GEOLOGICA HUNGARICA

FASCICULI INSTITUTI GEOLOGICI HUNGARIAE
AD ILLUSTRANDAM NOTIONEM GEOLOGICAM
ET PALAEONTOLOGICAM

SERIES PALAEONTOLOGICA

FASCICULUS 51

DR. LESS GYÖRGY: AZ EURÓPAI ORTHOPHRAGMINÁK
ŐSLÉNYTANA ÉS RÉTEGTANA

DR. GYÖRGY LESS: PALEONTOLOGY AND STRATIGRAPHY
OF THE EUROPEAN ORTHOPHRAGMINAE

INSTITUTUM GEOLOGICUM HUNGARICUM
BUDAPESTINI, DECEMBER 1987

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A kézirat lezárva 1986. december 1-én

Megjelent a Műszaki Könyvkiadó gondozásában
Felelős kiadó: DR. HÁMOR GÉZA
Műszaki vezető: KŐRIZS KÁROLY
Műszaki szerkesztő: METZKER SÁNDOR
A könyv formátuma: A4
Terjedelem: 47 (A5) ív
Példányszám: 880
Ábrák száma: 32
Betűcsalád és -méret: Extended, gm/gm
Papír minősége: 80 g delta és 120 g műnyomó
Azonossági szám: 01661

Egyetemi Nyomda — 87.5525 Budapest, 1987
Felelős vezető: SÜMEGHI ZOLTÁN igazgató

TARTALOM — CONTENTS

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BEVEZETÉS

Az eocénnel foglalkozó kutatók rétegtani beosztásaikhoz elsősorban a Nummulitidaeket, a plankton Foraminiferákat és a nannoplanktont használják fel, ugyanakkor a helyenként kőzetalkotó tömegben fellépő Orthophragminákat sokkal kevésbé veszik tekintetbe. Ennek oka az, hogy az ezzel a csoporttal foglalkozó kutatók rétegtani eredményei egymásnak ellentmondóak, így az a vélemény alakult ki, hogy az Orthophragminák perzisztensek, szemben az összes többi nagy Foraminiferával.

Ez a munka arra hivatott, hogy bemutassa az Orthophragminák biosztratigráfiai célokra való alkalmazására tett erőfeszítéseimet. Munkám során két területen igyekeztem eltérni az eddigi kutatók módszereitől. Az egyik az, hogy törekedtem minél nagyobb területről és lehetőleg minél több rétegtani szintből származó anyagot vizsgálni, szemben a korábbi kutatók legnagyobb részével, akik csak egy-egy szűk terület Orthophragmináival foglalkoztak. A másik, hogy vizsgálataim során a fő figyelmet a belső morfológiára fordítottam.

Kutatásaim megerősítették Brönnimann (1945b, 1951)-nak azt a nézetét, hogy az Orthophragminák két, egymástól rendszertanilag függetlenül kialakult családból, a Discocyclinidaekből és az Asterocyclinidaekből állanak, melyek azonban nagyon gyakran együtt fordulnak elő és morfológiájukban is sok hasonlóság van. Ezért célszerű őket együtt tárgyalni Orthophragmina összefoglaló név alatt. E név alkalmazásának csakis praktikus okai vannak (viszonylag rövid, a földtani irodalomban elterjedt), egyébként semmilyen rendszertani kategóriát nem jelöl, csakúgy, mint például a „nagy Foraminiferák" elnevezés.

Munkám legfontosabb eredményei két csoportba sorolhatók. Az egyik őslénytani jellegű: igyekeztem kidolgozni az Orthophragminák meghatározásának új módszerét, a taxonokat pontos (számszerű) definícióval ellátni, az eddigi irodalmat kritikailag értékelni. A másik rétegtani jellegű: az új őslénytani alapokra helyezkedve megkíséreltem rekonstruálni az Orthophragminák törzsfejlődését és kidolgozni rétegtanukat. Utóbbihoz hozzá kell tennem, hogy eredményeim nem véglegesek, mint ahogy nem végérvényesek a Nummulitesek, Alveolinák, plankton Foraminiferák és a nannoplanktonok finomrétegtani beosztásai sem. Épp ezért ezt a munkát csak mint az Orthophragminák törzsfejlődésének megismeréséhez és a rájuk alapozott rétegtani beosztáshoz vezető út egyik első lépését lehet értékelni.

Maga a dolgozat az 1981-ben írott és 1982-ben megvédett egyetemi doktori értekezésemen (Less 1981b) alapul, annak az újabb irodalmi adatokkal kibővített, illetve részben átdolgozott változata. Az átdolgozás leglényegesebb momentumai: Hardenbol—Berggren (1978) alapján a cuisi—lutéciai határ egy Nannoplankton zónával lejjebb került, valamint a középső-eocén felső részére itt a bartoni emelet elnevezést használom.

Mivel az értekezés tartalmazza a magyar nyelvű taxonleírásokat is, e dolgozatban ezeket csak angol nyelven közlöm.

Az Orthophragminák vizsgálatát 1974-ben, még a Moszkvai Ordzsonikidze Geológiai Egyetemen kezdtem el G. I. Nemkov professzor és V. L. Portnaja docens ösztönzésére.

A későbbiekben az ők, valamint Dr. Kecskeméti Tibor és Dr. Jámborné dr. Kness Mária segítségével nagyszámú krím-félszigeti és magyarországi mintát gyűjtöttem be. Ezenkívül Dr. Kecskeméti Tibor rendelkezésemre bocsátotta a Természettudományi Múzeum gazdag franciaországi, olaszországi, ausztriai és bulgáriai összehasonlító anyagát. Így mind földrajzi, mind rétegtani értelemben elég széles körű gyűjteményre tehettem szert, mely lehetővé tette számomra az Orthophragminák őslénytanának és rétegtani jelentőségének vizsgálatát. Mind a négyük szakmai és emberi támogatásáért őszinte köszönettel tartozom.

Köszönettel tartozom azoknak is, akik egyetemi és földtani intézeti munkám mellett lehetővé tették számomra az anyaggal való rendszeres foglalkozást, név szerint I. V. Csernov professzornak, Dr. Jámbor Áronnak, Böjtösné Varrók Kornéliának, és Dr. Nagy Elemérnek. Hálával tartozom még Dr. Hámor Gézának, a M. Áll. Földtani Intézet igazgatójának, aki munkámat kiadatta, Dr. Jámborné dr. Kness Máriának és Dr. Kecskeméti Tibornak az igényes szakmai lektorálásért, Dr. Dudich Endrének, Dr. Géczy Barnabásnak, Dr. Báldi Tamásnak, Dr. Báldiné dr. Beke Máriának és Dr. Szőts Endrének sokrétű szakmai tanácsaikért, Piros Christának alapos szerkesztői munkájáért, Seress Lászlónak kiváló angol nyelvű fordításáért.

A preparált példányok a M. Áll. Földtani Intézet Múzeumában vannak letétbe helyezve E. 4596—5031. lelt. sz. alatt.

AZ ORTHOPHRAGMINÁK KUTATÁSÁNAK TÖRTÉNETE

Az Orthophragminákról az első leírások a múlt század első éveiből származnak (FORTIS 1802, SCHLOTHEIM 1820). Az első rendszeresebb fajleírások a múlt század közepén születtek (SOWERBY 1840, MICHELIN 1846, D'ARCHIAC 1846, 1850, RÜTIMEYER 1850, GÜMBEL 1861, 1868, SCHAFHÄUTL 1863, KAUFMANN 1867). Ezen művek fő jellemzője a külső bélyegeken alapuló fajleírás, helyenként axiális metszetekkel és még ritkábban erősen torzított, idealizált rajzos equatoriális metszetekkel kiegészítve. Ugyanebben az időben CARPENTER (1850) már az Orthophragminák belső szerkezetét is tanulmányozta. Ezek a korai szerzők még a Lenticulites, Lycophris, Orbitulites, majd a D'ORBIGNY (1848) által bevezetett Orbitoides genus-neveket használták.

GÜMBEL (1868) az Orbitoideseken belül subgenusként elkülönítette a Discocyclinákat, Aktinocyclinákat, Asterocyclinákat és az azóta használatból kiment Rhipidocyclinákat a felső-kréta Orbitoides (s. s.)-ektől és az oligocén—alsó-miocénbeli Lepidocyclináktól. MUNIER-CHALMAS (1891) GÜMBEL fent említett első négy subgenusát Orthophragmina genus-név alatt leválasztotta az Orbitoides genusról, majd DOUVILLÉ (1898) megállapította a három rokon genus rétegtani helyét: az Orbitoidesekét a felső-szenonban, az Orthophragminákét az eocénben és a Lepidocyclinákét az oligocénben.

SCHLUMBERGER (1903, 1904) munkássága fontos, előrevivő lépés az Orthophragminák kutatásában. Ő az első, aki egyrészt fényképes ábrákat közölt, másrészt ő mutatott be először értékelhető equatoriális metszeteket az Orthophragminákról. Fajleírásaiban egyaránt koncentrált mind a külső, mind a belső bélyegekre.

SCHLUMBERGER irányzata mintegy 20 éven keresztül uralkodott, mely idő alatt értékelhető equatoriális metszeteket mutatott be DEPRAT (1905), PROVALE (1908), CHECCHIA-RISPOLI (1909a, b, 1911a, b, 1913, 1916, 1917, 1925) és PREVER (1912). Ezekben a munkákban sok ellentmondást találunk ugyan, de használható ábráikkal legalább megteremtették az alapot egy rendszerező, revíziós jellegű munkához.

Ezt a revíziót a kor nagy tekintélyű paleontológusa, DOUVILLÉ (1922) végezte el. A mű hatása sok tekintetben még ma is érezhető, és jelentős mértékben okolható azért, hogy az Orthophragminák mind a mai napig nincsenek jelentőségüknek megfelelően felhasználva a paleocén és az eocén rétegtani szintezésében. DOUVILLÉ ugyanis művében — úgy vélem — alábecsülte a belső morfológiai jegyek használhatóságát a fajmeghatározásban, ehelyett a külső bélyegek csaknem kizárólagos használatát hirdette. Ennek megfelelően a továbbiakban már csak alig (SILVESTRI 1923, 1948, NUTTALL 1925, 1926, DONCIEUX 1926, MEFFERT 1931, HENRICI 1934, REINA 1934, CAUDRI 1934, WITT PUYT 1941), vagy egyáltalán nem (LLUECA 1929) találkozhatunk a fajleírásokban a belső morfológiai jegyek leírásával, illetve ábrázolásával, a fajmeghatározásban pedig ezeket egyáltalán nem vették figyelembe. DOUVILLÉ érdemeként értékelhető viszont a Discocyclina, Actinocyclina és Asterodiscus (=Asterocyclina) nevek genus-szintre emelése, illetve a külső morfológiai jegyek (alak, granuláció, oldalkamrák) beható vizsgálata.

Az Orthophragminák kutatásában a jelenlegi időkig is tartó szakaszt BRÖNNIMANN (1938, 1940, 1941, 1942, 1945a, b, 1951) és WEIJDEN (1940) munkássága indította el.

BRÖNNIMANN legjelentősebb érdeme az Orthophragminák morfológiájának és szerkezetének beható vizsgálata, előbb két alcsaládra — Discocyclininae és Orbitoclypeinae (BRÖNNIMANN 1945b), majd két családra — Discocyclinidae és Asterocyclinidae (BRÖNNIMANN 1951) való bontása, elsősorban a mikroszférás juvenárium vizsgálata alapján. A svájci kutató, részben a háborús idők miatt, kutatásait viszonylag kis anyagon végezte, ezért jelentősebb rétegtani eredményeket nem ért el.

WEIJDEN (1940) monográfiájában az európai Orthophragminák (nála Discocyclinák) rétegtani jelentőségét kutatta, saját vizsgálati anyaga azonban a biarritzi szelvényre korlátozódott. Ennek ellenére ő volt az első, aki a fajmeghatározást (bár csak egyes fajoknál) a belső bélyegek — elsősorban az embrió alakja — alapján végezte el.

Az azóta eltelt időre egy-egy viszonylag szűk terület Orthophragmináinak feldolgozása a jellemző. A fajmeghatározásban a második világháború után is a külső bélyegek szerepe volt a döntő, mellettük azonban rendszeressé vált az equatoriális és axiális metszetek ábrázolása is.

Schweighauser (1953) a Vicenza környéki Orthophragminákat dolgozta fel az Aktinocyclinák kivételével, rétegtani következtetései azonban — véleményem szerint — nem meggyőzőek.

Neumann (1958) megkísérelte revízió alá venni a gazdag nyugat-aquitániai Orthophragmina faunát, azonban a külső bélyegeken alapuló határozásokon kívül munkájának több hiányossága is van. Például az Orthophragminák belső vázelemeiről közölt méretei konzekvensen 1,6—2×-esei a Weijden (1940), Schweighauser (1953) és mások, valamint az általam megfigyelteknek. Ezért ebben a munkában, ahol szükségesnek látszott, a Neumann által megadott vázelemméreteknek a 0,5—0,6-szorosát vettem figyelembe. Rétegtani adatai önmagukban sem túl meggyőzőek az Orthophragminák kormeghatározó értéke szempontjából, másrészt a Schweighauseréivel és Weijdenéivel összevetve tovább szélesítik egyes Orthophragmina fajok fajöltőit. Ugyanakkor nagy érdemei vannak az Orthophragminák axiális metszet alapján történő rendszerezésében.

Kecskeméti (1958, 1959) munkái az eddigi legalaposabbak a magyarországi Orthophragmina-irodalomban, bár csak az Ajka környéki képződményeket vizsgálta. Ábráinak többsége nyomdatechnikai okokból sajnálatosan rossz, így a csiszolati anyag egy részét — remélhetőleg jobb minőségben — ez a munka közli.

Belmusztakov (1959) bulgáriai, Bieda (1963) és Olempska (1973) lengyel, valamint Kacsarava (1981) grúziai munkáinak kritikai felhasználását a rossz ábraanyag nagyon megnehezíti. Ezzel szemben Köhler (1961, 1967), Samuel—Borza—Köhler (1972), Gross—Köhler et al. (1980) szlovákiai, Toumarkine (1967) és Massieux (1973) észak-corbiéres-i, valamint Sirotti (1978) priabonai dolgozatait jó leírások és ábraanyagok jellemzik.

Portnaja (1974, 1975) krím-félszigeti anyagra épülő dolgozatai közvetve azt tükrözik, hogy a külső bélyegeket alapul vevő fajmeghatározásokra épülő rétegtani beosztás egy adott körzet határain túllépve, érvényét veszti.

Az eddigi irányzatokhoz képest újként jelentkezett a biometriai, illetve populáció-statisztikai módszer az Orthophragmina-kutatásban. Elsőként Brolsma (1973) alkalmazta egy Ganból (DNy-Aquitania) származó mintán, majd Fermont (1982) és Setiawan (1983) jelentősebb izraeli, illetve priabonai anyagon. Munkáikban a belső szerkezet számszerűleg mérhető jellemzőire helyezték a hangsúlyt, ami Fermontnak (1982) megalapozott rétegtani következtetésekre is alapot nyújtott. Ezzel szemben — úgy vélem — bizonyos minőségi jellemzőket egyáltalán nem, vagy nem kellő mértékben vettek figyelembe, ami miatt minőségileg különböző fajokat hasonló mennyiségi jellemzőik alapján egybetartozónak véltek. Ezzel együtt is munkásságuk minőségileg új és progresszív, annál is inkább, mivel az általuk alkalmazott módszer más nagy Foraminiferáknál (Miogypsinák, Lepidorbitoidesek) már jelentős rétegtani eredményekhez nyújtott segítséget.

Munkámban nem térek ki a nagyobb rétegtani eredményeket adó amerikai, karibi és pacifikus Orthophragmina-kutatásokra, mivel Vaughan (1945) és Cole (1957, 1960) munkái alapján az eurázsiai és amerikai — pacifikus Orthophragminák egymástól elszigetelve, párhuzamosan fejlődtek.

Ezzel szemben Nagappa (1959), Sen Gupta (1963a, b) és Samanta (1963a, b, 1964, 1965a, b, 1967, 1968, 1969) munkái azt tükrözik, hogy az indiai szubkontinens Orthophragminái szoros rokonságban állnak az európaiakkal. Samanta (1969) volt az első, aki kísérletet tett a Discocyclinák törzsfejlődésének követésére Elő-India keretein belül.

AZ ORTHOPHRAGMINÁK MORFOLÓGIÁJA

Már jóval vizsgálataim előtt ismert volt, hogy az Orthophragminák voltaképpen két egymástól teljesen független csoportba sorolhatók (BRÖNNIMANN 1945b, 1951, CAUDRI 1972): a Discocyclinidaekbe és az Asterocyclinidaekbe (BRÖNNIMANN 1951). Mivel azonban a két család rendszeresen együtt fordul elő és morfológiai jegyeik között is nagyon sok a közös, célszerű e helyen együtt tárgyalni őket.

Általános felépítésük például teljesen megegyezik: mind a két család váza három rétegből áll (1. ábra)*: a középső ún. equatoriális rétegből, mely egy 0,05—0,1 mm vastagságú „lemez", aminek a közepén helyezkedik el a mindig kétkamrás embrió (az A-formáknál), vagy B-formák esetében a proloculum. Az embriót körkörös vagy csillagszerű ciklusok veszik körül, melyek equatoriális kamrákra tagolódnak. Az equatoriális réteget két oldalról szimmetrikusan ún. laterális rétegek veszik körül, amelyek jellegzetes gomb, lencse, esetleg csillag alakot adnak az Orthophragmináknak. A laterális réteg több, egymás fölött álló lemezből tevődik össze, melyek laterális kamrákra tagolódnak. A laterális rétegeket az equatoriális réteg szélétől induló pillérek szilárdítják meg, melyek granulumok formájában jelentkeznek a váz felületén és ott a legkülső laterális lemez laterális kamráival jellegzetes mintázatot (rozettát) alkotnak.

A váz alakja általában lapos vagy duzzadt lencse vagy korong alakú, középen mindkét oldalról az embrió fölött képződött búb (umbó) található. A vázon esetenként bordák, vagy pontszerű, vonalba rendeződött kitüremkedések találhatók. Csak az Asterocyclinidaeknél a váz csillag alakú (általában ötágú) is lehet. Az Orthophragminák belső bélyegeit az equatoriális rétegen áthaladó equatoriális metszetben, ill. az erre merőleges és az embrión áthaladó axiális metszetben tanulmányozhatjuk legjobban. Az ezektől eltérő tangenciális metszeteknek általában nagyon csekély az értékük (2. ábra).

A korábbi kutatók elsősorban a váz külső jegyeinek tulajdonítottak nagy jelentőséget (alak, rozetta), bár újabban az embrió jellegzetességeit is figyelembe vették. Vizsgálataim során a fő hangsúlyt az equatoriális réteg morfológiájára helyeztem, mivel úgy tapasztaltam, hogy a váz alakjának kisebb eltéréseire alapozott taxonómia „megbukik" a rétegtani kontrollon. Emellett természetesen figyelembe vettem a vázalakok jellegzetes (szignifikáns) eltéréseit is.

Ennek megfelelően az Orthophragmina-váz morfológiájának leírásában belülről kifelé, taxonómiai fontossági sorrend szerint haladok.

A B-FORMÁK JUVENÁRIUMA

A taxonómiai részben alkalmazott rövidítések:

I = a proloculum átmérője (μm),
S = a spirális szakaszban foglalt kamrák száma a proloculum nélkül,
s = a spirális szakasz átmérője (μm),
n = a félciklusok száma,
d = a nepionikus és spirális szakasz együttes átmérője (μm),
J = a juvenilis ciklusok száma,
j = a juvenilis, nepionikus és spirális szakasz együttes átmérője (μm),
l és h ugyanaz, mint az A-formák equatoriális kamráinál.

Az Orthophragminák két családja elkülönítésének legfőbb kritériuma a B-formák juvenáriumának jól látható különbözősége. Mivel a mikroszférás juvenárium a Foraminiferák esetében tükrözi a törzsfejlődés korai szakaszait, megállapítható, hogy a két család különböző ősöktől ered (BRÖNNIMANN 1945b, 1951, CAUDRI 1972). Ezek alapján indokolt két család, a Discocyclinidae és az Asterocyclinidae felállítása. Ennek megfelelően itt külön kell őket tárgyalni. A leírtak mind az equatoriális metszetre vonatkoznak.

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* Az ábrák és táblázatok az angol szövegben találhatók.

A Discocyclinidaek B-formáinak juvenáriuma

Minden Discocyclinidae ún. „Heterostegina"-jellegű juvenáriummal rendelkezik, azaz a 0,01—0,02 mm nagyságú, gömb alakú mikroszférás embriót (proloculumot) előbb 4—5 kamrából álló spirál veszi körül, majd e kamrák fokozatosan egyre szélesednek és a központi spirált féloldalról kezdik körülvenni. Ezek az ún. nepionikus kamrák (vagy félciklusok) azután kamrácskákra tagolódnak (mint a Heterosteginák esetében) és az egymást követő kamrák egyre nagyobb ívben kerítik be az előző kamrát egészen a teljes bekerítésig, ami után már az egyes (kamrácskákra tagolódó) juvenilis kamrák koncentrikus ciklusokban épülnek fel. Az eleinte széltében elnyúló kamrácskák a ciklusokban fokozatosan felmagasodnak, kifelé haladva felveszik normális, a perifériák felé elnyúlt alakjukat (3. ábra).

Első ránézésre a mikroszférás Discocyclinidae-juvenárium arról ismerhető fel, hogy a proloculum (ellentétben az Asterocyclinidaekkel) nem pontosan a juvenárium közepén, hanem attól oldalvást, excentrikusan helyezkedik el, valamint a nepionikus kamrák (félciklusok) jelenlétéről.

A mikroszférás embrió és a spirális szakasz felépítésében a Discocyclinidae család tagjai azonosak, azonban a nepionikus kamrák száma tekintetében jelentős különbségek fedezhetők fel. A legprimitívebb amerikai Athecocyclinák esetében számuk 12—15, a Nemkovelláknál 9—12, a primitív Discocyclináknál *(D. archiaci, D. fortisi)* 7—9, a fejlettebbeknél *(D. augustae, D. dispansa, D. pratti)* 5—7, míg a legfejlettebbek *(D. radians, D. nandori)* esetében ez a szám csak 3—4. Hasonló tendenciák más nagy Foraminiferáknál (Lepidorbitoides, Lepidocyclina) is megfigyelhetők. Ez a jelenség nepionikus akceleráció néven ismert, azaz a fejlett formák egyre kevesebbet őriznek meg őseik „örökségéből", egyre gyorsabban érik el a csak rájuk jellemző sajátosságokat.

Vizsgálataim során megfigyelhettem a kamrák, illetve kamrácskák közötti nyílások, az ún. sztolonok kialakulását is. A kamrák közötti ún. radiális sztolonok szélein kezdetben a kamrafal is megvastagszik, ez azonban a későbbiekben eltűnik, a ciklusok fokozatos felmagasodásával. Jellegzetes a kamrácskák közötti ún. annuláris sztolon kialakulása: a kamrácskákat elválasztó szeptum kezdetben a kamrafalból nő ki (a nepionikus kamráknál), a kamrácskák összeköttetését a disztális annuláris sztolon biztosítja. Ahol a nepionikus kamrák ciklusokba mennek át, ott ez megszűnik (nincs összeköttetés az egy ciklusban helyet foglaló kamrácskák között), majd a ciklusok felmagasodásával kialakul a csak a Discocyclinákra jellemző proximális annuláris sztolon. Ez a folyamat jól látszik a X. tábla 8—9. képén.

A fentebb leírtak azonban csak a Discocyclináknál mennek végbe teljességgel, az amerikai Pseudophragminák (s. l.)-nál végig megmarad a disztális annuláris sztolon, míg a Nemkovellák esetében a disztális annuláris sztolon eltűnik ugyan, de a proximális annuláris sztolon nem alakul ki (l. a 11. ábrát is).

Ily módon a nepionikus akceleráció ugyanolyan folyamata tanulmányozható a Pseudophragmina (s. l.) — Nemkovella—Discocyclina vonalon a sztolonrendszer fejlődésében, mint a nepionikus kamrák számának csökkenésében (kamrákat és kamrácskákat csak a B-formák juvenáriumánál különböztetünk meg, a fejlett — neanikus — stádium „kamrái" a nepionikus stádium „kamrácskáinak" felelnek meg, „ciklusai" pedig a juvenárium „kamráinak". Tudni kell azonban, hogy a Discocyclinidaek kamrái nem azonos módon alakultak ki az Asterocyclinidaek „valódi" kamráival).

Itt kell még megemlíteni, hogy a Discocyclinidaek esetében a generációs dimorfizmus különbözőképpen fejeződik ki a méretekben. A Nemkovellák A- és B-formái között e tekintetben nincs eltérés. A Discocyclinák esetében azonban minél nagyobb az A-forma embriója, annál nagyobbak a B-forma méretei. Az általam ismert legnagyobb átmérőjű Discocyclinák (10 cm) a bahcsiszeráji Szuvlu-Kaja-hegy szimferopoli emeletének tetején voltak találhatók *(D. stratiemanuelis)*, melyek A-embriója kb. 1 mm átmérőjű. A nemzedékek méretbeli eltérése azonban sokkal kevésbé kifejezett, mint a Nummuliteseknél, annál is inkább, mivel B-formáik sokkal kevésbé gyakoriak. Nagyméretű Discocyclina B-formák az ilerdi emelettől kezdve megtalálhatók a priabonai emelet tetejéig, ebben is különböznek a Nummulitesektől.

Az Asterocyclinidaek B-formáinak juvenáriuma

Minden Asterocyclinidae ún. „Lepidocyclina"-jellegű juvenáriummal rendelkezik, azaz a 0,01—0,02 mm nagyságú, gömb alakú mikroszférás embriót (proloculumot) 5—8 kamrából álló spirál veszi körül. Eddig minden kamrából egy további kamra képződött, a spirál utolsó tagjából viszont már kettő, két különböző irányban és ezután is az összes többi kamrából kettő (3. ábra). Idővel közös kamrák is képződnek és kialakul a ciklusos felépítés, egyelőre még tobozpikkelyszerű (juvenilis) kamrákkal, azaz az egy cikluson belüli kamráknak nincs közös válaszfaluk. Ezután alakul ki a közös válaszfal és a jellegzetes, nagyon enyhén hexagonális kamrák. Ezzel együtt a sztolonok is — melyek kezdetben a szeptumok alján voltak — fokozatosan feljebb tolódnak és kialakul a jellegzetes négysztolonos, majd később csak az amerikai Neodiscocyclináknál a hatsztolonos equatoriális kamra.

Első ránézésre a mikroszférás Asterocyclinidae-juvenárium arról ismerhető fel, hogy a mikroszférás embrió nagyjából a juvenárium középpontjában helyezkedik el, valamint a nepionikus kamrák (félciklusok) hiányoznak. A kamrák (ellentétben a Discocyclinidaekkel) valódi kamráknak tekinthetők. Az Asterocyclinák ill. egyes Orbitoclypeusok equatoriális rétegének csillagszerű (aszteroid) felépítése is a cikluson belüli közös válaszfalak kialakulásakor kezd kirajzolódni.

A nepionikus akceleráció az elsődleges spirálban helyet foglaló kamrák számának csökkenésében nyilvánul meg. A primitívebb Orbitoclypeusoknál *(O. portnayae, O. ramaraoi)* számuk 8—10, a fejlettebbeknél *(O. varians)* 5—7. Ugyanígy az Asterocyclináknál a primitívebbeknél *(A. stella taramellii)* számuk 7—9, a fejlettebbeknél *(A. stellata stellaris, A. alticostata)* 5—6.

Az Asterocyclinidaeknél a generációs dimorfizmus még kevésbé tükröződik a méretekben, mint a Discocyclinidaeknél. Mindössze a legnagyobb megaszférás embriójú alakoknál *(Orbitoclypeus chudeaui, Asterocyclina alticostata)* múlja felül a B-forma vázmérete mintegy 50%-kal az A-formáét.

A MEGASZFÉRÁS (A) EMBRIÓ

A taxonómiai részben alkalmazott rövidítések:

t = típus (5. ábra),
P_1, P_2, D_1, D_2, a, b: l. a 4. ábrát:
P_1 = a protoconch szélessége (μm),
P_2 = a protoconch magassága (μm),
D_1 = a deuteroconch szélessége (μm),
D_2 = a deuteroconch magassága (μm),
a = a protoconch és deuteroconch „talpának" távolsága (μm),
b = a protoconch és deuteroconch középpontja közötti távolság (μm),
P és D = a protoconch, ill. a deuteroconch átlagos átmérője (μm). Kiszámítása:

$$P=\sqrt{P_1 \cdot P_2}, \quad \text{ill.} \quad D=\sqrt{D_1 \cdot D_2},$$

R = a protoconch bekerítettségének mértéke. Kiszámítása:

$$R=\frac{a+P_2}{P_2},$$

E = az embrió „excentricitása". Kiszámítása:

$$E=\frac{b}{\frac{D_2}{2}}=\frac{\frac{D_2}{2}-\left(a+\frac{P_2}{2}\right)}{\frac{D_2}{2}}=1-\frac{2a+P_2}{D_2},$$

Q = az embrió két kamrájának nagyságbeli viszonya. Kiszámítása:

$$Q=\frac{D}{P}.$$

Egy Orthophragmina-populáció kb. 90%-át megaszférás egyedek alkotják, ezért, valamint gyors evolúciójuk és nagy formagazdagságuk miatt fajmeghatározásra jóval alkalmasabbak, mint a konzervatív bélyegeket inkább magukon viselő mikroszférás egyedek.

A megaszférás egyed leggyorsabban fejlődő része az embriója. Az embrió alakja döntő fontosságú a fajcsoportok, ill. fajok elkülönítésében, jóval kisebb szerepe van a fajokon belüli fejlődési stádiumok (alfajok) megkülönböztetésében. Ezzel szemben az embrió méretének elsődleges fontossága van ebben, fajcsoportok, ill. fajok elkülönítésében szerepe sokkal szerényebb.

Az Orthophragminák embriója két kamrából áll: a kisebb protoconchból, és a nagyobb, azt részben vagy egészen körülkerítő deuteroconchból, mely egyes esetekben másodlagosan tagolt is lehet. Ez általában jól látható pattintott equatoriális metszetben.

A protoconch és a deuteroconch egymáshoz való viszonyát (az embrió alakját) két tényező határozza meg: nagyságbeli és elhelyezkedési viszonyuk. Nagyságbeli viszonyukat (Q) a deuteroconch, illetve a protoconch átlagos átmérőjének hányadosa adja meg. Ez a legalkalmasabb mérőszám az isolepidin ($Q<1,30—1,35$) és semi-isolepidin ($Q>1,25—1,30$) embriók elkülönítésére. Elhelyezkedési viszonyukat több mérőszámmal is jellemezhetjük, ezek közül a legegyszerűbbnek az ún. bekerítettségi fok (R) és az excentricitás (E) mérése, kiszámítása, ill. használata bizonyult.

A bekerítettségi fok azt mutatja meg, hogy mennyire nyomult be a protoconch a deuteroconchba. Jól használható a trybliolepidin, semi-nephrolepidin és nephrolepidin embriók jellemzésére, viszont a centrilepidin embrió elég rosszul mutatható ki vele.

Az excentricitás azt mutatja meg, hogy milyen messze van egymástól a protoconch és deuteroconch középpontja a deuteroconch középpontja és alja közötti távolsághoz képest. Elsősorban a centrilepidin ($E=0{,}0$) és nephrolepidin ($E\approx 1{,}0$) embriókat mutatja ki jól.

A három mérőszám (Q, R és E) egymás függvényeként is leírható, ha $\frac{D_1}{P_1}=\frac{D_2}{P_2}=Q$. A valóságban ez közelítőleg igaz is. Így tehát:

$$Q\approx\frac{D_2}{P_2}=\frac{\dfrac{D_2}{2a+P_2}}{\dfrac{P_2}{2a+P_2}}=\frac{\dfrac{2a+P_2}{P_2}}{\dfrac{2a+P_2}{D_2}}=\frac{2\dfrac{a+P_2}{P_2}-1}{1-\left(1-\dfrac{2a+P_2}{D_2}\right)}=\frac{2R-1}{1-E}.$$

Az Orthophragminák embriótípusait névvel is jellemezhetjük (5., 6. ábrák és 1. táblázat):

Isolepidin embrió: a protoconch mérete csaknem eléri a deuteroconchét, a deuteroconch felőli fala alig görbült és alig nyomódik bele a deuteroconchba.

Semi-isolepidin embrió: a protoconch deuteroconch felőli fala még nem teljesen kör alakú, nagyobbik része a deuteroconchon kívül található.

Nephrolepidin embrió: a protoconch kerek, fele a deuteroconchon belül, fele kívül található.

Semi-nephrolepidin embrió: a protoconch már csak kicsit „lóg ki" a deuteroconchból.

Trybliolepidin embrió: a protoconch és a deuteroconch „talpa" hozzávetőleg egy vonalban helyezkedik el.

Umbilicolepidin embrió: a protoconch a deuteroconchba teljesen benyomult, annak „kocsányán" ül, de azt nem tagolja részekre.

Excentrilepidin embrió: a két kamrának már nincs közös fala, de az excentricitás még megfigyelhető. Egyes Orbitoclypeusoknál a deuteroconch fala megvastagodott.

Polylepidin embrió: a protoconch a deuteroconchon belül található, azt legalább két részre tagolja. Bizonyos mértékű excentricitás még látszik.

Centrilepidin embrió: a protoconch a deuteroconch közepén helyezkedik el, csak ritkán tagolja azt részekre, viszont gyakran együtt deformálódnak.

Ezen típusok között átmeneti változatok is előfordulnak. Az Asterocyclinidaekre az első négy, valamint az excentrilepidin típus, a Discocyclinidaekre az első kivételével valamennyi típus jellemző.

Ezen kívül van még egy embriótípus, mely nem illik be az előző sorba:

Eulepidin embrió: látszólag a trybliolepidin embrió rokona. Attól abban különbözik, hogy a deuteroconch fala hegyes- és nem derékszögben találkozik a protoconch falával, valamint hogy a protoconch meglehetősen nagy a deuteroconchoz képest. Létezik az excentrilepidin embrió felé való átmeneti változata is. Csak az Orbitoclypeusoknál fordul elő.

Az embrió nagyságán a protoconch, ill. a deuteroconch átlagos átmérőjét értem, melyet a 4. ábra alapján a $P=\sqrt{P_1 \cdot P_2}$, ill. a $D=\sqrt{D_1 \cdot D_2}$ képlettel számolhatunk ki. Erre azért van szükség, mert a különösen nagy méretű embriók deformáltak lehetnek. Ennek negatív hatásait küszöböli ki ez a módszer, amelynek eredményeképpen a statisztikai számításoknál kisebb szórásokat kapunk.

AZ EMBRIÓ KÖRÜLI (AUXILIÁRIS) KAMRÁK

A taxonómiai részben alkalmazott rövidítések:

t = típus (8. ábra),
N = az adauxiliáris kamrák száma,
L = a normálisan fejlett adauxiliáris kamra szélessége (μm) (l. a 9. ábrát is),
H = a normálisan fejlett adauxiliáris kamra magassága (μm) (l. a 9. ábrát is).

Az embrió körüli kamrák jellege és méretei az eddigi kutatások során még az embrió vizsgálatánál is kisebb hangsúlyt kapott. Vizsgálataim során megállapítottam, hogy az adauxiliáris kamrák jellege meghatározó erejű lehet fajcsoportok, illetve fajok elkülönítésénél, ugyanígy számuk (N) és méreteik (L, H) elsősorban alfajok (fajon belüli fejlődési stádiumok) megkülönböztetésénél játszik szerepet, de hangsúlyt kaphat a fajcsoportok, ill. fajok szétválasztásánál is.

Az auxiliáris kamrák főbb típusai a következők (7. ábra):

Fő auxiliáris kamrák: a protoconch és a deuteroconch találkozásánál, összeköttetésben a deuteroconchhal.

Adauxiliáris kamrák: a deuteroconch mentén közvetlen (sztolon) összeköttetésben a deuteroconchhal.

Interauxiliáris kamrák: a protoconch illetve a deuteroconch szegélyén, nincsenek közvetlen összeköttetésben az embrió kamráival, plazmaanyaguk a fő- ill. adauxiliáris kamrákból, esetleg a mellettük lévő interauxiliáris kamrákból származhatott.

Az auxiliáris kamrák utáni ciklus kamráit *periauxiliáris* kamráknak hívjuk.

BRÖNNIMANN (1941) három fő auxiliáris kamra elhelyezkedési típust állapított meg a Discocyclináknál attól függően, hogy az embrió körüli kamrák első (γ típus), második (β típus), vagy harmadik (α típus) ciklusa keríti először teljesen körül az egész embriót. Megfigyeléseim szerint ez a megkülönböztetés semmilyen többletet nem ad a fajmeghatározáshoz, mivel egyazon populáción belül is előfordulhatnak a különböző típusok.

Az adauxiliáris kamrák jellege vizsgálataim szerint kétfajta lehet (8. ábra):

— A deuteroconch szegélyén mind auxiliáris, mind interauxiliáris kamrák megtalálhatók.

— A deuteroconch szegélyén csak adauxiliáris kamrák helyezkednek el.

Az előbbi eset jóval ritkább és csak két típusa létezik:

1. ,,stellata" típus: az *Asterocyclina stellata*-ra jellemző csak, a deuteroconch körül három — esetenként tovább tagolt — adauxiliáris kamra található, melyek azonos méretűek a két fő auxiliáris kamrával és öten együtt kiindulópontját alkotják az equatoriális kamrák sugarainak. Az öt, embrióval közvetlen kapcsolatban lévő auxiliáris kamra között interauxiliáris kamrák helyezkednek el, melyek fölött az equatoriális kamra-ciklusok interradiális részei találhatók.

2. ,,daguini" típus: az eurázsiai ,,Orthophragminák között csak az *Orbitoclypeus daguini*-nál fordul elő, megtalálható azonban néhány nagyon primitív amerikai Orbitoclypeusnál és esetleg Asterocyclináknál is előfordul. Nagyon gyakori ellenben primitív Lepidorbitoideseknél (GORSEL 1975) és Lepidocyclináknál is.

Az embrióval közvetlen kapcsolatban csak a 2 fő auxiliáris kamra és esetleg egy-két adauxiliáris kamra van, közöttük interauxiliáris kamrák helyezkednek el, melyek képződése, illetve a további kamraciklusok kialakulása az Asterocyclinidaek B-formáinál leírt kamraciklus-képződésre emlékeztet (l. ott).

Az Orthophragminák között jóval elterjedtebb a második eset, melynek négy változata van.

3. ,,archiaci" típus: csak a Discocyclinák egy részére jellemző: az adauxiliáris kamrák külső fala egyenes, méreteikben nem különböznek a periauxiliáris kamráktól.

4. ,,varians" típus: az összes eurázsiai Orbitoclypeusra (az *O. daguini* kivételével), minden Nemkovellára, az Asterocyclinák és Discocyclinák kis részére jellemző: az adauxiliáris kamrák külső fala nem egyenes (ívelt vagy ékszerű). A periauxiliáris kamrák ugyanolyan szélesek, esetleg szélesebbek is, mint az adauxiliáris kamrák, viszont — bár eltérő mértékben — mindig rövidebbek. A Nemkovelláknál, az Orbitoclypeusoknál és Asterocyclináknál egy adauxiliáris kamrára általában egy periauxiliáris kamra jut, az idetartozó Discocyclináknál juthat valamivel több is.

5. ,,pratti" típus: elsősorban a *Discocyclina pratti*-ra, *D. pulcra*-ra és *D. radians*-ra jellemző: az adauxiliáris kamrák külső fala egyenes vagy gyengén ívelt, külső faluk megvastagodott, méreteik mind szélességben mind magasságban jelentősen felülmúlják a periauxiliáris kamráékét.

6. ,,alticostata" típus: csak az *Asterocyclina alticostata*-ra és az *A. schweighauseri*-re jellemző: a két-három adauxiliáris kamra és a két fő auxiliáris kamra nagyon széles, a sugarak válaszfalaiktól indulnak ki. A periauxiliáris kamrák már normális méretűek.

A hat ,,tiszta" típuson túl figyelembe kell venni, hogy a Discocyclináknál átmeneti esetek is előfordulhatnak a 3—4—5. típusok között, ill. az Asterocyclináknál az 1. és a 4. típus között.

Az adauxiliáris kamrák méreteinek ($L \times H$) vizsgálatakor ügyelni kell arra, hogy a mérendő kamra jellemző legyen az adauxiliáris kamrák összességére. A mérés metodikáját a 9. ábra mutatja.

AZ EQUATORIÁLIS KAMRÁK

A taxonómiai részben alkalmazott rövidítések:

s. c. = ciklusalakzat

g. p. = a növekedési jelleg típusa (12. ábra)

l = az equatoriális kamrák átlagos szélessége (falközéptől falközépig) (μm)

h = a perifériákhoz minél közelebb található equatoriális kamrák átlagos magassága (a kamra aljától a következő kamra aljáig) (μm)

$n_{0,5}$ ill. $n_{1,0}$ = az embrió szélétől számított első 0,5 ill. 1,0 mm-re eső ciklusok száma (13. ábra)

Az equatoriális kamrák jellegzetességeit az ,,Orthophragmina"-kutatók alig vették figyelembe, pedig azok meghatározott jelentőséggel bírnak a taxonómiai munka során. Így az equatoriális kamrák sztolonrendszere (10. ábra) változó az egyes nemzetségek között.

Fajcsoportokra ill. fajokra jellemző az egyes kamrasorok alakzata (kör, csillag), a kamrák alakja, ezen belül is szélessége, ill. az egymást követő ciklusok magassági viszonyai (növekedési jellege). Az egységnyi távolságra jutó ciklusszám alapján az egyes fajokon belül fejlődési stádiumokat (alfajokat) lehet egymástól elkülöníteni.

A kamrák sztolonrendszere

Az európai Orthophragminák equatoriális kamráik sztolonrendszere alapján 2 nagy csoportba oszthatók (irodalmi adatok alapján ugyanez érvényes az egész Tethysre).

a) 4-sztolonos equatoriális kamrák (10. ábra): csak radiális sztolonjaik vannak. Az Orbitoclypeusokra, Asterocyclinákra, valamint a Nemkovellákra jellemző. Megemlítendő, hogy az *Orbitoclypeus furcata* perifériális részein ehhez még 2 proximális annuláris sztolon társul, ezek kialakulása azonban másodlagos, a nagy fokú fejlettség, illetve specializáció eredménye.

b) 6-sztolonos equatoriális kamrák (10. ábra): a 4 radiális sztolon mellett még 2 proximális annuláris sztolon is található. Ugyanígy a radiális szeptumok mellett az annulárisak is megtalálhatók. Az összes Discocyclinára és az amerikai Neodiscocyclinákra jellemző. Egyes fajoknál (pl. *Discocyclina pratti*, *D. pulcra*, *D. radians*, *D. nandori*) azonban az equatoriális kamrák annyira megnyúltak, hogy ez a sztolonrendszer csak nehezen vehető ki.

Megjegyzendő, hogy van még egy harmadik sztolonrendszer is, mely az amerikai Pseudophragmina (s. l.)-knál fordul elő: ezek is 6-sztolonosak, de annuláris sztolonjaik disztálisak, csak egy fajta szeptumuk van, melyek összetettek: a szeptum radiális része különböző mértékig „nő ki" az annuláris részből.

A Discocyclinidaek törzsfejlődése a mikroszférás egyedek nepionikus akcelerációja mellett jól követhető az equatoriális kamrák morfológiáján is (11. ábra): a legprimitívebb stádiumban (Athecocyclina) csak annuláris szeptumok léteztek, alig látható radiális kinövéssel, egy cikluson belül csak egy kamra volt található. Ez a radiális kinövés egyre erőteljesebb lett (Pseudophragmina s. s., Proporocyclina), mígnem annyira megerősödött (Nemkovella), hogy radiális szeptummá alakult át, ezzel együtt megszűnt a disztális annuláris sztolon is. A legvégső stádiumban (Discocyclina) a radiális szeptum proximális végén újra annuláris sztolon keletkezett és az equatoriális kamra falai radiális és annuláris szeptumra váltak szét.

A ciklusok alakzata (s. c.)

A ciklusok alakzata (s. c.) a Discocyclinidaeknél valamint egyes Orbitoclypeusoknál *(O. ramaraoi, O. chudeaui, O. douvillei)* kör alakú. Sugárirányú kidomborodások egyes Discocyclináknál csak véletlenszerűen fordulhatnak elő (XV. tábla 8.). Csillagszerűek az összes Asterocyclinák. Eurázsiában leggyakrabban 5-ágúak, mindössze az *A. schweighauseri*-re jellemző a nagyobb (6—8) sugárszám. Az Asterocyclinák sugarai mindig nagyon határozottak, élesek (megjegyzendő, hogy a karibi és pacifikus Asterocyclinák jellegzetesen 4, vagy több — 7—10 — ágúak).

Egyes Orbitoclypeusoknál *(O. varians, O. bayani, O furcata)* inkább sugárirányú kidomborodások jelentkeznek (6—8 db), ezáltal a ciklusok hullámossá válnak. Ezek határozottabbak a külsőre is bordás alakoknál *(O. bayani, O. furcata)*. Létezik azonban olyan bordás Orbitoclypeus *(O. katoae)* is, amely körkörösen építi fel a kamraciklusokat.

Itt kell szólni az ún. regenerációs nyomokról is (pl. I. tábla 3.), melyek patologikus eredetűek, ui. amikor a vázat valamilyen sérülés éri, ezt a sérülést az állat úgy igyekszik korrigálni, hogy a sérült helyen gyorsabban növekszik, regenerálva önmagát, visszanyerve eredeti formáját.

A ciklusok növekedési jellege (g. p.)

Ez a tulajdonság nagyon jellemző az adott fajcsoportra és határozott típusokat lehet elkülöníteni a segítségével (12. ábra).

a) „archiaci" típus: a 2. ciklus magassága azonos az 1. ciklusével (1. ciklus alatt az embrió körüli kamrák értendők), az utána következő kamrák sem nyúlnak meg lényegesen. Primitívebb Discocyclinákra (*D. archiaci*, *D. fortisi* stb.) és Nemkovellákra *(N. evae)* jellemző.

b) „trabayensis" típus: a 2. ciklus magasabb az 1. ciklusnál, a magasságnövekedés egészen a szélekig tart. Egyes primitív Discocyclinákra *(D. trabayensis, D. broennimanni)* jellemző.

c) „strophiolata" típus: a 2. ciklus alacsonyabb az 1. ciklusnál, majd ezután a következő néhány ciklus magassága tovább csökken, a továbbiakban viszont egész a szélekig fokozatosan nő a ciklusok magassága. Eléggé elterjedt típus (*Discocyclina augustae, Nemkovella strophiolata, Orbitoclypeus katoae, Asterocyclina stellata, A. kecskemetii* stb.).

d) „varians" típus: a 2. ciklus valamivel alacsonyabb az 1. ciklusnál, ezután a következő néhány ciklus magassága nem változik, vagy alig növekszik, a nagyobb magasságnövekedés inkább a szélek felé jön létre. Az egyik legelterjedtebb típus (*Discocyclina dispansa, Orbitoclypeus ramaraoi, O. varians* stb.).

e) „pulcra" típus: a 2. ciklus jóval alacsonyabb az 1. ciklusnál, de a 3—4. ciklus már majdnem visszanyeri az eredeti magasságot és ezután a ciklusok magassága már csak alig emelkedik, végül állandósul. A fejlettebb Discocyclinákra jellemző (*D. pratti, D. pulcra, D. radians* stb.).

f) „spliti" típus: csak a *Discocyclina splitire* jellemző: az első néhány ciklus növekedési jellege hasonló a „pulcra" típushoz, a 6—8. ciklus után azonban (ezek a legmagasabbak) a magasság fokozatosan csökken, a külső ciklusok még a 2. ciklusnál is alacsonyabbak.

A különböző növekedési jellegek (g. p.) nem mindig határozottak, átmenetek is találhatók közöttük, ezért taxonómiai értékük kisebb, mint pl. az embrió alakjáé vagy az adauxiliáris kamrák jellegéé.

Az equatoriális kamrák alakja

Korábban az Orthophragminák equatoriális kamráit négy- illetve hatszögletűnek vették, ami abból a megfigyelésből eredt, hogy mind a két eset előfordul. Vizsgálataim során sikerült kideríteni, hogy a négyszögletes kamrák csak az annuláris szeptummal is bíró Discocyclinákra, a hatszögletes kamrák pedig a Nemkovellákra, Orbitoclypeusokra és Asterocyclinákra jellemzők, melyeknek csak radiális szeptumaik vannak. Fajok és fajcsoportok elkülönítésénél bír nagy jelentőséggel az equatoriális kamrák szélessége (*l*), mely a 3—6. ciklustól kezdve egészen a perifériákig gyakorlatilag állandó marad (mérésének metodikája azonos az adauxiliáris kamrák szélességének mérésével — l. a 9. ábrát). Így a Discocyclinák esetében az equatoriális kamrák szélessége általában 35 μm fölött van a *D. archiaci*-csoport fajainál, míg általában ez alatt van a *D. dispansa*-csoport fajainál.

A Nemkovelláknál a *N. evae*-t 40 μm körüli, a *N. fermonti*-t 35 μm körüli, a *N. strophiolata*-t 30 μm körüli equatoriális kamraszélesség jellemzi.

Az Orbitoclypeusok közül legszélesebbek az *O. chudeaui*-csoport fajainak equatoriális kamrái (35—50 μm), átlagos szélességűek (25—40 μm) az *O. seunesi*, az *O. ramaraoi*- és *O. varians*-csoport fajainak equatoriális kamrái; míg ennél is szűkebbek (20—25 μm) az *O. daguini* és az *O. pygmaea* esetében.

Az Asterocyclinák átlagos equatoriális kamraszélessége 25—30 μm, ennél szélesebbek az *A. alticostata* és az *A. schweighauseri* kamrái (35—40 μm).

Az equatoriális kamraciklusok magassága, mint látható az előző fejezetből is, meghatározott módon változik az embriótól a perifériák felé haladva, ugyanakkor az egyes fajokon belül is az egyre fejlettebb alfajok felé haladva az equatoriális kamrák magassága (*h*) fokozatosan nő, így szerepük lehet a fajon belüli fejlődési stádium (alfaj) meghatározásában. Mivel a találomra kiválasztott equatoriális kamra magasságának mérése meglehetősen szubjektív, ezt a fejlődést az embrió szélétől számított 0,5 ($n_{0,5}$), ill. 1,0 mm-en ($n_{1,0}$) belüli ciklusok számán keresztül mértem (13. ábra). A mérést lehetőleg regenerációs nyomoktól mentes ciklusokon keresztül kell elvégezni, az Asterocyclinidaeknél pedig mindig a sugárközi térben.

AZ EQUATORIÁLIS RÉTEG AXIÁLIS METSZETBEN

A taxonómiai részben előforduló rövidítések:

$L_p \cdot H_p$ = a protoconch hossza és magassága (μm)
$L_d \cdot H_d$ = a deuteroconch hossza és magassága (μm)
$l_e \cdot h_e$ = az equatoriális kamrák átlagos hossza és vastagsága az embrió közelében (utóbbi a két laterális szeptum vastagságával együtt értendő) (μm)
$l_l \cdot h_l$ = a laterális kamrák átlagos hossza és vastagsága (csak az egyik laterális szeptum vastagságával együtt) (μm)

Kutatásaim során a fő súlyt az equatoriális réteg equatoriális metszetben történő vizsgálatára helyzetem, mivel az könnyen feltárhatónak és nagy taxonómiai értékűnek bizonyult. Hasonló a helyzet a többi equatoriális réteggel rendelkező nagy Foraminiferánál is, ahol a fajra ill. alfajra történő meghatározás szintén csak az equatoriális metszet segítségével történhet.

Így, mivel én és a többi kutató is csak kevés jól orientált (tehát az embrió mindkét kamráján átmenő) axiális metszettel rendelkezünk és ezek egyébként is csak csiszolattal nyerhetők, segítségükkel egyelőre csak genus- esetleg fajcsoport-szintű meghatározások lehetségesek.

XIX. tábla — Plate XIX

Discocyclina aaroni aaroni n. sp. et ssp.

1. A-forma, equatoriális metszet, E. 4785, 56×
Dunaszentmiklós, lutéciai emelet középső része

2. A-forma, equatoriális metszet, E. 4788, 56×
Nussdorf, lutéciai emelet középső része

3. A-forma, equatoriális metszet, E. 4789, 56×
Montfort, lutéciai emelet középső része

Discocyclina euaensis Whipple

4—6. A-forma, equatoriális metszet, *4.:* E. 4791, *5.:* E. 4790, *6.:* E. 4792, 35×
Lábatlan, priabonai emelet középső része

Discocyclina pratti (Michelin) *aquitanica* n. ssp.

7. A-forma, equatoriális metszet, E. 4794, 35×

8. Holotypus, A-forma, equatoriális metszet, E. 4793, 35×
Horsarrieu, cuisi emelet középső része

10. A-forma, equatoriális metszet, E. 4795, 56×
Krím, cuisi emelet felső része

Discocyclina pratti (Michelin) *montfortensis* n. ssp.

9. A-forma, equatoriális metszet, E. 4796, 37×
Krím, lutéciai emelet alsó része

11. A-forma, equatoriális metszet, E. 4797, 35×
Nousse, lutéciai emelet középső része

12. Holotypus, A-forma, equatoriális metszet, E. 4798, 35×
Montfort, lutéciai emelet középső része

Discocyclina pratti pratti (Michelin)

13. A-forma, equatoriális metszet, E. 4802, 35×
Angoumé, lutéciai emelet felső része

* * *

Discocyclina aaroni aaroni n. sp. et ssp.

1. Form "A", equatorial section, E. 4785, 56×
Dunaszentmiklós, middle part of the Lutetian

2. Form "A", equatorial section, E. 4788, 56×
Nussdorf, middle part of the Lutetian

3. Form "A", equatorial section, E. 4789, 56×
Montfort, middle part of the Lutetian

Discocyclina euaensis Whipple

4—6. Form "A", equatorial section, *4.:* E. 4791, *5.:* E. 4790, *6.:* E. 4792, 35×
Lábatlan, middle part of the Priabonian

Discocyclina pratti (Michelin) *aquitanica* n. ssp.

7. Form "A", equatorial section, E. 4794, 35×

8. Holotype, form "A", equatorial section, E. 4793, 35×
Horsarrieu, middle part of the Cuisian

10. Form "A", equatorial section, E. 4795, 56×
Crimea, upper part of the Cuisian

Discocyclina pratti (Michelin) *montfortensis* n. ssp.

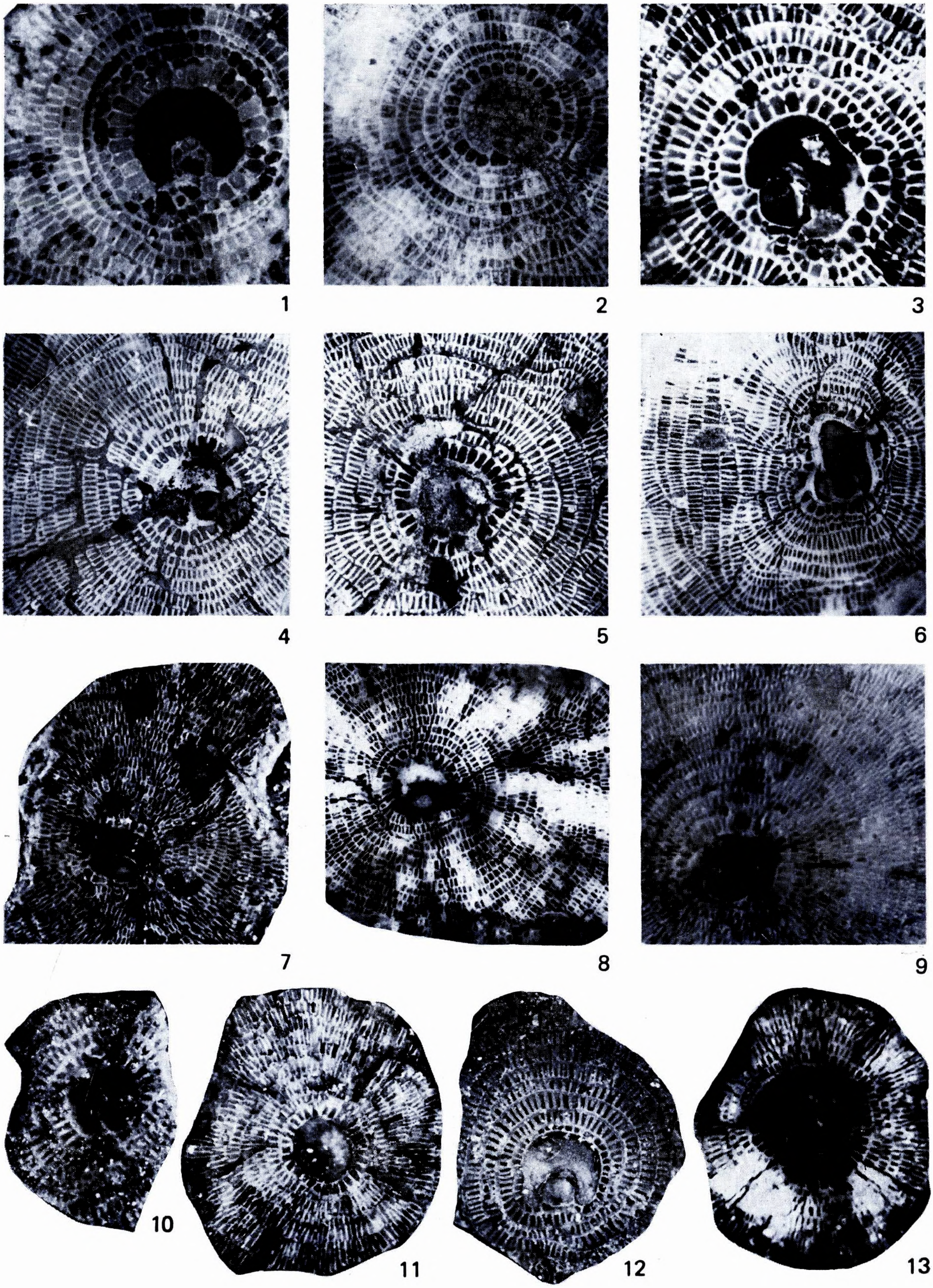
9. Form "A", equatorial section, E. 4796, 37×
Crimea, lower part of the Lutetian

11. Form "A", equatorial section, E. 4797, 35×
Nousse, middle part of the Lutetian

12. Holotype, form "A", equatorial section, E. 4798, 35×
Montfort, middle part of the Lutetian

Discocyclina pratti pratti (Michelin)

13. Form "A", equatorial section, E. 4802, 35×
Angoumé, upper part of the Lutetian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Az embrió axiális metszete

Az embrió axiális metszete csak akkor lehetne mérvadó a taxonómiai munka során, ha pontosan tudnánk, hogy az hol halad át az embrión. Ez azonban egyáltalán nem biztosítható, mivel az embrió irányítottsága nem látszik a váz külsején, így a csiszolás megkezdésekor nincs mire támaszkodni.

A különböző embriótípusok axiális metszeteit a 14. ábra szemlélteti, melyről kitűnik, hogy axiális metszetből az embrió típusa nem határozható meg egyértelműen. Ugyanakkor az Orbitoclypeusok excentri- és eulepidin embriója bizonyos esetekben jól elkülöníthető a többi típustól. Támpontot jelenthet a fajcsoportok megállapításánál az embrió mérete is, mivel azonban a metszet orientáltsága felől sohasem lehetünk bizonyosak, finomabb meghatározásokra a méret sem használható fel.

Az equatoriális kamrák axiális metszetben

Az Orthophragminák equatoriális rétegének axiális metszetbeli képével Brönnimann (1945b) és Neumann (1958) foglalkozott behatóbban. Brönnimann-nak (1945b) világosan sikerült megkülönböztetnie az Asterocyclinákat a Discocyclináktól azon az alapon, hogy az előbbiek equatoriális rétege a sugarakban megvastagszik, sőt több kamrasorra is szétválik, míg a Discocyclinák esetében ez nem figyelhető meg.

Neumann (1958) a tárgyalt jelleg alapján 5 csoportra osztotta fel a Discocyclinákat, ábrái és megfigyeléseim szerint azonban csak két csoport különíthető el biztonsággal, a Neumann (1958) által *D. seunesi*- és *D. douvillei*-csoportba sorolt Orbitoclypeusok, ill. a *D. augustae*-, *D. archiaci*- és *D. fortisi*-csoportba sorolt Discocyclinák. Ide tartoznak még a korábban Aktinocyclina néven elkülönített bordás Discocyclinák is.

Az Orbitoclypeusok jellegzetessége a perifériák felé erősen kiszélesedő equatoriális réteg, míg a Discocyclináknál ez egyáltalán nem, vagy csak gyengébb mértékben jelentkezik. Ily módon az equatoriális réteg axiális metszetbeli képe alapján a Discocyclinák, Orbitoclypeusok és Asterocyclinák jól elkülöníthetők egymástól. A Nemkovelláknál ezt a jelleget sem az irodalom, sem saját anyagom alapján nem sikerült jól tanulmányoznom. Hasonlóképpen ma még a bordás Orbitoclypeusok *(O. bayani, O. furcata, O. katoae)* ezen jellegéről sem tudunk sokat.

A ciklusok növekedési jellege (l. 16. old.) is jól kivehető axiális metszetben, ezenkívül azon fajoknál *(Discocyclina pratti, D. pulcra)*, melyeknél az adauxiliáris kamrák jóval magasabbak a 2. ciklus kamráinál, ez a különbség vastagságukban is megmutatkozik.

A LATERÁLIS KAMRÁK ÉS A PILLÉREK

A laterális kamrahálózat és az azt körülvevő pillérek korábban nagyon fontos szerepet játszottak a fajmeghatározásban. Vizsgálataim alapján jelentőségük inkább csak nemzetségek ill. fajcsoportok elkülönítésében van.

Laterális kamrák és pillérek axiális metszetben

Az egymás fölött elhelyezkedő laterális kamrarétegek általában jól követik az equatoriális réteg „relief"-jét: az equatoriális rétegből kiemelkedő embrió fölött a laterális rétegek búbot (umbó) képeznek, az Asterocyclinák sugarasan megvastagodott equatoriális rétege fölött a laterális rétegek is kitüremkednek, így a váz csillag alakú lesz.

Ez alól kivételt képeznek a bordás és pontozott Discocyclinák *(D. samantai, D. radians, D. nandori, D. knessae, D. kingae)*, ill. a bordás Orbitoclypeusok *(O. bayani, O. furcata, O. katoae)*, melyeknél a bordák ill. a pontszerű kitüremkedések látszólag csak a laterális réteg adott helyen történő megvastagodásából származnak.

A Discocyclinidaek és Asterocyclinidaek jól megkülönböztethetők a laterális kamrahálózat és a pillérek axiális metszetbeli képe alapján is. A Discocyclinidaek laterális kamrái jóval sűrűbben állnak egymás fölött az Asterocyclinidaekéhez képest, ugyanakkor pillléreik jóval vékonyabbak amazokénál.

Laterális kamrahálózat és pillérek a váz felszínén (a rozetta)

Mivel az Asterocyclinidaek pillérei nagyobb átmérőjűek és laterális kamráik is lazábban állnak egymás fölött, mint a Discocyclinidaeknél, laterális kamrahálózatuk és pillléreik is sokkal jobban kipreparálódnak a váz felszínén. Ez a jellegzetességük — kellő gyakorlat esetén — sokat segíthet az Orbitoclypeusok makroszkópos elkülönítésében a Discocyclináktól és a Nemkovelláktól.

A pillérek a váz felszínén ún. granulumok alakjában jönnek ki. Ezekhez a granulumokhoz illeszkednek a laterális kamrákat elválasztó szeptumok. Hálózatukat röviden rozettának nevezzük.

A rozettának alapvetően három típusát lehet megkülönböztetni: az első inkább a Discocyclinidaekre jellemző, a másik kettő csak az Asterocyclinidaekre (15. ábra).

a) „Discocyclina" típus: a granulumok általában kör alakúak, 50—100 μm átmérőjűek. Egy granulumot általában 6—7 laterális kamra vesz körül. A szomszédos granulumokat többnyire egy laterális szeptum köti össze. Az összes Discocyclinára jellemző.

b) „marthae" típus: a granulumok kör alakúak, 100—150 μm átmérőjűek, egy granulumot 8—14 laterális kamra vesz körül. A laterális kamrák hálózata sűrűbb, mint a granulumoké, így a granulumok között laterális kamrák pókhálója feszül, a szomszédos granulumok több laterális kamraválaszfallal vannak összekötve. Többek között az *Orbitoclypeus ramaraoi*-ra, *O. marthae*-ra, *O. varians*-ra, *O. furcata*-ra , *Asterocyclina stellata*-ra és az *A. stella*-ra jellemző.

c) „chudeaui" típus: a granulumok sokszög (4—6) alakúak, 100—150 μm átmérőjűek; egy granulumot 4—6 laterális kamra vesz körül. A granulumok elég szorosan állnak egymás mellett. A szomszédos granulumokat általában közvetlenül összekötik a laterális kamraválaszfalak. Többek között az *Orbitoclypeus chudeaui*-ra, *O. douvillei*-re, *Asterocyclina alticostata*-ra és *A. kecskemetii*-re jellemző. Ezek a típusok sem jelentkeznek azonban mindig jellegzetesen, ezért taxonómiai értékük alatta marad az equatoriális réteg bélyegeinek. Az összes Nemkovellára például „Discocyclina—chudeaui" átmeneti típusú rozetta jellemző.

Megjegyzendő továbbá, hogy egy faj különböző populációi között is olykor jelentős különbségek találhatók a rozettában (pl. az *Orbitoclypeus varians* ajkai, dudari és lábatlani, illetve az *O. chudeaui* ajkai és dudari populációi esetében). Ezért egyelőre nem látszik lehetségesnek finomabb rozetta-típusok elkülönítése.

A VÁZ ALAKJA (HABITUS)

A korábbi irodalomban (Gümbel 1868, Douvillé 1922) az Orthophragminákat elsősorban vázuk alakja szerint sorolták különböző nemzetségekbe. Így a korong vagy lencse alakú — egyébként díszítetlen — vázakat a Discocyclinákhoz, a csillag alakú vázakat az Asterocyclinákhoz (vagy Asterodiscusokhoz), a korong alakú bordázott vázakat az Aktinocyclinákhoz sorolták.

A belső szerkezeti vizsgálatok alapján (Brönnimann 1945b, Caudri 1972 és saját megfigyeléseim) ma már módosítani kell ezt az álláspontot: az igazán pregnáns külső bélyegek (bordázottság, csillagalakúság) is csak fajok elkülönítésére alkalmasak.

Az eurázsiai Orthophragminák közül a díszítetlen korong- vagy lencse alakú vázak éppúgy tartozhatnak a Discocyclinákhoz, mint a Nemkovellákhoz vagy az Orbitoclypeusokhoz.

Korábban nagy jelentőséget tulajdonítottak a váz lapos vagy duzzadt alakjának, azonban ez az elv is inkább csak általánosságban alkalmazható: a Discocyclinákra és Nemkovellákra inkább a lapos; az Orbitoclypeusokra inkább a duzzadt váz a jellemző. Ugyanakkor nagyon gyakran egy populáción belül is azonos belső szerkezettel bíró egyedek lehetnek laposak vagy duzzadtak is (pl. a krími *Discocyclina archiaci*- és *D. fortisi*- vagy az ajkai *D. augustae*-populációk).

Az ennél is kisebb különbségek, mint pl. a gallér milyensége, a duzzadtság mértéke pedig gyakorlatilag semmilyen jelentőséggel nem bír: pl. a legtöbb *Orbitoclypeus varians*-populációban a korábbi módszerekkel *Discocyclina nummulitica*-t, *D. varians*-t, *D. marthae*-t, *D. roberti*-t, *D. aspera*-t, *D. andrusovi*-t és *D. scalaris*-t is meg lehetne határozni, ha csak a külső bélyegeket vennénk figyelembe.

Más esetekben az ökológiai vagy patologikus eredetű vázformát vették taxonómiai bélyegnek. Pl. a *Discocyclina sella* a korábbi meghatározások alapján magában foglalta az összes nyereg alakú formát a legkülönbözőbb belső szerkezettel [*Discocyclina archiaci* a Krímből (Portnaja 1974), *D. augustae* és *D. dispansa* Ajkáról (Kecskeméti 1959) stb.], pedig jellegzetes formájukat nyilván valamilyen Lithotamniummal való szimbiózis során vették fel.

Ugyanígy a korábban a *D. bartholomei* elkülönítésére szolgáló hirtelen elvékonyodó perem alapján különböző korokból származó fajok keverhetők össze (pl. *D. archiaci archiaci* és *D. archiaci bartholomei* a Krímből, *D. archiaci bartholomei* Saint-Barthélémy-ből, *D. augustae augustae* és *D. discus dudarensis* Ajkáról). Ez a jelleg véleményem szerint patologikus eredetű, ugyanis ezeknél az egyedeknél mindig megfigyelhető a legutolsó equatoriális ciklusok elsorvadása is, azaz az állat utolsó, agonizáló stádiumát jelzi.

Ennek ellenére egyes populációkban az azonos belső szerkezettel bíró egyedeket meglepően hasonló külső alak is jellemezheti.

Ha ez a belső szerkezetnek a külső szerkezetre való kivetülése, úgy bizonyos mértékig fel is használható a fajmeghatározásban. Pl. tudjuk, hogy a kis nephrolepidin embrióval bíró alakok *(Discocyclina broennimanni, D. trabayensis, Nemkovella strophiolata)* esetében a kis — közel gömbalakú — embrió fölött a váz felszínén kicsiny hegyes umbó képződik és a váz is többnyire elég kicsi.

Ugyanígy a nagy centrilepidin embriójú *Discocyclina pulcra* lapos, korongalakú embriója fölött a búb is elmosódott, szabálytalan alakú és középen a protoconch helyén időnként kis behorpadás is észlelhető. Általában megfigyelhető az is, hogy a kis embriójú alakok váza kicsi, a nagy embrióval bíróké ettől sokkal nagyobb. Ugyanígy a nagy embriójú alakoknál a generációs dimorfizmus is sokkal jobban megmutatkozik a formák méretbeli eltérésében.

A korábban Aktinocyclinákhoz sorolt alakokat is meg kellett osztani a Discocyclinák s az Orbitoclypeusok között: magának az Aktinocyclina genusnak a megszüntetését az indokolta, hogy a korábban idesorolt alakok különböző Discocyclina ill. Orbitoclypeus fajokból alakultak ki, megfigyeléseim szerint már a fejlődésük végén. Ily módon egyértelmű, hogy a bordák olyan — a laterális rétegből képződött — járulékos elemek, melyek nem szolgáltathatnak kellő alapot önálló genus felállítására.

A bordák jellege elég jól alkalmazható a különböző bordázott fajok egymástól való elkülönítésére. Így sűrű egyenes, finom bordák (10—14) jellemzik a *Discocyclina radians*-t, a *D. knessae*-t és a *D. nandori*-t valamint a *D. samantai*-t, 7—9 vonalba rendeződött, pontszerű kitüremkedések a *D. kingae*-t, a búbtól induló és a szélek felé elágazó bordák az *Orbitoclypeus furcata*-t és az *O. bayani*-t (utóbbit nem mindig). Számuk 7—9. Az *O. katoae*-re szintén 7—9, búbtól induló borda jellemző, ezek azonban a szélek felé nem ágaznak el.

A bordás Discocyclinák mindig kör alakúak, a bordavégződések nem módosítják alakjukat, a bordás Orbitoclypeusok esetében azonban a váz alakja oldalnézetben kissé hullámos, ugyanis a váz mindig kissé szélesebb a bordavégződéseknél, mint a bordaközi térben.

A korábbi Asterocyclinák változtak viszonylag a legkevesebbet. Legtöbbször ötágú csillagalakjuk könnyen felismerhetővé teszi őket. A csillagalakúság ugyanis már az equatoriális rétegben is jelentkezik, így a váz felszíne csak méginkább kidomborítja az equatoriális réteg reliefjét.

Problémát okozhatnak a 6—7—8-ágú csillagalakok, ui. ilyenkor a meghatározandó egyed *Asterocyclina schweighauseri* és *Orbitoclypeus bayani* is lehet (utóbbi emellett „Aktinocyclina" alakot — l. fentebb — is felvehet). A problémát ebben az esetben csakis az equatoriális réteg vizsgálata döntheti el.

A régebbi irodalom az Asterocyclinákat olyan külső bélyegek alapján határozta meg, mint a sugarak hossza, jellege, a sugárközi tér megléte avagy annak hiánya, illetve a búb milyensége. Vizsgálataim szerint ennek éppoly csekély a jelentősége, mint a bordázatlan korong- vagy lencsealakú formák esetében. Az *Asterocyclina stellata* akár egy populációjából is ezzel a módszerrel *A. stellata*-t, *A. stella*-t, *A. stellaris*-t, *A. taramellii*-t és *A. pentagonalis*-t határozhatnánk meg (pl. Ajkáról, Lábatlanról). A faj- ill. alfajmeghatározást az Asterocyclinák esetében is csak belső szerkezeti vizsgálatokkal végezhetjük el.

AZ ORTHOPHRAGMINÁK RENDSZERTANI FELOSZTÁSA ÉS HATÁROZÁSA

Az Orthophragminák rendszerezésével az utóbbi jó száz évben nagyon sokan foglalkoztak. Közülük a legkiemelkedőbbek GÜMBEL (1868), MUNIER-CHALMAS (1891), HEIM (1908), DOUVILLÉ (1922, 1923), VAUGHAN—COLE (1940), BRÖNNIMANN (1945b, 1951), NEUMANN (1958) és CAUDRI (1972) e tárgykörében megjelent értekezései.

Kisebb jelentőségűek, de hasznos információkkal bírnak D'ORBIGNY (1848), CARPENTER et al. (1862), SILVESTRI (1907a, b, c), CHECCHIA-RISPOLI (1908, 1909a), VLERK (1923), BERRY (1928), GALLOWAY (1928), WEIJDEN (1940), RAO (1942), CAUDRI (1944), COLE (1948), RUIZ DE GAONA (1950), BIEDA (1963), SAMANTA (1965b) és PORTNAJA (1974) ezt a témát is érintő dolgozatai. Nézeteik részletes ismertetését nem tartom feladatomnak, annál is inkább, mivel 1958-ig bezárólag ez megtalálható NEUMANN (1958) munkájában. Ehelyett ismertetném saját álláspontomat e kérdésben.

AZ ORTHOPHRAGMINA CSALÁDOK ÉS NEMZETSÉGEK RENDSZERE

A modern rendszertannak a fejlődéstörténetet kell tükröznie. Vizsgálataim szerint az Orthophragminák filogenezise legjobban B-formáik juvenáriumán követhető, ez ugyanis pontosan tükrözi az illető alak fejlődésének különböző lépcsőfokait. A mikroszférás juvenárium rendkívül lassan változik, mindössze lassú nepionikus akceleráció tapasztalható, ugyanakkor a megaszférás alakoknak pontosan az embriójuk és annak közvetlen környezete a legfejlődőképesebb, így az ősi bélyegeket egyáltalán nem őrzi meg.

Ezek alapján BRÖNNIMANN (1945b, 1951) Orthophragmina-felosztása Discocyclinidaekre és Asterocyclinidaekre mikroszférás juvenáriumuk különbözősége alapján teljes mértékben helytálló ma is. Szétválasztásuk egyedüli kritériuma a különböző mikroszférás juvenárium, melynek leírása az előző fejezet elején található meg.

A Discocyclinidaeken belül a további felosztást az equatoriális kamrák felépítése alapján végezhetjük el: 4-sztolonos equatoriális kamrái vannak a Nemkovelláknak radiális szeptumokkal, 6-sztolonos equatoriális kamrái proximális annulársztolonokkal, annuláris és radiális szeptumokkal a Discocyclináknak.

A Pseudophragmina s. l.-oknak — ahová a Pseudophragmina s. s., Proporocyclina, Athecocyclina és Asterophragmina nemzetségek tartoznak — 6-sztolonos equatoriális kamrái vannak disztális annulársztolonokkal és csak annuláris szeptumokkal, melyekből különböző mértékig radiális kinövés fejlődik ki. Az Asterophragminákat az különbözteti meg a másik 3 genustól, hogy csillagalakú ciklusai vannak, míg azok között az annuláris szeptum radiális kinövésének mértéke alapján tehetünk különbséget: ez leggyengébb, szinte nem is érzékelhető a legprimitívebb Athecocyclináknál, erősebb, de nem éri el a következő ciklust a Pseudophragmina s. s.-eknél, míg legerősebb — annyira, hogy elérje a következő ciklust — a Proporocyclináknál.

Fejlődéstörténeti okok alapján az Aktinocyclina genust be kellett olvasztani a Discocyclina genusba, ugyanis a rá jellemző bordák, melyek teljes egészében a laterális réteg megvastagodásából keletkeztek, járulékos elemeknek tekinthetők. A bordás Discocyclinák vizsgálataim szerint többfajta borda nélküli Discocyclinából alakultak ki, így a *D. radians* és *D. nandori* a *D. dispansa*-ból, a *D. knessae* a *D. augustae*-ból, a *D. samantai* pedig a *D. pratti*-ból. Ugyanígy a vonalba rendeződött pontszerű kitüremkedésekkel bíró *D. kingae* a *D. dispansa*-ból alakulhatott ki. Ezek alapján az „Aktinocyclinák" nem tekinthetők fejlődéstörténetileg homofiletikusan kialakult csoportnak, így önálló, a Discocyclináktól különböző nemzetségnek sem. BRÖNNIMANN (1945a) az Aktinocyclinákra tartja jellemzőnek azt a tulajdonságot, hogy az egymás fölötti equatoriális kamrák nem sakktábla-szerűen váltják egymást, hanem többé-kevésbé pontosan egymás fölött helyezkednek el. Tapasztalataim szerint ez a tulajdonság csak a legfejlettebb „*A.*" *radians*-oknál, az „*A.*" *nandori*-knál és az „*A.*" *samantai*-knál figyelhető meg, ezenkívül azonban megtalálható igen fejlett borda nélküli alakoknál

(Discocyclina pratti, D. pulcra, D. euaensis) is, így nem szolgáltat kellő alapot külön genus elkülönítésére.

Az Asterocyclinidaek közé Brönnimann (1945b, 1951) két genust, az Asterocyclinákat és az Orbitoclypeusokat sorolta. Ezen két nemzetség equatoriális kamrái 4-sztolonosak és csak radiális szeptumokkal rendelkeznek. Egyedüli kivétel csak az *Orbitoclypeus furcata*, mely equatoriális rétegének csak a perifériális részein proximális annulársztolon kialakulásával 6-sztolonos equatoriális kamrák jönnek létre radiális, ill. annuláris szeptummal. Ezek kialakulása másodlagosnak tekinthető. Az ugyancsak ebbe a családba sorolt Neodiscocyclinák equatoriális kamrái 6-sztolonosak, proximális annulársztolonnal, radiális ill. annuláris szeptumokkal.

Az Asterocyclinákat az Orbitoclypeusoktól az különbözteti meg, hogy mikroszférás juvenáriumukban a ciklusok az elsődleges spirál befejeződése után rögtön csillagalakot vesznek fel. Ezek után a ciklusok mind csillagalakúak, az equatoriális réteg a sugarakban megvastagszik és több rétegre is szétoszlik. A külső alak követi az equatoriális réteg megvastagodását és így a váz jellegzetes (általában négy vagy ötágú) csillagalakot vesz fel.

Az Orbitoclypeusok között is találhatók csillagalakúak (*O. bayani* egy része) és bordások (*O. bayani* másik része, *O. katoae*, *O. furcata*). Ezek mikroszférás alakjainál azonban a ciklusok nem veszik fel a csillagalakot azonnal az elsődleges spirál után. Az equatoriális réteg sokkal kisebb mértékben vastagszik meg a sugarakban, mint az Asterocyclináknál, a sugarak száma ötnél mindig több és az Asterocyclinákénál sokkal gyengébbek. Ezeket a csillag alakú, ill. bordás Orbitoclypeusokat korábban az Asterocyclinák, ill. az Aktinocyclinák közé sorolták. Külön nemzetségbe sorolásuk azonban nem indokolt, ugyanis különböző borda nélküli Orbitoclypeusoktól származtathatók. Így az *O. bayani* az *O. ramaraoi*-tól, az *O. furcata* az *O. varians*-tól, az *O. katoae* pedig az *O. chudeaui*-tól.

Mindezek alapján az Orthophragminák (ezt az elnevezést e műben csakis a Discocyclinidae és Asterocyclinidae családok rövid összefoglalására használom, rendszertani jelentőséggel nem bír) szisztematikája a következő:

Familia Discocyclinidae Vaughan et Cole, 1940
Genera Discocyclina Gümbel, 1868
Nemkovella n. gen.
Athecocyclina Vaughan et Cole, 1940
Pseudophragmina Douvillé, 1923
Proporocyclina Vaughan et Cole, 1940
Asterophragmina Rao, 1942
Familia Asterocyclinidae Brönnimann, 1951
Genera Orbitoclypeus Silvestri, 1907
Asterocyclina Gümbel, 1868
Neodisocyclina Caudri, 1972

AZ ORTHOPHRAGMINÁK KAPCSOLATAI

Neumann (1958) azon az alapon, hogy hasonló megaszférás embriók a kréta alakoknál, az Orthophragmináknál és a Lepidocyclináknál is megfigyelhetők, a különböző típusú embrióval rendelkező Orthophragminákat különböző kréta alakoktól származtatta. Ugyanígy a különböző típusú embrióval rendelkező Lepidocyclinákat az analóg embriójú Orthophragminákkal kötötte össze (pl. Lepidorbitoides — „Nephrodiscodina" — Nephrolepidina vagy Simplorbitoides — *Discocyclina fortisi* — Pliolepidina — Multilepidina). Ez egyrészt saját rendszertanával is ellentmondásban van (hisz ezek szerint az „Orthophragmininae"-ket és a „Lepidocyclininae"-ket is polyfiletikus eredetűeknek tartja), másrészt teljességgel figyelmen kívül hagyja, hogy a Discocyclinidaeknek az összes többi orbitoid Foraminiferáétól eltérő mikroszférás juvenáriuma van, így az azokkal való bármilyen kapcsolat (így a közös ős is) kizárható.

A perforált kis Foraminiferák közül a Cyclocibicidesnek van hasonló felépítése a Discocyclinidaek mikroszférás juvenáriumához. Ez az alak a szenonban lép fel és esetleg őse lehet a Discocyclinidaeknek. Kisebb valószínűséggel, de lehet az ős valamilyen Operculina-féle is, mely már a paleocénben feltűnik.

A Discocyclinidaek legprimitívebb alakjának az Athecocyclinákat tekinthetjük, melyek ciklusait a radiális kinövések még alig tagolják kamrácskákra. Ebből alakulhatott ki még Amerikában a Pseudophragmina, majd a Proporocyclina nemzetség, melynél az annuláris szeptum radiális kinövése már egészen a következő ciklusig felér. Ez a három nemzetség a továbbiakban változatlan equatoriális kamraszerkezettel, ám egyszerűsödő mikroszférás juvenáriummal fejlődött tovább az eocén különböző szintjeiig Amerikában. Az Asterophragminát a Pseudophragmina földrajzilag izolált környezetben (Burma) kifejlődött oldalágának lehet tekinteni.

Equatoriális kamráinak szerkezete alapján (eltűnik a disztális annuláris sztolon és az annuláris szeptum radiálissá alakul át), valamint mikroszférás juvenáriumának bonyolultsága alapján a Nemkovellát a Proporocyclinától származtathatjuk és a Tethys legősibb Discocyclinidaejének tarthatjuk, melyből a már annuláris (proximális) sztolonnal bíró Discocyclinák fejlődtek ki (2. táblázat), melyek fokozatosan egyszerűsödő mikroszférás juvenáriummal az eocén végéig éltek.

A Discocyclinidaek utódairól nem tudunk, feltehetőleg utód nélkül haltak ki, mivel a későbbiekben hasonló mikroszférás juvenáriummal bíró alakok nem ismertek.

Az Asterocyclinidae családra jellemző mikroszférás juvenárium mind a krétavégi Lepidorbitoideseknél, mind az oligo—miocén Lepidocyclináknál megtalálható. Ennek ellenére az Asterocyclinidaek nem tekinthetők a Lepidorbitoidesek utódainak, illetve a Lepidocyclinák elődeinek, ugyanis a legősibb Asterocyclinidaek („Hexagonocyclina" és *Orbitoclypeus barkeri* az amerikai paleocénből) sokkal primitívebbek a kréta végének fejlett Lepidorbitoideseinél, ugyanígy a Lepidocyclinák ősei, a Helicostegina és a Helicolepidina jóval primitívebbek még az eddig ismert legprimitívebb Asterocyclinidaeknél is. Ezért a legvalószínűbbnek tűnik közös, vagy egymással közeli rokon (rotaloid) ősöket feltételezni ennél a három csoportnál, melyekből különböző időben, de hasonló módon fejlődtek ki a Lepidorbitoidesek, Asterocyclinidaek, ill. a Lepidocyclinák.

A család legősibb tagjának az Orbitoclypeusok tűnnek, melyek az eddig ismert leletek alapján Amerikából származhatnak, ugyanis a legősibb amerikai Orbitoclypeusok *(O. barkeri, O. mestieri)* primitívebb felépítésűek, mint az első európai Orbitoclypeus, az *O. seunesi* (l. még 194. old.). A nemzetség hamarosan Európába is átvándorolt, ahol az amerikaitól eltérő utakon fejlődött tovább.

Az Asterocyclinákat az Orbitoclypeusok utódainak lehet tartani, mivel morfológiailag bonyolultabbak, legfőbb vonásaikban azonban azonos felépítésűek, ugyanakkor annál valamivel később lépnek fel. Az amerikai és pacifikus Asterocyclinák legtöbbször 4 ágúak, míg az eurázsiaiak 5 ágúak. Ugyanakkor az eurázsiai Asterocyclinák mikroszférás juvenáriumainál elég gyakran megfigyelhető, hogy a spirál után közvetlenül csak 4 sugár alakul ki, az ötödik csak később, vagy egyáltalán nem. Ez alapján könnyen elképzelhető, hogy az Asterocyclinák is amerikai eredetűek, Európába csak később vándoroltak át.

Ugyanígy a Neodiscocyclinák (melyek csak Amerikából ismertek) is az Orbitoclypeusoktól származhatnak, hiszen azoktól csak proximális annuláris sztolonjukban különböznek. Rétegtanilag is az Orbitoclypeusok fölött lépnek fel. A Neodiscocyclinák hasonlóképpen alakulhattak ki az Orbitoclypeusokból, mint a Discocyclinák a Nemkovellákból.

Az Asterocyclinidae család utódairól nem tudunk.

AZ EURÁZSIAI ORTHOPHRAGMINÁK FEJLŐDÉSÉNEK ALAPVETŐ VONÁSAI

Az eurázsiai Orthophragmina fajokat néhány kutató már régebben megpróbálta csoportosítani. Ezek jellegzetessége, hogy mindig csak egy-két szempontot vettek figyelembe, a többiektől eltekintettek. Így DOUVILLÉ (1922) külső bélyegek alapján hat, WEIJDEN (1940) az embrió jellege alapján öt, NEUMANN (1958) az equatoriális réteg axiális metszetbeli jellege alapján öt, BIEDA (1963) az equatoriális kamrák equatoriális metszetbeli méretei alapján három, SAMANTA (1969) a vázméret, az embrió jellege és az equatoriális réteg vastagsága alapján három, PORTNAJA (1974, 1975) külső bélyegek és az embrió jellege alapján négy csoportot különített el.

Utóbbi két szerző a csoportosítás alapján kísérletet tett az indiai, ill. krím-félszigeti Discocyclinák filogenetikai sémájának felállítására is.

Miután munkámban az Orthophragminák meghatározásában nagyrészt a belső bélyegek vizsgálatára helyeztem a súlyt, szükség volt a taxonok új rendszerezésére, mely igyekezett a taxonómiai bélyegeket minél komplexebben figyelembe venni (l. még LESS 1983). A csoportosításnál igyekeztem olyan jellegekre támaszkodni, melyek eredetüket és fejlődésüket tükrözik, és így nagyrészt függetlenek a környezeti tényezőktől. Mivel az Orthophragminák fejlődésében sok közös vonás található, itt együtt tárgyalom az alapvető tendenciákat, jelezve, ha valamelyik közülük csak egy bizonyos csoportra jellemző. Az egyes nemzetségeken belül csoportokat különítettem el az alábbi bélyegek alapján:

— az equatoriális kamrák szélessége
— a mikroszférás juvenárium bonyolultsága (csak a Discocyclinidaeknél)
— a megaszférás embrió jellege (csak az Asterocyclinidaeknél)
— a rozetta jellege (csak az Asterocyclinidaeknél)

Ezek a bélyegek az adott csoportokon belül többé-kevésbé állandónak bizonyultak más bélyegekhez viszonyítva, így a legalkalmasabbnak tűntek a csoportok elkülönítésének kritériumaként.

A csoportokon belül fejlődési sorokat lehetett kijelölni a következő bélyegek alapján:

— a váz alakja (pl. bordák megléte vagy hiánya — a Discocyclináknál és Orbitoclypeusoknál)
— a megaszférás embrió jellege és nagyságrendje
— az adauxiliáris kamrák jellege
— a ciklusok alakzata, ill. az egymást követő ciklusok növekedési jellege.

A fejlődési sorokon belül egyenes, illetve oldalirányú fejlődést is meg lehetett figyelni. Amennyiben az egyenes fejlődési vonalon belül csak mennyiségi változások történtek, úgy az egyes fejlődési fokozatokat egy faj alfajainak tekintettem. Ilyen mennyiségi változások:

— az embrió nagyságának fokozatos növekedése,

— az embrió alakjának lassú változása (általában a protoconch fokozatos benyomulása a deuteroconchba — csak a Discocyclinidaeknél),

— az adauxiliáris kamrák számának fokozatos növekedése, ugyanígy fokozatos felmagasodásuk,

— az equatoriális kamrák magasságának növekedése illetve az embrió szélétől egységnyi távolságra található ciklusok számának fokozatos csökkenése.

Ha a mennyiségi változás minőségibe csapott át, úgy az új alakot új fajként értelmeztem, akár egyenesági, akár oldalági fejlődés esetén. Minőségi változásként értelmeztem a következőket:

— az embrió alakjának gyorsabb változását (pl. a centrilepidin embrió kialakulását minden esetben),

— az adauxiliáris kamrák jellegének megváltozását (pl. egyenes falúról ívelt falúra),

— az equatoriális kamraciklusok növekedési jellegének gyors változását,

— az equatoriális kamrák szélességének hirtelen csökkenését,

— a ciklusok alakjának megváltozását az Asterocyclinidaeknél,

— a rozetta típusának gyors megváltozását szintén csak az Asterocyclinidaeknél.

A filogenetikai kapcsolatok kijelölésénél jelentős szerepet játszott az adott formák megjelenési idejének viszonya is egymáshoz képest.

Összegezve: az Orthophragminák fejlődésére a következő tendenciák a jellemzőek:

1. a mikroszférás juvenárium lassú degenerálódása, egyszerűsödése (nepionikus akceleráció),
2. a megaszférás embrió fokozatos növekedése,
3. a protoconch fokozatos benyomulása a deuteroconchba (csak a Discocyclinidaeknél),
4. az adauxiliáris kamrák számának növekedése,
5. az auxiliáris kamrák (főleg magasságukban érzékelhető) megnagyobbodása
6. az adauxiliáris kamrák jellegének megváltozása; egyenes falú kamrákból ívelt falúak alakulnak ki (csak a Discocyclinidaeknél),
7. az equatoriális kamrák (főleg magasságukban) egyre nagyobbak lesznek,
8. ehhez kapcsolódóan, az embrió szélétől számított egységnyi távolságra egyre kevesebb kamraciklus jut,
9. az equatoriális kamraciklusok növekedési jellege egyre összetettebb lesz,
10. kör alakú ciklusokból hullámosak, majd csillagszerűek alakulnak ki (csak az Asterocyclinidaeknél),
11. bordás alakok alakulnak ki borda nélküliekből,
12. a pillérek nagysága differenciálódik (csak az Asterocyclinidaeknél),
13. a váz mérete fokozatosan megnagyobbodik (itt azonban a környezeti tényezők szerepe is igen nagy).

AZ EURÁZSIAI ORTHOPHRAGMINÁK HATÁROZÁSA

Az Orthophragminák határozása ebben a munkában elsősorban belső szerkezetük alapján történt. A külső bélyegek közül csak a bordásságot, a csillag-alakúságot és a rozetta típusát vettem figyelembe, mivel ezek vizsgálataim alapján nem ökológiai tényezők okozatai.

A belső és külső minőségi jellemzők (bordásság, csillag-alakúság, rozettatípus, embriótípus, az adauxiliáris kamrák jellege, az equatoriális kamra szélessége, ciklusalak, növekedési jelleg) különbségei alapján az egyes mintákban található alakokat populációkba csoportosítottam, melyek egyúttal különböző fajoknak feleltek meg a mintán belül. Az illető populációt alkotó egyedek mindegyikén lemértem bizonyos mennyiségi jellemzőket. Megaszférás alakok equatoriális metszete esetében ezek a következők voltak: a morfológiai részben részletesen leírt P_1, P_2, D_1, D_2, a, N, L, H, l, h, $n_{0,5}$ és $n_{1,0}$ értékek. A P_1 és P_2 illetve D_1 és D_2 értékek ismeretében kiszámítottam a P, D, ill. Q értékeket, a P_2, D_2 és a értékek ismeretében pedig az R és E értékeket. Az előbb felsorolt mennyiségi jellemzők között nyolc van olyan, melyek mérése egyrészt nem túl szubjektív, másrészt lényeges információt ad az illető populációnak a fajon belüli fejlettségéről, azaz viszonylag gyorsan evolucionáló mennyiségi jellemző. Ezek: az E, R, Q, P, D, N, H és $n_{0,5}$ értékek.

Mind a 8 mennyiségi jellemzőnek kiszámítottam a populációra jellemző számtani középértékét, szórását és a középérték 95%-os valószínűségű konfidenciáját.

A számtani középérték kiszámítása az ismert módon történt: $\bar{x} = \frac{\sum_{i=1\to n} x_i}{n}$, ahol $\bar{x}$ a kiszámított számtani középérték, x_i az egyes egyedeken mért érték, n pedig a vizsgált egyedek száma. Kivételt jelentettek a centrilepidin embrióval rendelkező fajok $\bar{E}$ értékei, melyeket eleve 0-nak vettem, mivel náluk nem dönthető el, hogy az E értékek pozitívak vagy negatívak.

A szórás és a konfidencia kiszámításánál figyelembe kellett venni, hogy az általam vizsgált populációk mindegyike ún. „kis mintá"-nak számít, azaz a szórás és a konfidencia kiszámítását nem a „nagy mintá"-knál megszokott módon kell végezni. A „kis minták" szórását a „nagy minták" szórásához hasonló módon számítjuk ki, az ún. Bessel-korrekció figyelembevételével, a $\sqrt{\frac{n}{n-1}}$ étékkel való szorzással.

Ily módon a szórás kiszámítása a következő:

$$\sigma = \sqrt{\frac{n}{n-1}} \cdot \sqrt{\frac{\sum_{i=1 \to n} (x_i - \bar{x})^2}{n}} = \sqrt{\frac{\sum_{i=1 \to n} (x_i - \bar{x})^2}{n-1}}.$$

Az adott populáció változékonyságát az ún. variabilitás: $V = \frac{\sigma}{\bar{x}}$ segítségével jellemezhetjük.

A konfidencia kiszámítása kis minták esetében a szórás és az ún. Student-függvény figyelembevételével történik. Utóbbi értékeit 95%-os konfidenciára a következő táblázat mutatja be (n a vizsgált egyedek száma, τ_n a Student-függvény megfelelő értéke osztva $\sqrt{n}$-nel):

n	τ_n	n	τ_n	n	τ_n	n	τ_n	n	τ_n
2	8,986	10	0,715	18	0,497	26	0,403	34	0,349
3	2,484	11	0,672	19	0,482	27	0,395	35	0,343
4	1,590	12	0,637	20	0,468	28	0,387	36	0,338
5	1,242	13	0,604	21	0,455	29	0,380	37	0,333
6	1,050	14	0,577	22	0,443	30	0,373	38	0,329
7	0,925	15	0,554	23	0,432	31	0,366	40	0,320
8	0,836	16	0,533	24	0,422	32	0,360	42	0,312
9	0,768	17	0,514	25	0,412	33	0,354	46	0,297

A 95%-os konfidencia (ϱ) kiszámítása ezek után: $\varrho = \sigma \cdot \tau_n$.

A fenti táblázatból látható, hogy ha n nagyon kicsi, akkor τ_n nagyon magas. Ezért a fenti számítási módot csak akkor alkalmaztuk, ha $n \geq 4$. Ha $n = 1-3$, a konfidenciát nem határoztuk meg.

A konfidencia (ϱ) ismeretében meg lehetett határozni a populációban az adott mennyiségi jellemző középértékének 95%-os valószínűségű konfidencia-intervallumát, mely $\bar{x} - \varrho$ és $\bar{x} + \varrho$ között helyezkedik el.

A konfidencia-intervallum ismeretének jelentősége a következő: általa meg tudjuk állapítani azt, hogy ha végtelen számú egyedet vizsgáltunk volna meg, akkor az adott mennyiségi jellemző középértéke is az általunk megadott konfidencia-intervallumba esett volna, természetesen nem 100, hanem csak 95 %-os valószínűséggel.

A B-formák equatoriális metszeteinek és az axiális metszeteknek elég kevés a számuk, ezért populáció vizsgálatra nem használtam fel őket. Határozásuk minőségi jegyek alapján történt.

Visszatérve az A-formák equatoriális metszetéhez: miután minden egyes populációban megtörtént a kiemelt mennyiségi jellemző vizsgálata, összehasonlítottam a különböző korú mintákból származó azonos minőségi jegyekkel bíró (tehát ugyanazon fajhoz tartozó) populációkat mennyiségi bélyegeik alapján. Az összehasonlításra tapasztalataim szerint a deuteroconch közepes mérete (D) a legalkalmasabb, ugyanis mérése a P értékkel együtt viszonylag a legobjektívebb, variabilitása (12,6% 103 populáció alapján) a $n_{0,5}$ és Q értékeké után a legkisebb, fejlődése pedig a kor függvényében a leggyorsabb. A többi mennyiségi jellemző közül a P értékek fejlődése lassabb, átlagos variabilitása (15,7% 98 populáció alapján) nagyobb. Az E, R és Q értékek mérése bonyolultabb, ezért szubjektívebb is, fejlődésük lassabb, bár a Q értékek variabilitása (10,9% 98 populáció alapján) kisebb. Az E és R értékek variabilitása nagyságuk függvényében nő, a szórás abszolút értéke azonban viszonylag állandó (az E esetében átlagosan 0,142, míg az R esetében 0,135 98—98 populáció alapján).

Az N értékek mérése elvileg objektívebb kellene, hogy legyen, mint a D értékeké. A gyakorlatban azonban ez nincs így, mivel az adauxiliáris kamrák radiális szeptumai egyes esetekben nehezen kivehetők. Fejlődésük is lassabb, mivel, bár nagyon lassan, de az adauxiliáris kamrák szélessége (L) is növekszik a korral. Variabilitásuk is nagyobb, mint a D értékeké (15,3% 89 populáció alapján. Még nagyobb a variabilitás — 24,2% 12 populáció alapján — az *Asterocyclina stellata* és *A. alticostata* esetében, hiszen N értékeik nagyon alacsonyak).

A H és $n_{0,5}$ értékek mérése a legszubjektívebb, ugyanis a mérő személy dönti el, hogy a sok lehetséges közül hol méri le őket. Evolúciójuk is lassabb, a H értékeknek pedig az átlagos variabilitása is nagyobb (14,3% 104 populáció alapján), mint a D értékeké. Az $n_{0,5}$ értékek esetében a variabilitás 11,0% 99 populáció alapján.

Annak ellenére döntöttem a D értékek összehasonlító szerepe mellett, hogy hasonló orbitoid Foraminiferáknál nem őket használják fel erre a célra.

Gorsel (1975) az európai Lepidorbitoideseknél más — az Orthophragmináknál nem mérhető — mennyiségi bélyegek mellett az N értékeket alkalmazta. Azonban a Lepidorbitoidesek adauxiliáris kamráinak száma általában jóval kisebb, mint az Orthophragmináké és a legtöbb esetben jól ki is rajzolódnak.

A Lepidocyclinák elkülönítésénél (VLERK 1973, VESSEM 1978) a protoconch deuteroconch általi bekerítettsége a fő krétérium, melyet százalékos arányban adnak meg és mely lényegét tekintve megfelel az itt leírt R, illetve E jelű jellemzőknek. Felhasználásuk korlátait fentebb részleteztem. A bekerítettség százalékos mérésére alkalmas műszerrel nem rendelkezem, de nem is valószínű, hogy alkalmas lenne az egyes Orthophragmina fajok fejlődési stádiumainak (alfajainak) elkülönítésére, mivel rengeteg faj embriója (pl. *Discocyclina fortisi*, *D. pulcra*, az Orbitoclypeus- és Asterocyclina fajok) egyáltalán nem változik a kor függvényében.

Annak ellenére, hogy a D értékeket ebben a munkában kiemelten kezelem, a többi mennyiségi jellemzőnek is van bizonyos jelentősége, többek között az egyes fajok populációi között változékonyság kimutatásának terén és a kontroll miatt is.

A $\bar{D}$ értékek kor szerinti tendenciózus emelkedése alapján az egyes, egymástól minőségi jegyeikben különböző fajokon belül fejlődési stádiumokat (egymástól csak mennyiségi jellemzőikben különböző alfajokat) lehetett elkülöníteni mesterséges határokkal. Ezekre azért volt szükség, hogy taxonómiailag kategorizálni lehessen az egyébként töretlen, ugrás nélküli fejlődést az érvényes nómenklatúrai szabályok szerint. A fejlődési stádiumok (alfajok) közötti mesterséges határokat mindenütt igyekeztem a rendelkezésemre álló (vizsgált és irodalmi) anyag alapján a legcélszerűbben felállítani úgy, hogy egyrészt a lehetőség szerinti legpontosabb rétegtani beosztáshoz adjon kellő alapot, másrészt úgy, hogy a populációk $\bar{D}$ értékeinek konfidencia-intervallumai nem túl nagy (6—10) egyedszám esetén is „beleférjenek" úgy-ahogy egy-egy alfaj mesterséges határai közé. Mivel az egy populáción belüli D értékek átlagos szórása a $\bar{D}$ érték 12,6%-a, mely kb. azonos a konfidenciával $n=6-7$ esetében, a $\bar{D}$ értékek átlagos konfidencia-intervalluma ebben az esetben a $\bar{D}$ érték kb. 25%-a. Ezért a mesterséges határok között legalább 25%-os eltérést minden esetben betartottam.

Felvetődik a kérdés, vajon a $\bar{D}$ értékek fejlődésére milyen hatást gyakorolhattak az ökológiai tényezők? Ezt teljes bizonyossággal megmondani nem lehet, annyi azonban tény, hogy az általam megvizsgált bahcsiszeráji szelvényben a $\bar{D}$ értékek folyamatosan növekedtek egy-egy fajon belül, annak ellenére, hogy ott különböző kőzetfajták (agyag, márga, mészkő) fordulnak elő és a keletkezési mélység is változó volt (a kísérő fauna alapján). A többi vizsgált mintában sem találtam ellentmondást a vizsgált populációk $\bar{D}$ értékei között.

Külön kell itt szólni a nómenklatúrai munkáról is. Mivel az Orthophragminák határozása az eddigiektől eltérő elvek alapján történt, szükség volt a teljes irodalmi anyag átértékelésére is. Törekvésem az volt, hogy ennek az átértékelésnek minél kevesebb, már bevezetett elnevezés essék áldozatul. Sajnos azonban a taxonok jó részét a múlt században írták le, az esetek nagy többségében a belső szerkezet ábrázolása nélkül. Ez egyébként századunkban is gyakran előfordult. Azokat az elnevezéseket, melyeket azóta sem kísért belső szerkezeti ábrázolás, egyértelműen ki kellett szűrni, mivel azonosíthatatlanok. Ki kellett szűrni azon elnevezések legnagyobb részét is, melyet a leírás óta kísért ugyan belső szerkezeti ábrázolás, de nem a típuslelőhelyről, ezért alkalmazásukban súlyos ellentmondások vannak. Csak abban az egy-két esetben lehetett őket megtartani („furcata", „strophiolata", „tenella"), amikor nem lehetett jobbat találni az irodalomban már bevezetett elnevezések között. Prioritási okok miatt is meg kellett szüntetni néhány nevet, valamint egy-két esetben azért is, mert a név, bár elvileg használható lenne, de több mint 50 éven át annyira elfelejtődött (nomen oblitum), hogy helyette egy másik elnevezés ivódott be a köztudatba (pl. „applanata" helyett „augustae").

Amennyiben egy nem junior szinonímaként leírt taxont a leíráskor belső szerkezeti ábrázolás is kísért, vagy később valaki más ábrázolt topotípusos példányról belső szerkezeti ábrát, az elnevezés természetesen megtartható volt.

A taxonok közötti gyors eligazodást szolgálja a 3. táblázat. A genusokat az alábbi kulccsal különböztethetjük meg:

1. Az equatoriális kamrák 6-sztolonosak, téglalap alakúak .... genus Discocyclina
2. Az equatoriális kamrák 4-sztolonosak, enyhén hatszögletűek:
   - *a)* A ciklusok csillag alakúak .... genus Asterocyclina
   - *b)* A ciklusok kör alakúak vagy hullámosak:
     - α) A B-formák juvenáriuma „Heterostegina"-jellegű (kiegészítő jelleg, mely a β esetben csak nagyon ritkán fordul elő: az A-formák embriója nephro- vagy semi-isolepidin típusú) .... genus Nemkovella
     - β) A B-formák juvenáriuma „Lepidocyclina"-jellegű (kiegészítő jelleg, mely az α esetben sosem fordul elő: a leggyakoribb embriótípusok: excentri-, eu- és trybliolepidin) .... genus Orbitoclypeus

A gyors meghatározás utáni ellenőrzést szolgálják a taxonleírások, melyekben bővebb magyarázat is található.

Leírásaimban a típuslelőhelyről, vagy ha innen nincs, más lelőhelyről elsőként belsőleg is ábrázolt példányt vettem a taxon alapjául. Ezek a leírás elején mint holo- vagy lectotypusok meg vannak jelölve, vagy ha az előbbi kettő nem ábrázol belső szerkezetet, magam jelöltem ki „Az A-formák equatoriális metszetének típusát" lehetőleg az irodalmi anyag alapján, de ha erre nem volt lehetőség, saját anyagomból. Mindenütt ügyeltem arra, hogy a megadott típus *D* értéke jellemző legyen a taxonra. Ily módon lehetőség nyílt arra, hogy régi elnevezések az új határozási módszerekkel is fenntarthatók legyenek.

Az általam leírt 91 taxon elnevezése közül 49 régi, 42 új. A fajként leírt alakok nevei közül 33 régi, 14 új, míg a csak alfajként leírt alakok elnevezései közül 16 a régi és 28 az új.

AZ ORTHOPHRAGMINÁK VIZSGÁLATÁNAK ELŐKÉSZÍTÉSE

A FELTÁRÁS MÓDSZERE

A terepen gyűjtött minta súlyát a benne foglalt Orthophragminák gyakorisága szabja meg. Tapasztalataim szerint a mészben gazdag üledékek tartalmazzák a legtöbb Orthophragminát, így belőlük 1 kg-nál nagyobb súlyú mintát nemigen kell venni. Minden esetben arra törekedtem, hogy a márgásabb részekből gyűjtsek, mivel ezek kiiszapolhatók és belőlük így izolált példányok nyerhetők ki, melyekben mind a belső, mind a külső bélyegek jól tanulmányozhatók. A mészben szegény agyagok és aleuritok jóval gyérebben tartalmaznak Orthophragminákat, a bennük található fajok száma is elég alacsony, így ezekből általában 1 kg-on felüli mintákat kell gyűjteni.

A hagyományos módon történő kiiszapolás után az izolált példányok külső bélyegeit binokuláris mikroszkóppal a legcélszerűbb vizsgálni. A rozetta vizsgálatánál egyes esetekben sokat segíthet egy rövid ideig (max. 1. percig) tartó, 5%-os sósavval történő maratás.

Az equatoriális réteg feltárására új módszert alkalmaztam, melyet korábban cikkekben ismertettem (LESS 1976, 1981a). Ennek lényege: a korábbi hosszadalmas és nagy alaposságot igénylő vékonycsiszolat-készítés helyett az Orthophragminákat kombinált fogó segítségével felpattintottam úgy, hogy az equatoriális réteg merőlegesen álljon a fogó pofáira. E módszer előnye, hogy jelentősen megnöveli az equatoriális réteg feltárásának termelékenységét, a váz az esetek 75—80%-ában pontosan az equatoriális réteg síkjában pattan fel (nem keletkeznek ferde metszetek), valamint az, hogy a két egyenértékű félvázon a külső bélyegek is vizsgálhatók maradnak. A módszer egyedüli hátránya, hogy a váz széléből jelentős részek lepattanhatnak, azonban mivel a taxonómiailag legfontosabb bélyegek (embrió, embrió körüli kamrák) a váz középpontjában találhatók, ez a meghatározást nem befolyásolja jelentősebben.

A módszer lényegében azonos a Nummulitesek pattintásának régesrég alkalmazott metódusával. Hogy ezidáig miért nem került szélesebb körű alkalmazásra, annak az lehet az oka, hogy a pattintás után közvetlenül csak az üres vázú vagy színes kitöltésű (vasokker, glaukonit) Orthophragminák vizsgálhatók. Az esetek többségében azonban a kalcitvázat másodlagos kalcit tölti ki, amely lehet porózus, vagy pátitosodott is. Mindkét esetben lila tintával történő festést alkalmaztam, mely a másodlagos kalcitba ivódva (porózus kalcit esetében), vagy a kalcit két generációja közé beivódva (pátitosodott kalcit esetében) mintegy előhívja az equatoriális réteg szerkezetét. A lila tinta előnye az, hogy a vizes öblítés csak a be nem ivódott tintát mossa ki, a beivódottat már nem képes. Jobb kontraszthatás elérése céljából a meszes üledékekből származó üres vázú, valamint a glaukonittal kitöltött Orthophragminákat is megfestettem.

Az equatoriális réteg vizsgálata binokuláris vagy éremikroszkóppal történik. A lila tintával megfestett, másodlagos kalcittal kitöltött vázakra vizet csepegtettem a zavaró fénytörési jelenségek kiküszöbölésére.

Az equatoriális réteg pattintással való feltárása nemcsak az Orthophragmináknál, hanem a többi orbitoid Foraminiferánál is alkalmazhatónak tűnik. Magam Lepidocyclinákon végeztem sikeres kísérleteket (LESS 1981a).

Axiális metszet nyerésére továbbra is csak a csiszolat útján való feltárás kínálkozik. Én csak véletlenül tört axiális metszeteket vizsgáltam.

A FÉNYKÉPEZÉS MÓDSZERE

Az Orthophragminák fényképezése nem könnyű feladat, mivel viszonylag nagy felületen kell rendkívül finom részleteket láthatóvá tenni.

A táblákon található fotók legnagyobbrészt saját felvételeim.

A váz külső alakjáról készült fotók egy része Moszkvában készült FMN—2 típusú univerzális paleontológiai fényképezőgéppel síkfilmre, másik részüket (II. tábla 9., IV. tábla 6., V. tábla 4., VI. tábla 4., VII. tábla 10., VIII. tábla 10., IX. tábla 3., XIV. tábla 9., XVII., tábla 9., XXI. tábla

4., 11—13., XXIII. tábla 1., XXV. tábla 1., XXVI. tábla 5., XXXII. tábla 5—6., XXXIV. tábla 11., XXXV. tábla 7., XLI. tábla 9., XLIII. tábla 1. és XLIV. tábla 10.) Laky Ildikó készítette a MÁFI mikropaleontológiai laboratóriumában mikroszkópon át, 24×36 mm-es kisfilmre.

A legnehezebb feladatot az equatoriális és axiális metszetekről készülő felvételek elkészítése okozta. Üres vázú Orthophragminákról a legjobb fotókat a fent említett FMN—2-es típusú készüléken lehetett készíteni, ugyanis ennek a legnagyobb a mélységélessége. E műszer hátránya ugyanakkor a viszonylag kicsi (max. 22 ×-es) nagyítás és ennek következtében a kicsiny felbontóképesség. Nagyobb felbontóképesség, ám kisebb mélységélesség jellemzi a Diósgyőri Gépgyár metallurgiai laboratóriumának Zeiss gyártmányú metallurgiai mikroszkópját és a MÁFI Polmi típusú mikroszkópját ércmikroszkópos feltéttel. Ezek a műszerek a kitöltött vázú és a mikroszférás Orthophragminák fotózásánál adták a legjobb eredményeket.

A legtöbb felvétel az említett Polmi típusú készülékkel készült, így ennek a metodikáját ismertetem részletesebben: A plasztilinba ágyazott equatoriális metszetet alkalmas montírozó készülékkel a tárgyasztallal párhuzamosra állítjuk, majd szükség szerint vizet cseppentünk rá. Én Forte 17 DIN-es kisfilmet használtam, melyen a legkontrasztosabb és ugyanakkor megfelelően árnyalt felvételt akkor sikerült kapnom, ha zöld szűrőt alkalmaztam és lehetőség szerint leszűkítettem az objektív nyílását. Ügyelni kell ugyanakkor arra, hogy az expozíciós idő ne legyen több 1 percnél, mivel ekkor egyrészt a plasztilinban lévő olaj túlzottan beivódik a vázba, másrészt az equatoriális metszetre cseppentett víz annyira elpárolog, hogy az veszélyezteti a kép élességét.

A VIZSGÁLT MINTÁK SZÁRMAZÁSI HELYE

Az általam vizsgált minták egy része (a szovjetunióbeli és magyarországi anyag) saját gyűjtésem, másik részét (a bulgáriai, ausztriai, olaszországi és franciaországi mintákat) a Természettudományi Múzeum gyűjteményéből KECSKEMÉTI TIBOR volt szíves rendelkezésemre bocsátani. Szelvényszerű gyűjtést a Krím-félszigeten, az ajkai Csékúti-árokban, a dunaszentmiklósi Kántor-kerti-patak bevágásában tudtam folytatni, a többi minta szórványszerű gyűjtésnek tekinthető.

KRÍM-FÉLSZIGET

A Krím-félsziget régóta ismert és jól feldolgozott eocén rétegei nyugodt településük (3°-kal dőlnek É felé), faunában való gazdagságuk és teljességük miatt rászolgálnak arra, hogy a Szovjetunió déli részei eocénjének sztratotípus-szelvényéül szolgáljanak. MURATOV—NEMKOV (1960) beosztása szerint a krími eocén négy emeletre, a bahcsiszeráji, szimferopoli, bodraki és almai emeletre tagolható. A bahcsiszeráji emelet képződményei transzgresszíven települnek a paleocén kácsai emeletére, majd a rétegsor végig folyamatos.

A Krím-félszigeten 1974-ben és 1975-ben folytattam gyűjtést. Először, 1974-ben csak a szimferopoli emelet legalsó 3 m-ét vizsgáltam a Bahcsiszeráj melletti Sztaroszelje falu felett É-ra emelkedő Szuvlu-Kaja-hegyen lévő sztratotípus-szelvényben (16. ábra — E jelű minták), valamint az innen KÉK-i irányban kb. 5 km-re lévő Ulakli falu felett emelkedő hegyen (U jelű minták).

1975-ben kb. 0,75 m-es mintavételi sűrűséggel sikerült begyűjtenem a Szuvlu-Kaja-hegy teljes szelvényét (B jelű minták), ennek folytatását az Alma folyó jobb partján található, szintén sztratotípus-szelvényből (A jelű minták). Ezenkívül még egy szelvényt gyűjtöttem be a Bodrak folyó bal partjáról (C jelű minták — l. a 16. ábrát is).

A krími eocén Nummulitidáit NEMKOV—BARHATOVA (1961), NEMKOV (1967), GOLEV (1971) és SCHAUB (1981), Orthophragmináit PORTNAJA (1974), nannoplanktonjait KAPELLOS (1973), plankton Foraminiferáit NEMKOV—SUTSZKAJA (1971) ismertette.

Bahcsiszeráji emelet (az OS, CR, CP, PA, PF és részben az NA populáció)

A sztratotípus-szelvény az emelet agyagrétegeit 33 m vastagságban tárja fel, a felső részén néhány nummuliteses mészkőpad betelepülésével. Legalsó 0,5 m-e erősen glaukonitos. NEMKOV—BARHATOVA (1961) Nummulitidaek alapján az emeletet 3 részre tagolja. Az alsó 5—6 m az *Operculina semiinvoluta*, a következő 10 m a *Nummulites crimensis*, a felső 18 m az *Assilina placentula* zónája.

Vizsgálataim szerint Orthophragminák alapján az emeleten belül 3 szintet lehet kijelölni, melyek közül a legfelső már a következő (szimferopoli) emeletbe is átnyúlik (4. táblázat).

Az *Operculina semiinvoluta*-zónára (OS populáció — B 1—8-as minták) és a *Nummulites crimensis*-zóna alsó kétharmadára (CR populáció — B 9—16-os minták) a *Discocyclina archiaci bakhchisaraiensis* jelenléte a legjellemzőbb.

A *Nummulites crimensis*-zóna felső harmadára és az *Assilina placentula*-zóna legalsó részére (CP populáció — B 17—22-es minták) a *Discocyclina archiaci staroseliensis* és az *Orbitoclypeus ramaraoi suvlukayensis* jelenléte a jellemző, míg az *Assilina placentula*-zóna legnagyobb részében (PA populáció — B 23—32-es és PF populáció — B 33—41-es minták) a *Discocyclina archiaci archiaci*, a *D. pseudoaugustae* és az *Orbitoclypeus ramaraoi crimensis* a legjellemzőbb fajok. Az emelet tetején (NA populáció, mely magában foglalja a következő emelet legalsó részét is — B 42—47-es, E 1—7-es és U 1—5-ös minták) a mikroszférás példányok egyedszáma jelentősen meghaladja a megaszférásokét, ezzel együtt itt új fajként jelenik meg a *Discocyclina pseudoaugustae* helyett a *D. fortisi fortisi*, valamint a *D. weijdeni*.

Szimferopoli emelet (részben az NA, valamint az NF, DA, DF és PO populációk)

A sztratotípus-szelvény az emelet képződményeit összesen 44 m vastagságban tárja fel, kőzetanyaga alul nummuliteses mészmárga (kb. 7 m), felül nummuliteses mészkő (kb. 37 m).

NEMKOV—BARHATOVA (1961) Nummulitidaek alapján az emeletet 3 részre tagolják.

Az alsó 6—7 m a *Nummulites distans minor* (=*N. nemkovi*), a középső 25 m a *N. distans*, míg a felső 12 m a *N. polygyratus* zónája.

Vizsgálataim alapján az emeleten belül 3 Orthophragmina-szintet lehet kijelölni (4. táblázat), melyek közül a legalsó a bahcsiszeráji emeletből nyúlik fel ide és ismertetése is ott található (NA populáció). Ez a zóna csak az emelet legalsó 1,5—2 m-ét foglalja magába.

Viszonylag éles a határ a következő (*Discocyclina fortisi simferopolensis*) Orthophragmina-szint felé, mely a *Nummulites distans minor*-zóna felső 3/4-ét (NF populáció — B 48—52-es, E 8—9-es és U 6—9-es minták) és a *Nummulites distans*-zóna alsó részét foglalja magában. A felső határ megállapítása itt egyelőre nem volt lehetséges, mivel a B 57-es minta fölött a B 75-ös mintáig terjedően a kőzet olyan kemény, hogy belőle Orthophragminákat nem tudtam izolálni. A DA populációba ezért feltételesen a B 53—74-es mintákat sorolom. A szintjelző fajon kívül jellemző még a *Discocyclina archiaci bartholomei*, a *D. senegalensis* és a *Nemkovella evae* jelenléte.

A B 75—78-as minták kőzetanyaga valamivel lazább az alatta lévőknél és elég fajgazdag Orthophragmina faunát tartalmaz. A minták egynémelyikéből Orthophragminákat is lehetett izolálni. A vizsgálatok alapján megállapítható volt, hogy a *Nummulites distans*-zóna felső részén (DF populáció — B 75—85-ös minták) és a *N. polygyratus*-zónának legalábbis az alsó részén (PO populáció — B 86—92-es, A 1—8-as és C 1—14-es minták) a legjellemzőbb taxonok a *Discocyclina stratiemanuelis*, a *D. dispansa taurica*, a *D. aaroni chalossensis*, a *D. pratti montfortensis*, a *Nemkovella fermonti*, az *Orbitoclypeus portnayae* és az *O. koehleri*.

Bodraki emelet (BO populáció)

A szimferopoli emeletből fokozatos átmenet van a 80—100 m vastag bodraki emeletbe. Az átmenetet, illetve az emelet nagy Foraminiferákat is tartalmazó alsó 15 m-ét (az ún. kuberlini szintet) Prijátnoje Szvidányije falu mellett az Alma folyó jobb partján a sztratotípus-szelvényben lehet vizsgálni (A 9—23-as minták). Jó szelvény található még Szkalisztoje falu mellett, a Bodrak folyó bal partján (C 15—30-as minták).

A bodraki emelet jellegzetes kőzetanyaga krétaszerű fehér mészkő, majd feljebb mészmárga, melyet már iszapolni is lehet.

A bodraki emelet lito- és biofáciese arra mutat, hogy a tenger fokozatosan mélyült. A nagy méretű Nummulitidaek itt teljességgel hiányoznak, a kis méretű Nummulitidaek faj- és egyedszáma fokozatosan csökken, majd a felsőbb keresztyini és kumi szintben teljesen el is tűnnek. Az Orthophragminák valamivel jobban bírták a tenger mélyülését, mivel a Nummulitidaek eltűnését követő 3—4 m-ben még jelen vannak. Ugyanakkor a plankton Foraminiferák faj- és egyedszámban is egyre gyarapodnak.

NEMKOV—BARHATOVA (1961) itt csak egy zónát, a *Nummulites incrassatus*-ét tudta elkülöníteni.

Vizsgálataim szerint az Orthophragminák alapján is csak egy szintet (*Discocyclina kingae*) lehet kijelölni (4. táblázat). Ennek a zónának az alatta lévővel való határát feltételesen az emelet alsó határán vontam meg, mivel Orthophragminákat csak az A 18—23-as és a C 22—25-ös mintákból lehetett izolálni. Lejjebb a kőzet túl kemény, feljebb pedig már nem tartalmaz Ortophragminákat. A jellemző fajokat a 4. táblázat mutatja be.

*

A krími sztratotípus-szelvény és a nyugat-európai eocén emeletek korrelációjáról többfajta nézet is létezik. Ezek közül a leglényegesebbeket az 5. táblázat mutatja be.

A klasszikus DNy-aquitániai és észak-olaszországi lelőhelyek Orthophragmina faunáival való összevetés alapján alakult ki az általam javasolt korreláció, mely KAPELLOSétól (1973) csak abban tér el, hogy én HARDENBOL—BERGGREN (1978) alapján a *Discoaster sublodoensis* nannoplanktonzónát (NP 14) már a lutéciai emelet alsó részébe sorolom.

Itt említendő még meg, hogy a Nummulitidaekhez hasonlóan az Orthophragminák között is találhatók olyan alakok a szimferopoli emelettől kezdve, amelyek feltehetően csak az ún. „Északi Nummulites Provinciá"-ra (Krím, Mangislak, Északi Aralon Inneni Terület, Dobrudzsa) korlátozódnak, hiszen a mediterrán régióban egyelőre nem találtam meg őket. Ezek a *Discocyclina kingae*, az *Orbitoclypeus koehleri* és az *O. portnayae*.

BULGÁRIA (DIKILITAS — DK POPULÁCIÓ)

Bulgáriából egyetlen mintám származik „Dikilitas — Oravecz J. gyűjtése" felirattal a Természettudományi Múzeum gyűjteményéből. A Várna melletti szelvény jól korrelálható a fentebb leírt krími sztratotípus-szelvénnyel, mivel azzal lényegében azonos kifejlődésű és ugyanúgy az ún. „Északi Nummulites Provinciá"-hoz tartozik (Nemkov 1967 szerint). A bahcsiszeráji emelettel azonosítható homokos—márgás ill. márgás rétegekből Belmusztakov (1960) gazdag Nummulites faunát írt le.

Az általam vizsgált mintából két Discocyclina-faj került elő: a *D. archiaci archiaci* és a *D. pseudoaugustae*, melyek egyértelműen a cuisi emelet alsó részét jelzik és feltehetően a szelvénynek a bahcsiszeráji emelet *Assilina placentula*-zónája felsőbb részeiből kerültek elő.

MAGYARORSZÁG

Magyarországon gyűjtött mintáim 4 területről származnak (17. ábra), melyeket itt rétegtanilag alulról felfelé haladva ismertetek.

Nyugati-Gerecse

Neszmély és Dunaszentmiklós környékén eocén képződmények csak a Dunaszentmiklósról induló és a Dunába ömlő Kántor-kerti- (vagy Tekeres-) patak, ill. a szintén a Dunába ömlő Bátor-berki- (vagy Téglagyári-) patak mély bevágásaiban vannak a felszínen (18. ábra), máshol a vastag lösz- ill. pannóniai képződmények elfedik. Diszkordánsan települ a Fülöp J. (1958) által leírt gerecsei kifejlődésű terrigén alsó-kréta képződményekre, azonban a lepusztítás miatt csak foszlányok maradtak meg belőle. A terület eocén képződményeit Gidai L. (1980) ismertette.

Nagy Foraminiferákat 4 feltárásban találtam, ezek közül csak kettő tartalmaz Orthophragminákat is.

Dunaszentmiklós (DM populáció)

A Kántor-kerti-patak felső részén (melynek másik elnevezése Iván halála), Dunaszentmiklóstól ÉK-i irányban 400 m-re az eocén rétegek diszkordáns települése az alsó-krétán jól látszik. Az eocén rétegsor itt alulról felfelé a következő (l. a 19. ábrát is):

1. 2 m tarka agyag
2. 4 m szenes, molluscás agyag
3. 5 m szürke „operculinás" agyagmárga

Az árokban található nagy Foraminiferákat tartalmazó képződményekből alulról felfelé kb. 1—1,5 m-ként 10 db mintát vettem. Ezek közül az alsó 4 (K 1—4-es minták) nem tartalmazott Orthophragminákat. Innen Jámborné Kness M. a következő Nummulitidae faunát határozta meg: *Nummulites anomalus*, *N. subplanulatus*, *Operculina ammonea* és *O. granulosa*, melyek alapján ezek a képződmények szerinte az alsó-eocén ypresi emeletének alsóbb, *Nummulites subplanulatus*-os szintjébe tartoznak.

A felső 6 mintában (K 5—8-as, KA és KF minták) már Orthophragminák is szerepelnek. Jámborné Kness M. az alsóbb mintákban is előforduló Nummulitidaeken kívül még az *Operculina parva*-t is meghatározta. Mindezek alapján ő ezeket a rétegeket az alsó-eocén cuisi emelet felsőbb, *Nummulites anomalus—N. subramondi* (=operculinás agyagmárga) szintjébe sorolta.

Ezen 6 minta mindegyikében előfordulnak a 6. táblázaton jelzett Orthophragminák. A minták korára vonatkozólag véleményem eltér Jámborné Kness M.-étól, miszerint én e rétegeket a lutéciai emelet középső részébe helyezem az Orthophragminák alapján, ugyanis a *Discocyclina dispansa nussdorfensis* csak erre a szintre jellemző (bővebben l. „az eurázsiai Orthophragminák rétegtana" c. részben).

Neszmély (NT populáció)

Nagy Foraminiferákat, így Orthophragminákat is tartalmazó sárga és szürke agyag található Neszmélyen, a Bátor-berki-patak középső részén. A települési viszonyok itt nagyon zavartak: alsó-kréta képződmények, eocén tarka agyag és foraminiferás agyag ismétlődő kibúvásai váltakoznak. Ez nyilván az erőteljes blokk-tektonika következménye.

Az innen vett 8 szórványmintám mind ugyanazt a faunát tartalmazta.

A Nummulitidaek Jámborné Kness M. meghatározása szerint: *Nummulites perforatus*, *N. striatus*, *N. anomalus*, *N. nitidus*, *N. subramondi*, *N. burdigalensis*, *Assilina exponens*, *A. laxispira*, *Operculina ammonea*, *O. granulosa*. Ezen fauna alapján ő a képződmény korát kora-lutéciainak tartja, másodlagosan bekerült nagy Foraminifera (köztük Discocyclina) fajokkal. Ez összhangban áll Jámborné Kness M. (1968) korábbi adataival.

Az Orthophragminák közül a Dunaszentmiklóson is meglévő *Discocyclina dispansa nussdorfensis*, a *D. aaroni aaroni*, valamint az ezekhez képest újnak számító *D. augustae atlantica* került elő (l. a 6. táblázatot is). Ez a feltárás egyértelműen az ún. ,,perforatus"-os rétegeket reprezentálja, melyek a Discocyclina fauna alapján itt kétségtelenül a lutéciai emelet középső részébe tartoznak. Orthophragminák áthalmozására utaló nyomokat nem találtam, sőt, megfigyeléseim szerint az összes nagy Foraminifera jobb megtartású ezekben a rétegekben, mint a Dunaszentmiklósnál található ún. ,,operculinás" rétegekben.

Déli-Bakony (Ajka környéke — AJ populáció)

A Déli-Bakony eocén képződményeit igen alaposan tanulmányozta Böckh (1875—1878), Hantken (1875b), Rozlozsnik (1925, 1928), Vecsey (1939), Szőts (1956), Kopek—Kecskeméti (1960) és Kopek et al. (1966, 1971). Munkáik alapján a rétegsorok egyértelműen tisztázottnak tekinthetők. Eltérések mutatkoznak az egyes rétegek korbesorolását illetően, itt Kopek et al. (1966, 1971) elsősorban Nummulites-vizsgálatokon alapuló rétegtani beosztása a legkorszerűbb. Munkám során a Kopek et al. (1966) beosztása szerinti ún. ,,millecaputos" és ,,glaukonitos" (XII. és XIII.) szint határán feldúsuló Orthophragminákat vizsgáltam, mivel a többi szintben ezek alig, vagy egyáltalán nem találhatók meg.

A fauna az összes általam vizsgált lelőhelyen (20. ábra) egykorúnak bizonyult, közöttük csak az egyes fajok gyakoriságában mutatkozott eltérés.

A Nummulitidaeket Kecskeméti T. (7. táblázat) határozta meg. Az ugyancsak Kecskeméti (1958, 1959) által feldolgozott Orthophragminákat kritikai értékeléseimmel a 8. táblázat, saját Orthophragmina-határozásaimat a 6. táblázat mutatja be.

A vizsgált lelőhelyek:

a) Halimba — Pityerdomb [megegyezik Kecskeméti (1959) gyűjtési helyével], sárga glaukonitos márgás mészkő (H 1—2-es minták).

b) Ajka, Köleskepe-árok felső vége, útbevágás a kanyarban [megegyezik Kecskeméti (1959) Köleskepe-3. sz. gyűjtési helyével], glaukonitos mészmárga (Ba 5—6-os és Kö 1—4-es minták).

c) Ajka, Köleskepe-árok felső vége, útbevágás a kanyarban [Kecskeméti (1959) Köleskepe-2. sz. gyűjtési helye], glaukonitos mészmárga, kb. 200 m-re É-ra a Köleskepe-3. sz. gyűjtési helytől. Mivel azóta ez a feltárás megsemmisült, én innen gyűjteni nem tudtam.

d) Ajka, Csékúti-árok a Jókai-aknától DNy-i irányban 500 m-re [részben azonos Kecskeméti (1959) Csékúti-árok nevű gyűjtési helyével].

A Jókai-akna fölött húzódó Csékúti-árok 25 m vastagságban tárja fel az Ajka környéki eocén képződmények legfelső rétegeit, így azok legteljesebb felszíni feltárását adja. Innen szelvényszerű gyűjtést folytattam, a rétegsor alulról felfelé a következő volt (l. a 21. ábrát is):

1. Sárga márgás mészkő tömeges *Nummulites millecaput*-okkal, ritkább Orthophragminákkal, gyakori Echinoideákkal — 5 m (J 1—2-es minták).

2. Zöldessárga, erősen glaukonitos mészmárga tömeges Orthophragminákkal, ritkábban *Nummulites millecaput*-okkal — 14 m (J 3—6-os minták).

3. Fehér márgás mészkő kevesebb glaukonittal, tömeges Orthophragminákkal, ezen belül is az Asterocyclinák dominálnak. A *Nummulites millecaput* egészen ritka — 4 m (J 7—8-as minták és CS minta).

4. Fehér mészmárga nagy Foraminiferák nélkül — 2 m.

Az eocén rétegsorra diszkordánsan pannóniai gyöngykavics települ alján áthalmozott eocén nagy Foraminiferákkal. Az 1. tagot a fauna viszonylagos szegénysége, az Asterocyclinák hiánya és az Echinoideák jelenléte alapján a halimbai Pityerdomb rétegeivel lehet leginkább összevetni. A 2. tagból származhat Kecskeméti (1959) Csékúti-árok megjelölésű, a 8. táblázaton bemutatott Orthophragmina faunája. Annak ellenére, hogy itt az Asterocyclinák alárendelt szerepet játszanak, a 2. tag kőzettani felépítése és Orthophragmina faunája alapján is a Köleskepe-árok fentebb leírt rétegeivel azonosítható. A 3. tag jellegzetessége az, hogy benne egyedszámban túlsúlyra jutnak az Asterocyclinák, ugyanakkor eltűnik a lejjebb jelentős szerepet játszó *Discocyclina pulcra balatonica*. Ezt a képződményt máshol Ajka környékén nem találtam meg. A 4. tag nagy Foraminiferákat nem tartalmaz, hasonló képződmények találhatók a Halimbai-medencében, ahol mélyfúrások mutatták ki.

A Csékúti-árok rétegsora, mely biosztratigráfiailag jól tagolható, Orthophragminák alapján gyakorlatilag egyidősnek tekinthető. Az az időintervallum, mely alatt ez a rétegsor leülepedett, túl kevés lehetett ahhoz, hogy az egyes fajokon belül statisztikailag kimutatható változások történjenek. A biosztratigráfiai tagolhatóság a tenger fokozatos mélyülésével függhet össze. Hasonló jellegű rétegsor található Priabonán a sztratotípus-szelvényben is (Sirotti 1978).

e) Ajka—Pula üzemi út bevágásai a Szőke-forrás fölött, glaukonitos mészmárga (Ba 3-as, Sz 5—8-as minták).

Az itt található Orthophragminákban gazdag képződményeknek az út bevágásában (100 m-en belül) néhány elég rossz feltárása található, melyek alapján nem tisztázható a kőzetek települési viszonya. Feltűnő itt az *Orbitoclypeus varians roberti* hiánya, amely máshol nagy egyedszámban fordul elő, ezen túl azonban ezek a rétegek a Köleskepe-árok rétegeivel, ill. a Csékúti-árok rétegsorának 2. tagjával azonosíthatóak.

f) Útbevágás az Ajka—Pula üzemi út lugos-tetői elágazásánál, a Lugos-tetőtől ÉNy-ra 2,4 km-re, sárgásfehér glaukonitos, márgás mészkő (SzT minta).

A Discocyclinák túlsúlya és az Asterocyclinák teljes hiánya alapján ennek a feltárásnak a rétegei leginkább a Csékúti-árok rétegsorának 1. tagjával azonosíthatók, bár attól gazdagabb faunát tartalmaznak.

g) Padragkút, Gyűr-hegy [Kecskeméti (1959) „Gyűr-hegy" gyűjtési helye]

Mivel itt a kőzet kemény mészkőből áll, melyből nem lehetett Orthophragminákat izolálni, így innen csak Kecskeméti T. vékonycsiszolatait vizsgáltam.

Összegezve: Az Ajka környékén található rendkívül gazdag Orthophragmina faunák biosztratigráfiailag ugyan kissé különböznek egymástól (ami valószínűleg különböző mélységviszonyokra vezethető vissza), kronosztratigráfiailag azonban egykorúnak tekinthetők. A kor (bartoni emelet alsó része) részletes megindoklása „az eurázsiai Orthophragminák rétegtana" c. részben található. Itt csak annyit jegyzek meg, hogy a *Discocyclina pulcra balatonica* és az *Orbitoclypeus varians roberti* csak erre a korra jellemzők, míg az *O. chudeaui pannonicus* jelenléte a mélyebb, az *Asterocyclina stellata stellata* és az *A. alticostata cuvillieri* jelenléte pedig a magasabb rétegektől való elhatárolást teszi egyértelművé.

Északi-Bakony (Dudar környéke — DU populáció)

Dudar környékének a Sűrű-hegyen lévő ma már felhagyott kőfejtőjéből Tomor—Thirring (1934) írta le először az Orthophragminákban gazdag márgát. Ezt követően Szőts (1956) is említi ezt az előfordulást. Kopek et al. (1966) valamint Kopek (1980) Dudar környékén általánosan elterjedtnek jelzik ezt a képződményt, rétegtani táblázatukban egykorúnak (felső-lutéciainak) tüntetve fel az Ajka és Lábatlan környéki discocyclinás kőzetekkel. Majzon (1966) is egykorúnak (auversinek) veszi az Ajka és Dudar környéki orthophragminás rétegeket, ugyanakkor a Lábatlan környékieket már fiatalabbnak, priabonainak.

A Sűrű-hegyen kívül Kecskeméti T. javaslatára a bakonyoszlopi Ördögárok Ny-i oldalán felvezető gyalogút bevágásaiból is vettem mintákat (22. ábra). A sűrű-hegyi és ördögároki minták azonos korúnak bizonyultak az Orthophragmina fauna kisebb eltérései ellenére is.

a) Sűrű-hegyi kőfejtő D-i fala, laza sárga és rózsaszín mészmárga (DS 1—5-ös, DS, DG és DH minták).

Ebben a feltárásban legalul a „főnummuliteses mészkő" legfelső „millecaputos" rétegei találhatók. A nagyon kemény mészkőben a *Nummulites millecaput* B-forma hatalmas, 10 cm-es átmérőt is elérő példányai kőzetalkotók, emellett Orthophragminák és Echinoideák is előfordulnak. Ebből a kőzetből iszapolható mintát nem sikerült kinyernem. Biofáciesében ez a képződmény nagyon hasonlít a Csékúti-árok rétegsorának 1. tagjához. Fölötte gyors átmenettel következik az Orthophragminákat tartalmazó sárga és rózsaszín mészmárga, mely azonban mindenütt csak maximálisan 2 m vastagságban van feltárva, a további részeket a valamikori kőfejtés mint meddőt, eltüntette. Szelvényszerű gyűjtésre itt nem volt lehetőség, ezért ebből a képződményből a kőfejtő D-i és Ny-i fala mentén 5 mintát vettem egymástól mintegy 20—25 m távolságra. Az öt (DS 1—5-ös) minta Orthophragmina faunája azonosnak bizonyult, a *Discocyclina pulcra baconica*-t azonban csak a délnyugatabbra eső (DS 4—5-ös) mintákban találtam meg. Az Orthophragmina fauna összetételét a 6. táblázat mutatja be. Ugyanerről a lelőhelyről Kecskeméti T. a 7. táblázaton jelzett Nummulitidaeket határozta meg. Fáciesében ez a képződmény a Csékúti-árok rétegsorának 2. tagjával vethető össze, bár glaukonittartalma attól jóval kisebb.

b) Bakonyoszlop, Ördögárok Ny-i oldalán felvezető gyalogút bevágásai, világos szürkéssárga márgás mészkő (D 1—7-es minták).

A gyalogút bevágásai csak foszlányokat tárnak fel az Orthophragmina-tartalmú rétegekből, melyekből Kecskeméti T. a 7. táblázaton jelzett Nummulitidaeket határozta meg. Gazdagabbak Orthophragminákban az Ördögárok bejáratától kb. 200 m-re található bevágások feltárásai (D 1—5-ös minták), melyekben a 6. táblázaton jelzett taxonok találhatók. A gyalogút mentén feljebb található feltárásokból (az Ördögárok bejáratától kb. 500 m-re — D 6—7-es minták) a 6. táblázaton jelzett szegényebb Orthophragmina faunát határoztam meg.

Ez a két faunaegyüttes szegényebb a sűrű-hegyinél. Jellegzetessége az *Orbitoclypeus varians scalaris* dominanciája az *O. chudeaui pannonicus*-szal szemben, míg a Sűrű-hegyen fordított a helyzet.

A fauna korának (bartoni emelet középső része) részletes megindokolása „az eurázsiai Orthophragminák rétegtana" c. részben található. Itt csak annyit jegyzek meg, hogy a *Discocyclina pulcra baconica* és az *Orbitoclypeus varians scalaris* csak erre a korra jellemzők, míg az *Asterocyclina stellata stellaris* és az *A. alticostata alticostata* jelenléte a mélyebb, a *Discocyclina dispansa hungarica* jelenléte pedig a magasabb rétegektől való elhatárolást teszi egyértelművé.

Keleti-Gerecse (Lábatlan környéke — LA populáció)

A Keleti-Gerecse és tágabb értelemben a Dorogi-medence eocén képződményeit HANTKEN (1865—66, 1868, 1871, 1878), ROZLOZSNIK et al. (1922), SZŐTS (1956) és GIDAI (1972) kutatásai nyomán viszonylag részletesen ismerjük.

Az összlet legfelső részén különböző mértékig letarolódva általánosan elterjedt a millecaputos—discocyclinás mészkő és homokkő, helyenként biotitos—tufás homok betelepülésekkel, emellett helyenként még megmaradtak foraminiferás mészmárga foszlányok is („piszkei márga"). Ezen kőzetek legnevezetesebb feltárása a Nyergesújfalu és Lábatlan közötti Sánc-hegy híres fala az országút mentén. Sajnos itt a kőzet nem volt alkalmas Orthophragminák kiiszapolására.

Hasonló jellegű kőzetek találhatók a Lábatlantól K—DK irányban 3 km-re fekvő Szent Józsefpuszta mellett (23. ábra), ahol a Raibl-patak jobb oldali nyúlványának fejében egy felhagyott kőfejtőben a biotitos—tufás homokcsíkokat tartalmazó szürkésfehér foraminiferás agyagmárga közé félig megszilárdult állapotban méteres nagyságú millecaputos—orthophragminás mészkőtömbök csúsztak be olisztolitként. A kétfajta kőzet határán az Orthophragminákat bőven tartalmazó mészkő anyaga fellazult és ezáltal kiiszapolhatóvá vált. A becsúszás tényét a foraminiferás agyagmárgának a mészkőtömbök általi zavart települése is igazolja.

Valószínűsíthető, hogy a millecaputos—orthophragminás mészkő és a foraminiferás agyagmárga keletkezése között nem telt el nagy időintervallum, az aljzat viszont morfológiailag tagolt és mobilis lehetett. Ezt a feltárást először SZŐTS (1956, p. 93) írta le („a bajóti Bányaszőlőktől Ny-ra a patak völgyében, egy kőfejtőben"), ugyaninnen GIDAI (1972) VITÁLISNÉ ZILAHY L. meghatározásában felső-eocén plankton Foraminiferákat, JÁMBORNÉ KNESS M. meghatározásában szintén felső-eocén Nummulitidaeket említ. Innen 9 (R 1—3, RA, RB, RC, RD, RF és RK) mintát vettem, azonban a zavart település miatt (olisztolitok) réteg szerinti gyűjtésről nem lehetett szó, így a talált Orthophragmina faunát a 6. táblázatban együtt ismertetem.

Hasonló jellegű, bár kisebb fajgazdagságú fauna került elő Bajóttól Ny-ra 500 m-re egy kisebb felhagyott kőfejtőben (23. ábra — BN minta). Az itt lelt taxonokat a 6. táblázat mutatja be. Itt a települési viszonyok látszólag nem olyan zavartak, bár az összletből a rossz feltártság miatt csak kevés látszik. Az idézett fauna a legalsó, 1 m vastagságban látható rétegekből került elő. Ez a millecaputos—orthophragminás márgás mészkő feljebb mészkőbe megy át, melyben az Operculinoidesek dominálnak, mellettük gyéren még *Orbitoclypeus furcata furcata* fordul elő. Ez az operculinoideses mészkő 4 m vastagságban látszik a feltárásban, további részei fedettek.

A Bajót—Bajna műút Domonkos-hegy oldalában lévő bevágásában (23. ábra) a foraminiferás márgás mészkőben kb. 1 m vastag biotitos—tufás homok-közbetelepülés található (BD minta), melyben egyedüli nagy Foraminiferaként — tömegesen — *Asterocyclina stellata stellaris* van jelen. Megtartása elég jónak mondható, bár igen porlékony.

A fent felsorolt kőzetek korának megítélésében két vélemény van: KOPEK et al. (1966) szerint a *Nummulites millecaput* jelenléte alapján felső-lutéciainak veendő, míg GIDAI (1972) és JÁMBOR-KNESS (1967, 1972) szerint a felső-eocén (priabonai) kor a helyes. Véleményük szerint a *N. millecaput* fajöltője kaukázusi és lengyelországi példák alapján felnyúlhat a felső-eocénbe, emellett a többi faunaelem is inkább a felső-eocén mellett bizonyít.

Ez utóbbi véleményhez csatlakozom magam is. Az Orthophragminák vizsgálata alapján ugyanis a *Discocyclina radians labatlanensis*, a *D. nandori*, az *Orbitoclypeus furcata furcata*, az *Asterocyclina stella praestellaris* és az *A. alticostata danubica* egyértelműen felső-eocén fajok, sőt a *Discocyclina dispansa umbilicata*, a *D. pratti minor* és az *Asterocyclina priabonensis* jelenléte lehetővé teszi a priabonai emelet alsó részétől való elhatárolást és a Priabona tipikus középső-priabonai rétegeivel való korrelációt is (l. még „az eurázsiai Orthophragminák rétegtana" c. részben).

Összefoglalva: Orthophragmina-vizsgálatok alapján korkülönbség mutatható ki a litológiailag és fauna-összetételében is hasonló Ajka, Dudar és Lábatlan környéki „millecaputos—discocyclinás" márgák és mészkövek között. Ez az egész dunántúli eocén rétegsor tetején lévő összlet DNy-ról ÉK felé haladva egyre fiatalodik, vagyis a faciológiailag lényegében azonosnak tekinthető képződmény kora az egyes lelőhelyeken tükrözi a DNy-ról előretörő transzgresszió egy adott szakaszát az adott régióban.

AUSZTRIA (NUSSDORF — ND POPULÁCIÓ)

Az Ausztriából származó egyetlen minta a Természettudományi Múzeum gyűjteményében „Nussdorf, erdőszél, középső-adelholzeni rétegek, A. HILLEBRANDT gyűjtése" címkét viseli. Ez alapján nagyon valószínűnek látszik, hogy a minta a VIII. Európai Mikropaleontológiai Kollokvium Kirándulásvezetőjének D I/5-ös megállóhelyéről származik (GOHRBANDT 1963). Itt szürke márga található gazdag Nummulites- és Assilina faunával, melyek alapján GOHRBANDT (1963) a lelőhely korát a középső-eocénben rögzíti.

A vizsgált minta gyéren tartalmazott Orthophragminákat, melyek közül *Discocyclina dispansa nussdorfensis*-t, *D. aaroni aaroni*-t és *Asterocyclina stellata adourensis*-t határoztam meg.

Ez a fauna egyértelműen a lutéciai emelet középső részét jelzi, ugyanis az első taxon csak itt fordul elő (bővebben l. „az eurázsiai Orthophragminák rétegtana" c. részben).

ÉSZAK-OLASZORSZÁG

Az észak-olaszországi minták mindannyian a klasszikus Vicenza környéki lelőhelyekről származnak.

Spilecco — SC populáció

A Monte Bolca Ny-i oldalában lévő sajátos kifejlődésű rétegsort és faunáját SUESS (1868), MUNIER-CHALMAS (1891), FABIANI (1915), DOUVILLÉ (1922), SCHWEIGHAUSER (1953), CITA—BOLLI (1961) és CITA—PICCOLI (1964) tanulmányozta. Az általam vizsgált minta „Spilecco, tufás márga" felirattal KECSKEMÉTI T. gyűjtése (SC minta és populáció). Ez a vörös tufás márga az irodalom alapján felső-kréta globotruncanás scaglia-mészkő és alsó-eocén korú brusaferri nummuliteses mészkő között fekszik.

Orthophragmina faunáját MUNIER-CHALMAS (1891), SCHLUMBERGER (1904), DOUVILLÉ (1922) és SCHWEIGHAUSER (1953) vizsgálta. Az előbbi három szerző az alsó-eocénbe, utóbbi a középső—felső-paleocénbe sorolta az itteni rétegeket.

Saját vizsgálataim *Orbitoclypeus ramaraoi neumannae*-t és *O. bayani*-t mutattak ki. Ezenkívül irodalmi adatok alapján bizonyítottnak vehető az *Asterocyclina stella taramellii* jelenléte is (SCHLUMBERGER 1904, NEUMANN 1958).

Az *Orbitoclypeus multiplicata* is meglévő, de kérdéses taxon (SCHLUMBERGER 1904). DOUVILLÉ (1922) *Discocyclina tenuis*-ának (=*D. archiaci archiaci* SCHWEIGHAUSER 1953 fotója alapján) spileccoi származása iránt erős kétségek merülnek fel. A minta korának eldöntésénél (ilerdi emelet középső része) döntő jelentősége van az *Orbitoclypeus ramaraoi neumannae*-nek, mely feltehetően csak erre a szintre korlátozódik (l. még „az eurázsiai Orthophragminák rétegtana" c. részt is), annál is inkább, mivel a Nummulitesek és a plankton Foraminiferák is ugyanezt a szintet jelzik.

Mossano — MS populáció

Az általam vizsgált minta a „Mossano, priabonien bázisa III-6/1" jelzést viseli, KOPEK G. és DUDICH E. gyűjtötte az 1968. évi eocén kollokvium során (MS minta és populáció). A kollokvium kirándulásvezetője alapján egyértelműen azonosítani lehetett a származási helyet: a mintát a mossanoi eocén szelvényben a tipikus felső-eocén fauna első megjelenési helyéről gyűjtötték. SCHWEIGHAUSER (1953) alapján a mossanoi priabonai alsó részét 60 m vastag kék márga és márgás mészkő képezi, melynek legalsó részéből ő és UNGARO (1968) felső-eocén Nummulitidaeket és plankton Foraminiferákat írtak le. Orthophragmináit SCHWEIGHAUSER (1953) ismertette.

Az általam vizsgált mintában a következő faunát találtam: *Discocyclina dispansa dispansa*, *D. augustae augustae*, *D. trabayensis vicenzensis*, *D. nandori*, *Nemkovella strophiolata tenella*, *Orbitoclypeus varians varians*, *Asterocyclina stellata stellaris*, *A. stella praestellaris*. Ezt a faunát a SCHWEIGHAUSER (1953) által ábrázolt *Discocyclina pratti pratti* (*D. sella* sensu SCHWEIGHAUSER) egészíti ki.

A minta alsó-priabonai korát itt nem kell bizonyítani, hiszen a mossanoi fauna volt az egyik legfontosabb viszonyítási alap a többi minta korának eldöntésénél.

Priabona — PR és VG populációk

A felső-eocén típusterületéről két mintát találtam: KECSKEMÉTI T. gyűjtötte őket és a „Priabona, új templom mögött" (PR minta és populáció) illetve a „Priabona, Valle Granella" (VG minta és populáció) címkét viselték.

A priabonai eocénnel foglalkozó legmodernebb munkák (HARDENBOL 1968, SIROTTI 1978 és SETIAWAN 1983) alapján azonosítani lehetett e mintákat, az „új templom mögötti" feltárás az ún. „asterocyclinás" szint márgáit és mészköveit, a Valle Granella-i feltárás a mélyebb „kék agyag" vagy esetleg a még mélyebb „discocyclinás" szintet reprezentálja. Jellegzetes felső-eocén Nummulitidaeit ROVEDA (1961) írta le.

Az Orthophragminákkal először GÜMBEL (1868) és DOUVILLÉ (1922) foglalkozott. Mindkettőjük munkájának nagy hiánya az equatoriális metszetek figyelmen kívül hagyása, fényképük nem közlése.

SIROTTI (1978) korszerű, szelvényszerű mintavételt folytatott a priabonai típusszelvényben és a következő taxonokat határozta meg (zárójelben e mű szerzőjének azonosításai): *Discocyclina* cf. *aspera* (=*D. dispansa umbilicata*), *D. sella* (=*D. augustae augustae*), *D. daguini* (=*D. trabayensis vicenzensis*), *D. discus* (*D.* =*dispansa umbilicata*), *Aktinocyclina radians* (=*D. radians labatlanensis* és *D. nandori*), *Asterocyclina stellaris* (=*A. priabonensis*,) *A. stellata* (=*A. stella praestellaris*), *A. stella* (=*A. stella praestellaris*) és *A. furcata* (=*Orbitoclypeus furcata furcata*).

Az első két fajt csak a „discocyclinás" és részben a „kék agyag" szintben találta meg, míg az utolsót csak az „asterocyclinás" szintben. Az összes többi faj előfordult mind a három szintben.

SETIAWAN (1983) biometriai módszerekkel négy minta Orthophragmináit vizsgálta. Két minta (Pr. 49 és 55) a „discocyclinás" szintből származott. Innen SETIAWAN (1983) *Discocyclina* I. cf. *D. applanata*-t (=*D. augustae augustae*), *D.* II. cf. *D. sella*-t (=*D. dispansa umbilicata* és ?*D. pratti minor*) és *Asterocyclina* I. cf. *A. stellaris*-t (=*A. stellata stellaris*) határozott meg (zárójelben e mű szerzőjének azonosításai).

A másik két minta (Pr. 126 és 135) az „asterocyclinás" szintből származott és *Discocyclina* III. cf. *D. augustae*-t (=*D. trabayensis vicenzensis*), *D. IV*-t (=*D. euaensis*), *Asterocyclina* II. cf. *A. priabonensis*-t (=*A. priabonensis*) és *A.* III. cf. *A. stella*-t (=*A. stella praestellaris*) tartalmazott.

Az általam vizsgált mintákban az Orthophragminák elég rossz megtartásúak voltak, emellett szegényesek is: Valle Granella: *Discocyclina dispansa umbilicata, D. nandori, Asterocyclina stellata stellaris*; Priabona: *Discocyclina trabayensis vicenzensis.*

Összességében Priabonán és Valle Granellán SIROTTI (1978), SETIAWAN (1983) és saját vizsgálataim alapján a következő Orthophragminák jelenlétét lehetett megállapítani: *Discocyclina augustae augustae, D. dispansa umbilicata, D. trabayensis vicenzensis, D. euaensis, D. radians labatlanensis, D. nandori, Orbitoclypeus furcata furcata, Asterocyclina priabonensis, A. stellata stellaris, A. stella praestellaris,* valamint valószínűleg *Discocyclina pratti minor* is.

Mivel korbeosztásunk egyik alappontja, nem szorul bizonyításra, hogy a priabonai típusszelvény a felső-eocén felsőbb részeit (VG populáció — priabonai emelet középső része, PR populáció — priabonai emelet felső része) képviseli.

NYUGAT-AQUITÁNIA

A Természettudományi Múzeum Őslénytárának nagy Foraminifera-gyűjteménye szép számmal tartalmaz innen Orthophragminákban gazdag mintákat is. Ezek a minták az eocén egyik klasszikus kifejlődési területéről származnak, melyek többségét az irodalom is sokoldalúan leírja.

Az Orthophragmina fajok mintegy felét erről a területről írták le, így a többi területekkel való korreláció során ezek a minták mintegy alappontul szolgáltak, annál is inkább, mivel rétegtani helyzetük is elég változatos, az alsó-eocén közepétől egészen a középső-eocén tetejéig terjed. A minták származási helyét a 24. ábra szemlélteti, leírásukkal az alábbiakban az általam megállapított rétegtani sorrend szerint haladok.

Gan — GA populáció

Az általam vizsgált minták M. NEUMANN (GM minta) és A. BLONDEAU (GB minta) gyűjtéséből származnak és a „Tuilerie de Gan" feliratot viselik.

Ez a lelőhely — a gani téglagyár agyaggödre — az irodalomban részletesen le van írva (DOUVILLÉ 1919, DOUVILLÉ—O'GORMAN 1929, GUBLER—POMEYROL 1946, SCHAUB 1951, NEUMANN 1958, HOTTINGER 1960, HOTTINGER et al. 1964, KAPELLOS—SCHAUB 1973, BROLSMA 1973, SCHAUB 1981). Az itt található kékesszürke agyagmárga innen nem messzire, 5 km-re DK-re egy másik klasszikus nagy Foraminifera-lelőhelyen, Bos d'Arros-ban is megtalálható (SCHLUMBERGER 1903, SCHAUB 1955, 1961, 1962, 1981, NEUMANN 1958, KAPELLOS—SCHAUB 1973).

A két lelőhely kora között KAPELLOS—SCHAUB (1973) Nummulites- és nannoplankton-vizsgálatai egészen minimális különbséget mutattak csak ki, a gani téglagyár agyaggödrének képződményeit még az alsó-cuisi alemelet felső részébe helyezték, míg a bos d'arros-i rétegeket az alsó—középső-cuisi határra.

A két lelőhely Orthophragmináival nagyon sokan (Schlumberger 1903, Douvillé 1922, Schweighauser 1953, Neumann 1958, Brolsma 1973) foglalkoztak.

A két általam vizsgált mintában a *Discocyclina archiaci archiaci* és a *D. dispansa ganensis* alakok fordultak elő gyakran, ritkábban volt megtalálható a *D. furoni*, míg az egy-egy példányban megtalált *Orbitoclypeus ramaraoi crimensis*-ről és *O. douvillei*-ről nem sikerült equatoriális metszetet készítenem, de Schlumberger (1903) és Neumann (1958) equatoriális metszetről készült ábrái alapján sikerült őket azonosítanom. Asterocyclinákat a két vizsgált mintában nem találtam, azonban Brolsma (1973) kiváló fotói alapján az itteni alakokat *A. stella taramellii*-nek és *A. stellata adourensis*-nek lehetett meghatározni. Nagyon valószínű, hogy e két taxon közötti átmeneti alakok is előfordulnak itt, lévén az utóbbi filogenetikai utódja az előbbinek.

A két lelőhely korát a Nummulitidaek és a nannoplanktonok egyértelműen a cuisi emelet középső részében jelölik ki (figyelembe véve Hardenbol—Berggren 1978 adatait is az alsó—középső-eocén határra vonatkozólag). Így ezek a lelőhelyek szolgáltak alappontul más lelőhelyek korának Orthophragminák alapján történő meghatározásához.

Le Porge — LP populáció

A Szőts Endre által gyűjtött minta (LP minta) a ,,Le Porge — foraminiferák utánhullásból — Gironde" címkét viseli. A gyűjtőtől szerzett információ alapján ez a fúrás márgákat fúrt abban az intervallumban, ahonnan ezek az utánhullott Foraminiferák származnak. Rétegtani célokra ez az anyag természetesen semmiképp sem alkalmas, mivel Orthophragmina faunája is kevert. Az anyag jó megtartása miatt azonban indokolt volt néhány fotót készíteni róluk, csakis paleontológiai érdekességük miatt.

Az anyag legnagyobb része *Discocyclina archiaci archiaci*-t és *D. archiaci bartholomei*-t tartalmazott. Előbbi a cuisi emelet alsó és középső részére, utóbbi a cuisi emelet felső és a lutéciai emelet alsó részére jellemző. Ezenkívül egy-egy példányban *Discocyclina furoni, D.* cf. *pulcra landesica, Nemkovella evae* valamint *Orbitoclypeus ramaraoi crimensis* került elő. Mindannyian a cuisi emelet középső és felső részére jellemzők. Mindezek alapján az utánhullott nagy Foraminiferák nagy valószínűséggel a cuisi emelet középső-felső részéből származnak.

Horsarrieu — HX populáció

Horsarrieu-ből 3 mintát sikerült megvizsgálnom. Kettőt közülük Szőts E. gyűjtött, egyikben ,,Horsarrieu, Marne à Xanthopsis, londinien" címke (HX minta), másikban ,,Horsarrieu, Marnière Sourbet, londinien" címke (HS minta) volt található. A gyűjtő közlése szerint e két minta egy helyről, a ,,Sourbet" márgafejtőből származik, csak különböző időben lett gyűjtve. A harmadik minta M. Neumann gyűjtése és a ,,Horsarrieu, Marne à Xanthopsis, Marnière Sourbet, yprézien supérieur" címkét tartalmazza (HN minta). Ezek alapján bizonyosra vehető, hogy mindhárom minta gyakorlatilag egy helyről származik, jelentéktelen faunisztikai különbségektől eltekintve koruk is teljesen azonos.

A kőzet, amelyet e minták reprezentálnak, az Adour folyó alsó folyásánál, Chalosse-ban elterjedt xanthopsisos fehér mészmárga, melyet részletesen Boulanger (1968) írt le. Korára vonatkozólag két elképzelés van. A francia szerzők (Burger et al. 1945, Neumann 1958, Boulanger 1968) az alsó-lutéciai alemeletbe helyezik (ezért meglepő a M. Neumann gyűjtötte mintán a felső-ypresi kormegjelölés). Ugyanakkor Hottinger—Schaub (1960), Kapellos—Schaub (1973), valamint Schaub (1981) az alsó-ciusi alemelet alsó részébe sorolják. Jelenleg tehát a xanthopsisos márgák korára vonatkozólag nincs olyan, mindenki által magáévá tett állásfoglalás, mint a gani rétegek esetében.

Nummuliteseit és nannoplanktonjait Kapellos—Schaub (1973) írta le. Orthophragmináival bővebben Schlumberger (1904) és Neumann (1955, 1958) foglalkozott.

Vizsgálataim során a 3 minta rendkívül fajgazdag anyagot szolgáltatott (zárójelben azon minták jelei, melyekben az adott taxon megtalálható volt): *Discocyclina archiaci archiaci* (HX), *D. weijdeni* (HX, HS, HN), *D. fortisi fortisi* (HX, HN), *D. augustae sourbetensis* (HX, HS, HN), *D. trabayensis trabayensis* (HX, HS), *D. aaroni chalossensis* (HX, HS), *D. pratti aquitanica* (HX, HN), *D. pulcra landesica* (HX), *Nemkovella evae* (HX, HS), *N. fermonti* (HN), *Orbitoclypeus varians horsarrieuensis* (HX, HN), *O. bayani* (HS, HN), *Asterocyclina stella taramellii* (HX, HN).

Orthophragminák alapján a horsarrieu-i minták a cuisi emelet középső részébe tartoznak, elsősorban a *Discocyclina fortisi fortisi* jelenléte alapján.

Megjegyzendő, hogy sok fajnak *(Discocyclina weijdeni, D. augustae, D. aaroni, D. pratti, D. pulcra, D. trabayensis, Nemkovella evae, Orbitoclypeus varians)* Horsarrieu az egyik legmélyebb előfordulása.

Saint-Barthélémy — SB populáció

Az innen származó egyetlen minta Szőts E. gyűjtése és a ,,Saint-Barthélémy, ÉNy-i útbevágás, márgás mészkő, londinien Niveau III.'' címkével van ellátva (SB minta). A gyűjtő közlése szerint az általa megjelölt lelőhely megegyezik az irodalomból ,,Maisonnave'' néven ismert lelőhellyel.

Az itteni eocén képződményeket először Douvillé (1905) sorolta be Nummulitidaek alapján egyrészt az alsó-lutéciai alemeletbe (Maisonnave), másrészt a felső-lutéciai alemeletbe (église). Adatait Schaub (1981) vizsgálatai sem módosították lényegesen.

Neumann (1958) az összes Saint-Barthélémy-i képződményt a ,,Couches de Brassempouy'' nevű összletbe helyezte, elsősorban Orthophragmináik hasonlósága miatt. Ez az összlet Burger et al. (1945) nyomán a felső-lutéciai alemeletnek felel meg.

Az itteni Orthophragminákkal Schlumberger (1903), Douvillé (1922) és Neumann (1958) foglalkozott. Alakjaik nagy része a ,,Maisonnave'' feltárásból származik, de első *Orthophragmina marthae*-jának egy része, valamint utóbbi kettő *Discocyclina roberti*-je nem innen, hanem a templom melletti feltárásból került elő. Értékelésem szerint ezek az alakok *Orbitoclypeus varians roberti*-t reprezentálnak, ez alapján lelőhelyének kora a bartoni emelet alsó részében rögzíthető, így nem azonosítható az itt tárgyalt lelőhellyel.

Az általam vizsgált minta a következő alakokat tartalmazta: *Discocyclina archiaci bartholomei*, *D. augustae sourbetensis*, *D. dispansa taurica*, *D. trabayensis trabayensis*, *Nemkovella evae*, *N. fermonti*, *N. strophiolata bodrakensis*, *Orbitoclypeus marthae*, *O. schopeni*, *O. douvillei*, *O. daguini*, *Asterocyclina stella taramellii*, *A. stellata adourensis*, *A. kecskemetii*, *A. schweighauseri*.

Orthophragminák alapján is a lelőhely a lutéciai emelet alsó részébe helyezhető, annál is inkább, mivel a *Nemkovella strophiolata bodrakensis* és a *Discocyclina dispansa taurica* csak ebben a szintben fordulnak elő.

A korbesorolások viszonylagos ellentmondás-mentessége miatt a továbbiakban ezt a lelőhelyet alappontként használom fel a rétegtani értékeléshez.

Caupenne — JG populáció

Az innen származó egyetlen minta Szőts E. gyűjtése és a ,,Caupenne, Ferme Jean Gazé'' címkét viseli (JG minta). Az irodalomból kivehetően a bezáró kőzet márga (,,Marnes de Jean Gazé'' — Kapellos—Schaub 1973, Schaub 1981).

Korát illetően a különböző irodalmi adatok különböző felfogást képviselnek: Burger et al. (1945) az alsó- és középső-lutéciai alemelet közé, Hottinger et al. (1956) Nummulitidaek alapján az alsó-lutéciai alemelet közepére, Neumann (1958) Orthophragminák alapján a felső-lutéciai alemeletbe, Hottinger et al. (1964) újfent Nummulitidaek alapján a felső-cuisi alemeletbe vagy a cuisi—lutéciai határra helyezte ezt az összletet. Legbővebben Kapellos—Schaub (1973) és Schaub (1981) foglalkozott a lelőhellyel és ,,Jean Gazé''-ról a *Nummulites manfredi*-zónába tartozó Nummulitidaekat, valamint a *Discoaster sublodoensis*-zónába tartozó nannoplanktonokat határoztak meg, mely alapján a lelőhelyet a felső-cuisi alemelet felső részébe helyezték.

Az általam vizsgált minta elég rossz megtartású Orthophragminákat tartalmazott, így csak *Discocyclina dispansa taurica*-t, *Orbitoclypeus chudeaui chudeaui*-t és *Asterocyclina schweighauseri*-t tudtam innen meghatározni.

A fauna korára legnagyobb valószínűséggel a lutéciai emelet alsó része adódik. Ez nem mond ellent Kapellos—Schaub (1973) és Schaub (1981) adatainak sem, ha figyelembe véve Hardenbol—Berggren (1978) véleményét a *Discoaster sublodoensis*-zónát a cuisi emelet felső részéből a lutéciai emelet alsó részébe helyezzük át.

Couches de Nousse (Gibret — GN populáció és Nousse — NC populáció)

Két Szőts E. gyűjtötte mintát (Gibret, Église, Couches de Nousse, lutétien — GN minta és Nousse, Crouts, lutétien — NC minta) itt együtt ismertetek, mivel mind az irodalmi adatok, mind Orthophragmina faunájuk alapján azonos szintből, az irodalomban ,,Couches de Nousse'' néven ismert összletből származnak.

Burger et al. (1945) ezt a glaukonitos agyag- és mészmárga-összletet a ,,Couches de Donzacq'' és a ,,Couches à grandes Nummulites'' közé, a középső-lutéciai alemeletbe helyezik.

Hottinger et al. (1956), Hottinger et al. (1964), Kapellos—Schaub (1973) és Schaub (1981) Nummulitidaek alapján a ,,Couches de Nousse'' rétegtani helyét az alsó—középső-lutéciai határon jelölik ki.

NEUMANN (1958) „Couches de Nousse" alatt láthatólag a svájci kutatókétól mélyebb rétegeket ért, mivel a Gibret — Église és Nousse — Crouts lelőhelyeket (utóbbi nála „tranchée du chemin de fer" néven szerepel) már a felső-lutéciai alemeletbe helyezi a „Couches à grandes Nummulites" tagjaként, míg nála a „Couches de Nousse"-ba tartozó lelőhelyeket még az alsó-lutéciai alemelet magasabb részébe teszi (NEUMANN nem különböztet meg önálló középső-lutéciai alemeletet).

Vizsgálataim során a két mintából a következő alakokat határoztam meg: *Discocyclina discus discus* (GN, NC), *D. augustae atlantica* (NC), *D. dispansa nussdorfensis* (GN, NC), *D. trabayensis trabayensis* (GN), *D. pratti montfortensis* (NC), *D. pulcra pulcra* (GN), *D. radians noussensis* (GN, NC), *Nemkovella strophiolata strophiolata* (GN, NC), *Orbitoclypeus douvillei* (GN), *O. chudeaui chudeaui* (NC), *Asterocyclina stellata adourensis* (GN, NC), *A. alticostata gallensis* (GN, NC).

A lelőhelyek korára nézve lényegében elfogadható a svájci kutatók állásfoglalása, bár HARDENBOL—BERGGREN (1978) módosított lutéciai emelete alapján arra inkább a lutéciai emelet középső része adódik. Ezek a lelőhelyek is alappontul szolgáltak egyéb lelőhelyek korának megállapításánál.

Montfort — FM populáció

Az innen származó minta SZŐTS E. gyűjtése és a „Montfort, Fontaine de la Médaille, lutétien" címkét viseli (FM minta).

Az itteni mészmárgákat DOUVILLÉ (1922) a felső-lutéciai alemeletbe helyezte, míg BURGER et al. (1945) a „Couches à grandes Nummulites"-hez sorolták, ennek megfelelően a középső- vagy felső-lutéciai alemeletbe tették.

HOTTINGER et al. (1956) itt csak *Nummulites aturicus* A- és B-formákat találtak, melyek alapján a lelőhelyet a középső-lutéciai alemelet felső részébe sorolták, majd a biarritzi emelet bevezetése után HOTTINGER et al. (1964) áthelyezték a felső-lutéciai alemeletbe. SCHAUB (1981) munkája is ezt az álláspontot tükrözi.

NEUMANN (1958) *Discocyclina sella*-t említ innen és a lelőhelyet késő-lutéciai korúnak veszi. Ábra híján ezt a meghatározást nem tudtam azonosítani.

Az általam vizsgált mintában a tömeges Nummulitesek mellett előfordult néhány Orthophragmina is, mégpedig: *Discocyclina dispansa nussdorfensis*, *D. aaroni aaroni*, *D. pratti montfortensis*, *D. radians noussensis*, *Asterocyclina stellata adourensis*, *A. schweighauseri*.

Orthophragminák alapján a kor megítélésében véleményem eltér a svájci kutatókétól. A lutéciai emelet középső részébe való helyezés alapja az, hogy a *Discocyclina dispansa nussdorfensis* fajöltője csak erre a szintre korlátozódik, míg a *D. radians noussensis*, a *D. pratti montfortensis* és az *Asterocyclina stellata adourensis* jelenléte a magasabb szintektől való elhatárolást teszi egyértelművé.

Angoumé — AM populáció

Az innen származó mintát SZŐTS E. gyűjtötte és „Angoumé, Marniére de Miretraine, lutétien" címkével látta el (AM minta).

Az itteni szürke márgáról irodalmi említést csak NEUMANN-nál (1958) találtam, aki az itteni rétegeket a felső-lutéciai alemeletbe helyezte. A Marniére de Miretraine-n kívül hasonló faunát közölt az itteni „Ruisseau de Château"-ból is.

Az általam vizsgált mintából a következő nagyon gazdag Orthophragmina fauna került elő: *Discocyclina stratiemanuelis*, *D. dispansa hungarica*, *D. pratti pratti*, *D. pulcra pulcra*, *D. radians radians*, *Nemkovella strophiolata strophiolata*, *Orbitoclypeus varians angoumensis*, *O. chudeaui chudeaui*, *O. furcata rovasendai*, *Asterocyclina stellata stellata*, *A. kecskemetii*, *A. stella taramellii*, *A. alticostata cuvillieri*.

A lelőhely kora Orthophragminák alapján a lutéciai emelet felső részében rögzíthető. A *Discocyclina dispansa hungarica*, a *D. radians radians*, a *D. pratti pratti* és az *Asterocyclina alticostata cuvillieri* jelenléte a mélyebb, a *D. pulcra pulcra*, az *Orbitoclypeus varians angoumensis* és az *O. chudeaui chudeaui* jelenléte pedig a magasabb szintektől való elhatárolást teszi egyértelművé.

Cauneille — CM populáció

„Cauneille, Rarcole marne, lutétien" címkét visel az a minta, melyet SZŐTS E. gyűjtött (CM minta).

NEUMANN (1958) ebből a helységből „Ruisseau de Peyrucat" feltárás-megjelöléssel *Discocyclina pratti*-t és *Asterodiscus cuvillieri*-t idéz. Ez a fauna nem ad kellő alapot arra, hogy az általam vizsgált mintát azonosíthassam a NEUMANN által vizsgálttal.

Az általam vizsgált minta glaukonitos márgából származik és Nummuliteseken kívül (meghatározásom szerint *N. perforatus*-hoz és *N. striatus*-hoz közel álló alakok) a következő Orthophragmina faunát tartalmazta: *Discocyclina augustae augustae, Orbitoclypeus daguini, O. varians varians, Asterocyclina alticostata alticostata, A. kecskemetii, A. stella stella* és *A. stellata stellaris.*

Orthophragminák alapján a lelőhelyet a bartoni emelet felső részébe lehetett besorolni. Az *Orbitoclypeus varians varians* jelenléte a mélyebb, az *Asterocyclina stella stella,* az *A. alticostata alticostata* és a *Nummulites perforatus*-hoz közelálló alak jelenléte pedig a magasabb rétegektől való elhatárolást teszi egyértelművé.

Siest — SO populáció

Innen két mintát vizsgáltam Szőts E. gyűjtéséből: az egyik a „Siest, Couches de Briande et Tourelle, priabonien inférieur" (BT minta), a másik a „Siest, Couches de Siest et Orist, priabonien supérieur" (SO minta) címkével volt ellátva. E két mintát a különböző kormegjelölés ellenére itt együtt tárgyalom, mivel faunájukban semmiféle különbséget nem találtam.

Az irodalomban egyedül Neumann-nál (1958) találtam utalást az itteni eocén képződményekre, de lelőhelyeit nem tudtam az általam vizsgáltakkal egyértelműen azonosítani.

Az általam vizsgált két minta közül a *Discocyclina javana* csak a BT mintában, míg a *D. augustae augustae, D. dispansa dispansa, D. radians radians, Orbitoclypeus varians varians és Asterocyclina stellata stellaris* mindkét mintában előfordult. Lényeges, hogy a BT minta tartalmazott *Nummulites perforatus*-hoz közel álló alakokat is.

Orthophragminák alapján a lelőhelyet a bartoni emelet felső részébe soroltam. A *Discocyclina dispansa dispansa* és az *Orbitoclypeus varians varians* jelenléte a mélyebb, a *Discocyclina radians radians* és a *Nummulites perforatus*-hoz közel álló alak jelenléte pedig a magasabb rétegektől való elhatárolást teszi egyértelművé.

Ebben a részben az Orthophragminák fejlődéstörténetét próbálom meg rekonstruálni a rendelkezésemre álló adatok alapján. Elsősorban az általam vizsgált mintákból nyert adatokat tudom figyelembe venni, de ahol ez lehetséges, a kritikailag értékelt irodalom tényanyagát is felhasználom. Az egyes alakok fajöltőjét a 9. és 10. táblázat mutatja be, ehhez fűzök itt némi magyarázatot.

A korok megállapításánál néhány alaposan és sokoldalúan megvizsgált lelőhelyet alappontul használtam fel. Ebben elsősorban Schaub és iskolája (Hottinger—Lehmann—Schaub 1964, Kapellos—Schaub 1973, Kapellos 1973, Schaub 1981) eredményeire támaszkodom azért, hogy a nagyobb ellentmondásokat elkerüljem, de figyelembe vettem Hardenbol—Berggren (1978) véleményét abban, hogy az NP 14-es (*Discoaster sublodoensis*) nannoplankton-zóna a lutéciai emelet alsó részét képviseli. A bartoni emelet elnevezést is az ő értelmezésükben használom.

Ilyen alappontok:

Spilecco (SC populáció) — ilerdi emelet középső része
Gan (GA populáció) — cuisi emelet középső része
Gibret (GN) és Nousse (NC populáció) — lutéciai emelet középső része
Mossano (MS populáció) — priabonai emelet alsó része
Priabona (VG, ill. PR populáció) — priabonai emelet középső, ill. felső része.

Az összes többi lelőhely korát ezekkel az „alappont"-okkal való összehasonlítás alapján határoztam meg.

A lelőhelyek korának meghatározása után az irodalmi anyagot is felhasználva alakítottam ki azt a 16 rétegtani egységet, melyet Orthophragminák alapján meg lehetett határozni. Ez a 16 rétegtani egység (az alábbiakban a zárójelben levő számok jelzik) később, szélesebb körű vizsgálatok után zónákká fejlődhet. E rétegtani egységek többségében (az 1., 2., 3., 4., 6., 7., 8., 9., 10., 11. és a 12-ben, valamint esetleg a 15-ben is) található olyan taxon, amely csak rá jellemző, míg a többieket a későbbiekben „concurrent range zone"-oknak nevezhetnénk.

Az első biztos Orthophragminák csak a paleogénben jelennek meg, Checchia-Rispoli—Gemmelaro (1909) szenonból leírt *Orthophragmina prima*-ja felülvizsgálatra szorul, ezért addig ezzel a formával nem foglalkozom.

Paleocén

(1) Biztosan csak az *Orbitoclypeus seunesi*-t lehet egyelőre kimutatni. Előfordulási területe Ny-Aquitánia *Operculina heberti*-s rétegei (Bénesse); valamint Hričovské Podhradie környékén a zátonymészkövek egy része.

Eocén

A paleocén és eocén határának az ilerdi emeletről tartott kollokvium 1974. november 18-i határozata alapján [Bull. Soc. Géol. France 1975, 7 (17/2) p. 223.] a thanéti és ilerdi emelet határát tekintem.

Az eocén alsó határának megvonásában bizonyos különbség van a kollokvium állásfoglalásában, mely az NP 9-es nannoplankton-zóna közepén helyezi azt el és Hardenbol—Berggren (1978) álláspontjában, mely a zóna tetejére helyezi azt. Ez az eltérés azonban rétegtani beosztásunkra egyelőre nincs befolyással.

Alsó-eocén

Az alsó-eocénben számos nagy Foraminiferákkal foglalkozó kutató az ilerdi és cuisi emeleteket használja. Erre az Orthophragminák fejlődésmenete is lehetőséget nyújt.

Ilerdi emelet

Esetleg az NP 9-es nannoplankton-zóna felső része, valamint az NP 10—11-es zónák és az

NP 12-es zóna alsó része tartozik ide. Innen már a paleocénétől gazdagabb Orthophragmina fauna ismert.

(2) Az ilerdi emelet alsó részébe sorolható kőzeteket én nem vizsgáltam és az irodalom is csak gyéren szolgáltat idevonatkozó adatokat. Hozzávetőlegesen az NP 9-es nannoplankton-zóna felső részének és az NP 10-es zónának felel meg. Idetartozhat Myjava és Hričovské Podhradie zátonymészköveinek egy része (Köhler 1961, Samuel et al. 1972); valamint a D-indiai Pondicherry rétegeinek egy része (Samanta 1967). Erre a rétegtani egységre az *Orbitoclypeus ramaraoi ramaraoi* jelenléte a jellemző. Egy aurignaci minta rossz megtartású példányainak vizsgálata alapján lehetséges, hogy a *Discocyclina archiaci bakhchisaraiensis* már itt megjelenik.

(3) Az ilerdi emelet középső részéből [Spilecco tufás márga rétegei — SC populáció; a Krím bahcsiszeráji emeletének alsó részei — OS és CR populáció; és részben az É-i Corbières (Massieux 1973); valamint Pondicherry (Samanta 1967, 1968) orthophragminás képződményei] egyelőre hét alak ismert. Ezek közül az *Orbitoclypeus ramaraoi neumannae* csak erre a szintre korlátozódik. Itt található csak meg együtt a kihaló *Discocyclina archiaci bakhchisaraiensis* és a megjelenő *D. broennimanni*, *D. furoni*, *Asterocyclina stella taramellii*, valamint az *Orbitoclypeus bayani*. Hozzávetőleg az NP 11-es nannoplankton zónának felel meg.

(4) Az ilerdi emelet felső részére (Krím bahcsiszeráji emeletének középső része — CP populáció; és részben az É-i Corbières; valamint Pondicherry Orthophragmina-tartalmú rétegei) jellemző csak a *Discocyclina archiaci staroseliensis* és az *Orbitoclypeus ramaraoi suvlukayensis*. E szintben fordul csak együtt elő a kihaló *Discocyclina broennimanni* és a megjelenő *D. pseudoaugustae*. Nagyjából az NP 12-es nannoplankton zóna alsó részének felel meg.

Cuisi emelet

Az alsó-eocén felsőbb részére már jóval gazdagabb Orthophragmina fauna jellemző.

(5) A cuisi emelet alsó részét (Krím bahcsiszeráji emeletének felső része — PA és PF populáció; Dikilitas — DK populáció; valamint részben az É-i Corbières Orthophragmina-tartalmú rétegei) a kihaló *Discocyclina pseudoaugustae*, valamint a megjelenő *D. archiaci archiaci* és *Orbitoclypeus ramaraoi crimensis* együttes jelenléte jellemzi. Hozzávetőleg az NP 12-es nannoplankton-zóna felső részének felel meg.

(6) A cuisi emelet középső részében [Gan, Tuilerie — GA populáció; Horsarrieu — HX populáció; Krím bahcsiszeráji és szimferopoli emeletének határa — NA populáció; valamint Bos d'Arros; Doazit; Sainte-Colombe és az Ein Avedat-i (Izrael) szelvény Fermont (1982) szerinti Is 187—259. mintái] található csak meg a *Discocyclina fortisi fortisi*. Itt fordul csak együtt elő a kihaló *D. archiaci archiaci*, *D. furoni* és a *D. dispansa ganensis*, illetve a megjelenő *Asterocyclina stellata adourensis*, *A. alticostata gallica*, *Orbitoclypeus varians horsarrieuensis* és a *Discocyclina aaroni chalossensis*. Leginkább az NP 13-as nannoplankton-zóna alsó részével párhuzamosítható.

(7) A cuisi emelet felső részéből származó faunát csak a Krím szimferopoli emeletéből, az NF és DA populációból; valamint a Le Porge-i fúrás — LP populáció egy részéből sikerült vizsgálnom. Ide tartoznak az Ein Avedat-i (Izrael) szelvény Fermont (1982) szerinti Is 260—330. mintái és esetleg Stöckweid bei Einsiedeln (Svájc) lelőhely is (Brönnimann 1945b). Csak e szintre jellemző a *Discocyclina fortisi simferopolensis*, mely még e kis időintervallumon belül is fejlődik. Itt található csak meg együtt a kihaló *D. pratti aquitanica*, ill. a megjelenő *D. archiaci bartholomei*, *D. senegalensis* és az *Orbitoclypeus schopeni*. Hozzávetőleg az NP 13-as nannoplankton-zóna felső részének felel meg.

Középső-eocén

A középső-eocénben érik el az Orthophragminák a virágkorukat. A középső-eocént én itt Hardenbol—Berggren (1978) alapján a lutéciai és a bartoni emelettel azonosítom. Határuk az NP 16-os nannoplankton-zónán belül húzódik. Az auversi emelet tarthatatlanságát Hottinger—Schaub (1960) bizonyította be, ugyanakkor azonban az általuk bevezetett biarritzi emeletet a nemzetközi szakközvélemény annyira nem fogadta el, hogy alkalmazása itt nem látszik célszerűnek, annál is inkább, mivel Biarritzból származó mintákat nem volt alkalmam vizsgálni. A kritikailag értékelt irodalom alapján is valószínűnek látszik, hogy a legalsó biarritzi rétegek (Rocher La Gourépe; Peyreblanque) Orthophragmina faunájuk alapján még jóval az Assilinák kihalása előtt keletkeztek, ugyanis felső-lutéciai rétegekkel (Angoumé) párhuzamosíthatók.

Lutéciai emelet

(8) A lutéciai emelet alsó részében [Saint-Barthélémy, „Maisonnave" — SB populáció; Caupenne, Jean Gazé — JG populáció; Saint-Martin-de-Seignaux, Moulin Larroque; Valle Grande bei Malo, Vanzi kőfejtő; Krím szimferopoli emeletének felső része — DF és PO populáció, bodraki emeletének alsó része — BO populáció; Kressenberg—Emanuel-Flöz; Podhradie (Köhler 1967); valamint az Ein Avedat-i (Izrael) szelvény Fermont (1982) szerinti Is 331—463. mintái] seregnyi új alak jelenik meg, melyek közül a *Nemkovella strophiolata bodrakensis* és az *Orbitoclypeus marthae* csak itt fordul elő. E szintben található csak meg együtt a kihaló *D. archiaci bartholomei*, *D. dispansa taurica* és a *N. evae*,

valamint a megjelenő *Discocyclina stratiemanuelis, D. pratti montfortensis, Orbitoclypeus chudeaui chudeaui* és *Asterocyclina kecskemetii.*

Elsősorban a *Discocyclina archiaci bartholomei* és a *D. stratiemanuelis* fejlődése alapján, de kihalási és megjelenési adatok alapján is (9. táblázat) elképzelhető, hogy a későbbiekben a szint kettéosztható lesz egy alsó (SB, DF és PO populációk; Vanzi) és egy felső (BO és JG populáció; Kressenberg; Podhradie) tagra. Hozzávetőleg az NP 14-es nannoplankton-zónának felel meg.

(9) A lutéciai emelet középső részében (Gibret — GN populáció; Nousse — NC populáció; Montfort, Fontaine de la Médaille — FM populáció; Nussdorf — ND populáció; Dunaszentmiklós — DM populáció; Neszmély — NT populáció) megjelenő új alakok közül a *Discocyclina augustae atlantica, D. dispansa nussdorfensis, D. aaroni aaroni* és a tipikus *D. radians noussensis* csak erre a szintre korlátozódik. Itt fordul csak együtt elő a kihaló *Asterocyclina stellata adourensis* és az *A. alticostata gallica*, ill. a megjelenő *Discocyclina discus discus* és a *Nemkovella strophiolata strophiolata.* Hozzávetőleg az NP 15-ös nannoplankton-zónának felel meg.

