aff. *clausum* Merla (Boiului Valley - Pădurea Craiului, Popa, 1981) (Pl. IX, Fig. 5); *Haugia illustris* (Denckmann) and *Pseudolioceras* cf. *gradatum* Buck. (Piatra Arsă Peak and Alunul Mare Valley - Someşul Cald Graben, Mantea et al., 1982) (Pl. IX, Figs. 8, 9); *Pseudomercaticeras* aff. *frantzi* (Reynes) and *Denckmannia* ? sp. (Piatra Bulzului - Bihor Mts, Popa et al., 1985); *Brodieia* cf. *bayani* Dum. (Poniciori - Pădurea Craiului, Patrulius in Patrulius et al., 1982); *Phymatoceras narbonense* (Buck.) and *Catacoeloceras* sp. ex gr. *C. crassum* Phill. (Vălăul Rece and Vălăul Preguzului - Pădurea Craiului, Patrulius in Patrulius et al., 1982); *Haugia (Haugia)* sp. (Crişanului Valley, Bihor Mts, Popa et al., 1985) (Pl. IX, Figs. 6, 7); *Pachylytoceras jurense* (Ziet.) (Munteana - Banat, Răileanu, 1960).

Thouarsense Zone to which are assigned: *Grammoceras thouarsense thouarsense* (d'Orb.), *Pseudogrammoceras fallaciosum* (Bayle), *P. latescens* (Simpson), *Pseudolioceras compactile* (Simpson), *Polyplectus pluricostatus* (Haas), *Polyplectus discoides* (Zieten), *Lobolytoceras* aff. *siemensi* (Denckmann), *Denckmannia* sp. (Sărăţii Valley - Perşani Mts, Popa, 1967) (Pl. X, Figs. 1, 2, 7; Pl. XI, Figs. 1-7; Pl. XII, Figs. 1-4); *Grammoceras thouarsense thouarsense* (d'Orb.), *Pseudogrammoceras fallaciosum* (Bayle), *Phymatoceras comensis* (v. Buch) (Lucava Valley - Rarău, Stănoiu, 1967; Patrulius et al., 1982); *Pseudogrammoceras struckmanni* (Denk.) (Codlea - collection Vâlceanu rev. Patrulius); *Pseudogrammoceras fallaciosum* (Bayle) (as *P. cotteswoldiae* Buckm.) (Izvoru Malului Valley - Rarău, Turculeţ, 1971 in Patrulius et al., 1981); *Pseudogrammoceras fallaciosum* (Bayle) (Munteana - Banat, Popa et al., 1977) (Pl.

LOCATION OF MAIN FOSSILIFEROUS SITES YIELDING LOWER JURASSIC AMMONITES IN THE ROMANIAN CARPATHIANS

TABLE 1



1 Munteana (South Carpathians)
2 Zamonița Valley
3 Nievra Valley
4 Poiana Lungă
5 Belareca Valley
6 Reșița
7 Lucava Valley (Rarău Massif)
8 Cristian
9 Sărății Valley (Perșani Mountains)
10 Codlea
11 Teleajen Valley
12 Strîmba Valley, Trotuș Valley (Hăghimaș Massif)
13 Brașov
14 Cascade Valley (Persani)
15 Plaiul Marcheș (Pădurea Craiului)
16 Borod Basin
17 Remeti Graben
18 Boiu Valley (Pădurea Craiului)
19 Mnierei Valley (Pădurea Craiului)
20 Someșul Cald Graben (Bihor Mountains)
21 Piatra Bulzului (Bihor Mountains)
22 Poniciori (Pădurea Craiului)
23 Vălăul Preguzului-Vălăul Rece (Pădurea Craiului)
24 Crișanului Valley-Gîrda Valley (Bihor Mountains)
25 Coasta Cailor (Pădurea Craiului)
26 Vadu Crișului (Pădurea Craiului)
27 Cuților Valley (Pădurea Craiului)
28 Peștireului Valley (Pădurea Craiului)
29 Ponița (Pădurea Craiului)
30 Valea Mare (Bihor Mountains)
31 Tepei Valley and its tributaries (Perșani Mountains)
32 Stanciului Valley (Perșani Mountains)
33 Pietrele Albe (Perșani Mountains)
34 Dealul Meghieș (Perșani Mountains)
35 Dealul Negru (Perșani Mountains)
36 Curmătura (Hăghimaș Massif)
37 Dealul Prașca (Rarău Massif)
38 Valea Izvoru Malului (Rarău Massif)
39 Piatra Zimbrului (Rarău Massif)
40 Pârâul Ghilcoș (Hăghimaș Massif)
41 Pârâul Suhardu (Hăghimaș Massif)
42 Pojorâta anticline (Rarău Massif)
43 Dealul Tabla Bușii (Pădurea Craiului)
44 Culmea Mica (A slope of the Zoina Valley-Bogîltin)
45 Surroundings of Moneasa (Codru Mountains)

LOWER JURASSIC AMMONITES IN ADNET FACIES

ELENA POPA and D. PATRULIUS Lower Jurassic Ammonites in the Romanian Carpathians

		STANDARD ZONES	EAST CARPATHIANS — TRANSYLVANIAN NAPPE SYSTEM — PERŞANI MOUNTAINS			HAGHIMAŞ SYNCLINE	RARĂU SYNCLINE
PLIENSBACHIAN	CARIXIAN	Jamesoni	*Uptonia jamesoni* (J. de C. Sow.) (31)				
SINEMURIAN	UPPER	Raricostatum	*Echioceras aff. rhodanicum* (Dum.) *Echioceras raricostatum* (Ziethen) *Paltechioceras sp. aff. P. aplanatum* (Hyatt) (33) *Leptechioceras sp.* *Epideroceras sp. aff. E. lorioli* (Hug.) *Zetoceras bonarelli* (Bettoni)	*Partschioceras meneghinii* Gemm *Calliphylloceras onatolicum* Meister *Calliphylloceras bicicolae* (Menegh.) *Calliphylloceras cf. emeryi* (Betoni) *Paradasyceras planispira* (Reynès) *Meneghiniceras libertus* (Gemm.) (33)	*Adnethiceras sp. aff. A. adnethicum* Hauer (31)		*Echioceras raricostatoides* (Vadasz) *Asteroceras stellare* (Sow.) *Paradasyceras uermoesense* (Herb.) *Juraphyllites transylvanicus* (Hauer) *Schistophylloceras lunense* (Di Stef.) *Schistophylloceras aulanotum* (Herb.) *Geyeroceras cylindricum bielzii* (Herb.) *Geyeroceras persanense* (Herb.) *Geyeroceras leptophyllum* (Hauer) *Geyeroceras cylindricum complanatum* Fuc. *Partschiceras cf. tenuistriatum* (Menegh.) *Calliphylloceras dubium* (Fuc.) *Calliphylloceras silvestre* (Herb.) (36)	*Partschioceras partschi* (Stur.) *Geyeroceras persanense* (Herbich) *Paradasyceras planispira* (Reynès) *Harpophylloceras bucovinicus* (Uhlig) *Meneghiniceras gardii* (Menegh.) *Lytoceras aff. scemenendum* Di. Stef. *Microderoceras keindli* (Emm.) *Gleviceras subguibalianum* Pia *Paltechioceras romanicus* (Uhlig) *Paltechioceras spp.* *Echioceras raricostatum* (Ziet.) *Zetoceras zetes* Orb. *Oxynoticeras cf. oxynotum* (Quenst.) (37)
		Oxynotum	Se presupune că există continuitate				
		Obtusum	*Asteroceras cf. suevicum* (Quenst.) *Asteroceras spp.* (31)	*Arnioceras semicostatum propinquum* Fucini *Arnioceras ceras* Hyatt *Arnioceras cf. obliquecostatum* (Ziethen) *Arnioceras hartmanni* (Oppel) *Arnioceras cf. dimorphum* Parona *?Arnioceras speciosum* Fucini *Arnioceras rejectum* Fucini *Arnioceras subrejectum* (Vadasz) *Arnioceras pseudospirolis* (Vadasz) *Arnioceras carenatus antiquus* (Vadasz) *Arnioceras semilaeve* Hauer *Arnioceras sp. cf. ceratitoides* (Quenst.) *Nefarnioceras althii* (Herbich) (31)	*Calliphylloceras sylvestre* (Herbich) *Geyeroceras cylindricum* (J. Sow.) *Juraphyllites gigas* (Fucini) *Ectocentrites petersi* (Hauer) *Aegolyfoceras sp.* *Arnioceras sp.* *Schlotheimia sp.* *Charmasseiceras marmoreum* (Oppel) (32)	*Paradasyceras uermoesense* (Herbich) *Ectocentrites (Cosmolytoceras) canavarii* (Bonarelli) (34) *Charmasseiceras sp.* *Epammonites (?) sp.* *Arnioceras spp.*	
	LOWER	Turneri	*Paracoloceras centauroides* (Savi si Meneg.) *Caenisites sp. ; Arietites sp.* *Metophioceras spp.* *Coroniceras sp. ; Paracoroniceras sp.* *Arnioceras spp.; Euagassiceras sp.* *Agassiceras scipionianum* (Orb.) (31)	*Juraphyllites transylvanicus* (Hauer) *Juraphyllites gigas* (Fucini) *Geyeroceras cylindricum* (Sow.) *Geyeroceras leptophyllum* (Hauer) *Geyeroceras persanense* (Herbich) *Geyeroceras oenotrium* (Fucini) *Geyeroceras szadeczkyi* (Vadasz) *Geyeroceras hungaricum* (Vadasz) *Geyeroceras prinzi* (Vadasz) *Ectocentrites alutae* (Herbich) *Dasyceras rakosense* (Herbich) *Paradasyceras uermoesense* (Herbich) *Paradasyceras tenuilobata* Râileanu *Paradasyceras lunense* (Di Stef.) *Tragolytoceras herbichi* (Bon.) *Tragolytoceras uitecinctum* (Hauer) *Tragolytoceras (?) simplex* (Vadasz) *Pleuroacanthites biformis* (Sow) *Analytoceras sp.* *Phylloceras lipoldi* (Hauer) *Calliphylloceras sylvestre* (Herb.) *Calliphylloceras dubium* (Fucini) (31)			*Caenisites turneri* (J. de C. Sow.) *Promicroceras planicosta* (Sow.) *Euagassiceras sauseanum* (Orb.) *Arnioceras mendax rarepicatus* Fucini *Tmaegoceras crassiceps* Pom. *Arietites bisulcatus* (Brug.) *Paracoloceras cf. coregonense* (Sow.) *Charmasseiceras marmoreum* (Oppel) *Charmasseiceras charmassei* (Orb.) *Metophioceras longidomus* (Quenst.) (36)	*Euagassiceras sauzeanum* (d'Orb.) (38)
		Semicostatum	*Metophioceras sp.* *Coroniceras lyra* Hyatt *Euagassiceras sp.* *Arnioceras spp.* (35)				
		Bucklandi					
HETTANGIAN	UPPER	Angulata	*Schlotheimia montana* Wähner *Schlotheimia pachygaster* (Suttner) *Schlotheimia exechoptycha* Wähner n.spp. *Schlotheimia sp. aff. extranodosa* (Wähner) *Schlotheimia sp. ex gr. stenorhyncha* Lange *Charmasseiceras marmoreum* (Oppel) (31) (32)				*Schlotheimia sp.* (39)
	MIDDLE	Liasicus	*Waehneroceras taxophorum* (Wähner) *Waehneroceras sp. ex gr. W. portlocki* (Wright) *Waehneroceras sp. ex gr. W. anisophyllum* (Wähner) *Franziceras sp. aff. F. ruidum* Buckman (31)			*Waehneroceras (Megastomoceras) cf. megastoma* (Gümbel) *Waehneroceras (Megastomoceras) cf. anisophyllum* (Waehner) (36)	
	LOWER	Planorbis				*Coloceras johnstoni* Sow. (36)	

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LOWER JURASSIC AMMONITES IN GRESTEN FACIES

ELENA POPA and D. PATRULIUS. Lower Jurassic Ammonites in the Romanian Carpathians

TABLE 3

		STANDARD ZONATION WITH-AMMONITES	LOCAL AMMONITE ZONATION				
			CARPATHIAN AREA				
			SOUTH-WESTERN CARPATHIANS		EAST CARPATHIANS	APUSENI MOUNTAINS	
			DANUBIAN REALM	GETIC REALM		BIHOR AUTOCHTHON	CODRU NAPPE SYSTEM
							FINIȘ NAPPE / VALANI NAPPE
TOARCIAN		Levesquei			*Pleydellia aalensis* (Zieten) ㊷ *Dumortieria levesquei* (d'Orb.) *Hammatoceras cf. insigne* (Zieten) ④ *Hammatoceras sp.* ⑨	*Pleydellia costulata* (Ziet) *Pleydellia subcompta* (Branco) *Pleydellia cf. galensis* (Ziet) *Pleydellia cf. distans* (Buck) *Dumortieria cf. exacta* Buck *Dumortieria sp. ex gr. D. diphyes* Buck *Dumortieria sp. ex gr. D. costula* (Rein) *Dumortieria sp. ex gr. D radians* (Rein) *Pleydellia sp. Dumortieria sp.* ⑯ ⑮	
		Thouarsense	*Pseudogrammoceras fallaciosum* (Bayle) ① *Grammoceras aff striatulum* (Sow.) ③		*Pseudogrammoceras fallaciosum* (Bayle) ⑨ ⑦ ㊱ *Pseudogrammoceras struckmanni* (Denk.) ㊵ *Pseudogrammoceras latescens* (Simpson) ⑨ *Grammoceras thouarsense thouarsense* (d'Orb) ⑨ ⑦ *Pseudolioceras compactile* (Simpson) ⑨ *Polyplectus pluricostatus* (Haas) ⑨ *Polyplectus discoides* (Zieten) ⑨ *Phymatoceras comensis* (V Buch.) ⑦ *Lobolytoceras aff siemensi* (Denckmann) ⑨ *Denckmannia sp* ⑨	*Pseudogrammoceras fallaciosum* (Bayle) ⑰ ⑱ *Pseudogrammoceras doerntense* (Denck.) ⑰ ㉒ *Pseudogrammoceras struckmanni* (Denck) ⑲ ㉑ ㉔ *Pseudogrammoceras quadratum* Quenst ⑭ *Catacoeloceras dumortieri* Maubeuge ⑮ *Pseudogrammoceras cf saemanni* (Dum.) ⑯ *Pseudogrammoceras cf latescens* (Simp.) ㉑ *Polyplectus pluricostatus* (Haas.) ⑱ *Grammoceras striatulum* (Sow.) ㉒ *Grammoceras thouarsense thouarsense* (d'Orb) ㉑ ⑰ ㉔ *Osperlioceras bicarinatum* (Zieten) ㉓ *Subcollina yeovilensis* Spath. ⑱	
		Variabilis	*Pachylytoceras jurense* (Ziet) ①			*Brodieia sp aff clausum* Merla ⑱ *Brodieia cf. bayani* Dum. ㉒ *Catacoeloceras sp. ex gr. C. crassum* Phill. ㉔ *Haugia illustris* (Denckmann) ㉕ *Phymatoceras narbonense* (Buck.) ㉖ *Pseudomercaticeras aff frantzi* (Reynes) ㉑ *Pseudolioceras cf. gradatum* (Buck.) ㉓ *Denckmannia ? sp.* ㉓ *Haugia (Haugia) sp.* ㉒	
		Bifrons	*Hildoceras bifrons* (Brug) *Hildoceras lusitanicum* (Meister) *Hildoceras sublevisoni* (Fucini) *Hildoceras semicosta* (Buckman) *Lytoceras sp ex gr. L. rhodanicum* (Manestier) *Porpoceras sp. ex gr. P. vortex* (Simpson) *Phymatoceras sp. ex gr. P. lilii* (Hauer) *Catacoeloceras sp. ex gr. C. jordani* (Guex) ①	*Hildoceras bifrons* (Brug) ⑥	*Hildoceras sublevisoni* (Fucini) ⑪ *Hildoceras semipolitum* Buck ⑫ *Dactylioceras commune* (Sow.) ⑨ *Peronoceras sp. ex. gr. P. subarmatum* (Yet B.) ⑬ *Hildoceras sp* ⑧	*Polyplectus apenninicus* (Haas) ⑰ *Hildoceras semipolitum* Buck. ⑱ ⑰ ㉕ *Catacoeloceras cf. broilii* (Mitzopoulos) ⑯ *Hildoceras bifrons* (Brug.) ⑰ ㉓ ㉕ *Hildoceras sublevisoni* (Fucini) ⑰ ⑱ ⑲ ㉔ ㉔ *Hildoceras lusitanicum* (Meister.) ㉑ ㉔ *Dactylioceras athlethicum* (Simp) ㉑ ㉔ ⑱ *Dactylioceras sp. ex gr. D. commune* (Sow.) *Phymatoceras sp.* ㉔ *Peronoceras sp ex gr P fibulatum* (Sow.) ㉕ *Zugodactylites sp gr Z. braunianus* (Orb.) ㉔ *Zugodactylites sp. Nodicoeloceras (?) sp.* ㉑ ㉔	
		Falcifer	*Harpoceras mulgravium* Young et Bird. *Harpoceras cf. falciferum* (Sow.) *Harpoceras exaratum* Young et Bird. *Hildaites sp. aff H serpentiniformis urcutensis* Geczy *Whitbiceras sp.* ③ *Harpoceras sp.* ⑭ ①		*Harpoceras mulgravium* Yet B. ⑪	*Nodicoeloceras crassoides* (Simp.) ⑭ *Nodicoeloceras sp.* ⑲ *Harpoceras mulgravium* (Yet B) ⑲ ㉖ *Harpoceratoides alternatus* (Simp.) ⑲ *Harpoceras falcifer* (Sow.) ⑰ *Harpoceras sp. ex gr. H. falcifer* (Sow.) ⑲	
		Tenuicostatum	*Dactylioceras (Orthodactylites) semicelatum* (Simpson) ②		*Dactylioceras tenuicostatum* (Yet B) *Dactylioceras cf. semicelatum* Simp. *Dactylioceras cf. helianthoides* Yok *D. aff crassulosum* Simp. ⑧	*Dactylioceras tenuicostatum* (Yet B) ⑱ ⑲ *Dactylioceras semicelatum* (Simp) ⑲ ㉚ ㉕ *Dactylioceras helianthoides* (Yok.) ㉘ *Dactylioceras' sp. aff. D acanthus* Orb. ⑰	
PLIENSBACHIAN	DOMERIAN	Spinatum	*Pleuroceras solare* (Phyll) ① *Pleuroceras solare* (Phyll) [sub *Pleuroceras costatus nudus* (Quenst] ④		*Pleuroceras solare* (Phillips) ⑨ ⑥ *Pleuroceras spinatum* (Brug.) ㊷	*Pleuroceras hawskerense* (Yet B) ㉚ *Pleuroceras gigas* Howarth ㉚ *Pleuroceras solare* (Phillips) ⑰ ㉚ ㉚ ⑱ ㉗ *Pleuroceras spinatum* (Brug.) ⑰ ⑱ ㉚ *Aegoceras nautiliforme* (Buck) ㉚ *Arieticeras sp.*	
		Margaritatus	*Amaltheus margaritatus* De Montfort *Amaltheus gloriosus* Hyatt *Protogrammoceras sp.* *Pseudamaltheus sp.* ①		*Amaltheus margaritatus* (Montf.) ⑧ *Paltarpites sp.* ⑧	*Amaltheus margaritatus* Montf ⑰ ⑯ ㉚ *Phylloceras frondosm* (Reynes) ⑱	
		Stokesi	*Amaltheus stokesi* (Sow.) ①		*Amaltheus stokesi* (Sow.) ⑧	*Amaltheus stokesi* (Sow.) ㉚	
	CARIXIAN	Davoei	*Aegoceras capricornu* (Schlatheim) *Liparoceras (Becheiceras) bechei* (Sow.) ①		*Aegoceras capricornu* (Schlatheim) ㊶ *Liparoceras (Becheiceras) cf. bechei* (Sow.) ⑫	*Androgynoceras sp ex gr A. hybridiforme* Spath ⑰ *Aegoceras sp* ㉚	*Tropidoceras sp.*
		Ibex	*Tropidoceras masseanum* (Orb.)		*Liparoceras sp.* ⑬ *Androgynoceras sp. aff. hybrida* (d'Orb.) ⑫	*Beaniceras luridum* (Simp.) ⑰ *Tropidoceras masseanum* (Orb.) ㉔	
		Jamesoni	*Acanthopleuroceras rursicosta* (Buckman) ① *Platypleuroceras cf. brevispina* (Sow.) ⑤			*Uptonia jamesoni* (Sow) ⑱ ㉚ ㉚	
SINEMURIAN	UPPER	Raricostatum Oxynotum Obtusum	*Promicroceras cf. planicosta* (Sow) ①				
	LOWER	Turneri Semicostatum Bucklandi			*Angulaticeras lacunatum* (Buckman) ⑧	*Arietites bucklandi* (Sow) ㉓	*Arnioceras sp. ex gr. A. semicostatum* (Yet B) *Agassiceras sp. aff. Ascipionanum* (Orb.) ⑩ *Arietites bisulcatus* Brug *Coroniceras sp.* ⑬
HETTANGIAN		Angulata Liasicus Planorbis					

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XIII, Fig. 5); *Grammoceras* aff. *striatulum* (Sow.) (Bogâltin Beds, Nievrei Valley - Banat, Năstăseanu, 1979); *Grammoceras* sp. ex gr. *G. thouarsense thouarsense* (d'Orb.), *Pseudogrammoceras fallaciosum* Bayle, *P.* cf. *doerntense* (Denck.) (Remeţi Graben - Pădurea Craiului, Popa, 1981) (Pl. X, Fig. 4; Pl. XII, Fig. 8; Pl. XIII, Figs. 1, 4); *Pseudogrammoceras fallaciosum* (Bayle), *P. quadratum* Quenst., *P.* cf. *saemanni* (Dum.), *Polyplectus pluricostatus* (Haas) (Boiului Valley, Pădurea Craiului, Popa, 1981) (Pl. X, Fig. 6; Pl. XIII, Figs. 1, 4; Pl. XIV, Fig. 4); *Pseudogrammoceras fallaciosum* Bayle (Birtinului Valley - Pădurea Craiului, and the east of the Borod Basin, col. Popa) (Pl. XII, Fig. 7; Pl. XIV, Fig. 2); *Pseudogrammoceras struckmanni* (Denck.), *Catacoeloceras dumortieri* Maubeuge, *Subcollina yeovilensis* Spath. (Mnierei Valley - Pădurea Craiului, Patrulius in Patrulius et al., 1982); *Pseudogrammoceras struckmanni* (Denck.), *Grammoceras thouarsense thouarsense* (d'Orb.) (Someşul Cald Graben - Bihor Mts, Mantea et al., 1982) (Pl. XIII, Figs. 2, 3); *Pseudogrammoceras struckmanni* (Denck.), *Grammoceras thouarsense thouarsense* (d'Orb.), *Osperlioceras bicarinatum* (Zieten); *Pseudogrammoceras* cf. *latescens* (Simp.) (Piatra Bulzului, Bihor Mts, Popa et al., 1985) (Pl. IX, Fig. 10; Pl. X, Fig. 5; Pl. XIII, Fig. 6; Pl. XIV, Fig. 1); *Pseudogrammoceras doerntense* (Denck), *Grammoceras striatulum* (Sow.) (Poniciori, Pădurea Craiului, Patrulius in Patrulius et al., 1982).

Levesquei Zone to which are assigned: *Dumortieria levesquei* (d'Orb.) and *Hammatoceras insigne* (Zieten) (Cristian - Braşov, Jekelius, 1915; see Popa, 1970); *Pleydellia aalensis* (Zieten) (north-eastern slope of the Pojorâta Anticline - Rarău, Turculeţ, 1971); *Hammatoceras* sp. (Sărăţii Valley - Perşani Mts, Popa, 1967).

In the Bihor Autochthon (Plaiul Marcheş) are reported (Patrulius, in Patrulius et al., 1982) the zones Pseudoradiosa and Aalensis (corresponding to the Levesquei Zone on zonal diagram elaborated by Dean et al. (1961) for the north-west European province) to which the following assemblage is assigned: *Pleydellia costulata* (Ziet.), *P. subcompta* (Branco), *P.* cf. *aalensis* (Ziet.), *P.* cf. *distans* (Buck.), *Dumortieria* cf. *exacta* Buck., *D.* sp. ex gr. *D. diphyes* Buck., *D.* sp. ex gr. *D. costula* (Rein.), *D.* sp. ex gr. *D. radians* (Rein.).

Pleydellia sp., *Dumortieria* sp. and *Hammatoceras* sp. specimens belonging to the Levesquei Zone (Popa, 1967, 1981) have been identified in the Boiului Valley (Pădurea Craiului), in the Sărăţii Valley (Perşani Mts) and in the eastern area of the Borod Basin (Pl. XIV, Figs. 5-7).

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Plate I

Fig. 1 — *Angulaticeras lacunatum* (BUCKMAN), Lower Sinemurian, Cristian - Braşov. Col. E. Jekelius. Rev. Elena Popa (x 2)

Fig. 2 — *Uptonia jamesoni* (J. de C. SOW.), Carixian, Jámesoni Zone. Boiului Valley, Pădurea Craiului. Col. Elena Popa (x 0,6)

Fig. 3 — *Acanthopleuroceras rursicosta* BUCKMAN, Carixian, Jamesoni Zone. Munteana - Banat. Col. Elena Popa (x 1,1)

Fig. 4 — *Aegoceras* sp., Carixian. Vadu Crişului, Pădurea Craiului. Col. D. Patrulius (x 1)

Fig. 5 — *Tropidoceras masseanum* (ORB.), Carixian, Ibex Zone. Munteana - Banat. Col. Elena Popa (x 1)

Figs. 6–9 — *Beaniceras luridum* (SIMPS.), Carixian, Ibex Zone. Leşului Valley - Pădurea Craiului. Col. Elena Popa. Figs. 6 and 7 (x 1); figs. 8 and 9 (x 1,8)

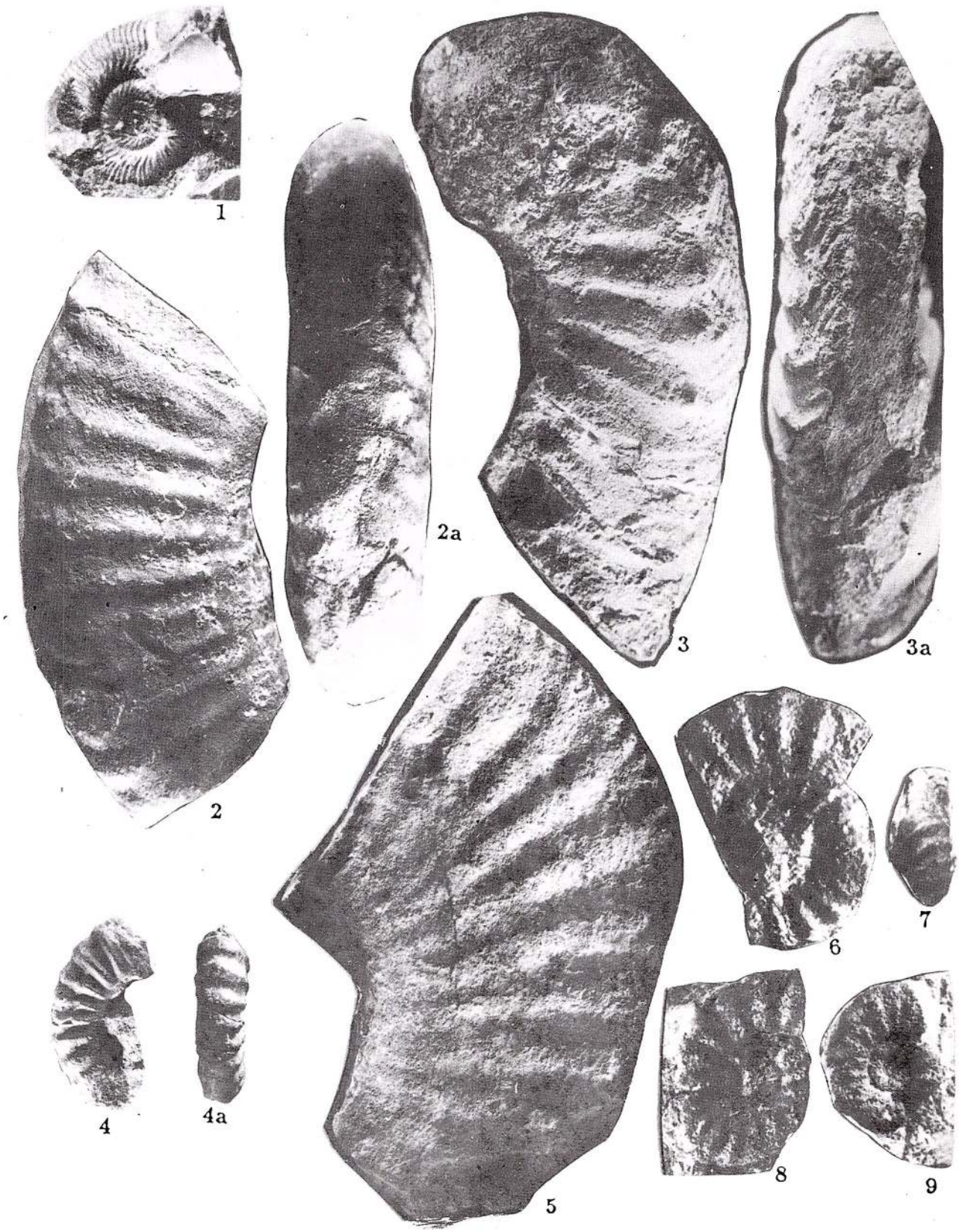


Plate II

Fig. 1 — *Tropidoceras masseanum* (ORB.), Carixian, Ibex Zone. Gârda Seacă - Bihor Mts. Col. G. Mantea. Det. Elena Popa (x 1)