(10) A lutéciai emelet felső részében (Angoumé — AM populáció; Biarritz, La Gourépe; Saint-Pierre-d'Irube, Daguerre; Bidart, Béhéréco; valamint CHECCHIA-RISPOLI 1909a, b, 1911 szicíliai mintáinak egy része) új alakként jelenik meg a csak erre a szintre korlátozódó *Discocyclina augustae olianae.*

E szintben együtt található a kihaló *Asterocyclina stella taramellii, Discocyclina stratiemanuelis, D. discus discus, D. pulcra pulcra, Orbitoclypeus chudeaui chudeaui* és *O. varians angoumensis*, illetve a megjelenő *Asterocyclina stellata stellata, A. alticostata cuvillieri, Discocyclina radians radians, D. dispansa hungarica, D. pratti pratti* és az *Orbitoclypeus furcata rovasendai.* Legnagyobb valószínűséggel az NP 16-os nannoplankton-zóna alsó részével párhuzamosítható.

Bartoni emelet

(11) A bartoni emelet alsó részébe sorolható valamennyi általam vizsgált ajkai minta (AJ populáció); a Saint Barthélémy-i (église); a Rajec-Schlucht-i (KÖHLER 1967) és a San Pancrazio-i (SCHWEIGHAUSER 1953) lelőhely. Csak erre a szintre jellemző a *Discocyclina pulcra balatonica* és az *Orbitoclypeus varians roberti.* Csak itt fordulnak együtt elő a kihaló *Asterocyclina stellata stellata* és *A. alticostata cuvillieri*, illetve a megjelenő *Discocyclina discus dudarensis, D. augustae augustae, Orbitoclypeus chudeaui pannonicus* és az *Asterocyclina stella stella.* Hozzávetőleg az NP 16-os nannoplankton-zóna felső részének felel meg.

(12) A bartoni emelet középső részébe az általam vizsgált dudari mintákat (DU populáció) és a biarritzi Villa Marbella lelőhelyet tudtam sorolni. Csak erre a szintre korlátozódik a *Discocyclina pulcra baconica* és az *Orbitoclypeus varians scalaris* fajöltője. Itt található csak együtt a kihaló *Orbitoclypeus chudeaui pannonicus*, illetve a megjelenő *Asterocyclina alticostata alticostata* és az *A. stellata stellaris.* A *Discocyclina dispansa hungarica*-t a szint közepe felé váltja fel a *D. dispansa sella.* Legnagyobb valószínűséggel az NP 17-es nannoplankton-zóna alsó részének felel meg.

(13) A bartoni emelet felső részébe a siesti (SO populáció) és a Cauneille-i (CM populáció) minták tartoznak Orthophragminák alapján az általam vizsgált faunák közül; valamint a biarritzi Côte des Basques alsó része az irodalmi adatok alapján. Önálló szintjelző alakja nincs, alulról az *Orbitoclypeus varians varians* és a *Discocyclina javana* megjelenése, felülről a *D. radians radians*, az *Orbitoclypeus furcata rovasendai* és az *Asterocyclina alticostata alticostata* kihalása határolja le. A *Discocyclina dispansa sella*-t a szint közepe táján váltja fel a *D. dispansa dispansa.* Hozzávetőleg az NP 17-es nannoplankton-zóna felső részének felel meg.

Felső-eocén

Priabonai emelet

Mivel Európában Orthophragminák csak a mediterrán provinciában fordulnak elő, a felső-eocént célszerűnek látszott itt a priabonai emelettel azonosítani. Az általam vizsgált minták és az irodalmi adatok alapján a priabonai emelet Orthophragminák alapján három szintre tagolható.

(14) A priabonai emelet alsó részében (Mossano — MS populáció; Biarritz, Côte des Basques; Assam, Garo Hills orthophragminás képződményeinek egy része) sem található önálló szintjelző alak. A *Discocyclina radians labatlanensis, D. trabayensis vicenzensis, D. nandori, Nemkovella strophiolata tenella* és *Asterocyclina stella praestellaris* megjelenése, illetve a *Discocyclina dispansa dispansa*, valamint a *D. pratti pratti* kihalása közötti időintervallum. Körülbelül az NP 18-as nannoplankton-zóna időtartamát öleli fel.

(15) Valószínűleg csak a priabonai emelet középső részében (Lábatlan környéke — LA populáció; Valle Granella — VG populáció; a priabonai típusszelvény discocyclinás és „kék agyag" rétegei; Cave Defilippi; Verona, Forte San Felice; Ralligstöcke; Daralaghez; Nolčovo és Konská-Stráň) fordul elő a *Discocyclina pratti minor.* Csak itt található együtt a megjelenő *D. dispansa umbilicata* és az *Asterocyclina priabonensis*, illetve a kihaló *Discocyclina discus dudarensis, Asterocyclina stellata stellaris* és az *Orbitoclypeus varians varians.* Hozzávetőleg az NP 19-es nannoplankton-zónának felel meg.

(16) Az eocén legtetején, a priabonai emelet felső részében (Priabona — asterocyclinás rétegek, PR populáció; Biarritz, La Cachaou; Assam, Garo Hills; valamint ÉNy-Marokkó orthophragminás rétegei) új alakok már nem jelennek meg, bár az *Asterocyclina stella praestellaris* és az *Orbitoclypeus furcata furcata* még itt is továbbfejlődni látszik, a *Discocyclina trabayensis vicenzensis* és az *Asterocyclina priabonensis* pedig ekkor éli virágkorát. Minden, az alsóbb szintekből áthúzódó alak kihal az eocén végén. Az ebben a szintben még előforduló további alakok: *Discocyclina javana, D. augustae augustae, D. radians labatlanensis, D. nandori, D. dispansa umbilicata, D. euaensis* és az *Orbitoclypeus pygmaea.* Az NP 20-as nannoplankton-zónának felelhet meg.

Ez a fentebb ismertetett biosztratigráfiai beosztás természetesen sok bizonytalansági tényezőt is tartalmaz, melyet a 9. és 10. táblázat szaggatott vonalai is érzékeltetnek. Ezenkívül, a táblázatokon kereszttel jelöltem a további bontási lehetőségeket, melyek igazolása a jövő feladata. A vizsgált anyag túl kicsi ahhoz, hogy korrekt zónákat lehetne kijelölni Orthophragminák alapján. Remélem azonban, hogy ez a beosztás alapja lehet egy későbbi, megalapozottabb rétegtani tagolásnak, abban pedig biztos vagyok, hogy megmutatja az Orthophragminák gyors fejlődési ütemét az eocénben, megcáfolva ezzel a perzisztenciájukról eddig kialakult — szerintem téves — véleményt.

Annak ellenére, hogy az Orthophragminák nem tartoznak a pelágikus élőlények közé, földrajzi elterjedésük igen jelentősnek mondható, ugyanis maradványaik mind az öt kontinensen megtalálhatók.

Mint a 25. ábrán is látható, az Orthophragminák két egymástól izolált területen, a hajdani Tethysben és a karibi—pacifikus térségben éltek. Ez az izoláció oly nagy mérvű, hogy csak két nemzetség, az Orbitoclypeus és az Asterocyclina található meg mind a két területen, de közös fajaik egyelőre nem ismertek (a Tethysre az ötágú, a karib—pacifikus térségre nagyrészt a négyágú Asterocyclinák a jellemzőek). Ezzel szemben a Discocyclinák és a Nemkovellák csak a hajdani Tethys területén fordulnak elő, míg az Athecocyclinák, Proporocyclinák, Pseudophragminák és Neodiscocyclinák csak a karibi—pacifikus térségben. A két provincia csak a Csendes-óceán ázsiai partvidékén érintkezik, ahová a Discocyclinák Ny-ról, míg a karibi—pacifikus Asterocyclinák K-ről jutottak el. A Pseudophragmina (s. l.)-kkal rokon Asterophragminák burmai előfordulására egyelőre nincs kellő magyarázat.

Ezek a tények arra utalnak, hogy a két nagy Orthophragmina-provincia egymástól korán izolálódhatott, és ez az izoláció az Atlanti-óceán szélességének növekedésével csak egyre nőtt.

Mint már említettem, mindkét Orthophragmina család bölcsője valahol a karibi térségben ringhatott. A kezdeti, provinciákra való elkülönülés után (mely az eocén kezdetéig lezajlott) a Discocyclinidaek nemzetségei és az Asterocyclinák már nem érintkeztek egymással. Ugyanez nem enynyire biztos az Orbitoclypeusok esetében, ugyanis egyes fajaik (*O. douvillei*, *O. varians*, *O. daguini*, *O. schopeni*) váratlan feltűnésére a Tethys eocénjében akár a karibi utánpótlás is magyarázat lehet.

Az egyes Orthophragmina fajok többsége földrajzilag szélesen elterjedt, az endémikus fajok száma elenyésző (ilyenek a *Discocyclina kingae*, *Orbitoclypeus portnayae* és *O. koehleri* a Krímben, illetve az *O. douvillei* Aquitániában).

Velük szemben más fajok (*Discocyclina archiaci*, *D. furoni*, *D. discus*, *D. javana*, *D. augustae*, *D. dispansa*, *D. euaensis*, *Orbitoclypeus ramaraoi*, *Asterocyclina alticostata*, *A. stellata*) többezer kilométeres távolságban is követhetők. Ez a tény jelentősen növeli szerepüket a távkorrelációs munkában is.

Az Orthophragminák ökológiájával foglalkozó irodalom eléggé szegényes, mindössze SCHLUMBERGER (1903), DOUVILLÉ (1922), NEUMANN (1958), BIEDA (1963), PORTNAJA (1974, 1976a, b) és FERMONT (1982) munkáiban találunk ezzel a témával foglalkozó részeket. Ennek a munkának sem volt elsődleges célja az Orthophragminák paleoökológiájának részletes vizsgálata, ezért itt csak az irodalomból ismert adatokat szeretném egy helyen összegezni és ahol lehetséges, saját megfigyeléseimmel kiegészíteni.

Az eurázsiai Orthophragminák a Tethys eocénjének jellegzetes, olykor kőzetalkotó mennyiségben is előforduló fenéklakó élőlényei voltak, melyek lassan változtatták helyzetüket a tengerfenéken, azaz a vagilis bentoszhoz tartoztak csakúgy, mint a többi felső-kréta- és paleogénbeli nagy Foraminifera. A váz alakja és elhelyezkedésük a kőzetekben is arra mutat, hogy a tengerfenéken vízszintesen helyezkedtek el. Feltehetően algákkal (elsősorban Lithothamniumokkal) táplálkoztak, melyre a velük való gyakori társulás is utal.

Nagyon sok Orthophragmina példányon ismerhetők fel valószínűleg utólagos fúrási nyomok (pl. III. tábla 1., XIII. tábla 7., XIV. tábla 10., XIX. tábla 4., XX. tábla 5., XXV. tábla 12., XXVIII. tábla 7., XXXIII. tábla 2., XXXVIII. tábla 9., XLIV. tábla 6. és XLV. tábla 8.). Ezeket SCHLUMBERGER (1903) „Orbitophage" nevű férgeknek (?) tulajdonította, bár helyenként (p. 276, text-fig. B) összekeverte az equatoriális kamrák sztolonjaival is.

Az Orthophragminák életterére vonatkozó ismereteink a következőek:

A tenger mélysége — még a selfen, de az erős hullámverés zónája alatt — 20—80 m lehetett, mivel különösen a vékonyabb vázú alakok (*Discocyclina pratti*, *D. radians*) aligha bírták volna az erős vízmozgatottságot. Ez a mélység nagyobb, mint a nagy Nummulitesek által kedvelt. Jellemző, hogy a középhegységi ún. „főnummuliteses" mészkőben alig fordulnak elő Orthophragminák. Általában megfigyelhető, hogy fokozatosan mélyülő körülmények között képződött szelvényekben (a Krím szimferopoli emeletének felső része és bodraki emelete, Ajka környéke, Priabona, Biarritz) az Orthophragminák elszaporodása mindig a Nummulitesek ritkulásával jár együtt és mindig tovább kitartanak (később tűnnek el), mint az utóbbiak. Az ilyen szelvények felső részében észrevehető az Asterocyclinák elszaporodása is. A nagyobb mélységre utal a glaukonittartalom megnövekedése is e szelvények felső részében.

A tenger hőmérséklete 25—30 °C körüli lehetett, melyre az Orthophragminák bizonyosan nagyon érzékenyek voltak, hiszen a Nummulitesek elterjedésének határa követhetően északabbra volt, mint az övéké. Így például nem fordulnak elő Orthophragminák Bretagne-ban, a Párizsi-, Londoni- és Brüsszeli-medencében, valamint Észak-Németországban, ahol egyes Nummulites fajok még éltek. Valószínű, hogy érzékenyebbek voltak az Orthophragminák a tenger sótartalom-ingadozására is, mint a Nummulitesek, hiszen transzgresszív szelvényekben (pl. Darvas-tó és általában a Déli-Bakony, Iszkaszentgyörgy környéke, Dorog) a legelső Nummulitesek Miliolinákkal, Orbitolitesekkel és Alveolinákkal együtt fordulnak elő a normálisnál valamivel kevésbé sós vízben, míg az Orthophragminák ezekkel a Foraminiferákkal szinte egyáltalán nem társulnak.

Az aljzat feltehetően iszapos volt, erre utal a váz alakja és a cementáló kőzetek minősége is (leggyakrabban márgák, márgás mészkövek, de agyagok is). A flis-képződmények homokköveiben található Orthophragminák feltehetően áthalmozottak.

Megfigyeléseim szerint az Orthophragminák kísérő faunájából leggyakrabban a *Nummulites millecaput*- és az *Assilina exponens*-csoport taxonjai fordulnak elő. Gyakoriak még az Operculinák, Operculinoidesek, Spiroclypeusok és Grzybowskiák is (utóbbi három csak a felső-eocénben) a nagy Foraminiferák közül. A többi állatcsoport közül említést érdemelnek a vastagabb héjú kagylók, a tengeri sünök, a rákok és a Bryozoák.

PALEONTOLOGY AND STRATIGRAPHY OF THE EUROPEAN ORTHOPHRAGMINAE

INTRODUCTION

The scientists investigating the Eocene have used first of all the Nummulitidae, the planktonic Foraminifera and the calcareous Nannoplankton for their stratigraphic subdivisions. Much less attention is paid to Orthophragminae, that appear in rock-forming quantities at certain places. Its reason is that the stratigraphic conclusions drawn by the scientists dealing with this group are contradictory. Consequently, Orthophragminae were believed to be persistent contrary to the rest of Larger Foraminifera.

The aim of this study is to show the author's efforts in using Orthophragminae for biostratigraphic purposes. In the present work attempt was made to deviate from the earlier workers' methods in two respects. On the one hand, the author tried to examine material from as large a territory and from as many stratigraphic levels as possible unlike the majority of the scientists, who studied the Orthophragminae of particular confined territories only. On the other hand, in the present work, the internal morphology was paid utmost attention.

The results have confirmed Brönnimann's (1945b, 1951) opinion that Orthophragminae consist of two families, namely, Discocyclinidae and Asterocyclinidae, phylogenetically independent from each other but rather similar in their morphology; very often they occur together. These are the reasons why these two families should be discussed together by the common name of Orthophragmina. This name is used because of mere practical reasons (it is relatively short and widely used in geological literature). It does not denote any taxonomic category just like for instance, "to Larger Foraminifera".

The main results of this work can be divided into two groups. The first one is palaeontological: The author worked out a new method to determine Orthophragminae, to give the taxa exact (numerical) definition and to evaluate critically the literature published so far. The other group is of stratigraphic character: On the new palaeontological basis we tried to reconstruct the phylogeny of Orthophragminae and to work out their stratigraphy. With respect to this latter it should be noted that these results are not considered similarly to the stratigraphic divisions of Nummulites, Alveolinae, planktonic Foraminifers and calcareous Nannoplankton that are not final either. For this reason, the present work can be regarded only as the first stage of getting acquainted with the phylogeny of Orthophragminae and as the first steps to the new stratigraphic subdivision based on them.

The present study is a partially revised version of the author's thesis (Less, 1981b) written in 1981 and defended in 1982, completed with the latest bibliographic data. The most important points of the revision were: On the basis of Hardenbol—Berggren (1978) the Cuisian—Lutetian border was put one calcareous Nannoplankton zone lower and the Bartonian denomination is used for marking the upper part of the Middle Eocene. As the cited thesis contains the description of the taxa in Hungarian, in the present work they can be found only in English.

I started to study Orthophragminae at the Moscow (Ordzhonikidze) Geological Institute under the guidance of prof. Nemkov, G. I. and doc. Portnaya, V. L. in 1974.

Later, with their and with Dr. Tibor Kecskeméti's and Dr. Mária Jámbor-Kness' assistance I collected a great number of samples from the Crimea and from Hungary. In addition, the rich comparative material of the Museum of Natural History (Budapest) coming from France, Italy, Austria and Bulgaria was made available for me by courtesy of Dr. Tibor Kecskeméti. So, geographically as well as stratigraphically, a rather rich collection was at my disposal, which enabled me to study the palaeontology and the stratigraphical importance of Orthophragminae. I owe all four of them thanks for their professional and moral support.

I am also grateful to those who, in the course of my work at the University and at the Hungarian Geological Institute made the regular study of the subject possible for me, namely, to prof. Tshernov, I. V., Dr. Áron Jámbor, Kornélia Böjtös-Varrók and Dr. Elemér Nagy.

I am indebted to Dr. Géza Hámor, Director of the Hungarian Geological Institute who made the publication possible, to Dr. Mária Jámbor-Kness and Dr. Tibor Kecskeméti for their thorough professional revision to Dr. Endre Dudich, Dr. Barnabás Géczy, Dr. Tamás Báldi, Dr. Mária Báldi-Beke and Dr. Endre Szőts for their advice, to Miss Christa Piros for her accurate editorship and to Mr. László Seress for the translation.

The specimens are deposited in the Museum of the Hungarian Geological Institute under the inventory numbers between E. 4596 and E. 5031.

THE HISTORY OF ORTHOPHRAGMINA RESEARCH

The first descriptions of Orthophragminae go back to the beginning of the last century. (Fortis 1802, Schlotheim 1820). The first more or less systematic descriptions are from the middle of the last century (Sowerby 1840, Michelin 1846, d'Archiac 1846, 1850, Rütimeyer 1850, Gümbel 1861, 1868, Schafhäutl 1863, Kaufmann 1867). In these works the descriptions are based mainly on the external morphology but sometimes axial sections, rarely strongly distorted and idealized drawings of equatorial sections were also published. Even at this time the internal morphology was already studied by Carpenter (1850). By these early authors still the genus names Lenticulites, Lycophris, Orbitolites and later Orbitoides introduced by d'Orbigny (1848) were used.

It was Gümbel (1868) who within the Orbitoides distinguished Discocyclinae, Aktinocyclinae, Asterocyclinae and Rhipidocyclinae (the denomination has not been used for a long time) as subgenera, from the Upper Cretaceous Orbitoides (s. s.) and from the Lepidocyclinae of the Oligocene and Lower Miocene.

Later Gümbel's first four subgenera, mentioned above, were separated from the genus Orbitoides and they were given the generic name Orthophragmina by Munier-Chalmas (1891). Then the stratigraphic positions of the three related genera were established by Douvillé (1898), that is, Orbitoides, Orthophragmina and Lepidocyclina in the Upper Senonian, Eocene and Oligocene, respectively.

Schlumberger's (1903, 1904) work is a major contribution to Orthophragmina research. On the one hand he was the first to publish photos, on the other hand his equatorial sections are the first appreciable ones of Orthophargminae. In his descriptions both the external and the internal features were considered.

Schlumberger's ideas were influential for about 20 years. During this period usable equatorial sections were published by Deprat (1905), Provale (1908), Checchia-Rispoli (1909a, b, 1911a, b, 1913, 1916, 1917, 1925) and Prever (1912). Though there were a lot of contradictions in these works, their usable figures gave a sound basis for a systematic revision.

The revision was carried out by Douvillé (1922) outstanding palaeontologist of the period. The impact of his work can be still felt in many respects. Mainly due to this work Orthophragminae even today are not used, as they could be, in the stratigraphic subdivision of the Paleocene and the Eocene. In his work Douvillé, in my opinion, underestimated the usefulness of the internal morphology in the species determination, instead he suggested the almost exclusive utilization of the external morphology. Consequently, from that time on, descriptions and depictions of inner morphological features could be hardly found (Silvestri 1923, 1948, Nuttall 1925, 1926, Doncieux 1926, Meffert 1931a, b, Henrici 1934, Reina 1934, Caudri 1934, Witt Puyt 1941) in descriptions, or no attention was paid to them at all (Llueca 1929). It is his merit, however, that Discocyclina, Actinocyclina and Asterodiscus (=Asterocyclina) names were raised to the genus level and the external features (shape, granularity, lateral chambers) were thoroughly examined.

The next period in Orthophragmina research lasting even today was started by Brönnimann's (1938, 1941, 1942, 1945a, b, 1951) and Weijden's (1940) works.

Brönnimann's most important merit is that he thoroughly studies the morphology and the structure of Orthophragminae, and that he was the first to divide them into two subfamilies, Discocyclininae and Orbitoclypeinae (Brönnimann, 1945b), then into two families, Discocyclinidae and Asterocyclinidae (Brönnimann 1951) mostly on the basis of the examination of the microspheric juvenarium. Partly because of the wartime, there was only a relatively small material available for the Swiss scientist, therefore no major stratigraphic results were achieved.

In Weijden's (1940) monograph the stratigraphic importance of the European Orthophragminae (referred by him as Discocyclinae) was investigated but his material was restricted to the Biarritz section only. In spite of this he was the first to carry out species determinations (though in the case of certain species only) on the basis of internal features mainly on the basis of the embryon shape.

The period since then can be characterized by the discussion of Orthophragminae from certain limited regions. Also after World War II, the external morphology played dominant role in species determination but at the same time descriptions of equatorial and axial sections became regular.

Orthophragminae from the vicinity of Vicenza except for Aktinocyclinae were described by SCHWEIGHAUSER (1953) but his conclusions, in my opinion, are not convincing.

NEUMANN (1958) attempted to revise the rich Orthophragmina fauna of W Aquitaine but in addition to her determinations based on the external morphology her work has other deficiencies as well. For instance, the dimensions of the internal test given by her are, as a rule, 1.6 to 2 times bigger than those found by WEIJDEN (1940), SCHWEIGHAUSER (1953) and others as well as by the present author. Therefore, in the present work, wherever it was necessary, the dimensions given by NEUMANN were considered to be 0.5 to 0.6 times of the given value. Her stratigraphic data are not too convincing either as far as the usefullness of Orthophragminae in age determination is concerned. On the other hand these data, compared to SCHWEIGHAUSER's and WEIJDEN's ones, further are widening the hemaera of certain Orthophragmina species. She deserves credit, however, for the systematization of Orthophragminae on the basis of the axial section.

KECSKEMÉTI's (1958, 1959) works have been the most thorough ones in the Hungarian Orthophragmina literature up to the present, though only the specimens found in the vicinity of Ajka are discussed. Unfortunately, most of his figures, owing to typographical reasons, are of poor quality. One part of his polished specimen are republished in the present work, hopefully in a better quality.

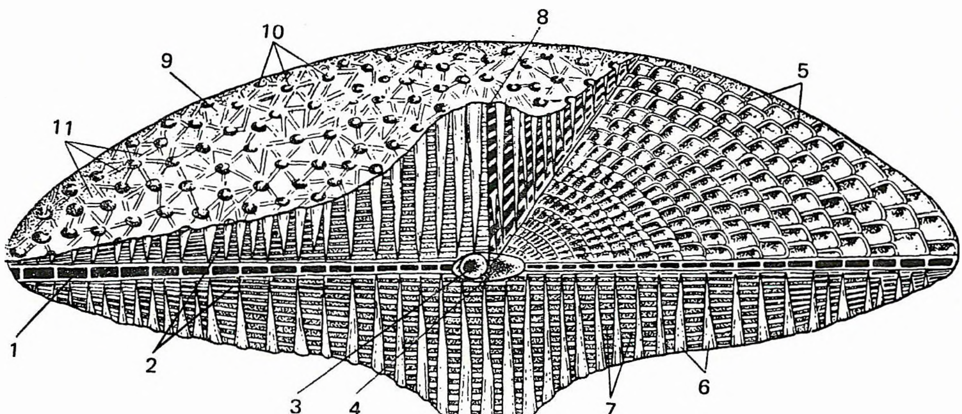
The works by BELMUSTAKOV (1959 Bulgaria), BIEDA (1963) and OLEMPSKA (1973 Poland) and KACHARAVA (1981 Georgia) were very difficult to use because of the poor quality figures. But the papers by KÖHLER (1961, 1967), SAMUEL—BORZA—KÖHLER (1972) and GROSS—KÖHLER et al. (1980 Slovakia), TOUMARKINE (1967) and MASSIEUX (1973 North-Corbières), and SIROTTI (1978 Priabona) contain good descriptions and figures.

In papers by PORTNAYA (1974, 1975) based on material from the Crimean Peninsula it is indirectly reflected that a stratigraphic division that uses species determination on the basis of the external morphology is no longer valid outside the borders of a certain area. As compared to the earlier trends, the biometric and population—statistical methods appeared as novelties in Orthophragmina research. These methods were first used by BROLSMA (1973) while examining a sample from Gan (SW Aquitaine), and later by FERMONT (1982) and SETIAWAN (1983) on greater materials from Israel and Priabona, respectively. In their works the emphasis was laid on the numerically definable, measurable features of the interior that provided a sound basis for well-founded stratigraphic conclusions (FERMONT 1982). In our opinion however certain qualitative features were not duly considered or not considered at all by them. As a result, qualitatively different species were believed to be of the same sort because of their quantitatively similar features. In spite of this, their results are qualitatively new and progressive, the more so, since the method used by them has already contributed to significant stratigraphic result in the case of other Larger Foraminifera (Miogypsina, Lepidorbitoides).

In the present work the American, Caribbean and Pacific Orthophragmina providing, investigations major stratigraphic results, are not dealt with, since according to VAUGHAN's (1945) and COLE's (1957, 1960) works the Eurasian and American—Pacific Orthophragminae developed simultaneously but separately from each other. On the contrary, NAGAPPA's (1959), SEN GUPTA's (1963a, b) and SAMANTA's (1963a, b, 1964, 1965a, b, 1967, 1968, 1969) works suggest that the Orthophragminae of the Indian subcontinent are closely related to the European ones. SAMANTA (1969) was the first who tried to follow the phylogeny of Discocyclinae within the boundaries of East India.

It has been already known much before our investigations that actually the Orthophragminae can be assigned to two groups, completely independent from each other (BRÖNNIMANN 1945b, 1951, CAUDRI 1972), namely, Discocyclinidae and Asterocyclinidae (BRÖNNIMANN 1951). But, as the two families regularly occur together and they bear a great many common morphological marks, it is expedient to discuss the two families together in this work.

Their general build-up for instance is identical: the tests of both families consist of three parts (text-fig. 1.): the central, so-called equatorial layer that is practically a 0.05—0.1 mm thick "lamina" at the centre of which sits the embryon (forms "A") always with two chambers or the proloculum in the case of forms "B". The embryon is surrounded by circular or asteroidal cycles that consist of



1. ábra. Az Orthophragminák általános felépítése PORTNAJA (1974) alapján, kisebb módosításokkal

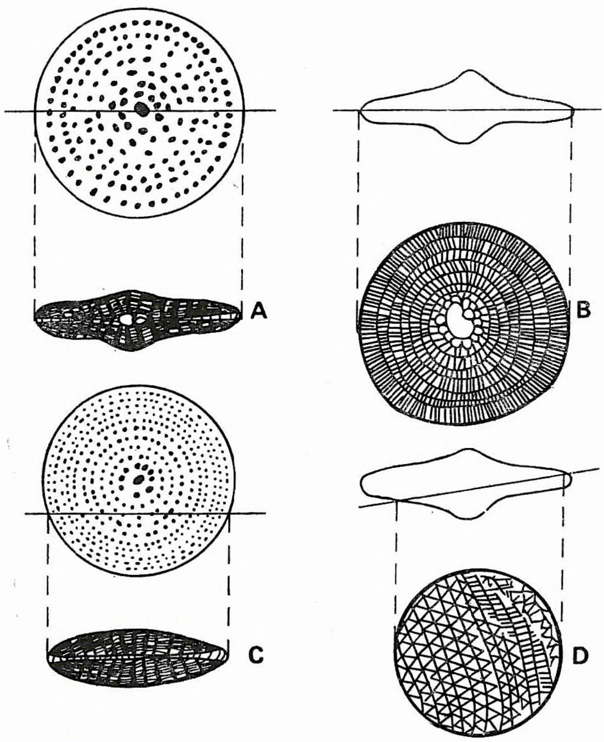
1. Equatoriális réteg, *2.* laterális réteg, megaszférás embrió: *3.* protoconch, *4.* deuteroconch, *5.* equatoriális kamrák, *6.* pillérek, *7.* laterális (oldal) kamrák axiális metszetben, *8.* búb (umbo), *9.* gallér, *10.* granulumok (pillérvégződések) a váz felszínén, *11.* laterális (oldal) kamrák a váz felszínén

Fig. 1. The general build-up of Orthophragminae according to PORTNAYA (1974), with smaller modifications

1. Equatorial layer, *2.* lateral layer, megalospheric embryon: *3.* protoconch, *4.* deuteroconch, *5.* equatorial chambers, *6.* pillars, *7.* lateral chambers in axial section, *8.* umbo, *9.* collar, *10.* granules (ends of pillars) on the test surface, *11.* lateral chambers on the test surface

equatorial chambers. Symmetrically on both sides the equatorial layer is enclosed by the so-called lateral layers that give characteristic buttonlike, lenticular or probably asteroidal shape to Orthophragminae. The lateral layer consists of more lamellae, one on the top of the other and these are built up of lateral chambers. The lateral layer is strengthened by pillars that start from the edge of the equatorial layer and take shape on the test surface as granules. With the lateral chambers of the outermost lateral lamella these granules form a typical pattern (rosette).

The test shape is generally flattened or inflate lenticular or disc-like with a topknot (umbo) at the centres on both sides above the embryon. Occasionally ribs or punctiform protuberances arranged in lines can be found on the test. The test can be asteroidal (five-branched) as well (only in case of Asterocyclinidae). The internal morphology of Orthophragminae can be best studied in the equatorial section cutting the equatorial layer and in the axial section perpendicular to the equatorial one and intersecting the embryon. Usually other than these two sections — tangentional ones — are of very little value (text-fig. 2.). Though by earlier investigators first of all to the external features



2. *ábra.* Az Orthophragminák különböző metszetei
A = axiális metszet, *B* = equatoriális metszet, *C*, *D* = tangenciális metszetek

Fig. 2. Various sections of Orthophragminae
A = axial section, *B* = equatorial section, *C*, *D* = tangential sections

of the test (shape, rosette) were attributed a high value recently the characteristics of the embryon were also considered. In the course of the investigations the main stress was put on the equatorial layer's morphology since our experience is that a taxonomy that is based on smaller differences of the test shape fails when it comes to stratigraphic control. Of course, the typical significant differences of the test shape were also taken into consideration.

Accordingly, in the morphological description of the Orthophragmina test we start from the internal to external, and the features are discussed in the order of taxonomic importance.

THE JUVENARIUM OF FORMS "B"

Abbreviations used in the taxonomic part:

I = diameter of proloculum (μm),
S = number of chambers in the spiral part, proloculum is not included,
s = diameter of the spiral section (μm),
n = number of half-cycles,
d = total diameter of the nepionic and spiral parts (μm),
J = number of juvenile cycles,
j = total diameter of the juvenile, nepionic and spiral parts (μm),

l and h are the same as those at the equatorial chambers of forms "A" (see there).

The most important criterion of the distinction of the two Orthophragmina families is the well-observable difference in the juvenariums of forms "B". Since in case of Foraminifera the microspheric juvenarium reflects the early stages of phylogeny, it can be established that the two families derive from different ancestors (Brönnimann 1945b, 1951, Caudri 1972). Accordingly, the introduction of the two families, namely, Discocyclinidae and Asterocyclinidae is justified. Consequently, they should be discussed separately from now on. All those written below refer to the equatorial section.

The juvenarium of forms "B" of Discocyclinidae

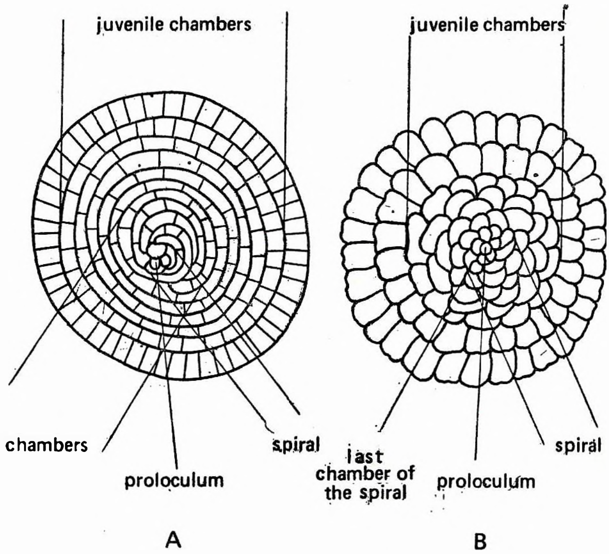
All Discocyclinidae is of so-called "Heterostegina" type juvenarium, that is, they have a spherical microspheric embryon (proloculum), ranging from 0.01 to 0.02 mm in diameter, encircled by a spiral consisting of 4–5 chambers at the beginning, then these chambers gradually grow wider and wider and start to enclose the central spiral from one side. Then these so-called nepionic chambers (or half-cycles) are divided into smaller chambers (in the same way as in the case of Heterostegina or Cycloclypeus) and these chambers coming one after the other form longer and longer arcs around the previous chambers until they completely enclose them. From then on the individual juvenile chambers (divided into chamberlets) are arranged in concentric cycles. The chamberlets, that are elongate broadwise at first, become gradually high in the cycles and getting outwards they take their normal shape, they become elongate towards the peripheries (text-fig. 3.).

The criteria that identify the microspheric Discocyclinidae juvenarium at first sight are; the proloculum (unlike in the case of Asterocyclinidae) is not situated exactly in the centre of the juvenarium but it sits sideways from the centre, excentrically, and secondly it can be recognized by the existence of the nepionic chambers (half-cycles).

The structure of the microspheric embryon and the spiral part is identical in case of all members of family Discocyclinidae, but there are significant differences as far as the number of nepionic chambers is concerned. In case of the most primitive Athecocyclinae from America they vary between 12 and 15 while Nemkovellae have 9 to 12, the primitive Discocyclinae *(D. archiaci, D. fortisi)* have 7 to 9, the more advanced ones *(D. augustae, D. dispansa, D. pratti)* have 5 to 7 and the most advanced Discocyclinae *(D. radians, D. nandori)* have only 3 to 4. Similar tendencies can be experienced in the case of other Larger Foraminifera (Lepidorbitoides, Lepidocyclina) as well. This phenomenon is known by the name "nepionic acceleration", that is, the advanced forms inherit less and less from their ancestors' properties, and faster and faster they reach the characteristic features that are only their own.

In the course of our investigations we had the possibility to observe the evolution of the openings, the so-called stolons, between chambers and chamberlets. On the edges of the so-called radial stolons, between the chambers, the chamber wall thickens at the beginning but later, with the gradual increase of the cycles in height, this thickening cannot be observed. The evolution of the so-called annular stolons, openings between chamberlets, is characteristic: the septum, that divides the chamberlets, at the beginning grows out from the chamber wall (in case of nepionic chambers), and the distal annular stolon serves as connection between the chamberlets. Where the nepionic chambers turn into cycles, this connection does not exist any longer (there is no connection between the chamberlets that are located in the same cycle). Afterwards with the increase of the cycles in height, the proximal annular stolon takes shape that is characteristic only of Discocyclinae. This process is easy to observe on pl. X, figs. 8—9.

The above described process is complete only in case of Discocyclinae, for the American Pseudophragminae (s.l.) the distal annular stolon is preserved all along, whereas for Nemkovellae the distal annular stolon disappears but the proximal annular stolon does not evolve (see also text-fig. 11.).



3. ábra. Az Orthophragminák B-generációs juvenáriumának vázlata
A = Discocyclinidaek esetében, *B* = Asterocyclinidaek esetében

Fig. 3. The scheme of the juvenariums of Orthophragminae forms "B"
A = in the case of Discocyclinidae, *B* = in the case of Asterocyclinidae

Thus in the Pseudophragmina (s.l.)—Nemkovella—Discocyclina line the same sort of progress of the nepionic acceleration can be studied in the evolution of the stolon structure, as in the nepionic chambers' decrease in numbers (chambers and chamberlets are only distinguished in the case of the juvenarium of forms "B", the chambers of the developed, neanic stage correspond to the chamberlets of the nepionic stage and its cycles correspond to the chambers of the juvenarium. It should be noted, however, that the chambers of Discocyclinidae did not evolve in the same way as the "real" chambers of Asterocyclinidae).

It should be also noted that in case of Discocyclinidae the dimorfism of generations appears differently in the dimensions. In this respect there is no difference between forms "A" and "B" of Nemkovellae. But as for the Discocyclinae the bigger the embryon of form "A" is the bigger the dimensions of forms "B" are. Discocyclinae with the biggest diameter (10 cm) known by the author were recovered from the top of the Suvlu-Kaya Hill's Simferopolian stage in Bakchisarai *(Discocyclina stratiemanuelis)*. The diameter of its embryon in the case of forms "A" is approximately 1 mm. The differences, however, as far as the dimensions are concerned, between the generations are far less explicit than in case of Nummulites, the more so, since their forms "B" of Discocyclinae can be found from the Ilerdian to the top of the Priabonian, so they are different from the Nummulites in this respect, too.

The juvenarium of forms "B" of Asterocyclinidae

All Asterocyclinidae possess so-called "Lepidocyclina" type juvenarium, that is, the spherical microspheric embryons (proloculum) with diameter ranging from 0.01 to 0.02 mm are surrounded by spirals consisting of 5 to 8 chambers. Up to this point one further chamber developed from each chamber but from the last chamber of the spiral two chambers did, in two different directions and from here on, similarly, two new ones will evolve from each chamber (text-fig. 3.). In due course common chambers will also evolve and the cyclic pattern appears first with "strobil-lamella-like" (juvenile) chambers within the same cycles have no common walls. Then the common walls and the typical, only slightly hexagonal chambers will develop. As a result, also the stolons — that originally were located at the bottom of the septa — are gradually pushed upwards, thus the typical equatorial chambers with four stolons, later with six stolons (only in the case of the American Neodiscocyclinae), come into existence.

The features that proclaim a microspheric Asterocyclinidae juvenarium at first sight are that the microspheric embryon sits approximately in the centre of the juvenarium and that the nepionic chambers (half-cycles) are missing. The chambers can be regarded as real ones (unlike in the case of Discocyclinidae). The asteroidal build-up of the equatorial layer of Asterocyclinae and certain Orbitoclypeus also starts to take shape when the common walls within the cycle appear.

The nepionic acceleration is indicated by the decrease in numbers of the chambers occupying position in the initial spiral. In case of the most primitive Orbitoclypei *(O. portnayae, O. ramaraoi)* there are 8 to 10 chambers while the more advanced ones *(O. varians)* have 5 to 7. Similarly, in the case of Asterocyclinae the primitive ones *(A. stella taramellii)* have 7 to 9, whereas the more advanced ones *(A. stellata stellaris, A. alticostata)* have 5 to 6 chambers.

In case of Asterocyclinidae the dimorphism of generations is still not reflected to the extent as in the case of Discocyclinidae. Forms "B" exceed forms "A" in size by 50 percent only in case of forms with the biggest megalospheric embryon *(Orbitoclypeus chudeaui, Asterocyclina alticostata)*.

THE MEGALOSPHERIC (A) EMBRYON

Abbrevations used in the taxonomic part:

t = type (text-fig. 5.),

P_1, P_2, D_1, D_2, a, b, see also on text-fig. 4.:

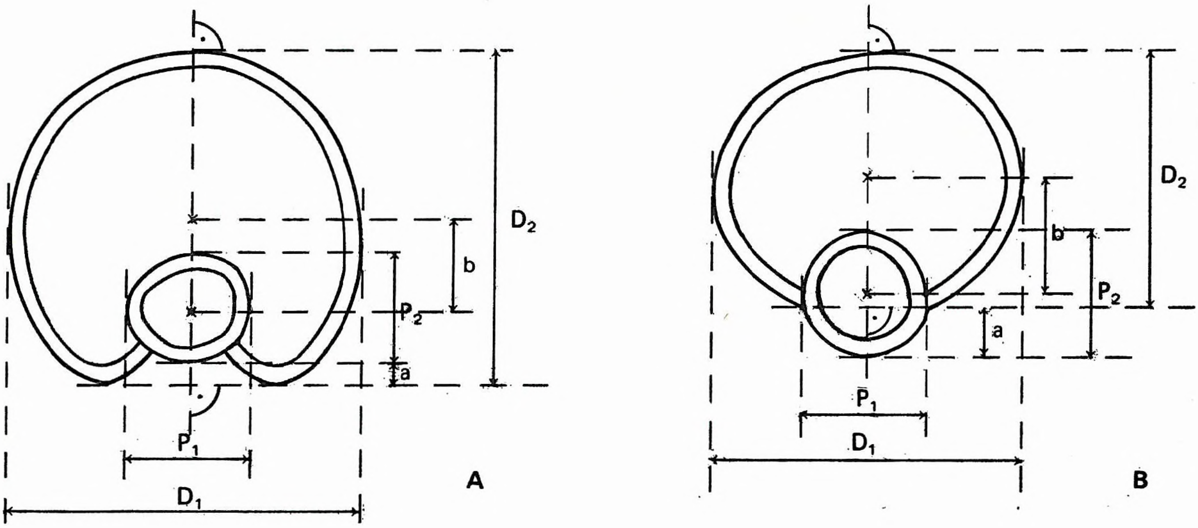
P_1 = width of protoconch (μm),
P_2 = height of protoconch (μm),
D_1 = width of deuteroconch (μm),
D_2 = height of deuteroconch (μm),
a = distance between the bottom of the protoconch and the bottom of the deuteroconch (μm),
b = distance between the centre of the protoconch and the centre of the deuteroconch (μm),

P and D = the average diameters of protoconch and deuteroconch, respectively (μm). Counted as:

$$P=\sqrt{P_1 \cdot P_2} \quad \text{and} \quad D=\sqrt{D_1 \cdot D_2}.$$

R = degree of enclosure of the protoconch. Counted as:

$$R=\frac{a+P_2}{P_2}.$$



4. ábra. Az Orthophragminák A-generációs embriója vázelemeinek mérési metodikája
A = az „a" méret pozitív, *B* = az „a" méret negatív

Fig. 4. Method of mensuration of the embryon in the case of Orthophragminae forms "A"
A = positive "a" dimension, *B* = negative "a" dimension

E = the "excentricity" of the embryon. Counted as:

$$E=\frac{b}{\frac{D_2}{2}}=\frac{\frac{D_2}{2}-\left(a+\frac{P_2}{2}\right)}{\frac{D_2}{2}}=1-\frac{2a+P_2}{D_2}.$$

Q = ratio of the sizes of the two embrionary chambers. Counted as:

$$Q=\frac{D}{P}.$$

As approximately 90 percent of the specimens in a particular Orthophragmina population are megalospheric, and also because of their rapid evolution and great variety of forms, they are far more suitable for species identification than the microspheric ones of which rather the conservative features are characteristic.

The most rapidly evolving part of the megalospheric specimen is its embryon. The shape of the embryon is of decisive importance in the distinction of species group and species but it is far less important in the distinction of stages of evolution (subspecies) within the species. On the other hand, the embryon size plays primary role in this, whereas it has a very modest role in the distinction of species groups and species.

The embryon of Orthophragminae consists of two chambers: the smaller protoconch and the bigger deuteroconch that partially or fully encircles the first. In some cases the deuteroconch may be also secondarily subdivided. Generally this can easily be observed in a chipped equatorial section.

The relationship of the protoconch and deuteroconch (the embryon's shape) is determined by two factors: their sizes and positions. Their size relations (Q) is expressed by the quotient of the average diameters of the deuteroconch and the protoconch. This is the most suitable index-number for the distinction of isolepidine ($Q<1.30-1.35$) and semi-isolepidine ($Q>1.25-1.30$) embryons. Their relation, as far as their positions are concerned, can be characterized by several parameters. Among these the calculation and usage of the degree of enclosure (R) and excentricity (E) proved to be the simplest ones.

The degree of enclosure shows how deeply the protoconch is pushed into the deuteroconch. It can be used fairly well for characterizing trybliolepidine, semi-nephrolepidine and nephrolepidine embryons but the centrilepidine embryon cannot be properly detected with it.

The excentricity shows how distant the centres of the protoconch and the deuteroconch are as compared to the distance between the bottom and the centre of the deuteroconch. This index-number well indicates first of all centrilepidine ($E=0.0$) and nephrolepidine embryons ($E\approx 1.0$).

The three index-numbers (Q, R and E) can be expressed as each other's function if $\frac{D_1}{P_1}=\frac{D_2}{P_2}=Q$ holds true. It is approximately so in reality, that is:

$$Q\approx\frac{D_2}{P_2}=\frac{\frac{D_2}{2a+P_2}}{\frac{P_2}{2a+P_2}}=\frac{\frac{2a+P_2}{P_2}}{\frac{2a+P_2}{D_2}}=\frac{2\frac{a+P_2}{P_2}-1}{1-\left(1-\frac{2a+P_2}{D_2}\right)}=\frac{2R-1}{1-E}.$$

The different embryon types of Orthophragminae were marked by various names (text-figs. 5—6, and table 1.):

Isolepidine embryon: The protoconch is nearly as big as the deuteroconch, its wall adjoining the deuteroconch is just a bit arcuate and it is just a little bit pushed into the deuteroconch.

Semi-isolepidine embryon: The wall of the protoconch adjoining the deuteroconch is still not a complete circle and its longer arc is still outside the deuteroconch.

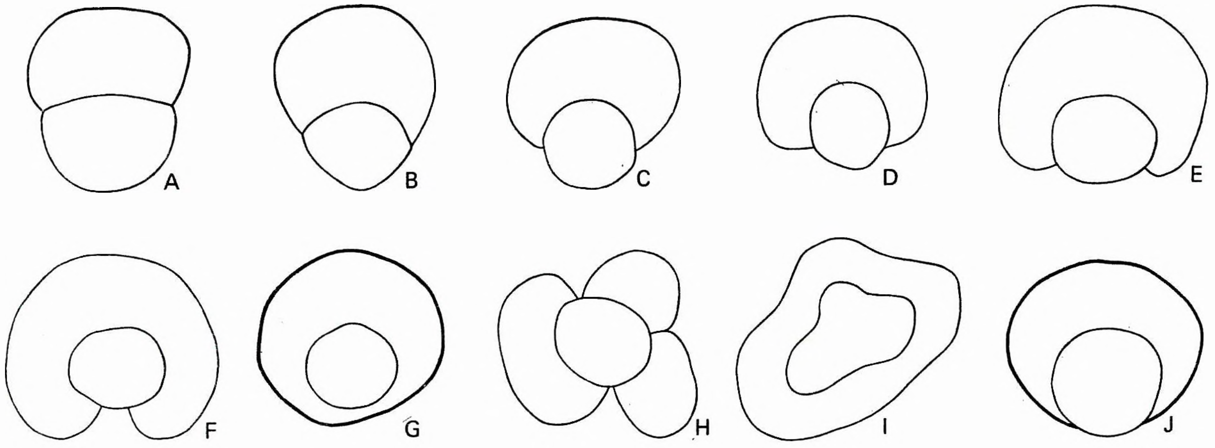
Nephrolepidine embryon: The protoconch is circular with half and half in and outside the deuteroconch.

Semi-nephrolepidine embryon: Only a small part of the protoconch is outside the deuteroconch.

Trybliolepidine embryon: The bottom of the protoconch and that of the deuteroconch are positioned approximately in one line.

Umbilicolepidine embryon: The protoconch is totally pushed into the deuteroconch and it sits on the peduncle of the deuteroconch. The latter is still not divided into parts.

Excentrilepidine embryon: The two chambers have no adjoining wall any longer, but the excentricity is still observable. In the case of certain Orbitoclypei the wall of the deuteroconch is thickened.



5. ábra. Az Orthophragminák A-generációinak különböző típusú embriói

A = isolepidin, *B* = semi-isolepidin, *C* = nephrolepidin, *D* = semi-nephrolepidin, *E* = trybliolepidin, *F* = umbilicolepidin, *G* = excentrilepidin, *H* = polylepidin, *I* = centrilepidin, *J* = eulepidin

Fig. 5. Various embryon types of the "A" generation Orthophragminae

A = isolepidine, *B* = semi-isolepidine, *C* = nephrolepidine, *D* = semi-nephrolepidine, *E* = trybliolepidine, *F* = umbilicolepidine, *G* = excentrilepidine, *H* = polylepidine, *I* = centrilepidine, *J* = eulepidine

1. táblázat — Table 1

A különböző embriótípusok lehetséges E, R és Q értékei

The possible values of E, R and Q in the case of various embryon types

Type of the embryon	*E*	*R*	*Q*
isolepidine	1.15—1.75	0.10—0.41	1.05—1.35
semi-isolepidine	1.07—1.75	0.14—0.45	1.23—1.74
nephrolepidine	0.85—1.30	0.24—0.66	1.36—2.30
semi-nephrolepidine	0.63—0.86	0.62—0.91	1.63—2.46
trybliolepidine	0.40—0.66	0.82—1.10	1.77—2.57
umbilicolepidine	0.21—0.52	1.05—1.46	1.70—2.60
polylepidine	0.05—0.30	1.17—1.72	1.56—2.60
centrilepidine	0.00—0.05	1.24—1.80	1.50—2.60
eulepidine	0.40—0.70	0.75—1.15	1.67—2.18
excentrilepidine	0.05—0.40	1.00—1.72	1.65—2.60

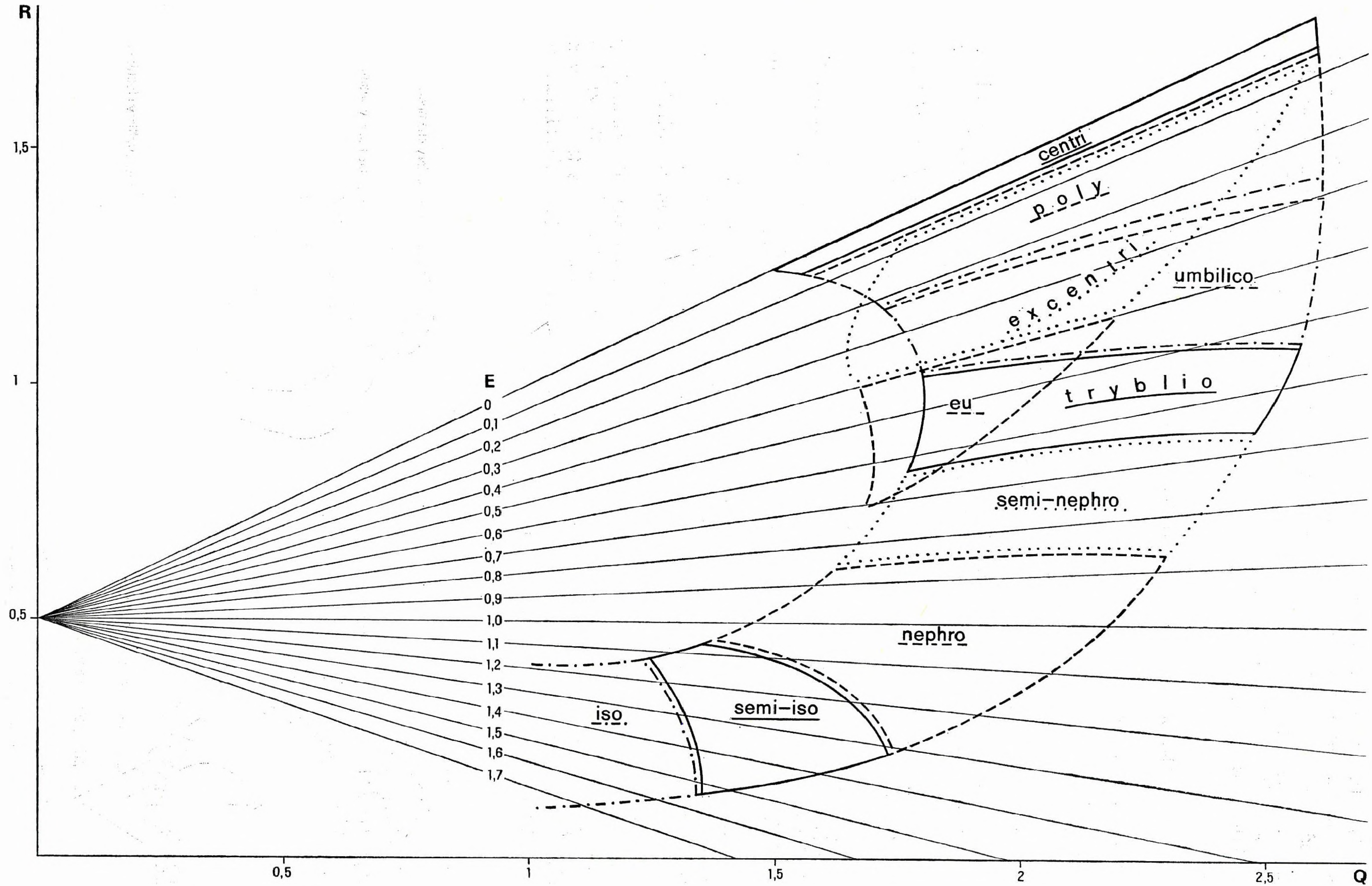
P o l y l e p i d i n e embryon: The protoconch can be found inside the deuteroconch. The latter is divided into two parts at least. A certain excentricity is still observable.

C e n t r i l e p i d i n e embryon: The protoconch sits in the centre of the deuteroconch. The latter is only rarely divided into parts but often they are mutually deformed.

Between these types transitional varieties also occur. Of Asterocyclinidae the first four and also the excentrilepidine embryon are characteristic, whereas all varieties save the first one are characteristic of Discocyclinidae.

Still there is an embryon type that does not fit in the above list.

E u l e p i d i n e embryon: seemingly it is related to the trybliolepidine embryon. The difference between them is that in case of eulepidine embryon the wall of the deuteroconch adjoins the wall of the protoconch at a sharp angle and not at a right angle. Also the protoconch is rather large as compar-



6. ábra. A különböző embriótípusok elhelyezkedése az E—R—Q nomogramon

Fig. 6. Position of the various embryon types on the E—R—Q nomogram

ed to the deuteroconch. It has a transitional variety towards the excentrilepidine type, too. This one occurs only in the case of Orbitoclypei.

Under the size of the embryon the average diameters of the protoconch and the deuteroconch are understood, counted as $P=\sqrt{P_1 \cdot P_2}$ and $D=\sqrt{D_1 \cdot D_2}$ according to text-fig. 4. The reason for this kind of determination is that the extremely large embryons may be deformed. Using this determination the negative effects of being deformed are eliminated and as a result we get smaller standard deviations at the statistical treatment of the data.

CHAMBERS AROUND THE EMBRYON (AUXILIARY CHAMBERS)

Abbrevations used in the taxonomic part:

t = type (text-fig. 8.)
N = number of adauxiliary chambers,
L = width of fully developed adauxiliary chambers (μm), see also text-fig. 9.,
H = height of fully developed adauxiliary chambers (μm), see also text-fig. 9.

Even smaller emphasis was laid on investigating the character and dimensions of the auxiliary chambers, on that of the embryon. My examinations proved that the character of the adauxiliary chambers may be of decisive value in the distinction of species groups and species, similarly their numbers (N) and their dimensions (L, H) play a role first of all in the distinction of subspecies (stages of evolution within the species) but these parameters may also be decisive in the separation of species groups and species.

Major types of auxiliary chambers (text-fig. 7.):

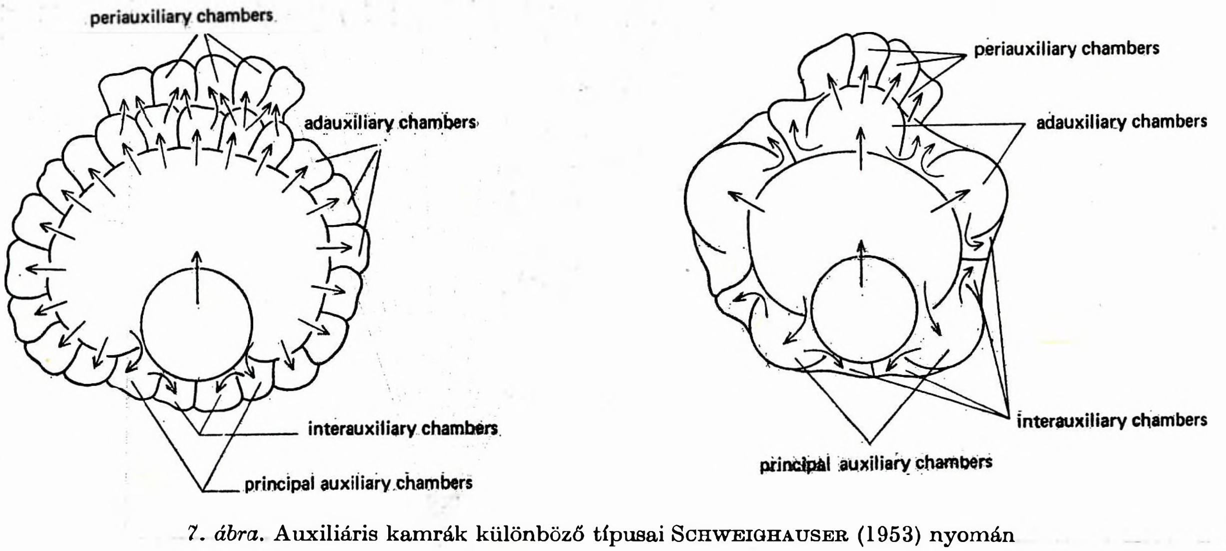
Principal auxiliary chambers: Situated at the meeting of the protoconch and the deuteroconch, connected with the deuteroconch.

Adauxiliary chambers: Situated along the deuteroconch, directly connected (stolon) with the deuteroconch.

Interauxiliary chambers: Situated at the edge of the protoconch and/or the deuteroconch, they have no direct connection to the embrionary chambers. Their plasma may have derived from the main or the adauxiliary chambers or possibly from the interauxiliary chambers, next to them.

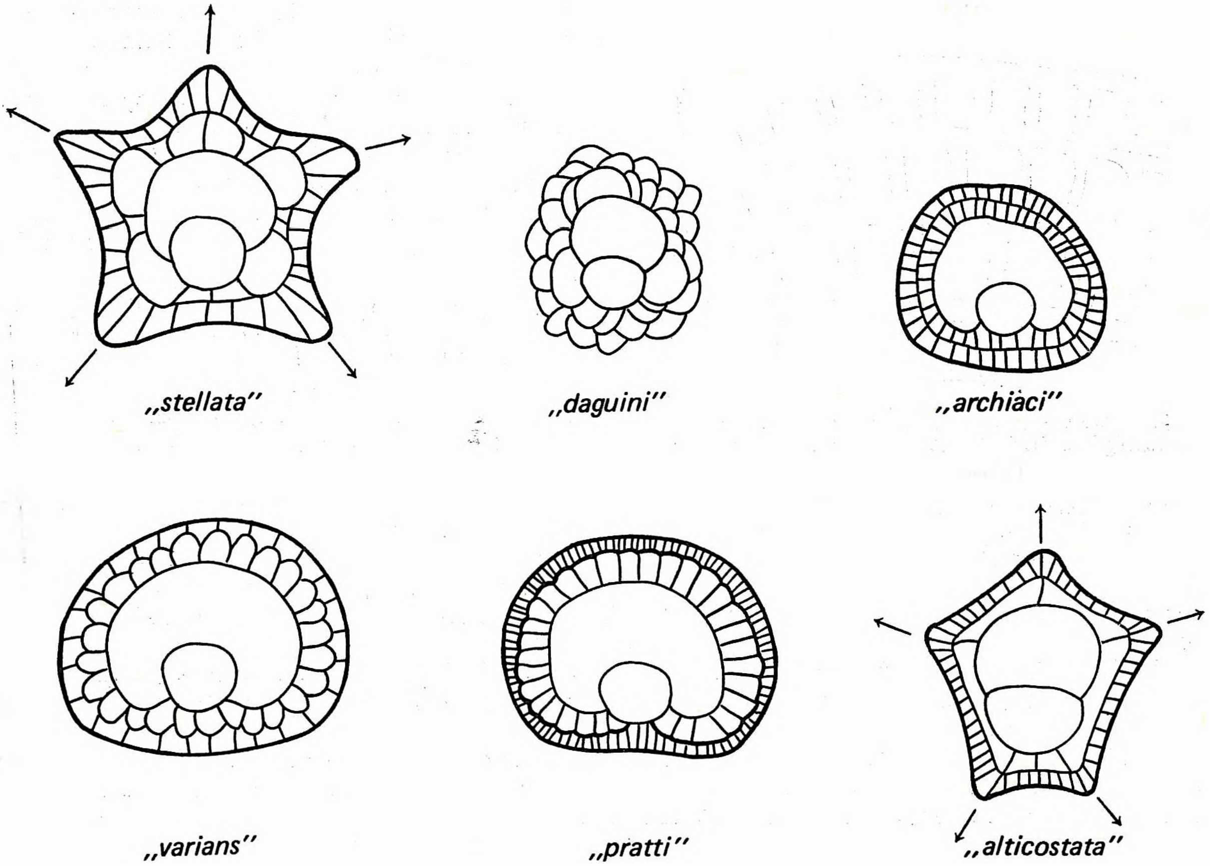
The chambers of the cycle subsequent to the cycle of the adauxiliary chambers are called *periauxiliary* chambers.

In case of Discocyclinae three main types of auxiliary chamber-positions were determined by Brönnimann (1941). These types are called α, β and γ depending on whether the first (type γ), the second (type β) or the third (type α) cycle of the equatorial chambers is to enclose the embryon totally. According to our observations this distinction does not furnish new data to species identification, since different types may occur even within the same population.



7. ábra. Auxiliáris kamrák különböző típusai Schweighauser (1953) nyomán

Fig. 7. Various types of auxiliary chambers after Schweighauser (1953)



8. ábra. Az Orthophragminák A-generációinak különböző típusú adauxiliáris kamrái

Fig. 8. Various type adauxiliary chambers of "A" generation Orthophragminae

According to our investigations the character of the adauxiliary chambers may be of two kinds (text-fig. 8.):

— At the edge of the deuteroconch both the adauxiliary and interauxiliary chambers can be found.

— At the edge of the deuteroconch there are only adauxiliary chambers.

The first case is far less common and it has only two types:

1. "stellata" type: It is characteristic only of *Asterocyclina stellata.* There are three, occasionally further subdivided, adauxiliary chambers around the deuteroconch, all equal in size with the two main auxiliary chambers. These five chambers form the initial point of the equatorial chamber's rays. Among the five chambers that are in direct connection with the embryon interauxiliary chambers sit above which the interradial parts of the equatorial chamber-annuli can be found.

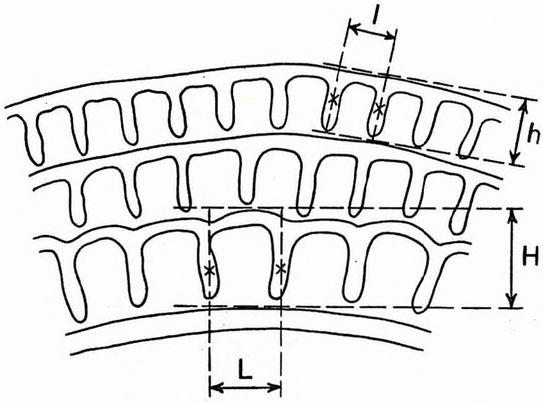
2. "daguini" type: Among the Eurasian Orthophragminae this type can be found only at *Orbitoclypeus daguini*, it may occur, however, at some very primitive American Orbitoclypeus and perhaps at Asterocyclinae as well. Besides, it is very frequent in the case of primitive Lepidorbitoides (Gorsel 1975) and Lepidocyclinae.

Only two main auxiliary chambers and probably one or two adauxiliary chambers are connected directly to the embryon. Between them interauxiliary chambers can be found. Their evolution being of and the development of further annuli, as well, resemble the way of formation described at forms "B" of Asterocyclinidae (see there).

Among the Orthophragminae the second case is more common. It has four varieties:

3. "archiaci" type: It is characteristic of one part of Discocyclinae only: The external walls of the adauxiliary chambers are straight, the chambers do not differ in size from the periauxiliary chambers.

4. "varians" type: It is characteristic of all Eurasian Orbitoclypei (save *O. daguini*), of all Nemkovellae and of a small part of Asterocyclinae and Discocyclinae as well: The external walls of



9. ábra. Az adauxiliáris és equatoriális kamrák szélességének (L és l) illetve magasságának (H és h) mérési metodikája

Fig. 9. Mensuration method of the width (L, l) and height (H, h) of the adauxiliary and equatorial chambers respectively

the adauxiliary chambers are not straight (arcuate or wedge-like). The periauxiliary chambers are of the same width as the adauxiliary chambers or probably they are even wider a bit but they are always shorter though to a different extent. In case of Nemkovellae, Orbitoclypei and Asterocyclinae generally one periauxiliary chamber falls to one adauxiliary chamber. In case of Discocyclinae belonging here this number may be somewhat bigger.

5. "pratti" type: This type, first of all, is characteristic of *Discocyclina pratti*, *D. pulcra* and *D. radians:* the external walls of the adauxiliary chambers are straight or gently arcuate, thickened. The width as well as the height of these chambers surpass the corresponding parameters of the periauxiliary chambers.

6. "alticostata" type: It is characteristic only of *Asterocyclina alticostata* and *A. schweighauseri:* The two or three adauxiliary chambers and the two main auxiliary chambers are very wide, the rays start from the common septa of these chambers. The periauxiliary chambers are already of the normal size.

It should be noted that over and above the "clear" types, in case of Discocyclinae, intermediates between types 3., 4. and 5. may also occur. Similarly, Asterocyclinae have transitional versions between types 1. and 4.

While examining the dimensions ($L \times H$) of the adauxiliary chambers it is important that the chamber to be measured should be characteristic of the entity of the adauxiliary chambers. The method of the measurement is shown on text-fig. 9.

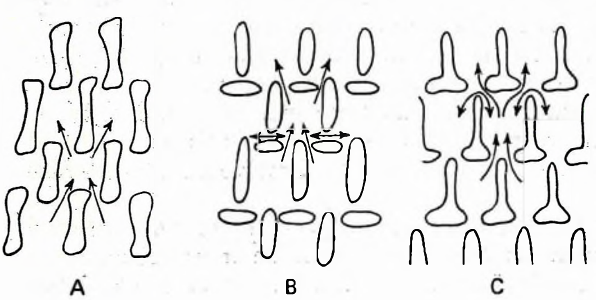
THE EQUATORIAL CHAMBERS

Abbrevations used in the taxonomic part:

s.c. = shape of cycle,
g.p. = growth pattern (text-fig. 12.),
l = the average width of the equatorial chambers (distance between the median lines of the walls) (μm),
h = the average height of equatorial chambers nearest to the edges (from the bottom of the chamber to that of the next chamber) (μm),
$n_{0.5}$ and $n_{1.0}$ = number of cycles falling to the first 0.5 and 1.0 mm, respectively, from the edge of the embryon (text-fig. 13.).

The characteristics of the equatorial chambers were hardly payed any attention to by the investigators of Orthophragminae though they are of decisive importance in taxonomic work. Thus the stolon build-up of the equatorial chambers is different in case of different genera.

The shape of the cycles (circular, undulated, asteroidal) and the shape of the chambers themselves, more closely the width and the height relations of subsequent annuli (g.p.), too, are characteristic of species groups and species. On the basis of the number of cycles falling to a linear unit different evolutional stages (subspecies) can be distinguished.



10. ábra. Az Orthophragminák különböző típusú equatoriális kamrái

A = 4-sztolonos radiális szeptumokkal, *B* = 6-sztolonos radiális és annuláris szeptumokkal, *C* = 6-sztolonos összetett szeptumokkal

Fig. 10. Various type equatorial chambers of Orthophragminae

A = 4 stoloned with radial septa, *B* = 6 stoloned with annular and radial septa, *C* = 6 stoloned with complex septa

The stolon system of the chambers

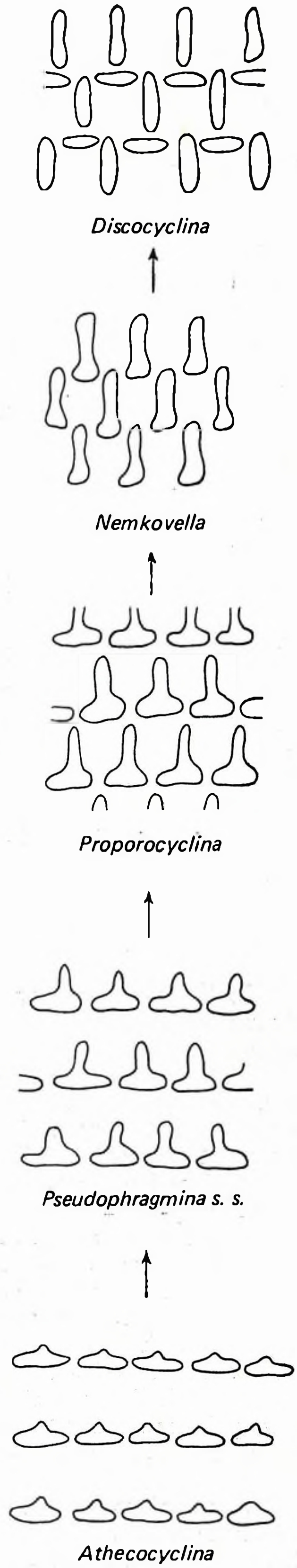
On the basis of the stolon system of their equatorial chambers, the European Orthophragminae can be divided into 2 major groups (according to bibliographic data the same refers to the whole Tethys, too.).

a) equatorial chambers with 4 stolons (text-fig. 10): They have only radial stolons. This chamber is characteristic of Orbitoclypei, Asterocyclinae and Nemkovellae. It should be noted that on the peripherial parts of *Orbitoclypeus furcata* these radial stolons are completed with 2 proximal annular stolons, the formation of which is secondary, it is the result of the high stage of evolution and the specialization,

b) equatorial chambers with 6 stolons (text-fig. 10.): In addition to the 4 radial stolons 2 proximal annular stolons can also be found. Similarly along the radial septa the annular ones can also be found. It is characteristic of all Discocyclinae and of the American Neodiscocyclinae. In case of certain species (for instance *Discocyclina pratti, D. pulcra, D. radians, D. nandori*), however, the equatorial chambers are so much elongated that this stolon system can be hardly recognized.

It should be noted that still there is a third type stolon system that occurs at the American Pseudophragminae (s.l.): They have 6 stolons, too, but their annular stolon is distal. They have only one type of septa, that are compound: the radial part of the septum emerges to different degrees from the annular part.

Apart from the nepionic acceleration of the microspheric specimens the phylogeny of Discocyclinidae can be also followed on the basis of the equatorial chambers' morphology (text-fig. 11.): at the most primitive stage (Athecocyclina) only annular septa exist with hardly visible radial outgrowth, and there was only one chamber within one cycle. This radial outgrowth became more and more powerful (Pseudophragmina s.s., Proporocyclina) until it reached a phase when it turned into radial septum and thus the distal annular stolon disappeared (Nemkovella). At the very last stage (Discocyclina) at the proximal edge of the radial septum annular stolon evolved again and the walls of the equatorial chambers were separated into radial and annular septa.



The shape of cycles (s.c.)

In the case of Discocyclinidae and certain Orbitoclypei *(O. ramaraoi, O. chudeaui, O. douvillei)* the shape of the cycles are circular. Radial protrusions on certain Discocyclinae may occur only accidently (pl. XV, fig. 8.). All Asterocyclinae are asteroidal. In Eurasia most often they are fivebranched, more branches (6 to 8) are characteristic only of *Asterocyclina schweighauseri*. The rays of Asterocyclinae are always very definite and sharp (it should be noted that the Caribbean and Pacific Asterocyclinae characteristically have 4 or more, 7 to 10 branches).

At certain Orbitoclypei *(O. varians, O. bayani, O. furcata)* rather radial protuberances occur (6 to 8) therefore the cycles become undulated. This undulation is more definite at forms that are ribbed externally as well *(O. bayani, O. furcata)*. Ribbed Orbitoclypeus *(O. katoae)* however, still exists the annuli of which is circularly built up.

Here the so-called traces of regeneration should be also mentioned (for example pl. I, fig. 3.) that are of parthological origin, that is, when the test suffered certain injury the animal tries to corrigate it by intense growth of the injured part, thus regenerating itself and its original shape.

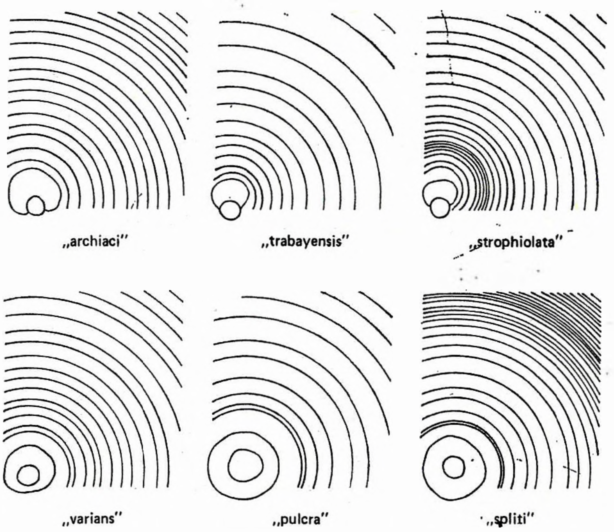
11. ábra. Az equatoriális kamrák fejlődése a különböző Discocyclinidae-genusok között

Fig. 11. The evolution of equatorial chambers between various genera of Discocyclinidae

The growth pattern of the annuli (g.p.)

This feature is most characteristic of the given species group and it is suitable for the distinction of definite types (text-fig. 12.).

a) "archiaci" type: The height of the second cycle is equal to that of the first one (by first cycle I mean the chambers directly enclosing the embryon) and the subsequent chambers do not grow significantly longer either. It is characteristic of less advanced Discocyclinae (*D. archiaci*, *D. fortisi* etc.) and Nemkovellae *(N. evae)*.



12. ábra. Az equatoriális kamrák ciklusai növekedési jellegének (g. p.) különböző típusai az Orthophragmináknál

Fig. 12. Various type growth patterns (g. p.) of the annuli in the case of Orthophragminae

b) "trabayensis" type: The second cycle is higher than the first one, the height increase is observable all the way to the edges. It is characteristic of certain primitive Discocyclinae *(D. trabayensis, D. broennimanni)*.

c) "strophiolata" type: The second cycle is lower than the first one, then the cycle height decreases in the next few cycles. Afterwards, all the way to the edges the height of the cycles gradually increases. It is a rather common type (*Discocyclina augustae, Nemkovella strophiolata, Orbitoclypeus katoae, Asterocyclina stellata, A. kecskemetii*, etc.).

d) "varians" type: The second cycle is somewhat lower than the first one. The height of the next few cycles does not change or hardly increases, whereas significant increase in cycle height may take place only around the edges. This is one of the most widespread types (*Discocyclina dispansa, Orbitoclypeus ramaraoi, O. varians*, etc.).

e) "pulcra" type: The second cycle is much lower than the first one, however, the third and fourth are again nearly as high as the first. Further on the cycle height hardly increases and finally it does not change at all. This type is characteristic of the more advanced Discocyclinae (*D. pratti, D. pulcra, D. radians*, etc.).

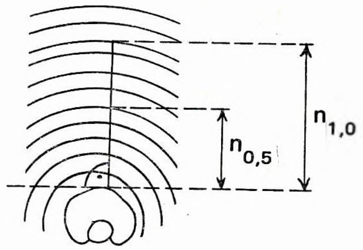
f) "spliti" type: It is characteristic of *Discocyclina spliti* only: the growth pattern of the first few cycles is similar to that of the "pulcra" type but after the 6–8th cycle (these are the highest ones) the cycles gradually decrease in height and the outermost cycles are even lower than the second one.

The various growth patterns (g.p.) are not always definite. There are intermediate stages between them as well, consequently they are of lower taxonomic value than for instance the shape of the embryon or the character of the adauxiliary chambers.

The shape of the equatorial chambers

Earlier the equatorial chambers of Orthophragminae were taken as rectangular and/or as hexagonal that can be explained by the fact that both shapes occur. In the course of investigation it could be established that the rectangular chambers are characteristic only of Discocyclinae, having annular septum whereas the hexagonal chambers are characteristic of Nemkovellae, Orbitoclypei, Asterocyclinae that have only radial septa. In the distinction of species groups and species the width of equatorial chambers (l) plays an important role. It is practically constant from the 3–6th cycle all the way to the peripheries (the method of measuring is the same as that of the adauxiliary chamber width — see text-fig. 9).

In case of Discocyclinae the width of the equatorial chambers is generally over 35 μm at species of the *D. archiaci* group, whereas it is below this limit at species of the *D. dispansa* group.



13. ábra. Az embrió szélétől számított 0,5 illetve 1,0 mm-re eső equatoriális kamraciklus-szám ($n_{0,5}$ ill. $n_{1,0}$) mérése

Fig. 13. Determination of the number of annuli within a 0.5 mm wide and a 1.0 mm wide stripe ($n_{0.5}$ and $n_{1.0}$ respectively) measured from the edge of the embryon

Within Nemkovellae, *N. evae* can be characterized approximately by 40 μm, *N. fermonti* by 35 μm, whereas *N. strophiolata* by 30 μm wide equatorial chambers.

Among Orbitoclypei the species of the *O. chudeaui* group possess the widest equatorial chambers (35 to 50 μm), *O. seunesi*, the species of the *O. ramaraoi* and *O. varians* groups have medium wide (25 to 40 μm) ones while *O. daguini* and *O. pygmaea* possess even narrower equatorial chambers (20 to 25 μm).

The average width of equatorial chambers in case of Asterocyclinae is between 25 and 30 μm but *A. alticostata* and *A. schweighauseri* have wider (35 to 40 μm) equatorial chambers.

The height of the equatorial chamber annuli, as it was pointed out in the previous chapter, changes in a definite way from the embryon to the peripheries, at the same time the height of the equatorial chambers (*h*), too, increases gradually within certain species from the less advanced to the more advanced subspecies. Consequently, the height may play a determinative role in the distinction of various stages of evolution (subspecies) within the species. Since the measurement of the height of randomly chosen equatorial chambers is rather subjective we measured this evolution through the number of cycles falling to a 0.5 mm wide ($n_{0.5}$) or to a 1 mm wide ($n_{1.0}$) stripe measured from the edge of the embryon (text-fig. 13.). Measurements should be carried out through cycles that are free of traces of regeneration and in the case of Asterocyclinae always in the interradial space.

THE EQUATORIAL LAYER IN THE AXIAL SECTION

Abbrevations used in the taxonomic part:

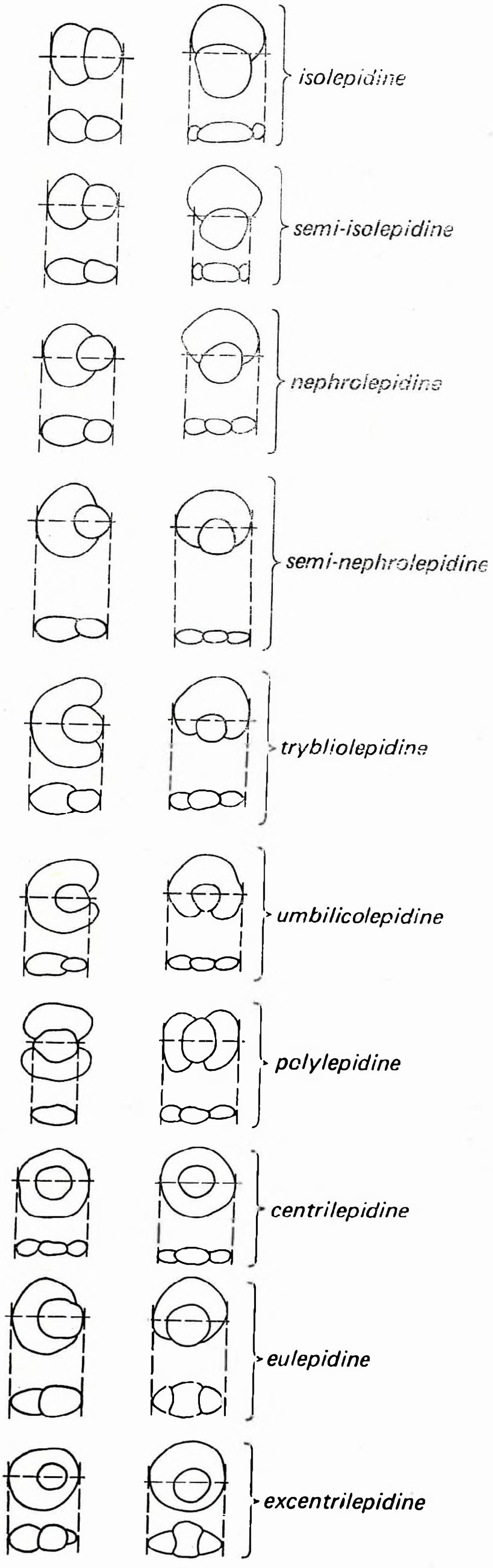
$L_p \times H_p$ = length and height of the protoconch (μm),
$L_d \times H_d$ = length and height of the deuteroconch (μm),
$l_e \times h_e$ = the average length and thickness of the equatorial chambers near the embryon (in the latter case the thickness of the two lateral septa is also included) (μm),
$l_l \times h_l$ = the average length and height of the lateral chambers (with the thickness of only one lateral septum) (μm).

In the course of our investigations the primary emphasis was laid on the examination of the equatorial section, since this section proved to be easy to uncover and it is of great taxonomic value. Similar is the case with other Larger Foraminifera with equatorial layer. In these cases the determination in respect of species and subspecies can be carried out also only with the help of equatorial section.

Since for other palaeontologists as well as for the author few well-oriented (section plane going through both chambers of the embryon) axial sections are available, and, in additon, these can be obtained only by polishing the specimens, determination on the basis of this section is possible at present only on the genus or perhaps on the species group level.

The axial section of the embryon

The axial section of the embryon could be conclusive in taxonomic work provided that we knew where exactly the section plane intersects the embryon. Unfortunately enough this cannot be guaranteed since the orientation of the embryon cannot be detected from outside the test and, as a result, there is no way to tell which side to polish the specimen from.



14. ábra. A különböző A-generációs embriótípusok axiális metszetben

Fig. 14. Various "A" generation embryon types in axial section

The axial sections of various embryon types are shown on text-fig. 14. According to this textfigure, on the basis of the axial section the embryon type cannot be definitely determined. At the same time the excentri- and eulepidine embryons of Orbitoclypei can be easily told, in certain cases, from other types. In the identification of species groups the embryon size may be also of help but, as we can never be sure of the orientation of the section, the dimension cannot be used for more precise determination either.

The equatorial chambers in the axial section

It was Brönnimann (1945b) and Neumann (1958) who thouroughly examined the axial view of the equatorial section of Orthophragminae. Brönnimann (1945b) managed to distinguish clearly Asterocyclinae from Discocyclinae starting from the fact that the equatorial layer of the first forms thickens in the rays, moreover, they even subdivide into more chamber-rows, whereas in the case of the latter forms it is not so.

On the basis of the above feature Discocyclinae were subdivided into 5 groups by Neumann (1958). According to her figures, however, and the author's observations, too only two groups can be distinguished with certainty, namely the Orbitoclypei assigned by Neumann (1958) to *Discocyclina seunesi* and *D. douvillei* groups, and the Discocyclinae that were included by her in the *D. archiaci*, *D. augustae* and *D. fortisi* groups. The ribbed Discocyclinae, earlier distinguished and referred to as Aktinocyclinae, also belong to this group.

A characteristic feature of Orbitoclypei is the equatorial layer that significantly thickens towards the edges. In the case of Discocyclinae this character is not observable at all or it appears very indefinitely.

In this way, on the basis of the axial view of the equatorial layer, Discocyclinae, Orbitoclypei and Asterocyclinae can be well distinguished from each other. This character in the case of Nemkovellae could not be properly studied on the basis of the literature and the author's own material either. Similarly, too little is known at the moment concerning the same character of the ribbed Orbitoclypei *(O. bayani, O. furcata, O. katoae)*.

The growth pattern of the annuli (see at p. 66.) is also easy to distinguish in axial section and, in addition, at those species *(Discocyclina pratti, D. pulcra)* the adauxiliary chambers of which are far higher than the chambers of the second cycle this difference appears in their thickness as well.

LATERAL CHAMBERS AND PILLARS

Earlier, the network of lateral chambers and the surrounding pillars played a very important role in species determination. According to our investigations their importance is limited more to the distinction of genera and species groups only.

Lateral chambers and pillars in the axial section

The lateral chamber-layers, situated one above the other generally well follow the "relief" of the equatorial layer: above the embryon, that stands out from the equatorial layer, the lateral layers form a topknot (umbo); above the radially thickened equatorial layer of Asterocyclinae the lateral layer protrude as well, thus forming asteroidal shape.

The ribbed and dotted Discocyclinae *(D. samantai, D. radians, D. nandori, D. knessae, D. kingae)* are exceptions in this respect as well as the ribbed Orbitoclypei *(O. bayani, O. furcata, O. katoae)* in the case of which the ribs and the punctiform protuberances seemingly derive merely from local thickening of the lateral layer.

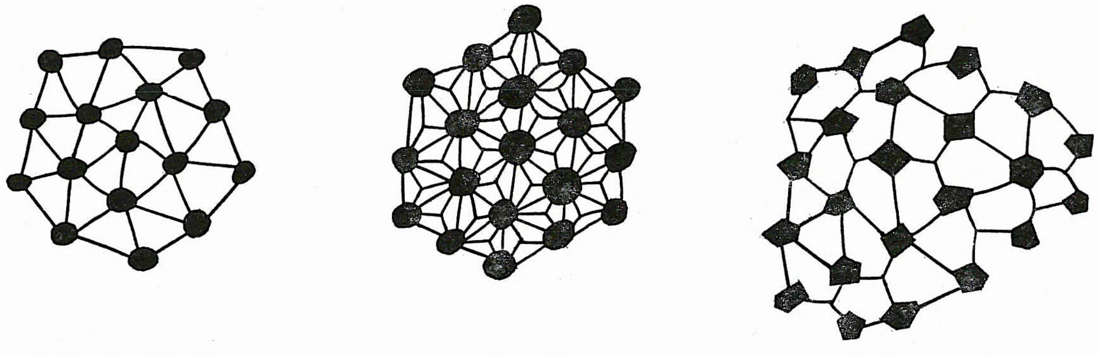
Discocyclinidae and Asterocyclinidae can be well distinguished on the basis of the axial view of the lateral chamber-network and the pillars, too. The lateral chambers of Discocyclinidae are much more densely situated on top of each other than the lateral chambers of Asterocyclinidae, at the same time pillars are far thinner than those of Asterocyclinidae.

Lateral chamber-network and pillars on the test surface (rosette)

As the pillars of Asterocyclinidae are bigger in diameter than those of Discocyclinidae and also because the lateral chambers are not so densely situated on top of each other as in the case of Discocyclinidae the lateral chamber-network and pillars more strongly appear on the test surface. This character — with proper experience — can help a lot in the macroscopic distinction of Orbitoclypei from Discocyclinae and Nemkovellae.

On the test surface the pillars appear in the shape of granules. The septa that divide the lateral chambers from each other adjoin to these granules. Their network is briefly called rosette.

Generally there are three different types of rosettes: the first is more characteristic of Discocyclinidae while the other two are characteristic of Asterocyclinidae only (text-fig. 15).



15. ábra. Az Orthophragminák főbb rozetta típusai

Fig. 15. Main rosette types of Orthophragminae

a) "Discocyclina" type: The granules are generally circular, 50 to 100 μm in diameter. Generally one granule is surrounded by 6 to 7 lateral chambers. The adjoining granules are generally connected together by a lateral septum. This type is characteristic of all Discocyclinae.

b) "marthae" type: The granules are circular, 100 to 150 μm in diameter. Each granule is surrounded by 8 to 14 lateral chambers. The network of the lateral chambers is more dense than that of the granules, that is, between the granules there is a "cobweb" of lateral chambers and the neighbouring granules are connected by more lateral chamberwalls. Among others, this type is characteristic of *Orbitoclypeus ramaraoi, O. marthae, O. varians, O. furcata, Asterocyclina stellata* and *A. stella.*

c) "chudeaui" type: The granules are polygonal (from rectangular to hexagonal), 100 to 150 μm in diameter. One granule is encircled by 4 to 6 lateral chambers. The granules are situated rather close to each other. Generally, the neighbouring granules are directly connected by lateral chamberwalls. Among others this type is characteristic of *Orbitoclypeus chudeaui, O. douvillei, Asterocyclina alticostata* and *A. kecskemetii.*

These types, however, do not always appear characteristically either, therefore their taxonomic value is beneath that of the equatorial layer. For instance, "Discocyclina—chudeaui" transitional type rosette is characteristic of all Nemkovellae.

It should be also noted that sometimes various populations of the same species show significant differences in the character of the rosette (for example the Ajka, Dudar and Lábatlan populations of *Orbitoclypeus varians* and also the Ajka and Dudar populations of *O. chudeaui*). Consequently, for the time being, the more accurate distinction between the rosette types is not possible.

THE TEST SHAPE (HABITUS)

Earlier (GÜMBEL 1868, DOUVILLÉ 1922), Orthophragminae were assigned to different genera, first of all on the basis of their test shape. So the disc-shaped or lenticular, otherwise not ornamented, tests were assigned to Discocyclinae, the asteroidal tests to Asterocyclinae (or Asterodiscus), whereas the disc-shaped ribbed tests were assigned to Aktinocyclinae.

On the basis of the examination of the internal morphology (BRÖNNIMANN 1945b, CAUDRI 1972, and the present author) this point of view should be modified: even the really characteristic external features (ribbing, asteroidal shape) are suitable only for the distinction of species.

Among the Eurasian Orthophragminae the simple disc-shaped or lenticular tests may equally belong to Discocyclinae, Nemkovellae or Orbitoclypei.

Earlier, great importance was attributed to the test's flatness or inflateness but this, too, can be used only in general: flat forms are more characteristic of Discocyclinae and Nemkovellae whereas inflate forms are more characteristic of Orbitoclypei. Nevertheless, it is quite frequent that specimen with the same internal morphology coming from the same population may possess flattened or inflate forms as well (for instance the Crimean *Discocyclina archiaci* and *D. fortisi* populations or the *D. augustae* populations from Ajka).

Differences, even smaller than this, like the character of the collar, the degree of inflateness are of no practical importance at all: for instance, using the earlier methods, specimens of the most *Orbitoclypeus varians* populations could have been identified as *Discocyclina nummulitica, D. varians, D. marthae, D. roberti, D. aspera, D. andrusovi* and *D. scalaris* if the external features were considered only.

In other cases, tests of ecologic or pathologic origin were regarded to be of taxonomic value. For example, according to earlier determinations all saddle forms with most diverse internal morphology (*Discocyclina archiaci* from the Crimea — PORTNAYA 1974, *D. augustae* and *D. dispansa* from Ajka — KECSKEMÉTI 1959, etc.) were included in *Discocyclina sella*, though obviously they took their shape during some sort of symbiosis with Lithothamnium.

In the same way, considering the rapidly tapering off edge that was used earlier for the distinction of *Discocyclina bartholomei*, species coming from various ages may be confused (for instance *Discocyclina archiaci archiaci* and *D. archiaci bartholomei* from the Crimea, *D. archiaci bartholomei* from Saint-Barthélémy, *D. augustae augustae* and *D. discus discus* from Ajka). This feature in our opinion, is of pathological origin, since in the case of these specimens the atrophy of the outermost equatorial cycles, that is the last dying phase of the animal is always observable.

In spite of this, in certain populations specimens with the same internal morphology may possess surprisingly similar exterior.

If this is the external reflection of the internal morphology, it may, to a certain extent, be used even for species identification. For instance, we know that in the case of forms with small nephrolepidine embryon *(Discocyclina broennimanni, D. trabayensis, Nemkovella strophiolata)* above the little, almost spherical, embryon a small, sharp umbo is formed on the test surface, and often the test itself is rather small, too.

Similarly, the *Discocyclina pulcra*, with large centrilepidine embryon, is flat, above its disc-like embryon the umbo is indistinct, irregular in shape, and in addition, at the centre, where the protoconch is situated small indention can be observed occasionally. Generally, it is also observable that forms with large embryon have big tests, whereas forms with small embryon have small tests. At the forms with large embryon the dimorphism of generations appears far stronger as far as differences in size are concerned.

Forms that were earlier assigned to Aktinocyclinae had to be divided between Discocyclinae and Orbitoclypei: The reason why genus Aktinocyclina itself was abolished is that the forms earlier assigned here evolved from different Discocyclina and Orbitoclypeus species, according to the author's observations, at the final stages of their evolution. Consequently, it is clear that the ribs, having been formed from the lateral layer, are such accessory elements that do not provide proper basis for setting up a distinct genus.

The character of the ribs can fairly well be used for the distinction of various ribbed forms. For example dense, straight and fine ribs (10 to 14) are characteristic of *Discocyclina radians, D. knessae* and *D. nandori* while punctiform protuberances arranged in 7 to 9 lines are characteristic of *D. kingae* and ribs that start from the umbo and bifurcate at the edges are characteristic of *Orbitoclypeus furcata* and often of *O. bayani*. Their number is ranging from 7 to 9. Also 7 to 9 ribs starting from the umbo but not bifurcating at the edges are characteristic of *O. katoae*.

The ribbed Discocyclinae are always circular, the endings of the ribs do not modify the test shape, nevertheless, in the case of Orbitoclypei the test, in side projection, is a bit undulated, since it is always a bit wider at the endings of the ribs than in the interray areas.

The earlier Asterocyclinae have changed relatively the least. Their asteroidal form, mostly with 5 rays, makes them easy to recognize. The star shapeness appears already in the equatorial layer so the relief of the equatorial layer is even more emphasized on the test surface.

Asteroidal forms with 6—7—8 branches may be problematic, since in this case the specimen to identify may be *Asterocyclina schweighauseri* or *Orbitoclypeus bayani* as well (besides, the latter may also take "Aktinocyclina" shape — see above). In such a case only the examination of the equatorial layer can be decisive.

Earlier in the literature Asterocyclinae were determined on the basis of external features like length and character of rays, existence or lack of interradial areas and the character of the umbo. According to our examination these features, similarly to the unribbed disc-shaped or lenticular forms, are of little importance. Relying upon these features *Asterocyclina stellata, A. stella, A. stellaris, A. taramellii* and *A. pentagonalis* might as well be identified from a single population of *A. stellata* (from Ajka and Lábatlan, for instance). In case of Asterocyclinae, too, species and subspecies determinations can be carried out by examining the internal morphology.

TAXONOMIC DIVISION OF ORTHOPHRAGMINAE AND THEIR DETERMINATION

A great many have dealt with the systematization of Orthophragminae in the past 100 years. Scientists, among them GÜMBEL (1868), MUNIER-CHALMAS (1891), HEIM (1908), DOUVILLÉ (1922, 1923), VAUGHAN—COLE (1940), BRÖNNIMANN (1945b, 1951), NEUMANN (1958) and CAUDRI (1972) provided the most outstanding papers on the subject.

The works of D'ORBIGNY (1848), CARPENTER et al. (1862), SILVESTRI (1907a, b, c) CHECCHIA-RISPOLI (1908, 1909a), VLERK (1923), BERRY (1928), GALLOWAY (1928), WEIJDEN (1940), RAO (1942), CAUDRI (1944), COLE (1948), RUIZ DE GAONA (1950), BIEDA (1963), SAMANTA (1965b) and PORTNAYA (1974) touching the subject are less important, nevertheless, they contributed valuable pieces of information concerning the subject.

The detailed acknowledgement of their views are not dealt with in the present work, since this summary until 1958 can be found in NEUMANN's (1958) work. Instead, the author would like to discuss his own ideas on the matter.

THE SYSTEM OF ORTHOPHRAGMINA FAMILIES AND GENERA

Modern taxonomy has to provide a reflection of the evolutionary process. According to our investigations the phylogeny of Orthophragminae can be best followed through the juvenarium of forms "B", since truly reflects the different stages of evolution of the actual forms. The evolution of the microspheric juvenarium is extraordinary slow, only small-paced nepionic acceleration can be detected. At the same time, in the case of the microspheric forms, it is the embryon and its close vicinity that is the most capable of evolution, consequently here the ancient features are not maintained at all.

That is why BRÖNNIMANN's (1945b, 1951) division of Orthophragminae into Discocyclinidae and Asterocyclinidae on the basis of the differences between the megalospheric juvenariums is completely reliable to this day. The only criterion of their distinction is the different microspheric juvenarium the description of which can be found on p. 56—58.

The further distinction within Discocyclinidae can be carried out considering the build-up of the equatorial chambers: Nemkovellae possess equatorial chambers with four stolons and with radial septa, whereas equatorial chambers with six (four radial plus two proximal annular) stolons and with annular and radial septa are characteristic of Discocyclinae.

Pseudophragminae (s.l.), to which the genera Pseudophragmina (s.s.), Proporocyclina, Asterophragmina and Athecocyclina belong, possess equatorial chambers with 6 stolons (with distal annular stolons) and only with annular septa from which radial protuberances evolve to a different degree. The distinctive mark that tells Asterophragminae from the other three genera is that it has asteroidal cycles, whereas the other three genera can be distinguished on the basis of the degree of the radial protruding of the annular septum: this protruding is the smallest, almost unobservable in the case of the most primitive Athecocyclinae, it is stronger at Pseudophragminae (s.s.) but still it does not reach the next cycle and it is the strongest at Proporocyclinae where it reaches the next cycle.

Owing to phylogenetic reasons, the genus Aktinocyclina had to be included in the genus Discocyclina, since the ribs, that are characteristic of Aktinocyclinae and came into being completely from the thickened lateral layer, can be regarded as accessory elements. According to our observations the ribbed Discocyclinae evolved from various sorts of unribbed Discocyclinae for instance *D. radians* and *D. nandori* from *D. dispansa*, *D. knessae* from *D. augustae*, whereas *D. samantai* from *D. pratti*. In the same way *D. kingae* with punctiform protuberances arranged into lines, may have evolved from *D. dispansa*. On these bases Aktinocyclinae cannot be considered to be a homophyletically evolved group, nor can it be regarded as a separate genus from Discocyclinae. According to BRÖNNIMANN (1945a) the feature that the equatorial chambers above one another are not arranged in a chess-board pattern but more or less exactly one on top of the other is characteristic of Aktinocyclinae. According to our experience this character can be observed only in the case of the most advanced "*Aktinocyclina*" *radians*, "*A*" *nandori* and "*A*" *samantai* but it can be found at the highly developed unribbed forms (*Discocyclina pratti, D. pulcra, D. euaensis*) as well, consequently, it does not provide a proper basis for the separation of a distinct genus.

In Asterocyclinidae two genera were included by BRÖNNIMANN (1945b, 1951), namely, Asterocyclina and Orbitoclypeus. The equatorial chambers of these two genera have four stolons and possess radial septa only. The only exception is *Orbitoclypeus furcata*, on the equatorial layer of which, only on its peripherial parts, with the evolution of proximal annular stolons, equatorial chambers with six stolons and with radial and annular septa come into being. The formation of these chambers can be considered to be secondary. The equatorial chambers of Neodiscocyclinae, also included in this family, have six stolons, proximal annular ones, and they possess annular and radial septa, respectively.

The feature, distinguishing Asterocyclinae from Orbitoclypei, is that in the microspheric juvenarium the cycles take asteroidal shape, immediately after the end of the primary spiral. Then, all cycles are asteroidal, the equatorial layer thickens in the rays and is also divided into more layers. The thickening of the equatorial layer is followed by the external form as well, so the test is typically asteroidal (generally with four or five rays).

Also asteroidal (one part of *Orbitoclypeus bayani*) and ribbed forms (the rest of *O. bayani, O. katoae, O. furcata*) can be found among the Orbitoclypei. The cycles of the microspheric specimens, however, do not take asteroidal shape right after the primary spiral. The equatorial layer thickens in the rays to a far lesser extent than in the case of Asterocyclinae, the number of rays is always more than five and these are much weaker than those of Asterocyclinae. Earlier, these asteroidal and ribbed Orbitoclypei were classed among Asterocyclinae and Aktinocyclinae. Their assignment, however, to distinct genus is not justified, since they can be derived from various unribbed Orbitoclypei. For instance, *O. bayani* can be derived from *O. ramaraoi*, *O. furcata* from *O. varians* and *O. katoae* from *O. chudeaui*.

Considering all these, the system of Orthophragminae (in the present work this denomination is used as a common name of Discocyclinidae and Asterocyclinidae but it has no taxonomic significance) is as follows:

Familia: Discocyclinidae VAUGHAN et COLE, 1940
Genera: Discocyclina GÜMBEL, 1868
Nemkovella n. gen
Athecocyclina VAUGHAN et COLE, 1940
Pseudophragmina DOUVILLÉ, 1923
Proporocyclina VAUGHAN et COLE, 1940
Asterophragmina RAO, 1942

Familia: Asterocyclinidae BRÖNNIMANN, 1951
Genera: Orbitoclypeus SILVESTRI, 1907
Asterocyclina GÜMBEL, 1868
Neodiscocyclina CAUDRI, 1972

THE RELATIONS OF ORTHOPHRAGMINAE

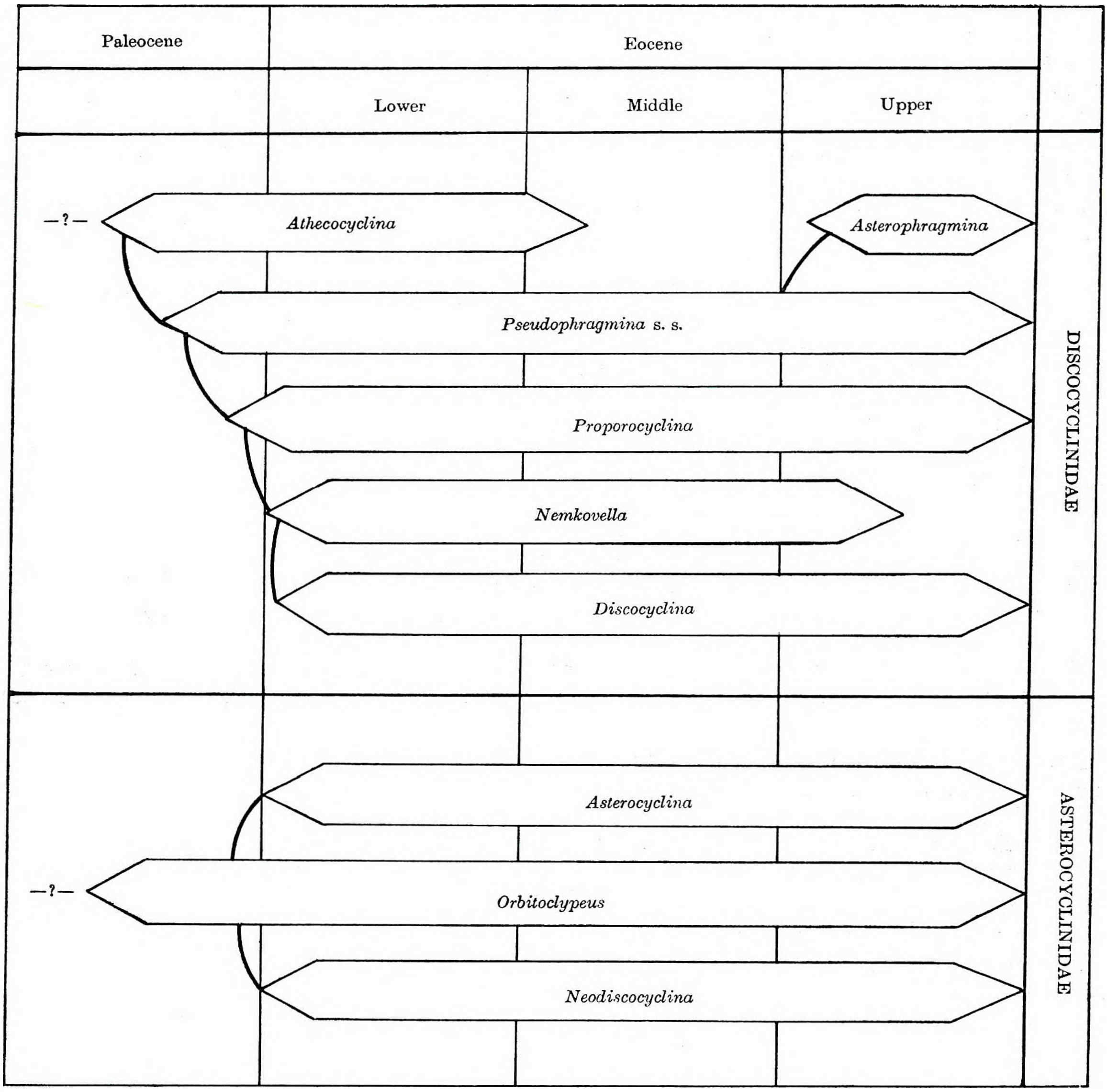
Based upon the principle that similar megalospheric embryons can be found in the case of Cretaceous forms (Orbitoides, Lepidorbitoides, etc.), at Orthophragminae and Lepidocyclinae, too. Orthophragminae with various embryon types were derived by NEUMANN (1958) from various Cretaceous forms. Similarly Lepidocyclina with various embryon types were connected to Orthophragminae with analogous embryon type (for instance Lepidorbitoides—"Nephrodiscodina"—Nephrolepidina or Simplorbitoides—*Discocyclina fortisi*—Pliolepidina—Multilepidina). On the one hand, NEUMANN's ideas contradict her own taxonomy (as both the "Orthophragmininae" and "Lepidocyclininae" are considered to be of polyphyletic origin), on the other hand, she completely disregarded the fact, that Discocyclinidae have microspheric juvenarium that are different from those of all other Orbitoidal Foraminifera, consequently any link between them (the common ancestor as well) can be ruled out.

From the perforated smaller Foraminifera, Cyclocibicides has similar structure to the microspheric juvenarium of Discocyclinidae. This form appears in the Senonian and probably it is the ancestor of Discocyclinidae.

Though it is less likely, the ancestor might be also some sort of Operculina, that appears already in the Paleocene.

Az Orthophragmina-genusok fejlődéstörténeti kapcsolatai *2. táblázat — Table 2*

The phylogenetic links of the Orthophragmina genera



Athecocyclina can be regarded as the most primitive form of Discocyclinidae. Its cycles are still hardly divided into chamberlets by radial outgrowths. From this might have evolved, already in America, genus Pseudophragmina and genus Proporocyclina at which the radial outgrowth of the annular septum reaches as far as the next cycle. Later on, the above three genera evolved until various levels of the Eocene in America with unchanged equatorial chamber build-up, but with the microspheric juvenariums becoming more and more simple. Asterophragmina can be regarded as the collateral line of Pseudophragmina, evolved within a geographically isolated region (Burma).

On the basis of the structure of their equatorial chambers (the distal annular stolon disappears and the annular septum turns into radial one), and of the complexity of their microspheric juvenarium, Nemkovellae can be derived from Proporocyclinae and they can be regarded as the most ancient Discocyclinidae of the Tethys from which Discocyclinae with annular (proximal) stolons evolved (table 2). With the microspheric juvenarium gradually becoming simple these forms lived until the end of the Eocene. No information is available about the descendants of Discocyclinidae, presumably they became extinct without offsprings since forms with similar microspheric juvenarium are not known from the ensuing period.

The microspheric juvenarium that is characteristic of familiy Asterocyclinidae can be found in the case of the Late Cretaceous Lepidorbitoides and the Oligo—Miocene Lepidocyclinae as well.

In spite of this, Asterocyclinidae cannot be considered to be the offsprings of Lepidorbitoides or the ancestors of Lepidocyclinae, since the most ancient Asterocyclinidae ("Hexagonocyclina" and *Orbitoclypeus barkeri* from the American Paleocene) are far more primitive than the developed Lepidorbitoides of the Late Cretaceous similarly, the ancestors of Lepidocyclinae, Helicostegina and Helicolepidina, are even far more primitive than the most primitive Asterocyclinidae known so far. Therefore it is quite possible to think of common or closely related (rotaloid) ancestors in case of these three groups from which in different time but in a similar way did the Lepidorbitoides, Asterocyclinidae and Lepidocyclinae evolve.

Orbitoclypei seem to be the most ancient members of the family. On the basis of the data available so far, they may originate from America, since the most ancient American Orbitoclypei *(O. barkeri, O. mestieri)* are more primitive than the first European Orbitoclypeus, *O. seunesi*, as far as their build-up is concerned (see p. 195., too).

Soon, the genus appeared in Europe, too, and compared to the American one it evolved in different ways.

Asterocyclinae can be regarded as descendants of Orbitoclypei, since their morphology is more complex, nevertheless the main features are identical, and also Asterocyclinae appear somewhat later than Orbitoclypei. In most cases the American and Pacific Asterocyclinae have four branches, whereas the Eurasian ones have five. At the same time, in case of the microspheric juvenariums of the Eurasian Asterocyclinae it quite often happens that right after the spiral only 4 rays evolve, the fifth one evolves only later or does not appear at all. Consequently, it is not impossible that Asterocyclinae, too, are of American origin and they got to Europe only later.

In the same way, Neodiscocyclinae (only known from America) may also derive from Orbitoclypei since they are different from the latter ones only in their proximal annular stolon. Also, stratigraphically they occur above Orbitoclypei. Neodiscocyclinae may have evolved from Orbitoclypei in the similar way as Discocyclinae did from Nemkovellae.

No information is available about the offsprings of family Asterocyclinidae.

THE MAIN FEATURES OF THE EVOLUTION OF THE EURASIAN ORTHOPHRAGMINAE

Earlier some paleontologists had already attempted to classify the Eurasian Orthophragminae. The common characteristics of these classifications is that only one or two features were considered while others were disregarded. As a result, on the basis of the external morphology Douvillé (1922) distinguished six different groups, at the same time, considering the embryon type five groups were distinguished by Weijden (1940); also five by Neumann (1958) on the basis of the axial section of the equatorial layer; three by Bieda (1963) on the basis of the dimensions of the equatorial chambers in equatorial section; three by Samanta (1969) considering the test size the character of the embryon and the thickness of the equatorial layer, and finally, four groups were distinguished by Portnaya (1974, 1975) on the basis of the external morphology and the character of the embryon.

On the basis of their classification the latter two authors made an attempt to establish the phylogenetic scheme of the Discocyclinae of India and those of the Crimea, respectively.

Since in the present work the main emphasis was laid upon the examination of the internal morphology, it was necessary to systemize the taxa according to a new order considering the taxonomic marks as complexly as it was possible (see also Less 1983). In the classification the author tried to rely on features in which the origin and the course of evolution are reflected and that are mostly independent from the environmental factors. As there are a lot of common features in the evolution of Orthophragminae, here the main tendencies are discussed features, however, that are characteristic only of particular groups are also indicated. Within particular genera groups were distinguished with regard to the following marks:

- width of the equatorial chambers,
- complexity of the microspheric juvenarium (only at Discocyclinidae),
- character of the megalospheric embryon (only at Asterocyclinidae),
- rosette type (only at Asterocyclinidae).

These features, compared to other ones, are more or less stable within the actual groups, consequently, these seemed to be the best criteria for the distinction of groups.

Within the groups various lineages could be marked out on the basis of the following features:

- shape of the test (for instance the existence or lack of ribs in the case of Discocyclinae and Orbitoclypei respectively),
- character and order of magnitude of the megalospheric embryon,
- character of the adauxiliary chambers,
- shape of the cycles and growth pattern of subsequent annuli.

In the lineages both direct and collateral course of evolution can be observed. If there are only quantitative changes within the direct line the different stages of evolution were considered as the subspecies of the actual species. Such quantitative changes are the following:

- gradual increase of the embryon size,
- slow changing of the embryon's shape (generally the gradual penetration of the protoconch into the deuteroconch — only in the case of Discocyclinidae),
- gradual increase of the adauxiliary chambers in numbers and also their gradual increase in height,
- increase of the equatorial chambers in height and the gradual increase in numbers of the cycles falling to a linear unit, measured from the edge of the embryon.

If the quantitative change turned into qualitative change the new form was taken as new species without distinction as to direct line or collateral line evolution. In our interpretation qualitative changes are as follows:

- rapid changing of the embryon's shape (for instance the formation of the centrilepidine embryon in all cases),
- the changing of the character of the adauxiliary chambers (for instance straight walls turning into arcuate ones),
- the quick change in the growth pattern of the annuli,
- the sudden decrease in width of the equatorial chambers,
- the change of shape of cycles at Asterocyclinidae,
- the rapid change of the rosette type, also at Asterocyclinidae only.

When the phylogenetic links were marked out the moments of the occurrences of actual forms and their relation in time also played an important role.

To sum up, the following trend are characteristic of the evolution of Orthophragminae:

1. The slow degeneration, simplification (nepionic acceleration) of the microspheric juvenarium,
2. the gradual increase of the megalospheric embryon in size,
3. the gradual penetration of the protoconch into the deuteroconch (only at Discocyclinidae),
4. the increase of the adauxiliary chambers in numbers,
5. the increase of the adauxiliary chambers in size (mainly their height),
6. the change in the character of the adauxiliary chambers: chambers with straight walls turn into chambers with arcuate walls (only at Discocyclinidae),
7. the equatorial chambers grow bigger and bigger (first of all higher and higher),
8. in connection with the previous character fewer and fewer annuli fall to a linear unit, measured from the edge of the embryon,
9. the growth pattern of the annuli becomes more and more complex,
10. the circular cycles turn into undulated and then into asteroidal ones (only at Asterocyclinidae),
11. ribbed forms evolve from unribbed ones,
12. the pillars become differentiated as per size (only at Asterocyclinidae),
13. the test size gradually increase (in this respect a very important role is played by environmental factors, too).

THE DETERMINATION OF EURASIAN ORTHOPHRAGMINAE

In the present work the determination of Orthophragminae is based first of all on the internal morphology. Among the external features only ribs, asteroidal shape and the type of the rosette were taken into account, since these festures, according to our examinations, are not the results of ecological factors.

On the basis of the differences in the internal and external qualitative features (ribs, asteroidal shape, rosette type, embryon type, character of the adauxiliary chambers, width of the equatorial chambers, shape of cycles, growth pattern of the annuli) the specimens of the samples were assigned to populations, that, at the same time, corresponded to various species within the sample. On each specimen of the actual population certain quantitative features were measured. In the case of megalospheric specimens the features P_1, P_2, D_1, D_2, a, N, L, H, l, h, $n_{0.5}$ and $n_{1.0}$ discussed in details in the morphological part were the following. By knowing P_1, P_2 and D_1, D_2 the values of P, D, Q were calculated and from P_2, D_2 and a the values of R and E were calculated. Among the formerly listed quantitative features the measurement of eight ones, on the one hand, is not too subjective, and on the other hand, they give essential information concerning the stage of evolution within the species, that is, the evolution of these quantitative features is relatively rapid. These features are as follows: E, R, Q, P, D, N, H and $n_{0.5}$.

In the case of all eight features the arithmetical means, the standard deviation and the 95 percent confidency interval, characteristic of the population were calculated.

The arithmetical means were calculated as usual:

$\bar{x}=\frac{\sum\limits_{i=1\to n} x_i}{n}$, were $\bar{x}$ is the calculated arithmetical mean, x_i is the value measured on the specimens, n is the number of the examined specimens. Species with centrilepidine embryon were not treated like this, their $\overline{E}$ values were taken as 0 in advance, since it cannot be decided in this case whether the values of E are positive or negative.

While calculating the standard deviation and confidency it had to be taken into consideration that each population examined is a so-called "small sample", that is, the calculations were carried out in a different way as compared to those usual in the case of "large samples". The standard deviation of "small samples" can be calculated similarly to that of "large samples" but considering the so-called Bessel-correction, multiplying by $\sqrt{\frac{n}{n-1}}$.

So the standard deviation is calculated as follows:

$$\sigma=\sqrt{\frac{n}{n-1}}\cdot\sqrt{\frac{\sum\limits_{i=1\to n}(x_i-\bar{x})^2}{n}}=\sqrt{\frac{\sum\limits_{i=1\to n}(x_i-\bar{x})^2}{n-1}}.$$

The variability of the given population can be characterized by the value of V counted as $V=\frac{\sigma}{\bar{x}}$.

The calculation of the confidency in the case of "small samples" can be carried out by considering the Student function. The values of this for 95 percent confidency is tabulated below (n is the number of the examined specimens, τ_n is the corresponding value of the Student function devided by $\sqrt{n}$):

n	τ_n	n	τ_n	n	τ_n	n	τ_n	n	τ_n
2	8.986	10	0.715	18	0.497	26	0.403	34	0.349
3	2.484	11	0.672	19	0.482	27	0.395	35	0.343
4	1.590	12	0.637	20	0.468	28	0.387	36	0.338
5	1.242	13	0.604	21	0.455	29	0.380	37	0.333
6	1.050	14	0.577	22	0.443	30	0.373	38	0.329
7	0.925	15	0.554	23	0.432	31	0.366	40	0.320
8	0.836	16	0.533	24	0.422	32	0.360	42	0.312
9	0.768	17	0.514	25	0.412	33	0.354	46	0.297

So the calculation of the 95 percent confidency is:

$$\varrho=\sigma\cdot\tau_n.$$

In the above table it is observable that if n is very small, τ_n is very high. Therefore the above way of calculation was used only when $n\geq 4$. If n was between 1 and 3, the confidency was not determined.

Knowing confidency (ϱ), it was possible to determine in the population the 95 percent confidency interval of the actual quantitative feature's arithmetical mean which is between $\bar{x}-\varrho$ and $\bar{x}+\varrho$.

The knowledge of the confidency interval is important because with its help it can be established that even if we could have examined infinitely numerous specimens, the arithmetical mean of the actual quantitative feature would have fallen into the given confidency interval although of course not with 100 but with 95 percent probability.

The equatorial sections of forms "B" and the axial sections are rare so they cannot be used for the examination of populations. Their identification was carried out on the basis of qualitative features.

Reverting to the equatorial section of forms "A": As the 8 selected quantitative features were examined in case of each population the populations, that had the same qualitative features (populations of the same species), but came from samples of different ages, were compared with respect to their quantitative features. In my experience the most suitable feature for comparison is the average diameter (D) of the deuteroconch, since its determination, along with P, is the most objective, its variability (12.6% on the basis of 103 populations) is the smallest after $n_{0.5}$ and Q, and its evolution with time is the quickest. Among the other quantitative features the evolution of P is slower, its average variability (15.7% on the basis of 98 populations) is greater. The determination of E, R and Q values are more complicated, consequently it is more subjective as well. Their evolution is slower, though the variability in the case of Q is smaller (10.9% on the basis of 98 populations). The variability of E and R increases in dependence on their values, however, the absolute value of the standard deviation remains relatively constant (on the basis of 98 populations it is 0.142 in the case of E and 0.135 in the case of R, on average).

Theoretically, the determination of the N values should be more objective than that of the D values. In reality, this is not the case, since the radial septa of the adauxiliary chambers are sometimes not easy to make out. In addition, their evolution is slower, since, though very slowly, the width (L)

Az Orthophragminák határozótáblázata

Table for the determination of Orthophragminae

Taxa			Shape and surface of the test	Type of the rosette	The equatorial section of the forms "A": The embryon: Characteristic type	The embryon: $\bar{P}$ (µm)	The embryon: $\bar{D}$ (µm)	The adauxiliary chambers: Characteristic type	The adauxiliary chambers: Number ($\bar{N}$)	The adauxiliary chambers: $\bar{H}$ (µm)	The equatorial chambers: Characteristic width (l—in µm)	The equatorial chambers: The cycles: Shape (s.c.)	The equatorial chambers: The cycles: Growth pattern (g.p.)	$\bar{n}_{0.5}$
Discocyclina	*archiaci*	*bakhchisaraiensis*	d	D	q (n)	125—165	220—280	a	19—25.5	45—65	35—45	k	a	10.5—13.0
		staroseliensis	d	D	q (t)	155—185	280—350	a	23—28	50—60	35—40	k	a	10.0—11.0
		archiaci	d	D	t (q)	180—240	350—500	a	26—36	55—72	35—45	k	a	8.0—10.5
		bartholomei	d	D	t	230—450	500—900	a	35—55	55—90	35—45	k	a	7.0—9.5
	furoni		d	D	q	105—155	180—300	a	16—24	40—55	30—40	k	a	10.0—13.0
	discus	*discus*	d	D	u	470—600	900—1200	a—p	65—95	100—135	35—45	k	a (p)	5.0—5.8
		dudarensis	d	D	u—x	510—750	1200—1950	p (a)	78—95	100—165	35—50	k	p (a)	4.5—5.8
	weijdeni		d	D	t (q)	220—290	400—520	a (p)	40—48	80—90	25—35	k	a (p)	6.5—7.5
	senegalensis		d	D	t—q	225—415	500—730	p	29—35	60—78	35—45	k	p (t)	6.3—10.0
	javana		d	D	p	420—650	930—1400	p	55—90	125—180	35—40	k	p	4.0—5.5
	pseudoaugustae		d	D	p	220—350	460—670	a	35—50	55—70	35—45	k	a	8.0—9.5
	fortisi	*fortisi*	d	D	c	290—450	600—800	a	50—65	70—95	40—45	k	a	5.5—8.5
		simferopolensis	d	D	c	400—500	800—950	a (p)	55—77	78—90	35—50	k	a	6.5—8.0
	stratiemanuelis		d	D	c	420—620	870—1150	p (a)	53—80	70—200	35—50	k	p (a)	4.7—7.5
	spliti	*spliti*	d	D	c	350—450	800—1200	a—p	50—70	80—100	35—45	k	y	6.0—7.5
		ajkaensis	d	D	c	500—650	1200—1440	p (a)	80—90	115—150	35—45	k	y	5.8—6.6
	broennimanni		d	D	n (s)	55—80	90—130	a	8—13	27—45	20—30	k	t	13.0—16.0
	augustae	*sourbetensis*	d	D	n—s	60—90	90—125	a	7—11.5	25—40	25—30	k	t—s	12.0—18.0
		atlantica	d	D	n (q)	70—107	125—160	a	11—15.5	30—40	25—30	k	s (t)	12.5—16.5
		olianae	d	D	q (n)	90—115	160—200	a	15—20	35—50	25—30	k	s	12.0—16.0
		augustae	d	D	q (n)	100—130	200—250	a	18—25	33—60	25—30	k	s (p)	11.0—15.0
	knessae		b	D	n	60—90	115—180	a	12—16	32—50	20—25	k	t—s	12.0—15.0

Discocyclina	*dispansa*	*ganensis*	d	D	n (q)	60—90	115—160	a	10—15	30—45	25—30	k	t—s	15.5—19.0
		taurica	d	D	q—n	90—110	160—200	a	15—23	32—47	25—30	k	s	12.5—14.5
		nussdorfensis	d	D	q (n)	115—160	200—250	a	19—28	32—50	25—30	k	s—v	11.5—14.2
		hungarica	d	D	q (n)	140—200	250—320	a	25—32	50—65	25—30	k	s (v)	12.0—14.5
		sella	d	D	q	145—215	320—400	a	30—38	50—70	25—30	k	s—v	10.0—13.5
		dispansa	d	D	t (q)	150—230	400—500	a (p)	33—48	50—75	25—35	k	s—a	8.0—12.0
		umbilicata	d	D	t (q)	210—300	500—700	a—p	40—52	55—90	25—40	k	a—p	6.0—9.5
	kingae		p	D	n—q	112—140	210—242	a	17.7—20.5	50—60	30—40	k	s—v	10.3—11.7
	radians	*noussensis*	b	D	q	100—150	175—280	a—p	15—25	55—65	25—30	k	p (v)	9.0—10.5
		radians	b	D	q	135—185	280—380	p	24—32	65—85	20—30	k	p	8.0—9.5
		laballanensis	b	D	t—q	200—285	380—540	p	24—35	85—115	25—35	k	p	5.5—7.2
	nandori		b	D	q (t)	100—170	200—300	p	17—23	55—75	20—25	k	t—p	7.5—11.0
	trabayensis	*trabayensis*	d	D	s (n)	50—70	75—100	v	3.5—6.5	20—30	25—35	k	t	14.0—21.0
		concentrica	d	D	n (s)	55—75	90—120	v	6.5—9	20—30	25—35	k	s—t	15.5—20.0
		vicenzensis	d	D	n	60—90	120—160	v	9—11	25—40	25—30	k	s—t	14.0—18.5
	aaroni	*chalossensis*	d	D	n (q)	85—105	150—190	v	15—20	35—55	25—30	k	s	12.5—15.5
		aaroni	d	D	t	90—175	220—350	v—p	21—27	55—90	30—35	k	s—p	8.5—12.5
	euaensis		d	D	q—t	130—195	300—530	p	25—35	65—100	25—35	k	p	6.5—8.0
	pratti	*aquitanica*	d	D	q (t)	130—190	200—320	p	17—27	45—65	20—30	k	p	9.0—12.0
		montfortensis	d	D	t—q	160—220	320—425	p	25—36	55—80	20—30	k	p	6.5—9.0
		pratti	d	D	t—u	175—260	425—600	p	33.5—42.5	70—100	25—30	k	p	6.8—8.2
		minor	d	D	x (p)	330—430	750—1000	p	55—65	110—150	25—35	k	p	4.7—6.0
	samantai		b	D	x	280—440	670—940	p	43—67	90—125	25—35	k	p	4.2—5.4
	pulcra	*landesica*	d	D	c	225—420	390—750	p	25—50	40—100	25	k	p	6.0—10.5
		pulcra	d	D	c	370—600	750—1200	p	38—90	100—190	25—35	k	p	3.6—6.0
		balatonica	d	D	c	650—765	1200—1500	p	79—90	205—227	30—45	k	p	3.4—3.8
		baconica	d	D	c	850—1030	1500—1800	p	85—100	225—265	35—40	k	p	2.8—3.2
Nemkovella	*evae*		d	D—c	n (s)	100—180	170—210	v	10—15	40—55	30—50	k	a (s)	11.0—17.5
	fermonti		d	D—c	s—n	70—100	105—140	v	7—12	25—45	30—40	k	s	14.5—19.0

Genus	Group	Taxa	Shape and surface of the test	Type of the rosette	The equatorial section of the forms "A" — The embryon: Characteristic type	P̄ (μm)	D̄ (μm)	The adauxiliary chambers: Characteristic type	Number (N)	H̄ (μm)	The equatorial chambers: Characteristic width (l — in μm)	The cycles: Shape (s.c.)	The cycles: Growth pattern (g.p.)	$\bar{n}_{0.5}$
Nemkovella	*strophiolata*	*bodrakensis*	d	D–c	s	45–70	65–125	v	3.5–6.5	20–35	35–45	k	s	15.0–22.0
		strophiolata	d	D–c	n–s	85–118	125–180	v	8–11.5	32–45	25–35	k	s	16.5–20.0
		tenella	d	D–c	n (q)	100–160	180–250	v	10–15	40–55	30–40	k	s	14.0–18.0
Orbitoclypeus	*seunesi*		d	D–m	e (t)	110–160	200–270	v	18–21	40–60	25–30	k	v	11.0–14.0
	ramaraoi	*ramaraoi*	d	m	n (e)	80–120	135–165	v	13–17	25–40	25–30	k	v (s)	15.5–17.5
		neumannae	d	m	e	90–150	165–220	v	12–24	37–48	30–35	k	v (s)	12.0–17.5
		suvlukayensis	d	m	e–x	120–150	220–280	v	19–24	42–53	30–40	k	v	11.0–14.0
		crimensis	d	m	x (e)	135–240	280–400	v	28–40	45–75	30–40	k	v	9.0–13.0
	marthae		d	m	x (e)	124–230	260–400	v	30–38	42–60	30–40	h	v	11.0–15.5
	multiplicata		h	m	e (x)	150–225	280–400	v	25–36	35–50	30	h	v	10–16
	bayani		e (c)	m	x (e)	130–210	245–360	v	25–40	40–65	30–45	h	v	10.0–12.5
	douvillei		d	c	e	75–165	130–350	v	14–20	35–65	30–50	k	t	10.0–17.0
	portnayae		d	m	e	60–80	115–155	v	10–14.5	25–37	30–35	h	v–t	13.0–17.5
	varians	*horsarrieuensis*	d	m	e–q	75–110	140–200	v	12–20	30–45	25–30	h	v	13.0–20.0
		angoumensis	d	m	e–x	120–150	200–250	v	22–28	40–50	25–35	h	v	12.0–16.0
		roberti	d	m	x (e)	145–175	250–320	v	25–30	50–60	30–35	h	v	11.0–13.0
		scalaris	d	m	x (e)	180–220	320–400	v	28–35	50–65	30–40	h	v	10.5–13.0
		varians	d	m	x (e)	200–300	400–580	v	32–48	52–70	30–45	h	v	9.0–12.0
	furcata	*rovasendai*	e	m	x	140–170	270–340	v	27–32	48–60	25–35	h	v	10.0–15.0
		furcata	e	m	x	140–200	340–480	v	31–41	60–75	30–40	h	v	8.5–13.0
	chudeaui	*chudeaui*	d	c	t	150–200	280–400	v	18–30	60–100	40–50	k	v	8.0–11.0
		pannonicus	d	c	t	165–265	400–500	v	19–28.5	80–120	40–55	k	v	7.0–8.5
	katoae		b	c	n–q	185–230	360–405	v	16.5–20	60–72	35–45	k	s	9.0–10.5
	schopeni		d	c	x	180–500	350–850	v	25–45	60–125	35–55	k	v	5.0–8.5

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Orbitoclypeus		*koehleri*	d	c	x (c)	200—300	525—750	v	35—52	60—85	45—60	h	v	5.6—7.6
		daguini	d	c	i—s	25—60	40—85	d	0—3	15—25	25—30	k, h	s	18.0—30.0
Asterocyclina		*pygmaea*	d	c	n	40—75	50—150	v	7—12	30—45	20—35	k, h	v	12.0—15.5
	stella	*taramellii*	c	m	n—s	60—110	90—140	v	5.5—12	22—40	20—30	c	s	17.0—23.0
		stella	c	m	s—n	100—140	140—180	v	8—12	30—40	20—35	c	s	17.0—23.0
		praestellaris	c	m	s	140—220	180—300	v	10—17	45—65	25—40	c	s	11.0—17.0
	stellata	*adourensis*	c	m	s—n	70—100	100—125	s	3—5	32—50	25—35	c	s	17.0—22.0
		stellata	c	m	n—s	84—104	125—160	s	3—5.4	35—50	20—35	c	s	18.0—22.0
		stellaris	c	m	n—s	95—145	160—200	s	3—7.3	42—62	20—35	c	s	14.0—19.7
		priabonensis	c	m	n (q)	100—145	160—230	v (s)	9—15	35—60	25—30	c	s	13.0—18.0
		kecskemetii	c	c	n—s	100—200	125—320	v (s)	5—12	45—60	25—35	c	s	11.0—18.0
	alticostata	*gallica*	c	c	i (s)	120—180	160—220	l (v)	2—7	35—40	30—40	c	s	11.0—18.0
		cuvillieri	c	c	i (s)	180—220	220—280	l	2—3.4	40—55	30—45	c	s	11.0—14.5
		alticostata	c	c	i (s)	220—300	280—360	l	3—4.5	50—60	35—45	c	s—v	9.0—12.0
		danubica	c	c	i (s)	300—380	360—450	l	3—5	55—70	35—45	c	v	9.5—11.0
		schweighauseri	c	c	s—i	175—350	250—500	l (v)	3—11	45—70	40—50	a	v—s	8.0—13.0

A váz alakja és felülete: *b* = diszkosz (korong) alakú, bordázott, *c* = csillag alakú, *d* = diszkosz (korong, lencse) alakú, sima felületű, *e* = nagyjából diszkosz (korong) alakú, bordázott, melyek a széleken elágaznak (bifurkálnak), *h* = lencse alakú, hullámos gallérú, *p* = diszkosz (korong) alakú, radiális sorokba rendeződve pontozott. A rozetta típusa: *c* = „chudeaui"-típusú, *D* = „Discocyclina"-típusú, *m* = „marthae"-típusú. Az A-generációs embrió jellemző típusa: *c* = centrilepidin, *e* = eulepidin, *i* = isolepidin, *n* = nephroiepidin, *p* = polylepidin, *q* = semi-nephrolepidin, *s* = semi-isolepidin, *t* = trybliolepidin, *u* = umbilicolepidin, *x* = excentrilepidin. Az adauxiliáris kamrák jellemző típusa: *a* = „archiaci", *d* = „daguini", *l* = „alticostata", *p* = „pratti", *s* = „stellata", *v* = „varians". Az equatoriális kamrák ciklusainak alakja: *a* = csillag alakú 6—8 sugárral, *c* = csillag alakú 5 (6) sugárral, *h* = hullámos 6—8 hullámmal, *k* = koncentrikus körök. Az equatoriális kamrák ciklusainak növekedési jellege: *a* = „archiaci"-típusú, *p* = „pulcra" típusú, *s* = „strophiolata"-típusú, *t* = „trabayensis"-típusú, *v* = „varians"-típusú, *y* = „spliti"-típusú.

The shape and surface of the test: *b* = discoidal (lenticular), ribbed, *c* = asteroidal, *d* = discoidal (lenticular), unribbed, *e* = approximately discoidal with bifurcating towards the edges ribs, *h* = lenticular, with undulated collar, *p* = discoidal with dots arranged in radial pattern. The rosette type: *c* = "chudeaui", *D* = "Discocyclina", *m* = "marthae". Characteristic type of the "A" generation embryon: *c* = centrilepidine, *e* = eulepidine, *i* = isolepidine, *n* = nephrolepidine, *p* = polylepidine, *q* = semi-nephrolepidine, *s* = semi-isolepidine, *t* = trybliolepidine, *u* = umbilicolepidine, *x* = excentrilepidine. Characteristic type of the adauxiliary chambers: *a* = "archiaci", *d* = "daguini", *l* = "alticostata", *p* = "pratti", *s* = "stellata", *v* = "varians". The shape of the cycles (s.c.): *a* = asteroidal with 6 to 8 rays, *c* = asteroidal with 5 (6) rays, *h* = undulated with 6 to 8 waves, *k* = circular. The growth pattern (g.p.) of the cycles: *a* = "archiaci", *p* = "pulcra", *s* = "strophiolata", *t* = "trabayensis", *v* = "varians", *y* = "spliti".

of the adauxiliary chambers increases with the age, their variability is also greater than that of the D values (15.3% on the basis of 89 populations). The variability is even greater, 24.2% on the basis of 12 populations, in the case of *Asterocyclina stellata* and *A. alticostata,* since their N values are very small. The determination of H an $n_{0.5}$ values is the most subjective, since it is up to the measuring person where to measure among the many possible places. Their evolution is slower too, and also the average variability of the H values (14.3% on the basis of 104 populations) is great. The average variability of the $n_{0.5}$ values is 11.0% on the basis of 99 populations.

I chose D for comparison in spite of the fact that in case of Orbitoidal Foraminefera other parameters are used for this purpose.

In case of the European Lepidorbitoides GORSEL (1975) used the values of N along with other parameters that cannot be measured in the case of Orthophragminae. Nevertheless, the number of adauxiliary chambers of Lepidorbitoides are much lower than those of Orbitophragminae and in most cases they are well discernable, too.

In the distinction of Lepidocyclinae (VLERK 1973, VESSEM 1978) the main criterion is the degree of enclosure of the protoconch by the deuteroconch that is given in percentage, and which, essentially, corresponds to the described parameters marked by R and E. The limits of their application were discussed earlier. Device for measuring the enclosure percentage is not at our disposal. It is not likely, however, that this could be suitable for the distinguishing of various evolutional stages (subspecies) of certain Orthophragmina species, since the embryons of a great many species (for instance *Discocyclina fortisi, D. pulcra,* the most of Orbitoclypei and Asterocyclinidae) do not change with time. In spite of the fact that the D values have been treated with extra emphasis, other quantitative features also have some importance, for instance, they are suitable for showing the variability between populations of the same species and also they provide a chance for checking.

On the basis of the tendency of increase in the $\bar{D}$ values in time, within certain species, that are different in their qualitative features, various evolutional stages (subspecies, that are different only in their quantitative features) could be distinguished using biometric limits. These limits were necessary, in order to make the taxonomic classification of the otherwise "quiet" period of evolution possible, on the basis of the existing nomenclatural rules. We tried to determine the boundaries between the various evolutional stages (subspecies) as expediently as possible so that they could give a sound basis for the most accurate stratigraphic classification, and so that the confidency intervals of the values, even in case of a moderate number of specimens (6—10), could be roughly within the limits of the actual subspecies.

Since the average standard deviation of the D values within one population is 12.6 percent of $\bar{D}$ that is approximately the same as the confidency if n is, 6 to 7. The average confidency interval of the $\bar{D}$ values in this case is approximately 25 percent of $\bar{D}$. Therefore, between the biometric limits, there is at least 25 percent difference in each case.

However, the question arises that what impact could the ecologic factors exercise on the evolution of the $\bar{D}$ values. Nothing can be established for sure concerning these factors. It is a fact, however, that in the Bakhchisaraian section, we examined, the $\bar{D}$ values were steadily increasing within the species although various kinds of rock (clay, marl, limestone) occurred there and in addition, the depth of their deposition were different as well (on the basis of the accompanying fauna). No contradictions have been found in the $\bar{D}$ values of the other examined populations, either.

Here the nomenclatural problems are of special importance. As the determination of Orthophragminae was carried out on the basis of principles, differing from the earlier ones, it was necessary to revise the whole literature on the subject. In this revision we tried to "sacrifice" the smallest number of names, introduced earlier. Unfortunately enough, the major part of the taxa was described in the last century, in most cases without depiction of the internal structure. This shortage has often been found in the literature of this century, too. The determinations that have no internal depiction even up to this day as unidentifiable, had to be definitely ruled out. The major part of those names, to which internal morphological depiction has been added since the first description but not of specimens coming from the type locality had to be ruled out as well because there are serious contradictions in their usage. They could be retained ("furcata", "strophiolata", "tenella") only if no better names could be found among the names already introduced in the literature. Some names had to be abolished for priority reasons. In one or two cases, names had to be ruled out because they were not used for more than fifty years and, since they were forgotten (nomen oblitum), other names became widely used (for instance "augustae" instead of "applanata").

If a taxon was described (not as a later synonym) and the description was accompanied by depiction of the internal morphology as well or later someone else gave such of a topotypical specimen, the denomination could be, of course, conserved.

Table 3. makes the quick orientation possible among the taxa. The genera can be distinguished using the following key:

1. The equatorial chambers are 6 stoloned, they are rectangular .... genus Discocyclina

2. The equatorial chambers are 4 stoloned, slightly hexagonal:
  a) The cycles are asteroidal .... genus Asterocyclina
  b) The cycles are circular or undulated:
    α) The juvenarium of forms "B" bears "Heterostegina" character (an additional feature that very rarely occurs in the β case: the embryon of forms "A" is of the nephro- or semi-isolepidine type) .... genus Nemkovella
    β) The juvenarium of forms "B" bears "Lepidocyclina" character (an additional feature, that never occurs in the α case: the most frequent embryon types of forms "A": excentri-, eu- and trybliolepidine) .... genus Orbitoclypeus.

The descriptions of the taxa serve to check. There detailed explanation is provided, too.

In the description given in the present work of the taxa the specimen that was first depicted internally from the type locality or, lacking specimen from the type locality, from other locality served as basis. These specimens are listed at the beginning of the description as holo- or lectotypes, or, in case these two do not have internal depictions the author marked out the type of the equatorial section of forms "A" on the basis of bibliographic data, or from our own material if bibliographic data were not available. In each case it was taken that the D value would be characteristic of the taxon. Thus the old denominations can be used in the case of the new methods of determination, too, became.

Among the 91 taxon-names 49 are old, 42 are new. Among the names of forms, described as species, 33 names are old, 14 are new, whereas among the names of forms described as subspecies 16 names are old and 28 are new.

THE METHOD OF PREPARATION

The weight of the individual samples collected in the field, is determined by the abundance of Orthophragminae in them. In the present writer's experience sediments of high carbonate-content contain the greatest number of Orthophragminae, i.e. it is unlikely that we need samples weighing more than 1 kg. In each case I tried to take samples from the more marly parts of the rock. In this case the samples can be washed and isolated specimens can be obtained, the internal as well as the external features of which are easy to examine. Low-carbonate and silty materials contain much less Orthophragminae, and the number of species found in them is rather low, too. In this case samples over 1 kg have to be collected.

After the traditional way of washing, the external features of the isolated specimens are the most expedient to examine, using a binocular microscope. While examining the rosette a short corrosion (max. 1 min.) by means of hydrochloric acid (5%) was of great use in certain cases.

To uncover the equatorial layer I used a new technique that was outlined earlier (Less 1976, 1981a). Its essence is the following: Instead of the traditional long and meticulous process of producing thin sections I chipped the Orthophragminae specimens exposing radial force to them by universal pliers so that the equatorial layer should be perpendicular to the pliers' jaws.

The advantage of this method is that the productivity of uncovering the equatorial layer significantly increases, and in 75—80% of the cases we get the exact median plane as section plane (no tangential sections are obtained) and, in addition, the two halves enable us to use them for further examination of the external features as well. The only disadvantage of the method is that significant parts of the edges may be chipped off from the test but, as the most important taxonomic marks (embryon, chambers around the embryon) can be found at the centre of the test, the identification is not affected significantly.

Essentially, the technique is the same as that used long since in case of Nummulites. The reason why it has not been widely used yet is that right after obtaining the chipped surface only specimens with empty tests or tests filled with coloured material (limonite, glauconite) can be examined. However, in the majority of the cases the calcite test itself is filled with secondary calcite which can be porous or sparitized as well. In both cases purple ink was used that soaks into the secondary calcite (in case of porous calcite) or permeates between the two calcite generations (in case of sparitized calcite), thus making visible the structure of the equatorial layer. The advantage of using the purple ink is that after rinsing the sample in water only the unnecessary part of ink is washed away, whereas the portion that was permeated stays. In order to get a better contrast, Orthophragminae having empty tests or filled with glauconite were also painted.

The examination of the equatorial layer was carried out using a binocular or ore microscope. In order to get rid of the disturbing refractional phenomena drops of water were put on the tests filled with secondary calcite.

To uncover the equatorial layer this method can be used not only in case of Orthophragminae but it seems to be suitable for uncovering other orbitoidal Formanifera as well. Using the technique, successful attempts were carried out in case Lepidocyclinae as well (Less 1981a).

To obtain axial sections the only way is the traditional polishing of the specimens. I examined only spontaneously broken axial sections.

THE METHOD OF PHOTOGRAPHING

To obtain photomicrographs on Orthophragminae is not easy, since the task is to make very fine details visible on a relatively large surface. Most of the photos on the tables were taken by the present author. The photos showing the external view of the tests were partly taken in Moscow using an FMN—2 type palaeontological camera and sheet film, partly in Budapest by Miss I. Laky (pl. II, fig. 9, pl. IV, fig. 6, pl. V, fig. 4, pl. VI, fig. 4, pl. VII, fig. 10, pl. VIII, fig. 10, pl. IX, fig. 3, pl. XIV, fig. 9, pl. XVII, fig. 9, pl. XXI, figs. 4, 11—13, pl. XXIII. fig. 1., pl. XXV, fig. 1, pl. XXVI, fig. 5, pl. XXXII, figs. 5—6, pl. XXXIV, fig. 11, pl. XXXV, fig. 7, pl. XLI, fig. 9, pl. XLIII, fig. 1 and pl. XLIV, fig. 10.) in the Micropalaeontological Laboratory of the Hungarian Geological Institute through microscope, using 24×36 mm film.

The most difficult was to obtain photographs on the equatorial and axial sections. The best photomicrographs on Orthophragminae with empty tests were taken using the FMN—2 type set, mentioned above, since this camera possesses the biggest depth of focus. However, the drawback of this set is the relatively small enlargement (max. ×22) and, as a result, the small resolving power. More resolving power but smaller depth of focus are characteristic of the Zeiss metallurgical microscope of the Machine Factory (DIGÉP) in Diósgyőr and the POLMI type ZEISS microscope with ore-microscope complement of the Hungarian Geological Institute. The latter two sets gave the best result in case of microspheric Orthophragminae with filled tests.

Most of the photographs were taken by using the POLMI type microscope. Therefore this method is outlined in details. The equatorial section embedded in plastilin has to be set parallel with the objective table with the help of a mounting device and, if necessary, water has to be dropped on the section. I used 17 DIN Forte film that gave the most contrastive, and at the same time properly shaded, photographs when we used green filter and tightened the objective window as much as possible. However, due attention has to be paid to the following: the time of exposure should not exceed 1 minute because on the one hand too much oil soaks into the test from the plastilin, and on the other hand the water drop evaporates to such extent that the sharpness of the photograph is endangered.

Some of the examined samples the material from the USSR and Hungary is the present writer's own sampling, the other samples come (from Bulgaria, Austria, Italy and France), from the collection of the Museum of Natural History (Budapest), these were kindly made available for me by Mr. T. KECSKEMÉTI. Sampling from profiles could be carried out in the Crimea, in Csékúti-árok at Ajka and in the cut of the stream called "Kántorkerti-patak" at Dunaszentmiklós. Other samples can be regarded as items of sporadic sampling.

CRIMEAN PENINSULA

The well-known and properly described Eocene beds of the Crimean Peninsula deserve to be considered as the stratotypical section of the Eocene of the southern regions, of the USSR because of undisturbed position (deeping only 3°N), abundance and completeness of their fauna. According to the subdivision of the Crimean Eocene by MURATOV—NEMKOV (1960) is divided into 4 stages, namely, the Bakhchisaraian, Simferopolian, Bodrakian and Almaian stages. The beds of the Bakhchisaraian stage overlie transgressively the Kachian stage of the Paleocene and, from then on the sequence is continuous.

The present writer sampled in the Crimea in 1974 and 1975. First, in 1974, only the lowermost 3 m of the Simferopolian stage was examined in the stratotypical section of the Suvlu-Kaya Hill to the N of Staroselie (near Bakhchisarai) (text-fig. 16. — samples marked by E) and 5 kms from here to the E-NE on the hill above the village called Ulakli (samples marked by U).

In 1975 approximately at 0.75 m intervals the whole section of the Suvlu-Kaya Hill was sampled (samples marked with B), and also the continuation of the section (also a stratotypical profile) on the right bank of the river Alma (samples marked with A). In addition samples were obtained from the left bank of the river Bodrak as well (samples marked with C).

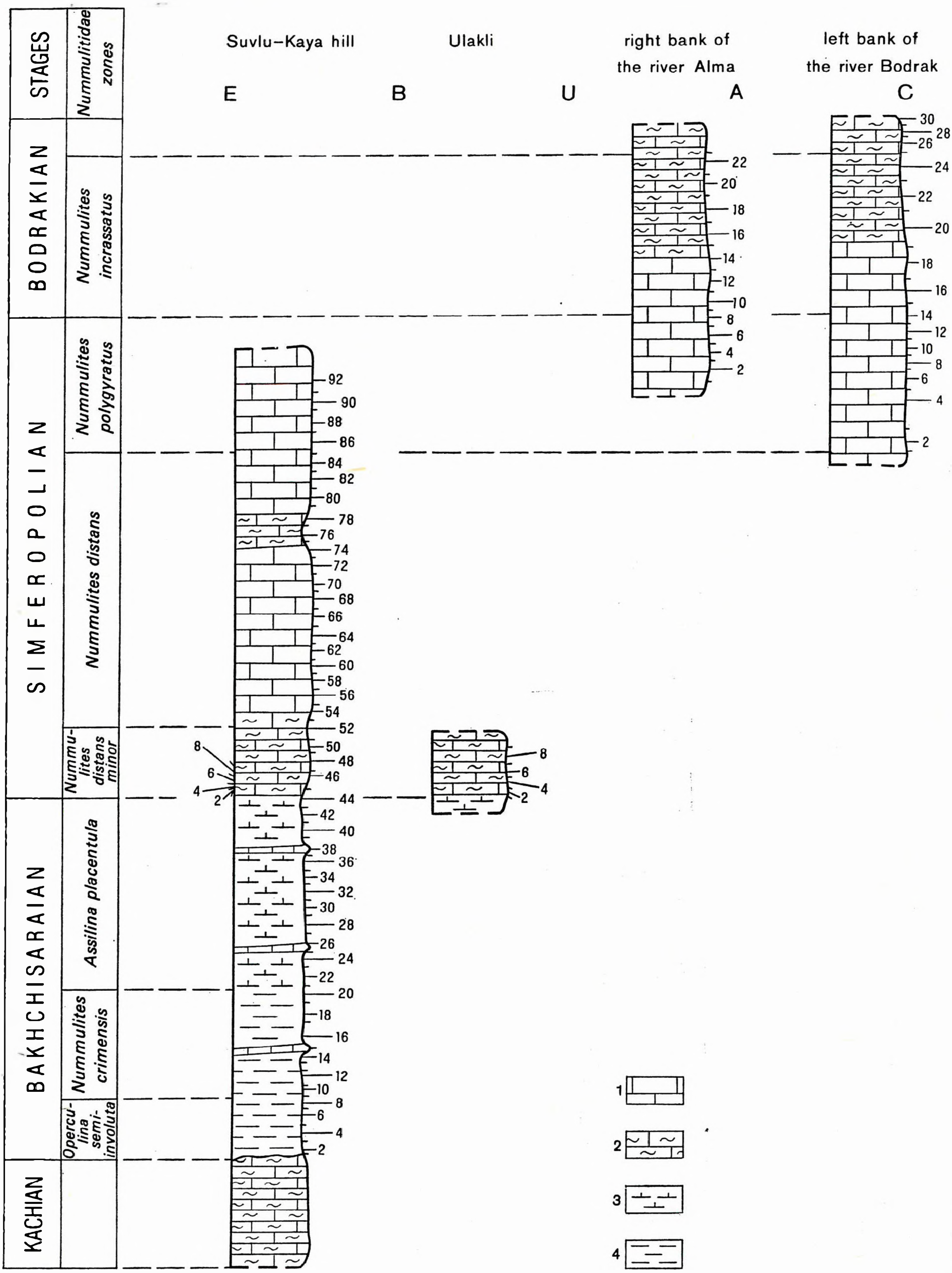
In the Crimean Eocene the Nummulitidae were described by NEMKOV—BARKHATOVA (1961), NEMKOV (1967), GOLEV (1971) and SCHAUB (1981), the Orthophragminae by PORTNAYA (1974) while the calcareous nannoplankton and the Planktonic Foraminifera were described by KAPELLOS (1973) and NEMKOV—SHUTSKAYA (1971), respectively.

Bakhchisaraian stage (populations OS, CR, CP, PA, PF and partially the population NA)

The stratotypical profile exposes a 33 m thick part of the clay beds of the stage, with some intercalations of nummulitic limestones at the upper part of the profile. The lowermost 0.5 m is rather glauconitic. On the basis of Nummulitidae the stage was divided into 3 parts by NEMKOV—BARKHATOVA (1961). The lowermost 5—6 m thick part is the zone of *Operculina semiinvoluta,* the next 10 m wide one is the zone of *Nummulites crimensis* and the uppermost 18 m thick one is the *Assilina placentula* zone. Our findings show that on the basis of Orthophragminae 4 levels can be marked out within the stage, the uppermost of which extends over to the next (Simferopolian) stage (Table 4.).

Of the *Operculina semiinvoluta* zone (population OS — samples B1—8) and of the lower two-thirds of the *Nummulites crimensis* zone (population CR — samples B9—16) the presence of *Discocyclina archiaci bakhchisaraiensis* is the most characteristic feature.

In the upper one-third of the *Nummulites crimensis* zone and in the lowermost part of the *Assilina placentula* zone (population CP — samples B17—22) the presence of *Discocyclina archiaci staroseliensis* and *Orbitoclypeus ramaraoi suvlukayensis* is characteristic, whereas in the major part of the *Assilina placentula* zone (population PA — samples B23—32 and population PF — samples B33—41) *Disco-*



16. ábra. Mintavételi pontok a Krím-félszigeten

1. Mészkő, 2. márgás mészkő, 3. agyagmárga, 4. agyag

Fig. 16. Places of sampling on the Crimean Peninsula

1. Limestone, 2. marly limestone, 3. clay marl, 4. clay

Az Orthophragminák eloszlása a Krím-félsziget néhány szelvényében (Szuvlu-Kaja-hegy, Alma-folyó jobb partja, Bodrak-folyó bal partja) összesítve

The distribution of Orthophragminae in some section of the Crimea (Suvlu-Kaya Hill, the right bank of the river Alma, the left bank of the river Bodrak), summarized

Local stratigraphical subdivision	Bakhchisaraian			Simferopolian			Bodrakian
Zones of Nummulitidae (by Nemkov et Barkhatova, 1961)	*Operculina semiinvoluta*	*Nummulites crimensis*	*Assilina placentula*	*Nummulites distans minor*	*Nummulites distans*	*Nummulites polygratus*	*Nummulites incrassatus*

	Taxa / European stratigraphical subdivision	Ilerdian		Cuisian			Lutetian
		Middle	Upper	Lower	Middle	Upper	Lower
Discocyclina	*archiaci* (Schlumb.) *bakhchisaraiensis* n. ssp.	—					
	broennimanni n. sp.	—	—				
	furoni Sam.	—	- -	- -	—		
	archiaci (Schlumb.) *staroseliensis* n. ssp.		—				
	pseudoaugustae Port.		—	—			
	archiaci archiaci (Schlumb.)			—			
	fortisi fortisi (D'Arch.)				—		
	weijdeni n. sp.				—		
	pratti (Mich.) *aquitanica* n. ssp.					—	
	fortisi (D'Arch.) *simferopolensis* n. ssp.					— - -	
	archiaci (Schlumb.) *bartholomei* (Schlumb.)					— - -	—
	senegalensis Abr.					— - -	—
	augustae Weijd. *sourbetensis* n. ssp.					— - -	— - - —
	trabayensis trabayensis Neum.					—	
	dispansa (Sow.) *taurica* n. ssp.						—
	pratti (Mich.) *monfortensis* n. ssp.						—
	aaroni chalossensis n. sp. et ssp.						—
	stratiemanuelis Brönn.						— - -
	kingae n. sp.						—
	radians (D'Arch.) *noussensis* n. ssp.						—
Nemkovella	*evae* n. sp.			- -	—	—	
	fermonti n. sp.						—
	strophiolata (Gümb.) *bodrakensis* n. ssp.						—
Orbitoclypeus	*ramaraoi* (Sam.) *suvlukayensis* n. ssp.		—				
	ramaraoi (Sam.) *crimensis* n. ssp.			—	—	—	
	koehleri n. sp.						—
	portnayae n. sp.						—
	cf. *bayani* (Mun.—Chalm.)						—
Asterocyclina stella (gümb.) *taramellii* (Mun.—Chalm.)			—				—

cyclina archiaci archiaci, *D. pseudoaugustae* and *Orbitoclypeus ramaraoi crimensis* are the most frequent taxa. At the top of the stage population NA, that includes the lower part of the next stage as well (samples B42—47, E1—7 and U1—5) the microspheric specimens outnumber the megalospheric ones and, in addition, instead of *Discocyclina pseudoaugustae*, as new taxon, *D. fortisi fortisi* appears here and *D. weijdeni* also can be found.

Simferopolian stage (partially the population NA and the populations NF, DA, DF and PO)

The stratotypical profile discloses a total thickness of 44 m from the rocks of the stage. The material is nummulitic calcareous marl at the bottom (about 7 m) and nummulitic limestone at the top (about 37 m).

The stage is subdivided into 3 parts by NEMKOV—BARKHATOVA (1961), on the basis of Nummulitidae.

The lower 6—7 metres represent the *Nummulites distans minor* (=*Nummulites nemkovi*) zone, the central 25 m the *Nummulites distans* zone and the uppermost 12 m the *Nummulites polygyratus* zone.

On the basis of our examinations three Orthophragminae levels can be established (Table 4). The lowermost one spreads up from the Bakhchisaraian stage and, therefore, its description can be found in the previous part (population NA). This zone includes only the lowermost 1.5 to 2 metres of the stage.

There is a relatively sharp dividing line towards the next Orthophragmina level (*Discocyclina fortisi simferopolensis*), that includes the upper three-fourth of the *Nummulites distans minor* zone (population NF — samples B48—52, E8—9, U6—9) and the lower part of the *Nummulites distans* zone. To determine the upper boundary has not been possible here so far, since above sample B57 up till the level of sample B75 the rock is so hard that it was impossible to isolate Orthophragminae from them. Therefore, temporarily, B53—74 are assigned to the population DA. In addition, to the level-marking taxon, the presence of *Discocyclina archiaci bartholomei*, *D. senegalensis* and *Nemkovella evae* are characteristic, too.

The limestone from which samples B75—78 were obtained is somewhat looser than that of the lower samples. It contains a fauna that is relatively rich in Orthophragminae. Orthophragminae could be also isolated from some of these samples. It could be established that at the upper part of the *Nummulites distans* zone (population DF — samples B75—85) and at least at the lower part of *Nummulites polygyratus* zone (population PO — samples B86—92, A1—8, C1—14) the most characteristic taxa are as follows: *Discocyclina stratiemanuelis*, *D. dispansa taurica*, *D. aaroni chalossensis*, *D. pratti montfortensis*, *Nemkovella fermonti*, *Orbitoclypeus portnayae*, and *O. koehleri*.

Bodrakian stage (BO population)

From the Simferopolian stage there is a gradual transition towards the 80 to 100 m mighty Bodrakian stage. The transition and the lower 15 m thick part (the so-called Kuberlin horizon) that contains larger Foraminifera, too, can be studied in the stratotypical profile on the right bank of the river Alma near Priyatnoye Svidanie (samples A9—23). Another good profile can be found near Skalistoye on the left bank of the river Bodrak (samples C15—30).

The typical material of the Bodrakian stage is white chalk-like limestone and at higher levels calcareous marl, that can be washed.

The litho- and biofacies of the Bodrakian stage suggest that the sea grew gradually deeper. Nummulitidae of large size are completely missing, the numbers of species and specimens of the small-sized Nummulitidae gradually decrease, and higher, in the Kerestin and Kum horizons they disappear completely. The Orthophragminae could bear the deepening of the sea somewhat better, since they can be found in the next 3—4 metres even after the disappearance of Nummulitidae. At the same time, the number of taxa and specimens of Planktonic Foraminifera is continuously increasing.

NEMKOV—BARKHATOVA (1961) could find here only one zone, namely, the zone of *Nummulites incrassatus*.

According to our present result on the basis of Orthophragminae, too, only one level (*Discocyclina kingae*) can be recognized (table 4). I put the lower border of this zone to the lower boundary of the stage since Orthophragminae could be isolated only from the following samples: A18—23 and C22—25. At lower levels the rock is too hard, whereas higher it does not contain any Orthophragminae. The typical taxa are shown in table 4.

Concerning the correlation of the Crimean stratotypical profile and the eocene stages of Western Europe different views exist. The most important ones are shown in table 5.

A krími sztratotípus-szelvény korrelációja a mediterrán eocénnel különböző szerzők felfogása szerint

Correlation of the Crimean stratotypical section with the Mediterranean Eocene, in the interpretation of various authors

Crimean stages			Bodrakian (Lower part)	Simferopolian	Bakhchisaraian				
Orthophragmina	Less (1987)	Correlation	Lower part of the Lutetian	Upper part of the Cuisian	Middle part of the Cuisian	Lower part of the Cuisian	Upper part of the Ilerdian	Middle part of the Ilerdian	
Orthophragmina	Portnaya (1974)	Correlation	Lower part of the Upper Eocene	Middle Eocene	Lower Eocene				
Orthophragmina	Portnaya (1974)	Zones	*Actinocyclina radians*	*Discocyclina pratti*		*Discocyclina sella*	*Discocyclina roberti*	*Discocyclina chudeaui*	
Calcareous nannoplankton	Kapellos (1973)	Correlation	Upper Cuisian	Middle Cuisian	Lower Cuisian	Ilerdian			
Calcareous nannoplankton	Kapellos (1973)	Zones	*Discoaster sublodoensis*	*Discoaster lodoensis*	*Marthasterites tribrachiatus*	*Discoaster binodosus*	*Discoaster multiradiatus*		
Nummulitidae	Schaub (1981)	Correlation	Lowermost Lutetian	Upper Cuisian	Middle Cuisian	Lower Cuisian	Upper Ilerdian	Lower – middle Ilerdian	
Nummulitidae	Golev (1971)	Correlation	Lower Lutetian	Upper Ypresian (Cuisian)	Lower Ypresian (Ilerdian) he refuses Nemkov – Barkhatova (1961) zones				
Nummulitidae	Schaub (1966)	Correlation	Lower part of the Upper Eocene	Gap	Upper part of the Lower Eocene (Cuisian)	Lower part of the Lower Eocene (Cuisian)			
Nummulitidae	Nemkov – Barkhatova (1961)	Correlation	Lower part of the Upper Eocene	Middle Eocene	Lower Eocene				
Nummulitidae	Nemkov – Barkhatova (1961)	Zones	*Nummulites incrassatus*	*Nummulites polygyratus*	*Nummulites distans*	*Nummulites distans minor*	*Assilina placentula*	*Nummulites crimensis*	*Operculina semiinvoluta*

The correlation proposed is based on the comparison with the Orthophragmina faunas of the classical localities of SW Aquitaine and N Italy. This differs from the correlation proposed by KAPELLOS (1973) only in that respect, that relying on HARDENBOL—BERGGREEN (1978), I assign the *Discoaster sublodoensis* calcareous nannoplankton zone (NP 14) to the lower part of the Lutetian.

It should be noted here that among the Orthophragminae just like among the Nummulitidae, such forms can be found that presumably, are characteristic only of the Northern Nummulitic Province (Crimea, Mangyshlak, Northern Cisaralia, Dobrudzha) since we could not find them in the Mediterranean up to the present. These are *Discocyclina kingae*, *Orbitoclypeus koehleri* and *O. portnayae*.

BULGARIA (DIKILITASH – DK POPULATION)

In the present work only one sample is described from Bulgaria, marked in the following way: "Dikilitash — sampled by J. ORAVECZ", from the collection of the Museum of Natural History (Budapest). The profile located not far from Varna can be well correlated with the Crimean stratotypical profile, described above, since they are of the same facies, and both profiles belong to the "Northern Nummulitic Province" (according to NEMKOV 1967). From the sandy-marly and marly beds, that can be indentified with the Bakhchisaraian stage, a rich Nummulites fauna was described by BELMUSTAKOV (1960).

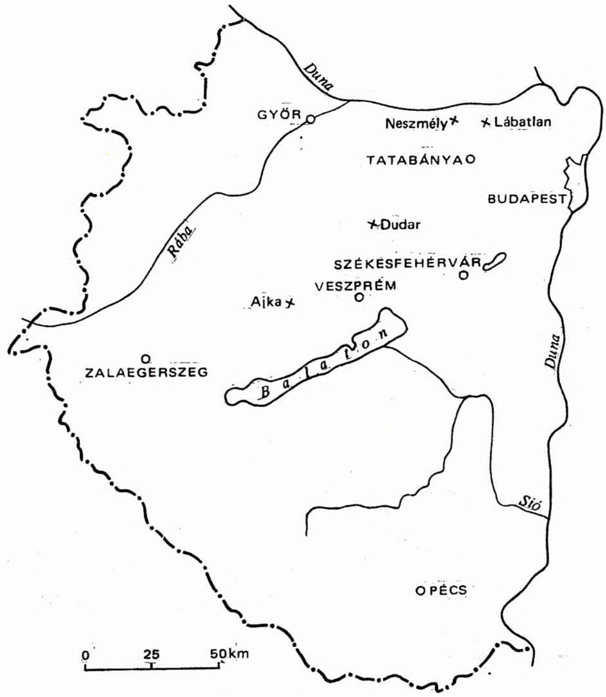
From the samples we examined two taxa of Discocyclinae could be isolated, namely, *Discocyclina archiaci archiaci* and *D. pseudoaugustae*. They unquestionably indicate the lower part of the Cuisian and presumably, they were collected from the upper part of the *Assilina placentula* zone.

HUNGARY

Samples collected in Hungary come from 4 different regions (text-fig. 17). These are discussed in the following section in stratigraphic order starting from below.

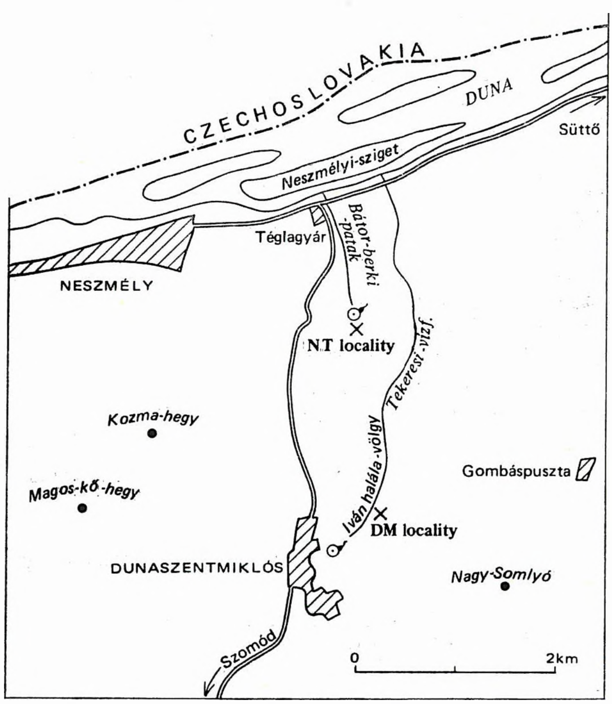
Western Gerecse

In the vicinity of Neszmély and Dunaszentmiklós Eocene rocks on the surface can be only found in the deep cuts of the streams, called "Kántorkerti-patak" (or "Tekeres-patak") starting from Dunaszentmiklós and "Bátor-berki patak", both of them running into the Danube (text-fig. 18). Elsewhere these rocks are covered by thick loess and/or Pannonian rocks. These rocks overlie unconformably the terrigenous Lower Cretaceous rocks (described by J. FÜLÖP 1958) of the Gerecse type, however, because



17. ábra. A szerző által vizsgált magyarországi Orthophragmina-lelőhelyek földrajzi helyzete

Fig. 17. Localities of Orthophragminae examined by the author in Hungary



18. ábra. A szerző által vizsgált nyugat-gerecsei Orthophragmina-lelőhelyek földrajzi helyzete

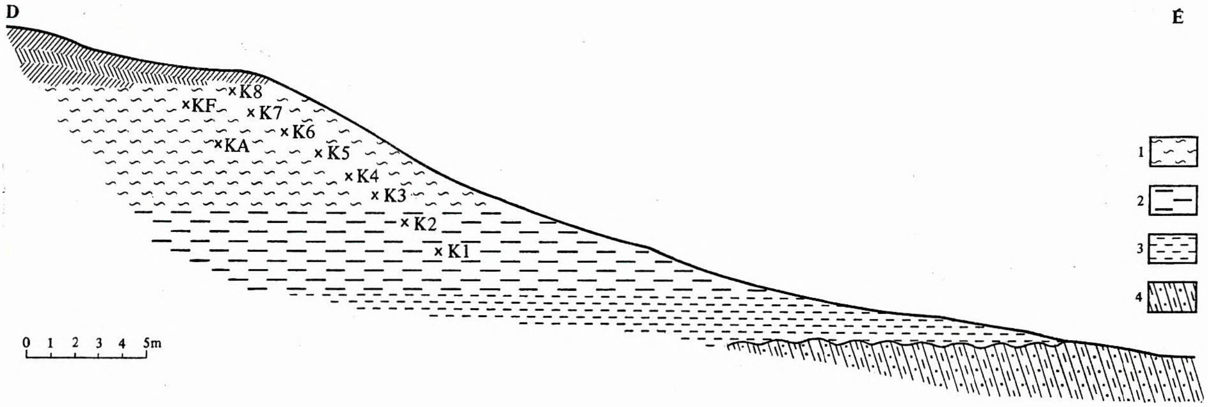
Fig. 18. Localities of Orthophragminae examined by the author in the Western Gerecse

of the denudation only small parts have remained. The Eocene rocks of the region were described by L. GIDAI (1980). Larger Foraminifera were found in 4 exposures, and among these only two contain Orthophragminae.

Dunaszentmiklós (population DM)

At the upper part of the "Kántor-kerti-patak" (otherwise known as "Iván halála") 400 m to the NE of Dunaszentmiklós the unconformable position the Eocene beds on the Lower Cretaceous ones is easy to observe. The sequence of the Eocene starting from below is as follows (see also text-fig. 19):

1. Variegated clay (2 m).
2. Carbonaceous clay with molluscs (4 m).
3. Grey Operculina-bearing clay marl (5 m).



19. ábra. Földtani szelvény a Kántor-kerti-patak bevágásában
K1—K8, KA és KF: mintavételi pontok. Eocén: *1.* operculinás agyagmárga, *2.* szenes, molluscás agyag, *3.* tarka agyag. Alsó-kréta: *4.* homokkő és aleurolit ritmikus váltakozása

Fig. 19. Geological section in the cut of the Kántor-kerti-patak
Places of sampling: K1—K8, KA and KF. Eocene: *1.* Operculina-bearing clay marl, *2.* carbonaceous clay with molluscs, *3.* variegated clay. Lower Cretaceous: *4.* Rhythmic alternation of sandstones and siltstones (D=S, É=N)

From the rocks, containing larger Foraminifera, 10 samples were taken from the ditch at intervals of 1 to 1.5 m starting from the bottom. Among these, the lower 4 samples (samples K1—4) did not contain any Orthophragminae. From these samples the following fauna of Nummulitidae was determined by M. JÁMBOR-KNESS: *Nummulites anomalus, N. subplanulatus, Operculina ammonea, O. granulosa.* On the basis of these forms in her opinion, they belong to a lower horizon of the Ypresian stage of the Lower Eocene, namely, to the *Nummulites subplanulatus*-bearing horizon.

In the upper 6 samples (samples K5—8, KA and KF) Orthophragminae can be found. Besides the Nummulitidae, that can be found in samples from lower levels, from the samples *Operculina parva* was also determined by M. JÁMBOR—KNESS. On the basis of the above facts these beds were assigned by her to the upper Cuisian in the lower Eocene, namely, to the *Nummulites anomalus—N. subramondi* (=Operculina-bearing clay marl) horizon.

All these six samples contain the Orthophragminae that are shown in table 6. As far as the age of the samples is concerned we do not share her opinion. We put these beds to the middle part of the Lutetian on the basis of Orthophragminae, since *Discocyclina dispansa nussdorfensis* is characteristic only of this level (see further details under "Stratigraphy of the Eurasian Orthophragminae").

Neszmély (population NT)

Yellow and grey clay, containing larger Foraminifera and also Orthophragminae can be found in Neszmély at the middle reach of the stream called "Bátor-berki-patak".

The geological setting is tectonically very disturbed here: Lower Cretaceous rocks, Eocene variegated clay and Foraminifera-bearing clay alternate with each other. This phenomenon obviously is a consequence of the strong block-tectonism.

The eight sporadic samples, collected here, all yielded the same fauna.

The Nummulitidae as determined by M. JÁMBOR-KNESS: *Nummulites perforatus, N. striatus, N. anomalus, N. nitidus, N. subramondi, N. burdigalensis, Assilina exponens, A. laxispira, Operculina*

Az Orthophragminák eloszlása a vizsgált magyarországi mintákban

The distribution of Orthophragminae in the Hungarian samples examined

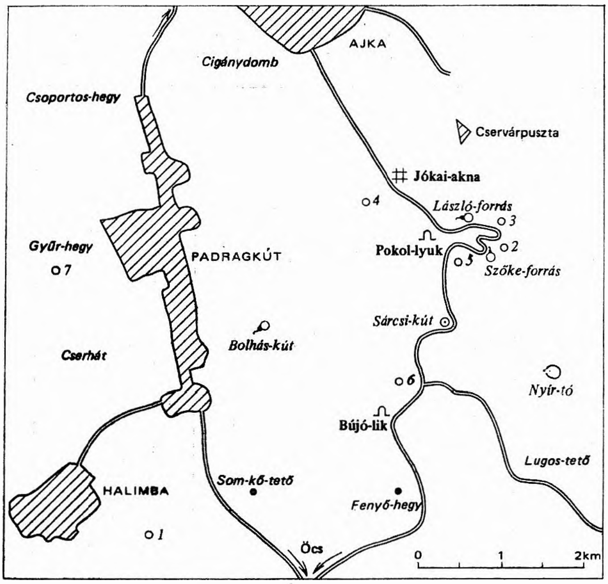
Taxa \ Localities		Dunaszentmiklós-Iván halála	Neszmély – Bátor-berki patak	Lower part of the Csékúti-árok	Middle part of the Csékúti-árok	Upper part of the Csékúti-árok	Halimba – Pityerdomb	Lugos-tető (Szt sample)	„Köleskepe 2" (KECSKEMÉTI T.)	Upper part of the Köleskepe-árok	Szőke-forrás	„Gyűrhegy" (KECSKEMÉTI T.)	Lower part of the Ördögárok	Upper part of the Ördögárok	Sűrűhegy	Józsefpuszta	Quarry W from Bajót	Bajót Domonkos-patak
				The vicinity of Ajka									Dudar			Lábatlan		
Stage		Lutetian		Bartonian												Priabonian		
		Middle		Lower									Middle			Middle		
Discocyclina	*dispansa* (Sow.) *nussdorfensis* n. ssp.	+	+															
	aaroni aaroni n. sp. et ssp.	+	+															
	knessae n. sp.	+												+	+			
	augustae WEIJD. *atlantica* n. ssp.		+															
	augustae augustae WEIJD.			+	+	+	+	+	+	+	+	+				+	+	
	discus (RÜTIM.) *dudarensis* n. ssp.			+	+	+	+	+		+	+	+			+	+		
	radians radians (D'ARCH.)				+	+		+	+	+	+							
	pulcra (CH.—RISP.) *balatonica* n. ssp.				+			+	+	+	+							
	dispansa (Sow.) *hungarica* KECSK.				+	+	+	+	+	+	+	+			+			
	spliti BUTT. et CHOR. *ajkaensis* n. ssp.				+			+	+									
	pratti pratti (MICH.)					+		+		+			+	+	+			
	trabayensis NEUM. *concentrica* KECSK.									+	+							
	pulcra (CH.—RISP.) *baconica* n. ssp.														+			
	dispansa (Sow.) *umbilicata* (DEPR.)															+		
	pratti (MICH.) *minor* Meff.															+		
	samantai n. sp.															+		
	euaensis WHIPPLE															+	+	
	radians (D'ARCH.) *labatlanensis* n. ssp.															+	+	
	nandori n. sp.															+	+	
Nemkovella strophiolata strophiolata (GÜMB.)									+	+	+				+			
Nemkovella strophiolata (GÜMB.) *tenella* (GÜMB.)																+		
Orbitoclypeus	*varians* (KAUFM.) *roberti* (DOUV.)			+	+	+		+	+	+		+						
	furcata (RÜTIM.) *rovasendai* (PREV.)			+	+	+			+	+	+		+					
	chudeaui (SCHLUMB.) *pannonicus* n. ssp.				+	+			+	+		+	+		+			
	katoae n. sp.							+										
	daguini (NEUM.)										+							
	varians (KAUFM.) *scalaris* (SCHLUMB.)												+	+	+			
	varians varians (KAUFM.)															+	+	
	furcata furcata (RÜTIM.)															+	+	
Asterocyclina	*stellata stellata* (D'ARCH.)				+	+			+	+	+	+						
	alticostata (NUTT.) *cuvillieri* (NEUM.)					+			+	+	+	+						
	kecskemetii n. sp.					+			+						+			
	alticostata alticostata (NUTT.)												+	+	+			
	stellata (D'ARCH.) *stellaris* (BRÜNN. in RÜT.)												+		+	+		+
	priabonensis GÜMB.															+		
	stella (GÜMB.) *praestellaris* BRÖNN.															+		
	alticostata (NUTT.) *danubica* n. ssp.															+	+	

ammonea, O. granulosa. On the basis of this fauna the rocks, that contain secondarily included larger Foraminifera (among them Discocyclinae), is considered by her to be Early Lutetian. This corresponds to her former (M. JÁMBOR-KNESS 1968) data.

Among the Orthophragminae *Discocyclina dispansa nussdorfensis* and *D. aaroni aaroni* were encountered, that can be also found in Dunaszentmiklós and, as a new taxon compared to the latter two, *D. augustae atlantica* was also found (see also table 6). This exposure unquestionably represents the so-called "perforatus"-bearing layers and on the basis of the Discocyclina fauna, they undoubtedly belong to the middle part of the Lutetian. Signs of redeposition of the Orthophragminae were not found, moreover, we found that all larger Foraminifera are better preserved than in the so-called "Operculina"-bearing beds at Dunaszentmiklós.

Southern Bakony Mts (the vicinity of Ajka — population AJ)

The Eocene formations of the Southern Bakony Mts were very thoroughly studied by BÖCKH (1875—1878), HANTKEN (1875b), ROZLOZSNIK (1925, 1928), VECSEY (1939), SZŐTS (1956), KOPEK—KECSKEMÉTI (1960) and KOPEK et al. (1966, 1971). On the basis of their works the sequences can be considered to be unanimously defined. There are differences, however, with respect to the ages of certain layers. In this aspect the stratigraphic subdivision given by KOPEK et al. (1966, 1971) based first of all on Nummulites, is the most up-to-date. I examined the Orthophragminae that abound at the boundary of the so-called "millecaput" and "glauconitic" (XII. and XIII.) horizons according to KOPEK's et al. (1966) subdivision, while in other levels they occur scarcely or do not occur at all.



20. ábra. A szerző által vizsgált Ajka környéki Orthophragmina-lelőhelyek földrajzi helyzete

1. Halimba, Pityerdomb, *2—3.* Köleskepe-árok felső vége (KECSKEMÉTI T. lelőhelyei): *2.* Köleskepe 3. sz., *3.* Köleskepe 2. sz. *4.* Csékúti-árok, *5.* üzemi út bevágásai a Szőke-forrás fölött, *6.* Lugos-tetői elágazás (SzT minta), *7.* Győr-hegy

Fig. 20. Localities of Orthophragminae examined by the author in the vicinity of Ajka

1. Halimba, Pityerdomb, *2—3.* upper end of the Köleskepe-árok (T. KECSKEMÉTI's localities): *2.* Köleskepe 3., *3.* Köleskepe 2., *4.* Csékúti-árok, *5.* factory's roadcuts above the Szőke-forrás, *6.* parting of the road at Lugos-tető (sample SzT), *7.* Győr-hegy

The fauna, at all of the localities examined (text-fig. 20) proved to be of the same age, differences between the localities could be detected only in the frequency of certain species.

The Nummulitidae were determined by T. KECSKEMÉTI (table 7). The review of the Orthophragminae, that were also determined by T. KECSKEMÉTI (1958, 1959), is shown in table 8, whereas our own determinations of Orthophragminae can be found in table 6.

The examined localities are the following:

a) Halimba—Pityerdomb [place of sampling is the same as KECSKEMÉTI's (1959) one], yellow glauconitic marly limestone (samples H1—2).

b) Ajka, the upper end of the ditch called "Köleskepe-árok", cut of the road at the curve place of sampling is the same as KECSKEMÉTI's one called: "Köleskepe—3", glauconitic calcareous marl (samples Ba 5, 6 and Kö 1—4).

c) Ajka, the upper end of the ditch called "Köleskepe-árok", cut of the road at the curve [KECSKEMÉTI's (1959) place of sampling: "Köleskepe—2"], glauconitic calcareous marl, approximately 200 m to the North of "Köleskepe—3". Since this exposure was destroyed in the meantime I could not sample from this place.

d) Ajka, Csékúti-árok, 500 m to the SW of Jókai-akna [partly the place of sampling is the same as KECSKEMÉTI's (1959) one].

The Csékúti-árok, situated above Jókai-akna, uncovers the uppermost 25 m thick part of the Eocene rocks in the vicinity of Ajka, so this is the most complete exposure of the beds. At this place sampling from the profile was carried out and the following layers were found from below upwards (see also text-fig. 21).

1. Yellow, marly limestone with *Nummulites millecaput* in large number with fewer Orthophragminae and abundant Echinoidea — 5 m (samples J1—2).

A Nummulitidae-fajok eloszlása néhány Ajka, illetve Dudar környéki lelőhelyen Kecskeméti T. meghatározásai alapján

The distribution of Nummulitidae species at some localities in the vicinity of Ajka and Dudar as identified by T. Kecskeméti

Taxa \ Localities		The vicinity of Ajka				The vicinity of Dudar	
		Köleskepe-árok		Csékúti-árok	Halimba, Pityerdomb	Sűrűhegy	Ördögárok N
		Locality No. 2	Locality No. 3				
Nummulites	*millecaput* A	+	+	+	+	+	+
	millecaput B	+	+	+	+	+	+
	variolarius A	+	+	+	+	+	+
	variolarius B	+	+	+	+	+	+
	praefabianii A	+	+	+	+		
	striatus A	+	+	+	+	+	+
	striatus B	+	+	+	+	+	+
	discorbinus A	+	+	+	+	+	+
	discorbinus B	+	+	+	+	+	+
	anomalus A	+	+	+	+	+	+
	anomalus B						+
	perforatus A	+		+	+	+	+
	perforatus B					+	+
	meneghini A	+		+	+	+	+
	dufrenoyi A					+	+
	dufrenoyi B					+	+
	brongniarti A					+	+
Assilina exponens A		+	+	+	+	+	+
Assilina exponens B		+	+	+	+	+	+

2. Greenish-yellow strongly glauconitic calcareous marl with multitude of Orthophragminae and fewer *Nummulites millecaput* — 14 m (samples J3—6).

3. White marly limestone containing less glauconite with Orthophragminae in large numbers. Asterocyclinae prevail among them. *Nummulites millecaput* can be very rarely found — 4 m (samples J7—8 and CS).

4. White calcareous marl without larger Foraminifera — 2 m.

The Eocene are unconformably overlain by Pannonian gravel with redeposited Eocene larger Foraminifera.

The first part, on the basis of the relative poorness of the fauna, the lack of the Asterocyclinae and the existence of the Echinoidea, can be compared best with the layers of Pityerdomb in Halimba.

KECSKEMÉTI's (1959) Orthophragminae fauna referred to as "Csékuter Graben", shown in table 8, may derive from the 2. horizon.

In spite of the fact that Asterocyclinae play a subordinate role here, on the basis of its lithology as well as its Orthophragminae fauna, the second horizon can be identified with the beds of Köleskepe-árok, described above. The characteristic feature of the third horizon is that Asterocyclinae prevail among the specimens and at the same time, *Discocyclina pulcra balatonica* that played important role in lower levels, disappears. In the surroundings of Ajka this kind of rock was found only at this place. The fourth horizon do not contain larger Foraminifera but similar rocks were found in the Halimba basin in boreholes.

The sequence of the profile of the Csékúti-árok, that can be biostratigraphically well subdivided, proves to be of the same age on the basis of Orthophragminae. The time interval during the sedimentation of the sequence may have been too short, so statistically detectable changes within the individual species could not take place.

The possibility of biostratigraphic subdivision may be due to the gradual deepening of the sea. Similar sequence were found in the stratotypical profile of Priabona, too (SIROTTI 1978).

e) Cuts of the factory road between Ajka and Pula above Szőke-forrás, glauconitic calcareous marl (samples Ba 3, Sz 5—8).

In these cuts within 100 m from the road poor quality exposures of rocks containing rich Orthophragmina fauna can be found. On the basis of them, however, the setting of the rocks cannot be established. The lack of *Orbitoclypeus varians roberti*, that can be found in large numbers elsewhere, is a striking feature here. Nevertheless, these layers can be identified with the second horizon of the sequence in Csékúti-árok and with the beds of the Köleskepe-árok.

f) Cut of the factory road at the Lugos-tető bisecting between Ajka and Pula 2.4 km to the northwest of Lugos-tető, yellowish-white glauconitic, marly limestone (sample SzT).

On the basis of the predominance of Discocyclinae and the complete lack of Asterocyclinae the beds of this outcrop, though the fauna here is richer, can be best identified with the horizon No. 1 of the Csékúti-árok.

g) Padragkút, Gyűrhegy (KECSKEMÉTI's 1959 sampling locality called "Gyűr-hegy").

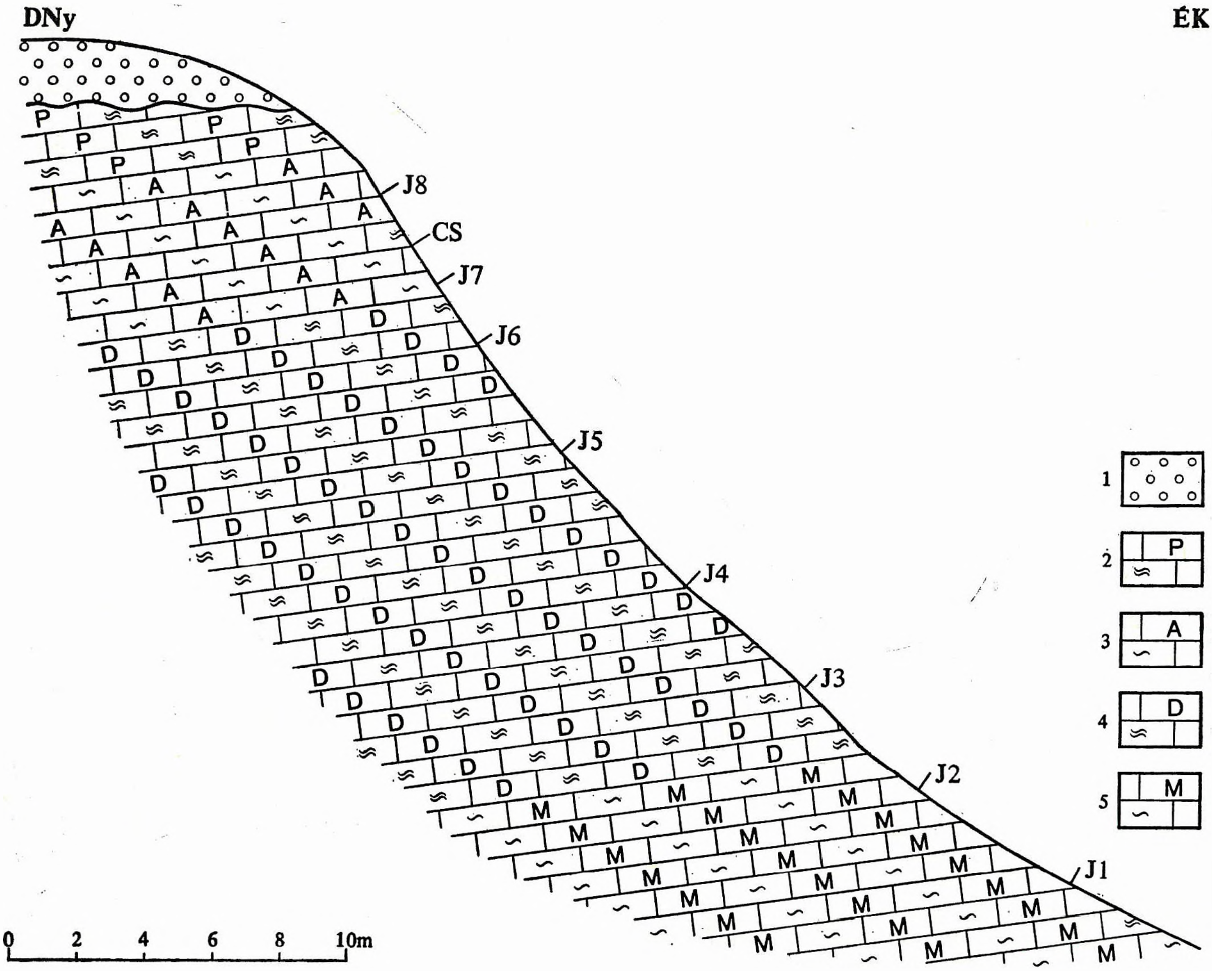
8. táblázat — Table 8

Kecskeméti (1958, 1959) ajkai Orthophragmina-fajai és azok szerző általi azonosításai

Kecskeméti's (1958, 1959) Orthophragmina species from Ajka and their identifications according to the present author's interpretation

Taxa by KECSKEMÉTI	Localities	Pityerdomb	Köleskepe 3	Köleskepe 2	Csékúti-árok	Gyűr-hegy
Actinocyclina	*patellaris*	—	—	rv	?	—
	radians	?	?	ra	?	—
	tenuicostata	—	—	ra	—	—
	variecostata	—	—	ke	—	—
Asterocyclina	*bayani*	—	—	?rv	—	—
	pentagonalis	?	—	st	—	—
	riojai	—	—	?rv	—	—
	stella	—	—	cu	—	—
	stellaris	—	?	st	?	—
	stellata	?	?	st	?	—
	taramellii	—	—	?st	—	—
Discocyclina	*archiaci*	?	—	?	au	—
	aspera	—	?	ro	?	—
	augustae	—	au	au* + sf*	—	—
	bartholomei	?	du*	?	du	—
	chudeaui	—	?	pa	?	—
	concentrica	—	co	?	—	—
	douvillei	—	—	au	—	—
	hungarica	—	hu	?	?	—
	nummulitica	?	?	ro	?	—
	papyracea	?	?	aj	aj*	—
	pratti	?	au*	au* + hu	?	?
	sella	?	?	au* + hu	?	?
	varians	?	?	ro	?	—
	sp.*	—	—	bl*	bl*	—

aj = *D. spliti ajkaensis*, au = *D. augustae augustae*, bl = *D. pulcra balatonica*, co = *D. trabayensis concentrica*, cu = *A. alticostata cuvillieri*, du = *D. discus dudarensis*, hu = *D. dispansa hungarica*, ke = *A. kecskemetii*, pa = *O. chudeaui pannonicus*, ra = *D. radians radians*, ro = *O. varians roberti*, rv = *O. furcata rovasendai*, sf = *N. strophiolata strophiolata*, st = *A. stellata stellata*, (A. = *Asterocyclina*, D. = *Discocyclina*, O. = *Orbitoclypeus*, N. = *Nemkovella*), ? = kontrollálhatatlan adat — data cannot be controlled, * = publikálatlan gyűjteményi anyag — unpublished material from T. KECSKEMÉTI's collection.