Fig. 2 — *Aegoceras capricornu* (SCHLOTHEIM), Carixian, Davoei Zone. Munteana - Banat. Col. Elena Popa (x 1,1)

Fig. 3 — *Amaltheus stokesi* (SOWERBY), Domerian, Stokesi Zone. Braşov. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 4 — *Amaltheus stokesi* (SOWERBY), Domerian, Stokesi Zone. Munteana - Banat. Col. Elena Popa (x 1,1)

Fig. 5 — *Amaltheus stokesi* (SOWERBY), Domerian, Stokesi Zone. Vadu Crişului - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 6 — *Paltarpites* sp., Domerian. Braşov. Col. E. Jekelius. Det. D. Patrulius & Elena Popa (x 0,3)

Fig. 7 — *Amaltheus margaritatus* (MONTF.), Domerian, Margaritatus Zone. Munteana - Banat. Col. Elena Popa (x 1,1)

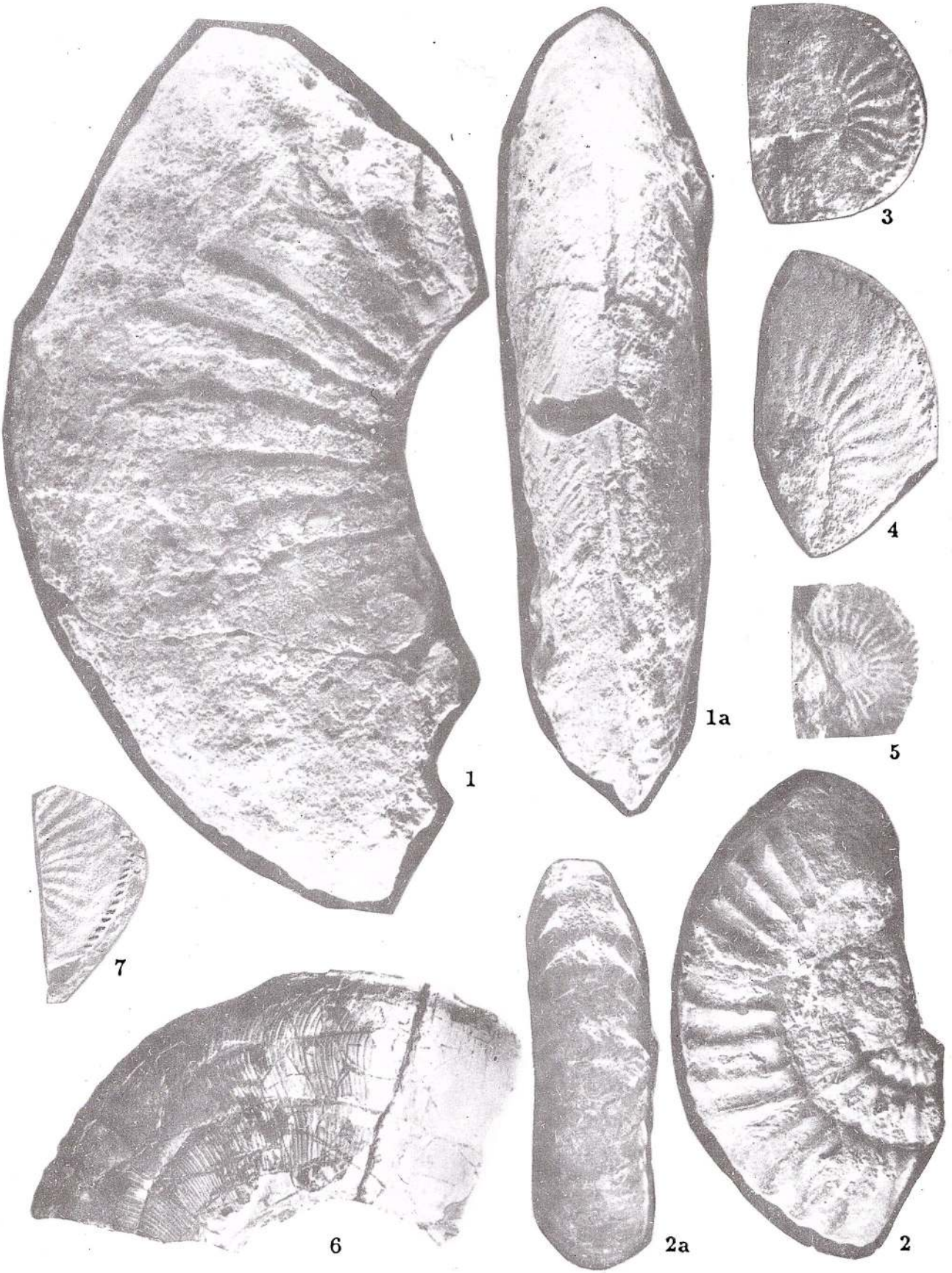


Plate III

Fig. 1 — *Amaltheus margaritatus* (MONTF.), Domerian, Margaritatus Zone. Munteana - Banat. Col. Elena Popa (x 1,1)

Fig. 2 — *Phylloceras frondosum* (REYNES), Domerian, Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 3 — *Amaltheus margaritatus* (MONTF.), Domerian, Margaritatus Zone. Vadu Crişului - Pădurea Craiului. Col. Th. Kräutner (x 1)

Fig. 4 — *Pleuroceras solare* (PHILLIPS), Domerian, Spinatum Zone. Cristian - Braşov. Rec. M. Săndulescu. Col. and det. Elena Popa (x 1)

Fig. 5 — *Pleuroceras solare* (PHILLIPS), Domerian, Spinatum Zone. Sărăţii Valley - Perşani Mts. Col. Elena Popa (x 1)

Fig. 6 — *Pleuroceras solare* (PHILLIPS), Domerian, Spinatum Zone. Cascadelor Valley - Perşani Mts. Col. Elena Popa (x 1)

Fig. 7 — *Pleuroceras solare* (PHILLIPS), Domerian, Spinatum Zone. Munteana - Banat. Col. Elena Popa (x 1)

Figs. 8 and 9 — *Pleuroceras solare* (PHILLIPS), Domerian, Spinatum Zone. Leşului Valley - Pădurea Craiului. Col. Elena Popa. Fig. 8 (x 2); fig. 9 (x 1)

Fig. 10 — *Pleuroceras solare* (PHILLIPS), Domerian, Spinatum Zone. Vadu Crişului - Pădurea Craiului. Col. D. Patrulius (x 1)

Fig. 11 — *Pleuroceras spinatum* (BRUGUIÈRE), Domerian, Spinatum Zone. Vadu Crişului - Pădurea Craiului. Col. D. Patrulius (x 1)

Fig. 12 — *Pleuroceras spinatum* (BRUGUIÈRE), Domerian, Spinatum Zone. Pădurea Craiului. Col. D. Patrulius (x 1)

Fig. 13 — *Pleuroceras hawskerense* (YOUNG et BIRD), Domerian, Spinatum Zone. Ponor Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1)

Fig. 14 — *Pleuroceras solare* (PHILLIPS), Domerian, Spinatum Zone. Ruginii Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1)

Fig. 15 — *Pleuroceras gigas* HOWARTH, Domerian, Spinatum Zone. Onceasa Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1)

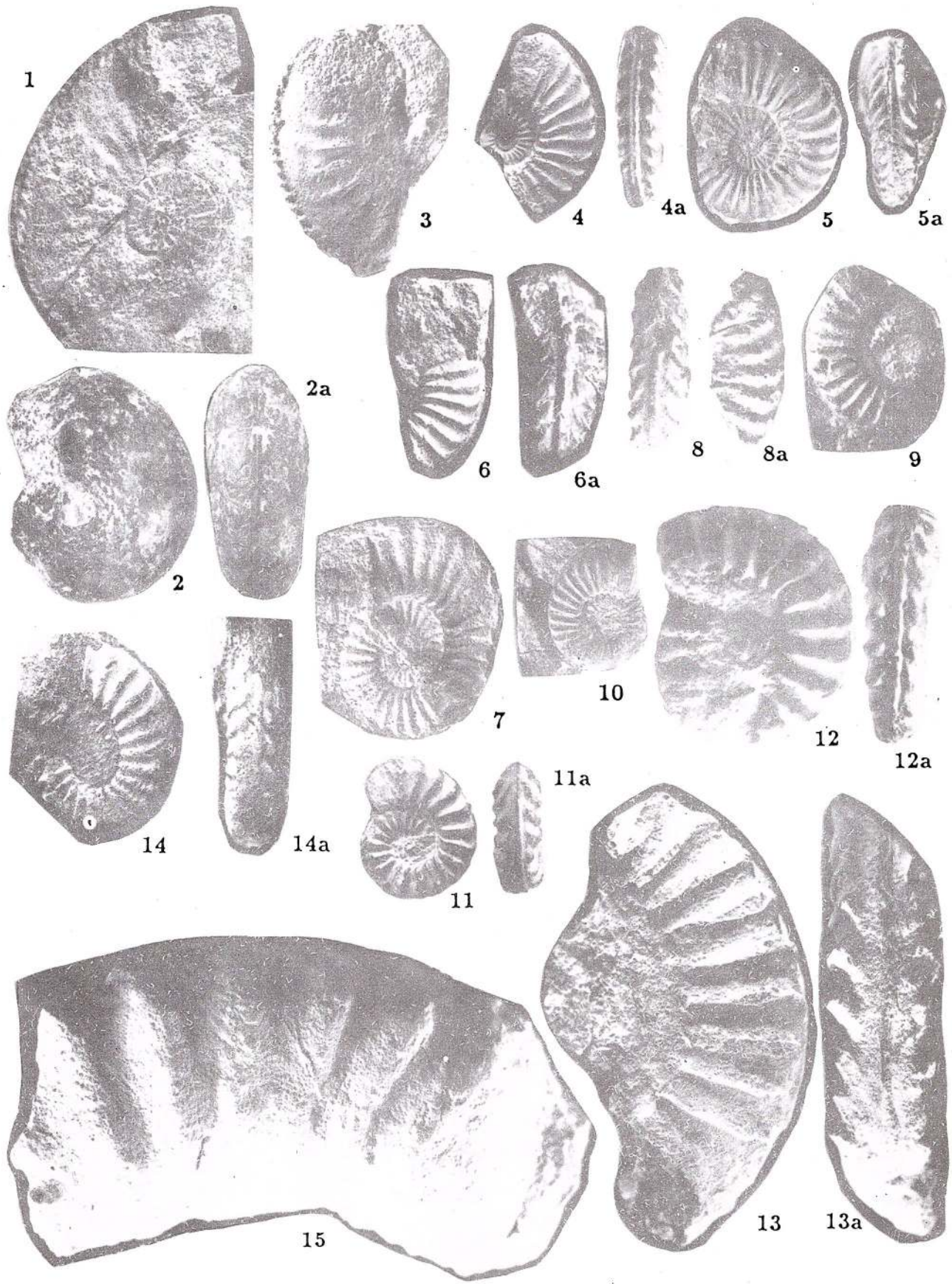


Plate IV

Fig. 1 — *Dactylioceras tenuicostatum* (Y. et B.), Toarcian, Tenuicostatum Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 2 — *Dactylioceras tenuicostatum* (Y. et B.), Toarcian, Tenuicostatum Zone. Mnierei Valley - Pădurea Craiului. Col. D. Patrulius (x 1)

Fig. 3 — *Dactylioceras tenuicostatum* (Y. et B.), Toarcian, Tenuicostatum Zone. Căldării Valley - Cristian, Braşov. Col. Elena Popa (x 1)

Fig. 4 — *Dactylioceras* cf. *semicelatum* (SIMPSON), Toarcian, Tenuicostatum Zone. Căldării Valley - Cristian, Braşov. Col. Elena Popa (x 1)

Fig. 5 — *Dactylioceras semicelatum* (SIMPSON), Toarcian, Tenuicostatum Zone. Zamoniţa Valley - Banat. Col. Elena Popa (x 1,2)

Fig. 6 — *Dactylioceras* cf. *semicelatum* (SIMPSON), Toarcian, Tenuicostatum Zone. Zamoniţa Valley - Banat. Col. Elena Popa (x 1,2)

Fig. 7 — *Nodicoeloceras crassoides* (SIMPSON), Toarcian, Falcifer Zone, Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 8 — *Hildaites* sp., aff. *H. serpentiniformis urkutensis* GÉCZY, Toarcian, Falcifer Zone. Munteana - Banat. Col. Elena Popa (x 1)

Fig. 9 — *Harpoceras mulgravium* YOUNG et BIRD, Toarcian, Falcifer Zone. Munteana - Banat. Col. Elena Popa (x 0,6)

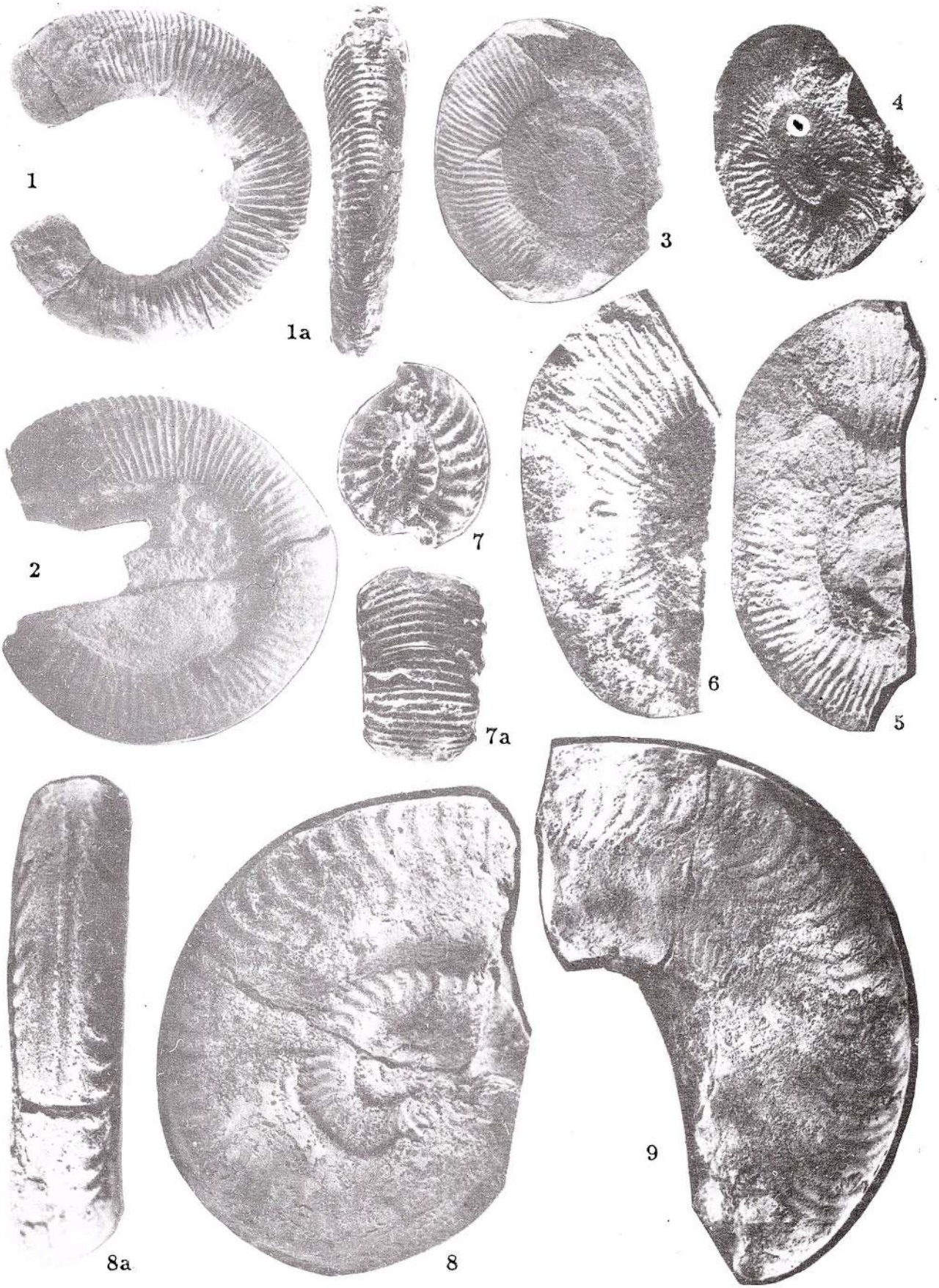


Plate V

Fig. 1 — *Harpoceras exaratum* (YOUNG et BIRD), Toarcian, Falcifer Zone. Munteana - Banat. Col. Elena Popa (x 1)

Fig. 2 — *Harpoceras* cf. *falciferum* (SOWERBY), Toarcian, Falcifer Zone. Munteana - Banat. Col. Elena Popa (x 0,6)

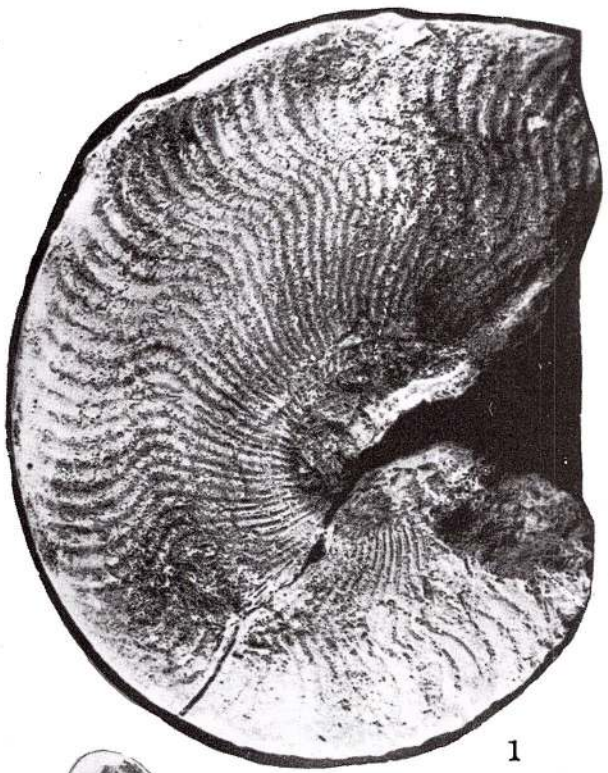
Fig. 3 — *Harpoceras* sp., ex gr. *H. falciferum* (SOWERBY), Toarcian, Falcifer Zone. Mnierei Valley - Pădurea Craiului. Col. D. Patrulius (x 1)

Fig. 4 — *Harpoceras mulgravium* YOUNG et BIRD, Toarcian, Falcifer Zone. Teleajenului Valley. Col. I. Motaş (x 1)

Fig. 5 — *Hildoceras sublevisoni* FUCINI, Toarcian, Bifrons Zone. Mnierei Valley - Pădurea Craiului. Col. Th. Kräutner. Det. Elena Popa (x 1)

Fig. 6 — *Hildoceras sublevisoni* FUCINI, Toarcian, Bifrons Zone. Teleajenului Valley. Col. I. Motaş (x 1)

Fig. 7 — *Peronoceras* sp., ex gr. *P. subarmatum* (YOUNG et BIRD), Toarcian, Bifrons Zone. Braşov (Hinter der Graft). Col. E. Jekelius (x 1)



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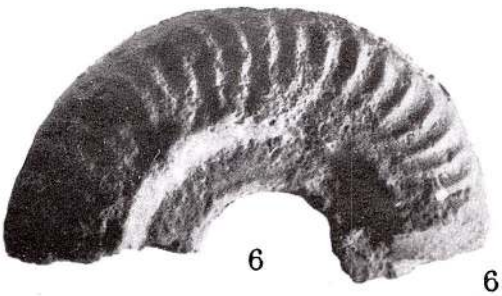

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Plate VI

Fig. 1 — *Catacoeloceras* cf. *broilii* (MITZOPOULOS), Toarcian, Bifrons Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Figs. 2 and 3 — *Hildoceras bifrons* (BRUGUIÈRE), Toarcian, Bifrons Zone. Bisericii Valley - Remeţi Graben. Col. Elena Popa (x 1)

Fig. 4 — *Hildoceras bifrons* (BRUGUIÈRE), Toarcian, Bifrons Zone. Pregusului Valley - Pădurea Craiului. Col. S. & J. Bordea. Det. D. Patrulius (x 1)

Fig. 5 — *Polyplectus appeninicus* (HAAS), Toarcian, Bifrons Zone. Bisericii Valley - Remeţi Graben. Col. Elena Popa (x 0,4)

Figs. 6 and 7 — *Hildoceras* cf. *semipolitum* BUCKMAN, Toarcian, Bifrons Zone. Fig. 6 - Boiului Valley, Pădurea Craiului; fig. 7 - Bisericii Valley, Remeţi Graben. Col. Elena Popa (x 1)

Fig. 8 — *Hildoceras lusitanicum* (MEISTER, Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 1)

Fig. 9 — *Hildoceras lusitanicum* (MEISTER), Toarcian, Bifrons Zone. Onceasa Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1,08)

Fig. 10 — *Hildoceras lusitanicum* (MEISTER), Toarcian, Bifrons Zone. Alunul Mic Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1,2)

Fig. 11 — *Hildoceras sublevisoni* (FUCINI), Toarcian, Bifrons Zone. Pârâul Ars - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1,2)

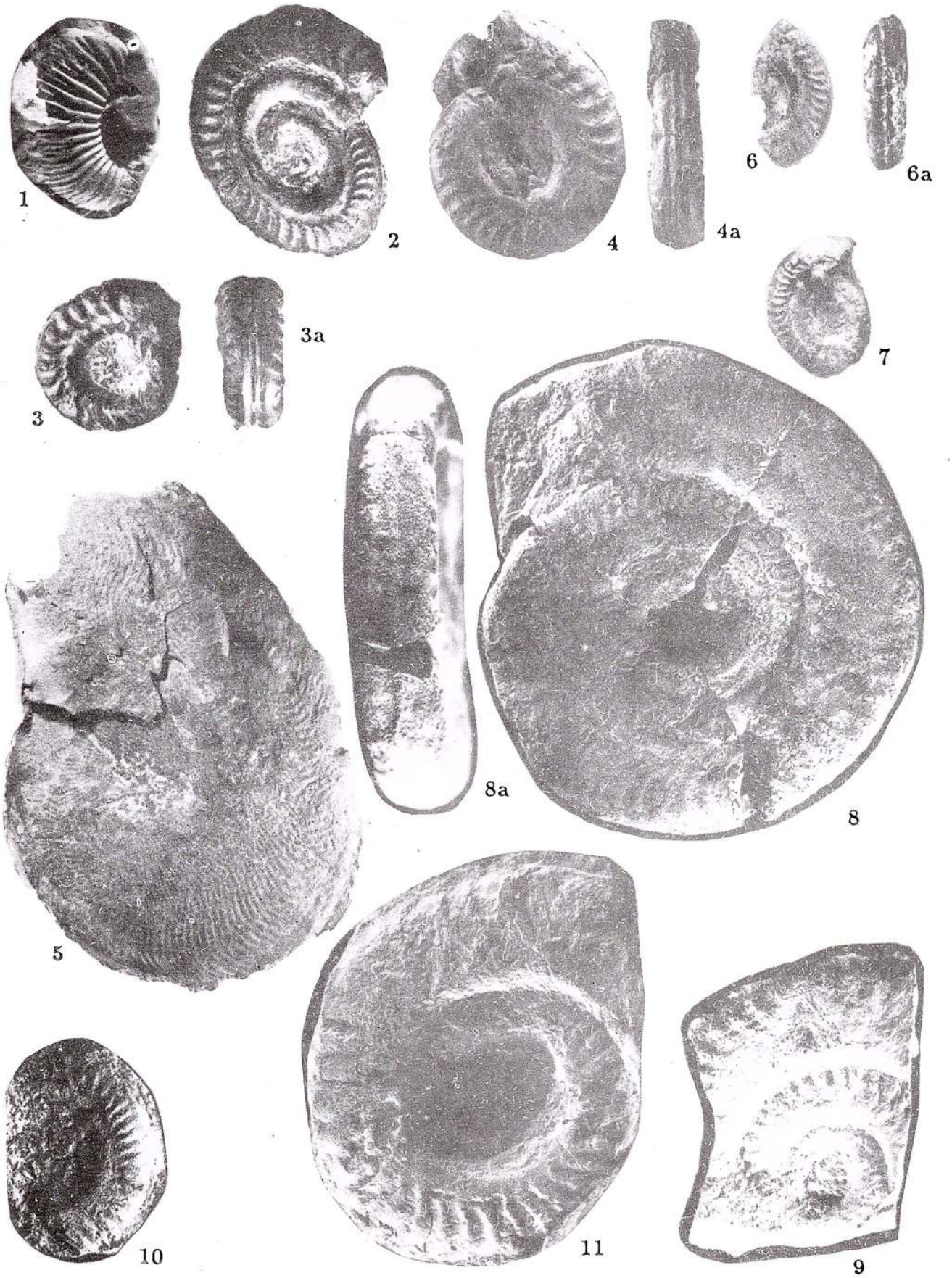

Plate VII

Fig. 1 — *Hildoceras sublevisoni* (FUCINI), Toarcian, Bifrons Zone. Onceasa Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1)

Figs. 2 and 3 — *Hildoceras sublevisoni* (FUCINI), Toarcian, Bifrons Zone. Bisericii Valley - Remeţi Graben. Col. Elena Popa (x 1)

Fig. 4 — *Hildoceras sublevisoni* (FUCINI), Toarcian, Bifrons Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 5 — *Hildoceras sublevisoni* (FUCINI), Toarcian, Bifrons Zone. Piatra Bulzului - Bihor Mts. Col. Elena Popa (x 1)

Figs. 6 and 7 — *Hildoceras sublevisoni* (FUCINI), Toarcian, Bifrons Zone. Crişanului Valley - Bihor Mts. Col. Elena Popa (x 1)

Figs. 8 and 9 — *Hildoceras sublevisoni* (FUCINI), Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 1)

Fig. 10 — *Porpoceras* sp., ex gr. *P. vortex* (SIMPSON), Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 1)