21. ábra. A Csékúti-árok földtani szelvénye

J1 – J8 és CS: mintavételi pontok. *1.* Kavics, *2.* plankton foraminiferás mészmárga, *3.* márgás mészkő elsősorban Asterocyclinákkal, *4.* mészmárga elsősorban Discocyclinákkal, *5.* márgás mészkő elsősorban *Nummulites millecaput*-okkal

Fig. 21. Geological section of Csékúti-árok

J1 – J8 and CS: places of sampling. *1.* Pebble, *2.* calcareous marl with plankton Foraminifera, *3.* marly limestone mainly with Asterocyclina, *4.* calcareous marl mainly with Discocyclina, *5.* marly limestone mainly with *Nummulites millecaput* (DNy=SW, ÉK=NE)

Since the rock, found here, is hard limestone, from which Orthophragminae could not be isolated, only the thin sections prepared by T. Kecskeméti were studied from this area.

Conclusion: The very rich Orthophragmina faunas that can be found in the vicinity of Ajka, though biostratigraphically somewhat different from each other (presumably due to the different depth conditions) can be chronostratigraphically considered to be of the same age.

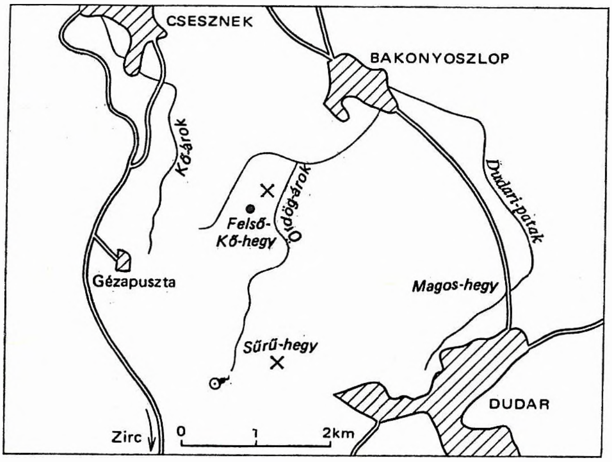
The reasons in detail with respect to the age (the lower part of the Bartonian) can be found in the section entitled "Stratigraphy of the Eurasian Orthophragminae". It should be noted, however, that *Discocyclina pulcra balatonica* and *Orbitoclypeus varians roberti* are characteristic only of this age, and the presence of *Orbitoclypeus chudeaui pannonicus* is a clear dividing line towards the lower layers, whereas the presence of *Asterocyclina stellata stellata* and *A. alticostata cuvillieri* makes the distinction clear from higher ones.

Northern Bakony Mts (the vicinity of Dudar — population DU)

The marl of the abandoned quarry of Sűrű-hegy, in the surroundings of Dudar containing rich Orthophragmina fauna, was first described by Tomor-Thirring (1934). Later, this occurrence was mentioned by Szőts (1956). In the surroundings of Dudar this kind of rock was said to be widespread by Kopek et al. (1966) and Kopek (1980). In their stratigraphic table it is marked as being of the same age (Upper Lutetian) as the Discocyclina-bearing rocks in the vicinity of Ajka and Lábatlan. The Orthophragmina-bearing beds of the surroundings of Ajka and Dudar are also considered to be of the same age (Auversian) by MAJZON (1966). At the same time the layers in the vicinity of Lábatlan are regarded to be younger, namely Priabonian. Following T. KECSKEMÉTI's proposal, in addition to the samples collected from Sűrű-hegy, I collected samples also in the cuts of the path leading upwards on the western side of Ördögárok at Bakonyoszlop (text-fig. 22). The samples from Sűrű-hegy and Ördögárok proved to be of the same age, in spite of smaller differences in the Orthophragmina fauna.

a) The southern wall of the quarry of Sűrű-hegy, unconsolidated yellow and pink calcareous marl (samples DS 1—5, DS, DG and DH).

In this exposure the uppermost "millecaput" beds of the "Hauptnummulitenkalk" (Szőc Limestone Formation) can be found at the bottom. In this very hard limestone the extraordinary large forms "B" of *Nummulites millecaput*, even as much as 10 cm in diameter, are in rock-forming multitude, and in addition Orthophragminae and Echinoideae can also be found. From this kind of rock, samples for cleaning could not be obtained. In its biofacies this rock is very similar to the horizon No. 1 of the sequence in Csékúti-árok.



22. ábra. A szerző által vizsgált Dudar környéki Orthophragmina-lelőhelyek földrajzi helyzete
x = mintavételi pont

Fig. 22. Localities of Orthophragminae examined by the author in the vicinity of Dudar
x = place of sampling

The next formation above, with a quick transition, is an Orthophragmina-bearing yellow and pink calcareous marl, that is exposed only to a maximum of 2 metres, as further parts were cleared away as dead rock of the one-time quarry. Sampling from the profile was not possible here, so from this rock 5 samples were taken along the southern and western walls of the quarry. The distance between the samples was approx. 20—25 m. The Orthophragmina fauna of the five samples (DS 1—5) proved to be the same but *Discocyclina pulcra baconica* was found only in two samples (DS 4—5) that were situated towards the south-west. The composition of the Orthophragmina fauna is shown in table 6. From the same locality the Nummulitidae, listed by T. KECSKEMÉTI in table 7, were determined. As far as the facies of this rock is concerned, it can be compared with the second horizon of the sequence in Csékúti-árok, though its glauconitic content is far lower than that of the latter.

b) Bakonyoszlop, cuts of the path leading upwards on the western side of Ördögárok, light greyish-yellow marly limestone (samples D 1—7).

The cuts of the path disclose only small parts from the Orthophragmina-bearing beds, from which the Nummulitidae, shown in table 7, were determined by T. KECSKEMÉTI. The cuts that are situated approximately 200 m from the entrance of Ördögárok (samples D 1—5) are richer in Orthophragminae. The taxa of these samples are shown in table 6. From the outcrops being a bit higher along the path (500 m from the entrance of Ördög-árok — samples D 6—7) poorer Orthophragmina fauna was determined shown in table 6.

These two fauna assemblages are poorer than the fauna of Sűrű-hegy. Its characteristic feature is the predominance of *Orbitoclypeus varians scalaris*, compared to *O. chudeaui pannonicus*, whereas at Sűrű-hegy the situation is just contrary.

The detailed reasoning concerning the age of the fauna (middle part of the Bartonian) can be found under "Stratigraphy of the Eurasian Orthophragminae". It should be noted, however, that *Discocyclina pulcra baconica* and *Orbitoclypeus varians scalaris* are characteristic only of this age, the presence of *Asterocyclina stellata stellaris* and *A. alticostata alticostata* gives an opportunity to separate the layer from lower ones, whereas the presence of *Discocyclina dispansa hungarica* makes the distinction clear from higher ones.

Eastern Gerecse (the vicinity of Lábatlan — population LA)

The Eocene rocks of the Eastern Gerecse and, in a wider sense, those of the Dorog basin are relatively well-known owing to the research of HANTKEN (1865—66, 1868, 1871, 1878), ROZLOZSNIK et al. (1922), SZŐTS (1956) and GIDAI (1972).

The upper part of the sequence consists of limestone and sandstone, denudated to different degrees at certain places with biotitic-tuffitic sandy intercalations containing *Nummulites millecaput* and Orthophragminae are general. At some places patches of Foraminifera-bearing calcareous marl (the so-called "Piszke marl") are also preserved. The most important exposure of these rocks is the renowned wall along the road of the hill called Sánc-hegy between Nyergesújfalu and Lábatlan. Unfortunately, it was impossible to recover Orthophragminae from the rocks found there.

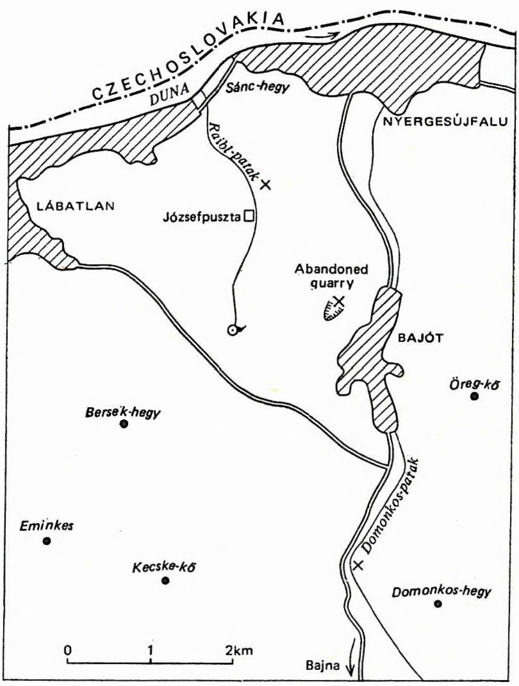
Similar rocks occur near Szent József-puszta that is 3 kms towards the east—south-east. Here at the head of the right hand side continuation of the stream, called Raibl-patak, in an abandoned quarry, *Nummulites millecaput* and Orthophragmina-bearing limestone pieces, and being 1 m in diameter, slipped as half solidified olistoliths between greyish-white Foraminifera-bearing claymarl beds that contain biotitic-tuffitic sand interbeds. At the boundary between the two different kinds of rock the limestone, containing a great many Orthophragminae became looser and as a result it can be washed. The fact of this slipping of the limestone pieces is also confirmed by the settling of the clay-marl disturbed by the limestones.

It is likely that between the formation of the *Nummulites millecaput* and Orthophragmina-bearing limestone and that the Foraminifera-bearing claymarl there was only a short interval and the substratum may have been mobile and morphologically articulated. This exposure was first described by Szőts (1956, p. 93.). From the same place (1972) Upper Eocene Planktonic Foraminifera (determined by L. Vitális-Zilahy) and Upper Eocene Nummulitidae (determined by M. Jámbor-Kness) were mentioned by Gidai.

9 samples were taken (R 1—3, RA, RB, RC, RD, RF and RK) from this place, however, due to the disturbed settling (olistoliths) layer by layer sampling from the profile was not possible, so the Orthophragmina fauna found here are shown together in table 6.

Similar fauna, though with fewer taxa, was found in a small quarry 500 m to the west of Bajót (text-fig. 23 — sample BN). The taxa found there are shown in table 6. The settling conditions seem not so disturbed here though only a small part is visible from the sequence due to the insufficient exposure. The fauna listed is from the lowermost beds outcropping in 1 m thickness. Somewhat higher this *Nummulites millecaput* and Orthophragmina-bearing marly limestone turns into limestone in which Operculinoides prevail, and scarcely *Orbitoclypeus furcata furcata* also occurs. A 4 m thick part of this Operculinoides-bearing limestone is visible while the rest is covered.

On the hillside of Domonkos-hegy, in the cut of the road between Bajót and Bajna, an approx. 1 m thick biotitic-tuffitic sand intercalation can be found in the Foraminifera-bearing marly limestone (sample BD). In this intercalation, as larger Foraminifera, only *Asterocyclina stellata stellaris* can be found in great numbers. It is relatively well-preserved, though it rather easily crumbles into dust.



23. ábra. A szerző által vizsgált kelet-gerecsei Orthophragmina-lelőhelyek földrajzi helyzete x = mintavételi pont

Fig. 23. Localities of Orthophragminae examined by the author in the Eastern Gerecse x = place of sampling

Concerning the ages of the above listed rocks there are two different opinions: According to Kopek et al. (1966) they should be regarded as Upper Lutetian, on the basis of the presence of *Nummulites millecaput*, whereas according to Gidai (1972) and Jámbor-Kness (1967, 1972) Late Eocene (Priabonian). In their opinion, on the basis of examples coming from the Caucasus and Poland, the time range of *Nummulites millecaput* may spread to the Late Eocene. Besides, other elements of the fauna also suggest the Upper Eocene.

We share this latter opinion, since on the basis of the examination of Orthophragminae *Discocyclina radians labatlanensis*, *D. nandori*, *Orbitoclypeus furcata furcata*, *Asterocyclina stella praestellaris* and *A. alticostata danubica* are undoubtedly Upper Eocene forms. Moreover, the presence of *Discocyclina dispansa umbilicata*, *D. pratti minor* and *Asterocyclina priabonensis* makes the distinction from the lower part of the Priabonian possible as well as the correlation to the typical Middle Priabonian layers of Priabona (see also in section "Stratigraphy of the Eurasian Orthophragminae").

Conclusion: On the basis of the examination of Orthophragminae, between rocks that are similar lithologically as well as in the composition of their faunas, namely *Nummulites millecaput* and Orthophragmina-bearing marls and limestones of the vicinity of Ajka, Dudar and Lábatlan, disparity of age can be detected. This series on the top of the whole Transdanubian Eocene is becoming younger and younger getting from the south-west towards the north-east, that is, the age of the rocks (that, essentially, can be considered to be of identical facies) well reflects the actual stage of the transgression coming from the south-west in the given region.

AUSTRIA (NUSSDORF — POPULATION ND)

The only sample from Austria in the collection of the Museum of Natural History (Budapest) is marked with the following label: "Nussdorf, fringe of the forest, Middle Adelhozen beds, leg. A. Hillebrandt." On this basis it is most likely that this sample comes from the stop D I/5 of the excursion guide of the VIII. European Colloquium of Micropalaeontology (Gohrbandt 1963). Grey marls with rich Nummulites and Assilina fauna can be found here, on the basis of which Gohrbandt (1963) puts the age of the locality to the Middle Eocene.

Few Orthophragminae were found in the sample examined. Among these *Discocyclina dispansa nussdorfensis*, *D. aaroni aaroni* and *Asterocyclina stellata adourensis* were identified.

This fauna unquestionably indicates the middle part of the Lutetian, since the first taxon can be found only there (further details can be found under "Stratigraphy of the Eurasian Orthophragminae").

NORTHERN ITALY

All samples from Northern Italy come from the classical localities in the vicinity of Vicenza.

Spilecco — population SC

The characteristic profile at the western slope of Monte Bolca and its fauna was studied by Suess (1868), Munier-Chalmas (1891), Fabiani (1915), Douvillé (1922), Schweighauser (1953), Cita—Bolli (1961) and Cita—Piccoli (1964). The sample examined was taken and marked by T. Kecskeméti with the following label: "Spilecco, tuffitic marl" (sample and population SC). On the basis of the literature, this red tuffitic marl lies between the Globotruncana-bearing scaglia-limestone of the Upper Cretaceous and the Brusaferri Nummulites-bearing limestone of the Lower Eocene.

Its Orthophragmina fauna was studied by Munier-Chalmas (1891), Schlumberger (1904), Douvillé (1922) and Schweighauser (1953). The beds examined were assigned to the Lower Eocene by the first three authors, whereas by the fourth they were assigned to the Middle—Upper Paleocene.

In the course of the present investigations *Orbitoclypeus ramaraoi neumannae* and *O. bayani* could be detected. In addition, on the basis of bibliographic data, the presence of *Asterocyclina stella taramellii* can also be accepted as a fact (Schlumberger 1904, Neumann 1958).

Orbitoclypeus multiplicata can also be found here (Schlumberger 1904), its validity, however, is questionable.

The Spilecco origin of Douvillé's (1922) *Discocyclina tenuis* (=*Discocyclina archiaci archiaci*, according to Schweighauser's 1953 figure) is rather doubtful. In the determination of the age of the sample (the middle part of the Ilerdian) a decisive role is played by *Orbitoclypeus ramaraoi neumannae* that, presumably, is limited only to this level (see also "Stratigraphy of the Eurasian Orthophragminae"). This conclusion is even more justified because this very level is indicated by the simultaneous presence of the Nummulites and the Planktonic Foraminifera.

Mossano — population MS

The sample examined bears the following label: "Mossano, base of the Priabonian III—6/1." The sample was collected by G. Kopek and E. Dudich in the course of the Eocene Colloque in 1968 (sample and population MS). According to the guidebook of the Colloque's excursion the locality could be definitely identified, so the sample was included in the Mossano Eocene section on the basis of the first place of occurrence of the typical Upper Eocene fauna. According to Schweighauser (1953), the lower part of the Priabonian of Mossano is embodied by a 60 m thick blue marl and marly limestone from the lowermost part of which Upper Eocene Nummulitidae and Planktonic Foraminifera were described by him and Ungaro (1968). The Orthophragminae of these beds were made known by Schweighauser (1953). In the sample examined the following fauna was found: *Discocyclina dispansa dispansa*, *D. augustae augustae*, *D. trabayensis vicenzensis*, *D. nandori*, *Nemkovella* *strophiolata tenella, Orbitoclypeus varians varians, Asterocyclina stellata stellaris, A. stella praestellaris.* Beside this fauna *Discocyclina pratti pratti* (*D. sella* sensu SCHWEIGHAUSER), described by SCHWEIGHAUSER (1953), could also be found.

The Lower Priabonian age of this sample is unnecessary to verify in this case, since the Mossano fauna served as one of the most important comparative basis when determining the ages of other samples.

Priabona — populations PR and VG

Two samples were found from the type locality of the Upper Eocene: They were taken and marked with the following labels by T. KECSKEMÉTI: "Priabona, behind the new church" (sample and population PR) and "Priabona, Valle Granella" (sample and population VG).

On the basis of the most recent dealing with the Priabonian Eocene (HARDENBOL 1968, SIROTTI 1978 and SETIAWAN 1983) these samples could be identified. The exposure labelled as "Behind the new church" represents the marls and limestones of the so-called "Asterocyclina beds". The exposure at the Valle Granella represents the "blue clay" or perhaps the even lower "Discocyclina beds". The characteristic Upper Eocene Nummulitidae of this level were described by ROVEDA (1961).

GÜMBEL (1868) and DOUVILLÉ (1922) were the first to deal with Orthophragminae. The main shortage of their works is that the equatorial sections were disregarded by both of them, and consequently, no photos of these sections were published.

Up-to-date sampling form was carried out by SIROTTI (1978) along the Priabonian type-section. The following taxa were identified by him (in brackets the present author's identifications can be found): *Discocyclina cf. aspera (=D. dispansa umbilicata), D. sella (=D. augustae augustae), D. daguini (=D. trabayensis vicenzensis), D. discus (=D. dispansa umbilicata), Aktinocyclina radians (=D. radians labatlanensis* and *D. nandori), Asterocyclina stellaris (=A. priabonensis), A. stellata (=A. stella praestellaris), A. furcata (=Orbitoclypeus furcata furcata).* He found the first two species only in the "Discocyclina beds" and partly in the "blue clay", whereas the last one was found only in the "Asterocyclina beds". The rest of the species could be found in all the three levels considered.

Using biometric methods, the Orthophragminae of 4 samples were examined by SETIAWAN (1983). Two samples (Pr. 49 and 55) were coming from the "Discocyclina beds". From here the following taxa were identified by SETIAWAN (1983) (in brackets the present author's identifications can be found): *Discocyclina I. cf. D. applanata (=D. augustae augustae), D. II. cf. sella* (*=D. dispansa umbilica* and *?D. pratti minor*) and *Asterocyclina I. cf. A. stellaris (=A. stellata stellaris).*

The two remaining samples (Pr. 126 and 135) were coming from the "Asterocyclina beds" and were containing *Discocyclina III. cf. D. augustae (=D. trabayensis vicenzensis), D. IV. (=D. euaensis), Asterocyclina II. cf. A. priabonensis (=A. priabonensis)* and *A. III. cf. A. stella (=A. stella praestellaris).*

In the samples examined the Orthophragminae were rather poorly preserved and in addition, they were few: Valle Granella: *Discocyclina dispansa umbilicata, D. nandori, Asterocyclina stellata stellaris;* Priabona: *Discocyclina trabayensis vicenzensis.*

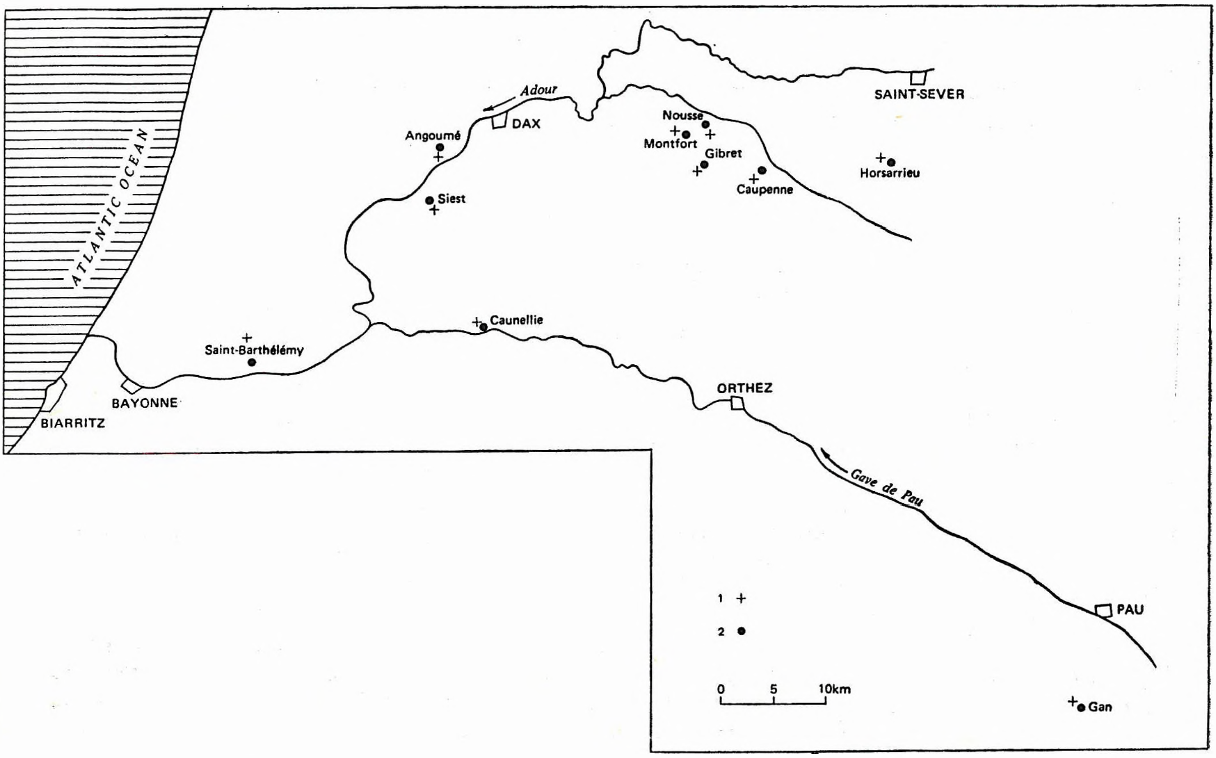
Conclusion: On the basis of SIROTTI's (1978), SETIAWAN's (1983) and the present writer's examination the presence of the following Orthophragminae could be established in Priabona and Valle Granella: *Discocyclina augustae augustae, D. dispansa umbilicata, D. trabayensis vicenzensis, D. euaensis, D. radians labatlanensis, D. nandori, Orbitoclypeus furcata furcata, Asterocyclina priabonensis, A. stellata stellaris, A. stella praestellaris* and, in all probability, *Discocyclina pratti minor*, too.

Since the type section of Priabona is one of the most important bases of our age-division it is unnecessary to prove that this section represents the upper part of the Upper Eocene (population VG — middle part of the Priabonian, population PR — upper part of the Priabonian).

WESTERN AQUITAINE

Samples from this region, containing rich Orthophragmina fauna, can be found in large numbers in the collection of Larger Foraminifera within the Palaeontological Collection of the Museum of Natural History (Budapest). These samples are coming from one of the classical territories of the Eocene that are already described in details.

Almost half of the Orthophragmina species were described from this area so, in the course of the correlation with other regions these samples could serve as bases. It is even more so, because their stratigraphic position is also rather varied. It is ranging from the middle of the Lower Eocene to as high as the top of the Middle Eocene. The localities of the samples' are shown in text-fig. 24, their descriptions can be found below, considering the stratigraphic order of sequence I established.



24. ábra. A szerző által vizsgált nyugat-aquitániai Orthophragmina-lelőhelyek földrajzi helyzete (Le Porge kivételével)
1. A konkrét lelőhely, *2.* a helység, melynek közelében fekszik

Fig. 24. Localities of Orthophragminae examined by the author in Western Aquitaine (without Le Porge)
1. The concrete place of sampling, *2.* the settlement in the vicinity of which the locality can be found

Gan — population GA

The samples examined in this paper were taken by M. NEUMANN (sample GM) and A. BLONDEAU (sample GB) and they were marked as: "Tuilerie de Gan".

This locality — the clay-pit of the brick factory in Gan — is described in details (DOUVILLÉ 1919, DOUVILLÉ—O'GORMAN 1929, GUBLER—POMEYROL 1946, SCHAUB 1951, NEUMANN 1958, HOTTINGER 1960, HOTTINGER et al. 1964. KAPELLOS—SCHAUB 1973, BROLSMA 1973, SCHAUB 1981). The bluish-grey claymarl, found here, can be also found in Bos d'Arros, the other classical locality of Larger Foraminifera, that is 5 kms to the SE (SCHLUMBERGER 1903, SCHAUB 1955, 1961, 1962, 1981, NEUMANN 1958, KAPELLOS—SCHAUB 1973).

Between the ages of the two localities only a very small difference could be detected on the basis of KAPELLOS—SCHAUB's (1973) examinations of Nummulites and calcareous nannoplankton. The samples from the claypit in Gan were assigned to the upper part of the Lower Cuisian, whereas the Bos d'Arros beds to the Lower — Middle Cuisian boundary.

A great number of experts dealt with the Orthophragminae of these two localities (SCHLUMBERGER 1903, DOUVILLÉ 1922, SCHWEIGHAUSER 1953, NEUMANN 1958, BROLSMA 1973).

In the two samples examined *Discocyclina archiaci archiaci* and *D. dispansa ganensis* were frequent, and *D. furoni* was rather scarce in both samples, whereas one specimen of *Orbitoclypeus ramaraoi crimensis* and one of *O. douvillei* could be found. The equatorial sections of the two taxa could not be obtained, they could be identified, however, on the basis of SCHLUMBERGER's (1903) and NEUMANN's (1958) figures of the equatorial section. No Asterocyclinae were found in the samples, but on the basis of BROLSMA's (1973) excellent photos the forms from this place could be identified as *Asterocyclina stella taramellii* and *A. stellata adourensis.* It is most likely that intermediate forms between these two taxa are also present, the latter being a phylogenetic descendant of the first.

The age of the two localities, on the basis of the Nummulitidae and calcerous nannoplankton, is the middle part of the Cuisian (considering also HARDENBOL—BERGGREN's (1978) data with respect to the Lower—Middle Eocene boundary). So, on the basis of Orthophragminae, these localities served as basis for the determination of other localities' age.

Le Porge — population LP

The sample (sample LP) collected by E. Szőts bears the following label: "Le Porge — fallen Foraminifera from borehole — Gironde". According to E. Szőts (pers. comm.) marls were intersected in the interval from which these Foraminifera originate. Of course, this material is not suitable for stratigraphic purposes at all, since its Orthophragminae fauna is mixed. As the material was properly preserved, however, it was reasonable to take photos merely for the sake of palaeontological interest.

The major part of the material was containing *Discocyclina archiaci archiaci* and *D. archiaci bartholomei*. The first is characteristic of the lower and middle part of the Cuisian, while the latter is characteristic of the upper part of the Cuisian and the lower part of the Lutetian. In addition, *D. furoni*, *D. cf. pulcra landesica*, *Nemkovella evae* and *Orbitoclypeus ramaraoi crimensis* were found, — though only — one specimen of each taxa. All these are characteristic of the middle and upper parts of the Cuisian. On the basis of all these it is most likely that the redeposited Larger Foraminifera are coming from the middle —upper part of the Cuisian.

Horsarrieu — Population HX

From Horsarrieu 3 samples could be examined. Two of them were collected by E. Szőts. These are accompanied by the following labels: "Horsarrieu, Marne à Xanthopsis, Londinien" (sample HX) and "Horsarrieu, Marniére Sourbet, Londinien" (sample HS). According to E. Szőts (pers. comm.) these two samples were collected from the same locality, namely from the marl-pit called "Sourbet" but at different occasions. The third sample was taken by M. Neumann and was marked with the label: "Horsarrieu, Marne à Xanthopsis, Marniére Sourbet, yprézien supérieur" (sample HN). Thus it can be taken for granted that, practically, all three samples originate from the same place. Disregarding minor differences in their fauna these samples are undoubtedly of the same age.

The rock represented by these samples is a Xanthopsis-bearing white calcareous marl, that was described by Boulanger (1968). It is common at the lower reach of the river Adour in Chalosse. With respect to the age of this rock, there are two different opinions. By the French authors (Burger et al. 1945, Neumann 1958, Boulanger 1968) the rock is put into the Lower Lutetian and this is why the Upper Ypresian for the sample taken by M. Neumann is surprising. At the same time, Hottinger—Schaub (1960), Kapellos—Schaub (1973) and Schaub (1981) assign it to the lower part of the Lower Cuisian. So, at the moment there is no common view as for example in case of the Gan beds, concerning the age of the Xanthopsis-bearing marls.

The Nummulites and the calcareous nannoplankton of this rock were described by Kapellos—Schaub (1973). Its Orthophragminae were discussed by Schlumberger (1904) and Neumann (1955, 1958).

In the course of the present examinations the 3 samples provided a material that was very rich in species (in brackets the identifying signs of the samples that contained the actual taxon can be found): *Discocyclina archiaci archiaci* (HX), *D. weijdeni* (HX, HS, HN), *D. fortisi fortisi* (HX, HN), *D. augustae sourbetensis* (HX, HS, HN), *D. trabayensis trabayensis* (HX, HS), *D. aaroni chalossensis* (HX, HS), *D. pratti aquitancia* (HX, HN), *D. pulcra landesica* (HX), *Nemkovella evae* (HX, HS), *N. fermonti* (HN), *Orbitoclypeus varians horsarrieuensis* (HX, HN), *O. bayani* (HS, HN), *Asterocyclina stella taramellii* (HX, HN).

On the basis of Orthophragminae, considering first of all the presence of *Discocyclina fortisi fortisi*, the Horsarrieu samples belong to the middle part of the Cuisian.

It should be noted that for many species (*Discocyclina weijdeni, D. augustae, D. aaroni, D. pratti, D. pulcra, D. trabayensis, Nemkovella evae, Orbitoclypeus varians*) the Horsarrieu locality is one of the deepest ones.

Saint-Barthélémy — Population SB

The only sample from this place was collected by E. Szőts. It is marked with the following label: "Saint-Barthélémy, NW road-cut, marly limestone, londinien Niveau III." In his opinion (pers. comm.) the locality given by him is the same as that called "Maisonnave" in the literature.

It was Douvillé (1905) who — on the basis of Nummulitidae — first assigned the Eocene rocks of this locality partly to the Lower Lutetian (Maisonnave) and partly to the Upper Lutetian (église). His data were not changed substantially by Schaub's (1981) examinations, either.

By Neumann (1958), all rocks from Saint-Barthélémy were put into the so-called "Couches de Brassempouy", first of all on the basis of the similarity of their Orthophragminae.

These rocks, relying on Burger et al. (1945) correspond to the Upper Lutetian substage.

The Orthophragminae of this place were dealt with by Schlumberger (1903), Douvillé (1922) and NEUMANN (1958). Most of their specimens were coming from the "Maisonnave" exposure, though some of SCHLUMBERGER's (1903) *Orthophragminae marthae* and the latter two authors' *Discocyclina roberti* were not from here but from the exposure at the church. In our opinion, these forms represent *Orbitoclypeus varians roberti* and on the basis of these the age of its locality can be put to the lower part of the Bartonian stage, i.e. it cannot be identified with the locality discussed here.

The sample examined was containing the following forms: *Discocyclina archiaci bartholomei, D. augustae sourbetensis, D. dispansa taurica, D. trabayensis trabayensis, Nemkovella evae, N. fermonti, N. strophiolata bodrakensis, Orbitoclypeus marthae, O. schopeni, O. douvillei, O. daguini, Asterocyclina stella taramellii, A. stellata adourensis, A. kecskemetii, A. schweighauseri.*

Also on the basis of Orthophragminae, the locality can be assigned to the lower part of the Lutetian, first of all because *Nemkovella strophiolata bodrakensis* and *Discocyclina dispansa taurica* can be only found at this level.

From now on, this locality is used as basis in the stratigraphic evaluation so that the age-divisions could be relatively free of contradictions.

Caupenne — Population JG

The only sample from here was taken by E. SZŐTS and it is marked by the following label: "Caupenne, Ferme Jean Gazé" (JG sample). According to the literature the enclosing rock is marl ("Marnes de Jeangazé" — KAPELLOS—SCHAUB 1973, SCHAUB 1981).

Concerning the age of the locality, bibliographic data represent different opinions: By BURGER et al. (1945) these rocks were assigned between the Lower and Middle Lutetian, by HOTTINGER et al. (1956) they were put into the middle of the Lower Lutetian substage on the basis of Nummulitidae. On the basis of Orthophragminae the rocks were put into the Upper Lutetian by NEUMANN (1958) and again, on the basis of Nummulitidae, by HOTTINGER et al. (1964) they were put into the Upper Cuisian or to the Cuisian—Lutetian boundary. It was KAPELLOS—SCHAUB (1973) who carried out the most complete examination of the locality. From "Jeangazé", Nummulitidae belonging to the *Nummulites manfredi* zone, and calcareous nannoplankton of the *Discoaster sublodoensis* zone were identified by them, and on this basis they assigned the locality to the upper part of the Upper Cuisian.

The sample examined contained rather poorly preserved Orthophragminae. Only *Discocyclina dispansa taurica, Orbitoclypeus chudeaui chudeaui* and *Asterocyclina schweighauseri* could be identified.

Most likely, the age of the fauna falls to the lower part of the Lutetian. This does not contradict KAPELLOS—SCHAUB's (1973) and SCHAUB's (1981) data, even if we consider HARDENBOL—BERGGREN's (1978) opinion and move the *Discoaster sublodoensis* zone from the Upper Cuisian into the Lower Lutetian.

Couches de Nousse (Gibret — Population GN and Nousse — Population NC)

Two samples (Gibret, Église, Couches de Nousse, Lutétien — GN sample and Nousse, Crouts, Lutétien — NC sample), both of them taken by E. SZŐTS are described here together, since on the basis of the bibliographic data as well as their Orthophragmina fauna they come from the same level, namely, from the series known as "Couches de Nousse".

This glauconitic clay and calcareous marl series is put, by BURGER et al. (1945), between the "Couches de Donzacq" and "Couches á grandes Nummulites" in the Middle Lutetian.

On the basis of Nummulitidae, the stratigraphic position of "Couches de Nousse" is marked out by HOTTINGER et al. (1956), HOTTINGER et al. (1964), KAPELLOS—SCHAUB (1973) and SCHAUB (1981) at the Lower — Middle Lutetian transition.

While referring to "Couches de Nousse" obviously a deeper level is meant by NEUMANN (1958) than by the Swiss authors, since she assigned the Gibret—Église and Nousse—Crouts localities, the latter one is referred to as "tranchée du chemin de fer" by her, to the Upper Lutetian as the member of "Couches á grandes Nummulites", whereas the localities belonging to the "Couches de Nousse" to a higher part of the Lower Lutetian. No separate Middle Lutetian is distinguished by NEUMANN.

In the course of the present study from the two samples the following forms were identified: *Discocyclina discus discus* (GN, NC), *D. augustae atlantica* (NC), *D. dispansa nussdorfensis* (GN, NC), *D. trabayensis trabayensis* (GN), *D. pratti montfortensis* (NC), *D. pulcra pulcra* (GN), *D. radians noussensis* (GN, NC), *Nemkovella strophiolata strophiolata* (GN, NC), *Orbitoclypeus douvillei* (GN), *O. chudeaui chudeaui* (NC), *Asterocyclina stellata adourensis* (GN, NC), *A. alticostata gallensis* (GN, NC).

As far as the age of the localities is concerned the opinion of the Swiss authors can be accepted, though on the basis of HARDENBOL—BERGGREN's (1978) modified Lutetian, the middle part of the Lutetian stage is more likely. These localities also served as basis for the datation of other localities.

Montfort — Population FM

This sample was taken by E. Szőts and it is marked with the following label: "Montfort, Fontaine de la Médaille, Lutetian" (Sample FM).

The age of calcareous marls were put into the Upper Lutetian by Douvillé (1922), whereas by Burger et al. (1945) they were referred to as "Couches á grandes Nummulites", consequently they were put into the Middle or Upper Lutetian.

By Hottinger et al. (1956) only *Nummulities aturicus* (forms "A" and "B") were found here and that is why they assigned the locality to the upper part of the Middle Lutetian. Then, after the introduction of the Biarritzian it was included into the Upper Lutetian by Hottinger et al. (1964). Schaub's (1981) work also accepts this view.

By Neumann (1958) *Discocyclina sella* is mentioned from there and the locality is regarded as Late Lutetian. With no figure available this determination could not be checked.

In the sample examined beside the multitude of Nummulites, some Orthophragminae were also found, namely: *Discocyclina dispansa nussdorfensis, D. aaroni aaroni, D. pratti montfortensis, D. radians noussensis, Asterocyclina stellata adourensis* and *A. schweighauseri*.

As far as the determination of age on the basis of Orthophragminae is concerned, I do not share the Swiss authors' opinion. The basis for placing it into middle part of the Lutetian is that the hemera of *Discocyclina dispansa nussdorfensis* is limited only to this level, whereas the presence of *D. radians noussensis, D. pratti montfortensis* and *Asterocyclina stellata adourensis* makes the distinction obvious from the higher levels.

Angoumé — Population AM

The sample from here was collected by E. Szőts and it bears the following label: "Angoumé, Marniére de Miretraine, Lutétien" (sample AM).

References concerning the grey marls of this locality could be found only at Neumann (1958). In her opinion these layers were assigned to the Upper Lutetian. Beside, the one from "Marniére de Miretraine", similar fauna was also published by her from the "Russieau de Chateau" from Angoumé.

The sample examined has yielded the following very rich Orthophragmina fauna: *Discocyclina stratiemanuelis, D. dispansa hungarica, D. pratti pratti, D. pulcra pulcra, D. radians radians, Nemkovella strophiolata strophiolata, Orbitoclypeus varians angoumensis, O. chudeaui chudeaui, O. furcata rovasendai, Asterocyclina stellata stellata, A. kecskemetii, A. stella taramellii, A. alticostata cuvillieri.*

The age of the locality, on the basis of Orthophragminae, can be fixed in the upper part of the Lutetian. The presence of *Discocyclina dispansa hungarica, D. radians radians, D. pratti pratti* and *Asterocyclina alticostata cuvillieri* makes the distinction clear from the lower levels, whereas the presence of *Discocyclina pulcra pulcra, Orbitoclypeus varians angoumensis* and *O. chudeaui chudeaui* makes the distinction possible from the higher levels.

Cauneille — Population CM

The sample collected by E. Szőts (sample CM) bears the following label: "Cauneille, Rarcole marne, Lutétien".

From this settlement referred to as "Ruisseau de Peyrucat" by Neumann (1958) specimens of *Discocyclina pratti* and *Asterocyclina cuvillieri* were mentioned. This fauna gives no due basis to identify the sample we examined with the specimens examined by Neumann.

The sample examined comes from glauconitic marls and, in addition to the Nummulites, that according to our determination are close to *Nummulites perforatus* and *N. striatus*, the following Orthophragmina fauna was found in it: *Discocyclina augustae augustae, Orbitoclypeus daguini, O. varians varians, Asterocyclina alticostata alticostata, A. kecskemetii, A. stella stella* and *A. stellata stellaris*.

On the basis of Orthophragminae, the locality could be assigned to the upper part of the Bartonian. The presence of *Orbitoclypeus varians varians* makes the distinction clear from the lower levels, whereas the presence of *Asterocyclina stella stella, A. alticostata alticostata* and also of a form that is close to *Nummulites perforatus* makes clear distinction possible from higher levels.

Siest — Population SO

Two samples were examined, both of them taken by E. Szőts. They had the following labels: "Siest, Couches de Briande et Tourelle, priabonien inférieur" (sample BT) and "Siest, Couches de Siest et Orist, priabonien supérieur" (sample SO). Despite the different age, indications, these two samples are discussed together, since no differences in their faunas could be found.

Reference in the literature with respect to the Eocene rocks of this locality could be only with Neumann (1958) but the exposures she examined could not be clearly identified with those studied by the present writer.

In the two samples, examined *Discocyclina javana* was found only in the BT sample, whereas *D. augustae augustae*, *D. dispansa dispansa*, *D. radians radians*, *Orbitoclypeus varians varians* and *Asterocyclina stellata stellaris* were found in both samples. It should be noted, however, that sample BT also contained forms that are close to *Nummulites perforatus*.

On the basis of Orthophragminae, the locality was assigned to the upper part of the Bartonian. The presence of *Discocyclina dispansa dispansa* and *Orbitoclypeus varians varians* makes possible the clear distinction from the lower levels, whereas *Discocyclina radians radians* and the form that is close to *Nummulites perforatus* makes clear distinction possible from the upper ones.

In this part an attempt will be made to reconstruct the Stratigraphy of Orthophragminae on the basis of the available data. First of all, those data were taken into consideration that were obtained in the course of our examinations but, in case if it was possible, the critically revised former data, were also taken into account. The intervals of the existence of different forms are shown in tables 9 and 10.

Remarks to the Tables:

For the determination of the age a few localities, examined thoroughly, from several points of view were used as basis. First of all, I relied on SCHAUB's and his school's (HOTTINGER—LEHMANN—SCHAUB 1964, KAPELLOS—SCHAUB 1973, KAPELLOS 1973, SCHAUB 1981), results, so that I could avoid major contradictions. I, however, also considered HARDENBOL—BERGGREN's (1978), opinion, i.e. that the calcareous nannoplankton zone NP 14 represents the lower part of the Lutetian. Also, the Bartonian denomination is used in their interpretation.

The following considerations were taken as basis:

Spilecco (population SC) — the middle part of the Ilerdian,
Gan (population GA) — the middle part of the Cuisian,
Gibret and Nousse (populations GN and NC respectively) — the middle part of the Lutetian,
Mossano (population MS) — the lower part of the Priabonian,
Priabona (population VG and PR) — the middle and upper parts of the Priabonian, respectively.

In case of all the other localities the ages were determined by way of correlation with the above bases.

Having determined the age of the localities, using the bibliographic data as well, the present writer established 16 stratigraphic units that could be determined on the basis of Orthophragminae. Later, after more thorough study these 16 stratigraphic units (hereunder marked by numbers in brackets) may evolve into zones. In most of them (in 1., 2., 3., 4., 6., 7., 8., 9., 10., 11. and 12. and possibly in 15. too) it is possible to find a taxon that is characteristic only of the actual unit, whereas the rest of the units can be regarded later as "concurrent range zones".

Orthophragminae appear first only in the Paleogene. CHECCHIA-RISPOLI—GEMMELARO's (1909) *Orthophragmina prima* from the Senonian should be revised, therefore this form is not discussed in the present work.

Paleocene

(1) For the time being, only *Orbitoclypeus seunesi* can be certainly detected. Places of occurrence: the *Operculina heberti*-bearing beds of W Aquitaine (Bénesse) and one part of the limestone reefs in the vicinity of Hričovské Podhradie (W Slovakia).

Eocene

On the basis of the resolution of the Colloque 18th November 1974, dealing with the Ilerdian (Bull. Soc. Geol. France 1975, 7(17/2) p. 223.) the boundary of the Thanetian and Ilderian was regarded as the dividing line between the Paleocene and the Eocene.

In the determination of the lower boundary of the Eocene the standpoint of the Colloque and HARDENBOL—BERGGREN's opinion are somewhat different. According to the decision of the Colloque this border is in the middle of the NP 9 calcareous nannoplankton zone, whereas the latter authors put this border to the top of the zone. This difference, however, does not affect the stratigraphic subdivision in the present work.

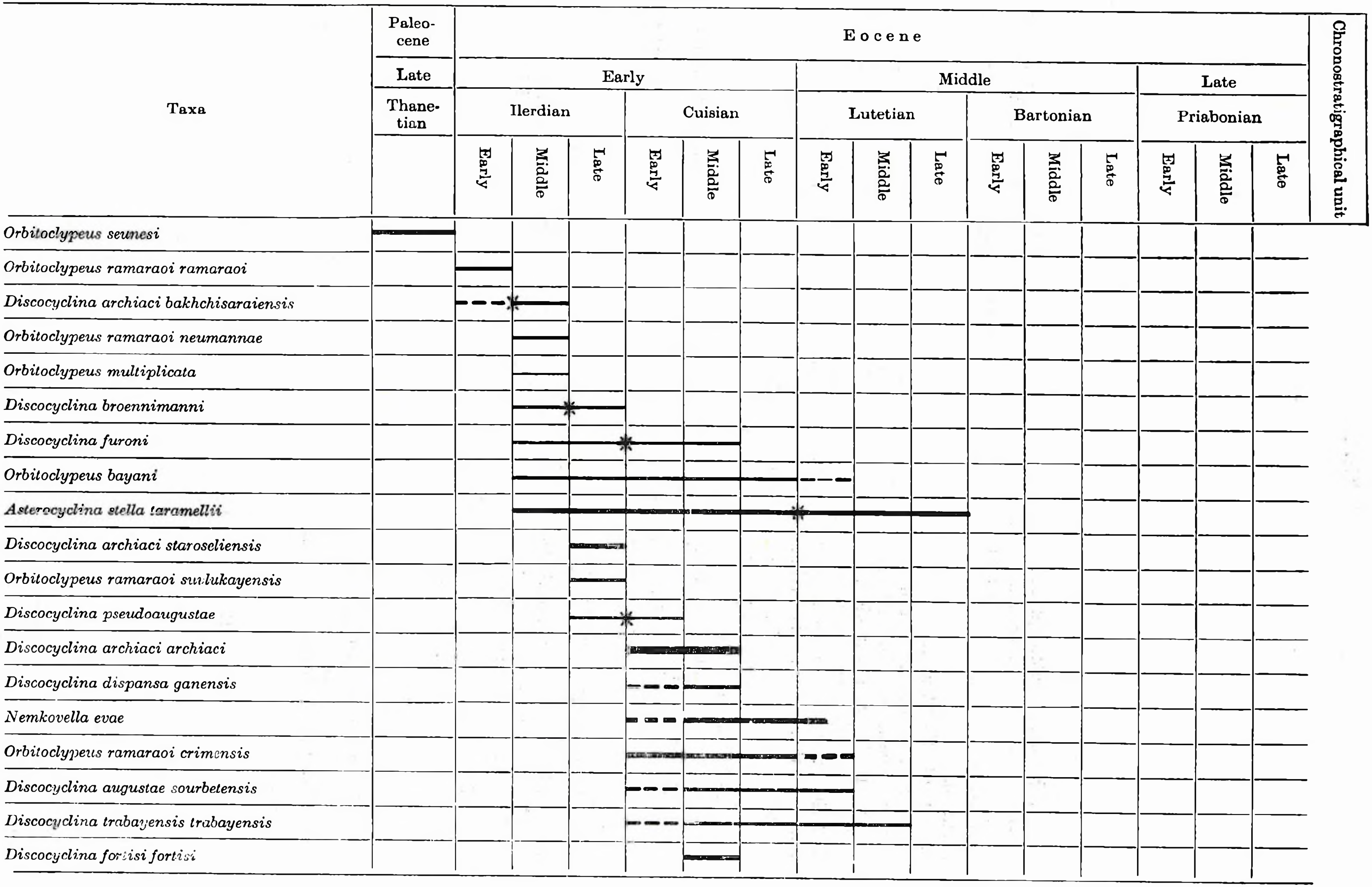
Lover Eocene

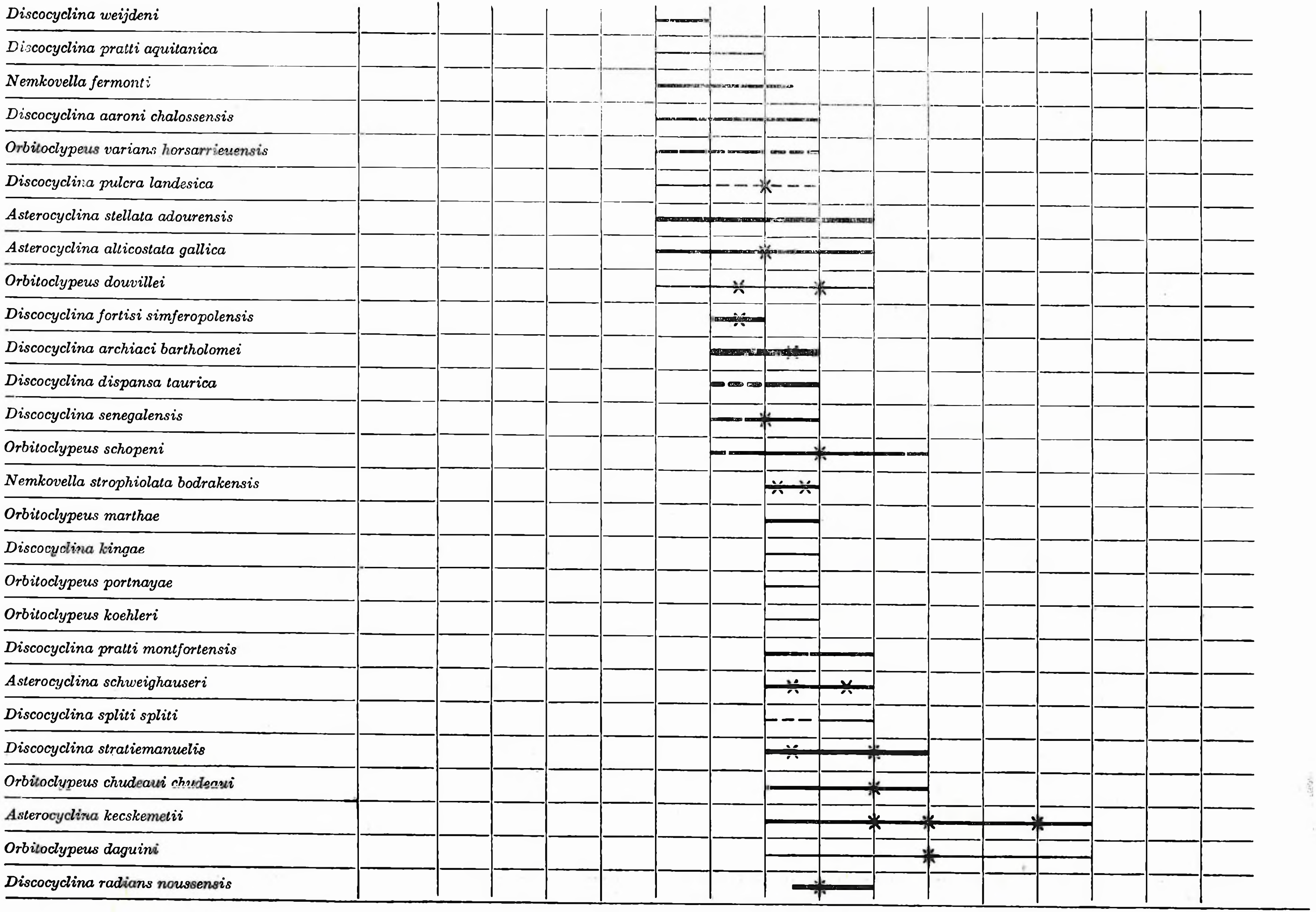
In the Lower Eocene the Ilerdian and Cuisian stages are used by several authors dealing with Larger Foraminifera. Possibility for this is also provided by the phylogeny of Orthophragminae.

9. *táblázat* — *Table 9*

Az Orthophragmina-taxonok fajöltői

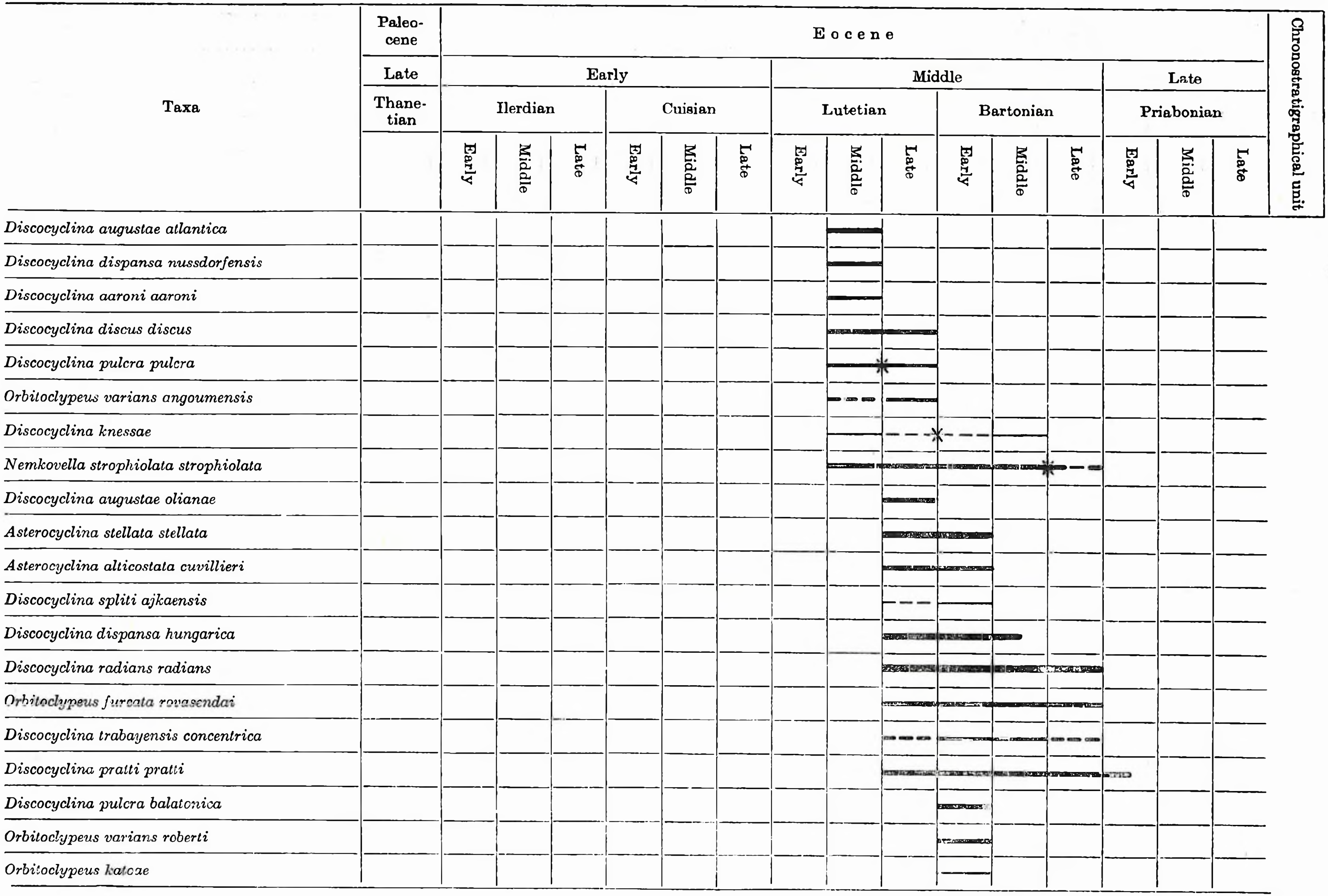
Ranges of Orthophragminae taxa

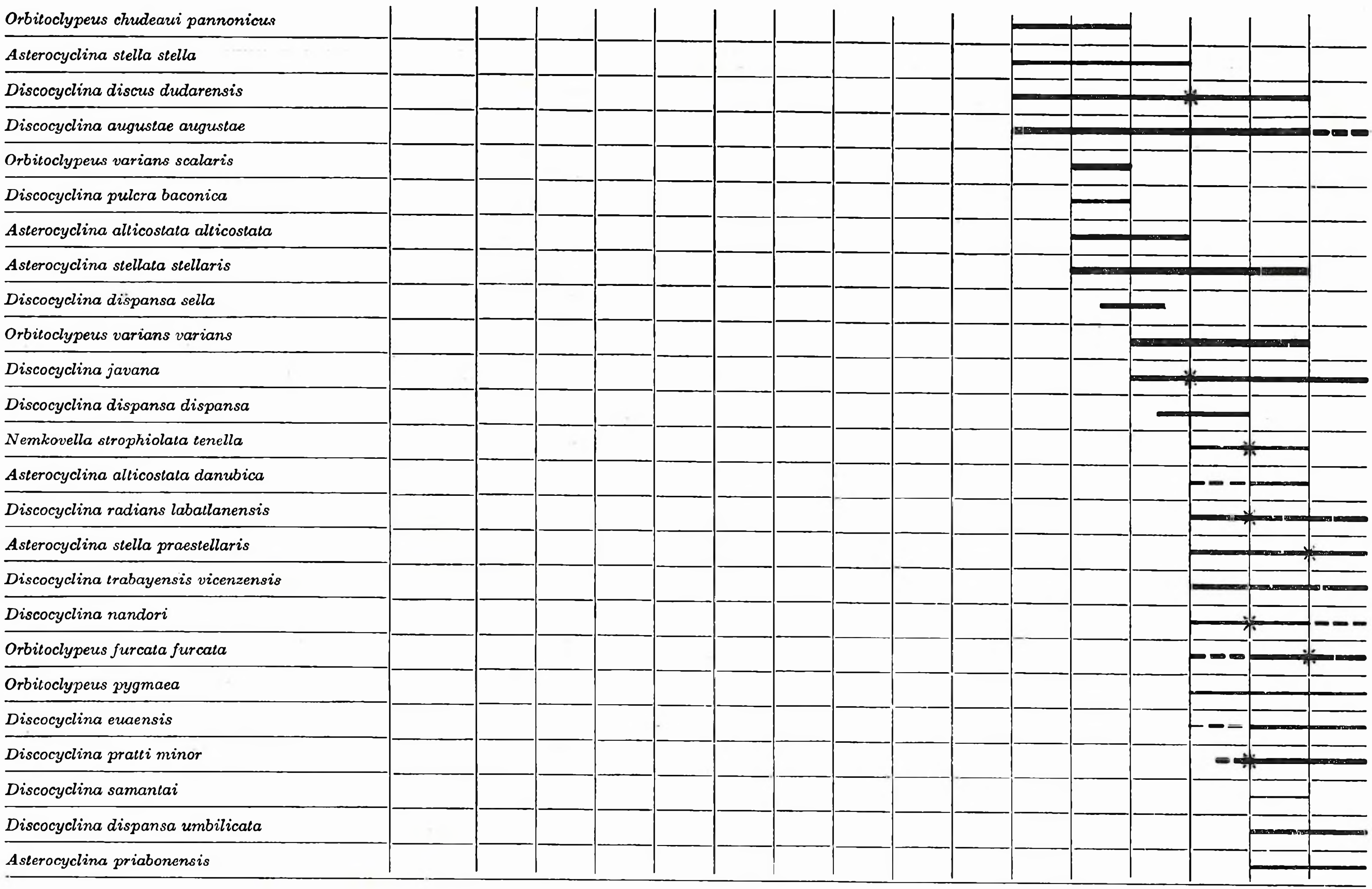




Discocyclina weijdeni
Discocyclina pratti aquitanica
Nemkovella fermonti
Discocyclina aaroni chalossensis
Orbitoclypeus varians horsarrieuensis
Discocyclina pulcra landesica
Asterocyclina stellata adourensis
Asterocyclina alticostata gallica
Orbitoclypeus douvillei
Discocyclina fortisi simferopolensis
Discocyclina archiaci bartholomei
Discocyclina dispansa taurica
Discocyclina senegalensis
Orbitoclypeus schopeni
Nemkovella strophiolata bodrakensis
Orbitoclypeus marthae
Discocyclina kingae
Orbitoclypeus portnayae
Orbitoclypeus koehleri
Discocyclina pratti montfortensis
Asterocyclina schweighauseri
Discocyclina spliti spliti
Discocyclina stratiemanuelis
Orbitoclypeus chudeaui chudeaui
Asterocyclina kecskemetii
Orbitoclypeus daguini
Discocyclina radians noussensis

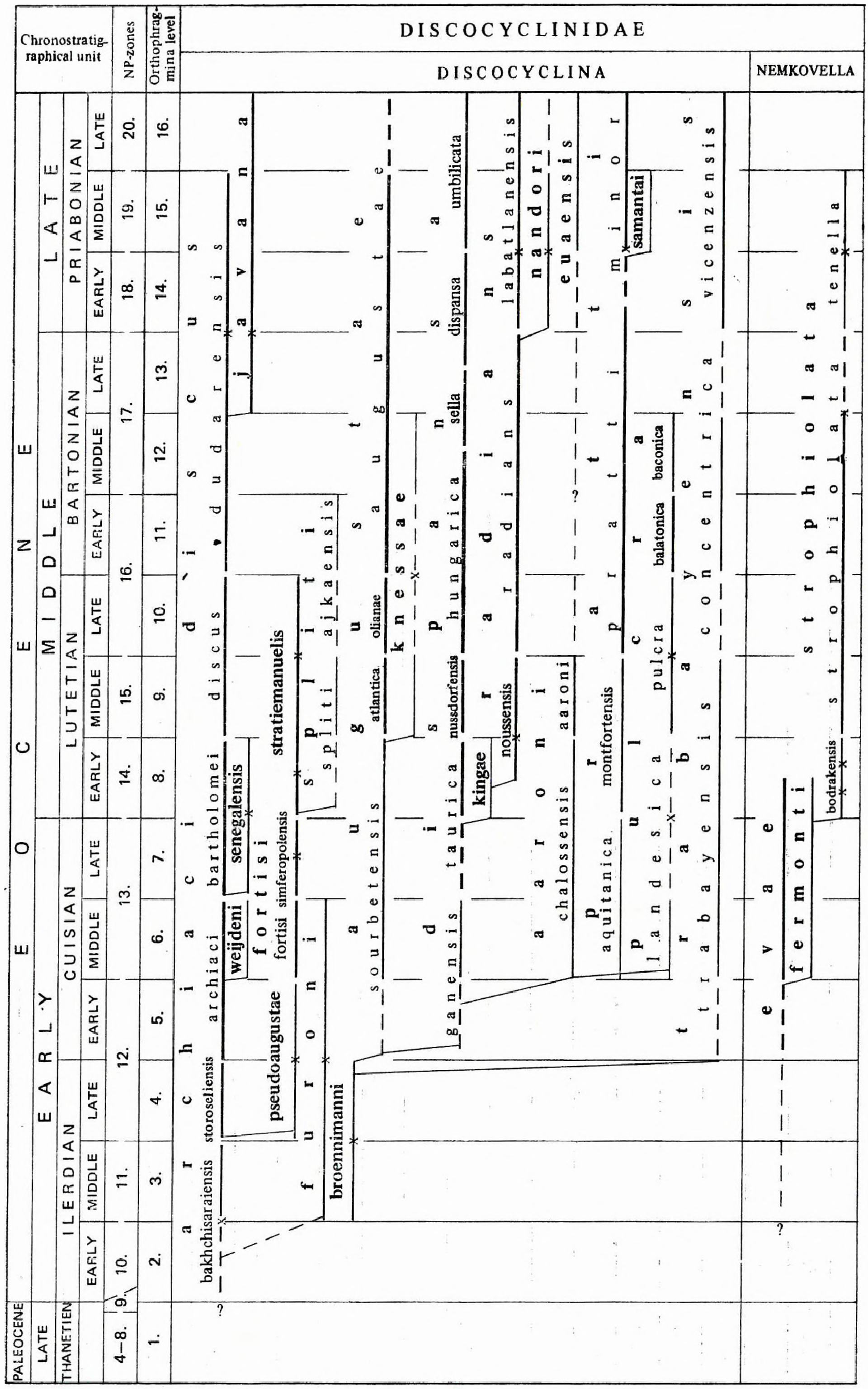
9. táblázat folytatása



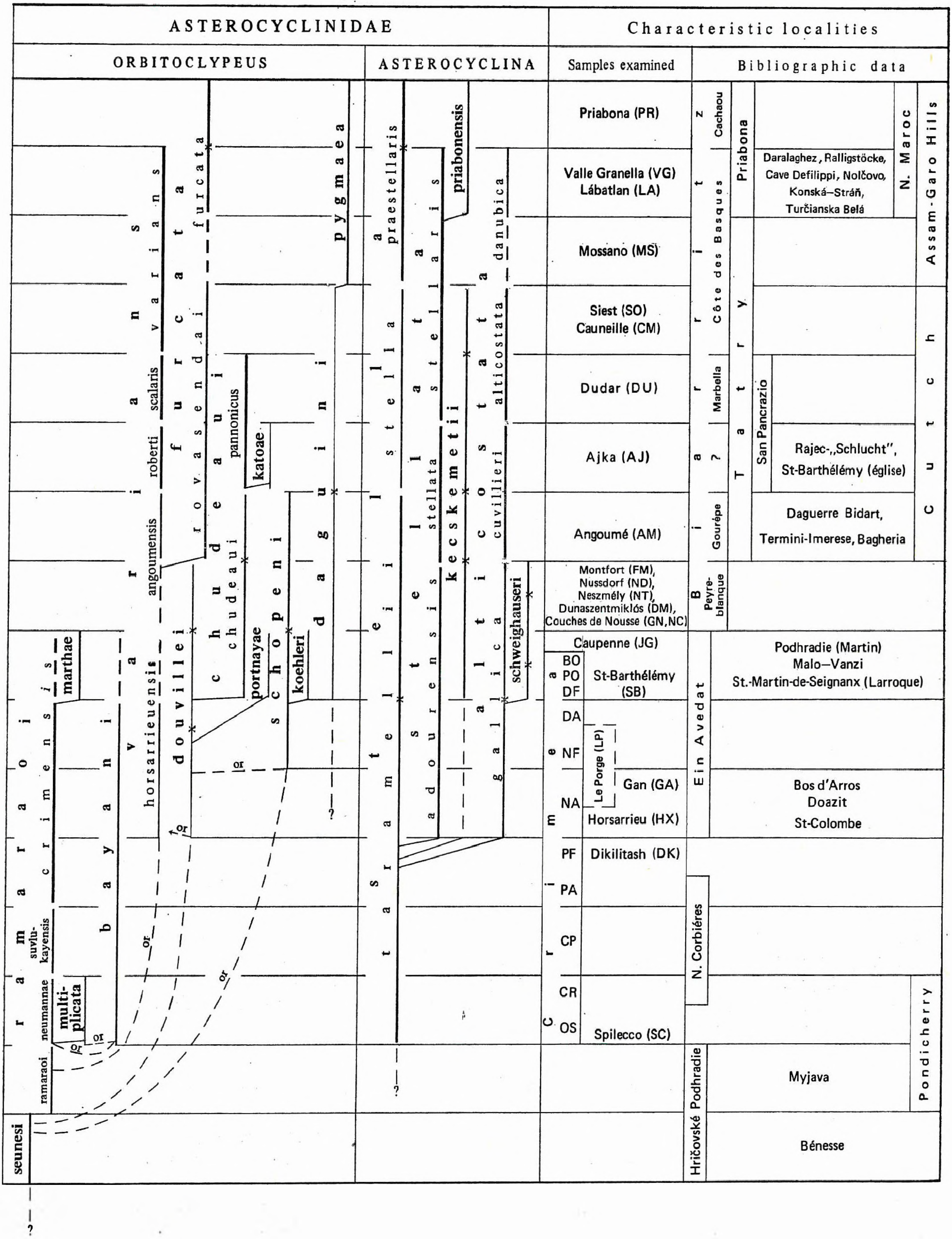


1 — unique; 2 rare; 3 frequent; 4 abundant; presumable occurrence; X possible further subdivision within the taxa.

Phylogenetic scheme of the



For legend, see Table 9


ASTEROCYCLINIDAE
Characteristic localities
ORBITOCLYPEUS
ASTEROCYCLINA
Samples examined
Bibliographic data
ramaraoi
neumannae
multiplicata
suvlukayensis
marthae
r a m a r a o i
c r i m e n s i s
b a y a n i
horsarrieuensis
angoumensis
roberti
scalaris
v a r i a n s
f u r c a t a
furcata
douvillei
rovasendai
c h u d e a u i
chudeaui
pannonicus
portnayae
katoae
s c h o p e n i
koehleri
d a g u i n i
p y g m a e a
or
?
seunesi
s t a r m a n n i
s t e l l a t a
praestellaris
stellata
s t e l l a r i s
priabonensis
a d o u r e n s i s
kecskemetii
a l t i c o s t a t a
alticostata
cuvillieri
danubica
g a l l i c a
schweighauseri
Priabona (PR)
Valle Granella (VG)
Lábatlan (LA)
Mossano (MS)
Siest (SO)
Cauneille (CM)
Dudar (DU)
Ajka (AJ)
Angoumé (AM)
Montfort (FM),
Nussdorf (ND),
Neszmély (NT),
Dunaszentmiklós (DM),
Couches de Nousse (GN,NC)
Caupenne (JG)
BO
PO
DF
St-Barthélémy (SB)
DA
NF
Le Porge (LP)
Gan (GA)
NA
Horsarrieu (HX)
PF
Dikilitash (DK)
PA
CP
CR
OS
Spilecco (SC)
C r i m e a
Cachaou
Côte des Basques
Marbella
Gourépe
Peyre-blanque
B i a r r i t z
?
T a t r y
Priabona
San Pancrazio
Daralaghez, Ralligstöcke,
Cave Defilippi, Nolčovo,
Konská-Stráň,
Turčianska Belá
N. Maroc
Assam-Garo Hills
Rajec-„Schlucht",
St-Barthélémy (église)
Daguerre Bidart,
Termini-Imerese, Bagheria
C u t c h
Ein Avedat
Podhradie (Martin)
Malo–Vanzi
St.-Martin-de-Seignanx (Larroque)
Bos d'Arros
Doazit
St-Colombe
N. Corbiéres
Hričovské Podhradie
Myjava
Pondicherry
Bénesse

Ilerdian

Probably the upper part of the calcareous nannoplankton zone NP 9 the NP 10—11 zones and the lower part of the NP 12 zone are the different substages.

From there onwards a rich Orthophragmina fauna, richer than that of the Paleocene, is known.

(2) The rocks that can be assigned to the lower part of the Ilerdian have not been examined by the author and, in addition, few data concerning the subject were available in the literature. Approximately it corresponds to the upper part of calcareous nannoplankton zone the NP 9 and the whole of NP 10. One part of the limestone reefs of Myjava and Hričovské Podhradie may also belong to here (Köhler 1961, Samuel et al. 1972), as well as one part of the Pondicherry layers in South India (Samanta 1967). The presence of *Orbitoclypeus ramaraoi ramaraoi* is characteristic of this stratigraphic unit. On the basis of the examination of some poorly preserved specimens in an Aurignac (SW Aquitaine) sample, it is possible that *Discocyclina archiaci bakhchisaraiensis*, already appears here.

(3) From the middle part of the Ilerdian (tuffitic marls of Spilecco — population SC), the lower parts of the Bakhchisaraian stage in the Crimea — populations OS and CR, and partly the Orthophragmina-bearing rocks of the Northern Corbières (Massieux 1973); and Pondicherry (Samanta 1967, 1968) seven forms are known at present. Of these, *Orbitoclypeus ramaraoi neumannae* is limited only to this level. This is the only unit, where the disappearing *Discocyclina archiaci bakhchisaraiensis* and the appearing *D. broennimanni*, *D. furoni*, *Asterocyclina stella taramellii* and *Orbitoclypeus bayani* can be found together. Approximately it corresponds to the NP 11 calcareous nannoplankton zone.

(4) *Discocyclina archiaci staroseliensis* and *Orbitoclypeus ramaraoi suvlukayensis* are characteristic only of the upper part of the Ilerdian (the middle part of the Bakhchisaraian stage of the Crimea — population CP and partly the Orthophragmina-bearing beds of the Northern Corbières and Pondicherry). The disappearing *Discocyclina broennimanni* and the appearing *D. pseudoaugustae* can be found together in this unit only. Roughly, it corresponds to the lower part of the calcareous nannoplankton zone NP 12.

Cuisian

As compared to the Ilerdian, a much richer Orthophragmina fauna is characteristic of the upper part of the Lower Eocene.

(5) The lower part of the Cuisian stage (the upper part of the Bakhchisaraian stage in the Crimea — populations PA and PF; Diklitash — population DK; and partially the Orthophragmina-bearing beds of the Northern Corbières) can be characterized by the coexistence of the disappearing *Discocyclina pseudoaugustae* and the appearing *D. archiaci archiaci* and *Orbitoclypeus ramaraoi crimensis*. Approximately, it corresponds to the upper part of the calcareous nannoplankton zone NP 12.

(6) The middle part of the Cuisian [Gan, Tuilerie — population GA; Horsarrieu — population HX; the transition of the Bakhchisaraian and Simferopolian stages in the Crimea — population NA; also Bos d'Arros; Doazit; Sainte-Colombe and the Is 187—259 samples of the Ein Avedat section (Israel) by Fermont (1982)] is the only unit where *Discocyclina fortisi fortisi* can be found. Only here the disappearing *Discocyclina archiaci archiaci*, *D. furoni D. dispansa ganensis* and the appearing *Asterocyclina stellata adourensis*, *A. alticostata gallica*, *Orbitoclypeus varians horsarrieuensis* and *D. aaroni chalossensis* occur together. It can be best correlated with the lower part of the NP 13 calcareous nannoplankton zone.

(7) The fauna of the upper part of the Cuisian could be studied only from the Simferopolian stage of the Crimea (populations NF and DA) and from the Le Porge borehole (population LP). The Is 260—330 samples of the Ein Avedat section (Israel) by Fermont (1982) and possibly Stöckweid bei Einsiedeln (Switzerland) (Brönnimann 1945b) belong, here too. This is the only unit where *Discocyclina fortisi simferopolensis*, that evolves within this short interval of time, can be found. The disappearing *D. pratti aquitanica* and the appearing *D. archiaci bartholomei*, *D. senegalensis* and *Orbitoclypeus schopeni* can be found together only here. Approximately it corresponds to the upper part of the NP 13 calcareous nannoplankton zone.

Middle Eocene

The most flourishing period of Orthophragminae is the Middle Eocene. Here, according to Hardenbol—Berggren (1978) the Lutetian and Bartonian stages are identified as Middle Eocene. Their boundary is within the NP 16 calcareous nannoplankton zone. The possibility of the Auversian stage was ruled out by Hottinger—Schaub (1960). The use of the Biarritzian, however introduced by them, is not reasonable, since it is not internationally accepted, in addition, the present writer did not have the opportunity to examine samples from Biarritz. On the basis of the critically evaluated literature, too, it is probable that, on the basis of their Orthophragmina fauna, the lowermost Biarritz layers (Rocher La Gourèpe; Peyreblanque) were formed much before the extinction of Assilinae, since they can be correlated to Upper Lutetian layers (Angoumé).

Lutetian

(8) In the lower part of the Lutetian [(Saint-Barthélémy, "Maisonnave" — population SB; Caupenne, Jeangazé — population JG, Saint-Martin-de-Seignanx, Moulin Larroque; Valle Grande bei Malo, Vanzi quarry; the upper part of the Simferopolian stage in the Crimea — populations DF and PO and the lower part of the Bodrakian stage — population BO, too; Kressenberg—Emanuel-Flöz; Podhradie (Slovakia, Köhler 1967); and also samples Is 331—463. of the Ein Avedat section is Israel by Fermont (1982)] a great many new forms appear among which *Nemkovella strophiolata bodrakensis* and *Orbitoclypeus marthae* can be found only here. This is the unit where the disappearing *Discocyclina archiaci bartholomei, D. dispansa taurica, Nemkovella evae* and the appearing *Discocyclina stratiemanuelis, D. pratti montfortensis, Orbitoclypeus chudeaui chudeaui* and *Asterocyclina kecskemetii* can be found together.

First of all on the basis of the evolution of *Discocyclina archiaci bartholomei* and *D. stratiemanuelis* but also considering the data with respect to extinction and emergence of taxa (see table 9.) it may be possible that the unit will be divided into a lower (populations SB, DF, PO, Vanzi) and an upper part (populations BO, JG, Kressenberg, Podhradie). Approximately it corresponds to the calcareous nannoplankton zone NP 14.

(9) Among the forms that appear in the middle part of the Lutetian (Gibret — population GN, Nousse — population NC, Montfort — population FM, Nussdorf — population ND, Dunaszentmiklós — population DM, Neszmély — population NT) *Discocyclina augustae atlantica, D. dispansa nussdorfensis, D. aaroni aaroni* and the typical *D. radians noussensis* are limited to this unit only. This is the only unit where the disappearing *Asterocyclina stellata adourensis* and *A. alticostata gallica* can be found along with the appearing *Discocyclina discus discus* and *Nemkovella strophiolata strophiolata.* Approximately, it corresponds to the calcareous nannoplankton zone NP 15.

(10) In the upper part of the Lutetian (Angoumé — population AM; Biarritz, La Gourépe; Saint-Pierre-d'Irube, Daguerre; Bidart — Béhéréco and one part of Checchia-Rispoli's (1909a b, 1911) Sicilian samples) the *Discocyclina augustae olianae* appears as a new form which is limited to this unit only.

In this unit, the disappearing *Asterocyclina stella taramellii, Discocyclina stratiemanuelis, D. discus discus, D. pulcra pulcra, Orbitoclypeus chudeaui chudeaui, O. varians angoumensis* and the appearing *Asterocyclina stellata stellata, A. alticostata cuvillieri, Discocyclina radians radians, D. dispansa hungarica, D. pratti pratti, Orbitoclypeus furcata rovasendai* can be found together. Most probably this unit corresponds to the lower part of the calcareous nannoplankton zone NP 16.

Bartonian

(11) All samples examined from Ajka (population AJ); the Saint-Barthélémy (église); the Rajec-Schlucht (Köhler 1967) and San Pancrazio (Schweighauser 1953) localities can be assigned to the lower part of the Bartonian. *Discocyclina pulcra balatonica* and *Orbitoclypeus varians roberti* are characteristic only of this unit. This is the only unit where the disappearing *Asterocyclina stellata stellata* and *A. alticostata cuvillieri* can be found together with the appearing *Discocyclina discus dudarensis, D. augustae augustae, Orbitoclypeus chudeaui pannonicus* and *Asterocyclina stella stella.* Approximately, it corresponds to the upper part of the calcareous nannoplankton zone NP 16.

(12) In the middle part of the Bartonian, the samples examined from Dudar (population DU), and from the Villa Marbella (Biarritz) locality, could be included. The periods of the occurrences of *Discocyclina pulcra baconica* and *Orbitoclypeus varians scalaris* are limited only to this unit. This is the only unit where the disappearing *Orbitoclypeus chudeaui pannonicus* and the appearing *Asterocyclina alticostata alticostata* and *A. stellata stellaris* can be found together. Around the middle of the unit *Discocyclina dispansa hungarica* is replaced by *D. dispansa sella.* Most likely this unit corresponds to the lower part of the NP 17 calcareous nannoplankton zone.

(13) Of the faunas examined the samples from Siest (population SO) and Cauneille (population CM) belong to the upper part of the Bartonian, on the basis of Orthophragminae. On the basis of bibliographic data, the lower part of Côte des Basques in Biarritz also belongs here. It has not got its own index form, its lower boundary is marked by the appearence of *Orbitoclypeus varians varians* and *Discocyclina javana,* whereas its top is marked by the extinction of *D. radians radians, Orbitoclypeus furcata rovasendai, Asterocyclina alticostata alticostata. Discocyclina dispansa sella* is replaced by *D. dispansa dispansa* approximately around the middle of the unit. Approximately, it corresponds to the upper part of the calcareous nannoplankton zone NP 17.

Upper Eocene

Priabonian

Since in Europe Orthophragminae can be found only in the Mediterranean, it appeared expedient here to identify the Upper Eocene with the Priabonian. On the basis of the samples examined and that of the bibliographic data the Priabonian can be divided into 3 parts with the aid of Orthophragminae.

(14) In the lower part of the Priabonian (Mossano — population MS; Biarritz, Côte des Basques; one part of the Orthophragmina-bearing rocks of Garo Hills, Assam) no level-marking forms can be found. It is the period between the appearance of *Discocyclina radians labatlanensis, D. trabayensis vicenzensis, D. nandori, Nemkovella strophiolata tenella, Asterocyclina stella praestellaris* and the extinction of *Discocyclina dispansa dispansa, D. pratti pratti.* Approximately it covers the duration of the calcareous nannoplankton NP 18.

(15) Probably the only unit, where *Discocyclina pratti minor* occurs is the middle part of the Priabonian (the vicinity of Lábatlan — population LA; Valle Granella — population VG; the Discocyclina-bearing and "blue clay" beds of the Priabona type section; Cave Defilippi; Verona, Forte San Felice; Ralligstöcke; Daralaghez; Nolčovo and Konská-Strāň). The appearing *Discocyclina dispansa umbilicata, Asterocyclina priabonensis* and the disappearing *Discocyclina discus dudarensis, Asterocyclina stellata stellaris* and *Orbitoclypeus varians varians* can be found together only here. Approximately it corresponds to the calcareous nannoplankton zone NP 19.

(16) At the top of the Eocene, in the upper part of the Priabonian (Priabona — Asterocyclina beds, population PR; Biarritz, La Cachaou; Assam, Garo Hills and NW Morocco) no new forms occur, nevertheless, *Asterocyclina stella praestellaris* and *Orbitoclypeus furcata furcata* seems to be evolving even here, whereas for *Discocyclina trabayensis vicenzensis* and *Asterocyclina priabonensis* this is the golden age. All forms survivly over from lower units became extinct at the end of the Eocene. Other forms that can also be found in this unit are as follows: *Discocyclina javana, D. augustae augustae, D. radians labatlanensis, D. nandori, D. dispansa umbilicata, D. euaensis* and *Orbitoclypeus pygmaea.* It may correspond to the calcareous nannoplankton zone NP 20.

Of course, the above described biostratigraphic division includes many uncertainty factors that are indicated by the dotted lines of Tables 9. and 10. as well. In addition, in these tables, the possible points of further division to be verified in the future are marked by crosses. The examined material is too small for a correct zonation on the basis of Orthophragminae. Nevertheless it is sincerely hoped that this subdivision can serve as basis for a better stratigraphic subdivision in the future and we are sure that is shows the quick pace of evolution of the Orthophragminae in the Eocene refuting the — in our opinion erroreous — view formed hitherto with respect to the persistency of Orthophragminae.

Despite the fact that the Orthophragminae are not pelagic forms, their geographic range is remarkable, since their remains can be found on all continents.

As it is shown in text-fig. 25, the Orthophragminae lived in two isolated territories, namely, in the one-time Tethys and in the Caribbean—Pacific region. This isolation was so definite that only two genera, namely, Orbitoclypeus and Asterocyclina can be found in both regions. Common species, however, are not yet known (Asterocyclina in the Tethys are five-branched, whereas in the Caribbean—Pacific region mostly four branched Asterocyclinae are characteristic). On the contrary, Discocyclinae and Nemkovellae occur only in the region of the one-time Tethys, whereas Athecocyclinae, Proporocyclinae, Pseudophragminae and Neodiscocyclinae occur only in the Caribbean—Pacific region.

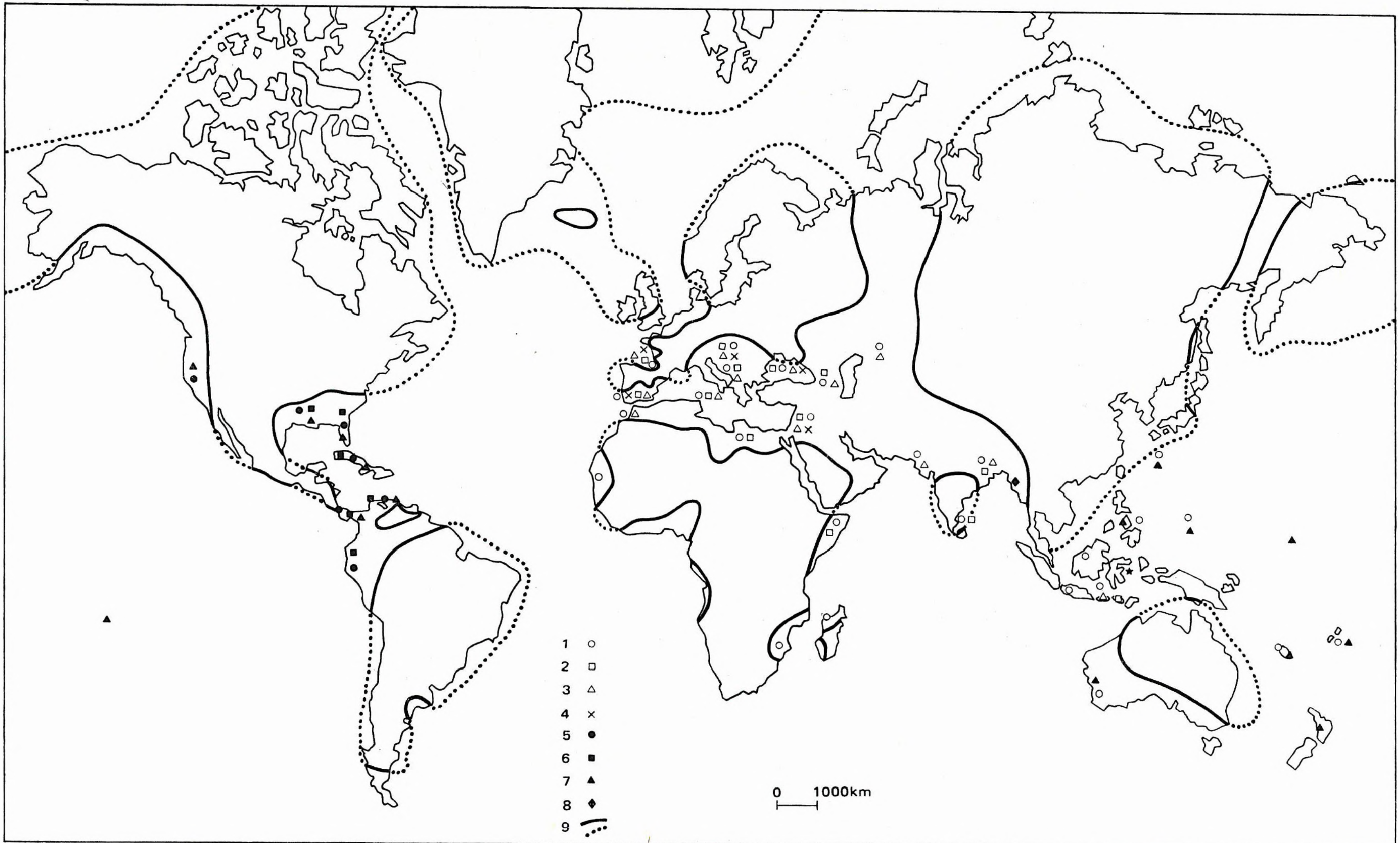
The two provinces are connected with each other only at the Asian coastline of the Pacific Ocean, where Disocyclinae got from the West and the Carribean—Pacific Asterocyclinae from the East. The Burman occurrence of Asterophragminae that are related to Pseudophragminae (s.l.) cannot be duly explained at present.

These facts may suggest that the two large Orthophragmina provinces could have been isolated very early and this isolation became more and more extensive with the widening of the Atlantic Ocean.

As it has been already mentioned (p. 74) the birthplace of both Orthophragmina families is somewhere in the Caribbean region. After the primary division of the provinces (that had taken place before the beginning of the Eocene) the genera of Discocyclinidae and Asterocyclinae had been separated for ever. This is not that certain in the case of Orbitoclypeus, since the unexpected appearence of their species *(O. douvillei, O. varians, O. daguini, O. schopeni)* in the Eocene of the Tethys may be as well explained supply from the Carribean.

Most of the Orthophragmina species have a wide geographic range, and there are only very few endemic species *(Discocyclina kingae, Orbitoclypeus portnayae, O. koehleri* in the Crimea and *O. douvillei* in Aquitaine).

Other species, unlike forms mentioned above, *(Discocyclina archiaci, D. furoni, D. discus, D. javana, D. augustae, D. dispansa, D. euaensis, Orbitoclypeus ramaraoi, Asterocyclina alticostata, A. stellata)* can be traced as far as thousands of kilometres. This fact highly increases their importance in the regional correlation as well.



25. ábra. Az Orthophragmina-genusok földrajzi elterjedése a középső-eocén ősföldrajzi térképén (a térkép Blondeau 1972 nyomán készült)
1. Discocyclina, *2.* a Tethys Orbitoclypeus-fajai, *3.* a Tethys Asterocyclina-fajai, *4.* Nemkovella, *5.* Athecocyclina, Proporocyclina, Pseudophragmina, *6.* amerikai Orbitoclypeus-fajok és Neodiscocyclina, *7.* karibi és pacifikus Asterocyclina-fajok, *8.* Asterophragmina, *9.* az egykori partvonal

Fig. 25. Geographic range of the Orthophragmina genera on the paleogeographical map of the Middle Eocene (the map was drawn after Blondeau 1972)
1. Discocyclina, *2.* Orbitoclypeus species of the Tethys, *3.* Asterocyclina, species of the Tethys, *4.* Nemkovella, *5.* Athecocyclina, Proporocyclina, Pseudophragmina, *6.* American Orbitoclypeus species and Neodiscocyclina, *7.* Caribbean and Pacific Asterocyclina species, *8.* Asterophragmina, *9.* the ancient coastline

SOME REMARKS ON THE ECOLOGY OF ORTHOPHRAGMINAE

The literature dealing with the ecology of Orthophragminae is rather poor. Details dealing with the subject can be found only in SCHLUMBERGER's (1903), DOUVILLÉ's (1922), NEUMANN's (1958), BIEDA's (1963), PORTNAYA's (1974, 1976a, b) and FERMONT's (1982) works. To examine thoroughly the paleoecology of the Orthophragminae was not the main goal of the present work either. The aim of the present writer was only to collect the data known from the literature and to complete them with the author's own observations where it was possible.

The Eurasian Orthophragminae were typical benthic forms in the Eocene of the Tethys and they sometimes occurred in rock-forming multitude. These creatures were slowly moving on the bottom of the sea, that is, they ranked among the vagile benthos as well as the other Upper Cretaceous and Paleogene Larger Foraminifera. The shape as well as the position of the tests in the rocks indicate that they settled down in horizontal position. Presumably they fed on algae (first of all Lithothamnium). This is also suggested by the fact that they can often be found together.

There are Orthophragmina specimens on the tests of which traces of bores, presumably from later periods, can be detected (e.g. pl. III. fig. 1., pl. XIII. fig. 7., pl. XIV. fig. 10., pl. XIX. fig. 4., pl. XX. fig. 5., pl. XXV. fig. 12., pl. XXVIII. fig. 7., pl. XXXIII. fig. 2., pl. XXXVIII. fig. 9., pl. XLIV. fig. 6., pl. XLV. fig. 8.). These bores were attributed by SCHLUMBERGER (1903) to the worms (?) called "Orbitophage" though, sometimes (p. 276, text-fig. B), he also confused them with the stolon of the equatorial chambers.

The data concerning the habitat of Orthophragminae are as follows:

Depth of the sea, still on the shelf, but under the zone of strongly rolling sea, may have been between 20 to 80 metres, since forms especially with thinner tests *(Discocyclina pratti, D. radians)*, could not have resist the powerful agitation of the water. This depth is already not favourable for the large Nummulites. It is characteristic that in the so-called "Hauptnummulitenkalk" of the Transdanubian Mid-Mountains Orthophragminae are very rare. Generally, it is observable that in profiles that were formed among gradually deepening conditions (the upper part of the Simferopolian and the Bodrakian stages of the Crimea, the vicinity of Ajka, Priabona, Biarritz) the multiplication and spreading of Orthophragminae is always observable along with the rarification of the Nummulites and Orthophragminae always persist for a longer time than the Nummulites. In the upper part of such profiles the propagation of Asterocyclinae is observable, too. The increased glauconite content of the upper part of the profiles also suggest greater depth.

The temperature of the sea-water may have been between 25 and 30 °C. As far as this temperature is concerned, Orthophragminae certainly were very sensitive to it, since the northern border of the occurrence of Nummulites was unquestionably farther towards the North than those of Orthophragminae. For example, no Orthophragminae can be found in Bretagne, in the Paris-, London- and Brussel-basins and in Northern Germany, where certain Nummulites species were still living. It is likely, too, that Orthophragminae were more sensitive to the fluctuation of salinity than Nummulites, since in transgressive profiles (e.g. Darvastó and generally the Southern Bakony, the vicinity of Iszkaszentgyörgy, Dorog) the first Nummulites can be found together with Miliolinae, Orbitolites and Alveolinae in waters that were less salty than the normal, whereas Orthophragminae, almost never can be found together with these foraminifers.

The substrate must have been silty. This is suggested by the shape of tests as well as the kind of the enclosing rocks (most often marls, marly limestones as well as clays). Orthophragminae that can be found in the sandstones of flysch sediments are presumably redeposited.

Among the accompanying faunas of Orthophragminae the taxa of *Nummulites millecaput-* and the *Assilina exponens*-group occur the most frequently. Operculina, Operculinoides, Spiroclypeus and Grzybowskia (the latter 3 only in the Upper Eocene) are also frequent among Larger Foraminifera. Among the other groups present Bivalviae with thick shell, Echinoidea crabs and Bryozoa have to be mentioned.

The method of description is basically the same as the usual practice for the description of Foraminifera.

The descriptions of species with no subspecies, species having subspecies, and the descriptions of the subspecies themselves are somewhat different in detail. In case of the latters ones, features that are characteristic of all subspecies can be found only at the discussion of the species, whereas the different marks can be found separately in the description of the particular subspecies. Other methods of description will be indicated at the given occasion.

a) Name: In accordance with the valid zoological nomenclature.

Points *b—i)* can be found only at species with no subspecies and at subspecies.

b) Reference to depictions.

c) Synonymic list.

d) Derivatio nominis: It can be found at the discussions of new taxa only.

e) Holotype.

f) Lectotype.

g) Type locality.

h) Type level.

i) The type of the equatorial section of forms "A".

j) Diagnosis: In case of species full diagnosis is given with the qualitative features that determine the species.

For subspecies only those quantitative features are given that distinguish the subspecies from other subspecies of the same species.

k) Description: It consists of two parts: i.e. the discussion of the external morphology and of the internal one.

At the species the external morphology is described in details, while at the subspecies only short description is given with respect to shape, size and ratio of the sizes of the two generations. The ratio always indicates how many times the diameter of form ,,B" is bigger than form "A".

The description of the internal morphology consists of 3 parts: The description of the equatorial section of forms "A", forms "B" and the axial section. The latter always refers to forms "A", since really the axial section of forms "B" is hardly known.

To save space abbrevations, explained in details in chapter "Morphology of Orthophragminae", are used everywhere.

The description of the equatorial section of forms "A" can be found at the discussion of species with no subspecies and at subspecies, too, since for species having subspecies all data of the subspecies that belong to the species should be considered.

The "lepidine" suffix was omitted in the denomination of the embryon type.

Shape of the cycles (s.c.) was given only at the discussion of Asterocyclinidae, since Discocyclinidae always have circular cycles.

Dots on top of certain quantitative features symbol (e.g. $\bar{E}$, $\bar{P}$, etc.) indicate approximately the 95 per cent confidency interval of the mean of the actual parameter.

Descriptions like "The equatorial section of forms "B" and "Axial section" can be found only at the discussion of species.

l) Phylogenetic position: It can be found only at the discussion of species.

The data of the relevant populations are shown on table 11.

m) Retrospection: This part can be found at both species and subspecies. Since the synonymic list represents our opinion on the taxon's boundaries, no explanation is given in connection with the list save that it is absolutely necessary, first of all nomenclatural questions are concerned here.

In case of the species having subspecies the reasons are given why the name of the species was chosen. The historical aspects of the denomination can be found under "Retrospection" of the nominate subspecies.

n) Variability: This part can be found only at the discussion of species. The typical differences within and between populations are discussed here. Differences between subspecies are not referred to, since these are discussed under "Phylogenetic position" at the description of the respective species.

o) Comparison: This part can be found at the discussion of species with no subspecies and subspecies.

In most of the cases those taxa are compared that are of similar exterior (unribbed, ribbed, asteroidal forms) of similar type and similar-sized embryon. These features are the easiest to observe. Embryon sizes are considered to be similar if the 95 per cent confidency interval, of the $\bar{D}$ values have common domain.

p) Range: It is indicated at species as well as subspecies but at species having subspecies only the stratigraphic range is given, since their geographical one is the sum total of the various subspecies' data.

After the description of the taxa the denominations can be found in alphabetical order that were ruled out in the present work but they appeared at least once in the synonymic lists of valid taxa. First a synonymic list, similar to that of the valid taxa can be found, then comes the reason why the name was ruled out.

The names, though used in the past 100 years in Eurasia but the bibliographic references of which, due to the lack of usable figures, could not be assigned to the synonymic lists of our taxa, are listed separately.

In these cases only the bibliographic data of the first publication can be found after the name. The reason why the name cannot be used is the same everywhere: the denomination is not identifiable.

The dimensions of the specimen the internal morphology of which were examinable can be also found in table 12, and are shown on the plates as well. Here the abbrevations are the same as used in the morphological part, and the following ones are also used: Prep. = Preparation, Pop. = Population.

Preparations No. E 4596 to E 5031 can be found in the Eocene section of the collection of the Hungarian Geological Institute's Palaeontological Department. Specimen marked with five-digit numbers without letter were prepared by Dr. Tibor Kecskeméti and can be found in the Palaeontological Collection of the Museum of Natural History (Budapest).

FAMILY DISCOCYCLINIDAE VAUGHAN ET COLE, 1940

Type of family: Discocyclina Gümbel, 1868

The test is disc-shaped, lenticular or very rarely asteroidal, sometimes with ribs or with punctiform bulges arranged in radial lines. The central equatorial layer is enclosed by two lateral layers that consist of lateral chambers reinforced by pillars.

Their microspheric juvenarium is of "Heterostegina" character, and it can be strongly reduced in some cases. The equatorial chambers are arranged in cycles. One cycle corresponds to one chamber of the microspheric juvenarium. The chambers in the cycles should be regarded as chamberlets.

Generally the equatorial chambers are rectangular, rarely hexagonal.

Range: From the Paleocene to the end of the Eocene.

The Caribbean and Pacific regions of America from California to Peru, the Tethys from Senegal to the Tonga Islands and from Lake Aral to the southern parts of Africa.

Genus Discocyclina Gümbel, 1868

Genotype: *Orbitulites pratti* Michelin, 1846, with Weijden's (1940) description and depiction.

Synonyms:
- 1848. Orbitoides d'Orbigny (partim)
- 1891. Orthophragmina Munier-Chalmas (partim)
- 1908. Nodocyclina Heim (partim)
- 1940. Umbilicodiscodina Weijden
- 1940. Trybliodiscodina Weijden (partim)
- 1950. Nephrodiscodina Ruiz de Gaona (partim)

The test is disc-shaped or lenticular, sometimes with ribs or with punctiform bulges arranged in radial lines.

The megalospheric embryon may be iso-, semi-iso-, nephro-, semi-nephro-, tryblio-, umbilico-, poly-, excentri- or centrilepidine.

The equatorial chambers are always with six stolons, with proximal annular stolons, with radial and annular septa. They look rectangular.
The cycles of the equatorial chambers are always circular.
Range: The whole of the Eocene.
The Tethys from Senegal to Tonga Islands and from Lake Aral to the southern parts of Africa.

PHYLOGENY OF DISCOCYCLINAE

Discocyclinae were divided here into two large groups, namely, group *Discocyclina archiaci* and group *D. dispansa*. The most important difference between them is in the width of their equatorial chambers. The first group can be characterized generally by 35 to 45 μm wide equatorial chambers, whereas generally 25 to 30 μm width is characteristic of the second group's equatorial chambers. Also there is difference between the two groups in the complexity of the microspheric juvenarium: 8 to 10 nepionic chambers are characteristic of the first group between the spiral and cyclic part, whereas 4 to 7 such chambers can be found in case of the second group. Similarly there is difference in the coarseness of the granules, too. The granules of the species in the *D. archiaci* are much bigger than those of the species in *D. dispansa* group.

According to our present knowledge the *D. archiaci* group can be derived from *D. archiaci bakchisaraiensis*, whereas the *D. dispansa* group from *D. broennimanni*. Between the two groups a phylogenetic link can be supposed with *D. furoni* as an intermediate form. The phylogenetic scheme of the two groups is shown on table 10.

Within the group *D. archiaci* two lineages can be found.

1. The most ancient one is the *D. archiaci—D. discus* line (see text-fig. 26) with tryblio-, umbilico-, excentri- and polylepidine embryon and with adauxiliary chambers, the walls of which are straight in the case of *D. archiaci* and arcuate in the case of *D. discus*. Its descendants in the collateral lines are: *D. furoni* with an embryon smaller by one order of magnitude than the average, can be derived from *D. archiaci bakchisaraiensis;* it can *D. weijdeni* with narrow (30 μm) equatorial chambers, it can be derived from *D. archiaci archiaci;* and *D. senegalensis* with adauxiliary chambers having arcuate walls that can be regarded as the collateral line of *D. archiaci bartholomei. D. javana* that has poly- and excentrilepidine embryon can be derived from *D. discus dudarensis*.

2. From the *D. archiaci staroseliensis* the *D. pseudoaugustae—D. fortisi—D. stratiemanuelis* lineage (see text-fig. 26) with poly- *(D. pseudoaugustae)*, later with centrilepidine *(D. fortisi* and *D. stratiemanuelis)* embryon gradually evolves. *D. stratiemanuelis* differs from its ancestors in the arcuate walls of its adauxiliary chambers. From *D. fortisi simferopolensis D. spliti* can be derived that is characterized by the complicated growth pattern of its annuli.

The "family tree" of group *D. dispansa* is more complex: it contains 7 lineages.

Two of these, the *D. augustae* and the *D. dispansa* lineages developed simultaneously. The difference between them is that on the same level the embryon at *D. dispansa*'s corresponding stage of evolution is always bigger by 1 or 2 orders of magnitude than that of *D. augustae* at the corresponding stage of evolution. In addition the protoconch of *D. dispansa* sits somewhat deeper in its deuteroconch.

1. The *D. augustae* lineage, that can be directly derived from *D. broennimanni* (see text-fig. 27), is characterized by semi-iso- and nephrolepidine embryon and adauxiliary chambers having straight walls. Its collateral line, *D. knessae*, is different, since this form is a ribbed one.

2. The subsequent embryon types of the *D. dispansa* lineage, that can be derived from the primitive *D. augustae sourbetensis* (see text-fig. 27), are: nephro-, semi-nephro- and trybliolepidine. The outer walls of the adauxiliary chambers are straight, the equatorial chambers are relatively low.

3. The ribbed *D. radians* lineage (see text-fig. 27) evolved from *D. dispansa taurica* through the dotted *D. kingae* or independently from it. It has trybliolepidine embryon, "pratti" type adauxiliary chambers and higher and higher equatorial chambers. Probably *D. nandori*, also ribbed, is the collateral line of this lineage. It has far narrower equatorial chambers (20—25 μm) than *D. radians* has.

4. The slowly developing *D. trabayensis* lineage (see text-fig. 27) with small semi-iso- and nephrolepidine embryon and flat, arcuate adauxiliary chambers can also be derived from *D. broennimanni*.

5. The *D. aaroni—D. euaensis* lineage that can be derived from *D. dispansa ganensis* (see text-fig. 28) is characterized by semi-nephro- and trybliolepidine embryon, at the same time the walls of its adauxiliary chambers are always arcuate. The equatorial chambers of *D. aaroni* are relatively low, whereas those of *D. euaensis* are high.

6. At a further stage of evolution from *D. aaroni chalossensis* the *D. pratti* lineage (see text-fig. 28) may have evolved with tryblio-, umbilico-, then poly- and excentrilepidine embryon, "pratti" type adauxiliary chambers and high equatorial chambers. The collateral line of the lineage is *D. samantai* that is of a ribbed form and has polylepidine embryon.

7. The *D. pulcra* lineage (see text-fig. 28) may have evolved from *D. pratti aquitanica*. It has centrilepidine embryon, "pratti" type adauxiliary chambers and very high equatorial chambers.

DESCRIPTION OF DISCOCYCLINA SPECIES AND SUBSPECIES

Discocyclina archiaci (SCHLUMBERGER), 1903

Diagnosis: Middle-sized and large, mostly flattened forms. The embryon is of the tryblio-lepidine type with transitions to the neighbouring (semi-nephro- and umbilicolepidine) types. The two chambers of the embryon are medium-sized or large. The adauxiliary chambers are of the "archiaci" type. Number of chambers: average or numerous. The adauxiliary, as well as the equatorial chambers are wide of medium height. The growth pattern of the annuli is of the "archiaci" type.

Description:

External morphology: Medium- and large-sized (diameter varies from 3 to 15 mm) forms. Generally, forms are slightly flattened with distinctly visible umbo of various size. Saddle forms are quite common. The rosette is of the "Discocyclina" type, usually the granules are distinctly visible and relatively large (diameter varies from 50 to 100 μm). Considerable differences in size between forms "A" and "B" can be observed only in the case of higher evolved subspecies.

Internal morphology:

The equatorial section of forms "B":

On the basis of SCHWEIGHAUSER's (1953 — pl. 8, fig. 12, pl. 10, fig. 11, text-fig. 36), CAUDRI's (1972 — pl. 2, figs. 1, 2) and our own preparations the juvenarium is of the "Heterostegina" type. $I=12-20$ μm, $S=4-7$, $s=30-55$ μm, $n=6-11$, $d=120-185$ μm, $J=15-20$, $j=700-800$ μm. The fully developed equatorial chambers of forms "B" do not differ from those of forms "A".

Axial section: Not having preparates of our own the following description was made on the basis of SCHLUMBERGER's (1903 — pl. 8, fig. 1, pl. 12, fig. 49), SCHWEIGHAUSER's (1953 — pl. 9, fig. 9, pl. 10, fig. 5.), NEUMANN's (1958 — pl. 10, fig. 8, pl. 11, fig. 2, pl. 26, figs. 3, 4) and MASSIEUX's (1973 — pl. 19, figs. 1—3) figures: Height of the embryon ranges from 100 to 200 μm, the equatorial layer more or less thickens towards to the edges, namely it is 40 to 60 μm thick near the embryon and 60 to 90 μm on the edges. The lateral wall is thick, the annular one is arcuate. The average dimensions of the lateral chambers are $60-120 \times 20-40$ μm.

Phylogenetic position (text-fig. 26): *Discocyclina archiaci* is one of the earliest Orthophragmina species, so its progenitors are unknown.

Within the species 4 stages of evolution (subspecies) can be marked out, using the following conventional biometric data for distinction:

Discocyclina archiaci bakhchisaraiensis (text-figs. 26a, b)	$\bar{D}<280$ μm
Discocyclina archiaci staroseliensis (text-fig. 26c)	$\bar{D}=280-350$ μm
Discocyclina archiaci archiaci (text-fig. 26d)	$\bar{D}=350-500$ μm
Discocyclina archiaci bartholomei (text-figs. 26e, f)	$\bar{D}=500-700$ μm

In the same way the development concerning the increase of $\bar{R}$, $\bar{Q}$, $\bar{P}$, $\bar{N}$, $\bar{H}$ and decrease of $\bar{E}$ and $\bar{n}_{0.5}$ values can be observed.

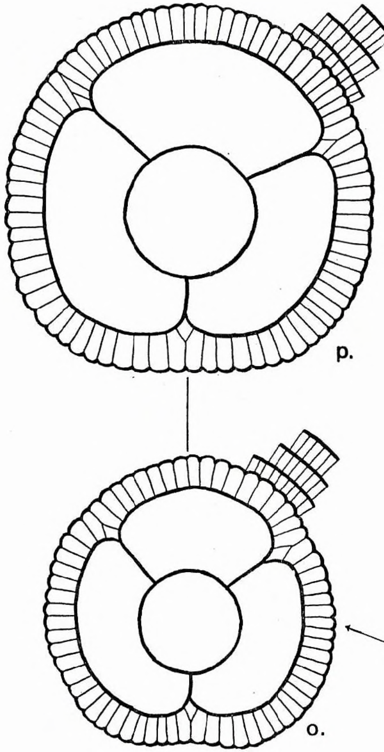
If later populations with $\bar{D}<220$ μm will be found in stratigraphic levels, lower than those known at present there may be an opportunity to distinct new subspecies too (see text-fig. 26a).

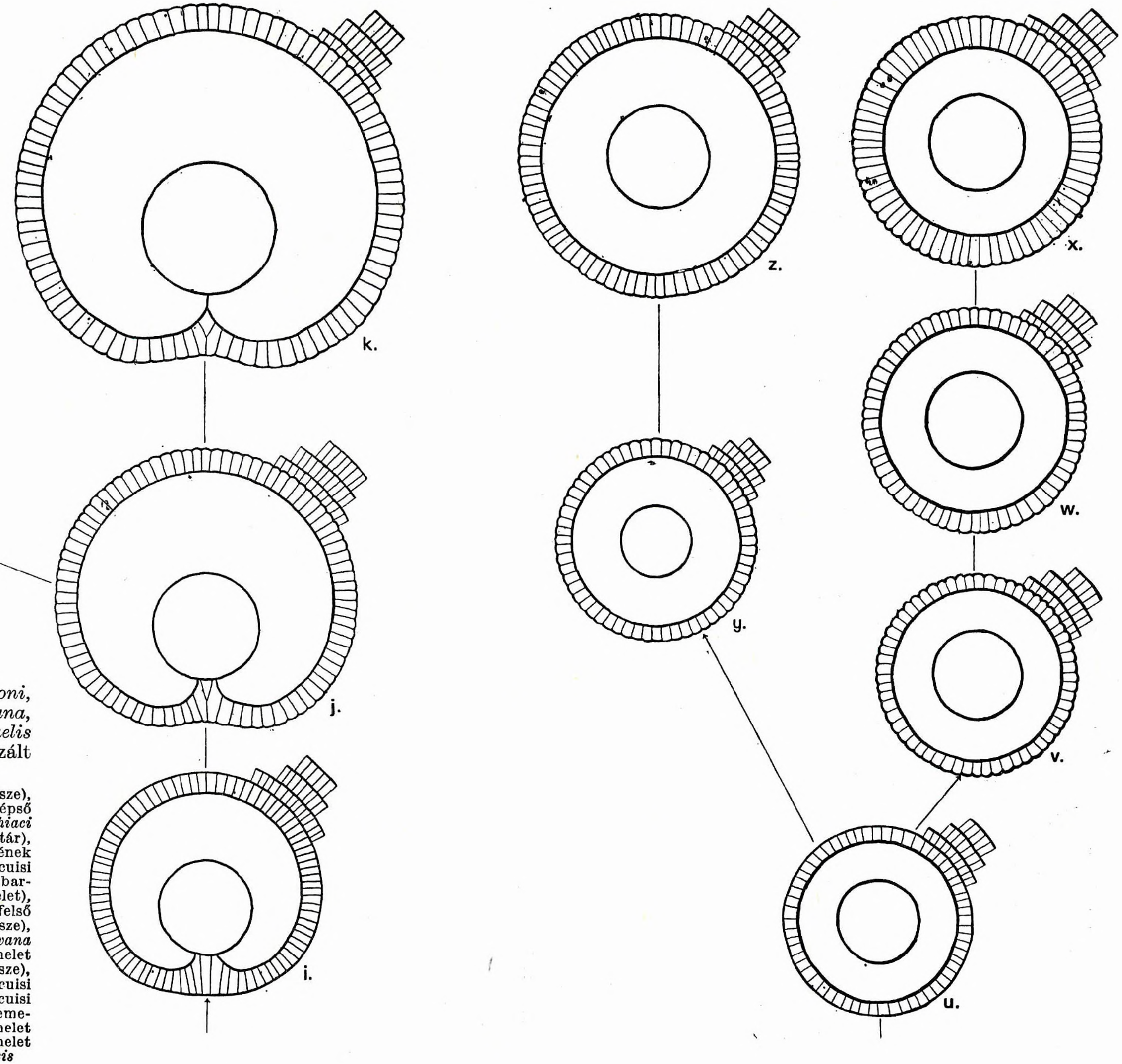
As its lineal descendant *Discocyclina discus* can be accounted, which differs from it by the larger test elements and by the transitional "archiaci-pratti" type adauxiliary chambers.

It is very likely, however, that between the two taxa (approximately at the boundary between the lower and middle part of the Lutetian) there might be a new transitional taxon with $\bar{D}$ ranging from 700 to 900 μm (see text-fig. 26f).

Most likely this new taxon too, would belong to *D. archiaci*, since KÖHLER's (1967) photos of "*D. ranikotensis*" — which in my opinion belongs to *D. archiaci* — show that the adauxiliary chambers are still of "archiaci" type. As we don't have own preparates of these forms, the segregation of a new subspecies — merely on the basis of the literature — is not yet timely.

As far as the collateral descendants are concerned *D. furoni* — that according to our present knowledge appears together with *D. archiaci staroseliensis* but differs from it by the much smaller test parameters — can be descended from *D. archiaci bakhchisaraiensis*. If later, however, this species





26. ábra. A *Discocyclina archiaci, D. furoni, D. discus, D. weijdeni, D. senegalensis, D. javana, D. pseudoaugustae D. fortisi, D. stratiemanuelis* és *D. spliti* filogenetikai kapcsolatai (idealizált equatoriális metszetek, 28×)

a* = *D. archiaci bakhchisaraiensis (ilerdi emelet alsó része), ***b* = *D. archiaci bakhchisaraiensis*** (ilerdi emelet középső része), ***c* = *D. archiaci staroseliensis*, *d* = *D. archiaci archiaci*, *e* = *D. archiaci bartholomei*** (cuisi—lutéciai határ), ***f* = *D. archiaci bartholomei*** (lutéciai emelet alsó részének teteje), ***g* = *D. furoni*** (ilerdi emelet), ***h* = *D. furoni*** (cuisi emelet), ***i* = *D. discus discus*, *j* = *D. discus dudarensis*** (bartoni emelet), ***k* = *D. discus dudarensis*** (priabonai emelet), ***l* = *D. weijdeni*, *m* = *D. senegalensis*** (cuisi emelet felső része), ***n* = *D. senegalensis*** (lutéciai emelet alsó része), ***o* = *D. javana*** (bartoni emelet felső része), ***p* = *D. javana*** (priabonai emelet), ***q* = *D. pseudoaugustae*** (ilerdi emelet felső része), ***r* = *D. pseudoaugustae*** (cuisi emelet alsó része), ***s* = *D. fortisi fortisi*, *t* = *D. fortisi simferopolensis*** (cuisi emelet felső része), ***u* = *D. fortisi simpferopolensis*** (cuisi emelet legfelső része), ***v* = *D. stratiemanuelis*** (lutéciai emelet legalsó része), ***w* = *D. stratiemanuelis*** (lutéciai emelet alsó—középső része), ***x* = *D. stratiemanuelis*** (lutéciai emelet felső része), ***y* = *D. spliti spliti*, *z* = *D. spliti ajkaensis***

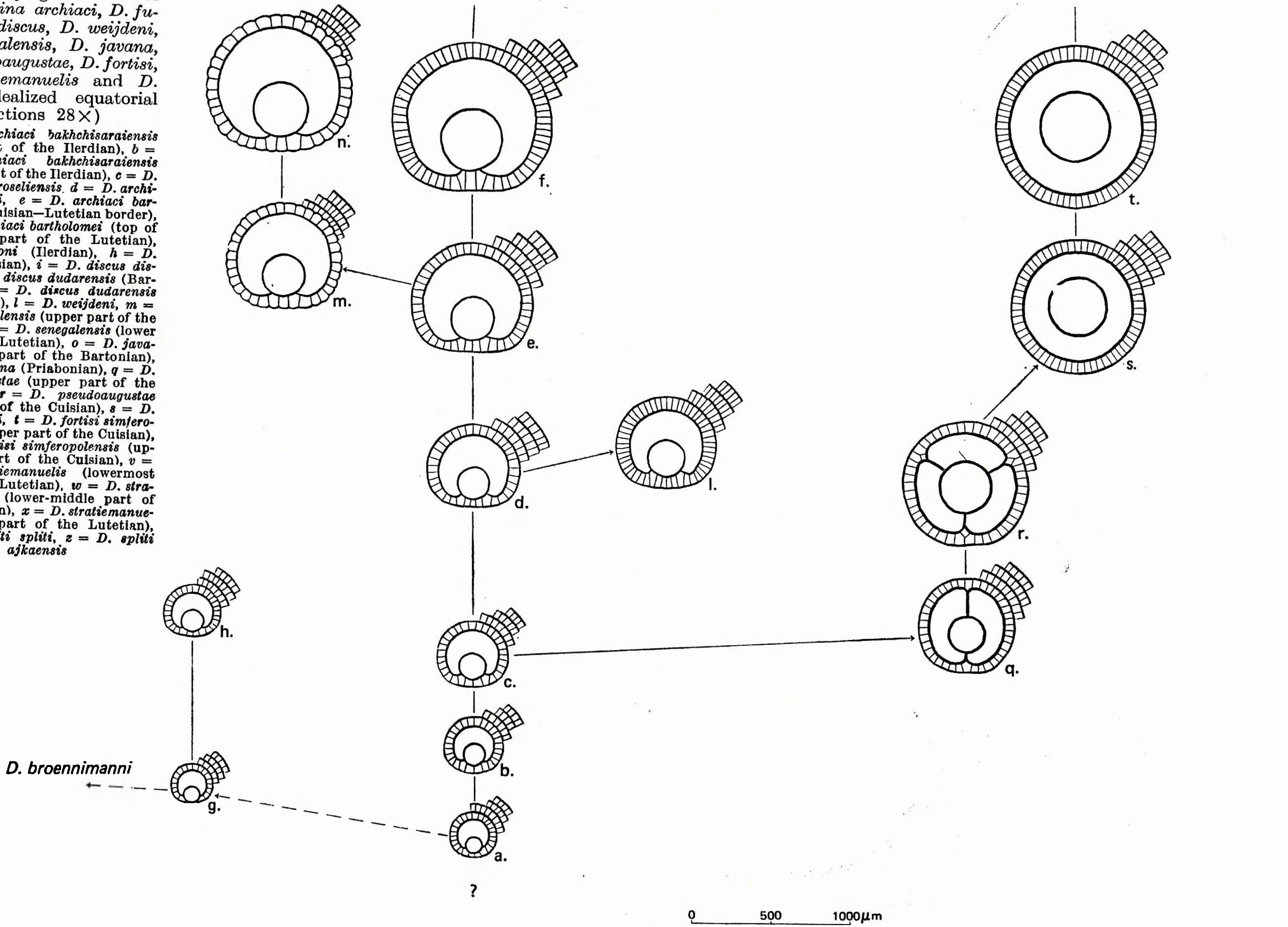
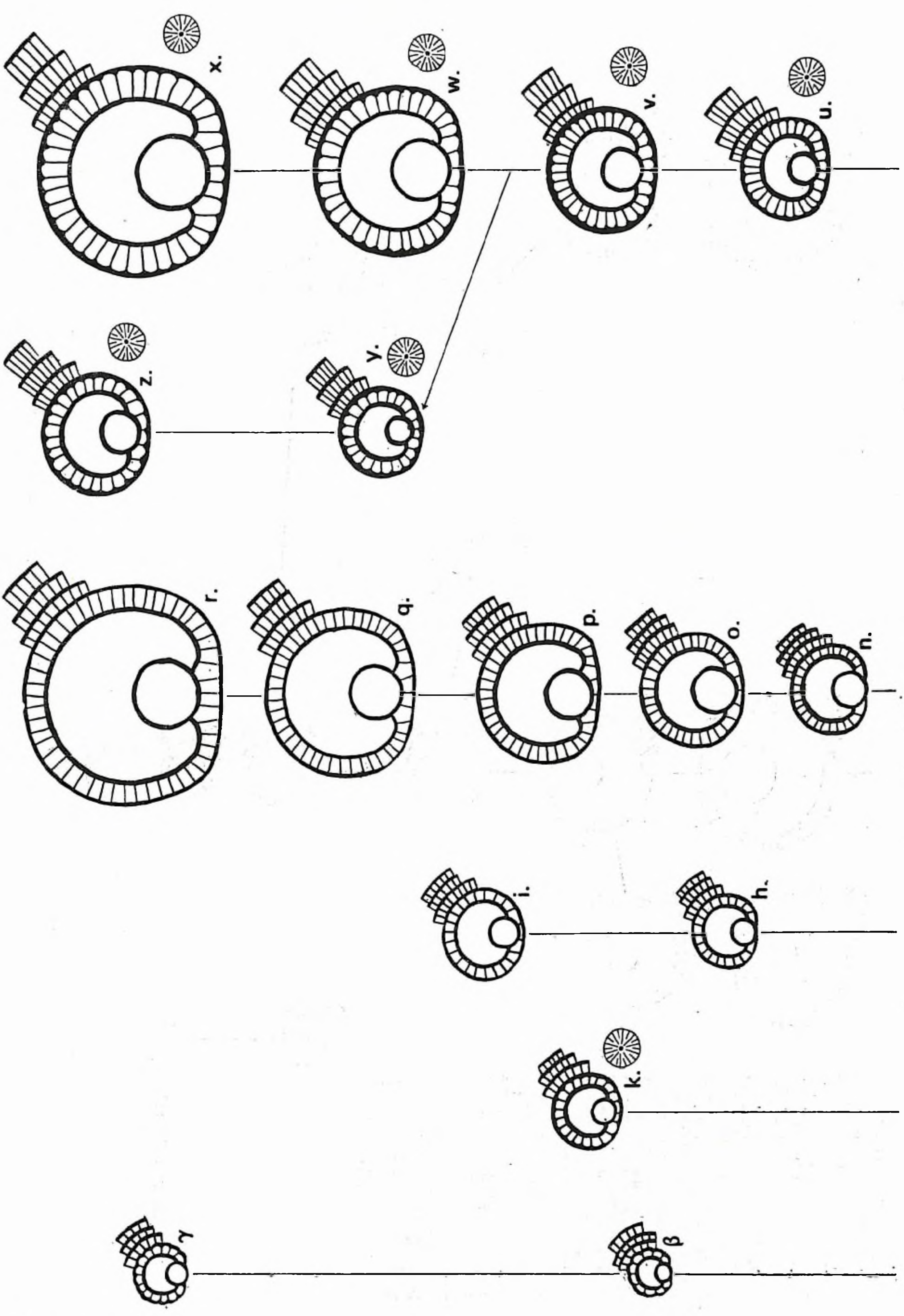


Fig. 26. Phylogenetic links of *Discocyclina archiaci, D. furoni, D. discus, D. weijdeni, D. senegalensis, D. javana, D. pseudoaugustae, D. fortisi, D. stratiemanuelis* and *D. spliti* (idealized equatorial sections 28×)

a = ***D. archiaci bakhchisaraiensis*** (lower part of the Ilerdian), *b* = = ***D. archiaci bakhchisaraiensis*** (middle part of the Ilerdian), *c* = ***D. archiaci staroseliensis***. *d* = ***D. archiaci archiaci***, *e* = ***D. archiaci bartholomei*** (Cuisian—Lutetian border), *f* = ***D. archiaci bartholomei*** (top of the lower part of the Lutetian), *g* = ***D. furoni*** (Ilerdian), *h* = ***D. furoni*** (Cuisian), *i* = ***D. discus discus***, *j* = ***D. discus dudarensis*** (Bartonian), *k* = ***D. discus dudarensis*** (Priabonian), *l* = ***D. weijdeni***, *m* = = ***D. senegalensis*** (upper part of the Cuisian), *n* = ***D. senegalensis*** (lower part of the Lutetian), *o* = ***D. javana*** (upper part of the Bartonian), *p* = ***D. javana*** (Priabonian), *q* = ***D. pseudoaugustae*** (upper part of the Ilerdian), *r* = ***D. pseudoaugustae*** (lower part of the Cuisian), *s* = ***D. fortisi fortisi***, *t* = ***D. fortisi simferopolensis*** (upper part of the Cuisian), *u* = ***D. fortisi simferopolensis*** (uppermost part of the Cuisian), *v* = = ***D. stratiemanuelis*** (lowermost part of the Lutetian), *w* = ***D. stratiemanuelis*** (lower-middle part of the Lutetian), *x* = ***D. stratiemanuelis*** (upper part of the Lutetian), *y* = ***D. spliti spliti***, *z* = ***D. spliti ajkaensis***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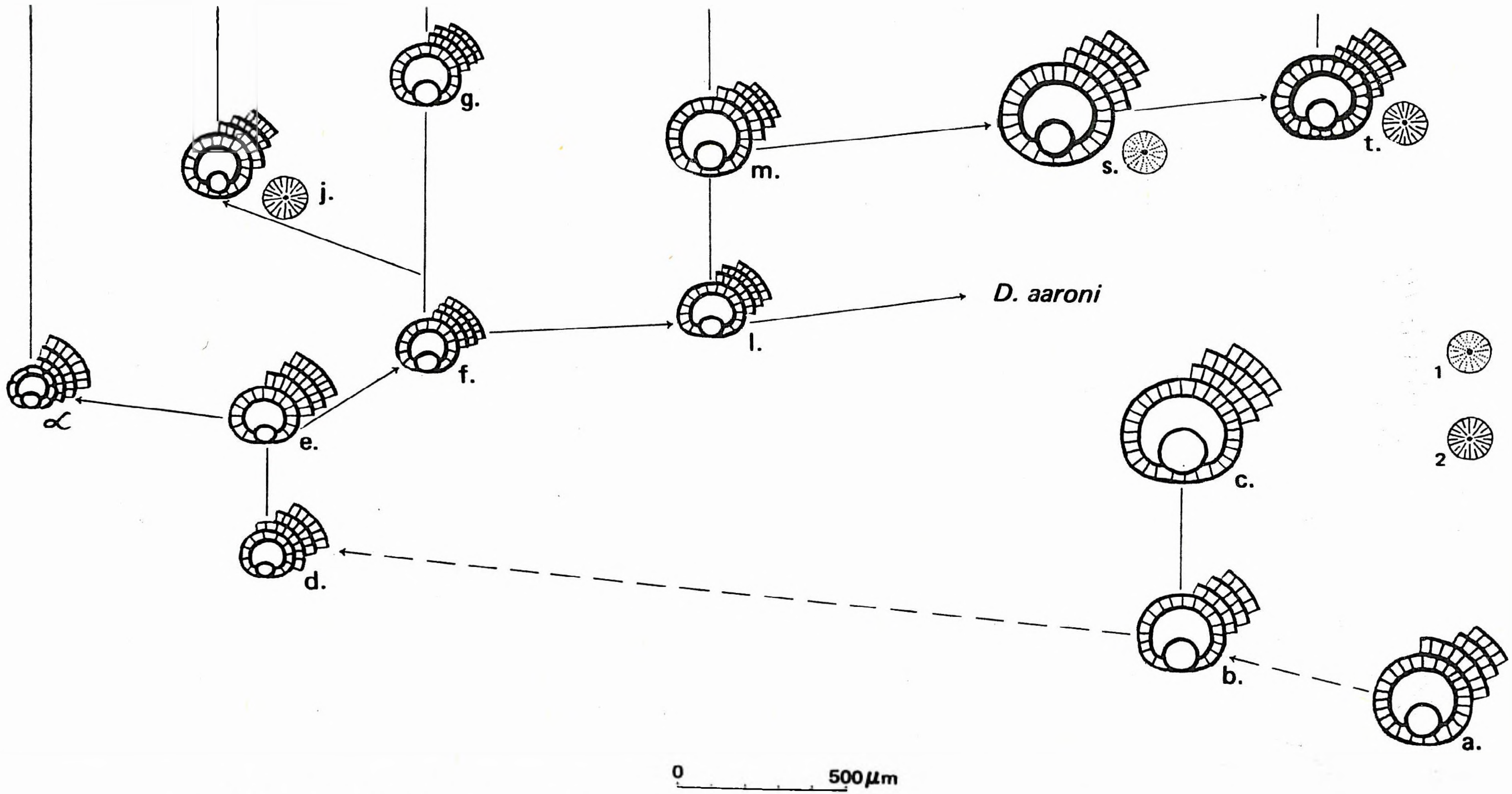
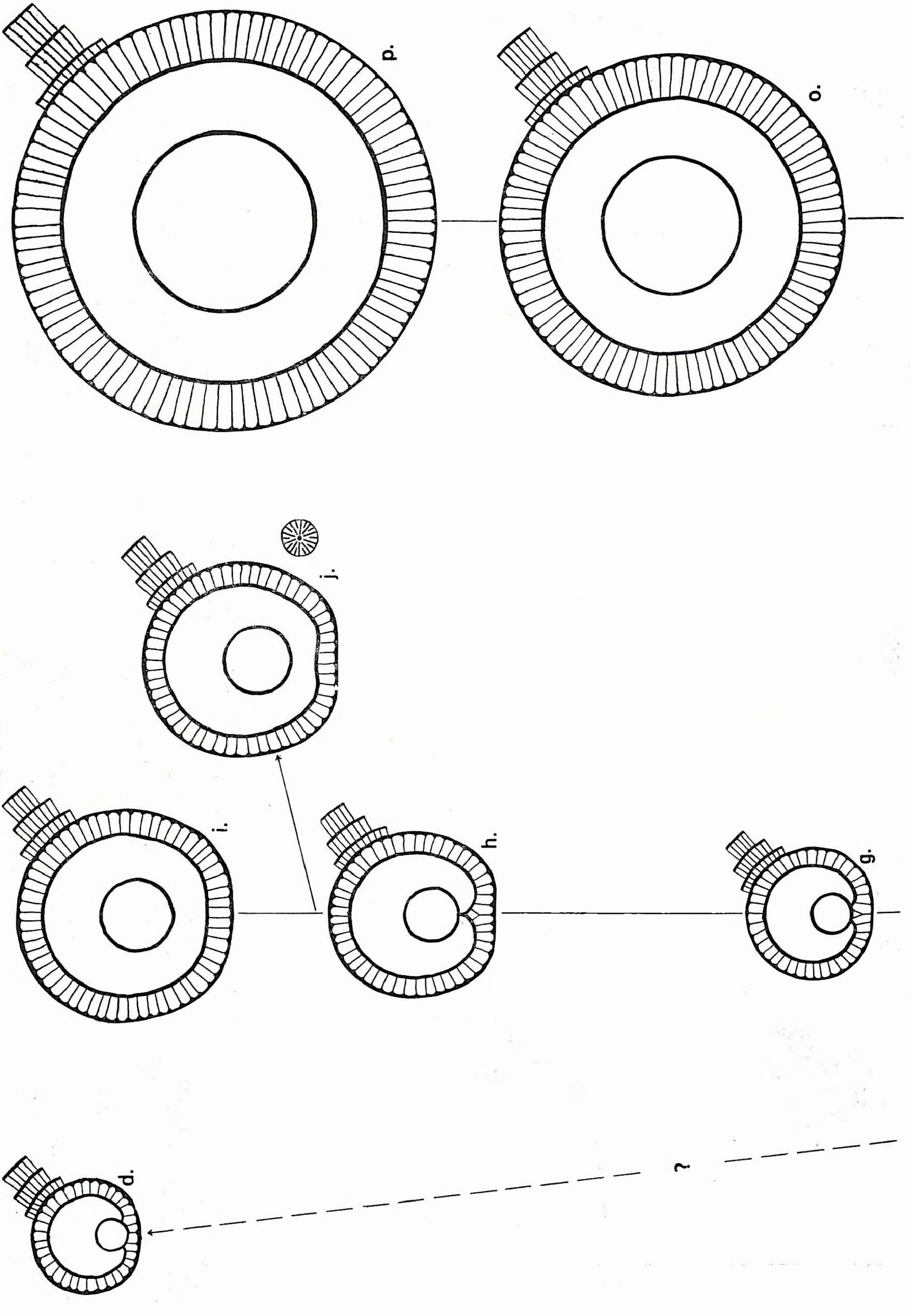


27. ábra. A *Discocyclina furoni*, *D. broennimanni*, *D. augustae*, *D. knessae*, *D. dispansa*, *D. kingae*, *D. radians*, *D. nandori*, és *D. trabayensis* filogenetikai kapcsolatai (idealizált equatoriális metszetek, 50×)

a = ***D. archiaci bakhchisaraiensis*** (ilerdi emelet alsó része), *b* = ***D. furoni*** (ilerdi emelet), *c* = ***D. furoni*** (cuisi emelet), *d* = ***D. broennimanni*** (ilerdi emelet középső része), *e* = ***D. broennimanni*** (ilerdi emelet felső része), *f* = ***D. augustae sourbetensis***, *g* = ***D. augustae atlantica***, *h* = ***D. augustae olianae***, *i* = ***D. augustae augustae***, *j* = ***D. knessae*** (lutéciai emelet), *k* = ***D. knessae*** (bartoni emelet), *l* = ***D. dispansa ganensis***, *m* = ***D. dispansa taurica***, *n* = ***D. dispansa nussdorfensis***, *o* = ***D. dispansa hungarica***, *p* = ***D. dispansa sella***, *q* = ***D. dispansa dispansa***, *r* = ***D. dispansa umbilicata***, *s* = ***D. kingae***, *t* = ***D. radians noussensis*** (lutéciai emelet alsó része), *u* = ***D. radians noussensis*** (lutéciai emelet középső része), *v* = ***D. radians radians***, *w* = ***D. radians labatlanensis*** (priabonai emelet alsó része), *x* = ***D. radians labatlanensis*** (priabonai emelet középső—felső része), *y* = ***D. nandori*** (priabonai emelet alsó része), *z* = ***D. nandori*** (priabonai emelet középső—felső része), *α* = ***D. trabayensis trabayensis***, *β* = ***D. trabayensis concentrica***, *γ* = ***D. trabayensis vicenzensis***. Kiegészítő jelek: *1.* radiálisan pontozott alak, *2.* bordás alak

Fig. 27. Phylogenetic links of *Discocyclina furoni*, *D. broennimanni*, *D. augustae*, *D. knessae*, *D. dispansa*, *D. kingae*, *D. radians*, *D. nandori* *D. trabayensis* (idealized equatorial sections, 50×)

a = ***D. archiaci bakhchisaraiensis*** (lower part of the Ilerdian), *b* = ***D. furoni*** (Ilerdian), *c* = ***D. furoni*** (Cuisian), *d* = ***D. broennimanni*** (middle part of the Ilerdian), *e* = ***D. broennimanni*** (upper part of the Ilerdian), *f* = ***D. augustae sourbetensis***, *g* = ***D. augustae atlantica***, *h* = ***D. augustae olianae***, *i* = ***D. augustae augustae***, *j* = ***D. knessae*** (Lutetian), *k* = ***D. knessae*** (Bartonian), *l* = ***D. dispansa ganensis***, *m* = ***D. dispansa taurica***, *n* = ***D. dispansa nussdorfensis***, *o* = ***D. dispansa hungarica***, *p* = ***D. dispansa sella***, *q* = ***D. dispansa dispansa***, *r* = ***D. dispansa umbilicata***, *s* = ***D. kingae***, *t* = ***D. radians noussensis*** (lower part of the Lutetian), *u* = ***D. radians noussensis*** (middle part of the Lutetian), *v* = ***D. radians radians***, *w* = ***D. radians labatlanensis*** (lower part of the Priabonian), *x* = ***D. radians labatlanensis*** (middle—upper parts of the Priabonian), *y* = ***D. nandori*** (lower part of the Priabonian), *z* = ***D. nandori*** (middle—upper parts of the Priabonian), *α* = ***D. trabayensis trabayensis***, *β* = ***D. trabayensis concentrica***, *γ* = ***D. trabayensis vicenzensis***. Complementary signs: *1.* radially dotted form, *2.* ribbed form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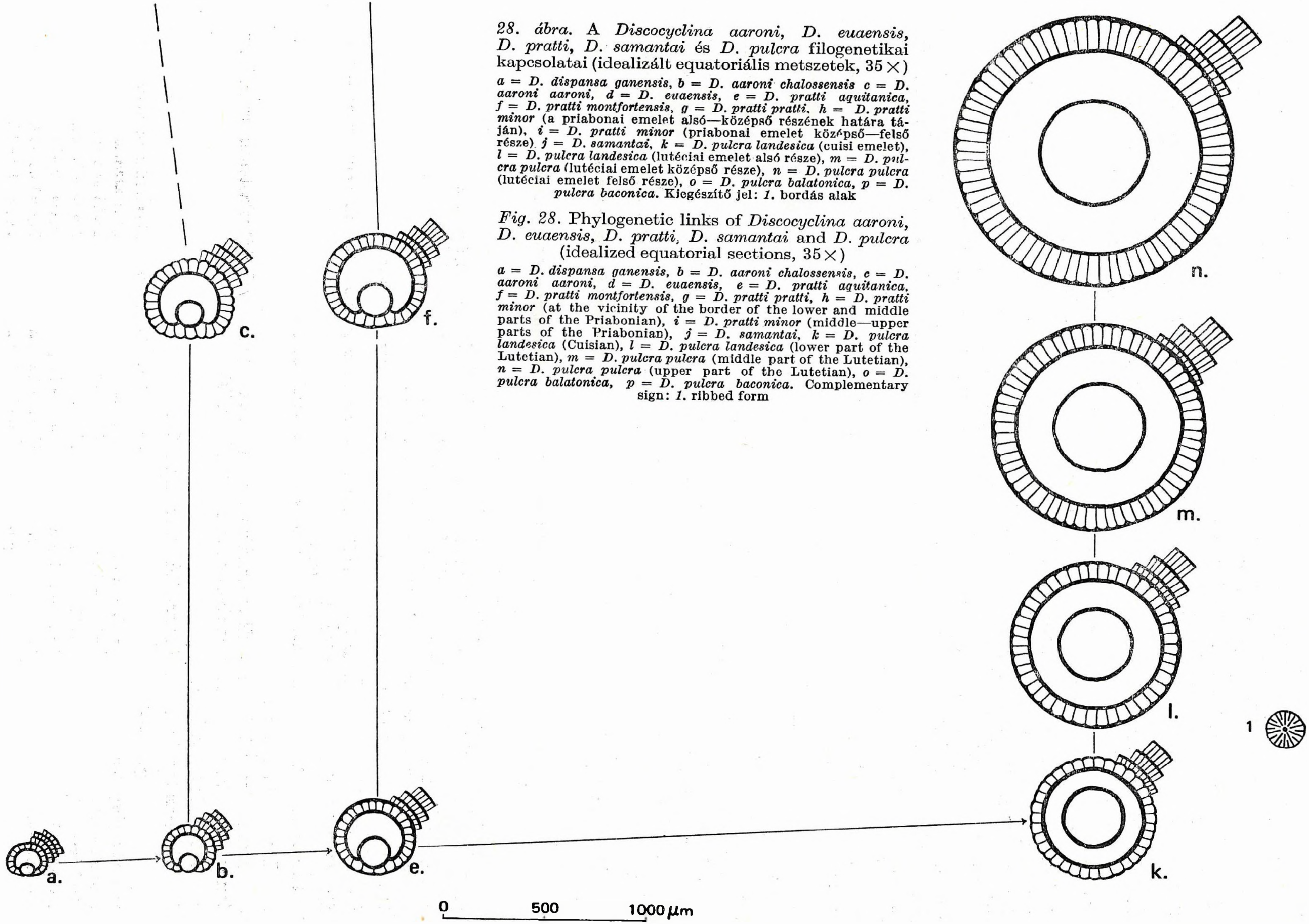


28. ábra. A *Discocyclina aaroni, D. euaensis, D. pratti, D. samantai* és *D. pulcra* filogenetikai kapcsolatai (idealizált equatoriális metszetek, 35×)

a = ***D. dispansa ganensis***, *b* = ***D. aaroni chalossensis*** *c* = ***D. aaroni aaroni***, *d* = ***D. euaensis***, *e* = ***D. pratti aquitanica***, *f* = ***D. pratti montfortensis***, *g* = ***D. pratti pratti***. *h* = ***D. pratti minor*** (a priabonai emelet alsó—középső részének határa táján), *i* = ***D. pratti minor*** (priabonai emelet középső—felső része) *j* = ***D. samantai***, *k* = ***D. pulcra landesica*** (cuisi emelet), *l* = ***D. pulcra landesica*** (lutéciai emelet alsó része), *m* = ***D. pulcra pulcra*** (lutéciai emelet középső része), *n* = ***D. pulcra pulcra*** (lutéciai emelet felső része), *o* = ***D. pulcra balatonica***, *p* = ***D. pulcra baconica***. Kiegészítő jel: *1.* bordás alak

Fig. 28. Phylogenetic links of *Discocyclina aaroni, D. euaensis, D. pratti, D. samantai* and *D. pulcra* (idealized equatorial sections, 35×)

a = ***D. dispansa ganensis***, *b* = ***D. aaroni chalossensis***, *c* = ***D. aaroni aaroni***, *d* = ***D. euaensis***, *e* = ***D. pratti aquitanica***, *f* = ***D. pratti montfortensis***, *g* = ***D. pratti pratti***, *h* = ***D. pratti minor*** (at the vicinity of the border of the lower and middle parts of the Priabonian), *i* = ***D. pratti minor*** (middle—upper parts of the Priabonian), *j* = ***D. samantai***, *k* = ***D. pulcra landesica*** (Cuisian), *l* = ***D. pulcra landesica*** (lower part of the Lutetian), *m* = ***D. pulcra pulcra*** (middle part of the Lutetian), *n* = ***D. pulcra pulcra*** (upper part of the Lutetian), *o* = ***D. pulcra balatonica***, *p* = ***D. pulcra baconica***. Complementary sign: *1.* ribbed form will have been found deeper than the levels known at present, it would also be feasible to derive the quickly developing *D. archiaci* from *D. furoni*, less capable of evolution.

D. pseudoaugustae with polylepidine embryon can be derived from *D. archiaci staroseliensis*, *D. weijdeni*, the equatorial chambers of which are narrower than those of *D. archiaci*, can be derived from *D. archiaci archiaci*, while *D. senegalensis* with less numerous adauxiliary chambers of "pratti" type can be derived from *D. archiaci bartholomei*, all the three in the collateral line of descent.

R e t r o s p e c t i o n : The species under discussion was segregated by Schlumberger (1903) from Bos d'Arros (SW-Aquitaine). This description and figures, however, are contradictory: the photos of the taxon's exterior are representing form described above, but in the equatorial section an *Orbitoclypeus ramaraoi crimensis* can be seen. This contradiction was taken over by Douvillé (1922) and Weijden (1940) too, though Douvillé (1922) published drawings of equatorial section that well coincide with the internal characteristics described above.

Schweighauser (1953), and in her revision work Neumann (1958) too, under the name *Discocyclina archiaci* definitely described and depicted a Discocyclina and not an Orbitoclypeus. Partly for this reason, and partly because a great majority of the experts shared this opinion (Caudri 1972, Samuel et al. 1972, Brolsma 1973, Portnaya 1974) it looked expedient to reserve the specific name "archiaci" for the Discocyclinae from Gan and Bos d'Arros as described above.

Simultaneously with the segregation of *D. archiaci* Schlumberger (1903) segregated another species, *D. bartholomei* from Saint-Barthélémy (SW-Aquitaine). For marking the species the more widely used name "archiaci" seems to be reasonable, while the name "bartholomei" can be used on the subspecies level.

Names like "tenuis", "irregularis", "nummulitica", "andrusovi", "aspera" and "papyracea" cannot be used for different reasons (see the reasons later), while the other names in usage refer to forms with different internal structure.

V a r i a b i l i t y : As far as the exterior is concerned the specimens of the species are highly variable. It was not by chance that Portnaya (1974) described these forms using 13 specific names, whereas in my opinion they belong to the same species. No doubt, that the specimens of *D. archiaci* are usually slightly flattened, but quite a few of them are more or less inflate, they are often saddle-shaped, and often have edges that rapidly grow very thin.

In the equatorial section among the qualitative characteristic the character of the adauxiliary chambers is relatively stable, though in some cases (see Pl. III, fig. 9) the "pratti" type, appears as well as the "varians" pattern in the growth of the annuli of the equatorial chambers. On the other hand the character of the embryon even within a particular population is rather variable, as it is shown on the photos and tabulated on table 11.

R a n g e : Probably from as deep as the lower part of the Ilerdian to the lower part of the Lutetian.

Discocyclina archiaci (Schlumberger), 1903 bakhchisaraiensis n. ssp.

Pl. I, figs. 1–6, text-figs. 26a, b and 27a

?1959. *Discocyclina ranikotensis* Davies — Nagappa, pl. 8, figs. 2, 3.
partim 1974. *Discocyclina nummulitica* (Gümbel) — Portnaya, pp. 79–83, pl. 13, figs. 2, 3
partim 1974. *Discocyclina chudeaui* (Schlumberger) — Portnaya, pp. 89–90, pl. 18, fig. 6
partim 1974. *Discocyclina douvillei* (Schlumberger) — Portnaya, pp. 91–93, pl. 19, figs. 5, 6
partim 1974. *Discocyclina augustae* Weijden — Portnaya, pp. 97–100, pl. 22, fig. 5

D e r i v a t i o n o m i n i s : From Bakhchisarai (Crimea), type locality of the taxon.
H o l o t y p e : Preparation E 4596 (Pl. I, fig. 2).
T y p e l o c a l i t y : Bakhchisarai — Suvlu-Kaya Hill — stratotypical profile — Bakhchisaraian stage — *Operculina semiinvoluta* zone — Sample B 7.
T y p e l e v e l : Middle part of the Ilerdian.
D i a g n o s i s : *Discocyclina archiaci* populations with $\bar{D}$ less than 280 µm.

D e s c r i p t i o n :

External morphology: Small and medium-sized (3 to 6 mm) usually slightly flattened forms. There is no substantial difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 26b):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (nephro)	$Q=1.37-2.34$	t: archiaci	g.p.: archiaci
$E=0.40-1.15$	$\bar{Q}=1.70-2.05$	$N=17-35$	$l=35-45$ µm
$\bar{E}=0.65-0.90$	$P=110-210$ µm	$\bar{N}=19-25.5$	$h=45-70$ µm
$R=0.38-1.06$	$\bar{P}=125-165$ µm	$L=35-45$ µm	$n_{0.5}=9.0-14.0$
$\bar{R}=0.60-0.80$	$D=220-360$ µm	$H=40-75$ µm	$\bar{n}_{0.5}=10.5-13.0$
	$\bar{D}=220-280$ µm	$\bar{H}=45-65$ µm	$n_{1.0}=20.0-27.0$

R e t r o s p e c t i o n : From the literature *Discocyclina archiaci* with $\bar{D}$ less than 280 μm were placed into the synonymic list. Since we have to deal with specimens and not populations, it is necessary with an uncertainty factor is to be counted with.

This holds true especially of NAGAPPA's (1959) not yet described *D. ranikotensis*, the test features of which cannot be clearly distinguished from the photo.

C o m p a r i s o n s : It has the same type adauxiliary chambers and similar-sized deuteroconch as the *Discocyclina augustae augustae-*, *D. dispansa nussdorfensis-* and *D. dispansa hungarica*-populations have, but differs from these by the different growth pattern of the annuli and mainly by the width of the equatorial chambers.

It is rather difficult, however, to distinguish it from *D. furoni*, that can be found in the lower and middle part of the Cuisian. As far as its morphology is concerned it differs only a little in the width of the equatorial chambers. The difference in the accompanying fauna however (since the levels are rather distant from each other) is significant.

R a n g e : The middle and probably the lower part of the Ilerdian.

Crimea — *Operculina semiinvoluta* and *Nummulites crimensis* zones of the Bakhchisaraian stage (samples B 2, 6, 7, 10, 13A, 14, 15); and Pakistan (Salt Range — "Nammal Limestone and Clay" — Ranikot series — conditionally).

Discocyclina archiaci (SCHLUMBERGER), 1903 **staroseliensis** n. ssp.

Pl. I, figs. 7—12, text-fig. 26c

partim 1968. *Discocyclina furoni* n. sp. — SAMANTA, pp. 70—72, pl. 6, fig. 1
1972. *Discocyclina archiaci* (SCHLUMBERGER) — SAMUEL et al., pp. 161—162, pl. 97, fig. 4
1972. *Discocyclina tenuis* DOUVILLÉ — SAMUEL et al., p. 161, pl. 97, figs. 1—3
partim 1974. *Discocyclina archiaci* (SCHLUMBERGER) — PORTNAYA, pp. 64—67, pl. 1, figs. 3, 4
partim 1974. *Discocyclina nummulitica* (GÜMBEL) — PORTNAYA, pp. 79—83, pl. 11, figs. 3, 5
partim 1974. *Discocyclina andrusovi* CIZANCOURT — PORTNAYA, pp. 83—85, pl. 14, fig. 6
partim 1974. *Discocyclina varians* (KAUFMANN) — PORTNAYA, pp. 85—88, pl. 16, figs. 1—3
partim 1974. *Discocyclina aspera* GÜMBEL — PORTNAYA, pp. 88—89, pl. 17, fig. 3

D e r i v a t i o n o m i n i s : Named after Staroselie (outlying part of Bakhchisarai Crimea), situated quite close to the type locality of the taxon.
H o l o t y p e : Preparation E 4601 (Pl. I, fig. 7).
T y p e l o c a l i t y : Bakhchisarai—Suvlu-Kaya Hill—Bakhchisaraian stage—boundary of the *Nummulites crimensis* and *Assilina placentula* zones—sample B 21.
T y p e l e v e l : The upper part of the Ilerdian.
D i a g n o s i s : *Discocyclina archiaci* populations with $\bar{D}$ ranging from 280 to 350 μm.

D e s c r i p t i o n :

External morphology: Medium-sized (4 to 8 mm) generally slightly flattened forms. The difference in size between forms "A" and "B" is not significant.

Internal morphology:

The equatorial section of forms "A" (text-fig. 26c):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (tryblio)	$Q=1.60-2.28$	*t:* archiaci	*g.p.:* archiaci
$E=0.48-0.95$	$\bar{Q}=1.75-2.00$	$N=18-35$	$l=35-40$ μm
$\bar{E}=0.60-0.80$	$P=125-250$ μm	$\bar{N}=23-28$	$h=50-75$ μm
$R=0.53-1.03$	$\bar{P}=155-185$ μm	$L=35-45$ μm	$n_{0.5}=8.2-12.0$
$\bar{R}=0.70-0.85$	$D=240-440$ μm	$H=40-75$ μm	$\bar{n}_{0.5}=10.0-11.0$
	$\bar{D}=280-350$ μm	$\bar{H}=50-60$ μm	$n_{1.0}=19.0-22.0$

R e t r o s p e c t i o n : Into the synonymic list *Discocyclina archiaci* with $\bar{D}$ ranging 280 to 350 μm were placed. Since the question is about specimens only and not populations we have to count with a major uncertainty factor. This factor is the smallest in the case of the forms in question given in the work of SAMUEL et al. (1972), since they provided us with other paleontological evidences as well concerning the Ilerdian age of the host rock.

C o m p a r i s o n : The size of its deuteroconch, the embryon, and the type of the adauxiliary chambers are similar to those of the *Discocyclina dispansa hungarica-* and *D. dispansa sella*-populations. However, it differs from them first of all by the wider equatorial chambers and different growth pattern of the annuli.

The way of distinction from the most advanced specimens of *D. furoni* is the same as it was in the case of *D. archiaci bakhchisaraiensis* described under the title "Comparisons".

R a n g e : The upper part of the Ilerdian.

Crimea — Bakhchisaraian stage — boundary of the *Nummulites crimensis* and *Assilina placentula* zones (samples B 19, 20, 21), W Slovakia (surroundings of Žilina: Jablonové, Hričovské Podhradie, etc.), S India (Pondicherry).

Discocyclina archiaci archiaci (Schlumberger), 1903

Pl. I, fig. 13; pl. II, figs. 1—2, 6, 9—11; pl. III, figs. 1—6, 8—11; text-fig. 26d

partim 1903. *Orthophragmina archiaci* n. sp. — Schlumberger, p. 277, pl. 8, figs. 5, 11
partim non 1903. *Orthophragmina archiaci* n. sp. — Schlumberger *(= Orbitoclypeus ramaraoi crimensis)*
partim 1903. *Orthophragmina pratti* (Michelin) — Schlumberger, pp. 274—277, pl. 8, figs. 1, 2
non 1908. *Orthophragmina archiaci* Schlumberger — Provale *(= Discocyclina dispansa sella)*
partim non 1912. *Orthophragmina archiaci* Schlumberger — Prever *(= Orbitoclypeus schopeni* et *O. varians varians)*
non 1916. *Orthophragmina archiaci* Schlumberger — Checchia-Rispoli *(= ?Orbitoclypeus schopeni)*
partim non 1917. *Orthophragmina archiaci* Schlumberger — Checchia-Rispoli *(= ?Orbitoclypeus schopeni)*
partim 1922. *Discocyclina archiaci* (Schlumberger) — Douvillé, pp. 65—66, text-figs. 3, 11(?)
partim non 1922. *Discocyclina archiaci* (Schlumberger) — Douvillé *(= Discocyclina furoni* et *Orbitoclypeus ramaraoi crimensis)*
?1922. *Discocyclina tenuis* n. sp. — Douvillé, p. 87, pl. 4, fig. 9
non 1925. *Orthophragmina archiaci* Schlumberger — Checchia-Rispoli *(= Orbitoclypeus varians varians* et *O. variansroberti)*
non 1925. *Discocyclina archiaci* var. *baluchistanensis* n. var. — Nuttall *(= ?Discocyclina fortisi simferopolensis)*
1926. *Orthophragmina (Discocyclina) irregularis* n. sp. — Doncieux, pp. 69—71, pl. 7, f. 19—24, text-fig. 30
partim 1926. *Orthophragmina (Discocyclina) pratti* (Michelin) — Doncieux, pp. 71—73, text-figs. 31, 33(?)
non 1926. *Orthophragmina (Discocyclina) archiaci* Schlumberger — Doncieux *(= Discocyclina furoni)*
partim 1929. *Discocyclina archiaci* (Schlumberger) — Llueca, pp. 268—270, pl. 21, fig. 4
?1929. *Discocyclina tenuis* Douvillé — Llueca, p. 281, text-fig. 57
non 1934. *Orthophragmina archiaci* Schlumberger — Reina *(= Orbitoclypeus varians varians)*
partim 1940. *Discocyclina (Eudiscodina) archiaci* (Schlumberger) — Weijden, pp. 22—23, pl. 1, fig. 1
partim 1940. *Discocyclina (Discocyclina) augustae* n. sp. — Weijden, pp. 23—26, pl. 1, fig. 6
?1940. *Discocyclina tenuis* Douvillé — Weijden, p. 68, pl. 12, fig. 7
partim non 1940. *Discocyclina (Eudiscodina) archiaci* (Schlumberger) — Weijden *(= Orbitoclypeus ramaraoi crimensis)*
1953. *Discocyclina archiaci* (Schlumberger) — Schweighauser, pp. 57—60, pl. 10, figs. 1, 2, 5, 11, text-figs. 13, 24, 25, 36, 44
1953. *Discocyclina tenuis* Douvillé — Schweighauser, pp. 74—75, pl. 12, fig. 11, text-fig. 47 (non 48)
partim 1958. *Discocyclina archiaci* (Schlumberger) — Neumann, pp. 81—84, pl. 10, figs. 1—8, pl. 26, figs. 3—4, text-figs. 20A, B
partim non 1958. *Discocyclina archiaci* (Schlumberger) — Neumann *(= Discocyclina archiaci bartholomei)*
non 1959. *Discocyclina archiaci* (Schlumberger) — Kecskeméti *(= Discocyclina augustae augustae)*
non 1959. *Discocyclina archiaci* (Schlumberger) — Belmustakov, pp. 47—48, pl. 14, figs. 21, 22, pl. 15, figs. 1—6
partim 1962. *Discocyclina archiaci* (Schlumberger) — Zernetsky, pp. 63—64, text-fig. 9
non 1965b. *Discocyclina archiaci* (Schlumberger) — Samanta *(= ?Discocyclina dispansa umbilicata)*
non 1967. *Discocyclina archiaci* (Schlumberger) — Köhler *(= ?Discocyclina dispansa sella)*
non 1971. *Discocyclina archiaci spliti* n. ssp. — Butterlin et Chorowicz *(= Discocyclina spliti spliti)*
?1972. *Discocyclina archiaci* (Schlumberger) — Caudri, pl. 2, figs. 1—2
1972. *Discocyclina archiaci* (Schlumberger) — Neumann, pl. 1, fig. 10, pl. 4, figs. 2, 3, 5—7, 9—13, pl. 5. figs. 3, 5, 6, 8
non 1972. *Discocyclina archiaci* (Schlumberger) — Samuel et al. *(= Discocyclina archiaci staroseliensis)*
partim 1973. *Discocyclina irregularis* Doncieux — Massieux, pp. 100—104, pl. 18, figs. 1—4, 6, 7, pl. 19, figs. 1—6
partim 1973. *Discocyclina archiaci* (Schlumberger) — Brolsma, pp. 418—419, pl. 1, figs. 1—4
partim non 1973. *Discocyclina archiaci* (Schlumberger) — Brolsma *(= Discocyclina furoni)*
partim 1974. *Discocyclina archiaci* (Schlumberger) — Portnaya, pp. 64—67, pl. 1, fig. 1
partim 1974. *Discocyclina bartholomei* (Schlumberger) — Portnaya, pp. 67—70, pl. 4. figs. 1—2
partim 1974. *Discocyclina pratti* (Michelin) — Portnaya, pp. 70—73, pl. 5, fig. 3
partim 1974. *Discocyclina discus* (Rütimeyer) — Portnaya, pp. 73—75, pl. 7, figs. 3—4
partim 1974. *Discocyclina sella* (d'Archiac) — Portnaya, pp. 75—78, pl. 9, figs. 2, 3
partim 1974. *Discocyclina scalaris* (Schlumberger) — Portnaya, pp. 78—79, pl. 10, fig. 7
partim 1974. *Discocyclina varians* (Kaufmann) — Portnaya, pp. 85—88, pl. 16, fig. 4
partim non 1974. *Discocyclina archiaci* (Schlumberger) — Portnaya *(= Discocyclina archiaci staroseliensis)*
non 1982. *Discocyclina archiaci* (Schlumberger) — Fermont *(= Orbitoclypeus ramaraoi crimensis)*

Holotype: Not indicated by the author of the taxon.
Lectotype: Schlumberger (1903), pl. 8, fig. 5.
Depository: École de Mines (Paris) — external form (definited by Neumann, 1958).
Type locality: Bos d'Arros (SW Aquitaine).
Type level: Not given by the author of the taxon (in our opinion the middle part of the Cuisian).
The type of the equatorial section of forms "A": Schweighauser (1953), pl. 10, fig. 2 and pl. 12, fig. 10 (both figures represent the same specimen) — Gan — Tuilerie (SW Aquitaine) — middle part of the Cuisian Depository: Universität Basel Geologisch-Paleontologisches Institut.
Diagnosis: *Discocyclina archiaci* populations with $\bar{D}$ ranging from 350 to 500 µm.

D e s c r i p t i o n :

External morphology: Medium-sized and bigger (4 to 10 mm), generally slightly flattened forms. The differences in the dimensions of forms "A" and "B" are sensible. Forms "B" are 1.2 to 1.5 times bigger than forms "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 26d):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (semi-nephro)	$Q = 1.59-2.61$	*t:* archiaci	*g.p.:* archiaci
$E = 0.35-0.95$	$\bar{Q} = 1.75-2.45$	$N = 23-44$	$l = 35-45$ µm
$\bar{E} = 0.50-0.75$	$P = 140-250$ µm	$\bar{N} = 26-36$	$h = 50-105$ µm
$R = 0.56-1.13$	$\bar{P} = 180-240$ µm	$L = 35-50$ µm	$n_{0.5} = 7.5-12.0$
$\bar{R} = 0.75-1.00$	$D = 290-590$ µm	$H = 50-90$ µm	$\bar{n}_{0.5} = 8.0-10.5$
	$\bar{D} = 350-500$ µm	$\bar{H} = 55-72$ µm	$n_{1.0} = 15.0-26.0$

R e m a r k s : Very rarely adauxiliary chambers of the "pratti" type may also occur (see pl. III, fig. 9). The annular wall is often thicker than the radial one.

R e t r o s p e c t i o n : Into the above synonymic list those bibliographic data were placed, the D or $\bar{D}$ values of which meet (or at least presumably meet) the requirements of the diagnosis.

Owing to SCHLUMBERGER's (1903) contradictory description and depiction (that was pointed out earlier in the description of the species) in the first half of our century under the name "archiaci" various taxa not fitting into this category were described. From this period only those specimens of the "archiaci" type can be considered as *Discocyclina archiaci archiaci* that were described and figured from Bos d'Arros and Gan.

SCHWEIGHAUSER's (1953) *Discocyclina archiaci* from Gan fortunately enough is characteristic of the population of that region as far as the dimensions of the test are concerned. The same refers to the forms announced by NEUMANN (1958) (considering her 1.6 to 2 times exaggerrated enlargements).

Later the *Discocyclina archiaci* population from Tuilerie de Gan was examined by BROLSMA (1973). Knowing his measured data it is most likely that he examined *D. archiaci* together with some *D. furoni*. In spite of this his results well coincide with ours, therefore the *D. archiaci archiaci* population from Gan should be considered as typical concerning both the species and subspecies, so much the more as from Bos d'Arros no photos have been published showing the equatorial section of the taxon. It is unlikely that the *D. archiaci* populations of Gan and those of Bos d'Arros differ essentially, since their accompanying Orthophragmina- and Nummulites-fauna and the nannoplankton-flora are very similar, and also KAPELLOS et SCHAUB (1973) could prove just a small disparity of age between the two localities.

C o m p a r i s o n : Similar-sized embryon and the same type of adauxiliary chambers are characteristic of *Discocyclina weijdeni*, *D. dispansa sella* and *D. dispansa dispansa*, but their equatorial chambers are narrower, higher and therefore more elongate as well.

R a n g e : The lower and middle part of the Cuisian.

SW Aquitaine (Gan, Bos d'Arros, Le Porge, Horsarrieu — HX sample), Northern Corbiéres, N Italy (Spilecco), E Bulgaria (surroundings of Varna: Dikili-tash), Crimea — the upper part of the Bakhchisaraian stage (*Assilina placentula*-zone) except for the lower transitional zone (samples B 24, 26 and 37).

Discocyclina archiaci (SCHLUMBERGER), 1903 **bartholomei** (SCHLUMBERGER), 1903

Pl. III, fig. 12; pl. IV, figs. 1—7, text-figs. 26e—f

1903. *Orthophragmina bartholomei* n. sp. — SCHLUMBERGER, pp. 281—282, pl. 11, fig. 45, pl. 12, figs. 47—50
1903. *Orthophragmina* sp. — SCHLUMBERGER, pl. 12, fig. 46
1922. *Discocyclina bartholomei* (SCHLUMBERGER) — DOUVILLÉ, pp. 66—67, text-fig. 10
?1927. *Discocyclina ranikotensis* n. sp. — DAVIES, pp. 281—282, pl. 22, figs. 10—12, text-fig. 4
partim 1929. *Discocyclina bartholomei* (SCHLUMBERGER) — LLUECA, pp. 270—271, text-fig. 55
1940. *Discocyclina bartholomei* (SCHLUMBERGER) — WEIJDEN, pp. 59—60, pl. 10, figs. 6—9
partim 1953. *Discocyclina* aff. *papyracea* (BOUBÉE) — SCHWEIGHAUSER, pp. 55—57, pl. 9, figs. 1, 2, 8, text-figs. 14, 43
partim 1958. *Discocyclina archiaci* (SCHLUMBERGER) — NEUMANN, pp. 81—84, pl. 11, figs. 1—3, pl. 35, fig. 4(?)
partim ?1958. *Discocyclina discus* (RÜTIMEYER) — NEUMANN, pp. 90—92, pl. 15, fig. 2(?), text-fig. 25
non 1959. *Discocyclina bartholomei* (SCHLUMBERGER) — KECSKEMÉTI (= *Discocyclina discus dudarensis*)
partim 1967. *Discocyclina ranikotensis* DAVIES — KÖHLER, pp. 70—71, pl. 13, figs. 3, 4, text-fig. 6B
partim 1974. *Discocyclina bartholomei* (SCHLUMBERGER) — PORTNAYA, pp. 67—70, pl. 3, figs. 1—3
partim non 1974. *Discocyclina bartholomei* (SCHLUMBERGER) — PORTNAYA (= *Discocyclina archiaci archiaci*)

Holotype: Not given by the author of the taxon.
Lectotype: SCHLUMBERGER (1903), pl. 12, fig. 47. Depository: École de Mines (Paris) — external form (our definition).
Type locality: Saint-Barthélémy (SW Aquitaine).
Type level: Not given by the author of the taxon (in our opinion the lower part of the Lutetian).
The type of the equatorial section of forms "A": Preparation E 4621, pl. IV, fig. 7, Saint-Barthélémy, lower part of the Lutetian.
Diagnosis: *Discocyclina archiaci* populations with $\bar{D}$ exceeding 500 µm.

Description:

External morphology: Large-sized (6 to 15 mm), mildly flattened or mildly rounded forms. The differences in the dimensions of forms "A" and "B" are significant (forms "B" are approximately 1.5 to 2 times bigger than forms "A").

Internal morphology:

The equatorial section of forms "A" (text-figs. 26e—f):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (umbilico, semi-nephro)	$Q = 1.47-3.80$	*t:* archiaci	*g.p.:* archiaci
	$\bar{Q} = 1.80-2.65$	$N = 27-62$	$l = 35-45$ µm
$E = 0.33-0.91$	$P = 170-460$ µm	$\bar{N} = 35-55$	$h = 60-100$ µm
$\bar{E} = 0.40-0.70$	$\bar{P} = 230-450$ µm	$L = 40-50$ µm	$n_{0.5} = 6.0-10.0$
$R = 0.56-1.55$	$D = 395-860$ µm	$H = 50-100$ µm	$\bar{n}_{0.5} = 7.0-9.5$
$\bar{R} = 0.80-1.25$	$\bar{D} = 500-900$ µm	$\bar{H} = 55-90$ µm	$n_{1.0} = 13.0-20.0$

Remarks: The annular wall of the equatorial chambers is thicker than the radial one.

Retrospection: The taxon was segregated from Saint-Barthélémy (SW Aquitaine) by SCHLUMBERGER (1903). As he pointed out the main characteristic feature of the taxon is the narrow edge quickly tapering off and growing thin in a step like pattern. No equatorial section of topotypical specimen has been published.

The description and figures from Saint-Barthélémy by SCHLUMBERGER (1903) were accepted without further examination by certain part of the researchers (DOUVILLÉ 1922, WEIJDEN 1940), while others (KECSKEMÉTI 1959, PORTNAYA 1974) considered the typical edge as the main characteristic feature in the definition of the taxon. As a result of this, forms — that are different from the typical *Discocyclina archiaci bartholomei* in the inner morphology — were misidentified going by the name "bartholomei".

It was NEUMANN (1958) who pointed out, that the quickly tapering off edge is of pathological origin, therefore it cannot be a distinguishing character. Putting NEUMANN's *Discocyclina discus* from Guiche (the locality "Bidart" given under the photo is probably erroreous) into the synonymic list I had to count with her inproper dimensions that are 1.6 to 2 times bigger than the real ones.

Comparison: Among the forms with no ribs and with similar type and similer-sized embryon *Discocyclina dispansa umbilicata*, *D. euaensis* and *D. pratti pratti* possess narrower and more elongate equatorial chambers, and their granules are finer.

The adauxiliary chambers of *D. senegalensis* are of the "pratti" type.

Range: The upper part of the Cuisian and the lower part of the Lutetian.

SW Aquitaine (Saint-Barthélémy, Le Porge, Guiche), N Italy (Valle Grande near Malo), Crimea — Simferopolian stage: the upper part of the *Nummulites distans minor* zone and the whole of the *N. distans* zone (samples E 9, B 49, 53, 54, 57, 77) and conditionally Pakistan (Thal — the uppermost part of the Ranikot series).

Discocyclina furoni SAMANTA, 1968

Pl. II, figs. 3—5, 7—8, 12, pl. III, fig. 7; text-figs. 26g—h, 27b—c

partim	1903.	*Orthophragmina pratti* (MICHELIN) — SCHLUMBERGER, pp. 274—277, pl. 8, fig. 3, text-fig. A
partim	1922.	*Discocyclina archiaci* (SCHLUMBERGER) — DOUVILLÉ, pp. 65—66, text-fig. 2
	1926.	*Orthophragmina (Discocyclina) archiaci* SCHLUMBERGER — DONCIEUX, pp. 64—66, pl. 7, figs. 6—10, text-figs. 23—25
partim	1926.	*Orthophragmina (Discocyclina) pratti* (MICHELIN) — DONCIEUX, pp. 71, 73, text-fig. 32
partim	1958.	*Discocyclina augustae* WEIJDEN — NEUMANN, pp. 84—86, pl. 12, figs. 5, 6(?), pl. 26. figs. 1—2(?), text-figs. 21
partim	1968.	*Discocyclina furoni* n. sp. — SAMANTA, pp. 70—72, pl. 5, figs. 1, 4—6, pl. 6. fig. 2, text-figs. 2A, C, G
partim non	1968.	*Discocyclina furoni* n. sp. — SAMANTA (= *Discocyclina archiaci staroseliensis* et *Orbitoclypeus ramaraoi ramaraoi*)
partim	1973.	*Discocyclina irregularis* DONCIEUX — MASSIEUX, pp. 100—104, pl. 18, fig. 5

partim 1973. *Discocyclina archiaci* (SCHLUMBERGER) — BROLSMA, pp. 418—419
partim 1974. *Discocyclina sella* (D'ARCHIAC) — PORTNAYA, pp. 75—78, pl. 9, fig. 1
partim 1974. *Discocyclina varians* (KAUFMANN) — PORTNAYA, pp. 85—88, pl. 15. fig. 5
partim ?1982. *Discocyclina varians* (KAUFMANN) — FERMONT, p. 135, table 6. (partim), pl. 10. fig. 1

Holotype: SAMANTA (1968) pl. 5, fig. 1 — external form. Depository: Geology Department of the University of Calcutta.
Type locality: Pondicherry (S India), Discocyclina-bearing Limestone—in a borehole located about 5 miles to the W of Pondicherry at depths between 150 and 180 metres.
Type level: Paleocene (according to SAMANTA, 1968), more closely in our opinion the middle or the upper part of the Ilerdian.
The type of the equatorial section of forms "A": SAMANTA (1968) pl. 5, fig. 4. Locality and depository are the same as those of the holotype.
Diagnosis: Small and medium-sized, flattened or inflate forms. Usually the embryon is of the semi-nephrolepidine type, the two chambers are relatively small. The adauxiliary chambers are of the "archiaci" type. They are relatively wide and low, can be found in medium numbers. The equatorial chambers are relatively wide and low, the growth pattern of the annuli is of the "archiaci" type.

Description:

External morphology: Small and medium-sized, mostly mildly flattened forms. Many of the forms "B" are inflate. Usually the umbo of varying size is distinctly visible. Saddle forms are frequent. The rosette is of the "Discocyclina" type, the granules are distinguishable, they are of medium and large size (40 to 80 µm in diameter). The differences between the dimensions of forms "A" and "B" are significant (×1.5 to 2).

Internal morphology:

The equatorial section of forms "A" (text-figs. 26g—h and 27b—c):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (tryblio, nephro)	$Q = 1.51-2.43$	*t*: archiaci	*g. p.*: archiaci
	$\bar{Q} = 1.75-2.30$	$N = 16-25$	$l = 30-40$ µm
$E = 0.46-1.00$	$P = 95-195$ µm	$\bar{N} = 16-24$	$h = 35-65$ µm
$\bar{E} = 0.60-0.90$	$\bar{P} = 105-155$ µm	$L = 30-40$ µm	$n_{0.5} = 9.8-14.0$
$R = 0.46-1.00$	$D = 175-330$ µm	$H = 35-60$ µm	$\bar{n}_{0.5} = 10.0-13.0$
$\bar{R} = 0.60-0.90$	$\bar{D} = 180-300$ µm	$\bar{H} = 40-55$ µm	$n_{1.0} = 17.0-21.0$

The equatorial section of forms "B": The juvenarium is of the Heterostegina type. I=15—20 µm, S=4—6, s=30—40 µm, n=6—9, d=150—180 µm, J=15—20, j=700—800 µm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: Not having preparation of our own we rely on SAMANTA's (1968) description and figures (pl. 5, figs. 5, 6, pl. 6, fig. 2). The height of the embryon is ranging from 125 to 150 µm. The equatorial layer grows rather thick towards the edges, near the embryon it ranges from 15 to 20 µm, while on the peripheries from 30 to 60 µm. The equatorial chambers are slightly elongate, the annular wall is arcuate. The lateral wall is much thicker than both the annular septum and the walls of the lateral chambers. The average dimensions of the lateral chambers are 50—70×20 µm, the chambers above the embryon are somewhat more flattened.

Phylogenetic position (text-figs. 26 and 27): *Discocyclina furoni* is without doubt evolutionally connected to *D. archiaci* in the course of development. On the basis of the data available *D. furoni* appears in higher stratigraphic levels than the first *D. archiaci* subspecies the "bakhchisaraiensis" does, therefore it can be regarded as its offspring.

It is not impossible though, that the relation is just the other way round, and *D. archiaci* can be regarded as the descendant of *D. furoni* but the evidence of this is not yet sufficient.

Within the species, owing to the low number of specimens we are not in the position to segregate any subspecies, though a certain evolution is observable in the increasing values of $\bar{R}$, $\bar{Q}$, $\bar{P}$, $\bar{D}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{E}$ and $\bar{n}_{0.5}$. Relying upon these findings it can be taken for granted, that the progress within the *D. furoni* is slower than that within the *D. archiaci*. On the basis of bigger than the present available material, the segregation of new subspecies (see text-figs. 26g, 27b and 26h, 27c, respectively) remains the task of the future.

On the basis of our data it is not clear-cut to state whether *D. furoni* became extinct without further descendants in the middle part of the Cuisian, or *D. broennimanni* can be eventually regarded as its descendant.

Retrospection: In the southern part of France forms — generally accompanying some *Discocyclina archiaci* populations but differing from those in their dimensions of the test (smaller by one or two orders of magnitude) — are long since known. Practically these forms could not be ranged to any of the known taxa.

So the preparation No. 1792 of SCHLUMBERGER's (1903) collection from Bos d'Arros was classified by the collector as "pratti", by DOUVILLÉ (1922) as "archiaci", while by NEUMANN (1958) it was classified as "augustae". Especially the first and the last classification seem to be absurd, since

Discocyclina pratti pratti as well as *D. augustae augustae* appear only in the upper part of the Middle Eocene. To make matters worse the scales of the enlargements and the dimensions of the internal test-elements are not correct and contradicting as well.

On the basis of his measured data it is likely that Brolsma (1973), while examining the *D. archiaci* population of Gan, he comparised some specimens of *D. furoni*, too.

Samanta (1968) segregated a new species from Pondicherry (S India) going by the name of *D. furoni* in wich in our opinion he treated alike 3 different taxa: the specimen shown on pl. 5, fig. 3 with its hexagonal equatorial chambers can be by no means a Discocyclina, it is rather an *Orbitoclypeus ramaraoi* described by Samanta (1967). Considering the large test, pl. 6, fig. 1 is more likely a depiction of *Discocyclina archiaci staroseliensis*, whereas the specimen of pl. 5, fig. 4 corresponds very well with the forms known from Bos d'Arros, Aude, the Crimea as well as with our own forms collected from Gan, Le Porge and the Crimea.

Because of this conformity it is expedient to leave the name "furoni" untouched in the case of these forms, even if the meaning is somewhat different from that of the original description. So much the more because names like "irregularis", cannot be used (see explanation later), while other used names refer to forms that are different in their internal morphology from those described above.

Variability: Concerning the exterior of the species it is remarkable that the megalospheric individuals are generally flat, whereas among the microspheric individuals inflate forms are frequent. Among the qualitative features of the equatorial section only the character of the embryon shows a certain variability.

Comparison: From the forms with similar-sized embryon and with the same type of adauxiliary chambers, *Discocyclina furoni* may be confused with the following taxa: *D. archiaci bakhchisaraiensis*, *D. archiaci staroseliensis*, *D. augustae olianae*, *D. augustae augustae*, *D. dispansa taurica*, *D. dispansa nussdorfensis* and *D. dispansa hungarica*.

The equatorial chambers of *D. furoni* are somewhat narrower than those of *D. archiaci* and — as *D. furoni* is generally accompanied by *D. archiaci* populations, the equatorial chambers of which are bigger than those of the *D. furoni* — the dimensions of the equatorial chambers can be a distinctive mark too. That is to say, of a particular *D. furoni* and a *D. archiaci* population with equal-sized embrionary chambers, the first can always be found in old strata, therefore their accompanying fauna is different as well.

It is easier to distinguish *D. furoni* from the *D. augustae* and the *D. dispansa* populations, since its equatorial chambers are always wider than those of the latter two. Also, the granules of *D. furoni* are larger. The difference in age is significant, therefore the accompanying fauna shows a great difference too.

Range: The middle and upper part of the Ilerdian and the lower and middle part of the Cuisian.

SW Aquitaine (Gan, Bos d'Arros, Le Porge), N Corbiéres (Coustouge, Fabrezan, etc.), Crimea: the *Nummulites crimensis* zone of the Bakhchisaraian stage (samples B 10, 14) and the lower part of the *N. distans minor* zone of the Simferopolian stage (samples E 3, 5 and U 3—4), Israel (Ein Avedat section — sample Is 199), S India (Pondicherry).

Discocyclina discus (Rütimeyer), 1850

Diagnosis: Large and flat forms with large granules. Usually the embryon is of the umbilicolepidine rarely of the excentrolepidine type. The two chambers of the embryon are extraordinary large. There are a great many wide and high adauxiliary chambers, they are of the "archiaci", the "pratti", or the transitional "archiaci-pratti" types. The equatorial chambers are wide and high, the growth pattern of the annuli is of the "archiaci", the "pulcra", or the transitional "archiaci-pulcra" types.

Description:

External morphology: Large (diameter ranging from 5 to 20 mm), flat forms with a well-defined but usually flat umbo, the diameter of which is 2 mm on the average. Saddle-shaped forms are common too. The rosette is of the Discocyclina-type, the granules are large, well discernable (the average diameter amounts to 100 μm, and arranged in concentric rings that can be observed especially on the peripheries. The difference in size between forms "A" and "B" is essential. Forms "B" are 2 to 3 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "B": We failed to obtain good quality preparation of the juvenarium and no such material has been found in the literature. In all probability it does not differ from the general Heterostegina type. The fully developed equatorial chambers do not differ from those of form "A".

Axial section: On the basis of NEUMANN's (1958 — pl. 14, fig. 7), BIEDA's (1963 — pl. 21, figs. 2, 3, pl. 23, figs. 4, 6), OLEMPSKA's (1973 — pl. 17, figs. 6, 8), GROSS, KÖHLER et al.'s (1980 — pl. 28, fig. 1) and our own (pl. V, fig. 7) figures the thickness of the embryon is ranging from 200 to 250 μm, the lateral wall of the equatorial layer is very thick (25 μm), the annular wall of the chambers are arcuate. The equatorial layer grows thick towards the edges. In the middle, thickness is ranging from 60 to 80 μm, while on the edges it is about 120 μm. The average dimensions of the lateral chambers are 60—100×25 μm.

Phylogenetic position (text-fig. 26): On the basis of the material available *Discocyclina archiaci bartholomei* can be regarded as the ancestor of *D. discus*, since they are rather similar as far as the qualitative features of their inner morphology are concerned (there is just a small disparity in the types of the adauxiliary chambers).

With respect to the quantitative features a step is noticeable between the two taxa. The existence of an intermediate taxon with $\bar{D}$ ranging from 700 to 900 μm is most likely [it is imaginable that KÖHLER's (1967) *D. ranikotensis* from Podhradie is this intermediate taxon]. Because of the character of the adauxiliary chambers this taxon presumably would still belong to *D. archiaci* and it may have been existing at the frontier of the lower and middle parts of the Lutetian stage.

Within the species 2 evolutional stages (subspecies) can be distinguished, using the following biometric limits:

Discocyclina discus discus (text-fig. 26i)	$\bar{D} < 1200$ μm
Discocyclina discus dudarensis (text-figs. 26j—k)	$\bar{D} > 1200$ μm

Later, on the basis of bigger material it is possible to segregate a third subspecies using the $\bar{D} > 1600$ μm biometric definition. The *D. discus* fauna from Lábatlan may belong to this group too. Since from this region we possess the preparation only of a single individual, there is no sound basis for the segregation of the third subspecies (see text-fig. 26k).

The evolution is easy to observe in the growing values of $\bar{P}$ and $\bar{D}$ while in the increase of $\bar{R}$, $\bar{Q}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{E}$ and $\bar{n}_{0.5}$ it is less noticeable.

We have no knowledge of any species that would be a direct descendant of *D. discus*, *D. javana*, which in our opinion appears together with the stratigraphic range of *D. discus dudarensis*, may be regarded as the follower of *D. discus dudarensis* in the collateral line of descent. Even if the embryon of *D. javana* is somewhat smaller, the unchanging polylepidine type proves the higher stage of evolution. Unlike *D. discus*, *D. javana* is always of the "pratti" type with respect to the character of the adauxiliary chambers and "pulcra" type concerning the growth pattern of the annuli.

Retrospection: *Discocyclina discus* is one of the species with the most complicated nomenclature. RÜTIMEYER's (1850) description is too general and the locality was not definitely given. The next who described the species was KAUFMANN (1867). Among his figures pl. 10, fig. 11 showing the axial section can be accepted as conclusive, since it clearly shows that the diameter of the embryon is about 1 mm. At the same time the other figures demonstrate the coarse granularity as well, so relying upon these, KAUFMANN's (1867) figures can be identified with the forms bearing the qualitative features described above.

In spite of this however using the name *D. discus*, SCHLUMBERGER (1903) figured *D. dispansa umbilicata*, thus making two groups among the workers giving further descriptions. The contradiction was deepened by HEIM (1908), who distinguished four subspecies within the species. In our opinion two of these, namely, the "laevicrassa" and the "granulatocrassa" are in good agreement with KAUFMANN's (1867) interpretation, whereas the other two, namely, the "granulatotenuis" and the "laevitenuis" correspond to SCHLUMBERGER's (1903) interpretation. Later on too, *D. discus* was identified both ways (KAUFMANN's interpretation was used by SCHWEIGHAUSER 1953, BIEDA 1963 and OLEMPSKA 1973, while SCHLUMBERGER's was used by NEUMANN 1958, PORTNAYA 1974, SIROTTI 1978). Considering the priority we prefer KAUFMANN's interpretation, therefore our nomenclaturial work too, was completed on this basis. Since up to standard figures showing the equatorial section of forms "A" were not published in any of the works, the type had to be chosen from our own material.

The following names of the synonymic list like "umbo" and "sowerbyi" cannot be used (see explanation later), while the other names used refer to forms that are different in their internal morphology from the above description.

Variability: The variability of the exterior of the species is considerable. Though rounded forms are missing, saddle forms can be found. The size and height of the umbo as well as the coarsness of the granules are variable.

As for the inner morphological elements the embryon's character and the adauxiliary type show the largest variation. The relatively low adauxiliary chambers and the equatorial chambers, that are somewhat narrower than the average (ranging from 35 to 40 μm in contradiction to 40 to 45 μm) are striking features in the case of specimens from the Dudar population. Also the annular walls of the equatorial chambers in specimens coming from Dudar are thinner than the average. These differences however are not sufficient in our opinion for their segregation as a distinct taxon.

Range: From the middle part of the Lutetian to the middle part of the Priabonian.