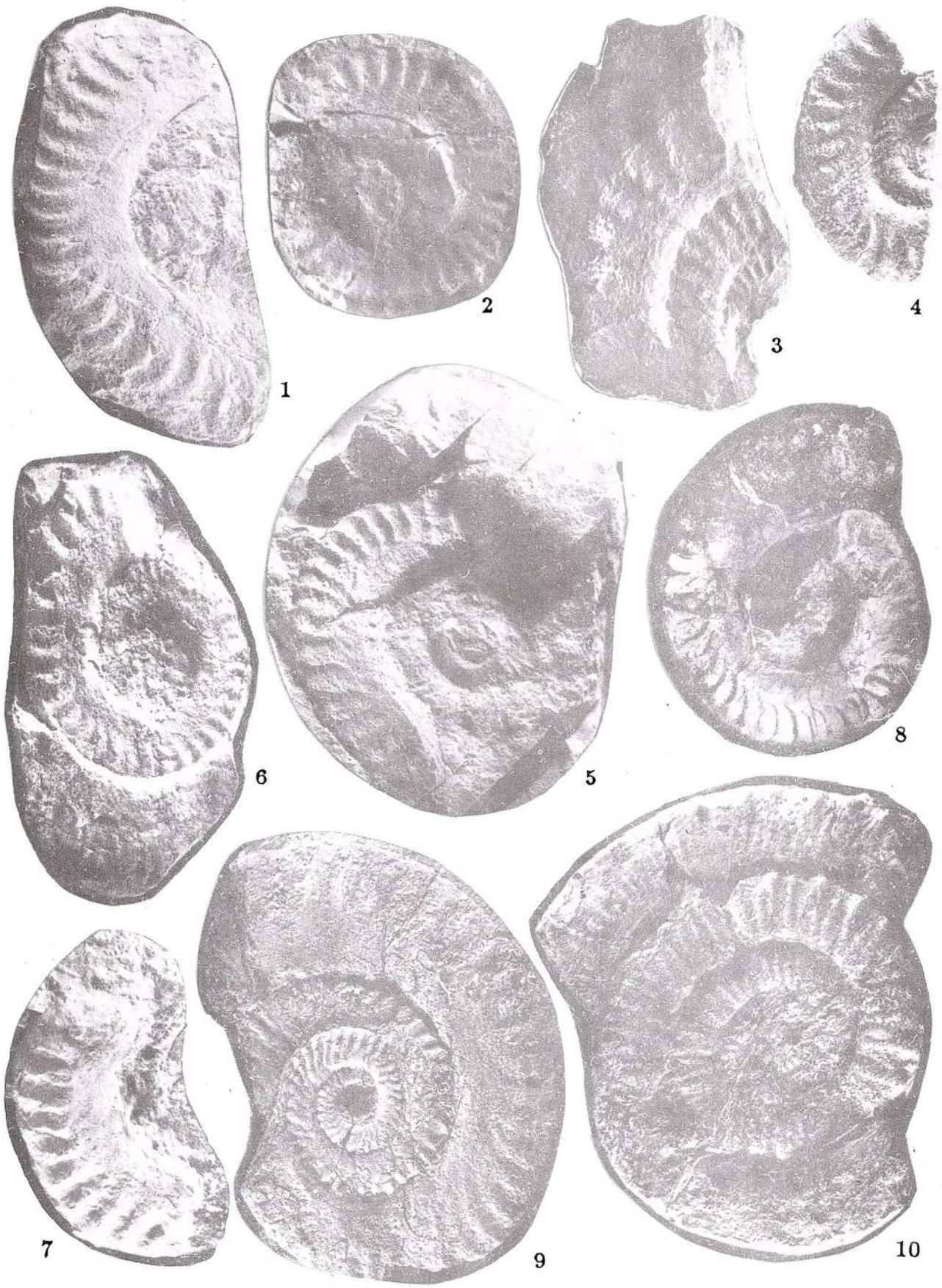

Plate VIII

Fig. 1 — *Porpoceras* sp., ex gr. *P. vortex* (SIMPSON), Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 1); 1a - detail

Fig. 2 — *Phymatoceras* sp., ex gr. *P. lilli* (HAUER), Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 0,6)

Figs. 3 and 4 — *Hildoceras semicosta* BUCKMAN, Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 1)

Fig. 5 — *Catacoeloceras* sp., ex gr. *C. jordani* GUEX., Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 1)

Fig. 6 — *Zugodactylites* sp., Toarcian, Bifrons Zone. Piatra Bulzului - Bihor Mts. Col. Elena Popa (x 1,2)

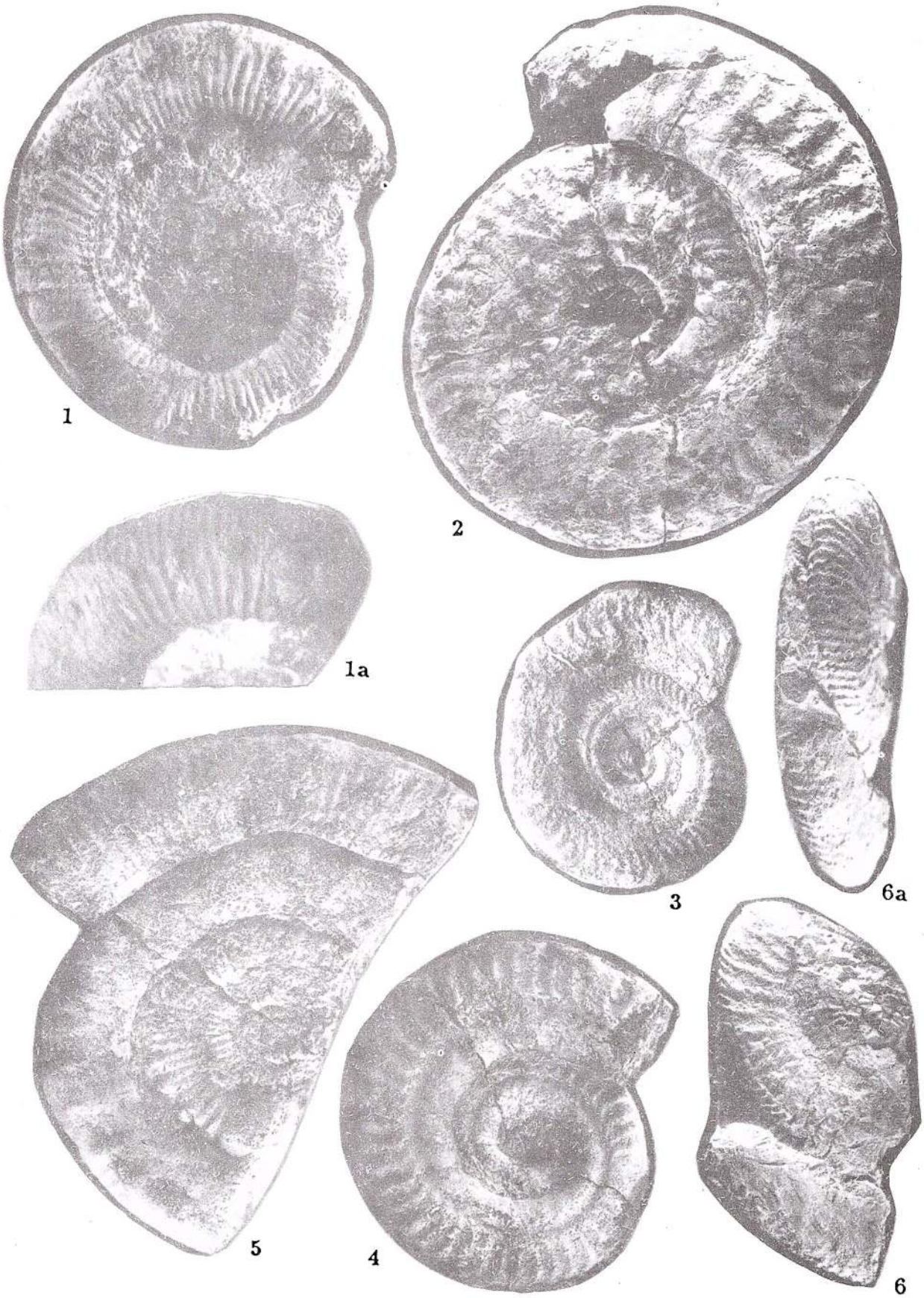

Plate IX

Fig. 1 — *Lytoceras* sp., ex gr. *L. rhodanicus* (MONESTIER), Toarcian, Bifrons Zone. Munteana - Banat. Col. Elena Popa (x 1)

Fig. 2 — *Phymatoceras* sp., Toarcian, Bifrons Zone. Pârâul Ars - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1)

Figs. 3 and 4 — *Phymatoceras* sp., Toarcian, Bifrons Zone. Onceasa Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa. Fig. 3 (x 1); fig. 4 (x 0,7)

Fig. 5 — *Brodieia* sp., aff. *B. clausum* MERLA, Toarcian, Variabilis Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Figs. 6 and 7 — *Haugia (Haugia)* sp., Toarcian, Variabilis Zone. Crişanului Valley - Bihor Mts. Col. Elena Popa (x 1)

Fig. 8 — *Haugia illustris* (DENCKMANN), Toarcian, Variabilis Zone. Piatra Arsă - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 0,8)

Fig. 9 — *Pseudolioceras* cf. *gradatum* BUCKMAN, Toarcian, Variabilis Zone. Alunul Mare Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 1)

Fig. 10 — *Pseudogrammoceras* cf. *latescens* (SIMPSON), Toarcian, Thouarsense Zone. Piatra Bulzului - Bihor Mts. Col. Elena Popa (x 1)

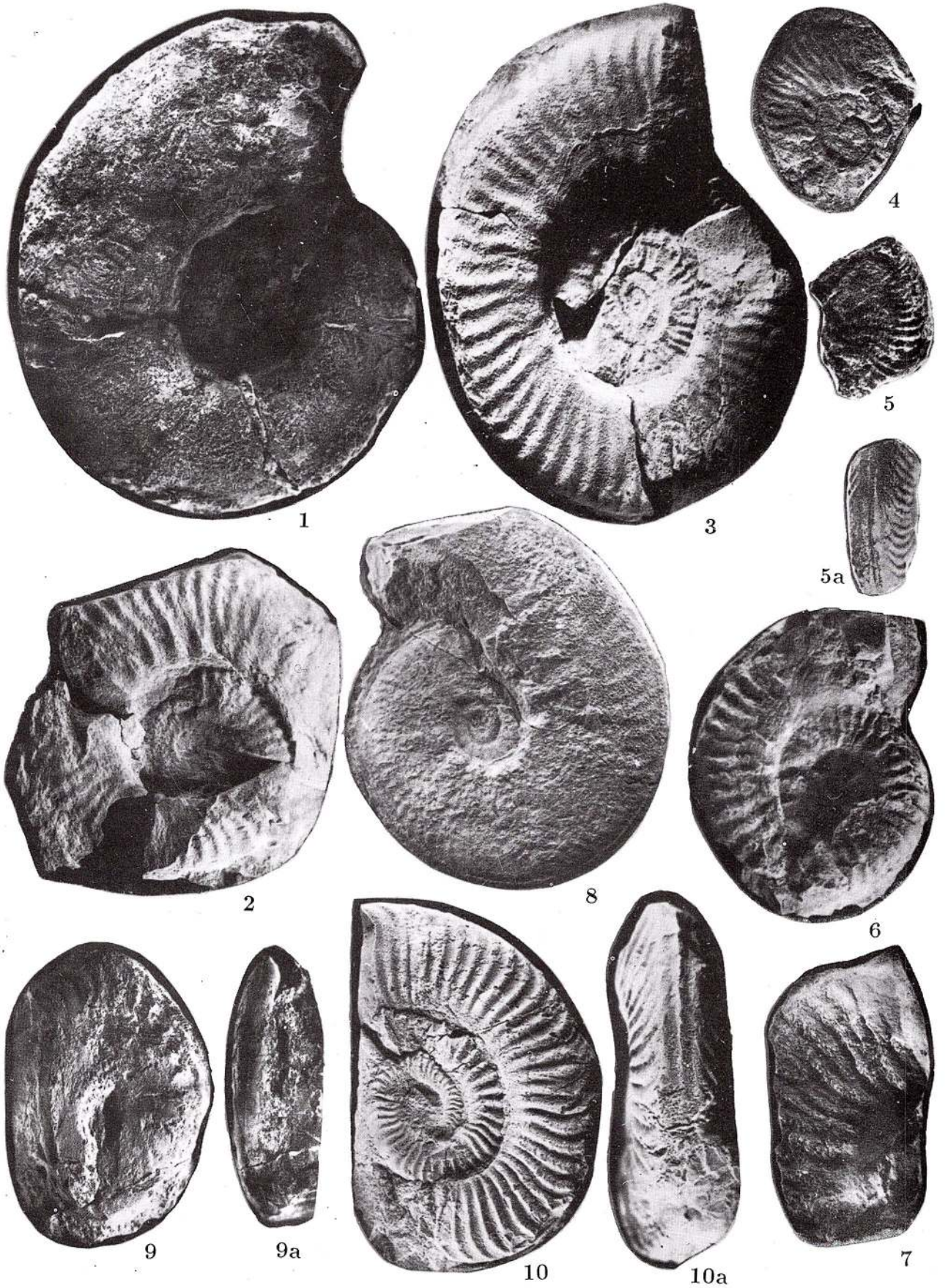

Plate X

Figs. 1 and 2 — *Grammoceras thouarsense thouarsense* (ORB.), Toarcian, Thouarsense Zone. Sărăţii Valley - Perşani Mts. Col. Elena Popa (x 1)

Fig. 3 — *Grammoceras thouarsense thouarsense* (ORB.), Toarcian, Thouarsense Zone. Lucava Valley - Rarău Massif. Col. Elena Popa (x 1)

Fig. 4 — *Grammoceras* sp., ex gr. *G. thouarsense thouarsense* (ORB.), Toarcian, Thouarsense Zone. Fruntea Crest - Remeţi Graben. Col. Elena Popa (x 1)

Fig. 5 — *Grammoceras thouarsense thouarsense* (ORB.), Toarcian, Thouarsense Zone. Piatra Bulzului - Bihor Mts. Col. Elena Popa (x 1)

Fig. 6 — *Polyplectus pluricostatus* (HAAS), Toarcian, Thouarsense Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 7 — *Pseudogrammoceras latescens* (SIMPSON), Toarcian, Thouarsense Zone. Sărăţii Valley - Perşani Mts. Col. Elena Popa (x 1)