Discocyclina discus discus (RÜTIMEYER), 1850

Pl. IV, figs. 8–10; text-fig. 26i

	1840.	*Lycophris ephippium* (SCHLOTHEIM) — SOWERBY, p. 327, pl. 24, figs. 15, 15a–b
	?1850.	*Orbitolites discus* n. sp. — RÜTIMEYER, p. 116, pl. 5, figs. 70, 71, 78, 80, 81
	1867.	*Orbitoides discus* (RÜTIMEYER) — KAUFMANN, pp. 160–162, pl. 10, figs. 11–16
	non 1903.	*Orthophragmina discus* (RÜTIMEYER) — SCHLUMBERGER (=?*Discocyclina dispansa umbilicata*)
	1908.	*Orthophragmina (Discocyclina) discus* (RÜTIMEYER) var. *granulatocrassa* n. var. — HEIM, p. 257
partim	?1908.	*Orthophragmina (Discocyclina) discus* (RÜTIMEYER) var. *laevicrassa* n. var. — HEIM, pp. 257–258, pl. 8, fig. 26
partim	non 1908.	*Orthophragmina (Discocyclina) discus* (RÜTIMEYER) — HEIM (=*Discocyclina dispansa umbilicata*)
	1926.	*Discocyclina sowerbyi* n. sp. — NUTTALL, pp. 149–150, pl. 8, figs. 1–3
	non 1940.	*Discocyclina (Umbilicodiscodina) discus* (RÜTIMEYER) — WEIJDEN (=*Discocyclina dispansa umbilicata*)
	?1953.	*Discocyclina discus* (RÜTIMEYER) — SCHWEIGHAUSER, pp. 73–74
partim	?1958.	*Discocyclina discus* (RÜTIMEYER) — NEUMANN, pp. 90–92, pl. 14, fig. 7
partim	non 1958.	*Discocyclina discus* (RÜTIMEYER) — NEUMANN (=*Discocyclina archiaci bartholomei, D. dispansa dispansa* et *D. dispansa umbilicata*)
	1963.	*Discocyclina discus* (RÜTIMEYER) — BIEDA, pp. 126–127, pl. 21, figs. 1–5
	1963a.	*Discocyclina (Discocyclina) sowerbyi* NUTTALL — SEN GUPTA, pp. 41–42, tables 5–8, pl. 2, fig. 2, pl. 3, figs. 1–10, pl. 4, figs. 1–8
partim	1973.	*Discocyclina discus* (RÜTIMEYER) — OLEMPSKA, p. 82, pl. 15, figs. 4, 6
partim	1973.	*Discocyclina scalaris* (SCHLUMBERGER) — OLEMPSKA, pp. 82–83, pl. 16, fig. 2
	non 1974.	*Discocyclina discus* (RÜTIMEYER) — PORTNAYA (=*Discocyclina archiaci archiaci*)
	non 1977.	*Discocyclina* cf. *discus* (RÜTIMEYER) — COCKBAIN (=*Discocyclina dispansa dispansa*)
	non 1978.	*Discocyclina discus* (RÜTIMEYER) — SIROTTI (=*Discocyclina dispansa umbilicata*)
	1980.	*Discocyclina discus* (RÜTIMEYER) — GROSS, KÖHLER et al., p. 182, pl. 28, fig. 1, text-fig. 37A

Holotype: Not given by the author of the taxon.
Lectotype: RÜTIMEYER (1850), pl. 5, fig. 70. Depository is unknown (probably in Switzerland)—external form (marked out by us).
Type locality: Any of the following localities: Schwändli (Appenzell), Dornbirn, Schwenberg (Einsiedeln), Bürgenstock bei Stanz, Ralligstöcken (Berglialp).
Type level: Not specified, probably the upper parts of the Lutetian.
The type of the equatorial section of forms "A": Preparation E 4628, pl. IV, fig. 9, Nousse (SW Aquitaine) — Crouts, the middle part of the Lutetian.
Diagnosis: *Discocyclina discus* populations with $\bar{D}$ less than 1200 μm.

Description:

External morphology: Large (ranging from 5 to 15 mm), more or less flattened, sometimes saddle-shaped tests. The difference in size between forms "A" and "B" is significant (forms "B" are 2 to 2.5 times bigger than forms "A").

Internal morphology:

The equatorial section of forms "A" (text-fig. 26i):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: umbilico (excentri, tryblio)	$Q = 1.57-2.40$	*t:* archiaci — pratti	*g.p.:* archiaci (pulcra)
	$\bar{Q} = 1.95-2.30$	$N = 60-98$	$l = 35-45$ μm
$E = 0.23-0.39$	$P = 480-612$ μm	$\bar{N} = 65-95$	$h = 80-135$ μm
$\bar{E} = 0.20-0.40$	$\bar{P} = 470-600$ μm	$L = 45-55$ μm	$n_{0.5} = 5.0-6.0$
$R = 0.81-1.48$	$D = 1025-1220$ μm	$H = 100-155$ μm	$\bar{n}_{0.5} = 5.0-5.8$
$\bar{R} = 1.10-1.35$	$\bar{D} = 900-1200$ μm	$\bar{H} = 100-135$ μm	$n_{1.0} = 9.2-13.0$

Remarks: The annular walls of the equatorial chambers are much thicker than the radial ones.

Retrospection: SCHWEIGHAUSER's (1953) *Discocyclina discus* was only conditionally placed into the synonymic list since it was only described but not depicted by the author.

The assignment of BIEDA's (1963) and OLEMPSKA's (1973) forms to this category is a bit obscure, since they examined only specimens and not populations. In addition these specimens were found in flysch sediments, in which considerable mixing of faunas may have happened. It is striking however that unlike the forms from Nousse and Gibret (umbilico- and trybliolepidine embryon) those from Poland have excentrilepidine type embryon.

Comparison: Among the forms with similarly large embryon, *Discocyclina fortisi simferopolensis, D. stratiemanuelis* and *D. pulcra pulcra* always have centrilepidine type embryon, while the embryon of *D. javana* and *D. pratti minor* is of the poly- and excentrilepidine type. On the other hand *D. discus discus* quite often have umbilicolepidine or even trybliolepidine embryon.

Range: The middle and upper parts of the Lutetian.

SW Aquitaine (Gibret, Nousse), Switzerland (Pilatus), possibly N Italy (Mossano and surroundings), Polish Tatras (Hruby Regiel, Potok Spadowiec), W India (NW Cutch), Central Slovakia (Liptov basin — Hrušečná pri Liskovej).

Discocyclina discus (Rütimeyer), 1850 **dudarensis** n. ssp.

Pl. V, figs. 1—10. text-figs. 26j—k

1959. *Discocyclina bartholomei* (Schlumberger) — Kecskeméti, pp. 50—51, pl. 1, fig. 9 (below), pl. 3, figs. 3, 7, text-fig. 13
partim 1963. *Discocyclina umbo* (Schafhäutl) — Bieda, pp. 131—132, pl. 22, figs. 3, 5, 6, pl. 23, figs. 2, 3, 6
1973. *Discocyclina fortisi* (d'Archiac) — Olempska, p. 86, pl. 16, fig. 6, pl. 17, fig. 5. (?)
1973. *Discocyclina umbo* (Schafhäutl) — Olempska, p. 87, pl. 17, fig. 7.

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E 4637, pl. V, fig. 8.
Type locality: Dudar—Sűrűhegy — abandoned quarry, SW side — sample DS 5.
Type level: The middle part of the Bartonian stage.
Diagnosis: *Discocyclina discus* populations with $\bar{D}$ exceeding 1200 μm.

Description:

External morphology: Large-sized (6 to 20 mm), more or less flattened, sometimes gently arched forms. The difference in size between forms "A" and "B" are essential. Forms "B" are 2.5 to 3 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-figs. 26j—k):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: umbilico-excentri	$Q = 1.18-3.15$	*t:* pratti (archiaci)	*g.p.:* pulcra (archiaci)
$E = 0.06-0.66$	$\bar{Q} = 1.90-3.60$	$N = 68-120$	$l = 35-50$ μm
$\bar{E} = 0.10-0.40$	$P = 390-980$ μm	$\bar{N} = 78-95$	$h = 95-160$ μm
$R = 0.79-2.32$	$\bar{P} = 510-750$ μm	$L = 45-65$ μm	$n_{0.5} = 4.0-6.0$
$\bar{R} = 1.10-1.60$	$D = 940-1950$ μm	$H = 90-165$ μm	$\bar{n}_{0.5} = 4.5-5.8$
	$\bar{D} = 1200-1950$ μm	$\bar{H} = 100-165$ μm	$n_{1.0} = 7.4-13.0$

Remarks: The annular walls of the equatorial chambers are much thicker (except for the specimens from Dudar) than the radial ones.

Retrospection: We tried give a better illustration (pl. V, fig. 5) of Kecskeméti's (1959) figure on "*Discocyclina bartholomei*". On the basis of our measurements the original scale of enlargement (×60) is not correct, it is in reality ×40.

The assignment of Bieda's (1963) and Olempska's (1973) forms to this category is a bit uncertain, since they examined specimens and not populations. In addition to this, the specimens are from flysch sediments, in which considerable mixing of faunas might have happened. Specimens with $\bar{D}$ exceeding 1200 μm were placed into this category.

Comparison: Among the forms with similar-sized embryon, contrasted with *Discocyclina discus dudarensis*, the embryon of *D. stratiemanuelis*, *D. spliti ajkaensis* and *D. pulcra balatonica* are always of the centrilepidine type, while *D. javana* has a polylepidine embryon.

Range: The Bartonian and the lower and middle parts of the Priabonian.

Polish Tatras (Hruby Regiel, Dolina Koscieliska, Dolina Małej łaky), Hungary: S Bakony [samples H 1, J 7, Ba 3, Sz 6, 8 and SzT from our own assemblage, samples named "Köleskepe-3", "Csékút" and "Gyűrhegy" are coming from Kecskeméti's (1959) collection], N Bakony (samples DS 2—5), E Gerecse (sample R 2).

Discocyclina weijdeni n. sp.

Pl. V, fig. 11, pl. VI, figs. 1—3, text-fig. 26l

Derivatio nominis: In honour of the outstanding Dutch researcher of Orthophragminae, this species was named after Wilhelmus Jacobus Maria Van der Weijden.
Holotype: Preparation E 4641, pl. VI, fig. 1.
Type locality: Horsarrieu (SW Aquitaine) — Marnière Sourbet — Sample HX.
Type level: The middle part of the Cuisian.

Diagnosis: Medium-sized, flattened forms. The embryon is of the trybliolepidine, less frequently it is of the semi-nephrolepidine type, the two chambers are moderately big. The adauxiliary chambers are of the "archiaci" type, they can be found in large numbers. They are narrow and relatively high. The growth pattern of the annuli is of the "archiaci" type.

Description:

External morphology: Medium-sized (3 to 6 mm), flattened forms with indistinct umbo. Forms may be gently arched. The rosette is of the "Discocyclina" type, the granules are medium-sized (about 50 μm in diameter). The ratio between the sizes of forms "A" and "B" is unknown for the time being, because of the lack of the latter forms.

Internal morphology:

The equatorial section of forms "A" (text-fig. 26l):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (semi-nephro)	$Q = 1.22-2.21$	*t:* archiaci (pratti)	*g.p.:* archiaci (pulcra)
$E = 0.26-0.66$	$\bar{Q} = 1.55-1.95$	$N = 34-58$	$l = 25-35$ μm
$\bar{E} = 0.40-0.70$	$P = 202-326$ μm	$\bar{N} = 40-48$	$h = 70-100$ μm
$R = 0.69-1.03$	$\bar{P} = 220-290$ μm	$L = 30-40$ μm	$n_{0.5} = 6.0-8.9$
$\bar{R} = 0.75-1.00$	$D = 327-595$ μm	$H = 75-100$ μm	$\bar{n}_{0.5} = 6.5-7.5$
	$\bar{D} = 400-520$ μm	$\bar{H} = 80-90$ μm	$n_{1.0} = 10.0-14.9$

The equatorial section of forms "B": Microspheric specimens of the taxon were not yet found. Presumeably the juvenarium shows Heterostegina character.

Axial section: The taxon could not be studied in this section.

Phylogenetic position (text-fig. 26): As *Discocyclina weijdeni* appears somewhat later than *D. archiaci archiaci* (but before *D. archiaci bartholomei*) it is in all probability the offspring of *D. archiaci archiaci*, and after all it differs from its ancestor only by the smaller width and the more elongate form of the equatorial chambers.

Intraspecific evolution cannot be pointed out due to the insufficient material available for study.

We have no knowledge of descendants of *D. weijdeni*, presumeably it became extinct without offspring, like the episodic form localized to the middle part of the Cuisian.

Retrospection: As forms similar to those described above, were not found in the literature, we had to segregate them as a new species.

Variability: Because of the low number of specimens only the gently curved form can be regarded as a variety with respect the exterior.

The character of the adauxiliary chambers ("archiaci" or transitional "archiaci-pratti" type) and the growth pattern of the annuli ("archiaci" or transitional "archiaci-pulcra" type) show variability. The thinness of the equatorial chambers, that is one of the main characteristic features of the species remains unchanged.

Comparison: Among the forms possessing similar-sized embryon, *Discocyclina weijdeni* may be confused with the following species: *D. archiaci archiaci*, *D. archiaci bartholomei*, *D. dispansa dispansa*, *D. dispansa umbilicata*, *D. senegalensis*, *D. pratti pratti* and *D. pratti montfortensis*.

To distinguish *D. weijdeni* from the first five taxa is possible considering the narrower and more elongate equatorial chambers, while the distinctive features in the case of the last three taxa are that the adauxiliary chambers are always of the "pratti", the growth pattern of the annuli is always of the "pulcra" type.

As an additional distinctive mark in the case of the *D. pratti*, the very long equatorial chambers — even more elongate than those of *D. weijdeni* — can be used.

Range: The middle part of the Cuisian.

SW Aquitaine (Horsarrieu — samples HX, HS, HN), Crimea: the lower part of the *Nummulites distans minor* zone in the Simferopolian stage (sample U 4).

Discocyclina senegalensis ABRARD, 1956

Pl. VI, figs. 4—6, 8, text-figs. 26m—n

1956. *Discocyclina senegalensis* n. sp. — ABRARD, pp. 237—241, pl. 11, figs. 1—7

Holotype: Not given by the author of the taxon.
Lectotype: ABRARD (1956), pl. 11, fig. 7, depository: Laboratoire de Géologie du Muséum (marked out by the present writer).
Type locality: Surroundings of Lam-Lam (Senegal).
Type level: Lutetian, in all probability in our opinion its lowermost part.
Diagnosis: Moderately large, flattened forms. The embryon is of the tryblio-, semi-nephro-, or perhaps the umbilicolepidine types. The embryonary chambers are relatively large. The adauxiliary chambers are in large numbers, they are wide but not too high. They represent the "pratti" type. The growth pattern of the annuli is of the "pulcra" type.

Description:

External morphology: Large-sized (ranging from 4 to 20 mm), often curved, flattened forms with diameter of umbo ranging from 1.5 to 2.5 mm. The umbo might be indented as well. The rosette is of the "Discocyclina" type, the granules are coarse (70 to 100 µm in diameter). Ratio between the sizes of forms "A" and "B" is unknown, because of the lack of the latter forms.

Internal morphology:

The equatorial section of forms "A" (text-figs. 26m–n):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (semi-nephro, umbilico)	$Q = 1.35-2.45$	*t:* pratti	*g.p.:* pulcra (trabayensis)
	$\bar{Q} = 1.50-2.30$	$N = 22-44$	$l = 35-45$ µm
$E = 0.33-0.87$	$P = 200-441$ µm	$\bar{N} = 29-35$	$h = 55-120$ µm
$\bar{E} = 0.45-0.85$	$\bar{P} = 225-415$ µm	$L = 40-65$ µm	$n_{0.5} = 5.2-10.0$
$R = 0.60-1.22$	$D = 447-833$ µm	$H = 50-90$ µm	$\bar{n}_{0.5} = 6.3-10.0$
$\bar{R} = 0.65-1.05$	$\bar{D} = 500-730$ µm	$\bar{H} = 60-78$ µm	$n_{1.0} = 11.0-20.0$

The equatorial section of forms "B": Microspheric specimens of the taxon were not yet found. Presumeably the juvenarium is of the ,,Heterostegina" type.

Axial section: We have knowledge of this section only from ABRARD's (1956, pl. 11, fig. 4) work. The specimen depicted there was rather poorly preserved, therefore the only fact that can be stated is that in axial section it resembles *Discocyclina archiaci* the most.

Phylogenetic position (text-fig. 26): We consider *Discocyclina senegalensis* as the offspring of *D. archiaci bartholomei*, since they occur together and they differ only in the numbers and type of the adauxiliary chambers.

Due to the scarce material available for study we can only suspect that between the Cuisian and Lutetian ages certain intraspecific evolution – represented by the increasing size of the deuteroconch* – took place. We are not yet in the position to segregate subspecies.

Data with respect to the offsprings are not available, presumeably the species became extinct with no further descendants.

Retrospection: The figures published by ABRARD (1956), describer of the species are not of the best quality, but the "pratti" type adauxiliary chambers, that can clearly tell the species from *Discocyclina archiaci* are distinctly visible. In our opinion the indented umbo is of no distinctive taxonomic value.

Variability: Externally, the indented umbo is characteristic of the Senegalese forms, while the bulging umbo and possibly even the gently curved shapes are typical of the Crimean forms.

As far as the inner features are concerned variability is due to the different embryon types. With respect to the Senegalese specimens the relatively quick increase in length of the equatorial chambers is easy to observe. This character could not be found in the Crimean forms, the test sizes of which are much smaller than those of the Senegalese ones.

Comparison: Among the forms possessing a similar-sized embryon *Discocyclina senegalensis* can be distinguished from *D. archiaci bartholomei* and *D. dispansa umbilicata* by the "pratti" type and lower numbers of the adauxiliary chambers, from *D. pratti pratti* by the equatorial chambers that are wider and less high.

Range: The upper part of the Cuisian and the lower part of the Lutetian.

Senegal (Lam-Lam), the Crimea – Simferopolian stage – the upper part of the *Nummulites distans minor* zone (samples E 9, B 50) and the whole of the *N. distans* zone (samples B 53, 77).

Discocyclina javana (VERBEEK), 1892

Pl. VI, figs. 7, 9, text-figs. 26o–p

1892. *Orbitoides ephippium* (SCHLOTHEIM) var. *javana* n. var. – VERBEEK, p. 109
1892. *Orbitoides papyracea* (BOUBÉE) var. *javana* n. var. – VERBEEK, p. 119, fig. 8
1892. *Orbitoides dispansa* (SOWERBY) – VERBEEK, p. 120, fig. 9
non 1892. *Orbitoides papyracea* (BOUBÉE) var. *javana minor* n. var. – VERBEEK (= ?)
1896. *Orbitoides ephippium* (SCHLOTHEIM) var. *javana* VERBEEK – VERBEEK et FENNEMA, pp. 1168–1171, pl. 9, figs. 138–143, pl. 10, figs. 152–154
1896. *Orbitoides papyracea* (BOUBÉE) var. *javana* VERBEEK – VERBEEK et FENNEMA, pp. 1171–1173, pl. 9, figs. 144–147, pl. 10, figs. 155–157
1896. *Orbitoides dispansa* (SOWERBY) – VERBEEK et FENNEMA, pp. 1173–1174, pl. 9, figs. 148–149, pl. 10. figs. 158–160
non 1896. *Orbitoides papyracea* (BOUBÉE) var. *javana minor* VERBEEK – VERBEEK et FENNEMA (= ?,

* (See text-figs 26 m and n, respectively)

1903. *Orthophragmina dispansa* (SOWERBY) — SCHLUMBERGER, pp. 285—287, pl. 11, figs. 42—44) pl. 12, figs. 51, 52
?1947. *Discocyclina umbilicata* (DEPRAT) — BURSCH, pp. 57—59, pl. 3, figs. 18, 21, 24
1959. *Discocyclina sowerbyi* NUTTALL — NAGAPPA, pl. 11, figs. 1—2
1959. *Discocyclina omphala* (FRITSCH) — NAGAPPA, pl. 11, figs. 3—5
1963a. *Discocyclina (Discocyclina) sijuensis* n. sp. — SAMANTA, pp. 39—40, figs. 1—4
1964. *Discocyclina (Discocyclina) javana* (VERBEEK) — SAMANTA, pp. 340—343, pl. 1, figs. 1—12, pl. 2, figs. 1—7
partim 1964. *Discocyclina (Discocyclina) omphalus* (FRITSCH) — SAMANTA, pp. 343—345, pl. 3, figs 3, 4, 9
1965b. *Discocyclina javana* (VERBEEK) — SAMANTA, pp. 422, 424, pl. 4, figs. 6—9
partim 1965b. *Discocyclina omphalus* (FRITSCH) — SAMANTA, p. 424, pl. 2, figs. 10, 11
1965b. *Discocyclina sowerbyi* NUTTALL — SAMANTA, pp. 426, 428, pl. 3, figs. 1—6, pl. 4, fig. 10

Holotype: Not given by the author of the taxon.
Lectotype: VERBEEK et FENNEMA (1896) — pl. 10, fig. 153, referred to as *Orbitoides ephippium* var. *javana*, depository unknown — external form marked out by the present writer.
Type locality: Baguelen, Karangsamboung or riviére Sourouan (Java).
Type level: Not given (in our opinion the uppermost part of the Middle Eocene or the Upper Eocene).
The type of the equatorial section of forms "A": SCHLUMBERGER (1903), pl. 11, fig. 43, going by the name of *Orthophragmina dispansa* — Java (presumeably the surroundings of Jogjakarta), age not indicated, depository: École de Mines (Paris).
Diagnosis: Large-sized, mostly flattened forms. Polylepidine embryon (rarely with transition towards the umbilicolepidine type). The embryonic chambers are large. The adauxiliary chambers are of the "pratti" type, numerous, extraordinary wide and high. The equatorial chambers are wide and high, the growth pattern of the annuli is of the "pulcra" type.

Description:

External morphology: Large-sized (6 to 50 mm), flattened forms, with indistinct umbo of varying size. Curved and saddle-shaped forms are rather common. The rosette is of the "Discocyclina" type, the granules are relatively distinctable, medium-sized (diameter ranging from 50 to 70 μm). The difference in size between forms "A" and "B" is significant (three- to fivefold).

Internal morphology:

The equatorial section of forms "A" (text-figs. 26o—p):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: poly (rarely umbilico)	$Q = 1.39-2.42$	*t:* pratti	*g.p.:* pulcra
$E = 0.00-0.40$	$\bar{Q} = 1.60-2.40$	$N = 40-110$	$l = 35-40$ μm
$\bar{E} = 0.10-0.35$	$P = 325-900$ μm	$\bar{N} = 55-90$	$h = 100-150$ μm
$R = 1.00-1.58$	$\bar{P} = 420-650$ μm	$L = 50-70$ μm	$n_{0.5} = 3.5-6.0$
$\bar{R} = 1.10-1.50$	$D = 770-1900$ μm	$H = 95-220$ μm	$\bar{n}_{0.5} = 4.0-5.5$
	$\bar{D} = 930-1400$ μm	$\bar{H} = 125-180$ μm	$n_{1.0} = 7.0-12.0$

Remarks: The annular walls of the equatorial chambers are thicker than the radial ones.

The equatorial section of forms "B": We could not study own material, but relying upon SAMANTA's (1964, pl. 2, fig. 5, pl. 3, fig. 9 and 1965b, pl. 4, fig. 10) figures it is clear that the juvenarium is of the „Heterostegina" type, the nepionic part, however, is strongly reduced. This refers the more evolved stage of the species. I = 18—20 μm, S = 5—6, s = 60—80 μm, n = 5—6, d = 120—130 μm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: As own preparation was not available we relied upon SCHLUMBERGER's (1903, pl. 11, fig. 44) and SAMANTA's (1964, pl. 1, figs. 9—12, pl. 3, fig. 4 and 1965b, pl. 2, fig. 11, pl. 3, figs. 5, 6, pl., 4, figs. 8, 9) figures. Height of the embryon ranges from 200 to 300 μm, the equatorial layer somewhat thickens towards the peripheries, thickness at centre varies from 70 to 100 μm, at the edges from 100 to 120 μm. The lateral wall is thick, the annular one is arcuate. The average dimensions of the lateral chambers are 100×40 μm.

Phylogenetic position (text-fig. 26): Most likely *Discocyclina javana* derives from *Discocyclina discus dudarensis* collaterally and differs from it in the somewhat smaller embryon which is nearly always of the polylepidine type.

On the basis of the material available different stages of evolution cannot be distinguished within the species, though it is most likely that in the uppermost part of the Middle Eocene, the $\bar{D}$ values of the populations are less than 1200 or 1300 μm, whereas in the case of the Upper Eocene populations they exceed this limit (see text-figs. 26o and p, respectively).

We have no knowledge of descendants of the species, in all probability this most advanced taxon became extinct with no offsprings.

Retrospection: The species was segregated in Indonesia by VERBEEK (1892) going by the names of *Orbitoides papyracea* var. *javana* and *O. ephippium* var. *javana,* marking the microspheric and megalospheric specimens, respectively, according to the work published by VERBEEK et FENNEMA (1896). Though the schematic drawings of this work are somewhat roughly sketched, comparing them with SCHLUMBERGER's (1903) *Orthophragmina dispansa* described from Jogjakarta, it is very likely that they conform to each other as well as to the above description. Later SAMANTA's (1964, 1965b) descriptions from Assam served as major contribution.

As the synonymic list shows, the taxon was described under other names as well, both from Indonesia (SCHLUMBERGER 1903, BURSCH 1947) and Assam (NAGAPPA 1959, SAMANTA 1963a, 1964, 1965b). These names refer to certain varieties of the exterior only, whereas the internal morphology of all the assigned forms, in our opinion, are the same.

Among these, the name "dispansa" – according to SEN GUPTA's (1963a) work (see at the description of "dispansa") surely does not refer to the forms with the above internal morphology, while the usage of names like "omphalus", "sowerbyi", and "sijuensis" can be ruled out a priori (see explanation later).

Variability: The external characters show the greatest variation as it is obvious considering the numerosity of the related names. Saddle-shapeness and central identure are both common. On the other hand the internal characters are rather stable.

Comparison: *Discocyclina javana* can only be confused with forms possessing a similar-sized, extraordinary large embryon.

Among these species *D. stratiemanuelis*, *D. spliti ajkaensis*, *D. pulcra balatonica* and *D. pulcra baconica* always have a centrilepidine embryon, whereas *D. javana*'s embryon is practically always of the polylepidine type.

The embryon of *D. pratti minor* is somewhat smaller, the equatorial chambers are narrower.

The most difficult is the separation from *D. discus discus* and *D. discus dudarensis*. In the case of these forms however tryblio- or umbilicolepidine embryon, "archiaci" type adauxiliary chambers and growth pattern may occur rather often, contrarily to *D. javana* in the case of which it never or very rarely happens. Furthermore from *D. discus* and *D. javana* coming from the same strata the embryon of the first one is always somewhat bigger than that of the latter.

Range: The upper part of the Bartonian and the Priabonian.

SW Aquitaine (Siest – sample BT), India (Assam – Garo Hills), Java.

Discocyclina pseudoaugustae PORTNAYA, 1973

Pl. VI, fig. 10, pl. VII, figs. 1–7, text-figs. 26q–r

1973. *Discocyclina pseudoaugustae* n. sp. – PORTNAYA, pp. 135–138, pl. 1, figs. 1–6, pl. 2, figs. 1–4
1974. *Discocyclina pseudoaugustae* PORTNAYA – PORTNAYA, pp. 107–109, pl. 27, figs. 1–6 (?), pl. 28, figs. 1–5
partim 1974. *Diascocyclina fortisi* (D'ARCHIAC) – PORTNAYA, pp. 104–107, pl. 26, figs. 4–7
1981a. *Discocyclina pseudoaugustae* PORTNAYA – LESS, pl. 1, fig. 1

Holotype: PORTNAYA (1973) pl. 1. figs. 1, 5 and PORTNAYA (1974) pl. 27, fig. 1. Preparate N° 159/173, depository: Moskovsky Geologorazvedochny Institut im. S. Ordzhonikidze – external form.
Type locality: Crimea, Bakhchisarai, Suvlu-Kaya Hill, stratotypical profile, Bakhchisaraian stage (no further position is given).
Type level: Lower Eocene (in our opinion the upper part of the Ilerdian or the lower part of the Cuisian). The type of the equatorial section of forms "A": PORTNAYA (1973) pl. 2, figs. 1, 2. and PORTNAYA (1974) pl. 28, fig. 4. Preparate N° 159/183, other data agree with those of the holotype.
Diagnosis: Medium-sized, generally flattened forms. The embryon is of the polylepidine type, the two chambers are moderately large. The adauxiliary chambers are of the "archiaci" type and can be found in relatively large numbers. The adauxiliary as well as the equatorial chambers are wide and not too high. The growth pattern of the annuli is of the "archiaci" type.

Description:

External morphology: Medium-sized (3 to 7 mm), mostly flattened forms but rounded forms may also occur. The umbo of varying size is usually well discernable. Occasionally forms are gently curved. The rosette is of the "Discocyclina" type, the large-sized granules (diameter varies from 60 to 100 μm) are distinctly visible. Forms "B" are 1.5 to 2 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-figs. 26q–r):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: poly (poly-umbilico)	$Q = 1.68-2.59$	*t*: archiaci	*g.p.*: archiaci
$E = 0.00-0.45$	$\bar{Q} = 1.90-2.20$	$N = 31-38$	$l = 35-45$ μm
$\bar{E} = 0.00-0.30$	$P = 195-375$ μm	$\bar{N} = 35-50$	$h = 50-80$ μm
$R = 1.05-1.79$	$\bar{P} = 220-350$ μm	$L = 35-50$ μm	$n_{0.5} = 7.7-11.0$
$\bar{R} = 1.20-1.50$	$D = 425-700$ μm	$H = 50-80$ μm	$\bar{n}_{0.5} = 8.0-9.5$
	$\bar{D} = 460-670$ μm	$\bar{H} = 55-70$ μm	$n_{1.0} = 15.5-20.0$

The equatorial section of forms "B": We failed to obtain good-quality preparation of microspheric specimens of the taxon. Presumably the juvenarium is of the Heterostegina type.

Axial section: In this section the taxon could not be studied. PORTNAYA's (1974, pl. 28, fig. 5) figure is strongly retouched but the thickness of the embryon amounting to 200 μm is observable. Thickness of the equatorial layer near the embryon is 60 μm. The dimensions of the lateral chambers are 120×40 μm on the average.

Phylogenetic position (text-fig. 26): In all probability *Discocyclina pseudoaugustae* can be derived from *D. archiaci,* that differs merely in the embryon's type. More concretely the derivation from *D. archiaci staroseliensis* looks the most likely, since the lowermost locality of *D. pseudoaugustae* in the Crimea coincide with the stratigraphic range of this particular *D. archiaci* subspecies. The material examined does not permit the segregation of subspecies though a certain evolution is noticeable between the populations originated from upper part of the Ilerdian in the Crimea and the lower part of the Cuisian at Dikilitash in the increasing $\bar{P}$, $\bar{D}$, $\bar{N}$ and the decreasing $\bar{E}$ values (see text-figs. 26q and r, respectively).

The descendant of the species in the direct line is *Discocyclina fortisi,* the embryon of which is not polylepidine any more but of the centrilepidine type. Stratigraphically *D. fortisi* appears above *D. pseudoaugustae* after extinction of the latter and the quantitative features of the interior also suggest a more advanced evolutional stage.

Retrospection: The species was segregated by PORTNAYA (1973) on the plea that externally the taxon resembles *Discocyclina augustae,* while internally it resembles *D. fortisi.* In fact the inner morphology of *D. pseudoaugustae* and *D. fortisi* conform to each other but they differ however from that of the typical *D. fortisi* of France, the embryon of which is of the centrilepidine type unlike the embryon of *D. pseudoaugustae,* that belongs to the polylepidine type. The synonymic list was completed considering this train of thoughts.

Variability: Externally, *Discocyclina pseudoaugustae* is just as variable as most of the *Discocyclina* species. Practically, the qualitative features of the internal morphology are stable.

Comparison: Only some *Discocyclina pratti pratti* being on a higher level of evolution and *D. pratti minor* may possess similar-sized polylepidine embryon but the equatorial chambers of these are narrower and higher.

Range: The upper part of the Ilerdian and the lower part of the Cuisian.

Crimea — Bakhchisaraian stage: boundary of the *Nummulites crimensis* and *Assilina placentula* zones (sample B 19) and the *A. placentula* zone (sample B 39), Bulgaria (Dikilitash).

Discocyclina fortisi (d'ARCHIAC), 1850

Diagnosis: Large-sized, generally flattened forms. Centrilepidine embryon, possibly transitional towards the polylepidine type. Large embryonary chambers. The adauxiliary chambers are of the "archiaci" type or possibly transitional towards the "pratti" type. "Archiaci" type growth pattern, very rarely transitional towards the "pulcra" type.

Description:

External morphology: Large (diameter ranging from 4 to 40 mm), most of the cases flattened forms. Rarely the smaller forms can be rounded as well. The umbo, ranging from 1.5 to 3 mm in diameter may be well-defined or indistinct too with indention at the centre. Getting on from umbo to collar step like transition is frequent. Gently curved shapes may occur. The rosette is of the "Discocyclina" type, the granules are coarse, distinctly visible (50 to 100 μm in diameter). The difference in size between forms "A" and "B" is considerable (two- to sixfold).

Internal morphology:

The equatorial section of forms "B": There were only poorly-preserved forms available for study. The juvenarium is of the Heterostegina type. I and S could not be measured. $s = 40-50$ μm, $n = 7-10$, $d = 180-200$ μm, $J = 10-14$, $j = 750-900$ μm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: Relying on NEUMANN's (1958, pl. 16, fig. 5 and pl. 27, figs. 1, 2) and our own preparations, the height of the embryon varies from 150 to 200 μm, the equatorial layer grows very thin towards the edges, its thickness at centre varies from 80 to 100 μm, on the edges from 50 to 60 μm. The lateral wall is relatively thick (20 to 30 μm), the annular one is arcuate. The dimensions of the lateral chambers are 70—100×25—35 μm on average.

Phylogenetic position (text-fig. 26): *Discocyclina fortisi* can be regarded as the lineal descendant of *D. pseudoaugustae.* It differs from the latter only by the type of the embryon and by the dimensions of particular elements of the test (P, D, H, h).

Within the species two stages of evolution (subspecies) can be distinguished using the following biometric limits:

Discocyclina fortisi fortisi (text-fig. 26s)	$\bar{D} < 800$ μm
Discocyclina fortisi simferopolensis (text-figs. 26t—u)	$\bar{D} > 800$ μm

Also the development is noticeable in the increase of $\bar{P}$ and $\bar{N}$, while, $\bar{E}$, $\bar{R}$, $\bar{Q}$, $\bar{H}$ and $\bar{n}_{0.5}$ are practically unchangeable. In the case of the most developed specimens adauxiliary chambers of the transitional "archiaci—pratti" type also occur (see text-fig. 26u).

The offsprings of *D. fortisi* are: *D. stratiemanuelis* and *D. spliti.*

These species, appearing above *D. fortisi* resemble very much their ancestor. The adauxiliary chambers of *D. stratiemanuelis* however are of the "pratti" type, whereas *D. spliti* differs the "spliti" type growth pattern.

R e t r o s p e c t i o n : The species was segregated by D'ARCHIAC (1850). Biarritz and Horsarrieu were given as localities of the species. DOUVILLÉ (1922) and WEIJDEN (1940) described the species from the uppermost Eocene layers of Biarritz, namely from La Cachaou, but satisfactory depiction was not given by them.

Therefore we have to concur with NEUMANN's (1958) opinion, because she completed the description of the forms from Horsarrieu and Doazit with proper figures. Accordingly, DOUVILLÉ's (1922) and WEIJDEN's (1940) forms must be excluded from the synonymic list, since *Discocyclina fortisi*, being confined to the Cuisian cannot occur in the uppermost part of the Eocene.

At the same time NEUMANN (1955, 1958) placed into her synonymic list all those forms that have or may have poly- or centrilepidine embryon. This cannot be accepted since *D. stratiemanuelis*, *D. spliti* and *D. pulcra* as well possess a centrilepidine embryon. Moreover, she also put into the list SCHWEIGHAUSER's (1953, text-fig. 32) *D. pratti* (form "B") from Sainte-Colombe, but this depiction may refer equal force to *D. archiaci*, *D. weijdeni*, *D. pratti*, *D. pulcra* or *D. fortisi.*

Perhaps it was *D. fortisi*, that was described — and illustrated by inadequate figures — by NUTTALL (1925) and BELMUSTAKOV (1959) going by the names of *D. archiaci* var. *baluchistanensis* and *D. umbo* respectively. These names, however, cannot be used (see explanation later).

V a r i a b i l i t y : the variability of the external features already pointed out under the title: External morphology.

As far as the internal features are concerned the shape of the embryon can be varied to the extent that the deuteroconch, secondarily, may split into a few smaller chambers (see NEUMANN, 1958, pl. 24, fig. 1 and pl. VIII, fig. 1 of the present work). Even so the extraordinarily low excentricity remains the same, therefore this embryon type, too, must be regarded as centrilepidine.

Particular attention should be paid to the *Discocyclina fortisi* populations found in the lower part of the *Nummulites distans* zone of the Crimea (samples B 53, 54). The adauxiliary chambers of these forms are of the transitional "archiaci—pratti" type, they are wider and lower than those of the typical *D. fortisi* also the number of chambers is lower than excepted. Most likely it is so because these populations may already be regarded as transitional ones towards the phylogenetic offspring, *D. stratiemanuelis.*

R a n g e : The middle and upper parts of the Cuisian.

Discocyclina fortisi fortisi (D'ARCHIAC), 1850

Pl. VII, figs. 8—9, text-fig. 26s

partim 1850. *Orbitolites fortisi* n. sp. — D'ARCHIAC, p. 404, pl. 14, figs. 10—12
non 1922. *Discocyclina fortisi* (D'ARCHIAC) — DOUVILLÉ, p. 87. (= ?)
partim 1929. *Discocyclina fortisi* (D'ARCHIAC) — LLUECA, pp. 273—274, text-fig. 56
non 1940. *Discocyclina fortisi* (D'ARCHIAC) — WEIJDEN, pp. 33—34. (= ?)
1955. *Discocyclina fortisi* (D'ARCHIAC) — NEUMANN, pp. 126—129, pl. 6, fig. 1, pl. 7, fig. 1
1958. *Discocyclina fortisi* (D'ARCHIAC) — NEUMANN, pp. 94—97, pl. 15, figs. 3—6, pl. 16, figs. 1—5, pl. 27, figs. 1—2, text-fig. 27
1970. *Discocyclina fortisi* (D'ARCHIAC) — PAPP et TURNOVSKY, pl. 69, fig. 1, pl. 74, figs. 1—2
non 1973. *Discocyclina fortisi* (D'ARCHIAC) — OLEMPSKA *(= Discocyclina discus dudarensis)*
partim 1974. *Discocyclina fortisi* (D'ARCHIAC) — PORTNAYA, pp. 104—107, pl. 26, figs. 1—2
partim non 1974. *Discocyclina fortisi* (D'ARCHIAC) — PORTNAYA *(= Discocyclina pseudoaugustae)*
non 1980. *Discocyclina fortisi* (D'ARCHIAC) — GROSS, KÖHLER et al. *(= Discocyclina pulcra balatonica)*
non 1981a. *Discocyclina fortisi* (D'ARCHIAC) — LESS *(= Discocyclina fortisi simferopolensis)*

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : D'ARCHIAC (1850) pl. 14, fig. 12
Depository: École de Mines (Paris) — external form (marked out by the present writer).
T y p e l o c a l i t y : Horsarrieu (Landes — SW Aquitaine).
T y p e l e v e l : Not given by the author of the taxon (in our opinion the middle part of the Cuisian stage).
The t y p e of the equatorial section of forms "A": NEUMANN (1955) pl. 7, fig. 1 and NEUMANN (1858) pl. 16, fig. 2. Depository: presumably Université de Paris — Doazit, middle part of the Cuisian.
D i a g n o s i s : *Discocyclina fortisi* populations with $\bar{D}$ less than 800 μm.

D e s c r i p t i o n :

External morphology: Large-sized (4 to 40 mm), mostly flattened forms.

Internal morphology:

The equatorial section of forms "A" (text-fig. 26s):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri (perhaps centri-poly)	$Q=1.59-2.20$	*t:* archiaci	*g.p.:* archiaci
	$\bar{Q}=1.70-2.10$	$N=48-83$	$l=40-45$ µm
$E=0.00-0.13$	$P=290-600$ µm	$\bar{N}=50-65$	$h=65-90$ µm
$\bar{E}=0.00$	$\bar{P}=290-450$ µm	$L=40-50$ µm	$n_{0.5}=5.5-10.5$
$R=1.32-1.57$	$D=500-950$ µm	$H=65-95$ µm	$\bar{n}_{0.5}=5.5-8.5$
$\bar{R}=1.35-1.55$	$\bar{D}=600-800$ µm	$\bar{H}=70-95$ µm	$n_{1.0}=11.0-16.0$

Remarks: The annular walls of the equatorial chambers are thicker than the radial ones.

Retrospection: *Discocyclina fortisi* specimens with D less than 800 µm were placed into the synonymic list.

NEUMANN's (1955, 1958) *D. fortisi* coming from the *Xanthopsis dufourii*-bearing layers of Aquitaine could be studied in population on the basis of the dimensions given by her. Consequently, the $\bar{D}$ less than 800 µm relation holds true of that population, considering the usual 1.6 to 2 times exaggerated enlargements of the author and our own examinations as well.

Comparison: Only *Discocyclina pulcra landesica* and *D. pulcra pulcra* have similar-sized centrilepidine embryon but the equatorial chambers of these are much narrower than those of *Discocyclina fortisi fortisi*, in addition the adauxiliary chambers are of the "pratti", their growth pattern is of the "pulcra" type.

Range: The middle part of the Cuisian.

SW Aquitaine (Chalosse – *Xanthopsis dufourii*-bearing layers – Horsarrieu, Doazit, Sainte-Colombe), Austria (Klein St. Paul in Kärnten), Crimea – the lower part of the ***Nummulites distans minor*** zone (sample U 2).

Discocyclina fortisi (D'ARCHIAC), 1850 simferopolensis n. ssp.

Pl. VII, figs. 10–14, pl. VIII, figs. 1–4, text-figs. 26t–u

?1925. *Discocyclina archiaci* (SCHLUMBERGER) var. *baluchistanensis* n. var. – NUTTALL, pp. 446–447, pl. 27, fig. 8, text-fig. 5

?1959. *Discocyclina umbo* (SCHAFHÄUTL) – BELMUSTAKOV, p. 50, pl. 18, figs. 3–6

1981a. *Discocyclina fortisi* (D'ARCHIAC) – LESS, pl. 1, fig. 2

Derivatio nominis: Named after the local stratigraphical denomination of the taxon's type locality.
Holotype: Preparation E 4660, pl. VII, fig. 13
Type locality: Crimea, Bakhchisarai, Suvlu-Kaya Hill, Simferopolian stage, middle part of the *Nummulites distans minor* zone, sample B 50.
Type level: The upper part of the Cuisian.
Diagnosis: *Discocyclina fortisi* populations with $\bar{D}$ exceeding 800 µm.

Description:

External morphology: Large (4 to 25 mm), mostly flattened forms.

Internal morphology:

The equatorial section of forms "A" (text-figs. 26t–u):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q=1.57-2.30$	*t:* archiaci (pratti)	*g.p.:* archiaci (rarely archiaci-pulcra)
$E=0.00-0.12$	$\bar{Q}=1.75-2.05$		
$\bar{E}=0.00$	$P=280-700$ µm	$N=42-100$	$l=35-50$ µm
$R=1.21-1.67$	$\bar{P}=400-500$ µm	$\bar{N}=55-77$	$h=75-130$ µm
$\bar{R}=1.35-1.50$	$D=580-1250$ µm	$L=40-70$ µm	$n_{0.5}=5.7-9.0$
	$\bar{D}=800-950$ µm	$H=65-110$ µm	$\bar{n}_{0.5}=6.5-8.0$
		$\bar{H}=78-90$ µm	$n_{1.0}=11.8-15.8$

Remarks: The annular septa of the equatorial chambers are thicker than the radial ones.

Retrospection: Since the quality of the depiction does not allow sure identification, NUTTALL's (1925) and BELMUSTAKOV's (1959) forms were conditionally placed into the synonymic list on the basis of the embryon size and the similar stratigraphic level.

Comparison: *Discocyclina stratiemanuelis*, *D. spliti spliti* and *D. pulcra pulcra* possess similar-sized centrilepidine embryon.

The adauxiliary chambers of the first and the last species are of the "pratti" type and the equatorial chambers of *D. pulcra pulcra* are even more narrow and higher, too. *D. spliti spliti* can be distinguished from all the other forms by the "spliti" type growth pattern of the annuli.

R a n g e : The upper part of the Cuisian.

Crimea — Simferopolian stage — the middle and upper parts of the *Nummulites distans minor* zone and the lower part of the *N. distans* zone (samples U 7, E 9, B 49, 50, 53, 54), perhaps Bulgaria (Obzor, near Varna) and Pakistan (Baluchistan, Laki series).

Discocyclina stratiemanuelis Brönnimann, 1942

Pl. VIII. figs. 5—9, text-figs. 26v—x

?1863. *Hymenocyclus umbo* n. sp. — Schafhäutl, p. 106, pl. 14, figs. 5a—k, 8a—c
?1922. *Discocyclina umbo* (Schafhäutl) — Douvillé, pp. 85—86, text-figs. 12, 26, 27
1942. *Discocyclina strati-emanuelis* n. sp. — Brönnimann, pp. 307—314, pl. 22, figs. 1—8, text-figs. 1—4
?1945b. *Discocyclina papyracea* (Boubée) — Brönnimann, pp. 587—588, pl. 21, fig. 3, text-figs. 4—5
partim ?1967. *Discocyclina umbo* (Schafhäutl) — Köhler, pp. 76—77, pl. 13, fig. 5, text-fig. 6E

H o l o t y p e : Brönnimann (1942) pl. 22, fig. 7, text-fig. 2b Preparate No 43, depository: presumably Naturhistorisches Museum, Basel.
T y p e l o c a l i t y : Kressenberg (Bavaria), Emanuel-Flöz, iron ore, sample 1/247.
T y p e l e v e l : Eocene with no closer definition (in our opinion the lower part of the Lutetian).
D i a g n o s i s : Large-sized, mostly very flat forms. Centrilepidine embryon. Large embrionary chambers. The adauxiliary chambers are of the "pratti" type (perhaps transitional towards the "archiaci" type), numerous, relatively wide and high as well as the equatorial chambers, the growth pattern of which is of the "pulcra" type (perhaps transitional towards the "archiaci" type).

D e s c r i p t i o n :

External morphology: Large-sized (5 to 30 mm), usually very flat forms generally with an indistinct umbo of varying size. Gently curved shapes may occur. The rosette is of the "Discocyclina" type, the granules are distinctly visible, relatively large (diameter varies from 60 to 100 μm). Ratio between the dimensions of forms "A" and "B" is significant (three- to eightfold).

Internal morphology:

The equatorial section of forms "A" (text-figs. 26v—x):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q = 1.68-2.52$	*t*: pratti (archiaci-pratti)	*g.p.*: pulcra (archiaci-pulcra)
$E = 0.00-0.15$	$\bar{Q} = 1.75-2.10$	$N = 40-85$	$l = 35-50$ μm
$\bar{E} = 0.00$	$P = 350-760$ μm	$\bar{N} = 53-80$	$h = 80-125$ μm
$R = 1.27-1.79$	$\bar{P} = 420-620$ μm	$L = 45-70$ μm	$n_{0.5} = 4.7-8.5$
$\bar{R} = 1.35-1.55$	$D = 720-1340$ μm	$H = 60-200$ μm	$\bar{n}_{0.5} = 4.7-7.5$
	$\bar{D} = 870-1150$ μm	$\bar{H} = 70-200$ μm	$n_{1.0} = 10.0-16.0$

R e m a r k s : The annular walls of the equatorial chambers are thicker than the radial ones.

The equatorial section of forms "B": Since good-quality preparation of our own is not available we rely on the forms coming from the type locality of the taxon defined as *Discocyclina papyracea* by Brönnimann (1942, pl. 21, fig. 3 and text-figs. 4, 5), and conditionally placed into the synonymic list. The juvenarium is of the Heterostegina type, I = 15 μm, S = 5—6, s = 40—50 μm, n = 7—8, d = 150—160 μm. The values of J, j, l and h cannot be measured on the basis of the figures.

Axial section: The taxon could not be examined in this section and no data from the literature are available.

P h y l o g e n e t i c p o s i t i o n (text-fig. 26): *Discocyclina stratiemanuelis* is regarded by us as the offspring of *D. fortisi simferopolensis*, since it appears above the latter and differs from it first of all in the adauxiliary chamber type and in the growth pattern of the annuli.

For the time being we do not distinguish stages of evolution within the species, mainly because progress in the $\bar{P}$, $\bar{D}$ and $\bar{N}$ values cannot be detected. In spite of this the evolution in the increase of $\bar{H}$ and decrease of $\bar{n}_{0.5}$ is observable, that is, according to their stratigraphic position the Crimean forms are the most primitive, the forms from Kressenberg are more advanced, whereas the forms coming from Angoumé represent the present known highest stage of evolution (see text-figs. 26u, v and w respectively). Presumably further research of rich material will make possible the segregation of subspecies.

Up to now, we do not know the descendants of this species. Presumably it became extinct without offspring.

R e t r o s p e c t i o n : The species was described from Kressenberg (Bavaria) by Brönnimann (1942) going by the name of "strati-emanuelis". The hyphen between the two parts is omitted considering the instruction of the "International Codex of Zoological Nomenclature". Owing to the author's good figures accompanying the description of the taxon it is easy to identify the species.

Forms "B" from Kressenberg, referred to as *D. papyracea*, were also published by him (BRÖNNIMANN, 1945b). These forms were conditionally put into the synonymic list (the name "papyracea" cannot be used, see explanation later).

BRÖNNIMANN's (1942) forms might be identical with SCHAFHÄUTL's (1863) and DOUVILLÉ's (1922) *D. umbo* also coming from Kressenberg. Since satisfactory figures showing the internal structure were not published by them and the name "umbo" was used for marking other forms as well (see there) it is more expedient to use the name: "stratiemanuelis" for marking the forms described above.

Variability: Changes of the test size, the possible curvature of the test and the varying size and shape of the umbo embody the changeability of the species.

Among the internal test-elements the height of the adauxiliary chambers and shape of the equatorial chambers may differ in different populations. Presumably this is the result of the phylogenesis (see phylogenetic position).

Comparison: *Discocyclina fortisi simferopolensis*, *D. spliti spliti* and *D. pulcra pulcra* possess similar-sized centrilepidine embryon. The adauxiliary chambers and the growth pattern of the first form are of the "archiaci" type, the second form shows "spliti" type growth pattern, whereas the equatorial chambers of the third one are narrower and longer than those of *D. stratiemanuelis*.

Range: The whole of the Lutetian.

SW Aquitaine (Angoumé), Bavaria (Kressenberg), Slovakia (Podhradie near Martin), Crimea — Simferopolian stage — the upper part of the *Nummulites distans* zone and the *N. polygyratus* zone (samples B 75, 76, 77, 84 and 91).

Discocyclina spliti BUTTERLIN et CHOROWICZ, 1971

Diagnosis: Large, slightly flattened forms. The embryon is centrilepidine, the two chambers are large. The adauxiliary chambers are of the "pratti" type (with transition towards the "archiaci" type), numerous, wide and high. The equatorial chambers are rather low in comparison to their width. The growth pattern of the annuli is of the "spliti" type.

Description:

External morphology: Large-sized (6 to 12 mm) slightly flattened forms (they may also resemble moderately inflate forms). The missing umbo is characteristic. Curved forms do not occur. The rosette is of the "Discocyclina" type, the granules are coarse (80 to 150 μm in diameter). Ratio between the dimensions of forms "A" and "B" is unknown due to the lack of the latter forms.

Internal morphology:

The equatorial section of forms "B": Microspheric forms of the species were not yet found, the juvenarium, presumably shows Heterostegina character.

Axial section: Not having own preparation, relying on BUTTERLIN et CHOROWICZ's (1971, pl. 1, figs. 8, 9) data the height of the embryon varies from 200 to 280 μm, the equatorial layer does not grow thick towards the edges, it is evenly 80 to 110 μm thick. The lateral wall is thick, the annular one is arcuate. The lateral chambers are 100×40 μm big on the average.

Phylogenetic position (text-fig. 26): In all likelihood *Discocyclina spliti* can be derived from *D. fortisi simferoplensis* since it appears in higher stratigraphic levels.

There is however an objection against the derivation of the species from *D. stratiemanuelis*, namely the latter is too specialized to be the ancestor of another species, that is overspecialized in other direction.

Within the species 2 stages of evolution (subspecies) can be distinguished by the following biometric limits:

Discocyclina spliti spliti (text-fig. 26y)	$\bar{D} < 1200$ μm
Discocyclina spliti ajkaensis (text-fig. 26z)	$\bar{D} > 1200$ μm

Similarly, the development is observable in the definitely increasing values of $\bar{P}$, $\bar{D}$, $\bar{H}$, in the somewhat decreasing value of $\bar{n}_{0.5}$ and in the strengthening "pratti" character of the adauxiliary chambers.

We have no knowledge of the descendants of this rather rare species. Presumably it became extinct without offspring at the beginning of the Bartonian.

Retrospection: The taxon was described by BUTTERLIN et CHOROWICZ (1971) as a subspecies of *Discocyclina archiaci*. The embryon was considered by them to be of the "eudiscodine" type, their figures however are totally contradicting, showing centrilepidine embryon. It turns out from their description and figures (Pl. 1, figs. 2, 10, 11) that the growth pattern of the annuli is of the "spliti" type. Accordingly, there is good reason to segregate the taxon as a separate species.

For identifying the forms with the internal morphology described above, the name "papyracea" given by KECSKEMÉTI (1959) cannot be used (see the reasons later).

Variability: Within the two known populations both the exterior and the interior show very little variability. Moreover, they differ from each other morely in the quantitative features of the inner morphological elements of the test.

Range: The Lutetian and the lower part of the Bartonian.

Yugoslavia (Split area) and Hungary (Ajka area).

Discocyclina spliti spliti BUTTERLIN et CHOROWICZ, 1971

Text-fig. 26y

1971. *Discocyclina archiaci* (SCHLUMBERGER) *spliti* n. ssp. — BUTTERLIN et CHOROWICZ, pp. 267—271, pl. 1, figs. 1—11

Holotype: BUTTERLIN et CHOROWICZ (1971) pl. 1, figs. 10, 11. Preparation No 105, depository: École Normale Supérieure de Saint-Cloud (France).
Type locality: Village of Konjsko near Split (Yugoslavia).
Type level: The lowermost part of the Upper Lutetian substage (according to the authors of the taxon), in our interpretation the middle part of the Lutetian.
Diagnosis: *Discocyclina spliti* populations with $\bar{D}$ less than 1200 μm.

Description:

External morphology: Large (6 to 8 mm), moderately flattened or slightly rounded forms.

Internal morphology:

The equatorial section of forms "A" (text-fig. 26y):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q = 1.68-2.16$	*t:* archiaci—pratti	*g.p.:* spliti
$E = 0.00-0.16$	$\bar{Q} = 1.70-2.10$	$N = 45-75$	$l = 35-45$ μm
$\bar{E} = 0.00$	$P = 300-500$ μm	$\bar{N} = 50-70$	$h = 60-100$ μm
$R = 1.34-1.46$	$\bar{P} = 350-450$ μm	$L = 40-50$ μm	$n_{0.5} = 5.5-8.0$
$\bar{R} = 1.35-1.55$	$D = 700-1350$ μm	$H = 70-110$ μm	$\bar{n}_{0.5} = 6.0-7.5$
	$\bar{D} = 800-1200$ μm	$\bar{H} = 80-100$ μm	$n_{1.0} = 12.0-17.0$

Remarks: The annular walls of the equatorial chambers are thicker than the radial ones.

Retrospection: Material of this taxon was not available, so the above description was based on description and figures, given by BUTTERLIN et CHOROWICZ (1971). As a result the given values are approximate. An additional difficulty is the inadequate scales of enlargement related to the figures. Figs. 6 and 7 are the depictions of the same thin section, the scales of enlargement however are contradictory, namely, the test-elements on fig. 7 looks 1.2 times bigger than on fig. 6 and similarly, the dimensions on fig. 11 are 1.4 times bigger than on fig. 10. In spite of this it is demonstrable that in the examined population $\bar{D}$ is ranging from 850 to 1000 μm. Concerning this subdivision of the species into two subspecies became possible.

Comparison: The "spliti" type growth pattern of the annuli makes it easy to mark this taxon off from all the other forms with similar-sized centrilepidine embryon *(Discocyclina fortisi simferopolensis, D. stratiemanuelis, D. pulcra pulcra)*.

Range: Presumably the lower and middle parts of the Lutetian.

Yugoslavia (village of Konjsko near Split).

Discocyclina spliti BUTTERLIN et CHOROWICZ, 1971 **ajkaensis** n. ssp.

Pl. VIII, figs. 10—11, pl. IX, figs. 1—2, text-fig. 26z

partim 1959. *Discocyclina papyracea* (BOUBÉE) — KECSKEMÉTI, pp. 47—49, pl. 2, figs. 8, 10—13, text-figs. 11a, c, d

Derivatio nominis: Named after Ajka, town not far from the type locality of the taxon, in Hungary.
Holotype: Preparation E 4673, pl. IX, fig. 2.
Type locality: A cut of the factory road between Ajka and Pula at the parting of the ways to Lugostető, 1 km E—NE from Lugostető, sample SzT.
Type level: The lower part of the Bartonian.
Diagnosis: *Discocyclina spliti* populations with $\bar{D}$ bigger than 1200 μm.

Description:

External morphology: Large-sized (6 to 12 mm) flattened or slightly inflate forms.

Internal morphology:

The equatorial section of forms "A" (text-fig. 26z):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q = 2.03-2.50$	*t:* pratti (archiaci—pratti)	*g.p.:* spliti
$E = 0.00-0.10$	$\bar{Q} = 2.00-2.40$	$\underline{N} = 74-90$	$l = 35-45$ µm
$\bar{E} = 0.00$	$P = 530-640$ µm	$\bar{N} = 80-90$	$h = 85-120$ µm
$R = 1.44-1.78$	$\bar{P} = 500-650$ µm	$L = 45-60$ µm	$n_{0.5} = 5.4-7.0$
$\bar{R} = 1.50-1.80$	$D = 1120-1600$ µm	$\underline{H} = 90-150$ µm	$\bar{n}_{0.5} = 5.8-6.6$
	$\bar{D} = 1200-1440$ µm	$\bar{H} = 115-150$ µm	$n_{1.0} = 11.5-15.5$

R e m a r k s : The annular septa of the equatorial chambers are thicker than the radial ones.

R e t r o s p e c t i o n : KECSKEMÉTI's (1959) thin sections of "*Discocyclina papyracea*" the name of which otherwise cannot be used (see explanation later) was examined by us, and it was possible to identify it with our examined forms, coming from the surroundings of Ajka and possessing the above characteristic features.

The segregation of a new subspecies became necessary, since the quantitative features of the interior differ in their tendency from the similar parameters of BUTTERLIN et CHOROWICZ's (1971) forms from Yugoslavia.

C o m p a r i s o n : The only form with similar-sized centrilepidine embryon is *Discocyclina pulcra balatonica*. It differs from *D. spliti ajkaensis* by the higher equatorial chambers and by the different growth pattern of the annuli.

R a n g e : The lower part of the Bartonian and presumably the upper part of the Lutetian too.

Hungary — S Bakony — sample SzT from own assemblage, also considering KECSKEMÉTI's (1959) preparations: samples "Köleskepe-2" and "Csékúti-árok".

Discocyclina broennimanni n. sp.

Pl. IX, figs. 3—6, 8, text-figs. 27d—e

1973. *Discocyclina* ex. gr. *augustae* WEIJDEN — BOMBIȚĂ, pl. 2, figs. 2/15, 3/7(?)
partim 1974. *Discocyclina trabayensis* NEUMANN — PORTNAYA, pp. 100—101, pl. 23, figs. 6—10

D e r i v a t i o n o m i n i s : The species named for Paul Brönnimann of Switzerland in recognition of his contribution to the Orthophragmina-research.
H o l o t y p e : Preparation E 4677, pl. IX, fig. 4.
T y p e l o c a l i t y : Crimea, Suvlu-Kaya hill, Bakhchisaraian stage, the lower part of the *Nummulites crimensis* zone, sample B 10.
T y p e l e v e l : The middle part of the Ilerdian.
D i a g n o s i s : Small, very flat forms. The embryon is of the nephrolepidine type, transition towards the semi-isolepidine type is possible. The two chambers are very small. The adauxiliary chambers are of "archiaci" character, few, medium-wide but very low. The equatorial chambers are narrow and low, the growth pattern of the annuli is of the "trabayensis" type.

D e s c r i p t i o n :

External morphology: Small (2 to 4 mm) very much flattened forms. The umbo may either be very little and outstanding or it may be missing. Curved forms were not found. "Discocyclina" type rosette. The granules are relatively coarse (50 to 70 µm in diameter) and arranged in concentric rings. The ratio between the sizes of forms "A" and "B" is unknown because of the lack of the latter forms.

Internal morphology:

The equatorial section of forms "A" (text-figs. 27d—e):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-iso)	$Q = 1.41-2.02$	*t:* archiaci	*g.p.:* trabayensis
$E = 0.82-1.31$	$\bar{Q} = 1.60-1.90$	$\underline{N} = 7-13$	$l = 20-30$ µm
$\bar{E} = 0.85-1.20$	$P = 52-80$ µm	$\bar{N} = 8-13$	$h = 40-70$ µm
$R = 0.27-1.00$	$\bar{P} = 55-80$ µm	$L = 25-40$ µm	$n_{0.5} = 13.0-16.0$
$\bar{R} = 0.35-0.65$	$D = 81-120$ µm	$\underline{H} = 25-45$ µm	$\bar{n}_{0.5} = 13.0-15.8$
	$\bar{D} = 90-130$ µm	$\bar{H} = 27-45$ µm	$n_{1.0}$ is unknown

The equatorial section of forms "B": Microspheric specimens were found neither in the studied samples nor in the literature. The juvenarium is presumably of the Heterostegina type.

Axial section: In this section the taxon could not be studied.

P h y l o g e n e t i c p o s i t i o n (text-fig. 27): We can only guess the ancestors of this very primitive Discocyclina. Since to our present knowledge *D. broennimanni* appears later than *D. archiaci*, it looks imaginable that it derives from the latter through major mutation possibly with *D. furoni* being an intermediate form.

The insufficient material available for study does not provide a basis for the segregation of subspecies within the species but it is observable that in certain parameters ($\bar{P}$, $\bar{D}$, $\bar{N}$, $\bar{H}$) the CP population is more advanced than the CR one (see text-figs. 27d and e respectively).

In our opinion this very primitive species can be regarded as the ancestor of two more advanced species, namely, *Discocyclina augustae* and *D. trabayensis*, appearing in higher stratigraphic levels.

R e t r o s p e c t i o n : Names like "augustae" and "trabayensis" used earlier for marking this species refer to forms with similar but still somewhat different internal morphology, therefore the introduction of the new name is justified.

V a r i a b i l i t y : Within the two examined populations the characteristic features are relatively stable. Differences between these populations are those given in "Phylogenetic position".

C o m p a r i s o n : This species may be confused with forms with similarly small embryon and with few adauxiliary chambers.

Among these forms the equatorial chambers of *Nemkovella fermonti*, *N. strophiolata bodrakensis*, *Orbitoclypeus ramaraoi ramaraoi* and *O. pygmaea* are with 4 stolons, so they give the semblance of hexagonal shape.

The embryon's excentricity in the case of *Discocyclina augustae sourbetensis* in somewhat bigger, the embryon is semi-isolepidine.

The embryon of *D. dispansa ganensis* is bigger, it has more adauxiliary chambers and the growth pattern of the annuli is of the "archiaci" type.

The adauxiliary chambers of *D. trabayensis trabayensis* are of the "varians" type, and the excentricity of the embryon is somewhat bigger.

The segregation from the latter three taxa is rather difficult. It is not surprising however considering the phylogenetic position. For this very reason the accompanying fauna may help a lot in the identification.

R a n g e : The middle and upper parts of the Ilerdian.

Crimea — Suvlu-Kaya Hill — Bakhchisaraian stage, the lowermost part of the *Nummulites crimensis* zone (sample B 10), transitional part of the *N. crimensis* and the *Assilina placentula* zones (sample B 19), Rumania — E Carpathes (Ruisseau Manoli and possibly Slănic valley as well).

Discocyclina augustae Weijden, 1940

D i a g n o s i s : Small- and medium-sized, mostly flattened forms. Nephrolepidine type embryon with possible transition towards the semi-isolepidine and semi-nephrolepidine types. Both chambers are small. The adauxiliary chambers are mostly of the "archiaci" type, narrow, low and can be found in low or medium numbers. The equatorial chambers are also narrow and relatively low, the growth pattern of the annuli closely resembles the "strophiolata" type.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (2 to 8 mm), generally flattened forms but inflate forms may also occur. Saddle forms are common. The umbo is very variable in size and character, it may also be missing. The rosette is of the "Discocyclina" type, the granules are fine, often hardly distinctable (30 to 50 μm in diameter). Major differences in size between forms "A" and "B" can be observed only in the case of more advanced subspecies.

Internal morphology:

The equatorial section of forms "B": On the basis of our own preparations and Samanta's figures (1965b, pl. 2, fig. 7, pl. 3, fig. 13, pl. 4, figs. 11, 12) the juvenarium is of the Heterostegina type. The low values of "d" and "n" are remarkable in comparison for example to *Discocyclina archiaci*. I=10—20 μm, S=5—6, s=35—40 μm, n=5—8, d=95—145 μm, J=8—16, j=500—800 μm. Concerning the theory of the nepionic acceleration (Gorsel, 1975) *D. augustae* would be more advanced than *D. archiaci*.

Axial section: Not having own preparation we relied on Samanta's (1963b, pl. 95, fig. 4 and 1965b, pl. 2, fig. 5, pl. 3, figs. 11, 12, pl. 4, figs. 3, 5) and Sirotti's (1978, pl. 1, fig. 5) figures and data. Accordingly, the height of the embryon varies from 100 to 140 μm. The equatorial layer grows thick towards the edges, being 45 to 55 μm at centre and 60 to 70 μm on the peripheries. The lateral wall is relatively thin, the annular one is arcuate. The average dimensions of the lateral chambers are: 100—125×30—40 μm.

P h y l o g e n e t i c   p o s i t i o n (text-fig. 27): *Discocyclina broennimanni* can be regarded as the ancestor of *D. augustae* from which it developed gradually as shown by the transitions of the corresponding morphological features.

On the basis of the available material 4 evolutional stages of development (subspecies) can be distinguished within the species using the following conventional biometric limits:

Discocyclina augustae sourbetensis (text-fig. 27f)	$\bar{D} < 125$ μm
Discocyclina augustae atlantica (text-fig. 27g)	$\bar{D} = 125-160$ μm
Discocyclina augustae olianae (text-fig. 27h)	$\bar{D} = 160-200$ μm
Discocyclina augustae augustae (text-fig. 27i)	$\bar{D} > 200$ μm

Similar distinct progress is observable in the increase of $\bar{P}$ and $\bar{N}$. In the increasing values of $\bar{R}$, $\bar{Q}$ and $\bar{H}$ and decreasing values of $\bar{E}$, $\bar{n}_{0.5}$ the progress is less definite.

Till now we have no knowledge of lineal descendants of the species. Collaterally, *Discocyclina knessae* and *D. dispansa* may be regarded as descendants. In fact, the first one is a ribbed variety of *D. augustae*. Concerning the stratigraphic level of the occurrence and the test dimensions the derivation from *D. augustae atlantica* is the most likely.

D. dispansa was already differentiated at an early stage of the evolution of *D. augustae* and from then on the two species developed side by side, since their subspecies possessing similar-sized embryon are very much alike. The somewhat higher excentricity of *D. augustae*'s embryon is not always sufficient as a distinctive mark. The assumption that we have to deal with two distinct species with their own evolutional history is supported by the following evidence:

In more than one sample (Crimea — the upper part of the *Nummulites distans* zone, Saint-Barthélémy, Neszmély, Nousse, Ajka, Siest, Mossano, Lábatlan) populations of both species occur. In all of these samples it is the just occurring subspecies of *D. dispansa* that shows the higher stage of evolution with respect to the quantitative internal parameters. Following the same train of thoughts between *D. augustae* and *D. dispansa* populations seemingly representing the same stage of evolution, the latter always appears earlier, in lower stratigraphic levels, whereas the corresponding *D. augustae* appears only after the extinction of *D. dispansa*. So here a nice example for evolutional convergency is displayed: The slowly developing *D. augustae* is following the consecutive evolutional stages of the quicker developing *D. dispansa*. Therefore in the distinction the composition of the accompanying fauna is the most important distinctive mark.

R e t r o s p e c t i o n : In a certain respect the describer of the species, WEIJDEN (1940) made a mistake when he failed to identify his well-illustrated "augustae" from Biarritz with GÜMBEL's (1868) and PREVER's (1912) "applanata". Actually these forms are identical as SIROTTI (1978) pointed out.

This name, however, became so current in the literature that supplanting "augustae" by "applanata", practically not used in 66 years, is not expedient any more (see later too).

For marking the other forms with the above characters among the current denominations of the literature the later introduced name "olianae" (ALMELA et RIOS, 1942) can be used on the subspecies level. The rest of the names cannot be used, either because they refer to forms with different features or in the cases of "applanata", "eamesi", and "nummulitica" they cannot be used anyhow (see later too).

V a r i a b i l i t y : The exterior of this very widespread species is extraordinarily varied: the many different names of this species was not given for nothing.

As far as the interior is concerned over and above the typical "archiaci", rarely transitional "archiaci—varians" (pl. IX, fig. 11), moreover "varians—pratti" type adauxiliary chambers (pl. X, fig. 7) may also occur. This form could only be defined as "aff.".

Both the height of the adauxiliary chambers (H) and the growth pattern of the annuli may also be most variable.

R a n g e : From the lower part of the Cuisian to the uppermost part of the Priabonian.

Discocyclina augustae WEIJDEN, 1940 **sourbetensis** n. ssp.

Pl. IX, figs. 7, 9—12, pl. X. fig. 1, pl. XVII, fig. 4, text-fig. 27f

partim 1958. *Discocyclina trabayensis* NEUMANN — NEUMANN, pp. 111—112, pl. 24, fig. 3

D e r i v a t i o   n o m i n i s : Named after the type locality of the taxon.
H o l o t y p e : Preparation E 4681, pl. IX, fig. 11.
T y p e   l o c a l i t y : Horsarrieu (SW Aquitaine) — Marniére Sourbet, sample HX.
T y p e   l e v e l : The middle part of the Cuisian stage.
D i a g n o s i s : *Discocyclina augustae* populations with $\bar{D}$ less than 125 μm.

Description:

External morphology: Small (2 to 4 mm), mostly flattened forms. There is no significant difference in diameter between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27f):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro—semi-iso	$Q=1.21-1.81$	*t:* archiaci (perhaps archiaci—varians)	*g.p.:* trabayensis—strophiolata
$E=0.60-1.44$	$\bar{Q}=1.35-1.70$	$N=7-13$	$l=25-30$ μm
$\bar{E}=0.90-1.20$	$P=55-100$ μm	$\bar{N}=7.0-11.5$	$h=35-80$ μm
$R=0.25-0.81$	$\bar{P}=60-90$ μm	$L=30-35$ μm	$n_{0.5}=12.0-20.0$
$\bar{R}=0.35-0.60$	$D=83-141$ μm	$H=25-50$ μm	$\bar{n}_{0.5}=12.0-18.0$
	$\bar{D}=90-125$ μm	$\bar{H}=25-40$ μm	$n_{1.0}=21.0-28.0$

Retrospection: NEUMANN (1958), when dealing with the species *Discocyclina trabayensis* also figured forms bearing the features described above. The width of the equatorial chambers being correct, this form was put into the synonymic list accepting the original scale of enlargement. No doubt, the two forms are close to each other, since they derive from the same ancestor *(D. broennimanni)*. The separation of the two forms, however, is justified even at this place, on the basis of the different course of evolution on the one hand and the examination of both species' specimens coming from the same type locality (layers with Xanthopsis in Horsarrieu) on the other.

Comparison: Among the unribbed forms that have similar-sized and similar type embryon, the equatorial chambers of *Nemkovella strophiolata bodrakensis*, *N. fermonti*, *Orbitoclypeus ramaraoi ramaraoi* and *O. pygmaea* are with four stolons, they give the semblance of hexagonal shape.

The embryon of *D. broennimanni* is less excentric, the growth pattern of the annuli is clearly of the "trabayensis" type and due to the different stratigraphic level the accompanying fauna is different as well.

The embryon of *D. dispansa ganensis* is of the nephrolepidine type and it has more adauxiliary chambers.

The adauxiliary chambers of *D. trabayensis trabayensis* and *D. trabayensis concentrica* are of the "varians" type.

Range: The Cuisian and the lower part of the Lutetian.

SW Aquitaine (Horsarrieu — samples HX, HS, HN and Saint-Barthélémy), Crimea — Simferopolian stage (the upper part of the *Nummulites distans minor* zone — samples U 7, E 9, B 50; and the *N. distans* zone — samples B 53, 77, 82) and the lower part of the Bodrakian stage (sample A 23).

Discocyclina augustae WEIJDEN, 1940 atlantica n. ssp.

Pl. X, figs. 2—4, text-fig. 27g

?1929. *Orthophragmina (Discocyclina) dispansa* (SOWERBY) — VLERK, pp. 21—22, figs. 15, 38a—c
?1965b. *Discocyclina augustae* WEIJDEN — SAMANTA, pp. 421—422, pl. 3, figs. 7—13, pl. 4, fig. 12

Derivatio nominis: Named after the Atlantic ocean the type locality of the taxon being close to it.
Holotype: Preparation E 4688, pl. X, fig. 3.
Type locality: Nousse (SW Aquitaine) — Crouts.
Type level: The middle part of the Lutetian.
Diagnosis: *Discocyclina augustae* populations with $\bar{D}$ ranging from 125 to 160 μm.

Description:

External morphology: Small-sized (2 to 5 mm), mostly flattened forms. The ratio between the dimensions of forms "A" and "B" is not too high (varying from $\times 1$ to $\times 1.5$).

Internal morphology:

The equatorial section of forms "A" (text-fig. 27g):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-nephro)	$Q=1.45-2.29$	*t:* archiaci	*g.p.:* strophiolata (trabayensis)
$E=0.64-1.21$	$\bar{Q}=1.60-1.80$	$N=10-18$	$l=25-30$ μm
$\bar{E}=0.75-1.05$	$P=70-107$ μm	$\bar{N}=11.0-15.5$	$h=40-85$ μm
$R=0.33-0.78$	$\bar{P}=75-95$ μm	$L=25-45$ μm	$n_{0.5}=10.8-18.2$
$\bar{R}=0.45-0.70$	$D=115-169$ μm	$H=25-50$ μm	$\bar{n}_{0.5}=12.5-16.5$
	$\bar{D}=125-160$ μm	$\bar{H}=30-40$ μm	$n_{1.0}=22.8-27.0$

R e t r o s p e c t i o n : The two forms were only conditionally included into the synonymic list, since not populations were studied, moreover their locality is rather far from Europe and their given stratigraphic level do not coincide with our assumption.

C o m p a r i s o n : Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Nemkovella fermonti*, *N. strophiolata strophiolata* and *Orbitoclypeus ramaraoi ramaraoi* are with four stolons, shape slightly hexagonal.

The adauxiliary chambers of *Discocyclina trabayensis vicenzensis* are of the "varians" type.

It is very difficult, however, to distinguish *D. augustae atlantica* from. *D. dispansa ganensis*, in the case of which the smaller excentricity of the embryon is of rather low distinctive value.

Because of the considerable difference between the respective stratigraphic levels the accompanying fauna is totally different.

R a n g e : The middle part of the Lutetian.

SW Aquitaine (Nousse), Hungary: W Gerecse (Neszmély), perhaps India (Assam — Garo Hills) and NE Borneo.

Discocyclina augustae WEIJDEN, 1940 olianae ALMELA et RIOS, 1942

Text-fig. 27h

partim 1922. *Discocyclina sella* (D'ARCHIAC) — DOUVILLÉ, pp. 69—70, text-fig. 24
1942. *Discocyclina olianae* n. sp. — ALMELA et RIOS, pp. 58—65, text-figs. 1—4
1958. *Discocyclina augustae* WEIJDEN var. *olianae* ALMELA et RIOS — NEUMANN, pp. 86—87, pl. 12, figs. 7—10 , text-fig. 22
partim 1958. *Discocyclina sella* (D'ARCHIAC) — NEUMANN, pp. 106—109, pl. 22, fig. 4, text-fig. 33a
partim 1974. *Discocyclina sella* (D'ARCHIAC) — PORTNAYA, pp. 75—78, pl. 8, fig. 2

H o l o t y p e : Not given by the authors of the taxon.
L e c t o t y p e : ALMELA et RIOS (1942), p. 64, text-figs. 3—4. Depository: presumably Instituto Geol. Min. (Madrid) — marked out by the present writer.
T y p e l o c a l i t y : "Cuesta bonica", to the E of Oliana (village in Lérida Provincia, NE Spain), near the cemetery, grey marl intercalation between sandstone beds.
T y p e l e v e l : Upper Eocene (Bartonian stage) by the authors (in our opinion the upper part of the Lutetian).
D i a g n o s i s : *Discocyclina augustae* populations with $\bar{D}$ ranging from 160 to 200 µm.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (3 to 6 mm) generally flattened forms. The ratio between the sizes of forms "A" and "B" cannot be given, since the latter forms were not yet found.

Internal morphology:

The equatorial section of forms "A" (text-fig. 27h):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (nephro)	$Q=1.68-2.18$	*t:* archiaci	*g.p.:* strophiolata
$E=0.55-1.20$	$\bar{Q}=1.60-1.95$	$N=12-22$	$l=25-30$ µm
$\bar{E}=0.70-1.00$	$P=70-125$ µm	$\bar{N}=15-20$	$h=50-90$ µm
$R=0.45-0.88$	$\bar{P}=90-115$ µm	$L=25-40$ µm	$n_{0.5}=10.0-17.0$
$\bar{R}=0.50-0.80$	$D=145-225$ µm	$H=30-55$ µm	$\bar{n}_{0.5}=12.0-16.0$
	$\bar{D}=160-200$ µm	$\bar{H}=35-50$ µm	$n_{1.0}=21.0-29.0$

R e t r o s p e c t i o n : Lacking own preparations the above description is based on the bibliographic data of the synonymic list.

Even RUIZ DE GAONA (1950) and NEUMANN (1958) thought that ALMELA et RIOS's (1942) *Discocyclina olianae* is in reality a variety of *D. augustae*. Evaluating the data it became clear that the main difference between these forms is not in the indention of the umbo, as it was pointed out by the above authors but in the more primitive inner morphology. Therefore the denomination, with the above definition could remain untouched.

Into the synonymic list forms with D ranging from 160 to 200 µm were placed. Since this evaluation was made relying on individuals and not on populations, the inclusion may be conditional to a certain extent. Considering NEUMANNS' (1958) data we counted with the 1.6 to 2 times the real size enlargements she used in most of the cases.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Nemkovella evae*, *Nemkovella strophiolata strophiolata* and *N. strophiolata tenella* are with four stolons, they look somewhat hexagonal.

The equatorial chambers of *Discocyclina furoni* are wider, the embryon is less excentric.

The adauxiliary chambers of *D. aaroni chalossensis* are of the "varians" type and the embryon is less excentric.

The most difficult is the segregation from *D. dispansa taurica*, the embryon of which is somewhat less excentric and it has a bit more adauxiliary chambers. Since they represent different stratigraphic levels, the accompanying faunas are different too.

R a n g e : To all probability the upper part of the Lutetian.

SW Aquitaine (St-Pierre-d'Irube — Daguerre, Bidart — Béhéréco), N Spain (Oliana — near Lérida).

Discocyclina augustae augustae Weijden, 1940

Pl. X, figs. 5—6, 8—12, pl. XI, figs. 1—4, text-fig. 27i

?1868. *Orbitoides (Discocyclina) applanata* n. sp. — Gümbel, pp. 700—701, pl. 3, figs. 17, 18, 35—37
1905. *Orthophragmina* cf. *varians* (Kaufmann) — Deprat, pp. 505—506, pl. 18, figs. 20—21
1912. *Orthophragmina applanata* (Gümbel) — Prever, pp. 139—141, pl. 1, fig. 6, pl. 3, fig. 6
partim 1940. *Discocyclina (Discocyclina) augustae* n. sp. — Weijden, pp. 23—26, pl. 1, figs. 4, 5, 7, 8, pl. 2, figs. 1, 2, 11
partim 1940. *Discocyclina (Discocyclina) varians* (Kaufmann) — Weijden, pp. 58—59, pl. 10, fig. 3
partim non 1940. *Discocyclina (Discocyclina) augustae* n. sp. — Weijden (= *Discocyclina archiaci archiaci*)
1941. *Discocyclina augustae* Weijden — Brönnimann, pp. 253—260, pl. 14, figs. 7—12, pl. 15, figs. 1—2, text-figs. 2—5
non 1941. *Discocyclina (Discocyclina) augustae* Weijden — Witt Puyt (= ?*Discocyclina trabayensis concentrica*)
1950. *Discocyclina augustae* Weijden — Ruiz de Gaona, pp. 12—17, pl. 1, figs. 1—8
partim 1953. *Discocyclina augustae* Weijden — Schweighauser, pp. 49—51, pl. 8, figs. 1 (?), 3, pl. 13, fig. 4, text-fig. 41 (partim)
partim non 1953. *Discocyclina augustae* Weijden — Schweighauser (= *Nemkovella strophiolata tenella*)
non 1955. *Discocyclina augustae* Weijden — Neumann (= *Nemkovella evae*)
non 1958. *Discocyclina augustae* Weijden — Neumann (= *Discocyclina furoni* et *Nemkovella evae*)
non 1958. *Discocyclina augustae* Weijden var. *oliane* Almela et Rios — Neumann (= *Discocyclina augustae olianae*)
1959. *Discocyclina augustae* Weijden — Kecskeméti, pp. 40—41, pl. 1, figs. 3, 5, 7, text-fig. 6
1959. *Discocyclina archiaci* (Schlumberger) — Kecskeméti, pp. 49—50, pl. 3, figs. 1, 2, 4, text-fig. 12. (?)
1959. *Discocyclina douvillei* (Schlumberger) — Kecskeméti, pp. 57—58, pl. 4, figs. 3, 6, text-fig. 18 (?)
non 1959. *Discocyclina augustae* Weijden — Belmustakov, pp. 48—49, pl. 16, figs. 5—7, pl. 17, figs. 2, 4 (?) (= ?)
non 1962. *Discocyclina augustae* Weijden — Zernetsky, pp. 61—63, pl. 14, figs. 3, 4, pl. 15, figs. 1—3 (= *Discocyclina* sp.)
1963b. *Discocyclina (Discocyclina) eamesi* n. sp. — Samanta, pp. 661—664, pl. 95, figs. 1—4
1965b. *Discocyclina eamesi* Samanta — Samanta, p. 422, pl. 4, figs. 1—5
partim 1965b. *Discocyclina sella* (d'Archiac) — Samanta, p. 426, pl. 2, figs. 1—5, 7, pl. 4, fig. 11
non 1965b. *Discocyclina augustae* Weijden — Samanta (= ?*Discocyclina augustae atlantica*)
partim 1967. *Discocyclina daguini* Neumann — Köhler, p. 77, pl. 15, fig. 3, text-fig. 6A
partim 1973. *Discocyclina augustae* Weijden — Olempska, pp. 83—84, pl. 16, fig. 4
partim 1973. *Discocyclina nummulitica* (Gümbel) — Olempska, pp. 80—81, pl. 15, fig. 3
non 1973. *Discocyclina augustae* Weijden — Brolsma (= *Discocyclina dispansa ganensis*)
non 1973. *Discocyclina* ex. gr. *augustae* Weijden — Bombiță (= *Discocyclina broennimanni*)
partim non 1974. *Discocyclina augustae* Weijden — Portnaya (= *Discocyclina archiaci bakhchisaraiensis*)
1978. *Discocyclina applanata* Gümbel — Sirotti, pp. 53—54, pl. 1, figs. 1—5
1978. *Discocyclina sella* (d'Archiac) — Sirotti, p. 59, pl. 2, figs. 3—7
non 1980. *Discocyclina augustae* Weijden — Gross, Köhler et al. (= *Discocyclina dispansa hungarica*)
1981a. *Discocyclina applanata* Gümbel — Less, pl. 1, figs. 3, 6
non 1982. *Discocyclina augustae* Weijden — Fermont [= *Nemkovella evae* et Discocyclina sp. indet. B (pl. 11, figs. 4, 5)]
1983. *Discocyclina I.* cf. *D. applanata* Gümbel — Setiawan, pl. 97, table 5 (partim), pl. 17, fig. 5
partim ?1983. Discocyclina (dispansa-group) — Setiawan, p. 89, pl. 16, fig. 5
partim ?1983. Discocyclina (papyracea-group) — Setiawan, p. 89, pl. 16, fig. 6
non 1983. *Discocyclina III.* cf. *D. augustae* Weijden — Setiawan (= *Discocyclina trabayensis vicenzensis*)

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : Weijden (1940) pl. 2, fig. 2. Depository: Rijks-Universiteit, Leiden (marked out by the author of the present work).
T y p e l o c a l i t y : Biarritz (SW Aquitaine), Côte des Basques, it cannot be decided which of the following three samples: Cosijn/334, Weijden/13 or 14.
T y p e l e v e l : On the basis of Weijden's (1940) data it cannot be decided whether the "Bartonian" stage of the Upper Eocene (samples: Cosijn/334 and Weijden/13) or the "Auversian" stage from the uppermost part of the Middle Eocene (sample: Weijden/14). (In our opinion the upper part of the Bartonian or the Priabonian.)
D i a g n o s i s : *Discocyclina augustae* populations with $\bar{D}$ exceeding 200 μm.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (4 to 8 mm) mostly flattened forms. Forms "B" are 1.5 to 2 times the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27i):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (nephro)	$Q=1.38-2.48$	*t:* archiaci	*g.p.:* strophiolata (pulcra)
$E=0.49-1.17$	$\bar{Q}=1.65-2.10$	$N=14-27$	$l=25-30$ µm
$\bar{E}=0.60-0.95$	$P=85-147$ µm	$\bar{N}=18-25$	$h=50-90$ µm
$R=0.39-1.06$	$\bar{P}=100-130$ µm	$L=25-40$ µm	$n_{0.5}=9.8-16.5$
$\bar{R}=0.55-0.85$	$D=172-277$ µm	$H=30-60$ µm	$\bar{n}_{0.5}=11.0-15.0$
	$\bar{D}=200-250$ µm	$\bar{H}=33-60$ µm	$n_{1.0}=19.0-31.0$

R e m a r k s : The annular walls of the equatorial chambers, especially near the embryon, are somewhat thicker than the radial ones.

R e t r o s p e c t i o n : WEIJDEN's (1940) "augustae" from Biarritz was placed into the synonymic list as population. The drawings between pp. 24. and 25. have also been considered. Although the scale of enlargement is not given comparing the drawings with the photos, most likely they are magnified 35 times. Thus $\bar{D}=206\pm18$ µm. It is incorrect however to use the name "augustae" as WEIJDEN (1940) did, for marking SCHLUMBERGER's (1903) "pratti"-s from Bos d'Arros. This is the reason why these forms were only partially put into the synonymic list. Similarly, KECSKEMÉTI's (1959) forms as population were put into the list, after we had examined his unpublished preparations and samples as well from the locality given by him. The other forms were included in the list as individuals, therefore in some cases the classification may be uncertain. GÜMBEL's (1868) "applanata"-s from Priabona were included after SIROTTI (1978) had re-examined them.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Nemkovella evae* and *N. strophiolata tenella* are with 4 stolons, they give the semblance of hexagonal shape.

The equatorial chambers of *Discocyclina furoni* and *D. archiaci bakhchisaraiensis* are wider, the embryon is less excentric.

The adauxiliary chambers of *D. aaroni chalossensis* and *D. aaroni aaroni* are of the "varians" type, those of *D. pratti aquitanica* are of the "pratti" type.

To distinguish it from *D. dispansa nussdorfensis* is possible considering first of all the character of the accompanying fauna.

R a n g e : The Bartonian and the Priabonian stages.

N Spain (Igualada), SW Aquitaine (Biarritz — Côte des Basques, Cauneille, Siest — BT, SO samples), N Italy (Verona — Forte San Felice, Mossano, Priabona — behind the new church and Valle Granella, Cave Defilippi — Gassino), Polish Tatras (Hruby Regiel), W Slovakia (Rajec), S Bakony (surroundings of Ajka — samples Ba 3, 6, J 6—7, Kö 2, SzT and Sz 7) are from our own sampling, samples "Köleskepe-2", "Köleskepe-3", "Csékuti Árok", and "Gyűrhegy" are from KECSKEMÉTI's (1959) sampling, E Gerecse (surroundings of Lábatlan — samples R 1 and BN), India (Assam — Garo Hills), New Caledonia.

Discocyclina knessae n. sp.

Pl. XI, figs. 5—9, text-figs. 27j—k

D e r i v a t i o n o m i n i s : Named in honour of MRS. MÁRIA JÁMBOR-KNESS Hungarian researcher of Larger Foraminifera.
H o l o t y p e : Preparation E. 4702, pl. XI, fig. 8.
T y p e l o c a l i t y : Dunaszentmiklós (Hungary, Komárom county) — "Iván halála" — sample K 5.
T y p e l e v e l : The middle part of the Lutetian.
D i a g n o s i s : Medium-sized, very flat forms with thin, fine ribs. The embryon is nephrolepidine, the two chambers are small. The adauxiliary chambers are of the "pratti" type, they can be found in medium numbers. They are narrow and low. The equatorial chambers are very narrow, compared with this they are rather high. The growth pattern of the annuli is of the transitional "strophiolata—trabayensis" type.

D e s c r i p t i o n :

External morphology: Medium-sized (4 to 8 mm) disc-like, very flat forms with a small sharp protruding umbo from which 8 to 10 fine ribs run towards the edges. "Discocyclina" type rosette. The granules are very fine, hardly distinctable (25 to 40 µm in diameter). The ratio of the sizes of forms "A" and "B" is unknown because of the lack of the latter forms.

Internal morphology:

The equatorial section of forms "A" (text-figs. 27j–k):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-nephro, semi-iso)	$Q = 1.63-2.28$	*t:* archiaci	*g.p.:* trabayensis–strophiolata
	$\bar{Q} = 1.60-2.05$	$N = 11-16$	
$E = 0.73-1.26$	$P = 57-92$ µm	$\bar{N} = 12-16$	$l = 20-25$ µm
$\bar{E} = 0.75-1.10$	$\bar{P} = 60-90$ µm	$L = 30-45$ µm	$h = 45-70$ µm
$R = 0.27-0.80$	$D = 97-173$ µm	$H = 25-50$ µm	$n_{0.5} = 11.2-16.0$
$\bar{R} = 0.40-0.70$	$\bar{D} = 115-180$ µm	$\bar{H} = 32-50$ µm	$\bar{n}_{0.5} = 12.0-15.0$
			$n_{1.0}$ is unknown

The equatorial section of forms "B": Microspheric specimens were not found in the examined populations.

Axial section: In this section the taxon could not be studied.

P h y l o g e n e t i c p o s i t i o n (text-fig. 27): *Discocyclina augustae atlantica* can be regarded as the ancestor of the species, since practically the two forms are alike near the embryon; moreover they lived in the same age. Differences can only be detected a bit further from the embryon in the shape of the equatorial chambers and in the accessory ribbing.

On the basis of the scarce material, it is not yet possible to distinguish for sure the different evolutional stages within the species. It seems to be sure, however, that – in good agreement with the statigraphic lavel – the forms from Dudar are more advanced than the forms from Dunaszentmiklós practically in all quantitative features.

There is no information about the descendants of the species. In all probability this strongly specialized form became extinct without offspring in the middle part of the Bartonian.

R e t r o s p e c t i o n : Ribbed forms with similar internal morphology were not found in the literature, that is why I segregated the taxon as a new species.

V a r i a b i l i t y : Externally, the species is not variable. One form within the population from Dunaszentmiklós (see pl. XI, fig. 6) differs slightly from the others in its more elongate equatorial chambers. It would be overhasty, however, to build a new distinct species upon this single individual. The equatorial chamber-annuli of the form shown on pl. XI, fig. 9 – one of the two examined specimens from Dudar – are not completely round, seven radial bulges are observable on them. This, though very rarely, can be observed in the case of some *Discocyclina radians* (also ribbed forms) too, therefore the taxonomic distinction is not justified if this is only a single phenomenon. If, however, this feature later turns to be characteristic to the Dudar populations, the segregation of these forms into a new distinct taxon is imaginable.

C o m p a r i s o n : Among the ribbed Discocyclinae this species has the smallest embryon. Some very early *Discocyclina radians noussensis* (in the Crimea for example) and *D. nandori* may have similarly small embryons but the equatorial chambers of these are much longer near the embryon than they were in the case of *D. knessae*. (The growth pattern of the annuli is close to the "pulcra" type.) The embryons of the ribbed Orbitoclypeus forms are much bigger and different in type.

R a n g e : From the middle part of the Lutetian to the middle part of the Bartonian.

W Gerecse (Dunaszentmiklós – samples K 5–6 and KF) and N Bakony (Dudar – samples D 6 and DS 5).

Discocyclina dispansa (SOWERBY), 1840

D i a g n o s i s : Small-, medium- or large-sized, flattened forms, but they may be inflate and curved as well. The embryon is mostly of the semi-nephrolepidine type. The size of the embryonary chambers and the number of the adauxiliary chambers are functions of the particular stage of the phylogenesis. The adauxiliary chambers are of the "archiaci" type (possibly of the "archiaci–pratti" transitional type), narrow or moderately wide, low or moderately high. The equatorial chambers are small or average in width and height. The growth pattern of the annuli may be almost of any type except for the "spliti" type, however it is not too characteristic to any of the types.

D e s c r i p t i o n :

External morphology: The diameter of the test may vary from 2 to 20 mm depending on the stage of phylogenesis. Very flat or rounded forms may also occur, curved and saddle-shaped forms are common, too. The size and character of the umbo is unconclusive. The only thing that is sure that the small, flat forms with well-defined umbo are more characteristic of the early stages of the phylogenesis, whereas at the farther stages of evolution the larger and more rounded forms with bigger but indistinct umbo are more characteristic. The rosette is of the "Discocyclina" type, the granules are medium-sized (40 to 70 µm), and generally arranged in concentric rings. At first there is hardly any difference in size between forms "A" and "B", later however the latter forms can be 2 to 3 times bigger.

Internal morphology:

The equatorial section of forms "B": On the basis of our own preparations and also according to other workers' (BRÖNNIMANN, 1945b — text-fig. 3, SCHWEIGHAUSER 1953 — text-fig. 27, NAGAPPA 1959 — pl. 10, figs. 6—7, SEN GUPTA 1963a — pl. 2, figs. 3, 6—7) data, the juvenarium is of the "Heterostegina" type, the nepionic phase is reduced. I = 10—18 μm, S = 5, s = 27—35 μm, n = 5—8, d = 100—130 μm, J = 10—15, j = 500—800 μm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: Lacking our preparations, relying upon NEUMANN's (1958 — pl. 24, fig. 8, pl. 26, fig. 5), SEN GUPTA's (1963a — pl. 1, fig. 9, pl. 2, fig. 1), HO YEN et al.'s (1976 — pl. 12, figs. 1—7), SIROTTI's (1978 — pl. 1, figs. 10—11, pl. 2, figs. 12—13) and GROSS–KÖHLER et al.'s (1980 — pl. 27, fig. 6, pl. 28, fig. 7) data, the height of the embryon is ranging from 120 to 250 μm, the equatorial layer is evenly thick or slightly grows thick towards the edges (40 to 50 μm near the embryon and 40 to 80 μm at the edges). The lateral septum is medium thick, the annular one is arcuate. The average dimensions of the lateral chambers are: 80—125×30—50 μm.

Phylogenetic position (text-fig. 27): The species can be derived from *Discocyclina augustae*, from the early phase of its development. The course of development of both species was discussed under "Phylogenetic position" of *D. augustae.*

The pace of evolution within the species is relatively rapid, that is why 7 different evolutional stages (subspecies) could be distinguished using the following conventional biometric limits:

Discocyclina dispansa ganensis (text-fig. 27l)	$\bar{D} < 160$ μm
Discocyclina dispansa taurica (text-fig. 27m)	$\bar{D} = 160-200$ μm
Discocyclina dispansa nussdorfensis (text-fig. 27n)	$\bar{D} = 200-250$ μm
Discocyclina dispansa hungarica (text-fig. 27o)	$\bar{D} = 250-320$ μm
Discocyclina dispansa sella (text-fig. 27p)	$\bar{D} = 320-400$ μm
Discocyclina dispansa dispansa (text-fig. 27q)	$\bar{D} = 400-500$ μm
Discocyclina dispansa umbilicata (text-fig. 27r)	$\bar{D} > 500$ μm

The rate of evolution in the increase of $\bar{P}$ and $\bar{N}$ is similarly high. Somewhat less rapid and not so clear-cut is the increase of $\bar{R}$, $\bar{Q}$, $\bar{H}$ and the decrease of $\bar{E}$ and $\bar{n}_{0.5}$.

Two collateral descendants of the species are known in: *Discocyclina kingae* which is internally similar to *D. dispansa*, but it is dotted — can be derived from *D. dispansa taurica* and *D. aaroni* — the characteristic features of which, too, are similar but its adauxiliary chambers are of the "varians" type — can be derived from *D. dispansa ganensis.*

Retrospection: Many subspecies of the species have long synonymic lists. This fact, too, shows that this form is rather common in the Eocene of the Tethys. The oldest of the used names: "ephippium" cannot be used (see later), whereas the next one, "dispansa" is well known with respect to the locality and the internal morphology [by SEN GUPTA's (1963a) revision] as well. Accordingly the use of this name is scarcely disputable. Three of the later used names ("sella", "umbilicata" and "hungarica") can be used on the subspecies level, some refer to forms with different internal morphology, while others ("submedia", "distefanoi", "tellinii", "omphalus", "molengraaffi", "moluccana", "rudis", "indopacifica", "sowerbyi") cannot be used at all (see explanation later).

Variability: As far as the description of the exterior is concerned the variability is considerable. This is characteristic within particular populations, too, since individuals of the same population were described by different authors under many different names. Among the internal characters $\bar{E}$, $\bar{R}$, $\bar{L}$, $\bar{H}$ and $\bar{n}_{0.5}$ values can be most variable between particular populations. Within the populations however the characteristic features are more or less stable. The growth pattern of the annuli shows a great variability. This is so, because in most of the cases they do not really resemble any of the "clear" types.

Range: The Cuisian, the Middle and Upper Eocene.

Discocyclina dispansa (SOWERBY), 1840 **ganensis** n. ssp.

Pl. XI, figs. 10—13, text-figs. 27l, 28a

?1953. *Discocyclina submedia* (D'ARCHIAC) — SCHWEIGHAUSER, pp. 65—66, pl. 11, fig. 7, text-fig. 27
partim 1958. *Discocyclina trabayensis* NEUMANN — NEUMANN, pp. 111—112, pl. 24, figs. 1, 8, text-fig. 35a
1972. *Discocyclina trabayensis* NEUMANN — NEUMANN, pl. 4, figs. 14—15
1973. *Discocyclina augustae* WEIJDEN — BROLSMA, pp. 417—418, pl. 1, figs. 5, 6, pl. 2, figs. 3, 5
partim 1974. *Discocyclina trabayensis* NEUMANN — PORTNAYA, pp. 100—101, pl. 23, fig. 1

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E. 4705, pl. XI, fig. 13.

T y p e l o c a l i t y : Gan (SW Aquitaine) — Tuilerie, sample GM.
T y p e l e v e l : The middle part of the Cuisian.
D i a g n o s i s : *Discocyclina dispansa* populations with $\bar{D}$ less than 160 μm.

D e s c r i p t i o n :

External morphology: Small (2 to 5 mm), flat forms. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-figs. 27l and 28a):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-nephro)	$Q=1.48-1.94$	*t:* archiaci	*g.p.:* trabayensis—strophiolata
$E=0.77-1.25$	$\bar{Q}=1.50-1.80$		
$\bar{E}=0.75-1.10$	$P=55-95$ μm	$N=9-18$	$l=25-30$ μm
$R=0.27-0.69$	$\bar{P}=60-90$ μm	$\bar{N}=10.0-15.0$	$h=45-50$ μm
$\bar{R}=0.40-0.70$	$D=107-164$ μm	$L=25-35$ μm	$n_{0.5}=15.0-19.0$
	$\bar{D}=115-160$ μm	$H=25-50$ μm	$\bar{n}_{0.5}=15.5=19.0$
		$\bar{H}=30-45$ μm	$n_{1.0}$ is unknown

R e t r o s p e c t i o n : BROLSMA's (1973) *Discocyclina augustae* from Gan was put into the synonymic list as population. His data correspond well with ours. SCHWEIGHAUSER's (1953) "submedia" from Bos d'Arros was conditionally put into the list owing the reduced nepionic phase of form "B". NEUMANN's (1958) and PORTNAYA's (1974) "trabayensis" from Gan were put into the list because this form does not occur there, as far as we know, but forms that are similar to the exterior described above are common there. As no any applicable name has been found I classed these forms into a new distinct taxon.

C o m p a r i s o n : Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Nemkovella fermonti* and *Orbitoclypeus ramaraoi ramaraoi* are with 4 stolons, shape slightly hexagonal.

The adauxiliary chambers of *Discocyclina trabayensis* as well as *D. aaroni chalossensis* are of the "varians" type.

It is rather difficult to distinguish the species from *D. augustae atlantica.* Though the latter's embryon is a bit less excentric the different accompanying fauna can be of the greatest distinctive value.

R a n g e : The middle and probably the lower part of the Cuisian.

SW Aquitaine (Gan — Tuilerie, samples GM and GB; also presumably Bos d'Arros).

Discocyclina dispansa (SOWERBY), 1840 **taurica** n. ssp.

Pl. XII, figs. 1—6, text-fig. 27m

D e r i v a t i o n o m i n i s : Named after the ancient denomination of the Crimea.
H o l o t y p e : Preparation E. 4709, pl. XII, fig. 1.
T y p e l o c a l i t y : Crimea, Suvlu—Kaya Hill, Simferopolian stage — the upper part of the *Nummulites distans* zone — sample B 75.
T y p e l e v e l : The lower part of the Lutetian.
D i a g n o s i s : *Discocyclina dispansa* populations with $\bar{D}$ ranging from 160 to 200 μm.

D e s c r i p t i o n :

External morphology: Small-sized (2.5 to 6 mm) flat forms. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27m):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro—nephro	$Q=1.48-2.15$	*t:* archiaci	*g. p.:* strophiolata (trabayensis, varians)
$E=0.61-1.14$	$\bar{Q}=1.75-2.05$		
$\bar{E}=0.75-1.00$	$P=74-130$ μm	$N=11-25$	$l=25-30$ μm
$R=0.38-0.88$	$\bar{P}=90-110$ μm	$\bar{N}=15-23$	$h=50-70$ μm
$\bar{R}=0.50-0.75$	$D=159-227$ μm	$L=25-40$ μm	$n_{0.5}=11.5-16.0$
	$\bar{D}=160-200$ μm	$H=30-50$ μm	$\bar{n}_{0.5}=12.5-14.5$
		$\bar{H}=32-47$ μm	$n_{1.5}=21.0-28.0$

R e t r o s p e c t i o n : Since no forms with the above characters have been found in the literature, the segregation of a new taxon became necessary.

Comparison: Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Nemkovella evae* are with 4 stolons and slightly hexagonal.

The adauxiliary chambers of *Discocyclina aaroni chalossensis* are of the "varians" type.

The equatorial chambers of *D. furoni* are wider.

The distinction of the species from *D. augustae olianae* is possible considering the bigger excentricity of the latter's embryon and the different accompanying fauna.

Range: The lower part of the Lutetian and probably the upper part of the Cuisian, too.

SW Aquitaine (Saint-Barthélémy, Caupenne), Crimea — Simferopolian stage — the upper part of the *Nummulites distans* zone (samples B 75—78, 82).

Discocyclina dispansa (Sowerby), 1840 **nussdorfensis** n. ssp.

Pl. XII, figs. 7—12, pl. XIII, fig. 1, text-fig. 27n

partim ?1958. *Discocyclina sella* (d'Archiac) — Neumann, pp. 106—109, pl. 26, fig. 5

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E. 4719, pl. XII, fig. 12.
Type locality: Nussdorf (Austria), to the NE of the village — skirts of the forest — Middle Adelholzen Beds.
Type level: The middle part of the Lutetian.
Diagnosis: *Discocyclina dispansa* populations with $\bar{D}$ ranging from 200 to 250 µm.

Description:

External morphology: Small-sized (3 to 6 mm), mostly flattened forms. The ratio of the dimension of forms "A" and "B" is unknown, since the latter forms have not yet been found.

Internal morphology:

The equatorial section of forms "A" (text-fig. 27n):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (nephro)	$Q = 1.42-2.18$	*t:* archiaci	*g.p.:* strophiolata—varians
$E = 0.46-1.09$	$\bar{Q} = 1.65-2.05$		
$\bar{E} = 0.65-0.95$	$P = 105-170$ µm	$N = 18-32$	$l = 25-30$ µm
$R = 0.44-0.96$	$\bar{P} = 115-160$ µm	$\bar{N} = 19-28$	$h = 50-90$ µm
$\bar{R} = 0.55-0.80$	$D = 200-275$ µm	$L = 25-45$ µm	$n_{0.5} = 10.5-14.7$
	$\bar{D} = 200-250$ µm	$H = 25-60$ µm	$\bar{n}_{0.5} = 11.5-14.2$
		$\bar{H} = 32-50$ µm	$n_{1.0} = 18.0-27.0$

Remarks: It may be found that in the initial cycles the annular septa of the equatorial chambers are thicker than the radial ones.

Retrospection: It is due to the locality that Neumann's (1958) axial section of *Discocyclina sella* from Gibret was conditionally put into the synonymic list.

Since forms with the above characters could not be found in the literature, it became necessary to segregate this new taxon.

Comparison: Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Discocyclina furoni* are wider, while the adauxiliary chambers of *D. aaroni chalossensis* and *D. aaroni aaroni* are of the "varians" type.

The distinction from *D. augustae augustae* is possible considering the somewhat different excentricity and the character of the accompanying fauna.

Range: The middle part of the Lutetian.

SW Aquitaine (Nousse, Gibret, Montfort), Austria (Nussdorf), and W Gerecse (Dunaszentmiklós — sample KF and Neszmély).

Discocyclina dispansa (Sowerby), 1840 **hungarica** Kecskeméti, 1959

Pl. XIII. figs. 2—8, 10—11, pl. XIV, figs. 1—2, text-fig. 27o

1907b. *Orbitoclypeus tellinii* n. sp. — Silvestri, p. 177, pl. 1, figs. 14, 17
?1916. *Orthophragmina di-stefanoi* Checchia-Rispoli — Checchia-Rispoli, pl. 4, figs. 3—4
1917. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli, pp. 258—260, pl. 3—4, fig. 5, pl. 9, fig. 8
1923. *Orbitoclypeus tellinii* Silvestri — Silvestri, pl. 1, fig. 14
1941. *Discocyclina (Discocyclina) sella* (d'Archiac) — Witt Puyt, p. 62, pl. 5, figs. 2—3
1959. *Discocyclina hungarica* n. sp. — Kecskeméti, pp. 51—52, pl. 3, figs. 5, 6, 8, text-fig. 14(?)
1959. *Discocyclina sella* (d'Archiac) — Kecskeméti, pp. 42—43, pl. 1, figs. 4, 6, 9 (above), text-fig. 7(?)

1959. *Discocyclina pratti* (MICHELIN) — KECSKEMÉTI, pp. 43—45, pl. 1, figs. 8, 10, 11, pl. 2, figs. 1—5, text-figs. 8(?), 9
partim 1973. *Discocyclina varians* (KAUFMANN) — OLEMPSKA, p. 80, pl. 14, fig. 5
1976. *Discocyclina sowerbyi* NUTTALL — HO YEN et al., p. 67, pl. 12, figs. 1—7(?), 8, 9(?)
1980. *Discocyclina augustae* WEIJDEN — GROSS, KÖHLER et al., pp. 181—182, pl. 27, figs. 6(?), 7, text-fig. 37F(?)
1981a. *Discocyclina dispansa* (SOWERBY) — LESS, pl. 1, fig. 4
1982. *Orbitoclypeus marthae* (SCHLUMBERGER) — LAGHI et SIROTTI, p. 3, text-fig. 3

Holotype: KECSKEMÉTI (1959), pl. 3, fig. 6, preparation M 58/290, depository: Természettudományi Múzeum Őslénytár (Budapest) — external form.
Type locality: Padrag (surroundings of Ajka), Csékuti árok, sample "Csékút".
Type level: Upper Lutetian substage (in our opinion the lower part of the Bartonian stage).
The type of the equatorial section of forms "A": KECSKEMÉTI (1959) pl. 3, fig. 5, preparation 61732, sample "Köleskepe-3", depository and stratigraphic position are the same as those of the holotype.
Diagnosis: *Discocyclina dispansa* populations with $\bar{D}$ ranging from 250 to 320 μm.

Description:

External morphology: Small- and medium-sized (4 to 10 mm), mostly moderately flattened forms. Forms "B" are 1.5 to 2 times the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27o):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (nephro)	$Q=1.24-2.52$	*t*: archiaci	*g.p.*: strophiolata (varians)
$E=0.48-1.36$	$\bar{Q}=1.70-2.05$		
$\bar{E}=0.60-0.95$	$P=102-229$ μm	$N=21-36$	$l=25-30$ μm
$R=0.33-1.00$	$\bar{P}=140-200$ μm	$\bar{N}=25-32$	$h=45-80$ μm
$\bar{R}=0.55-0.90$	$D=225-382$ μm	$L=25-40$ μm	$n_{0.5}=10.8-16.0$
	$\bar{D}=250-320$ μm	$H=40-70$ μm	$\bar{n}_{0.5}=12.0-14.5$
		$\bar{H}=50-65$ μm	$n_{1.0}=21.0-31.0$

Remarks: Near the embryon the annular walls of the equatorial chambers are thicker than the radial ones.

Retrospection: Forms with *D* ranging from 250 to 320 μm were put into the synonymic list. The inclusion is uncertain to some extent, since the question is about individuals and not populations.

The name "tellinii" has not been used identifiably since 1923 (see later too), therefore we used here the newer "hungarica" name. KECSKEMÉTI (1959), the denominator, has segregated the form on the basis of the exterior (edges tapering off rapidly). In this case, however, this mark is of pathological origin, it has no distinctive taxonomic value and it is not too characteristic of the forms with the internal morphology depicted by him. In addition, he marked these forms using other names as well.

Comparison: Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Discocyclina archiaci bakhchisaraiensis, D. archiaci staroseliensis* and *D. furoni* are wider.

The adauxiliary chambers of *D. aaroni aaroni* are of the "varians", while those of *D. pratti aquitanica* are of the "pratti" type.

Range: The upper part of the Lutetian and the lower and middle parts of the Bartonian.
SW Aquitaine (Angoumé), Italy (Madonie, Roseto Valfortore, Vasciano presso Todi), Dalmatia (Ljubuški), Polish Tatras (Hruby Regiel), S and N Bakony [surroundings of Ajka — samples Ba 6, Sz 7, J 8 and SzT are from our own collection, samples "Köleskepe-2", "Köleskepe-3" and "Gyűrhegy" are from KECSKEMÉTI's (1959) collection; surroundings of Dudar — samples DS 1—5 and D 1], Liptov Basin (Partizánska Lupča), Himalaya (Mount Everest).

Discocyclina dispansa (SOWERBY), 1840 **sella** (D'ARCHIAC), 1850

Text-fig. 27p

1850. *Orbitolites sella* n. sp. — D'ARCHIAC, p. 405, pl. 8, figs. 16, 16a
1903. *Orthophragmina sella* (D'ARCHIAC) — SCHLUMBERGER, pp. 278—279, pl. 9, figs. 14—16, 25
non 1905. *Orthophragmina* cf. *sella* (D'ARCHIAC) — DEPRAT (=*Discocyclina dispansa umbilicata*)
1908. *Orthophragmina sella* (D'ARCHIAC) — PROVALE, p. 74, pl. 5, fig. 13
1908. *Orthophragmina archiaci* SCHLUMBERGER — PROVALE, pp. 74—75, pl. 6, fig. 2
1908. *Orthophragmina scalaris* SCHLUMBERGER — PROVALE, pp. 75—76, pl. 5, figs. 14—15, pl. 6, fig. 1
partim 1912. *Orthophragmina ephippium* (SCHLOTHEIM) — PREVER, pp. 135—139, pl. 1, fig. 3, pl. 3, fig. 4
1912. *Orthophragmina scalaris* SCHLUMBERGER — PREVER, pp. 141—143, pl. 1, fig. 4
partim 1922. *Discocyclina sella* (D'ARCHIAC) — DOUVILLÉ, pp. 69—70, pl. 4, fig. 6
partim non 1922. *Discocyclina sella* (D'ARCHIAC) — DOUVILLÉ (=*Discocyclina augustae olianae*)

non 1925. *Orthophragmina sella* (D'ARCHIAC) — CHECCHIA-RISPOLI *(= ?Orbitoclypeus schopeni)*
1940. *Discocyclina (Trybliodiscodina) sella* (D'ARCHIAC) — WEIJDEN, pp. 48—50, pl. 7, figs. 3—5
non 1941. *Discocyclina (Discocyclina) sella* (D'ARCHIAC) — WITT PUYT *(= Discocyclina dispansa hungarica)*
non 1953. *Discocyclina sella* (D'ARCHIAC) — SCHWEIGHAUSER *(= Discocyclina dispansa dispansa* et *D. pratti pratti)*
non 1958. *Discocyclina sella* (D'ARCHIAC) — NEUMANN *(= Discocyclina augustae olianae, D. aaroni aaroni* et *?Discocyclina dispansa nussdorfensis)*
non 1959. *Discocyclina sella* (D'ARCHIAC) — KECSKEMÉTI *(= Discocyclina dispansa hungarica)*
partim 1963. *Discocyclina pratti* (MICHELIN) — BIEDA, pp. 129—131, pl. 22, fig. 4, text-fig. 10
partim 1965b. *Discocyclina omphalus* (FRITSCH) — SAMANTA, p. 424, pl. 2, fig. 9
partim non 1965b. *Discocyclina sella* (D'ARCHIAC) — SAMANTA *(= Discocyclina augustae augustae)*
partim ?1967. *Discocyclina archiaci* (SCHLUMBERGER) — KÖHLER, pp. 69—70, text-fig. 6C
partim 1974. *Discocyclina sella* (D'ARCHIAC) — PORTNAYA, pp. 75—78, pl. 8, fig. 1
partim non 1974. *Discocyclina sella* (D'ARCHIAC) — PORTNAYA *(= Discocyclina furoni, D. archiaci archiaci* et *D. augustae olianae)*
non 1978. *Discocyclina sella* (D'ARCHIAC) — SIROTTI *(= Discocyclina augustae augustae)*
1980. *Discocyclina sella* (D'ARCHIAC) — GROSS, KÖHLER et al., pp. 183—184, pl. 28, fig. 7, text-fig. 37D
non 1983. *Discocyclina II.* cf. *D. sella* (D'ARCHIAC) — SETIAWAN *(= Discocyclina dispansa umbilicata* et *?D. pratti minor)*

Holotype: Not given by the author of the taxon.
Lectotype: D'ARCHIAC (1850) pl. 8, fig. 16, depository: presumably École des Mines (Paris) — external form (marked out by us).
Type locality: Biarritz (SW Aquitaine) — presumably Villa Marbella or the southern part of the Côte des Basques that is closer to the first locality.
Type level: Not specified (in our opinion the middle—upper part of the Bartonian).
The type of the equatorial section of forms "A": Weijden (1940) pl. 7, fig. 5, Biarritz, Villa Marbella or the southern part of the Côte des Basques, situated close to the first locality, depository: Rijks-Universiteit Leiden (Holland).
Diagnosis: *Discocyclina dispansa* populations with $\bar{D}$ ranging from 320 to 400 μm.

Description:

External morphology: Medium-sized (5 to 12 mm), mostly flattened forms. The ratio of the dimensions of forms "A" and "B" is unknown for the time being.

Internal morphology:

The equatorial section of forms "A" (text-fig. 27p):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (tryblio, nephro)	$Q = 1.91-2.62$ $\bar{Q} = 1.85-2.40$	*t:* archiaci	*g.p.:* strophiolata—varians (archiaci)
$E = 0.50-0.90$	$P = 115-240$ μm	$N = 25-42$	$l = 25-30$ μm
$\bar{E} = 0.55-0.85$	$\bar{P} = 145-215$ μm	$\bar{N} = 30-38$	$h = 50-80$ μm
$R = 0.57-0.89$	$D = 300-450$ μm	$L = 35-40$ μm	$n_{0.5} = 9.5-14.5$
$\bar{R} = 0.65-0.95$	$\bar{D} = 320-400$ μm	$H = 45-75$ μm	$\bar{n}_{0.5} = 10.0-13.5$
		$\bar{H} = 50-70$ μm	$n_{1.0} = 18.0-25.0$

Remarks: Especially near the embryon the annular walls of the equatorial chambers are thicker than the radial ones.

Retrospection: Lacking own preparations the above description was based on bibliographic data.

The describer D'ARCHIAC (1850), characterized the species by its saddle form. Later, several saddle-shaped forms belonging to different taxa were described going by this name. SCHLUMBERGER (1903) was the first to depict the inner morphology, though not from the type locality of the taxon but from Préchacq. In spite of this, luckily enough, this form is identical with WEIJDEN's (1940) "sella" coming from the type locality. Also a depiction is given of the nice equatorial section. Due to this conformity DOUVILLÉ's (1922) and PORTNAYA's (1974) "sella" from Préchacq were also placed into the synonymic list in spite of the fact that only their external depiction is available.

The other specimens in the list were included if D was between 320 and 400 μm, although conditionally, since individuals and not populations were examined.

Comparison: Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Discocyclina archiaci staroseliensis* and *D. archiaci archiaci* are wider, while the adauxiliary chambers of *D. pratti montfortensis* are of the "pratti" type, the equatorial chambers are more elongate.

Range: The middle and upper parts of the Bartonian, not passing into the Priabonian.

SW Aquitaine (Biarritz — Côte des Basques, Villa Marbella; Préchacq), Polish Tatras (Hruby Regiel, Potók Chłabówka), W Slovakia (surroundings of Rajec and Martin), Liptov Basin (Partizánska Lupča), India (Assam — Garo Hills), central part of Borneo (Oegioe Alan).

Discocyclina dispansa dispansa (Sowerby), 1840

Pl. XIII, figs. 9, 12, pl. XIV, figs. 3, 6, text-fig. 27g

1840. *Lycophris dispansus* n. sp. — Sowerby, p. 327, pl. 24, figs. 16, 16a—b
partim ?1861. *Orbitoides dispansa* (Sowerby) — Carter, pp. 446—450, pl. 16, fig. 1b
partim non 1861. *Orbitoides dispansa* (Sowerby) — Carter, pp. 446—450, pl. 16, fig. 1a (= ?)
non 1892. *Orbitoides dispansa* (Sowerby) — Verbeek (= *Discocyclina javana)*
non 1896. *Orbitoides dispansa* (Sowerby) — Verbeek et Fennema (= *Discocyclina javana)*
non 1903. *Orthophragmina dispansa* (Sowerby) — Schlumberger (= *Discocyclina javana)*
non 1909a. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli (= *Orbitoclypeus varians roberti* et *?O. schopeni)*
non 1909b. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli (= *Orbitoclypeus varians varians)*
non 1911a. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli (= *Orbitoclypeus varians angoumensis* et *O. varians varians)*
partim non 1912. *Orthophragmina dispansa* (Sowerby) — Prever (= *Orbitoclypeus varians varians)*
1913. *Orthophragmina scalaris* Schlumberger — Checchia-Rispoli, p. 118, pl. 6 (2), figs. 10—11
1913. *Orthophragmina umbelicata* Deprat — Checchia-Rispoli, p. 118, pl. 6 (2), figs. 12—14
non 1916. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli (= *Orbitoclypeus varians varians)*
non 1917. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli (= *Discocyclina dispansa hungarica)*
1926. *Discocyclina dispansa* (Sowerby) — Nuttall, pp. 145—147, pl. 7, figs. 1—3, 5
non 1929. *Orthophragmina (Discocyclina) dispansa* (Sowerby) — Vlerk (= *?Discocyclina augustae atlantica)*
partim 1953. *Discocyclina sella* (d'Archiac) — Schweighauser, pp. 66—67, pl. 11, fig. 10, text-fig. 49
non 1957. *Discocyclina (Discocyclina) dispansa* (Sowerby) — Hanzawa (= *Discocyclina dispansa umbilicata)*
partim 1958. *Discocyclina discus* (Rütimeyer) — Neumann, pp. 90—92, pl. 14, fig. 8
1959. *Discocyclina dispansa* (Sowerby) — Nagappa, pl. 10, figs. 6, 7, 8
1963a. *Discocyclina (Discocyclina) dispansa* (Sowerby) — Sen Gupta, pp. 39—41, table 1—4, pl. 1, figs. 1—9, pl. 2, figs. 1, 3—9
non 1965b. *Discocyclina dispansa* (Sowerby) — Samanta (= *Discocyclina dispansa umbilicata)*
1973. *Discocyclina pratti* (Michelin) — Olempska, pp. 85—86, pl. 17, fig. 3
1977. *Discocyclina* cf. *discus* (Rütimeyer) — Cockbain, p. 69, pl. 37, figs. B—E
partim 1980. *Discocyclina pratti* (Michelin) — Gross, Köhler et al., p. 183, pl. 28, fig. 5
non 1981a. *Discocyclina dispansa* (Sowerby) — Less (= *Discocyclina dispansa hungarica)*
non 1983. Discocyclina (dispansa-group) — Setiawan (= *?Discocyclina augustae augustae* et *?D. trabayensis vicenzensis)*

Holotype: Not given by the author of the taxon. Nuttall (1926) could not find Sowerby's material at the presumed depository (British Museum — Natural History — London).
Neotype: Nuttall (1926) pl. 7, fig. 1, depository: Sedgwick Museum (London) — external form.
Type locality: 1 mile to S of Waghapadar (NW Cutch, Western India), the lower part of the middle Khirthar series.
Type level: Middle Eocene, without closer specification (presumeably the uppermost part).
The type of the equatorial section of forms "A": Sen Gupta (1963a) pl. 1, figs. 1—2, Babia Hill (15 miles ot the N of Waghapadar — NW Cutch — W India), Khirthar series — Middle—Upper Eocene. Depository: Indian Institute of Technology (Kharagpur, India) or Cornell University, Ithaca (N. Y. — USA).
Diagnosis: *Discocyclina dispansa* populations with $\bar{D}$ ranging from 400 to 500 µm.

Description:

External morphology: Medium- and large-sized (5 to 15 mm) flattened or inflate forms. Forms "B" are 2 to 3 times the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27q):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (semi-nephro)	$Q=1.60-3.38$	*t:* archiaci (rarely archiaci—pratti)	*g.p.:* strophiolata—varians (varians, pulcra)
$E=0.47-0.76$	$\bar{Q}=2.00-2.60$		
$\bar{E}=0.55-0.70$	$P=130-250$ µm		
$R=0.68-1.09$	$\bar{P}=150-230$ µm	$N=30-48$	$l=25-35$ µm
$\bar{R}=0.80-1.05$	$D=380-540$ µm	$\bar{N}=33-48$	$h=50-80$ µm
	$\bar{D}=400-500$ µm	$L=30-45$ µm	$n_{0.5}=8.0-13.5$
		$H=50-80$ µm	$\bar{n}_{0.5}=8.0-12.0$
		$\bar{H}=50-75$ µm	$n_{1.0}=16.0-22.0$

Remarks: Especially near the embryon the annular walls of the equatorial chambers are thicker than the radial ones.

Retrospection: The internal morphology of Sowerby's (1840), Carter's (1861), Nuttall's (1926) and Nagappa's (1959) "dispansa" and the fact that $\bar{D}$ is ranging from 400 to 500 µm at the type locality was made clear by Sen Gupta (1963a).

Comparison: Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Discocyclina archiaci archiaci* are wider, those of *D. weijdeni* and *D. pratti pratti* are higher. The adauxiliary chambers of the latter are of the "pratti" type.

Range: The uppermost part of the Bartonian and the lower part of the Priabonian.
SW Aquitaine (Siest — samples BT and SO), French Alps (Villeneuve-Loubet?), Italy (Mossano, San Marco la Catola), Polish Tatras (Hruby Regiel), Liptov Basin (Partizánksa Lupča), India (NW Cutch — Waghapadar), NW Australia (Giralia anticline).

Discocyclina dispansa (Sowerby), 1840 **umbilicata** (Deprat), 1905

Pl. XIV, figs. 4—5, 7—8, text-fig. 27r

?1903. *Orthophragmina discus* (Rütimeyer) — Schlumberger, pp. 279—280, pl. 9, fig. 26, text-fig. D
1905. *Orthophragmina umbilicata* n. sp. — Deprat, pp. 497—501, pl. 16, figs. 2—11, text-figs. A—E
1905. *Orthophragmina* cf. *sella* (d'Archiac) — Deprat, pp. 504—505, pl. 17, figs. 15—18
partim ?1908. *Orthophragmina (Discocyclina) discus* (Rütimeyer) — Heim, pp. 256—260, pl. 8, fig. 27
non 1908. *Orthophragmina (Nodocyclina) umbilicata* Deprat — Heim, p. 271, text-fig. 25 (= *Asterocyclina* sp.)
1912. *Orthophragmina pratti* (Michelin) — Prever, pp. 122—128, pl. 1, fig. 1, pl. 3, figs. 1, 2
non 1913. *Orthophragmina umbilicata* Deprat — Checchia-Rispoli (= *Discocyclina dispansa dispansa*)
1934. *Discocyclina molengraaffi* n. sp. — Henrici, pp. 46—47, pl. 2, fig. 22, pl. 3, figs. 9, 11, pl. 4, figs. 2—3, 7
1934. *Orthocyclina moluccana* n. sp. — Henrici, p. 49, pl. 3, fig. 8, pl. 4, fig. 11
1940. *Discocyclina (Umbilicodiscodina) discus* (Rütimeyer) — Weijden, pp. 31—32, pl. 3, fig. 3
1941. *Discocyclina* aff. *varians* (Kaufmann) — Brönnimann, pp. 261—269, pl. 14, figs. 1—6, 13, pl. 15, figs. 3, 4, text-figs. 6—8
1945b. *Discocyclina* aff. *varians* (Kaufmann) — Brönnimann, pp. 586—587, pl. 22, fig. 3, text-fig. 3
non 1947. *Discocyclina umbilicata* (Deprat) — Bursch (= *?Discocyclina javana*)
1950. *Discocyclina rudis* n. sp. — Azzaroli, p. 128 (30), pl. 13, figs. 9—11, pl. 14, figs. 1—5
1957. *Discocyclina omphala* (Fritsch) — Cole, pp. 347—349, pl. 115, figs. 1—12
1957. *Discocyclina (Discocyclina) indopacifica* n. sp. — Hanzawa, pp. 82—83, pl. 12, figs. 1, 2, pl. 13, figs. 2, 5, 6
?1957. *Discocyclina (Discocyclina) dispansa* (Sowerby) — Hanzawa, pp. 83—84, pl. 13, figs. 1, 3, 4, pl. 14, figs. 2, 3, 8, 9
partim 1958. *Discocyclina discus* (Rütimeyer) — Neumann, pp. 90—92, pl. 15, fig. 1
1960. *Discocyclina (Discocyclina) omphala* (Fritsch) — Cole, pp. A-5, A-6, pl. 2, figs. 1, 2, 5—8, 11
partim 1963. *Discocyclina pratti* (Michelin) — Bieda, pp. 129—130, pl. 22, fig. 2
partim 1964. *Discocyclina (Discocyclina) omphalus* (Fritsch) — Samanta, pp. 343—345, pl. 3, fig. 2
?1965b. *Discocyclina archiaci* (Schlumberger) — Samanta, p. 421, pl. 1, figs. 1—4
1965b. *Discocyclina dispansa* (Sowerby) — Samanta, p. 422, pl. 1, figs. 9—11
1967. *Discocyclina pratti* (Michelin) — Köhler, pp. 71—72, pl. 13, fig. 1, text-fig. 6A
1978. *Discocyclina* cf. *aspera* Gümbel — Sirotti, pp. 54, 56, pl. 1, figs. 6—12
1978. *Discocyclina discus* (Rütimeyer) — Sirotti, pp. 58—59, pl. 2, figs. 8—13
partim 1983. *Discocyclina II.* cf. *D. sella* (d'Archiac) — Setiawan, pp. 97—98, table 5. (partim), pl. 17, fig. 6
partim ?1983. Discocyclina (sella-group) — Setiawan, p. 89, pl. 16, fig. 7

Holotype: Not given by the author of the taxon.
Lectotype: Deprat (1905) pl. 16, fig. 4, depository unknown (marked out by the present writer).
Type locality: Popidéry (New Caledonia).
Type level: The Upper Lutetian substage (in our opinion the Upper Eocene is more likely).
Diagnosis: *Discocyclina dispansa* populations with $\bar{D}$ exceeding 500 μm.

Description:

External morphology: Medium- and large-sized (5 to 20 mm), flattened or inflate forms. Forms "B" are 2 to 3 times the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig 27r):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (semi-nephro)	$Q = 1.42 - 2.88$	*t:* archiaci—pratti	*g.p.:* archiaci—pulcra
$E = 0.35 - 0.83$	$\bar{Q} = 2.00 - 2.70$	$N = 40 - 55$	$l = 25 - 40$ μm
$\bar{E} = 0.50 - 0.75$	$P = 200 - 320$ μm	$\bar{N} = 40 - 52$	$h = 70 - 100$ μm
$R = 0.37 - 1.20$	$\bar{P} = 210 - 300$ μm	$L = 35 - 60$ μm	$n_{0.5} = 5.5 - 11.0$
$\bar{R} = 0.75 - 1.10$	$D = 460 - 800$ μm	$H = 50 - 110$ μm	$\bar{n}_{0.5} = 6.0 - 9.5$
	$\bar{D} = 500 - 700$ μm	$\bar{H} = 55 - 90$ μm	$n_{1.0} = 12.0 - 22.0$

Remarks: The annular septa of the equatorial chambers are thicker than the radial ones especially near the embryon.

Retrospection: We used the earliest applicable name for marking the forms described above. Deprat's (1905) (the describer of the taxon) figures give clear information about the internal morphology. All individuals with *D* bigger than 500 μm were placed into the synonymic list, though the inclusion is to some extent uncertain.

C o m p a r i s o n : Among the unribbed forms with similar-sized and similar type embryon the embryon of *Discocyclina archiaci bartholomei* is less excentric, its adauxiliary chambers are always of the "archiaci" type and the equatorial chambers are somewhat wider. The accompanying fauna is totally different.

The adauxiliary chambers of *D. senegalensis* and *D. pratti pratti* are always of the "pratti" type and the equatorial chambers of the latter form are much longer.

R a n g e : The middle and the upper parts of the Priabonian.

Switzerland (Ralligstöcke), N Italy (Priabona — behind the new church and Valle Granella; Verona — Forte San Felice; Gassino — Cave Defilippi), Polish Tatras (Olczyska dolina), W Slovakia (Konská Stráň near Žilina), E Gerecse (the surroundings of Lábatlan — samples R1—2 and RA), Somalia, India (Assam — Garo Hills), Timor, New Caledonia, Saipan and Viti Levu (the Fiji Islands).

Discocyclina kingae n. sp.

Pl. XIV, figs. 9—12, text-fig. 27s

partim 1974. *Actinocyclina radians* (D'ARCHIAC) — PORTNAYA, pp. 109—110, pl. 29, figs. 5—7
1974. *Actinocyclina* sp. — PORTNAYA, p. 111, pl. 30, figs. 4, 5

D e r i v a t i o n o m i n i s : The species is named after the author's daughter, Kinga.
H o l o t y p e : Preparation E. 4740, pl. XIV, fig. 11.
T y p e l o c a l i t y : The Crimea, right bank of the river Alma, stratotype profile, the lower part of the Bodrakian stage, Sample A18.
T y p e l e v e l : The lower part of the Lutetian.
D i a g n o s i s : Medium-sized, flattened forms with punctiform bulges arranged in radial rows on the collar starting from the umbo. Nephro-, semi-nephrolepidine type embryon, medium-sized embryonary chambers. The adauxiliary chambers are of the "archiaci" type, they can be found in medium numbers. The adauxiliary as well as the equatorial chambers are medium wide and medium high. The growth pattern of the annuli is of the transitional "varians—strophiolata" type.

D e s c r i p t i o n :

External morphology: Medium-sized (4 to 8 mm), flattened forms with small, sharp umbo. Starting from the umbo puctiform bulges, arranged in 8 to 12 radial rows, can be found on the collar. They are 0.2 to 0.3 mm in diameter. The "Discocyclina" type rosette is scarcely visible, since the granules are very small (20 to 40 μm in diameter). The ratio of the dimensions of forms "A" and "B" is unknown, since the latter forms have not been found yet.

Internal morphology:

The equatorial section of forms "A" (text-fig. 27s):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro—semi-nephro	$Q = 1.48-2.11$	*t:* archiaci	*g.p.:* strophiolata—varians
$E = 0.63-1.18$	$\bar{Q} = 1.70-1.95$	$N = 15-22$	
$\bar{E} = 0.74-0.98$	$P = 102-167$ μm	$\bar{N} = 17.7-20.5$	$l = 30-40$ μm
$R = 0.36-0.86$	$\bar{P} = 112-140$ μm	$L = 30-50$ μm	$h = 50-105$ μm
$\bar{R} = 0.52-0.72$	$D = 185-271$ μm	$H = 45-75$ μm	$n_{0.5} = 9.0-12.0$
	$\bar{D} = 210-242$ μm	$\bar{H} = 50-60$ μm	$\bar{n}_{0.5} = 10.3-11.7$
			$n_{1.0} = 18.0-23.0$

R e m a r k s : Near the embryon the annular walls of the equatorial chambers are thicker than the radial ones.

The equatorial section of forms "B": Forms "B" of the taxon have not been found yet. Presumably the juvenarium is of the "Heterostegina" type.

Axial section of the species could not be studied.

P h y l o g e n e t i c p o s i t i o n (text-fig. 27): Considering the stratigraphic level and the very similar morphology, the species can be regarded as an offspring of *Discocyclina dispansa taurica.*

Data on intraspecific evolution are not available, since only one population is known.

Discocyclina radians may be the descendant of the species, since *D. kingae* is transitional between *D. dispansa* and *D. radians* with respect to both the exterior and interior features and the stratigraphic position as well. The only thing that may contradict the above statement is its very scarce occurrence.

R e t r o s p e c t i o n : This species was described and depicted by PORTNAYA (1974) under the name of *Actinocyclina radians* and *Ac.* sp. but there were given no data concerning the internal morphology. Our examinations made clear that the forms described above are significantly different, both externally and internally, from *Discocyclina radians.* Accordingly, their segregation into a new distinct species is justified.

V a r i a b i l i t y : The population studied proved to be stable in the external as well as the internal features. Relying upon PORTNAYA's (1974) data there is a certain variability in the arrangement of the little punctiform bulges on the surface.

C o m p a r i s o n : No data being available on other dotted Discocyclinae, species cannot be confused with any other species as far as the exterior is concerned. Internally, however, it is very much similar to *Discocyclina augustae augustae* and *D. dispansa nussdorfensis*.

R a n g e : The lower part of the Lutetian.

Crimea — the lower part of the Bodrakian stage (samples A18 and C22).

Discocyclina radians (D'ARCHIAC), 1850

D i a g n o s i s : Medium- and large-sized forms with 12 to 16 radial ribs. The embryon is trybliolepidine to semi-nephrolepidine. The two chambers are medium-sized. "Pratti" (perhaps transitional "pratti—archiaci") type adauxiliary chambers. They can be found in medium numbers, generally they are wide and of varying height. The outer walls of these chambers are characteristically thick. The equatorial chambers are narrow and high. "Pulcra" (possibly transitional "pulcra—varians") type growth pattern.

D e s c r i p t i o n :

External morphology: Medium- and large-sized (4 to 15 mm) always flattened forms with small, sharp umbo from which 12 to 16 radial ribs start. From the middle of the collar more ribs may start among the initial ones. The rosette is of the "Discocyclina" type, though generally indistinguishable, since the granules are very small (20 to 40 μm in diameter). The size ratio sizes of forms "A" and "B" varies from 1 to 2.5.

Internal morphology:

The equatorial section of forms "B": On the basis of our own preparations and perhaps SIROTTI's (1978 — pl. 3, fig. 6) data the juvenarium is of the "Heterostegina" type, but the nepionic phase is very strongly reduced. $I=20-23$ μm, $S=5$, $s=45-50$ μm, $n=3-4$, $d=110$ μm, $J=20$, $j=1000$ μm.

Axial section: Lacking own preparations, we relied on SCHLUMBERGER's (1904 — pl. 4, fig. 19) and NEUMANN's (1958 — pl. 34, figs. 5—7, pl. 37, fig. 4) data. The height of the embryon is 200 μm, the thickness of the equatorial chambers grows towards the edges, being 30 to 40 μm near the embryon and 50 to 60 μm on the peripheries. The lateral septa of the equatorial chambers are medium thick, the annular ones are arcuate. The average dimensions of the lateral chambers are $120-150\times40$ μm.

P h y l o g e n e t i c p o s i t i o n (text-fig. 27): The species can be regarded as a descendant of *Discocyclina kingae*, since the latter displays transitional features, externally as well as internally, between *Discocyclina dispansa* and *D. radians*. It is imaginable however, that there is a direct link between these two species.

At present on the basis of the material available 3 evolutional stages can be distinguished within the species using the following biometric limits:

Discocyclina radians noussensis (text-figs. 27t—u):	$\bar{D}<280$ μm
Discocyclina radians radians (text-fig. 27v):	$\bar{D}=280-380$ μm
Discocyclina radians labatlanensis (text-figs. 27w—x):	$\bar{D}>380$ μm.

On the basis of more abundant material the segregation of a subspecies with $\bar{D}$ less than 220 μm may be possible (in the lower part of the Lutetian — see text-fig. 27t), also another subspecies with $\bar{D}$ ranging from 360 to 450 μm may be found on the border of the Middle—Upper Eocene (see text-fig. 27w). In this case the upper range boundary of *Discocyclina radians radians* and the lower one of *D. radians labatlanensis* would certainly change.

Similarly to $\bar{D}$, there is a positive increase in $\bar{P}$, $\bar{N}$ and $\bar{H}$ parameters. The decrease in $\bar{n}_{0.5}$ and $\bar{E}$ and the increase in $\bar{R}$ and $\bar{Q}$ are not so explicit.

Discocyclina nandori another ribbed form, might possibly be derived from *D. radians radians*. Its equatorial chambers are even more elongate than those of its presumed ancestor but the embryon is much smaller, therefore the relation is imaginable only through mutation.

R e t r o s p e c t i o n : For marking the ribbed Discocyclinae "radians" is by far the most widespread name and the earliest as well. Since the internal morphology of the specimens from the type locality is known too, there is no objection to the use of this name, so much the more because on the one hand, the used names for ribbed Discocyclinae are newer, on the other hand the internal morphology of the specimens coming from the type localities are unknown in all cases (for example "tenuicostata" and "variecostata" — see later, too, and "crassicostata", "pinguis" and "praeradians").

The reasons why the earlier used names "Aktinocyclina" and "Actinocyclina" for marking the ribbed Discocyclinae have been ruled out, can be found in the systematic part.

The feature that the equatorial chambers are arranged one above the other and not in a chess-board pattern was considered by BRÖNNIMANN (1945a) to be the criterion of "Aktinocyclina". Our figures, however, show that this is not exactly the case, since in the first cycles around the embryon the chess-board pattern is observable. No doubt, however, that with their increase in length the equatorial chambers look as if they were arranged one above the other. It is so, because the annular septa gradually became stunted. This atrophy, however, can be observed in much unribbed Discocyclinae as *D. euaensis*, *D. pratti* and *D. pulcra*, too, therefore this feature cannot be used to distinguish "Aktinocyclina" as a genus.

Variability: Both externally and internally this species is not too variable. Only the number and thickness of the ribs may vary within certain limits and very rarely it may occur that the cycles are not arranged exactly in circles but slight radial humps (waves) can be observed (see pl. XV, fig. 8).

Range: Lutetian, Bartonian and Priabonian.

Discocyclina radians (D'ARCHIAC), 1850 noussensis n. ssp.

Pl. XV, figs. 1–8, 11, text-figs. 27t–u

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E. 4745, pl. XV, fig. 3.
Type locality: Nousse (SW Aquitaine) — Crouts.
Type level: The middle part of the Lutetian.
Diagnosis: *Discocyclina radians* populations with $\bar{D}$ less than 280 µm.

Description:

External morphology: Medium-sized (4 to 7 mm), flattened forms with 12 to 16 ribs. Forms "B" are 1 to 1.5 times the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-figs. 27t–u):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro	$Q=1.72-2.76$	*t:* archiaci—pratti	*g.p.:* pulcra (varians)
$E=0.48-0.87$	$\bar{Q}=1.70-2.30$	$N=15-32$	$l=25-30$ µm
$\bar{E}=0.65-0.85$	$P=102-172$ µm	$\bar{N}=15-25$	$h=55-105$ µm
$R=0.60-1.10$	$\bar{P}=100-150$ µm	$L=30-45$ µm	$n_{0.5}=7.9-11.3$
$\bar{R}=0.60-0.90$	$D=176-337$ µm	$H=55-80$ µm	$\bar{n}_{0.5}=9.0-10.5$
	$\bar{D}=175-280$ µm	$\bar{H}=55-65$ µm	$n_{1.0}=14.5-20.0$

Remarks: Near the embryon the annular walls of the equatorial chambers are much thicker than the radial ones.

Retrospection: Since forms with the above description have not been found in the literature, it was necessary to segregate a new taxon.

Comparisons: Among the ribbed forms *Discocyclina knessae* and *D. nandori* possess similar-sized and similar type embryon but the equatorial chambers of the former are shorter, whereas those of the latter are longer and narrower.

Range: The lower and middle parts of the Lutetian.

SW Aquitaine (Nousse, Gibret, Montfort), Crimea — the lower part of the Bodrakian stage (sample C23).

Discocyclina radians radians (D'ARCHIAC), 1850

Pl. XV, figs. 9, 10, 12–15, pl. XVI, figs. 1–5, text-fig. 27v

1850. *Orbitolites radians* n. sp. — D'ARCHIAC, pp. 405–406, pl. 8, figs. 15, 15a–b
partim 1904. *Orthophragmina radians* (D'ARCHIAC) — SCHLUMBERGER, pp. 122–124, pl. 4, fig. 16, text-fig. 3
partim non 1904. *Orthophragmina radians* (D'ARCHIAC) — SCHLUMBERGER (=*Discocyclina radians labatlanensis*)
non 1912. *Orthophragmina radians* (D'ARCHIAC) — PREVER (=*Discocyclina radians labatlanensis*)
partim 1922. *Actinocyclina radians* (D'ARCHIAC) — DOUVILLÉ, pp. 79–80, pl. 5, figs. 6, 7
1940. *Discocyclina (Discocyclina) radians* (D'ARCHIAC) — WEIJDEN, pp. 44–46, pl. 5, figs. 2–6
1945. *Discocyclina (Actinocyclina) radians* (D'ARCHIAC) — VAUGHAN, pp. 85–86, pl. 32, figs. 1, 1a, 2, 2a
partim non 1945a. *Aktinocyclina radians* (D'ARCHIAC) — BRÖNNIMANN (=?*Discocyclina radians labatlanensis*)
partim 1958. *Actinocyclina radians* (D'ARCHIAC) — NEUMANN, pp. 125–127, pl. 34, figs. 1–4, 5–7(?), pl. 36, fig. 3, text-fig. 43
partim non 1958. *Actinocyclina radians* (D'ARCHIAC) — NEUMANN (=*Discocyclina radians labatlanensis*)

	1959.	*Actinocyclina radians* (D'ARCHIAC) — KECSKEMÉTI, pp. 60—61, pl. 4, fig. 8, 11(?), text-fig. 20
	1959.	*Actinocyclina tenuicostata* GÜMBEL — KECSKEMÉTI, pp. 62—63, pl. 5, figs. 1, 4, text-fig. 22
partim	1959.	*Actinocyclina variecostata* GÜMBEL — KECSKEMÉTI, pp. 63—65, text-fig. 23
partim	1974.	*Actinocyclina radians* (D'ARCHIAC) — PORTNAYA, pp. 109—110, pl. 29, figs. 1—4
partim non	1974.	*Actinocyclina radians* (D'ARCHIAC) — PORTNAYA *(= Discocyclina kingae)*
non	1978.	*Actinocyclina radians* (D'ARCHIAC) — SIROTTI *(= Discocyclina radians labatlanensis* et *D. nandori)*
	1981a.	*Discocyclina radians* (D'ARCHIAC) — LESS, pl. 2, fig. 1

Holotype: Not specified by the author of the taxon.
Lectotype: D'ARCHIAC (1850) pl. 8, fig. 15. and DOUVILLÉ (1922) pl. 5, fig. 6, depository: École de Mines (Paris) — external form (marked out by us).
Type locality: Biarritz — no closer location is given (possibly Côte des Basques or Villa Marbella).
Type level: Not given (probably Bartonian).
The type of the equatorial section of forms "A": SCHLUMBERGER (1904) pl. 4, fig. 16 and NEUMANN (1958) pl. 34, figs. 3—4 (preparation 2168) SCHLUMBERGER, depository: École de Mines — Paris), Biarritz — Villa Marbella (according to NEUMANN, 1958), Upper Eocene (according to NEUMANN 1958) or Bartonian (in the present writer's opinion).
Diagnosis: *Discocyclina radians* populations with $\bar{D}$ ranging from 280 to 380 μm

Description:

External morphology: Medium- and large-sized (5 to 10 mm) flattened forms with 12 to 16 ribs. Forms "B" are 1.5 to 2 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27v):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (tryblio, nephro)	$Q = 1.53-2.56$	*t:* pratti	*g. p.:* pulcra
	$\bar{Q} = 1.85-2.15$	$N = 19-35$	$l = 20-30$ μm
$E = 0.40-1.02$	$P = 105-232$ μm	$\bar{N} = 24-32$	$h = 55-130$ μm
$\bar{E} = 0.55-0.90$	$\bar{P} = 135-185$ μm	$L = 30-55$ μm	$n_{0.5} = 6.3-12.0$
$R = 0.48-1.03$	$D = 214-371$ μm	$H = 50-100$ μm	$\bar{n}_{0.5} = 8.0-9.5$
$\bar{R} = 0.60-0.95$	$\bar{D} = 280-380$ μm	$\bar{H} = 65-85$ μm	$n_{1.0} = 10.5-16.5$

Remarks: The annular walls of the adauxiliary chambers as well as those of the equatorial chambers are very thick as compared to the radial walls.

Retrospection: No figures on the internal morphology were published by D'ARCHIAC (1850), the denominator of the species. SCHLUMBERGER's (1904) and WEIJDEN's (1940) figures show specimens with D exceeding 280 μm, whereas VAUGHAN's (1945) figure represent a form with D less than 280 μm. NEUMANN (1958) published SCHLUMBERGER's (1904) figure, but the scale of enlargement is evidently incorrect. Taking into account 1.6 to 2 times the given size, D is about 280 μm. However considering the accompanying fauna *(Discocyclina pratti pratti, D. augustae augustae, Orbitoclypeus varians scalaris* and *Asterocyclina stellata stellaris)* it is expedient to accept SCHLUMBERGER's (1904) and WEIJDEN's (1940) data. After our examinations of KECSKEMÉTI's (1959) ribbed Discocyclinae they were included as population. The embryon of the "radians" figured by KECSKEMÉTI, is very big comparing to the population's average, whereas the photo and the drawing of the "variecostata" are obvious contradictory. The first shows an *Orbitoclypeus furcata*, while the latter is a *Discocyclina radians.*

Comparison: Among the ribbed Discocyclinae only the most advanced *Discocyclina nandori* may have similar-sized and similar type embryon, but its equatorial chambers are narrower, in addition the accompanying fauna widely differs too.

Range: The upper part of the Lutetian and the whole Batonian.

SW Aquitaine (Biarritz — Villa Marbella and the southern, lower part of the Côte des Basques; Angoumé, Siest — samples BT and SO), S Bakony [surroundings of Ajka — samples Ba 3, 5—6, CS, J 4—6, 8, Kö 2, 4 and SzT are from our own sampling, "Köleskepe-2, 3" are from KECSKEMÉTI's (1959) sampling].

Discocyclina radians (D'ARCHIAC), 1850 **labatlanensis** n. ssp.

Pl. XVI, figs. 6—7, text-figs. 27w—x

partim	1904.	*Orthophragmina radians* (D'ARCHIAC) — SCHLUMBERGER, pp. 122—124, pl. 4, figs. 15, 17, 19
	1912.	*Orthophragmina radians* (D'ARCHIAC) — PREVER, pp. 166—169, pl. 2, fig. 1, pl. 3, figs. 1, 5
partim	?1945a.	*Aktinocyclina radians* (D'ARCHIAC) — BRÖNNIMANN, pp. 560—578, pl. 20, figs. 1—3, text-figs. 1—13
partim	1958.	*Actinocyclina radians* (D'ARCHIAC) — NEUMANN, pp. 125—127, pl. 36, fig. 4
partim	1978.	*Aktinocyclina radians* (D'ARCHIAC) — SIROTTI, pp. 59—60, 62, pl. 3, figs. 1—3, 5, 6(?)

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E. 4761, pl. XVI, fig. 6.

Type locality: Lábatlan, József-puszta, abandoned stone-pit at Raibl-patak, sample RF.
Type level: The middle part of the Priabonian.
Diagnosis: *Discocyclina radians* populations with $\bar{D}$ exceeding 380 μm.

Description:

External morphology: Medium- and large-sized (5 to 15 mm) flattened forms with 12 to 16 ribs. Forms "B" are 2 to 2.5 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-figs. 27w—x):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio—semi-nephro	Q = 1.58—2.37	*t*: pratti	*g. p.*: pulcra
E = 0.22—1.00	$\bar{Q}$ = 1.80—2.20	N = 24—37	l = 25—35 μm
$\bar{E}$ = 0.45—0.80	P = 167—330 μm	$\bar{N}$ = 24—35	h = 95—150 μm
R = 0.50—1.04	$\bar{P}$ = 200—285 μm	L = 40—65 μm	$n_{0.5}$ = 5.4—7.8
$\bar{R}$ = 0.70—1.00	D = 380—630 μm	H = 75—140 μm	$\bar{n}_{0.5}$ = 5.5—7.2
	$\bar{D}$ = 380—540 μm	$\bar{H}$ = 85—115 μm	$n_{1.0}$ = 10.0—14.0

Remarks: Near the embryon the annular walls of the equatorial chambers are much thicker than the radial ones. Especially thick are the annular septa of the adauxiliary chambers.

Retrospection: Those forms were assigned to the synonymic list the D parameter of which is over 380 μm. Since the question is about individuals the inclusion is to some extent uncertain. Brönnimann's (1945a) figures and his drawings are contradictory: Considering the figures' scale of enlargement his forms should be included in this category, whereas relying on the scale of the drawings they belong to *Discocyclina radians radians*. On the basis of the accompanying fauna *(D. dispansa umbilicata, D. augustae augustae)*, though conditionally, we have chosen the first possibility.

Comparison: No other ribbed Discocyclinae possess similar-sized and similar type embryon.

Range: The Priabonian.

SW Aquitaine (Biarritz — La Cachaou), N Italy (Priabona — behind the new church, Brendola, Cave Defilippi — Gassino and conditionally Verona — Forte San Felice and Chiavona), Switzerland (Ralligstöcke) and the E Gerecse (surroundings of Lábatlan — samples R 1—2, BN, RA, RK and RF).

Discocyclina nandori n. sp.

Pl. XVI, figs. 8—12, text-figs. 27y—z

partim 1978. *Aktinocyclina radians* (d'Archiac) — Sirotti, pp. 59—60, 62, pl. 3, fig. 4

Derivatio nominis: The name was given in honour of my father and brother, Sr. and Jr. Nándor Less.
Holotype: Preparation E. 4763, pl. XVI, fig. 11.
Type locality: Bajót, near Lábatlan — abandoned stone-pit to the W of the village, sample BN.
Type level: The middle part of the Priabonian.
Diagnosis: Small- and medium-sized, flattened forms with 15 to 20 radial ribs. Semi-nephrolepidine (perhaps trybliolepidine) embryon. The two chambers are somewhat smaller than the average size. The adauxiliary chambers are of the "pratti" type, their outer walls are characteristically thick. They can be found in medium numbers, they are rather wide, but relatively low. The equatorial chambers are very narrow, compared to this they are very high. The growth pattern of the annuli is of the transitional "trabayensis—pulcra" type.

Description:

External morphology: Small- and medium-sized (3 to 6 mm), always flattened forms with small, sharp umbo, from which 15 to 20 radial ribs start. Between these ribs other ones may also start from the middle of the collar. "Discocyclina" type rosette, though not easily distinctable, since the granules are very small (diameter ranges from 20 to 40 μm). The size ratio of forms "A" and "B" is unknown for the time being.

Internal morphology:

The equatorial section of forms "A" (text-figs. 27y—z):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (tryblio)	Q = 1.61—2.11	*t*: pratti	*g.p.*: trabayensis—pulcra
E = 0.46—0.98	$\bar{Q}$ = 1.65—2.05	N = 17—23	l = 20—25 μm
$\bar{E}$ = 0.55—0.85	P = 97—172 μm	$\bar{N}$ = 17—23	h = 60—100 μm
R = 0.52—0.97	$\bar{P}$ = 100—170 μm	L = 30—50 μm	$n_{0.5}$ = 7.0—11.2
$\bar{R}$ = 0.60—0.95	D = 197—313 μm	H = 55—80 μm	$\bar{n}_{0.5}$ = 7.5—11.0
	$\bar{D}$ = 200—300 μm	$\bar{H}$ = 55—75 μm	$n_{1.0}$ = 15.0—20.0

Remarks: Near the embryon the annular walls of the equatorial chambers are much thicker than the radial ones. Especially thick are the annular septa of the adauxiliary chambers.

The equatorial section of forms "B": Forms "B" – that are undoubtedly the ones of the species – have not been found. It is imaginable, though, that SIROTTI's (1978 – pl. 3, fig. 6) figure is a depiction of the junevarium of the taxon's form "B". Even if it is not the case, it is most likely that the juvenarium is of the "Heterostegina" type but the nepionic phase is very strongly reduced.

Axial section: We have no data on the taxon's axial section.

Phylogenetic position (text-fig. 27): On the basis of the available data it is most likely that *Discocyclina radians radians* can be regarded as the ancestor of *D. nandori*, that appears around the ancestor's extinction-datum. Basically their morphology is the same but the build-up of *D. nandori* is somewhat finer: the ribs are thinner, the embryon is smaller, the equatorial chambers are narrower and longer. The transition between the two species however, is imaginable only by a major mutation.

For the time being data are not sufficient to distinguish different evolutional stages within the species though it is observable that the specimens from Lábatlan and Priabona (see at SIROTTI 1978) are more advanced than the ones from Mossano and Valle Granella as far as the $\bar{P}$, $\bar{D}$, $\bar{N}$ and $\bar{H}$ parameter means are concerned (see text-figs. 27y and 27z, respectively).

No data are available concerning the descendants of this very strongly specialized species, probably it became extinct without offsprings at the end of the Eocene.

Retrospection: Beside the typical *Discocyclina radians* – going by the same name – specimens, that have much smaller embryon and narrower equatorial chambers than those of the "radians", were also figured from Priabona by SIROTTI (1978). Similar duality was experienced by us while examining the samples from Lábatlan. Later, the forms described above were found in samples from Mossano and Valle Granella too, for the labelling of which the introduction of a new name became necessary.

Variability: On the basis of the data found so far, the species seems to be relatively stable both externally and internally.

Comparison: Among the ribbed Discocyclinae the most advanced *D. knessae* and *D. radians noussensis* may have similar type and similar-sized embryon: The equatorial chambers of these, however, are much less elongate, especially near the embryon.

Range: Priabonian.

N Italy (Mossano, Priabona – behind the new church and Valle Granella), E Gerecse (surroundings of Lábatlan – samples BN and RA).

Discocyclina trabayensis NEUMANN, 1955

Diagnosis: Small, generally flattened forms. The embryon is semi-isolepedine or nephrolepidine. Both chambers are very small. The adauxiliary chambers are of the "varians" type, they are very low in numbers, varying in width but very low. The equatorial chambers are narrow, near the embryon they are very low, compared to this they are high on the peripheries. The growth pattern of the annuli is of the "trabayensis" or the transitional "trabayensis–strophiolata" type.

Description:

External morphology: Small-sized (1.5–5 mm), generally flat or very flat forms, though inflate ones may also occur. The umbo is usually small and sharp. The rosette is of the "Discocyclina" type, the granules – often arranged in concentric rings – are of medium size (varying from 40 to 70 μm). There is no difference between the sizes of forms "A" and "B".

Internal morphology:

The equatorial section of forms "B": On the basis of our preparations and SIROTTI's (1978 – pl. 2, fig 1) data the juvenarium is of the "Heterostegina" type. $I = 10-14$ μm, $S = 4-5$, $s = 40-50$ μm, $n = 6-7$, $d = 150-160$ μm, $J = 10-12$, $j = 600-800$ μm.

Axial section: In lack of own preparation we relied on SIROTTI's (1978 – pl. 2, fig. 2) data. The height of the embryon is ranging from 50 to 70 μm, the equatorial layer is 40 μm thick near the embryon and grows to 60 μm towards the peripheries. The lateral septum is rather thin, the annular one is straight. The average dimension of the lateral chambers is 60×25 μm.

Phylogenetic position (text-fig. 27): *Discocyclina broennimanni* can be regarded as the ancestor of the species, since *D. trabayensis* differs from this taxon only in the character of its embryon and adauxiliary chambers and stratigraphically it comes after *D. broennimanni*.

On the basis of the data available, 3 evolutional stages (subspecies) can be distinguished using the following biometric limits:

Discocyclina trabayensis trabayensis (text-fig. 27α):	$\bar{D} < 100$ μm and $\bar{N} < 6.5$
Discocyclina trabayensis concentrica (text-fig. 27β):	$\bar{D} = 90-120$ μm and $\bar{N} = 6.5-9$
Discocyclina trabayensis vicenzensis (text-fig. 27γ):	$\bar{D} > 120$ μm and $\bar{N} > 9$

Similarly to $\bar{D}$ and $\bar{N}$, analogous development is observable in the increase of $\bar{P}$, too. The increase of $\bar{R}$, $\bar{Q}$, $\bar{H}$ and the decrease of $\bar{E}$ and $\bar{n}_{0.5}$ parameter means do not indicate such firm tendency.

For the time being no data are available on the descendants of the species, it is not impossible though, that they will be found in the future.

Retrospection: The first describer, NEUMANN (1955) gave a correct depiction of the species from the type locality. Later, however, on the basis of the similar exterior forms of *Discocyclina augustae sourbetensis* and *D. dispansa ganensis* were also assigned to this species (incorrectly in our opinion) by her (NEUMANN 1958). The improperly depicted "concentrica" name (KECSKEMÉTI 1959) is at a priority disadvantage compared to the "trabayensis" denomination. By some researchers (KÖHLER 1967, SIROTTI 1978) forms, that belong to this category, were also described going by the name of "daguini". The cause of this mistreatment is a certain similarity in the exterior, the inadequate type-description and the faultiness of the given dimensions (see later too).

Variability: Both the exterior (see at the description) and the interior of this species are rather variable. The variability of the interior is significant first of all in the varying degree of curvature of the adauxiliary chambers.

Range: The Cuisian, Lutetian, Bartonian and Priabonian.

Discocyclina trabayensis trabayensis NEUMANN, 1955

Pl. XVII, figs. 1—3, 5—9, 13, text-fig. 27α

	1955.	*Discocyclina trabayensis* n. sp. — NEUMANN, p. 130. pl. 6, figs. 2—4, pl. 7, figs. 2, 3
partim	1958.	*Discocyclina trabayensis* NEUMANN — NEUMANN, pp. 111—112, pl. 24, figs. 2(?), 4—7, text-fig. 35b
partim non	1958.	*Discocyclina trabayensis* NEUMANN — NEUMANN (=*Discocyclina augustae sourbetensis* et *D. dispansa ganensis*)
non	1972.	*Discocyclina trabayensis* NEUMANN — NEUMANN (=*Discocyclina dispansa ganensis*)
partim	1974.	*Discocyclina trabayensis* NEUMANN — PORTNAYA, pp. 100—101, pl. 23, figs. 2—4
partim non	1974.	*Discocyclina trabayensis* NEUMANN — PORTNAYA (=*Discocyclina broennimanni* et *D. dispansa ganensis*)

Holotype: NEUMANN (1955) pl. 7, fig. 2 and NEUMANN (1958) pl. 24, figs. 4—7, depository not given, presumably Université de Paris.
Type locality: Doazit (SW Aquitaine) — near the cross-roads at Saint-Sever.
Type level: The Lower Lutetian substage (in the present writer's opinion the middle part of the Cuisian stage).
Diagnosis: *Discocyclina trabayensis* populations with $\bar{D}$ less than 100 μm and $\bar{N}$ less than 6.5.

Description:

External morphology: Small (1.5 to 4 mm), usually flattened forms. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27α):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-iso (nephro)	$Q=1.17-1.71$	*t:* varians	*g.p.:* trabayensis
$E=0.94-1.64$	$\bar{Q}=1.25-1.70$	$N=3-7$	$l=25-35$ μm
$\bar{E}=1.00-1.45$	$P=52-77$ μm	$\bar{N}=3.5-6.5$	$h=40-80$ μm
$R=0.15-0.54$	$\bar{P}=50-70$ μm	$L=25-60$ μm	$n_{0.5}=13.0-21.5$
$\bar{R}=0.20-0.50$	$D=71-102$ μm	$H=20-30$ μm	$\bar{n}_{0.5}=14.0-21.0$
	$\bar{D}=75-100$ μm	$\bar{H}=20-30$ μm	$n_{1.0}=27.0-35.0$

Retrospection: See "Retrospection" at the discussion of the species.

Comparison: Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Nemkovella strophiolata bodrakensis*, *Orbitoclypeus daguini* and *O. pygmaea* are with four stolons and they give the semblance of hexagonal shape.

The adauxiliary chambers of *Discocyclina broennimanni* and *D. augustae sourbetensis* are of the "archiaci" type.

Range: The Cuisian and the lower and middle parts of the Lutetian.

SW Aquitaine (Doazit, Horsarrieu — samples HX and HS, Saint-Barthélémy, Gibret), Crimea — Simferopolian stage, the upper part of the *Nummulites distans minor* zone (samples E9 and U7), the lower part of the Bodrakian stage (samples A23 and C25).

Discocyclina trabayensis NEUMANN, 1955 **concentrica** KECSKEMÉTI, 1959

Pl. XVII, figs. 10—12, pl. XVIII, figs. 1—2, text-fig. 27β

?1941. *Discocyclina (Discocyclina) augustae* WEIJDEN — WITT PUYT, p. 61, pl. 5, fig. 1
1959. *Discocyclina concentrica* n. sp. — KECSKEMÉTI, pp. 45—47, pl. 2, figs. 6, 7, 9, text-fig. 10(?)

Holotype: KECSKEMÉTI (1959) pl. 2, fig. 6, preparation M 58/289, depository: Természettudományi Múzeum Őslénytár (Budapest) — external form.
Type locality: Ajka, the upper end of the Köleskepe ditch — sample "Köleskepe-3".
Type level: The Upper Lutetian substage (in our opinion the lower part of the Bartonian stage).
The type of the equatorial section of forms "A": Preparation E. 4776, pl. XVII, figs. 10 an d12 — above Szőke-forrás a cut of the factory road between Ajka and Pula (sample Ba 3), the lower part of the Bartonian.
Diagnosis: *Discocyclina trabayensis* populations with $\bar{D}$ ranging from 90 to 120 μm and $\bar{N}$ ranging from 6.5 to 9.

Description:

External morphology: Small-sized (2 to 4 mm), generally flattened forms. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 27β):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: naphro (semi-iso)	$Q = 1.55-1.74$	*t:* varians	*g.p.:* strophiolata—trabayensis
$E = 0.75-1.21$	$\bar{Q} = 1.40-1.80$	$N = 7-11$	
$\bar{E} = 0.90-1.20$	$P = 55-70$ μm	$\bar{N} = 6.5-9.0$	$l = 25-35$ μm
$R = 0.36-0.71$	$\bar{P} = 55-75$ μm	$L = 25-45$ μm	$h = 35-75$ μm
$\bar{R} = 0.35-0.60$	$D = 88-122$ μm	$H = 20-30$ μm	$n_{0.5} = 16.0-19.5$
	$\bar{D} = 90-120$ μm	$\bar{H} = 20-30$ μm	$\bar{n}_{0.5} = 15.5-20.0$
			$n_{1.0}$ is unknown

Remarks: In the first few cycles the annular walls of the equatorial chambers are thicker than the radial ones.

Retrospection: KECSKEMÉTI (1959), the denominator of the taxon illustrated its inner morphology by a poorly preserved specimen (pl. XVIII, fig. 2 of the present work). This is why a new type had to be chosen for the equatorial section of forms "A". Within the population from Ajka two forms can be found with slightly different internal morphology. These forms differ from each other in the degree of curvature of the adauxiliary chambers. Due to the insufficient material there is no reason at present for their separation.

Comparison: Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Nemkovella fermonti*, *N. strophiolata bodrakensis* and *Orbitoclypeus pygmaea* are with four stolons, therefore they give the semblance of hexagonal shape.

The adauxiliary chambers of *Discocyclina broennimanni*, *D. augustae sourbetensis* and *D. dispansa ganensis* are of the "archiaci" type.

Range: Bartonian and probably the upper part of the Lutetian too.

Dalmatia (Ljubuški) and the S Bakony (surroundings of Ajka — samples Sz 7—8, Ba 3, Kö 4 are from our own sampling, sample "Köleskepe-3" is from KECSKEMÉTI's (1959) sampling.

Discocyclina trabayensis NEUMANN, 1955 **vicenzensis** n. ssp.

Pl. XVIII, figs. 3—5, text-fig. 27γ

partim 1967. *Discocyclina daguini* NEUMANN — KÖHLER, p. 77, pl. 15, fig. 4
1978. *Discocyclina daguini* NEUMANN — SIROTTI, pp. 56, 58, pl. 1, figs. 13—15, pl. 2, figs. 1, 2
1983. *Discocyclina III.* cf. *D. augustae* WEIJDEN — SETIAWAN, p. 98, table 5 (partim), pl. 17, fig. 7
partim ?1983. Discocyclina (dispansa-group) — SETIAWAN, p. 89

Derivatio nominis: Named after Vicenza, town situated close to the type locality of the taxon.
Holotype: Preparation E. 4780, pl. XVIII, fig. 5.
Type locality: Priabona, behind the new church ("Asterocyclina beds").
Type level: The upper part of the Priabonian stage.
Diagnosis: *Discocyclina trabayensis* populations with $\bar{D}$ exceeding 120 μm and $\bar{N}$ over 9.

Description:

External morphology: Small-sized (2.5 to 5 mm), generally flattened forms. The size ratio of forms "A" and "B" is unknown for the time being.

Internal morphology:

The equatorial section of forms "A" (text-fig. 27γ):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro	$Q = 1.52-2.08$	*t:* varians	*g.p.:* strophiolata — trabayensis
$E = 0.83-1.11$	$\bar{Q} = 1.50-2.00$		
$\bar{E} = 0.80-1.10$	$P = 60-110$ μm	$N = 7-12$	$l = 25-30$ μm
$R = 0.41-0.67$	$\bar{P} = 60-90$ μm	$\bar{N} = 9-11$	$h = 45-70$ μm
$\bar{R} = 0.40-0.65$	$D = 118-180$ μm	$L = 25-45$ μm	$n_{0.5} = 14.0-18.8$
	$\bar{D} = 120-160$ μm	$H = 25-40$ μm	$\bar{n}_{0.5} = 14.0-18.5$
		$\bar{H} = 25-40$ μm	$n_{1.0} = 23.0-32.0$

Remarks: In the first few cycles the annular walls of the equatorial chambers are thicker than the radial ones.

Retrospection: For the forms described above new name had to be introduced, since the earlier used names "daguini" and "augustae" refer to forms with different internal morphology.

In spite of the fact that the holotype is just a single member of the population examined by us, on the basis of SETIAWAN's (1983) data it could be pointed out that, even as a member of a larger population, it meets the critera of the diagnosis.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Nemkovella fermonti*, *N. strophiolata strophiolata*, *Orbitoclypeus ramaraoi ramaraoi* and *O. pygmaea* are with four stolons, therefore they give the semblance of hexagonal shape.

The adauxiliary chambers of *Discocyclina augustae atlantica* and *D. dispansa ganensis* are of the "archiaci" type.

Range: Priabonian.

N Italy (Mossano, Priabona) and W Slovakia (Nolčovo — near Martin).

Discocyclina aaroni n. sp.

Diagnosis: Small and medium-sized, generally flattened forms. Usually the embryon is semi-nephrolepidine, the two chambers are medium-sized. The adauxiliary chambers are of the "varians" type (transition towards the "pratti" type is possible), medium in numbers and medium wide, compared to this they are rather low. The equatorial chambers are narrow, not too high. The growth pattern of the annuli is of the "strophiolata" type (transition towards the "pulcra" type is possible).

Description:

External morphology: Small and medium-sized (3 to 7 mm), mostly flattened forms, though somewhat rounded forms may also occur. Curved and even is more saddle-shaped forms can also be found. The umbo is not too big, often indistinct. The rosette is of the "Discocyclina" type, the granules are medium-sized (diameter varies from 50 to 80 μm). The ratio of the sizes of forms "A" and "B" is unknown for the time being since the latter forms have not been found yet.

Internal morphology:

The equatorial section of forms "B": Microspheric specimens of the taxon have not been found yet. The juvenarium is presumably of the "Heterostegina" type.

Axial section: In this section the taxon could not be studied.

Phylogenetic position (text-fig. 28): The species can be derived from *Discocyclina dispansa ganensis*. In the early stage of its evolution it differs from the ancestor only in the character of its adauxiliary chambers.

On the basis of the known material two evolutional stages (subspecies) can be distinguished within the species using the following biometric limits:

Discocyclina aaroni chalossensis (text-fig. 28b): $\bar{D} < 220$ μm
Discocyclina aaroni aaroni (text-fig. 28c): $\bar{D} > 220$ μm

On the basis of more abundant material further subspecies might be distinguished. The evolution is observable in the increase of $\bar{R}$, $\bar{Q}$, $\bar{P}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{E}$ and $\bar{n}_{0.5}$ parameter means as well.

Among the possible descendants of the species *Discocyclina pratti* may have been separated from *D. aaroni chalossensis* at an early stage of its development. *D. pratti* differs from its ancestor first of all by its more elongate equatorial chambers.

It is possible that *D. euaensis* is the lineal descendant of the species, though the probable intermediate forms from the Late Lutetian and Bartonian are not yet known.

Retrospection: This rare species was mentioned only one occasion in the literature (NEUMANN 1958), going by the unsuitable "sella" denomination. Therefore it was necessary to segregate this taxon as a new one.

V a r i a b i l i t y : Variability of the exterior is discussed in the "Description". The internal morphology of this species is practically stable.

R a n g e : From the middle part of the Cuisian to the end of the middle part of the Lutetian.

Discocyclina aaroni n. sp. **chalossensis** n. ssp.

Pl. XVIII, figs. 6–9, text-fig. 28b

D e r i v a t i o n o m i n i s : Named after the geographical unit in which the type locality is situated.
H o l o t y p e : Preparation E. 4782, pl. XVIII, fig. 6.
T y p e l o c a l i t y : Horsarrieu (SW Aquitaine) — Marniére Sourbet — sample HX.
T y p e l e v e l : The middle part of the Cuisian.
D i a g n o s i s : *Discocyclina aaroni* populations with $\bar{D}$ less than 220 μm.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (3 to 6 mm), mostly flattened forms.

Internal morphology:

The equatorial section of forms "A" (text-fig. 28b):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-nephro)	$Q=1.60-1.97$	*t:* varians	*g.p.:* strophiolata
$E=0.77-1.16$	$\bar{Q}=1.65-1.95$	$N=14-21$	$l=25-30$ μm
$\bar{E}=0.80-1.05$	$P=85-110$ μm	$\bar{N}=15-20$	$h=55-90$ μm
$R=0.38-0.71$	$\bar{P}=85-105$ μm	$L=25-40$ μm	$n_{0.5}=12.5-15.8$
$\bar{R}=0.45-0.70$	$D=139-197$ μm	$H=35-60$ μm	$\bar{n}_{0.5}=12.5-15.5$
	$\bar{D}=150-190$ μm	$\bar{H}=35-55$ μm	$n_{1.0}=22.0-26.0$

R e m a r k s : In the first few cycles the annular walls of the equatorial chambers are somewhat thicker than the radial ones.

R e t r o s p e c t i o n : The forms described above are not mentioned at all in the literature, this is why the separation of the new taxon was necessary.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Nemkovella evae, N. fermonti, N. strophiolata tenella, Orbitoclypeus seunesi, O. ramaraoi neumannae, O. douvillei, O. varians horsarrieuensis* and *O. varians angoumensis* are with four stolons, slightly hexagonal in shape.

The adauxiliary chambers of *Discocyclina furoni, D. augustae olianae, D. augustae augustae, D. dispansa taurica* and *D. dispansa nussdorfensis* are of the "archiaci" type.

R a n g e : The middle and upper parts of the Cuisian and the lower part of the Lutetian.

SW Aquitaine (Horsarrieu — samples HX, HS), Crimea — Simferopolian stage — the upper part of the *Nummulites distans* zone (samples B 75–77).

Discocyclina aaroni aaroni n. sp. et n. ssp.

Pl. XVIII, figs. 10–12, pl. XIX, figs. 1–3, text-fig. 28c

partim 1958. *Discocyclina sella* (D'ARCHIAC) — NEUMANN, pp. 106–109, pl. 22, figs. 5(?), 7, text-fig. 33b

D e r i v a t i o n o m i n i s : Named after my son, Áron.
H o l o t y p e : Preparation E. 4786, pl. XVIII, figs. 10–11.
T y p e l o c a l i t y : Neszmély, Bátor-berki patak.
T y p e l e v e l : The middle part of the Lutetian.
D i a g n o s i s : *Discocyclina aaroni* populations with $\bar{D}$ exceeding 220 μm.

D e s c r i p t i o n :

External morphology: Medium-sized (4 to 7 mm), generally flattened forms.

Internal morphology:

The equatorial section of forms "A" (text-fig. 28c):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (semi-nephro, umbilico)	$Q=1.88-2.68$	*t:* varians–pratti	*g.p.:* strophiolata–pulcra
	$\bar{Q}=1.95-2.45$		
$E=0.33-0.97$	$P=90-198$ μm	$N=20-29$	$l=30-35$ μm
$\bar{E}=0.35-0.82$	$\bar{P}=90-175$ μm	$\bar{N}=21-27$	$h=50-100$ μm
$R=0.53-1.43$	$D=240-372$ μm	$L=35-50$ μm	$n_{0.5}=8.5-13.5$
$\bar{R}=0.70-1.20$	$\bar{D}=220-350$ μm	$H=55-90$ μm	$\bar{n}_{0.5}=8.5-12.5$
		$\bar{H}=55-90$ μm	$n_{1.0}=18.0-25.0$

R e m a r k s : In the first few cycles the annular walls of the equatorial chambers are thicker than the radial ones.

R e t r o s p e c t i o n : See "Retrospection" at the discussion of the species.

C o m p a r i s o n : Among the unribbed forms with similar-sized and similar type embryon the equatorial chambers of *Orbitoclypeus seunesi* and *O. douvillei* are with four stolons, therefore they look slightly hexagonal.

The adauxiliary chambers of *Discocyclina archiaci bakhchisaraiensis*, *D. archiaci staroseliensis*, *D. furoni furoni*, *D. augustae augustae*, *D. dispansa nussdorfensis*, *D. dispansa hungarica* and *D. dispansa sella* are of the "archiaci" type.

The equatorial chambers of *D. euaensis*, *D. pratti aquitanica*, *D. pratti montfortensis* are higher and more elongate.

R a n g e : The middle part of the Lutetian.

SW Aquitaine (Montfort, Guiche), Austria (Nussdorf), W Gerecse (Neszmély, Dunaszentmiklós — samples K5, KA, KF).

Discocyclina euaensis Whipple, 1932

Pl. XIX, figs. 4—6, text-fig. 28d

?1905. *Orthophragmina* cf. *varians* (Kaufmann) — Deprat, pp. 505—506, pl. 18, fig. 22
1932. *Discocyclina euaensis* n. sp. — Whipple, p. 84, pl. 22, figs. 3—7, text-fig. 6
1963b. *Discocyclina (Discocyclina) assamica* n. sp. — Samanta, pp. 658—661, pl. 94, figs. 1—6
1965b. *Discocyclina assamica* Samanta — Samanta, p. 421, pl. 1, figs. 5—8
1983. *Discocyclina* IV. — Setiawan, p. 98, table 5 (partim), pl. 17, fig. 8
partim ?1983. Discocyclina (papyracea-group) — Setiawan, p. 89

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : Whipple (1932) pl. 22, fig. 3, depository presumably Bernice P. Bishop Museum, Honolulu (marked out by the present writer).
T y p e l o c a l i t y : At the bottom of the eastern side of the Pinnacle limestone summit, the Eua Island (Tonga Islands), locality N° E—318, situated close to the centre of the island.
T y p e l e v e l : Upper Eocene.

D i a g n o s i s : Large, very flat forms. The embryon is of the semi-nephro—trybliolepidine type. The two chambers are moderately big. The adauxiliary chambers are of the "pratti" type, wide and high, they can be found in medium numbers. The equatorial chambers are narrow and very high, the growth pattern of the annuli is of the "pulcra" type.

D e s c r i p t i o n :

External morphology: Large-sized (6 to 15 mm), very flat forms, generally with small, sharp umbo. The "Discocyclina" type rosette is not easy to observe, since the granules are small (30 to 50 μm in diameter). The ratio of the sizes of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 28d):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro—tryblio	$Q=1.90-2.90$	*t:* pratti	*g.p.:* pulcra
$E=0.48-0.94$	$\bar{Q}=2.05-2.75$	$N=23-36$	$l=25-35$ μm
$\bar{E}=0.50-0.85$	$P=114-195$ μm	$\bar{N}=25-35$	$h=90-180$ μm
$R=0.57-1.26$	$\bar{P}=130-195$ μm	$L=40-60$ μm	$n_{0.5}=6.5-8.5$
$\bar{R}=0.70-1.00$	$D=300-530$ μm	$H=55-105$ μm	$\bar{n}_{0.5}=6.5-8.0$
	$\bar{D}=300-530$ μm	$\bar{H}=65-100$ μm	$n_{1.0}=13.0-16.5$

R e m a r k s : In the first cycles the annular walls of the equatorial chambers are thicker than the radial ones.

The equatorial section of forms "B": Microspheric specimens of the taxon were not yet found.

Axial section: Lacking own preparations, on the basis of Samanta's (1963b — pl. 94, figs. 3—4 and 1965b — pl. 1, figs. 7—8) figures, height of the embryon is ranging from 100 to 150 μm, the equatorial layer is 40 to 50 μm thick near the embryon and on the peripheries as well. The lateral septum is thin, the annular one is slightly curved. The lateral chambers are 60×30 μm big on the average.

P h y l o g e n e t i c p o s i t i o n (text-fig. 28): The derivation of the species is rather uncertain. It might be a late descendant of *Discocyclina aaroni*, though stratigraphically there is a gap between the two species in the Bartonian.

The intraspecific evolution cannot be established, since the 5 known populations come from different geographical regions that are located far from each other.

No data are available on the descendants of the species, this most likely that it became extinct in the Late Eocene without offspring.

R e t r o s p e c t i o n : Presumably the scale of enlargement of Deprat's (1905) "cf. varians" is incorrect, the extraordinary large equatorial chambers make us think so, anyway. The "euaensis" name was introduced by WHIPPLE (1932) along with proper figures of the internal morphology, therefore it has unconditional priority compared to the "assamica" name which was introduced by SAMANTA (1963b, 1965b).

Variability: Between the internal morphological elements of the remote populations there are smaller differences in the dimensions (especially in D, H and h values). This however can also be a consequence of geographic isolation. Data concerning the variability of the exterior are not available.

Comparison: *Discocyclina euaensis* is very much similar to the *D. radians* in its internal morphology, but the lack of the ribs clearly distinguishes it from the latter form. This was the reason why SAMANTA (1965b) proposed to stop using the "Aktinocyclina" genus-name.

Among the unribbed forms with similar-sized and similar type embryon the adauxiliary chambers of *Discocyclina archiaci*, *D. weijdeni* and *D. dispansa* are mostly of the "archiaci" type.

The equatorial chambers of *D. senegalensis* are wider, especially near the embryon, and lower at the same time.

The equatorial chambers of *Orbitoclypeus chudeaui* have four stolons, they look hexagonal.

Only the distinction from *Discocyclina pratti montfortensis* and *D. pratti pratti* is not easy. With the same embryon-size, *D. euaensis* has somewhat less adauxiliary chambers, while the equatorial chambers are slightly more elongate. The accompanying fauna differs too, since these forms represent different stratigraphic levels, *D. euaensis* occurs together with *D. pratti minor* — the embryon of which is much larger and different in type — and with other forms of the Upper Eocene.

Range: The Priabonian.

N Italy (Priabona — "Asterocyclina beds"), E Gerecse (surroundings of Lábatlan — samples RA, RK, Rl and BN), India (Assam — Garo Hills), New Caledonia, Tonga Islands (Eua Island).

Discocyclina pratti (MICHELIN), 1846

Diagnosis: Medium- and large-sized, generally flattened forms. The embryon developes from the nephrolepidine to the polylepidine type. The two chambers are medium or large sized. The adauxiliary chambers are always of the "pratti" type, they are medium or high in numbers, relatively wide and of varying height. The equatorial chambers are narrow but high. The growth pattern of the annuli is always of the "pulcra" type.

Description:

External morphology: Medium- and large-sized (3 to 20 mm), generally flattened forms, though inflate ones may also occur. The umbo is of varying size, generally it has no distinct outline. "Discocyclina" type rosette, small granules (diameter varies from 30 to 50 μm). The size ratio of forms "A" and "B" is not stable, generally forms "B" are 1.5 to 3 times the size of forms "A".

Internal morphology:

The equatorial section of forms "B": On the basis of our own preparations and SCHWEIGHAUSER's (1953 — text-fig. 30) data, the juvenarium is of the "Heterostegina" type. I=15—16 μm, S=5, s=35—55 μm, n=5—7, d=150—170 μm, J=14—18, j=800—1000 μm.

Axial section: Not having preparation of our own, we relied on the following author's data: SCHWEIGHAUSER (1953 — pl. 9, fig. 5), NEUMANN (1958 — pl. 19, fig. 7, pl. 27, figs. 5—6) and GROSS—KÖHLER et al. (1980 — pl. 28, fig. 6). The height of the embryon varies from 100 to 150 μm. The equatorial layer is 30 to 40 μm thick near the embryon and it thickens up to 70—80 μm towards the edges. The lateral septum is thin, the annular one is straight. The lateral chambers are 100—120× ×30—40 μm big on the average.

Phylogenetic position (text-fig. 28): Most likely *Discocyclina aaroni chalossensis* is the ancestor of the species. They differ from each other in the character of their adauxiliary chambers and in the length of their equatorial chambers.

On the basis of the data available 4 evolutional stages (subspecies) can be distinguished for the time being using the following biometric limits:

Discocyclina pratti aquitanica (text-fig. 28e):	$\bar{D}<320$ μm
Discocyclina pratti montfortensis (text-fig. 28f):	$\bar{D}=320-425$ μm
Discocyclina pratti pratti (text-fig. 28g):	$\bar{D}=425-600$ μm
Discocyclina pratti minor (text-fig. 28i):	$\bar{D}>750$ μm

Similarly to the increase of $\bar{D}$, development is observable in the increase of $\bar{R}$, $\bar{Q}$, $\bar{P}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{E}$, $\bar{n}_{0.5}$ parameter means.

The task of further research is to find the still missing subspecies with $\bar{D}$ ranging from 600 to 750 μm between *D. pratti pratti* and *D. pratti minor* (see text-fig. 28h). If such taxon does not exist, the promotion of *D. pratti minor* to *D. minor* as species is imaginable.

Discocyclina pratti aquitanica may be the probable ancestor of *D. pulcra* since this is the closest taxon concerning both age and morphology. *D. samantai*, however, certainly derives from *D. pratti minor*, it can be regarded as the ribbed variety of the latter form.

R e t r o s p e c t i o n : This species, one of those that have long since been known, became the victim of many misapprehensions, since the internal morphology of the forms from Biarritz — type locality of the taxon — became known totally only after the revision by WEIJDEN (1940). Earlier, CARPENTER's (1850) figures were too schematic, even though they were coming from the type locality, they could not be identified at all with the above description. So, almost none of the "pratti"-s described from the type locality, show the above discussed internal morphology. Using other names ("canavarii", "umbo"), however, forms that can be assigned to this category were described. The first one is a junior synonym, while the synonymic list of the latter is too confused to be of any practical value (see later, too). However, the denomination "minor", which was originally described as a variety of "umbo", can be used on the subspecies level.

V a r i a b i l i t y : See the "Description" for the changeability of the exterior. As far as the interior is concerned the great variability of the embryon type is remarkable especially in the case of the nominate subspecies. To a lesser degree the convexity of the outer walls of the adauxiliary chambers may also be changeable.

R a n g e : The whole Eocene, except for the Ilerdian and the lower part of the Cuisian.

Discocyclina pratti (MICHELIN), 1846 **aquitanica** n. ssp.

Pl. XIX, figs. 7—8, 10, text-fig. 28e

D e r i v a t i o n o m i n i s : Named after the bigger geographical unit of the type locality.
H o l o t y p e : Preparation E. 4793, pl. XIX, fig. 8.
T y p e l o c a l i t y : Horsarrieu (SW Aquitaine) — Marniére Sourbet — sample HN.
T y p e l e v e l : The middle part of the Cuisian stage.
D i a g n o s i s : *Discocyclina pratti* populations with $\bar{D}$ less than 320 µm.

D e s c r i p t i o n :

External morphology: Small (3 to 5 mm), generally flattened forms. The ratio of the sizes of forms "A" and "B" are not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 28e):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-nephro (tryblio)	$Q=1.52-1.88$	*t:* pratti	*g.p.:* pulcra
$E=0.63-0.76$	$\bar{Q}=1.50-1.90$	$N=20-24$	$l=20-30$ µm
$\bar{E}=0.50-0.85$	$P=152-164$ µm	$\bar{N}=17-27$	$h=60-70$ µm
$R=0.70-0.84$	$\bar{P}=130-190$ µm	$L=30-50$ µm	$n_{0.5}=10.0-11.2$
$\bar{R}=0.60-0.90$	$D=231-296$ µm	$H=50-60$ µm	$\bar{n}_{0.5}=9.0-12.0$
	$\bar{D}=200-320$ µm	$\bar{H}=45-65$ µm	$n_{1.0}=20.0-22.0$

R e m a r k s : In the first few cycles the annular septa of the equatorial chambers are thicker than the radial ones.

R e t r o s p e c t i o n : Since forms similar to the above description have not been found in the literature a new taxon had to be established.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Orbitoclypeus chudeaui chudeaui* are with four stolons, they look hexagonal.

The adauxiliary chambers of *Discocyclina archiaci bakhchisaraiensis*, *D. archiaci staroseliensis*, *D. furoni* and *D. dispansa hungarica* are of the "archiaci" type, whereas those of *D. aaroni aaroni* are more close to the "varians" type, they are characteristically curved.

R a n g e : The middle and upper parts of the Cuisian.

SW Aquitaine (Horsarrieu — samples HX and HN), Crimea — Simferopolian stage — the middle part of the *Nummulites distans minor* zone (sample U6).

Discocyclina pratti (MICHELIN), 1846 **montfortensis** n. ssp.

Pl. XIX, figs. 9, 11—12, text-fig. 28f

D e r i v a t i o n o m i n i s : Named after the type locality of the taxon.
H o l o t y p e : Preparation E. 4798, pl. XIX, fig. 12.
T y p e l o c a l i t y : Montfort — Fontaine de la Médaille.
T y p e l e v e l : The middle part of the Lutetian.
D i a g n o s i s : *Discocyclina pratti* populations with $\bar{D}$ ranging from 320 to 425 µm.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (4 to 7 mm), usually flattened forms. The size ratio of forms "A" and "B" is unknown up to now.

Internal morphology:

The equatorial section of forms "A" (text-fig. 28f):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio—semi-nephro	$Q = 1.63-2.46$	*t:* pratti	*g.p.:* pulcra
$E = 0.50-0.90$	$\bar{Q} = 1.70-2.40$	$N = 27-36$	$l = 20-30$ µm
$\bar{E} = 0.50-0.80$	$P = 145-224$ µm	$\bar{N} = 25-36$	$h = 70-100$ µm
$R = 0.59-1.07$	$\bar{P} = 160-220$ µm	$L = 35-45$ µm	$n_{0.5} = 6.8-8.0$
$\bar{R} = 0.75-1.10$	$D = 327-407$ µm	$H = 45-80$ µm	$\bar{n}_{0.5} = 6.5-9.0$
	$\bar{D} = 320-425$ µm	$\bar{H} = 55-80$ µm	$n_{1.0} = 15.0-17.0$

R e m a r k s : In the initial cycles the annular walls of the equatorial chambers are thicker than the radial ones.

R e t r o s p e c t i o n : Since forms complying with above description were not found in the literature, it was necessary to establish a new taxon.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Orbitoclypeus chudeaui chudeaui* and *O. chudeaui pannonicus* are with four stolons, they look hexagonal.

The adauxiliary chambers of *Discocyclina archiaci staroseliensis*, *D. archiaci archiaci*, *D. weijdeni* and *D. dispansa sella* are of the "archiaci" type.

The adauxiliary chambers of *D. aaroni aaroni* are more of the "varians" type, its equatorial chambers are less elongate. The most difficult is to distinguish it from *D. euaensis* but the equatorial chambers of this species are somewhat longer and due to the different stratigraphic level the accompanying fauna is rather different, too.

R a n g e : The lower and middle part of the Lutetian.

SW Aquitaine (Nousse, Montfort), Crimea — the upper part of the Simferopolian stage (sample B 76).

Discocyclina pratti pratti (MICHELIN), 1846

Pl. XIX, fig. 13, pl. XX, fig. 1—11, tex-fig. 28g

1846. *Orbitolites prattii* n. sp. — MICHELIN, livre 23, p. 278, pl. 63, fig. 14
non 1850. *Orbitoides pratti* (MICHELIN) — CARPENTER, p. 32, pl. 8, figs. 32—36 (= Discocyclina indet. sp.)
non 1903. *Orthophragmina pratti* (MICHELIN) — SCHLUMBERGER (= *Discocyclina archiaci archiaci* et *D. furoni*)
1908. *Orbitoides (Orthophragmina) canavarii* n. sp. — CHECCHIA-RISPOLI, pp. 7, 12
1909a. *Orthophragmina canavarii* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI, pp. 109—110, pl. 4, figs. 15—17, pl. 5, figs. 10—11
1911a. *Orthophragmina canavarii* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI, p. 165, pl. 5, figs. 16, 43
non 1912. *Orthophragmina pratti* (MICHELIN) — PREVER (= *Discocyclina dispansa umbilicata*)
partim 1922. *Discocyclina pratti* (MICHELIN) — DOUVILLÉ, p. 67, pl. 4, fig. 5, text-figs. 18—19
non 1926. *Orthophragmina (Discocyclina) pratti* (MICHELIN) — DONCIEUX (= *Discocyclina archiaci archiaci* et *D. furoni*)
1929. *Discocyclina pratti* (MICHELIN) — LLUECA, pp. 271—273, pl. 22, figs. 1, 2
1940. *Discocyclina (Umbilicodiscodina) pratti* (MICHELIN) — WEIJDEN, pp. 39—43, pl. 5, figs. 2—6, pl. 6, fig. 1, 17 text-figs. on p. 43
partim 1953. *Discocyclina pratti* (MICHELIN) — SCHWEIGHAUSER, pp. 52—55, pl. 9, figs. 3, 5, 10, 13, text-figs. 21, 30, 42
partim 1953. *Discocyclina sella* (D'ARCHIAC) — SCHWEIGHAUSER, pp. 66—67, pl. 11, fig. 11
partim non 1953. *Discocyclina pratti* (MICHELIN) — SCHWEIGHAUSER, text-fig. 32 (= Discocyclina indet. sp. B)
1958. *Discocyclina pratti* (MICHELIN) — NEUMANN, pp. 100—103, pl. 19, figs. 1—7, pl. 27, figs. 5—6, pl. 36, fig. 3, text-fig. 30
non 1959. *Discocyclina pratti* (MICHELIN) — KECSKEMÉTI (= *Discocyclina dispansa hungarica*)
partim 1962. *Discocyclina pratti* (MICHELIN) — ZERNETSKY, pp. 64—66, text-fig. 10
partim non 1962. *Discocyclina pratti* (MICHELIN) — ZERNETSKY, pp. 64—66, pl. 14, fig. 5. (= *Discocyclina* sp.)
non 1963. *Discocyclina pratti* (MICHELIN) — BIEDA (= *Discocyclina dispansa sella* et *D. dispansa umbilicata*)
non 1967. *Discocyclina pratti* (MICHELIN) — KÖHLER (= *Discocyclina dispansa umbilicata*)
non 1973. *Discocyclina pratti* (MICHELIN) — OLEMPSKA (= *Discocyclina dispansa dispansa*)
partim 1974. *Discocyclina pratti* (MICHELIN) — PORTNAYA, pp. 70—73, pl. 5, fig. 1
partim non 1974. *Discocyclina pratti* (MICHELIN) — PORTNAYA (= *Discocyclina archiaci archiaci*)
partim 1980. *Discocyclina pratti* (MICHELIN) — GROSS, KÖHLER et al., p. 183, pl. 28, fig. 6, text-fig. 37C
partim non 1980. *Discocyclina pratti* (MICHELIN) — GROSS, KÖHLER et al. (= *Discocyclina dispansa dispansa*)
1981a. *Discocyclina pratti* (MICHELIN) — LESS, pl. 1, fig. 5

H o l o t y p e : Not specified by the author of the taxon.
L e c t o t y p e : MICHELIN (1846) pl. 63, fig. 14, depository unknown — external form (marked out by the author of the present work).

T y p e l o c a l i t y : Biarritz — Falaise Handia, Villa Marbella or Côte des Basques.
T y p e l e v e l : Not specified (in the present writer's opinion the Bartonian).
The t y p e of the equatorial section of form "A": WEIJDEN (1940) — pl. 5, fig. 6, depository: Rijksuniversiteit Leiden. Biarritz — Villa Marbella or Côte des Basques (in the present writer's opinion).
D i a g n o s i s : *Discocyclina pratti* populations with $\bar{D}$ ranging from 425 to 600 μm.

D e s c r i p t i o n :

External morphology: Medium- and large-sized (4 to 15 mm), generally flattened forms. Forms "B" are approximately 2 times bigger than the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 28g):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (semi-nephro, umbilico, excentri)	$Q = 1.58-3.28$	*t:* pratti	*g.p.:* pulcra
	$\bar{Q} = 2.05-2.50$	$N = 27-67$	$l = 25-30$ μm
$E = 0.03-1.00$	$P = 110-508$ μm	$\bar{N} = 33.5-42.5$	$h = 65-140$ μm
$\bar{E} = 0.40-0.60$	$\bar{P} = 175-260$ μm	$L = 35-60$ μm	$n_{0.5} = 5.5-10.0$
$R = 0.50-1.62$	$D = 350-910$ μm	$H = 55-155$ μm	$\bar{n}_{0.5} = 6.8-8.2$
$\bar{R} = 0.90-1.15$	$\bar{D} = 425-600$ μm	$\bar{H} = 70-100$ μm	$n_{1.0} = 11.5-18.0$

R e m a r k s : In the initial cycles the annular walls of the equatorial chambers are thicker than the radial ones.

R e t r o s p e c t i o n : All populations and specimens, the D and $\bar{D}$ values of which are ranging from 425 to 600 μm, were included into the synonymic list. Some external forms published from the type locality (Biarritz) were assigned, too. In the Dudar population the very much changeable excentricity is remarkable (see "Variability" at the discussion of the species). The intermediates of the different embryon types can also be found in the population, so the forms with excentrilepidine embryon, for example, could not be assigned to a distinct species. Actually, this phenomenon is one of the major reasons why the "minor" taxon was assigned to the species *Discocyclina pratti.*

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Orbitoclypeus chudeaui pannonicus* are wider, less elongate, they are with four stolons, therefore they look hexagonal.

The adauxiliary chambers of *Discocyclina archiaci archiaci*, *D. archiaci bartholomei*, *D. weijdeni*, *D. dispansa dispansa* and *D. dispansa umbilicata* are mostly of the "archiaci" type.

The equatorial chambers of *D. senegalensis* are wider, much less elongate.

The most difficult is the distinction from *D. euaensis*, the adauxiliary chambers of which are fewer — with the condition that the embryons are equal-sized — and the equatorial chambers of which are somewhat longer. Due to the different stratigraphic level the accompanying fauna is different, too.

R a n g e : The upper part of the Lutetian, the Bartonian and the lower part of the Priabonian.

SW Aquitaine (Biarritz — Côte des Basques; Angoumé), N Italy (Mossano), S and N Bakony (surroundings of Ajka — samples CS, Ba 6 and SzT; surroundings of Dudar — samples D1, D7, DS 1, DS 3—5, DS and DG), Liptov Basin (Závažna Poruba).

Discocyclina pratti (MICHELIN), 1846 **minor** MEFFERT, 1931

Pl. XX, fig. 12, pl. XXI, figs. 1—3, text-figs. 28h—i

	1931a.	*Discocyclina umbo* (SCHAFHÄUTL) var. *minor* n. var. — MEFFERT, pp. 28—31, 54—55, pl. 6, figs. 1—5, pl. 7, fig. 2, text-figs. 4—6
partim	?1967.	*Discocyclina umbo* (SCHAFHÄUTL) — KÖHLER, pp. 76—77, pl. 13, fig. 6
partim	?1983.	*Discocyclina II.* cf. *D. sella* (D'ARCHIAC) — SETIAWAN, pp. 97—98, table 5 (partim)

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : MEFFERT (1931a) pl. 6, fig. 1, presumable depository: Centralny Nautchno-Issledovat'elsky Institut (Moscow) — marked out by the present writer.
T y p e l o c a l i t y : Malishki (Armenia — surroundings of Daralaghez), Ak-dag limestones.
T y p e l e v e l : The Upper Lutetian substage (by the author of the taxon), Upper Eocene (the present writer's opinion).
D i a g n o s i s : *Discocyclina pratti* populations with $\bar{D}$ exceeding 750 μm.

D e s c r i p t i o n :

External morphology: Large (6 to 20 mm), generally flattened forms. Forms "B" are 2.5 to 3 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 28i):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (poly)	$Q=1.81-3.10$	*t:* pratti	*g.p.:* pulcra
$E=0.02-0.28$	$\bar{Q}=2.10-2.50$	$N=50-80$	$l=25-35$ µm
$\bar{E}=0.06-0.17$	$P=255-600$ µm	$\bar{N}=55-65$	$h=105-160$ µm
$R=1.26-1.67$	$\bar{P}=330-430$ µm	$L=40-70$ µm	$n_{0.5}=4.0-8.0$
$\bar{R}=1.35-1.55$	$D=585-1177$ µm	$H=100-165$ µm	$\bar{n}_{0.5}=4.7-6.0$
	$\bar{D}=750-1000$ µm	$\bar{H}=110-150$ µm	$n_{1.0}=7.0-15.0$

R e m a r k s : In the first cycles the annular septa of the equatorial chambers are thicker than the radial ones.

R e t r o s p e c t i o n : MEFFERT (1931a), the denominator published a good figure on the internal morphology of the taxon. On this basis it is clear that the taxon is not a subspecies of "umbo" — the synonymic list of which is rather mixed — but rather a subspecies of "pratti" (see also in "Retrospection" of *Discocyclina pratti pratti*). The depiction in the lower half of text-fig. 5 in MEFFERT (1931a) is not characteristic of the taxon, in addition it is clearly discernable that the section was not well-oriented, therefore, for the time being, we ignored in the description the trybliolepidine embryon of the figure. The reason, why one of KÖHLER's (1967) "umbo"-s was only conditionally put into the synonymic list, is that the presented detail is too small for clear identification.

In our opinion SETIAWAN (1983) has described two taxa going by the name of *Discocyclina II.* cf. *D. sella.* One of these taxa, the one the *D* of which is around 1000 µm, may answer the criteria of the above described forms. This opportunity was also pointed out by SETIAWAN (1983, p. 94) himself.

C o m p a r i s o n : The taxon may only be confused with forms that have similarly large umbilico-, poly- or excentrilepidine embryon.

Among these the adauxiliary chambers of the most advanced *Discocyclina archiaci bartholomei* specimens and those of *D. pseudoaugustae, D. fortisi fortisi* and *D. fortisi simferopolensis* are of the "archiaci" type.

The embryons of *D. stratiemanuelis, D. spliti spliti* and *D. pulcra pulcra* are centrilepidine.

D. samantai is a ribbed form.

The embryon of *D. javana* is somewhat bigger and its equatorial chambers are wider.

R a n g e : The middle part of the Priabonian and probably the top of its lower part, too.

W Slovakia (Konská-Stráň near Rajec), E Gerecse (surroundings of Lábatlan — samples R 1, RA, RB, RD and RF), Armenia (surroundings of Daralaghez) and probably N Italy (Priabona).

Discocyclina samantai n. sp.

Pl. XXI, figs. 4—6, text-fig. 28j

D e r i v a t i o n o m i n i s : In honour of the Indian Orthophragmina-researcher, BIMAL K. SAMANTA.
H o l o t y p e : Preparation: E. 4814, pl. XXI, figs. 4—5.
T y p e l o c a l i t y : Lábatlan, József-puszta, sample R 2.
T y p e l e v e l : The middle part of the Priabonian.
D i a g n o s i s : Large-sized, flattened forms with 10 to 12 radial ribs. The embryon is excentrilepidine, the two chambers are large. The adauxiliary chambers are of the "pratti" type, numerous, wide and high. The equatorial chambers are relatively narrow but very high at the same time. "Pulcra" type growth pattern.

D e s c r i p t i o n :

External morphology: Large (8 to 15 mm), always flat forms. The umbo is 2 to 2.5 mm in diameter, strongly protruding. From here 10 to 12 thick radial ribs start. Between these ribs new ones may start, too, from the middle of the collar. "Discocyclina" type rosette, medium-sized granules (40 to 70 µm in diameter). The size ratio of forms "A" and "B" is unknown for the time being because the latter forms have not yet been found.

Internal morphology:

The equatorial section of forms "A" (text-fig. 28j):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri	$Q=1.95-2.63$	*t:* pratti	*g.p.:* pulcra
$E=0.19-0.35$	$\bar{Q}=2.00-2.60$	$N=45-66$	$l=25-35$ µm
$\bar{E}=0.10-0.45$	$\bar{P}=348-394$ µm	$\bar{N}=43-67$	$h=125-170$ µm
$R=1.27-1.48$	$P=280-440$ µm	$L=45-60$ µm	$n_{0.5}=4.2-5.3$
$\bar{R}=1.20-1.50$	$D=755-920$ µm	$H=100-120$ µm	$\bar{n}_{0.5}=4.2-5.4$
	$\bar{D}=670-940$ µm	$\bar{H}=90-125$ µm	$n_{1.0}=7.0-9.5$

R e m a r k s : In the initial cycles the annular walls of the equatorial chambers are thicker than the radial ones.

The equatorial section of forms "B": Microspheric specimens of the taxon were not found yet. Presumably the juvenarium is of the "Heterostegina" type.

Axial section: In this section the taxon could not be studied.

Phylogenetic position (text-fig. 28): No doubt, the species derives from the unribbed *Discocyclina pratti minor*, the internal morphology of which is conform with that of the descendant.

No data are available concerning the intraspecific evolution, since till now the species is known from only one population.

Also, we have no knowledge of probable descendants, the existence of which is not too likely, since *Discocyclina samantai* is one of the most specialized form at the end of the Eocene.

Retrospection: Ribbed forms with similar morphology were not known, that is why this new species had to be established. The discovery of this species, coming undoubtedly from *Discocyclina pratti*, is one of the most conclusive reasons for ruling out the genus-name "Aktinocyclina".

Variability: Those few forms, that are coming from the only population, are practically stable both externally and internally.

Comparison: The other ribbed forms have different type embryon, while forms with similar type and similar-sized embryon are unribbed without exception, so this species cannot be confused with any other one.

Range: The middle part of the Priabonian.

E Gerecse (surroundings of Lábatlan — samples RK, R 1—2).

Discocyclina pulcra (Checchia-Rispoli), 1909

Diagnosis: Medium- and large-sized, slightly inflate forms. The embryon is centrilepidine, the two chambers may vary in size from medium to extraordinary large. The "pratti" type adauxiliary chambers are numerous, wide and of varying height. The equatorial chambers are narrow or moderately wide, compared to this they are very high. The annular septum of the equatorial chambers are often stunted. The growth pattern of the annuli is of the "pulcra" type.

Description:

External morphology: Medium- and large-sized (4 to 15 mm), slightly inflate forms. Large umbo with smooth or indented (concave) top. The rosette is of the "Discocyclina" type, though hardly distinctable, since the granules, that are arranged in concentric rings, are small (40 to 60 μm in diameter). Forms "B" are approximately 2 times bigger than forms "A".

The equatorial section of forms "B": The few studied microspheric specimens were poorly preserved, the only thing that can be stated is that the juvenarium is of the "Heterostegina" type.

Axial section: On the basis of the only preparation we obtained through natural fracture, also, according to Gross—Köhler et al. (1980 — pl. 28, fig. 2) the height of the embryon is 200 μm, the equatorial layer is approximately 50 μm thick near the embryon. The lateral septum is thin, the annular one is just slightly curved or it is straight. The lateral chambers are 80×20 μm big on the average.

Phylogenetic position (text-fig. 28): On the basis of the available data the species can be derived from *Discocyclina pratti*, which is the closest taxon, more concretely from its most ancient subspecies.

Among the Orthophragminae this species has one of the quickest course of evolution, 4 evolutional stages (subspecies) can be distinguished for the time being using the following biometric limits:

Discocyclina pulcra landesica (text-figs. 28k—l):	$\bar{D}<750$ μm
Discocyclina pulcra pulcra (text-figs. 28m—n):	$\bar{D}=750-1200$ μm
Discocyclina pulcra balatonica (text-fig. 28o):	$\bar{D}=1200-1500$ μm
Discocyclina pulcra baconica (text-fig. 28p):	$\bar{D}>1500$ μm

Except for $\bar{E}$, $\bar{R}$ and $\bar{Q}$ similarly rapid evolution is detectable in the increase of $\bar{P}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{n}_{0.5}$ values.

On the basis of more complete material the separation of a new subspecies — characterized by the $\bar{D}$ varies from 950 to 1200 μm biometric unit — from *D. pulcra pulcra* could be possible (see text-fig. 28n). This subspecies would enclose the Angoumé population.

It is likely, too, that $\bar{D}$ less than 600 μm holds true of the Horsarrieu population. If this is so, it is imaginable that populations with $\bar{D}$ between 600 and 750 μm are also existing and these could be distinguished on the subspecies level (see text-fig. 28l).

No data are available concerning the descendants of this overspecialized species.

R e t r o s p e c t i o n : Form with the above characters was first described by CHECCHIA-RISPOLI (1909b). Though the "pulcra" name, given by the author, has not been used since then, there is no good reason to rule out this name, since the internal morphology of the specimens from the type locality is known. The "fortisi" denomination used by GROSS—KÖHLER et al. (1980) refers to forms with different internal morphology.

V a r i a b i l i t y : The internal qualitative features of the species are stable. The exterior however is more changeable. The typical indented umbo is not characteristic of all specimens, in addition pathological protruberances may be found on it (see pl. XXI, fig. 12).

R a n g e : From the middle part of the Cuisian to the end of the middle part of the Bartonian.

Discocyclina pulcra (CHECCHIA-RISPOLI), 1909 **landesica** n. ssp.

Pl. XXI, figs. 7, 10, text-figs. 28k—l

D e r i v a t i o n o m i n i s : Named after Landes (SW France), county of the taxon's type locality.
H o l o t y p e : Preparation E. 4816, pl. XXI, figs. 7, 10.
T y p e l o c a l i t y : Horsarrieu (SW Aquitaine) — Marniére Sourbet — sample HX.
T y p e l e v e l : The middle part of the Cuisian.
D i a g n o s i s : *Discocyclina pulcra* populations with $\bar{D}$ less than 750 μm.

D e s c r i p t i o n :

External morphology: Medium-sized (4 to 5 mm), slightly inflate forms. The ratio of the sizes of forms "A" and "B" is unknown for the time being because of the lack of the latter forms.

Internal morphology:

The equatorial section of forms "A" (text-figs. 28k—l):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q=1.63$	*t:* pratti	*g.p.:* pulcra
$E=0.06$	$\bar{Q}=1.50-2.00$	$N=35$	$l=25$ μm
$\bar{E}=0.00$	$P=314$ μm	$\bar{N}=25-50$	$h=90$ μm
$R=1.24$	$\bar{P}=225-420$ μm	$L=45$ μm	$n_{0.5}=8.8$
$\bar{R}=1.20-1.50$	$D=512$ μm	$H=55$ μm	$\bar{n}_{0.5}=6.0-10.5$
	$\bar{D}=390-750$ μm	$\bar{H}=40-100$ μm	$n_{1.0}=17.0$

R e m a r k s : In the first few cycles the annular walls of the equatorial chambers are thicker than the radial ones.

R e t r o s p e c t i o n : The form described above is not known from the literature and during our examination only a single specimen was found. The quantitative features of this specimen however are so much different from those of *Discocyclina pulcra pulcra*, the offspring, that its segregation into a distinct subspecies was justified.

C o m p a r i s o n : Perhaps *Discocyclina fortisi fortisi* may have such small centrilepidine embryon but the character of the adauxiliary chambers and the equatorial chambers' width and length are totally different.

R a n g e : The middle and presumably the upper part of the Cuisian and the lower part of the Lutetian stage.
SW Aquitaine (Horsarrieu — sample HX).

Discocyclina pulcra pulcra (CHECCHIA-RISPOLI), 1909

Pl. XXI, figs. 8—9, 15, text-figs. 28m—n

1909b. *Orthophragmina pulcra* n. sp. — CHECCHIA-RISPOLI, pp. 202—203, pl. 1, figs. 17a—b, 18, 18bis
H o l o t y p e : Not specified by the author of the taxon.
L e c t o t y p e : CHECCHIA-RISPOLI (1909b) pl. 1, fig. 18, depository in all likelihood: Museo della R. Universitá di Palermo, (marked out by the present author).
T y p e l o c a l i t y : Cacasacco (Termini-Imerese near Palermo), 2. layer [according to CHECCHIA-RISPOLI's (1909b) drawing, p. 178].
T y p e l e v e l : The Lower Bartonian substage (that is, the lower part of the Upper Eocene, according to the author of the taxon), in our opinion the middle or upper parts of the Lutetian.
D i a g n o s i s : *Discocyclina pulcra* populations with $\bar{D}$ varying from 750 to 1200 μm.

D e s c r i p t i o n :

External morphology: Medium-sized (5 to 8 mm), slightly rounded forms. The ratio of the sizes of forms "A" and "B" is unknown up to now.

Internal morphology:

The equatorial section of forms "A" (text-figs. 28m—n):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q=1.76-2.21$	*t:* pratti	*g.p.:* pulcra
$E=0.01-0.11$	$\bar{Q}=1.75-2.10$	$N=38-80$	$l=25-35$ µm
$\bar{E}=0.00$	$P=369-648$ µm	$\bar{N}=38-90$	$h=130-180$ µm
$R=1.30-1.88$	$\bar{P}=370-600$ µm	$L=40-60$ µm	$n_{0.5}=3.4-5.2$
$\bar{R}=1.30-1.60$	$D=810-1272$ µm	$H=115-210$ µm	$\bar{n}_{0.5}=3.6-6.0$
	$\bar{D}=750-1200$ µm	$\bar{H}=100-190$ µm	$n_{1.0}=6.0-10.5$

Remarks: In the first 3 or 4 cycles the annular walls of the equatorial chambers are thicker than the radial ones, then they become stunted.

Retrospection: The above description was based on our own preparations and the first describer, CHECCHIA-RISPOLI's (1909b — pl. 1, fig. 18) figures. In the case of the latter the number of the adauxiliary chambers was recorded relying on the drawing (pl. 1, fig. 18bis) of the embryon and its vicinity.

It is imaginable though, that this drawing shows fewer adauxiliary chambers than really exist.

Comparison: Any of the forms that have similar-sized centrilepidine embryon *(Discocyclina fortisi fortisi, D. fortisi simferopolensis, D. stratiemanuelis, D. spliti spliti)* has wider and less elongate equatorial chambers.

Range: The middle and upper parts of the Lutetian.

SW Aquitaine (Gibret, Angoumé), Sicily (Cacasacco near Palermo).

Discocyclina pulcra (CHECCHIA-RISPOLI), 1909 **balatonica** n. ssp.

Pl. XXI, figs. 12—14, pl. XXII, figs. 1—5, text-fig. 28o

1980. *Discocyclina fortisi* (D'ARCHIAC) — GROSS—KÖHLER et al. p. 182, pl. 28, fig. 2, text-fig. 37B

Derivatio nominis: Named after the Lake Balaton, the type locality being close to it.

Holotype: Preparation E. 4826, pl. XXII, fig. 2.

Type locality: Ajka, the upper end of Köleskepe-árok, sample Kö 1.

Type level: The lower part of the Bartonian stage.

Diagnosis: *Discocyclina pulcra* populations with $\bar{D}$ ranging from 1200 to 1500 µm.

Description:

External morphology: Medium- and large-sized (6 to 15 mm), slightly inflate forms (forms "B" are more rounded). Forms "B" are approximately 2 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 28o):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q=1.58-2.28$	*t:* pratti	*g.p.:* pulcra
$E=0.00-0.14$	$\bar{Q}=1.80-1.95$	$N=66-120$	$l=30-45$ µm
$\bar{E}=0.00$	$P=475-1099$ µm	$\bar{N}=79-90$	$h=150-230$ µm
$R=1.25-1.58$	$\bar{P}=650-765$ µm	$L=50-90$ µm	$n_{0.5}=2.8-4.4$
$\bar{R}=1.35-1.45$	$D=938-2024$ µm	$H=160-270$ µm	$\bar{n}_{0.5}=3.4-3.8$
	$\bar{D}=1200-1500$ µm	$\bar{H}=205-227$ µm	$n_{1.0}=5.1-8.0$

Remarks: Except for the first two cycles the annular septa of the equatorial chambers are stunted.

Retrospection: Forms with the above characters were published only by GROSS—KÖHLER et al. (1980) but the "fortisi" name, they used, do not refer to the above forms, this is why we had to segregate this new taxon. This form was also found in T. KECSKEMÉTI's collection. He identified the form as *Discocyclina* sp. but did not publish it.

Comparison: The equatorial chambers of forms with similar-sized centrilepidine embryon *(Discocyclina stratiemanuelis, D. spliti ajkaensis)* are much less elongate.

Range: The lower part of the Bartonian.

S Bakony (surroundings of Ajka — samples Sz 5, 6, 8; Ba 3, 5, 6; Kö 1, 3; J 3 and SzT are from our own sampling; samples "Köleskepe-2" and "Csékút" are from KECSKEMÉTI's sampling), Central Slovakia (Liptov Basin — Hruby Grúň).

Discocyclina pulcra (CHECCHIA-RISPOLI), 1909 **baconica** n. ssp.

Pl. XXI, fig. 11, pl. XXII, figs. 6—9, text-fig. 28p

Derivatio nominis: Named after the Bakony, the bigger geographic unit including the type locality.

Holotype: Preparation E. 4830, pl. XXII, fig. 7.

Type locality: Dudar, Sűrű-hegy, sample DS 5.

Type level: The middle part of the Bartonian stage.
Diagnosis: *Discocyclina pulcra* populations with $\bar{D}$ exceeding 1500 μm.

Description:

External morphology: Medium- and large-sized (6 to 10 mm), slightly inflate forms. The size ratio of forms "A" and "B" is unknown for the time being because the latter forms are missing.

Internal morphology:

The equatorial section of forms "A" (text-fig. 28p):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: centri	$Q=1.54-2.17$	*t:* pratti	*g.p.:* pulcra
$E=0.01-0.14$	$\bar{Q}=1.70-1.90$	$N=76-128$	$l=35-40$ μm
$\bar{E}=0.00$	$P=652-1311$ μm	$\bar{N}=85-100$	$h=165-260$ μm
$R=1.19-1.57$	$\bar{P}=850-1030$ μm	$L=50-90$ μm	$n_{0.5}=2.4-3.8$
$\bar{R}=1.30-1.45$	$D=1247-2014$ μm	$H=205-300$ μm	$\bar{n}_{0.5}=2.8-3.2$
	$\bar{D}=1500-1800$ μm	$\bar{H}=225-265$ μm	$n_{1.0}=4.7-7.2$

Remarks: Except for the first two cycles the annular walls of the equatorial chambers are stunted.

Retrospection: The segregation of the new taxon was justified, since forms with the above characters were not found in the literature.

Comparison: The equatorial chambers of forms with similar-sized centrilepidine embryon (*Discocyclina stratiemanuelis, D. spliti ajkaensis*) are much less elongate.

Range: The middle part of the Bartonian.

N Bakony (surroundings of Dudar — samples DS 4—5).

Genus Nemkovella n. gen.

Genotype: *Orbitoides strophiolata* Gümbel, 1868, with Schlumberger's (1903) description and depiction.

Derivatio nominis: In honour of the outstanding researcher of Larger Foraminifera prof. G. I. Nemkov (Moscow).

The test is disc-shaped or lenticular with an umbo in its centre.

The megalospheric embryon may be nephro- or semi-isolepidine.

The equatorial chambers are always with four stolons and with radial walls only. They are slightly hexagonal. The cycles are always circular.

Range: The Lower and Middle Eocene and the lower part of the Upper Eocene as well.

The European part of the Tethys.

PHYLOGENY OF THE NEMKOVELLAE

The earliest *Nemkovella* known up to now is *N. evae.* It has nephro- and semi-nephrolepidine embryon, the growth pattern of its annuli is of the "archiaci" type and its equatorial chambers are relatively wide (35 to 40 μm on the average).

From it may have evolved — through *N. fermonti* (see table 10 and text-fig. 29) — the *N. strophiolata* lineage, the embryon of which bears nephro- and semi-nephrolepidine character, its adauxiliary chambers are lower, its equatorial chambers are narrower (25 to 30 μm) and the growth pattern of its annuli is more complex than in the case of *N. evae.*

DESCRIPTION OF THE SPECIES AND SUBSPECIES OF NEMKOVELLAE

Nemkovella evae n. sp.

Pl. XXIII, figs. 1—7, 9—12, pl. XXIV, figs. 1—4, text-fig. 29a

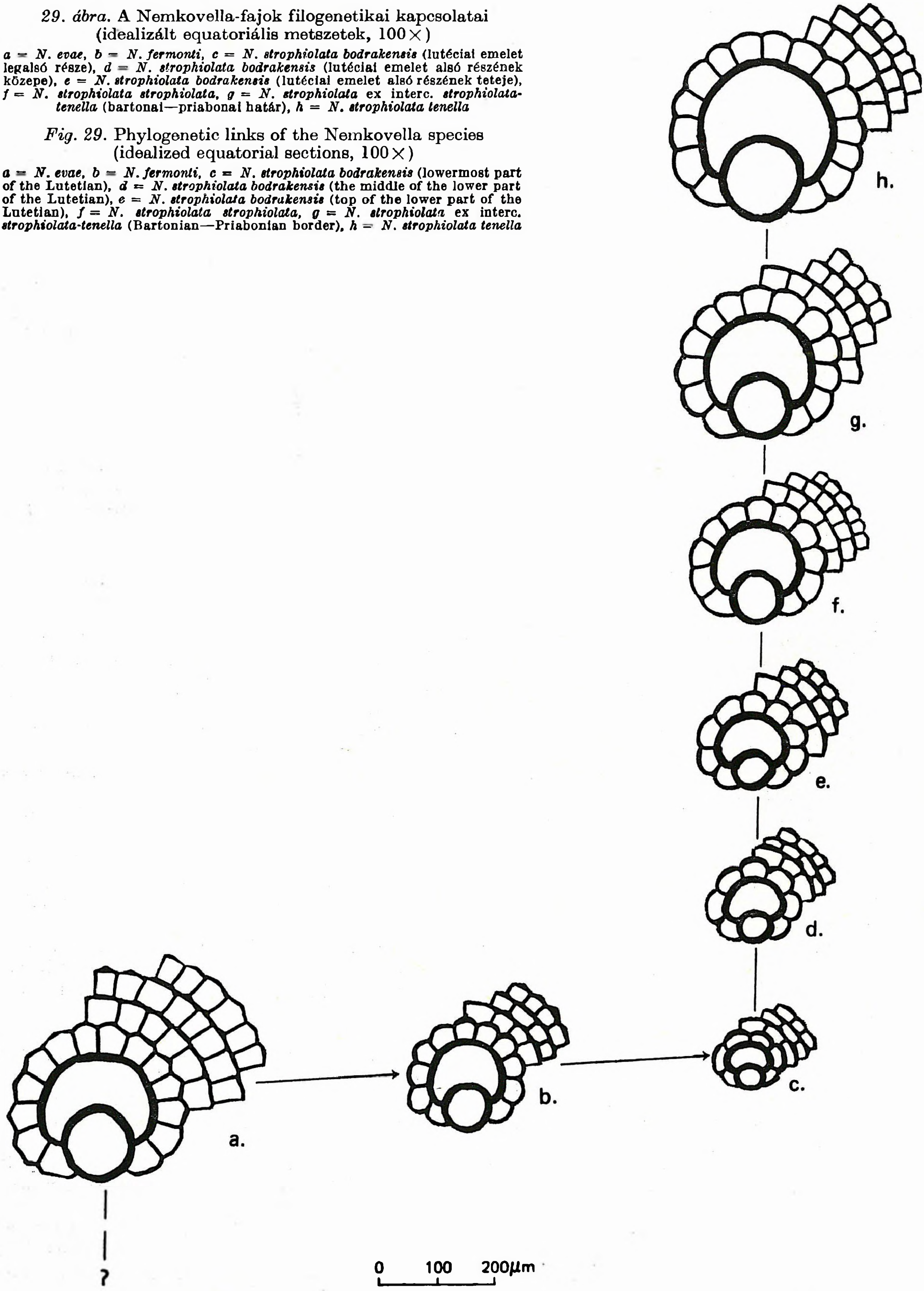
1955. *Discocyclina augustae* Weijden — Neumann, pp. 129—130, pl. 7, fig. 5
partim 1958. *Discocyclina augustae* Weijden — Neumann, pp. 84—86, pl. 12, fig. 3.
1973. *Discocyclina* sp. — Bombiţă, pl. 2, fig. 5/13
partim 1974. *Discocyclina strophiolata* (Gümbel) — Portnaya, pp. 101—104, pl. 24, fig. 5
partim 1982. *Discocyclina augustae* Weijden — Fermont, p. 136, table 6 (partim), pl. 8, figs. 1—4

29. ábra. A Nemkovella-fajok filogenetikai kapcsolatai (idealizált equatoriális metszetek, 100×)

a = *N. evae*, *b* = *N. fermonti*, *c* = *N. strophiolata bodrakensis* (lutéciai emelet legalsó része), *d* = *N. strophiolata bodrakensis* (lutéciai emelet alsó részének közepe), *e* = *N. strophiolata bodrakensis* (lutéciai emelet alsó részének teteje), *f* = *N. strophiolata strophiolata*, *g* = *N. strophiolata* ex interc. *strophiolata-tenella* (bartonai—priabonai határ), *h* = *N. strophiolata tenella*

Fig. 29. Phylogenetic links of the Nemkovella species (idealized equatorial sections, 100×)

a = *N. evae*, *b* = *N. fermonti*, *c* = *N. strophiolata bodrakensis* (lowermost part of the Lutetian), *d* = *N. strophiolata bodrakensis* (the middle of the lower part of the Lutetian), *e* = *N. strophiolata bodrakensis* (top of the lower part of the Lutetian), *f* = *N. strophiolata strophiolata*, *g* = *N. strophiolata* ex interc. *strophiolata-tenella* (Bartonian—Priabonian border), *h* = *N. strophiolata tenella*



partim 1982. *Discocyclina varians* (KAUFMANN) — FERMONT, p. 135, table 6 (partim), pl. 9, figs. 1—2, pl. 11, figs. 6—7(?)

?1982. *Discocyclina* sp. — FERMONT, pp. 137—138, table 6 (partim), pl. 8, figs. 5—6

Derivatio nominis: The species is named after the describer's mother, MRS. NÁNDOR LESS maiden name ÉVA SZABÓ.

Holotype: Preparation E. 4836, pl. XXIV, fig. 3.

Type locality: Crimea, Suvlu-Kaya Hill, Simferopolian stage, the middle part of the *Nummulites distans minor* zone, sample E 9.

Type level: The upper part of the Cuisian.

Diagnosis: Small- and medium-sized, flat forms. The embryon is of the nephrolepidine type (transition towards the semi-isolepidine type is possible). The two chambers are smaller than the average. The adauxiliary chambers are of the "varians" type. They are relatively low in numbers, varying in width but low. The equatorial chambers are relatively wide but low. "Archiaci" type growth pattern (transitions towards the "strophiolata" or "trabayensis" types are possible).

Description:

External morphology: Small- and medium-sized (3 to 6 mm), moderately flattened forms. The umbo is varying in size, strongly protruding but the transition from umbo to collar is not too sharp. The rosette is of the transitional "Discocyclina—chudeaui" type, the granules are relatively large (100 to 120 μm in diameter) on the umbo but small (30 to 50 μm in diameter) on the collar. Forms "B" are 1 to 1.5 times bigger than the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 29a):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-iso, iso)	$Q=1.11-2.03$	*t:* varians	*g.p.:* archiaci (strophiolata, trabayensis)
$E=0.76-1.69$	$\bar{Q}=1.35-1.80$	$N=8-24$	$l=30-50$ μm
$\bar{E}=0.85-1.20$	$P=85-196$ μm	$\bar{N}=10-15$	$h=35-90$ μm
$R=0.10-0.70$	$\bar{P}=100-180$ μm	$L=35-75$ μm	$n_{0.5}=9.5-18.5$
$\bar{R}=0.35-0.60$	$D=135-259$ μm	$H=35-65$ μm	$\bar{n}_{0.5}=11.0-17.5$
	$\bar{D}=170-210$ μm	$\bar{H}=40-55$ μm	$n_{1.0}=22.0-36.5$

The equatorial section of forms "B": On the basis of FERMONT's (1982 — pl. 11, figs. 6—7) and our own preparations the juvenarium is of the "Heterostegina" type, the nepionic phase is developed. I = 10—15 μm, S = 5, s = 35—45 μm, n = 10—14, d = 180—250 μm, J = 8—13, j = 500—600 μm.

Axial section: In this section the taxon could not be studied.

Phylogenetic position (text-fig. 29): At present no data are available with respect to the ancestors of the species. It is imaginable that they are outside Europe.

Intraspecific evolution is not detectable. The Cuisian forms do not differ from those of the lower part of the Lutetian.

We consider *Nemkovella fermonti* as direct descendant of the species. It is an intermediate form between *N. evae* and *N. strophiolata*.

Retrospection: The following denominations like NEUMANN's (1955, 1958) "augustae", PORTNAYA's (1974) "strophiolata", FERMONT's (1982) "augustae" and "varians" cannot be used, since these names refer to forms with different internal morphology. Therefore the establishment of a new taxon was necessary.

It should be noted that NEUMANN's (1955, 1958) form from Doazit has somewhat more (24) adauxiliary chambers than our studied specimens do. However, the character and size of the embryon and the hexagonal equatorial chambers as well make clear the rightness of this inclusion, even if the scale of enlargement is not correct.

Variability: The external characters of the species are relatively stable. Among the internal features the width of the equatorial chambers and the growth pattern of the annuli are the most changeable.

A striking feature is the isolepidine type embryons of the forms from Israel, described by FERMONT (1982) as *Discocyclina* sp. This is why these forms were only conditionally included into the synonymic list.

Comparison: It is the moderate hexagonality of the equatorial chambers that clearly distinguishes species from the Discocyclinae among the forms with similar type and similar-sized embryon.

The embryons of all Orbitoclypeus, that are a bit similar to *Nemkovella evae*, are less excentric.

Among the Nemkovellae the embryon of *N. fermonti* is smaller and it has fewer adauxiliary chambers as well. The equatorial chambers of *N. strophiolata strophiolata* and *N. strophiolata tenella* are narrower, the growth pattern of the annuli clearly shows "strophiolata" character.

R a n g e : The Cuisian and the lower part of the Lutetian.

SW Aquitaine (Horsarrieu — samples HX, HS; Doazit, Le Porge, Saint-Barthélémy), Rumania (the Eastern Carpathians — Zabala Basin), Crimea — Bakhchisaraian stage — according to PORTNAYA (1974 — pl. 24, fig. 5) — presumably the upper part of it, Simferopolian stage — the whole of the *Nummulites distans minor* zone (samples U 2, 3, 7, E 9, B 50) and the lower part of the *N. distans* zone (sample B 53), Israel (presumably the whole of the Ein Avedat section).

Nemkovella fermonti n. sp.

Pl. XXIII, fig. 8, pl. XXIV, figs. 5—6, text-fig. 29b

D e r i v a t i o n o m i n i s : In honour of the Dutch Orthophragmina-researcher, named after W. J. J. FERMONT.
H o l o t y p e : Preparation E. 4843, pl. XXIV, fig. 5.
T y p e l o c a l i t y : Crimea, Suvlu-Kaya Hill — Simferopolian stage, the top of the *Nummulites distans* zone, sample B 77.
T y p e l e v e l : The lower part of the Lutetian.
D i a g n o s i s : Small-sized, flattened forms. The embryon is transitional semi-iso—nephrolepidine, the two chambers are small. The adauxiliary chambers are of the "varians" type, low in numbers, relatively narrow and low. The equatorial chambers are medium wide and low. The growth pattern of the annuli is of the "strophiolata" type.

D e s c r i p t i o n :

External morphology: Small-sized (2.5—5 mm), moderately flattened forms. The umbo is of varying size, well-protruding, generally slopes downwards into the collar. The rosette is of the transitional "Discocyclina—chudeaui" type. The granules are much bigger (approximately 100 μm in diameter) on the umbo than on the collar (40 to 50 μm in diameter). The size ratio of the forms "A" and "B" are not yet known, because of the lack of the latter forms.

Internal morphology:

The equatorial section of forms "A" (text-fig. 29b):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-iso—nephro	$Q = 1.33-1.71$	*t:* varians	*g.p.:* strophiolata
$E = 0.96-1.30$	$\bar{Q} = 1.35-1.65$	$N = 7-11$	$l = 30-40$ μm
$\bar{E} = 0.95-1.30$	$P = 70-97$ μm	$\bar{N} = 7-12$	$h = 35-85$ μm
$R = 0.24-0.53$	$\bar{P} = 70-100$ μm	$L = 30-50$ μm	$n_{0.5} = 15.5-18.0$
$\bar{R} = 0.30-0.55$	$D = 116-135$ μm	$H = 25-50$ μm	$\bar{n}_{0.5} = 14.5-19.0$
	$\bar{D} = 105-140$ μm	$\bar{H} = 25-45$ μm	$n_{1.0}$ is unknown

The equatorial section of forms "B": Microspheric specimens of the taxon have not been found yet. Presumably the juvenarium is of the "Heterostegina" type with well developed nepionic phase.

Axial section: In this section the taxon could not be examined.

P h y l o g e n e t i c p o s i t i o n (text-fig. 29): *Nemkovella evae* and *N. strophiolata bodrakensis* may be the ancestor and offspring of the species respectively, since its internal morphology is of transitional character between these two taxa and the species appears after the first taxon but before the latter one.

The course of intraspecific evolution cannot be detected on the basis of the available data.

R e t r o s p e c t i o n : The reason why the establishment of the new species is justified is that transitional forms between *Nemkovella evae* and *N. strophiolata bodrakensis* were found in Cuisian and Lower Lutetian beds. Such forms are not known from the literature.

V a r i a b i l i t y : Among the few data available the following one should be noted: the adauxiliary chambers' character of the only specimen from Horsarrieu somewhat differs from the "varians" type (see pl. XXIII, fig. 8).

C o m p a r i s o n : Among the forms with similar type and similar-sized embryon the equatorial chambers of the Discocyclinae are with 6 stolons, they are rectangular in shape.

The equatorial chambers of *Orbitoclypeus pygmaea* are narrower, gentle waves are observable in the cycles. The juvenarium of forms "B" is totally different in type.

The embryon of *Nemkovella evae* is bigger with somewhat lower excentricity. It has more adauxiliary chambers, the equatorial chambers are somewhat wider, the growth pattern of the annuli does not show typical "strophiolata" character.

The embryon of *N. strophiolata bodrakensis* is smaller, more excentric. It has fewer adauxiliary chambers and in the initial cycles the equatorial chambers are much lower.

Perhaps the distinction from *N. strophiolata strophiolata* is the most difficult. This form however possess narrower equatorial chambers and the growth pattern of its annuli bears a stronger "strophiolata" character. Due to the difference in stratigraphic level the accompanying fauna is rather different, too.

Range: The middle and upper parts of the Cuisian and the lower part of the Lutetian.

SW Aquitaine (Horsarrieu – sample HN, Saint-Barthélémy), Crimea – Simferopolian stage – the upper part of the *Nummulites distans* zone (sample B 77).

Nemkovella strophiolata (Gümbel), 1868

Diagnosis: Small-sized, flattened forms. The embryon is of the transitional nephro–semi-isolepidine type, the two chambers are small. The "varians" type adauxiliary chambers are few, medium wide and low. The equatorial chambers are narrow or medium wide, they are very low near the embryon but higher on the peripheries. The growth pattern of the annuli is of the "strophiolata" type.

Description:

External morphology: Small-sized (1.5 to 5 mm), flat forms. The small, sharp umbo gradually slopes towards the collar. The rosette is of the transitional "Discocyclina–chudeaui" type, the granules on the umbo are somewhat bigger (80 to 100 μm in diameter) than on the collar (40 to 60 μm in diameter). There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "B": On the basis of our preparations the juvenarium is of the "Heterostegina" type, the nepionic phase is still rather developed. I=12–15 μm, S=4, s=25–35 μm, n=13–14, d=160–200 μm, J=10–15, j=600–750 μm.

Axial section: Lacking own preparations on the basis of Schlumberger's (1903 – pl. 10, fig. 37) figure the height of the embryon is ranging from 100 to 120 μm. The equatorial layer is 40 μm thick near the embryon and it thickens up to 80 μm towards the peripheries. The lateral septum is thin, the partion-walls of the chambers are straight. The lateral chambers are 50–60×20–25 μm big on the average.

Phylogenetic position (text-fig. 29): *Nemkovella fermonti* can be regarded as the ancestor of the species, since this is the closest taxon to *N. strophiolata* and stratigraphically it comes before *N. strophiolata.*

On the basis of the available data 3 evolutional stages (subspecies) can be distinguished using the following biometric limits:

Nemkovella strophiolata bodrakensis (text-figs. 29c–e):	$\bar{D} < 125$ μm
Nemkovella strophiolata strophiolata (text-fig. 29f)	$\bar{D} = 125-180$ μm
Nemkovella strophiolata tenella (text-fig. 29h):	$\bar{D} > 180$ μm

In addition to the increase of $\bar{D}$, similar definite development is detectable in the increase of $\bar{R}$, $\bar{P}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{E}$ parameter means.

The tendency of the increase of $\bar{Q}$ and decrease of $\bar{n}_{0.5}$ is not so explicit.

On the basis of bigger material it is imaginable to define a subspecies – characterized by the $\bar{D}$ less than 80 μm biometric unit – from *N. strophiolata bodrakensis* (see text-fig. 29c). This subspecies would enclose the Saint-Barthélémy population. Another subspecies with $\bar{D}$ ranging from 100 to 125 μm may also be separated (see text-fig. 29e). Likewise a further subspecies with $\bar{D}$ ranging from 160 to 200 μm may be distinguished as a consequence of which the definition of *N. strophiolata strophiolata* and *N. strophiolata tenella* as well would change to a certain extent (see text-fig. 29g).

Up to now no data were found concerning the offsprings of the species.

Retrospection: Gümbel (1868), who gave the "strophiolata" name, did not illustrate the inner morphology of the taxon. Also, none has published this species from the type locality since then. Therefore those of Schlumberger's (1903) description and figures should be accepted as conclusive that are not from the type locality, even if it is not sure that they coincide with Gümbel's (1868) "strophiolata" from Kressenberg. The following describers either repeated Schlumberger's (1903) description and figures or going by this name they described forms with features other than described above.

It was also Gümbel (1868) who gave the "tenella" name to those Bavarian forms the internal morphology of which too, is unknown. Since, however, the first figure (Gross–Köhler et al. 1980) illustrating this name (similarly to "strophiolata" not topotypical) was disclosed only nowadays, this name, unlike "strophiolata", can be used on the subspecies level only.

The "augustae" name, used by Schweighauser (1953), refer to forms with different internal morphology.

Variability: Among the external features the umbo size is the most changeable. As far as the interior is concerned wider than the average equatorial chambers of the Crimean *Nem-*

kovella strophiolata bodrakensis is a striking feature. Since these forms are the same as *N. strophiolata* in the rest of the qualitative features, there is no good reason to establish a distinct taxon.

Range: The Lutetian and Bartonian stages and the lower and middle parts of the Priabonian.

Nemkovella strophiolata (Gümbel), 1868 bodrakensis n. ssp.

Pl. XXIV, figs. 7–12, text-figs. 29c–e

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E. 4847, pl. XXIV, fig. 10.
Type locality: Crimea, left bank of the river Bodrak, the lower part of the Bodrakian stage, sample C 25.
Type level: The lower part of the Lutetian stage.
Diagnosis: *Nemkovella strophiolata* populations with $\bar{D}$ less than 125 μm.

Description:

External morphology: Small (1.5 to 3 mm), flattened forms. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-figs. 29c–e):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-iso	$Q = 1.28-1.62$	*t:* varians	*g.p.:* strophiolata
$E = 1.09-1.46$	$\bar{Q} = 1.30-1.55$	$N = 3-7$	$l = 35-45$ μm
$\bar{E} = 1.10-1.45$	$P = 47-69$ μm	$\bar{N} = 3.5-6.5$	$h = 40-60$ μm
$R = 0.22-0.44$	$\bar{P} = 45-70$ μm	$L = 30-40$ μm	$n_{0.5} = 14.5-22.0$
$\bar{R} = 0.20-0.45$	$D = 64-97$ μm	$H = 20-35$ μm	$\bar{n}_{0.5} = 15.0-22.0$
	$\bar{D} = 65-125$ μm	$\bar{H} = 20-35$ μm	$n_{1.0}$ is unknown

Remarks: In the outer annuli the height of the equatorial chambers may well increase almost without any transition.

Retrospection: Forms with the above described inner morphology are completely unknown in the literature, this is why a new taxon had to be established.

Comparison: Among the forms with similar type and similar-sized embryon the equatorial chambers of Discocyclinae are with 6 stolons, they are rectangular.

The adauxiliary chambers of *Orbitoclypeus daguini* are different in type while the equatorial chambers of *O. pygmaea* are narrower, the annuli are moderately waved.

The embryon of *Nemkovella fermonti* is somewhat bigger and less excentric, it has more adauxiliary chambers and its equatorial chambers are higher in the periembryonal annuli.

Range: The lower part of the Lutetian.

SW Aquitaine (Saint-Barthélémy), Crimea – the lower part of the Bodrakian stage (samples A 23 and C 25).

Nemkovella strophiolata strophiolata (Gümbel), 1868

Pl. XXV, figs. 1–10, text-fig. 29f

?1868. *Orbitoides (Rhipidocyclina) strophiolata* n. sp. – Gümbel, pp. 705–706, pl. 4, figs. 25–28
1903. *Orthophragmina strophiolata* (Gümbel) – Schlumberger, pp. 284–285, pl. 10, figs. 30, 36, 37, text-fig. F
1922. *Discocyclina strophiolata* (Gümbel) – Douvillé, pp. 74, 92
partim 1929. *Discocyclina strophiolata* (Gümbel) – Llueca, pp. 285–286, text-fig. 61
1940. *Discocyclina (Discocyclina) strophiolata* (Gümbel) – Weijden, pp. 56–57, pl. 9, figs. 8–10
non 1959. *Discocyclina strophiolata* (Gümbel) – Belmustakov, p. 54, pl. 19, figs. 15–16. (= ?)
partim 1974. *Discocyclina strophiolata* (Gümbel) – Portnaya, pp. 101–104, pl. 24, figs. 1–3
partim non 1974. *Discocyclina strophiolata* (Gümbel) – Portnaya [= *Nemkovella evae* et Discocyclina indet. sp. (pl. 24, fig. 8)]

Holotype: Not given by the author of the taxon.
Lectotype: Gümbel (1868), pl. 4, fig. 25, depository not specified – external form (marked out by us).
Type locality: Hammer (Kressenberg – Bavarian Alps).
Type level: Not specified.
The type of the equatorial section of forms "A": Schlumberger (1903), pl. 10, fig. 36, text-fig. F, Biarritz, Villa Marbella, the middle part of the Bartonian, depository: École de Mines (Paris).
Diagnosis: *Nemkovella strophiolata* populations with $\bar{D}$ ranging from 125 to 180 μm.

Description:

External morphology: Small-sized (2.5 to 5 mm), flattened forms. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 29f):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro–semi-iso	$Q=1.18-1.71$	*t:* varians	*g.p.:* strophiolata
$E=0.91-1.60$	$\bar{Q}=1.40-1.60$	$N=6-14$	$l=25-35$ µm
$\bar{E}=0.95-1.25$	$P=77-130$ µm	$\bar{N}=8.0-11.5$	$h=35-75$ µm
$R=0.20-0.57$	$P=85-118$ µm	$L=35-50$ µm	$n_{0.5}=14.5-22.8$
$\bar{R}=0.30-0.55$	$D=123-204$ µm	$H=30-50$ µm	$\bar{n}_{0.5}=16.5-20.0$
	$\bar{D}=125-180$ µm	$\bar{H}=32-45$ µm	$n_{1.0}=30.5-39.0$

R e t r o s p e c t i o n : The reason, why GÜMBEL's (1868) "strophiolata" was conditionally included, can be found under "Retrospection" at the discussion of the species. SCHLUMBERGER's (1903) "strophiolata" in the equatorial section fell onto the lower limit of the subspecies' biometric unit, specified in the "Diagnosis". The embryon of the form depicted in the axial section is visibly somewhat bigger. For this reason and considering the known accompanying fauna *(Discocyclina pratti pratti, Orbitoclypeus varians scalaris)*, too, nevertheless this form as well as the later repeated descriptions and figures could be assigned to this category.

C o m p a r i s o n : Among the forms with similar type and similar sized embryon the equatorial chambers of the Disocyclinae are with 6 stolons, they are rectangular.

The embryon of *Orbitoclypeus ramaraoi ramaraoi* is less excentric, it has more adauxiliary chambers. The growth pattern and the juvenarium of forms "B" are different, too. The latter two features are suitable for distinguishing the taxon from *O. pygmaea* as well. Also *O. pygmaea* has undulated annuli.

The embryon of *Nemkovella evae* is generally somewhat bigger, less excentric, it has more adauxiliary chambers, different growth pattern and wider equatorial chambers.

The embryon of *N. fermonti* is somewhat smaller, its equatorial chambers are a bit wider and the growth pattern is not so explicit as that of the discussed taxon. Due to the difference in stratigraphic level the accompanying fauna is rather different.

R a n g e : The middle and upper parts of the Lutetian and the whole Bartonian.

SW Aquitaine (Gibret, Nousse, Angoumé, Biarritz – Villa Marbella), S Bakony [surroundings of Ajka – samples Ba 3, 6; Sz 5, 8; Kö 2, 4 are from our own sampling; sample "Köleskepe-2" is from KECSKEMÉTI's (1959) collection], N Bakony (surroundings of Dudar – sample DS 3).

Nemkovella strophiolata (GÜMBEL), 1868 **tenella** (GÜMBEL), 1868

Pl. XXV, figs. 11–12, text-fig. 29h

?1868. *Orbitoides (Discocyclina) tenella* n. sp. – GÜMBEL, p. 698, pl. 3, figs. 1, 2, 30, 31

partim 1953. *Discocyclina augustae* WEIJDEN – SCHWEIGHAUSER, pp. 49–51, pl. 8, fig. 2, text-fig. 41 (on the right side, below)

1980. *Discocyclina tenella* GÜMBEL – GROSS–KÖHLER et al., p. 184, pl. 27, fig. 8, text-fig. 37E (?)

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : GÜMBEL (1868), pl. 3, fig. 1 – external form, depository unknown (marked out by the present writer).
T y p e l o c a l i t y : Hammer (Bavarian Alps).
T y p e l e v e l : Not specified.
The t y p e of the equatorial section of forms "A": GROSS–KÖHLER et al. (1980), pl. 27, fig. 8, depository: Geologický Ústav D. Štúra, Bratislava; Partizánska Ľupča, presumably the Priabonian.
D i a g n o s i s : *Nemkovella strophiolata* populations with $\bar{D}$ bigger than 180 µm.

D e s c r i p t i o n :

External morphology: Small-sized (3 to 5 mm), flattened forms. The ratio of the sizes of forms "A" and "B" is unknown, since the latter forms are not yet found.

Internal morphology:

The equatorial section of forms "A" (text-fig. 29h):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-nephro)	$Q=1.38-2.10$	*t:* varians	*g.p.:* strophiolata
$E=0.75-1.09$	$\bar{Q}=1.50-1.90$	$N=10-16$	$l=30-35$ µm
$\bar{E}=0.75-1.00$	$P=100-157$ µm	$\bar{N}=10-15$	$h=40-60$ µm
$R=0.43-0.75$	$\bar{P}=100-160$ µm	$L=40-50$ µm	$n_{0.5}=15.0-16.5$
$\bar{R}=0.50-0.70$	$D=179-250$ µm	$H=40-50$ µm	$\bar{n}_{0.5}=14.0-18.0$
	$\bar{D}=180-250$ µm	$\bar{H}=40-55$ µm	$n_{1.0}=29.0-31.0$

R e t r o s p e c t i o n : See "Retrospection" at the discussion of the species.

C o m p a r i s o n : Among the forms with similar-sized and similar type embryon the equatorial chambers of Discocyclinae are with 6 stolons, they are rectangular.

The equatorial chambers of *Nemkovella evae* are wider, the growth pattern of the annuli is different.

R a n g e : The lower and middle parts of the Priabonian.

N Italy (Mossano), E Gerecse (surroundings of Lábatlan — samples RA, RF), Central Slovakia (Liptov Basin — Partizánska Ľupča), probably the Bavarian Alps (Hammer, Kressenberg).

FAMILY ASTEROCYCLINIDAE BRÖNNIMANN, 1951

Type of the family: *Asterocyclina* GÜMBEL, 1868

Synonym: *Orbitoclypeidae* CAUDRI, 1972

The test can be discoidal with ribs bifurcating at the edges, star-shaped or lenticular. The central equatorial layer is enclosed by two lateral layer that consist of lateral chambers strengthened by pillars.

Its microspheric juvenarium bears "Lepidocyclina" character. The equatorial chambers are arranged in cycles. They can be regarded as real chambers corresponding with a chamber in the spiral of the microspheric juvenarium.

Generally, the equatorial chambers are hexagonal, rarely rectangular.

R a n g e : The upper part of the Paleocene and the entire Eocene.

The Caribbean and Pacific regions of the American Continent from Peru to Alaska, Polynesia, the Tethys from Morocco to New Caledonia and from Lake Aral to Somali.

Genus Orbitoclypeus Silvestri, 1907

Genotype: *Orbitoides varians* KAUFMANN 1867, with SCHLUMBERGER's (1903) description and depiction*

Synonyms: *Orthophragmina* MUNIER-CHALMAS, 1891 (partim)
Exagonocyclina CHECCHIA-RISPOLI, 1909
Eudiscodina WEIJDEN, 1940
Trybliodiscodina WEIJDEN, 1940 (partim)
Hexagonocyclina CAUDRI, 1944
Neodiscocyclina CAUDRI, 1972 (partim)

Mostly the test is lencticular, but it may also be disc-shaped with radial ribs that may bifurcate on the edges. Rarely they may be star-shaped as well (with 6 to 8 rays).

In the microspheric juvenarium the cycles do not take asteroidal shape at all. Rarely they may be strongly undulated but only in the neanic stage.

Mostly the megalospheric embryon is excentri-, eu- or perhaps trybliolepidine, very rarely (in the case of primitive forms) isolepidine as well.

The equatorial chambers are always with four stolons except for one form (*Orbitoclypeus furcata*, see p. 214). They have only radial stolons and walls, they look hexagonal.

The cycles of the equatorial chambers are either circular or slightly undulated. In the rays (if they exist) the equatorial layer hardly or do not thickens at all and never divide into more layers.

R a n g e : The upper part of the Paleocene and the entire Eocene.

The Caribbean region of the American Continent and the Tethys from Spain to Timor and to Somali.

PHYLOGENY OF THE EURASIAN ORBITOCLYPEI

Except for the specially structured *Orbitoclypeus daguini* and *O. pygmaea* of unknown origin (presumably the first is the ancestor of the latter one) (see text-fig. 31), all the Eurasian Orbitoclypei can be derived from the Paleocene *O. seunesi* (see table 10 and text-fig. 30) that has medium-sized eu—trybliolepidine embryon, circular annuli and medium wide (30 to 35 μm) equatorial chambers.

The *O. ramaraoi* group can be directly derived from *O. seunesi*. The "marthae" type rosette is always characteristic of this group. The width of the equatorial chambers varies from 25 to 40 μm.

On the basis of our present knowledge only *O. ramaraoi* forms lineage within the group. Eulepidine, later excentrilepidine embryon and circular annuli are characteristic of this species. As the col-

* The genotype, given by SILVESTRI (1907a) was depicted by LAGHI—SIROTTI (1982) referred to as *Orbitoclypeus nummuliticus* (GÜMBEL). The latter name cannot be used in the present writer's opinion (see explanation later). The above figure shows an *Orbitoclypeus varians varians* (KAUFMANN) in our opinion.

30. ábra. Az *Orbitoclypeus seunesi*-től származtatható Orbitoclypeus-fajok filogenetikai kapcsolatai (idealizált equatoriális metszetek, 50×)

a = *O. seunesi*, *b* = *O. ramaraoi ramaraoi*, *c* = *O. ramaraoi neumannae*, *d* = *O. ramaraoi suvlukayensis* *e* = *O. ramaraoi crimensis*, *f* = *O. marthae*, *g* = *O. multiplicata*, *h* = *O. bayani*, *i* = *O. douvillei* (cuisi emelet középső része), *j* = *O. douvillei* (lutéciai emelet alsó része), *k* = *O. douvillei* (lutéciai emelet középső része), *l* = *O. portnayae*, *m* = *O. varians horsarrieuensis*, *n* = *O. varians angoumensis*, *o* = *O. varians roberti*, *p* = *O. varians scalaris*, *q* = *O. varians varians*, *r* = *O. furcata rovasendai*, *s* = *O. furcata furcata* (priabonai emelet középső része), *t* = *O. furcata furcata* (priabonai emelet felső része), *u* = *O. chudeaui chudeaui* (lutéciai emelet alsó—középső része), *v* = *O. chudeaui chudeaui* (lutéciai emelet felső része), *w* = *O. chudeaui pannonicus*, *x* = *O. katoae*, *y* = *O. schopeni* (cuisi—lutéciai határ), *z* = *O. schopeni* (lutéciai emelet középső—felső része), *α* = *O. koehleri*. Kiegészítő jelek: *1.* „chudeaui"-típusú rozettával rendelkező bordázatlan alak, *2.* hullámos gallérú alak, *3.* „marthae"-típusú rozettával rendelkező bordás alak, *4.* „chudeaui"-típusú rozettával rendelkező bordás alak

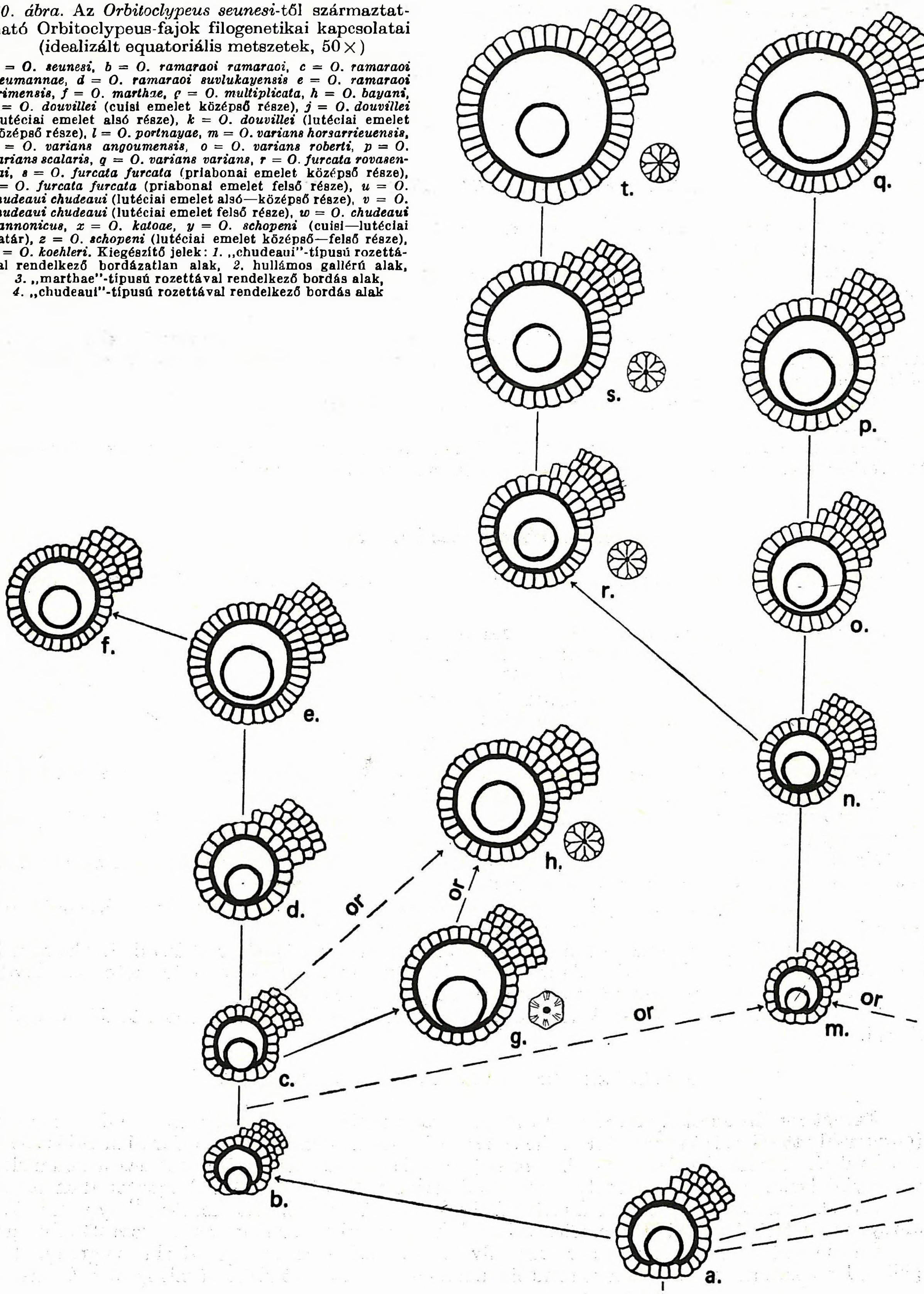
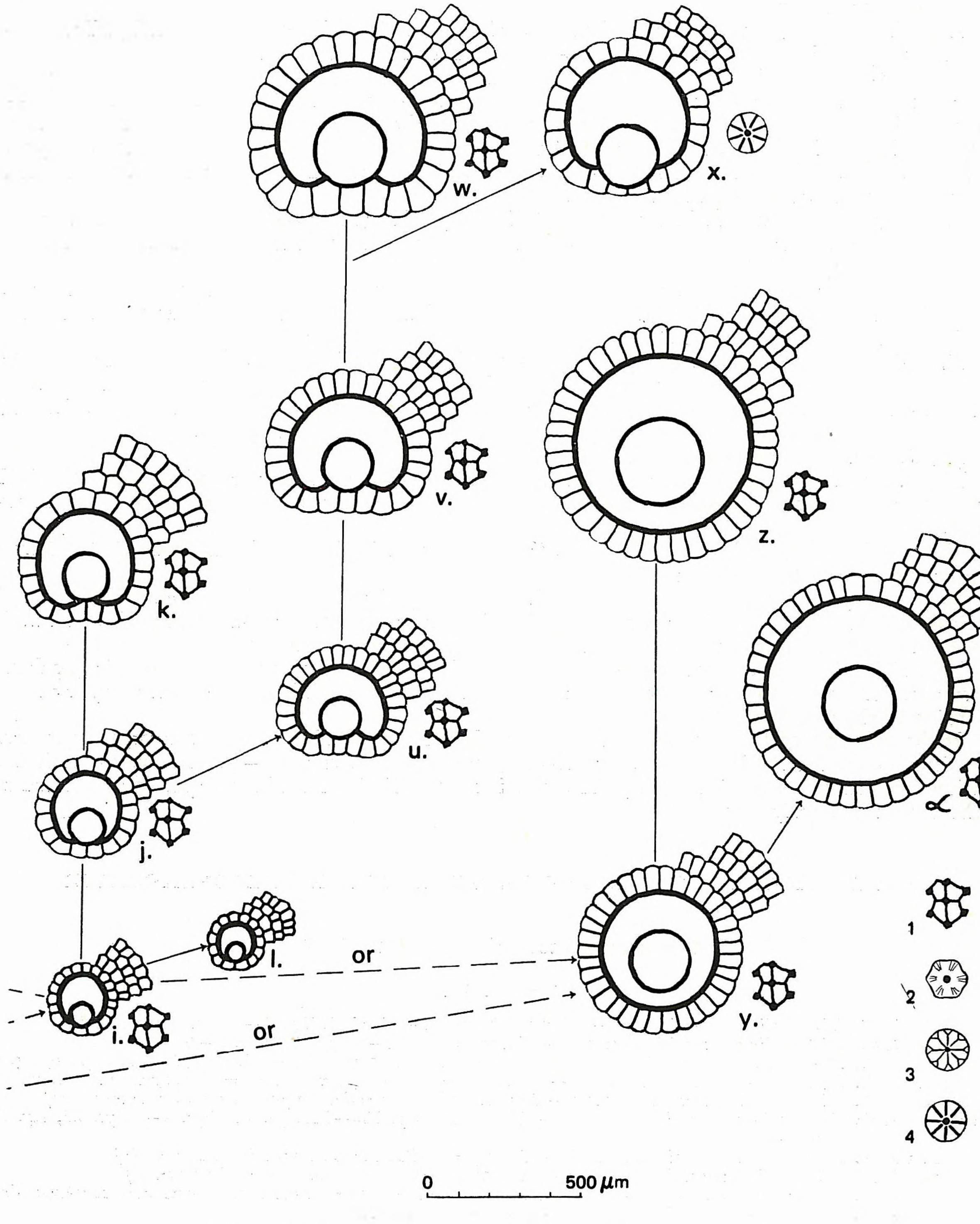


Fig. 30. Phylogenetic links of Orbitoclypeus species that can be derived from *O. seunesi* (idealized equatorial sections, 50×)

a = *O. seunesi*, *b* = *O. ramaraoi ramaraoi*, *c* = *O. ramaraoi neumannae*, *d* = *O. ramaraoi suvlukayensis*, *e* = *O. ramaraoi crimensis*, *f* = *O. marthae*, *g* = *O. multiplicata*, *h* = *O. bayani*, *i* = *O. douvillei* (middle part of the Cuisian), *j* = *O. douvillei* (lower part of the Lutetian), *k* = *O. douvillei* (middle part of the Lutetian), *l* = *O. portnayae*, *m* = *O. varians horsarrieuensis*, *n* = *O. varians angoumensis*, *o* = *O. varians roberti*, *p* = *O. varians scalaris*, *q* = *O. varians varians*, *r* = *furcata rovasendai*, *s* = *O. furcata furcata* (middle part of the Priabonian), *t* = *O. furcata furcata* (upper part of the Priabonian), *u* = *O. chudeaui chudeaui* (lower—middle parts of the Lutetian), *v* = *O. chudeaui chudeaui* (upper part of the Lutetian), *w* = *O. chudeaui pannonicus*, *x* = *O. katoae*, *y* = *O. schopeni* (Cuisian—Lutetian border), *z* = *O. schopeni* (middle—upper parts of the Lutetian), *α* = *O. koehleri*. Complementary signs: *1.* unribbed forms with „chudeaui" type rosette, *2.* form with undulated collar, *3.* ribbed form with „marthae" type rosette, *4.* ribbed form with „chudeaui" type rosette



lateral branch of this very lineage, *O. multiplicata* (its validity is questionable) and *O. marthae* can be regarded. The first is different from *O. ramaraoi neumannae*, the ancestor, in its bigger embryon and undulated cycles, while the latter one differs from *O. ramaraoi crimensis*, the ancestor, in its more complex rosette and slightly undulated cycles.

It is *O. ramaraoi neumannae* from which *O. bayani* may have branched out (perhaps with *O. multiplicata* being an intermediate form) with excentrilepidine embryon, strongly undulated annuli, with ribs and sometimes even star-shaped.

In all probability the *O. douvillei* group also derives from *O. seunesi*, though the rather wide gap between them is empty up to now.

The "chudeaui" type rosette is nearly always characteristic of the group. Excentrilepidine embryon only very rarely occurs, whereas the eu- and trybliolepidine ones are frequent.

Within the group the *O. douvillei* lineage can be characterized by the eulepidine embryon, circular annuli and the equatorial chambers that are low — except for those on the peripheries — narrow in the initial cycles (30 μm) but grow wider and wider (up to 50 μm) in the outer ones (since the material found is insufficient, it is still not possible to divide the lineage into subspecies). *O. portnayae*, the collateral descendant, differs from *O. douvillei* in the "marthae" type rosette, in its smaller embryon and narrower equatorial chambers.

Probably the *O. chudeaui* lineage, characterized by wide (40 to 45 μm) equatorial chambers, trybliolepidine embryon and circular cycles with no ribs, may have emerged around the Cuisian—Lutetian boundary from the moderately developed *O. douvillei*.

The same refers to *O. katoae*, a collateral branch of *O. chudeaui*, save that this is a ribbed form. In addition the embryon is somewhat more excentric and the growth pattern of the annuli is more complex than that of *O. chudeaui*.

The origin of the *O. varians* group cannot be decided yet. The "marthae" type rosette suggests that it is related to *O. ramaraoi* whereas the initial size of the embryon speaks of a relation to *O. douvillei*. The undulated annuli, the 30 to 35 μm (at last 40 μm) wide equatorial chambers, the eu-, then the typical excentrilepidine embryon are always characteristic of the group.

The *O. varians* lineage is unribbed.

The *O. furcata* lineage, that can be derived from *O. varians angoumensis* and consists of ribbed forms, has always excentrilepidine embryon and its cycles are more undulated than those of its ancestor.

The *O. schopeni* group is characterized by the large excentrilepidine embryon, wide (40 to 50 μm) equatorial chambers and "chudeaui" type rosette.

The *O. schopeni* lineage (the subdivision of it into subspecies is not yet timely, since the material available is insufficient) can be characterized by circular, cycles whereas the cycles of *O. koehleri*, that can be regarded as the collateral descendant of the first are undulated.

The origin of the group cannot be established yet. It is divided by a wide stratigraphic gap from *O. seunesi*. Comparing to *O. douvillei* the initial size of its embryon is big. *O. chudeaui* appears later according to the data available up to now.

It should be noted that sometimes in the case of Orbitoclypei a high-degree convergency occurs. Therefore the distinction between *O. bayani—O. furcata*, and *O. marthae—O. varians*, respectively, which are of different ages, is not easy. The criteria for the distinction of these species can be found in the following descriptions.

DESCRIPTION OF THE SPECIES AND SUBSPECIES OF EUROPEAN ORBITOCLYPEI

Orbitoclypeus seunesi (Douvillé), 1922

Text-fig. 30a

1922. *Discocyclina seunesi* n. sp. — Douvillé, pp. 64—65, pl. 4, figs. 1—4, text-figs. 1, 6, 15
1940. *Discocyclina seunesi* Douvillé — Weijden, pp. 66—67, pl. 12, figs. 2—5
1942. *Discocyclina douvillei* (Schlumberger) — Heybroek, pp. 420—421, pl. 4, figs. 1, 2, pl. 5, fig. 8
non 1945b. *Discocyclina seunesi* Douvillé — Brönnimann, p. 589, text-fig. 7. (= Discocyclina indet. sp. B)
non 1953. *Discocyclina seunesi* Douvillé — Schweighauser (= *Orbitoclypeus ramaraoi neumannae*)
partim 1958. *Discocyclina seunesi* Douvillé — Neumann, pp. 109—110, pl. 23, figs. 1—7, pl. 25, fig. 2, text-fig. 34
non 1959. *Discocyclina seunesi* Douvillé — Papp (= *Orbitoclypeus ramaraoi suvlukayensis*)
non 1961. *Discocyclina seunesi* Douvillé — Köhler (= *Orbitoclypeus ramaraoi ramaraoi*)
non 1970. *Discocyclina seunesi* Douvillé — Papp et Turnovsky (= *Orbitoclypeus ramaraoi suvlukayensis*)
1972. *Discocyclina seunesi* Douvillé — Neumann, pl. 4, fig. 8
1972. *Discocyclina seunesi* Douvillé — Samuel et al., p. 159, 95, figs. 1—7
partim 1972. *Discocyclina douvillei* (Schlumberger) — Samuel et al., p. 160, pl. 96, fig. 2
1977. *Discocyclina seunesi* Douvillé — Zernetsky, pp. 56—58, pl. 1, figs. 1—7

H o l o t y p e : Considering the description it is presumable that pl. 4, fig. 1 might have been regarded by the author of the taxon as holotype (in DOUVILLÉ 1922), presumable depository: Université Sorbonne (Paris) — external form.
T y p e l o c a l i t y : Bénesse (SW Aquitaine), to the south of Dax, near Lescouméres.
T y p e l e v e l : According to the author of the taxon: the Danian stage, according to HOTTINGER et al. (1964) the bottom of the Montion—Thanetian stage.
The t y p e of the equatorial section of forms "A": DOUVILLÉ (1922, text-fig. 1.) and NEUMANN (1958), pl. 23, fig. 5, preparation 1444, collection H. DOUVILLÉ, Nay-Arros, presumable depository and stratigraphic level are the same as those of the holotype.
D i a g n o s i s : Small-sized, moderately flattened or slightly inflate forms. The rosette is of the transitional "Discocyclina—marthae" type. The embryon is eulepidine (sometimes trybliolepidine), the two chambers are small. The adauxiliary chambers are of the "varians" type, medium in numbers, moderately narrow and low. The equatorial chambers are also narrow and low. The annuli are circular, the growth pattern is of the "varians" type.

D e s c r i p t i o n :

External morphology: Small-sized (3 to 6 mm), moderately flattened or slightly inflate forms. Often the umbo is rather indistinct and it may be surrounded by indenture. The rosette is between the "marthae" and "Discocyclina" types, the granules are round and coarse (80 to 120 μm in diameter), they are surrounded by 7 to 10 lateral chambers. No data are available concerning the ratio of the sizes of forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30a):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu (tryblio)	$Q = 1.71 - 1.86$	t: varians	$s.c.$: circular
$E = 0.40 - 0.55$	$\bar{Q} = 1.65 - 2.00$	$N = 18 - 21$	$g.p.$: varians
$\bar{E} = 0.35 - 0.65$	$P = 100 - 725$ μm	$\bar{N} = 18 - 21$	$l = 25 - 30$ μm
$R = 0.84 - 1.00$	$\bar{P} = 110 - 160$ μm	$L = 30 - 40$ μm	$h = 35 - 50$ μm
$\bar{R} = 0.80 - 1.05$	$D = 190 - 300$ μm	$H = 40 - 50$ μm	$n_{0.5} = 10.0 - 14.5$
	$\bar{D} = 200 - 270$ μm	$\bar{H} = 40 - 50$ μm	$\bar{n}_{0.5} = 11.0 - 14.0$
			$n_{1.0}$ is unknown

The equatorial section of forms "B": No one has published any reliable photos on the microspheric juvenarium of the species which presumably shows "Lepidocyclina" character. BRÖNNIMANN's (1945b) figure shows Discocyclina, therefore in our opinion it cannot be assigned to this category.

Axial section: On the basis of NEUMANN (1958 pl. 23, fig. 7, pl. 25, fig. 2), SAMUEL et al. (1972, pl. 95, figs. 3—7) and ZERNETSKY (1977, pl. 1, figs. 1, 7) the height of the embryon is ranging from 150 to 200 μm. It is very important that the equatorial layer thickens towards the peripheries, being 50 to 70 μm thick at the centre and 150 to 200 μm on the edges. The lateral septum is thick near the embryon but thin on the edges. The annular septum is somewhat curved. The lateral chambers are 90×30 μm big on the average.

P h y l o g e n e t i c p o s i t i o n (text-fig. 30): *Orbitoclypeus seunesi* is the oldest known Eurasian Orthophragmina. Its ancestors might be found on the American continent in our opinion. Possible ancestors might be VAUGHAN's (1929) "*Discocyclina*" *weaveri* from Mexico, CAUDRI's (1944) "*Discocyclina*" *aguerrevei* from Venezuela and SACHS's (1957) "*Discocyclina*" *mestieri* from Cuba. All these forms were described from the Paleocene and considering the character of their adauxiliary and equatorial chambers, too, in our opinion they are Orbitoclypei. The embryons of the above discussed forms are somewhat smaller than that of *Orbitoclypeus seunesi* and the fewer adauxiliary chambers, too, suggest a transition towards the more primitive "daguini" type.

On the basis of the available bibliographic data the distinction of subspecies within the species is not possible.

It looks certain that the descendant of the species is *Orbitoclypeus ramaraoi* that replaces it stratigraphically. Lacking other data, we consider *O. douvillei* and perhaps *O. schopeni*, too, as descendants (the derivation from either *O. douvillei* or *O. chudeaui* cannot be ruled out here), though a wide stratigraphic gap separates them from *O. seunesi*.

R e t r o s p e c t i o n : As we do not have a single specimen of this species, the above description is completely based on bibliographic data.

DOUVILLÉ (1922), the describer of the species, gives the Danian stage as its stratigraphic level. The only drawing he published on the internal morphology well represents the qualitative features of the taxon but the given scale of enlargement is presumably incorrect, considering the width of the adauxiliary chambers. Later describers either repeated DOUVILLÉ's (1922) description and figures (WEIJDEN, 1940) or using this name described forms that are from other regions and do not belong to this category (BRÖNNIMANN, 1945b; SCHWEIGHAUSER, 1953). No wonder, since the proper description and depiction of the forms from the type locality were not published until 1958 (NEUMANN). In spite of the fact that the scales of enlargement of the equatorial sections are most likely incorrect, it was possible to form a notion of the qualitative features of the taxon. On the basis of the axial sections, published by NEUMANN (1958) it is clear that this taxon is an Orbitoclypeus and not Discocyclina, and as the taxon comes from Globorotalia bearing layers it can be established that it is not from the Danian stage. These so-called *Operculina héberti* bearing beds were placed by HOTTINGER et al. (1964) to the bottom of the Montian—Thanetian stage.

A general opinion of the international literature is that "seunesi" is the only Orthophragmina of stratigraphic value unquestionably indicating the Paleocene. The result of this was that those researchers who identified Orthophragminae from supposed Paleocene beds reported "seunesi" as well. The examination of the internal morphology made clear that some of these forms (see the ones marked with "non" in the synonymic list) do not belong to this species. In fact they are from the Ilerdian stage in the present writer's opinion.

The "douvillei" published by HEYBROEK (1942) and SAMUEL et al. (1972) show the same morphology as the typical "seunesi" does, the first is different from the latter only in its somewhat more inflate test, so they were included into the synonymic list.

Each form in the synonymic list is the only Orthophragmina of its own particular locality. On the basis of these findings it is most likely that *Orbitoclypeus seunesi* is the only Eurasian Orthophragmina of the Paleocene and its range is localized to this very level.

Variability: Lacking own preparations the only thing that can be stated, relying on the literature, that the test is rather changeable as far as the inflate shape is concerned.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of Discocyclinae are with 6 stolons, they are rectangular. In the axial section the equatorial layer does not grow so thick towards the rims as in the case of the discussed taxon.

The cycles of *Orbitoclypeus marthae*, *O. varians angoumensis* and *O. varians roberti* are undulated and rather the excentrilepidine embryon, which never occurs in the case of *O. seunesi*, is characteristic of these forms.

The rosette of *O. douvillei* is of the "chudeaui" type, the growth pattern is of the "trabayensis" type.

The most difficult task is the distinction from *O. ramaraoi neumannae*, *O. ramaraoi suvlukayensis* and *O. ramaraoi crimensis*. The granules of these taxa however are generally bigger and they are surrounded by more lateral chambers. In the case of these forms, too, excentrilepidine embryons frequently occur. It should also be noted, that the equatorial layer of *O. ramaraoi* thickens to a lesser extent towards the edges. The stratigraphic level is also different, since most of the cases these taxa occur together with other Orthophragminae, whereas *O. seunesi* occurs alone according to the available data.

Range: The Paleocene, presumably only its upper (Thanetian) levels.

SW Aquitaine (Bénesse, Nay-Arros — the so-called *Operculina héberti* bearing layers), NW Slovakia (Hričovské Podhradie), Crimea [surroundings of Bielogorsk, the left bank of the river Mokry Indol, from the Kachian (=Thanetian) stage], S Liban.

Orbitoclypeus ramaraoi (SAMANTA), 1967

Diagnosis: Small- and medium-sized, inflate or moderately flattened forms. "Marthae" type rosette. The embryon may be nephro-, semi-nephro-, eu- and excentrilepidine, the two embrionary chambers are small or medium-sized. The adauxiliary chambers are of the "varians" type, they are medium in numbers, relatively narrow or medium wide, low or medium high. The equatorial chambers are narrow or medium wide, their height is depending on the subspecies' stage of development. The cycles are circular, their growth pattern is of the "varians" type with possible transition towards the "strophiolata" type.

Description:

External morphology: Small or medium-sized (2 to 7 mm) more or less inflate forms. Larger tests are more flat. Only the more rounded forms may have umbo occasionally but it is indistinct. The granules are round, medium-sized or very coarse (80 to 150 μm in diameter). The rosette is characteristically of the "marthae" type, the granules are surrounded by 9 to 16 lateral chambers. The scarce data available up to now show no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "B": Lacking own preparations, on the basis of SCHWEIGHAUSER's (1953, text-figs. 33—34) the juvenarium is of the "Lepidocyclina" type. I=10—12 μm, S=9—12, s=70—95 μm, J and j are not yet known.

Axial section: Lacking own preparations on the basis of the following workers' data: KÖHLER (1961, pl. 5, figs. 3—4, pl. 6, figs. 3—4), SAMANTA (1967, pl. 1, figs. 14—20), TOUMARKINE (1967, pl.

1, figs. 6—7), SAMUEL et al. (1972, pl. 96, figs. 3—11) and MASSIEUX (1973, pl. 19, fig. 9) the height of the embryon is ranging from 150 to 250 μm. The equatorial layer is 40 to 50 μm thick at centre and 60 to 80 μm on the edges. The lateral septum is thick the annular one is arcuate a little or not at all. The lateral chambers are 60—75×25—30 μm big on the average.

Phylogenetic position (text-fig. 30): *Orbitoclypeus ramaraoi* is the oldest Eurasian Orbitoclypeus after *O. seunesi* and it is most likely that they are offspring and ancestor respectively and *O. ramaraoi* came into being through the embryon's decreasing in size and increasing in excentricity.

Up to now 4 evolutional stages of development (subspecies) can be distinguished by the following biometric limits:

Orbitoclypeus ramaraoi ramaraoi (text-fig. 30b):	$\bar{D} < 165$ μm
Orbitoclypeus ramaraoi neumannae (text-fig. 30c):	$\bar{D} = 165-220$ μm
Orbitoclypeus ramaraoi suvlukayensis (text-fig. 30d):	$\bar{D} = 220-280$ μm
Orbitoclypeus ramaraoi crimensis (text-fig. 30e):	$\bar{D} > 280$ μm

It is imaginable that with respect to the middle and upper parts of the Cuisian stage even the $\bar{D} > 350$ μm biometric unit is characteristic and in this case there would be an opportunitiy to segregate a further distinct subspecies. Though on the basis of the poor findings from these layers of the Suvlu—Kaya Hill this probability is questionable.

Similarly to $\bar{D}$, development is observable in the increase of $\bar{R}$, $\bar{Q}$, $\bar{P}$, $\bar{N}$, $\bar{H}$ and decrease of $\bar{E}$, $\bar{n}_{0.5}$ parameter means.

Presumably four species may have derived from *Orbitoclypeus ramaraoi*. Two of these [the very defectively known *O. multiplicata* of uncertain validity with undulated annuli and the ribbed or star-shaped *O. bayani* (in this case the derivation from even *O. multiplicata* cannot be ruled out either)] may be derived from the early *O. ramaraoi neumannae* concerning the stratigraphic level of their occurrence, whereas — also relying upon the stratigraphic levels — *O. marthae* with its moderately undulated annuli may be derived from *O. ramaraoi crimensis*.

On the basis of the rosette type *O. varians*, too, may descended from *O. ramaraoi*, though owing to the initial size of the embryon the origin from *O. douvillei* cannot be ruled out either.

Retrospection: This species has been known for a long time from the lower parts of the European Eocene. However, each of its given names suits other forms or — as in the case of "himerensis" — cannot be used at all (see explanation later). It was only in 1967 that these forms were given new proper names by SAMANTA ("ramaraoi") and TOUMARKINE ("neumannae"). The first has a half year advantage over the latter, therefore "ramaraoi" can be used for marking the species while "neumannae" can be used on the subspecies level. These names however are still not commonly used but, unfortunately in our opinion, the names unsuitable for these forms are frequent in the literature even after 1967.

Variability: Within certain populations both the interior and the exterior show limited variability. The populations may differ first of all in the test size and in the complexity of the rosette. In particular populations (Ovčiarsko in Slovakia, Le Porge, Bos d'Arros, etc.) it is observable that the equatorial chambers rapidly grow long on the edges while in the case of others they do not. It is also a striking feature that the adauxiliary chambers of the forms from Spilecco and those of some forms from Israel are wider than expected and consequently they are lower in numbers.

Range: The Ilerdian and Cuisian stages.

Orbitoclypeus ramaraoi ramaraoi (SAMANTA), 1967

Text-fig. 30b

1961. *Discocyclina seunesi* DOUVILLÉ — KÖHLER, pp. 19—21, pl. 5, figs. 1—4
1961. *Discocyclina douvillei* (SCHLUMBERGER) — KÖHLER, pp. 21—23, pl. 6, figs. 1, 3, 4
1967. *Discocyclina ramaraoi* n. sp. — SAMANTA, pp. 234—240, pl. 1, figs. 1—20, text-figs. 2—5
partim 1968. *Discocyclina furoni* n. sp. — SAMANTA, pp. 70—75, pl. 5, fig. 3
partim 1972. *Discocyclina douvillei* (SCHLUMBERGER) — SAMUEL et al., p. 160, pl. 96, figs. 1, 3—7
1972. *Discocyclina* sp. — SAMUEL et al., pp. 160—162, pl. 96, figs. 8—11

Holotype: SAMANTA (1967), pl. 1, fig. 1, depository: University of Calcutta, Geology Department — external form.
Type locality: 5/8 mile to the East of Sedarappattu (near Pondicherry — S India), the upper marl unit of the Pondicherry Formation.
Type level: Ypresian (in the present writer's opinion the lower part of the Ilerdian).
The type of the equatorial section of forms "A": SAMANTA (1967), pl. 1, fig. 9, its depository, locality and level are the same as those of the holotype.
Diagnosis: *Orbitoclypeus ramaraoi* populations with $\bar{D}$ less than 165 μm.

D e s c r i p t i o n :

External morphology: Small (2 to 4 mm), moderately rounded forms with "marthae" type rosette. The ratio of the sizes of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30b):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-nephro, eu)	$Q=0.94-1.77$	*t:* varians	*s.c.:* circular
	$\bar{Q}=1.25-1.70$	$N=11-19$	*g.p.:* varians (strophiolata)
$E=0.54-1.51$	$P=80-130$ µm	$\bar{N}=13-17$	
$\bar{E}=0.65-1.15$	$\bar{P}=80-120$ µm	$L=25-35$ µm	$l=25-30$ µm
$R=0.29-0.88$	$D=115-180$ µm	$\underline{H}=25-40$ µm	$h=30-45$ µm
$\bar{R}=0.40-0.75$	$\bar{D}=135-165$ µm	$\bar{H}=25-40$ µm	$n_{0.5}=15.5-17.5$
			$\bar{n}_{0.5}=15.5-17.5$
			$n_{1.0}$ is unknown

R e t r o s p e c t i o n : Lacking own preparations the above description is based on bibliographic data. Those forms were included into the synonymic list the D of which is under 165 µm. On the basis of SAMANTA's (1967) description and figures it is clear-cut that this criterion holds true of the Pondicherry forms as population as well. A certain part of the forms from the vicinity of Žilina, sampled by SAMUEL et al. (1972) were included in the list, since it is observable that in axial section the equatorial layer does not grow so thick towards the edges as in the case of *O. seunesi*.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Discocyclina augustae atlantica* and *D. dispansa ganensis* are with 6 stolons, they look rectangular.

Orbitoclypeus douvillei possess "chudeaui" type rosette, its equatorial chambers are much higher on the edges and the growth pattern of its annuli is of the "trabayensis" type.

The cycles of *Orbitoclypeus portnayae* are sometimes undulated, its embryon is less excentric. The size of the deuteroconch being the same, the protoconch is smaller than that of *O. ramaraoi ramaraoi*, in addition its equatorial chambers may be more elongate on the edges.

The cycles of *O. varians horsarrieuensis* are undulated.

R a n g e : The lower part of the Ilerdian.

W Slovakia (Myjava, Hričovské Podhradie), S India (Pondicherry).

Orbitoclypeus ramaraoi (SAMANTA), 1967 neumannae (TOURMARKINE), 1967

Pl. XXVI, figs. 1–2, text-fig. 30c

1953. *Discocyclina seunesi* DOUVILLÉ — SCHWEIGHAUSER, pp. 46–47, pl. 8, figs. 5, 7, 8, text-figs. 12, 39
partim 1953. *Discocyclina douvillei* (SCHLUMBERGER) — SCHWEIGHAUSER, pp. 75–77, text-figs. 34, 53
partim 1958. *Discocyclina douvillei* (SCHLUMBERGER) — NEUMANN, pp. 92–93, text-fig. 26A
1967. *Discocyclina neumannae* n. sp. — TOUMARKINE, pp. 210–212, pl. 1, figs. 1–8
1973. *Discocyclina neumannae* TOUMARKINE — MASSIEUX, pp. 104–105, pl. 19, figs. 7–9

H o l o t y p e : TOUMARKINE (1967), pl. 1, figs. 1–2, depository: Laboratoire de Micropaléontologie de l'Université de Paris.
T y p e l o c a l i t y : Mont-Cayla (Aude).
T y p e l e v e l : Lower Eocene — the upper part of the marine limestones of Mont-Cayla (in the present writer's opinion the middle part of the Ilerdian).
D i a g n o s i s : *Orbitoclypeus ramaraoi* populations with $\bar{D}$ ranging from 165 to 220 µm.

D e s c r i p t i o n :

External morphology: Small-sized (2.5 to 5 mm), rounded forms with "marthae" type rosette. The size ratio of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30b):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu (semi-nephro, excentri)	$Q=1.32-2.64$	*t:* varians	*s.c.:* circular
	$\bar{Q}=1.70-2.05$		*g.p.:* varians (strophiolata)
$E=0.22-0.69$	$P=87-162$ µm	$N=11-25$	
$\bar{E}=0.30-0.65$	$\bar{P}=90-150$ µm	$\bar{N}=12-24$	$l=30-35$ µm
$R=0.72-1.08$	$D=164-250$ µm	$L=30-50$ µm	$h=45-90$ µm
$\bar{R}=0.70-1.10$	$\bar{D}=165-220$ µm	$\underline{H}=35-50$ µm	$n_{0.5}=11.0-17.5$
		$\bar{H}=37-48$ µm	$\bar{n}_{0.5}=12.0-17.5$
			$n_{1.0}=21.0-30.0$

R e t r o s p e c t i o n : A common feature of the assigned forms from the *N* Corbières and Spilecco is that $\bar{D}$ is ranging from 165 to 220 μm. This clearly turns out from the diagram (text-fig. 1) published by TOUMARKINE (1967) and from the statistical analysis of the Spilecco forms examined by the present writer. The "seunesi" and "douvillei" denominations used by SCHWEIGHAUSER (1953) refer to related forms with different internal morphology. In the case of the form depicted by MASSIEX (1973) *D* equals 235 μm, nevertheless this form was assigned to this category, since the author put the deuteroconch diameter 125 and 250 μm, consequently $\bar{D}$ may vary mostly between 165 and 220 μm.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of Discocyclinae are with 6 stolons, they look rectangular.

The cycles of *Orbitoclypeus varians horsarrieuensis* and *O. varians angoumensis* are undulated.

The embryon of *O. douvillei* is always of the eulepidine type, the rosette bears "chudeaui" character and the growth pattern is of the "trabayensis" type.

The embryon of *O. seunesi* can never be excentrilepidine, its rosette is less complex and in axial section the equatorial layer grows much wider. It has no accompanying fauna of Orthophragmina.

R a n g e : The middle part of the Ilerdian.

S France (N Corbières), N Italy (Spilecco).

Orbitoclypeus ramaraoi (SAMANTA), 1967 **suvlukayensis** n. ssp.

Pl. XXVI, figs. 3—4, text-fig. 30d

1959. *Discocyclina seunesi* DOUVILLÉ — PAPP, p. 171, abb. 5, figs. 1, 2
1970. *Discocyclina seunesi* DOUVILLÉ — PAPP et TURNOVSKY, pl. 69, fig. 2
partim 1974. *Discocyclina marthae* (SCHLUMBERGER) — PORTNAYA, pp. 96—97, pl. 21, figs. 4, 5

D e r i v a t i o n o m i n i s : Named after the type locality of the taxon.
H o l o t y p e : Preparation E. 4864, pl. XXVI, fig. 3.
T y p e l o c a l i t y : Crimea, Suvlu-Kaya Hill, Bakhchisaraian stage, transitional part of the *Nummulites crimensis* and *Assilina placentula* zones, sample B 20.
T y p e l e v e l : The upper part of the Ilerdian.
D i a g n o s i s : *Orbitoclypeus ramaraoi* populations with $\bar{D}$ ranging from 220 to 280 μm.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (3 to 6 mm), moderately rounded forms with "marthae" type rosette. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30d):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu—excentri	Q = 1.60—2.12	*t:* varians	*s.c.:* circular
E = 0.26—0.84	$\bar{Q}$ = 1.65—2.00	N = 19—26	*g.p.:* varians
$\bar{E}$ = 0.30—0.70	P = 112—150 μm	$\bar{N}$ = 19—24	l = 30—40 μm
R = 0.68—1.33	$\bar{P}$ = 120—150 μm	L = 30—50 μm	h = 45—70 μm
$\bar{R}$ = 0.80—1.15	D = 202—267 μm	H = 40—55 μm	$n_{0.5}$ = 9.8—14.6
	$\bar{D}$ = 220—280 μm	$\bar{H}$ = 42—53 μm	$\bar{n}_{0.5}$ = 11.0—14.0
			$n_{1.0}$ = 21.0—28.5

R e t r o s p e c t i o n : The establishment of a new taxon was necessary, since the earlier used "seunesi" and "marthae" names of *Orbitoclypeus ramaraoi* with *D* ranging from 220 to 280 μm cannot be used for marking this taxon, as they refer to different — though related — forms.

C o m p a r i s o n : Among the unribbed forms with similar-sized and similar type embryon the annuli of *Orbitoclypeus varians angoumensis* and *O. varians roberti* are undulated.

The embryon of *O. douvillei* is always of the eulepidine type, the rosette bears "chudeaui" character.

The embryon of *O. seunesi* is never excentrilepidine, its rosette is less complex, in axial section the equatorial layer grows wider and in its localities it is not accompanied by other Orthophragminae.

R a n g e : The upper part of the Ilerdian.

Surroundings of Salzburg (Kühlgraben am Untersberg), Crimea — Bakhchisaraian stage — transitional part of the *Nummulites crimensis* and *Assilina placentula* zones (sample B 20) and according to PORTNAYA (1974) the transitional part of the *Operculina semiinvoluta* and *Nummulites crimensis* zones as well.

Orbitoclypeus ramaraoi (SAMANTA), 1967 **crimensis** n. ssp.

Pl. XXVI, figs. 5–12, text-fig. 30e

partim 1903. *Orthophragmina archiaci* n. sp. — SCHLUMBERGER, p. 277, pl. 8, fig. 7, text-fig. C
partim 1922. *Discocyclina archiaci* (SCHLUMBERGER) — DOUVILLÉ, pp. 65–66, text-fig. 4
partim 1922. *Discocyclina scalaris* (SCHLUMBERGER) — DOUVILLÉ, pp. 68–69, text-figs. 7, 22
partim 1929. *Discocyclina scalaris* (SCHLUMBERGER) — LLUECA, pp. 279–280, pl. 22, fig. 13
partim 1940. *Discocyclina (Eudiscodina) archiaci* (SCHLUMBERGER) — WEIJDEN, pp. 22–23, pl. 1, fig. 2
?1951. *Discocyclina (Orbitoclypeus) himerensis* SILVESTRI — VIALLI, pp. 141–142, pl. 7, fig. 17
1953. *Discocyclina scalaris* (SCHLUMBERGER) — SCHWEIGHAUSER, pp. 48–49, pl. 8, figs. 4, 6, 9, 13, text-figs. 18, 33, 40
partim 1958. *Discocyclina scalaris* (SCHLUMBERGER) — NEUMANN, pp. 104–106, pl. 21, fig. 2, text-fig. 32A
1972. *Discocyclina scalaris* (SCHLUMBERGER) — SAMUEL et al., p. 162, pl. 98, fig. 1
1972. *Discocyclina roberti* DOUVILLÉ — SAMUEL et al., pp. 162–163, pl. 98, figs. 2–4
partim 1974. *Discocyclina roberti* DOUVILLÉ — PORTNAYA, pp. 93–96, pl. 20, figs. 2–6
partim 1982. *Discocyclina varians* (KAUFMANN) — FERMONT, p. 135, table 6 (partim), pl. 9, figs. 3–4(?), 5–6, pl. 10, figs. 3–4
1982. *Discocyclina archiaci* (SCHLUMBERGER) — FERMONT, p. 137, table 6 (partim), pl. 10, figs. 5, 6

Derivatio nominis: Named after the larger geographic unit of the type locality of the taxon.
Holotype: Preparation E. 4866, pl. XXVI, figs. 6–7.
Type locality: Crimea, Suvlu-Kaya Hill, Bakhchisaraian stage, the lower part of the *Assilina placentula* zone, sample B 24.
Type level: The lower part of the Cuisian.
Diagnosis: *Orbitoclypeus ramaraoi* populations with $\bar{D}$ exceeding 280 μm.

Description:

External morphology: Medium-sized (4 to 7 mm), moderately inflate or moderately flattened forms with "marthae" type rosette. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30e):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (eu)	$Q = 1.54-2.20$	*t:* varians	*s.c.:* circular
$E = 0.05-0.73$	$\bar{Q} = 1.65-2.00$	$N = 28-40$	*g.p.:* varians
$\bar{E} = 0.05-0.40$	$P = 135-257$ μm	$\bar{N} = 28-40$	$l = 30-40$ μm
$R = 0.76-1.50$	$\bar{P} = 135-240$ μm	$L = 30-40$ μm	$h = 50-110$ μm
$\bar{R} = 1.05-1.40$	$D = 255-442$ μm	$H = 40-80$ μm	$n_{0.5} = 8.5-13.6$
	$\bar{D} = 280-400$ μm	$\bar{H} = 45-75$ μm	$\bar{n}_{0.5} = 9.0-13.0$
			$n_{1.0} = 15.5-26.0$

Retrospection: In each case of the assigned forms $\bar{D}$ or D is over 280 μm. Theoretically the "archiaci" name could be used for marking these forms, since SCHLUMBERGER (1903), while describing this taxon, published a figure on the internal morphology and this figure well coincides with the above description. The exterior and the equatorial section of form "B", however, do not represent Orbitoclypeus any more but Discocyclina. Later, the majority of the authors used the "archiaci" name for marking Discocyclinae. We did not want to depart from this common usage either, so we did not used "archiaci" as well as other names that refer to different Orbitoclypei. This is the reason why a new denomination had to be introduced for marking the discussed taxon.

Some forms that were only externally depicted [*Discocyclina scalaris* (partim) by DOUVILLÉ 1922, LLUECA 1929, NEUMANN 1958] were also included in the synonymic list owing to their characteristic rosette and the coincidence with SCHLUMBERGER's (1903) localities (Bos d'Arros, Gan).

Comparison: Among the unribbed forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus marthae*, *O. varians roberti*, *O. varians scalaris* and *O. multiplicata* are undulated.

The equatorial chambers of *O. schopeni* and *O. chudeaui chudeaui* are wider, the rosette is of the "chudeaui" type and its embryon only exceptionally can be similar to that of the taxon under discussion.

The embryon of *O. douvillei* is never excentrilepidine, its rosette bears "chudeaui" character.

Nor can *O. seunesi* have excentrilepidine embryon. Its rosette is less complex, in axial section the equatorial layer grows much wider towards the periphery. In its localities it is the only Orthophragmina population, unlike the taxon under discussion.

Range: The Cuisian and probably the lower part of the Lutetian.

SW Aquitaine (Gan, Bos d'Arros, Le Porge), N Italy (Valdeforte, Adda di Paderno), NW Slovakia (surroundings of Žilina — Ovčiarsko, Vlčia jama), Crimea — Bakhchisaraian stage — the lower part of the *Assilina placentula* zone (sample B 24), according to PORTNAYA (1974) the upper part of the zone as well, Simferopolian stage — the lower part of the *Nummulites distans minor* zone (sample E 5), the lower part of the *N. distans* zone (samples B 53, 57), Israel (the lower parts of Ein Avedat section for sure, its upper — Lower Lutetian — parts probably).

Orbitoclypeus marthae (SCHLUMBERGER), 1903

Pl. XXVII, figs. 1–3, text-fig. 30f

partim 1903. *Orthophragmina marthae* n. sp. — SCHLUMBERGER, p. 284, pl. 10, figs. 27–29, 32, pl. 11, fig. 40
partim non 1903. *Orthophragmina marthae* n. sp. — SCHLUMBERGER *(= Orbitoclypeus varians roberti)*
1922. *Discocyclina marthae* (SCHLUMBERGER) — DOUVILLÉ, p. 72, text-fig. 9
1929. *Discocyclina marthae* (SCHLUMBERGER) — LLUECA, pp. 289–290, fig. 63
1940. *Discocyclina (Eudiscodina) marthae* (SCHLUMBERGER) — WEIJDEN, pp. 34–35, pl. 3, figs. 8–11
non 1941. *Discocyclina (Discocyclina) marthae* (SCHLUMBERGER) — WITT PUYT *(= Orbitoclypeus varians roberti)*
1953. *Discocyclina marthae* (SCHLUMBERGER) — SCHWEIGHAUSER, p. 64, text-fig. 48 (non 47!)
1953. *Discocyclina roberti* DOUVILLÉ — SCHWEIGHAUSER, pp. 60–62, pl. 9, fig. 8, pl. 10, figs., 12, 13, text-fig. 45
partim 1958. *Discocyclina marthae* (SCHLUMBERGER) — NEUMANN, 97–98, pl. 17, fig. 1
partim 1958. *Discocyclina scalaris* (SCHLUMBERGER) — NEUMANN, pp. 104–106, pl. 21, figs. 3, 4, pl. 25, fig. 3, text-fig. 32B
partim non 1958. *Discocyclina marthae* (SCHLUMBERGER) — NEUMANN *(= Orbitoclypeus varians angoumensis)*
non 1959. *Discocyclina marthae* (SCHLUMBERGER) — BELMUSTAKOV, p. 52, pl. 19, fig. 6 (= ?)
partim 1974. *Discocyclina marthae* (SCHLUMBERGER) — PORTNAYA, pp. 96–97, pl. 21, figs. 1–3
partim non 1974. *Discocyclina marthae* (SCHLUMBERGER) — PORTNAYA *(= Orbitoclypeus ramaraoi suvlukayensis)*
non 1982. *Orbitoclypeus marthae* (SCHLUMBERGER) — LAGHI et SIROTTI *(= Discocyclina dispansa hungarica)*

Holotype: Not given by the author of the taxon.
Lectotype: SCHLUMBERGER (1903), pl. 10, fig. 32. and NEUMANN (1958), pl. 17, fig. 1 (according to NEUMANN 1958), depository: École de Mines (Paris), external form.
Type locality: Saint-Barthélémy (SW Aquitaine).
Type level: Not specified. In the present writer's opinion the lower part of the Lutetian.
The type of the equatorial section of forms "A": SCHLUMBERGER (1903), pl. 10, fig. 27, the further data are the same as those of the lectotype.
Diagnosis: Small, inflate forms. "Marthae" type rosette. Mostly the embryon is excentrilepidine but it may be eulepidine as well. The two chambers are medium-sized. The adauxiliary chambers are of the "varians" type, medium in numbers, moderately narrow and low similarly to the equatorial chambers the cycles of which are moderately undulated and have "varians" type growth pattern.

Description:

External morphology: Small-sized (2.5 to 5 mm), more or less rounded forms, rarely with very narrow collar. The rosette is most complex, it is of the "marthae" type. The granules are very coarse (100 to 200 μm in diameter) especially above the embryon. Among the largest granules smaller ones can also be found. Each of these is surrounded by 12 to 14 lateral chambers that are rather small. The size ratio of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30f):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (eu)	$Q = 1.61-2.24$	*t:* varians	*s.c:* undulated with 6–8 waves
$E = 0.06-0.46$	$\bar{Q} = 1.80-2.10$	$N = 30-40$	*g.p.:* varians
$\bar{E} = 0.12-0.35$	$P = 110-232$ μm	$\bar{N} = 30-38$	$l = 30-40$ μm
$R = 1.08-1.40$	$\bar{P} = 124-230$ μm	$L = 25-40$ μm	$h = 30-80$ μm
$\bar{R} = 1.15-1.35$	$D = 240-425$ μm	$H = 40-65$ μm	$n_{0.5} = 10.0-16.0$
	$\bar{D} = 260-400$ μm	$\bar{H} = 42-60$ μm	$\bar{n}_{0.5} = 11.0-15.5$
			$n_{1.0} = 24.0-30.0$

The equatorial section of forms "B": Microspheric specimens of the species have not been found yet. The juvenarium presumably bears "Lepidocyclina" character.

Axial section: Lacking own preparations we relied on SCHLUMBERGER's (1903, pl. 10, figs. 28–29) and SCHWEIGHAUSER's (1953, pl. 9, fig. 8) data. Considering these, the height of the embryon is ranging from 150 to 250 μm. The equatorial layer is 55 to 65 μm thick near the embryon and it thickens to as much as 90 to 100 μm towards the peripher. The lateral septum is thick, the annular one is moderately arcuate. The lateral chambers are 60×35 μm big on the average.

Phylogenetic position (text-fig. 30): *Orbitoclypeus marthae* can be regarded as an offspring of *O. ramaraoi crimensis*, since stratigraphically it comes directly after the latter and they are similar externally as well as internally. The only thing that differs is the moderately undulated annuli of *O. marthae*.

Nothing particular can be established concerning the intraspecific evolution, since the species is known only from two localities approximately of the same age.

No data are available up to now concerning the descendants of the taxon. Presumably it became extinct without offspring as early as the beginning of the Lutetian.

R e t r o s p e c t i o n : SCHLUMBERGER (1903), the describer of the species, gave proper depiction from Saint-Barthélémy — usable even today — of both the external and internal features. At the same time from the same locality but from different stratigraphic level (Saint-Barthélémy, église) going by this very name he also depicted the exterior of *Orbitoclypeus varians roberti*. This misappreh ension has been made clear by DOUVILLÉ (1922) and NEUMANN (1958) since then.

Unfortunately the distinction of *O. marthae* from *O. ramaraoi* on the basis of the interior and especially on the basis of the rosette is very difficult. Even more difficult is to distinguish the species from the several subspecies of *O. varians*. This is the reason why more than one "marthae" description — referring to stratigraphic levels different from that of *O. marthae* — had to be put over to *O. ramaraoi* and *O. varians*.

Only those forms could be included in the synonymic list that either repeated the original (SCHLUMBERGER, 1903) description and figures or came from the corresponding stratigraphic level and their depiction suits the above description.

Among the latter forms SCHWEIGHAUSER's (1953) "roberti" from Vanzi (N Italy) occurs together with *Discocyclina archiaci bartholomei* (referred to as *D.* aff. *papyracea* by SCHWEIGHAUSER) coming from the lower part of the Lutetian. Its internal morphology is the same as SCHLUMBERGER's (1903) "marthae", while externally only the existence of the collar tells it from the topotypical "marthae".

From practically the same layer (Saint-Martin-de-Seignanx, Moulin Larroque, according to DOUVILLÉ 1905 and HOTTINGER et al. 1956) as that of the original locality similar forms, referred to as "scalaris", were depicted by NEUMANN (1958). These forms differ from the "marthae" of Saint-Barthélémy only in their less inflate test.

Smaller external differences of this kind between different localities are observable in the case of nearly all Orthophragminae, therefore no particular importance is attached to this phenomenon in the present work.

V a r i a b i l i t y : See the "Description" and "Retrospection" for the variability of the exterior. On the basis of the data available the internal features are more or less stable.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the annuli of *Orbitoclypeus seunesi*, *O. ramaraoi crimensis*, *O. douvillei*, *O. schopeni* and *O. chudeaui chudeaui* are not undulated.

It is very difficult to distinguish it from *O. varians roberti* and *O. varians scalaris*. The only difference is in the more undulated cycles of these latter taxa. The stratigraphic level however is completely different, hence the difference of the accompanying fauna, too.

R a n g e : The lower part of the Lutetian.

SW Aquitaine (Saint-Barthélémy, maisonnave and north-westward cut of the road; Saint-Martin-de-Seignanx, Moulin Larroque), N Italy (Vanzi near Malo).

Orbitoclypeus multiplicata (GÜMBEL), 1868

Text-fig. 30g

1868. *Orbitoides (Rhipidocyclina) multiplicata* n. sp. — GÜMBEL, pp. 704—705, pl. 4, figs. 20, 21—24(?)
1904. *Orthophragmina multiplicata* (GÜMBEL) — SCHLUMBERGER, pp. 125—126, pl. 3, fig. 10, pl. 4, figs. 18, 20, text-fig. 4
non 1963. *Discocyclina multiplicata* (GÜMBEL) — BIEDA, pp. 121—122, pl. 20, fig. 1 (= *Orbitoclypeus varians* indet. ssp.)
non 1967. *Discocyclina multiplicata* (GÜMBEL) — KÖHLER (= *Orbitoclypeus varians angoumensis*)

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : GÜMBEL (1868), pl. 4, fig. 20, depository: coll. prof. SUESS — external form (marked out by the present writer).
T y p e l o c a l i t y : Monte Spilecco (N Italy).
T y p e l e v e l : Not specified (in the present writer's opinion the middle part of the Ilerdian).
The t y p e of the equatorial section of forms "A": SCHLUMBERGER (1904), pl. 4, fig. 18, depository: École de Mines (Paris), further data are the same as those of the lectotype.
D i a g n o s i s : Small- and medium-sized, moderately inflate forms with undulated collar. "Marthae" type rosette. The embryon is of the eulepidine type, the two chambers are medium-sized. The adauxiliary chambers are of the "varians" type, they are medium in numbers, narrow and relatively low. The equatorial chambers are relatively narrow and medium high. The cycles are undulated, the growth pattern is of the "varians" type.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (3 to 7 mm), moderately inflate forms. The umbo is well distinctable, it takes up approximately two thirds of the test diameter. The collar around the umbo is curved and undulated with 5 to 8 waves. "Marthae" type rosette. The granules and the lateral chambers are the closest to those of *Orbitoclypeus ramaraoi* and *O. bayani*. The sizes ratio of forms "A" and "B" is unknown for the time being.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30g):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu (?excentri)	$Q=1.92$	*t:* varians	*s.c.:* undulated, with 5–8 waves
$E=0.34$	$\bar{Q}=1.70-2.10$	N is unknown	*g.p.:* varians
$\bar{E}=0.25-0.50$	$P=174$ µm	$\bar{N}=25-36$ (estimated)	$l=30$ µm
$R=1.10$	$\bar{P}=150-225$ µm	$L=30-40$ µm (estimated)	$h=70$ µm
$\bar{R}=0.95-1.25$	$D=335$ µm	H is unknown	$n_{0.5}=13.0$
	$\bar{D}=280-400$ µm	$\bar{H}=35-50$ µm (estimated)	$\bar{n}_{0.5}=10-16$
			$n_{1.0}$ is unknown

The equatorial section of forms "B": Microspheric specimens of the species have not been found yet.

Axial section: The scale of enlargement of GÜMBEL's (1868) rather schematic drawing is strongly questionable and its locality is unknown. It is observable all the same that the equatorial layer grows rather thick towards the edges.

SCHLUMBERGER's (1904, pl. 4, fig. 20) somewhat indistinct figure shows that the height of the embryon is about 200 µm, the equatorial layer is approximately 80 µm thick near the embryon and it grows thicker towards the edges.

Phylogenetic position (text-fig. 30): On the basis of the similarity of the stratigraphic position, rosette and morphology the derivation from *Orbitoclypeus ramaraoi neumannae* is the most likely.

No data are available with respect to the intraspecific evolution.

This taxon either became extinct with no offspring or it is an intermediate form between *O. ramaraoi* and *O. bayani,* since the annuli of the latter are strongly undulated and ribs appear on it as well. Perhaps the undulated collar appearing on *O. multiplicata* can be regarded as the forerunner of these ribs.

Retrospection: Lacking own preparations the above description was based on bibliographic data.

On GÜMBEL's (1868) — the describer of the taxon — schematic drawings only the undulated collar, the "marthae" type rosette and in axial section the equatorial layer that grows thick outwards are well-illustrated but no information is given concerning the characteristic features of the equatorial section. In addition GÜMBEL (1868) marked two places as localities: Spilecco and Kressenberg. SCHLUMBERGER (1904) published the equatorial section of the taxon from Spilecco. The above description is based on this section. BIEDA's (1963) and KÖHLER's (1967) "multiplicata" were discovered from quite another stratigraphic level than the Spilecco beds. Their above identification was based on their internal morphology.

With respect to this form, that is undoubtedly known only from Spilecco the question occurs: whether it is a valid species at all, since the undulated collar, its most characteristic feature may as well be the consequence of ecological factors. To answer this question is possible only after the thorough examination of the Spilecco material. Until then — conditionally — this denomination can remain.

Variability: Due to the very scarce data there is no way to characterize the variability of the taxon.

Comparison: Among the forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus seunesi, O. ramaraoi crimensis, O. douvillei, O. schopeni* and *O. chudeaui chudeaui* are circular.

Though the cycles of *O. marthae, O. varians roberti* and *O. varians scalaris* are undulated their collars are not.

Orbitoclypeus bayani, O. furcata rovasendai and *O. furcata furcata* are ribbed forms, their cycles are much more undulated.

Range: The middle part of the Ilerdian.

N Italy (Spilecco).

Orbitoclypeus bayani (MUNIER-CHALMAS), 1891

Pl. XXVII, figs. 4–6, text-fig. 30h

1891. *Orthophragmina bayani* n. sp. — MUNIER-CHALMAS, pp. 29, 37
1904. *Orthophragmina bayani* MUNIER-CHALMAS — SCHLUMBERGER, pp. 131–132, pl. 4, figs. 21, 22, pl. 5, fig. 23
1904. *Orthopragmina decorata* n. sp. — SCHLUMBERGER, pp. 124–125, pl. 3, fig. 11
1904. *Orthophragmina munieri* n. sp. — SCHLUMBERGER, p. 125, pl. 3, fig. 12
1922. *Asterodiscus bayani* (MUNIER-CHALMAS) — DOUVILLÉ, pp. 94–95
1922. *Asterodiscus decoratus* (SCHLUMBERGER) — DOUVILLÉ, p. 79

1922. *Asterodiscus munieri* (SCHLUMBERGER) — DOUVILLÉ, p. 79
1929. *Asterodiscus decoratus* (SCHLUMBERGER) — LLUECA, p. 302, fig. 65
partim 1929. *Asterodiscus munieri* (SCHLUMBERGER) — LLUECA, pp. 301—302, fig. 64
1940. *Discocyclina (Discocyclina) bayani* (MUNIER-CHALMAS) — WEIJDEN, p. 26, pl. 2, figs. 3—5
1940. *Discocyclina decorata* (SCHLUMBERGER) — WEIJDEN, p. 61, pl. 11, fig. 2
1940. *Discocyclina munieri* (SCHLUMBERGER) — WEIJDEN, pp. 63—64, pl. 11, fig. 4
1955. *Actinocyclina munieri* (SCHLUMBERGER) — NEUMANN, pp. 131—132, pl. 6, fig. 6, pl. 7, figs. 4, 6, 7
1958. *Actinocyclina patellaris* (SCHLOTHEIM) — NEUMANN, pp. 123—125, pl. 33, figs. 1, 2, 4—6, text-fig. 42
non 1959. *Asterocyclina bayani* (MUNIER-CHALMAS) — KECSKEMÉTI *(=?Orbitoclypeus furcata rovasendai)*
non 1959. *Asterocyclina bayanii* (MUNIER-CHALMAS) — BELMUSTAKOV *(=?Orbitoclypeus furcata rovasendai)*
1973. *Asterodiscus taramellii* (MUNIER-CHALMAS) — MASSIEUX, pp. 105—106, pl. 19, figs. 10—12
?1974. *Actinocyclina munieri* (SCHLUMBERGER) — PORTNAYA, pp. 110—111, pl. 30, figs. 1—3
1974. *Asterocyclina* sp. — PORTNAYA, text-fig. 10b

Holotype: Not given by the author of the taxon.
Lectotype: SCHLUMBERGER (1904), pl. 4, fig. 22, depository: École de Mines (Paris) — marked out by the present writer.
Type locality: Monte Spilecco (N Italy).
Type level: Not specified (in our opinion the middle part of the Ileridan).
Diagnosis: Medium-sized, flattened or slightly inflate ribbed forms. Asteroidal forms may also occur with 6 to 7 rays. The embryon is excentrilepidine or perhaps eulepidine, the two chambers are medium-sized. The adauxiliary chambers are of the "varians" type, medium in numbers, medium wide and high as well as the equatorial chambers. The cycles are strongly undulated, their growth pattern is of the "varians" type.

Description:

External morphology: Medium- and large-sized (5 to 12 mm) flat or moderately rounded forms with distinct umbo varying from 2 to 3 mm in diameter. From the umbo 6 to 8 thick radial ribs start. Between these ribs generally interrib areas are formed. If not; the test is asteroidal. If so; the ribs may branch into two towards the edges. The rosette is of the "marthae" type. The granules are the biggest on the umbo (diameter varies from 100 to 150 μm), whereas on the interrib areas they are quite fine (30 to 50 μm in diameter). Each granule is surrounded by 9 to 12 lateral chambers. The size ratio of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30h):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (eu)	$Q=1.59-2.26$	*t:* varians	*s.c.:* undulated, with 6—8 stronger waves
$E=0.05-0.89$	$\bar{Q}=1.55-2.00$	$N=25-42$	*g.p.:* varians
$\bar{E}=0.05-0.60$	$P=130-210$ μm	$\bar{N}=25-40$	$l=30-45$ μm
$R=0.61-1.44$	$\bar{P}=130-210$ μm	$L=35-45$ μm	$h=50-160$ μm
$\bar{R}=0.90-1.45$	$D=230-400$ μm	$H=40-70$ μm	$n_{0.5}=9.0-12.5$
	$\bar{D}=245-360$ μm	$\bar{H}=40-65$ μm	$\bar{n}_{0.5}=10.0-12.5$
			$n_{1.0}=17.0-23.3$

The equatorial section of forms "B": Microspheric specimens of the species have not been found yet. Presumably the juvenarium bears "Lepidocyclina" character.

Axial section: Not having own preparations on the basis of SCHLUMBERGER's (1904, pl. 4, fig. 21), NEUMANN's (1958, pl. 33, fig. 5) and MASSIEUX's (1973, pl. 19, fig. 12) figures the height of the embryon is ranging from 250 to 360 μm. The equatorial layer is 60 μm thick near the embryon and it thickens up to 100 μm towards the edges. The lateral septum is thick, the annular one is slightly arcuate. None of the above 3 figures inform us whether the equatorial layer is divided into more layers in the ribs or not. In the lateral layers the chambers are 60×35 μm big on the average.

Phylogenetic position (text-fig. 30): On the basis of the stratigraphic position and owing to the similarity of certain internal and external features *Orbitoclypeus bayani* can be derived from *O. ramaraoi neumannae*, probably with *O. multiplicata* — the validity of which is doubtful — being an intermediate form.

Concerning the intraspecific evolution nothing can be established on the basis of the literature and the material examined by us, since practically there is no difference between the forms of the middle part of the Ilerdian from Spilecco and those of the middle part of the Cuisian found in Horsarrieu. Only MASSIEUX's (1973) specimens from the Northern Corbières are somewhat smaller in their quantitative features than the average.

In all probability this overspecialized species became extinct without offspring at the beginning of the Middle Eocene. Though they are very similar it is not likely that *O. furcata* is directly related to *O. bayani,* since ribbed Orbitoclypei are not known from the middle part of the Lutetian stage. In addition the embryon size of the oldest known "furcata" is much smaller than that of the "bayani". These two species show a nice example of the convergency within the Orbitoclypei.

Retrospection: After MUNIER-CHALMAS's (1891) "nomen nudum" denomination the forms assigned here were clearly described and depicted by SCHLUMBERGER (1904), so the "bayani" name can be used unlike "patellaris", "decorata" and "munieri" (see explanation later). The "taramellii" and "*Asterocyclina* sp." names used for marking star-shaped forms should be ruled out because of the internal morphology. The same refers to the "bayani" name used for marking forms from the more upper parts of the Eocene.

Variability: The variability of the exterior has already been discussed above. With respect to the inner morphology the embryon's type and size are the most changeable.

Comparison: Among the ribbed forms with similar type and similar-sized embryon *O. bayani* may only be confused with *O. furcata rovasendai* and *O. furcata furcata.*

The ribs of the latter forms however are nearly always divided into two on the edges, they are never star-shaped, their cycles are stronger undulated and their equatorial chambers are somewhat narrower. Due to the difference in stratigraphic level the accompanying fauna is totally different.

Range: From the middle part of the Ilerdian to the lower part of the Lutetian.

S France (Horsarrieu – samples HX, HN, Doazit, Sainte-Colombe, Northern Corbiéres), N Italy (Spilecco), Crimea (Bakhchisaraian stage at the vicinity of Feodosia; Suvlu-Kaya Hill – Simferopolian stage – the upper part of the *Nummulites polygyratus* zone – according to PORTNAYA, 1974).

Orbitoclypeus douvillei (SCHLUMBERGER), 1903

Pl. XXVII, figs. 7–9, text-figs. 30i–k

1903. *Orthophragmina douvillei* n. sp. – SCHLUMBERGER, pp. 283–284, pl. 9, figs. 21, 22(?), 23–24
1922. *Discocyclina douvillei* (SCHLUMBERGER) – DOUVILLÉ, p. 71
1940. *Discocyclina (Discocyclina) douvillei* (SCHLUMBERGER) – WEIJDEN, pp. 32–33, pl. 3, figs. 4–7
non 1942. *Discocyclina douvillei* (SCHLUMBERGER) – HEYBROEK *(=Orbitoclypeus seunesi)*
partim 1953. *Discocyclina douvillei* (SCHLUMBERGER) – SCHWEIGHAUSER, pp. 75–77, pl. 12, fig. 3
partim non 1953. *Discocyclina douvillei* (SCHLUMBERGER) – SCHWEIGHAUSER *(=Orbitoclypeus ramaraoi neumannae)*
partim 1958. *Discocyclina douvillei* (SCHLUMBERGER) – NEUMANN, pp. 92–93, pl. 11, figs. 4, 5(?), 6, 7(?), 8, 9, text-fig. 26B
partim non 1958. *Discocyclina douvillei* (SCHLUMBERGER) – NEUMANN *(=Orbitoclypeus ramaraoi neumannae)*
non 1959. *Discocyclina douvillei* (SCHLUMBERGER) – KECSKEMÉTI *(=Discocyclina augustae augustae)*
non 1961. *Discocyclina douvillei* (SCHLUMBERGER) – KÖHLER *(=Orbitoclypeus ramaraoi ramaraoi)*
non 1963. *Discocyclina douvillei* (SCHLUMBERGER) – BIEDA *(=Orbitoclypeus varians roberti)*
non 1972. *Discocyclina douvillei* (SCHLUMBERGER) – SAMUEL et al. *(=Orbitoclypeus seunesi* et *O. ramaraoi ramaraoi)*
partim 1974. *Discocyclina douvillei* (SCHLUMBERGER) – PORTNAYA, pp. 91–93, pl. 19, fig. 1–3
partim non 1974. *Discocyclina douvillei* (SCHLUMBERGER) – PORTNAYA *(=Discocyclina archiaci bakhchisaraiensis)*

Holotype: Not specified by the author of the taxon.
Lectotype: SCHLUMBERGER (1903), pl. 9, fig. 21. and NEUMANN (1958), pl. 11, fig. 4 (according to NEUMANN 1958), depository: École de Mines (Paris) – external form.
Type locality: Daguerre – according to SCHLUMBERGER (1903) or Bos d'Arros – according to NEUMANN (1958) – both are from SW Aquitaine.
Type level: Not given [in our opinion the upper part of the Lutetian on the basis of SCHLUMBERGER's (1903) type locality or the middle part of the Cuisian on the basis of NEUMANN's (1958) type locality].
The type of the equatorial section of forms "A": SCHLUMBERGER (1903), pl. 9, fig. 23 and NEUMANN (1958), pl. 11, figs. 6, 8, preparation 2165 (3), coll. SCHLUMBERGER, depository: École de Mines (Paris), Bos d'Arros (SW Aquitaine) – according to NEUMANN (1958, p. 93) – the middle part of the Cuisian.
Diagnosis: Small-sized, strongly inflate forms with "chudeaui" type rosette. The embryon is eulepidine, the two chambers are moderately small. The adauxiliary chambers are of the "varians" type, they are low in numbers, medium wide but low. The equatorial chambers are narrow or medium wide, generally low but very high on the edges. The cycles are circular, their growth pattern is of the "trabayensis" type.

Description:

External morphology: Small-sized (2 to 5 mm), strongly inflate forms. The umbo is distinct, conical, it is surrounded by narrow collar. The transition between umbo and collar is smooth. The rosette is the closest to the "chudeaui" type: granules are large on the top of the umbo (100 to 150 μm in diameter), elsewhere they are finer, polygonal and surrounded by 6 to 8 lateral chambers.

Internal morphology:

The equatorial section of forms "A" (text-figs. 30i–k):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu	$Q=1.78-2.29$	*t:* varians	*s.c.:* circular
$E=0.36-0.96$	$\bar{Q}=1.70-2.30$	$N=14-19$	*g.p.:* trabayensis
$\bar{E}=0.35-0.70$	$P=72-167$ μm	$\bar{N}=14-20$	$l=30-50$ μm
$R=0.54-1.19$	$\bar{P}=75-165$ μm	$L=30-60$ μm	$h=35-200$ μm
$\bar{R}=0.80-1.20$	$D=130-345$ μm	$H=35-70$ μm	$n_{0.5}=10.0-18.0$
	$\bar{D}=130-350$ μm	$\bar{H}=35-65$ μm	$\bar{n}_{0.5}=10.0-17.0$
			$n_{1.0}=19.0-30.0$

The equatorial section of forms "B": Microspheric specimens of the species have not been found yet. Presumably the juvenarium bears "Lepidocyclina" character.

Axial section: Lacking own preparations on the basis of the data given by SCHLUMBERGER (1903, pl. 9, fig. 24) and NEUMANN (1958, pl. 11, fig. 9) in respect of the oldest known forms of the species (from Bos d'Arros), the embryon is 80 μm high, the equatorial layer hardly grows thick towards the edges, it is 25 μm thick near the embryon and 30 to 35 μm on the peripheries. The lateral septum is thin the annular one is straight. The average size of the chambers in the lateral layers is 90×30 μm.

P h y l o g e n e t i c p o s i t i o n (text-fig. 30): Hardly anything is known with respect to the ancestor of *Orbitoclypeus douvillei*. Accordingly conditionally we consider it to derive from *O. seunesi* as the earliest Orbitoclypeus.

On the basis of the data available for us the intraspecific evolution was rapid but the material found so far is so scarce that to distinguish subspecies is not yet timely. It is likely that in the case of the most primitive forms known so far coming from the Middle Cuisian of Bos d'Arros $\bar{D}$ is less than 200 μm (see text-fig. 30i), the same parameter of the Saint-Barthélémy (Lower Lutetian) population is ranging from 200 to 280 μm (see text-fig. 30j), whereas it is over 280 μm in the case of the most advanced Gibret (Middle Lutetian) population (see text-fig. 30k).

The same sort of evolution is detectable in the increase of $\bar{R}$, $\bar{P}$ and $\bar{H}$ and in the decrease of $\bar{E}$ and $\bar{n}_{0.5}$. But strangely enough $\bar{N}$ hardly increases that is due to the gradual increase in width *(L)* of the adauxiliary chambers.

The most important descendant of *O. douvillei*, *O. chudeaui* differs from its ancestor in its more excentric embryon and in its somewhat wider equatorial chambers.

O. portnayae, a native of Crimea only, with slightly undulated cycles and "marthae" type rosette may also be an offspring as well as *O. varians horsarrieuensis* that is similar to the latter form but it has much stronger undulated annuli. In the case of this taxon however on the basis of the relatively early appearance the derivation from *O. ramaraoi* can not be ruled out.

A link may be presumed towards *O. schopeni*, too, though the initial size of the embryon divides them at the same time. In the case of *O. schopeni* the derivation from neither *O. seunesi* nor *O. chudeaui* can be ruled out.

R e t r o s p e c t i o n : SCHLUMBERGER (1903), the first describer, gave a satisfactory depiction of the taxon but the localities given by him are not completely sure, since for the same external form he marked "Daguerre" as locality, while NEUMANN (1958) revising the taxon marked "Bos d'Arros". For the equatorial and axial sections no localities were given by SCHLUMBERGER (1903). According to NEUMANN (1958, p. 93) and on the basis of the specimens' quantitative features it can only be presumed that these forms are coming from Bos d'Arros, since the forms from Saint-Barthélémy and Daguerre must be more advanced in their quantitative features. Also the question occurs whether "douvillei" can be found at all in Daguerre, and what if SCHLUMBERGER (1903) depicted *Orbitoclypeus chudeaui chudeaui*. Ignoring the internal morphology this question cannot be decided at present.

Later, SCHLUMBERGER's (1903) description and figures were either repeated (DOUVILLÉ 1922, WEIJDEN 1940), or forms externally somewhat similar but internally different coming from not topotypical localities were described going by this name. SCHWEIGHAUSER's (1953) as well as NEUMANN's (1958) forms that were included in the synonymic list are from SCHLUMBERGER's collection (specimens from Bos d'Arros). The high quality depiction is due to NEUMANN (1958) but unfortunately the scale of enlargement and the dimensions of the inner test are not correct.

V a r i a b i l i t y : On the basis of the scarce material found so far the qualitative features are practically stable.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the annuli of *Orbitoclypeus marthae*, *O. portnayae*, *O. varians horsarrieuensis*, *O. varians angoumensis*, *O. varians roberti*, *O. varians scalaris* and *O. multiplicata* are more or less undulated.

The rosette of *O. seunesi* is of the transitional "Discocyclina—marthae" type, while *O. ramaraoi ramaraoi*, *O. ramaraoi neumannae*, *O. ramaraoi suvlukayensis* and *O. ramaraoi crimensis* have "marthae" type rosette.

O. chudeaui chudeaui possess trybliolepidine embryon, its adauxiliary chambers are higher in numbers and higher as well. The equatorial chambers are wider, the growth pattern of the annuli is of the "varians" type.

R a n g e : From the middle part of the Cuisian to the top of the middle part of the Lutetian.

On the basis of the data known up to now only SW Aquitaine (Bos d'Arros, Saint-Barthélémy, Gibret).

Orbitoclypeus portnayae n. sp.

Pl. XXVII, figs. 10–12, pl. XXVIII, figs. 1–8, text-fig. 301

D e r i v a t i o n o m i n i s : Named after the Soviet Orthophragmina researcher, VLADILENA LVOVNA PORTNAYA.
H o l o t y p e : Preparation E. 4879, pl. XXVII, fig. 11.
T y p e l o c a l i t y : Crimea — Suvlu-Kaya Hill — Simferopolian stage, the top of the *Nummulities distans* zone, sample B 77.
T y p e l e v e l : The lower part of the Lutetian.
D i a g n o s i s : Small, inflate forms. The rosette bears "marthae" character. The eulepidine embryon is small. The adauxiliary chambers are of the "varians" type, they are low in numbers, narrow and low similarly to the equatorial chambers but these may rapidly grow long on the edges. Depending on this the growth pattern of the moderately undulated annuli may be of the "varians" or "trabayensis" types.

D e s c r i p t i o n :

External morphology: Small (1.5 to 3 mm) inflate forms with well-defined umbo that may be surrounded by a narrow collar. "Marthae" type rosette. The granules are the coarsest on top of the umbo (80 to 120 μm in diameter) but finer on the edges. They are encircled by 10 to 14 lateral chambers. Forms "B" are 1.2 to 1.5 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30l):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu	$Q = 1.70 - 2.08$	*t:* varians	*s.c.:* gently undulated with 6 to 7 waves
$E = 0.48 - 0.67$	$\bar{Q} = 1.70 - 2.15$	$N = 9 - 16$	*g.p.:* varians or trabayensis
$\bar{E} = 0.45 - 0.70$	$P = 65 - 72$ μm	$\bar{N} = 10.0 - 14.5$	$l = 30 - 35$ μm
$R = 0.73 - 1.00$	$\bar{P} = 60 - 80$ μm	$L = 30 - 45$ μm	$h = 30 - 90$ μm
$\bar{R} = 0.75 - 1.00$	$D = 119 - 150$ μm	$H = 25 - 40$ μm	$n_{0.5} = 12.0 - 19.0$
	$\bar{D} = 115 - 155$ μm	$\bar{H} = 25 - 37$ μm	$\bar{n}_{0.5} = 13.0 - 17.5$
			$n_{1.0}$ is unknown

The equatorial section of forms "B": On the basis of a relatively large number of preparations the juvenarium bears "Lepidocyclina" character, I=10–15 μm, S=8–13, s=75–110 μm, J=10–14, j=600–700 μm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: The species could not be studied in this section.

P h y l o g e n e t i c p o s i t i o n (text-fig. 30): *Orbitoclypeus douvillei* may be the most probable ancestor. The taxon differs from it only in its slightly undulated annuli, in the smaller size of its embryon and in its "marthae" type rosette.

Since the species was found in one population only, nothing can be established concerning the intraspecific evolution.

No data are available concerning the offsprings of the species.

R e t r o s p e c t i o n : Since the above described forms are not known from the literature and as they can be clearly distinguished from the similar forms their segregation into a new distinct species is justified.

V a r i a b i l i t y : In the only population that was examined all characters save the growth pattern proved to be stable.

C o m p a r i s o n : Among the unribbed forms with similar type and similar-sized embryon the annuli of *Orbitoclypeus ramaraoi ramaraoi* are circular and its embryon is more excentric.

The rosette of *O. douvillei* is of the "chudeaui" type, its cycles are circular.

The cycles of *O. varians horsarrieuensis* are much stronger undulated, "trabayensis" type growth pattern do not occur and its embryon is somewhat bigger.

R a n g e : The lower part of the Lutetian.

Crimea — Simferopolian stage, the upper part of the *Nummulites distans* zone (samples B 76, 77).

Orbitoclypeus varians (KAUFMANN), 1867

D i a g n o s i s : Small- and medium-sized, more or less inflate forms. "Marthae" type rosette. The embryon bears excentri- or eulepidine character, the two chambers are small or medium-sized. The adauxiliary chambers are of the "varians" type, low or medium in numbers, narrow or medium wide, low or medium high similarly to the equatorial chambers. The cycles are undulated with 6 to 8 stronger waves. The growth pattern is of the "varians" type.

D e s c r i p t i o n :

External morphology: Small- or medium-sized (2 to 8 mm), more or less rounded forms with or without a narrow collar. The rosette is of the "marthae" type but its complexity is different depending on the actual population. The granules are generally bigger on the umbo (80 to 150 μm in diameter) than on the peripheric surface. Each granule is surrounded by 8 to 14 tiny lateral chambers. In the case of the more advanced subspecies forms "B" are 1.2 to 1.5 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "B": On the basis of KÖHLER's (1967, pl. 12, fig. 5 and pl. 14, fig. 3) and our own preparations the juvenarium bears "Lepidocyclina" character. I = 14—18 μm, S = 6—8, s = 70—85 μm, J = 18—22, j = 800—1300 μm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: On the basis of abundant bibliographic data (SCHLUMBERGER 1903, pl. 8, fig. 4, pl. 10, figs. 34—35, pl. 11, fig. 40; WITT PUYT 1941, pl. 5, fig. 7; SCHWEIGHAUSER 1953, pl. 10, fig. 6, pl. 11, fig. 4; NEUMANN 1958, pl. 17, fig. 5, pl. 18, fig. 7, pl. 20, fig. 7, pl. 21, fig. 6, pl. 24, figs. 4—5; KÖHLER 1967, pl. 12, fig. 3, pl. 14, figs. 5—6; GROSS—KÖHLER et al. 1980, pl. 27, fig. 5, pl. 28, fig. 3) and our own preparation the height of the embryon is ranging from 125 to 250 μm. The equatorial layer grows remarkably thick towards the edges (from 40 to 60 μm to as much as 80 to 220 μm). The lateral septum is thick near the embryon and thin at the edges, the annular septum is slightly arcuate. The size of the lateral chambers is 60—100 × 25—30 μm on the average.

P h y l o g e n e t i c p o s i t i o n (text-fig. 30): The origin of *Orbitoclypeus varians* cannot be decided yet. The "marthae" type rosette suggests a link towards *O. ramaraoi*, whereas the initial size of the embryon suggests that rather *O. douvillei* is related.

5 evolutional stages (subspecies) could be distinguished within the species using the following biometric limits:

Orbitoclypeus varians horsarrieuensis (text-fig. 30m):	$\bar{D} < 200$ μm
Orbitoclypeus varians angoumensis (text-fig. 30n):	$\bar{D} = 200—250$ μm
Orbitoclypeus varians roberti (text-fig. 30o):	$\bar{D} = 250—320$ μm
Orbitoclypeus varians scalaris (text-fig. 30p):	$\bar{D} = 320—400$ μm
Orbitoclypeus varians varians (text-fig. 30q):	$\bar{D} > 400$ μm

Similar development is observable in the increase of $\bar{P}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{n}_{0.5}$. $\bar{E}$, $\bar{R}$, $\bar{Q}$ parameter means hardly (if ever) change, *L* and *l* slowly increase.

On the basis of the first known appearance *O. furcata* can be derived from *O. varians angoumensis*. It may be regarded as the ribbed variety of the discussed species because they are very similar in their internal morphology.

R e t r o s p e c t i o n : The history of this species is one of the most complicated ones among the Orthophragminae since the forms included by us were described under not less them 17 different names. The first one among these names, identifiably depicted by the first describer, was "varians" (KAUFMANN 1867), therefore we considered this name to be valid for marking the species. Two other later names, namely "scalaris" and "roberti" can be used on the subspecies level, 5 among the other 14 refer to other taxa, whereas the remainder 9 ("andrusovi", "aspera", "apula", "dubia", "distefanoi", "isseli", "llarenai", "nummulitica", "zitteli") cannot be used (see explanation later).

V a r i a b i l i t y : Since this species is one of the commonest ones among the Orthophragminae its changeability is well-known. The most significant is the changeability of the exterior and the rosette even within a population. It is not for nothing for instance that CHECCHIA-RISPOLI (1909a, 1911a, 1916), SCHWEIGHAUSER (1953), KECSKEMÉTI (1959), BIEDA (1963) and KÖHLER (1967) described particular populations under several names. After examining the internal morphology it was proved that the degree of inflateners of the test the existence or lack of the narrow collar and the smaller changeability of the rosette are not taxonomic but ecologic categories. The characters of the interior are relatively stable within the populations. Besides the evolutionary trends due to the disparity of age (see et "Phylogenetic position") the degree of undulation may also change between the populations. From this point of view the unusually slight undulation of the annuli of the Lábatlan specimens is a striking feature.

R a n g e : From the middle part of the Cuisian to the middle part of the Priabonian.

Orbitoclypeus varians (KAUFMANN), 1867 **horsarrieuensis** n. ssp.

Pl. XXVIII, figs. 9–12, text-fig. 30m

partim ?1982. *Discocyclina varians* (KAUFMANN) — FERMONT, p. 135, table 6 (partim), pl. 10, fig. 2

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E. 4886, pl. XXVIII, fig. 11.
Type locality: Horsarrieu (SW Aquitaine) — Marniére Sourbet — sample HS.
Type level: The middle part of the Cuisian.
Diagnosis: *Orbitoclypeus varians* populations with $\bar{D}$ less than 200 μm.

Description:

External morphology: Small-sized (2 to 4 mm), inflate forms with "marthae" type rosette. The ratio of the sizes of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30m):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu–semi-nephro	Q = 1.48–2.17	*t:* varians	*s.c.:* undulated, with 6 to 8 stronger waves
E = 0.24–0.79	$\bar{Q}$ = 1.60–2.00	N = 12–19	*g.p.:* varians
$\bar{E}$ = 0.30–0.70	P = 64–122 μm	$\bar{N}$ = 12–20	l = 25–30 μm
R = 0.72–1.24	$\bar{P}$ = 75–110 μm	L = 35–45 μm	h = 45–60 μm
$\bar{R}$ = 0.85–1.20	D = 137–200 μm	H = 25–45 μm	$n_{0.5}$ = 12.5–21.7
	$\bar{D}$ = 140–200 μm	$\bar{H}$ = 30–45 μm	$\bar{n}_{0.5}$ = 13.0–20.0
			$n_{1.0}$ = 25.0–34.0

Retrospection: The name "varians", used by FERMONT (1982) for marking the above described forms, refers to forms with different internal morphology, this is why a new name had to be introduced.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus ramaraoi ramaraoi*, *O. ramaraoi neumannae* and *O. douvillei* are circular.

The cycles of *O. portnayae* are less undulated and often its growth pattern is of the "trabayensis" type.

Range: The middle and upper parts of the Cuisian stage, perhaps the lower part of the Lutetian stage as well.

SW Aquitaine (Horsarrieu — samples HS, HX), Israel (Ein Avedat section — sample Is 276).

Orbitoclypeus varians (KAUFMANN), 1867 **angoumensis** n. ssp.

Pl. XXIX, figs. 1–4, text-fig. 30n

partim 1911a. *Orthophragmina dispansa* (SOWERBY) — CHECCHIA-RISPOLI, p. 966, pl. 5, figs. 14, 18, 39, pl. 6, figs. 58–60
partim 1958. *Discocyclina marthae* (SCHLUMBERGER) — NEUMANN, pp. 97–98, pl. 17, figs. 2–5, text-fig. 28
1967. *Discocyclina multiplicata* (GÜMBEL) — KÖHLER, pp. 66–68, pl. 12, figs. 5(?), 6

Derivatio nominis: Named after the type locality of the taxon.
Holotype: Preparation E. 4889, pl. XXIX, fig. 2.
Type locality: Angoumé (SW Aquitaine) — Marnière de Miretraine.
Type level: The upper part of the Lutetian stage.
Diagnosis: *Orbitoclypeus varians* populations with $\bar{D}$ ranging from 200 to 250 μm.

Description:

External morphology: Small-sized (2.5 to 5 mm), inflate forms with "marthae" type rosette. The ratio of the sizes of forms "A" and "B" is unknown.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30n):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: eu–excentri	Q = 1.39–2.28	*t:* varians	*s. c.:* undulated with 6 to 8 stronger waves
E = 0.16–0.94	$\bar{Q}$ = 1.65–1.85	N = 17–35	*g. p.:* varians
$\bar{E}$ = 0.36–0.55	P = 95–192 μm	$\bar{N}$ = 22–28	l = 25–35 μm
R = 0.54–1.36	$\bar{P}$ = 120–150 μm	L = 25–40 μm	h = 35–100 μm
$\bar{R}$ = 0.85–1.10	D = 175–311 μm	H = 35–65 μm	$n_{0.5}$ = 11.0–18.5
	$\bar{D}$ = 200–250 μm	$\bar{H}$ = 40–50 μm	$\bar{n}_{0.5}$ = 12.0–16.0
			$n_{1.0}$ = 25.0–30.0

R e t r o s p e c t i o n : The *Orbitoclypeus varians* was included in the synonymic list where the *D* (in case of KÖHLER 1967: $\bar{D}$) is between 200 and 250 μm.

The earlier used names for marking these forms do not refer to the forms with the above described inner morphology this is why a new name had to be introduced.

C o m p a r i s o n : All unribbed forms with similar type and similar-sized embryon *(Orbitoclypeus seunesi, O. ramaraoi neumannae, O. ramaraoi suvlukayensis, O. douvillei)* have circular annuli.

R a n g e : With absolute certainty it is known only from the upper part of the Lutetian but presumably it can be found in the middle part of the stage, too.

SW Aquitaine (Angoumé, Saint-Pierre-d'Irube — Daguerre), Sicily (Palermo — Bagheria), W Slovakia (surroundings of Rajec: "Rajec—Schlucht" and "Poluvšie—Brücke").

Orbitoclypeus varians (KAUFMANN), 1867 roberti (DOUVILLÉ), 1922

Pl. XXIX, figs. 5—12, pl. XXX, figs. 1—5, text-fig. 30o

partim	1903.	*Orthophragmina marthae* n. sp. — SCHLUMBERGER, p. 284, pl. 11, fig. 39
partim	1909a.	*Orthophragmina dispansa* (SOWERBY) — CHECCHIA-RISPOLI, p. 107, pl. 5, fig. 13
	1911a.	*Orthophragmina di-stefanoi* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI, p. 299, pl. 1, fig. 21
	1911a.	*Orthophragmina* cfr. *dubia* CHECCHIA-RISPOLI, pp. 299—300, pl. 1, fig. 20
partim	1912.	*Orthophragmina varians* (KAUFMANN) — PREVER, pp. 152—157, pl. 1, fig. 8, pl. 3, fig. 11
	1917.	*Orthophragmina...* — CHECCHIA-RISPOLI, pl. 10, fig. 8.
	1922.	*Discocyclina roberti* n. sp. — DOUVILLÉ, pp. 72—73, pl. 4, fig. 10.
partim	1925.	*Orthophragmina archiaci* (SCHLUMBERGER) — CHECCHIA-RISPOLI, pl. 2, fig. 10
	1929.	*Discocyclina roberti* DOUVILLÉ — LLUECA, pp. 290—291, pl. 23, figs. 29—36
	1940.	*Discocyclina roberti* DOUVILLÉ — WEIJDEN, pp. 65—66, pl. 11, figs. 8, 10, 11
	1941.	*Discocyclina (Discocyclina) marthae* (SCHLUMBERGER) — WITT PUYT, pp. 61—62, pl. 5, figs. 4, 7
	1953.	*Discocyclina roberti* DOUVILLÉ var. *llarenai* RUIZ DE GAONA — SCHWEIGHAUSER, pp. 62—63, pl. 10, figs. 4, 8, text-figs. 19, 46
partim	1953.	*Discocyclina aspera* GÜMBEL — SCHWEIGHAUSER, pp. 70—71, pl. 11, figs. 3, 5, 8, text-figs. 15, 51 (partim)
non	1953.	*Discocyclina roberti* DOUVILLÉ — SCHWEIGHAUSER *(=Orbitoclypeus marthae)*
	1958.	*Discocyclina roberti* DOUVILLÉ — NEUMANN, pp. 103—104, pl. 20, figs. 1—7, text-fig. 31
	1959.	*Discocyclina scalaris* (SCHLUMBERGER) — KECSKEMÉTI, pp. 39—40, pl. 1, figs. 1—2, text-fig. 5
	1959.	*Discocyclina nummulitica* (GÜMBEL) — KECSKEMÉTI, pp. 53—54, pl. 3, figs. 9, 10, 12, text-fig. 15
	1959.	*Discocyclina aspera* GÜMBEL — KECSKEMÉTI, pp. 54—56, pl. 3, fig. 11, pl. 4, figs. 1, 5, text-fig. 16
	1959.	*Discocyclina varians* (KAUFMANN) — KECSKEMÉTI, pp. 56—57, pl. 4, figs. 2, 4, 7, text-fig. 17
non	1959.	*Discocyclina roberti* DOUVILLÉ — BELMUSTAKOV *(=?Orbitoclypeus varians varians)*
	1963.	*Discocyclina douvillei* (SCHLUMBERGER) — BIEDA, pp. 117—118, pl. 18, fig. 1
partim	1967.	*Discocyclina roberti* DOUVILLÉ — KÖHLER, pp. 64—66, pl. 12, fig. 4
partim non	1967.	*Discocyclina roberti* DOUVILLÉ — KÖHLER *(=Orbitoclypeus varians scalaris)*
non	1972.	*Discocyclina roberti* DOUVILLÉ — SAMUEL et al. *(=Orbitoclypeus ramaraoi crimensis)*
partim	1974.	*Discocyclina roberti* DOUVILLÉ — PORTNAYA, pp. 93—96, pl. 20, fig. 1
partim non	1974.	*Discocyclina roberti* DOUVILLÉ — PORTNAYA *(=Orbitoclypeus ramaraoi crimensis)*
	1980.	*Discocyclina aspera* GÜMBEL — GROSS—KÖHLER et al., p. 181, pl. 27, fig. 5, text-fig. 37I

H o l o t y p e : DOUVILLÉ (1922), pl. 4, fig. 10, presumable depository: Université Sorbonne (Paris) — external form.
T y p e l o c a l i t y : Saint-Barthélémy — sous l'église.
T y p e l e v e l : Lower Lutetian substage (in our opinion the lower part of the Bartonian stage).
The t y p e of the equatorial section of forms "A": NEUMANN (1958), pl. 20, fig. 5, presumable depository: Université Paris, further data are the same as those of the holotype.
D i a g n o s i s : *Orbitoclypeus varians* populations with $\bar{D}$ ranging from 250 to 320 μm.

D e s c r i p t i o n :

External morphology: Medium-sized (3 to 6 mm), inflate or moderately inflate forms with "marthae" type rosette. Forms "B" are somewhat bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30o):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (eu)	$Q = 1.52-2.39$	*t:* varians	*s.c.:* undulated with 6 to 8 stronger waves
$E = 0.09-0.53$	$\bar{Q} = 1.70-1.90$	$N = 22-38$	*g.p.:* varians
$\bar{E} = 0.20-0.35$	$P = 108-200$ μm	$\bar{N} = 25-30$	$l = 30-35$ μm
$R = 0.82-1.42$	$\bar{P} = 145-175$ μm	$L = 30-45$ μm	$h = 40-100$ μm
$\bar{R} = 1.05-1.30$	$D = 240-372$ μm	$H = 40-70$ μm	$n_{0.5} = 9.0-16.0$
	$\bar{D} = 250-320$ μm	$\bar{H} = 50-60$ μm	$\bar{n}_{0.5} = 11.0-13.0$
			$n_{1.0} = 17.0-27.0$

Retrospection: When *Orthophragmina marthae* was first described by SCHLUMBERGER (1903) figures from Saint-Barthélémy were published not only from the "maisonnave" but also from the "église" locality. The forms coming from the latter locality were given the "roberti" name by DOUVILLÉ (1922). Neither of them, however, depicted the internal morphology. The only depiction of the inner morphology from the type locality can be found in NEUMANN's (1958) work; the scale of enlargement given by her, however, is incorrect in all probability, therefore we increased the scale to its double.

In spite of all these, this is the most suitable name for marking the forms described above and for the forms with D between 250 to 320 μm of the synonymic list.

Due to the fact that the topotypical "roberti" are poorly known, forms with different inner morphology though with similar rosette were also described under this name.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus seunesi, O. ramaraoi suvlukayensis, O. ramaraoi crimensis, O. douvillei* and *O. chudeaui chudeaui* are circular.

The collar of *O. multiplicata* is undulated.

The most difficult is the distinction from *O. marthae.* The cycles of this form are less undulated and due to the difference in stratigraphic level the accompanying fauna is also totally different.

Range: The lower part of the Bartonian.

SW Aquitaine (Saint-Barthélémy — église), N Italy (surroundings of Vicenza — San Pancrazio, Piemont — Villa Mela), S Italy (Palermo — Termini-Imerese and Bagheria; Foggia — Roseto Valfortore; Castelluccio Valmaggiore), Hercegovina (Ljubuški), S Bakony [surroundings of Ajka — samples Ba 5, 6; J 1, 2, 5; Kö 1, 2 and SzT are from our own sampling; samples "Köleskepe-2" and "Gyűrhegy" are from KECSKEMÉTI's (1959) one], NW Slovakia (surroundings of Žilina — Rajec—Schlucht), Liptov Basin (Haragušovce pri Liskovej).

Orbitoclypeus varians (KAUFMANN), 1867 **scalaris** (SCHLUMBERGER), 1903

Pl. XXX, figs. 6—12, text-fig. 30p

1903. *Orthophragmina scalaris* n. sp. — SCHLUMBERGER, pp. 277—278, pl. 8, fig. 4, pl. 9, figs. 12—13
non 1908. *Orthophragmina scalaris* SCHLUMBERGER — PROVALE *(=Discocyclina dispansa sella)*
1909a. *Orthophragmina di-stefanoi* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI, pp. 110—112, pl. 4, figs. 6—13.
non 1909a. *Orthophragmina scalaris* SCHLUMBERGER — CHECCHIA-RISPOLI *(=Orbitoclypeus varians varians)*
non 1912. *Orthophragmina scalaris* SCHLUMBERGER — PREVER *(=Discocyclina dispansa sella)*
1913. *Orthophragmina apula* n. sp. — CHECCHIA-RISPOLI, pp. 119—120, pl. 6. (2), figs. 15—16
non 1913. *Orthophragmina scalaris* SCHLUMBERGER — CHECCHIA-RISPOLI *(=Discocyclina dispansa dispansa)*
non 1916. *Orthophragmina scalaris* SCHLUMBERGER — CHECCHIA-RISPOLI *(=Orbitoclypeus varians varians* et *?O. schopeni)*
1917. *Orthophragmina aspera* (GÜMBEL) — CHECCHIA-RISPOLI, pp. 260—261, pl. 10, fig. 4
partim 1922. *Discocyclina scalaris* (SCHLUMBERGER) — DOUVILLÉ, pp. 68—69, text-figs. 8, 23
partim non 1922. *Discocyclina scalaris* (SCHLUMBERGER) — DOUVILLÉ *(=Orbitoclypeus ramaraoi crimensis)*
partim 1929. *Discocyclina scalaris* (SCHLUMBERGER) — LLUECA, pp. 279—280, pl. 23, figs. 1—4
partim non 1929. *Discocyclina scalaris* (SCHLUMBERGER) — LLUECA *(=Orbitoclypeus ramaraoi crimensis)*
non 1940. *Discocyclina (Eudiscodina) scalaris* (SCHLUMBERGER) — WEIJDEN *(=Orbitoclypeus varians varians)*
partim 1948. *Orthophragmina varians* (KAUFMANN) — SILVESTRI, pp. 9—11 (185—187), pl. 4. (35.), fig. 9
partim 1953. *Discocyclina nummulitica* (GÜMBEL) — SCHWEIGHAUSER, pp. 68—70, pl. 12, figs. 4, 5, 7—9, text-figs. 16, 50 (partim)
1953. *Discocyclina andrusovi* CIZANCOURT — SCHWEIGHAUSER, pp. 77—78, pl. 10, figs. 3, 6, 7, text-figs. 17, 54
non 1953. *Discocyclina scalaris* (SCHLUMBERGER) — SCHWEIGHAUSER *(=Orbitoclypeus ramaraoi crimensis)*
partim 1958. *Discocyclina scalaris* (SCHLUMBERGER) — NEUMANN, pp. 104—106, pl. 21, figs. 1, 5, 6, pl. 25, fig. 4
partim 1958. *Discocyclina nummulitica* (GÜMBEL) — NEUMANN, pp. 99—100, pl. 18, figs. 1—5, 7, pl. 25, fig. 5, text-fig. 29
partim non 1958. *Discocyclina scalaris* (SCHLUMBERGER) — NEUMANN *(=Orbitoclypeus marthae* et *O. ramaraoi crimensis)*
non 1959. *Discocyclina scalaris* (SCHLUMBERGER) — KECSKEMÉTI *(=Orbitoclypeus varians roberti)*
partim non 1959. *Discocyclina scalaris* (SCHLUMBERGER) — BELMUSTAKOV *(=Orbitoclypeus varians varians)*
partim 1963. *Discocyclina varians* (KAUFMANN) — BIEDA, pp. 119—121, pl. 19, fig. 4
partim 1963. *Discocyclina nummulitica* (GÜMBEL) — BIEDA, pp. 124—125, pl. 20, fig. 8
partim non 1963. *Discocyclina scalaris* (SCHLUMBERGER) — BIEDA *(=Orbitoclypeus varians varians)*
?1967. *Discocyclina scalaris* (SCHLUMBERGER) — KÖHLER, pp. 66, 69
partim 1967. *Discocyclina roberti* DOUVILLÉ — KÖHLER, pp. 64—66, pl. 12, figs. 2, 3, text-fig. 6D
partim 1967. *Discocyclina nummulitica* (GÜMBEL) — KÖHLER, pp. 72—75, pl. 14, figs. 2, 3(?), 5, text-fig. 6F
partim 1967. *Discocyclina varians* (KAUFMANN) — KÖHLER, pp. 74—76, pl. 14, fig. 6, pl. 15, figs. 1, 2
partim ?1970. *Discocyclina nummulitica* (GÜMBEL) — PAVIČ, pl. 13, fig. 9.
non 1970. *Discocyclina scalaris* (SCHLUMBERGER) — PAVIČ *(=Orbitoclypeus varians varians)*

non 1972. *Discocyclina scalaris* (SCHLUMBERGER) — SAMUEL et al. *(=Orbitoclypeus ramaraoi crimensis)*
partim non 1973. *Discocyclina scalaris* (SCHLUMBERGER) — OLEMPSKA *(=Discocyclina discus discus)*
partim 1974. *Discocyclina scalaris* (SCHLUMBERGER) — PORTNAYA, pp. 78—79, pl. 10, figs. 1—4
partim non 1974. *Discocyclina scalaris* (SCHLUMBERGER) — PORTNAYA *(=Discocyclina archiaci archiaci)*

Holotype: Not given by the author of the taxon.
Lectotype: SCHLUMBERGER (1903), pl. 9, fig. 13 and NEUMANN (1958) pl. 21, fig. 1(?) (marked out by NEUMANN 1958), depository: École de Mines (Paris) — external form.
Type locality: Biarritz (SW Aquitaine) — Villa Marbella.
Type level: Not specified (in our opinion the middle part of the Bartonian).
The type of the equatorial section of forms "A": SCHLUMBERGER (1903), pl. 9, fig. 12, the further data are the same as those of the lectotype.
Diagnosis: *Orbitoclypeus varians* populations with $\bar{D}$ ranging from 320 to 400 μm.

Description:

External morphology: Medium-sized (3.5 to 7 mm), moderately inflate forms with "marthae" type rosette. Forms "B" are approximately 1.2 to 1.5 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30p):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (eu)	$Q=1.47-2.43$	*t:* varians	*s.c.:* undulated with 6 to 8 stronger waves
$E=0.03-0.61$	$\bar{Q}=1.65-1.90$	$N=24-42$	*g.p.:* varians
$\bar{E}=0.20-0.40$	$P=165-252$ μm	$\bar{N}=28-35$	$l=30-40$ μm
$R=0.75-1.46$	$\bar{P}=180-220$ μm	$L=35-60$ μm	$h=45-65$ μm
$\bar{R}=1.00-1.25$	$D=285-437$ μm	$H=45-80$ μm	$n_{0.5}=9.0-14.5$
	$\bar{D}=320-400$ μm	$\bar{H}=50-65$ μm	$\bar{n}_{0.5}=10.5-13.0$
			$n_{1.0}=19.0-27.0$

Retrospection: SCHLUMBERGER's (1903), the first describer's figures are suitable for identifying the taxon. The *Orbitoclypeus varians*, the D or $\bar{D}$ of which is between 320 and 400 μm were included in the synonymic list.

On the basis of the equatorial chambers' width NEUMANN's (1958) pl. 18, fig. 5 was included considering the original scale of enlargement given by her, whereas pl. 18, fig. 3 was assigned taking into account 1.6 to 2 times the scale of enlargement given by her.

It is surprising that the name of this taxon, otherwise properly described for the first time, was used for marking a great many forms with various internal morphology. This phenomenon, presumably, is due to the occasional similarity in the external character of the discussed taxon to other taxa.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus seunesi, O. ramaraoi crimensis, O. douvillei, O. schopeni* and *O. chudeaui chudeaui* are circular.

The edges of *O. multiplicata* are undulated.

The most difficult is the distinction from *O. marthae.* The annuli of this however are less undulated and owing to the differing stratigraphic level, the accompanying fauna is different, too.

Range: The middle part of the Bartonian.

SW Aquitaine (Biarritz — Villa Marbella, Bidart — Béhéréco, Siest [bois d'Orist — the latter is in NEUMANN's (1958) original enlargement], N Italy (surroundings of Vicenza — San Pancrazio), S Italy (Palermo — Termini-Imerese, Foggia — Roseto Valfortore, Capitanata — San Marco la Catola), N Bakony (surroudings of Dudar — Samples D 1—3, 7, DS 2, 5 and DH), W Slovakia (surroundings of Žilina — Rajec—Schlucht, Poluvšie, surroundings of Martin — Horné Jaseno), Polish Tatras (Dolina Koscielłiska, Potok Sziwianskich Szalasów), Crna Gora (Sutorina), N Somali (Gungumale).

Orbitoclypeus varians varians (KAUFMANN), 1867

Pl. XXXI, figs. 1—12, pl. XXXII, figs. 1—4, text-fig. 30q

?1867. *Orbitoides varians* n. sp. — KAUFMANN, pp. 158—160, pl. 10, figs. 1—10
partim 1903. *Orthophragmina varians* (KAUFMANN) — SCHLUMBERGER, p. 281, pl. 10, figs. 31, 33, 35
partim non 1903. *Orthophragmina varians* (KAUFMANN) — SCHLUMBERGER, pl. 10, fig. 38(= ?)
non 1905. *Orthophragmina* cf. *varians* (KAUFMANN) — DEPRAT *(=Discocyclina augustae augustae* et *?D. euaensis)*
1907a. *Orbitoclypeus himerensis* n. sp. — SILVESTRI, p. 106
1908. *Orthophragmina (Rhipidocyclina) varians* (KAUFMANN) — HEIM, pp. 266—267
1908. *Orbitoides (Orthophragmina) zitteli* n. sp. — CHECCHIA-RISPOLI, pp. 7, 14
non 1908. *Orthophragmina varians* (KAUFMANN) — PROVALE *(=Orbitoclypeus pygmaea)*
non 1908. *Orthophragmina varians* (KAUFMANN) var. *selliformis* n. var. — PROVALE *(=Orbitoclypeus pygmaea)*

1909a. *Orthophragmina scalaris* Schlumberger — Checchia-Rispoli, pp. 107—108, pl. 4, fig. 4
1909a. *Orthophragmina zitteli* Checchia-Rispoli — Checchia-Rispoli, pp. 133—134, pl. 7, figs. 3, 4, 19—22, pl. 5, fig. 14
1909b. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli, p. 204, pl. 1, fig. 20
partim 1911a. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli, p. 185, pl. 7, fig. 12
1911a. *Orthophragmina zitteli* Checchia-Rispoli — Checchia-Rispoli, p. 165
partim 1912. *Orthophragmina archiaci* Schlumberger — Prever, pp. 143—145, pl. 1, fig. 9, pl. 3, fig. 7
1912. *Orthophragmina isseli* n. sp. — Prever, pp. 146—148, pl. 1, fig. 11, pl. 3, figs. 8, 9
partim 1912. *Orthophragmina dispansa* (Sowerby) — Prever, pp. 157—161, pl. 2, figs. 2, 3
partim non 1912. *Orthophragmina varians* (Kaufmann) — Prever *(=Orbitoclypeus varians roberti)*
1916. *Orthophragmina dispansa* (Sowerby) — Checchia-Rispoli, pl. 4, fig. 6
1916. *Orthophragmina scalaris* (Schlumberger) — Checchia-Rispoli, pl. 4, fig. 11
1922. *Discocyclina varians* (Kaufmann) — Douvillé, pp. 90—91
partim 1925. *Orthophragmina archiaci* (Schlumberger) — Checchia-Rispoli, pl. 2, figs. 9, 11
1929. *Discocyclina varians* (Kaufmann) — Llueca, pp. 286—287, fig. 62
1934. *Orthophragmina archiaci* (Schlumberger) — Reina, pp. 44—45, pl. 4, fig. 3, pl. 5, figs. 4, 5
1934. *Orthophragmina aspera* (Gümbel) — Reina, pp. 46—47, pl. 5, figs. 1—2
partim 1940. *Discocyclina (Discocyclina) varians* (Kaufmann) — Weijden, pp. 58—59, pl. 10, figs. 1—2, 4—5
1940. *Discocyclina (Eudiscodina) nummulitica* (Gümbel) — Weijden, pp. 35—37, pl. 4, figs. 4—6, 8
1940. *Discocyclina (Eudiscodina) scalaris* (Schlumberger) — Weijden, pp. 46—48, pl. 6, figs. 7—9, pl. 7, figs. 1—2, 2 text-figs. in p. 48
partim non 1940. *Discocyclina (Discocyclina) varians* (Kaufmann) — Weijden *(=Discocyclina augustae augustae)*
non 1941. *Discocyclina* aff. *varians* (Kaufmann) — Brönnimann *(=Discocyclina dispansa umbilicata)*
non 1945b. *Discocyclina* aff. *varians* (Kaufmann) — Brönnimann *(=Discocyclina dispansa umbilicata)*
non 1948. *Orthophragmina varians* (Kaufmann) — Silvestri *(=Orbitoclypeus varians scalaris* et *O. schopeni)*
partim 1953. *Discocyclina varians* (Kaufmann) — Schweighauser, pp. 71—73, pl. 11, figs. 1, 4, 12, pl. 12, fig. 6, text-fig. 52
partim non 1953. *Discocyclina varians* (Kaufmann) — Schweighauser, pl. 11, fig. 9, text-fig. 35 (=*Discocyclina indet.* sp. B)
partim 1959. *Discocyclina scalaris* (Schlumberger) — Belmustakov, p. 49, pl. 17, fig. 7
?1959. *Discocyclina roberti* Douvillé — Belmustakov, p. 52, pl. 19, figs. 3—5
non 1959. *Discocyclina varians* (Kaufmann) — Kecskeméti *(=Orbitoclypeus varians roberti)*
partim 1963. *Discocyclina varians* (Kaufmann) — Bieda, pp. 119—121, pl. 19, figs. 1, 3
partim 1963. *Discocyclina* sp. aff. *varians* (Kaufmann) — Bieda, p. 121, pl. 19, figs. 5—6
partim 1963. *Discocyclina scalaris* (Schlumberger) — Bieda, pp. 122—123, pl. 20, fig. 2
partim non 1963. *Discocyclina varians* (Kaufmann) — Bieda *(=Orbitoclypeus varians scalaris)*
partim 1967. *Discocyclina varians* (Kaufmann) — Köhler, pp. 74—76, pl. 14, fig. 8, text-fig. 6G
partim 1967. *Discocyclina nummulitica* (Gümbel) — Köhler, pp. 72—75, pl. 14, fig. 4
partim non 1967. *Discocyclina varians* (Kaufmann) — Köhler *(=Orbitoclypeus varians scalaris)*
1970. *Discocyclina scalaris* (Schlumberger) — Pavič, pl. 14, figs. 3—5.
partim non 1973. *Discocyclina varians* (Kaufmann) — Olempska *(=Discocyclina dispansa hungarica)*
partim 1974. *Discocyclina varians* (Kaufmann) — Portnaya, pp. 85—88, pl. 15, figs. 1—2
partim non 1974. *Discocyclina varians* (Kaufmann) — Portnaya *(=Discocyclina furoni, D. archiaci staroseliensis* et *D. archiaci archiaci)*
1980. *Discocyclina nummulitica* (Gümbel) — Gross, Köhler et al., p. 183, pl. 28, fig. 3, text-fig. 37H
partim 1982. *Orbitoclypeus nummuliticus* (Gümbel) — Laghi et Sirotti, p. 2, text-fig. 1
non 1982. *Discocyclina varians* (Kaufmann) — Fermont [=*?Discocyclina furoni*, D. indet. sp. B (pl. 11, figs. 8—9), *Nemkovella evae, Orbitoclypeus ramaraoi crimensis* et *O. varians horsarrieuensis*]

Holotype: Not given by the author of the taxon.
Lectotype: Kaufmann (1867), pl. 10, figs. 1—2, presumable depository: Museum Bern — external view (marked out by the present author).
Type locality: presumably Pilatus (Switzerland) — flysch beds between Wängenalp and Gschwändalp.
Type level: Not specified (presumably the upper part of the Bartonian or the lower part of the Upper Eocene).
The type of the equatorial section of forms "A": Schlumberger (1903), pl. 10, fig. 33, depository: École de Mines (Paris), Ralligstöcke (near Interlaken — Switzerland), Upper Eocene.
Diagnosis: *Orbitoclypeus varians* populations with $\bar{D}$ exceeding 400 μm.

Description:

External morphology: Medium-sized (4 to 8 mm), moderately flattened or slightly inflate forms. Forms "B" are 1.2 to 1.5 times the size of forms "A". The rosette is of the "marthae" type.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30q):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (eu)	$Q=1.54-2.87$	*t:* varians	*s.c.:* undulated with 6 to 8 stronger waves
$E=0.10-0.43$	$\bar{Q}=1.60-2.00$	$N=29-55$	*g.p.:* varians
$\bar{E}=0.15-0.40$	$P=151-376$ μm	$\bar{N}=32-48$	$l=30-45$ μm
$R=0.90-1.58$	$\bar{P}=200-300$ μm	$L=35-50$ μm	$h=40-105$ μm
$\bar{R}=1.00-1.25$	$D=307-639$ μm	$H=50-80$ μm	$n_{0.5}=8.0-13.0$
	$\bar{D}=400-580$ μm	$\bar{H}=52-70$ μm	$\bar{n}_{0.5}=9.0-12.0$
			$n_{1.0}=16.0-25.5$

R e t r o s p e c t i o n : The figures by KAUFMANN (1867), the first describer, are sufficient to identify the taxon but the drawings are too schematic to represent the equatorial section of forms "A". The three varieties, desribed by him, namely, "granulata", "intermedia" and "laeviscula" differ from each other only in the size of their granules therefore these forms have no importance at all any more.

SCHLUMBERGER's (1903) forms from Switzerland are coming from levels corresponding to the level of the topotypical specimens. These forms are properly depicted so one of them may serve as type of the equatorial section of forms "A", so much the more as its embryon is similar to that on KAUFMANN's (1867) drawings, that is, *D* is over 400 μm.

On the above basis the forms, the *D* of which is bigger than 400 μm were assigned to the synonymic list. Forms, however, coming from S Italy and N Africa with *D* bigger than 650 μm were not included. The cycles of these are generally circular and their equatorial chambers are wider than those of the "varians" (discussed in details at *Orbitoclypeus schopeni*).

While describing the "varians" taxon the palaeontologists concentrated first of all not on the inner morphology but on the external features. This is the reason why even the most outstanding experts (WEIJDEN 1940, BRÖNNIMANN 1941, 1945b, SCHWEIGHAUSER 1953, PORTNAYA 1974) described forms belonging to Discocyclinae under this name.

C o m p a r i s o n : Among the forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus schopeni* and *O. chudeaui pannonicus* are circular, their equatorial chambers are wider.

The equatorial chambers of *O. koehleri* are much bigger and it has "chudeaui" type rosette.

R a n g e : The upper part of the Bartonian and the lower and middle parts of the Priabonian. SW Aquitaine (Biarritz — Côte des Basques, Siest — samples BT and SO, Cauneille), N Italy (Mossano, Piemont — Cave Defilippi), S Italy (Palermo — Termini-Imerese and Bagheria; Madonie; Castelluccio Valmaggiore), Switzerland (Ralligstöcke, Pilatus), Polish Tatras (Potok Sziwianskich Szalasów, Dolina Białego, Dolina Lejowa), NW Slovakia (surroundings of Rajec — Poluvšie, surroundings of Martin — Horné Jaseno), Liptov Basin (Vážec, Hlboko potok), E Gerecse (surroundings of Lábatlan — samples RA, RF, R 2 and BN), Crna Gora (Tivat), Bulgaria (Asenovgrad and the vicinity of Provadiya), Rhodes.

Orbitoclypeus furcata (RÜTIMEYER), 1850

D i a g n o s i s : Medium- and large-sized flat forms with 7 to 9 thick ribs that bifurcate at the edges. "Marthae" type rosette. The embryon bears excentrilepidine character, the two chambers — from which often the protoconch cannot be seen — are average in size. The "varians" type adauxiliary chambers are medium in numbers, medium wide and medium high as well as the width and height of the equatorial chambers. These may significantly increase in length towards the peripheries. At the edges the equatorial chambers have 2 annular stolons as well, so there they have 6 stolons. The cycles are undulated with 7 to 9 very strong waves, the growth pattern is of the "varians" type.

D e s c r i p t i o n :

External morphology: Medium- and large-sized (5 to 15 mm) flattened forms with small (1.5 to 2 mm in diameter) semispheric umbo, from which 7 to 9 ribs start and bifurcate at the edges. "Marthae" type rosette. The granules are coarse on the umbo and on the ribs (80 to 120 μm in diameter) but much finer on the interrib surface. The granules are encircled by 8 to 12 tiny lateral chambers. In case of the most primitive subspecies forms "B" are 1.5 to 2 times bigger than forms "A".

The equatorial section of forms "B": As far as we know our preparation is the first to disclose the characteristic signs of the "Lepidocyclina"-like juvenarium. Its features are as follows: $I = 18$ μm, $S = 9$, $s = 75$ μm, $J = 18$, $j = 900$ μm. The fully developed equatorial chambers and their cycles do not differ from those of forms "A".

Axial section: Lacking own preparation, on the basis of the data by SCHLUMBERGER (1904, pl. 4, fig. 13), PREVER (1912, pl. 3, figs. 14—16), NEUMANN (1958, pl. 32, fig. 6) and SIROTTI (1978, pl. 3, fig. 10) the height of the embryon is between 180 and 200 μm. The equatorial layer is 50 to 60 μm thick near the embryon, it thickens up to 150 μm towards the edges but only at the ribs. On the basis of the above listed figures it is likely that the equatorial layer in the ribs is not divided into more layers. The lateral septum is not thick even near the embryon, and it is explicitely thin at the ribs. The annular septum is slightly arcuate. The average size of lateral chambers is 80—100×30—40 μm.

P h y l o g e n e t i c p o s i t i o n (text-fig. 30): Owing to the great similarity of their rosette, internal morphology and stratigraphic position *Orbitoclypeus furcata* can be derived from *O. varians* (from the "angoumensis" subspecies) and it can be regarded as the ribbed variety of this taxon. Due to the great difference in the stratigraphic levels the derivation from *O. bayani*, also a ribbed form can be ruled out.

At present 2 evolutional stage (subspecies) can be distinguished using the following biometric units:

Orbitoclypeus furcata rovasendai (text-fig. 30r): $\bar{D}<340$ μm
Orbitoclypeus furcata furcata (text-figs. 30s—t): $\bar{D}>340$ μm

It is possible that in the course of further examinations subspecies "furcata" might be divided into two subspecies by the $\bar{D}=450$ μm dividing line (see text-fig. 30s and t, respectively) since the D parameter of SIROTTI's (1978) specimen from Priabona equals 480 μm (for these forms the "furcata" subspecies name could remain, while a new denomination should be introduced for the Lábatlan population and for other similar populations the $\bar{D}$ of which is between 340 and 450 μm).

Evolution, similarly to $\bar{D}$, is observable in the increase of $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{n}_{0.5}$ parameter means.

In all probability this highly specialized species became extinct without offsprings at the end of the Eocene.

R e t r o s p e c t i o n : The nomenclature of the ribbed Orbitoclypei found in the upper parts of the Eocene is one of the most complicated ones.

Theoretically, SCHLOTHEIM's (1820) Bavarian "pattelaris" takes priority but its inner morphology has been unknown so it cannot be decided whether these forms belong to those described by us as "bayani" or they belong to the forms discussed herein (see the details at the end). For this reason our opinion is that this denomination cannot be used.

On the basis of the accompanying fauna (*Discocyclina radians, Asterocyclina stellata* — BRÖNNIMANN 1945a, b) RÜTIMEYER's (1850) "furcata" certainly comes from the upper parts of the Eocene. The bifurcation of the ribs at the edges is well distinctable on the figure given by the describer. Though RÜTIMEYER (1850) did not illustrate the internal morphology of the taxon this species exceptionally, is more or less identifiable on the basis of the exterior, too.

Later, forms that belong to this category were described under several more names but it should be noted that the "furcata" name was used only for this species, though the inner morphology of the topotypical specimen is unknown ever since.

PREVER's (1904b, 1912) "rovasendai" name, though it has been out of use for a long time, can be used on the subspecies level.

Among the further names used for marking this species "bayani", "stella" and "taramellii" refer to forms with different internal morphology, whereas "patellaris", "variecostata" and "riojai" cannot be used (see explanation at the end).

V a r i a b i l i t y : Both the external and the internal qualitative features of the taxon are stable.

R a n g e : From the upper part of the Lutetian to the top of the Priabonian.

Orbitoclypeus furcata (RÜTIMEYER), 1850 **rovasendai** (PREVER), 1904

Pl. XXXII, figs. 5—11, pl. XXXIII, figs. 1—3, text-fig. 30r

partim 1904. *Orthophragmina patellaris* (SCHLOTHEIM) — SCHLUMBERGER, pp. 120—122, pl. 3, fig. 6, pl. 4, figs. 13—14
1904b. *Orthophragmina rovasendai* n. sp. — PREVER, p. 18, pl. 6, fig. 8
1912. *Orthophragmina rovasendai* PREVER — PREVER, pp. 169—171, pl. 2, figs. 6, 7, pl. 3, fig. 16
1912. *Orthophragmina taramellii* MUNIER-CHALMAS — PREVER, pp. 179—181, pl. 2, fig. 10, pl. 3, fig. 14
partim 1922. *Actinocyclina furcata* (RÜTIMEYER) — DOUVILLÉ, p. 97
partim 1929. *Actinocyclina furcata* (RÜTIMEYER) — LLUECA, p. 311, text-fig. 68
partim 1940. *Discocyclina (Discocyclina?) furcata* (RÜTIMEYER) — WEIJDEN, p. 62, pl. 4, figs. 1—2
partim 1940. *Discocyclina (Discocyclina?) patellaris* (SCHLOTHEIM) — WEIJDEN, pp. 37—38, pl. 4, figs. 1—2
partim 1958. *Asterodiscus furcata* (RÜTIMEYER) — NEUMANN, pp. 121—123, pl. 32, figs. 2, 4, 6, text-fig. 41
partim 1959. *Actinocyclina patellaris* (SCHLOTHEIM) — KECSKEMÉTI, pp. 61—62, pl. 4, figs. 9, 10, 12
partim ?1959. *Actinocyclina variecostata* GÜMBEL — KECSKEMÉTI, pp. 63—65, pl. 5, fig. 3
?1959. *Asterocyclina bayani* (MUNIER-CHALMAS) — KECSKEMÉTI, p. 71, pl. 5, fig. 13
1959. *Asterocyclina riojai* (LLUECA) — KECSKEMÉTI, pp. 71—72, pl. 5, fig. 14
?1959. *Astercyclina bayani* (MUNIER-CHALMAS) — BELMUSTAKOV, p. 56, pl. 20, fig. 13
1981a. *Orbitoclypeus patellaris* (SCHLOTHEIM) — LESS, pl. 2, fig. 6

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : PREVER (1904b), pl. 6, fig. 8, depository, presumably, Torino, R. Museo Geologico — external view (marked out by the present author).
T y p e l o c a l i t y : Gassino (N Italy).
T y p e l e v e l : The Bartonian (in our opinion not the Upper Eocene but rather the Bartonian stage as interpreted herein).
The t y p e of the equatorial section of forms "A": PREVER (1912), pl. 2, fig. 6, depository is the same as that of the lectotype, Cave Defilippi (Gassino), presumably the Bartonian stage.
D i a g n o s i s : *Orbitoclypeus furcata* populations with $\bar{D}$ less than 340 μm.

D e s c r i p t i o n :

External morphology: Medium- and large-sized (5 to 12 mm), flattened forms with 7 to 9 thick ribs that bifurcate at the edges. "Marthae" type rosette. Forms "B" are 1.5 to 2 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30r):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri	$Q = 1.66-2.44$	t: varians	$s.c.$: undulated, with 7 to
$E = 0.12-0.43$	$\bar{Q} = 1.80-2.20$	$N = 25-35$	9 very strong waves
$\bar{E} = 0.12-0.36$	$P = 131-185$ μm	$\bar{N} = 27-32$	$g.p.$: varians
$R = 1.10-1.39$	$\bar{P} = 140-170$ μm	$L = 30-45$ μm	$l = 25-35$ μm
$\bar{R} = 1.15-1.35$	$D = 245-332$ μm	$H = 40-65$ μm	$h = 40-95$ μm
	$\bar{D} = 270-340$ μm	$\bar{H} = 48-60$ μm	$n_{0.5} = 10.0-17.0$
			$\bar{n}_{0.5} = 10.0-15.0$
			$n_{1.0} = 22.0-29.0$

R e m a r k s : At the edges the equatorial chambers have 2 annular stolons as well, so they have altogether 6 stolons.