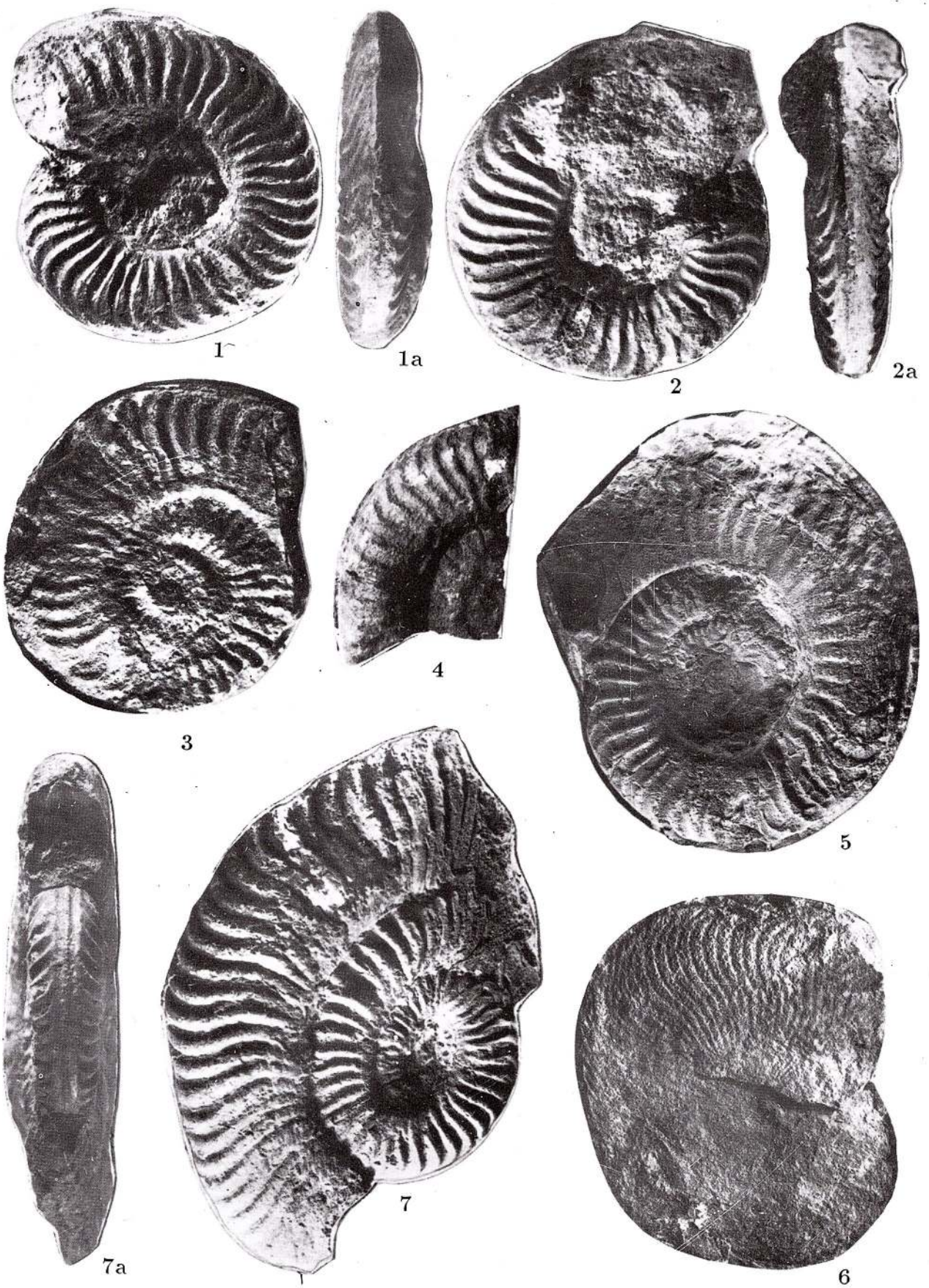

Plate XI

Fig. 1 — *Pseudogrammoceras latescens* (SIMPSON) (x 1)

Fig. 2 — *Denckmannia* sp. (x 1,2)

Fig. 3 — *Polyplectus discoides* (ZIETEN) (x 1)

Fig. 4 — *Pseudolioceras compactile* (SIMPSON) (x 1,1)

Fig. 5 — *Polyplectus pluricostatus* (HAAS) (x 1)

Figs. 6 and 7 — *Pseudogrammoceras fallaciosum* (BAYLE). Fig. 6 (x 1); fig. 7 (x 0,7)

Figs. 1–7 — Toarcian, Thouarsense Zone, Sărăţii Valley - Perşani Mts. Col. Elena Popa

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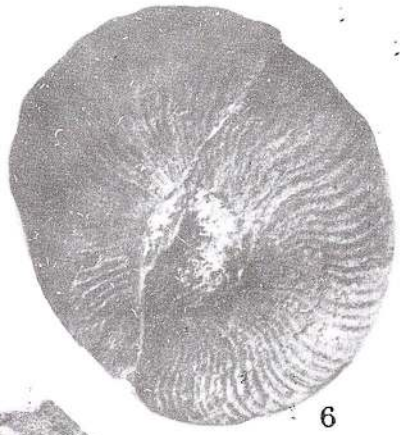

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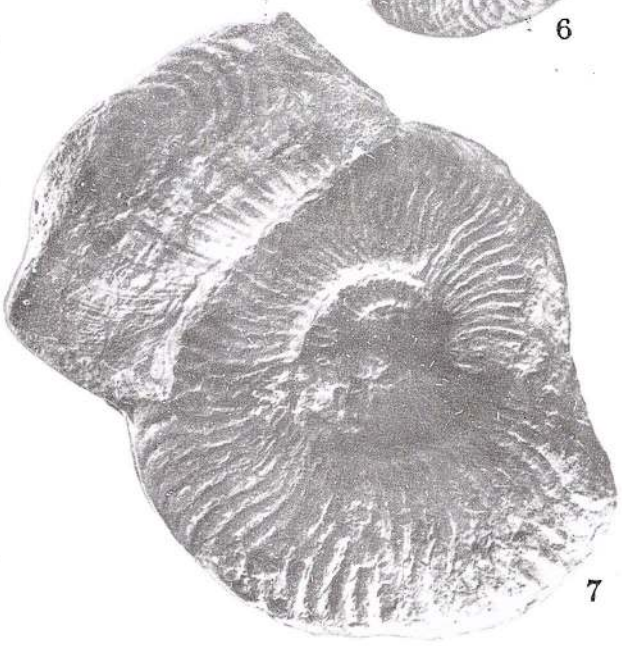

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Plate XII

Fig. 1–4 — *Pseudogrammoceras fallaciosum* (BAYLE), Toarcian, Thouarsense Zone. Sărăţii Valley - Perşani Mts. Col. Elena Popa. Figs. 1, 3 and 4 (x 1); fig. 2 (x 0,7)

Fig. 5 and 6 — *Pseudogrammoceras* cf. *doerntense* (DENCKMANN), Toarcian, Thouarsense Zone. Fruntea Crest - Remeţi Graben. Col. Elena Popa (x 1)

Fig. 7 — *Pseudogrammoceras fallaciosum* (BAYLE), Toarcian, Thouarsense Zone. Birtinului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 8 — *Pseudogrammoceras fallaciosum*, (BAYLE), Toarcian, Thouarsense Zone. Bisericii Valley - Remeţi Graben. Col. Elena Popa (x 1)

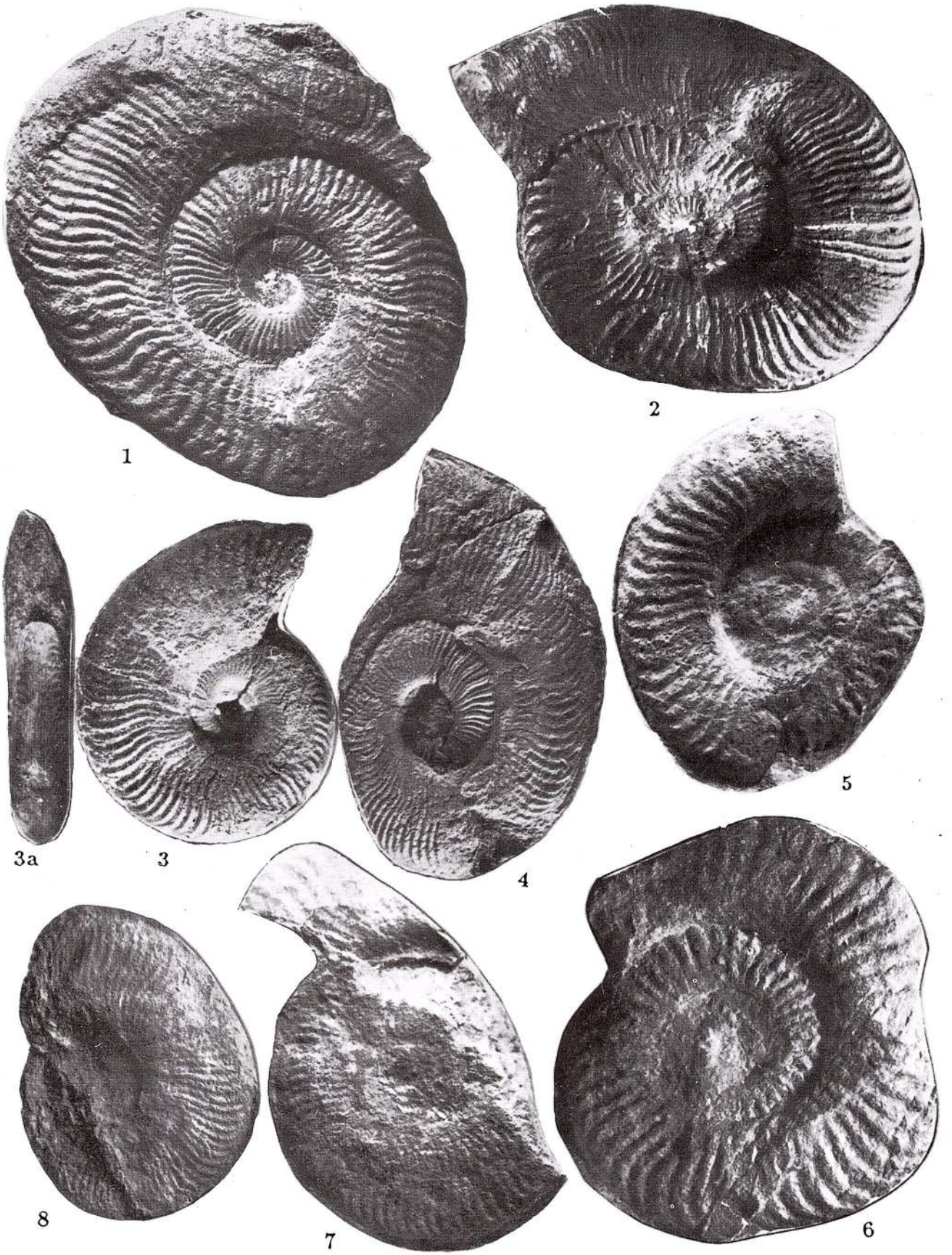


Plate XIII

Figs. 1 and 4 — *Pseudogrammoceras fallaciosum* (BAYLE), Toarcian, Thouarsense Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig.2 — *Pseudogrammoceras struckmanni* (DENCKMANN), Toarcian, Thouarsense Zone. Onceasa Valley - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 0,7)

Fig. 3 — *Pseudogrammoceras struckmanni* (DENCKMANN), Toarcian, Thouarsense Zone. Piatra Arsă - Someşul Cald Graben. Col. G. Mantea. Det. Elena Popa (x 0,9)

Fig. 5 — *Pseudogrammoceras fallaciosum* (BAYLE), Toarcian, Thouarsense Zone. Munteana - Banat. Col. Elena Popa (x 1,1)

Fig. 6 — *Pseudogrammoceras* cf. *latescens* (SIMPSON), Toarcian, Thouarsense Zone. Piatra Bulzului - Bihor Mts. Col. Elena Popa (x 1)

Plate XIV

Fig. 1 — *Osperlioceras bicarinatum* (ZIETEN), Toarcian, the bottom of the Thouarsense Zone. Piatra Bulzului - Bihor Mts. Col. Elena Popa (x 1)

Fig. 2 — *Pseudogrammoceras fallaciosum* (BAYLE), Toarcian, Thouarsense Zone. East of the Borod Basin. Col. Elena Popa (x 1)

Fig. 3 — *Lobolytoceras* aff. *siemensi* (DENCKMANN), Toarcian, Thouarsense Zone. Sărăţii Valley - Perşani Mts. Col. Elena Popa (x 0,6)

Fig. 4 — *Pseudogrammoceras fallaciosum* (BAYLE), Toarcian, Thouarsense Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

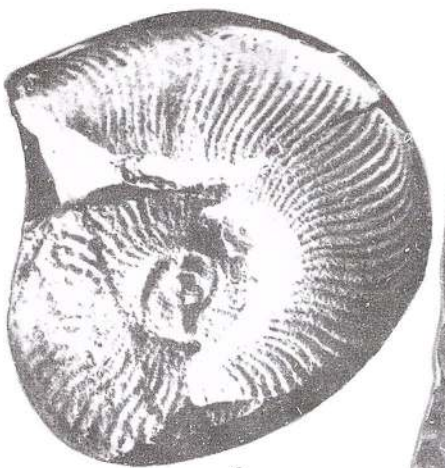
Fig. 5 — *Hammatoceras* sp., Toarcian, Levesquei Zone. Sărăţii Valley - Perşani Mts. Col. Elena Popa (x 1)

Fig. 6 — *Pleydellia* sp., Toarcian, Levesquei Zone. Boiului Valley - Pădurea Craiului. Col. Elena Popa (x 1)

Fig. 7 — *Dumortieria* sp., Toarcian, Levesquei Zone. East of the Borod Basin. Col. Elena Popa (x 1)

1

3



2

5

5a

4

7

7a

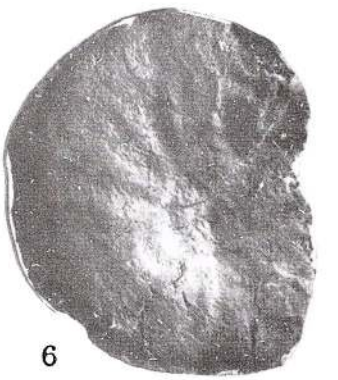


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Plate XV

Fig. 1 — *Wachneroceras toxophorum* (WAEHNER), Middle Hettangian, Liasicus Zone. Tepei Valley - Perşani Mts. Col. D.M.Preda. Det. Gr. Răileanu. Rev. Elena Popa (x 1)

Fig. 2 — *Ectocentrites petersi* (HAUER), Upper Hettangian, Angulata Zone. Stanciului Valley - Perşani Mts. Col. D. Patrulius, Elena Popa, Ileana Popescu (x 1)

Fig. 3 — *Ectocentrites petersi* (HAUER), Upper Hettangian, Angulata Zone. Racoşul de Jos - Perşani Mts. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 4 — *Aegolytoceras* sp., Upper Hettangian. Stanciului Valley - Perşani Mts. Col. D. Patrulius, Elena Popa, Ileana Popescu (x 1)