R e t r o s p e c t i o n : Those forms were included in the case of which D is less or at least presumably less than 340 μm.

Up to the present day Prever (1912) gave the best depiction of the form with the above described internal morphology, and what is more, the specimen depicted by him is a topotypical one as the depiction was prepared about his own earlier described forms (Prever 1904b).

It should be noted that we considered 1.6 to 2 times the scale of the enlargement given by Neumann (1958) and 0.5 to 0.6 times her given dimensions of the internal morphology.

C o m p a r i s o n : There is only one ribbed form, namely *Orbitoclypeus bayani* with similar type and similar-sized embryon.

The ribs of this form however bifurcate only in the minority of the cases but they often have asteroidal shape that never occurs in the case of *O. furcata rovasendai*. The equatorial chambers of *O. bayani* are wider but always with 4 stolons only. Due to the difference in stratigraphic level its accompanying fauna is totally different.

R a n g e : The upper part of the Lutetian and the whole of the Bartonian.

SW Aquitaine (Angoumé), French Alps (Villeneuve-Loubet), N Italy (Piemont — Cave Defilippi, Reggione Cavaggione), S and N Bakony [surroundings of Ajka — samples Ba 2, 3, 6, Sz 5, 6, J 1, 4, 6, Kö 1—2 and CS are from the present author's own sampling, sample "Köleskepe-2" is from Kecskeméti's (1959) sampling; surroundings of Dudar — sample D 3], Bulgaria (surroundings of Kardzhali).

Orbitoclypeus furcata furcata (Rütimeyer), 1850

Pl. XXXIII, figs. 4—7, text-figs. 30s—t

?1850. *Orbitulites furcata* n. sp. — Rütimeyer, p. 118, pl. 5, fig. 75
?1908. *Orthophragmina (Actinocyclina) furcata* (Rütimeyer) — Heim, p. 270
partim ?1922. *Actinocyclina furcata* (Rütimeyer) — Douvillé, p. 97
partim non 1922. *Actinocyclina furcata* (Rütimeyer) — Douvillé (= *Orbitoclypeus furcata rovasendai*)
partim ?1929. *Actinocyclina furcata* (Rütimeyer) — Llueca, p. 311, text-fig. 68
1931a. *Actinocyclina furcata* (Rütimeyer) — Meffert, pp. 37—38, 56, pl. 7, figs. 5—8, 11, 13, 14
partim ?1940. *Discocyclina (Discocyclina?) furcata* (Rütimeyer) — Weijden, p. 62
partim non 1940. *Discocyclina (Discocyclina?) furcata* (Rütimeyer) — Weijden (= *Orbitoclypeus furcata rovasendai*)
partim non 1958. *Asterodiscus furcata* (Rütimeyer) — Neumann (= *Orbitoclypeus furcata rovasendai*)
?1970. *Asterodiscus stella* (Gümbel) — Pavič, pl. 14, fig. 7
1978. *Asterocyclina furcata* (Rütimeyer) — Sirotti, pp. 65—66, pl. 3, figs. 7—10

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : Rütimeyer (1850), pl. 5, fig. 75, depository not given — external view (marked out by the present author).
T y p e l o c a l i t y : Platti bei Lauenen or Stierendungel (Switzerland).
T y p e l e v e l : Not specified (presumably the Priabonian).
The t y p e of the equatorial section of forms "A": Sirotti (1978), pl. 3, figs. 8—9, preparation No. 19133, depository: Micropaleontological Collection of the Institute of Paleontology at Modena University, Priabona, "Asterocyclina" beds, sample 36, the upper part of the Priabonian.
D i a g n o s i s : *Orbitoclypeus furcata* populations with $\bar{D}$ exceeding 340 μm.

D e s c r i p t i o n :

External morphology: Large (7 to 15 mm), flattened forms with 7 to 9 thick ribs that bifurcate at the edges. "Marthae" type rosette. The ratio of the sizes of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-figs. 30s—t):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri	$Q = 1.92-2.30$	t: varians	s.c.: undulated with 7 to 9 very strong waves
$E = 0.08-0.23$	$\bar{Q} = 1.90-2.30$	$N = 27-45$	g.p.: varians
$\bar{E} = 0.05-0.25$	$P = 155-160$ µm	$\bar{N} = 31-41$	$l = 30-40$ µm
$R = 1.43-1.58$	$\bar{P} = 140-200$ µm	$L = 35-50$ µm	$h = 50-115$ µm
$\bar{R} = 1.35-1.60$	$D = 307-481$ µm	$H = 60-85$ µm	$n_{0.5} = 8.0-14.0$
	$\bar{D} = 340-480$ µm	$\bar{H} = 60-75$ µm	$\bar{n}_{0.5} = 8.5-13.0$
			$n_{1.0} = 16.0-26.0$

Remarks: At the edges the equatorial chambers have 2 annular stolons, too, so they have altogether 6 stolons.

Retrospection: The Upper Eocene forms the D of which is bigger than 340 µm were included in the synonymic list.

As mentioned above under "Retrospection" at the discussion of the species, the internal morphology of the topotypical specimen are unknown to this very day. From the same locality, however, such inclined sections of *Discocyclina radians* and *Asterocyclina stellata* are known from BRÖNNIMANN's (1945a, b) works that indicate the age of the localities to be rather Upper Eocene than Middle Eocene. For this reason we use the "furcata" name on the subspecies level for marking forms that come from the Priabonian stage, and correspond to the criteria of the diagnosis.

Comparison: Only *Orbitoclypeus bayani* possess similar type and similar-sized embryon among the ribbed forms. Only in the minority of the cases do the ribs bifurcate at the edges. Its equatorial chambers are always with 4 stolons. Due to the difference in stratigraphic level the accompanying fauna is totally different.

Range: The Priabonian stage.

N Italy (Priabona — behind the new church — the upper part of the "Asterocyclina" beds), Switzerland (surroundings of Lauenen), E Gerecse (surroundings of Lábatlan — samples RA, R 1, BN), Crna Gora (Rustovo), Armenia (surroundings of Daralaghez — "Dzhagatai" Limestone).

Orbitoclypeus chudeaui (SCHLUMBERGER), 1903

Diagnosis: Medium-sized, inflate forms with "chudeaui" type rosette. Mostly the embryon is trybliolepidine, rarely, it may also be semi-nephro-, eu-, umbilico- and even excentrilepidine. The two chambers are medium-sized. The "varians" type adauxiliary chambers are medium in numbers, wide and high as well as the equatorial chambers. The growth pattern of the annuli is of the "varians" type.

Description:

External morphology: Medium-sized (3 to 7 mm), strongly inflate forms. The conical umbo is encircled by a narrow collar. "Chudeaui" type rosette, polygonal granules. The parameters are the biggest on the top of the umbo (80 to 120 µm in diameter), elsewhere they are finer. Each of them is surrounded by 4 to 6 lateral chambers the size of which is equal to that of the granule. In case of the most advanced subspecies forms "B" are 1.5 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "B": As far as we know our preparation is the first to disclose the features of the Lepidocyclina type juvenarium. They are as follow: I = 18 µm, S = 6, s = 90 µm, J = 8, j = 500 µm. The fully developed equatorial chambers and their annuli do not differ from those of forms "A".

Axial section: Due to the lack of own preparation we relied on SCHLUMBERGER's (1903, pl. 9, fig. 18), SCHWEIGHAUSER's (1953, pl. 9, fig. 4), NEUMANN's (1958, pl. 13, fig. 5) and GROSS, KÖHLER's et al. (1980, pl. 28, fig. 4) figures. No doubt, SCHWEIGHAUSER's and NEUMANN's scales of enlargement are not correct, NEUMANN's scale was doubly counted.

On the basis of these the height of the embryon is between 125 and 150 µm. The equatorial layer is 30 to 40 µm thick near the embryon and it thickens to 70—100 µm towards the edges. The lateral septum is thin, the annular one is straight. The lateral chambers are 100×50 µm big on the average.

Phylogenetic position (text-fig. 30): On the basis of the rosette, the embryon type, the similarity of the cycles' shape and the stratigraphic occurrence the species can be derived from the moderately developed *Orbitoclypeus douvillei*.

Two stages of evolution (subspecies) can be distinguished using the following biometric limits:

Orbitoclypeus chudeaui chudeaui (text-figs. 30u—v): $\bar{D} < 400$ µm

Orbitoclypeus chudeaui pannonicus (text-fig. 30w): $\bar{D} > 400$ µm

On the basis of more complete material the segregation of a third subspecies is possible. It could be characterized by the $\bar{D}$ less than 320 μm diagnosis (see text-fig. 30u) and possibly it could be found in Lower—Middle Lutetian boundary beds.

Similar evolution is observable in the increase of $\bar{P}$, L, $\bar{H}$ and in the decrease of $\bar{n}_{0.5}$. The $\bar{E}$, $\bar{R}$, $\bar{Q}$, $\bar{N}$ values do not increase.

The ribbed *Orbitoclypeus katoae*, the internal features of which hardly differ from those of the discussed species, can undoubtedly be derived from *O. chudeaui chudeaui.*

On the basis of its related (rosette, wide equatorial chambers) and at the same time more advanced (large excentrilepidine embryon) morphology *Orbitoclypeus schopeni* may also be a descendant. The data available up to now, however, show that this species occurs somewhat earlier than *O. chudeaui.*

R e t r o s p e c t i o n : SCHLUMBERGER (1903), the describer of the species, illustrated the equatorial section of forms "A" by a low quality photo. This section of the topotypical specimens is unknown to this day. The exterior of this species however is rather characteristic therefore misinterpretation was rare. WEIJDEN's (1940) figures perfectly show the internal morphology of the species. Later on, the experts followed him. It should be noted that NEUMANN's (1958) scales of enlargement accompanying the figures on the internal morphology are 0.5 to 0.6 times smaller than the real scales, also her given internal test dimensions are 1.6 to 2 times bigger than the real ones.

V a r i a b i l i t y : The qualitative features of the species are relatively stable, and in spite of this, there are smaller differences in the rosette within the populations. Similarly, there are smaller differences in the very gently undulated cycles of certain specimens in the most advanced populations.

R a n g e : From the lower part of the Lutetian to the middle part of the Bartonian.

Orbitoclypeus chudeaui chudeaui (SCHLUMBERGER), 1903

Pl. XXXIII, fig. 13, pl. XXXIV, figs. 1—3, text-figs. 30u—v

1903. *Orthophragmina chudeaui* n. sp. — SCHLUMBERGER, pp. 282—283, pl. 9, figs. 18—20, text-fig. E
1922. *Discocyclina chudeaui* (SCHLUMBERGER) — DOUVILLÉ, pp. 71—72
1940. *Discocyclina (Trybliodiscodina) chudeaui* (SCHLUMBERGER) — WEIJDEN, pp. 27—31, pl. 2, figs. 6—11, pl. 3, figs. 1—2
non 1953. *Discocyclina chudeaui* (SCHLUMBERGER) — SCHWEIGHAUSER *(=Orbitoclypeus chudeaui pannonicus)*
1958. *Discocyclina chudeaui* (SCHLUMBERGER) — NEUMANN, pp. 87—88, pl. 13, figs. 1—6, pl. 36, fig. 1, text-fig. 23
non 1958. *Discocyclina chudeaui* (SCHLUMBERGER) — KECSKEMÉTI *(=Orbitoclypeus chudeaui pannonicus)*
non 1963. *Discocyclina chudeaui* (SCHLUMBERGER) — BIEDA *(=Orbitoclypeus chudeaui pannonicus)*
partim non 1973. *Discocyclina chudeaui* (SCHLUMBERGER) — OLEMPSKA *(=Orbitoclypeus chudeaui pannonicus)*
partim 1974. *Discocyclina chudeaui* (SCHLUMBERGER) — PORTNAYA, pp. 89—90, pl. 18, figs. 1—3
partim non 1974. *Discocyclina chudeaui* (SCHLUMBERGER) — PORTNAYA *(=Discocyclina archiaci bakhchisaraiensis)*
1980. *Discocyclina chudeaui* (SCHLUMBERGER) — GROSS—KÖHLER et al., pp. 182—183, pl. 28, fig. 4

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : SCHLUMBERGER (1903), pl. 9, fig. 20 and NEUMANN (1958), pl. 13, fig. 1 (marked out by NEUMANN, 1958), depository: École de Mines (Paris) — external form.
T y p e l o c a l i t y : Daguerre (SW Aquitaine).
T y p e l e v e l : Not specified (in our opinion the upper part of the Lutetian).
The t y p e of the equatorial section of forms "A": WEIJDEN (1940), pl. 2, fig, 11, depository: Rijks—Universiteit Leiden; Biarritz, rocher de la Gourépe, the upper part of the Lutetian.
D i a g n o s i s : *Orbitoclypeus chudeaui* populations with $\bar{D}$ less than 400 μm.

D e s c r i p t i o n :

External morphology: Medium-sized (3 to 5 mm) strongly inflate forms with "chudeaui" type rosette. The ratio of the sizes of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-figs. 30u—v):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio -semi-nephro, eu)	$Q=1.80-2.19$	*t:* varians	*s.c.:* circular
	$\bar{Q}=1.70-2.20$	$N=20-26$	*g.p.:* varians
$E=0.38-0.73$	$P=172-194$ μm	$\bar{N}=18-30$	$l=40-50$ μm
$\bar{E}=0.45-0.75$	$\bar{P}=150-200$ μm	$L=40-60$ μm	$h=60-75$ μm
$R=0.75-1.18$	$D=309-399$ μm	$H=70-90$ μm	$n_{0.5}=8.8-11.5$
$\bar{R}=0.75-1.10$	$\bar{D}=280-400$ μm	$\bar{H}=60-100$ μm	$\bar{n}_{0.5}=8.0-11.0$
			$n_{1.0}=18.0-22.0$

R e t r o s p e c t i o n : On the basis of SCHLUMBERGER's (1903) figure on the axial section of the topotypical specimen from Daguerre, it can be established that the deuteroconch diameter is less than 400 μm, so the "chudeaui" name, as a subspecies category, can be used for marking the above described forms. WEIJDEN's (1940) and NEUMANN's (1958) forms included in the synonymic list answer the criteria of the diagnosis as population.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of the Discocyclinae are with 6 stolons, they look rectangular.

The cycles of *Orbitoclypeus marthae*, *O. varians roberti*, *O. varians scalaris* and *O. multiplicata* are undulated.

The rosette of *O. seunesi* and *O. ramaraoi crimensis* is different, their equatorial chambers are narrower.

The equatorial chambers of *O. douvillei*, too, are narrower, its embryon is less eccentric, the growth pattern of its annuli is of the "trabayensis" type.

The embryon of *O. schopeni* is always excentrilepidine.

Range: The whole of the Lutetian.

SW Aquitaine (Caupenne — Ferme Jean Gazé, Nousse — Crouts, Saint-Pierre-d'Irube — Daguerre, Biarritz — rocher de la Gourépe), Liptov Basin (Bežan).

Orbitoclypeus chudeaui (SCHLUMBERGER), 1903 **pannonicus** n. ssp.

Pl. XXXIV, figs. 4—12, pl. XXXV, figs. 1—6, text-fig. 30w

1953. *Discocyclina chudeaui* (SCHLUMBERGER) — SCHWEIGHAUSER, pp. 51—52, pl. 9, figs. 4, 7, 12, text-fig. 20
1958. *Discocyclina chudeaui* (SCHLUMBERGER) — KECSKEMÉTI, pp. 39—41, pl. 1, figs. 1—5, text-figs. 1a—d
1963. *Discocyclina chudeaui* (SCHLUMBERGER) — BIEDA, pp. 118—119, pl. 18, figs. 2—4, text-fig. 11
partim 1973. *Discocyclina chudeaui* (SCHLUMBERGER) — OLEMPSKA, pp. 78—79, pl. 14, fig. 2

Derivatio nominis: Named after the Latin denomination of the bigger geographical unit (Transdanubia) including the type locality.
Holotype: Preparation E. 4940, pl. XXXV, fig. 4.
Type locality: Dudar, Sűrűhegy, the eastern part of the abandoned stone-pit, sample DS 1.
Type level: The middle part of the Bartonian.
Diagnosis: *Orbitoclypeus chudeaui* populations with $\bar{D}$ over 400 μm.

Description:

External morphology: Medium-sized (4 to 7 mm), strongly inflate forms with "chudeaui" type rosette. Forms "B" are approximately 1.5 times bigger than forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 30w):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: tryblio (eu, umbilico, semi-nephro, excentri)	$Q=1.52-2.43$	*t:* varians	*s.c.:* circular
	$\bar{Q}=1.80-2.25$	$N=18-30$	*g.p.:* varians
$E=0.34-0.97$	$P=157-307$ μm	$\bar{N}=19-28.5$	$l=40-55$ μm
$\bar{E}=0.38-0.72$	$\bar{P}=165-265$ μm	$L=45-100$ μm	$h=55-130$ μm
$R=0.52-1.30$	$D=335-574$ μm	$H=55-130$ μm	$n_{0.5}=6.0-10.0$
$\bar{R}=0.75-1.20$	$\bar{D}=400-500$ μm	$\bar{H}=80-120$ μm	$\bar{n}_{0.5}=7.0-8.5$
			$n_{1.0}=13.0-20.0$

Remark: The cycles of certain specimen are just slightly undulated.

Retrospection: For all forms, included in the synonymic list, D is over 400 μm. For marking these forms the "chudeaui" name was used in the literature though this name, as a subspecies category, is not suitable to mark the above described forms. For this reason did we have to segregate this new taxon.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of the Discocyclinae have 6 stolons, they give the semblance of rectangular shape.

The cycles of *Orbitoclypeus varians varians* and *O. koehleri* are always undulated.

The embryon of *O. schopeni* is always of the excentrilepidine type, whereas that of *O. chudeaui* is only very rarely excentrilepidine.

Range: The lower and middle parts of the Bartonian.

N Italy (San Pancrazio), Polish Tatras (Hruby Regiel), S and N Bakony (surroundings of Ajka: samples Ba 5, 6; J 3, 7 and Kö 1 are from our own sampling, samples "Köleskepe-2" and "Gyűrhegy" are from T. KECSKEMÉTI's sampling. Surroundings of Dudar: samples D 1, 3; DS 1—3, 5; DS).

Orbitoclypeus katoae n. sp.

Pl. XXXV, figs. 7—12, text-fig. 30x

D e r i v a t i o n o m i n i s : Named after the author's wife, Mrs. Márta Less-Kató.
H o l o t y p e : Preparation E. 4944, pl. XXXV, figs. 8—9.
T y p e l o c a l i t y : The cut of the factory road at the Lugos-tető road junction between Ajka and Pula — sample SzT.
T y p e l e v e l : The lower part of the Bartonian.
D i a g n o s i s : Medium-sized, flattened forms with 7 to 10 protruding ribs that do not bifurcate at the edges. "Chudeaui" type rosette. The embryon is nephro—semi-nephrolepidine, the two chambers are medium-sized. The "varians" type adauxiliary chambers are low in numbers, wide, but not too high. The equatorial chambers are moderately wide and of varying height. The cycles are circular, their growth pattern is of the "strophiolata" type.

D e s c r i p t i o n :

External morphology: Medium-sized (4 to 7 mm), flattened forms with small bulging umbo from which 7 to 10 thin but distinct ribs start. These do not bifurcate at the edges. The rosette is of the "chudeaui" type, the polygonal granules are coarse (60 to 100 μm in diameter) on the umbo and on the ribs but finer in the interrib surface. Each of them is surrounded by 5 to 6 lateral chambers the size of which is equal to that of the granule. The ratio of the sizes of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30x):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro—semi-nephro	$Q = 1.52-2.26$	*t:* varians	*s.c.:* circular
$E = 0.54-1.27$	$\bar{Q} = 1.70-2.00$	$N = 15-20$	*g.p.:* strophiolata
$\bar{E} = 0.70-1.05$	$P = 175-263$ μm	$\bar{N} = 16.5-20.0$	$l = 35-45$ μm
$R = 0.32-1.06$	$\bar{P} = 185-230$ μm	$L = 55-80$ μm	$h = 60-110$ μm
$\bar{R} = 0.45-0.80$	$D = 332-427$ μm	$H = 55-75$ μm	$n_{0.5} = 8.7-11.0$
	$\bar{D} = 360-405$ μm	$\bar{H} = 60-72$ μm	$\bar{n}_{0.5} = 9.0-10.5$
			$n_{1.0} = 15.0-21.0$

The equatorial section of forms "B": Microspheric specimen of the species have not been found yet.

Axial section: In this section the species could not be studied.

P h y l o g e n e t i c p o s i t i o n (text-fig. 30): On the basis of its internal morphology and its stratigraphic position *Orbitoclypeus katoae* undoubtedly derives from *O. chudeaui chudeaui*, it is the latter's ribbed variety.

Since the species is known only from one population, development within the species cannot be pointed out.

This species, specialized almost to the utmost verge, became extinct without offspring.

R e t r o s p e c t i o n : The discussed species is completely unknown in the literature, this is why it was described as a new one.

V a r i a b i l i t y : The individuals of the examined population differ from each other only in the firmness of the "strophiolata" growth pattern.

C o m p a r i s o n : Among the ribbed forms only *Discocyclina radians radians* and *D. radians labatlanensis* have similar type and similar-sized embryon but the equatorial chambers of these are much longer and in addition they have 6 stolons.

R a n g e : The lower part of the Bartonian.

S Bakony (surroundings of Ajka — sample SzT).

Orbitoclypeus schopeni (CHECCHIA-RISPOLI), 1908

Pl. XXXIII, figs. 8—9, text-figs. 30y—z

	1908.	*Orbitoides (Exagonocyclina) schopeni* n. sp. — CHECCHIA-RISPOLI, p. 12
	1909a.	*Exagonocyclina schopeni* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI, p. 104, pl. 4, figs. 22—23
	?1909a.	*Orthophragmina dispansa* (SOWERBY) — CHECCHIA-RISPOLI, pp. 107, 133, pl. 4, fig. 26, pl. 7, figs. 8—10
partim	1912.	*Orthophragmina archiaci* SCHLUMBERGER — PREVER, pp. 143—145, pl. 1, fig. 5
	?1916.	*Orthophragmina archiaci* SCHLUMBERGER — CHECCHIA-RISPOLI, pl. 4, fig. 5
partim	?1916.	*Orthophragmina scalaris* SCHLUMBERGER — CHECCHIA-RISPOLI, pl. 4, fig. 9
partim	?1917.	*Orthophragmina archiaci* SCHLUMBERGER — CHECCHIA-RISPOLI, pp. 257—258, pl. 10, fig. 3
	?1925.	*Orthophragmina sella* (D'ARCHIAC) — CHECCHIA-RISPOLI, pl. 5, fig. 9
	1945b.	*Orbitoclypeus himerensis* SILVESTRI — BRÖNNIMANN, pp. 606—608, pl. 22, figs. 1, 2, 4—9, text-figs. 20—23
partim	1948.	*Orthophragmina varians* (KAUFMANN) — SILVESTRI, pp. 9—11 (185—187), pl. 3. (34), fig. 10, pl. 4 (35), fig. 12

Holotype: Not given by the author of the taxon.
Lectotype: CHECCHIA-RISPOLI (1909a), pl. 4, fig. 23, presumable depository: Museo di Geologia della R. Universitá di Palermo (marked out by the present author).
Type locality: Vallone Tre Pietre (Termini-Imerese near Palermo), 3. layer (on the basis of CHECCHIA-RISPOLI's (1909a) drawing, p. 54).
Type level: The Upper Lutetian substage (in our opinion the upper part of the Lutetian).
Diagnosis: Small- and medium-sized, more or less inflate forms with "chudeaui" type rosette. The embryion is of excentrilepidine character, the two chambers are rather big. The "varians" type adauxiliary chambers are numerous, wide and high as well as the equatorial chambers. The cycles are circular, their growth pattern is of the "varians" type.

Description:

External morphology: Small- and medium-sized (2.5 to 10 mm), more or less inflate forms with a narrow collar or without collar. The rosette is of the "chudeaui" type. The granules are more coarse (80 to 120 μm in diameter) on top of the umbo than elsewhere. Each granule is surrounded by 5 to 7 lateral chambers the size of which is the same as that of the granule. There is no difference in size, at least not in the species' early stage of evolution between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-figs. 30y—z):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri	$Q = 1.54-2.39$	*t:* varians	*s.c.:* circular
$E = 0.09-0.40$	$\bar{Q} = 1.70-2.30$	$N = 28-44$	*g.p.:* varians
$\bar{E} = 0.10-0.40$	$P = 192-485$ μm	$\bar{N} = 25-45$	$l = 35-55$ μm
$R = 1.00-1.52$	$\bar{P} = 180-500$ μm	$L = 35-65$ μm	$h = 60-145$ μm
$\bar{R} = 1.10-1.50$	$D = 350-850$ μm	$H = 55-125$ μm	$n_{0.5} = 5.0-8.0$
	$\bar{D} = 350-850$ μm	$\bar{H} = 60-125$ μm	$\bar{n}_{0.5} = 5.0-8.5$
			$n_{1.0} = 10.0-15.0$

The equatorial section of forms "B": Lacking own preparation on the basis of BRÖNNIMANN's (1945b, pl. 22, figs. 4—6 and text-fig. 21) figures the juvenarium is of the Lepidocyclina type. I = 9 μm, S = 8, s = 78 μm, J and j values are unknown.

Axial section: Neither own data nor bibliographic ones are available in respect of the axial section of the species.

Phylogenetic position (text-fig. 30): According to our present knowledge the species appears without major precedents. It is divided by a wide stratigraphic gap from *Orbitoclypeus seunesi*. Compared to *O. douvillei* its embryon is too big, even in the initial stage. *O. chudeaui* appears later. On the basis of the data available up to now, the American origin cannot be ruled out either.

Despite the scarce available material (and due to this fact the subdivision into subspecies is not yet possible) it can be stated for sure that the populations from the upper part of the Cuisian stage (Stöckweid bei Einsiedeln) and that from the lower part of the Lutetian stage (Saint-Barthélémy) can be characterized by the $\bar{D}$ less than 500 μm biometric limit (see text-fig. 30y), whereas $\bar{D}$ bigger than 500 μm is characteristic of the populations found in the upper parts of the Lutetian stage (S Italy, Sicily, Somali, see text-fig. 30z).

Similarly to the increase of $\bar{D}$ the increase of $\bar{P}$, $\bar{L}$, $\bar{H}$, l and h and the decrease of $\bar{n}_{0.5}$ parameters is presumable.

Orbitoclypeus koehleri with undulated cycles can be derived from the early *O. schopeni*. The rosette type and the adauxiliary chambers are alike for both forms.

Retrospection: The above description was based on bibliographic data save the only preparation, examined by the author. Some forms of the synonymic list were only conditionally included since their depictions are of rather poor quality.

The "himerensis" name applied for marking the species cannot be used (see the explanation at the end) while the rest of the names refer to forms with different internal morphology.

Variability: On the basis of the very few bibliographic data, mostly with inproper depictions, and our only specimen the changeability of the species cannot be characterized.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus marthae*, *O. varians scalaris*, *O. varians varians*, *O. koehleri and O. multiplicata* are undulated.

The embryons of *O. chudeaui chudeaui* and *O. chudeaui pannonicus* are only very rarely excentrilepidine.

The equatorial chambers of *O. ramaraoi crimensis* are much more narrow.

Range: For certain the species occurs only in the upper part of the Cuisian and in the whole of the Lutetian but a wider interval is also imaginable.

SW Aquitaine (Saint-Barthélémy), Switzerland (Stöckweid bei Einsiedeln), S Italy (Sicily — Termini-Imerese; Madonie; Roseto Valfortore; Castelluccio Valmaggiore; Lazio — Colle Monitola), N Somali (Gungumale).

Orbitoclypeus koehleri n. sp.

Pl. XXXIII, figs. 10—12, text-fig. 30α

Derivatio nominis: Named in honour of the Slovakian Orthophragmina-researcher EDUARD KÖHLER.
Holotype: Preparation E. 4928, pl. XXXIII, figs. 10—11.
Type locality: Crimea — Suvlu-Kaya Hill — Simferopolian stage — the upper part of the *Nummulites distans* zone — sample B 77.
Type level: The lower part of the Lutetian stage.
Diagnosis: Medium-sized, moderately inflate forms with "chudeaui" type rosette. The embryon is excentrilepidine (perhaps centrilepidine), the two chambers are large. The "varians" type adauxiliary chambers are numerous, wide and high as well as the equatorial chambers. The cycles are undulated with 6 to 7 waves, their growth pattern is of the "varians" type.

Description:

External morphology: Medium-sized (4 to 7 mm) moderately inflate forms with no collar. The rosette is of the "chudeaui" type. The granules are not too big (60 to 80 μm in diameter) and are practically of equal size at the centre as well as at the edges. Each granule is surrounded by 6 to 7 lateral chambers the size of which is the same as that of the granule. The ratio of the sizes of forms "A" and "B" is unknown, since the latter forms have not been found yet.

Internal morphology:

The equatorial section of forms "A" (text-fig. 30α):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: excentri (centri)	$Q=2.24-2.66$	*t*: varians	*s.c.*: undulated with 6 to 7 waves
$E=0.00-0.11$	$\bar{Q}=2.20-2.60$	$N=36-50$	*g.p.*: varians
$\bar{E}=0.00-0.25$	$P=235-269$ μm	$\bar{N}=35-52$	$l=45-60$ μm
$R=1.48-1.68$	$\bar{P}=200-300$ μm	$L=50-55$ μm	$h=90-115$ μm
$\bar{R}=1.40-1.80$	$D=535-710$ μm	$H=55-85$ μm	$n_{0.5}=6.2-7.2$
	$\bar{D}=525-750$ μm	$\bar{H}=60-85$ μm	$\bar{n}_{0.5}=5.6-7.6$
			$n_{1.0}=11.0-14.0$

The equatorial section of forms "B": Microspheric specimens of the species have not been found yet.

Axial section: In axial section the species could not be examined.

Phylogenetic position (text-fig. 30): According to all indications the species derives from the early *Orbitoclypeus schopeni* and it differs from that only in its embryon size and in the undulation of its annuli.

Since the species is known only from one population the intraspecific evolution cannot be pointed out.

No data are available concerning the offspring of the species.

Retrospection: The species described above is completely unknown from the literature this is why it had to be described as a new one.

Variability: Within the only known population both the external and the internal features are more or less stable.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the cycles of *Orbitoclypeus schopeni* and *O. chudeaui pannonicus* are circular.

The rosette of *O. varians varians* is of the "marthae" type and its equatorial chambers are much more narrow.

Range: The lower part of the Lutetian.

Crimea — Simferopolian stage — the upper part of the *Nummulites distans* zone (samples B 75, 77).

Orbitoclypeus daguini (NEUMANN), 1958

Pl. XXXVI, figs. 1—6, text-figs. 31a—b

?1958. *Discocyclina daguini* n. sp. — NEUMANN, p. 89, pl. 13, figs. 7—9, text-fig. 24
non 1967. *Discocyclina daguini* NEUMANN — KÖHLER (=*Discocyclina augustae augustae* et *D. trabayensis vicenzensis*)
non 1978. *Discocyclina daguini* NEUMANN — SIROTTI (=*Discocyclina trabayensis vicenzensis*)

Holotype: Not given by the author of the taxon.
Lectotype: NEUMANN (1958), pl. 13, fig. 7, depository presumably Université Paris (Laboratoire Micropaléontologie) — external form (marked out by the present author).
Type locality: Préchacq (SW Aquitaine) — Ferme Belotte or marniére Maisonnave.
Type level: The Upper Lutetian substage (?).
The type of the equatorial section of forms "A": Preparation E. 4950, pl. XXXVI, figs. 3, 6, the cut of the factory road above Szőke-forrás between Ajka and Pula, sample Sz 7, the lower part of the Bartonian stage.

D i a g n o s i s : Very small, inflate forms. "Chudeaui" type rosette. The embryon is iso- or semi-isolepidine, the two chambers are extremely small. The "daguini" type adauxiliary chambers are very few, medium wide and very low. The cycles may be circular and undulated as well. In the latter case they are undulated with 6 to 7 gentle waves. Their growth pattern is of the "strophiolata" type.

D e s c r i p t i o n :

External morphology: Very small (1 to 2 mm), more or less inflate forms with narrow collar. "Chudeaui" type rosette. The granules are equal-sized everywhere on the test surface. Each granule, 40 to 60 µm in diameter, is surrounded by 5 to 6 lateral chambers the size of which is the same as that of the granule. The ratio of the sizes of forms "A" and "B" is unknown to this day.

Internal morphology:

The equatorial section of forms "A" (text-figs. 31a–b):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: iso, semi-iso	$Q=1.19-1.67$	t: daguini	$s.c.$: circular or undulated with 6 to 7 gentle waves
$E=1.12-1.62$	$\bar{Q}=1.15-1.65$	$N=1$	$g.p.$: strophiolata
$\bar{E}=1.15-1.65$	$P=27-52$ µm	$\bar{N}=0-3$	$l=25-30$ µm
$R=0.12-0.40$	$\bar{P}=25-60$ µm	$L=30-45$ µm	$h=25-55$ µm
$\bar{R}=0.15-0.40$	$D=45-77$ µm	$H=20$ µm	$n_{0.5}=20.4-29.0$
	$\bar{D}=40-85$ µm	$\bar{H}=15-25$ µm	$\bar{n}_{0.5}=18.0-30.0$
			$n_{1.0}$ is unknown

The equatorial section of forms "B": Microspheric specimen of the taxon have not been found yet.

Axial section: Lacking own preparations we rely on NEUMANN's (1958, pl. 13, fig. 10) section, the section plane of which avoided the embryon, and in addition, the scale of enlargement is undoubtedly incorrect. The only facts that can be stated are: the equatorial layer thickens a bit towards the edges, the lateral septum is relatively thin and the annular one is gently curved.

P h y l o g e n e t i c   p o s i t i o n (text-fig. 31): On the basis of the very scarce material not even the species' connection to Orbitoclypei is certain, since it widely differs from the earlier described Orbitoclypei, consequently the phylogenetic relation to them cannot be presumed either.

The occasionally undulated annuli and the fact that *Orbitoclypeus pygmaea*, its presumable descendant, has a microspheric juvenarium, similar to Lepidocyclina type, suggest the belonging to the genus. Certain primitive Lepidorbitoides and Lepidocyclinae, the ancestors of which might have been related to those of Orbitoclypei, do have adauxiliary chambers that are similar to those referred to as "daguini" in this work, so species "daguini", described here, certainly is neither a Discocyclina nor a Nemkovella. At the same time its equatorial chambers are just a bit hexagonal, therefore the relation to Lepidocyclinae can be ruled out as well. The material available is insufficient to separate a new genus, therefore, for the moment, we assigned the species to Orbitoclypei.

The material available – though found at different localities and in different stratigraphic levels – is so scarce that nothing can be established concerning the intraspecific evolution. It is possible that the Saint-Barthélémy form with circular cycles (see text-fig. 31a) and the forms from Ajka and Cauneille with undulated cycles (see text-fig. 31b) are two consecutive subspecies. The decision concerning this question is the task of further research.

Orbitoclypeus pygmaea, from the Far East, may be the descendant of the species. It is different only in the more advanced character of the adauxiliary chambers of the taxon.

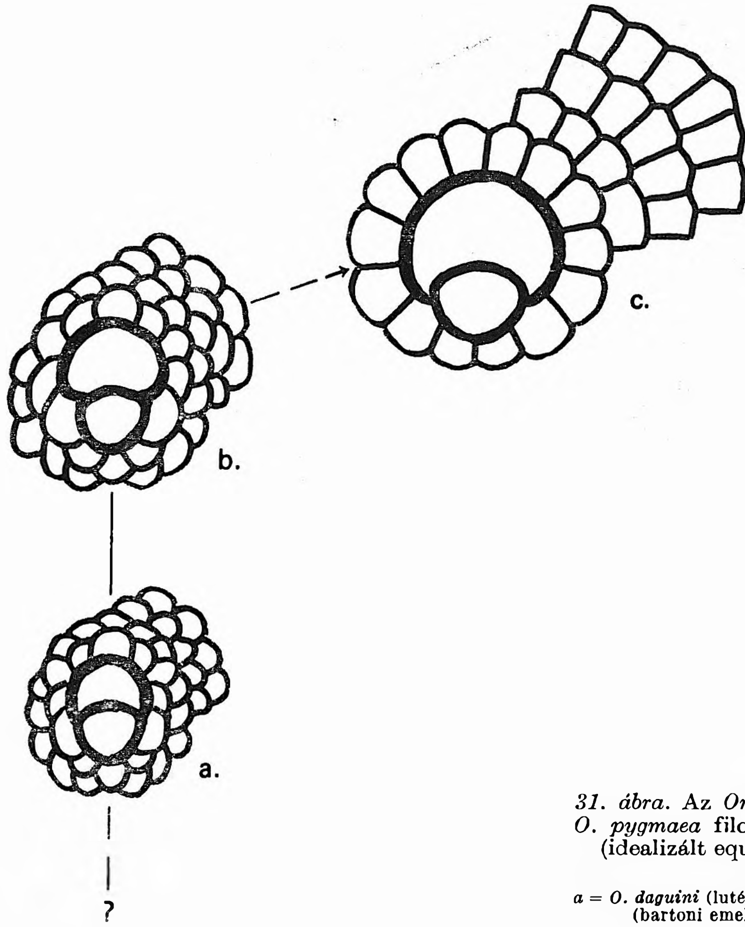
R e t r o s p e c t i o n : NEUMANN's (1958), the describer's, figures hardly show anything about the internal morphology of the taxon, since the sections are not well-oriented. The given scale of enlargement of the axial section is certainly incorrect. As far as the equatorial section is concerned, in all probability, as it is general in the case of this author, the given scale of enlargement is 0.5 to 0.6 times greater than the real one. If we take this into consideration we get an embryon size that is characteristic only of the above discussed forms. The belonging to these forms is supported by NEUMANN's (1958) text-fig. 24b, too.

Later describers considered first of all the "very small, inflate form" character of the taxon and therefore forms with different internal morphology were described under this name. Surely this misinterpretation was due to the first describer's incorrect data.

V a r i a b i l i t y : On the basis of the small material only the cycle shapes, discussed at "Phylogenetic position", can be regarded as variable.

C o m p a r i s o n : None of the Eurasian Orthophragminae possess similar type adauxiliary chambers and such a small embryon.

R a n g e : Their earliest occurrence is in the lower part of the Lutetian stage. From that time on they are traceable to the top of the Bartonian stage.



31. ábra. Az *Orbitoclypeus daguini* és *O. pygmaea* filogenetikai kapcsolatai (idealizált equatoriális metszetek, 200×)

a = *O. daguini* (lutéciai emelet), *b* = *O. daguini* (bartoni emelet), *c* = *O. pygmaea*

Fig. 31. Phylogenetic links of *Orbitoclypeus daguini* and *O. pygmaea* (idealized equatorial sections, 200×)

a = *O. daguini* (Lutetian), *b* = *O. daguini* (Bartonian), *c* = *O. pygmaea*

SW Aquitaine (Saint-Barthélémy, Pouillon, Préchacq, Cauneille), S Bakony (the vicinity of Ajka — samples Sz 5 and 7).

Orbitoclypeus pygmaea (Henrici), 1934

Text-fig. 31c

1908. *Orthophragmina varians* (Kaufmann) — Provale, pp. 72—73, pl. 5, figs. 7—10
1908. *Orthophragmina varians* (Kaufmann) var. *selliformis* n. var. — Provale, p. 73, pl. 5, figs. 11—12
1934. *Discocyclina pygmaea* n. sp. — Henrici, pp. 47—48, pl. 3, figs. 7, 12, pl. 4, fig. 4
1964. *Discocyclina (Discocyclina) pygmaea* Henrici — Samanta, pp. 345—347, pl. 4, figs. 1—16
1965b. *Discocyclina pygmaea* Henrici — Samanta, pp. 424, 426, pl. 2, figs. 12—14
non 1976. *Discocyclina pygmaea* Henrici — Ho Yen et al., pp. 67—68, pl. 12, fig. 10(=?)

Holotype: Not given by the author of the taxon.
Lectotype: Henrici (1934), pl. 4, fig. 4, depository: Geol. Mus. Delft (marked out by the present author.)
Type locality: Noil Noni, near Noil Toko (Timor), "Landschaft Miomaffo NR. 536." coll. Molengraaff.
Type level: "wahrscheinlich yprézien" (in our opinion the Upper Eocene is more likely).
Diagnosis: Small-sized, inflate forms with "chudeaui" type rosotte. Generally the embryon is of the nephrolepidine type, the two chambers are small. The adauxiliary chambers are of the "varians" type, few, narrow and low as well as the equatorial chambers. Generally the cycles are slightly undulated, their growth pattern is of the "varians" type.

Description:

External morphology: Small-sized (1 to 5 mm), more or less inflate forms with narrow collar. "Chudeaui" type rosette. The granules are 40 to 60 μm in diameter, equal-sized on the whole surface of the test. They are surrounded by 5 to 6 lateral chambers the size of which is the same as that of the granule. There is no difference in size between forms "A" and "B".

Internal morphology:
The equatorial section of forms "A" (text-fig. 31c):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-iso, semi-nephro)	$Q=1.44-2.33$	*t:* varians	*s.c.:* undulated with 6 to 7 gentle waves or circular
$E=0.80-1.23$	$\bar{Q}=1.60-2.20$	$N=8-13$	*g.p.:* varians
$\bar{E}=0.80-1.20$	$P=41-75$ µm	$\bar{N}=7-12$	$l=20-35$ µm
$R=0.31-0.68$	$\bar{P}=40-75$ µm	$L=20-45$ µm	$h=30-80$ µm
$\bar{R}=0.30-0.70$	$D=60-150$ µm	$H=30-40$ µm	$n_{0.5}=11.2-16.2$
	$\bar{D}=50-150$ µm	$\bar{H}=30-45$ µm	$\bar{n}_{0.5}=12.0-15.5$
			$n_{1.0}$ is unknown

The equatorial section of forms "B": On the basis of SAMANTA's (1964, pl. 4, fig. 15) figure the juvenarium is the closest to the Lepidocyclina type, though the proloculum somewhat eccentrically sits in the juvenarium. I = 21 µm, S = 8, s = 57 µm, J and j cannot be established. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: According to HENRICI's (1934, pl. 3, fig. 12) and SAMANTA's (1964, pl. 4, figs. 9–13, 1965b, pl. 2, figs. 13–14) data the height of the embryon is ranging from 60 to 70 µm. The equatorial layer is 30 to 40 µm thick near the embryon and 40 to 50 µm thick at the peripheries. The lateral septum is thick, the annular one is curved. The lateral chambers are 70×30 µm big on the average.

Phylogenetic position (text-fig. 31): *Orbitoclypeus daguini* may be the ancestor of the species from which the species differs by its somewhat bigger embryon and in its more advanced adauxiliary chambers. With respect to belonging the species to Orbitoclypei the same train of thought can be followed as in the case of *O. daguini* (see "Phylogenetic position" at *O. daguini*).

Owing to the few bibliographic data no conclusion can be drawn concerning the course of evolution within the species, however it is striking that the embryon of HENRICI's (1934) "pygmaea" from Timor is much smaller than those of PROVALE's (1908) and SAMANTA's (1964, 1965b) forms from Borneo and Assam respectively.

No data are available concerning the offsprings of the species.

Retrospection: Lacking own preparation the above description was based on bibliographic data.

PROVALE (1908), HEINRICI (1934) and SAMANTA (1964, 1965b) as well gave rather good internal depiction of the Borneo, Timor and Assam forms respectively. The "varians" name used by PROVALE (1908) refers to forms with different internal morphology and the "selliformis" name has been forgotten since then (see explanation at the end). In connection with the name "pygmaea" used by HENRICI (1934) and SAMANTA (1964, 1965b) there was hardly any misunderstanding.

Variability: As it was pointed out earlier, too, the test dimensions of HENRICI's (1934) forms from Timor are smaller than the average. In addition the cycles of PROVALE's (1908) Borneo forms are circular unlike those of the Timor and Assam forms.

Comparison: Among the unribbed forms with similar type and similar-sized embryon the equatorial chambers of *Discocyclina broennimanni*, *D. augustae sourbetensis* and *D. trabayensis* have 6 stolons.

The cycles of *Nemkovella fermonti*, *N. strophiolata bodrakensis* and *N. strophiolata strophiolata* are never undulated.

The *Orbitoclypeus daguini* has "daguini" type adauxiliary chambers.

Range: The Priabonian stage.

NE India (Assam – Garo Hills), Borneo, Timor.

Genus Asterocyclina GÜMBEL, 1868

Genotype: *Calcarina stellata* D'ARCHIAC, 1846, with NEUMANN's (1958) description and depiction.

Synonyms: *Asteriacites** SCHLOTHEIM, 1820
*Asterodiscus*** SCHAFTHÄUTL, 1863
*Cisseis**** GUPPY, 1866
Orthophragmina MUNIER-CHALMAS, 1891 (partim)
Nodocyclina HEIM, 1908 (partim)

* Due to *Asterozoa*.
** Homonym with *Asterodiscus* EHRENBERG, 1840.
*** Homonym with *Cisseis* LAPORTE et GORY, 1839.

Orthocyclina VLERK, 1923
Asterodiscocyclina BERRY, 1928
Isodiscodina WEIJDEN, 1940
Nephrodiscodina RUIZ DE GAONA, 1950 (partim)

The test is asteroidal, mostly with 4 or with 5 rays. In the microspheric juvenarium the cycles take asteroidal shape right after the initial spiral. The megalospheric embryon may be iso-, semi-iso- or nephrolepidine. The equatorial chambers are always with 4 stolons, they have only radial septa and radial stolons, and look hexagonal. The equatorial layer strongly thickens in the rays and there it is divided into more layers.

R a n g e : The whole of the Eocene, probably the uppermost part of the Paleocene, too.

The Caribbean and the Pacific regions of America from Peru to Alaska, the Pacific Isles, the Tethys from Morocco to New Caledonia and from Lake Aral to Somali.

PHYLOGENY OF THE EURASIAN ASTEROCYCLINAE

Asterocyclina stella taramellii can be regarded as the common ancestor of the Eurasian Asterocyclinae (see table 10. and text-fig. 32).

The *Asterocyclina stella* lineage can be characterized by "marthae" type rosette, small-, later medium-sized nephro-, semi-isolepidine embryon, deuteroconch with thicker and thicker walls, "varians" type adauxiliary chambers, narrow (25 to 30 μm) equatorial chambers and sharper and sharper rays.

The *A. stellata* lineage, that starts from *A. stella taramellii* (the intermediate forms are known from Gan — BROLSMA, 1973) can be characterized by "marthae" type rosette, small nephrolepidine embryon, "stellata" type adauxiliary chambers and narrow (25 to 30 μm) equatorial chambers. In the case of *A. priabonensis*, the offspring of *A. stellata*, owing to its evolution the "stellata" type adauxiliary chambers disappear again.

Of the *A. kecskemetii* lineage* (its subdivision into subspecies is not possible yet because of the scarce material) "chudeaui" type rosette, relatively large nephrolepidine embryon and very sharp rays are characteristic. The adauxiliary chambers are of "varians" type, the equatorial chambers are narrow (25 to 30 μm).

The *Asterocyclina alticostata* lineage may also derive from *A. stella taramellii*. It is characterized by "chudeaui" type rosette, medium-sized and large isolepidine embryon, rapidly evolving "alticostata" type adauxiliary chambers and wider and wider equatorial chambers (30 to 40 μm).

Its collateral line, *A. schweighauseri* may have evolved from the early *A. alticostata gallica*. The difference between them is in the number of rays (*A. schweighauseri* has 6 to 8 rays while *A. alticostata* generally has 5 or 6) and in the bigger embryon of *A. schweighauseri* in the course of the simultaneous evolution of the two species in the Early—Middle Lutetian. In the case of the most primitive *A. schweighauseri* the transitional "alticostata"—"varians" type adauxiliary chambers are frequent.

Besides those listed, in our opinion FERMONT's (1982) form described as *Asterophragmina* cf. *pagoda* also belongs to Asterocyclinae. This form, too, may also derive from *Asterocyclina stella taramellii* (see also "Phylogenetic position" at *A. stella*).

DESCRIPTION OF THE EUROPEAN ASTEROCYCLINA SPECIES AND SUBSPECIES

Asterocyclina stella (GÜMBEL), 1861

D i a g n o s i s : Small-sized, mostly inflate, asteroidal forms with 5 or rarely with 6 rays, generally with no interray areas. "Marthae" type rosette. The embryon is semi-iso- or nephrolepidine. The two chambers are small- or probably medium-sized. The adauxiliary chambers are of the "varians" type (with an inclination to the "stellata" type), low in numbers, varying in width and height. The cycles of the equatorial chambers are asteroidal with 5, rarely with 6 rays. On the interradial areas the chambers are narrow and low, the growth pattern is of the "strophiolata" type.

D e s c r i p t i o n :

External morphology: Small-sized (1 to 4 mm), more or less inflate, asteroidal forms with 5, rarely with 6 rays, generally with no interray areas. In the case of the most advanced forms, however,

* Which also starts from *A. stella taramellii*.

these areas may evolve. Only the flat forms have well-defined umbo. "Marthae" type rosette. The granules are coarse on the umbo (60 to 120 μm in diameter) and much finer on the rays and on the probably existing interray areas. Each granule is encircled by 8 to 14 tiny lateral chambers. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "B": Lacking own preparation on the basis of BRÖNNIMANN's (1938, pl. 10, fig. 2, text-fig. 2; 1945b, pl. 21, figs. 1—2. and text-figs. 9—11) and FERMONT's (1982, pl. 11, figs. 1—3) figures the juvenarium bears Lepidocyclina character. I=10—20 μm, S=10—13, s=70—115 μm, J=16—20, j=1200—1500 μm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: Lacking own preparation on the basis of the data by SCHLUMBERGER (1904, pl. 6, figs. 53, 56—57), PREVER's (1912, pl. 3, figs. 18—19), BRÖNNIMANN (1940, pl. 2, figs. 16—17), NEUMANN (1958, pl. 28, fig. 10) and SIROTTI (1978, pl. 4, figs. 8, 12) the embryon is 80 to 200 μm high. The equatorial layer is 30 to 60 μm thick near the embryon and 40 to 80 μm thick at the edges provided that the section plane goes through an interray area. In the rays more layers can be found, one on top of the other, their total thickness may amount to as much as 200 μm. The lateral septum is not too thick. The annular one is arcuate in the case of primitive forms, whereas it is nearly straight in the case of the more advanced forms. The size of the lateral chambers are 30—60×20—25 μm on the average.

Phylogenetic position (text-fig. 32): *Asterocyclina stella* is the earliest known Eurasian Asterocyclina. Its ancestors are not known, in our opinion they may turn up in America.

On the basis of the bibliographic data and our own examinations 3 evolutional stages (subspecies) can be distinguished within the species using the following biometric limits.

Asterocyclina stella taramellii (text-figs. 32a—b)	$\bar{D}<140$ μm
Asterocyclina stella stella (text-fig. 32c)	$\bar{D}=140-180$ μm
Asterocyclina stella praestellaris (text-figs. 32d—e)	$\bar{D}>180$ μm

Similarly to $\bar{D}$, the evolution is observable in the increase of $\bar{P}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{n}_{0.5}$ parameter values. The upward tendency of $\bar{E}$, $\bar{R}$ and $\bar{Q}$ cannot be definitely ascertained at the moment.

According to the data available up to now it is likely that subspecies "taramellii" as well as subspecies "praestellaris" can be subdivided into 2 further parts by the 110 μm and the 230 μm dividing lines respectively.

The first subdivision is indicated by FERMONT's (1982) data from Israel, in the case of which for the Cuisian forms (samples Is 199—335) $\bar{D}$ is less than 110 μm (see text-fig. 32a), whereas in the case of the Lutetian forms (samples Is 336—462) $\bar{D}$ is over 110 μm (see text-fig. 32b). This hypothesis, seemingly, is not confirmed by our own examinations, though the reason of this may as well be that the Horsarrieu forms suggest transition towards *A. kecskemetii*, whereas the Saint-Barthélémy forms indicate transition towards *A. stellata.* Unfortunately enough the rosette of the Horsarrieu forms is poorly preserved, both "marthae" and "chudeaui" characters are observable. Since the question is about the initial phase of the lineages, the distinction is not clear-cut on the basis of the internal features either, though it is a fact that the adauxiliary chambers of the Saint-Barthélémy forms are lower and more convex than the average.

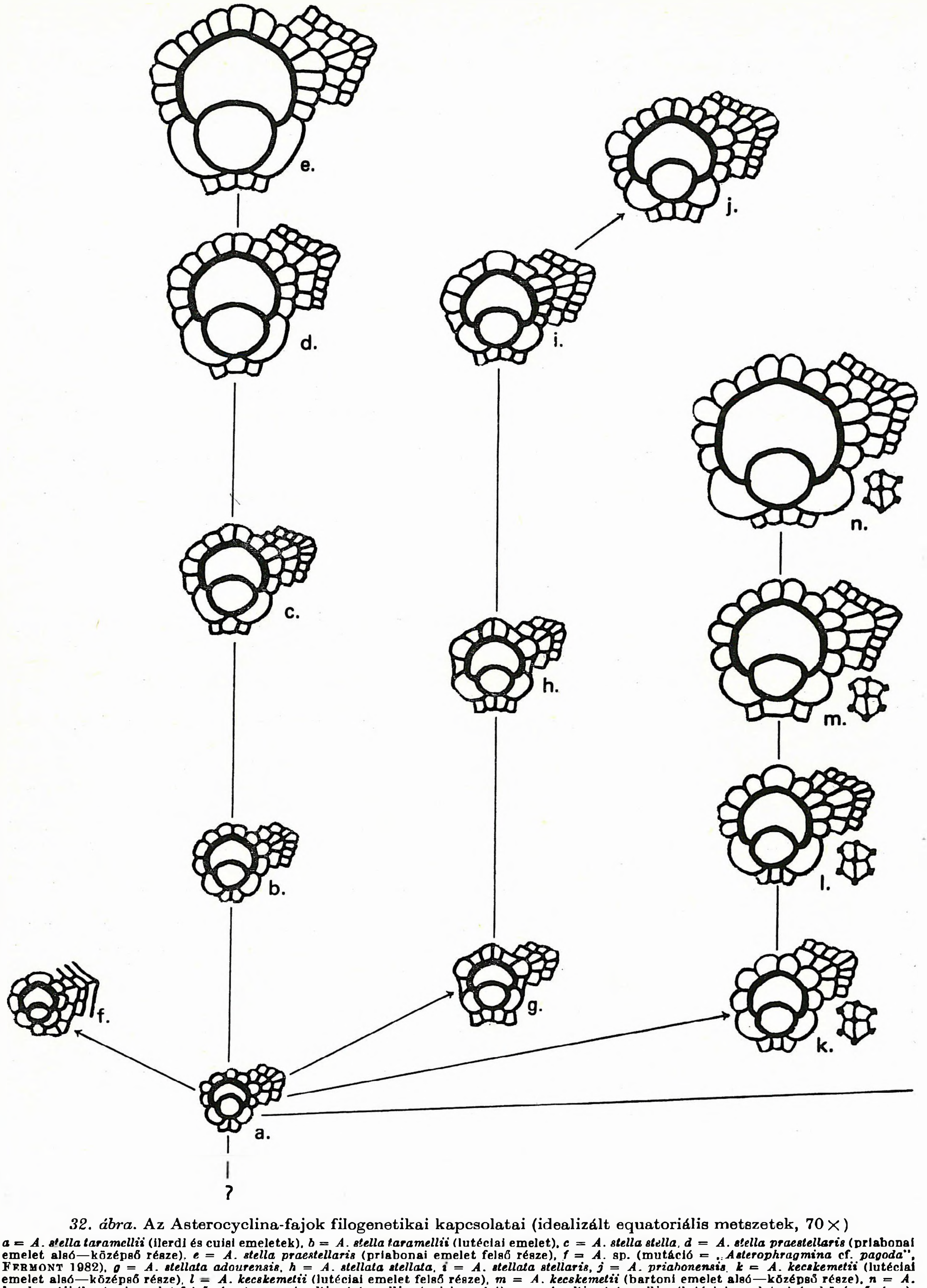
The subdivision of *A. stella praestellaris* by the 230 μm dividing line seems to be more clear-cut but due to the available insufficient material the subdivision cannot be carried out. Accordingly, $\bar{D}$ less than 230 μm (see text-fig. 32d) would be characteristic of the forms from the lower and middle parts of the Priabonian stage (Mossano, Lábatlan and a certain part of BRÖNNIMANN's 1938, 1940, 1945b material from Morocco) whereas forms from the upper part of the stage (Priabona — "Asterocyclina beds" — on the basis of SIROTTI, 1978 and SETIAWAN, 1983, as well as the rest of the material from Morocco) could be characterized by the $\bar{D}$ bigger than 230 μm limit (see text-fig. 32e).

At an early stage of the evolution of the species the following species derive from *A. stella taramellii*, *A. stellata*, *A. kecskemetii*, *A. alticostata* (see the reasons at the discussion of these taxa) and a peculiar form from Israel, described by FERMONT (1982) as *Asterophragmina* cf. *pagoda* (RAO) (FERMONT 1982, pl. 7, figs. 3—5).

In spite of the fact that the fully developed equatorial chambers really do not have radial septa, the identification is not correct in our opinion, since the microspheric juvenarium of the real *Asterophragmina pagoda* from Burma is of Hetrostegina character and it is not likely, in our opinion, in the case of FERMONT's (1982) forms from Israel. We rather suppose that the form in question is a short-lived mutation of *Asterocyclina stella taramellii* (see also text-fig. 32f).

The descendants of the advanced subspecies of *A. stella* are not known.

Retrospection: Among the three names, namely "stella", "taramellii" and "praestellaris" that can be used for marking the above described forms the first one has priority, therefore it



32. ábra. Az Asterocyclina-fajok filogenetikai kapcsolatai (idealizált equatoriális metszetek, 70×)

a = ***A. stella taramellii*** (ilerdi és cuisi emeletek), *b* = ***A. stella taramellii*** (lutéciai emelet), *c* = ***A. stella stella***, *d* = ***A. stella praestellaris*** (priabonai emelet alsó—középső része), *e* = ***A. stella praestellaris*** (priabonai emelet felső része), *f* = ***A.*** sp. (mutáció = „***Asterophragmina*** cf. ***pagoda***", Fermont 1982), *g* = ***A. stellata adourensis***, *h* = ***A. stellata stellata***, *i* = ***A. stellata stellaris***, *j* = ***A. priabonensis***, *k* = ***A. kecskemetii*** (lutéciai emelet alsó—középső része), *l* = ***A. kecskemetii*** (lutéciai emelet felső része), *m* = ***A. kecskemetii*** (bartoni emelet alsó—középső része), *n* = ***A. kecskemetii*** (bartoni emelet felső része), *o* = ***A. alticostata gallica*** (cuisi emelet), *p* = ***A. alticostata gallica*** (lutéciai emelet alsó—középső része), *q* = ***A. alticostata cuvillieri***, *r* = ***A. alticostata alticostata***, *s* = ***A. alticostata danubica***, *t* = ***A. schweighauseri*** (lutéciai emelet legalsó része), *u* = ***A. schweighauseri*** (lutéciai emelet alsó—középső részének határa), *v* = ***A. schweighauseri*** (lutéciai emelet középső részének teteje).
Kiegészítő jel: *1.* „chudeaui"-típusú rozettával rendelkező alak

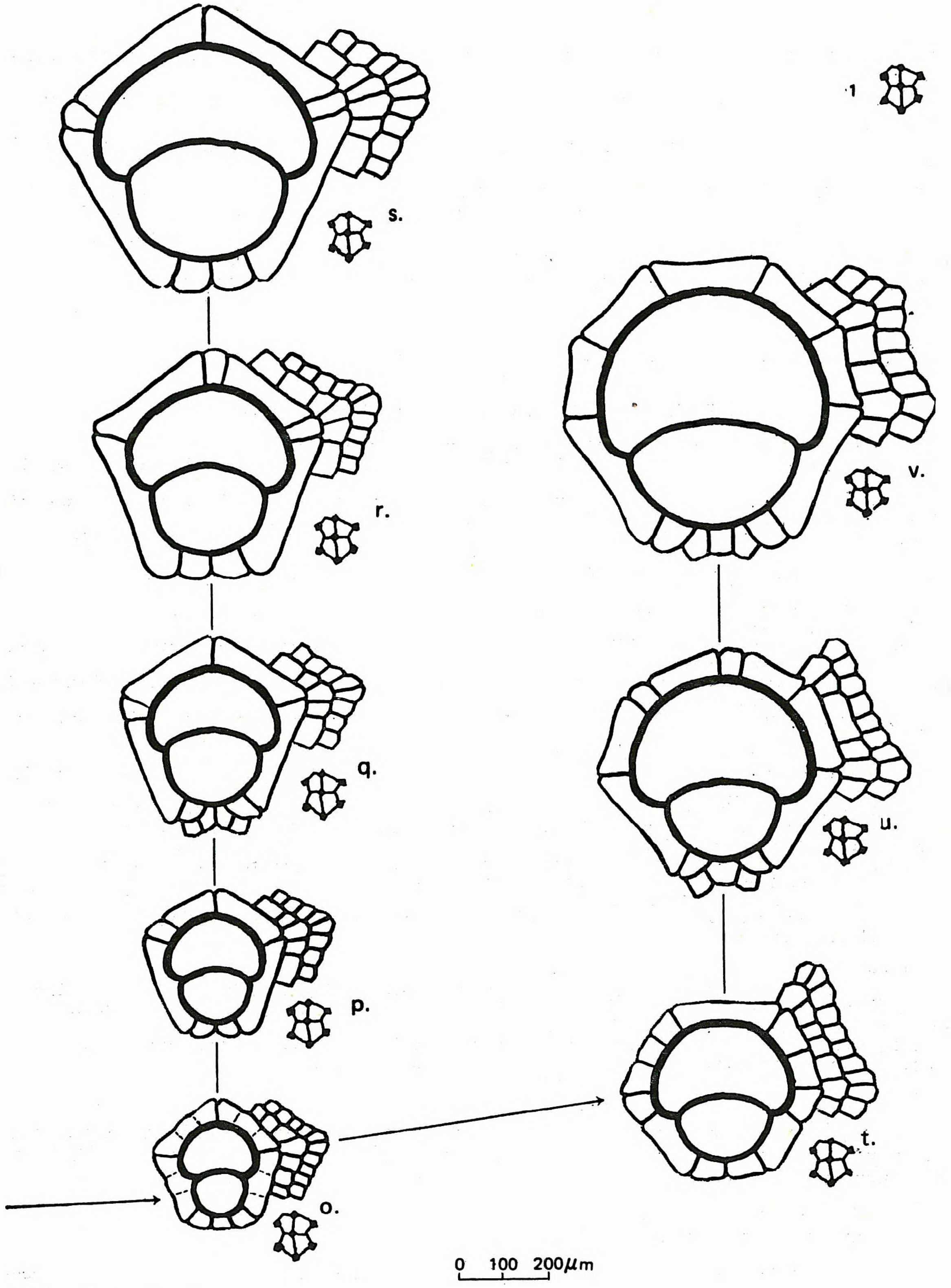


Fig. 32. Phylogenetic links of the Asterocyclina species (idealized equatorial sections, 70×)

a = *A. stella taramellii* (Ilerdian and Cuisian), *b* = *A. stella taramellii* (Lutetian), *c* = *A. stella stella*, *d* = *A. stella praestellaris* (lower—middle parts of the Priabonian), *e* = *A. stella praestellaris* (upper part of the Priabonian), *f* = *A.* sp. (mutation = „*Asterophragmina* cf. *pagoda*", FERMONT 1982), *g* = *A. stellata adourensis*, *h* = *A. stellata stellata*, *i* = *A. stellata stellaris* *j* = *A. priabonensis* *k* = *A. kecskemetii* (lower—middle parts of the Lutetian), *l* = *A. kecskemetii* (upper part of the Lutetian), *m* = *A. kecskemetii* (lower—middle parts of the Bartonian), *n* = *A. kecskemetii* (upper part of the Bartonian), *o* = *A. alticostata gallica* (Cuisian), *p* = *A. alticostata gallica* (lower—middle parts of the Lutetian), *q* = *A. alticostata cuvillieri*, *r* = *A. alticostata alticostata*, *s* = *A. alticostata danubica*, *t* = *A. schweighauseri* (lowermost part of the Lutetian), *u* = *A. schweighauseri* (border of the lower and middle parts of the Lutetian), *v* = *A. schweighauseri* (top of the middle part of the Lutetian). Complementary sign: *1.* form with „chudeaui" type rosette can be used for denominating the species, too. The other two names can be used on the subspecies level.

The "stellata" and "stellaris" names, also in usage, refer to forms with different internal morphology.

V a r i a b i l i t y : The external variability has already been discussed at the description of the exterior.

In BRÖNNIMANN's (1940) Moroccan populations the considerable changeability of the embryon size is a striking feature as well as the relatively large embryon of PAPP—TURNOVSKY's (1970) Austrian forms. In different populations the definiteness of the rays in the equatorial section is also different.

R a n g e : From the middle part of the Ilerdian to the top of the Priabonian.

Asterocyclina stella (GÜMBEL), 1861 **taramellii** (MUNIER-CHALMAS), 1891

Pl. XXXVI, figs. 7—12, pl. XLII, fig. 10, text-figs. 32a—b

1891. *Orthophragmina taramellii* n. sp. — MUNIER-CHALMAS, pp. 29, 33, 37
1904. *Orthophragmina taramellii* MUNIER-CHALMAS — SCHLUMBERGER, p. 131, pl. 6, figs. 41—46, 51, 57
non 1912. *Orthophragmina taramellii* MUNIER-CHALMAS — PREVER *(= Orbitoclypeus furcata rovasendai)*
partim 1922. *Asterodiscus taramellii* (MUNIER-CHALMAS) — DOUVILLÉ, pp. 93—94
partim 1940. *Discocyclina (Discocyclina) taramellii* (MUNIER-CHALMAS) — WEIJDEN, pp. 57—58, pl. 9, figs. 11—14
partim 1953. *Asterocyclina taramellii* (MUNIER-CHALMAS) — SCHWEIGHAUSER, pp. 88—90, text-fig. 58 (partim on the left side)
partim 1953. *Asterocyclina stella* (GÜMBEL) — SCHWEIGHAUSER, pp. 90—91, text-fig. 59 (partim — on the left side)
partim non 1953. *Asteroryclina taramellii* (MUNIER-CHALMAS) — SCHWEIGHAUSER *(= Asterocyclina stellata stellata* et *A. stellata stellaris)*
partim 1958. *Asterodiscus taramellii* (MUNIER-CHALMAS) — NEUMANN, pp. 118—119, pl. 28, figs. 9—10, pl. 29, fig. 1, text-fig. 39
partim non 1958. *Asterodiscus taramellii* (MUNIER-CHALMAS) — NEUMANN *(= Asterocyclina stellata adourensis)*
non 1958. *Asterocyclina taramellii* (MUNIER-CHALMAS) — KECSKEMÉTI *(= Asterocyclina stellata stellata)*
1959. *Asterocyclina taramellii* (MUNIER-CHALMAS) — PAPP, p. 171, abb. 5, fig. 3
1969. *Asterocyclina taramellii* (MUNIER-CHALMAS) — NEMKOV et PORTNAYA, pp. 34—36, pl. 1, figs. 1—2, text-fig. 2
?1969. *Asterocyclina stella* (GÜMBEL) — NEMKOV et PORTNAYA, pp. 38—39, pl. 1, fig. 6, text-fig. 5
1970. *Asterocyclina taramellii* (MUNIER-CHALMAS) — PAPP et TURNOVSKY, pl. 69, fig. 3
partim 1973. *Asterocyclina stellata* (D'ARCHIAC) — BROLSMA, pp. 419—420, pl. 2, figs. 1—2
non 1973. *Asterodiscus taramellii* (MUNIER-CHALMAS) — MASSIEUX *(= Orbitoclypeus bayani)*
1982. *Asterocyclina taramellii* (MUNIER-CHALMAS) — FERMONT, pp. 131—132, table 3 (partim), pl. 4, figs. 1—6, pl. 11, figs. 1—3
1982. *Asterocyclina stella* (GÜMBEL) — FERMONT, pp. 132—133, table 3 (partim), pl. 5, figs. 1—6
?1982. *Asterocyclina* — FERMONT, table 1, pl. 3, figs. 1—18

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : SCHLUMBERGER (1904), pl. 6, fig. 51 and NEUMANN (1958), pl. 28, fig. 9 and pl. 29, fig. 1, preparation 2216. (SCHLUMBERGER), depository: École des Mines (Paris) — marked out by the present writer.
T y p e l o c a l i t y : Monte Spilecco (N Italy).
T y p e l e v e l : Not specified (in the present writer's opinion the middle part of the Ilerdian stage).
D i a g n o s i s : *Asterocyclina stella* populations with $\bar{D}$ less than 140 μm.

D e s c r i p t i o n :

External morphology: Small (1 to 3 mm), more or less inflate asteroidal forms with 5 or rarely with 6 rays. No interray areas. "Marthae" type rosette. The ratio of the sizes of forms "A" and "B" is not known yet.

Internal morphology:

The equatorial section of forms "A" (text-figs. 32a—b):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro—semi-iso	$Q = 1.19-1.90$	*t:* varians	*s.c.:* asteroidal with 5 (6) rays
$E = 0.63-1.33$	$\bar{Q} = 1.25-1.75$	$N = 5-12$	*g.p.:* strophiolata
$\bar{E} = 0.85-1.25$	$P = 60-125$ μm	$\bar{N} = 5.5-12.0$	$l = 20-30$ μm
$R = 0.33-0.73$	$\bar{P} = 60-110$ μm	$L = 25-60$ μm	$h = 25-60$ μm
$\bar{R} = 1.25-1.75$	$D = 77-161$ μm	$H = 20-40$ μm	$n_{0.5} = 17.0-27.0$
	$\bar{D} = 90-140$ μm	$\bar{H} = 22-40$ μm	$\bar{n}_{0.5} = 17.0-23.0$
			$n_{1.0}$ is unknown

R e t r o s p e c t i o n : The species was mentioned only as "nomen nudum" by Munier-Chalmas (1891), the denominator. Later it was Schlumberger (1904), who described the specimens coming form Munier-Chalmas's collection and he also depicted the internal morphology, though it is hardly recognizable on his sketches. This figure was also published by Neumann (1958) but the scale given by her for the enlargement, in all probability, is 0.5 to 0.6 times the real one. The confusion in the synonymic list is due to determination on the basis of the external morphology. The "stella" and "stellata" names, though they were given earlier refer to forms with different internal morphology.

C o m p a r i s o n : Among the asteroidal forms with similar type and similar-sized embryon the adauxiliary chambers of *Asterocyclina stellata adourensis* and *A. stellata stellata* are of the "stellata" type.

The embryon of *A. kecskemetii* is generally much larger, but even if it is not, its rays are much more definite.

R a n g e : From the middle part of the Ilerdian stage to the end of the Lutetian.

SW Aquitaine (Gan—Tuilerie, Horsarrieu samples HX and HN, Saint-Barthélémy Angoumé), N Italy (Spilecco), Austria (Kühlgraben am Unterberg near Salzburg), Crimea (Suvlu-Kaya Hill: Bakhchisaraian stage, the upper part of the *Nummulites crimensis* zone, sample B 20, and Simferopolian stage, the upper part of the *N. distans* zone, samples B 76—77; Bakhchisaraian stage of the vicinity of Feodosiya), Israel (the whole of the Ein Avedat section).

Asterocyclina stella stella (Gümbel), 1861

Pl. XLII, figs. 7—10, text-fig. 32c

?1861. *Hymenocyclus stella* n. sp. — Gümbel, p. 653

?1868. *Orbitoides (Asterocyclina) stella* (Gümbel) — Gümbel, pp. 716—717, pl. 2, figs. 117a—c, pl. 4, figs. 8—10, 19

partim 1904. *Orthophragmina stella* (Gümbel) — Schlumberger, pp. 132—133, pl. 6, figs. 47—50, 53—56

partim non 1904. *Orthophragmina stella* (Gümbel) — Schlumberger *(=?Asterocyclina kecskemetii)*

non 1905. *Orthophragmina stella* (Gümbel) — Deprat, p. 508, pl. 19, fig. 29. (=Asterocyclina indet. sp. — pacific form)

partim non 1912. *Orthophragmina stella* (Gümbel) — Prever *(=Asterocyclina stella praestellaris)*

1922. *Asterodiscus stella* (Gümbel) — Douvillé, pp. 76—77, 93, text-fig. 13

partim 1929. *Asterodiscus stella* (Gümbel) — Llueca, pp. 297—298, pl. 24, figs. 15—17

non 1938. *Asterocyclina* aff. *stella* (Gümbel) — Brönnimann *(=Asterocyclina stella praestellaris)*

partim 1940. *Discocyclina (Discocyclina) stella* (Gümbel) — Weijden, pp. 50—53, pl. 8, figs. 1—3

non 1940. *Asterocyclina stella* (Gümbel) — Brönnimann *(=Asterocyclina stella praestellaris)*

partim 1953. *Asterocyclina stella* (Gümbel) — Schweighauser, pp. 90—91, pl. 13, fig. 6

partim non 1953. *Asterocyclina stella* (Gümbel) — Schweighauser *(=Asterocyclina stellata stellata* et *A. stella taramellii)*

partim 1958. *Asterodiscus stella* (Gümbel) — Neumann, pp. 112—114, pl. 28, figs. 2, 5, text-figs. 36a—b

partim non 1958. *Asterodiscus stella* (Gümbel) — Neumann *(=Asterocyclina stellata adourensis, A. stellata stellaris* et *A. kecskemetii)*

non 1959. *Asterocyclina stella* (Gümbel) — Kecskeméti *(=Asterocyclina alticostata cuvillieri)*

partim non 1963. *Asterocyclina stella* (Gümbel) — Bieda *(=Asterocyclina stella praestellaris)*

non 1967. *Asterocyclina stella* (Gümbel) — Köhler *(=Asterocyclina stellata stellata)*

non 1969. *Asterocyclina stella* (Gümbel) — Nemkov et Portnaya *(=?Asterocyclina stella taramellii)*

non 1970. *Asterodiscus stella* (Gümbel) — Pavič *(=Orbitoclypeus furcata furcata)*

non 1977. *Asterocyclina* sp. cf. *A. stella* (Gümbel) — Cockbain, p. 70, pl. 37, figs. F, G, H, I (=Asterocyclina indet. sp. — pacific form)

non 1978. *Asterocyclina stella* (Gümbel) — Sirotti *(=Asterocyclina stella praestellaris)*

1980. *Asterocyclina stellaris* (Brünner) — Gross, Köhler et al, p. 180, pl. 27, fig. 3

non 1983. *Asterocyclina* III. cf. *A. stella* (Gümbel) — Setiawan *(=Asterocyclina stella praestellaris)*

non 1983. *Asterocyclina* (*stellata/stella*-group) — Setiawan (*=?Asterocyclina stellata stellaris* et *?A. stella praestellaris)*

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : Gümbel (1868), pl. 2, fig. 117, depository not given — external form (marked out by the present writer).
T y p e l o c a l i t y : Bavarian Alps (no closer specification, Hammer, Sinning, Höllgraben or Kressenberg).
T y p e l e v e l : Not specified.
The t y p e of the equatorial section of forms "A": Schlumberger (1904), pl. 6, fig. 54 and Neumann (1958), pl. 28, fig. 5, preparation 2270. (coll. Schlumberger), depository: École de Mines (Paris), Biarritz — Villa Marbella, in the present writer's opinion the Bartonian.
D i a g n o s i s : *Asterocyclina stella* populations with $\bar{D}$ ranging from 140 to 180 μm.

D e s c r i p t i o n :

External morphology: Small (1—2.5 mm), inflate asteroidal forms with 5 strong rays, with "marthae" type rosette and with no interray areas. The size ratio of forms "A" and "B" is not known yet.

Internal morphology:

The equatorial section of forms "A" (text-fig. 32c):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-iso—nephro	$Q = 1.23-1.68$	*t:* varians	*s.c.:* asteroidal with 5 very strong rays
$E = 1.04-1.27$	$\bar{Q} = 1.30-1.60$	$N = 8-12$	*g.p.:* strophiolata
$\bar{E} = 1.00-1.30$	$P = 100-147$ µm	$\bar{N} = 8-12$	$l = 20-35$ µm
$R = 0.36-0.48$	$\bar{P} = 100-140$ µm	$L = 30-60$ µm	$h = 25-45$ µm
$\bar{R} = 0.35-0.50$	$D = 133-192$ µm	$H = 30-40$ µm	$n_{0.5} = 19.0-20.0$
	$\bar{D} = 140-180$ µm	$\bar{H} = 30-40$ µm	$\bar{n}_{0.5} = 17.0-23.0$
			$n_{1.0}$ is unknown

R e m a r k s : The external walls of the adauxiliary chambers are hardly bit arcuate.

R e t r o s p e c t i o n : The "stella" name was first used by GÜMBEL (1861), though only as "nomen nudum". It was also GÜMBEL (1868) who described and depicted this species, the scale of enlargement of the equatorial section is undoubtedly incorrect. It is clear, nevertheless, that the rays are very definite. Since then no figure was published about the internal morphology of this taxon of Bavarian origin, therefore the above description was based on SCHLUMBERGER's (1904), SCHWEIGHAUSER's (1953) and NEUMANN's (1958) specimens from Biarritz.

Thus, it can be assumed that in the Biarritz population $\bar{D}$ is less than 180 µm if we count with NEUMANN's (1958) presumably incorrectly given scale of enlargement.

Due to the determination on the basis of the external morphology this name was also used for marking forms with different internal morphology.

C o m p a r i s o n : Among the asteroidal forms of similar type and similar-sized embryon the adauxiliary chambers of the various *Asterocyclina stellata* subspecies are of the "stellata" type.

The embryon of *A. priabonensis* is less excentric, the external walls of its adauxiliary chambers are more arcuate, its rosette is simpler and its rays are not so definite.

The rosette of *A. kecskemetii* is of the "chudeaui" type, its embryon is less excentric and generally larger as well.

R a n g e : The Bartonian.

SW Aquitaine (Biarritz — Villa Marbella, Halchou, Cauneille), Central Slovakia (Liptov Basin—Východná, Potok Hybica) and probably the Bavarian Alps.

Asterocyclina stella (GÜMBEL), 1861 praestellaris BRÖNNIMANN, 1940

Pl. XLII, figs. 11—12, text-figs. 32d—e

	1912.	*Orthophragmina stella* (GÜMBEL) — PREVER, pp. 171—173, pl. 2, figs. 4, 5(?), pl. 3, figs. 18, 19
	1938.	*Asterocyclina stellaris* (BRÜNNER) — BRÖNNIMANN, pp. 305—308, pl. 9, figs. 1—2, pl. 10, figs. 1—2, 5—8, text-figs. 2, 3
	1938.	*Asterocyclina* aff. *stellata* (D'ARCHIAC) — BRÖNNIMANN, text-fig. 1b in p. 306
	1938.	*Asterocyclina* aff. *stella* (GÜMBEL) — BRÖNNIMANN, pl. 10, figs. 3—4, text-fig. 1a in p. 306
partim	1940.	*Discocyclina (Discocyclina) stellaris* (BRÜNNER) — WEIJDEN, pp. 53—54, pl. 8, figs. 9—10
	1940.	*Asterocyclina praestellaris* n. sp. — BRÖNNIMANN, p. 30, pl. 1, fig. 6, pl. 2, fig. 19
	1940.	*Asterocyclina stella* (GÜMBEL) — BRÖNNIMANN, p. 28, pl. 1, figs. 3, 7, pl. 2, fig. 2, text-fig. 6a
	1940.	*Asterocyclina* aff. *stellata* (D'ARCHIAC) — BRÖNNIMANN, p. 29, pl. 1, figs. 1, 2, 4, 8, 9, pl. 2, figs. 3, 4, 11, 13, text-figs. 6c—d
	1940.	*Asterocyclina stellaris* (BRÜNNER) — BRÖNNIMANN, pp. 30—31, pl. 1, figs. 5, 10, 11, pl. 2, figs. 1, 5—7, 12, 14—17, text-figs. 6e—g
	1940.	*Asterocyclina*... — BRÖNNIMANN, text-fig. 6b
partim	1945b.	*Asterocyclina stellaris* (BRÜNNER) — BRÖNNIMANN, pp. 592—594, pl. 21, figs. 1, 2, 7, 9, text-figs. 1, 9—10, 14—16, 18, 19
	1945b.	*Asterocyclina* aff. *stellata* (D'ARCHIAC) — BRÖNNIMANN, p. 594, text-fig. 11
partim	1963.	*Asterocyclina stella* (GÜMBEL) — BIEDA, p. 137, pl. 26, figs. 4, 5(?)
	1978.	*Asterocyclina stella* (GÜMBEL) — SIROTTI, pp. 62, 64, pl. 4, figs. 11—14
	1978.	*Asterocyclina stellata* (D'ARCHIAC) — SIROTTI, p. 65, pl. 4, figs. 3—10
	1983.	*Asterocyclina* III. cf. *A. stella* (GÜMBEL) — SETIAWAN, p. 88, table 5 (partim), pl. 17, fig. 3
partim	?1983.	*Asterocyclina* (*stellata/stella*-group) — SETIAWAN, p. 81, pl. 16, figs. 3—4

H o l o t y p e : BRÖNNIMANN (1940), pl. 1, fig. 6 at the bottom to the right, presumable depository: Naturhistorisches Museum, Basel — external form.

T y p e l o c a l i t y : Pop. VI. 302B, "Vallée à l'est du Sondage Financo" (NW Morocco).

T y p e l e v e l : "Lédien" (in the present writer's opinion Upper Eocene).

The t y p e of the equatorial section of forms "A": BRÖNNIMANN (1940), pl. 2, fig. 1, depository and stratigraphic level are the same as those of the holotype, pop. V. 202A, "Grande Vallée de Basra" (NW Morocco) — referred to as *Asterocyclina stellaris*.

D i a g n o s i s : *Asterocyclina stella* populations with $\bar{D}$ bigger than 180 µm.

D e s c r i p t i o n :

External morphology: Small (2 to 3.5 mm), inflate or flattened asteroidal forms with 5 very definite rays, with or without interray areas and with "marthae" type rosette. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-figs. 32d—e):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-iso	$Q = 1.16-1.66$	*t:* varians	*s.c.:* asteroidal with 5 strong or very strong rays
$E = 1.09-1.47$	$\bar{Q} = 1.25-1.55$	$N = 8-20$	*g.p.:* strophiolata
$\bar{E} = 1.10-1.35$	$P = 130-297$ µm	$\bar{N} = 10-17$	$l = 25-40$ µm
$R = 0.21-0.46$	$\bar{P} = 140-220$ µm	$L = 40-110$ µm	$h = 35-70$ µm
$\bar{R} = 0.25-0.45$	$D = 170-393$ µm	$H = 45-85$ µm	$n_{0.5} = 9.0-19.0$
	$\bar{D} = 180-300$ µm	$\bar{H} = 45-65$ µm	$\bar{n}_{0.5} = 11.0-17.0$
			$n_{1.0}$ is unknown

R e m a r k s : The external walls of the adauxiliary chambers are nearly straight, just a bit arcuate.

R e t r o s p e c t i o n : For all forms, included in the synonymic list on the basis of bibliographic data, $\bar{D}$ or D is bigger than 180 µm.

For marking the forms, described above, only the "praestellaris" name can be used with certain limitations. The reason for this is that under this name only external forms were depicted by BRÖNNIMANN (1940), at the same time the internal morphology was declared by him to be identical with that of the Moroccan forms referred to as *Asterocyclina stellaris*. In our opinion however these forms answer the criteria of the above description.

C o m p a r i s o n : Among the asteroidal forms of similar type and similar-sized embryon, *Asterocyclina stellata stellaris* has "stellata", while *A. alticostata gallica* and *A. alticostata cuvillieri* have "alticostata" type adauxiliary chambers.

The embryon of *A. priabonensis* is less excentric, the external walls of its adauxiliary chambers are more arcuate.

The rosette of *A. kecskemetii* is of the "chudeaui" type, its embryon is less excentric.

R a n g e : The Priabonian.

NW Morocco (Grande Vallée de Basra and Vallée à l'est du sondage Financo), N Italy (Mossano, Priabona, Cave Defilippi — Gassino), Polish Tatras (Potok Chłabówka), E Gerecse (the surroundings of Lábatlan — sample RA).

Asterocyclina stellata (D'ARCHIAC), 1846

D i a g n o s i s : Small or sometimes medium-sized, inflate or flat, asteroidal forms with 5 rays, with or without interray areas. "Marthae" type rosette. The embryon bears semi-iso- or nephrolepidine character, the two chambers are small. The adauxiliary chambers are of the "stellata" type between 3 and 7 in numbers, and they are wide and of varying height. The equatorial chambers are narrow and low in the interray space. The cycles are asteroidal, mostly with 5 well-developed rays. Their growth pattern is of the "strophiolata" type.

D e s c r i p t i o n :

External morphology: Small-, probably medium-sized (1.5 to 5 mm), more or less inflate or flattened, asteroidal forms with 5 rays, with or without interray areas. Forms "B" may as well have 4 rays. Flat forms have recognizable umbo. "Marthae" type rosette. The granules are rather coarse (60 to 100 µm in diamter) on the umbo, and just a bit smaller on the rays but very fine on the interray surface. The granules are surrounded by 8 to 12 tiny lateral chambers. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "B": On the basis of KÖHLER's (1967, pl. 16, fig. 3) and our own data the juvenarium is of Lepidocyclina character. Approximately half and half of the asteroidal cycles have 4 rays and 5 rays. $\bar{I} = 12-20$ µm, $S = 6-12$, $s = 50-90$ µm, $J = 15-25$, $j = 700-1000$ µm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: On the basis of SCHLUMBERGER's (1904, pl. 6, fig. 40), NEUMANN's (1958, pl. 28, figs. 3, 6, pl. 29, figs. 2, 6—7, pl. 30, figs. 6—7), KÖHLER's (1967, pl. 16, fig. 2) and GROSS, KÖHLER's et al. (1980, pl. 27, fig. 2) and our own data the height of the embryon is between 100 and 200 µm.

The equatorial layer is 30 to 50 μm thick near the embryon. At the interray areas it is 50 to 70 μm thick, while in the rays the equatorial layer itself is divided into 4 or 5 layers. Their total width can be put to 150 to 250 μm. The lateral chambers are 40—80×30 μm on the average.

Phylogenetic position (text-fig. 32): *Asterocyclina stellata* certainly derives from *A. stella taramellii* since their intermediate forms are known, for instance, from Gan (see Brolsma, 1973) and Saint-Barthélémy.

3 evolutional stages (subspecies) can be distinguished within the species using the following biometric units:

Asterocyclina stellata adourensis (text-fig. 32g)	$\bar{D}<125$ μm
Asterocyclina stellata stellata (text-fig. 32h)	$\bar{D}=125-160$ μm
Asterocyclina stellata stellaris (text-fig. 32i)	$\bar{D}>160$ μm

Similar development is observable in the increase of $\bar{P}$, $\bar{H}$ and in the decrease of $\bar{n}_{0.5}$. Practically $\bar{E}$, $\bar{R}$ and $\bar{Q}$ are constant, whereas $\bar{N}$ increases slowly and indefinitely.

A. priabonensis can be certainly derived from *A. stellata stellaris*, since their intermediate forms can be found in the Lábatlan population.

Retrospection: The history of the determination of this species is one of the most complicated ones. On the basis of the external morphology it was described under 9 various names. Among these names "stellata" is the earliest, therefore this one can be regarded as the valid name of the species. From the other names "stellaris" can be used on the subspecies level.

Names like "taramellii", "stella", "priabonensis" and "matanzensis" refer to forms with different internal morphology (see remarks in connection with the last name at the end).

For various reasons names like "pentagonalis", "soeroeansis" and "dubia" cannot be used (see explanation at the end).

Variability: The changeability of the exterior was already discussed under "Description". The qualitative features of the inner morphology are constant both within one population and among the populations. Nevertheless one abnormal form was found (pl. XXXIX, figs. 5—6) in the Ajka population which is, owing to its bigger embryon and the character of its adauxiliary chambers, different from the average form, and there are observable differences even between the two test-halves.

Range: From the middle part of the Cuisian to the middle part of the Priabonian.

Asterocyclina stellata (d'Archiac), 1846 **adourensis** n. ssp.

Pl. XXXVII, figs. 1—12, pl. XXXVIII, figs. 1—8 text-fig. 32g

partim	1958.	*Asterodiscus stella* (Gümbel) — Neumann, pp. 112—114, pl. 28, fig. 3
partim	1958.	*Asterodiscus taramellii* (Munier-Chalmas) — Neumann, pp. 118—119, pl. 29, fig. 2
	?1965a.	*Asterocyclina matanzensis* Cole — Samanta, pp. 23—25, pl. 1, figs. 1—12
partim	1973.	*Asterocyclina stellata* (d'Archiac) — Brolsma, pp. 419—420, pl. 2, figs. 4, 6, 7

Derivatio nominis: Named after the river Adour, that flows not far from the type locality of the taxon
Holotype: Preparation E. 4965, pl. XXXVIII, figs. 5, 7.
Type locality: Nousse (SW Aquitaine) — Crouts.
Type level: The middle part of the Lutetian.
Diagnosis: *Asterocyclina stellata* populations with $\bar{D}$ less than 125 μm.

Description:

External morphology: Small-sized (1.5 to 2.5 mm), asteroidal forms mostly with 5 rays, with no interray areas and with "marthae" type rosette. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 32g):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-iso-nephro	$Q=1.22-1.93$	*t:* stellata	*s.c.:* asteroidal, generally with 5 definite rays
$E=0.88-1.39$	$\bar{Q}=1.35-1.75$	$N=3-7$	*g.p.:* strophiolata
$\bar{E}=0.95-1.30$	$P=62-100$ μm	$\bar{N}=3.0-5.0$	$l=25-35$ μm
$R=0.18-0.58$	$\bar{P}=70-100$ μm	$L=50-100$ μm	$h=25-60$ μm
$\bar{R}=0.35-0.50$	$D=94-136$ μm	$H=30-55$ μm	$n_{0.5}=16.2-24.0$
	$\bar{D}=100-125$ μm	$\bar{H}=32-50$ μm	$\bar{n}_{0.5}=17.0-22.0$
			$n_{1.0}$ is unknown

R e t r o s p e c t i o n : Those forms were included in the synonymic list the D or $\bar{D}$ of which is less than 125 μm. It is because of the different stratigraphic level (Upper Eocene?) why SAMANTA's (1965a) specimens from Assam were conditionally assigned. NEUMANN's (1958) forms were included on the basis of the Gibret locality.

For marking the above described forms names used in the citations are not suitable, since they refer to forms with different internal morphology. This is the reason why the new taxon had to be distinguished.

C o m p a r i s o n : The adauxiliary chambers of *Asterocyclina stella taramellii*, the only form of similar type and similar-sized embryon, are not of the "stellata" type.

R a n g e : From the middle part of the Cuisian to the middle part of the Lutetian.

SW Aquitaine (Gan — Tuilerie, Saint-Barthélémy, Nousse, Gibret, Montfort), Austria (Nussdorf) and probably Assam (Garo Hills).

Asterocyclina stellata stellata (D'ARCHIAC), 1846

Pl. XXXVIII, figs. 9—11, pl. XXXIX, figs. 1—4, 7—10, text-fig. 32h

1846. *Calcarina stellata* n. sp. — D'ARCHIAC, p. 199, pl. 7, figs. 1, 1a
partim 1904. *Orthophragmina stellata* (D'ARCHIAC) — SCHLUMBERGER, pp. 126—128, pl. 5, fig. 33, pl. 6, fig. 10
partim non 1904. *Orthophragmina stellata* (D'ARCHIAC) — SCHLUMBERGER *(=Asterocyclina stellata stellaris)*
partim non 1908. *Orthophragmina (Asterocyclina) stellata* (D'ARCHIAC) — HEIM *(=?Asterocyclina stellata stellaris)*
partim ?1909a. *Orthophragmina dubia* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI, p. 108, pl. 4, fig. 3
partim non 1929. *Asterodiscus stellatus* (D'ARCHIAC) — LLUECA *(=?Asterocyclina stellata stellaris)*
non 1938. *Asterocyclina* aff. *stellata* (D'ARCHIAC) — BRÖNNIMANN *(=Asterocyclina stella praestellaris)*
partim 1940. *Discocyclina (Discocyclina) stellata* (D'ARCHIAC) — WEIJDEN, pp. 54—56, pl. 9, fig. 5
partim non 1940. *Discocyclina (Discocyclina) stellata* (D'ARCHIAC) — WEIJDEN *(=Asterocyclina stellata stellaris)*
non 1940. *Asterocyclina* aff. *stellata* (D'ARCHIAC) — BRÖNNIMANN *(=Asterocyclina stella praestellaris)*
non 1945b. *Asterocyclina* aff. *stellata* (D'ARCHIAC) — BRÖNNIMANN *(=Asterocyclina stella praestellaris)*
partim 1953. *Asterocyclina stellata* (D'ARCHIAC) — SCHWEIGHAUSER, pp. 86—88, pl. 13, fig. 5, text-fig. 57
partim 1953. *Asterocyclina taramellii* (MUNIER-CHALMAS) — SCHWEIGHAUSER, pp. 88—90, pl. 13, fig. 2 (non 3), text-fig. 58 (partim — on the centre and right side)
partim 1953. *Asterocyclina stella* (GÜMBEL) — SCHWEIGHAUSER, pp. 90—91 pl. 13, fig. 8, text-fig. 59 (partim — on the right side)
partim non 1953. *Asterocyclina stellata* (D'ARCHIAC) — SCHWEIGHAUSER *(=Asterocyclina stellata stellaris)*
partim 1958. *Asterodiscus stellatus* (D'ARCHIAC) — NEUMANN, pp. 116—118, pl. 30, figs. 1—6, text-fig. 38
partim non 1958. *Asterodiscus stellatus* (D'ARCHIAC) — NEUMANN *(=Asterocyclina stellata stellaris)*
1958. *Asterocyclina taramellii* (MUNIER-CHALMAS) — KECSKEMÉTI, pp. 41—42, pl. 1, figs. 6—8, text-fig. 2
1959. *Asterocyclina stellaris* (BRÜNNER) — KECSKEMÉTI, pp. 66—67, pl. 5, figs. 2, 5, text-fig. 25(?)
1959. *Asterocyclina pentagonalis* (SCHAFHÄUTL) — KECSKEMÉTI, pp. 67—68, pl. 5, figs. 7, 10, text-fig. 26(?)
1959. *Asterocyclina stellata* (D'ARCHIAC) — KECSKEMÉTI, pp. 68—70, pl. 5, figs. 8, 11, text-fig. 27(?)
partim 1967. *Asterocyclina stellata* (D'ARCHIAC) — KÖHLER, pp. 79, 81—83, pl. 16, fig. 5
1967. *Asterocyclina stella* (GÜMBEL) — KÖHLER, pp. 78—80, pl. 16, figs. 1, 2—3(?)
partim non 1967. *Asterocyclina stellata* (D'ARCHIAC) — KÖHLER *(=Asterocyclina stellata stellaris)*
non 1973. *Asterocyclina stellata* (D'ARCHIAC) — BROLSMA *(=Asterocyclina stellata adourensis* et *A. stella taramellii)*
non 1978. *Asterocyclina stellata* (D'ARCHIAC) — SIROTTI *(=Asterocyclina stella praestellaris)*
non 1980. *Asterocyclina stellatus* (D'ARCHIAC) — GROSS—KÖHLER et al. *(=Asterocyclina stellata stellaris)*
partim 1981a. *Asterocyclina stellata* (D'ARCHIAC) — LESS, pl. 2, fig. 3
partim non 1981a. *Asterocyclina stellata* (D'ARCHIAC) — LESS *(=Asterocyclina stellata stellaris)*
non 1983. *Asterocyclina* (*stellata/stella*-group) — SETIAWAN *(=?Asterocyclina stellata stellaris* et *?A. stella praestellaris)*

H o l o t y p e : Not given by the author of the taxon.
L e c t o t y p e : D'ARCHIAC (1846), pl. 7, fig. 1, depository: École de Mines (Paris) — external form (marked out by the present writer).
T y p e l o c a l i t y : Biarritz (SW Aquitaine) — rocher de la Gourèpe.
T y p e l e v e l : Not specified (in the present writer's opinion the upper part of the Lutetian).
The t y p e of the equatorial section of forms "A": NEUMANN (1958), pl. 30, figs. 4—5, depository: Université de Paris, further data are the same as those of the lectotype.
D i a g n o s i s : *Asterocyclina stellata* populations with D ranging from 125 to 160 μm.

D e s c r i p t i o n :

External morphology: Small-sized (2 to 4 mm), inflate or flattened, asteroidal forms, mostly with 5 rays, with or without interray areas and with "marthae" type rosette. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 32h):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro—semi-iso	$Q = 1.21-1.92$	*t:* stellata	*s.c.:* asteroidal, mostly with 5 definite rays
$E = 0.68-1.43$	$\bar{Q} = 1.30-1.65$	$N = 3-7$	*g.p.:* strophiolata
$\bar{E} = 0.90-1.20$	$P = 65-110$ µm	$\bar{N} = 3.0-5.4$	$l = 20-35$ µm
$R = 0.25-0.76$	$\bar{P} = 84-104$ µm	$L = 45-100$ µm	$h = 25-65$ µm
$\bar{R} = 0.35-0.55$	$D = 114-159$ µm	$H = 30-80$ µm	$n_{0.5} = 16.0-23.5$
	$\bar{D} = 125-160$ µm	$\bar{H} = 35-50$ µm	$\bar{n}_{0.5} = 18.0-22.0$
			$n_{1.0} = 30.0-36.0$

R e t r o s p e c t i o n : Those forms were included in the synonymic list the D or $\bar{D}$ of which is between 125 and 160 µm, or those that are coming from the type locality, that is, from Biarritz — rocher de la Gourépe.

No figure was published by D'ARCHIAC (1846), the first describer, on the internal morphology of the taxon, and SCHLUMBERGER (1904), too, has published only the axial section of the forms coming from the type locality. On the basis of these, however, it is likely that D is less than 160 µm. This seems to be confirmed by NEUMANN's (1958) equatorial section from the type locality. Though this section is not well-oriented and therefore the character of the adauxiliary chambers is not easy to recognize but D, here too, is less than 160 µm, taking into consideration scale of enlargement is in general incorrectly given by the author.

On the basis of the reasons given above, the description can be correlated with the "stellata" denomination that has priority among all the other names.

The major confusion in the synonymic list is due to the determination on the basis of the external form.

C o m p a r i s o n : None of the asteroidal forms of similar type and similar-sized embryon has definite "stellata" type adauxiliary chambers.

R a n g e : The upper part of the Lutetian and the lower part of the Bartonian.

SW Aquitaine (Biarritz — rocher de la Gourèpe; Angoumé), N Italy (the surroundings of Vicenza — San Pancrazio), Sicily (Termini-Imerese — Vallone Tre Pietre), W Slovakia (Turčianska Belá, Rajec), S Bakony (the vicinity of Ajka — samples Ba 3, 5, 6, Sz 5—8, CS, Kö 1, 3—4 are from the present writer's own sampling, samples "Köleskepe-2" and "Gyűrhegy" are from T. KECSKEMÉTI's one).

Asterocyclina stellata (D'ARCHIAC), 1846 **stellaris** (BRÜNNER, 1848 in RÜTIMEYER), 1850

Pl. XXXIX, figs. 11—12, pl. XL, figs. 1—11, pl. XLI, figs. 1—6, text-fig. 32i

1850. *Orbitolites stellaris* BRÜNNER — RÜTIMEYER, p. 118, pl. 5, fig. 74
partim 1904. *Orthophragmina stellata* (D'ARCHIAC) — SCHLUMBERGER, pp. 126—128, pl. 5, figs. 31, 32, 34—36, pl. 6, figs. 37—39, text-fig. 5
1904. *Orthophragmina* sp. — SCHLUMBERGER, pl. 5, fig. 24
1908. *Orthophragmina (Asterocyclina) stellata* (D'ARCHIAC) — HEIM, pp. 268—269
partim 1912. *Orthophragmina priabonensis* (GÜMBEL) — PREVER, pp. 174—176, pl. 2, figs. 8—9
partim ?1922. *Asterodiscus stellaris* (BRÜNNER) — DOUVILLÉ, pp. 94—95, text-fig. 14
1923. *Orthocyclina soeroeaensis* n. sp. — VLERK, pp. 91—98, figs. 1, 2
partim ?1929. *Asterodiscus stellatus* (D'ARCHIAC) — LLUECA, pp. 300—301, pl. 25, fig. 18
non 1938. *Asterocyclina stellaris* (BRÜNNER) — BRÖNNIMANN *(= Asterocyclina stella praestellaris)*
partim 1940. *Discocyclina (Discocyclina) stellata* (D'ARCHIAC) — WEIJDEN, pp. 54—56, pl. 9, figs. 1—4, 6—7
non 1940. *Discocyclina (Discocyclina) stellaris* (BRÜNNER) — WEIJDEN *(= Asterocyclina stella praestellaris* et *A. alticostata danubica)*
non 1940. *Asterocyclina stellaris* (BRÜNNER) — BRÖNNIMANN *(= Asterocyclina stella praestellaris)*
partim non 1945b. *Asterocyclina stellaris* (BRÜNNER) — BRÖNNIMANN *(= Asterocyclina stella praestellaris)*
partim 1953. *Asterocyclina stellata* (D'ARCHIAC) — SCHWEIGHAUSER, pp. 86—88, pl. 13, figs. 3, 10
partim 1953. *Asterocyclina pentagonalis* (SCHAFHÄUTL) — SCHWEIGHAUSER, pp. 85—86, pl. 13, figs. 1, 9, text-fig. 56 (partim — on the right side)
partim 1953. *Asterocyclina taramellii* (MUNIER-CHALMAS) — SCHWEIGHAUSER, pp. 88—90, pl. 13, fig. 11
non 1953. *Asterocyclina stellaris* (BRÜNNER) — SCHWEIGHAUSER *(= Asterocyclina priabonensis)*
non 1955. *Asterodiscus* cf. *stellaris* (BRÜNNER) — NEUMANN, pp. 132—133, pl. 6, fig. 7. (= Asterocyclina indet. sp.)
non 1957. *Discocyclina (Asterocyclina) stellaris* (BRÜNNER) — HANZAWA, p. 84, pl. 14, figs. 1, 5—7. (= Asterocyclina indet. sp. — pacific form)
1958. *Asterodiscus stellaris* (BRÜNNER) — NEUMANN, pp. 114—116, pl. 29, figs. 3—7, text-fig. 37
partim 1958. *Asterodiscus stella* (GÜMBEL) — NEUMANN, pp. 112—114, pl. 28, fig. 6
partim 1958. *Asterodiscus stellatus* (D'ARCHIAC) — NEUMANN, pp. 116—118, pl. 30, fig. 7
non 1959. *Asterocyclina stellaris* (BRÜNNER) — KECSKEMÉTI *(= Asterocyclina stellata stellata)*
1967. *Asterocyclina stellaris* (BRÜNNER) — KÖHLER, pp. 79—81, pl. 16, fig. 4

partim 1967. *Asterocyclina stellata* (D'ARCHIAC) — KÖHLER, pp. 79, 81—83, pl. 16, fig. 6
non 1978. *Astericyclina stellaris* (BRÜNNER) — SIROTTI (= *Asterocyclina priabonensis*)
1980. *Asterocyclina stellatus* (D'ARCHIAC) — GROSS, KÖHLER et al., pp. 180—181, pl. 27, fig. 2
non 1980. *Asterocyclina stellaris* (BRÜNNER) — GROSS, KÖHLER et al. (= *Asterocyclina stella stella*)
partim 1981a. *Asterocyclina stellata* (D'ARCHIAC) — LESS, pl. 2, fig. 5
1983. *Asterocyclina* I. cf. *A. stellaris* (BRÜNNER) — SETIAWAN, p. 87, table 5 (partim), pl. 17, figs. 1—2
partim ?1983. *Asterodyclina stellata* (stella-group) — SETIAWAN, p. 81
partim ?1983. *Asterocyclina* (*stellaris*-group) — SETIAWAN, p. 81
partim non 1983. *Asterocyclina* (*stellaris*-group) — SETIAWAN (= ?*Asterocyclina priabonensis*)

Holotype: Not given by the author of the taxon.
Lectotype: RÜTIMEYER (1850), pl. 5, fig. 74, depository unknown — external form (marked out by the present writer).
Type locality: One of the following localities: Wallis-Wispillen, Platti bei Lauenen, Ralligstöcke, Bürgenstock (Unterwalden).
Type level: Not specified (in the present writer's opinion the upper part of the Middle Eocene or the Upper Eocene).
The type of the equatorial section of forms "A": SCHLUMBERGER (1904), pl. 5, fig. 36, depository: École de Mines (Paris), Ralligstöcke (near Interlaken), Upper Eocene.
Diagnosis: *Asterocyclina stellata* populations with $\bar{D}$ exceeding 160 μm.

Description:

External morphology: Small- and medium-sized (2.5 to 5 mm), generally flattened, asteroidal forms mostly with 5 rays, with interray areas and "marthae" type rosette. There is no difference in size between forms "A" and "B" but often the latter forms have only 4 rays.

Internal morphology:

The equatorial section of forms "A" (text-fig. 32i):

Embryon:
t: nephro—semi-iso
$E = 0.59-1.44$
$\bar{E} = 0.87-1.30$
$R = 0.17-0.80$
$\bar{R} = 0.30-0.60$
$Q = 1.15-1.83$
$\bar{Q} = 1.35-1.70$
$P = 82-175$ μm
$\bar{P} = 95-145$ μm
$D = 137-217$ μm
$\bar{D} = 160-200$ μm

Adauxiliary chambers:
t: stellata (stellata—varians)
$N = 3-9$
$\bar{N} = 3.0-7.3$
$L = 65-150$ μm
$H = 30-65$ μm
$\bar{H} = 42-62$ μm

Equatorial chambers:
s.c.: asteroidal, mostly with 5 strong rays
g.p.: strophiolata
$l = 20-35$ μm
$h = 25-100$ μm
$n_{0.5} = 13.5-21.0$
$\bar{n}_{0.5} = 14.0-19.7$
$n_{1.0} = 25.0-33.5$

Retrospection: In case of all the assigned forms in the synonymic list D or $\bar{D}$ is bigger than 160 μm.

The assumed denominator, BRÜNNER (1848) did not even mention the name of the taxon in his work, however, he, was mentioned as author by RÜTIMEYER (1850). Nor do RÜTIMEYER's figures show the internal morphology of the taxon, and the locality is not definitely given. Fortunately enough from one of RÜTIMEYER's localities (Ralligstöcke) a high quality figure showing the internal morphology was published by SCHLUMBERGER (1904), though under the name of "stellata". Since these denominations were based on the external features they can hardly be valid now. Based on RÜTIMEYER's (1850) denomination, SCHLUMBERGER's (1904) figure and the above description the above species can be identified.

NEUMANN's (1958) pl. 29, fig. 5 included in the list on the basis of the equatorial chambers' width, was considered in the author's original scale of enlargement.

Because of the great variability in the habitus of the Asterocyclinae the synonymic list is so mixed up. The majority of the authors in the list determined the various taxa of Asterocyclinae on the basis of the external morphology.

Comparison: None of the asteroidal forms of similar type and similar-sized embryon has definitely "stellata" type adauxiliary chambers.

Range: The middle and upper part of the Bartonian stage and the lower and middle parts of the Priabonian stage.

SW Aquitaine (Siest — samples BT and SO; Cauneille; Biarritz — Villa Marbella), Switzerland (Ralligstöcke), N Italy (Mossano, Brendola, Priabona — "Discocyclina beds", Valle Granella, Sorgente, Villa Lard — Gassino), French Alps (Villeneuve-Loubet), W Slovakia (Horné Jaseno, Rajec), Liptov Basin (Ružomberok), N Bakony (surroundings of Dudar — samples D 3 and DS 5), E Gerecse (the vicinity of Lábatlan — samples RA, RK, RF, R 1—2 and BD), Indonesia (Soeroea).

Asterocyclina priabonensis Gümbel, 1868

Pl. XLI, figs. 7–8, text-fig. 32j

?1868. *Orbitoides (Asterocyclina) priabonensis* n. sp. — Gümbel, pp. 715–716, pl. 4, figs. 36–41
partim non 1912. *Orthophragmina priabonensis* (Gümbel) — Prever *(= Asterocyclina stellata stellaris)*
partim non 1916. *Orthophragmina priabonensis* (Gümbel) — Checchia-Rispoli *(Asterocyclina alticostata danubica)*
1953. *Asterocyclina stellaris* (Brünner) — Schweighauser, pp. 83–85, pl. 12, figs. 1–2, text-fig. 55
1978. *Asterocyclina stellaris* (Brünner) — Sirotti, p. 64, pl. 3, figs. 11–15, pl. 4, figs. 1–2
1983. Asterocyclina II. cf. *A. priabonensis* Gümbel — Setiawan, p. 88, table 5 (partim), pl. 17, fig. 4
partim ?1983. Asterocyclina (stellaris-group) — Setiawan, p. 81, pl. 16, figs. 1–2

Holotype: Not given by the author of the taxon.
Lectotype: Gümbel (1868), pl. 4, figs. 36a–b, depository not given (marked out by the present writer).
Type locality: On the basis of the denomination presumably Priabona (more exactly, in all probability the so-called "Asterocyclina beds").
Type level: Not specified (presumably the upper part of the Priabonian).
The type of the equatorial section of forms "A": Setiawan (1983), pl. 17, fig. 4 (referred to as Asterocyclina II. cf. *A. priabonensis*), Priabona, sample Pr 135, the upper part of the Priabonian presumed depository: Department of Micropaleontology, University of Utrecht.
Diagnosis: Small- and medium-sized flattened asteroidal forms mostly with 5 rays and with interray areas. "Marthae" type rosette. Usually the embryon bears nephrolepidine character, the two chambers are medium-sized. The few, wide and relatively high adauxiliary chambers are of the "varians" type. The cycles of the equatorial chambers are asteroidal with 5 definite rays. In the interray space the chambers are narrow and relatively low. The growth pattern of the annuli is of the "strophiolata" type.

Description:

External morphology: Small- and medium-sized (3 to 6 mm) flattened, asteroidal forms mostly with 5 rays and with interray areas. It has small, well-defined umbo on the surface of which the granules are rather coarse (60 to 100 µm in diameter) as well as on the rays, whereas they are fine on the interray surface. The rosette is of the "marthae" type, the granules are encircled by 8 to 12 tiny lateral chambers. The size ratio of forms "A" and "B" is not yet known.

Internal morphology:

The equatorial section of forms "A" (text-fig. 32j):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro (semi-nephro)	$Q = 1.54-1.85$	*t:* varians (varians—stellata)	*s. c.:* asteroidal, mostly with 5 definite rays
$E = 0.60-1.06$	$\bar{Q} = 1.50-1.80$	$N = 8-17$	*g. p.:* strophiolata
$\bar{E} = 0.70-1.00$	$P = 90-142$ µm	$\bar{N} = 9-15$	$l = 25-30$ µm
$R = 0.46-0.76$	$\bar{P} = 100-145$ µm	$L = 30-70$ µm	$h = 30-55$ µm
$\bar{R} = 0.45-0.75$	$D = 150-230$ µm	$H = 30-55$ µm	$n_{0.5} = 15.0-17.5$
	$\bar{D} = 160-230$ µm	$\bar{H} = 35-60$ µm	$\bar{n}_{0.5} = 13.0-18.0$
			$n_{1.0}$ is unknown

Remarks: The external wall of the adauxiliary chambers is arcuate.

The equatorial section of forms "B": Microspheric specimens of the taxon have not been found yet. Presumably the juvenarium is of Lepidocyclina character.

Axial section: We have no preparation of this section, and Sirotti's (1978, pl. 3, fig. 15) figure does not give any appreciable information about the internal morphology either.

Phylogenetic position (text-fig. 32): *Asterocyclina priabonensis* can be regarded as the direct descendant of *A. stellata stellaris,* since the only difference between them is that in case of *A. priabonensis* the adauxiliary chambers enclose the whole contour of the deuteroconch and these chambers cannot be distinguished so they seem as if they were reshaped into "varians" type chambers. Transitional forms between these two taxa can be also found in the Lábatlan population (see for example pl. XLI, figs. 3 and 5).

On the basis of Setiawan's (1983) data in the Priabonian type section the development within the species is observable in the increase of $\bar{P}$ and $\bar{D}$, and at the same time it is striking that the values of these parameters are lower than the corresponding values of the Lábatlan forms, that are stratigraphically deeper situated.

This species became extinct without offspring at the very end of the Eocene.

Retrospection: Gümbel's (1868) depiction on the internal morphology of the taxon was not satisfactory, therefore the above description is based on Setiawan's (1983) measurement and figures. The "stellaris" name used by Schweighauser (1953) and Sirotti (1978) refer to forms with different internal morphology.

Variability: The two known populations of the species (from Priabona and from Lábatlan) are a bit different with respect to the embryon size, that is, the *D* values of the specimens from Priabona are rather below 200 µm, whereas *D* bigger than 200 µm is more characteristic of the Lábatlan forms. The other quantitative and qualitative features are the same.

C o m p a r i s o n : Among the asteroidal forms of similar type and similar-sized embryon the adauxiliary chambers of *Asterocyclina stellata stellaris* are of the "stellata" type.

The embryon of *A. alticostata gallica* is more isolepidine, its adauxiliary chambers are of the "alticostata" type, the rosette is of the "chudeaui" type and its equatorial chambers are wider.

The rosette of *A. kecskemetii* is of the "chudeaui" type, its rays are more definite and, due to the difference in stratigraphic level, the accompanying fauna is different, too.

The most difficult is to distinguish the species from *A. stella stella* and *A. stella praestellaris*. The embryon of these taxa are more excentric, their rosette is a bit more complex (the granules are surrounded by more lateral chambers), their rays are sharper and the external walls of their adauxiliary chambers are much less arcuate than those of the discussed taxon (the "stellata" heritage cannot be observed).

R a n g e : The middle and upper parts of the Priabonian.

N Italy (Priabona), E Gerecse (the surroundings of Lábatlan — samples R 1 and RF).

Asterocyclina kecskemetii n. sp.

Pl. XLI, figs. 9—11, pl. XLII, figs. 1—6, text-figs. 32k—n

partim ?1904. *Orthophragmina stella* (Gümbel) — Schlumberger, pp. 132—133, pl. 6, figs. 52, 58
partim ?1958. *Asterodiscus stella* (Gümbel) — Neumann, pp. 112—114, pl. 28, fig. 4
partim 1959. *Actinocyclina variecostata* Gümbel — Kecskeméti, pp. 63—65, pl. 5, fig. 6

D e r i v a t i o n o m i n i s : In honour of the Hungarian researcher of Larger Foraminifera — named after Dr. Tibor Kecskeméti.
H o l o t y p e : Preparation E 5001, pl. XLII, fig. 1.
T y p e l o c a l i t y : Ajka, the upper end of the Csékuti árok, sample CS.
D i a g n o s i s : Small- and medium-sized flattened asteroidal forms with 5 to 6 rays and with interray areas. "Chudeaui" type rosette. The embryon is nephro- or semi-isolepidine, the two chambers are small or medium-sized. The adauxiliary chambers are of the "varians" or the transitional "stellata—varians" types, relatively wide, medium high and few in numbers. The two large principal auxiliary chambers are characteristic of the species. The cycles of the equatorial chambers are asteroidal with 5 or 6 very definite rays. In the interray space the chambers are narrow and lower than the average. The growth pattern of the annuli is of the "strophiolata" type.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (2.5 to 6 mm) flattened asteroidal forms generally with 5 but often with 6 rays. The interray space is mostly well developed. There is a well-defined, medium-sized umbo at the centre of the test. "Chudeaui" type rosette. The polygonal granules are coarse on the umbo (60 to 100 μm in diameter) whereas on the rays and, especially on the interray surface, they are finer. Each granule is surrounded by 4 to 6 lateral chambers the size of which is the same as that of the granule. The ratio of the sizes of forms "A" and "B" is not known yet.

Internal morphology:

The equatorial section of forms "A" (text-figs. 32k—n):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: nephro—semi-iso	$Q = 1.29-1.91$	*t:* varians (varians—stellata)	*s.c.:* asteroidal with five (six) very strong rays
$E = 0.92-1.24$	$\bar{Q} = 1.40-1.85$	$N = 5-12$	*g.p.:* strophiolata
$\bar{E} = 0.90-1.25$	$P = 102-182$ μm	$\bar{N} = 5-12$	$l = 25-35$ μm
$R = 0.30-0.56$	$\bar{P} = 100-200$ μm	$L = 45-115$ μm	$h = 35-70$ μm
$\bar{R} = 0.35-0.55$	$D = 132-304$ μm	$H = 45-60$ μm	$n_{0.5} = 11.4-18.0$
	$\bar{D} = 125-320$ μm	$\bar{H} = 45-60$ μm	$\bar{n}_{0.5} = 11.0-18.0$
			$n_{1.0} = 23.0-30.0$

R e m a r k s : The principal auxiliary chambers are characteristically large, much larger than the adauxiliary chambers.

The equatorial section of forms "B": No microspheric specimens of the taxon have been found. Presumably the juvenarium is of Lepidocyclina character.

Axial section: In this section the taxon could not be studied by the present author.

P h y l o g e n e t i c p o s i t i o n (text-fig. 32): On the basis of the first findings *Asterocyclina kecskemetii* can be derived from *A. stella taramellii*. The specimens from Horsarrieu already show a certain similarity both in the external (rosette) and internal features with the primitive *A. kecskemetii* (Saint-Barthélémy, Angoumé) (see also "Phylogenetic position" at *A. stella*, too).

Because of the scarce available material no evolutional stages (subspecies) within the species can be distinguished at present. In spite of this fact probably the *A. kecskemetii* is one of the most rapidly developing Asterocyclina species, and this evolulion is detectable especially in the rapid growth of the embryon. On the basis of richer material even four subspecies might be distinguished, separated by the 160, 200 and 250 μm dividing lines as far as $\bar{D}$ is concerned (see test-figs. 32k, l, m and n respectively). Similarly, evolution is observable in the increase of $\bar{R}$, $\bar{Q}$, $\bar{P}$ and in the decrease of $\bar{E}$, respectively.

A. kecskemetii is one of the most specialized species of its genus, the descendants of which are still unknown.

Retrospection: The introduction of the new name for marking the above described forms became necessary, since, on the one hand, SCHLUMBERGER's (1904) and NEUMANN's (1958) "stella" name refer to forms with different internal morphology (the internal morphology on the figures given in the synonymic list cannot be taken as certain, hence the conditional inclusion).

On the other hand KECSKEMÉTI's (1959) "variecostata" name, in GÜMBEL's (1868) original interpretation, refers to ribbed Discocyclinae (the figure cited in the synonymic list is shown in the present work, too, on pl. XLII, fig. 3).

Variability: On the basis of the data, available so far, both the internal and the external features of this species (not disregarding the intraspecific evolution) are relatively constant.

Comparison: Among the asteroidal forms of similar type and similar-sized embryon the adauxiliary chambers of *Asterocyclina stellata stellata* and *A. stellata stellaris* are of the "stellata" type, their rosettes are of the "marthae" type.

The rosettes of *A. stella taramellii*, *A. priabonensis*, *A. stella stella* and *A. stella praestellaris* are also of the "marthae" type.

The adauxiliary chambers of *A. alticostata gallica*, *A. alticostata cuvillieri* and *A. alticostata alticostata* are of the "alticostata" type, their equatorial chambers are wider.

Range: The Lutetian and Bartonian.

SW Aquitaine (Saint-Barthélémy, Angoumé, Cauneille and probably Daguerre), S and N Bakony (the surroundings of Ajka — samples CS, J 7 are from our own sampling, sample "Köleskepe 2" is from T. KECSKEMÉTI's sampling; the surroundings of Dudar — sample DS).

Asterocyclina alticostata (NUTTALL), 1926

Diagnosis: In the majority of the cases medium-sized, flattened asteroidal forms with 5 to 10 rays and with interray areas. "Chudeaui" type rosette. The embryon is isolepidine (sometimes semi-isolepidine), the two chambers are medium-sized. The adauxiliary chambers are of "alticostata" character (at the most primitive forms they can be of transitional "alticostata—varians" type), very wide and medium high. They are very low in numbers. The cycles of the equatorial chambers are asteroidal. From the embryon 5, sometimes 6, definite rays start. A bit farther from the embryon new rays may appear among the initial ones. In the interray space the chambers are wide and relatively high. The growth pattern of the annuli is of the transitional "strophiolata—varians" type.

Description:

External morphology: Medium- or rarely small-sized (2 to 8 mm), flattened or slightly inflate asteroidal forms with 5 to 10 rather definite rays, with or rarely without interray areas. The umbo of varying size is well-defined. "Chudeaui" type rosette. The polygonal granules are the coarsest on the umbo (50 to 80 μm in diameter), finer on the rays and especially fine on the interray surface. Each granule is surrounded by 5 to 7 lateral chambers the size of which are of the same size or bigger than the granule. Small difference in size between forms "A" and "B" is detectable only in case of the most developed forms.

Internal morphology:

The equatorial section of forms "B": The juvenarium is of Lepidocyclina character. I = 18—20 μm, S = 7—8, s = 75—90 μm, J = 15—27, j = 700—1200 μm. The fully developed equatorial chambers do not differ from those of forms "A" but the number of rays starting from the juvenarium is lower (4 to 6).

Axial section: Lacking own preparation, on the basis of NEUMANN's (1958, pl. 31, figs. 5, 7—8, pl. 32, fig. 5) and SEN GUPTA's (1963b, pl. 8, figs. 1, 3—4) data, the embryon is 180 to 250 μm high. The equatorial layer is 50 to 60 μm thick near the embryon, it thickens to 70 to 100 μm in the interray space, whereas in the rays, the equatorial layer having been divided into more layers, the thickness may amount even to 600 μm. The lateral septum is thick, the annular one is arcuate. The lateral chambers are 100×30 μm big on the average.

Phylogenetic position (text-fig. 32): On the basis of FERMONT's (1982) data, after the nomenclatural reinterpretation, *Asterocyclina alticostata* can probably be derived from *A. stella taramellii* since it appears after the former species and as far as the "alticostata" type adauxiliary chambers are concerned their emergence is observable on FERMONT's (1982, pl. 6, figs. 1—6) forms from Israel.

We distinguished 4 stages of evolution (subspecies) within the species using the following biometric limits:

Asterocyclina alticostata gallica (text-figs. 32o—p):	$\bar{D} < 220$ µm
Asterocyclina alticostata cuvillieri (text-fig. 32q):	$\bar{D} = 220-280$ µm
Asterocyclina alticostata alticostata (text-fig. 32r):	$\bar{D} = 280-360$ µm
Asterocyclina alticostata danubica (text-fig. 32s):	$\bar{D} > 360$ µm

On the basis of FERMONT's (1982) material from Israel the distinction of a further subspecies may be possible provided that the dividing line between the predomination of the transitional "alticostata—varians" type adauxiliary chambers and that of the clear "alticostata" type adauxiliary chambers can be marked out in the Ein Avedat section (see also text-figs. 32o and p).

Similarly to $\bar{D}$, evolution is observable in the increase of $\bar{P}$, $\bar{N}$, $\bar{H}$ and in the decrease of $\bar{n}_{0.5}$.

The collateral descendant of the species, after FERMONT (1982) is *A. schweighauseri*, that can be derived from *A. alticostata gallica* (see the discussion of *A. schweighauseri*).

R e t r o s p e c t i o n : From the 7 names used in the literature for marking the species two, namely, "alticostata" and "cuvillieri" can be used. The first one has priority while the second one can be used on the subspecies level.

Names like "stella", "stellaris" and "priabonensis" refer to forms with different internal morphology while "pentagonalis" and "suruaensis" ("soeroeaensis") for various reasons cannot be used (see the explanation at the end).

V a r i a b i l i t y : The changeability of the exterior was already dealt with in the description.

In the qualitative features of the inner morphology only the less advanced forms of subspecies "gallica" show occasional changeability in the "alticostata—varians" intermediate adauxiliary chambers, otherwise, the species is easy to identify. In spite of this two specimens bearing abnormal marks were found, so, for a certain extent, they can be misleading.

In the case of KECSKEMÉTI's (1959, pl. 5, fig. 12, text-fig. 28) specimen, described as *Asterocyclina stella* two deuteroconch belong to one protoconch (see also pl. XLIV, fig. 9). In the cited work the protoconch must have been wrongly retouched.

The number of the adauxiliary chambers (18) of the specimen on pl. XLV, fig. 7 is abnormal. It is due to the division of the original "alticostata" type chambers into smaller chamberlets. Since this phenomenon was experienced only in the case of this specimen, the distinction of a new species is not justified.

R a n g e : From the middle part of the Cuisian to the middle part of the Priabonian.

Asterocyclina alticostata (NUTTALL), 1926 gallica n. ssp.

Pl. XLIII, figs. 9—12, pl. XLIV, figs. 1—2, text-figs. 32o—p

partim 1940. *Discocyclina (Isodiscodina) pentagonalis* (SCHAFHÄUTL) — WEIJDEN, pp. 38—39, pl. 5, fig. 1
1982. *Asterocyclina cuvillieri* (NEUMANN) — FERMONT, p. 133, table 4 (partim — sample Is 276 ??), pl. 6, figs. 1—6

D e r i v a t i o n o m i n i s : The subspecies is named after Latin name of the country (Gallia) that includes the type locality of the taxon.
H o l o t y p e : Preparation E 5015, pl. XLIII, fig. 12.
T y p e l o c a l i t y : Nousse (SW Aquitaine) — Crouts.
T y p e l e v e l : The middle part of the Lutetian.
D i a g n o s i s : *Asterocyclina alticostata* populations with $\bar{D}$ less than 220 µm.

D e s c r i p t i o n :

External morphology: Small- and medium-sized (2 to 4 mm), slightly inflate asteroidal forms with 5 or 6 rays, with, or rarely without interray areas. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-figs. 32o—p):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: iso (semi-iso)	$Q = 1.10-1.38$	*t:* alticostata (alticostata—varians)	*s.c.:* asteroidal with five (six) strong rays starting from the embryon
$E = 1.25-1.65$	$\bar{Q} = 1.15-1.35$	$N = 2-9$	*g.p.:* strophiolata
$\bar{E} = 1.20-1.50$	$P = 125-177$ µm	$\bar{N} = 2.0-7.0$	$l = 30-40$ µm
$R = 0.11-0.37$	$\bar{P} = 120-180$ µm	$L = 60-220$ µm	$h = 40-85$ µm
$\bar{R} = 0.20-0.40$	$D = 140-245$ µm	$H = 30-50$ µm	$n_{0.5} = 11.2-20.0$
	$\bar{D} = 160-220$ µm	$\bar{H} = 35-50$ µm	$\bar{n}_{0.5} = 11.0-18.0$
			$n_{1.0} = 22.5-35.0$

Retrospection: For all forms included in the synonymic list $\bar{D}$ (or D in the case of WEIJDEN 1940) is less than 220 µm.

Among the denominations used for marking the above described forms, "cuvillieri" refer to forms with more developed internal morphology whereas "pentagonalis" may not be used at all (see the explanation at the end). Thus the new name had to be introduced.

Comparison: None of the Asterocyclinae of similar-sized embryon has "alticostata" type adauxiliary chambers.

Range: From the middle part of the Cuisian to the top of the middle part of the Lutetian.

SW Aquitaine (Gibret, Nousse, Biarritz — rocher de Peyreblanque), Israel (the lower part of the Ein Avedat section).

Asterocyclina alticostata (NUTTALL), 1926 **cuvillieri** (NEUMANN), 1958

Pl. XLIV, figs. 3—9, text-fig. 32q

1934. *Asterocyclina* aff. *pentagonalis* (SCHAFHÄUTL) — CAUDRI, pp. 97—99, pl. 3, figs. 1—9

partim 1940. *Discocyclina (Isodiscodina) pentagonalis* (SCHAFHÄUTL) — WEIJDEN, pp. 38—39, pl. 4, fig. 7

1958. *Asterodiscus cuvillieri* n. sp. — NEUMANN, pp. 119—121, pl. 31, figs. 1—8, pl. 32, fig. 5, text-fig. 40

1959. *Asterocyclina stella* (GÜMBEL) — KECSKEMÉTI, pp. 70—71, pl. 5, figs. 9(?), 12, text-fig. 28

1963b. *Asterocyclina alticostata* (NUTTALL) — SEN GUPTA, pp. 96—98, pl. 8, figs. 1—8, text-fig. 2

non 1967. *Asterocyclina cuvillieri* (NEUMANN) — KÖHLER (=*Asterocyclina alticostata alticostata* et *A. alticostata danubica*)

1981a. *Asterocyclina alticostata* (NUTTALL) — LESS, pl. 2, figs. 2, 4

non 1982. *Asterocyclina cuvillieri* (NEUMANN) — FERMONT (=*Asterocyclina alticostata gallica*)

Holotype: Not given by the author of the taxon.
Lectotype: NEUMANN (1958), pl. 31, figs. 3—4, presumable depository: Université Paris (marked out by the present writer).
Type locality: Bidart (SW Aquitaine) — ravin de Béhéréco.
Type level: "Auversien" (in the present writer's opinion the upper part of the Lutetian).
Diagnosis: *Asterocyclina alticostata* populations with $\bar{D}$ ranging from 220 to 280 µm.

Description:

External morphology: Small- and medium-sized (2 to 5 mm) slightly inflate asteroidal forms generally with 5 to 8 rays, with or rarely without interray areas. "Chudeaui" type rosette. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 32q):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: iso (semi-iso)	$Q=1.00-1.58$	t: alticostata	*s.c.*: asteroidal with 5 (6)
$E=1.23-2.03$	$\bar{Q}=1.05-1.35$	$N=2-4$	strong rays that
$\bar{E}=1.30-1.70$	$P=158-232$ µm	$\bar{N}=2.0-3.4$	starts from the em-
$R=0.15-0.38$	$\bar{P}=180-220$ µm	$L=110-260$ µm	bryon
$\bar{R}=0.10-0.30$	$D=172-300$ µm	$H=30-60$ µm	*g.p.*: strophiolata
	$\bar{D}=220-280$ µm	$\bar{H}=40-55$ µm	$l=30-45$ µm
			$h=50-130$ µm
			$n_{0.5}=10.0-15.0$
			$\bar{n}_{0.5}=11.0-14.5$
			$n_{1.0}=19.5-26.0$

Remarks: Between the rays starting from the embryon, a bit farther on new ones may evolve.

Retrospection: For all forms included in the synonymic list D or $\bar{D}$ is between 220 and 280 µm.

NEUMANN (1958), the first describer, gave proper depiction of the taxon's internal morphology, the given scale of enlargement cannot be correct, since no European Orthophragminae has 60 to 80 µm wide equatorial chambers. For this reason the original scale was doubled and the given dimensions were halved while examining "cuvillieri". So D of the specimens from the type locality can be put to about 240 µm.

Comparison: Only the most primitive forms of *Asterocyclina schweighauseri* may have similar type and similar-sized embryon and adauxiliary chambers. From these embryons, however, 6 or 7 rays start, compared to 5, that is generally characteristic of the discussed taxon. Owing to the difference in stratigraphic level the accompanying fauna is different.

Range: The upper part of the Lutetian and the lower part of the Bartonian.

SW Aquitaine (Angoumé, Bidart — Béhéréco), S Bakony (the surroundings of Ajka, samples Ba 3, 5—6, Kö 2, 4, Sz 6, 8 and CS are from our own sampling; samples "Köleskepe-2" and "Gyűr-hegy" are from that of T. KECSKEMÉTI), W India (NW Cutch — Lakhpat, Baiawa), Indonesia (Soemba Island).

Asterocyclina alticostata alticostata (Nuttall), 1926

Pl. XLIV. figs. 10–11, pl. XLV, figs. 1–3, text-fig. 32r

1926. *Actinocyclina alticostata* n. sp. — Nuttall, p. 151, pl. 8, figs. 6–8
1934. *Orthocyclina suruaensis* Vlerk — Henrici, p. 48, pl. 4, fig. 8
non 1963b. *Asterocyclina alticostata* (Nuttall) — Sen Gupta (= *Asterocyclina alticostata cuvillieri*)
partim 1967. *Asterocyclina cuvillieri* (Neumann) — Köhler, pp. 79, 83, pl. 15, fig. 5
non 1981a. *Asterocyclina alticostata* (Nuttall) — Less (= *Asterocyclina alticostata cuvillieri*)

Holotype: Nuttall (1926), pl. 8, fig. 8, depository: Sedgwick Museum (Cambridge) — external form.
Tpe locality: West of Lakhmirani (Cutch, W India) — the lower part of the middle Khirthar series.
Type level: Upper Lutetian substage (in the present writer's opinion the upper part of the Bartonian).
The type of the equatorial section of forms "A": Nuttall (1926), pl. 8, fig. 6, further data are the same as that of the holotype.
Diagnosis: *Asterocyclina alticostata* populations with $\bar{D}$ ranging from 280 to 360 μm.

Description:

External morphology (Plate XLIV, figs. 10–11): Medium-sized (4 to 7 mm), mostly flattened, asteroidal forms generally with 5 to 8 rays and with interray areas. The rosette is of the "chudeaui" type. There may be a small difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-fig. 32r):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: iso (semi-iso)	$Q = 1.00-1.34$	*t:* alticostata	*s.c.:* asteroidal, with 5 or 6 strong rays starting from the embryon
$E = 1.00-1.60$	$\bar{Q} = 1.10-1.30$	$N = 2-6$	
$\bar{E} = 1.15-1.50$	$P = 224-326$ μm	$\bar{N} = 3.0-4.5$	
$R = 0.17-0.50$	$\bar{P} = 220-300$ μm	$L = 100-350$ μm	
$\bar{R} = 0.20-0.40$	$D = 265-392$ μm	$H = 45-80$ μm	*g.p.:* strophiolata–varians
	$\bar{D} = 280-360$ μm	$\bar{H} = 50-60$ μm	$l. = 35-45$ μm
			$h = 50-120$ μm
			$n_{0.5} = 7.5-15.5$
			$\bar{n}_{0.5} = 9.0-12.0$
			$n_{1.0} = 16.5-25.0$

Remarks: Between the rays starting from the embryon, a bit farther on other rays may evolve.

Retrospection: Nuttall (1926), the first describer, gave a proper depiction of the taxon (according to pl. 8, fig. 6. D equals 351 μm) but on the basis of the exterior he identified it as Actinocyclina.

This misinterpretation was corrected by Sen Gupta (1963b) but the specimens he examined were not coming from the type locality but from its neighbourhood, besides, these forms presumably represent a lower stratigraphic level, since their D equals 225 μm, and on this basis they cannot be included in the synonymic list of subspecies "alticostata".

Henrici's (1934) and Köhler's (1967) forms were assigned to the taxon on the basis of their embryon size.

Comparison: Only the less advanced *Asterocyclina schweighauseri* is of similar type and similar-sized embryon and adauxiliary chambers. From the embryon of these forms, however, 6 to 8 rays start. Due to the difference in stratigraphic level the accompanying fauna is totally different.

Range: The middle and upper parts of the Bartonian stage.

SW Aquitaine (Cauneille), NW Slovakia (the surroundings of Rajec — Konská—Stráň), N Bakony (the surroundings of Dudar — samples D 1, 3, 7, DS 3, 5 and DS), W India (NW Cutch — Lakhmirani), Indonesia (Timor).

Asterocyclina alticostata (Nuttall), 1926 **danubica** n. ssp.

Pl. XLV, figs. 4–11, text-fig. 32s

partim 1916. *Orthophragmina priabonensis* (Gümbel) — Checchia-Rispoli, pl. 4, fig. 8
partim 1940. *Discocyclina (Discocyclina) stellaris* (Brünner) — Weijden, pp. 53–54, pl. 8, fig. 8
partim 1967. *Asterocyclina cuvillieri* (Neumann) — Köhler, pp. 79, 83, pl. 15, fig. 6

Derivatio nominis: Named after the river Danube the type locality being close to it.
Holotype: Preparation E 5027, pl. XLV, fig. 5.
Type locality: Lábatlan, József-puszta, sample R 1.
Type level: The middle part of the Priabonian.
Diagnosis: *Asterocyclina alticostata* populations with $\bar{D}$ bigger than 360 μm.

D e s c r i p t i o n :

External morphology: Medium-sized (4 to 8 mm), flattened asteroidal forms generally with 5 to 10 rays and with interray areas. "Chudeaui" type rosette. Forms "B" are 1.2 to 1.5 times the size of forms "A".

Internal morphology:

The equatorial section of forms "A" (text-fig. 32s):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: iso (semi-iso)	$Q = 0.96-1.54$	*t:* alticostata	*s.c.:* asteroidal, with 5 to 7 strong rays starting from the embryon
$E = 1.13-1.85$	$\bar{Q} = 1.15-1.35$	$N = 2-6$	*g.p.:* varians
$\bar{E} = 1.20-1.50$	$P = 269-414$ µm	$\bar{N} = 3-5$	$l = 35-45$ µm
$R = 0.13-0.42$	$\bar{P} = 300-380$ µm	$L = 70-350$ µm	$h = 70-155$ µm
$\bar{R} = 0.20-0.40$	$D = 316-567$ µm	$H = 50-90$ µm	$n_{0.5} = 8.0-12.2$
	$\bar{D} = 360-450$ µm	$\bar{H} = 55-70$ µm	$\bar{n}_{0.5} = 9.5-11.0$
			$n_{1.0} = 17.2-22.0$

R e m a r k s : Between the rays starting from the embryon, a bit farther on new ones may evolve.

R e t r o s p e c t i o n : The forms with D exceeding 360 µm were included in the synonymic list. Among the names used for marking these forms "stellaris", "priabonensis" and "cuvillieri" refer to forms with other than the above described internal morphology.

Since there was no usable name left a new name had to introduced.

C o m p a r i s o n : Only the most advanced *Asterocyclina schweighauseri* have similar-type and similar-sized embryon and adauxiliary chambers. From the embryon of these forms however 6 to 8 rays start. Also the stratigraphic level is rather different, consequently the accompanying fauna is totally different.

R a n g e : The lower and middle parts of the Priabonian stage.

SW Aquitaine (Biarritz — presumably Côte des Basques), S Italy (Madonie), NW Slovakia (the surroundings of Martin — Turčianska Belá), E Gerecse (the surroundings of Lábatlan — samples R 1—2, RA, RB, RF, RK and BN).

Asterocyclina schweighauseri n. sp.

Pl. XLIII, figs. 1—8, text-figs. 32t—v

1982. *Asterocyclina* sp. — Fermont, pp. 133—134, table 4 (partim), pl. 7, figs. 1—2

D e r i v a t i o n o m i n i s : Named in honour of Jakob Schweighauser Swiss expert of Orthophragminae
H o l o t y p e : Preparation E 5014, pl. XLIII, fig. 6.
T y p e l o c a l i t y : Montfort (SW Aquitaine) — Fontaine de la Médaille.
T y p e l e v e l : The middle part of the Lutetian.
D i a g n o s i s : Medium-sized, moderately inflate, asteroidal forms with 6 to 8 rays, generally with no interray areas. "Chudeaui" type rosette. The embryon is semi-iso—isolepidine, the two chambers are medium-sized. The adauxiliary chambers are of the "alticostata" or probably of the transitional "varians—alticostata" type, very wide, medium high and very low in numbers. The cycles of the equatorial chambers are asteroidal with 6 to 8 definite rays. In the interray space the chambers are wide and medium high. The growth pattern of the annuli is of the transitional "varians—strophiolata" type.

D e s c r i p t i o n :

External morphology: Medium-sized (2.5 to 6 mm), slightly inflate asteroidal forms with 6 to 8 not too definite rays, and generally with no interray areas. "Chudeaui" type rosette. The granules are the largest at the centre (60 to 100 µm in diameter) and finer on the rays. Each granule is surrounded by 5 to 7 lateral chambers, the size of which is the same or bigger as that of the granule. There is no difference in size between forms "A" and "B".

Internal morphology:

The equatorial section of forms "A" (text-figs. 32t—v):

Embryon:		Adauxiliary chambers:	Equatorial chambers:
t: semi-iso—iso	$Q = 1.22-1.48$	*t:* alticostata (alticostata —varians)	*s.c.:* asteroidal with 6 to 8 strong rays
$E = 0.91-1.36$	$\bar{Q} = 1.20-1.50$	$N = 3-11$	*g.p.:* varians—strophiolata
$\bar{E} = 1.00-1.35$	$P = 179-323$ µm	$\bar{N} = 3-11$	$l = 40-50$ µm
$R = 0.22-0.60$	$\bar{P} = 175-350$ µm	$L = 50-220$ µm	$h = 50-70$ µm
$\bar{R} = 0.25-0.50$	$D = 265-465$ µm	$H = 50-70$ µm	$n_{0.5} = 8.9-12.2$
	$\bar{D} = 250-500$ µm	$\bar{H} = 45-70$ µm	$\bar{n}_{0.5} = 8.0-13.0$
			$n_{1.0}$ is unknown

The equatorial section of forms "B": The juvenarium of the only known microspheric specimen is of Lepidocyclina character. I=18 μm, S=12, s=95 μm, J=16, j=800 μm. The fully developed equatorial chambers do not differ from those of forms "A".

Axial section: In this section the taxon could not be examined.

Phylogenetic position (text-fig. 32): According to FERMONT's (1982) data with regard to the nomenclatural reinterpretation *Asterocyclina schweighauseri* can be derived from *A. alticostata gallica* from which it is different in the tendentiously larger size of the embryon in the faster (and shorter at the same time) course of evolution, and in the bigger number of its rays. The fact, that the most primitive forms (*A. alticostata gallica* from Israel from the middle part of the Cuisian and *A. schweighauseri* from Saint-Barthélémy from the lower part of the Lutetian) of both taxa may have "alticostata—varians" transitional type adauxiliary chambers, also speaks for the above origin.

To mark out the course of evolution, and to distinguish stages within the species is not yet actual due to the scarce material. The only fact is that the embryon rapidly grows in size during the existence of the species (see text-figs. 32t, u and v, respectively).

The offsprings of the species are not known. In all probability the species became extinct without offsprings at about the end of the Lutetian stage.

Retrospection: Forms with the above characteristics were described only by FERMONT (1982), referred to as *Asterocyclina* sp., i.e. the new species had to be segregated.

Variability: The most important is the changing of the type of the adauxiliary chambers in the course of evolution, since there is a specimen with transitional "alticostata—varians" type adauxiliary chambers among the most primitive forms from Saint-Barthélémy. To find other difference was not possible because of the insufficient material.

Comparison: Because of the type and size of its embryon and adauxiliary chambers this species can only be confused with the various subspecies of *Asterocyclina alticostata.*

A remarkable difference is that generally 5 rays start from the embryon of *A. alticostata* whereas *A. schweighauseri* has more. Forms of the two species with equal-sized embryon occur in different periods, that is, *A. alticostata* is 1 to 3 substages behind *A. schweighauseri* in the evolution, so the accompanying Orthophragmina fauna is always different.

Range: According to the data available up to now the lower and middle part of the Lutetian. SW Aquitaine (Saint-Barthélémy, Caupenne — Ferme Jean Gazé, Montfort), Israel (Ein Avedat section).

REMARKS CONCERNING THE ABOLISHED DENOMINATIONS

Abolished denominations in the synonymic lists of valid taxa

"andrusovi"

1948. *Discocyclina andrusovi* n. sp. — CIZANCOURT, pp. 52—54, pl. 7, fig. 15, pl. 8. fig. 21, pl. 11, figs. 22, 26, 29) (=?)
1953. *Discocyclina andrusovi* CIZANCOURT — SCHWEIGHAUSER (=*Orbitoclypeus varians scalaris*)
partim 1974. *Discocyclina andrusovi* CIZANCOURT — PORTNAYA (=*Discocyclina archiaci staroseliensis*)

By CIZANCOURT (1948), the describer of the species, no proper depiction were published on the internal morphology. As no one has examined topotypical specimens from Bojnice (Central Slovakia) since then, it cannot be determined what CIZANCOURT's (1948) species really is. This uncertainty is reflected by later descriptions and depictions as well.

"applanata"

1868. *Orbitoides (Discocyclina) applanata* n. sp. — GÜMBEL (=?*Discocyclina augustae augustae*)
1912. *Orthophragmina applanata* (GÜMBEL) — PREVER (=*Discocyclina augustae augustae*)
1978. *Discocyclina applanata* GÜMBEL — SIROTTI (=*Discocyclina augustae augustae*)
1981a. *Discocyclina applanata* GÜMBEL — LESS (=*Discocyclina augustae augustae*)
1983. *Discocyclina* I. cf. *D. applanata* GÜMBEL — SETIAWAN (=*Discocyclina augustae augustae*)

GÜMBEL's (1868), i.e. the describer's figures offer no sufficient information on the internal morphology. PREVER (1912) was the first whose good quality figures on the species could be identified, his specimens however are not topotypical. 66 years later it was SIROTTI (1978) and later SETIAWAN (1983) who described and depicted topotypical specimens from Priabona. In our opinion, GÜMBEL's (1868) "applanata" was correctly identified with WEIJDEN's (1940) "augustae" and the latter name became so widely used in the literature of Orthophragminae that we abolish it for the sake of a denomination that was not used for 66 years and was practically forgotten.

"apula"

1913. *Orthophragmina apula* n. sp. — CHECCHIA-RISPOLI (=*Orbitoclypeus varians scalaris*)

On the basis of the poor quality figures given by CHECCHIA-RISPOLI (1913), the describer the above identification could not be carried out. Besides, this is a junior synonym and it is a forgotten one as it has not been used since then.

"aspera"

1868. *Orbitoides (Discocyclina) aspera* n. sp. — GÜMBEL, pp. 698—700, pl. 3, figs. 13—14, 33—34(= ?)
1917. *Orthophragmina aspera* (GÜMBEL) — CHECCHIA-RISPOLI (*= Orbitoclypeus varians scalaris)*
1934. *Orthophragmina aspera* (GÜMBEL) — REINA *(= Orbitoclypeus varians varians)*
partim 1953. *Discocyclina aspera* GÜMBEL — SCHWEIGHAUSER *(= Orbitoclypeus varians roberti)*
1959. *Discocyclina aspera* GÜMBEL — KECSKEMÉTI *(= Orbitoclypeus varians roberti)*
partim 1974. *Discocyclina aspera* GÜMBEL — PORTNAYA *(= Discocyclina archiaci staroseliensis)*
1978. *Discocyclina* cf. *aspera* GÜMBEL — SIROTTI *(= Discocyclina dispansa umbilicata)*
1980. *Discocyclina aspera* GÜMBEL — GROSS, KÖHLER et al. *(= Orbitoclypeus varians roberti)*

The figures given by GÜMBEL (1868), the describer no sufficient information with respect to the internal morphology. Since then no usable figures about topotypical specimens from Hammer (Bavaria) or from Biarritz, showing the main characters of the interior, were published, consequently it is not known what GÜMBEL's (1868) species really is. This uncertainty is reflected by later descriptions and depictions as well.

"assamica"

1963b. *Discocyclina assamica* n. sp. — SAMANTA *(= Discocyclina euaensis)*
1965b. *Discocyclina assamica* SAMANTA — SAMANTA *(= Discocyclina euaensis)*

SAMANTA (1963b) gave proper depiction of the taxon's internal morphology, however, he disregarded the forms with internal morphology were already published earlier from the Tonga Islands by WHIPPLE (1932). So this denomination has to be ruled out as a later synonym.

"baluchistanensis"

1925. *Discocyclina archiaci (*SCHLUMBERGER*)* var. *baluchistanensis* n. var. — NUTTALL *(= ?Discocyclina fortisi simferopolensis)*

NUTTALL (1925), the describer of the species, morphology was illustrated by a schematic drawing of the embryon on which not even the position of the protoconch in the deuteroconch is shown. The above temporary identification was carried out merely on the basis of the size and shape of the deuteroconch. Since then nobody has dealt with the taxon. Because of the insufficient description and depiction it seems expedient to abolish this denomination.

"canavarii"

1908. *Orbitoides (Orthophragmina) canavarii* n. sp. — CHECCHIA-RISPOLI *(= Discocyclina pratti pratti)*
1909a. *Orthophragmina canavarii* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI (*= Discocyclina pratti pratti)*
1911a. *Orthophragmina canavarii* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI *(= Discocyclina pratti pratti)*

CHECCHIA-RISPOLI (1909a, 1911a), the describer of the species gave a proper depiction on the internal morphology on the basis of which the above identification could be carried out. These figures are far earlier than the first good quality figures on the internal morphology of *Discocyclina pratti pratti* (WEIJDEN, 1940). What is conclusive, however, in the case is that the "pratti" name that is sufficiently identified, takes priority and it is very widely used, as compared to the "canavarii" name that has been out of use for the past 75 years.

"decorata"

1904. *Orthophragmina decorata* n. sp. — SCHLUMBERGER *(= Orbitoclypeus bayani)*
1922. *Asterodiscus decoratus* (SCHLUMBERGER) — DOUVILLÉ *(= Orbitoclypeus bayani)*
1929. *Asterodiscus decoratus* (SCHLUMBERGER) — LLUECA *(= Orbitoclypeus bayani)*
1940. *Discocyclina decorata* (SCHLUMBERGER) — WEIJDEN *(= Orbitoclypeus bayani)*

The species was described by SCHLUMBERGER (1904) from Sainte-Colombe but no information was given on the internal morphology. SCHLUMBERGER's (1904) depiction and description were simply repeated by the other 3 authors listed above. Since NEUMANN (1955, 1958) as well as ourselves had examined forms of similar external morphology from the Xanthopsis beds of Aquitaine (that includes the taxon's type locality as well) occasion was given for the identification. In our opinion the name that can be used for marking these forms is "bayani", since it was earlier distinguished and also the internal morphology is known. So the "decorata" name as a synonym can be ruled out.

"distefanoi"

1906. *Orthophragmina di-stefanoi* n. sp. — CHECCHIA-RISPOLI, pp. 326—327(= ?)
1909a. *Orthophragmina di-stefanoi* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI *(=Orbitoclypeus varians scalaris)*
1911b. *Orthophragmina di-stefanoi* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI *(= Orbitoclypeus varians roberti)*
1916. *Orthophragmina di-stefanoi* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI *(= ?Discocyclina dispansa hungarica)*

Checchia-Rispoli's (1909a, 1911b, 1916), the describer's poor quality depictions on the internal morphology as it is observable in the above list are ambiguous. In these depictions the convexity, used as the criterion of the distinction is common. This feature, however, is not suitable for separatly different taxa in our opinion. In addition, this name has not been really used since 1916, so practically it has been forgotten.

"dubia"

1908. *Orbitoides (Orthophragmina) dubia* n. sp. — Checchia-Rispoli, p. 6(= ?)
partim 1909a. *Orthophragmina dubia* Checchia-Rispoli — Checchia-Rispoli *(= ?Asterocyclina stellata stellata)*
1911b. *Orthophragmina* cfr. *dubia* Checchia-Rispoli — Checchia-Rispoli *(= Orbitoclypeus varians roberti)*

Similarly to the previous case the depictions of rather poor quality showing the internal morphology are contradictory. This name, too, can be regarded as a forgotten one because it has not been used since 1911 and in addition it is a later synonym.

"eamesi"

1963a. *Discocyclina (Discocyclina) eamesi* n. sp. — Samanta *(= Discocyclina augustae augustae)*
1965b. *Discocyclina eamesi* Samanta — Samanta *(= Discocyclina augustae augustae)*

This denomination is a later synonym of "augustae", since Samanta's (1963b, 1965b) figures of the internal morphology shows, beyond question, the rightness of this identification. On one of these figures (Samanta, 1963b, pl. 95, fig. 3) two deuteroconch belong to the protoconch of the specimen, so its embryon looks umbilico—polylepidine.

"ephippium"

1820. *Lenticulites ephippium* n. sp. — Schlotheim, p. 89. (= ?)
1840. *Lycophris ephippium* (Schlotheim) — Sowerby *(= Discocyclina discus discus)*
1892. *Orbitoides ephippium* (Schlotheim) var. *javana* n. var. — Verbeek *(= Discocyclina javana)*
1896. *Orbitoides ephippium* (Schlotheim) var. *javana* Verbeek — Verbeek—Fennema *(= Discocyclina javana)*
partim 1912. *Orthophragmina ephippium* (Schlotheim) — Prever *(= Discocyclina dispansa sella)*
1953. *Discocyclina ephippium* (Schlotheim) — Schweighauser, p. 65, text-fig. 29 (= Discocyclina indet. sp. B)

The description given by Schlotheim (1820), the denominator was very short and no figure was published at all. Since then no one has published figures on the internal morphology of topotypical Bavarian specimens. I.e. it is not known what Schlotheim's (1820) species really is. This uncertainty is also reflected by later descriptions and depictions among which Sowerby's (1840) "ephippium" serves as the basis of the later "sowerbyi" species (see there).

"granulatocrassa"

1908. *Orthophragmina (Discocyclina) discus* (Rütimeyer) var. *granulatocrassa* n. var. — Heim *(= Discocyclina discus discus)*

This form was identified by Heim (1908), the describer of the variety, with Kaufmann's (1867) "discus", that serves as the basis of the "discus" description in the present work. This is the reason why the two forms could be identified. The different "discus" varieties, however, can be ruled out, since in our opinion these are not the varieties of "discus" but forms belonging to various species. It should be noted that although the different varieties denominations were mentioned, in reality, nobody has used them since Heim (1908).

"himerensis"

1907a. *Orbitoclypeus himerensis* n. sp. — Silvestri *(= Orbitoclypeus varians varians)*
1945b. *Orbitoclypeus himerensis* Silvestri — Brönnimann *(= Orbitoclypeus schopeni)*
1951. *Discocyclina (Orbitoclypeus) himerensis* Silvestri — Vialli *(= ?Orbitoclypeus ramaraoi crimensis)*

The form was described very briefly from Termini-Imerese by Silvestri (1907a). Later it was depicted by Laghi—Sirotti (1982). The above identification was carried out on the basis of the latter, so the species name can be regarded as a later synonym. At the same time, the Orbitoclypeus name can remain since this is the first name that can be used for marking non-asteroidal forms with hexagonal equatorial chambers.

"indopacifica"

1957. *Discocyclina (Discocyclina) indopacifica* n. sp. — Hanzawa *(= Discocyclina dispansa umbilicata)*

Hanzawa (1957) gave proper depiction of the taxon's internal morphology but disregarded the fact that forms with this sort of internal morphology were already published from New Caledonia by Deprat (1905). So the name should be ruled out as a later synonym.

"irregularis"

1926. *Orthophragmina (Discocyclina) irregularis* n. sp. — DONCIEUX *(=Discocyclina archiaci archiaci)*
1973. *Discocyclina irregularis* DONCIEUX — MASSIEUX *(=Discocyclina archiaci archiaci* et *D. furoni)*

DONCIEUX's (1926), the describer's drawings and MASSIEUX's (1973) figures showing the internal morphology of their topotypical specimens made the above identification possible. Consequently, this rarely used denomination has to be abolished as the later synonym is the much wider used "archiaci" name, which, in addition, ranks in priority.

"isseli"

1912. *Orthophragmina isseli* n. sp. — PREVER *(=Orbitoclypeus varians varians)*

Good quality figures were published by PREVER (1912), the describer of the species, on the internal morphology. The above identification was based on these figures. Accordingly, this taxon, no figures were published on its inner morphology since then, should be ruled out as a later synonym.

"laevicrassa"

partim 1908. *Orthophragmina (Discocyclina) discus* (RÜTIMEYER*)* var. *laevicrassa* n. var. — HEIM (=*?Discocyclina discus discus)*

The rather temporary identification above was made possible only by HEIM's (1908, pl. 8, fig. 26) figure that shows so wide equatorial chambers that they may be as well equatorial chambers of *Discocyclina discus discus*. The reason why the "laevicrassa" name was abolished is the same as that in the case of "granulatocrassa" (see there).

"llarenai"

1946. *Discocyclina roberti* DOUVILLÉ var. *llarenai* n. var. — RUIZ DE GAONA, p. 204, pl. 2, fig. 28. (= ?)
1953. *Discocyclina roberti* DOUVILLÉ var. *llarenai* RUIZ DE GAONA — SCHWEIGHAUSER (=*Orbitoclypeus varians roberti)*

Neither the first nor the other describers have published usable figures on the internal morphology of topotypical specimens. In spite of the fact that SCHWEIGHAUSER's (1953) figures could be identified this denomination is qualified as a later synonym.

"matanzensis"

1957. *Asterocyclina matanzensis* n. sp. — COLE, p. 350, pl. 117, figs. 6—10, pl. 118, figs. 9—18. (=*Asterocyclina matanzensis* — Pacific form, which is not discussed in the present work)
1965a. *Asterocyclina matanzensis* COLE — SAMANTA *(=?Asterocyclina stellata adourensis)*

On the basis of the figures published by COLE (1957), the first describer, this name belongs to the typical Pacific Asterocyclinae with 4 rays. In this sense the denomination can be used, but it cannot be used for marking SAMANTA's (1965a) Asterocyclinae from Assam, that are tipically European ones with 5 rays and "stellata" type adauxiliary chambers.

"molengraaffi"

1934. *Discocyclina molengraaffi* n. sp. — HENRICI *(=Discocyclina dispansa umbilicata)*

Owing to HENRICI's (1934), the describer's good quality figures from Timor showing the internal morphology of the taxon there is no doubt about the rightousness of the above indentification. Accordingly, this denomination as a later given synonym has to be ruled out.

"moluccana"

1934. *Orthocyclina moluccana* n. sp. — HENRICI *(=Discocyclina dispansa umbilicata)*

The reasons for its being a later synonym are the same as in the case of "molengraaffi". On the figure* showing the internal morphology we could not find the hexagonal equatorial chambers on the basis of which the assignment to "Orthocyclina" could be justified.

"munieri"

1904. *Orthophragmina munieri* n. sp. — SCHLUMBERGER *(=Orbitoclypeus bayani)*
1922. *Asterodiscus munieri* (SCHLUMBERGER) — DOUVILLÉ *(=Orbitoclypeus bayani)*
partim 1929. *Asterodiscus munieri* (SCHLUMBERGER*)* — LLUECA *(=Orbitoclypeus bayani)*
1940. *Discocyclina munieri (*SCHLUMBERGER) — WEIJDEN *(=Orbitoclypeus bayani)*
1955. *Actinocyclina munieri* (SCHLUMBERGER*)* — NEUMANN *(=Orbitoclypeus bayani)*
1974. *Actinocyclina munieri* (SCHLUMBERGER*)* — PORTNAYA *(=?Orbitoclypeus bayani)*

* HENRICI 1934, pl. 4, fig. 11.

The history of the denomination from SCHLUMBERGER (1904) to WEIJDEN (1940) is completely the same as that of "decorata". NEUMANN (1955) united the two species under the name of "munieri", also the internal morphology of specimens from the same Xanthopsis beds was depicted by her and it was also NEUMANN (1958) who changed the name of these forms to "patellaris". In our opinion the "bayani" name is the expedient one for marking these forms since it was distinguished earlier than "munieri" and the figures showing its internal morphology, too, were published earlier (so it ranks in priority compared to "munieri").

"nummulitica"

1861. *Hymenocyclus (?) nummuliticus* n. sp. — GÜMBEL, p. 653 (= ?)
1868. *Orbitoides (Rhipidocyclina) nummulitica* (GÜMBEL) — GÜMBEL, pp. 702—704, pl. 4, figs. 1—3, 17—18 (= ?)
1940. *Discocyclina (Eudiscodina) nummulitica* (GÜMBEL) — WEIJDEN *(= Orbitoclypeus varians varians)*
partim 1953. *Discocyclina nummulitica (*GÜMBEL*)* — SCHWEIGHAUSER *(= Orbitoclypeus varians scalaris)*
partim 1958. *Discocyclina nummulitica (*GÜMBEL*)* — NEUMANN *(= Orbitoclypeus varians scalaris)*
1959. *Discocyclina nummulitica (*GÜMBEL*)* — KECSKEMÉTI *(= Orbitoclypeus varians roberti)*
partim 1963. *Discocyclina nummulitica (*GÜMBEL*)* — BIEDA *(= Orbitoclypeus varians scalaris)*
1967. *Discocyclina nummulitica (*GÜMBEL*)* — KÖHLER *(= Orbitoclypeus varians scalaris* et *O. varians varians)*
partim 1970. *Discocyclina nummulitica (*GÜMBEL*)* — PAVIČ *(= ?Orbitoclypeus varians scalaris)*
partim 1973. *Discocyclina nummulitica (*GÜMBEL*)* — OLEMPSKA *(= Discocyclina augustae augustae)*
1974. *Discocyclina nummulitica (*GÜMBEL*)* — PORTNAYA *(= Discocyclina archiaci bakhchisaraiensis* et *D. archiaci staroseliensis)*
1980. *Discocyclina nummulitica* (GÜMBEL) — GROSS, KÖHLER et al. *(= Orbitoclypeus varians varians)*
1982. *Orbitoclypeus nummuliticus (*GÜMBEL) — LAGHI—SIROTTI *(= Orbitoclypeus varians varians)*

The first reference to the name (GÜMBEL 1861) is a "nomen nudum", since no description and no figures were given. The second reference, though it was accompanied by figures that give some information on the internal morphology, is unquestionably incorrect as far as the equatorial section's scale of enlargement is concerned.

Even if GÜMBEL's (1861, 1868) "nummulitica" is identical with KAUFMANN's (1867) "varians" (as it was supposed by GÜMBEL 1868, DOUVILLÉ 1922 and NEUMANN 1958 but not verified at all on topotypical specimens) for the above two reasons the name is at a priority disadvantages compared to "varians" (as the 1861 "nomen nudum" denomination cannot be accepted). On the other hand, KAUFMANN's (1867) figures are of higher quality and, in all probability, their scales of enlargement are correct.

Although the two names mark two distinct taxa as was supposed by SCHWEIGHAUSER (1953), SCHLUMBERGER (1903), WEIJDEN (1940), KECSKEMÉTI (1959), BIEDA (1963), KÖHLER (1967) and PORTNAYA (1974) none of the names in the identification can be replaced by "nummulitica" because these names are accompanied by satisfactory depictions from their own type localities unlike "nummulitica". On the basis of these it seems expedient to abolish this widely used but inproperly defined denomination.

"omphalus"

1875. *Orbitoides omphalus* n. sp. — FRITSCH, pp. 142—143, pl. 18, fig. 13, pl. 19, fig. 5 (= ?)
1957. *Discocyclina omphala* (FRITSCH) — COLE *(= Discocyclina dispansa umbilicata)*
1959. *Discocyclina omphala* (FRITSCH) — NAGAPPA *(= Discocyclina javana)*
1960. *Discocyclina (Discocyclina) omphala* (FRITSCH) — COLE *(= Discocyclina dispansa umbilicata)*
1964. *Discocyclina (Discocyclina) omphalus* (FRITSCH) — SAMANTA *(= Discocyclina javana* et *D. dispansa umbilicata)*
1965b. *Discocyclina omphalus* (FRITSCH) — SAMANTA *(= Discocyclina javana* et *D. dispansa sella)*

FRITSCH's (1875), the first describer's, figures do not give sufficient information on the internal morphology of the taxon. The interior of topotypical specimens from Borneo is not known up to this day, though according to COLE (1957), the internal morphology of the Borneo specimens, that were sent to H. DOUVILLÉ by DR. TOBLER and referred to as "omphalus", is identical with the internal morphology of "omphalus" from Saipan. This statement, since no figure is available, cannot be accepted. From the above identifications it is clear that the taxon was variously interpreted by different authors. For these reasons it is not advisable to use this name.

"papyracea"

1832. *Nummulites papyracea* n. sp. — BOUBÉE, p. 445. (= ?)
1892. *Orbitoides papyracea* (BOUBÉE) var. *javana* n. var. — VERBEEK *(= Discocyclina javana)*
1896. *Orbitoides papyracea* (BOUBÉE) var. *javana* VERBEEK — VERBEEK—FENNEMA *(= Discocyclina javana)*
1945b. *Discocyclina papyracea* (BOUBÉE) — BRÖNNIMANN *(= ?Discocyclina stratiemanuelis)*
1953. *Discocyclina* aff. *papyracea* (BOUBÉE) — SCHWEIGHAUSER [= *Discocyclina archiaci bartholomei* et D. indet. sp. B (pl. 9, fig. 6, text-figs. 28, 37.)]
partim 1959. *Discocyclina papyracea* (BOUBÉE) — KECSKEMÉTI *(= Discocyclina spliti ajkaensis)*
1983. Discocyclina (papyracea-group) — SETIAWAN *(= ?Discocyclina augustae augustae* et *?D. euaensis)*

BOUBÉE (1832), the denominator gave no satisfactory depiction on the internal morphology, besides, the type locality cannot be identified. In reality, according to NEUMANN (1958, pp. 76, 78), Cretaceous beds can be found in Boulogne (Haute-Garonne). From the above identifications it is clear that all the authors giving figures of any value showing the internal morphology differently interpreted this name. For these reasons this name is not possible to use.

"patellaris"

1820. *Asteriacites patellaris* n. sp. — SCHLOTHEIM, p. 76, pl. 12, fig. 6 (= ?)
partim 1904. *Orthophragmina patellaris* (SCHLOTHEIM) — SCHLUMBERGER *(=Orbitoclypeus furcata rovasendai)*
partim 1940. *Discocyclina (Discocyclina ?) patellaris* (SCHLOTHEIM) — WEIJDEN *(=Orbitoclypeus furcata rovasendai)*
1958. *Actinocyclina patellaris* (SCHLOTHEIM) — NEUMANN *(=Orbitoclypeus bayani)*
partim 1959. *Actinocyclina patellaris* (SCHLOTHEIM) — KECSKEMÉTI *(=Orbitoclypeus furcata rovasendai)*
1981a. *Orbitoclypeus patellaris* (SCHLOTHEIM) — LESS *(=Orbitoclypeus furcata rovasendai)*

SCHLOTHEIM (1820), the denominator, gave no information at all about the internal morphology of the taxon. The internal morphology of topotypical specimens from Bavaria is unknown to the present day. Consequently, opinions vary: which of the typical forms with bifurcating ribs can be marked with this name, those that are coming from the lower parts of the Eocene (DOUVILLÉ 1922, NEUMANN 1958) or those that are from the upper parts of the Eocene (SCHLUMBERGER 1904, KECSKEMÉTI 1959). In our opinion, for the first forms the "bayani" name is far better, since its internal morphology is known on the basis of topotypical specimens, whereas for the latter forms the "furcata" and "rovasendai" names can be used, in the usage of which duality, similar to that of "patellaris", was not experienced. For these reasons it seems expedient to abolish this name.

"pentagonalis"

1863. *Asterodiscus pentagonalis* n. sp. — SCHAFHÄUTL, p. 107, pl. 15, figs. 2a—d (= ?)
1905. *Orthophragmina pentagonalis* (SCHAFHÄUTL) — DEPRAT, pp. 507—508, pl. 18, figs. 24—25, pl. 19, fig. 27, text-fig. G [= *Asterocyclina penuria* COLE (pacific form)]
1934. *Asterocyclina* aff. *pentagonalis* (SCHAFHÄUTL) — CAUDRI *(=Asterocyclina alticostata cuvillieri)*
partim 1940. *Discocyclina (Isodiscodina) pentagonalis* (SCHAFHÄUTL) — WEIJDEN *(=Asterocyclina alticostata gallica* et *A. alticostata cuvillieri)*
1953. *Asterocyclina pentagonalis* (SCHAFHÄUTL) — SCHWEIGHAUSER *(=Asterocyclina stellata stellaris)*
partim 1959. *Asterocyclina pentagonalis* (SCHAFHÄUTL) — KECSKEMÉTI *(=Asterocyclina stellata stellata)*

SCHAFHÄUTL (1863), the denominator gave no sufficient information on the internal morphology of the taxon. The internal morphology of topotypical specimens from Bavaria are unknown to this very day. For this reason the above identifications of bibliographic data widely differ from each other, so this name is not expedient to use.

"ranikotensis"

1927. *Discocyclina ranikotensis* n. sp. — DAVIES *(=?Discocyclina archiaci bartholomei)*
1953. *Discocyclina ranikotensis* DAVIES — SCHWEIGHAUSER, p. 75, text-fig. 31 *(=Discocyclina indet.* sp. B)
1959. *Discocyclina ranikotensis* DAVIES — NAGAPPA *(=Discocyclina archiaci bakhchisaraiensis)*
partim 1967. *Discocyclina ranikotensis* DAVIES—KÖHLER *(=Discocyclina archiaci bartholomei)*

The figures by DAVIES (1927), the first describer's as well as those by NAGAPPA's (1959) on the topotypical specimen are of poor quality and they contradict each other. Even if we accept DAVIES's (1927), and later KÖHLER's (1967) interpretation, this name is qualified as the later synonym of "bartholomei".

"riojai"

1927. *Asterodiscus riojai* n. sp. — LLUECA, p. 424 (= ?)
1929. *Asterodiscus riojai* LLUECA — LLUECA, pp. 304—305, pl. 26, figs. 6—7 (= ?)
1959. *Asterocyclina riojai* (LLUECA) — KECSKEMÉTI *(=Orbitoclypeus furcata rovasendai)*

No figure on the inner morphology was published by LLUECA (1927, 1929), the describer and no information is available to this day on the internal morphology of topotypical specimens. KECSKEMÉTI's (1959) forms could be identified after examining the internal morphology of specimens from the actual locality, though figures on the equatorial section were not published by him either.

"rudis"

1950. *Discocyclina rudis* n. sp. — AZZAROLI *(=Discocyclina dispansa umbilicata)*

On the basis of the good quality figures by AZZAROLI's (1950), the describer's showing the internal morphology of the taxon from Somali the rightousness of the above identification is most likely. Accordingly, this denomination being a later synonym have to be ruled out.

"selliformis"

1908. *Orthophragmina varians* (KAUFMANN) var. *selliformis* n. var. — PROVALE *(=Orbitoclypeus pygmaea)*

PROVALE (1908), the describer, published identifiable figures on the taxon's internal morphology, however, this name has not been used since then, so practically it is a forgotten one. Instead of this name HENRICI's (1934) "pygmaea" came into use. Considering the common usage it seems expedient not to use this denomination.

"sijuensis"

1963a. *Discocyclina (Discocyclina) sijuensis* n. sp. — SAMANTA *(=Discocyclina javana)*

This denomination was revoked, in 1964, by the denominator himself, so it cannot be used. The "javana" name is used instead.

"soeroeaensis"

1923. *Orthocyclina soeroeaensis* n. sp. — VLERK *(=Asterocyclina stellata stellaris)*
1934. *Orthocyclina suruaensis* VLERK — HENRICI *(=Asterocyclina alticostata alticostata)*

On the basis of the proper figures by VLERK (1923), the first describer's proper figures the above identification is unquestionable. So this denomination has to be ruled out as a later synonym.

"sowerbyi"

1926. *Discocyclina sowerbyi* n. sp. — NUTTALL *(=Discocyclina discus discus)*
1959. *Discocyclina sowerbyi* NUTTALL — NAGAPPA *(=Discocyclina javana)*
1963a. *Discocyclina (Discocyclina) sowerbyi* NUTTALL — SEN GUPTA *(=Discocyclina discus discus)*
1965b. *Discocyclina sowerbyi* NUTTALL — SAMANTA *(=Discocyclina javana)*
1976. *Discocyclina sowerbyi* NUTTALL — HO YEN et al. *(=Discocyclina dispansa hungarica)*

NUTTALL (1926), the describer applied this denomination to SOWERBY's (1840) *Lycophris ephippium* as "nomen novum". None of them has published any figures on the internal morphology. SEN GUPTA's (1963a) figures published from the neighbourhood of the type locality suggest that the above identification is most likely. The only difference is in the saddle shape of "sowerbyi" but sometimes this feature occurs in case of the European *Discocyclina discus*, and, in addition, it is not a taxonomic category in our opinion but the consequence of ecological factors. Thus the denomination can be ruled out as a later synonym.

"submedia"

1846. *Orbitolites submedia* n. sp. — D'ARCHIAC, p. 406(=?)
1953. *Discocyclina submedia* (D'ARCHIAC) — SCHWEIGHAUSER *(=?Discocyclina dispansa ganensis)*

D'ARCHIAC (1846), the first describer, did not publish any figure at all on the internal morphology and no figures were published from Biarritz, the type locality since then either. SCHWEIGHAUSER's (1953) forms could be temporarily identified on the basis of the external similarity and especially considering the low numbers of the juvenarium's nepionic chambers in forms "B".

"tellinii"

1907b. *Orbitoclypeus tellinii* n. sp. — SILVESTRI *(=Discocyclina dispansa hungarica)*
1923. *Orbitoclypeus tellinii* SILVESTRI — SILVESTRI *(=Discocyclina dispansa hungarica)*

This denomination has not been used for identification for the last 63 years therefore it is regarded as a forgotten one. "Hungarica" is used instead. It should be noted that there is a contradiction in the genus name (Orbitoclypeus) given by SILVESTRI (1907b, 1923), since it should have hexagonal equatorial chambers and the equatorial section in which these hexagonal chambers are not observable at all.

"tenuicostata"

1868. *Orbitoides (Aktinocyclina) tenuicostata* n. sp. — GÜMBEL, pp. 709—710, pl. 2, fig. 114, pl. 4, fig. 35 (=?)
1959. *Actinocyclina tenuicostata* GÜMBEL — KECSKEMÉTI *(=Discocyclina radians radians)*

The only identifiable depiction is not from the type locality and in addition it is a synonym of another one, that ranks in priority, consequently the denomination cannot be used.

"tenuis"

1922. *Discocyclina tenuis* n. sp. — DOUVILLÉ *(=?Discocyclina archiaci archiaci)*
1929. *Discocyclina tenuis* DOUVILLÉ — LLUECA *(=?Discocyclina archiaci archiaci)*
1940. *Discocyclina tenuis* DOUVILLÉ — WEIJDEN *(=?Discocyclina archiaci archiaci)*
1953. *Discocyclina tenuis* DOUVILLÉ — SCHWEIGHAUSER *(=Discocyclina archiaci archiaci)*
1972. *Discocyclina tenuis* DOUVILLÉ — SAMUEL et al. *(=Discocyclina archiaci staroseliensis)*

No figure were published on the internal morphology by DOUVILLÉ (1922), the denominator. However, it was his collection from which a thin section photo by Spilecco, and the type locality was published by SCHWEIGHAUSER (1953). This photo made the above identification possible. It is strange however that DOUVILLÉ's (1922) "tenuis" was not found by SCHWEIGHAUSER (1953) in Spilecco so the origin of this thin section is doubtful. Even if these doubts have no sound basis the denomination has to be ruled out as a later synonym.

"umbo"

1863. *Hymenocyclus umbo* n. sp. — SCHAFHÄUTL *(= ?Discocyclina stratiemanuelis)*
1922. *Discocyclina umbo* (SCHAFHÄUTL) — DOUVILLÉ *(= ?Discocyclina stratiemanuelis)*
1931a. *Discocyclina umbo* (SCHAFHÄUTL) var. *minor* n. var. — MEFFERT *(= Discocyclina pratti minor)*
1959. *Discocyclina umbo* (SCHAFHÄUTL) — BELMUSTAKOV *(= ?Discocyclina fortisi simferopolensis)*
partim 1963. *Discocyclina umbo* (SCHAFHÄUTL) — BIEDA *(= Discocyclina discus dudarensis)*
1967. *Discocyclina umbo* (SCHAFHÄUTL) — KÖHLER *(= ?Discocyclina stratiemanuelis* et *?D. pratti minor)*
1973. *Discocyclina umbo* (SCHAFHÄUTL) — OLEMPSKA *(= Discocyclina discus dudarensis)*

This denomination from Kressenberg (S Bavaria) was introduced by SCHAFHÄUTL (1863) but no usable figures were published on the equatorial and axial sections. A drawing, on the embryon's axial section was published by DOUVILLÉ (1922) but this may as well be the section of *Discocyclina discus*, *D. fortisi*, *D. stratiemanuelis*, *D. spliti* or *D. javana.* From the type locality no other identifiable figures were published under this name. In case of other localities the denomination was used for marking various forms (see the above identifications).

From Kressenberg referred to as *Discocyclina stratiemanuelis*, thoroughly described and properly illustrated a new species was introduced by BRÖNNIMANN (1942) that can be temporarily identified with SCHAFHÄUTL's (1863) and DOUVILLÉ's (1922) "umbo". Owing to the clear depiction and proper figures, however, it seems reasonable to mark the Kressenberg forms with "stratiemanuelis" and to rule out the "umbo" name.

"variecostata"

1868. *Orbitoides (Aktinocyclina) variecostata* n. sp. — GÜMBEL, pp. 710—711, pl. 4. figs. 33—34 (= ?)
1959. *Actinocyclina variecostata* GÜMBEL — KECSKEMÉTI *(= Discocyclina radians radians, ?Orbitoclypeus furcata rovasendai* et *Asterocyclina kecskemetii)*

No usable figure was published by GÜMBEL (1868), the first describer, showing the internal morphology and no figure was published from San Martino, the type locality, either. But one thing is clear from GÜMBEL's (1868) figures, namely, this denomination refers to ribbed Discocyclinae.

From the material of later describers having reexamined the localities and on the basis of the figures, only KECSKEMÉTI's (1959) forms could be indentified but the "variecostata" name is not suitable for any of his forms, since "radians" ranks in priority, "rovasendai"is Orbitoclypeus, whereas "kecskemetii" is Asterocyclina and not ribbed Discocyclina. Consequently the denomination should not be used.

"zitteli"

1908. *Orbitoides (Orthophragmina) zitteli* n. sp. — CHECCHIA-RISPOLI *(= Orbitoclypeus varians varians)*
1909a. *Orthophragmina zitteli* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI *(= Orbitoclypeus varians varians)*
1911a. *Orthophragmina zitteli* CHECCHIA-RISPOLI — CHECCHIA-RISPOLI *(= Orbitoclypeus varians varians)*

The above identifications could be carried out on the basis of CHECCHIA-RISPOLI's (1909a, 1911a) rather poor quality figures. The criterion of the species' distinction is that the protoconch is not observable. This may be due to pathological or polishing technical reasons. Accordingly, the denomination is a later synonym, in addition it is a forgotten one, as it has been out of use for 75 years.

Identification of bibliographic data without species denomination

1903. *Orthophragmina* sp. — SCHLUMBERGER *(= Discocyclina archiaci bartholomei)*
1904. *Orthophragmina* sp. — SCHLUMBERGER *(= Asterocyclina stellata stellaris)*
1917. *Orthophragmina* ... — CHECCHIA-RISPOLI *(= Orbitoclypeus varians roberti)*
1940. *Asterocyclina* ... — BRÖNNIMANN *(= Asterocyclina stella praestellaris)*
1972. *Discocyclina* sp. — SAMUEL et al. *(= Orbitoclypeus ramaraoi ramaraoi)*
1973. *Discocyclina* sp. — BOMBITA *(= Nemkovella evae)*
1974. *Actinocyclina* sp. — PORTNAYA *(= Discocyclina kingae)*
1974. *Asterocyclina* sp. — PORTNAYA *(= Orbitoclypeus bayani)*
1982. *Asterocyclina* sp. — FERMONT *(= Asterocyclina schweighauseri)*
1982. *Asterocyclina* — FERMONT *(= Asterocyclina stella taramellii)*
1983. *Discocyclina* IV. — SETIAWAN *(= Discocyclina euaensis)*

List of denominations not included in the synonymic lists

"abchasica": 1979. *Discocyclina abchasica* I. KACHARAVA — MREVLISHVILI, p. 21
"abichi": 1933. *Discocyclina abichi* n. sp. — GOLUBIATNIKOV, p. 2
"aprutina": 1904a. *Orthophragmina aprutina* n. sp. — PREVER, pp. 983—984, fig. 11
"asterifera": 1861. *Orbitoides asterifera* n. sp. — CARTER, pp. 451—452, pl. 17, fig. 3
"asteriscus": 1867. *Orbitoides asteriscus* n. sp. — KAUFMANN, pp. 155—157, pl. 9, figs. 11—16
"chelussii": 1904a. *Orthophragmina chelussii* n. sp. — PREVER, pp. 984—985, fig. 10
"circumvallata": 1904a. *Orthophragmina circumvallata* n. sp. — PREVER, p. 987, fig. 8
"colcanapi": 1906. *Orthophragmina colcanapi* n. sp. — DOUVILLÉ, pp. 7—8, pl. 1, figs. 4—5
"colchetica": 1981. *Discocyclina colchetica* n. sp. — Z. KACHARAVA, pp. 115—116, pl. 3, figs. 5—8
"corbarica": 1926. *Orthophragmina (Discocyclina) corbarica* n. sp. — DONCIEUX, pp. 66—69, pl. 7. figs. 11—18, text-figs. 26—29
"crassicostata": 1922. *Actinocyclina crassicostata* n. sp. — DOUVILLÉ, p. 99, pl. 5, fig. 8
"crassula": 1876. *Orbitoides crassula* n. sp. — MAYER-EYMAR, p. 23, pl. 1, figs. 4—5
"dagestanica": 1933. *Discocyclina dagestanica* n. sp. — GOLUBIATNIKOV, p. 2
"dilabida": 1883. *Orbitoides dilabida* n. sp. — SCHWAGER, pp. 140—141, pl. 29, figs. 7a—e
"doncieuxi": 1927. *Asterodiscus doncieuxi* n. sp. — LLUECA, p. 424
"electa": 1931. *Discocyclina sella* (D'ARCHIAC) var. *electa* n. var. — RENGARTEN, pp. 23—24, pl. 3, figs. 5—6
"fournieri": 1905. *Orthophragmina umbilicata* n. sp. var. *fournieri* n. var. — DEPRAT, pp. 501—502, pl. 17, fig. 12
"fritschi": 1912. *Orthophragmina fritschi* n. sp. — DOUVILLÉ, pp. 288—289, pl. 24, fig. 2
"granulatotenuis": 1908. *Orthophragmina (Discocyclina) discus* (RÜTIMEYER) var. *granulatotenuis* n. var. — HEIM, pp. 256—257
"gümbeli": 1904. *Orthophragmina gümbeli* n. sp. — SCHLUMBERGER, p. 122, text-fig. 2
"illyrica": 1904a. *Orthophragmina illyrica* n. sp. — PREVER, p. 984, fig. 12
"indica": 1926. *Discocyclina javana* (VERBEEK) var. *indica* n. var. — NUTTALL, pp. 147—148, pl. 7, figs. 4, 6—7, pl. 8, fig. 4
"kressenbergensis": 1908. *Orthophragmina (Discocyclina) kressenbergensis* n. sp. — HEIM, p. 263
"laevitenuis": 1908. *Orthophragmina (Discocyclina) discus* (RÜTIMEYER) var. *laevitenuis* n. var. — HEIM pp. 258—259, pl. 8, fig. 22
"lanceolata": 1904. *Orthophragmina lanceolata* n. sp. — SCHLUMBERGER, pp. 128—130, pl. 5, figs. 25—30, text-fig. B
"lucifera": 1867. *Orbitoides lucifera* n. sp. — KAUFMANN, pp. 157—158, pl. 9, figs. 17—21
"magnirregularis": 1922. *Orthophragmina patellaris* (SCHLOTHEIM) var. *magnirregularis* n. var. — SACCO, p. 356, text-fig. A
"malladai": 1927. *Asterodiscus malladai* n. sp. — LLUCEA, p. 424
"major": 1908. *Orthophragmina (Discocyclina) archiaci* SCHLUMBERGER var. *major* n. var. — HEIM, p. 263
"navarroi": 1927. *Asterodiscus navarroi* n. sp. — LLUECA, p. 425
"ninae": 1981. *Discocyclina ninae* n. sp. — Z. KACHARAVA, pp. 114—115, pl. 3, figs. 1—4
"nudimargo": 1883. *Orbitoides nudimargo* n. sp. — SCHWAGER, pp. 139—140, pl. 29, figs. 8a—e
"obesa": 1948. *Orthophragmina varians* (KAUFMANN) var. *obesa* n. var. — SILVESTRI, pp. 11—12. (187—188), pl. 32, fig. 4
"parmula": 1850. *Orbitoides parmula* n. sp. — RÜTIMEYER, p. 117, pl. 5, figs, 72—73
"perregularis": 1922. *Orthopragmina patellaris* (SCHLOTHEIM) var. *perregularis* n. var. — SACCO, p. 356. text-fig. D
"pieltaini": 1927. *Asterodiscus pieltaini* n. sp. — LLUECA, p. 425
"pinguis": 1922. *Actinocyclina pinguis* n. sp. — DOUVILLÉ, pp. 80—81, pl. 5, figs. 3—4
"plana": 1929. *Discocyclina sella* (D'ARCHIAC) var. *plana* n. var. — LLUECA, pp. 277—278, pl. 22, figs. 7—10
"portisi": 1908. *Orbitoides (Orthophragmina) portisi* n. sp. — CHECCHIA-RISPOLI, p. 12
"praeradians": 1922. *Actinocyclina praeradians* n. sp. — DOUVILLÉ, p. 80, pl. 5, fig. 5
"prima": 1909. *Orbitoides (Orthophragmina?) prima* n. sp. — CHECCHIA-RISPOLI—GEMMELARO, pp. 169—170, pl. 2, figs. 6, 10—12
"pseudamericana": 1922. *Orthophragmina patellaris* (Schlotheim) var. *pseudamericana* n. var. — SACCO, p. 356, text-figs. B—C
"rossica": 1931b. *Discocyclina rossica* n. sp. — MEFFERT, p. 4
"rugosa": 1904a. *Orthophragmina rugosa* n. sp. — PREVER, p. 987, fig. 6
"saccoi": 1908. *Orbitoides (Orthophragmina) saccoi* n. sp. — CHECCHIA-RISPOLI, p. 12
"samnitica": 1904a. *Orthophragmina samnitica* n. sp. — PREVER, p. 985, fig. 9
"scarantana": 1868. *Orbitoides (Asterocyclina) priabonensis* n. sp. *scarantana* n. ssp. — GÜMBEL, p. 138, pl. 4. fig. **41**
"schlumbergeri": 1904a. *Orthophragmina schlumbergeri* n. sp. — PREVER, pp. 986—987, fig. 7
"somaliensis": 1950. *Discocyclina somaliensis* n. sp. — AZZAROLI, p. 127. (29.), pl. 13, fig. 2, pl. 14, fig. 6
"spileccensis": 1891. *Orthophragmina spileccensis* n. sp. — MUNIER-CHALMAS, p. 38
"stachei": 1891. *Orthophragmina stachei* n. sp. — MUNIER-CHALMAS, pp. 29, 37
"steinmanni": 1908. *Orbitoides (Exagonocyclina) steinmanni* n. sp. — CHECCHIA-RISPOLI, p. 21
"stellifera": 1891. *Orthophragmina stellifera* n. sp. — MUNIER-CHALMAS, pp. 29, 37
"triangolaris": 1911a. *Orthophragmina triangolaris* n. sp. — CHECCHIA-RISPOLI, pp. 168—170, pl. 5, figs. 13, 41
"trigonalis": 1908. *Orbitoides (Orthophragmina) trigonalis* n. sp. — CHECCHIA-RISPOLI, p. 14
"undulata": 1926. *Discocyclina undulata* n. sp. — NUTTALL, pp. 150—151, pl. 7, figs. 8—9, pl. 8, fig. 5
"vasconica": 1946. *Discocyclina roberti* DOUVILLÉ car. *vasconica* n. var. — RUIZ DE GAONA, p. 204, pl. 2, fig. 26
"veronensis": 1922. *Discocyclina veronensis* n. sp. — DOUVILLÉ, pp. 88—89, pl. 4, fig. 8
"vinassai": 1904a. *Orthophragmina vinassai* n. sp. — PREVER, pp. 985—986, fig. 13

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A TAXONNEVEK BETŰRENDES MUTATÓJA
LIST OF TAXA IN ALPHABETICAL ORDER

(A zárójelben lévő nevek használaton kívüliek)
(Denominations in brackets are invalids)

Population	*E* No	*E* Range	*E* Mean ± ϱ	*R* No	*R* Range	*R* Mean ± ϱ	*Q* No	*Q* Range	*Q* Mean ± ϱ	*P* (μm) No	*P* (μm) Range	*P* (μm) Mean ± ϱ
Discocyclina archiaci												
OS	3	0.63–0.75	0.72	3	0.70–0.77	0.72	3	1.60–2.00	1.78	3	125–147	139
CR	12	0.42–1.14	0.78 ± 0.11	12	0.38–1.06	0.69 ± 0.10	12	1.56–2.34	1.87 ± 0.16	12	115–212	146 ± 18
CP	20	0.48–0.95	0.71 ± 0.04	20	0.53–0.97	0.75 ± 0.04	20	1.60–2.28	1.82 ± 0.08	20	127–250	171 ± 14
PA	14	0.54–0.85	0.69 ± 0.06	14	0.61–0.90	0.77 ± 0.05	14	1.59–2.23	1.84 ± 0.10	14	154–232	199 ± 13
PF	1	0.54	0.54	1	0.93	0.93	1	2.08	2.08	1	150	150
DK	1	0.58	0.58	1	0.85	0.85	1	1.86	1.86	1	227	227
LP	4	0.38–0.60	0.52 ± 0.17	4	0.87–1.04	0.99 ± 0.13	4	1.80–2.52	2.13 ± 0.47	4	177–245	198 ± 52
GA	12	0.43–0.95	0.63 ± 0.10	12	0.56–1.12	0.89 ± 0.10	12	1.72–2.61	2.30 ± 0.18	14	140–235	195 ± 16
HX	1	0.35	0.35	1	1.09	1.09	1	2.04	2.04	1	230	230
NF	6	0.47–0.67	0.57 ± 0.08	6	0.76–1.05	0.90 ± 0.11	6	1.82–2.11	1.96 ± 0.16	6	263–353	310 ± 31
DA	6	0.39–0.91	0.62 ± 0.21	6	0.56–1.55	0.92 ± 0.37	6	1.47–3.80	2.11 ± 0.91	6	174–434	309 ± 99
DF	4	0.33–0.64	0.50 ± 0.20	4	0.78–1.12	0.96 ± 0.23	4	1.62–2.32	1.99 ± 0.46	4	229–415	315 ± 122
LP	4	0.45–0.75	0.58 ± 0.20	4	0.79–1.02	0.93 ± 0.16	4	1.97–2.58	2.32 ± 0.46	4	209–331	269 ± 81
SB	16	0.34–0.70	0.49 ± 0.04	16	0.88–1.22	1.06 ± 0.06	16	1.79–3.04	2.30 ± 0.14	16	170–460	273 ± 36
Discocyclina furoni												
CR	2	0.83–0.94	0.88	2	0.56–0.65	0.60	2	1.66–1.81	1.74	2	97–114	104
LP	1	0.71	0.71	1	0.76	0.76	1	1.88	1.88	1	147	147
GA	4	0.50–0.71	0.61 ± 0.14	4	0.75–1.00	0.89 ± 0.18	4	2.02–2.34	2.17 ± 0.21	4	97–130	116 ± 26
NA	4	0.46–1.00	0.72 ± 0.39	4	0.50–0.96	0.76 ± 0.37	4	1.70–2.43	1.99 ± 0.55	4	117–192	152 ± 57
Discocyclina discus												
GN	2	0.32–0.39	0.36	2	0.98–1.25	1.11	2	1.82–2.27	2.04	2	489–579	534
NC	6	0.23–0.33	0.27 ± 0.04	6	1.21–1.36	1.27 ± 0.06	6	1.97–2.40	2.12 ± 0.19	6	480–612	533 ± 66
AJ	12	0.06–0.66	0.30 ± 0.11	12	0.79–2.32	1.26 ± 0.26	12	1.18–3.15	2.20 ± 0.35	12	394–978	632 ± 125
DU	7	0.14–0.27	0.21 ± 0.04	7	1.24–1.58	1.40 ± 0.11	7	1.84–2.50	2.14 ± 0.22	7	481–841	664 ± 110
LA	1	0.13	0.13	1	1.64	1.64	1	2.59	2.59	1	746	746
Discocyclina weijdeni												
HX	5	0.43–0.66	0.53 ± 0.12	5	0.69–0.95	0.86 ± 0.13	5	1.22–2.21	1.75 ± 0.44	5	202–326	249 ± 62
NA	1	0.26	0.26	1	1.03	1.03	1	1.81	1.81	1	282	282
Discocyclina senegalensis												
NF	4	0.38–0.73	0.59 ± 0.24	4	0.74–1.22	0.96 ± 0.33	4	2.06–2.45	2.20 ± 0.28	4	224–278	255 ± 37
DA	2	0.70–0.73	0.71	2	0.67–0.70	0.68	2	1.35–1.45	1.40	2	374–441	408
DF	1	0.87	0.87	1	0.60	0.60	1	1.52	1.52	1	414	414
Discocyclina javana												
SO	7	0.01–0.39	0.17 ± 0.14	7	1.07–1.58	1.35 ± 0.16	7	1.96–2.42	2.23 ± 0.16	7	326–569	492 ± 72
Discocyclina pseudoaugustae												
CP	10	0.00–0.44	0.17 ± 0.10	10	1.05–1.79	1.32 ± 0.14	10	1.83–2.59	2.08 ± 0.15	10	194–327	246 ± 27
DK	5	0.03–0.20	0.12 ± 0.08	5	1.20–1.41	1.27 ± 0.12	5	1.81–2.16	2.00 ± 0.16	5	225–377	296 ± 82
PF	1	0.11	0.11	1	1.59	1.59	1	1.92	1.92	1	342	342
Discocyclina fortisi												
HX	3	0.07–0.10	0.00	3	1.34–1.49	1.41	3	1.79–1.87	1.83	3	340–445	388
NA	1	0.00	0.00	1	1.48	1.48	1	2.18	2.18	1	297	297
NF	17	0.01–0.10	0.00 ± 0.03	17	1.30–1.66	1.43 ± 0.05	17	1.57–2.28	1.96 ± 0.10	17	279–698	455 ± 57
DA	18	0.00–0.12	0.00 ± 0.03	18	1.21–1.67	1.44 ± 0.05	18	1.66–2.30	1.96 ± 0.08	18	352–632	468 ± 39
Discocyclina stratiemanuelis												
DF	9	0.00–0.08	0.00 ± 0.02	9	1.27–1.73	1.45 ± 0.10	9	1.73–2.49	1.93 ± 0.18	9	379–761	509 ± 89
PO	3	0.01–0.15	0.00	3	1.34–1.47	1.40	3	1.69–2.25	1.89	3	402–696	560
AM	3	0.07–0.15	0.00	3	1.28–1.39	1.35	3	1.74–2.16	1.96	3	450–595	538
Discocyclina spliti												
AJ	5	0.00–0.10	0.00 ± 0.08	5	1.50–1.78	1.65 ± 0.15	5	2.03–2.50	2.21 ± 0.23	5	532–635	580 ± 56
Discocyclina broennimanni												
CR	10	0.82–1.31	1.07 ± 0.12	10	0.27–0.64	0.44 ± 0.10	10	1.52–2.02	1.75 ± 0.12	10	52–64	57 ± 2
CP	2	0.90–1.16	1.03	2	0.38–0.58	0.48	2	1.72–1.94	1.83	2	62–67	65

statisztikai adatai

Orthophragmina populations

D (μm)			N			H (μm)			$n_{0.5}$			Determination of the subspecies
No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	
3	232–255	245	3	20–24	22.0	3	40–50	45.0	3	10.2–11.5	11.1	bakhchisaraiensis
12	217–367	270 ± 33	12	17–35	22.2 ± 3.4	12	45–90	57.5 ± 7.4	12	9.2–14.0	12.1 ± 1.0	bakhchisaraiensis
20	245–438	309 ± 22	19	18–34	25.7 ± 2.3	20	40–75	55.2 ± 3.2	20	8.2–12.0	10.6 ± 0.5	staroseliensis
15	287–409	363 ± 18	15	23–33	27.7 ± 2.0	15	50–90	62.7 ± 5.6	15	8.2–11.5	10.1 ± 0.5	archiaci
1	312	312	1	29	29.0	1	55	55.0	1	11.0	11.0	? archiaci
1	422	422	1	30	30.0	1	50	50.0	1	9.5	9.5	archiaci
4	374–440	416 ± 48	4	23–36	32.0 ± 9.6	4	50–60	55.0 ± 6.5	4	7.5–11.0	8.6 ± 1.8	archiaci
13	314–590	440 ± 48	12	24–44	32.9 ± 3.0	14	50–90	65.4 ± 6.8	14	7.9–12.0	8.8 ± 0.7	archiaci
1	469	469	1	40	40.0	1	60	60.0	1	8.0	8.0	archiaci
6	484–745	611 ± 96	5	35–49	41.0 ± 7.5	6	50–65	57.5 ± 5.5	6	8.0–10.0	9.2 ± 0.9	bartholomei
6	480–665	594 ± 85	6	27–45	37.0 ± 6.4	6	75–100	85.8 ± 10.2	6	6.0–9.0	7.7 ± 1.2	bartholomei
4	477–740	615 ± 184	4	28–58	42.2 ± 19.6	4	60–90	76.2 ± 21.9	4	6.0–8.5	7.1 ± 1.8	bartholomei
4	532–657	614 ± 92	4	42–55	47.0 ± 8.9	4	60–70	65.0 ± 9.2	4	6.8–8.0	7.5 ± 0.8	bartholomei
16	395–857	620 ± 66	16	36–62	48.0 ± 4.7	16	55–90	67.8 ± 4.1	16	6.5–9.8	7.6 ± 0.5	bartholomei
2	176–189	182	2	16	16.0	2	35–45	40.0	2	11.7–14.0	12.8	—
1	277	277	1	21	21.0	1	50	50.0	1	10.0	10.0	—
4	212–278	250 ± 45	4	19–25	21.0 ± 4.3	4	50–60	56.2 ± 7.6	4	10.0–11.8	10.9 ± 1.2	—
4	269–327	293 ± 39	4	20–25	23.2 ± 3.8	4	50–55	53.8 ± 4.0	4	9.8–10.0	10.0 ± 0.2	—
2	1055–1109	1082	2	90	90.0	2	110–155	132.5	2	5.7–6.0	5.8	discus
6	1027–1219	1127 ± 77	6	60–98	79.0 ± 14.5	6	100–130	116.7 ± 14.7	6	5.0–5.8	5.4 ± 0.4	discus
13	941–1568	1309 ± 131	10	69–110	87.5 ± 9.6	15	90–155	127.3 ± 10.4	15	4.3–6.0	5.4 ± 0.4	dudarensis
11	1147–1876	1449 ± 145	10	80–120	96.5 ± 10.1	11	90–130	109.6 ± 8.8	10	4.0–5.7	4.9 ± 0.4	dudarensis
1	1933	1933	1	95	95.0	1	165	165.0	1	4.7	4.7	dudarensis
5	327–595	437 ± 118	6	34–58	43.3 ± 11.0	6	75–100	82.5 ± 9.8	6	6.0–8.9	7.1 ± 1.1	—
1	511	511	1	41	41.0	1	90	90.0	1	7.0	7.0	—
4	462–650	563 ± 133	4	22–44	33.8 ± 15.5	4	50–65	60.0 ± 11.2	4	7.4–10.0	8.8 ± 2.2	—
2	543–596	569	2	28–31	29.5	2	75–80	77.5	2	7.9–8.9	8.4	—
2	629–833	730	1	35	35.0	2	65–90	77.5	2	5.2–7.5	6.4	—
7	770–1287	1095 ± 166	7	40–80	65.6 ± 12.7	7	95–220	157.1 ± 35.2	7	4.0–6.0	5.0 ± 0.7	—
10	426–640	510 ± 54	8	31–55	40.6 ± 6.4	10	50–75	63.5 ± 6.4	10	7.7–11.0	8.9 ± 0.7	—
5	455–695	588 ± 136	5	35–58	46.6 ± 13.6	5	55–80	62.0 ± 12.9	5	8.0–10.0	8.6 ± 0.7	—
1	687	687	1	50	50.0	1	65	65.0	1	8.0	8.0	—
3	637–795	709	3	50–60	55.0	3	65–90	76.7	3	6.0–10.0	7.3	fortisi
2	646–692	669	2	48–52	50.0	2	90–95	92.5	2	5.6–6.6	6.1	fortisi
18	579–1232	867 ± 79	18	48–100	70.1 ± 6.8	18	75–110	84.4 ± 4.3	18	5.7–7.9	6.7 ± 0.3	simferopolensis
20	762–1142	900 ± 49	20	42–75	59.3 ± 4.1	20	65–90	82.4 ± 3.9	20	6.5–9.0	7.8 ± 0.3	simferopolensis
12	717–1339	959 ± 96	10	40–70	60.0 ± 6.9	11	60–110	82.3 ± 11.2	12	5.5–8.5	7.2 ± 0.6	—
4	905–1206	1028 ± 204	4	60–84	68.0 ± 18.0	4	75–95	85.0 ± 13.0	4	6.5–8.0	7.0 ± 1.1	—
3	971–1185	1048	3	60–72	67.3	3	155–200	175.0	2	4.7–4.8	4.8	—
8	1122–1594	1321 ± 119	7	74–90	85.3 ± 4.8	8	90–150	132.5 ± 17.2	8	5.4–7.0	6.2 ± 0.4	ajkaensis
10	81–117	99 ± 8	10	7–13	9.0 ± 1.3	10	25–40	30.5 ± 3.6	8	13.7–16.0	15.1 ± 0.7	—
2	115–120	118	2	11–13	12.0	2	45	45.0	2	13.0–15.0	14.0	—

Population	E			R			Q			P (μm)		
	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ
Discocyclina augustae												
HX	8	0.60 – 1.44	1.08 ± 0.22	8	0.25 – 0.81	0.46 ± 0.15	8	1.21 – 1.81	1.51 ± 0.18	8	62 – 100	79 ± 12
NF	3	1.06 – 1.31	1.18	3	0.27 – 0.46	0.36	3	1.48 – 1.67	1.60	3	55 – 75	64
DA	2	1.35 – 1.40	1.38	2	0.25	0.25	2	1.25 – 1.52	1.39	2	65 – 71	68
DF	3	0.79 – 1.23	1.04	3	0.36 – 0.62	0.47	3	1.48 – 1.63	1.54	3	55 – 75	65
SB	2	0.92 – 1.12	1.02	2	0.42 – 0.56	0.49	2	1.62 – 1.71	1.66	2	60 – 80	70
BO	2	0.71 – 0.91	0.81	2	0.56 – 0.75	0.65	2	1.45 – 2.02	1.74	2	60 – 95	77
NC	17	0.82 – 1.21	0.97 ± 0.06	17	0.33 – 0.67	0.52 ± 0.05	17	1.54 – 1.89	1.72 ± 0.05	17	70 – 107	87 ± 5
NT	5	0.64 – 1.00	0.86 ± 0.20	5	0.50 – 0.78	0.61 ± 0.16	5	1.56 – 1.91	1.68 ± 0.17	5	70 – 90	83 ± 11
AJ	11	0.49 – 1.03	0.85 ± 0.10	11	0.48 – 0.87	0.62 ± 0.07	11	1.56 – 1.92	1.73 ± 0.10	11	105 – 142	119 ± 10
CM	1	1.07	1.07	1	0.45	0.45	1	1.46	1.46	1	120	120
SO	12	0.71 – 1.17	0.87 ± 0.08	12	0.39 – 0.77	0.62 ± 0.07	12	1.38 – 2.13	1.83 ± 0.12	12	95 – 147	118 ± 9
MS	2	0.67 – 0.69	0.68	2	0.77 – 0.84	0.81	2	1.88 – 2.26	2.07	2	97 – 137	117
LA	3	0.62 – 0.95	0.79	3	0.54 – 0.83	0.67	3	1.65 – 1.84	1.78	3	120 – 137	126
VG	4	0.61 – 0.81	0.66 ± 0.15	4	0.67 – 0.92	0.82 ± 0.17	4	1.88 – 2.07	1.98 ± 0.14	4	85 – 134	102 ± 35
Discocyclina knessae												
DM	7	0.73 – 1.26	0.92 ± 0.17	7	0.27 – 0.80	0.57 ± 0.16	7	1.63 – 2.28	1.85 ± 0.23	7	57 – 92	73 ± 12
DU	1	0.77	0.77	1	0.73	0.73	1	1.99	1.99	1	87	87
Discocyclina dispansa												
GA	6	0.77 – 1.25	0.93 ± 0.19	6	0.27 – 0.69	0.55 ± 0.16	6	1.48 – 1.94	1.65 ± 0.18	6	55 – 95	77 ± 16
DF	14	0.67 – 1.14	0.92 ± 0.10	14	0.38 – 0.83	0.58 ± 0.08	14	1.48 – 2.15	1.84 ± 0.10	14	74 – 122	97 ± 6
SB	9	0.61 – 1.12	0.85 ± 0.14	9	0.42 – 0.88	0.65 ± 0.13	9	1.56 – 2.12	1.91 ± 0.15	9	85 – 130	103 ± 9
JG	2	0.90 – 1.10	1.00	2	0.59 – 0.60	0.60	2	1.77 – 2.06	1.91	2	102 – 120	111
NC	3	0.75 – 0.92	0.82	3	0.56 – 0.71	0.66	3	1.61 – 2.02	1.78	3	115 – 139	126
GN	4	0.65 – 0.94	0.80 ± 0.19	4	0.54 – 0.81	0.67 ± 0.18	4	1.43 – 1.81	1.67 ± 0.26	4	132 – 152	142 ± 14
DM	1	0.98	0.98	1	0.52	0.52	1	2.03	2.03	1	117	117
NT	1	0.76	0.76	1	0.77	0.77	2	1.59 – 2.17	1.88	2	126 – 152	139
ND	4	0.46 – 1.09	0.73 ± 0.45	4	0.44 – 0.96	0.75 ± 0.40	4	1.42 – 2.18	1.76 ± 0.50	4	105 – 170	134 ± 42
FM	1	0.88	0.88	1	0.60	0.60	1	1.79	1.79	1	145	145
AM	4	0.59 – 0.91	0.76 ± 0.21	4	0.57 – 0.85	0.71 ± 0.19	4	1.62 – 1.92	1.74 ± 0.21	4	117 – 229	170 ± 73
AJ	5	0.67 – 1.36	0.90 ± 0.33	5	0.33 – 0.86	0.62 ± 0.23	5	1.24 – 2.33	1.74 ± 0.48	5	150 – 217	172 ± 34
DU	12	0.48 – 0.86	0.66 ± 0.08	12	0.62 – 0.97	0.82 ± 0.08	12	1.63 – 2.45	1.89 ± 0.14	12	102 – 180	152 ± 13
SO	2	0.52 – 0.64	0.58	2	0.95 – 1.09	1.02	2	2.46 – 2.52	2.49	2	165 – 202	184
MS	3	0.48 – 0.76	0.66	3	0.76 – 1.00	0.86	3	1.96 – 2.90	2.32	3	162 – 250	210
LA	3	0.48 – 0.74	0.59	3	0.72 – 1.17	0.95	3	1.77 – 2.33	2.09	3	268 – 315	289
VG	2	0.81 – 0.83	0.82	2	0.71 – 0.76	0.74	2	2.38 – 2.54	2.46	2	226 – 229	228
Discocyclina kingae												
BO	11	0.63 – 1.18	0.86 ± 0.12	11	0.36 – 0.86	0.62 ± 0.10	11	1.48 – 2.11	1.83 ± 0.12	11	102 – 167	126 ± 14
Discocyclina radians												
BO	1	0.87	0.87	1	0.60	0.60	1	1.72	1.72	1	102	102
NC	26	0.48 – 0.85	0.69 ± 0.04	26	0.62 – 1.10	0.84 ± 0.06	26	1.76 – 2.76	2.14 ± 0.09	27	115 – 172	133 ± 5
GN	5	0.52 – 0.82	0.68 ± 0.14	5	0.64 – 0.97	0.80 ± 0.15	5	1.77 – 2.01	1.90 ± 0.13	5	134 – 152	145 ± 10
FM	2	0.55 – 0.80	0.68	2	0.73 – 0.95	0.84	2	2.20 – 2.36	2.28	2	102 – 115	109
AM	7	0.55 – 1.02	0.77 ± 0.18	7	0.48 – 0.96	0.72 ± 0.17	7	1.67 – 2.34	2.01 ± 0.20	7	122 – 164	147 ± 15
AJ	24	0.40 – 0.93	0.62 ± 0.05	24	0.54 – 1.03	0.87 ± 0.06	24	1.53 – 2.56	2.01 ± 0.10	24	105 – 232	159 ± 12
SO	5	0.47 – 0.72	0.57 ± 0.12	5	0.74 – 1.03	0.92 ± 0.13	5	1.86 – 2.19	2.05 ± 0.17	5	152 – 192	171 ± 19
LA	6	0.22 – 1.00	0.63 ± 0.27	7	0.50 – 1.00	0.82 ± 0.17	6	1.58 – 2.34	1.94 ± 0.31	7	167 – 330	243 ± 52
Discocyclina nandori												
MS	2	0.58 – 0.62	0.60	2	0.90 – 0.95	0.92	2	1.92 – 2.11	2.02	2	97 – 107	102
LA	5	0.46 – 0.98	0.71 ± 0.28	5	0.52 – 0.97	0.74 ± 0.24	5	1.61 – 1.94	1.81 ± 0.16	5	131 – 172	154 ± 21
VG	2	0.81 – 0.83	0.82	2	0.65 – 0.77	0.71	2	1.84 – 2.08	1.96	2	102 – 107	104
Discocyclina trabayensis												
HX	3	1.00 – 1.32	1.20	3	0.30 – 0.50	0.37	3	1.56 – 1.62	1.60	3	52 – 62	56
NF	2	0.94 – 1.19	1.06	2	0.36 – 0.54	0.45	2	1.58 – 1.71	1.64	2	55	55
SB	2	1.14 – 1.33	1.24	2	0.31 – 0.40	0.35	2	1.37 – 1.65	1.51	2	52 – 65	58
BO	6	1.17 – 1.64	1.36 ± 0.18	6	0.15 – 0.40	0.29 ± 0.10	6	1.17 – 1.53	1.35 ± 0.14	6	50 – 77	62 ± 11
GN	2	1.16 – 1.25	1.20	2	0.33 – 0.36	0.35	2	1.37 – 1.70	1.54	2	60 – 67	63
AJ	4	0.75 – 1.21	1.05 ± 0.33	4	0.36 – 0.71	0.48 ± 0.26	4	1.55 – 1.74	1.63 ± 0.13	4	55 – 70	64 ± 10
MS	3	0.91 – 1.04	0.97	3	0.46 – 0.58	0.53	3	1.74 – 2.04	1.85	3	67 – 70	68
PR	1	0.89	0.89	1	0.58	0.58	1	1.52	1.52	1	97	97

D (μm)			N			H (μm)			$n_{0.5}$			Determination of the subspecies
No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	
8	100–141	116 ± 12	8	7–13	9.8 ± 1.8	8	25–35	31.2 ± 3.0	8	12.5–16.5	14.3 ± 1.3	sourbetensis
3	92–124	103	3	9–12	10.0	3	25–40	31.7	3	15.5–18.0	16.4	sourbetensis
2	89–99	94	2	7–8	7.5	2	25–35	30.0	2	15.5–17.0	16.2	sourbetensis
3	83–111	100	3	8–9	8.7	3	25–45	31.7	3	15.7–16.7	16.3	sourbetensis
2	97–137	117	3	7–11	9.0	2	25–40	32.5	2	15.5–20.0	17.8	sourbetensis
2	121–138	130	2	9–13	11.0	2	30–50	40.0	1	12.0	12.0	? sourbetensis
17	115–169	141 ± 8	16	11–18	14.1 ± 1.2	17	30–50	35.6 ± 3.3	17	13.6–18.2	15.5 ± 0.8	atlantica
5	125–150	138 ± 11	5	10–14	11.8 ± 2.0	5	25–50	37.0 ± 12.1	5	10.8–17.0	13.8 ± 2.8	atlantica
12	172–236	207 ± 12	12	15–25	20.1 ± 2.0	12	30–55	39.2 ± 6.3	12	12.5–16.2	14.4 ± 0.7	augustae
1	175	175	1	16	16.0	1	30	30.0	1	13.5	13.5	? augustae
12	172–273	215 ± 19	12	14–24	20.3 ± 2.3	12	30–45	39.6 ± 3.2	12	9.8–13.0	11.5 ± 0.6	augustae
2	219–258	238	2	21–27	24.0	2	55–60	57.5	2	11.0–12.0	11.5	augustae
4	169–226	210 ± 44	4	17–23	20.0 ± 3.9	4	50–55	53.8 ± 4.0	4	11.6–15.5	13.4 ± 2.6	augustae
4	174–277	202 ± 80	4	16–25	19.8 ± 4.0	4	45–55	50.0 ± 6.5	4	11.0–16.5	14.6 ± 2.2	augustae
7	97–164	135 ± 21	7	11–16	13.6 ± 2.3	7	25–50	40.0 ± 8.4	5	12.0–16.0	13.1 ± 2.1	–
1	173	173	1	16	16.0	2	40–50	45.0	2	11.2–14.5	12.8	–
6	107–142	126 ± 13	6	9–16	12.8 ± 2.7	6	25–30	35.7 ± 8.6	6	15.0–19.0	17.2 ± 1.9	ganensis
14	159–197	177 ± 7	14	11–22	16.7 ± 2.0	14	35–50	45.0 ± 2.5	14	12.2–16.0	13.7 ± 0.7	taurica
9	171–227	195 ± 14	9	15–23	18.3 ± 2.0	9	30–40	36.7 ± 5.8	9	11.5–14.8	13.1 ± 0.9	taurica
2	210–212	211	2	25	25.0	2	30	30.0	2	12.5–13.2	12.8	? taurica
3	216–232	224	3	22–31	25.0	3	45–50	46.7	3	13.5–14.7	14.2	nussdorfensis
4	208–263	237 ± 41	4	26–32	27.8 ± 4.6	4	25–35	32.5 ± 8.0	4	12.0–14.5	13.6 ± 1.8	nussdorfensis
1	237	237	1	21	21.0	1	50	50.0	1	11.5	11.5	nussdorfensis
2	242–273	258	2	18–20	19.0	2	25–60	42.4	2	10.5–15.0	12.8	? nussdorfensis
4	219–242	230 ± 15	4	18–22	20.5 ± 2.8	4	30–40	35.0 ± 6.5	4	12.0–14.0	12.8 ± 1.5	nussdorfensis
1	260	260	1	20	20.0	1	40	40.0	1	12.0	12.0	? nussdorfensis
5	225–382	291 ± 72	5	21–36	28.0 ± 4.8	5	60–70	62.0 ± 5.6	5	11.0–15.5	13.3 ± 2.1	hungarica
5	265–349	292 ± 42	5	27–34	30.5 ± 5.0	5	40–65	52.0 ± 17.9	5	11.4–16.0	13.5 ± 2.1	hungarica
12	236–345	285 ± 20	12	23–32	28.1 ± 1.8	12	45–70	59.2 ± 5.9	12	10.8–15.7	12.8 ± 0.9	hungarica
2	415–498	456	2	45–48	46.5	2	50	50.0	2	10.0–10.5	10.2	dispansa
3	461–490	473	4	35–44	39.8 ± 5.9	4	55–70	61.2 ± 10.0	3	9.0–13.5	11.7	dispansa
3	557–624	601	3	44–49	46.0	3	60–110	86.7	3	5.5–7.8	6.6	umbilicata
2	537–582	560	2	40–43	41.5	2	50–60	55.0	2	7.5–11.0	9.2	umbilicata
11	185–271	226 ± 16	11	15–22	19.1 ± 1.4	11	45–75	55.0 ± 5.8	11	9.0–12.0	11.0 ± 0.7	–
1	176	176	1	15	15.0	1	55	55.0	1	9.0	9.0	noussensis
26	225–337	265 ± 10	27	17–23	23.8 ± 1.3	27	55–80	63.2 ± 2.7	27	7.9–11.3	9.9 ± 0.4	noussensis
5	255–302	275 ± 22	5	21–29	24.2 ± 3.9	5	55–60	58.0 ± 3.4	5	9.0–11.0	10.2 ± 1.1	noussensis
2	224–272	248	2	21–28	24.5	2	55–60	57.5	2	9.9–1.0	10.0	noussensis
7	245–326	293 ± 27	8	21–30	26.0 ± 2.8	8	50–90	71.2 ± 10.7	8	8.1–11.0	9.1 ± 0.8	radians
24	214–374	314 ± 19	24	19–35	26.9 ± 1.8	24	55–100	79.0 ± 5.3	23	6.3–12.0	8.9 ± 0.6	radians
5	327–366	349 ± 19	5	25–34	29.0 ± 4.5	5	70–95	83.0 ± 12.1	5	7.2–9.8	8.5 ± 1.3	radians
8	390–627	480 ± 62	7	30–37	32.7 ± 2.7	10	75–140	100.0 ± 12.8	10	5.4–7.8	6.7 ± 0.6	labatlanensis
2	205	205	2	17–28	17.5	2	55	55.0	2	10.0–11.2	10.6	–
5	245–313	279 ± 32	4	20–23	21.5 ± 2.1	5	55–80	66.0 ± 11.9	5	7.0–10.0	9.0 ± 1.5	–
2	197–212	204	2	17–20	18.5	2	55–60	57.5	2	8.5–9.2	8.8	–
3	81–100	88	3	4–6	5.0	3	20–25	21.7	3	15.8–18.0	16.7	trabayensis
2	87–94	91	2	4–6	5.0	2	20–25	22.5	2	13.0–19.0	16.0	trabayensis
2	86–89	88	2	5	5.0	2	25–30	27.5	2	17.2–19.5	18.4	trabayensis
6	71–100	83 ± 10	6	3–6	4.5 ± 1.1	6	20–30	26.7 ± 4.3	3	13.0–17.5	15.2	trabayensis
2	92–102	97	2	4–5	4.5	2	25	25.0	2	18.5–21.5	20.0	trabayensis
4	88–122	104 ± 22	3	7–11	8.7	4	25–30	26.2 ± 4.0	4	16.0–19.5	17.6 ± 2.4	concentrica
3	118–137	126	4	7–11	9.5 ± 2.8	4	25–30	27.5 ± 4.6	3	16.8–18.8	17.9	vicenzensis
1	147	147	1	12	12.0	1	40	40.0	1	14.0	14.0	vicenzensis

Population	E			R			Q			P (μm)		
	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ
Discocyclina aaroni												
HX	2	0.81—0.86	0.84	2	0.63—0.67	0.65	2	1.80—1.97	1.88	2	90—100	95
DF	9	0.77—1.16	0.97 ± 0.09	9	0.38—0.71	0.52 ± 0.08	9	1.60—1.91	1.75 ± 0.07	9	85—110	94 ± 7
DM	3	0.48—0.86	0.61	3	0.62—1.11	0.90	3	1.94—2.41	2.19	3	145—166	152
NT	6	0.33—0.97	0.57 ± 0.23	6	0.53—1.43	0.98 ± 0.31	6	1.88—2.52	2.21 ± 0.26	6	110—198	139 ± 36
ND	1	0.62	0.62	1	0.91	0.91	1	2.32	2.32	1	115	115
FM	1	0.82	0.82	1	0.68	0.68	1	2.26	2.26	1	155	155
Discocyclina euaensis												
LA	6	0.57—0.73	0.66 ± 0.06	6	0.77—1.03	0.90 ± 0.10	6	1.90—2.87	2.43 ± 0.37	6	152—195	174 ± 18
Discoydina pratti												
HX	2	0.63—0.76	0.70	2	0.70—0.84	0.77	2	1.80—1.88	1.84	2	157—164	160
NF	1	0.68	0.68	1	0.71	0.71	1	1.52	1.52	1	152	152
DF	2	0.60—0.77	0.69	2	0.68—0.85	0.76	2	1.63—1.85	1.74	2	187—224	205
NC	1	0.50	0.50	1	1.07	1.07	1	2.02	2.02	1	162	162
FM	4	0.50—0.90	0.67 ± 0.32	4	0.59—1.07	0.85 ± 0.36	4	2.07—2.46	2.28 ± 0.27	4	145—198	168 ± 40
AM	14	0.23—0.77	0.55 ± 0.08	14	0.75—1.36	0.99 ± 0.11	14	1.58—3.18	2.30 ± 0.25	14	110—272	199 ± 26
AJ	2	0.56—0.58	0.57	2	1.00—1.20	1.10	2	2.34—2.62	2.48	2	180—223	202
DU	37	0.03—1.00	0.50 ± 0.09	37	0.50—1.62	1.01 ± 0.09	37	1.61—3.28	2.22 ± 0.13	37	152—508	235 ± 23
LA	15	0.02—0.28	0.11 ± 0.05	15	1.26—1.67	1.46 ± 0.07	15	1.81—3.10	2.31 ± 0.20	16	255—600	372 ± 44
Discocyclina samantai												
LA	3	0.19—0.35	0.28	3	1.27—1.48	1.35	3	1.95—2.63	2.28	3	348—394	364
Discocyclina pulcra												
HX	1	0.06	0.00	1	1.24	1.24	1	1.63	1.63	1	314	314
GN	1	0.09	0.00	1	1.30	1.30	1	1.76	1.76	1	489	489
AM	5	0.01—0.11	0.00 ± 0.09	5	1.32—1.88	1.51 ± 0.29	5	1.76—2.21	1.97 ± 0.22	5	401— 648	527 ± 133
AJ	29	0.00—0.14	0.00 ± 0.02	29	1.25—1.58	1.40 ± 0.03	29	1.56—2.28	1.87 ± 0.07	29	475—1099	707 ± 57
DU	15	0.01—0.14	0.00 ± 0.04	15	1.19—1.57	1.38 ± 0.07	15	1.54—2.17	1.80 ± 0.10	15	652—1311	939 ± 91
Nemkovella evae												
LP	1	1.18	1.18	1	0.42	0.42	1	1.11	1.11	1	169	169
HX	5	0.90—1.16	1.09 ± 0.13	5	0.36—0.58	0.44 ± 0.10	5	1.32—1.78	1.47 ± 0.25	5	97—189	131 ± 44
NA	4	0.78—1.09	0.96 ± 0.22	4	0.43—0.62	0.52 ± 0.14	4	1.33—2.03	1.70 ± 0.48	4	92—147	114 ± 41
NF	11	0.76—1.27	1.04 ± 0.10	11	0.33—0.70	0.48 ± 0.08	11	1.39—2.02	1.68 ± 0.14	11	90—135	108 ± 10
DA	1	1.03	1.03	1	0.47	0.47	1	1.74	1.74	1	100	100
SB	2	0.88—1.00	0.94	2	0.50—0.60	0.55	2	1.74—1.84	1.78	2	97—102	100
Nemkovella fermonti												
HX	1	0.96	0.96	1	0.53	0.53	1	1.50	1.50	1	90	90
DF	5	1.09—1.30	1.18 ± 0.11	5	0.31—0.44	0.38 ± 0.06	5	1.42—1.71	1.55 ± 0.16	5	70—87	88 ± 9
SB	3	1.00—1.30	1.13	3	0.24—0.43	0.33	3	1.33—1.54	1.44	3	79—97	90
Nemkovella strophiolata												
SB	2	1.09—1.36	1.23	2	0.30—0.44	0.37	2	1.38—1.45	1.42	2	47—52	50
BO	3	1.28—1.46	1.36	3	0.22—0.27	0.25	3	1.28—1.62	1.43	3	50—69	60
NC	18	1.00—1.35	1.15 ± 0.05	18	0.23—0.50	0.39 ± 0.04	18	1.28—1.71	1.50 ± 0.09	18	77—127	97 ± 5
GN	4	0.91—1.33	1.11 ± 0.28	4	0.27—0.57	0.42 ± 0.20	4	1.48—1.54	1.51 ± 0.04	4	80—100	89 ± 14
AM	1	1.17	1.17	1	0.38	0.38	1	1.46	1.46	1	87	87
AJ	10	0.94—1.60	1.16 ± 0.14	10	0.20—0.54	0.40 ± 0.07	10	1.18—1.62	1.47 ± 0.11	10	87—130	108 ± 10
DU	1	0.93	0.93	1	0.55	0.55	1	1.47	1.47	1	100	100
MS	2	0.75—1.09	0.92	2	0.43—0.75	0.59	2	1.53—2.10	1.82	2	100—117	108
LA	3	0.75—1.05	0.88	3	0.46—0.66	0.58	3	1.38—1.76	1.58	3	124—157	143
Orbitoclypeus ramaraoi												
SC	4	0.45—0.69	0.58 ± 0.16	4	0.74—1.07	0.88 ± 0.23	4	1.56—2.64	1.88 ± 0.81	4	87—137	107 ± 35
CP	6	0.26—0.84	0.49 ± 0.27	6	0.68—.133	0.97 ± 0.27	6	1.60—2.12	1.83 ± 0.21	6	112—150	133 ± 15
PA	4	0.05—0.34	0.21 ± 0.51	4	1.17—1.50	1.28 ± 0.24	4	1.82—2.01	1.90 ± 0.14	4	160—167	162 ± 5
LP	1	0.26	0.26	1	1.05	1.05	1	1.54	1.54	1	195	195
NA	1	0.26	0.26	1	1.08	1.08	1	1.59	1.59	1	195	195
DA	1	0.32	0.32	1	1.21	1.21	1	2.20	2.20	1	135	135
Orbitoclypeus marthae												
SB	8	0.06—0.46	0.22 ± 0.10	8	1.08—1.40	1.26 ± 0.09	8	1.73—2.24	1.96 ± 0.16	8	110—200	148 ± 24

D (μm)			N			H (μm)			$n_{0.5}$			Determination of the subspecies
No	Range	Mean ± ρ	No	Range	Mean ± ρ	No	Range	Mean ± ρ	No	Range	Mean ± ρ	
2	162—197	180	2	17—21	19.0	2	35—40	37.5	2	12.5—13.0	12.8	chalossensis
9	139—194	165 ± 14	9	14—20	16.3 ± 1.5	9	40—60	48.3 ± 5.1	9	13.0—15.8	14.7 ± 1.0	chalossensis
3	322—349	332	3	23—29	26.0	3	85—90	88.3	3	9.6—10.8	10.1	aaroni
6	240—372	302 ± 55	6	20—28	23.8 ± 3.4	6	55—80	63.3 ± 11.8	6	8.6—13.5	10.8 ± 1.8	aaroni
1	267	267	1	21	21.0	1	55	55.0	1	10.8	10.8	aaroni
1	351	351	1	27	27.0	1	65	65.0	1	8.5	8.5	aaroni
8	336—500	419 ± 47	8	30—36	31.9 ± 3.5	8	75—105	83.8 ± 9.2	8	6.8—8.5	7.5 ± 0.5	—
2	295—296	296	2	20—21	20.5	2	50—55	52.5	2	10.0—11.2	10.6	aquitanica
1	231	231	1	24	24.0	1	60	60.0	1	10.5	10.5	aquitanica
2	346—365	346	2	27—30	28.5	2	65—70	67.5	2	7.5—8.0	7.8	montfortensis
1	327	327	1	28	28.0	1	80	80.0	1	8.0	8.0	montfortensis
4	341—407	380 ± 49	3	31—36	33.3	4	45—70	60.0 ± 17.2	4	6.8—8.0	7.6 ± 0.9	montfortensis
15	350—617	450 ± 44	15	27—40	35.6 ± 2.2	15	60—110	85.7 ± 9.2	10	6.5—9.6	7.6 ± 0.6	pratti
2	422—584	503	3	32—45	37.3	2	55—90	72.5	3	6.0—7.0	6.5	pratti
37	382—910	511 ± 40	37	27—67	39.6 ± 3.0	37	76—155	90.1 ± 6.0	37	5.5—8.6	7.1 ± 0.3	pratti
16	585—1177	844 ± 84	15	50—80	60.9 ± 4.3	16	110—160	140.3 ± 8.9	16	4.0—8.0	5.3 ± 0.6	minor
4	755—920	808 ± 139	3	45—66	55.0	5	100—120	108.0 ± 11.3	5	4.2—5.3	4.8 ± 0.5	—
1	512	512	1	35	35.0	1	55	55.0	1	8.8	8.8	landesica
1	859	859	1	60	60.0	1	115	115.0	1	5.2	5.2	pulcra
5	832—1272	1031 ± 221	5	72—80	76.4 ± 4.4	5	120—210	161.0 ± 40.3	5	3.4—4.8	4.2 ± 0.7	pulcra
30	938—2024	1306 ± 82	28	66—120	84.7 ± 5.4	31	160—270	216.3 ± 10.4	31	2.8—4.4	3.6 ± 0.2	balatonica
15	1247—2014	1674 ± 122	15	76—128	92.6 ± 8.1	15	205—300	246.3 ± 19.3	15	2.4—3.8	3.0 ± 0.2	baconica
1	188	188	1	14	14.0	1	55	55.0	1	12.5	12.5	—
5	146—259	191 ± 60	5	8—14	10.8 ± 2.8	5	40—50	43.0 ± 5.6	5	15.5—18.5	17.2 ± 1.4	—
4	169—196	188 ± 20	4	11—16	13.2 ± 3.3	4	35—65	48.8 ± 19.9	4	9.5—12.0	11.2 ± 1.8	—
11	135—245	181 ± 21	11	9—17	13.1 ± 1.9	11	45—60	49.5 ± 3.2	11	11.5—15.5	14.0 ± 1.0	—
1	174	174	1	11	11.0	1	45	45.0	1	13.0	13.0	—
2	177—178	178	2	11—14	12.5	2	40	40.0	2	15.0—16.0	15.5	—
1	135	135	1	11	11.0	1	35	35.0	1	18.0	18.0	—
5	116—128	123 ± 8	5	8—9	8.2 ± 0.6	5	25—35	30.0 ± 4.4	4	15.5—17.5	16.9 ± 1.2	—
3	122—132	127	3	7—9	8.0	3	30—50	40.0	3	16.0—17.5	16.5	—
2	68—72	70	2	3—5	4.0	2	20	20.0	2	20.0—22.0	21.0	bodrakensis
3	64—97	86	3	4—7	5.0	3	30—35	31.7	3	14.5—22.0	17.8	bodrakensis
18	129—174	146 ± 6	18	6—13	9.7 ± 0.9	19	30—40	34.0 ± 1.7	19	16.0—22.8	18.1 ± 0.8	strophiolata
4	123—154	135 ± 22	4	7—11	8.5 ± 2.8	4	30—35	32.5 ± 4.6	4	17.5—20.5	19.1 ± 2.1	strophiolata
1	127	127	1	8	8.0	1	35	35.0	1	20.0	20.0	strophiolata
10	125—204	158 ± 15	10	7—14	10.3 ± 1.4	10	30—50	38.5 ± 4.5	10	14.5—21.0	18.0 ± 1.6	strophiolata
1	147	147	1	11	11.0	1	45	45.0	1	18.0	18.0	strophiolata
2	179—210	194	2	10—12	11.0	2	40	40.0	2	15.5—16.5	16.0	tenella
3	203—250	224	2	12—13	12.5	2	45—50	47.5	2	15.8—16.5	16.2	tenella
5	164—224	198 ± 34	5	11—17	14.0 ± 2.8	5	35—50	43.0 ± 8.3	4	15.0—17.5	16.1 ± 1.8	neumannae
7	202—267	242 ± 23	7	19—26	21.3 ± 2.7	7	40—55	47.9 ± 5.2	7	9.8—14.6	12.3 ± 1.6	suvlukayensis
6	295—322	309 ± 14	6	28—32	30.0 ± 1.5	6	45—60	48.3 ± 6.4	5	10.0—13.0	11.2 ± 1.6	crimensis
1	342	342		—		1	40	40.0	1	11.5	11.5	crimensis
1	310	310	1	30	30.0	1	45	45.0		—		crimensis
2	297—323	310	1	30	30.0	2	55—80	67.5	2	8.5—11.0	9.8	crimensis
8	240—355	286 ± 30	8	30—35	31.9 ± 1.5	8	40—55	45.6 ± 4.7	7	13.5—16.0	14.7 ± 0.8	—

Population	E No	E Range	E Mean ± ϱ	R No	R Range	R Mean ± ϱ	Q No	Q Range	Q Mean ± ϱ	P (μm) No	P (μm) Range	P (μm) Mean ± ϱ
Orbitoclypeus bayani												
SC			—			—			—			—
HX	3	0.05 – 0.20	0.14	3	1.22 – 1.38	1.28	3	1.59 – 2.01	1.76	3	157 – 210	187
Orbitoclypeus douvillei												
SB	1	0.48	0.48	1	1.00	1.00	1	2.29	2.29	1	115	115
GN	2	0.36 – 0.51	0.43	2	0.94 – 1.19	1.07	2	1.78 – 2.20	1.99	2	157 – 167	162
Orbitoclypeus portnayae												
DF	4	0.48 – 0.67	0.55 ± 0.13	4	0.73 – 1.00	0.88 ± 0.18	4	1.70 – 2.08	1.93 ± 0.87	4	65 – 72	69 ± 5
Orbitoclypeus varians												
HX	4	0.24 – 0.64	0.46 ± 0.32	4	0.77 – 1.24	1.02 ± 0.34	4	1.48 – 2.14	1.81 ± 0.43	4	64 – 122	94 ± 44
AM	25	0.16 – 0.94	0.46 ± 0.06	25	0.54 – 1.36	0.97 ± 0.07	25	1.39 – 2.28	1.74 ± 0.08	25	95 – 192	137 ± 11
AJ	42	0.11 – 0.48	0.27 ± 0.04	42	0.82 – 1.32	1.16 ± 0.04	42	1.54 – 2.11	1.81 ± 0.04	42	125 – 200	160 ± 6
DU	20	0.11 – 0.40	0.28 ± 0.04	20	0.96 – 1.42	1.12 ± 0.06	20	1.51 – 2.43	1.74 ± 0.09	20	165 – 245	201 ± 11
CM	10	0.10 – 0.41	0.22 ± 0.07	10	0.92 – 1.32	1.18 ± 0.08	10	1.61 – 1.92	1.74 ± 0.08	10	175 – 336	244 ± 35
SO	2	0.17 – 0.28	0.22	2	1.06 – 1.18	1.12	2	1.61 – 1.75	1.68	2	217 – 297	257
MS	1	0.34	0.34	1	1.30	1.30	1	2.17	2.17	1	184	184
LA	10	0.17 – 0.43	0.30 ± 0.07	10	1.00 – 1.19	1.10 ± 0.06	10	1.54 – 1.82	1.69 ± 0.06	10	205 – 376	271 ± 37
Orbitoclypeus furcata												
AM			—			—			—			—
AJ	6	0.12 – 0.43	0.24 ± 0.12	6	1.10 – 1.39	1.25 ± 0.11	6	1.66 – 2.44	2.00 ± 0.30	6	131 – 177	154 ± 15
DU	2	0.32 – 0.36	0.34	2	1.20 – 1.28	1.24	2	1.99 – 2.10	2.04	2	144 – 164	154
LA	2	0.08 – 0.23	0.16	2	1.43 – 1.58	1.51	2	1.92 – 2.30	2.11	2	155 – 160	158
Orbitoclypeus chudeaui												
NC	1	0.51	0.51	1	1.06	1.06	1	1.80	1.80	1	172	172
AM	1	0.73	0.73	1	0.75	0.75	1	1.91	1.91	1	181	181
AJ	8	0.34 – 0.61	0.45 ± 0.07	8	0.94 – 1.30	1.08 ± 0.10	9	1.86 – 2.36	2.14 ± 0.13	9	157 – 262	198 ± 34
DU	25	0.43 – 0.97	0.66 ± 0.06	25	0.52 – 1.04	0.83 ± 0.06	25	1.52 – 2.43	1.89 ± 0.09	26	176 – 307	246 ± 17
Orbitoclypeus katoae												
AJ	9	0.54 – 1.27	0.88 ± 0.18	9	0.32 – 1.06	0.63 ± 0.18	9	1.52 – 2.26	1.85 ± 0.17	9	175 – 263	209 ± 22
Orbitoclypeus schopeni												
SB	1	0.31	0.31	1	1.24	1.24	1	2.00	2.00	1	192	192
Orbitoclypeus koehleri												
DF	3	0.00 – 0.11	0.07	3	1.48 – 1.68	1.59	3	2.24 – 2.66	2.39	3	235 – 269	251
Orbitoclypeus daguini												
SB	1	1.22	1.22	1	0.38	0.38	1	1.19	1.19	1	42	42
AJ	2	1.60	1.60	2	0.12 – 0.20	0.16	2	1.21 – 1.27	1.24	2	45 – 52	48
CM	1	1.17	1.17	1	0.38	0.38	1	1.64	1.64	1	47	47
Asterocyclina stella												
CP	1	1.11	1.11	1	0.44	0.44	1	1.33	1.33	1	87	87
HX	5	0.64 – 1.28	0.96 ± 0.37	5	0.33 – 0.72	0.53 ± 0.23	5	1.31 – 1.49	1.42 ± 0.09	5	82 – 90	86 ± 5
DF	3	0.85 – 1.24	1.00	3	0.37 – 0.62	0.52	3	1.19 – 1.82	1.49	3	67 – 109	86
SB	6	1.05 – 1.33	1.18 ± 0.10	6	0.33 – 0.47	0.38 ± 0.06	6	1.28 – 1.90	1.54 ± 0.27	6	60 – 80	70 ± 9
AM	1	1.24	1.24	1	0.37	0.37	1	1.29	1.29	1	97	97
CM	1	1.04	1.04	1	0.48	0.48	1	1.39	1.39	3	105 – 135	120
MS	1	1.09	1.09	1	0.44	0.44	1	1.45	1.45	1	147	147
LA	1	1.36	1.36	1	0.31	0.31	1	1.26	1.26	1	152	152
Asterocyclina stellata												
SB	3	1.00 – 1.29	1.17	3	0.31 – 0.50	0.40	3	1.22 – 1.36	1.31	3	70 – 100	87
NC	14	0.89 – 1.39	1.08 ± 0.07	14	0.18 – 0.58	0.44 ± 0.05	14	1.52 – 1.93	1.72 ± 0.06	14	62 – 85	73 ± 3
GN	4	1.04 – 1.33	1.21 ± 0.19	4	0.29 – 0.37	0.36 ± 0.13	4	1.46 – 1.57	1.52 ± 0.07	4	65 – 92	79 ± 19
FM	1	1.08	1.08	1	0.44	0.44	1	1.46	1.46	1	95	95
ND	1	0.96	0.96	1	0.53	0.53	1	1.77	1.77	1	77	77
AM	8	0.68 – 1.43	1.09 ± 0.26	8	0.25 – 0.76	0.46 ± 0.17	8	1.21 – 1.72	1.44 ± 0.15	8	77 – 110	94 ± 10
AJ	17	0.71 – 1.25	1.04 ± 0.07	17	0.31 – 0.75	0.48 ± 0.05	17	1.28 – 1.92	1.55 ± 0.08	17	65 – 110	90 ± 6
DU	3	1.03 – 1.07	1.05	3	0.45 – 0.48	0.47	3	1.50 – 1.78	1.61	3	97 – 105	102
CM	4	1.06 – 1.27	1.15 ± 0.14	5	0.32 – 0.60	0.44 ± 0.13	4	1.32 – 1.73	1.50 ± 0.31	6	102 – 145	113 ± 17

D (μm)			N			H (μm)			$n_{0.5}$			Determination of the subspecies
No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	
1	372	372	1	30	30.0	1	60	60.0	1	11.5	11.5	—
3	310—355	327	3	26—35	30.3	3	50—60	55.0	2	11.0—12.5	11.8	—
1	240	240	1	18	18.0	1	55	55.0	1	11.5	11.5	—
2	297—345	321	2	19	19.0	2	60—70	65.0	1	10.0	10.0	—
4	119—150	134 ± 23	4	9—16	12.2 ± 4.8	4	25—40	31.2 ± 10.0	4	12.0—19.0	15.2 ± 4.6	—
4	137—200	165 ± 48	4	12—18	15.2 ± 5.1	4	25—45	36.2 ± 13.6	4	17.5—21.7	17.9 ± 5.2	horsarrieuensis
29	175—311	237 ± 14	29	17—35	23.9 ± 1.7	29	35—65	47.1 ± 2.5	27	12.2—18.5	15.2 ± 0.6	angoumensis
46	240—372	290 ± 7	46	22—35	28.1 ± 1.0	46	50—70	55.2 ± 1.5	46	9.0—15.0	11.9 ± 0.4	roberti
20	285—437	347 ± 19	20	24—42	31.2 ± 2.0	20	45—65	54.0 ± 2.8	19	9.0—14.5	11.8 ± 0.7	scalaris
10	307—564	424 ± 60	10	35—55	43.6 ± 5.1	10	50—70	57.0 ± 4.8	10	10.0—13.0	10.6 ± 0.9	varians
2	380—479	429	2	33—35	34.0	2	75	75.0	2	8.0—10.5	9.2	varians
1	400	400	1	43	43.0	1	80	80.0	1	10.5	10.5	varians
12	362—607	457 ± 43	9	29—45	34.9 ± 4.2	11	50—80	64.5 ± 7.1	12	8.5—13.0	10.8 ± 0.9	varians
1	285	285		—		1	55	55.0	1	14.5	14.5	rovasendai
14	245—332	289 ± 16	14	25—35	30.3 ± 1.6	15	40—60	51.7 ± 3.7	15	12.2—17.0	14.4 ± 0.8	rovasendai
2	302—326	314	2	27	27.0	2	50—65	57.5	2	10.0—11.0	10.5	rovasendai
8	307—471	386 ± 46	7	27—45	35.7 ± 4.9	7	60—85	65.9 ± 9.4	8	8.0—14.0	11.4 ± 1.6	furcata
1	309	309	1	26	26.0	1	70	70.0	1	9.4	9.4	chudeaui
1	346	346	1	20	20.0	1	90	90.0	1	9.8	9.8	chudeaui
10	335—555	424 ± 51	9	18—30	25.6 ± 3.2	10	70—100	93.0 ± 9.8	10	6.9—10.0	7.9 ± 0.6	pannonicus
25	355—574	454 ± 23	23	16—29	21.0 ± 1.5	26	55—100	88.5 ± 9.3	27	6.0—10.0	8.1 ± 0.5	pannonicus
9	332—427	382 ± 25	8	15—20	18.2 ± 1.6	9	55—75	65.6 ± 5.9	8	8.7—11.0	9.8 ± 0.7	—
1	385	385	1	28	28.0	1	80	80.0	1	7.0	7.0	—
4	535—710	626 ± 89	4	36—50	43.5 ± 9.2	4	55—85	71.2 ± 21.9	4	6.2—7.2	6.6 ± 0.8	—
1	50	50	1	1	1.0	1	20	20.0	1	24.0	24.0	—
2	57—63	60	2	1	1.0	2	20	20.0	2	25.0—29.0	27.0	—
1	77	77	1	1	1.0	1	20	20.0	1	20.4	20.4	—
1	116	116	1	11	11.0	1	40	40.0	1	17.0	17.0	taramellii
5	110—134	122 ± 12	6	6— 8	7.3 ± 0.9	6	20—30	25.8 ± 4.0	3	20.0—21.0	20.7	taramellii
3	120—130	124	3	8—11	9.3	3	25—30	28.3	3	19.0—20.2	19.7	taramellii
6	77—118	107 ± 16	6	5— 8	6.5 ± 1.3	6	25—30	27.5 ± 2.9	6	17.0—21.8	18.8 ± 1.9	taramellii
1	125	125	1	10	10.0	1	35	35.0	1	19.3	19.3	taramellii
1	165	165	1	12	12.0	1	35	35.0	1	20.0	20.0	stella
1	213	213	1	12	12.0	1	60	60.0	1	14.0	14.0	praestellaris
1	191	191	1	13	13.0	1	55	55.0	1	19.0	19.0	praestellaris
3	94—136	114	3	3—7	4.3	3	30—45	36.7	3	16.2—19.5	18.1	adourensis
14	102—131	118 ± 5	14	3—5	3.5 ± 0.4	14	30—45	35.0 ± 2.8	11	18.5—24.0	21.0 ± 1.1	adourensis
4	102—134	119 ± 23	4	3—4	3.5 ± 0.9	4	30—50	41.2 ± 13.6	3	18.0—19.5	18.8	adourensis
1	139	139	1	5	5.0	1	40	40.0		—		? adourensis
1	136	136	1	3	3.0	1	40	40.0		—		? adourensis
8	118—150	134 ± 9	8	3—7	4.2 ± 1.2	9	30—50	40.0 ± 5.2	7	16.0—22.4	20.1 ± 2.1	stellata
17	114—159	138 ± 7	17	3—7	4.4 ± 0.6	17	30—80	43.5 ± 5.8	16	16.5—23.5	20.5 ± 1.0	stellata
3	145—187	165	3	4—5	4.7	3	35—50	41.7	2	18.0—21.0	19.5	stellaris
4	152—195	173 ± 28	2	3	3.0	2	50—65	57.5	3	17.5—19.0	18.3	stellaris

Population	E No	E Range	E Mean ± ϱ	R No	R Range	R Mean ± ϱ	Q No	Q Range	Q Mean ± ϱ	P (μm) No	P (μm) Range	P (μm) Mean ± ϱ
Asterocyclina stellata												
SO	7	1.04–1.44	1.18 ± 0.13	7	0.27–0.47	0.38 ± 0.08	7	1.15–1.70	1.52 ± 0.17	7	100–175	121 ± 26
MS	8	0.90–1.29	1.14 ± 0.11	8	0.32–0.56	0.40 ± 0.07	8	1.36–1.59	1.49 ± 0.07	8	107–142	117 ± 10
LA	13	0.59–1.24	0.98 ± 0.11	13	0.33–0.80	0.52 ± 0.08	13	1.32–1.83	1.57 ± 0.10	13	82–145	117 ± 11
VG	1	1.14	1.14	1	0.38	0.38	1	1.78	1.78	1	92	92
Asterocyclina priabonensis												
LA	3	0.83–1.06	0.94	3	0.46–0.63	0.55	3	1.54–1.80	1.65	3	112–142	133
Asterocyclina kecskemetii												
SB	1	1.24	1.24	1	0.37	0.37	1	1.29	1.29	1	102	102
AM	1	1.04	1.04	1	0.48	0.48	1	1.40	1.40	1	121	121
AJ	4	0.98–1.20	1.09 ± 0.15	4	0.38–0.52	0.44 ± 0.10	4	1.45–1.81	1.59 ± 0.27	4	117–169	142 ± 44
DU	3	0.95–1.10	1.03	3	0.43–0.54	0.48	3	1.66–1.91	1.79	3	112–155	131
CM	1	0.92	0.92	1	0.56	0.56	1	1.67	1.67	1	182	182
Asterocyclina alticostata												
NC	2	1.40–1.43	1.42	2	0.26–0.28	0.27	2	1.20–1.29	1.25	2	162–177	170
GN	5	1.25–1.41	1.30 ± 0.08	5	0.29–0.37	0.33 ± 0.04	5	1.17–1.38	1.30 ± 0.10	5	152–177	165 ± 13
AM	7	1.47–1.73	1.61 ± 0.10	7	0.15–0.26	0.20 ± 0.04	7	1.00–1.34	1.14 ± 0.10	7	172–217	198 ± 15
AJ	10	1.23–1.50	1.35 ± 0.07	10	0.26–0.38	0.31 ± 0.03	10	1.05–1.58	1.24 ± 0.10	10	160–229	204 ± 16
DU	17	1.06–1.60	1.36 ± 0.08	17	0.17–0.47	0.31 ± 0.05	17	1.00–1.34	1.20 ± 0.04	17	224–319	264 ± 13
CM	2	1.00–1.38	1.19	2	0.27–0.50	0.38	2	1.20–1.21	1.21	2	248–326	287
LA	12	1.13–1.85	1.37 ± 0.14	12	0.13–0.42	0.31 ± 0.06	12	0.96–1.54	1.25 ± 0.12	12	269–388	330 ± 29
Asterocyclina schweighauseri												
SB	2	1.02–1.23	1.12	2	0.34–0.49	0.42	2	1.43–1.48	1.45	2	179–216	198
JG	1	1.00	1.00	1	0.60	0.60	1	1.37	1.37	1	231	231
FM	1	1.36	1.36	1	0.22	0.22	1	1.44	1.44	1	323	323

A populáció-rövidítések jegyzéke a lelőhelyleírásoknál, míg *E*, *R*, *Q*, *P*, *D*, *N*, *H* és $n_{0.5}$ magyarázata a morfológiai részben található meg.

The list of abbreviation for populations can be found at the descriptions of the localities, whereas the explanation of *E*, *R*, *Q*, *P*, *D*, *N*, *H* and $n_{0.5}$ is in the morphological part.

D (µm)			N			H (µm)			$n_{0.5}$			Determination of the subspecies
No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	No	Range	Mean ± ϱ	
7	163–207	179 ± 16	7	3–5	4.0 ± 0.8	7	50–65	56.4 ± 5.1	7	13.5–18.0	15.7 ± 1.6	stellaris
8	149–198	173 ± 13	8	3–7	5.1 ± 1.0	8	45–55	50.6 ± 3.5	8	15.5–20.0	18.4 ± 1.3	stellaris
13	132–212	183 ± 15	13	3–9	6.0 ± 1.3	13	30–60	46.9 ± 4.9	13	14.5–21.0	17.7 ± 1.2	stellaris
1	164	164	1	7	7.0	1	50	50.0	1	21.0	21.0	stellaris
3	201–229	216	3	10–14	12.3	3	45–55	51.7	2	15.0–16.0	15.5	–
1	132	132	1	5	5.0	1	50	50.0		–		–
1	169	169	1	12	12.0	1	45	45.0		–		–
4	192–248	224 ± 38	4	10–11	10.5 ± 0.9	4	45–60	52.5 ± 10.3	4	11.4–13.5	13.0 ± 1.7	–
3	202–257	234	3	8–11	9.3	3	45–55	51.7	3	13.5–18.0	16.2	–
1	304	304	1	11	11.0	1	60	60.0	1	12.8	12.8	–
2	209–213	211	2	2–3	2.5	2	50	50.0	2	11.2–11.8	11.5	gallica
5	204–245	215 ± 21	5	2–3	2.2 ± 0.6	5	45–50	47.0 ± 3.4	4	12.0–13.5	13.1 ± 0.9	gallica
7	172–253	225 ± 24	5	2	2.0 ± 0.0	5	30–55	43.0 ± 10.4	6	12.3–15.0	13.4 ± 1.1	cuvillieri
10	198–300	252 ± 23	10	2–4	2.9 ± 0.5	10	30–60	48.0 ± 5.9	9	10.0–15.0	12.2 ± 1.3	cuvillieri
17	265–377	316 ± 17	16	2–6	3.8 ± 0.7	17	45–80	53.8 ± 4.6	17	7.5–15.5	11.2 ± 1.0	alticostata
2	300–392	346		–		1	50	50.0	2	9.0–10.0	9.5	alticostata
12	316–567	408 ± 39	11	2–6	4.0 ± 0.9	12	50–90	61.2 ± 7.2	12	8.0–12.2	10.3 ± 0.8	danubica
2	265–308	287	2	3–11	7.0	2	50	50.0	2	9.0–10.5	9.8	–
1	355	355	1	4	4.0	1	65	65.0	1	12.2	12.2	–
1	465	465	1	8	8.0	1	60	60.0	1	8.9	8.9	–

A belső szerkezetileg ábrázolt Orthophragmina-egyedek méretei
The dimensions of Orthophragmina specimens internally figurated

A vázelemméretek szimbólumainak magyarázata a morfológiai részben található
The explanation of symbols marking the dimensions of the test elements is in the morphological part

Name	Prep.	Pop.	Sample	P_1	P_2	P	D_1	D_2	D	a	E	R	Q	N	L	H	l	h	$n_{0.5}$	$n_{1,0}$
D. ar. bk.	E4596	OS	B 7	145	150	147	270	240	255	−45	0.75	0.70	1.74	24	40	45	40	45	11.5	—
D. ar. bk.	E4597	CR	B 13A	155	140	147	245	215	230	−55	0.86	0.61	1.56	21	45	55	40	55	13.0	26.0
D. ar. bk.	E4598	CR	B 14	160	180	170	390	345	367	+10	0.42	1.06	2.16	35	35	90	35	60	9.2	20.0
D. ar. ss.	E4600	CP	B 21	150	155	152	285	280	282	−5	0.48	0.97	1.86	23	35	55	35	55	9.5	—
D. ar. ss.	E4601	CP	B 21	160	165	162	350	260	302	−35	0.64	0.79	1.86	25	40	50	35	60	11.0	—
D. ar. ar.	E4604	PA	B 24	235	190	211	440	305	366	−30	0.57	0.84	1.73	31	35	60	35	105	9.0	19.0
D. ar. ar.	E4605	PA	B 24	220	195	207	470	325	391	−35	0.62	0.92	1.89	33	35	55	40	70	10.3	19.0
D. ar. ar.	E4606	PF	B 37	155	145	150	360	270	312	−10	0.54	0.93	2.08	29	40	55	45	90	11.0	21.0
D. ar. ar.	E4607	DK	DK	220	235	227	450	395	422	−35	0.58	0.85	1.86	30	40	50	40	70	9.5	20.0
D. ar. ar.	E4610	GA	GB	205	190	197	510	425	466	−20	0.65	0.90	2.36	37	40	60	45	60	10.2	23.0
D. ar. ar.	E4611	GA	GB	160	190	174	445	390	417	+15	0.44	1.08	2.40	36	40	70	45	80	9.0	17.5
D. ar. ar.	E4612	LP	LP	205	190	197	490	350	414	−25	0.60	0.87	2.10	23	35	55	35	55	7.8	16.5
D. ar. ar.	E4613	LP	LP	250	240	245	460	420	440	+10	0.38	1.04	1.80	36	40	60	40	60	9.0	26.0
D. ar. bt.	E4615	NF	E 9	330	280	304	715	560	633	−30	0.61	0.89	2.08	49	40	65	40	80	10.0	17.0
D. ar. bt.	E4616	DA	B 57	360	350	355	590	460	521	−155	0.91	0.56	1.47	34	45	85	35	85	6.8	—
D. ar. bt.	E4617	DF	B 77	255	400	319	730	750	740	+50	0.33	1.12	2.32	58	50	70	35	95	7.5	--
D. ar. bt.	E4618	LP	LP	250	260	255	720	600	657	−55	0.75	0.79	2.58	45	45	70	45	70	7.8	16.5
D. ar. bt.	E4619	SB	SB	210	200	205	705	550	623	+40	0.49	1.20	3.04	50	45	65	45	65	6.5	15.0
D. ar. bt.	E4620	SB	SB	235	240	237	560	490	524	+30	0.39	1.12	2.21	38	45	70	45	70	7.5	16.0
D. ar. bt.	E4621	SB	SB	355	305	329	755	605	676	0	0.50	1.00	2.06	52	45	70	45	70	7.5	15.0
D. fu.	E4623	LP	LP	150	145	147	295	260	277	−35	0.71	0.76	1.88	21	35	50	35	50	10.0	20.0
D. fu.	E4624	GA	GM	95	100	97	230	195	212	−15	0.64	0.85	2.19	19	35	50	40	60	11.8	21.1
D. fu.	E4625	NA	E 3	130	125	127	290	250	269	−5	0.46	0.96	2.12	25	40	50	40	65	10.0	18.5
D. dc. dc.	E4628	NC	NC	550	485	516	1110	950	1027	+100	0.28	1.21	1.97	74	45	100	35	115	5.8	9.9
D. dc. dc.	E4629	NC	NC	500	595	545	985	1250	1110	+155	0.28	1.26	2.04	60	55	130	40	110	5.5	11.6
D. dc. dc.	E4630	GN	GN	515	465	489	1200	1025	1109	+115	0.32	1.25	2.27	90	50	155	40	80	6.0	13.0
D. dc. du.	E4631	AJ	Ba 3	650	720	684	1800	1550	1670	+370	0.06	1.51	2.44	110	50	140	40	100	4.5	10.0
D. dc. du.	E4632	AJ	Sz 8	465	495	480	1025	1000	1012	+105	0.30	1.21	2.11	68	55	120	40	110	6.0	12.0
D. dc. du.	E4633	AJ	SzT	905	560	712	2040	1205	1568	+200	0.20	1.36	2.20	100	50	155	40	130	4.6	8.8
D. dc. du.	61731	AJ	Csék	855	620	728	1360	1290	1325	+100	0.36	1.16	1.82	85	70	140	35	125	5.0	9.0
D. dc. du.	E4635	DU	DS 3	515	450	481	1140	1155	1147	+200	0.26	1.44	2.38	87	50	120	35	115	5.4	—
D. dc. du.	E4636	DU	DS 5	755	600	673	1455	1390	1422	+210	0.27	1.35	2.11	107	45	110	35	95	4.9	10.8
D. dc. du.	E4637	DU	DS 5	800	620	704	1445	1160	1295	+150	0.21	1.24	1.84	83	45	95	35	140	5.0	—
D. dc. du.	E4638	LA	R 2	790	705	746	2020	1850	1933	+450	0.13	1.64	2.59	95	65	165	50	140	4.7	9.0
D. we.	E4639	HX	HS	205	200	202	500	400	447	−20	0.60	0.90	2.21	40	35	100	35	100	6.0	10.0
D. we.	E4640	HX	HN	190	230	209	445	300	365	−30	0.43	0.87	1.75	34	40	75	25	70	7.2	14.9
D. we.	E4641	HX	HX	355	300	326	695	510	595	−15	0.47	0.95	1.82	58	30	80	30	80	6.0	12.0
D. we.	E4642	NA	U 4	265	300	282	600	435	511	+10	0.26	1.03	1.81	41	40	90	30	100	7.0	12.0
D. sg.	E4644	NF	E 9	240	210	224	585	365	462	−55	0.73	0.74	2.06	22	50	50	40	60	10.0	—
D. sg.	E4645	NF	E 9	310	250	278	640	580	609	+55	0.38	1.22	2.19	44	45	65	40	65	10.0	—
D. sg.	E4646	NF	B 50	270	260	265	655	645	650	+5	0.58	1.02	2.45	39	50	65	45	70	7.4	15.5
D. ja.	E4647	SO	BT	470	510	490	1180	1000	1086	+240	0.01	1.47	2.22	71	60	150	40	110	5.0	9.0

D. ja.	E4648	SO	BT	580	500	539	1440	1150	1287	+100	0.39	1.20	2.39	78	60	180	40	105	5.5	11.0
D. ps.	E4650	CP	B 19	205	300	248	530	520	525	+90	0.08	1.30	2.12	45	35	50	35	50	9.0	—
D. ps.	E4651	CP	B 19	255	240	247	660	620	640	+190	0.00	1.79	2.59	55	40	65	45	80	7.7	15.6
D. ps.	E4652	DK	DK	240	255	247	540	445	490	+50	0.20	1.20	1.98	35	40	55	40	55	8.5	18.0
D. ps.	E4653	DK	DK	270	300	285	635	600	617	+105	0.15	1.35	2.16	50	45	60	45	60	8.5	18.0
D, ps.	E4654	DK	DK	195	260	225	505	410	455	+55	0.10	1.21	2.02	35	45	55	45	55	8.0	18.0
D. ps.	E4655	DK	DK	355	340	347	705	685	695	+140	0.10	1.41	2.00	55	50	80	45	65	10.0	20.0
D. fo. fo.	E4656	HX	HX	380	305	340	625	650	637	+150	0.07	1.49	1.87	55	40	90	40	90	6.0	12.0
D. fo. fo.	E4657	NA	U 2	300	295	297	725	575	646	+140	0.00	1.48	2.18	48	50	95	45	85	6.6	13.0
D. fo. si.	E4659	NF	E 9	300	260	279	615	545	579	+135	0.03	1.52	2.08	48	40	75	40	90	7.0	—
D. fo. si.	E4660	NF	B 50	555	360	447	1010	790	893	+210	0.01	1.58	2.00	73	45	90	45	90	6.0	14.8
D. fo. si.	E4661	NF	E 9	485	350	412	850	690	766	+150	0.06	1.43	1.86	58	40	80	40	80	7.0	—
D. fo. si.	E4663	DA	B 54	470	460	465	895	885	890	+185	0.06	1.40	1.91	59	50	80	40	100	7.0	11.9
D. fo. si.	E4664	DA	B 54	410	350	379	900	710	799	+170	0.03	1.49	2.11	54	50	90	40	95	7.8	15.8
D. fo. si.	E4665	DA	B 54	490	330	402	1040	660	828	+150	0.04	1.46	2.06	52	70	80	40	90	7.8	—
D. sm.	E4667	DF	B 76	580	480	528	1100	900	995	+190	0.04	1.40	1.88	65	50	75	50	110	6.5	—
D. sm.	E4668	DF	B 76	—	—	—	905	850	877	—	—	—	—	68	45	90	50	90	8.5	—
D. sm.	E4669	DF	B 77	—	—	—	1000	900	949	—	—	—	—	70	45	90	45	100	6.5	—
D. sm.	E4670	PO	B 91	680	495	580	1060	900	977	+200	0.01	1.40	1.68	68	45	85	50	90	6.5	—
D. sm.	E4671	AM	AM	605	535	569	1090	895	988	+150	0.07	1.28	1.74	72	50	155	40	120	4.8	—
D. sp. aj.	66172	AJ	Köl-2	555	410	477	1220	925	1062	+220	0.08	1.54	2.23	82	45	110	45	100	5.5	14.0
D. sp. aj.	E4673	AJ	SzT	745	380	532	1635	1080	1329	+295	0.10	1.78	2.50	87	50	150	40	100	7.0	15.5
D. sp. aj.	E4674	AJ	SzT	690	555	619	1355	1165	1256	+350	0.08	1.63	2.03	87	50	140	35	105	6.0	14.0
D. br.	E4676	CR	B 10	55	55	55	100	85	92	−20	0.82	0.64	1.67	8	30	25	25	50	16.0	—
D. br.	E4677	CR	B 10	55	55	55	110	90	99	−25	0.94	0.54	1.80	9	30	30	30	55	16.0	—
D. br.	E4678	CR	B 10	55	55	55	105	80	92	−30	1.06	0.46	1.67	7	35	30	25	40	16.0	—
D. br.	E4679	CP	B 19	65	60	62	145	100	120	−25	0.90	0.58	1.94	13	30	45	30	45	15.0	—
D. au. so.	E4680	HX	HS	70	60	65	130	100	114	−25	0.90	0.58	1.75	10	30	30	25	80	13.0	21.0
D. au. so.	E4681	HX	HX	75	75	75	110	95	102	−50	1.26	0.33	1.36	11	30	30	25	65	12.5	23.0
D. au. so.	E4683	NF	E 9	70	55	62	100	85	92	−30	1.06	0.45	1.48	9	25	30	25	55	18.0	—
D. au. so.	E4684	DF	B 77	70	60	65	125	90	106	−35	1.11	0.42	1.63	9	35	25	30	55	15.7	26.0
D. au. so.	E4685	BO	A 23	100	90	105	165	115	138	−40	0.91	0.56	1.45	13	35	50	30	40	12.0	—
D. au. at.	E4686	NT	NT	90	85	87	150	135	142	−40	0.96	0.53	1.63	11	30	25	30	55	14.5	—
D. au. at.	E4687	NC	NC	105	110	107	190	150	169	−45	0.88	0.59	1.64	16	25	45	25	50	17.2	—
D. au. at.	E4688	NC	NC	85	80	82	145	120	132	−30	0.83	0.62	1.69	12	25	30	25	50	15.6	—
D. au. au.	E4689	AJ	Ba 3	105	105	105	220	185	202	−35	0.81	0.67	1.92	21	30	30	30	50	15.0	28.0
D. au. au.	E4690	AJ	Ba 3	150	135	142	255	205	229	−45	0.78	0.67	1.61	25	25	30	25	50	13.5	26.0
D. au. au.	E4692	SO	BT	110	100	105	250	200	224	−30	0.80	0.70	2.13	23	30	35	30	90	12.5	21.0
D. au. au.	E4693	SO	BT	140	130	135	255	205	229	−60	0.92	0.54	1.70	22	30	40	30	55	12.5	—
D. au. au.	E4694	SO	SO	115	125	120	255	215	234	−35	0.74	0.72	1.95	20	35	40	30	60	10.5	—
D. au. au.	E4695	SO	BT	95	95	95	190	155	172	−35	0.84	0.63	1.81	14	30	35	25	60	13.0	—
D. au. au.	E4696	MS	MS	100	95	97	245	195	219	−15	0.67	0.84	2.26	21	40	60	25	50	12.0	24.0
D. au. au.	E4697	MS	MS	145	130	137	295	225	258	−30	0.69	0.77	1.88	27	40	55	25	50	11.0	21.0
D. au. au.	E4698	LA	BN	135	140	137	255	200	226	−50	0.80	0.64	1.65	17	35	50	25	70	11.6	24.8
D. aff. au.	E4699	AJ	J 7	100	85	92	205	150	175	−50	1.10	0.41	1.90	16	35	55	30	60	13.0	23.5
D. kn.	E4701	DM	K 5	80	95	92	155	145	150	−45	0.97	0.53	1.63	15	45	45	20	60	12.0	—
D. kn.	E4702	DM	K 5	85	95	90	155	140	147	−40	0.89	0.58	1.63	11	40	35	25	55	12.0	—
D. kn.	E4703	DM	K 5	60	55	57	100	95	97	−40	1.26	0.27	1.70	11	30	25	25	70	16.0	—
D. kn.	E4704	DU	DS 5	100	75	87	200	150	173	−20	0.77	0.73	1.98	16	30	40	20	50	14.5	—
D. dp. ga.	E4705	GA	GM	100	85	92	155	120	136	−35	0.88	0.59	1.48	16	25	50	25	45	15.0	—
D. dp. ga.	E4706	GA	GM	85	70	77	145	105	123	−35	1.00	0.50	1.60	13	30	40	25	45	15.0	—
D. dp. tu.	E4708	DF	B 77	105	90	97	195	180	187	−35	0.89	0.61	1.93	20	35	45	25	55	15.5	28.0
D. dp. tu.	E4709	DF	B 75	105	110	107	205	185	195	−30	0.73	0.73	1.82	19	35	50	25	55	13.2	—
D. dp. tu.	E4711	SB	SB	105	95	100	195	150	171	−50	1.03	0.47	1.71	17	30	30	30	55	14.0	24.0

Name	Prep.	Pop.	Sample	P_1	P_2	P	D_1	D_2	D	a	E	R	Q	N	L	H	l	h	$n_{0.5}$	$n_{1.0}$
D. dp. tu.	E4712	SB	SB	130	130	130	250	165	203	−75	1.12	0.42	1.56	15	30	30	30	50	11.5	—
D. dp. tu.	E4713	SB	SB	105	110	107	240	215	227	−20	0.67	0.82	2.12	23	30	30	25	50	11.5	—
D. dp. nu.	E4714	NC	NC	120	110	115	270	200	232	−30	0.75	0.73	2.02	31	25	45	25	80	14.5	—
D. dp. nu.	E4715	GN	GN	155	150	152	295	235	263	−50	0.79	0.67	1.73	32	30	35	30	60	12.0	23.0
D. dp. nu.	E4716	DM	KF	130	105	117	250	225	237	−50	0.99	0.52	2.03	21	35	50	30	90	11.5	21.2
D. dp. nu.	E4717	NT	NT	145	110	126	305	245	273	−25	0.76	0.77	2.17	20	45	60	30	90	10.5	18.0
D. dp. nu.	E4718	ND	ND	180	160	170	260	225	242	−90	1.09	0.44	1.42	21	30	40	25	60	13.0	—
D. dp. nu.	E4719	ND	ND	140	125	132	245	195	219	−45	0.82	0.64	1.66	22	30	35	30	50	12.0	24.0
D. dp. nu.	E4720	FM	FM	140	150	145	260	260	260	−60	0.88	0.60	1.79	20	40	40	30	50	12.0	—
D. dp. hu.	E4721	AM	AM	105	130	117	230	220	225	−20	0.59	0.85	1.92	25	25	60	25	70	14.0	23.0
D. dp. hu.	E4722	AM	AM	200	150	173	305	295	300	−35	0.73	0.77	1.73	26	35	60	25	45	15.5	—
D. dp. hu.	E4723	AM	AM	165	160	162	285	240	262	−55	0.79	0.66	1.62	32	25	60	25	50	12.8	—
D. dp. hu.	61732	AJ	Köl-3	145	120	132	270	235	252	−50	0.91	0.58	1.91	24	35	50	25	50	14.0	28.0
D. dp. hu.	E4724	AJ	Sz 7	190	160	174	355	240	292	−55	0.79	0.66	1.68	34	25	40	25	55	13.5	24.0
D. dp. hu.	E4725	AJ	J 8	210	225	217	315	230	269	−150	1.36	0.23	1.24	29	30	60	25	60	13.8	30.0
D. dp. hu.	E4726	DU	DS 1	140	135	137	265	210	236	−30	0.64	0.78	1.72	23	35	50	25	50	13.0	26.0
D. dp. hu.	E4727	DU	DS 5	165	155	160	320	255	286	−35	0.67	0.77	1.79	29	35	55	25	70	12.0	25.0
D. dp. dp.	E4729	SO	BT	160	170	165	410	420	415	+15	0.52	1.09	2.52	45	35	50	30	60	10.0	20.0
D. dp. dp.	E4730	SO	SO	205	200	202	495	500	497	−10	0.64	0.95	2.46	48	30	50	30	70	10.5	19.0
D. dp. dp.	E4731	MS	MS	170	155	162	500	440	469	−25	0.76	0.84	2.90	40	35	60	25	50	13.5	—
D. dp. dp.	E4732	MS	MS	250	250	250	500	480	490	0	0.48	1.00	1.96	35	45	70	25	60	9.0	—
D. dp. um.	E4733	LA	R 1	305	235	268	650	600	624	+40	0.48	1.17	2.33	49	45	90	25	100	5.5	—
D. dp. um.	E4734	LA	R 2	305	265	284	695	555	621	−10	0.56	0.96	2.19	44	50	110	30	100	6.6	13.9
D. dp. um.	E4735	VG	VG	250	210	229	585	580	582	−50	0.81	0.76	2.54	40	40	60	35	70	7.5	18.0
D. dp. um.	E4736	VG	VG	250	205	226	565	510	537	−60	0.83	0.71	2.38	43	35	50	35	70	11.0	22.0
D. ki.	E4738	BO	A 18	105	105	105	225	205	215	−15	0.63	0.86	2.05	21	30	45	40	85	12.0	21.0
D. ki.	E4739	BO	A 18	155	145	150	300	245	271	−55	0.86	0.62	1.81	20	45	65	35	60	11.6	21.1
D. ki.	E4740	BO	A 18	115	110	112	250	205	226	−25	0.71	0.77	2.02	22	45	55	35	55	11.0	19.9
D. ra. no.	E4741	BO	C 23	105	100	102	200	155	176	−40	0.87	0.60	1.72	15	35	55	30	100	9.0	—
D. ra. no.	E4743	NC	NC	115	120	117	225	210	217	−10	0.52	0.92	2.03	23	60	60	25	60	11.1	—
D. ra. no.	E4744	NC	NC	120	120	120	290	250	269	−10	0.60	0.92	2.36	23	35	70	25	55	10.7	—
D. ra. no.	E4745	NC	NC	115	125	120	255	265	260	+5	0.49	1.04	2.27	26	30	60	25	65	9.4	—
D. ra. no.	E4746	NC	NC	145	140	142	305	270	287	0	0.48	1.00	2.10	27	35	60	25	85	10.9	19.5
D. ra. no.	E4747	GN	GN	150	140	145	305	255	279	−35	0.72	0.75	1.92	22	45	55	25	80	11.0	—
D. ra. no.	E4748	FM	FM	105	100	102	250	200	224	−5	0.55	0.95	2.20	21	45	55	25	65	10.0	—
D. ra. no.	E4749	FM	FM	120	110	115	295	250	272	−30	0.80	0.73	2.36	28	35	60	25	95	9.9	16.2
D. ra. ra.	E4750	AM	AM	110	135	122	290	280	285	−5	0.55	0.96	2.34	29	40	75	20	80	9.0	—
D. ra. ra.	E4751	AM	AM	160	150	155	300	300	300	−50	0.83	0.67	1.94	26	35	70	25	70	9.0	—
D. ra. ra.	E4752	AM	AM	120	135	127	275	260	267	−25	0.67	0.82	2.10	22	40	50	25	90	10.0	—
D. ra. ra.	E4754	AJ	CS	210	205	207	355	330	342	−60	0.74	0.71	1.65	23	50	100	25	70	6.8	14.5
D. ra. ra.	E4755	AJ	CS	155	155	155	355	355	355	+5	0.54	1.03	2.29	24	55	85	30	70	7.8	—
D. ra. ra.	E4756	AJ	J 4	135	135	135	260	200	228	−30	0.62	0.78	1.69	19	40	60	25	65	11.7	—
D. ra. ra.	E4758	SO	BT	155	170	162	345	340	342	+5	0.47	1.03	2.11	26	45	90	25	75	7.2	—
D. ra. ra.	E4759	SO	SO	150	155	152	350	305	327	−5	0.52	0.97	2.15	30	40	95	25	60	8.5	—
D. ra. la.	E4760	LA	RA	200	220	210	455	450	452	−25	0.62	0.89	2.15	30	50	100	30	105	7.2	13.9
D. ra. la.	E4761	LA	RF	200	140	167	460	330	390	0	0.58	1.00	2.34	31	60	105	30	95	7.8	—
D. na.	E4762	MS	MS	120	95	107	215	195	205	−10	0.62	0.90	1.92	17	40	55	25	60	10.0	—
D. na.	E4763	LA	BN	185	160	172	350	280	313	−15	0.46	0.91	1.82	23	45	55	20	85	9.0	19.0

D. na.	E4764	LA	BN	155	140	147	305	235	268	−55	0.87	0.61	1.82	21	40	60	25	95	9.7	19.0
D. na.	E4765	VG	VG	105	100	102	225	200	212	−35	0.85	0.65	2.08	20	30	55	20	95	8.5	—
D. tr. tr.	E4766	HX	HX	55	50	52	100	65	81	−35	1.32	0.30	1.56	4	45	20	25	55	15.8	—
D. tr. tr.	E4767	HX	HX	55	50	52	95	75	84	−35	1.27	0.30	1.62	6	30	20	25	80	15.8	—
D. tr. tr.	E4768	NF	E 9	55	55	55	95	80	87	−35	1.19	0.36	1.58	4	25	20	25	50	18.0	—
D. tr. tr.	E4769	SB	SB	65	65	65	105	75	89	−45	1.33	0.31	1.37	5	40	30	30	80	19.0	—
D. tr. tr.	E4770	SB	SB	55	50	52	105	70	86	−30	1.14	0.40	1.65	5	40	25	30	40	17.2	—
D. tr. tr.	E4771	BO	C 25	60	55	57	95	80	87	−35	1.19	0.36	1.53	5	45	30	35	50	19.5	—
D. tr. tr.	E4774	GN	GN	75	60	67	105	80	92	−40	1.25	0.33	1.37	4	60	25	35	60	17.5	—
D. tr. co.	E4775	AJ	Sz 8	65	65	65	120	85	101	−40	1.18	0.38	1.55	8	45	25	30	35	21.5	35.0
D. tr. co.	E4776	AJ	Ba 3	75	55	64	120	90	104	−30	1.06	0.46	1.62	7	40	25	30	45	18.0	—
D. tr. co.	E4777	AJ	Kö 4	70	70	70	125	120	122	−20	0.75	0.71	1.74	11	30	30	25	75	19.5	—
D. tr. co.	61727	AJ	Köl-3	70	65	67	—	—	—	—	—	—	—	—	—	—	25	60	16.0	—
D. tr. vi.	E4778	MS	MS	75	65	70	130	115	122	−35	1.04	0.46	1.74	10	25	25	45	45	15.5	—
D. tr. vi.	E4779	MS	MS	75	60	67	170	110	137	−25	0.91	0.58	2.04	11	25	30	30	50	18.0	—
D. tr.vi.	E4780	PR	PR	100	95	97	160	135	147	−40	0.89	0.58	1.52	12	35	40	30	70	18.8	32.0
D. aa. cl.	E4781	HX	HS	105	95	100	210	185	197	−35	0.86	0.63	1.97	21	40	40	30	55	14.0	23.0
D. aa. cl.	E4782	HX	HX	90	90	90	165	160	162	−30	0.81	0.67	1.80	17	35	35	30	80	12.5	—
D. aa. cl.	E4783	DF	B 75	95	90	92	165	145	155	−40	0.93	0.56	1.68	17	35	50	25	60	13.0	22.0
D. aa. cl.	E4784	DF	B 76	105	105	105	200	165	182	−40	0.85	0.62	1.73	20	25	60	25	55	15.5	—
D. aa. aa.	E4785	DM	KA	130	165	146	350	300	324	−5	0.48	0.97	2.22	29	50	90	30	95	13.0	—
D. aa. aa.	E4786	NT	NT	110	115	112	255	225	240	−15	0.62	0.87	2.14	20	40	55	30	60	9.6	—
D. aa. aa.	E4787	NT	NT	125	105	115	305	245	273	+10	0.49	1.10	2.37	22	45	55	30	55	13.5	23.0
D. aa. aa.	E4788	ND	ND	115	115	115	285	250	267	−10	0.62	0.91	2.32	21	40	55	35	70	11.5	—
D. aa. aa.	E4789	FM	FM	155	155	155	405	305	351	−50	0.82	0.68	2.26	27	45	65	35	65	10.8	—
D. eu.	E4790	LA	R 1	185	195	190	435	385	409	−45	0.73	0.67	2.15	31	45	105	30	100	8.0	20.0
D. eu.	E4791	LA	R 1	200	190	195	405	340	371	−35	0.65	0.82	1.90	31	40	75	25	105	6.8	15.0
D. eu.	E4792	LA	RA	160	160	160	360	450	402	−15	0.71	0.91	2.51	32	50	85	25	100	6.8	15.0
D. pr. aq.	E4793	HX	HN	180	150	164	350	250	296	−45	0.76	0.70	1.80	21	45	55	25	60	7.7	13.8
D. pr. aq.	E4794	HX	HX	160	155	157	305	285	295	−25	0.63	0.84	1.88	20	50	50	25	70	11.2	22.0
D. pr. aq.	E4795	NF	U 7	150	155	152	260	205	231	−45	0.68	0.71	1.52	24	30	60	25	70	10.0	20.0
D. pr. mo.	E4796	DF	B 76	205	170	187	400	300	346	−25	0.60	0.85	1.85	27	45	65	20	75	10.5	—
D. pr. mo.	E4797	NC	NC	180	145	162	345	310	327	+10	0.50	1.07	2.02	28	35	80	25	100	8.0	16.0
D. pr. mo.	E4798	FM	FM	195	200	197	415	400	407	0	0.50	1.00	2.07	36	40	45	30	90	8.0	—
D. pr. pr.	E4799	AM	AM	155	220	185	490	515	502	−50	0.77	0.77	2.71	37	55	100	25	90	6.8	—
D. pr. pr.	E4800	AM	AM	200	150	173	530	445	486	+50	0.44	1.33	2.81	39	45	90	25	90	7.0	—
D. pr. pr.	E4801	AM	AM	250	200	224	400	315	355	−45	0.65	0.77	1.58	27	40	65	25	70	7.0	—
D. pr. pr.	E4802	AM	AM	185	240	211	445	440	442	+50	0.23	1.21	2.10	36	45	110	25	85	7.5	—
D. pr. pr.	E4803	AJ	CS	255	195	223	550	620	584	+40	0.56	1.20	2.62	45	45	90	25	140	6.5	—
D. pr. pr.	E4805	DU	DS 5	175	160	167	485	405	443	+95	0.14	1.59	2.65	47	40	105	25	105	6.5	—
D. pr. pr.	E4806	DU	DG	400	405	402	740	700	720	+90	0.16	1.22	1.79	67	40	90	25	100	7.0	13.9
D. pr. pr.	E4807	DU	DS	255	190	220	520	460	489	−95	1.00	0.50	2.22	34	45	95	25	85	6.5	13.5
D. pr. pr.	E4808	DU	DS	190	205	197	455	455	455	+70	0.24	1.34	2.31	42	45	130	30	125	6.5	13.0
D. pr. pr.	E4809	DU	DS 4	195	190	192	460	355	404	−30	0.63	0.84	2.10	27	45	90	25	105	6.0	11.5
D. pr. mi.	E4810	LA	R 1	370	440	403	790	720	754	+125	0.04	1.28	1.87	68	40	155	30	120	7.6	15.2
D. pr. mi.	E4811	LA	RA	360	400	379	785	705	744	+105	0.14	1.26	1.96	57	50	125	30	105	5.8	11.4
D. pr. mi.	E4812	LA	RA	395	405	400	980	1000	990	+205	0.18	1.51	2.48	64	50	150	35	150	6.0	12.0
D. pr. mi.	E4813	LA	RD	450	500	474	860	860	860	+160	0.05	1.32	1.81	63	50	160	30	130	4.0	—
D. sa.	E4814	LA	R 2	350	350	350	750	830	789	+110	0.31	1.31	2.25	—	60	110	35	170	6.0	12.0
D. sa.	E4815	LA	RK	385	315	348	890	950	920	+150	0.35	1.48	2.63	54	50	115	35	160	4.6	7.9
D. pu. ln.	E4816	HX	HX	340	290	314	570	460	512	+70	0.06	1.24	1.63	35	45	55	25	90	4.2	—
D. pu. pu.	E4817	GN	GN	520	460	489	905	815	859	+140	0.09	1.30	1.76	60	50	115	35	130	8.8	17.0
D. pu. pu.	E4818	AN	AM	600	455	522	1105	760	916	+150	0.01	1.33	1.76	80	45	160	25	160	5.2	10.5
D. pu. pu.	E4819	AM	AM	690	555	619	1205	1105	1154	+250	0.04	1.45	1.86	72	50	120	30	140	4.4	—

Name	Prep.	Pop.	Sample	P_1	P_2	P	D_1	D_2	D	a	E	R	Q	N	L	H	l	h	$n_{0.5}$	$n_{1.0}$
D. pu. bl.	E4822	AJ	Ba 5	600	570	585	1220	1140	1179	+230	0.10	1.40	2.02	80	60	190	40	195	3.5	7.0
D. pu. bl.	E4823	AJ	Ba 5	1500	550	908	2100	950	1412	+160	0.08	1.29	1.56	110	65	210	45	190	3.8	6.8
D. pu. bl.	E4824	AJ	Ba 6	1280	720	960	1910	1420	1647	+300	0.07	1.42	1.72	120	60	250	40	180	3.4	6.6
D. pu. bl.	E4825	AJ	Ba 6	580	520	549	1285	1100	1189	+260	0.06	1.50	2.17	76	50	200	35	160	3.9	8.0
D. pu. bl.	E4826	AJ	Kö 1	870	700	780	1440	1270	1352	+280	0.01	1.40	1.73	97	50	230	30	150	3.2	6.5
D. pu. bc.	E4828	DU	DS 5	1810	950	1311	2600	1560	2014	+270	0.04	1.28	1.54	128	55	255	35	185	2.9	6.1
D. pu. bc.	E4829	DU	DS 5	840	820	830	1750	1510	1626	+320	0.03	1.39	1.96	87	65	260	35	170	2.8	6.1
D. pu. bc.	E4830	DU	DS 5	1360	1045	1192	2160	1715	1925	+280	0.06	1.27	1.62	115	70	280	40	250	2.6	4.7
D. pu. bc.	E4831	DU	DS 5	960	610	765	1890	1410	1632	+350	0.07	1.57	2.13	82	90	300	40	190	2.4	4.8
N. ev.	E4832	LP	LP	150	190	169	215	165	188	−110	1.18	0.42	1.11	14	55	55	45	55	12.5	23.0
N. ev.	E4833	HX	HX	145	125	135	205	155	178	−75	1.16	0.40	1.32	10	50	50	45	35	17.2	—
N. ev.	E4834	HX	HX	205	175	189	305	220	259	−100	1.11	0.43	1.37	12	75	45	45	40	15.5	32.0
N. ev.	E4836	NF	E 9	110	100	105	250	180	212	−45	0.94	0.55	2.02	12	45	45	40	50	11.5	—
N. ev.	E4837	NF	E 9	105	100	102	205	150	175	−40	0.87	0.60	1.72	16	35	45	40	45	14.5	—
N. ev.	E4840	SB	SB	105	100	102	195	160	177	−40	0.88	0.60	1.74	14	35	40	40	50	15.0	—
N. ev.	E4841	SB	SB	105	90	97	205	155	178	−45	1.00	0.50	1.84	11	45	40	40	45	16.0	—
N. fe.	E4842	HX	HN	95	85	90	145	125	135	−40	0.96	0.53	1.50	11	30	35	35	45	18.0	—
N. fe.	E4843	DF	B 77	80	70	75	150	110	128	−40	1.09	0.43	1.71	8	40	35	35	40	15.5	—
N. fe.	E4844	DF	B 77	75	65	70	135	100	116	−40	1.15	0.38	1.66	8	35	30	35	35	17.0	—
N. sf. bo.	E4845	SB	SB	50	45	47	85	55	68	−25	1.09	0.44	1.45	5	30	20	35	45	22.0	—
N. sf. bo.	E4846	SB	SB	55	50	52	95	55	72	−35	1.36	0.30	1.38	3	30	20	35	60	20.0	—
N. sf. bo.	E4847	BO	C 25	65	55	60	105	90	97	−40	1.28	0.27	1.62	7	35	35	45	40	17.0	—
N. sf. bo.	E4848	BO	C 25	55	45	50	75	55	64	−35	1.46	0.22	1.28	4	35	30	45	45	22.0	—
N. sf. sf.	E4851	NC	NC	95	90	92	165	120	141	−55	1.17	0.39	1.53	11	35	35	30	55	16.0	33.0
N. sf. sf.	E4852	NC	NC	100	90	95	155	125	139	−50	1.08	0.44	1.46	12	35	35	30	45	19.8	—
N. sf. sf.	E4853	GN	GN	85	75	80	145	105	123	−55	1.33	0.27	1.54	8	40	30	30	50	20.0	37.0
N. sf. sf.	E4855	AJ	Sz 8	100	105	102	180	150	164	−55	1.03	0.48	1.61	11	45	50	30	45	20.0	—
N. sf. sf.	E4856	AJ	Sz 5	85	90	87	145	130	137	−45	1.00	0.50	1.58	7	50	30	30	55	21.0	—
N. sf. sf.	E4857	AJ	Ba 3	105	85	94	160	145	152	−50	1.10	0.41	1.62	11	45	50	30	45	20.0	—
N. sf. sf.	E4858	DU	DS 3	100	100	100	160	135	147	−45	0.93	0.55	1.47	11	40	45	25	55	18.0	—
N. sf. te.	E4859	MS	MS	130	105	117	200	160	179	−60	1.09	0.43	1.53	10	45	40	35	40	16.5	31.0
N. sf. te.	E4860	LA	RF	140	110	124	250	190	218	−40	0.84	0.64	1.76	12	50	45	30	50	16.5	—
O. rr. ne.	E4861	SC	SC	100	105	102	200	150	173	−20	0.57	0.81	1.70	11	50	40	30	45	17.5	—
O. rr. ne.	E4862	SC	SC	95	75	84	225	220	222	+5	0.61	1.07	2.64	14	50	55	35	50	15.0	—
O. rr. su.	E4863	CP	B 20	115	110	112	205	200	202	−35	0.80	0.68	1.80	19	50	50	30	45	14.6	28.5
O. rr. su.	E4864	CP	B 20	140	120	130	250	225	237	+20	0.29	1.17	1.83	22	45	55	35	55	12.0	—
O. rr. cr.	E4866	PA	B 24	185	150	167	335	305	320	+25	0.34	1.17	1.92	31	30	45	40	60	11.0	—
O. rr. cr.	E4867	LP	LP	190	200	195	390	300	342	+10	0.27	1.05	1.54	—	30	40	35	110	11.5	23.0
O. rr. cr.	E4868	NA	E 6	190	200	195	310	310	310	+15	0.26	1.08	1.59	30	30	45	35	55	—	—
O. rr. cr.	E4869	DA	B 53	130	140	135	300	295	297	+30	0.32	1.21	2.20	30	40	80	40	90	8.5	15.5
O. ma.	E4871	SB	SB	160	125	141	300	285	292	+50	0.21	1.40	2.07	32	30	40	30	30	14.2	—
O. ma.	E4872	SB	SB	150	150	150	295	295	295	+50	0.15	1.33	1.97	32	40	55	30	50	15.5	28.0
O. by.	E4873	SC	SC	—	—	—	385	360	372	—	—	—	—	30	45	60	35	80	11.5	—
O. by.	E4874	HX	HN	190	200	195	305	315	310	+50	0.05	1.25	1.59	26	45	60	45	160	11.0	17.0
O. by.	E4875	HX	HN	170	145	157	310	320	315	+55	0.20	1.38	2.01	30	35	50	40	55	12.5	23.3
O. do.	E4876	SB	SB	100	120	115	250	230	240	0	0.48	1.00	2.29	18	45	55	45	115	11.5	19.0
O. do.	E4877	GN	GN	160	155	157	355	335	345	+30	0.36	1.19	2.20	19	60	60	50	200	10.0	20.0
O. po.	E4879	DF	B 77	70	75	72	155	145	150	0	0.48	1.00	2.08	16	45	40	30	40	15.0	—

O. po.	E4880	DF	B 77	60	70	65	140	110	124	−10	0.54	0.86	1.91	13	30	30	30	30	19.0	—
O. va. ho.	E4885	HX	HS	135	110	122	210	155	180	−25	0.61	0 77	1.48	18	40	40	30	55	16.0	28.0
O. va. ho.	E4886	HX	HS	85	70	77	150	135	142	+10	0.33	1.14	1.84	13	40	25	30	45	21.7	—
O. va. ho.	E4887	HX	HS	75	55	64	150	125	137	−5	0.64	0.91	2.14	12	45	35	30	55	19.5	34.0
O. va. an.	E4888	AM	AM	230	200	214	345	280	311	−55	0.68	0.72	1.45	33	25	65	30	50	14.5	—
O. va. an.	E4889	AM	AM	125	135	130	230	205	217	−5	0.39	0.96	1.67	23	35	40	30	60	15.0	—
O. va. an.	E4890	AM	AM	120	145	132	250	245	247	+30	0.16	1.21	1.87	26	35	45	30	60	12.2	—
O. va. an.	E4891	AM	AM	110	105	107	200	200	200	0	0.48	1.00	1.87	21	30	45	35	50	14.5	—
O. va. ro.	E4892	AJ	BA 6	145	155	150	255	295	274	+25	0.30	1.16	1.83	26	40	60	30	50	12.5	23.0
O. va. ro.	E4893	AJ	J 2	185	185	185	300	305	302	+35	0.16	1.19	1.63	34	35	60	35	80	10.5	22.0
O. va. ro.	E4894	AJ	J 2	160	160	160	275	275	275	+10	0.34	1.06	1.72	25	30	50	30	60	12.0	23.0
O. va. ro.	E4895	AJ	SzT	150	150	150	290	260	275	+10	0.35	1.07	1.83	31	30	60	35	60	11.0	22.0
O. va. sc.	E4900	DU	D 2	240	250	245	410	370	389	+30	0.16	1.12	1.59	36	40	65	40	50	11.2	22.3
O. va. sc.	E4901	DU	D 7	200	210	205	370	365	367	+25	0.29	1.12	1.79	32	40	60	35	60	11.0	20.0
O. va. sc.	E4902	DU	DH	235	205	219	370	385	377	+25	0.34	1.12	1.72	26	50	60	35	55	11.0	20.0
O. va. sc.	E4903	DU	DS 2	170	170	170	300	295	297	+5	0.39	1.03	1.75	30	40	50	35	55	14.0	27.0
O. va. va.	E4907	CM	CM	205	190	197	380	365	372	+45	0.23	1.24	1.89	40	40	55	30	45	10.0	—
O. va. va.	E4908	CM	CM	240	260	250	505	455	479	+50	0.21	1.19	1.92	43	40	55	40	50	10.0	—
O. va. va.	E4912	SO	SO	205	230	217	400	360	380	+15	0.28	1.06	1.75	33	45	75	45	70	10.5	20.0
O. va. va.	E4913	MS	MS	205	165	184	400	400	400	+50	0.34	1.30	2.17	43	35	80	35	50	10.5	24.0
O. va. va.	E4914	LA	RA	330	290	309	510	510	510	+45	0.26	1.16	1.65	33	45	75	35	70	13.0	24.6
O. va. va.	E4915	LA	RF	405	350	376	625	590	607	+20	0.34	1.06	1.61	45	45	80	40	65	10.0	19.5
O. fc. rv.	61738	AJ	Köl-2	—	—	—	300	300	300	—	—	—	—	30	35	45	35	50	15.0	28.0
O. fc. rv.	E4919	AJ	Sz 6	155	155	155	330	320	315	+60	0.14	1.39	2.03	32	45	60	35	60	13.0	—
O. fc. rv.	E4920	AJ	Ba 3	155	160	157	310	305	307	+45	0.18	1.28	1.96	31	40	45	35	50	17.0	—
O. fc. rv.	E4921	AJ	Ba 6	115	150	131	305	335	320	+50	0.25	1.33	2.44	32	35	60	35	65	13.5	26.0
O. fc. rv.	E4922	AJ	Kö 1	150	155	152	340	325	332	+15	0.43	1.10	2.18	34	35	55	35	70	15.0	27.2
O. fc. fc.	E4924	LA	RA	—	—	—	355	350	352	—	—	—	—	36	40	60	35	55	14.0	26.0
O. fc. fc.	E4925	LA	BN	—	—	—	400	430	415	—	—	—	—	37	45	75	35	55	11.0	21.5
O. fc. fc.	E4926	LA	BN	155	155	155	350	365	357	+90	0.08	1.58	2.30	35	35	60	35	70	11.5	22.0
O. sc.	E4927	SB	SB	200	185	192	370	400	385	+45	0.31	1.24	2.00	28	50	80	45	80	7.0	—
O. ko.	E4928	DF	B 77	220	250	235	645	605	625	+150	0.09	1.60	2.66	45	50	80	50	95	6.2	—
O. ko.	E4929	DF	B 75	260	220	239	550	520	535	+150	0.00	1.68	2.24	36	50	55	60	115	7.2	—
O. ch. ch.	E4931	NC	NC	185	160	172	335	285	309	−10	0.51	0.94	1.79	26	45	70	45	65	9.4	18.8
O. ch. ch.	E4932	AM	AM	205	160	181	400	300	346	−40	0.73	0.75	1.91	20	50	90	40	70	9.8	—
O. ch. pa.	66173	AJ	Köl-2	200	180	190	435	360	396	+25	0.36	1.14	2.08	22	60	100	40	55	8.0	19.0
O. ch. pa.	E4933	AJ	Ba 6	160	165	162	390	360	375	+10	0.49	1.06	2.32	25	50	85	40	65	8.8	18.0
O. ch. pa.	E4934	AJ	J 7	255	235	245	455	455	455	+5	0.46	1.02	1.86	25	50	105	50	85	7.8	—
O. ch. pa.	E4935	AJ	J 7	205	190	197	410	400	405	+30	0.38	1.16	2.06	30	50	90	40	85	6.9	15.2
O. ch. pa.	E4936	AJ	J 3	170	165	167	390	400	395	+50	0.34	1.30	2.36	27	50	80	50	80	7.8	14.7
O. ch. pa.	E4938	DU	DS	200	155	176	450	405	427	−10	0.67	0.94	2.43	24	65	100	50	90	8.5	15.0
O. ch. pa.	E4939	DU	DS	305	235	268	510	405	454	−70	0.76	0.70	1.69	19	80	55	40	55	10.0	—
O. ch. pa.	E4940	DU	DS 1	305	300	302	570	500	534	−10	0.44	0.97	1.77	26	60	100	40	85	8.0	15.6
O. ch. pa.	E4941	DU	DS 5	260	250	255	610	455	527	−5	0.47	0.98	2.07	29	50	100	45	80	8.0	17.0
O. ka.	E4944	AJ	SzT	220	220	220	455	330	388	−105	0.97	0.52	1.76	15	80	65	40	100	9.5	17.0
O. ka.	E4945	AJ	SzT	205	225	215	405	400	402	−25	0.56	0.89	1.87	16	70	60	40	60	9.5	19.0
O. ka.	E4946	AJ	SzT	300	230	263	480	380	427	−105	0.95	0.54	1.62	18	65	75	40	90	10.0	18.0
O. ka.	E4947	AJ	SzT	210	155	180	435	380	407	+10	0.54	1.06	2.26	20	60	60	40	80	9.0	17.0
O. dg.	E4948	SB	SB	45	40	42	55	45	50	−25	1.22	0.38	1.19	1	35	20	30	35	24.0	—
O. dg.	E4949	AJ	Sz 5	50	40	45	65	50	57	−35	1.60	0.12	1.27	1	30	20	25	25	29.0	—
O. dg.	E4950	AJ	Sz 7	55	50	52	80	50	63	−40	1.60	0.20	1.21	1	45	20	25	35	25.0	—
A. sl. ta.	E4951	CP	B 20	85	90	87	150	90	116	−50	1.11	0.44	1.33	11	25	40	20	45	17.0	—
A. sl. ta.	E4952	HX	HN	90	90	90	155	115	134	−35	0.83	0.61	1.49	8	30	25	30	25	—	—
A. sl. ta.	E4953	HX	HN	90	90	90	150	110	128	−25	0.64	0.72	1.42	7	45	20	25	45	21.0	—

Name	Prep.	Pop.	Sample	P_1	P_2	P	D_1	D_2	D	a	E	R	Q	N	L	H	l	h	$n_{0.5}$	$n_{1.0}$
A. sl. ta.	E4954	DF	B 77	85	80	82	145	100	120	−35	0.90	0.56	1.46	8	60	30	30	30	20.0	—
A. sl. ta.	E4955	SB	SB	70	85	77	110	100	105	−45	1.05	0.47	1.36	7	45	25	25	50	17.5	—
A. sl. ta.	E4956	SB	SB	60	60	60	100	60	77	−40	1.33	0.33	1.28	7	50	30	30	25	21.0	—
A. sl. ta.	E4957	SB	SB	80	70	75	135	90	110	−45	1.22	0.36	1.47	7	45	30	25	60	17.0	—
A. sl. ta.	E5005	AM	AM	100	95	97	150	105	125	−60	1.24	0.37	1.29	10	30	35	25	45	19.3	—
A. sl. sl.	E5007	CM	CM	135	105	119	195	140	165	−55	1.04	0.48	1.39	12	45	35	25	25	20.0	—
A. sl. pt.	E5008	MS	MS	160	135	147	275	165	213	−75	1.09	0.44	1.45	12	120	60	25	35	14.0	—
A. sl. pt.	E5009	LA	RA	160	145	152	235	155	191	−100	1.36	0.31	1.26	13	45	55	25	35	19.0	—
A. st. ad.	E4958	SB	SB	100	100	100	160	115	136	−50	1.00	0.50	1.36	7	85	45	25	25	18.5	—
A. st. ad.	E4959	SB	SB	95	90	92	140	90	112	−55	1.22	0.39	1.22	3	50	35	35	30	19.5	—
A. st. ad.	E4960	SB	SB	75	65	70	105	85	94	−45	1.29	0.31	1.34	3	50	30	35	50	16.4	—
A. st. ad.	E4964	NC	NC	75	65	70	145	110	126	−30	0.95	0.54	1.93	5	50	35	25	40	20.0	—
A. st. ad.	E4965	NC	NC	65	60	62	115	90	102	−25	0.89	0.58	1.77	3	50	30	25	40	20.2	—
A. st. ad.	E4966	NC	NC	80	70	75	150	115	131	−35	1.00	0.50	1.86	4	65	30	25	55	24.0	—
A. st. ad.	E4968	GN	GN	70	60	65	115	90	102	−40	1.22	0.33	1.57	3	55	30	30	45	19.5	—
A. st. ad.	E4970	ND	ND	80	75	77	160	115	136	−35	0.96	0.53	1.77	3	60	40	25	50	21.5	—
A. st. st.	E4971	AM	AM	105	95	100	140	105	121	−70	1.43	0.26	1.21	3	70	40	20	40	18.0	—
A. st. st.	E4972	AM	AM	80	75	77	150	110	128	−20	0.68	0.73	1.66	4	70	30	20	45	22.0	—
A. st. st.	E4973	AM	AM	110	95	102	160	110	133	−70	1.41	0.26	1.30	6	85	45	25	40	21.0	—
A. st. st.	E4974	AJ	Sz 7	115	100	107	190	130	157	−55	1.08	0.45	1.47	3	95	80	25	35	18.0	—
A. st. st.	E4975	AJ	Sz 8	100	90	95	165	130	146	−50	1.08	0.44	1.54	4	80	45	30	25	22.0	—
A. st. st.	E4976	AJ	CS	100	90	95	160	120	139	−50	1.08	0.44	1.46	5	70	50	30	25	22.0	—
A. aff. st.	E4980	AJ	Ba 6	155	125	139	270	220	244	−75	1.11	0.40	1.76	4	160	85	25	45	11.5	—
A. st. sr.	E4981	CM	CM	120	95	107	200	145	170	−55	1.10	0.42	1.59	3	95	50	30	30	19.0	—
A. st. sr.	E4982	CM	CM	150	140	145	205	185	195	−95	1.27	0.32	1.34	3	100	65	30	25	18.5	—
A. st. sr.	E4986	SO	BT	105	95	100	195	140	165	−50	1.04	0.47	1.65	5	90	50	30	55	17.0	—
A. st. sr.	E4987	SO	BT	160	130	144	225	190	207	−95	1.32	0.27	1.44	4	140	60	35	55	13.5	—
A. st. sr.	E4988	SO	SO	115	100	107	200	150	173	−60	1.13	0.40	1.62	4	70	50	25	50	16.5	—
A. st. sr.	E4990	MS	MS	145	105	123	220	160	188	−70	1.22	0.33	1.53	5	95	50	25	50	15.5	—
A. st. sr.	E4991	MS	MS	125	100	112	200	145	170	−65	1.21	0.35	1.52	3	65	55	25	40	16.5	25.0
A. st. sr.	E4992	LA	RA	150	100	122	210	150	177	−65	1.20	0.35	1.45	6	105	50	25	50	15.5	—
A. st. sr.	E4993	LA	RA	155	135	145	250	180	212	−75	1.08	0.44	1.46	4	105	55	25	50	18.0	—
A. st. sr.	E4994	LA	R 2	110	110	110	200	145	170	−60	1.07	0.45	1.54	9	110	45	25	50	20.0	—
A. st. sr.	E4995	LA	BD	145	120	132	240	165	199	−80	1.24	0.33	1.51	9	80	45	30	65	14.5	—
A. st. sr.	E4996	VG	VG	105	80	92	185	145	164	−50	1.14	0.38	1.78	7	85	50	25	50	21.0	—
A. pb.	E4997	LA	RF	150	135	142	255	205	229	−50	0.83	0.63	1.61	10	70	55	25	55	15.0	—
A. pb.	E4998	LA	R 1	160	125	141	255	185	217	−55	0.92	0.56	1.54	14	50	55	25	40	15.0	—
A. ke.	E4999	AM	AM	140	105	121	205	140	169	−55	1.04	0.48	1.40	12	50	45	25	40	—	—
A. ke.	E5001	AJ	CS	140	105	121	235	205	219	−50	0.98	0.52	1.81	11	50	55	30	40	13.5	—
A. ke.	E5002	AJ	CS	185	155	169	285	215	248	−90	1.12	0.42	1.47	10	55	50	50	40	13.5	—
A. ke.	61740	AJ	Köl-2	145	100	120	235	195	214	−55	1.05	0.45	1.78	13	45	45	—	—	—	—
A. ke.	E5003	DU	DS	125	130	127	285	205	242	−60	0.95	0.54	1.91	8	115	55	30	55	17.0	—
A. ke.	E5004	DU	DS	160	150	155	315	210	257	−85	1.10	0.43	1.66	11	75	55	30	70	13.5	28.0
A. al. gl.	E5015	NC	NC	170	155	162	250	175	209	−115	1.43	0.26	1.29	3	200	50	40	60	11.8	25.5
A. al. gl.	E5017	GN	GN	195	160	177	300	200	245	−110	1.30	0.32	1.38	2	220	45	35	50	13.5	22.5
A. al. cu.	E5019	AM	AM	200	160	179	285	200	239	−130	1.50	0.19	1.34	2	250	50	30	55	12.3	23.0
A. al. cu.	E5020	AM	AM	225	190	207	300	190	239	−140	1.47	0.26	1.16	2	225	45	40	40	13.8	—
A. al. cu.	E5021	AJ	Ba 3	210	175	192	290	200	241	−120	1.32	0.31	1.26	3	200	45	35	55	10.8	—

A. al. cu.	E5022	AJ	CS	220	195	207	280	170	218	−140	1.50	0.28	1.05	4	150	50	35	115	11.2	—
A. al. cu.	E5023	AJ	Kö 2	255	205	229	360	250	300	−155	1.42	0.38	1.31	3	225	50	30	75	11.0	—
A. al. cu.	61744	AJ	Köl-2	220	220	220	{ 245	175	207	−195	1.97	0.11	0.94	—	—	45	35	60	13.0	25.0
							{ 225	165	193	−195	2.03	0.11	0.88							
A. al. al.	E5024	DU	D 7	270	220	244	360	230	288	−170	1.52	0.21	1.18	3	280	50	35	90	11.6	19.8
A. al. al.	E5025	DU	DS	350	275	310	485	280	369	−150	1.09	0.46	1.19	4	220	60	45	70	10.2	—
A. al. al.	E5026	DU	DS 5	310	250	278	450	255	339	−170	1.35	0.32	1.22	5	100	60	40	60	11.0	21.5
A. al. dn.	E5027	LA	R 1	350	260	302	500	305	391	−150	1.13	0.42	1.30	3	300	60	35	125	9.9	—
A. al. dn.	E5028	LA	R 1	420	320	367	715	450	567	−210	1.22	0.34	1.54	18	70	90	35	120	8.0	—
A. al. dn.	E5029	LA	RA	400	350	374	455	285	360	−255	1.56	0.27	0.96	4	240	50	40	80	12.2	22.0
A. sw.	E5010	SB	SB	240	195	216	365	260	308	−100	1.02	0.49	1.43	11	150	50	40	50	9.0	—
A. sw.	E5011	SB	SB	200	160	179	320	220	265	−105	1.23	0.34	1.48	3	180	50	40	50	10.5	—
A. sw.	E5013	JG	JG	280	190	231	420	300	355	−95	1.00	0.50	1.37	4	180	65	50	60	12.2	—
A. sw.	E5014	FM	FM	410	255	323	540	400	465	−200	1.36	0.22	1.44	8	150	60	50	70	8.9	—

Name	Equatorial sections of forms "B"									
	Prep.	Pop.	Sample	*I*	*S*	*s*	*n*	*d*	*l*	*h*
D. ar. bk.	E4599	CR	B 15	14	5	35	7	170	40	55
D. ar. ss.	E4602	CP	B 21	18	4	40	10	160	40	65
D. ar. ss.	E4603	CP	B 21	20	5	55	6	135	35	45
D. ar. ar.	E4609	GA	GB	18	6	45	8	175	40	75
D. ar. ar.	E4614	LP	LP	12	5	30	11	185	45	60
D. fu.	E4626	NA	U 3	18	5	35	7	155	40	50
D. fo. si.	E4666	DA	B 54	—	—	40	10	180	40	90
D. au. so.	E4682	HX	HS	10	5	40	8	145	30	70
D. au. au.	E4691	AJ	Sz 7	20	5	40	7	110	25	55
D. dp. ga.	E4707	GA	GM	18	5	35	5	110	25	45
D. dp. hu.	E4728	DU	D 1	10	5	35	6	130	25	50
D. ra. ra.	E4757	AJ	SzT	20	5	50	4	110	30	100
D. tr. tr.	E4772	BO	A 23	11	5	45	7	160	30	50
D. pr. pr.	E4804	AJ	SzT	15	5	55	7	150	25	100
N. ev.	E4835	HX	HX	11	5	35	12	220	45	45
N. ev.	E4838	NF	B 50	15	5	42	12	220	40	80
N. sf. bo.	E4849	BO	C 25	14	4	30	13	200	45	50
N. sf. sf.	E4854	GN	GN	—	4	—	14	160	35	45
O. po.	E4881	DF	B 76	15	13	80	—	—	30	30
O. po.	E4882	DF	B 76	10	10	100	—	—	35	80
O. po.	E4883	DF	B 76	15	9	110	—	—	30	50
O. po.	E4884	DF	B 77	15	12	80	—	—	35	50
O. va. ro.	E4896	AJ	Ba 5	—	—	70	—	—	30	70
O. va. ro.	E4897	AJ	Ba 6	—	—	80	—	—	35	90
O. va. ro.	E4898	AJ	J 2	18	6	85	—	—	35	60
O. va. ro.	E4899	AJ	SzT	14	8	85	—	—	35	60
O. va. sc.	E4904	DU	DS 7	18	6	70	—	—	35	50
O. va. va.	E4909	CM	CM	18	8	80	—	—	35	45
O. va. va.	E4910	CM	CM	16	6	75	—	—	40	45
O. fc. vv.	E4923	AJ	J 4	18	9	75	—	—	25	90
O. ch. pa.	E4942	DU	D 3	18	6	90	—	—	45	110
A. st. ad.	E4961	SB	SB	17	9	60	—	—	30	50
A. st. ad.	E4962	SB	SB	15	9	70	—	—	30	50

Name	Equatorial sections of forms "B"									
	Prep.	Pop.	Sample	*I*	*S*	*s*	*n*	*d*	*l*	*h*
A. st. ad.	E4963	SB	SB	14	10	90	—	—	35	65
A. st. ad.	E4969	GN	GN	20	8	50	—	—	30	25
A. st. st.	E4977	AJ	Ba 5	—	—	50	—	—	25	45
A. st. sr.	E4983	CM	CM	18	7	65	—	—	25	30
A. st. sr.	E4984	CM	CM	18	6	50	—	—	25	30
A. st. sr.	E4989	SO	BT	20	9	75	—	—	30	50
A. al. cu.	E5016	NC	NC	20	7	80	—	—	35	85
A. al. dn.	E5030	LA	RB	18	8	75	—	—	35	90
A. al. dn.	E5031	LA	RK	20	8	90	—	—	35	60
A. sw.	E5012	SB	SB	18	12	95	—	—	40	50

Name	Axial sections of forms "A"										
	Prep.	Pop.	Sample	*Lp*	*Hp*	L_d	H_d	l_e	h_e	l_i	l_l
D. dc. du.	61747	AJ	Gyürh	470	145	915	170	110	80	100	25
D. fo. si.	E4662	NF	E 9	500	115	910	150	90	80	75	30
D. pu. bl.	E4827	AJ	Ba 3	675	175	1180	200	175	60	80	20
O. va. va.	E4916	LA	RF	215	220	345	135	50	100	100	35
A. st. st.	E4979	AJ	CS	110	120	145	150	30	30	70	40
A. st. sr.	E4985	CM	CM	—	—	160	125	35	35	70	35

A. = Asterocyclina, *D.* = Discocyclina, *N.* = Nemkovella, *O.* = Orbitoclypeus, *aa.* = aaroni, *ad.* = adourensis, *aj.* = ajkaensis, *al.* = alticostata, *an.* = angoumensis, *aq.* = aquitanica, *ar.* = archiaci, *at.* = atlantica, *au.* = augustae, *bc.* = baconica, *bk.* = bakhchisaraiensis, *bl.* = balatonica, *bo.* = bodrakensis, *br.* = broennimanni, *bt.* = bartholomei, *by.* = bayani, *ch.* = chudeaui, *cl.* = chalossensis, *co.* = concentrica, *cr.* = crimensis, *cu.* = cuvillieri, *dc.* = discus, *dg.* = daguini, *dn.* = danubica, *do.* = douvillei, *dp.* = dispansa, *du.* = dudarensis, *eu.* = euaensis, *ev.* = evae, *fc.* = furcata, *fe.* = fermonti, *fo.* = fortisi, *fu.* = furoni, *ga.* = ganensis, *gl.* = gallica, *ho.* = horsarrieuensis, *hu.* = hungarica, *ja.* = javana, *ka.* = katoae, *ke.* = kecskemetii, *ki.* = kingae, *kn.* = knessae, *ko.* = koehleri, *la.* = labatlanensis, *ln.* = landesica, *ma.* = marthae, *mi.* = minor, *mo.* = montfortensis, *mu.* = multiplicata, *na.* = nandori, *ne.* = neumannae, *no.* = noussensis, *nu.* = nussdorfensis, *ol.* = olianae, *pa.* = pannonicus, *pb.* = priabonensis, *po.* = portnayae, *pr.* = pratti, *ps.* = pseudoaugustae, *pt.* = praestellaris, *pu.* = pulcra, *py.* = pygmaea, *ra.* = radians, *ro.* = roberti, *rr.* = ramaraoi, *rv.* = rovasendai, *sa.* = samantai, *sc.* = scalaris, *se.* = sella, *sf.* = strophiolata, *sg.* = senegalensis, *sh.* = schopeni, *si.* = simferopolensis, *sl.* = stella, *sm.* = stratiemanuelis, *sn.* = seunesi, *so.* = sourbetensis, *sp.* = spliti, *sr.* = stellaris, *ss.* = staroseliensis, *st.* = stellata, *su.* = sulvukayensis, *sw.* = schweighauseri, *ta.* = taramellii, *te.* = tenella, *tr.* = trabayensis, *tu.* = taurica, *um.* = umbilicata, *va.* = varians, *vi.* = vicenzensis, *we.* = weijdeni.

FÉNYKÉPTÁBLÁK — PLATES

I. tábla — Plate I

Discocyclina archiaci (SCHLUMBERGER) *bakhchisaraiensis* n. ssp.

1. A-forma, rozetta, B 14-es minta, E. 4598, 35×
2. Holotypus, A-forma, equatoriális metszet, E. 4596, 35×
3., *4.* A-forma, equatoriális metszet, *3.:* E. 4597, *4.:* E. 4598, 35×
5. B-forma, equatoriális metszet, E. 4599, 56×
6. B-forma, equatoriális metszet, E. 4599, 140×
Krím, ilerdi emelet középső része

Discocyclina archiaci (SCHLUMBERGER) *staroseliensis* n. ssp.

7\. Holotypus, A-forma, equatoriális metszet, E. 4601, 35×
8. A-forma, equatoriális metszet, E. 4600, 35×
9., *11.* B-forma, equatoriális metszet, *9.:* E. 4602, *11.:* E. 4603, 56×
10., *12.* B-forma, equatoriális metszet, *10.:* E. 4602, *12.:* E. 4603, 140×
Krím, ilerdi emelet felső része

Discocyclina archiaci archiaci (SCHLUMBERGER)

13. A-forma, equatoriális metszet, E. 4605, 35×
Krím, cuisi emelet alsó része

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Discocyclina archiaci (SCHLUMBERGER) *bakhchisaraiensis* n. ssp.

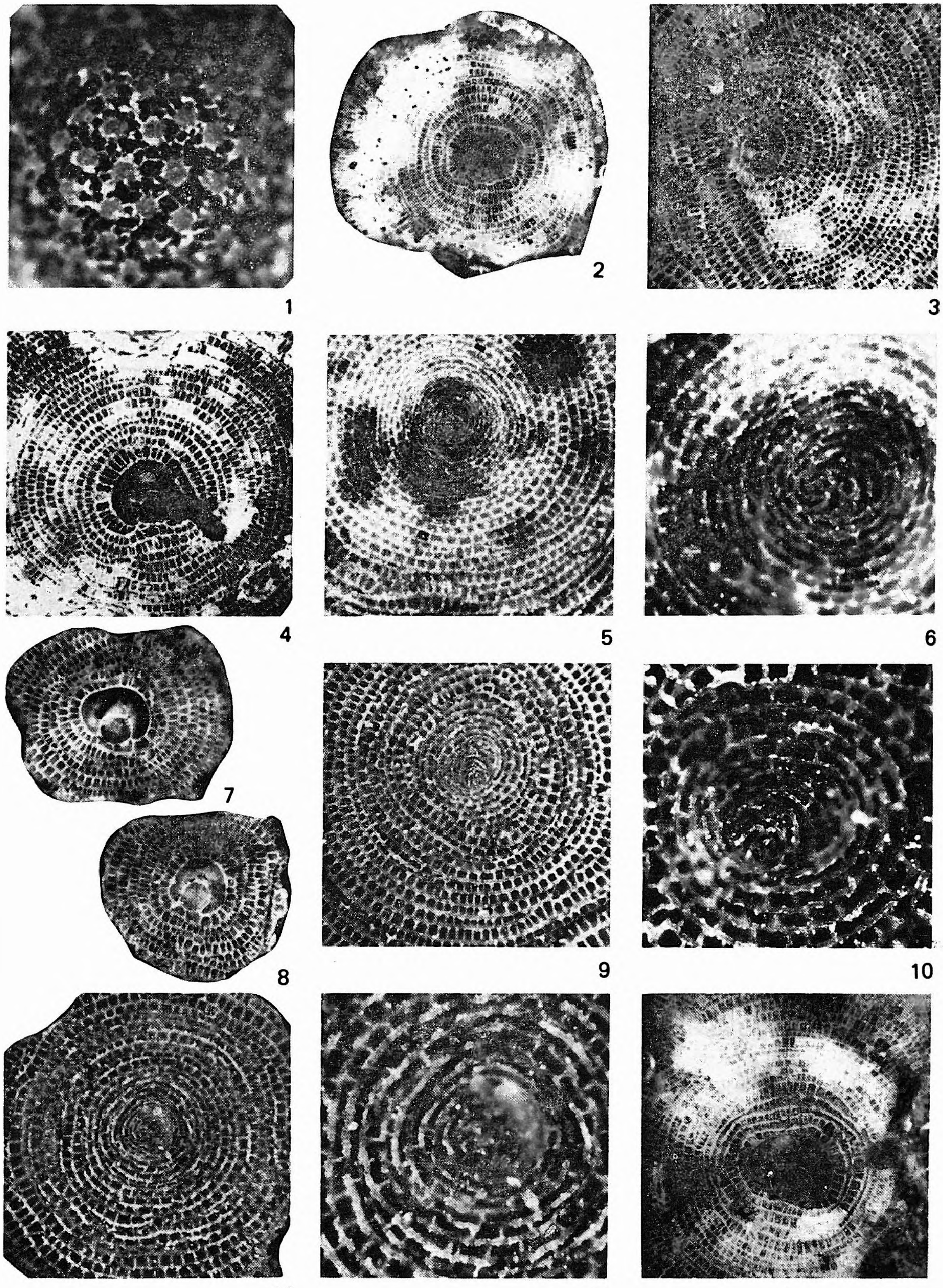
1. Form "A", rosette, sample B 14, E. 4598, 35×
2. Holotype, form "A", equatorial section, E. 4596, 35×
3., *4.* Form "A", equatorial section, *3.:* E. 4597, *4.:* E. 4598, 35×
5. Form "B", equatorial section, E. 4599, 56×
6. Form "B", equatorial section, E. 4599, 140×
Crimea, middle part of the Ilerdian

Discocyclina archiaci (SCHLUMBERGER) *staroseliensis* n. ssp.

7. Holotype, form "A", equatorial section, E. 4601, 35×
8. Form "A", equatorial section, E. 4600, 35×
9., *11.* From "B", equatorial section, *9.:* E. 4602, *11.:* E. 4603, 56×
10., *12.* Form "B", equatorial section, *10.:* E. 4602, *12.:* E. 4603, 140×
Crimea, upper part of the Ilerdian

Discocyclina archiaci archiaci (SCHLUMBERGER)

13. Form "A", equatorial section, E. 4605, 35×
Crimea, lower part of the Cuisian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II. tábla — Plate II

Discocyclina archiaci archiaci (SCHLUMBERGER)

1—2. A-forma, equatoriális metszet, *1.*: E. 4604, *2.*: E. 4606. 35×
Krím, cuisi emelet alsó része

6. A-forma, equatoriális metszet, E. 4607, 35×
Dikilitas, cuisi emelet alsó része

9. Külső alak, GM minta, E. 4608, 9,5×

10. Rozetta, GM minta, E. 4608, 35×

11. B-forma, GB minta, rozetta, E. 4609, 35×
Gan, cuisi emelet középső része

Discocyclina furoni SAMANTA

3. B-forma, külső alak, E 6-os minta, E. 4627, 14×

4. A-forma, rozetta, E 3-as minta, E. 4625, 20×

5. A-forma, equatoriális metszet, E. 4625, 37×

7. B-forma, equatoriális metszet, E. 4626, 56×

8. B-forma, equatoriális metszet, E. 4626, 140×
Krím, cuisi emelet középső része

12. A-forma, equatoriális metszet, E. 4624, 35×
Gan, cuisi emelet középső része

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Discocyclina archiaci archiaci (SCHLUMBERGER)

1—2. Form "A", equatorial section, *1.*: E. 4604, *2.*: E. 4606, 35×
Crimea, lower part of the Cuisian

6. Form "A", equatorial section, E. 4607, 35×
Dikilitash, lower part of the Cuisian

9. External view, sample GM, E. 4608, 9.5×

10. Rosette, sample GM, E. 4608, 35×

11. Form "B", sample GB, rosette, E. 4609, 35×
Gan, middle part of the Cuisian

Discocyclina furoni SAMANTA

3. Form "B", external view, sample E 6, E. 4627, 14×

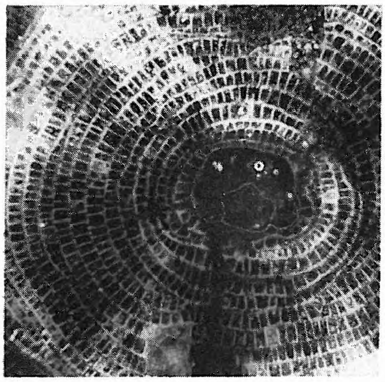
4. Form "A", rosette, sample E 3, E. 4625, 20×

5. Form "A", equatorial section, E. 4625, 37×

7. Form "B", equatorial section, E. 4626, 56×

8. Form "B", equatorial section, E. 4626, 140×
Crimea, middle part of the Cuisian

12. Form "A", equatorial section, E. 4624, 35×
Gan, middle part of the Cuisian



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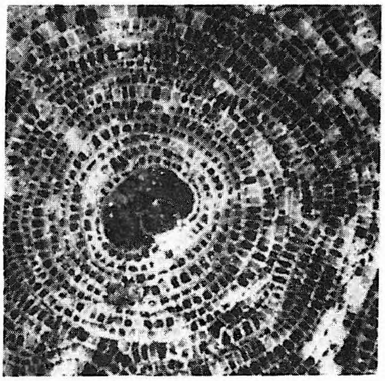

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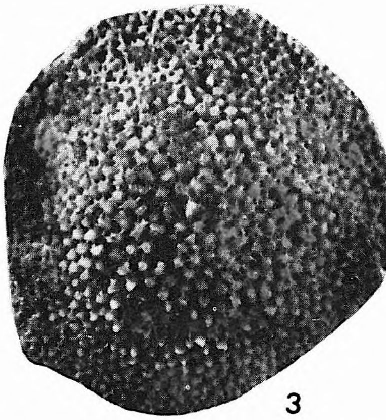

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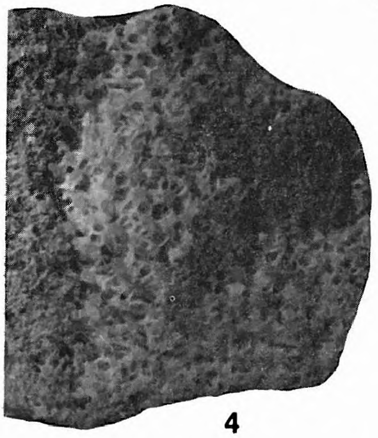

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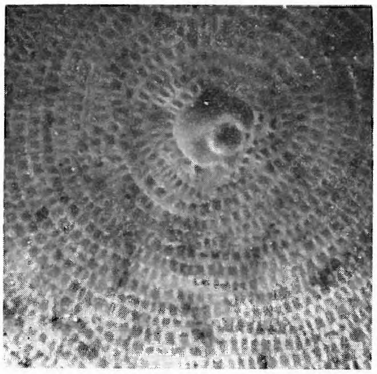

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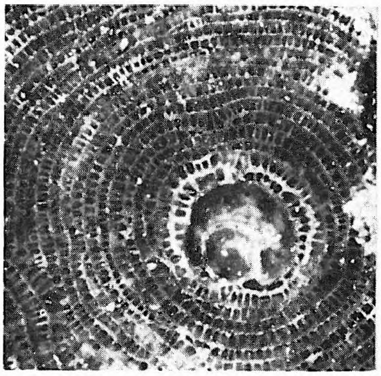

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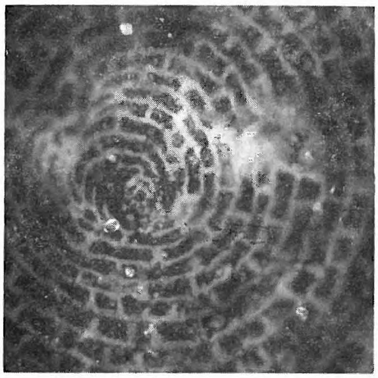

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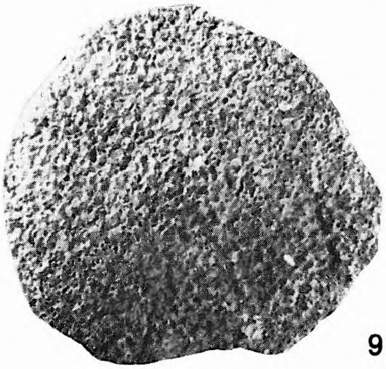

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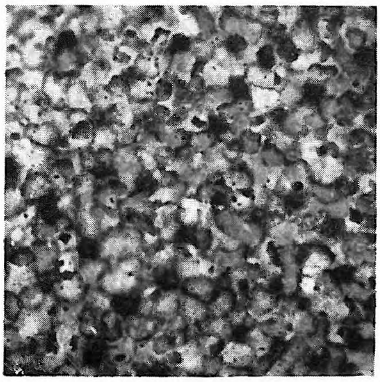

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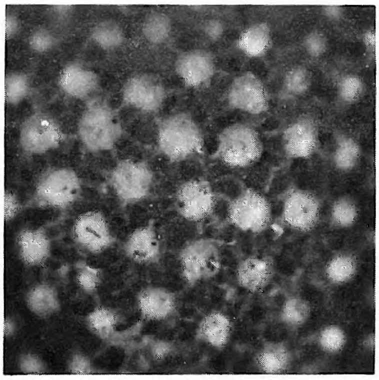

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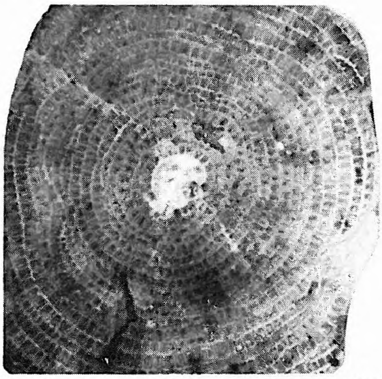

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III. tábla — Plate III

Discocyclina archiaci archiaci (SCHLUMBERGER)

1—2. A-forma, equatoriális metszet, *1.:* E. 4611, *2.:* E. 4610, 35×
3. B-forma, equatoriális metszet, E. 4609, 56×
4. B-forma, equatoriális kamrák, E. 4609, 140×
5. B-forma, laterális kamrák pórusai, E. 4609, 140×
6. B-forma, equatoriális metszet, E. 4609, 140×
Gan, cuisi emelet középső része
8—9. A-forma equatoriális metszet, *8.:* E. 4613, *9.:* E. 4612, 35×
10. B-forma, equatoriális metszet, E. 4614, 56×
11. B-forma, equatoriális metszet, E. 4614, 140×
Le Porge, cuisi emelet középső része

Discocyclina furoni SAMANTA

7. A-forma, equatoriális metszet, E. 4623, 35×
Le Porge, cuisi emelet középső része

Discocyclina archiaci (SCHLUMBERGER) *bartholomei* (SCHLUMBERGER)

12. A-forma, equatoriális metszet, E. 4618, 35×
Le Porge, cuisi emelet felső része

* * *

Discocyclina archiaci archiaci (SCHLUMBERGER)

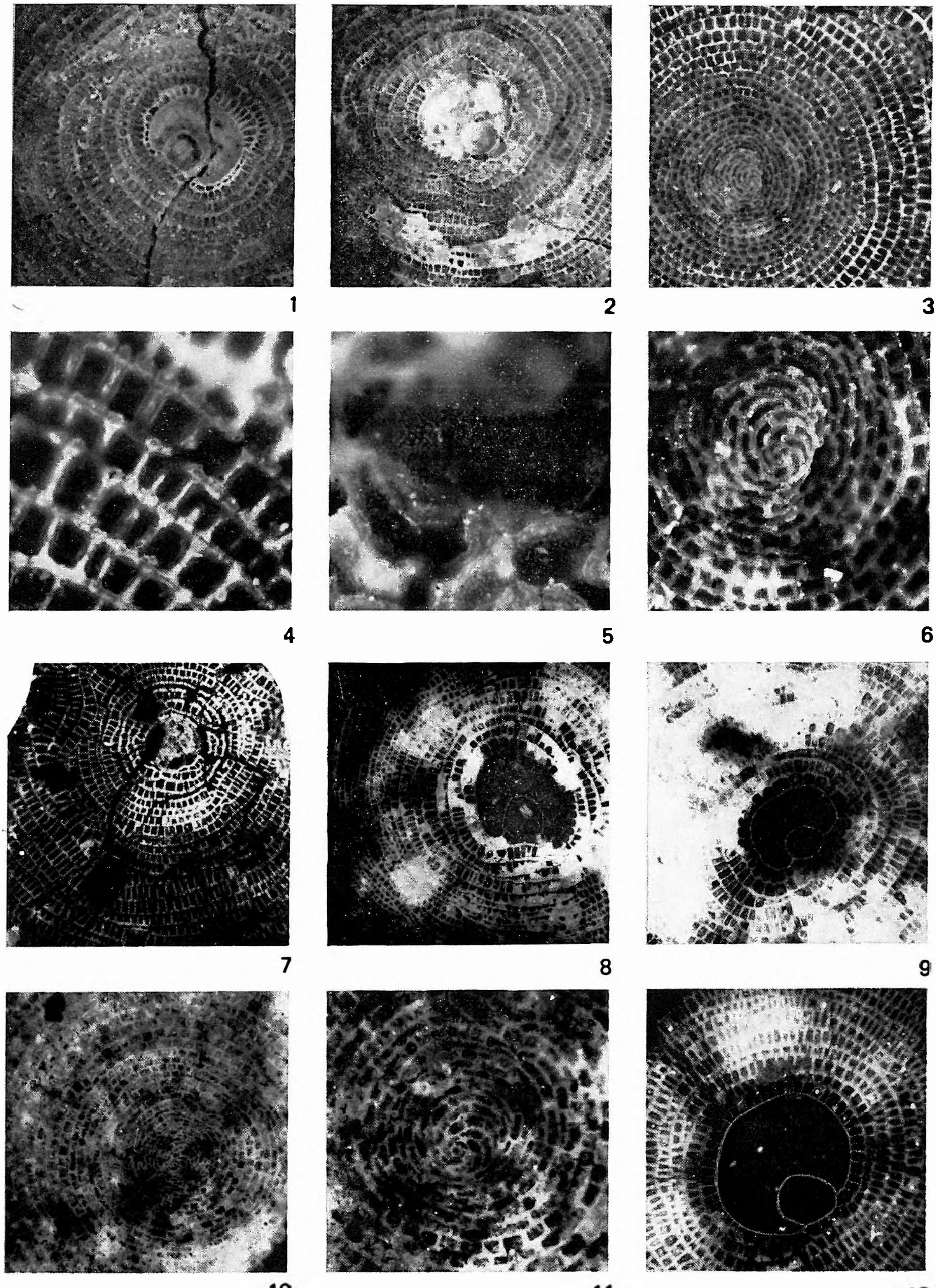
1—2. Form "A", equatorial section, *1.:* E. 4611, *2.:* E. 4610, 35×
3. Form "B", equatorial section, E. 4609, 56×
4. Form "B", equatorial chambers, E. 4609, 140×
5. Form "B", pores of the lateral chambers, E. 4609, 140×
6. Form "B", equatorial section, E. 4609, 140×
Gan, middle part of the Cuisian
8—9. Form "A", equatorial section, *8.:* E. 4613, *9.:* E. 4612, 35×
10. Form "B", equatorial section, E. 4614, 56×
11. Form "B", equatorial section, E. 4614, 140×
Le Porge, middle part of the Cuisian

Discocyclina furoni SAMANTA

7. Form "A", equatorial section, E. 4623, 35×
Le Porge, middle part of the Cuisian

Discocyclina archiaci (SCHLUMBERGER) *bartholomei* (SCHLUMBERGER)

12. Form "A", equatorial section, E. 4618, 35×
Le Porge, upper part of the Cuisian



IV. tábla — Plate IV

Discocyclina archiaci (SCHLUMBERGER) *bartholomei* (SCHLUMBERGER)

1—2. A-forma, equatoriális metszet, *1.:* E. 4615, *2.:* E. 4616, 35×
Krím, cuisi emelet felső része

3. A-forma, equatoriális metszet, E. 4617, 30×
Krím, lutéciai emelet alsó része

4—5. A-forma, equatoriális metszet, *4.:* E. 4619, *5.:* E. 4620, 35×

6. B-forma, külső alak, E. 4622, 7,5×

7. Az A-formák equatoriális metszetének típusa, E. 4621, 35×
Saint-Barthélémy, lutéciai emelet alsó része

Discocyclina discus discus (RÜTIMEYER)

8. A-forma, equatoriális metszet, E. 4630, 22×
Gibret, lutéciai emelet középső része

9. Az A-formák equatoriális metszetének típusa, E. 4628, 22×

10. A-forma, equatoriális metszet, E. 4629, 22×
Nousse, lutéciai emelet középső része

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Discocyclina archiaci (SCHLUMBERGER) *bartholomei* (SCHLUMBERGER)

1—2. Form "A", equatorial section, *1.:* E. 4615, *2.:* E. 4616, 35×
Crimea, upper part of the Cuisian

3. Form "A", equatorial section, E. 4617, 30×
Crimea, lower part of the Lutetian

4—5. Form "A", equatorial section, *4.:* E. 4619, *5.:* E. 4620, 35×

6. Form "B", external view, E. 4622, 7.5×

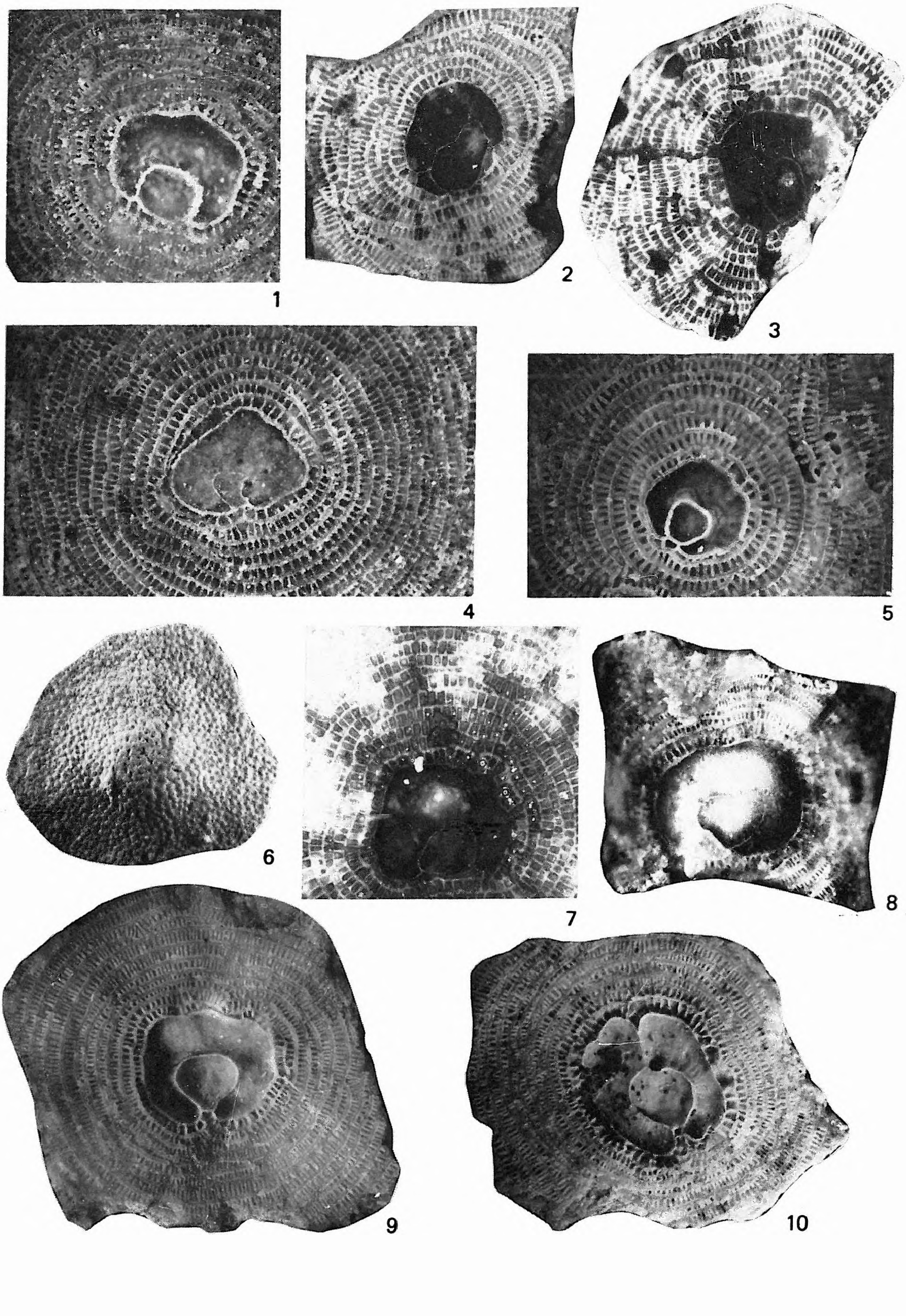
7. The type of the equatorial section of forms "A", E. 4621, 35×
Saint-Barthélémy, lower part of the Lutetian

Discocyclina discus discus (RÜTIMEYER)

8. Form "A", equatorial section, E. 4630, 22×
Gibret, middle part of the Lutetian

9. The type of the equatorial section of forms "A", E. 4628, 22×

10. Form "A", equatorial section, E. 4629, 22×
Nousse, middle part of the Lutetian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V. tábla — Plate V

Discocyclina discus (RÜTIMEYER) *dudarensis* n. ssp.

1. A-forma, equatoriális metszet, E. 4631, 30×
2—3., *5.* A-forma, equatoriális metszet, *2.*: E. 4633, *3.*: E. 4632, *5.*: 61 731, 22×
4. Külső alak, Ba 3-as minta, E. 4634, 8×
7. A-forma, axiális metszet, 61 747, 35×
Ajka, bartoni emelet alsó része
6., *9.* A-forma, equatoriális metszet, *6.*: E. 4635, *9.*: E. 4636, 22×
8. Holotypus, A-forma, equatoriális metszet, E. 4637, 22×
Dudar, bartoni emelet középső része
10. A-forma, equatoriális metszet, E. 4638, 22×
Lábatlan, priabonai emelet középső része

Discocyclina weijdeni n. sp.

11. A-forma, equatoriális metszet, E. 4642, 35×
Krím, cuisi emelet középső része

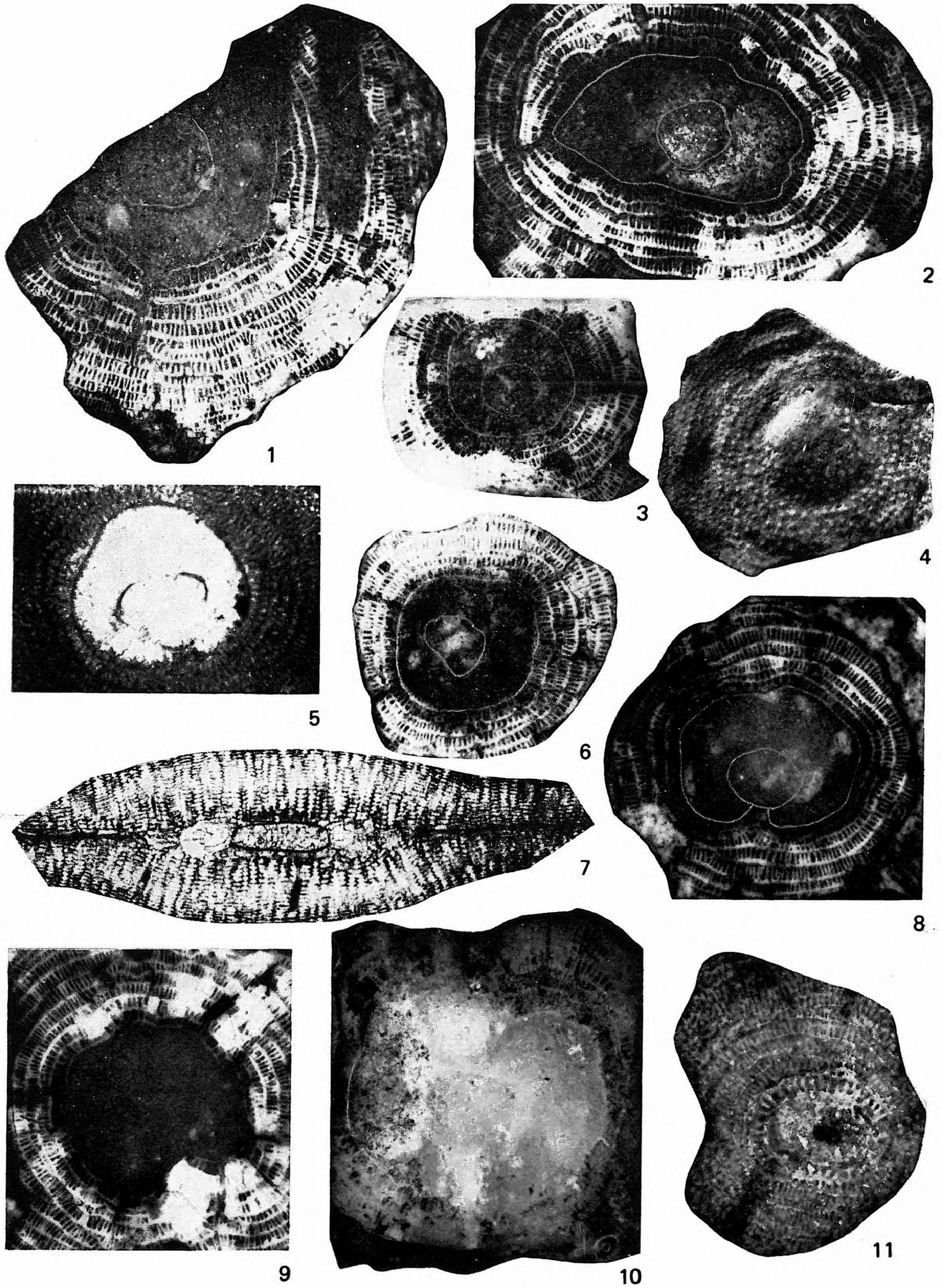
* * *

Discocyclina discus (RÜTIMEYER) *dudarensis* n. ssp.

1. Form "A", equatorial section, E. 4631, 30×
2—3., *5.* Form "A", equatorial section, *2.*: E. 4633, *3.*: E. 4632, *5.*: 61 731, 22×
4. External view, sample Ba 3, E. 4634, 8×
7. Form "A", axial section, 61 747, 35×
Ajka, lower part of the Bartonian
6., *9.* Form "A", equatorial section, *6.*: E. 4635, *9.*: E. 4636, 22×
8. Holotype, form "A", equatorial section, E. 4637, 22×
Dudar, middle part of the Bartonian
10. Form "A", equatorial section, E. 4638, 22×
Lábatlan, middle part of the Priabonian

Discocyclina weijdeni n. sp.

11. Form "A", equatorial section, E. 4642, 35×
Crimea, middle part of the Cuisian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VI. tábla — Plate VI

Discocyclina weijdeni n. sp.

1. Holotypus, A-forma, equatoriális metszet, E. 4641, 35×
2—3. A-forma, equatoriális metszet, *2.:* E. 4639, *3.:* E. 4640, 35×
Horsarrieu, cuisi emelet középső része

Discocyclina senegalensis Abrard

4. Külső alak, E 9-es minta, E. 4643, 5,5×
5—6. A-forma, equatoriális metszet, *5.:* E. 4644, *6.:* E. 4645, 38×
8. A-forma, equatoriális metszet, E. 4646, 35×
Krím, cuisi emelet felső része

Discocyclina javana (Verbeek)

7., 9. A-forma, equatoriális metszet, *7.:* E. 4648, *9.:* E. 4647, 22×
Siest, bartoni emelet felső része

Discocyclina pseudoaugustae Portnaya

10. A-forma, rozetta, B 19-es minta, E. 4651, 35×
Krím, ilerdi emelet felső része

* * *

Discocyclina weijdeni n. sp.

1. Holotype, form "A", equatorial section, E. 4641, 35×
2—3. Form "A", equatorial section, *2.:* E. 4639, *3.:* E. 4640, 35×
Horsarrieu, middle part of the Cuisian

Discocyclina senegalensis Abrard

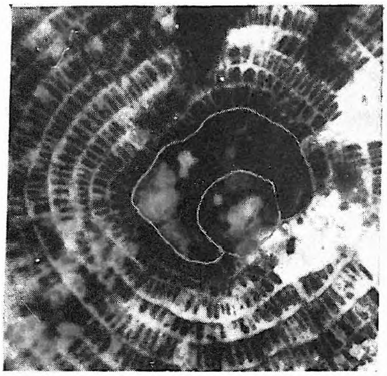
4. External view, sample E 9, E. 4643, 5.5×
5—6. Form "A", equatorial section, *5.:* E. 4644, *6.:* E. 4645, 38×
8. Form "A", equatorial section, E. 4646, 35×
Crimea, upper part of the Cuisian

Discocyclina javana (Verbeek)

7., 9. Form "A", equatorial section, *7.:* E. 4648, *9.:* E. 4647, 22×
Siest, upper part of the Bartonian

Discocyclina pseudoaugustae Portnaya

10. Form "A", rosette, sample B 19, E. 4651, 35×
Crimea, upper part of the Ilerdian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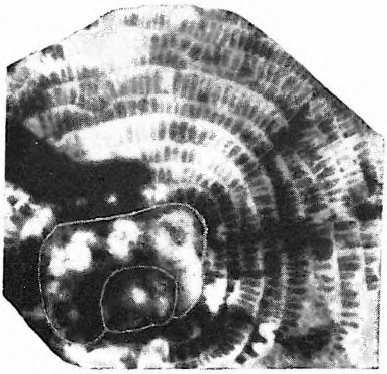
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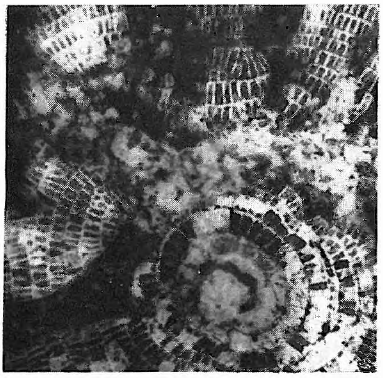
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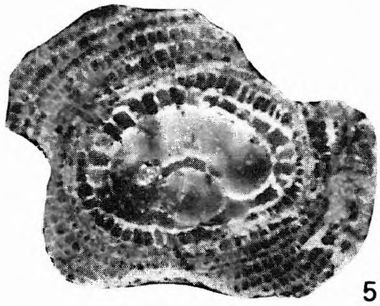
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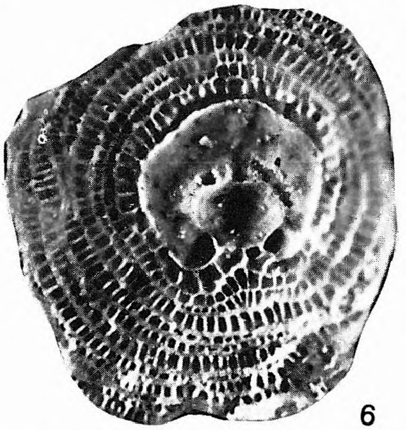
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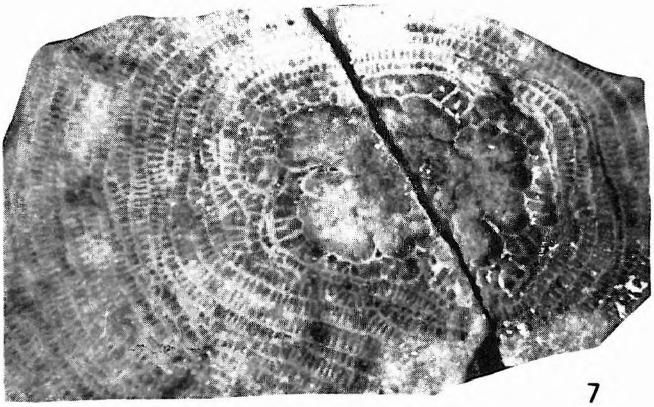
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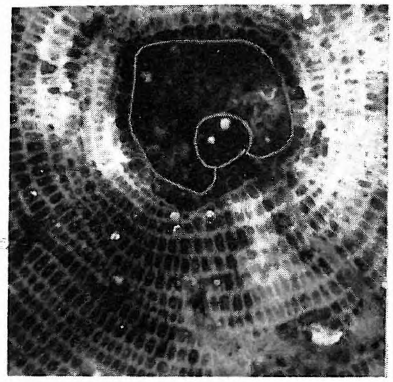
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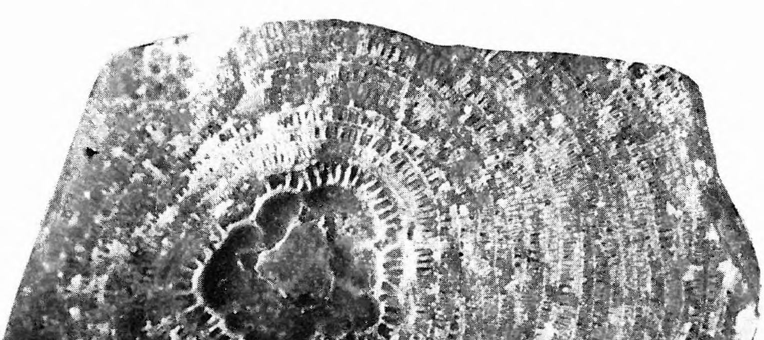
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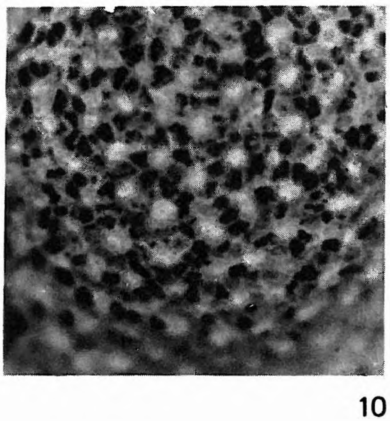
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VII. tábla — Plate VII

Discocyclina pseudoaugustae PORTNAYA

1. A-forma, külső alak, B 19-es minta, E. 4649, 22×

2., 4. A-forma, equatoriális metszet, *2.:* E. 4651, *4.:* E. 4650, 22×
Krím, ilerdi emelet felső része

3., 5—7. A-forma, equatoriális metszet, *3.:* E. 4653, *5.:* E. 4652, *6.:* E. 4655, *7.:* E. 4654, 22×
Dikilitas, cuisi emelet alsó része

Discocyclina fortisi fortisi (D'ARCHIAC)

8. A-forma, equatoriális metszet, E. 4656, 22×
Horsarrieu, cuisi emelet középső része

9. A-forma, equatoriális metszet, E. 4657, 22×
Krím, cuisi emelet középső része

Discocyclina fortisi (D'ARCHIAC) *simferopolensis* n. ssp.

10. Külső alak, E 9-es minta, E. 4658, 5,5×

11. A-forma, equatoriális metszet, E. 4659, 18×

12. A-forma, equatoriális metszet, E. 4661, 19×

13. Holotypus, A-forma, equatoriális metszet, E. 4660, 22×

14. A-forma, axiális metszet, E. 4662, 22×
Krím, cuisi emelet felső része

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Discocyclina pseudoaugustae PORTNAYA

1. Form "A", external view, sample B 19, E. 4649, 22×

2., 4. Form "A", equatorial section, *2.:* E. 4651, *4.:* E. 4650, 22×
Crimea, upper part of the Ilerdian

3., 5—7. Form "A", equatorial section, *3.:* E. 4653, *5.:* E. 4652, *6.:* E. 4655, *7.:* E. 4654, 22×
Dikilitash, lower part of the Cuisian

Discocyclina fortisi fortisi (D'ARCHIAC)

8. Form "A", equatorial section, E. 4656, 22×
Horsarrieu, middle part of the Cuisian

9. Form "A", equatorial section, E. 4657, 22×
Crimea, middle part of the Cuisian

Discocyclina fortisi (D'ARCHIAC) *simferopolensis* n. ssp.

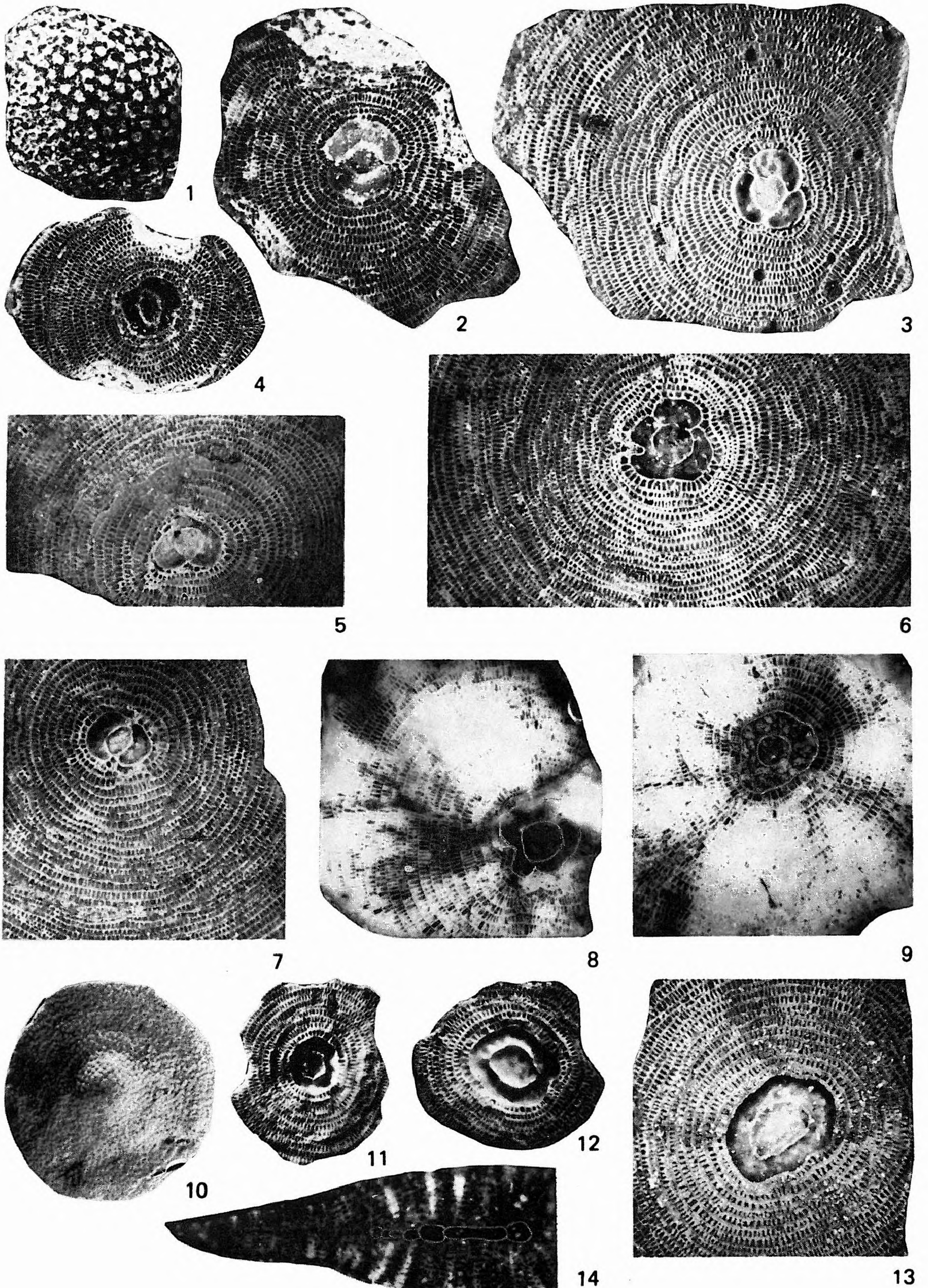
10. External view, sample E 9, E. 4658, 5.5×

11. Form "A", equatorial section, E. 4659, 18×

12. Form "A", equatorial section, E. 4661, 19×

13. Holotype, form "A", equatorial section, E. 4660, 22×

14. Form "A", axial section, E. 4662, 22×
Crimea, upper part of the Cuisian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VIII. tábla — Plate VIII

Discocyclina fortisi (d'Archiac) *simferopolensis* n. ssp.

1—3. A-forma, equatoriális metszet, *1.:* E. 4663, *2.:* E. 4665, *3.:* E. 4664, 22×
4. B-forma, equatoriális metszet, E. 4666, 56×
Krím, B 54-es minta, cuisi emelet felső része

Discocyclina stratiemanuelis Brönnimann

5—6. A-forma, equatoriális metszet, *5.:* E. 4667, *6.:* E. 4670, 22×
7—8. A-forma, equatoriális metszet, *7.:* E. 4668, *8.:* E. 4669, 30×
Krím, lutéciai emelet alsó része
9. A-forma, equatoriális metszet, E. 4671, 22×
Angoumé, lutéciai emelet felső része

Discocyclina spliti Butterlin—Chorowicz *ajkaensis* n. ssp.

10. Külső alak, SzT minta, E. 4672, 6×
11. A-forma, equatoriális metszet, 66 172, 22×
Ajka, bartoni emelet alsó része

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Discocyclina fortisi (d'Archiac) *simferopolensis* n. ssp.

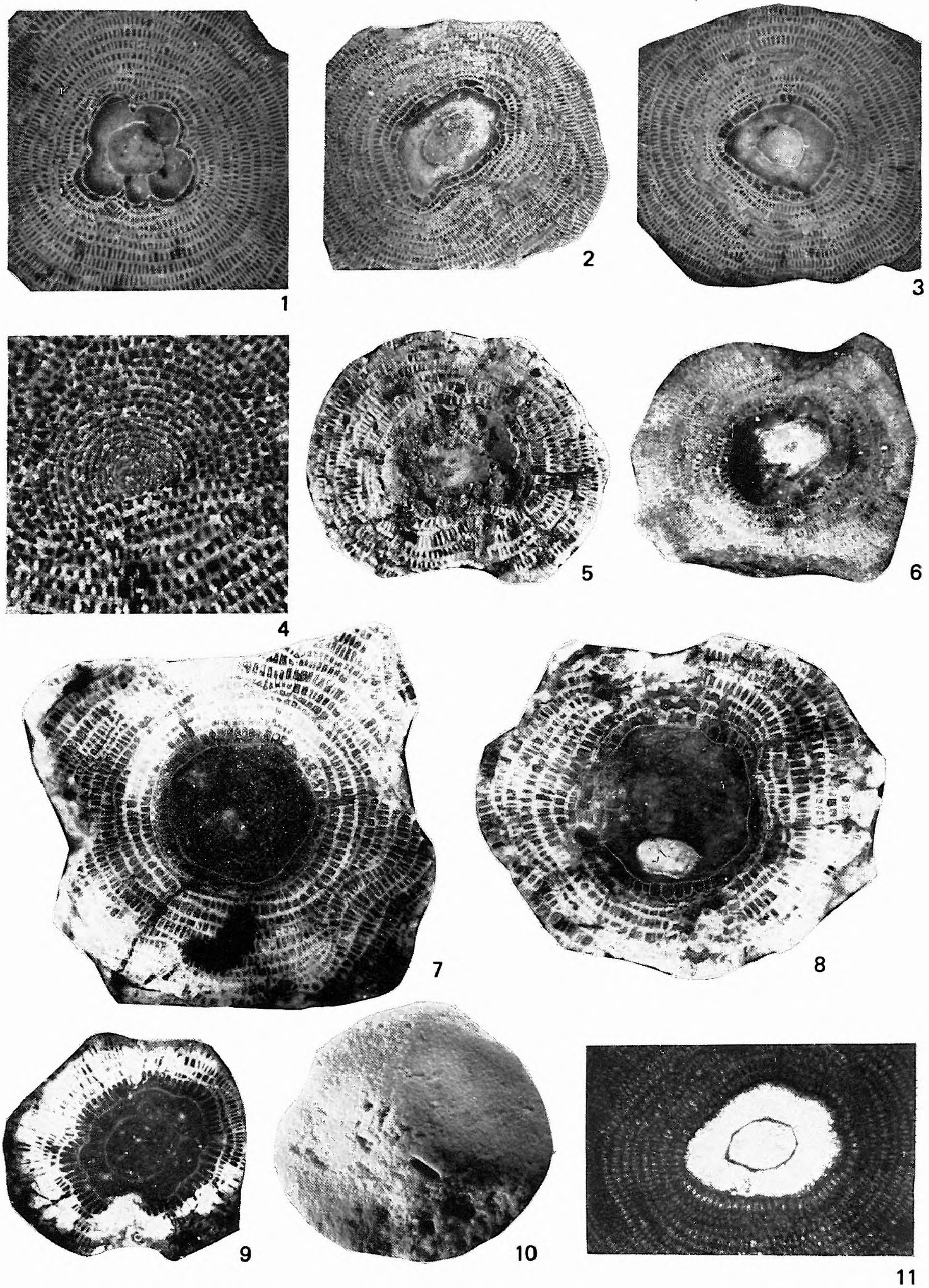
1—3. Form "A", equatorial section, *1.:* E. 4663, *2.:* E. 4665, *3.:* E. 4664, 22×
4. Form "B", equatorial section, E. 4666, 56×
Crimea, sample B 54, upper part of the Cuisian

Discocyclina stratiemanuelis Brönnimann

5—6. Form "A", equatorial section, *5.:* E. 4667, *6.:* E. 4670, 22×
7—8. Form "A", equatorial section, *7.:* E. 4668, *8.:* E. 4669, 30×
Crimea, lower part of the Lutetian
9. Form "A", equatorial section, E. 4671, 22×
Angoumé, upper part of the Lutetian

Discocyclina spliti Butterlin—Chorowicz *ajkaensis* n. ssp.

10. External view, sample SzT, E. 4672, 6×
11. Form "A", equatorial section, 66 172, 22×
Ajka, lower part of the Bartonian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IX. tábla — Plate IX

Discocyclina spliti BUTTERLIN—CHOROWICZ *ajkaensis* n. ssp.

1. A-forma, equatoriális metszet, E. 4674, 22×
2. Holotypus, A-forma, equatoriális metszet, E. 4673, 22×
Ajka, bartoni emelet alsó része

Discocyclina broennimanni n. sp.

3. Külső alak, B 10-es minta, E. 4675, 14×
4. Holotypus, A-forma, equatoriális metszet, E. 4677, 56×
5—6. A-forma, equatoriális metszet, *5.:* E. 4676, *6.:* E. 4678, 56×
Krím, ilerdi emelet középső része
8. A-forma, equatoriális metszet, E. 4679, 56×
Krím, ilerdi emelet felső része

Discocyclina augustae WEIJDEN *sourbetensis* n. ssp.

7. A-forma, equatoriális metszet, E. 4683, 56×
Krím, cuisi emelet felső része
9. B-forma, equatoriális metszet, E. 4682, 56×
10. A-forma, equatoriális metszet, E. 4680, 56×
11. Holotypus, A-forma, equatoriális metszet, E. 4681, 56×
12. B-forma, equatoriális metszet, E. 4682, 140×
Horsarrieu, cuisi emelet középső része

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Discocyclina spliti BUTTERLIN—CHOROWICZ *ajkaensis* n. ssp.

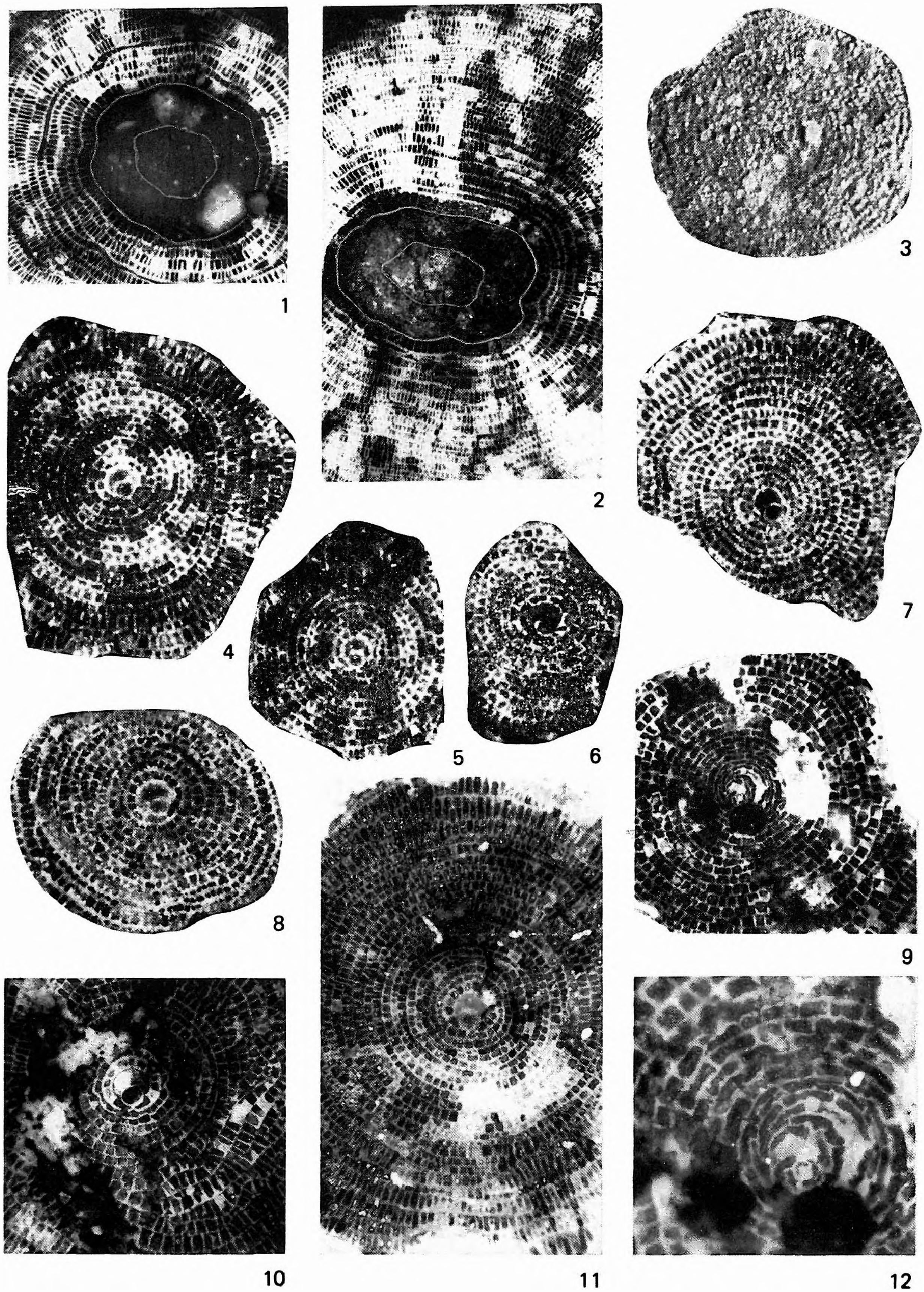
1. Form "A", equatorial section, E. 4674, 22×
2. Holotype, form "A", equatorial section, E. 4673, 22×
Ajka, lower part of the Bartonian

Discocyclina broennimanni n. sp.

3. External view, sample B 10, E. 4675, 14×
4. Holotype, form "A", equatorial section, E. 4677, 56×
5—6. Form "A", equatorial section, *5.:* E. 4676, *6.:* E. 4678, 56×
Crimea, middle part of the Ilerdian
8. Form "A", equatorial section, E. 4679, 56×
Crimea, upper part of the Ilerdian

Discocyclina augustae WEIJDEN *sourbetensis* n. ssp.

7. Form "A", equatorial section, E. 4683, 56×
Crimea, upper part of the Cuisian
9. Form "B", equatorial section, E. 4682, 56×
10. Form "A", equatorial section, E. 4680, 56×
11. Holotype, form "A", equatorial section, E. 4681, 56×
12. Form "B", equatorial section, E. 4682, 140×
Horsarrieu, middle part of the Cuisian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X. tábla — Plate X

Discocyclina augustae WEIJDEN *sourbetensis* n. ssp.

1. A-forma, equatoriális metszet, E. 4685, 56×
Krím, lutéciai emelet alsó része

Discocyclina augustae WEIJDEN *atlantica* n. ssp.

2. A-forma, equatoriális metszet, E. 4686, 56×
Neszmély, lutéciai emelet középső része

3. Holotypus, A-forma, equatoriális metszet, E. 4688, 56×

4. A-forma, equatoriális metszet, E. 4687, 56×
Nousse, lutéciai emelet középső része

Discocyclina augustae augustae WEIJDEN

5. A-forma, equatoriális metszet, E. 4690, 35×

6. A-forma, equatoriális metszet, E. 4689, 30×

8. B-forma, equatoriális metszet, E. 4691, 56×

9. B-forma, equatoriális metszet, E. 4691, 200×
Ajka, bartoni emelet alsó része

10–12. A-forma, equatoriális metszet, *10.:* E. 4694, *11.:* E. 4692, *12.:* E. 4693, 35×
Siest, bartoni emelet felső része

Discocyclina aff. *augustae* WEIJDEN

7. A-forma, equatoriális metszet, E. 4699, 35×
Ajka, bartoni emelet alsó része

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Discocyclina augustae WEIJDEN *sourbetensis* n. ssp.

1. Form "A", equatorial section, E. 4685, 56×
Crimea, lower part of the Lutetian

Discocyclina augustae WEIJDEN *atlantica* n. ssp.

2. Form "A", equatorial section, E. 4686, 56×
Neszmély, middle part of the Lutetian

3. Holotype, form "A", equatorial section, E. 4688, 56×

4. Form "A", equatorial section, E. 4687, 56×
Nousse, middle part of the Lutetian

Discocyclina augustae augustae WEIJDEN

5. Form "A", equatorial section, E. 4690, 35×

6. Form "A", equatorial section, E. 4689, 30×

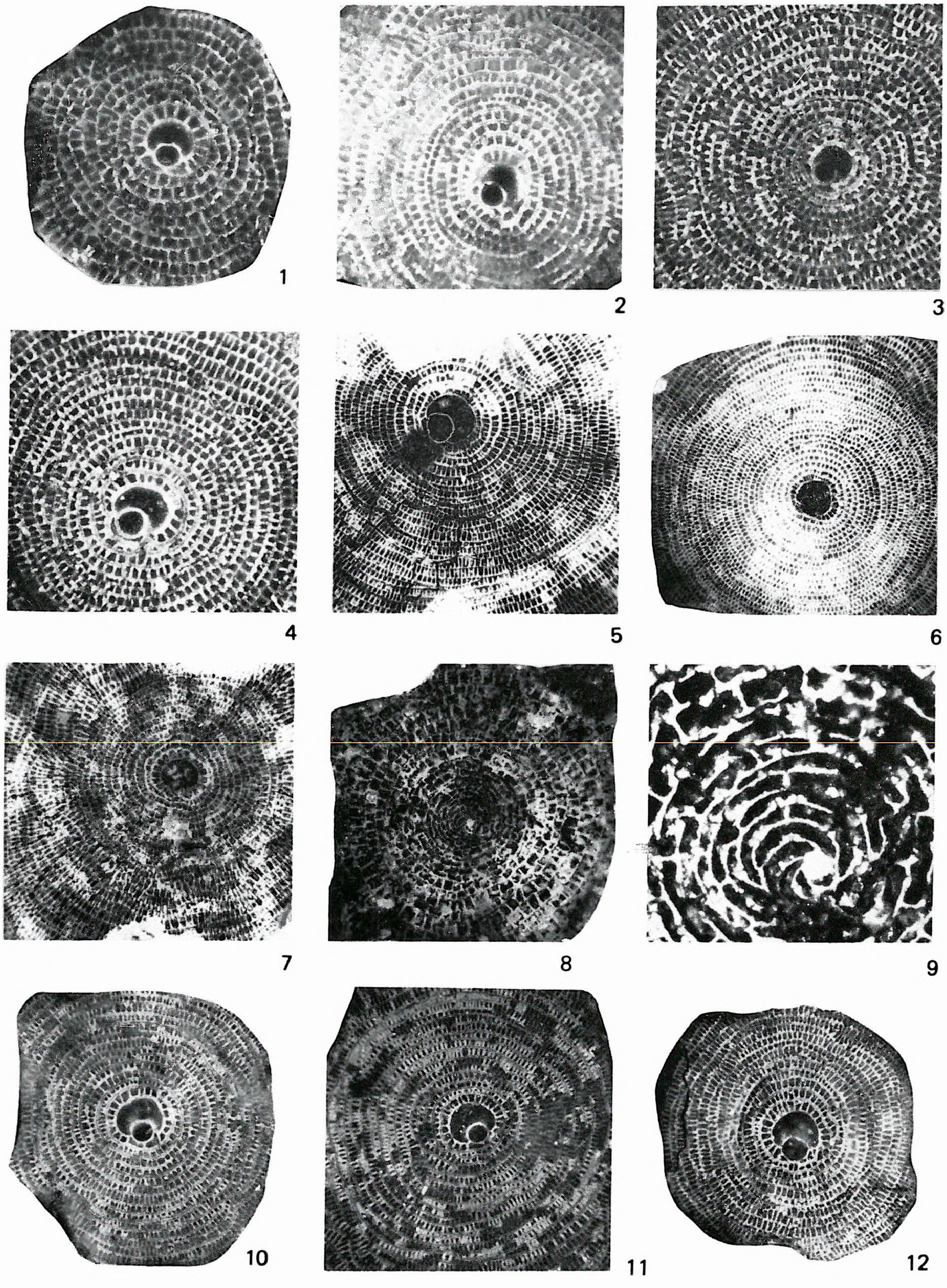
8. Form "B", equatorial section, E. 4691, 56×

9. Form "B", equatorial section, E. 4691, 200×
Ajka, lower part of the Bartonian

10–12. Form "A", equatorial section, *10.:* E. 4694, *11.:* E. 4692, *12.:* E. 4693, 35×
Siest, upper part of the Bartonian

Discocyclina aff. *augustae* WEIJDEN

7. Form "A", equatorial section, E. 4699, 35×
Ajka, lower part of the Bartonian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XI. tábla — Plate XI

Discocyclina augustae augustae WEIJDEN

1. A-forma, equatoriális metszet, E. 4695, 35×
Siest, bartoni emelet felső része

2—3. A-forma, equatoriális metszet, *2.:* E. 4697, *3.:* E. 4696, 35×
Mossano, priabonai emelet alsó része

4. A-forma, equatoriális metszet, E. 4698, 35×
Lábatlan, priabonai emelet középső része

Discocyclina knessae n. sp.