Fig. 5 — *Charmasseiceras marmoreum* (OPPEL), Upper Hettangian, Angulata Zone. Stanciului Valley - Perşani Mts. Col. D. Patrulius, Elena Popa, Ileana Popescu (x 1)

Fig. 6 — *Charmasseiceras marmoreum* (OPPEL), Upper Hettangian, Angulata Zone. Racoşul de Jos - Perşani Mts. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 7 — *Schlotheimia montana* (WAEHNER), Upper Hettangian, Angulata Zone. Tepei Valley - Perşani Mts. Col. D. Patrulius (x 1)

Fig. 8 — *Juraphyllites* sp., Hettangian-Lower Sinemurian (condensed beds). Stanciului Valley - Perşani Mts. Col. D. Patrulius, Elena Popa, Ileana Popescu (x 1)

Fig. 9 — *Coroniceras lyra* (HYATT), Lower Sinemurian, Bucklandi Zone. Dealu Negru - Perşani Mts. Col. D. Patrulius (x 1)

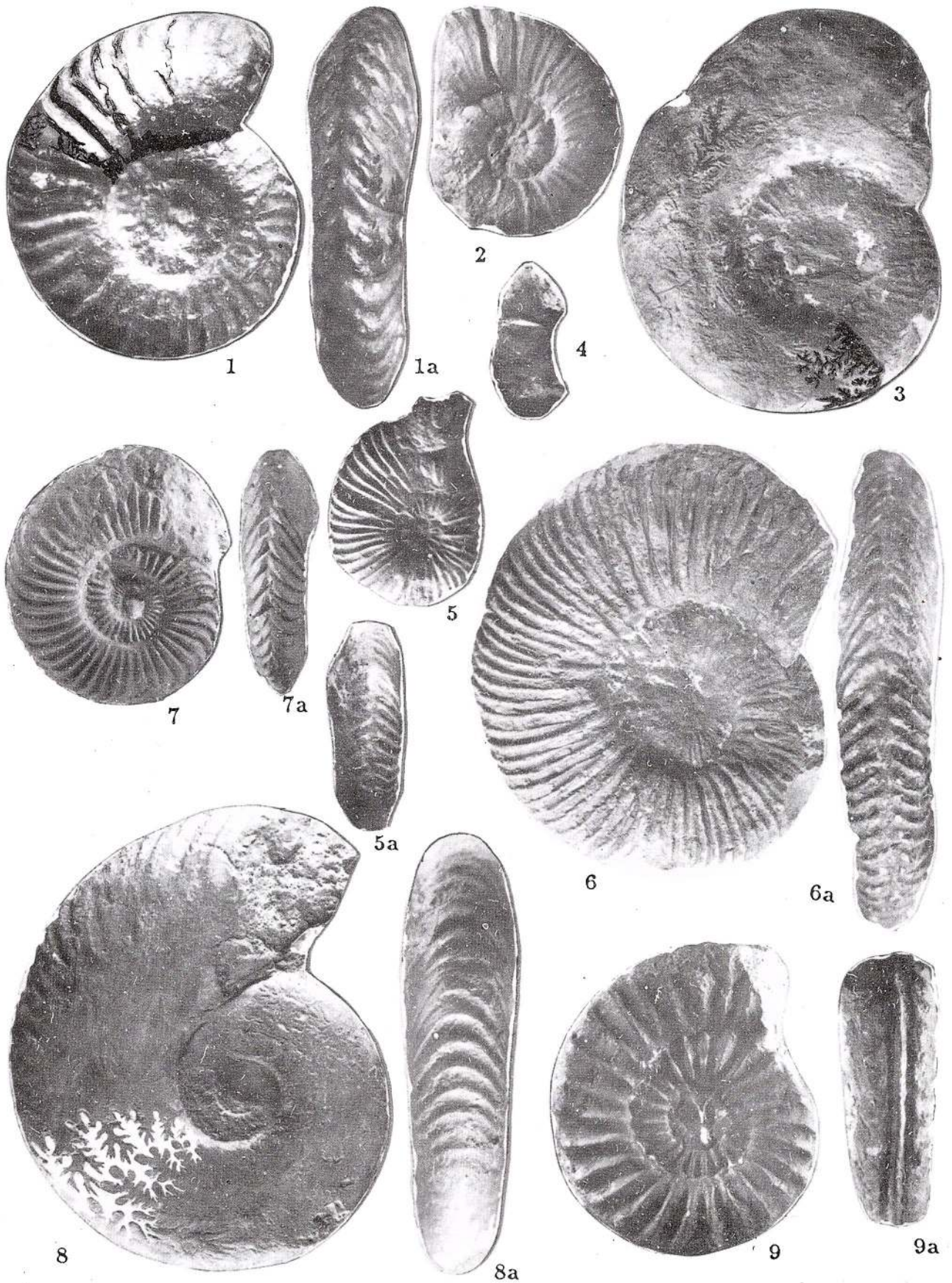


Plate XVI

Fig. 1 — *Paradasyceras uermoesense* HERBICH.. Col. D. Patrulius, Elena Popa (x 1)

Fig. 2 — *Paradasyceras tenuilobata* RĂILEANU. Col. D. Patrulius, Elena Popa (x 1)

Fig. 3 — *Geyeroceras cylindricum* (SOWERBY). Col. D. Patrulius, Elena Popa (x 1)

Fig. 4 — *Arietites* sp. Sinemurian. Stanciului Valley - Perşani Mts. Col. D. Patrulius, Elena Popa, Ileana Popescu (x 1)

Fig. 5 — *Geyeroceras szadeczkyi* (VADASZ). Col. D. Patrulius (x 1)

Fig. 6 — *Calliphylloceras* sp., aff. *C. sylvestre* (HERBICH). Col. D. Patrulius, Elena Popa (x 1)

Fig. 7 — *Geyeroceras cylindricum compressum* (FUCINI). Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 8 — *Geyeroceras leptophyllum* (HAUER). Col. D. Patrulius, Elena Popa (x 1)

Fig. 9 — *Geyeroceras leptophyllum* (HAUER). Col. E. Jekelius. Rev. Elena Popa (x 1)

Figs. 1–3, 5, 6 and 8 — Hettangian-Lower Sinemurian (condensed beds). Tepei Valley - Perşani Mts
Figs. 7 and 9 – Hettangian-Lower Sinemurian (condensed beds). Racoşul de Jos - Perşani Mts

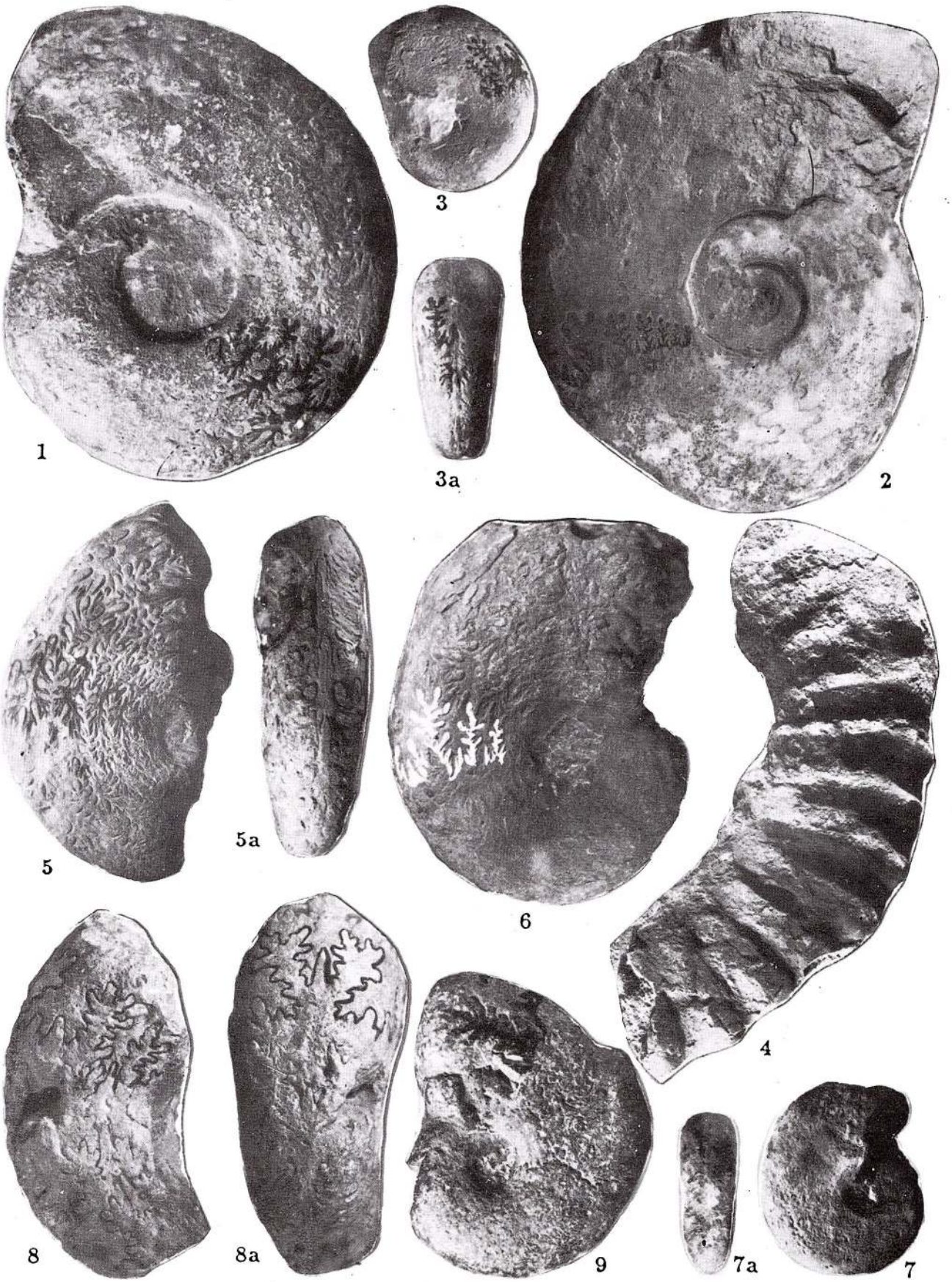


Plate XVII

Fig. 1 — *Geyeroceras cylindricum bielzii* HERBICH. Col. E. Jekelius (x 1)

Fig. 2 — *Paradasyceras uermoesense* (HERBICH). Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 3 — *Geyeroceras persanense* (HERBICH). Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 4 — *Geyeroceras cylindricum* (SOWERBY). Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 5 — *Juraphyllites* sp. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 6 — *Geyeroceras persanense* (HERBICH). Col. D.M.Preda. Rev. Elena Popa (x 1)

Fig. 7 — *Paradasiceras lunense* (DE STEF.). Col. E. Jekelius (x 1)

Figs. 1–7 — Hettangian-Lower Sinemurian (condensed beds). Racoşul de Jos - Perşani Mts

Plate XVIII

Fig. 1 — *Juraphyllites transilvanicus dorsoplanatus* FUCINI, Hettangian-Lower Sinemurian (condensed beds). Racoşul de Jos - Perşani Mts. Col. D.M.Preda. Det. Gr. Răileanu (x 1)

Fig. 2 — *Euagassiceras* sp., Lower Sinemurian. Racoşul de Jos - Perşani Mts. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 3 — *Paradasyceras uermoesense* (HERBICH), Hettangian-Lower Sinemurian (condensed beds). Racoşul de Jos - Perşani Mts. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 4 — ? *Adnethiceras* sp., aff. *A. adnethicum* (HAUER), Upper Sinemurian. Tepei Valley - Perşani Mts. Col. D. Patrulius, Elena Popa (x 1)

Fig. 5 — *Partschiceras* sp., Upper Sinemurian. Racoşul de Jos - Perşani Mts. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 6 — *Asteroceras obtusum* (SOWERBY), Upper Sinemurian. Racoşul de Jos - Perşani Mts. Col. E. Jekelius. Rev. Elena Popa (x 1)

Fig. 7 — *Epideroceras* sp., Upper Sinemurian. Pietrele Albe - Perşani Mts. Col. D. Patrulius (x 1)

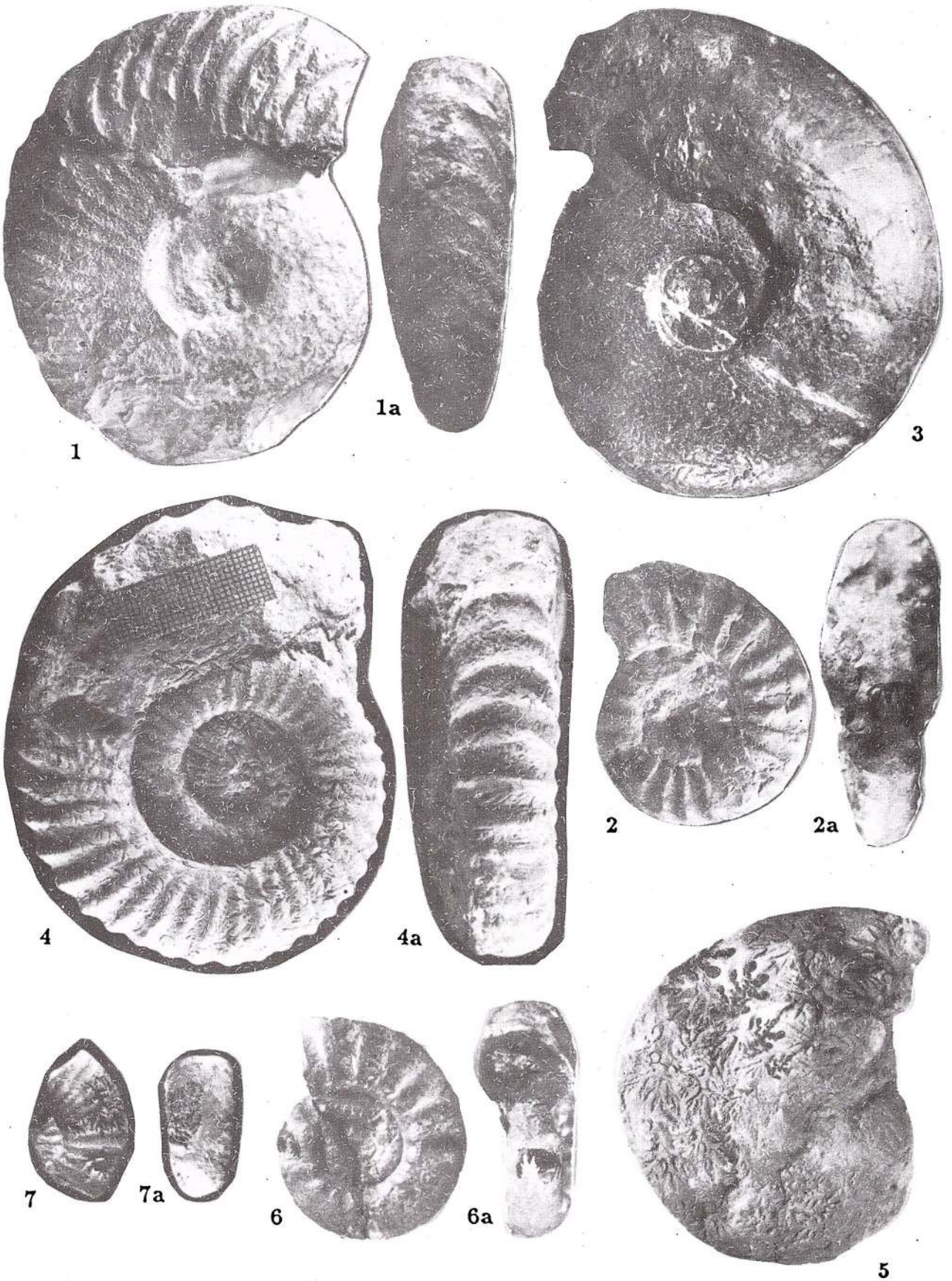


Plate XIX

Fig. 1 — *Arnioceras* sp., Lower Sinemurian. Racoşul de Jos - Perşani Mts. Col. E. Jekelius (x 1)

Fig. 2 — *Paltechioceras* sp., Upper Sinemurian. Dealul Praşca - Rarău Massif. Col. D. Patrulius, Elena Popa (x 1)

Fig. 3 — *Echioceras* sp., aff. *E. rhodanicum* (DUM.), Upper Sinemurian, Raricostatum Zone. Pietrele Albe - Perşani Mts. Col. D. Patrulius (x 1)

Fig. 4 — *Epideroceras* sp., aff. *E. lorioli* (HUG.), Upper Sinemurian, Raricostatum Zone. Pietrele Albe - Perşani Mts. Col. D. Patrulius (x 1)

Fig. 5 – *Uptonia* sp., aff. *U. jamesoni* (SOWERBY), Carixian. Dealul Negru – Perşani Mts. Col. D. Patrulius (X 1)

Fig. 6 – *Lytoceras* sp., Upper Sinemurian. Pietrele Albe – Perşani Mts. Col. D. Patrulius (X 1)

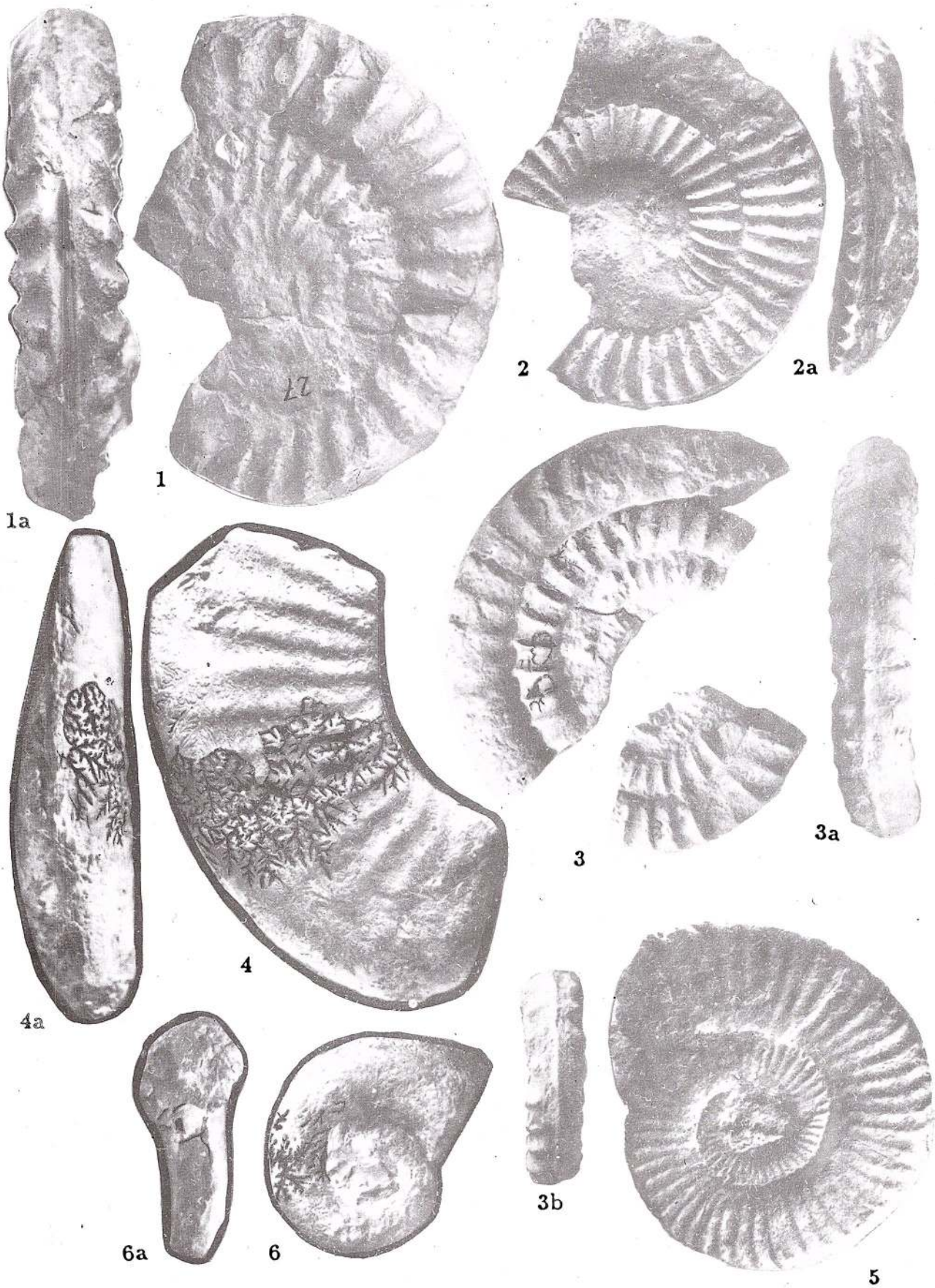


Plate XX

Fig. 1 — *Phylloceras meneghinii* GEMM., Upper Sinemurian. Pietrele Albe - Perşani Mts. Col. D. Patrulius, Elena Popa. Figs. 1 and 1a (x 1); fig. 1b (x 3)

Fig. 2 — *Partschiceras* cf. *P. tenuistriatum* (MENEGHINI), Upper Sinemurian. Pietrele Albe - Perşani Mts. Col. D. Patrulius, Elena Popa. Figs. 2 and 2a (x 2); fig. 2b x 5,5)

Fig. 3 — *Zetoceras bonarelli* OSETT, Upper Sinemurian. Pietrele Albe - Perşani Mts. Col. D. Patrulius, Elena Popa. Figs. 3 and 3a (x 1); fig. 3b (x 3)

Fig. 4 — *Calliphylloceras bicicolae* (MENEGHINI), Upper Sinemurian. Pietrele Albe - Perşani Mts. Col. D. Patrulius, Elena Popa. Figs. 4 and 4a (x 1); fig 4b (x 4)

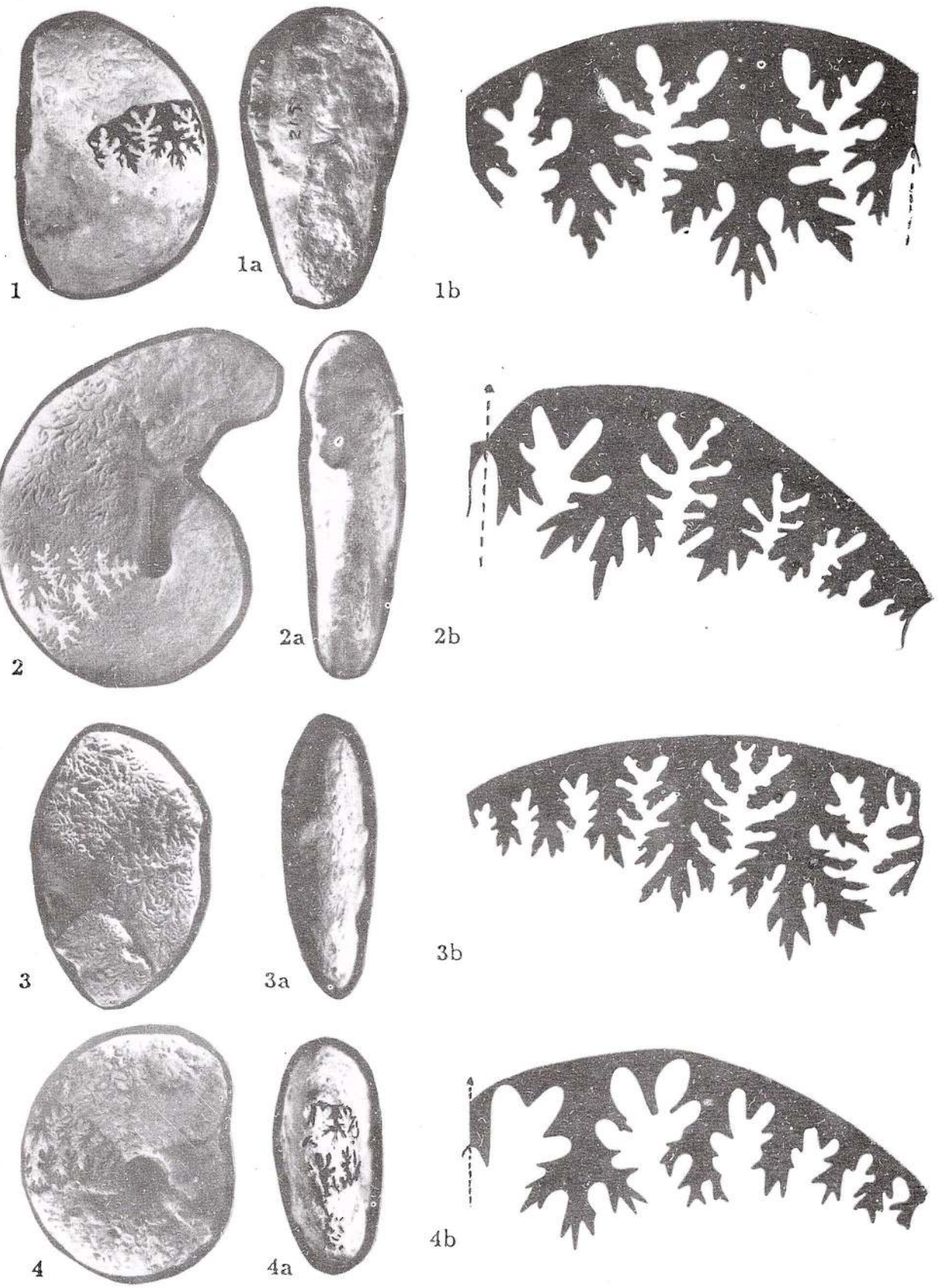


Plate XXI

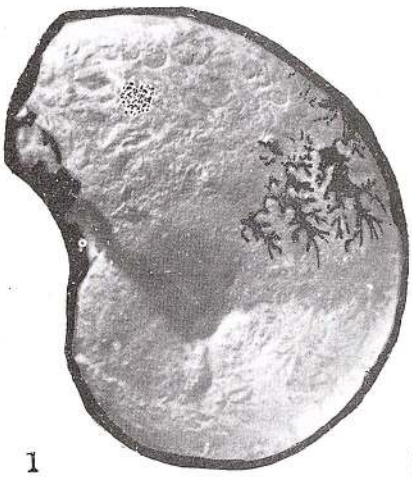
Fig. 1 — *Calliphylloceras anatolicum* MEIST. Figs. 1 and 1a (x 1); fig. 1b (x 3)

Fig. 2 — *Calliphylloceras* cf. *C. emeryi* (BETTONI). Figs. 2 and 2a (x 1); fig. 2b (x 3)

Fig. 3 — *Meneghiniceras libertus* GEMM. Figs 3 and 3a (x 2); fig. 3b (x 3,5)

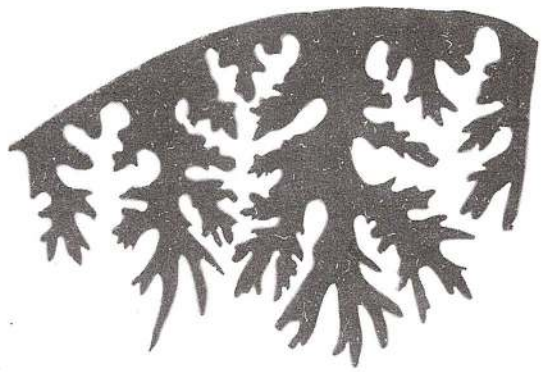
Fig. 4 — *Paradasyceras planispira* (REYNÈS). Figs. 4 and 4a (x 1); fig. 4b (x 5,5)

Figs. 1–4 — Upper Sinemurian. Pietrele Albe - Perşani Mts. Col. D. Patrulius, Elena Popa



1

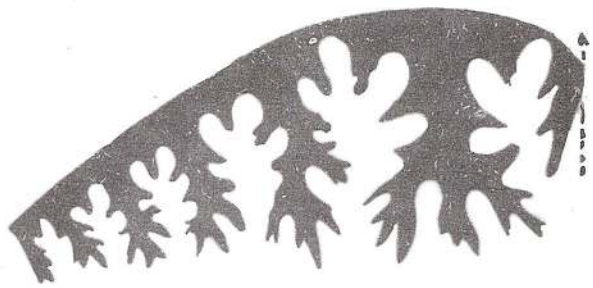
1a



1b

2

2a



2b

3

3a

3b

4

4a

4b

DAN CONSTANTIN PATRULIUS
(1921–1982)

Lucrări şi hărţi geologice publicate

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