5. Külső alak, K 5-ös minta, E. 4700, 15×

6—7. A-forma, equatoriális metszet, *6.:* E. 4703, *7.:* E. 4701, 56×

8. Holotypus, A-forma, equatoriális metszet, E. 4702, 56×
Dunaszentmiklós, lutéciai emelet középső része

9. A-forma, equatoriális metszet, E. 4704, 56×
Dudar, bartoni emelet középső része

Discocyclina dispansa (SOWERBY) *ganensis* n. ssp.

10. B-forma, equatoriális metszet, E. 4707, 56×

11. A-forma, equatoriális metszet, E. 4706, 56×

12. B-forma, equatoriális metszet, E. 4707, 140×

13. Holotypus, A-forma, equatoriális metszet, E. 4705, 56×
Gan, cuisi emelet középső része

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Discocyclina augustae augustae WEIJDEN

1. Form "A", equatorial section, E. 4695, 35×
Siest, upper part of the Bartonian

2—3. Form "A", equatorial section, *2.:* E. 4697, *3.:* E. 4696, 35×
Mossano, lower part of the Priabonian

4. Form "A", equatorial section, E. 4698, 35×
Lábatlan, middle part of the Priabonian

Discocyclina knessae n. sp.

5. External view, sample K 5, E. 4700, 15×

6—7. Form "A", equatorial section, *6.:* E. 4703, *7.:* E. 4701, 56×

8. Holotype, form "A", equatorial section, E. 4702, 56×
Dunaszentmiklós, middle part of the Lutetian

9. Form "A", equatorial section, E. 4704, 56×
Dudar, middle part of the Bartonian

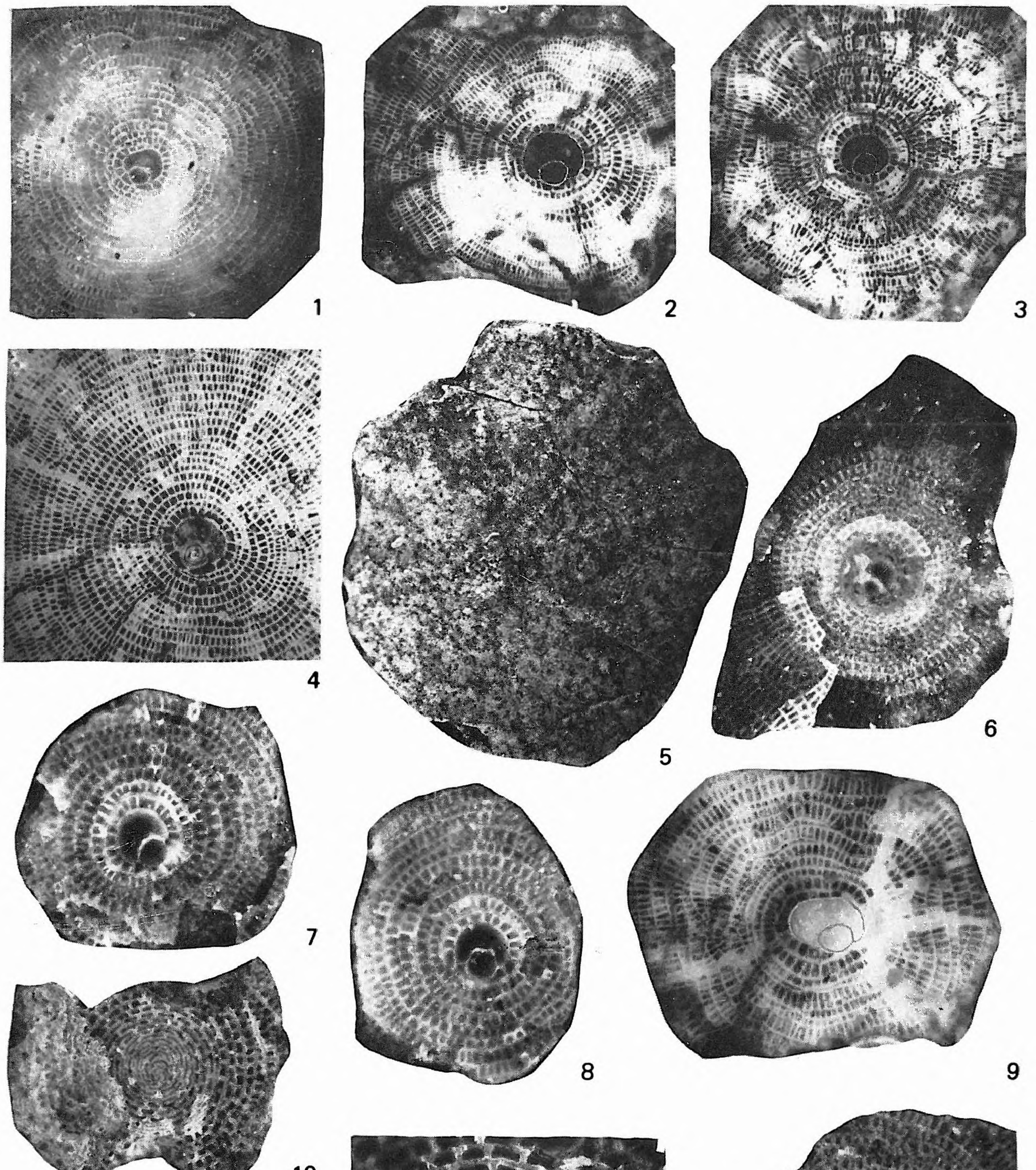
Discocyclina dispansa (SOWERBY) *ganensis* n. ssp.

10. Form "B", equatorial section, E. 4707, 56×

11. Form "A", equatorial section, E. 4706, 56×

12. Form "B", equatorial section, E. 4707, 140×

13. Holotype, form "A", equatorial section, E. 4705, 56×
Gan, middle part of the Cuisian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XII. tábla — Plate XII

Discocyclina dispansa (SOWERBY) *taurica* n. ssp.

1. Holotypus, A-forma, equatoriális metszet, E. 4709, 56×
2. A-forma, equatoriális metszet, E. 4708, 56×
Krím, lutéciai emelet alsó része
3. Külső alak, E. 4710, 18,5×
4–6. A-forma, equatoriális metszet, *4.:* E. 4713, *5.:* E. 4712, *6.:* E. 4711, 56×
Saint-Barthélémy, lutéciai emelet alsó része

Discocyclina dispansa (SOWERBY) *nussdorfensis* n. ssp.

7. A-forma, equatoriális metszet, E. 4716, 35×
Dunaszentmiklós, lutéciai emelet középső része
8. A-forma, equatoriális metszet, E. 4717, 35×
Neszmély, lutéciai emelet középső része
9. A-forma, equatoriális metszet, E. 4715, 35×
Gibret, lutéciai emelet középső része
10. A-forma, equatoriális metszet, E. 4714, 35×
Nousse, lutéciai emelet középső része
11. A-forma, equatoriális metszet, E. 4718, 35×
12. Holotypus, A-forma, equatoriális metszet, E. 4719, 35×
Nussdorf, lutéciai emelet középső része

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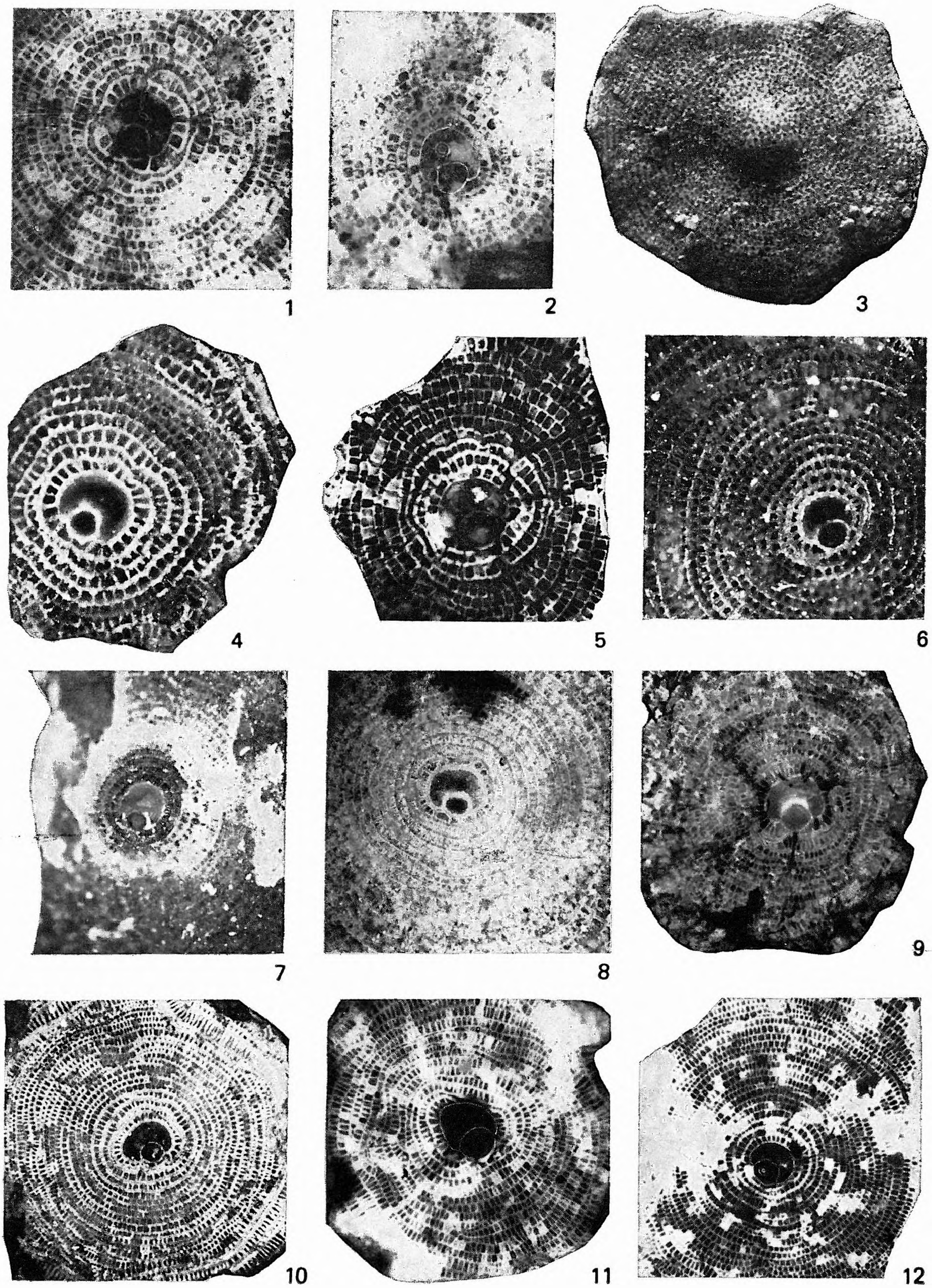
Discocyclina dispansa (SOWERBY) *taurica* n. ssp.

1. Holotype, form "A", equatorial section, E. 4709, 56×
2. Form "A", equatorial section, E. 4708, 56×
Crimea, lower part of the Lutetian
3. External view, E. 4710, 18.5×
4–6. Form "A", equatorial section, *4.:* E. 4713, *5.:* E. 4712, *6.:* E. 4711, 56×
Saint-Barthélémy, lower part of the Lutetian

Discocyclina dispansa (SOWERBY) *nussdorfensis* n. ssp.

7. Form "A", equatorial section, E. 4716, 35×
Dunaszentmiklós, middle part of the Lutetian
8. Form "A", equatorial section, E. 4717, 35×
Neszmély, middle part of the Lutetian
9. Form "A", equatorial section, E. 4715, 35×
Gibret, middle part of the Lutetian
10. Form "A", equatorial section, E. 4714, 35×
Nousse, middle part of the Lutetian
11. Form "A", equatorial section, E. 4718, 35×
12. Holotype, form "A", equatorial section, E. 4719, 35×
Nussdorf, middle part of the Lutetian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XIII. tábla — Plate XIII

Discocyclina dispansa (SOWERBY) *nussdorfensis* n. ssp.

1. A-forma, equatoriális metszet, E. 4720, 35×
Montfort, lutéciai emelet középső része

Discocyclina dispansa (SOWERBY) *hungarica* KECSKEMÉTI

2—4. A-forma, equatoriális metszet, *2.:* E. 4721, *3.:* E. 4723, *4.:* E. 4722, 35×
Angoumé, lutéciai emelet felső része

5. A-forma, rozetta patologikus alak búbján, J 8-as minta, E. 4725, 35×

6—7. A-forma, equatoriális metszet, *6.:* E. 4725, *7.:* E. 4724, 35×

8. Az A-formák equatoriális metszetének típusa, 61 732, 35×
Ajka, bartoni emelet alsó része

10—11. A-forma, equatoriális metszet, *10.:* E. 4726, *11.:* E. 4727, 35×
Dudar, bartoni emelet középső része

Discocyclina dispansa dispansa (SOWERBY)

9., 12. A-forma, equatoriális metszet, *9.:* E. 4730, *12.:* E. 4729, 35×
Siest, bartoni emelet felső része

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Discocyclina dispansa (SOWERBY) *nussdorfensis* n. ssp.

1. Form "A", equatorial section, E. 4720, 35×
Montfort, middle part of the Lutetian

Discocyclina dispansa (SOWERBY) *hungarica* KECSKEMÉTI

2—4. Form "A", equatorial section, *2.:* E. 4721, *3.:* E. 4723, *4.:* E. 4722, 35×
Angoumé, upper part of the Lutetian

5. Form "A", rosette on the umbo of a pathologic specimen, sample J 8, E. 4725, 35×

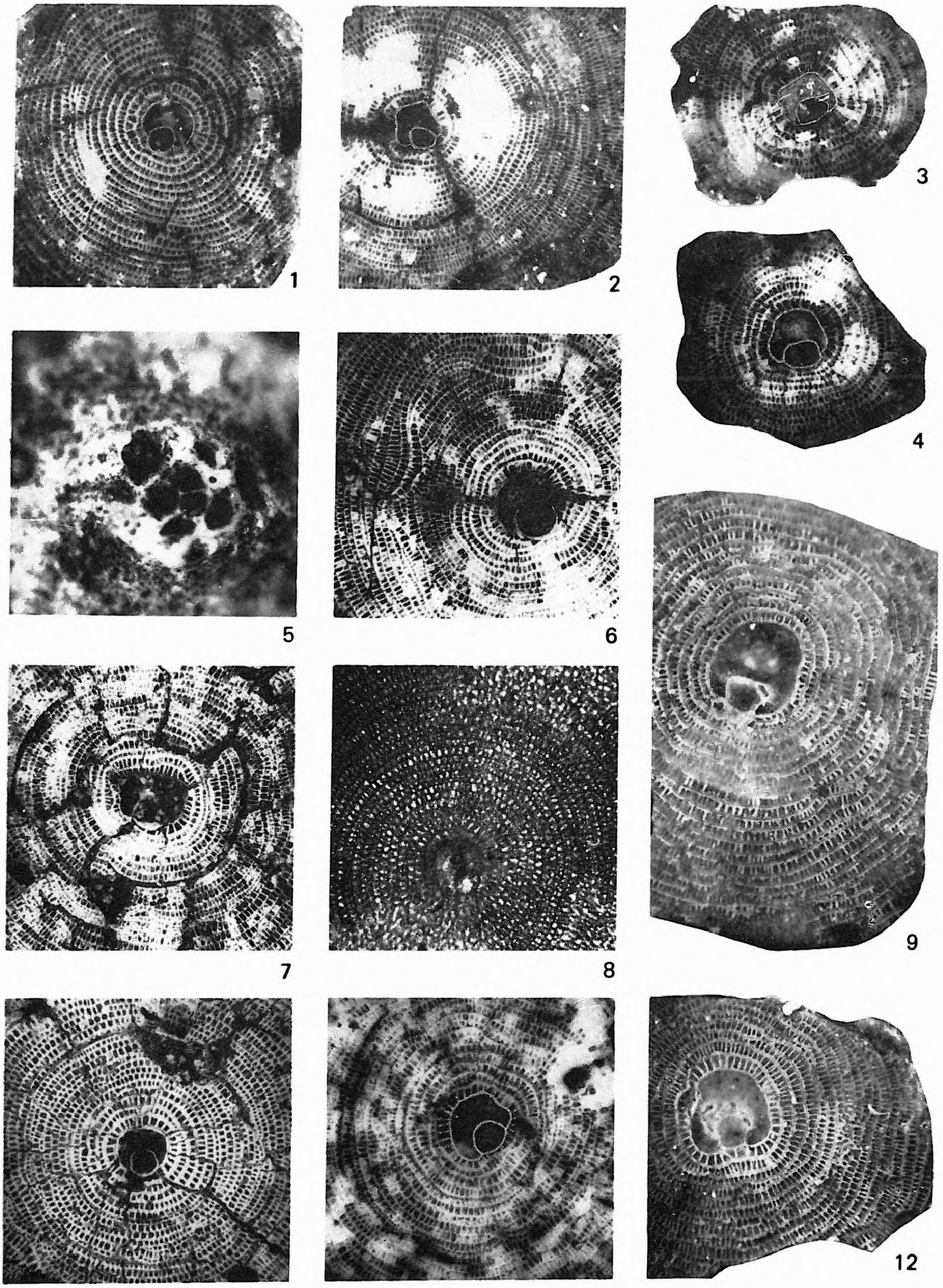
6—7. Form "A", equatorial section, *6.:* E. 4725, *7.:* E. 4724, 35×

8. The type of the equatorial section of forms "A", 61 732, 35×
Ajka, lower part of the Bartonian

10—11. Form "A", equatorial section, *10.:* E. 4726, *11.:* E. 4727, 35×
Dudar, middle part of the Bartonian

Discocyclina dispansa dispansa (SOWERBY)

9., 12. Form "A", equatorial section, *9.:* E. 4730, *12.:* E. 4729, 35×
Siest, upper part of the Bartonian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XIV. tábla — Plate XIV

Discocyclina dispansa (SOWERBY) *hungarica* KECSKEMÉTI

1. B-forma, equatoriális metszet, E. 4728, 56×
2. B-forma, equatoriális metszet, E. 4728, 140×
Dudar, bartoni emelet középső része

Discocyclina dispansa dispansa (SOWERBY)

3., 6. A-forma, equatoriális metszet, *3.:* E. 4731, *6.:* E. 4732, 35×
Mossano, priabonai emelet alsó része

Discocyclina dispansa (SOWERBY) *umbilicata* (DEPRAT)

4—5. A-forma, equatoriális metszet, *4.:* E. 4733, *5.:* E. 4734, 35×
Lábatlan, priabonai emelet középső része
7—8. A-forma, equatoriális metszet, *7.:* E. 4736, *8.:* E. 4735, 35×
Valle Granella, priabonai emelet középső része

Discocyclina kingae n. sp.

9. Külső alak, A 18-as minta, E. 4737, 7×
10., 12. A-forma, equatoriális metszet, *10.:* E. 4739, *12.:* E. 4738, 35×
11. Holotypus, A-forma, equatoriális metszet, E. 4740, 35×
Krím, lutéciai emelet alsó része

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Discocyclina dispansa (SOWERBY) *hungarica* KECSKEMÉTI

1. Form "B", equatorial section, E. 4728, 56×
2. Form "B", equatorial section, E. 4728, 140×
Dudar, middle part of the Bartonian

Discocyclina dispansa dispansa (SOWERBY)

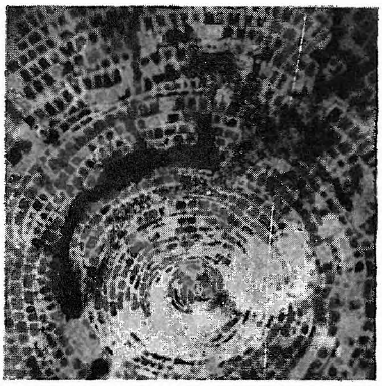
3., 6. Form "A", equatorial section, *3.:* E. 4731, *6.:* E. 4732, 35×
Mossano, lower part of the Priabonian

Discocyclina dispansa (SOWERBY) *umbilicata* (DEPRAT)

4—5. Form "A", equatorial section, *4.:* E. 4733, *5.:* E. 4734, 35×
Lábatlan, middle part of the Priabonian
7—8. Form "A", equatorial section, *7.:* E. 4736, *8.:* E. 4735, 35×
Valle Granella, middle part of the Priabonian

Discocyclina kingae n. sp.

9. External view, sample A 18, E. 4737, 7×
10., 12. Form "A", equatorial section, *10.:* E. 4739, *12.:* E. 4738, 35×
11. Holotype, form "A", equatorial section, E. 4740, 35×
Crimea, lower part of the Lutetian



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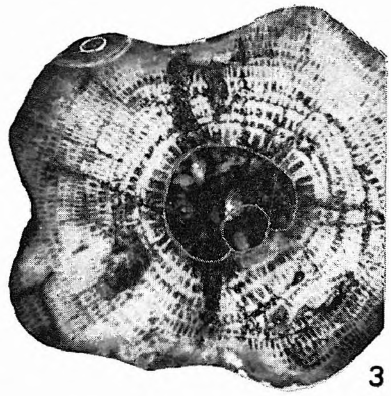

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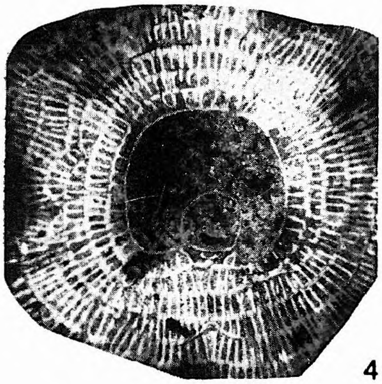

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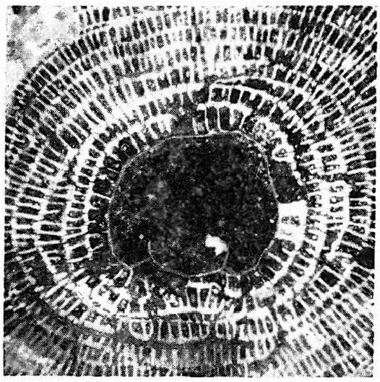

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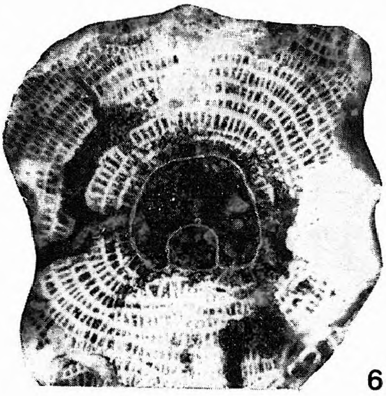

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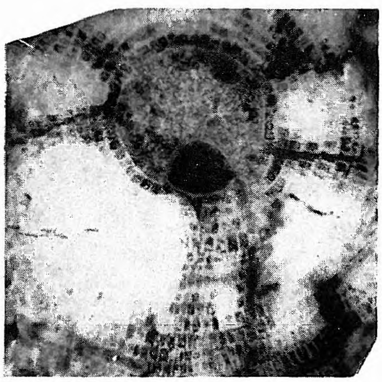

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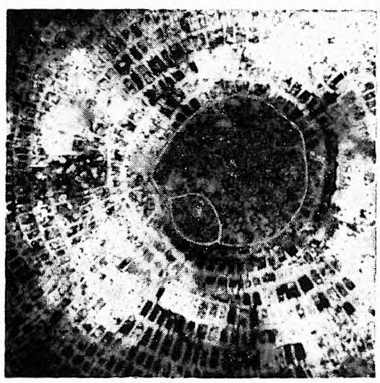

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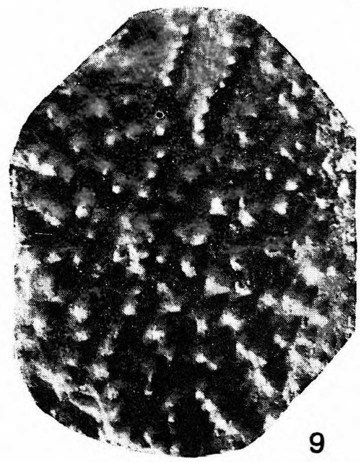

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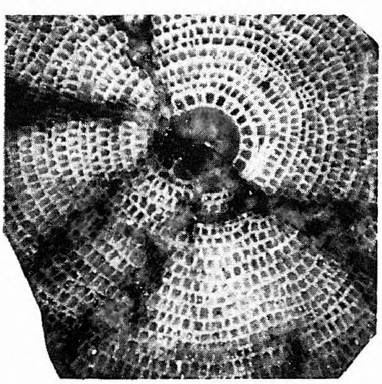

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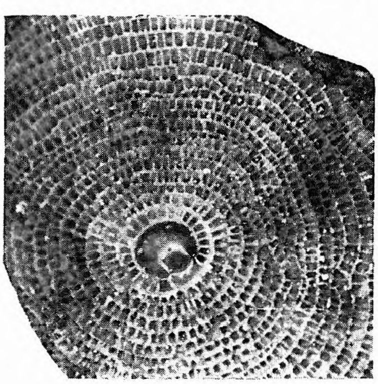

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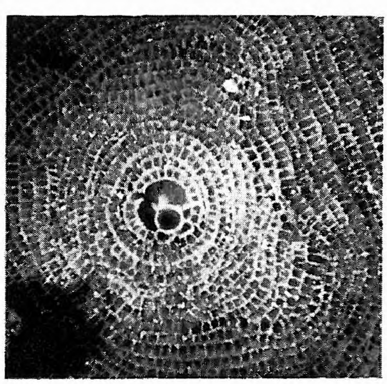

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XV. tábla — Plate XV

Discocyclina radians (D'ARCHIAC) *noussensis* n. ssp.

1. A-forma, equatoriális metszet, E. 4741, 35×
Krím, lutéciai emelet alsó része

2., 5. A-forma, equatoriális metszet, *2.:* E. 4748, *5.:* E. 4749, 35×
Montfort, lutéciai emelet középső része

3. Holotypus, A-forma, equatoriális metszet, E. 4745, 35×

4. Külső alak, E. 4742, 22×

7—8., 11. A-forma, equatoriális metszet, *7.:* E. 4744, *8.:* E. 4743, *11.:* E. 4746, 35×
Nousse, lutéciai emelet középső része

6. A-forma, equatoriális metszet, E. 4747, 35×
Gibret, lutéciai emelet középső része

Discocyclina radians radians (D'ARCHIAC)

9—10., 12. A-forma, equatoriális metszet, *9.:* E. 4751, *10.:* E. 4750, *12.:* E. 4752, 35×
Angoumé, lutéciai emelet felső része

13. Külső alak, a kagyló felületére települt váz követi annak bordázatát, Ba 3-as minta, E. 4753, 6×

14—15. A-forma, equatoriális metszet, *14.:* E. 4755, *15.:* E. 4756, 35×
Ajka, bartoni emelet alsó része

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Discocyclina radians (D'ARCHIAC) *noussensis* n. ssp.

1. Form "A", equatorial section, E. 4741, 35×
Crimea, lower part of the Lutetian

2., 5. Form "A", equatorial section, *2.:* E. 4748, *5.:* E. 4749, 35×
Montfort, middle part of the Lutetian

3. Holotype, form "A", equatorial section, E. 4745, 35×

4. External view, E. 4742, 22×

7—8., 11. Form "A", equatorial section, *7.:* E. 4744, *8.:* E. 4743, *11.:* E. 4746, 35×
Nousse, middle part of the Lutetian

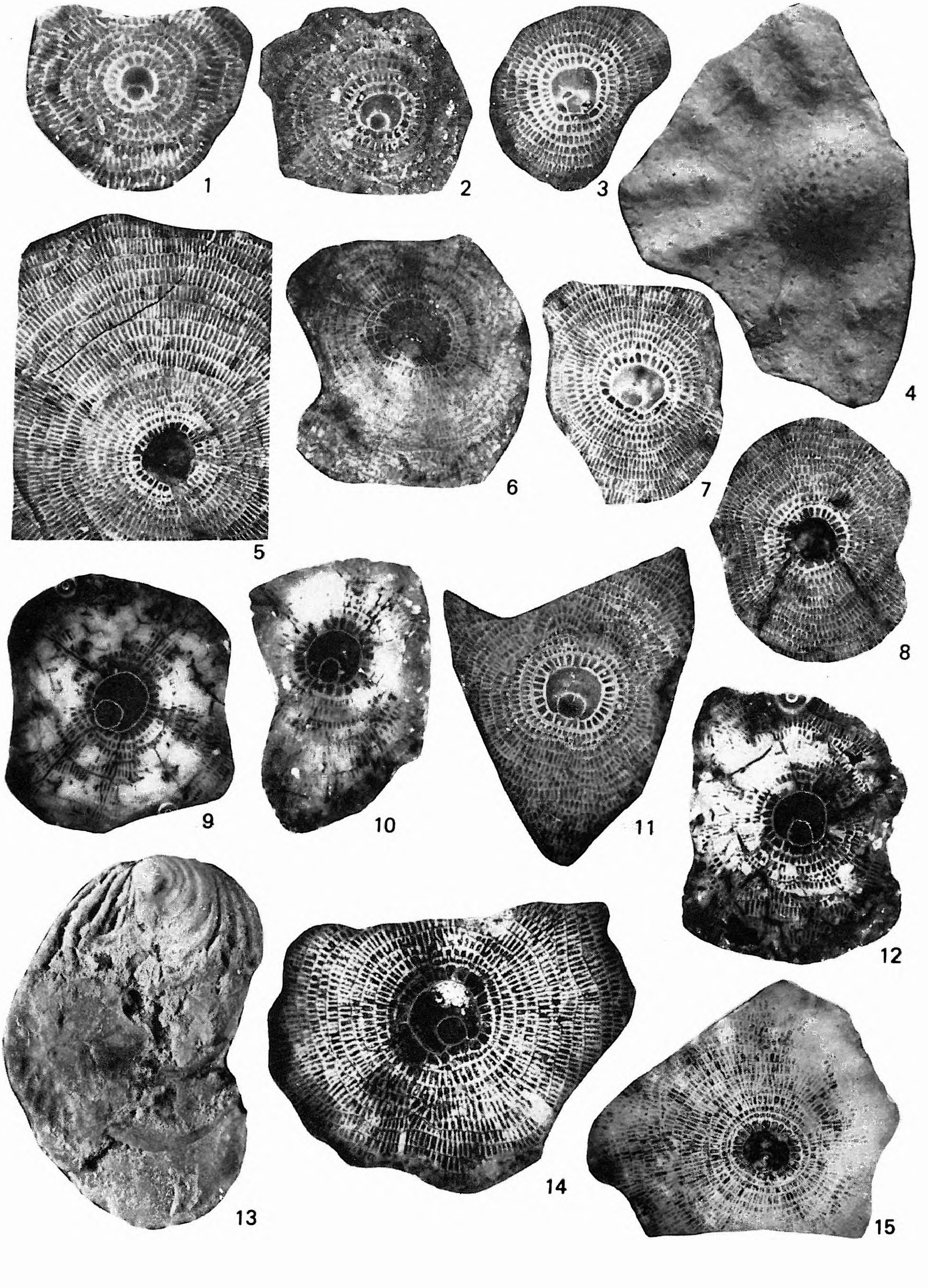
6. Form "A", equatorial section, E. 4747, 35×
Gibret, middle part of the Lutetian

Discocyclina radians radians (D'ARCHIAC)

9—10., 12. Form "A", equatorial section, *9.:* E. 4751, *10.:* E. 4750, *12.:* E. 4752, 35×
Angoumé, upper part of the Lutetian

13. External view, the test, situated on the shell's surface, is ribbing, sample Ba **3**, E. 4753, 6×

14—15. Form "A", equatorial section, *14.:* E. 4755, *15.:* E. 4756, 35×
Ajka, lower part of the Bartonian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XVI. tábla — Plate XVI

Discocyclina radians radians (D'ARCHIAC)

1. A-forma, equatoriális metszet, E. 4754, 35×
2. B-forma, equatoriális metszet, E. 4757, 56×
3. B-forma, equatoriális metszet, E. 4757, 140×
Ajka, bartoni emelet alsó része
4—5. A-forma, equatoriális metszet, *4.:* E. 4758, *5.:* E. 4759, 35×
Siest, bartoni emelet felső része

Discocyclina radians (D'ARCHIAC) *labatlanensis* n. ssp.

6. Holotypus, A-forma, equatoriális metszet, E. 4761, 35×
7. A-forma, equatoriális metszet, E. 4760, 35×
Lábatlan, priabonai emelet középső része

Discocyclina nandori n. sp.

8. A-forma, rozetta, E. 4762, 35×
9. A-forma, equatoriális metszet, E. 4762, 56×
Mossano, priabonai emelet alsó része
10. A-forma, equatoriális metszet, E. 4765, 56×
Valle Granella, priabonai emelet középső része
11. Holotypus, A-forma, equatoriális metszet, E. 4763, 56×
12. A-forma, equatoriális metszet, E. 4764, 56×
Lábatlan, priabonai emelet középső része

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Discocyclina radians radians (D'ARCHIAC)

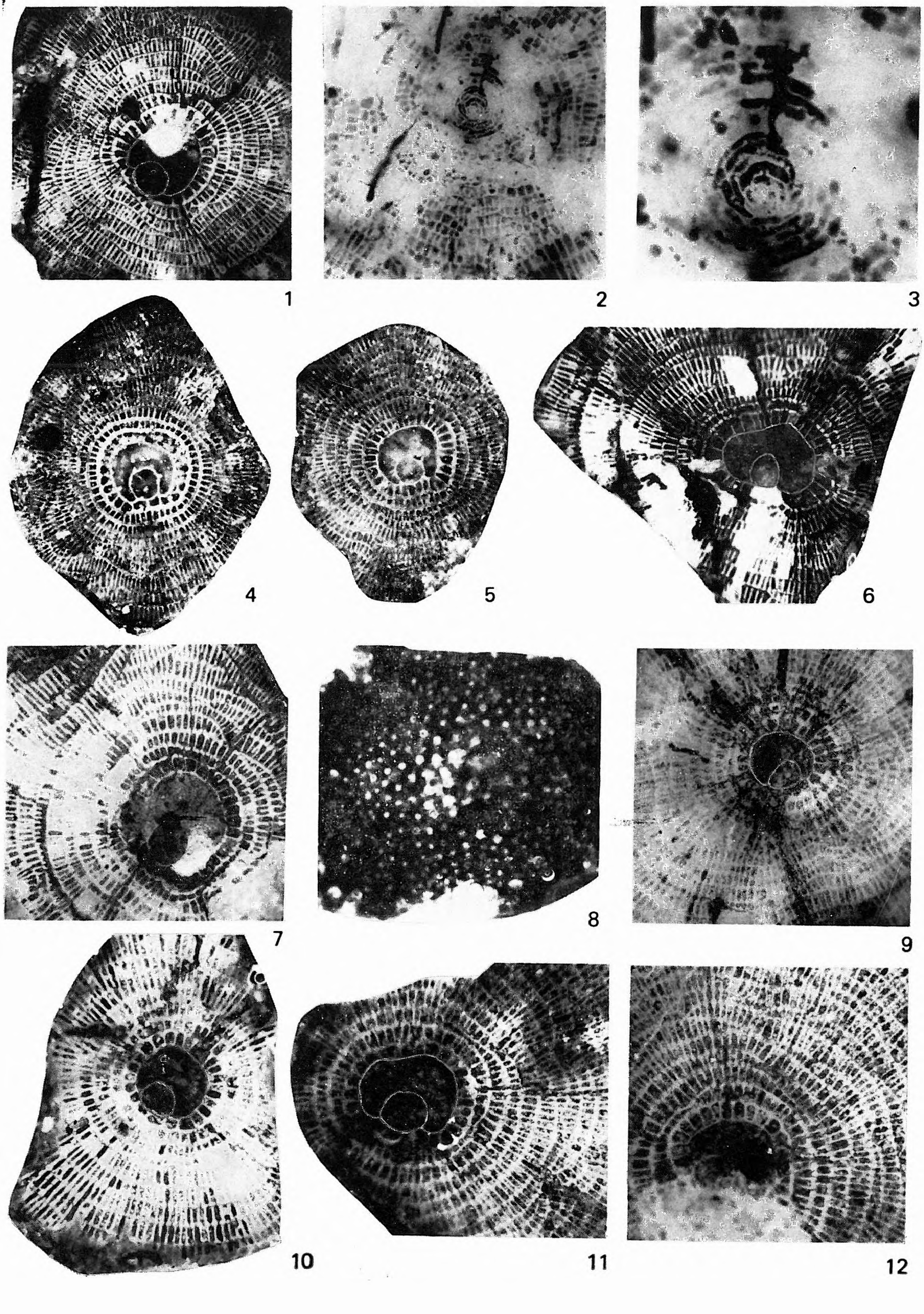
1. Form "A", equatorial section, E. 4754, 35×
2. Form "B", equatorial section, E. 4757, 56×
3. Form "B", equatorial section, E. 4757, 140×
Ajka, lower part of the Bartonian
4—5. Form "A", equatorial section, *4.:* E. 4758, *5.:* E. 4759, 35×
Siest, upper part of the Bartonian

Discocyclina radians (D'ARCHIAC) *labatlanensis* n. ssp.

6. Holotype, form "A", equatorial section, E. 4761, 35×
7. Form "A", equatorial section, E. 4760, 35×
Lábatlan, middle part of the Priabonian

Discocyclina nandori n. sp.

8. Form "A", rosette, E. 4762, 35×
9. Form "A", equatorial section, E. 4762, 56×
Mossano, lower part of the Priabonian
10. Form "A", equatorial section, E. 4765, 56×
Valle Granella, middle part of the Priabonian
11. Holotype, form "A", equatorial section, E. 4763, 56×
12. Form "A", equatorial section, E. 4764, 56×
Lábatlan, middle part of the Priabonian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XVII. tábla — Plate XVII

Discocyclina trabayensis trabayensis NEUMANN

1. A-forma, equatoriális metszet, E. 4768, 56×
Krím, cuisi emelet felső része

2—3. A-forma, equatoriális metszet, *2.:* E. 4767, *3.:* E. 4766, 56×
Horsarrieu, cuisi emelet középső része

5. A-forma, equatoriális metszet, E. 4771, 56×

6. B-forma, equatoriális metszet, E. 4772, 140×
Krím, lutéciai emelet alsó része

7—8. A-forma, equatoriális metszet, *7.:* E. 4769, *8.:* E. 4770, 56×
Saint-Barthélémy, lutéciai emelet alsó része

9. Külső alak, E. 4773, 20×

13. A-forma, equatoriális metszet, E. 4774, 56×
Gibret, lutéciai emelet középső része

Discocyclina augustae WEIJDEN *sourbetensis* n. ssp.

4. A-forma, equatoriális metszet, E. 4684, 56×
Krím, lutéciai emelet alsó része

Discocyclina trabayensis NEUMANN *concentrica* KECSKEMÉTI

10. Az A-formák equatoriális metszetének típusa, E. 4776, 56×

11. A-forma, equatoriális metszet, E. 4775, 56×

12. Az A-formák equatoriális metszetének típusa, E. 4776, 200×
Ajka, bartoni emelet alsó része

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Discocyclina trabayensis trabayensis NEUMANN

1. Form "A", equatorial section, E. 4768, 56×
Crimea, upper part of the Cuisian

2—3. Form "A", equatorial section, *2.:* E. 4767, *3.:* E. 4766, 56×
Horsarrieu, middle part of the Cuisian

5. Form "A", equatorial section, E. 4771, 56×

6. Form "B", equatorial section, E. 4772, 140×
Crimea, lower part of the Lutetian

7—8. Form "A", equatorial section, *7.:* E. 4769, *8.:* E. 4770, 56×
Saint-Barthélémy, lower part of the Lutetian

9. External view, E. 4773, 20×

13. Form "A", equatorial section, E. 4774, 56×
Gibret, middle part of the Lutetian

Discocyclina augustae WEIJDEN *sourbetensis* n. ssp.

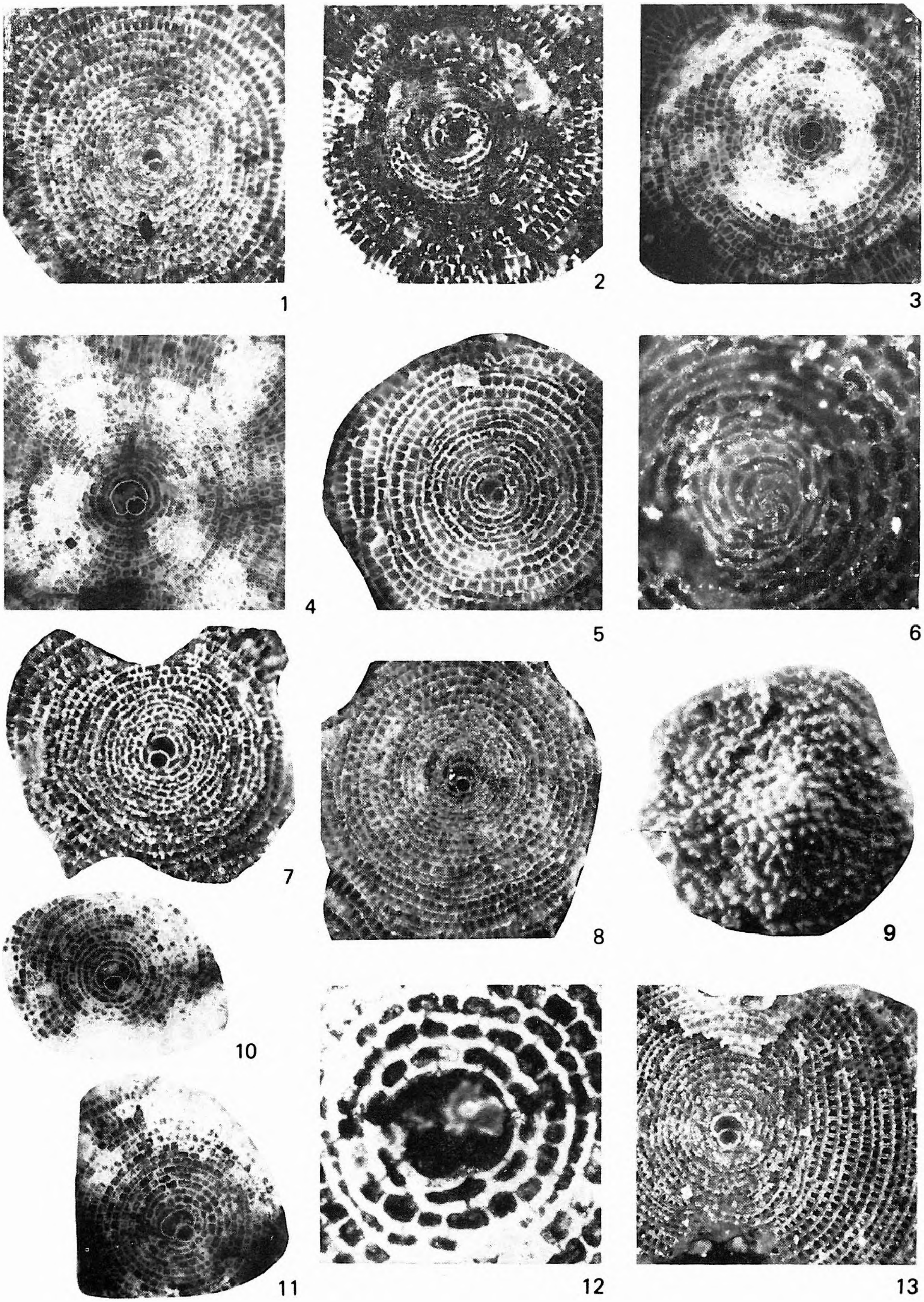
4. Form "A", equatorial section, E. 4684, 56×
Crimea, lower part of the Lutetian

Discocyclina trabayensis NEUMANN *concentrica* KECSKEMÉTI

10. The type of the equatorial section of forms "A", E. 4776, 56×

11. Form "A", equatorial section, E. 4775, 56×

12. The type of the equatorial section of forms "A", E. 4776, 200×
Ajka, lower part of the Bartonian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XVIII. tábla — Plate XVIII

Discocyclina trabayensis NEUMANN *concentrica* KECSKEMÉTI

1—2. A-forma, equatoriális metszet, *1.*: E. 4777, *2.*: 61 727, 56×
Ajka, bartoni emelet alsó része

Discocyclina trabayensis NEUMANN *vicenzensis* n. ssp.

3—4. A-forma, equatoriális metszet, *3.*: E. 4778, *4.*: E. 4779, 56×
Mossano, priabonai emelet alsó része

5. Holotypus, A-forma, equatoriális metszet, E. 4780, 56×
Priabona, priabonai emelet felső része

Discocyclina aaroni chalossensis n. sp. et n. ssp.

6. Holotypus, A-forma, equatoriális metszet, E. 4782, 56×

7. A-forma, equatoriális metszet, E. 4781, 56×
Horsarrieu, cuisi emelet középső része

8—9. A-forma, equatoriális metszet, *8.*: E. 4783, *9.*: E. 4784, 56×
Krím, lutéciai emelet alsó része

Discocyclina aaroni aaroni n. sp. et ssp.

10. Holotypus, A-forma, rozetta, E. 4786, 35×

11. Holotypus, A-forma, equatoriális metszet, E. 4786, 56×

12. A-forma, equatoriális metszet, E. 4787, 56×
Neszmély, lutéciai emelet középső része

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Discocyclina trabayensis NEUMANN *concentrica* KECSKEMÉTI

1—2. Form "A", equatorial section, *1.*: E. 4777, *2.*: 61 727, 56×
Ajka, lower part of the Bartonian

Discocyclina trabayensis NEUMANN *vicenzensis* n. ssp.

3—4. Form "A", equatorial section, *3.*: E. 4778, *4.*: E. 4779, 56×
Mossano, lower part of the Priabonian

5. Holotype, form "A", equatorial section, E. 4780, 56×
Priabona, upper part of the Priabonian

Discocyclina aaroni chalossensis n. sp. et n. ssp.

6. Holotype, form "A", equatorial section, E. 4782, 56×

7. Form "A", equatorial section, E. 4781, 56×
Horsarrieu, middle part of the Cuisian

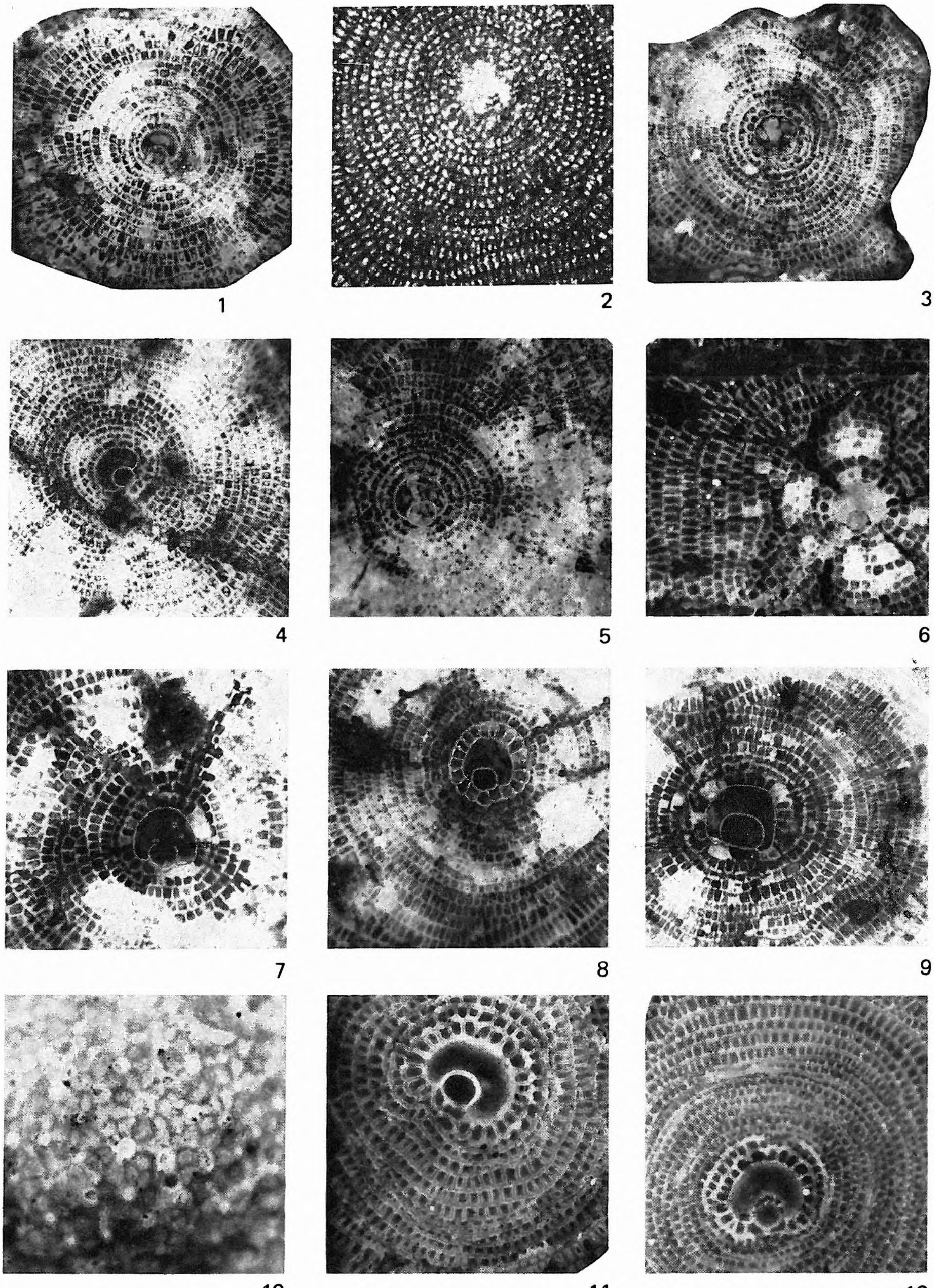
8—9. Form "A", equatorial section, *8.*: E. 4783, *9.*: E. 4784, 56×
Crimea, lower part of the Lutetian

Discocyclina aaroni aaroni n. sp. et ssp.

10. Holotype, form "A", rosette E. 4786, 35×

11. Holotype, form "A", equatorial section, E. 4786, 56×

12. Form "A", equatorial section, E. 4787, 56×
Neszmély, middle part of the Lutetian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XIX. tábla — Plate XIX

Discocyclina aaroni aaroni n. sp. et ssp.

1. A-forma, equatoriális metszet, E. 4785, 56×
Dunaszentmiklós, lutéciai emelet középső része
2. A-forma, equatoriális metszet, E. 4788, 56×
Nussdorf, lutéciai emelet középső része
3. A-forma, equatoriális metszet, E. 4789, 56×
Montfort, lutéciai emelet középső része

Discocyclina euaensis WHIPPLE

4—6. A-forma, equatoriális metszet, *4.:* E. 4791, *5.:* E. 4790, *6.:* E. 4792, 35×
Lábatlan, priabonai emelet középső része

Discocyclina pratti (MICHELIN) *aquitanica* n. ssp.

7. A-forma, equatoriális metszet, E. 4794, 35×
8. Holotypus, A-forma, equatoriális metszet, E. 4793, 35×
Horsarrieu, cuisi emelet középső része
10. A-forma, equatoriális metszet, E. 4795, 56×
Krím, cuisi emelet felső része

Discocyclina pratti (MICHELIN) *montfortensis* n. ssp.

9. A-forma, equatoriális metszet, E. 4796, 37×
Krím, lutéciai emelet alsó része
11. A-forma, equatoriális metszet, E. 4797, 35×
Nousse, lutéciai emelet középső része
12. Holotypus, A-forma, equatoriális metszet, E. 4798, 35×
Montfort, lutéciai emelet középső része

Discocyclina pratti pratti (MICHELIN)

13. A-forma, equatoriális metszet, E. 4802, 35×
Angoumé, lutéciai emelet felső része

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Discocyclina aaroni aaroni n. sp. et ssp.

1. Form "A", equatorial section, E. 4785, 56×
Dunaszentmiklós, middle part of the Lutetian
2. Form "A", equatorial section, E. 4788, 56×
Nussdorf, middle part of the Lutetian
3. Form "A", equatorial section, E. 4789, 56×
Montfort, middle part of the Lutetian

Discocyclina euaensis WHIPPLE

4—6. Form "A", equatorial section, *4.:* E. 4791, *5.:* E. 4790, *6.:* E. 4792, 35×
Lábatlan, middle part of the Priabonian

Discocyclina pratti (MICHELIN) *aquitanica* n. ssp.

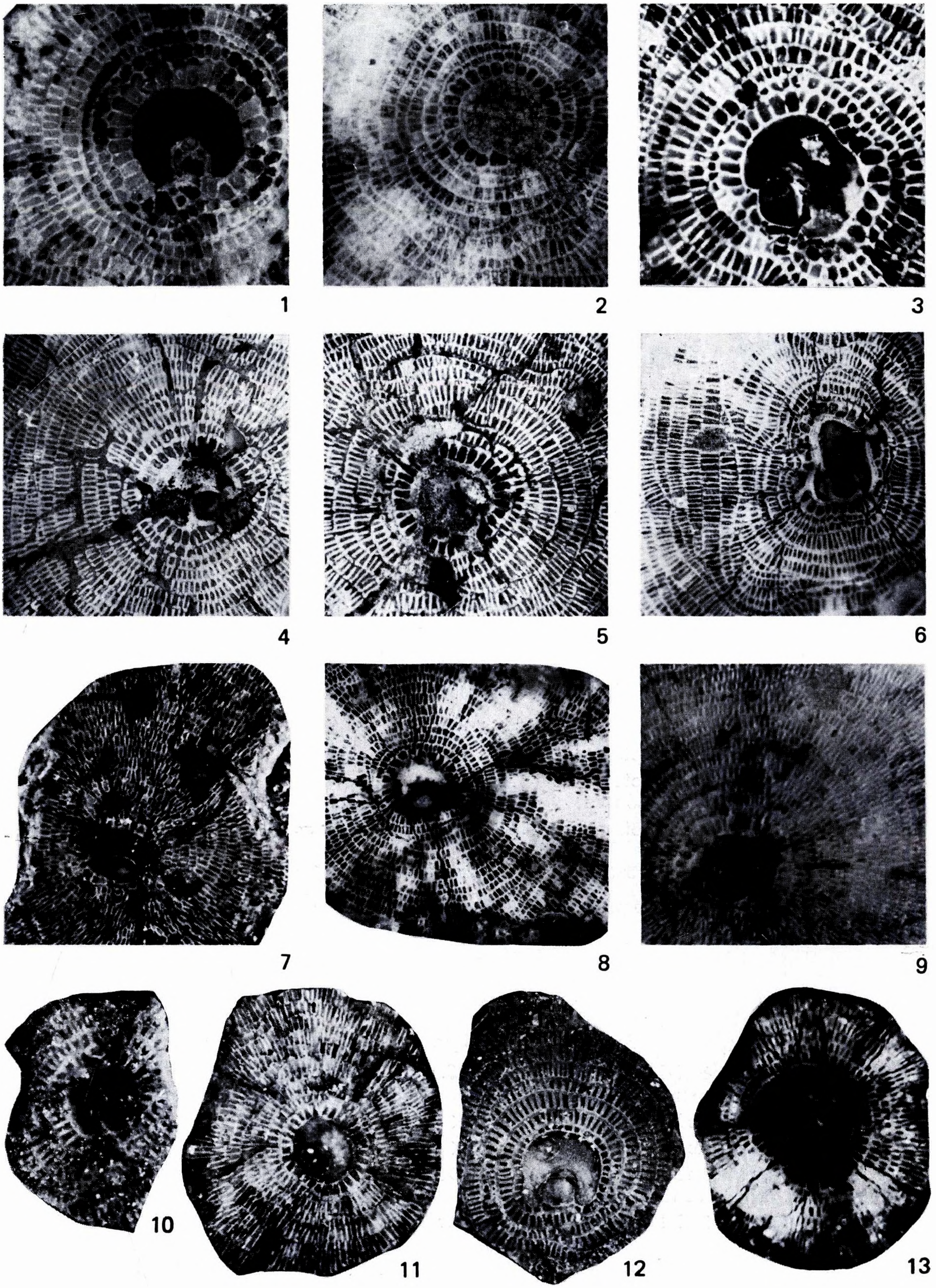
7. Form "A", equatorial section, E. 4794, 35×
8. Holotype, form "A", equatorial section, E. 4793, 35×
Horsarrieu, middle part of the Cuisian
10. Form "A", equatorial section, E. 4795, 56×
Crimea, upper part of the Cuisian

Discocyclina pratti (MICHELIN) *montfortensis* n. ssp.

9. Form "A", equatorial section, E. 4796, 37×
Crimea, lower part of the Lutetian
11. Form "A", equatorial section, E. 4797, 35×
Nousse, middle part of the Lutetian
12. Holotype, form "A", equatorial section, E. 4798, 35×
Montfort, middle part of the Lutetian

Discocyclina pratti pratti (MICHELIN)

13. Form "A", equatorial section, E. 4802, 35×
Angoumé, upper part of the Lutetian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XX. tábla — Plate XX

Discocyclina pratti pratti (MICHELIN)

1—3. A-forma, equatoriális metszet, *1.*: E. 4800, *2.*: E. 4801, *3.*: E. 4799, 35×
Angoumé, lutéciai emelet felső része

4. A-forma, equatoriális metszet, E. 4803, 35×

5. B-forma, equatoriális metszet, E. 4804, 56×

6. B-forma, equatoriális metszet, E. 4804, 140×
Ajka, bartoni emelet alsó része

7—11. A-forma, equatoriális metszet, *7.*: E. 4808, *8.*: E. 4809, *9.*: E. 4807, *10.*: E. 4805, *11.*: E. 4806, 35×
Dudar, bartoni emelet középső része

Discocyclina pratti (MICHELIN) *minor* MEFFERT

12. A-forma, equatoriális metszet, E. 4812, 22×
Lábatlan, priabonai emelet középső része

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Discocyclina pratti pratti (MICHELIN)

1—3. Form "A", equatorial section, *1.*: E. 4800, *2.*: E. 4801, *3.*: E. 4799, 35×
Angoumé, upper part of the Lutetian

4. Form "A", equatorial section, E. 4803, 35×

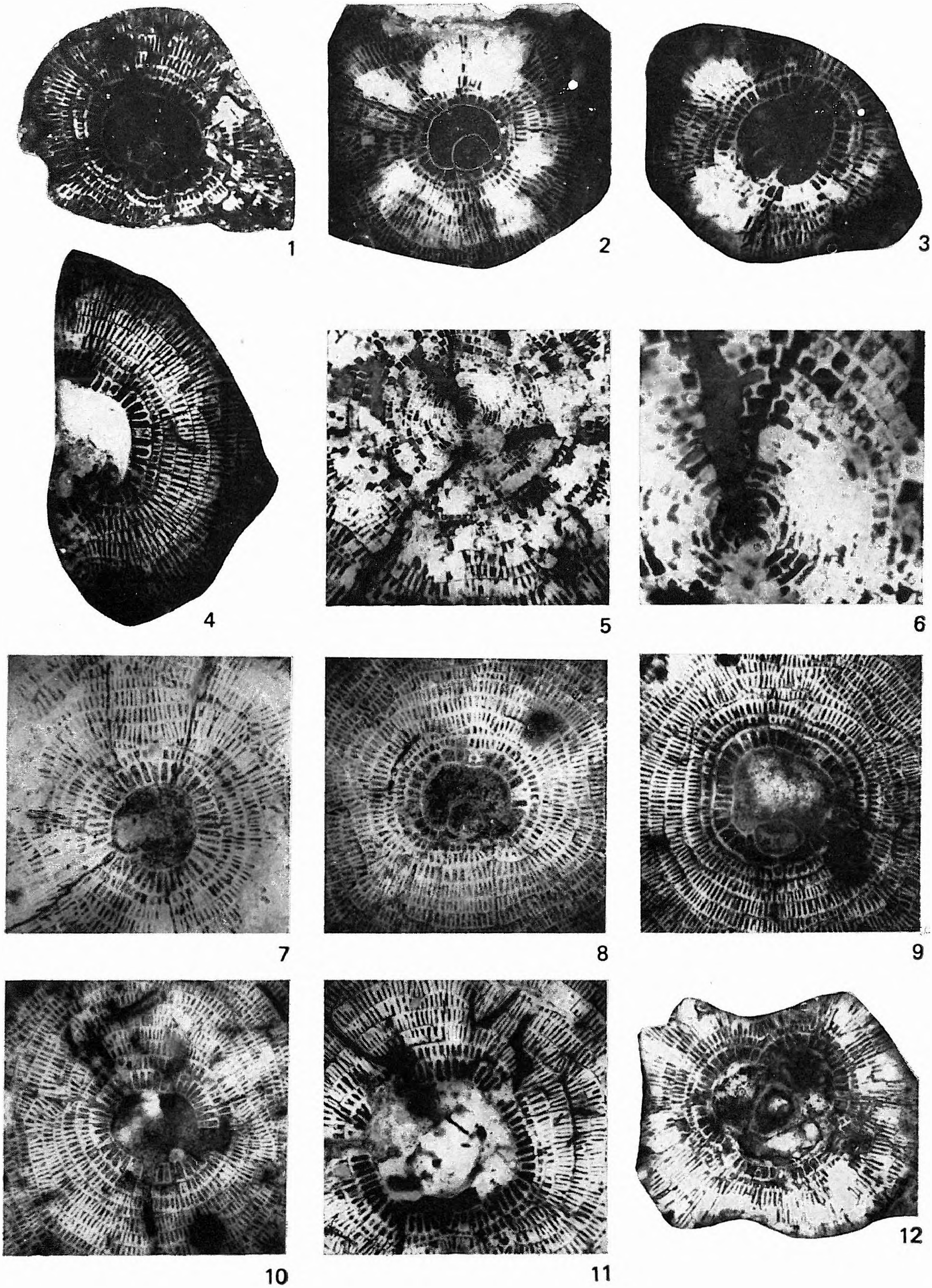
5. Form "B", equatorial section, E. 4804, 56×

6. Form "B", equatorial section, E. 4804, 140×
Ajka, lower part of the Bartonian

7—11. Form "A", equatorial section, *7.*: E. 4808, *8.*: E. 4809, *9.*: E. 4807, *10.*: E. 4805, *11.*: E. 4806, 35×
Dudar, middle part of the Bartonian

Discocyclina pratti (MICHELIN) *minor* MEFFERT

12. Form "A", equatorial section, E. 4812, 22×
Lábatlan, middle part of the Priabonian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XXI. tábla — Plate XXI

Discocyclina pratti (MICHELIN) *minor* MEFFERT

1—3. A-forma, equatoriális metszet, *1.*: E. 4813, *2.*: E. 4810, *3.*: E. 4811, 22×
Lábatlan, priabonai emelet középső része

Discocyclina samantai n. sp.

4. Holotypus, A-forma, külső alak, R 2-es minta, E. 4814, 11×
5. Holotypus, A-forma, equatoriális metszet, E. 4814, 22×
6. A-forma, equatoriális metszet, E. 4815, 35×
Lábatlan, priabonai emelet középső része

Discocyclina pulcra (CHECCHIA-RISPOLI) *landesica* n. ssp.

7. Holotypus, A-forma, equatoriális metszet, E. 4816, 22×
10. Holotypus, A-forma, equatoriális metszet, E. 4816, 30×
Horsarrieu, cuisi emelet középső része

Discocyclina pulcra pulcra (CHECCHIA-RISPOLI)

8—9. A-forma, equatoriális metszet, *8.*: E. 4818, *9.*: E. 4819, 22×
Angoumé, lutéciai emelet felső része
15. A-forma, equatoriális metszet, E. 4817, 22×
Gibret, lutéciai emelet középső része

Discocyclina pulcra (CHECCHIA-RISPOLI) *baconica* n. ssp.

11. A-forma, külső alak, DS 5-ös minta, E. 4828, 10×
Dudar, bartoni emelet középső része

Discocyclina pulcra (CHECCHIA-RISPOLI) *balatonica* n. ssp.

12. A-forma, külső alak, patologikus egyed, Kö 3-as minta, E. 4821, 17×
13. A-forma, külső alak, Ba 3-as minta, E. 4820, 11×
14. A-forma, axiális metszet, E. 4827, 22×
Ajka, bartoni emelet alsó része

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Discocyclina pratti (MICHELIN) *minor* MEFFERT

1—3. Form "A", equatorial section, *1.*: E. 4813, *2.*: E. 4810, *3.*: E. 4811, 22×
Lábatlan, middle part of the Priabonian

Discocyclina samantai n. sp.

4. Holotype, form "A", external view, sample R 2, E. 4814, 11×
5. Holotype, form "A", equatorial section, E. 4814, 22×
6. Form "A", equatorial section, E. 4815, 35×
Lábatlan, middle part of the Priabonian

Discocyclina pulcra (CHECCHIA-RISPOLI) *landesica* n. ssp.

7. Holotype, form "A", equatorial section, E. 4816, 22×
10. Holotype, form "A", equatorial section, E. 4816, 30×
Horsarrieu, middle part of the Cuisian

Discocyclina pulcra pulcra (CHECCHIA-RISPOLI)

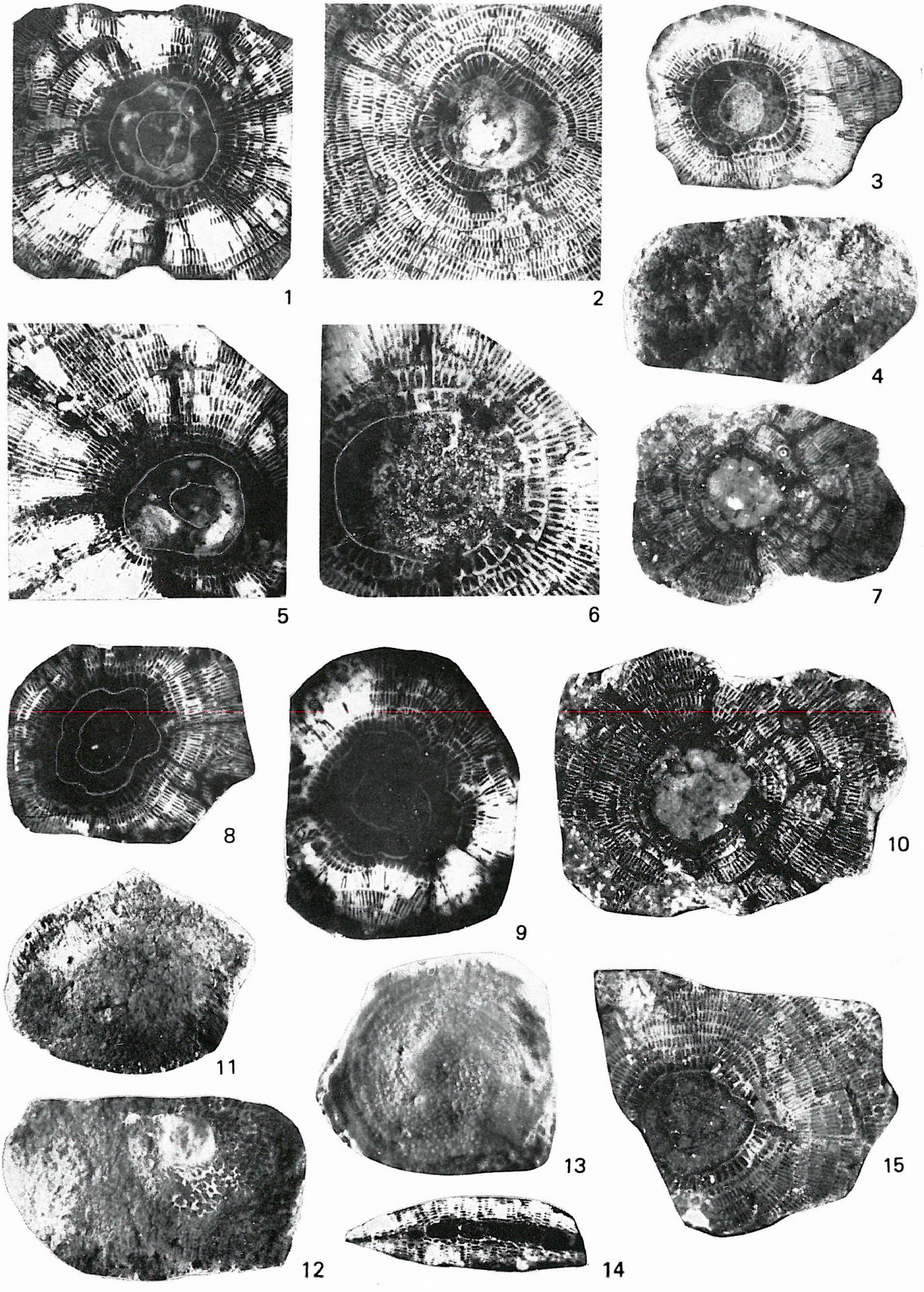
8—9. Form "A", equatorial section, *8.*: E. 4818, *9.*: E. 4819, 22×
Angoumé, upper part of the Lutetian
15. Form "A", equatorial section, E. 4817, 22×
Gibret, middle part of the Lutetian

Discocyclina pulcra (CHECCHIA-RISPOLI) *baconica* n. ssp.

11. Form "A", external view, sample DS 5, E. 4828, 10×
Dudar, middle part of the Bartonian

Discocyclina pulcra (CHECCHIA-RISPOLI) *balatonica* n. ssp.

12. Form "A", external view, pathologic specimen, sample Kö 3, E. 4821, 17×
13. Form "A", external view, sample Ba 3, E. 4820, 11×
14. Form "A", axial section, E. 4827, 22×
Ajka, lower part of the Bartonian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XXII. tábla — Plate XXII

Discocyclina pulcra (CHECCHIA-RISPOLI) *balatonica* n. ssp.

1., *3—5.* A-forma, equatoriális metszet, *1.:* E. 4825, *3.:* E. 4822, *4.:* E. 4823, *5.:* E. 4824, 22×
2. Holotypus, A-forma, equatoriális metszet, E. 4826, 22×
Ajka, bartoni emelet alsó része

Discocyclina pulcra (CHECCHIA-RISPOLI) *baconica* n. ssp.

6., *8—9.* A-forma, equatoriális metszet, *6.:* E. 4829, *8.:* E. 4828, *9.:* E. 4831, 22×
7. Holotypus, A-forma, equatoriális metszet, E. 4830, 22×
Dudar, bartoni emelet középső része

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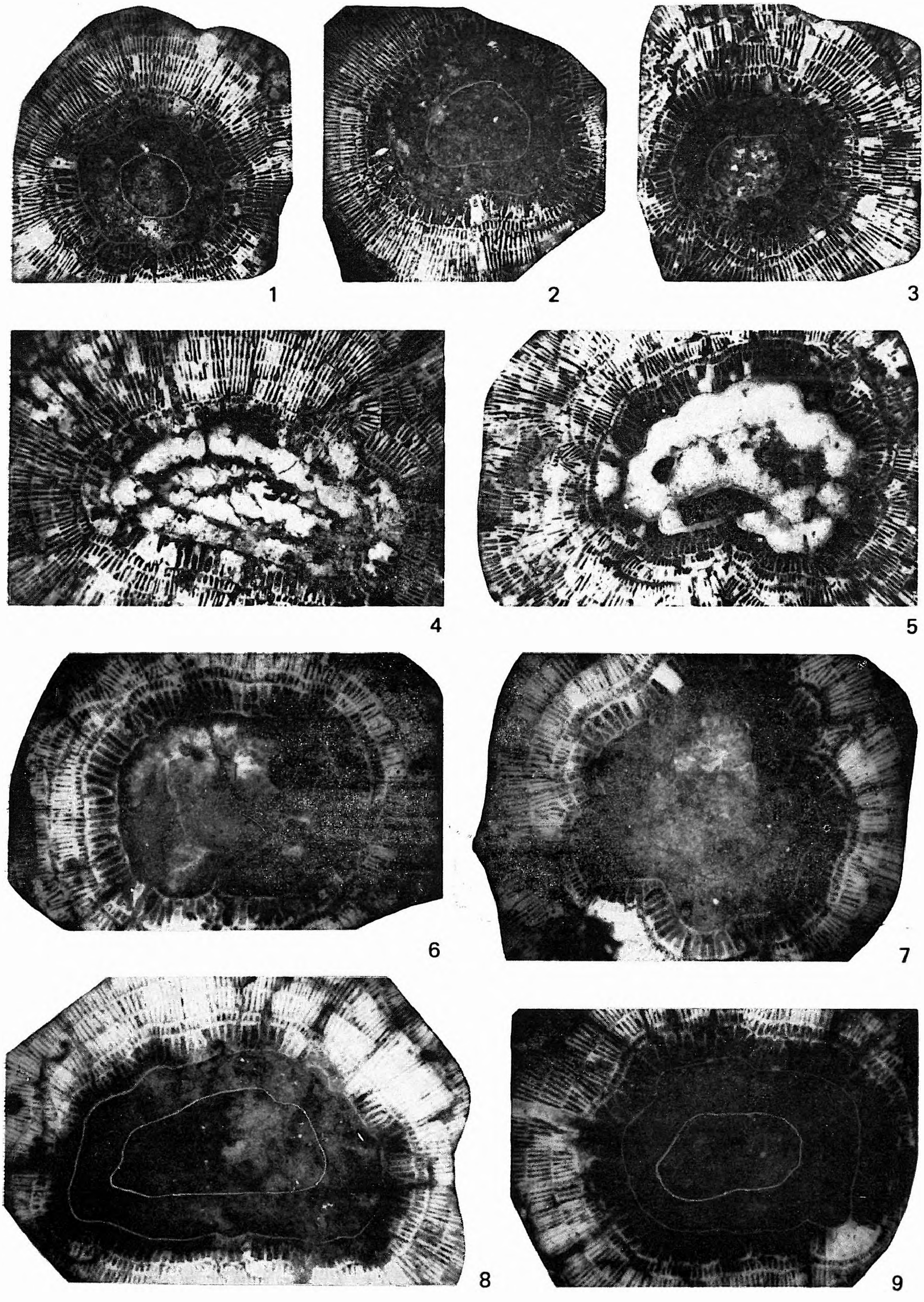
Discocyclina pulcra (CHECCHIA-RISPOLI) *balatonica* n. ssp.

1., *3—5.* Form "A", equatorial section, *1.:* E. 4825, *3.:* E. 4822, *4.:* E. 4823, *5.:* E. 4824, 22×
2. Holotype, form "A", equatorial section, E. 4826, 22×
Ajka, lower part of the Bartonian

Discocyclina pulcra (CHECCHIA-RISPOLI) *baconica* n. ssp.

6., *8—9.* Form "A", equatorial section, *6.:* E. 4829, *8.:* E. 4828, *9.:* E. 4831, 22×
7. Holotype, form "A", equatorial section, E. 4830, 22×
Dudar, middle part of the Bartonian



XXIII. tábla — Plate XXIII

Nemkovella evae n. sp.

1. A-forma, külső alak, E. 4832, 16×
9. A-forma, equatoriális metszet, E. 4832, 35×
Le Porge, cuisi emelet középső—felső része
2. A-forma, rozetta, HX minta, E. 4834, 35×
3. A-forma, equatoriális metszet, E. 4834, 35×
4. A-forma, equatoriális metszet, E. 4833, 56×
5. B-forma, equatoriális metszet, E. 4835, 56×
6. A-forma, equatoriális kamrák, E. 4834, 125×
Horsarrieu, cuisi emelet középső része
7. B-forma, külső alak, E 9-es minta, E. 4839, 22×
Krím, cuisi emelet felső része
10. A-forma, külső alak, E. 4840, 35×
11—12. A-forma, equatoriális metszet, *11.:* E. 4841, *12.:* E. 4840, 56×
Saint-Barthélémy, lutéciai emelet alsó része

Nemkovella fermonti n. sp.

8. A-forma, equatoriális metszet, E. 4842, 56×
Horsarrieu, cuisi emelet középső része

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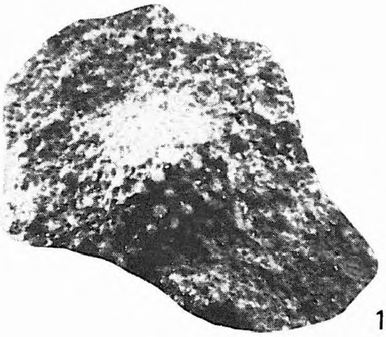
Nemkovella evae n. sp.

1. Form "A", external view, E. 4832, 16×
9. Form "A", equatorial section, E. 4832, 35×
Le Porge, middle—upper part of the Cuisian
2. Form "A", rosette, sample HX, E. 4834, 35×
3. Form "A", equatorial section, E. 4834, 35×
4. Form "A", equatorial section, E. 4833, 56×
5. Form "B", equatorial section, E. 4835, 56×
6. Form "A", equatorial chambers, E. 4834, 125×
Horsarrieu, middle part of the Cuisian
7. Form "B", external view, sample E. 9, E. 4839, 22×
Crimea, upper part of the Cuisian
10. Form "A", external view, E. 4840, 35×
11—12. Form "A", equatorial section, *11.:* E. 4841, *12.:* E. 4840, 56×
Saint-Barthélémy, lower part of the Lutetian

Nemkovella fermonti n. sp.

8. Form "A", equatorial section, E. 4842, 56×
Horsarrieu, middle part of the Cuisian



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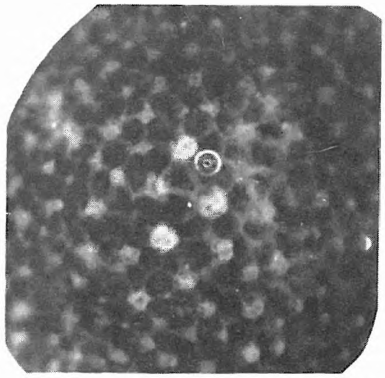

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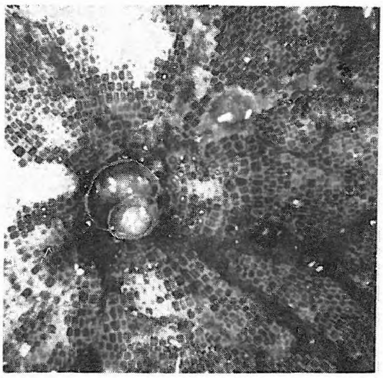

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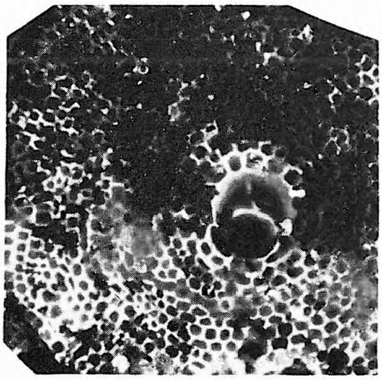

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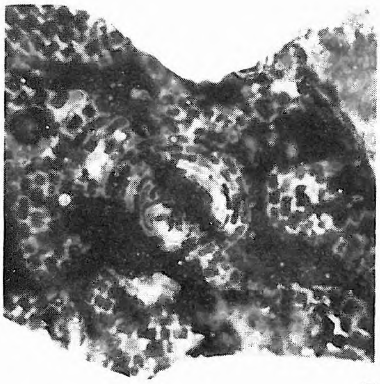

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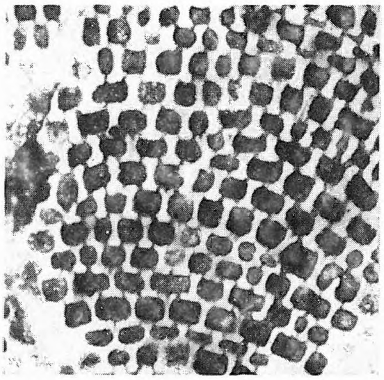

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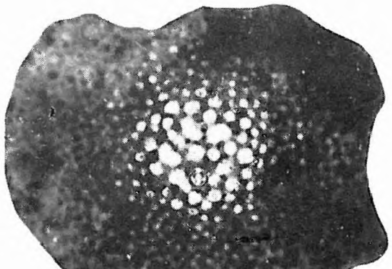

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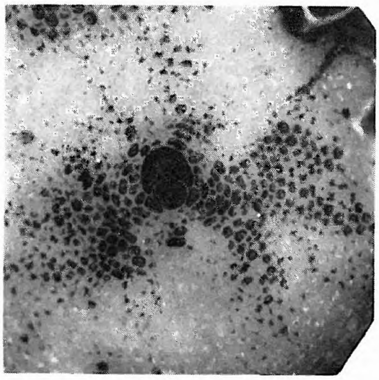

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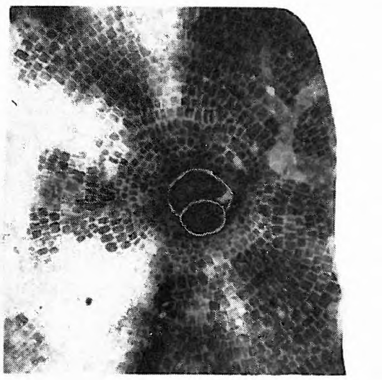

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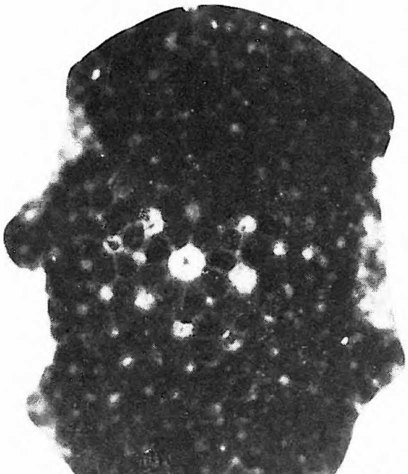

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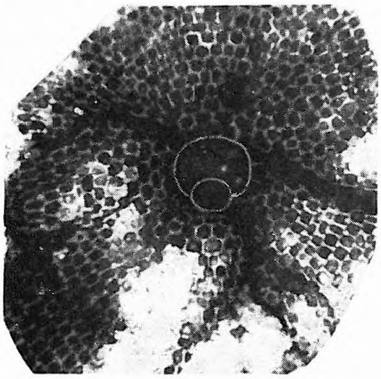

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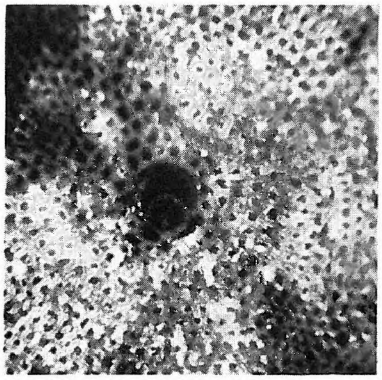

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XXIV. tábla — Plate XXIV

Nemkovella evae n. sp.

1. B-forma, equatoriális metszet, E. 4838, 56×
2. B-forma, equatoriális metszet, E. 4838, 140×
3. Holotypus, A-forma, equatoriális metszet, E. 4836, 56×
4. A-forma, equatoriális metszet, E. 4837, 56×
Krím, cuisi emelet felső része

Nemkovella fermonti n. sp.

5. Holotypus, A-forma, equatoriális metszet, E. 4843, 56×
6. A-forma, equatoriális metszet, E. 4844, 56×
Krím, lutéciai emelet alsó része

Nemkovella strophiolata (GÜMBEL) *bodrakensis* n. ssp.

7. B-forma, equatoriális metszet, E. 4849, 56×
8. B-forma, equatoriális metszet, E. 4849, 140×
9. A-forma, equatoriális metszet, E. 4848, 56×
10. Holotypus, A-forma, equatoriális metszet, E. 4847, 56×
Krím, lutéciai emelet alsó része
11—12. A-forma, equatoriális metszet, *11.:* E. 4845, *12.:* E. 4846, 56×
Saint-Barthélémy, lutéciai emelet alsó része

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Nemkovella evae n. sp.

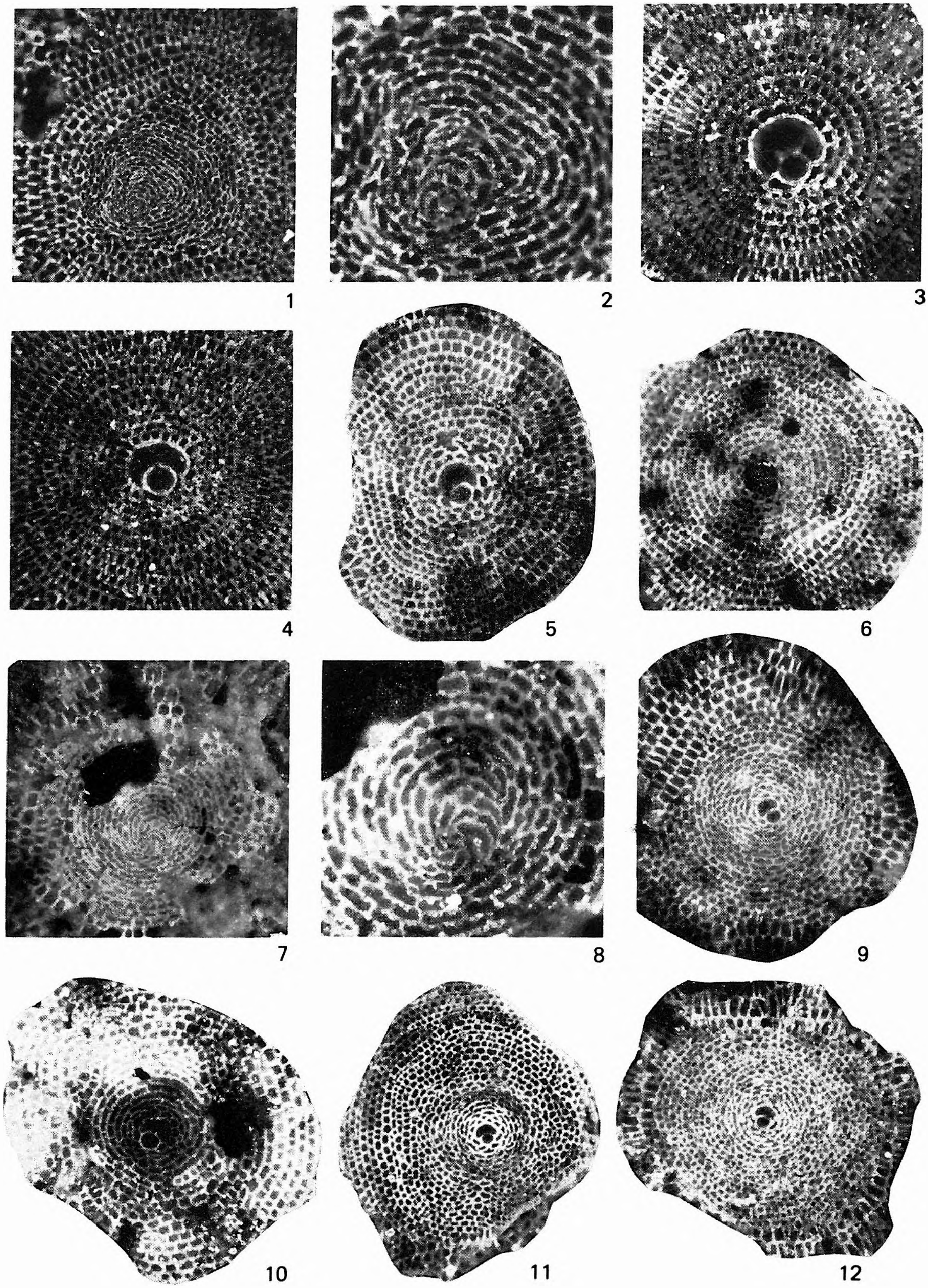
1. Form "B", equatorial section, E. 4838, 56×
2. Form "B", equatorial section, E. 4838, 140×
3. Holotype, form "A", equatorial section, E. 4836, 56×
4. Form "A", equatorial section, E. 4837, 56×
Crimea, upper part of the Cuisian

Nemkovella fermonti n. sp.

5. Holotype, form "A", equatorial section, E. 4843, 56×
6. Form "A", equatorial section, E. 4844, 56×
Crimea, lower part of the Lutetian

Nemkovella strophiolata (GÜMBEL) *bodrakensis* n. ssp.

7. Form "B", equatorial section, E. 4849, 56×
8. Form "B", equatorial section, E. 4849, 140×
9. Form "A", equatorial section, E. 4848, 56×
10. Holotype, form "A", equatorial section, E. 4847, 56×
Crimea, lower part of the Lutetian
11—12. Form "A", equatorial section, *11.:* E. 4845, *12.:* E. 4846, 56×
Saint-Barthélémy, lower part of the Lutetian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XXV. tábla — Plate XXV

Nemkovella strophiolata strophiolata (GÜMBEL)

1. Külső alak, E. 4850, 14×
4—5. A-forma, equatoriális metszet, *4.:* E. 4852, *5.:* 4851, 56×
Nousse, lutéciai emelet középső része
2. B-forma, equatoriális metszet, E. 4854, 56×
3. B-forma, equatoriális metszet, E. 4854, 140×
6. A-forma, equatoriális metszet, E. 4853, 56×
Gibret, lutéciai emelet középső része
7. A-forma, equatoriális metszet, E. 4857, 30×
8—9. A-forma, equatoriális metszet, *8.:* E. 4855, *9.:* E. 4856, 56×
Ajka, bartoni emelet alsó része
10. A-forma, equatoriális metszet, E. 4858, 56×
Dudar, bartoni emelet középső része

Nemkovella strophiolata (GÜMBEL) *tenella* (GÜMBEL)

11. A-forma, equatoriális metszet, E. 4859, 56×
Mossano, priabonai emelet alsó része
12. A-forma, equatoriális metszet, E. 4860, 56×
Lábatlan, priabonai emelet középső része

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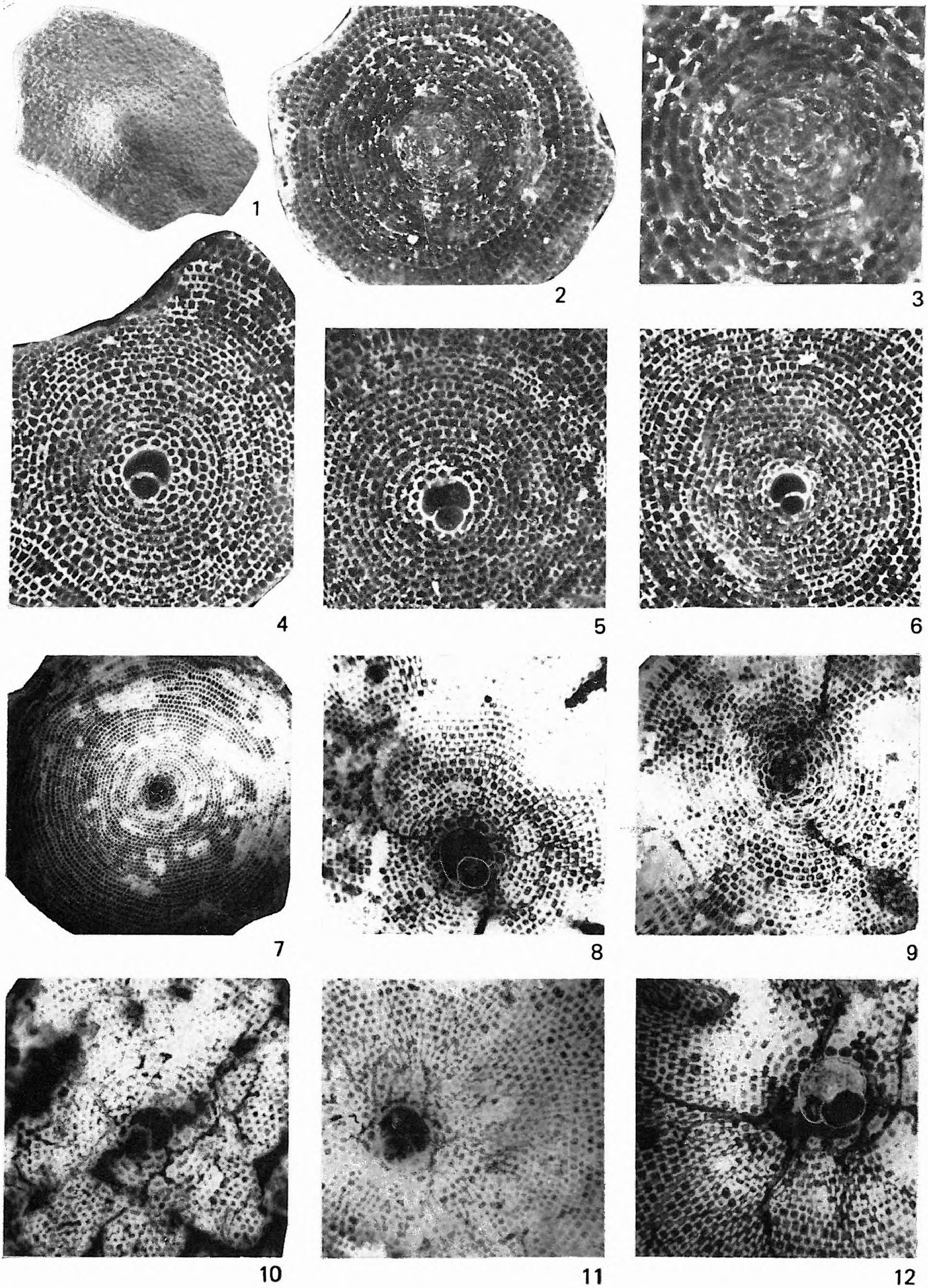
Nemkovella strophiolata strophiolata (GÜMBEL)

1. External view, E. 4850, 14×
4—5. Form "A", equatorial section, *4.:* E. 4852, *5.:* E. 4851, 56×
Nousse, middle part of the Lutetian
2. Form "B", equatorial section, E. 4854, 56×
3. Form "B", equatorial section, E. 4854, 140×
6. Form "A", equatorial section, E. 4853, 56×
Gibret, middle part of the Lutetian
7. Form "A", equatorial section, E. 4857, 30×
8—9. Form "A", equatorial section, *8.:* E. 4855, *9.:* E. 4856, 56×
Ajka, lower part of the Bartonian
10. Form "A", equatorial section, E. 4858, 56×
Dudar, middle part of the Bartonian

Nemkovella strophiolata (GÜMBEL) *tenella* (GÜMBEL)

11. Form "A", equatorial section, E. 4859, 56×
Mossano, lower part of the Priabonian
12. Form "A", equatorial section, E. 4860, 56×
Lábatlan, middle part of the Priabonian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XXVI. tábla — Plate XXVI

Orbitoclypeus ramaraoi (SAMANTA) *neumannae* (TOUMARKINE)

1—2. A-forma, equatoriális metszet, *1.*: E. 4861, *2.*: E. 4862, 56×
Spilecco, ilerdi emelet középső része

Orbitoclypeus ramaraoi (SAMANTA) *suvlukayensis* n. ssp.

3. Holotypus, A-forma, equatoriális metszet, E. 4864, 35×
4. A-forma, equatoriális metszet, E. 4863, 35×
Krím, ilerdi emelet felső része

Orbitoclypeus ramaraoi (SAMANTA) *crimensis* n. ssp.

5. Külső alak, B 24-es minta, E. 4865, 8,5×
6. Holotypus, A-forma, rozetta, B 24-es minta, E. 4866, 35×
7. Holotypus, A-forma, equatoriális metszet, E. 4866, 35×
Krím, cuisi emelet alsó része
8. A-forma, rozetta, E 6-os minta, E. 4868, 15×
9. A-forma, equatoriális metszet, E. 4868, 35×
Krím, cuisi emelet középső része
10. A-forma, equatoriális metszet, E. 4869, 35×
Krím, cuisi emelet felső része
11. A-forma, equatoriális metszet, E. 4867, 35×
12. A-forma, equatoriális kamrák, E. 4867, 125×
Le Porge, cuisi emelet középső—felső része

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Orbitoclypeus ramaraoi (SAMANTA) *neumannae* (TOUMARKINE)

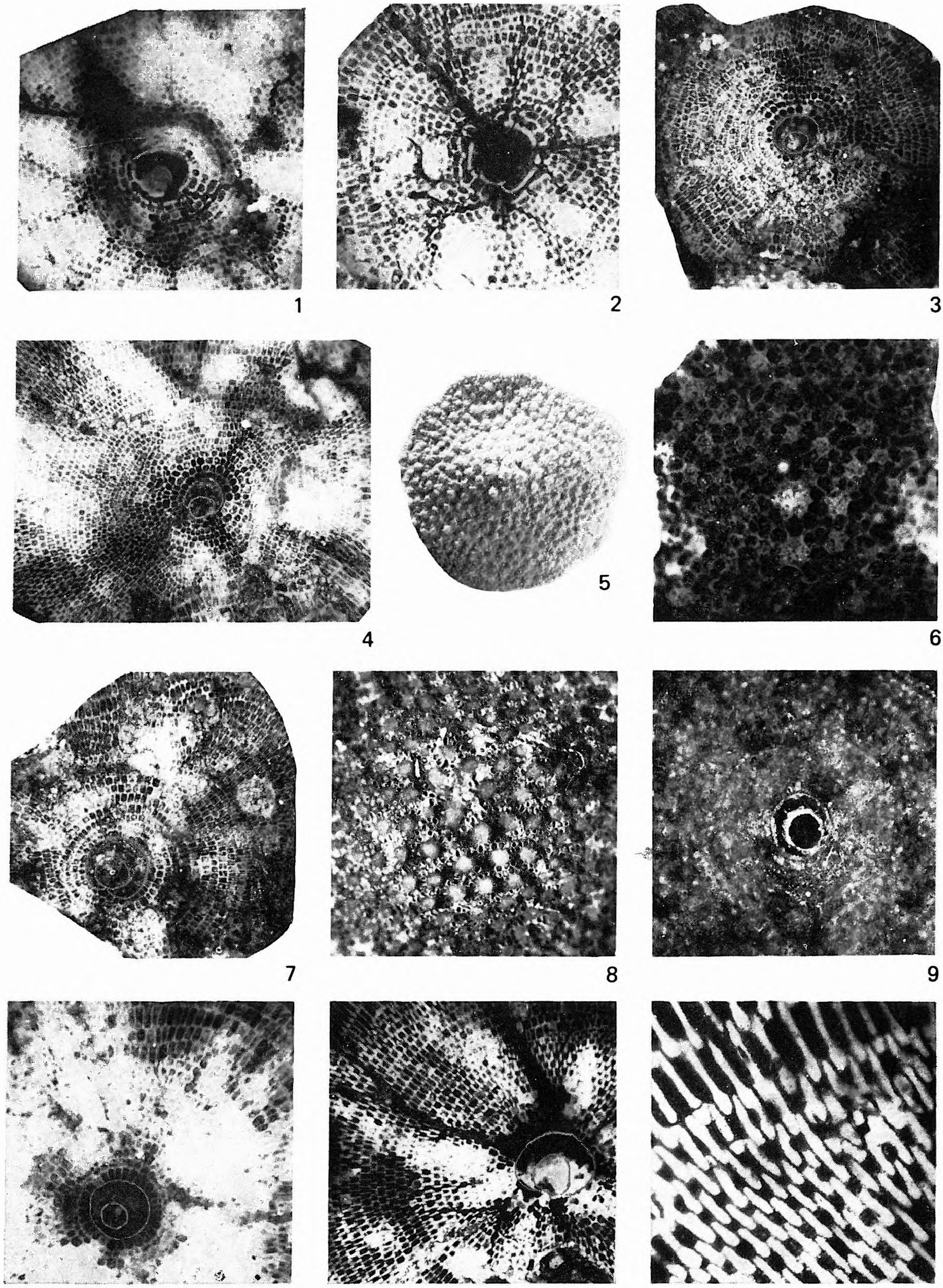
1—2. Form "A", equatorial section, *1.*: E. 4861, *2.*: E. 4862, 56×
Spilecco, middle part of the Ilerdian

Orbitoclypeus ramaraoi (SAMANTA) *suvlukayensis* n. ssp.

3. Holotype, form "A", equatorial section, E. 4864, 35×
4. Form "A", equatorial section, E. 4863, 35×
Crimea, upper part of the Ilerdian

Orbitoclypeus ramaraoi (SAMANTA) *crimensis* n. ssp.

5. External view, sample B 24, E. 4865, 8.5×
6. Holotype, form "A", rosette, sample B 24, E. 4866, 35×
7. Holotype, form "A", equatorial section, E. 4866, 35×
Crimea, lower part of the Cuisian
8. Form "A", rosette, sample E 6, E. 4868, 15×
9. Form "A", equatorial section, E. 4868, 35×
Crimea, middle part of the Cuisian
10. Form "A", equatorial section, E. 4869, 35×
Crimea, upper part of the Cuisian
11. Form "A", equatorial section, E. 4867, 35×
12. Form "A", equatorial chambers, E. 4867, 125×
Le Porge, middle—upper part of the Cuisian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XXVII. tábla — Plate XXVII

Orbitocylpeus marthae (SCHLUMBERGER)

1. A-forma, külső alak, E. 4870, 22×
2—3. A-forma, equatoriális metszet, *2.:* E. 4872, *3.:* E. 4871, 35×
Saint-Barthélémy, lutéciai emelet alsó része

Orbitoclypeus bayani (MUNIER-CHALMAS)

4. A-forma, equatoriális metszet, E. 4873, 35×
Spilecco, ilerdi emelet középső része
5—6. A-forma, equatoriális metszet, *5.:* E. 4875. *6.:* E. 4874, 35×
Horsarrieu, cuisi emelet középső része

Orbitoclypeus douvillei (SCHLUMBERGER)

7. A-forma, külső alak, E. 4876, 17×
8. A-forma, equatoriális metszet, E. 4876, 35×
Saint-Barthélémy, lutéciai emelet alsó része
9. A-forma, equatoriális metszet, E. 4877, 35×
Gibret, lutéciai emelet középső része

Orbitoclypeus portnayae n. sp.

10. Külső alak, B 77-es minta, E. 4878, 22×
11. Holotypus, A-forma, equatoriális metszet, E. 4879, 56×
12. A-forma, equatoriális metszet, E. 4880, 56×
Krím, lutéciai emelet alsó része

* * *

Orbitoclypeus marthae (SCHLUMBERGER)

1. Form "A", external view, E. 4870, 22×
2—3. Form "A", equatorial section, *2.:* E. 4872, *3.:* E. 4871, 35×
Saint-Barthélémy, lower part of the Lutetian

Orbitoclypeus bayani (MUNIER-CHALMAS)

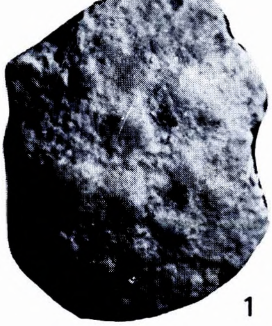
4. Form "A", equatorial section, E. 4873, 35×
Spilecco, middle part of the Ilerdian
5—6. Form "A", equatorial section, *5.:* E. 4875, *6.:* E. 4874, 35×
Horsarrieu, middle part of the Cuisian

Orbitoclypeus douvillei (SCHLUMBERGER)

7. Form "A", external view, E. 4876, 17×
8. Form "A", equatorial section, E. 4876, 35×
Saint-Barthélémy, lower part of the Lutetian
9. Form "A", equatorial section, E. 4877, 35×
Gibret, middle part of the Lutetian

Orbitoclypeus portnayae n. sp.

10. External view, sample B 77, E. 4878, 22×
11. Holotype, form "A", equatorial section, E. 4879, 56×
12. Form "A", equatorial section, E. 4880, 56×
Crimea, lower part of the Lutetian



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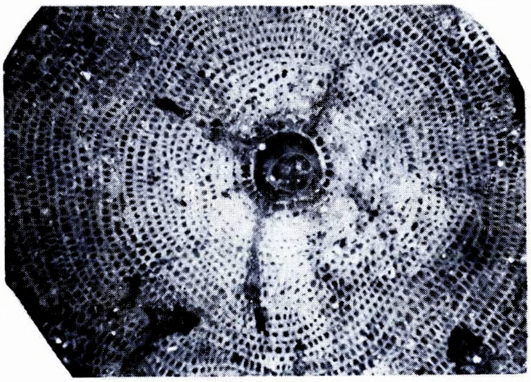

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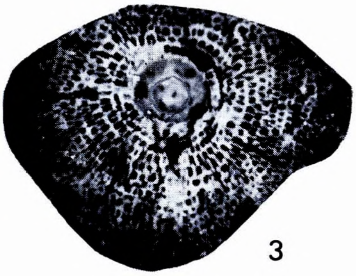

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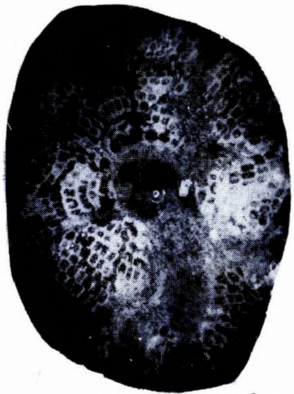

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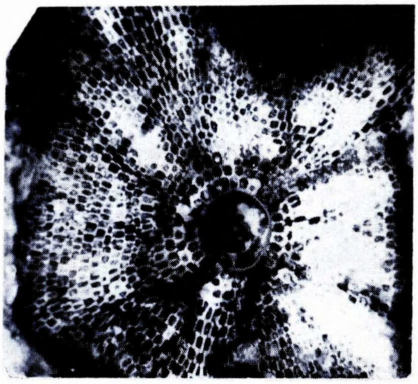

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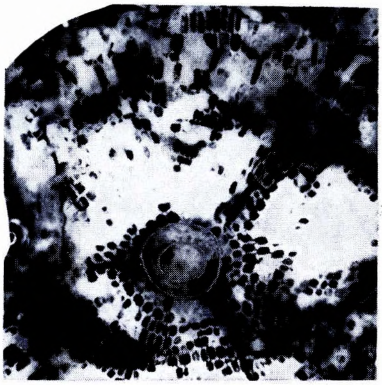

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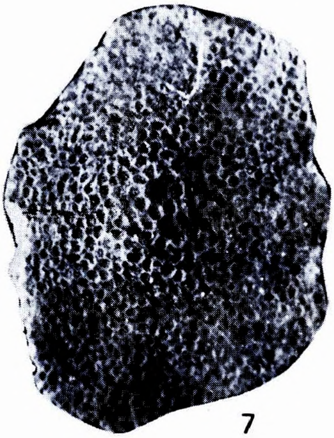

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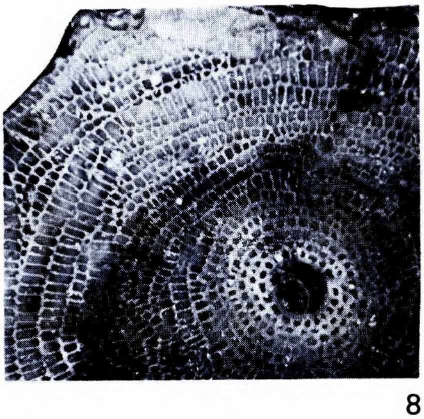

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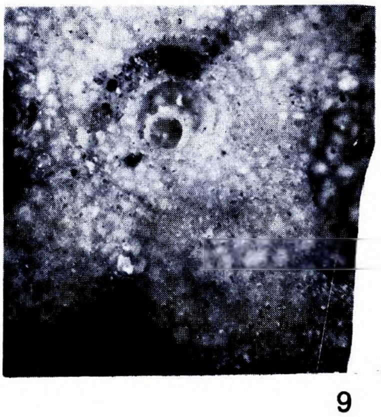

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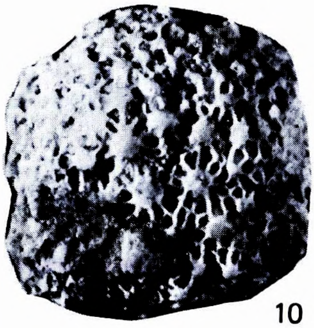

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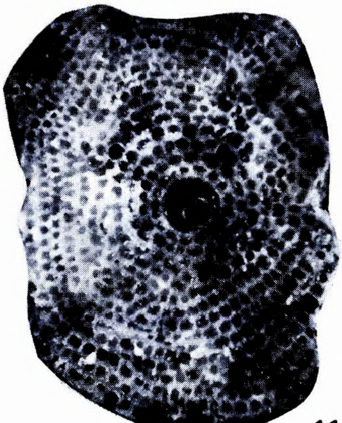

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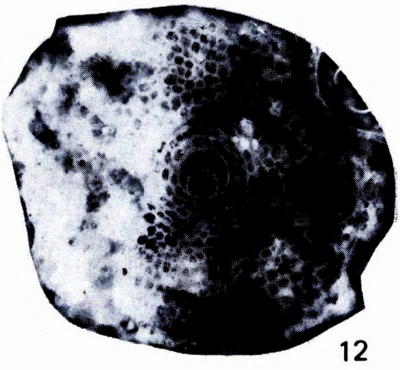

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XXVIII. tábla — Plate XXVIII

Orbitoclypeus portnayae n. sp.

1., *3—4.*, *7.* B-forma, equatoriális metszet, *1.:* E. 4884, *3.:* E. 4883, *4.:* E. 4882, *7.:* E. 4881, 56×
2., *5—6.*, *8.* B-forma, equatoriális metszet, *2.:* E. 4884, *5.:* E. 4882, *6.:* E. 4883, *8.:* E. 4881, 140×
Krím, lutéciai emelet alsó része

Orbitoclypeus varians (KAUFMANN) *horsarrieuensis* n. ssp.

9. A-forma, equatoriális metszet, E. 4887, 35×
10., *12.* A-forma, equatoriális metszet, *10.:* E. 4885, *12.:* E. 4887, 56×
11. Holotypus, A-forma, equatoriális metszet, E. 4886, 56×
Horsarrieu, cuisi emelet középső része

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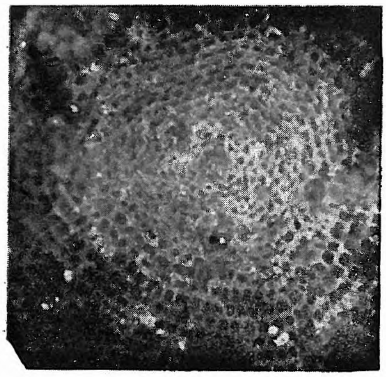
Orbitoclypeus portnayae n. sp.

1., *3—4.*, *7.* Form "B", equatorial section, *1.:* E. 4884, *3.:* E. 4883, *4.:* E. 4882, *7.:* E. 4881, 56×
2., *5—6.*, *8.* Form "B", equatorial section, *2.:* E. 4884, *5.:* E. 4822, *6.:* E. 4883, *8.:* E. 4881, 140×
Crimea, lower part of the Lutetian

Orbitoclypeus varians (KAUFMANN) *horsarrieuensis* n. ssp.

9. Form "A", equatorial section, E. 4887, 35×
10., *12.* Form "A", equatorial section, *10.:* E. 4885, *12.:* E. 4887, 56×
11. Holotype, form "A", equatorial section, E. 4886, 56×
Horsarrieu, middle part of the Cuisian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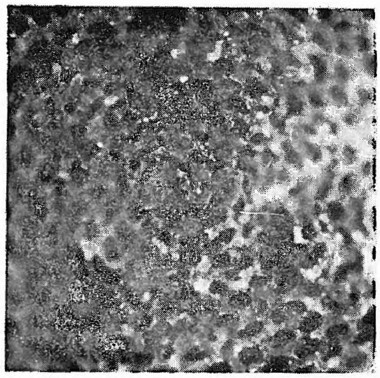
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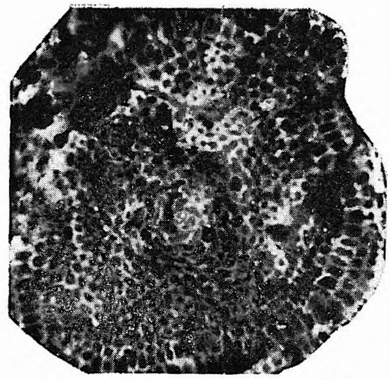
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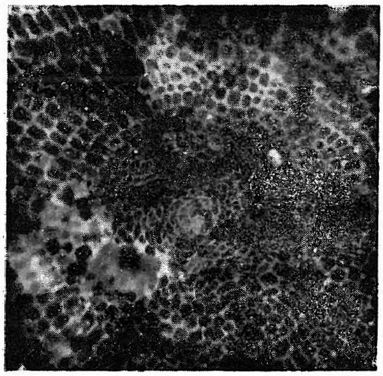
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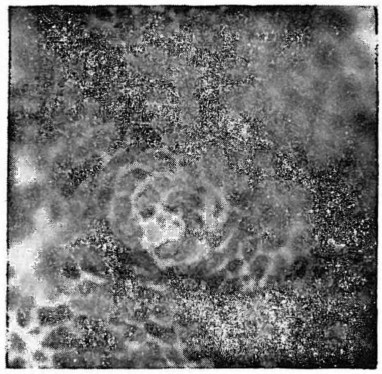
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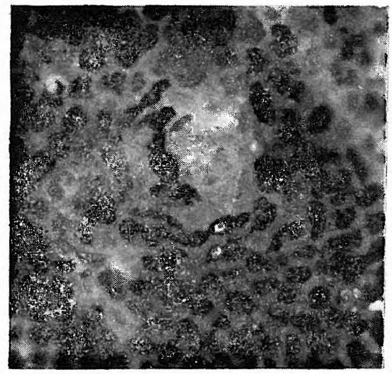
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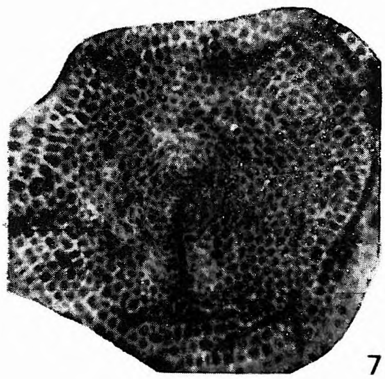
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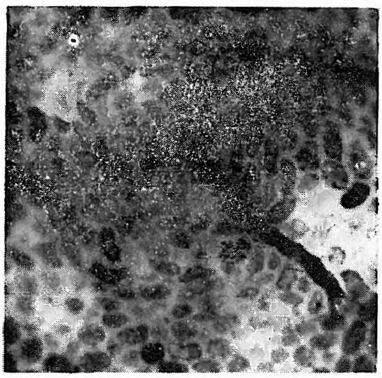
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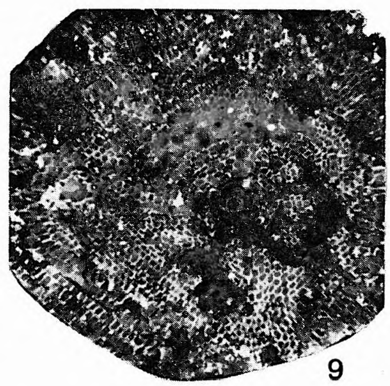
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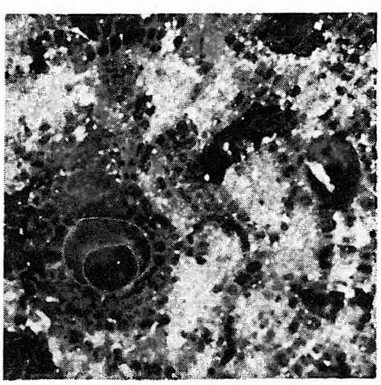
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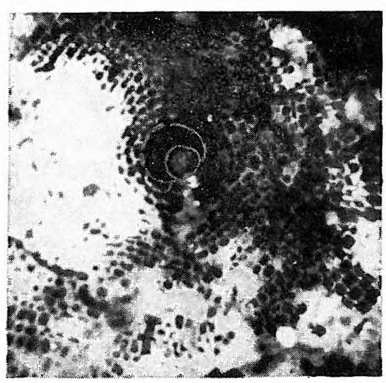
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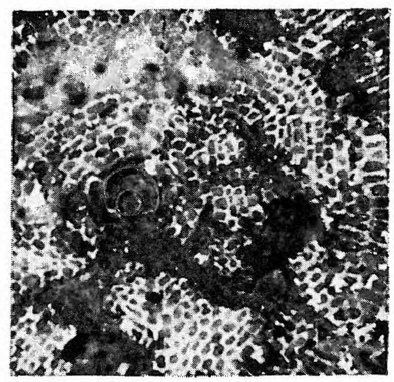
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XXIX. tábla — Plate XXIX

Orbitoclypeus varians (KAUFMANN) *angoumensis* n. ssp.

1., *3—4.* A-forma, equatoriális metszet, *1.*: E. 4890, *3.*: E. 4888, *4.*: E. 4891, 35×
2. Holotypus, A-forma, equatoriális metszet, E. 4889, 35×
Angoumé, lutéciai emelet felső része

Orbitoclypeus varians (KAUFMANN) *roberti* (DOUVILLÉ)

5., *7.*, *9—10.* B-forma, equatoriális metszet, *5.*: E. 4899, *7.*: E. 4896, *9.*: E. 4897, *10.*: E. 4898, 56×
6., *8.*, *11—12.* B-forma, equatoriális metszet, *6.*: E. 4899, *8.*: E. 4896, *11.*: E. 4898, *12.*: E. 4897, 140×
Ajka, bartoni emelet alsó része

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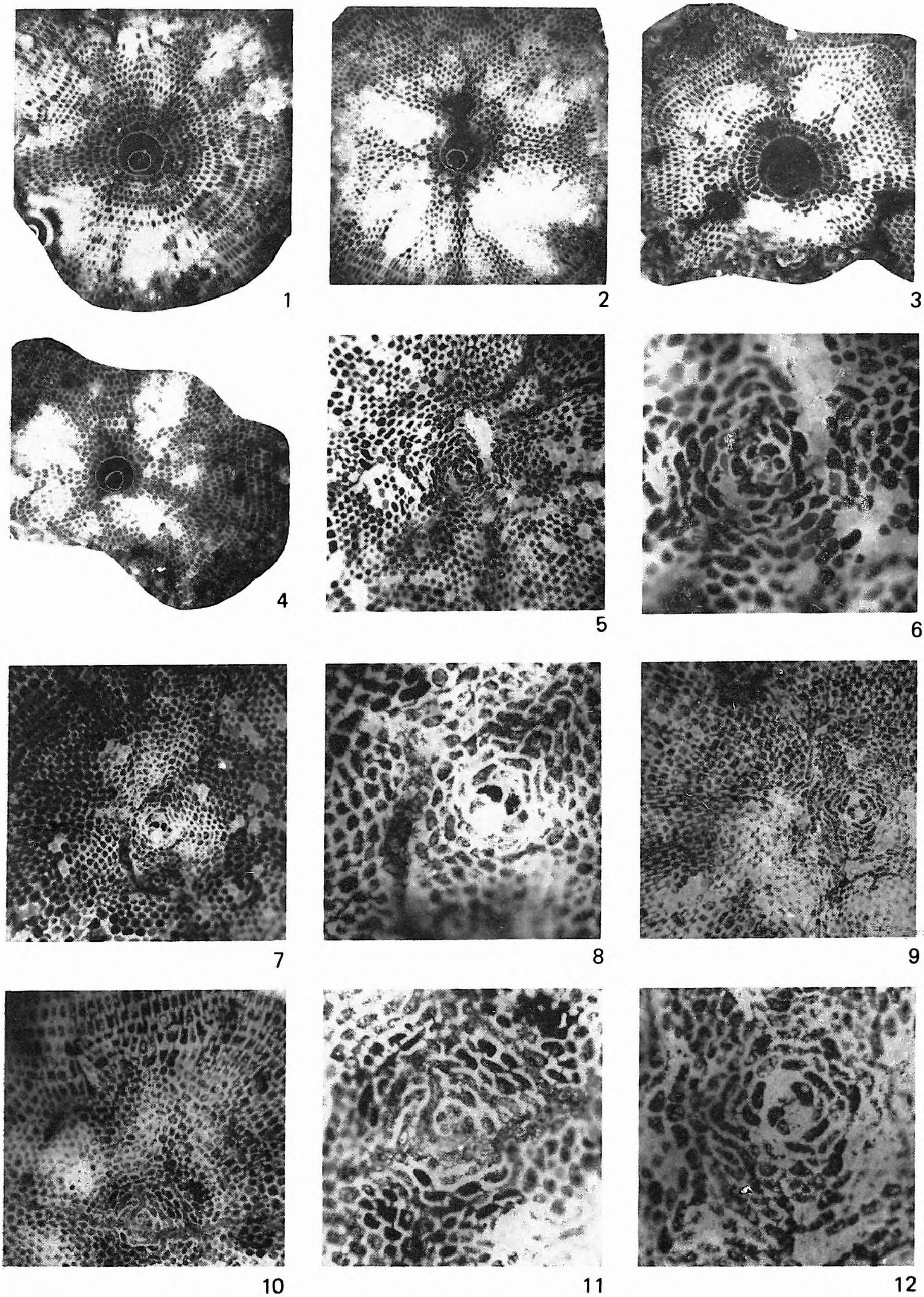
Orbitoclypeus varians (KAUFMANN) *angoumensis* n. ssp.

1., *3—4.* Form "A", equatorial section, *1.*: E. 4890, *3.*: E. 4888, *4.*: E. 4891, 35×
2. Holotype, form "A", equatorial section, E. 4889, 35×
Angoumé, upper part of the Lutetian

Orbitoclypeus varians (KAUFMANN) *roberti* (DOUVILLÉ)

5., *7.*, *9—10.* Form "B", equatorial section, *5.*: E. 4899, *7.*: E. 4896, *9.*: E. 4897, *10.*: E. 4898, 56×
6., *8.*, *11—12.* Form "B", equatorial section, *6.*: E. 4899, *8.*: E. 4896, *11.*: E. 4898, *12.*: E. 4897, 140×
Ajka, lower part of the Bartonian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XXX. tábla — Plate XXX

Orbitoclypeus varians (KAUFMANN) *roberti* (DOUVILLÉ)

1. A-forma, rozetta, SzT minta, E. 4895, 35×
2—5. A-forma, equatoriális metszet, *2.*: E. 4893, *3.*: E. 4894, *4.*: E. 4892, *5.*: E. 4895, 35×
Ajka, bartoni emelet alsó része

Orbitoclypeus varians (KAUFMANN) *scalaris* (SCHLUMBERGER)

6. A-forma, rozetta, D 7-es minta, E. 4901, 35×
7—10. A-forma, equatoriális metszet, *7.*: E. 4903, *8.*: E. 4900, *9.*: E. 4902, *10.*: E. 4901, 35×
11. B-forma, equatoriális metszet, E. 4904, 56×
12. B-forma, equatoriális metszet, E. 4904, 140×
Dudar, bartoni emelet középső része

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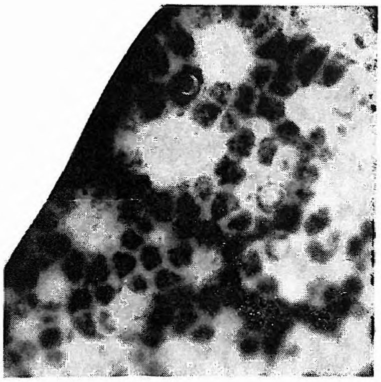
Orbitoclypeus varians (KAUFMANN) *roberti* (DOUVILLÉ)

1. Form "A", rosette, sample SzT, E. 4895, 35×
2—5. Form "A", equatorial section, *2.*: E. 4893, *3.*: E. 4894, *4.*: E. 4892, *5.*: E. 4895, 35×
Ajka, lower part of the Bartonian

Orbitoclypeus varians (KAUFMANN) *scalaris* (SCHLUMBERGER)

6. Form "A", rosette, sample D 7, E. 4901, 35×
7—10. Form "A", equatorial section, *7.*: E. 4903, *8.*: E. 4900, *9.*: E. 4902, *10.*: E. 4901, 35×
11. Form "B", equatorial section, E. 4904, 56×
12. Form "B", equatorial section, E. 4904, 140×
Dudar, middle part of the Bartonian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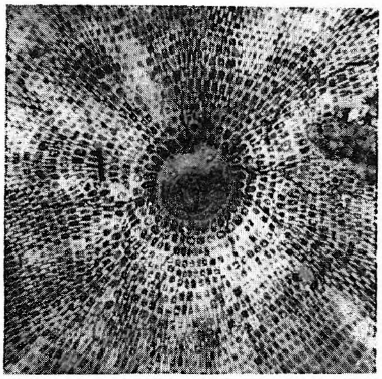
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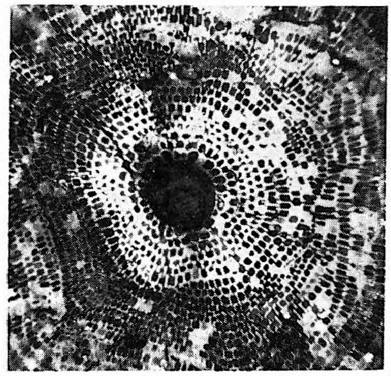
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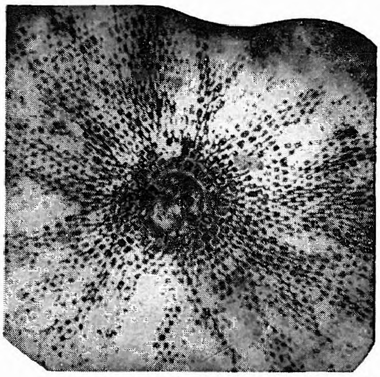
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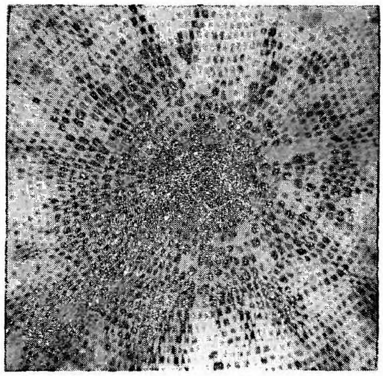
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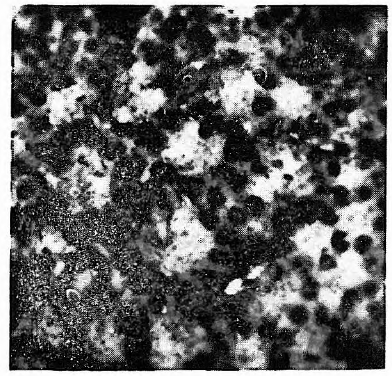
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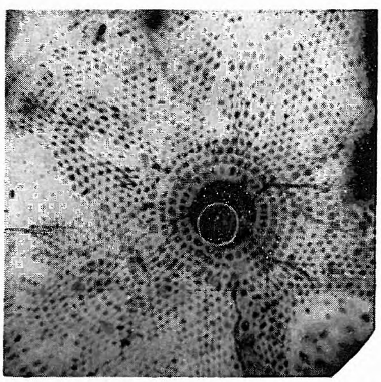
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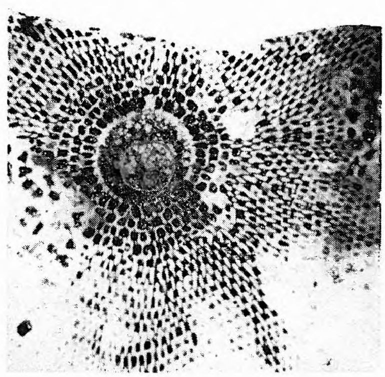
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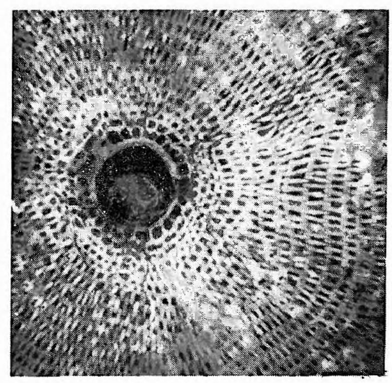
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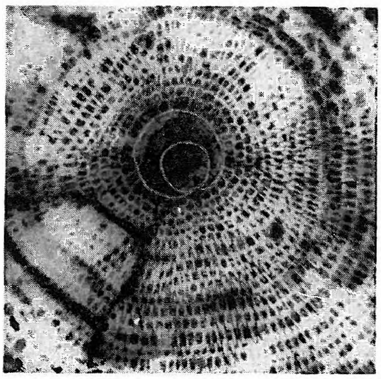
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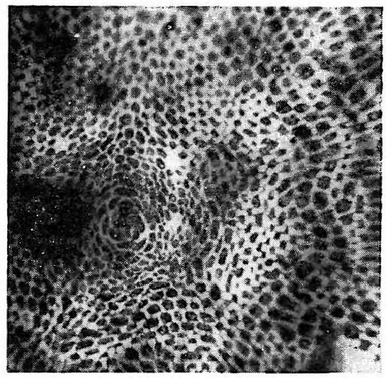
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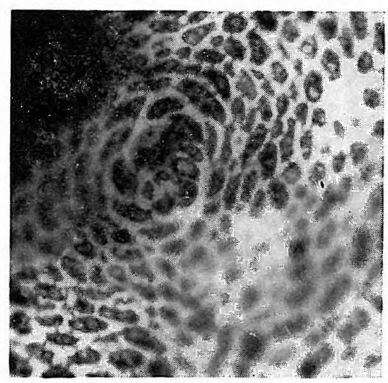

12

XXXI. tábla — Plate XXXI

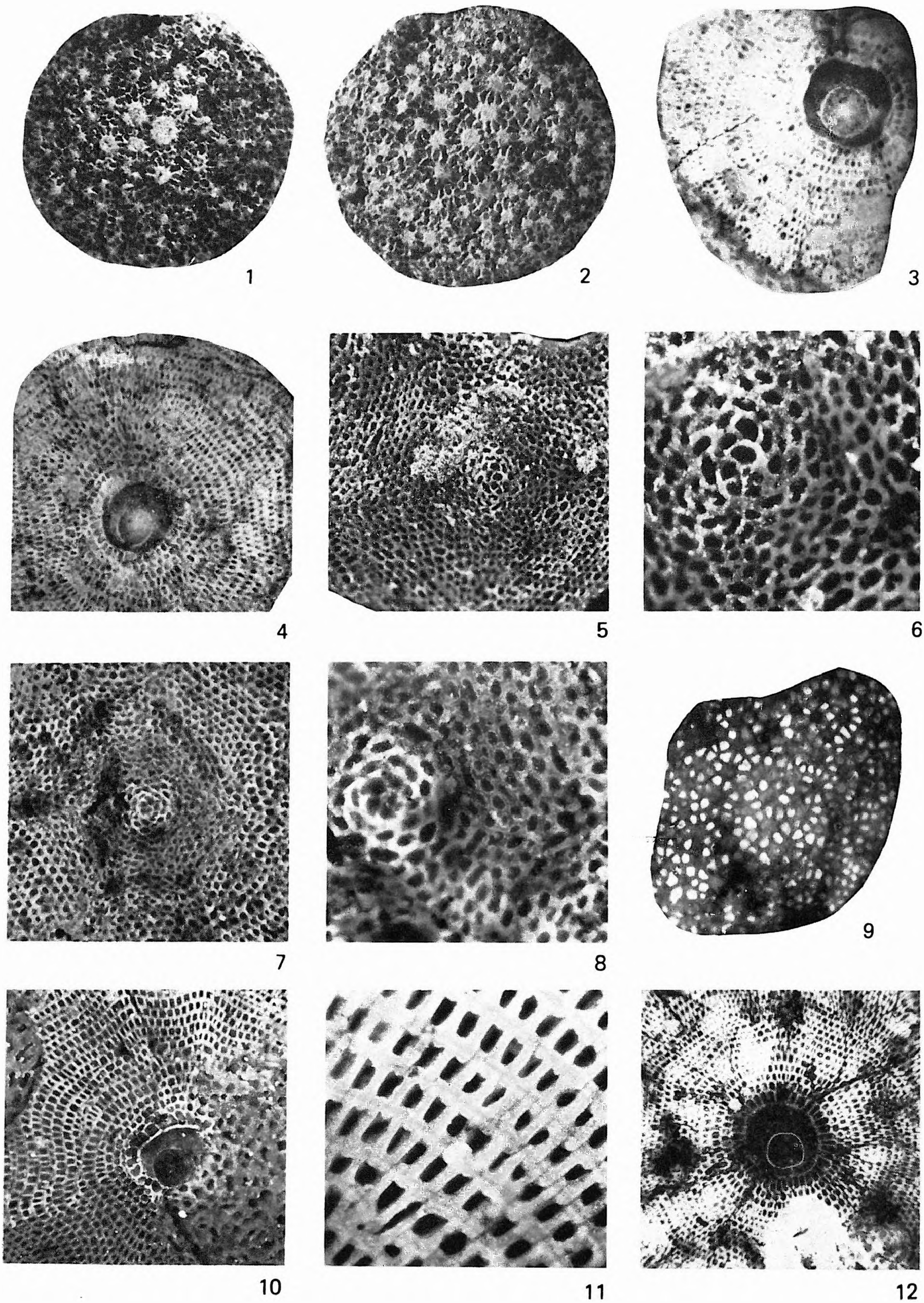
Orbitoclypeus varians varians (KAUFMANN)

1. Külső alak, E. 4905, 20×
2. Külső alak, E. 4906, 20×
3—4. A-forma, equatoriális metszet, *3.:* E. 4908, *4.:* E. 4907, 35×
5., 7. B-forma, equatoriális metszet, *5.:* E. 4910, *7.:* E. 4909, 56×
6., 8. B-forma, equatoriális metszet, *6.:* E. 4910, *8.:* E. 4909, 140×
Cauneille, bartoni emelet felső része
9. A-forma, rozetta, BT minta, E. 4911, 22×
10. A-forma, equatoriális metszet, E. 4912, 35×
11. A-forma, equatoriális kamrák, E. 4912, 125×
Siest, bartoni emelet felső része
12. A-forma, equatoriális metszet, E. 4913, 35×
Mossano, priabonai emelet alsó része

* * *

Orbitoclypeus varians varians (KAUFMANN)

1. External view, E. 4905, 20×
2. External view, E. 4906, 20×
3—4. Form "A", equatorial section, *3.:* E. 4908, *4.:* E. 4907, 35×
5., 7. Form "B", equatorial section, *5.:* E. 4910, *7.:* E. 4909, 56×
6., 8. Form "B", equatorial section, *6.:* E. 4910, *8.:* E. 4909, 140×
Cauneille, upper part of the Bartonian
9. Form "A", rosette, sample BT, E. 4911, 22×
10. Form "A", equatorial section, E. 4912, 35×
11. Form "A", equatorial chambers, E. 4912, 125×
Siest, upper part of the Bartonian
12. Form "A", equatorial section, E. 4913, 35×
Mossano, lower part of the Priabonian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XXXII. tábla — Plate XXXII

Orbitoclypeus varians varians (KAUFMANN)

1—2. A-forma, equatoriális metszet, *1.*: E. 4915, *2.*: E. 4914, 35×
3. A-forma, rozetta, RA minta, E. 4914, 35×
4. A-forma, axiális metszet, E. 4916, 22×
Lábatlan, priabonai emelet középső része

Orbitoclypeus furcata (RÜTIMEYER) *rovasendai* (PREVER)

5. Külső alak, Kö 2-es minta, E. 4917, 4×
6. Külső alak, Ba 3-as minta, E. 4918, 10×
7—10. A-forma, equatoriális metszet, *7.*: E. 4920, *8.*: E. 4919, *9.*: 61 738, *10.*: E. 4922, 35×
11. A-forma, equatoriális kamrák, E. 4922, 90×
Ajka, bartoni emelet alsó része

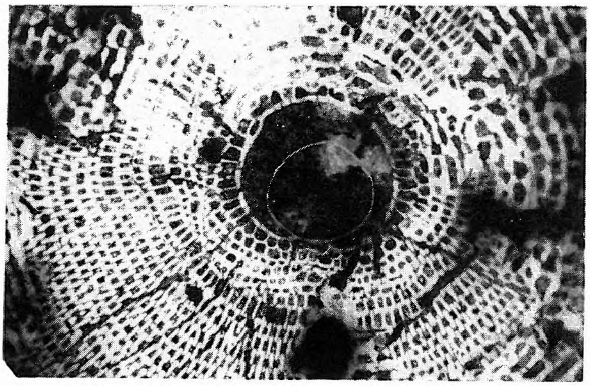
* * *

Orbitoclypeus varians varians (KAUFMANN)

1—2. Form "A", equatorial section, *1.*: E. 4915, *2.*: E. 4914, 35×
3. Form "A", rosette, sample RA, E. 4914, 35×
4. Form "A", axial section, E. 4916, 22×
Lábatlan, middle part of the Priabonian

Orbitoclypeus furcata (RÜTIMEYER) *rovasendai* (PREVER)

5. External view, sample Kö 2, E. 4917, 4×
6. External view, sample Ba 3, E. 4918, 10×
7—10. Form "A", equatorial section, *7.*: E. 4920, *8.*: E. 4919, *9.*: 61 738, *10.*: E. 4922, 35×
11. Form "A", equatorial chambers, E. 4922, 90×
Ajka, lower part of the Bartonian



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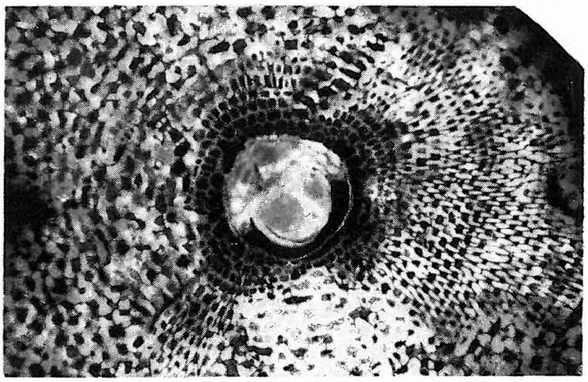

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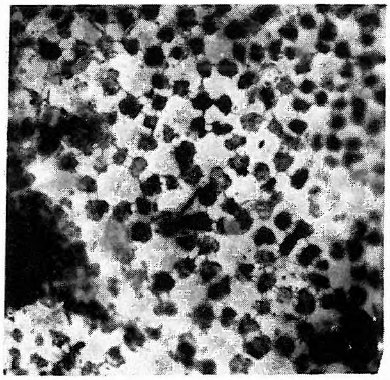

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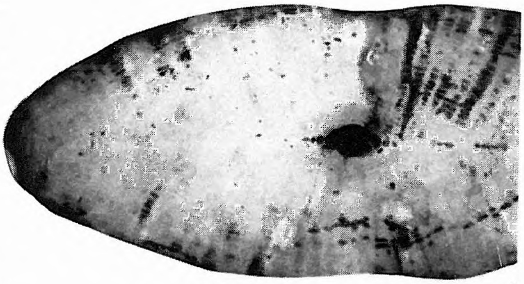

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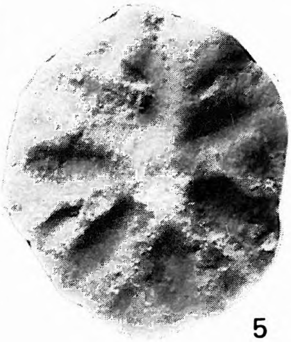

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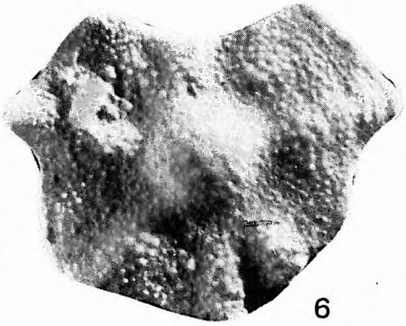

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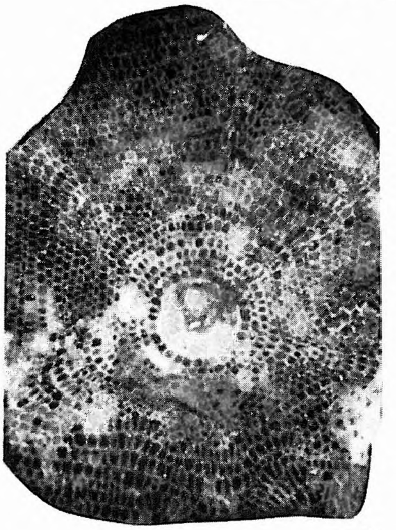

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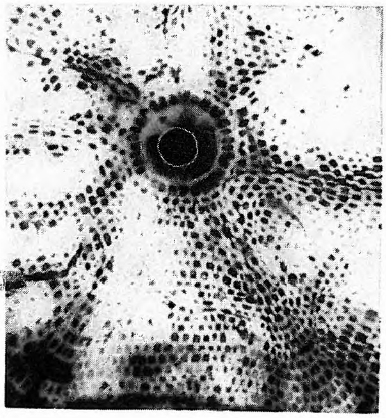

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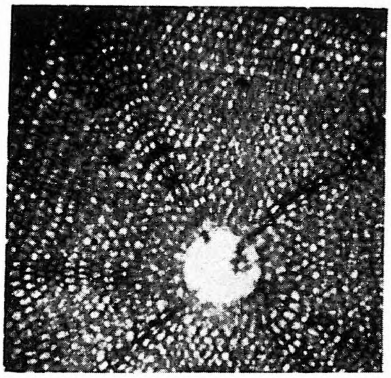

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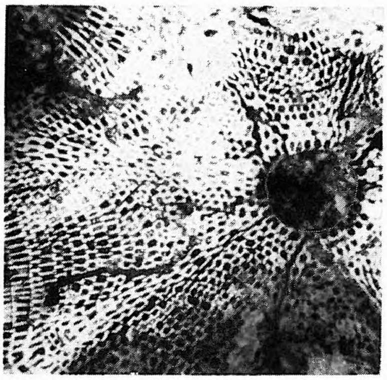

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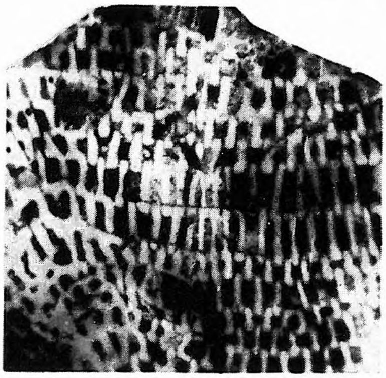

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XXXIII. tábla — Plate XXXIII

Orbitoclypeus furcata (RÜTIMEYER) *rovasendai* (PREVER)

1. A-forma, equatoriális metszet, E. 4921, 35×
2. B-forma, equatoriális metszet, E. 4923, 56×
3. B-forma, equatoriális metszet, E. 4923, 140×
Ajka, bartoni emelet alsó része

Orbitoclypeus furcata furcata (RÜTIMEYER)

4—6. A-forma, equatoriális metszet, *4.:* E. 4926, *5.:* E. 4924, *6.:* E. 4925, 35×
7. A-forma, rozetta, BN minta, E. 4926, 35×
Lábatlan, priabonai emelet középső része

Orbitoclypeus schopeni (CHECCHIA-RISPOLI)

8. A-forma, külső alak, E. 4927, 35×
9. A-forma, equatoriális metszet, E. 4927, 38×
Saint-Barthélémy, lutéciai emelet alsó része

Orbitoclypeus koehleri n. sp.

10. Holotypus, A-forma, rozetta, B 77-es minta, E. 4928, 35×
11. Holotypus, A-forma, equatoriális metszet, E. 4928, 35×
12. A-forma, equatoriális metszet, E. 4929, 35×
Krím, lutéciai emelet alsó része

Orbitoclypeus chudeaui chudeaui (SCHLUMBERGER)

13. A-forma, rozetta, E. 4930, 35×
Caupenne, lutéciai emelet alsó része

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Orbitoclypeus furcata (RÜTIMEYER) *rovasendai* (PREVER)

1. Form "A", equatorial section, E. 4921, 35×
2. Form "B", equatorial section, E. 4923, 56×
3. Form "B", equatorial section, E. 4923, 140×
Ajka, lower part of the Bartonian

Orbitoclypeus furcata furcata (RÜTIMEYER)

4—6. Form "A", equatorial section, *4.:* E. 4926, *5.:* E. 4924, *6.:* E. 4925, 35×
7. Form "A", rosette, sample BN, E. 4926, 35×
Lábatlan, middle part of the Priabonian

Orbitoclypeus schopeni (CHECCHIA-RISPOLI)

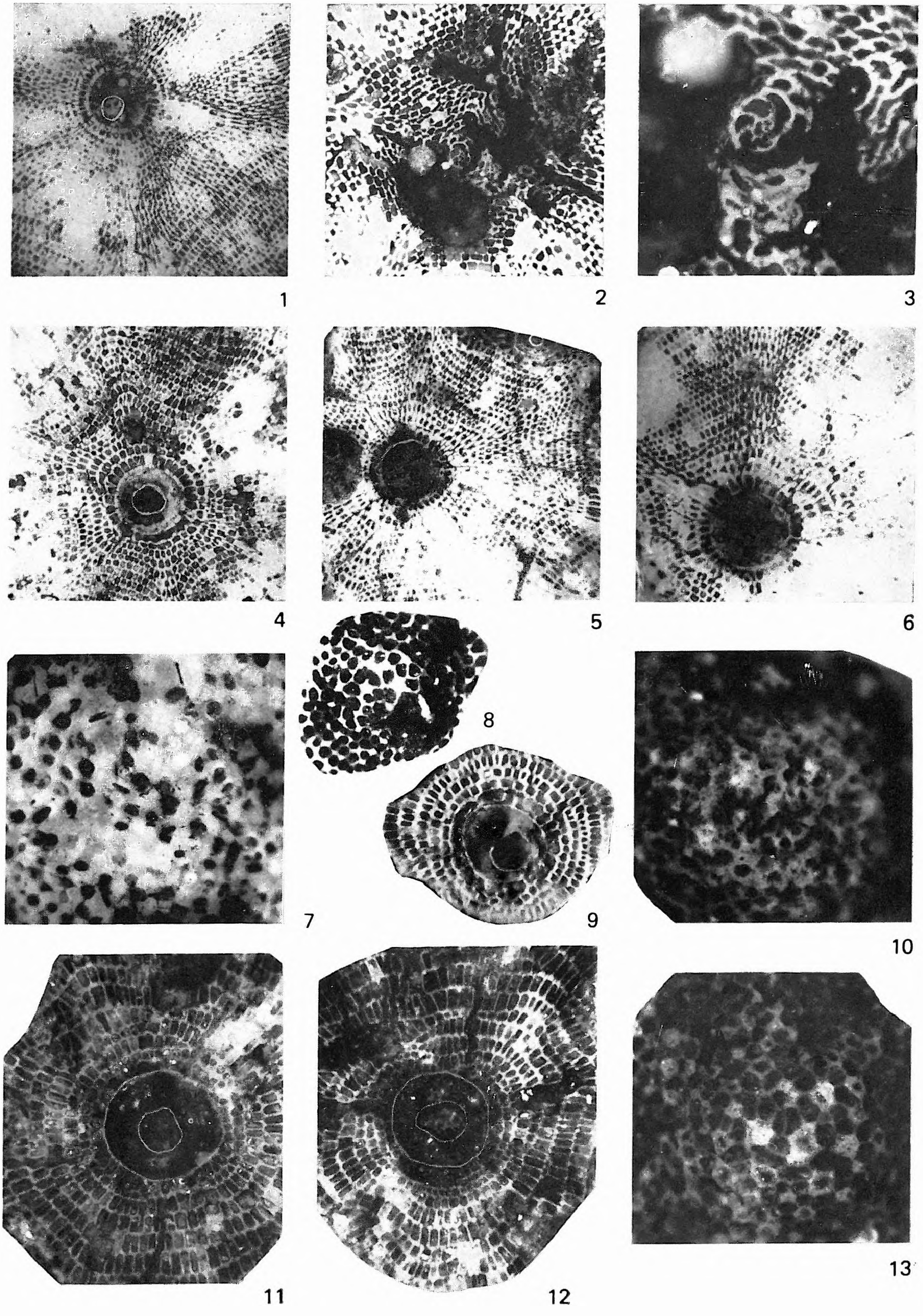
8. Form "A", external view, E. 4927, 35×
9. Form "A", equatorial section, E. 4927, 38×
Saint-Barthélémy, lower part of the Lutetian

Orbitoclypeus koehleri n. sp.

10. Holotype, form "A", rosette, sample B 77, E. 4928, 35×
11. Holotype, form "A", equatorial section, E. 4928, 35×
12. Form "A", equatorial section, E. 4929, 35×
Crimea, lower part of the Lutetian

Orbitoclypeus chudeaui chudeaui (SCHLUMBERGER)

13. Form "A", rosette, E. 4930, 35×
Caupenne, lower part of the Lutetian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XXXIV. tábla — Plate XXXIV

Orbitoclypeus chudeaui chudeaui (SCHLUMBERGER)

1. A-forma, rozetta, E. 4931, 35×
2. A-forma, equatoriális metszet, E. 4931, 35×
Nousse, lutéciai emelet középső része
3. A-forma, equatoriális metszet, E. 4932, 35×
Angoumé, lutéciai emelet felső része

Orbitoclypeus chudeaui (SCHLUMBERGER) *pannonicus* n. ssp.

4. A-forma, rozetta, J 7-es minta, E. 4934, 35×
5. A-forma, rozetta, J 7-es minta, E. 4935, 35×
6—10. A-forma, equatoriális metszet, *6.:* E. 4934, *7.:* E. 4936, *8.:* E. 4933, *9.:* E. 4935, *10.:* 66 173, 35×
Ajka, bartoni emelet alsó része
11. Külső alak, DS 3-as minta, E. 4937, 12,5×
12. A-forma, rozetta, DS minta, E. 4938, 35×
Dudar, bartoni emelet középső része

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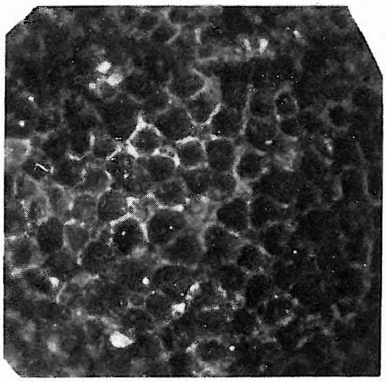
Orbitoclypeus chudeaui chudeaui (SCHLUMBERGER)

1. Form "A", rosette, E. 4931, 35×
2. Form "A", equatorial section, E. 4931, 35×
Nousse, middle part of the Lutetian
3. Form "A", equatorial section, E. 4932, 35×
Angoumé, upper part of the Lutetian

Orbitoclypeus chudeaui (SCHLUMBERGER) *pannonicus* n. ssp.

4. Form "A", rosette, sample J 7, E. 4934, 35×
5. Form "A", rosette, sample J 7, E. 4935, 35×
6—10. Form "A", equatorial section, *6.:* E. 4934, *7.:* E. 4936, *8.:* E. 4933, *9.:* E. 4935, *10.:* 66 173, 35×
Ajka, lower part of the Bartonian
11. External view, sample DS 3, E. 4937, 12.5×
12. Form "A", rosette, sample DS, E. 4938, 35×
Dudar, middle part of the Bartonian



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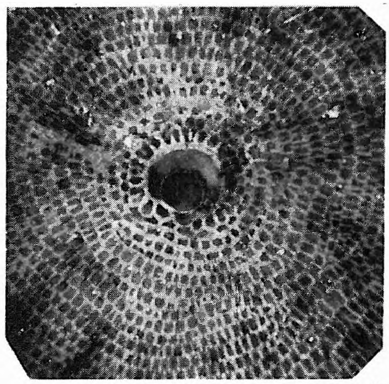

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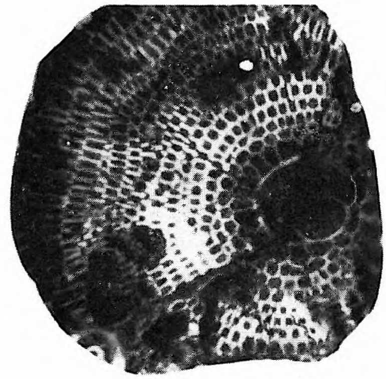

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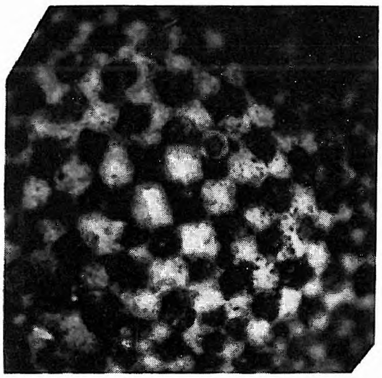

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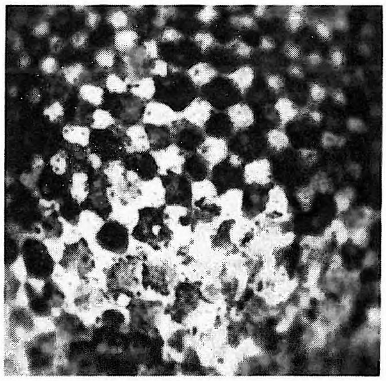

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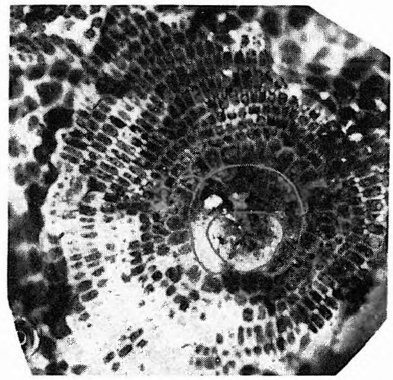

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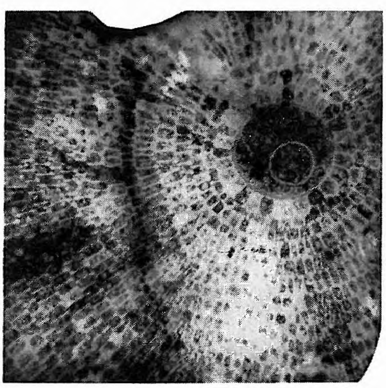

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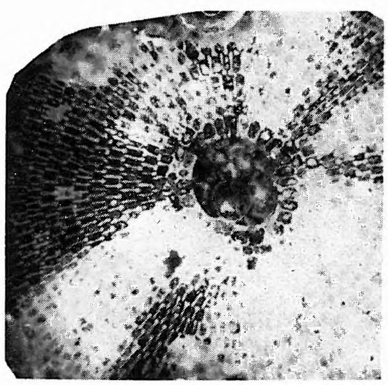

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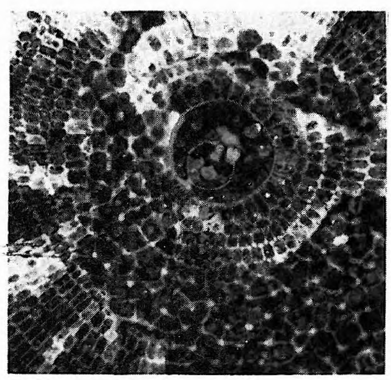

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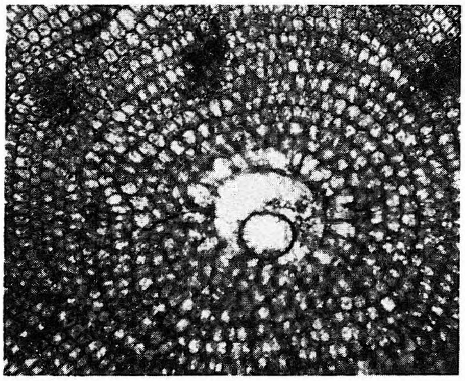

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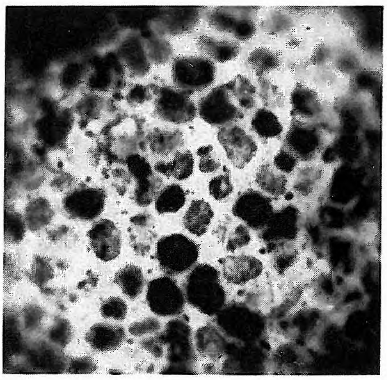

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XXXV. tábla — Plate XXXV

Orbitoclypeus chudeaui (SCHLUMBERGER) *pannonicus* n. ssp.

1—3. A-forma, equatoriális metszet, *1.*: E. 4941, *2.*: E. 4938, *3.*: E. 4939, 35×
4. Holotypus, A-forma, equatoriális metszet, E. 4940, 35×
5. B-forma, equatoriális metszet, E. 4942, 56×
6. B-forma, equatoriális metszet, E. 4942, 140×
Dudar, bartoni emelet középső része

Orbitoclypeus katoae n. sp.

7. Külső alak, SzT minta, E. 4943, 11×
8. Holotypus, A-forma, rozetta, SzT minta, E. 4944, 35×
9. Holotypus, A-forma, equatoriális metszet, E. 4944, 35×
10—12. A-forma, equatoriális metszet, *10.*: E. 4947, *11.*: E. 4946, *12.*: E. 4945, 35×
Ajka, bartoni emelet alsó része

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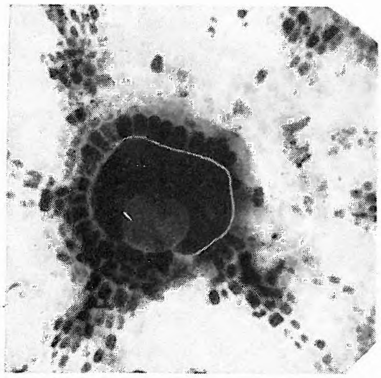
Orbitoclypeus chudeaui (SCHLUMBERGER) *pannonicus* n. ssp.

1—3. Form "A", equatorial section, *1.*: E. 4941, *2.*: E. 4938, *3.*: E. 4939, 35×
4. Holotype, form "A", equatorial section, E. 4940, ×35
5. Form "B", equatorial section, E. 4942, 56×
6. Form "B", equatorial section, E. 4942, 140×
Dudar, middle part of the Bartonian

Orbitoclypeus katoae n. sp.

7. External view, sample SzT, E. 4943, 11×
8. Holotype, form "A", rosette, sample SzT, E. 4944, 35×
9. Holotype, form "A", equatorial section, E. 4944, 35×
10—12. Form "A", equatorial section, *10.*: E. 4947, *11.*: E. 4946, *12.*: E. 4945, 35×
Ajka, lower part of the Bartonian



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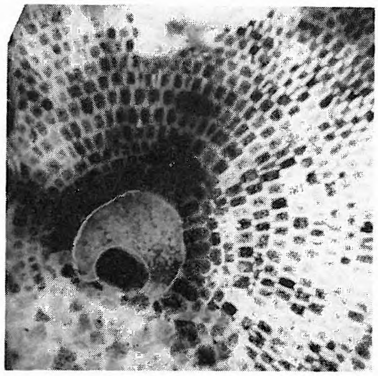

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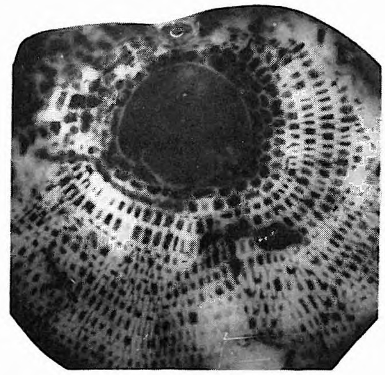

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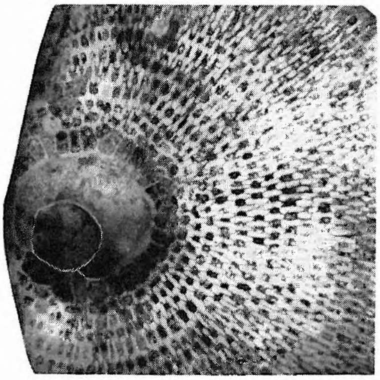

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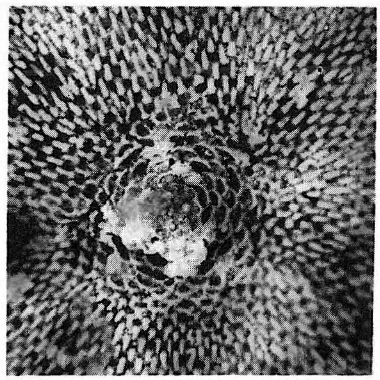

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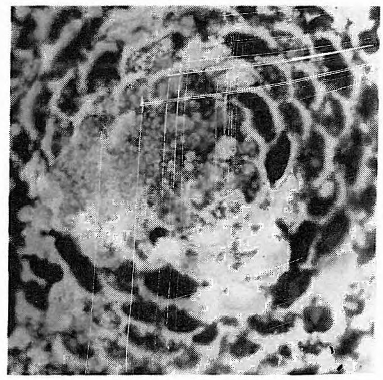

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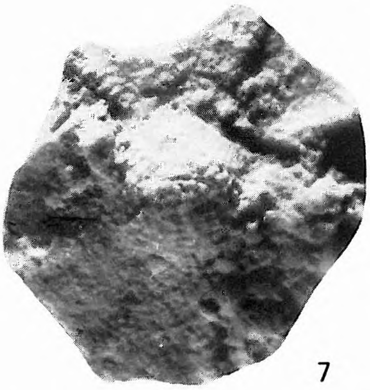

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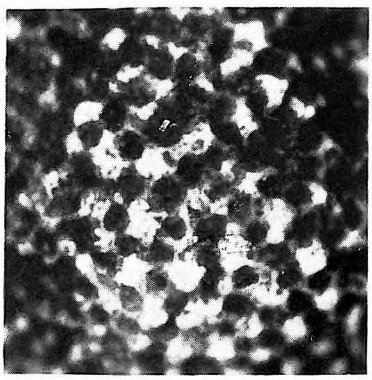

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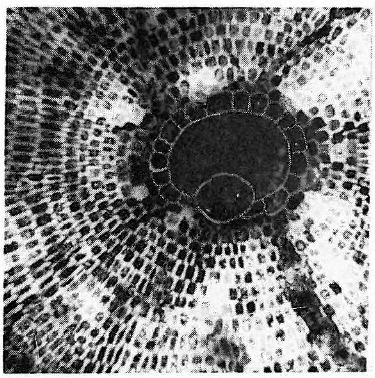

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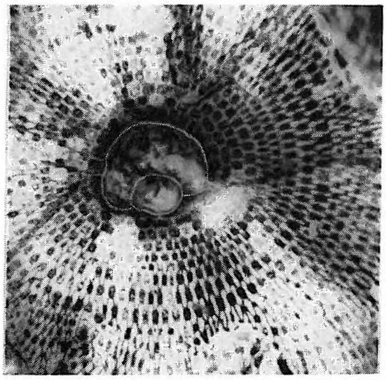

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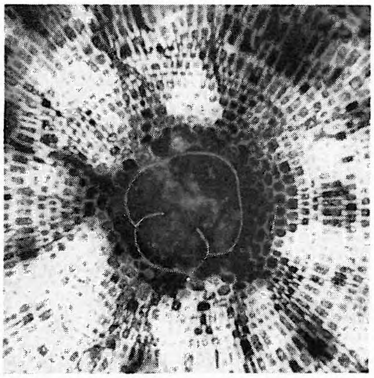

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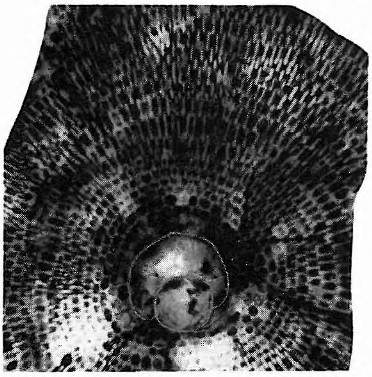

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XXXVI. tábla — Plate XXXVI

Orbitoclypeus daguini (NEUMANN)

1. A-forma, equatoriális metszet, E. 4948, 56×
4. A-forma, equatoriális metszet, E. 4948, 200×
Saint-Barthélémy, lutéciai emelet alsó része
2. A-forma, equatoriális metszet, E. 4949, 56×
3. Az A-formák equatoriális metszetének típusa, E. 4950, 56×
5. A-forma, equatoriális metszet, E. 4949, 140×
6. Az A-formák equatoriális metszetének típusa, E. 4950, 140×
Ajka, bartoni emelet alsó része

Asterocyclina stella (GÜMBEL) *taramellii* (MUNIER-CHALMAS)

7. A-forma, equatoriális metszet, E. 4951, 56×
Krím, ilerdi emelet felső része

8. A-forma, equatoriális metszet, E. 4954, 56×
Krím, lutéciai emelet alsó része
9—10. A-forma, equatoriális metszet, *9.:* E. 4953, *10.:* E. 4952, 56×
Horsarrieu, cuisi emelet középső része
11—13. A-forma, equatoriális metszet, *11.:* E. 4955, *12.:* E. 4956, *13.:* E. 4957, 56×
Saint-Barthélémy, lutéciai emelet alsó része

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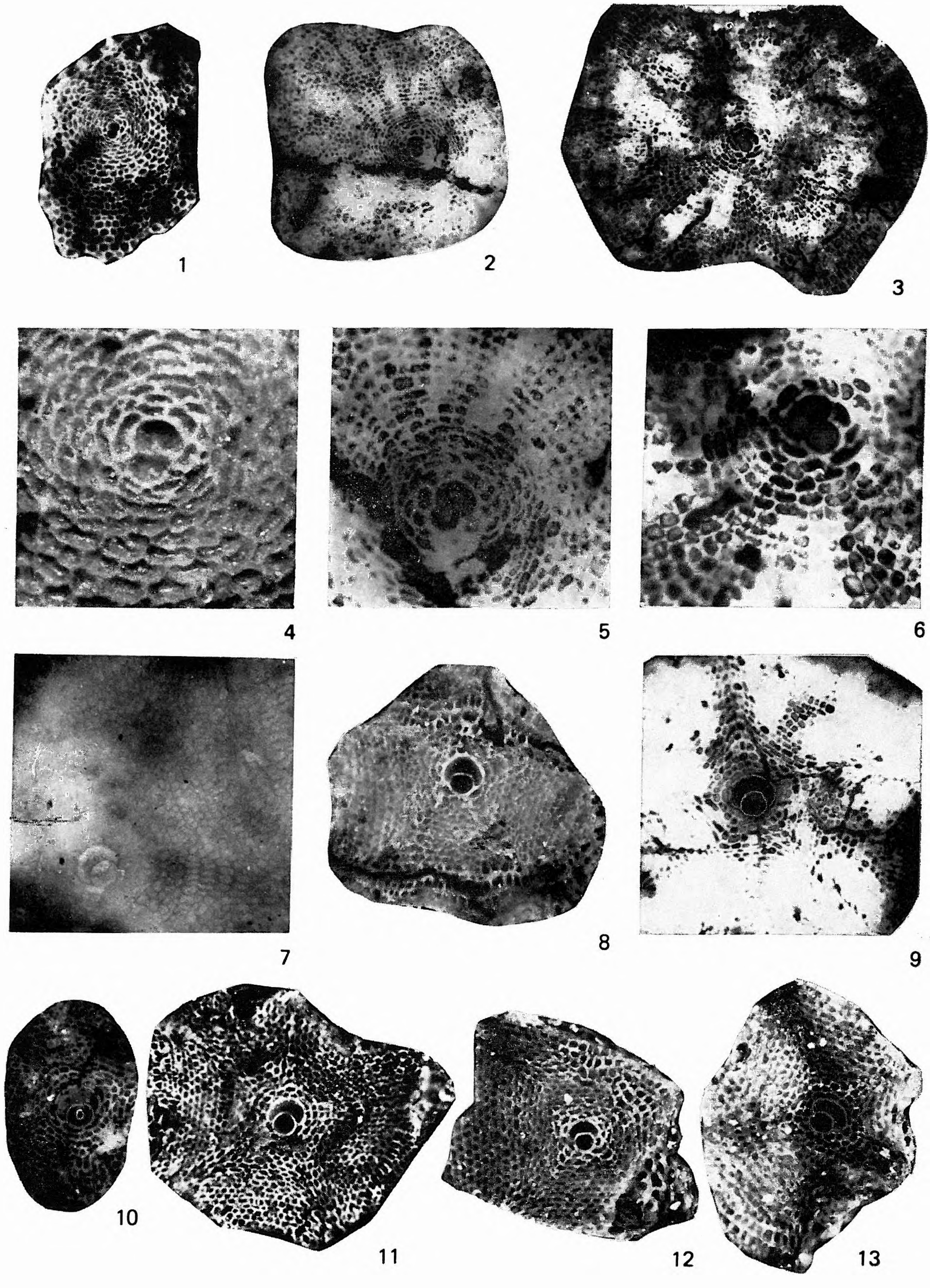
Orbitoclypeus daguini (NEUMANN)

1. Form "A", equatorial section, E. 4948, 56×
4. Form "A", equatorial section, E. 4948, 200×
Saint-Barthélémy, lower part of the Lutetian
2. Form "A", equatorial section, E. 4949, 56×
3. The type of the equatorial section of forms "A", E. 4950, 56×
5. Form "A", equatorial section, E. 4949, 140×
6. The type of the equatorial section of forms "A", E. 4950, 140×
Ajka, lower part of the Bartonian

Asterocyclina stella (GÜMBEL) *taramellii* (MUNIER-CHALMAS)

7. Form "A", equatorial section, E. 4951, 56×
Crimea, upper part of the Ilerdian
8. Form "A", equatorial section, E. 4954, 56×
Crimea, lower part of the Lutetian
9—10. Form "A", equatorial section, *9.:* E. 4953, *10.:* E. 4952, 56×
Horsarrieu, middle part of the Cuisian
11—13. Form "A", equatorial section, *11.:* E. 4955, *12.:* E. 4956, *13.:* E. 4957, 56×
Saint-Barthélémy, lower part of the Lutetian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XXXVII. tábla — Plate XXXVII

Asterocyclina stellata (D'ARCHIAC) *adourensis* n. ssp.

1—3. A-forma, equatoriális metszet, *1.:* E. 4959, *2.:* E. 4960, *3.:* E. 4958, 56×
4., *6—7.* B-forma, equatoriális metszet, *4.:* E. 4962, *6.:* E. 4961, *7.:* E. 4963, 56×
5., *8—9.* B-forma, equatoriális metszet, *5.:* E. 4962, *8.:* E. 4963, *9.:* E. 4961, 140×
Saint-Barthélémy, lutéciai emelet alsó része
10. A-forma, equatoriális metszet, E. 4970, 125×
Nussdorf, lutéciai emelet középső része
11. B-forma, equatoriális metszet, E. 4969, 56×
12. B-forma, equatoriális metszet, E. 4969, 140×
Gibret, lutéciai emelet középső része

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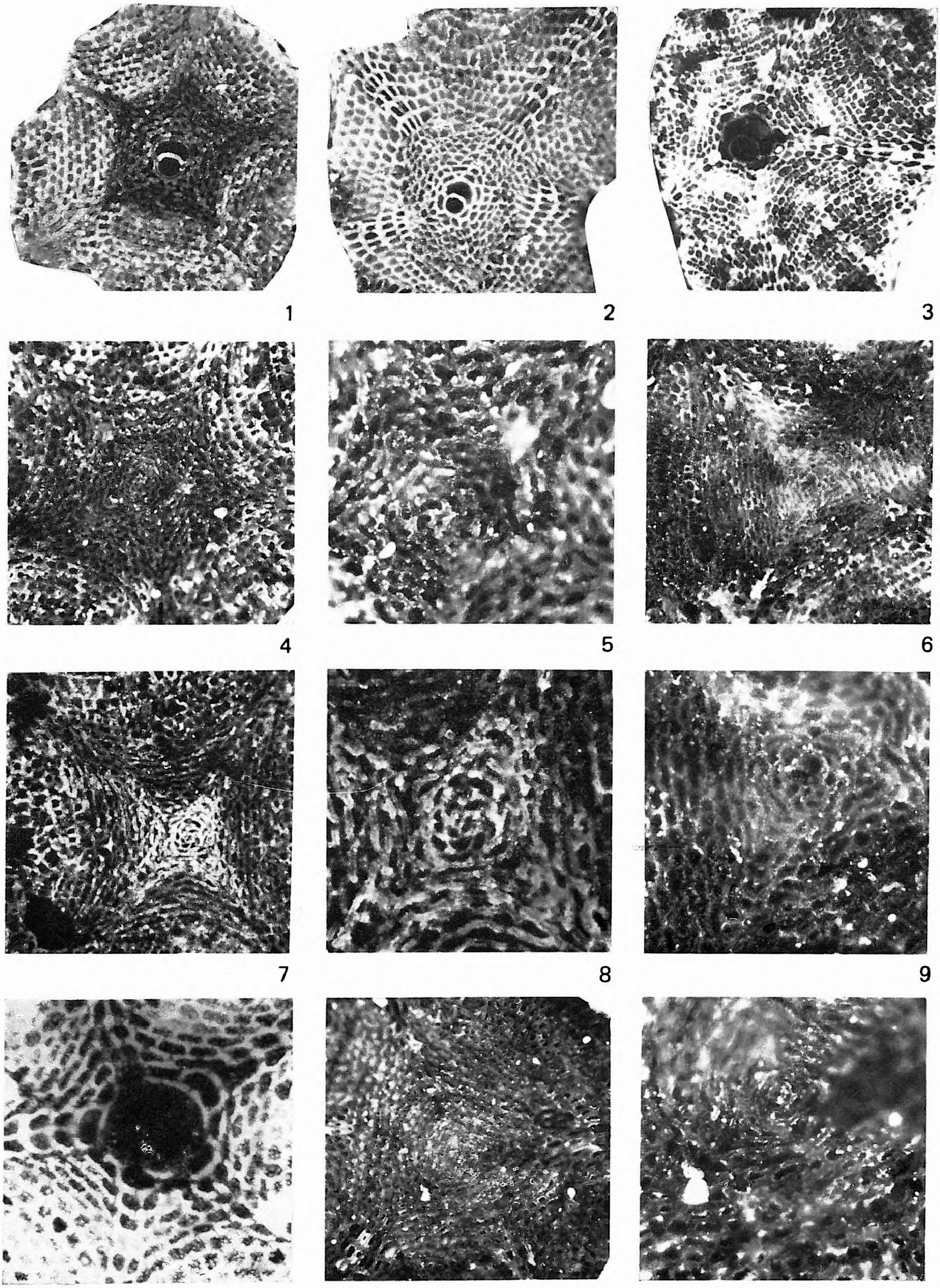
Asterocyclina stellata (D'ARCHIAC) *adourensis* n. ssp.

1—3. Form "A", equatorial section, *1.:* E. 4959, *2.:* E. 4960, *3.:* E. 4958, 56×
4., *6—7.* Form "B", equatorial section, *4.:* E. 4962, *6.:* E. 4961, *7.:* E. 4963, 56×
5., *8—9.* Form "B", equatorial section, *5.:* E. 4962, *8.:* E. 4963, *9.:* E. 4961, 140×
Saint-Barthélémy, lower part of the Lutetian
10. Form "A", equatorial section, E. 4970, 125×
Nussdorf, middle part of the Lutetian
11. Form "B", equatorial section, E. 4969, 56×
12. Form "B", equatorial section, E. 4969, 140×
Gibret, middle part of the Lutetian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XXXVIII. tábla — Plate XXXVIII

Asterocyclina stellata (D'ARCHIAC) *adourensis* n. ssp.

1. A-forma, külső alak, E. 4967, 22×
2. A-forma, rozetta, E. 4968, 35×
3. A-forma, equatoriális metszet, E. 4968, 56×
Gibret, lutéciai emelet középső része
4. A-forma, rozetta, E. 4964, 35×
5. Holotypus, A-forma, rozetta, E. 4965, 35×
6., *8.* A-forma, equatoriális metszet, *6.:* E. 4966, *8.:* E. 4964, 56×
7. Holotypus, A-forma, equatoriális metszet, E. 4965, 56×
Nousse, lutéciai emelet középső része

Asterocyclina stellata stellata (D'ARCHIAC)

9—11. A-forma, equatoriális metszet, *9.:* E. 4972, *10.:* E. 4971, *11.:* E. 4973, 56×
Angoumé, lutéciai emelet felső része

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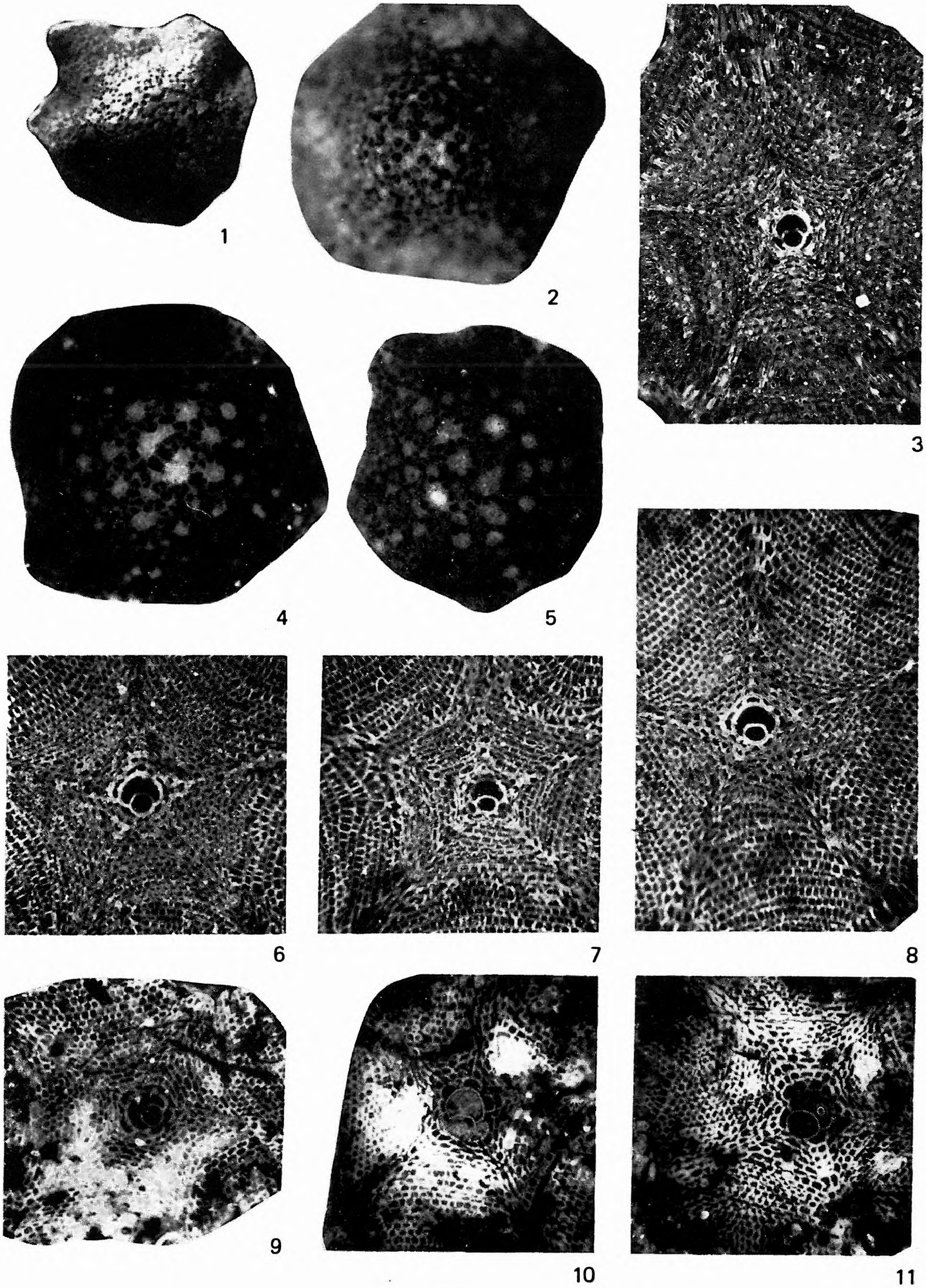
Asterocyclina stellata (D'ARCHIAC) *adourensis* n. ssp.

1. Form "A", external view, E. 4967, 22×
2. Form "A", rosette, E. 4968, 35×
3. Form "A", equatorial section, E. 4968, 56×
Gibret, middle part of the Lutetian
4. Form "A", rosette, E. 4964, 35×
5. Holotype, form "A", rosette, E. 4965, 35×
6., *8.* Form "A", equatorial section, *6.:* E. 4966, *8.:* E. 4964, 56×
7. Holotype, form "A", equatorial section, E. 4965, 56×
Nousse, middle part of the Lutetian

Asterocyclina stellata stellata (D'ARCHIAC)

9—11. Form "A", equatorial section, *9.:* E. 4972, *10.:* E. 4971, *11.:* E. 4973, 56×
Angoumé, upper part of the Lutetian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XXXIX. tábla — Plate XXXIX

Asterocyclina stellata stellata (D'ARCHIAC)

1. A-forma, rozetta, Sz 7-es minta, E. 4974, 35×
2—3., *7.* A-forma, equatoriális metszet, *2.*: E. 4979, *3.*: E. 4976, *7.*: E. 4975, 56×
4. A-forma, axiális metszet, E. 4974, 35×
8. B-forma, equatoriális metszet, E. 4977, 56×
9. B-forma, equatoriális metszet, E. 4977, 140×
10. B-forma, equatoriális metszet, Ba 6-os minta, E. 4978, 56×
Ajka, bartoni emelet alsó része

Asterocyclina aff. *stellata* (D'ARCHIAC)

5—6. A-forma, a két szétpattintott félház equatoriális metszete, E. 4980, 56×
Ajka, bartoni emelet alsó része

Asterocyclina stellata (D'ARCHIAC) *stellaris* (BRÜNNER in RÜTIMEYER)

11—12. A-forma, equatoriális metszet, *11.*: E. 4988, *12.*: E. 4986, 56×
Siest, bartoni emelet felső része

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Asterocyclina stellata stellata (D'ARCHIAC)

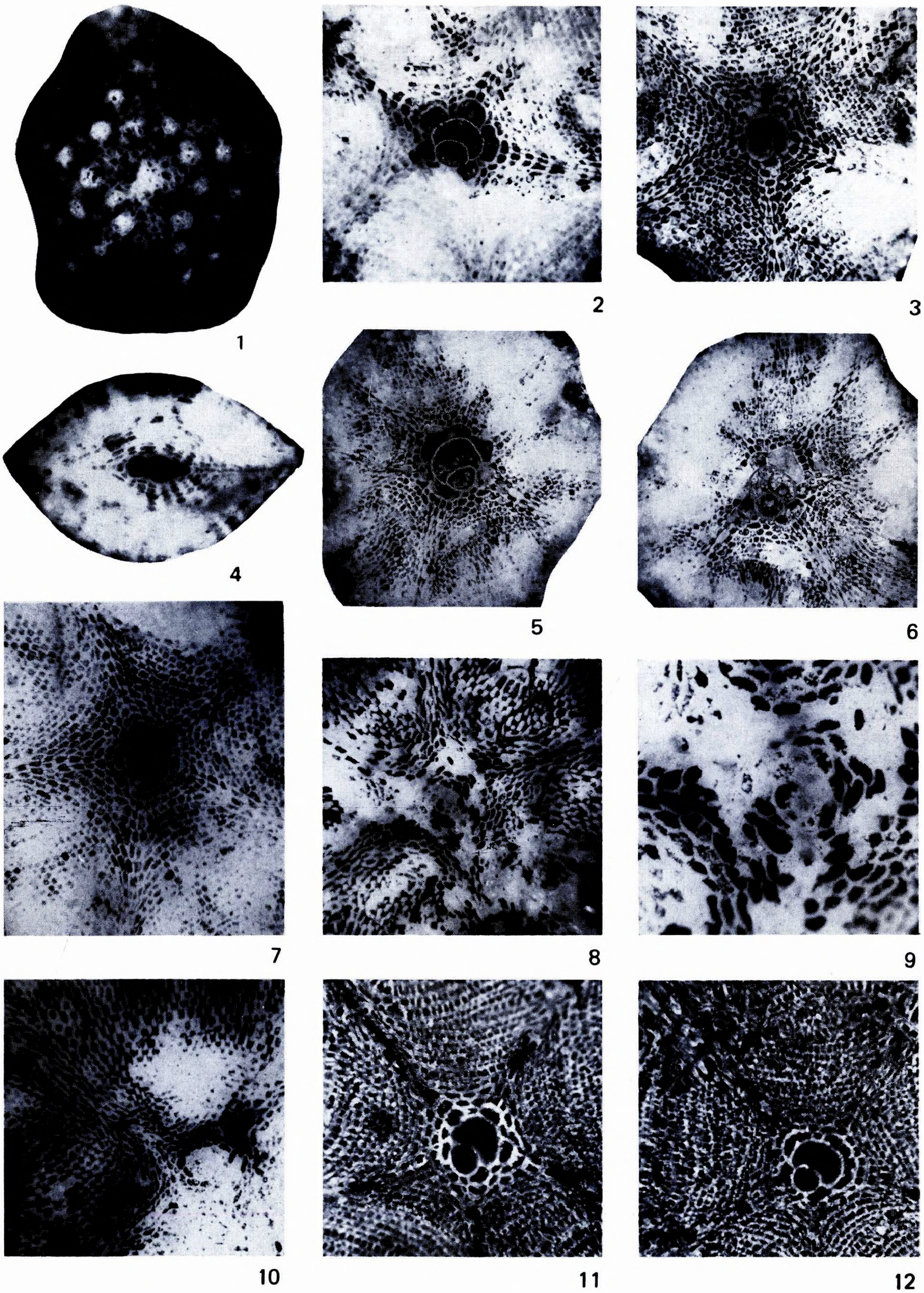
1. Form "A", rosette, sample Sz 7, E. 4974, 35×
2—3., *7.* Form "A", equatorial section, *2.*: E. 4974, *3.*: E. 4976, *7.*: E. 4975, 56×
4. Form "A", axial section, E. 4979, 35×
8. Form "B", equatorial section, E. 4977, 56×
9. Form "B", equatorial section, E. 4977, ×140
10. Form "B", equatorial section, sample Ba 6, E. 4978, 56×
Ajka, lower part of the Bartonian

Asterocyclina aff. *stellata* (D'ARCHIAC)

5—6. Form "A", equatorial sections of the two splitted up half-tests, E. 4980, 56×
Ajka, lower part of the Bartonian

Asterocyclina stellata (D'ARCHIAC) *stellaris* (BRÜNNER in RÜTIMEYER)

11—12. Form "A", equatorial section, *11.*: E. 4988, *12.*: E. 4986, 56×
Siest, upper part of the Bartonian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XL. tábla — Plate XL

Asterocyclina stellata (D'ARCHIAC) *stellaris* (BRÜNNER in RÜTIMEYER)

1. B-forma, equatoriális metszet, E. 4989, 56×
2. B-forma, equatoriális metszet, E. 4989, 140×
3. A-forma, equatoriális metszet, E. 4987, 56×
Siest, bartoni emelet felső része
4—5. A-forma, equatoriális metszet, *4.:* E. 4981, *5.:* E. 4982, 56×
6. A-forma, axiális metszet, E. 4985, 56×
7., *9.* B-forma, equatoriális metszet, *7.:* E. 4983, *9.:* E. 4984, 56×
8., *10.* B-forma, equatoriális metszet, *8.:* E. 4983, *10.:* E. 4984, 140×
Cauneille, bartoni emelet felső része
11. A-forma, equatoriális metszet, E. 4991, 56×
Mossano, priabonai emelet alsó része

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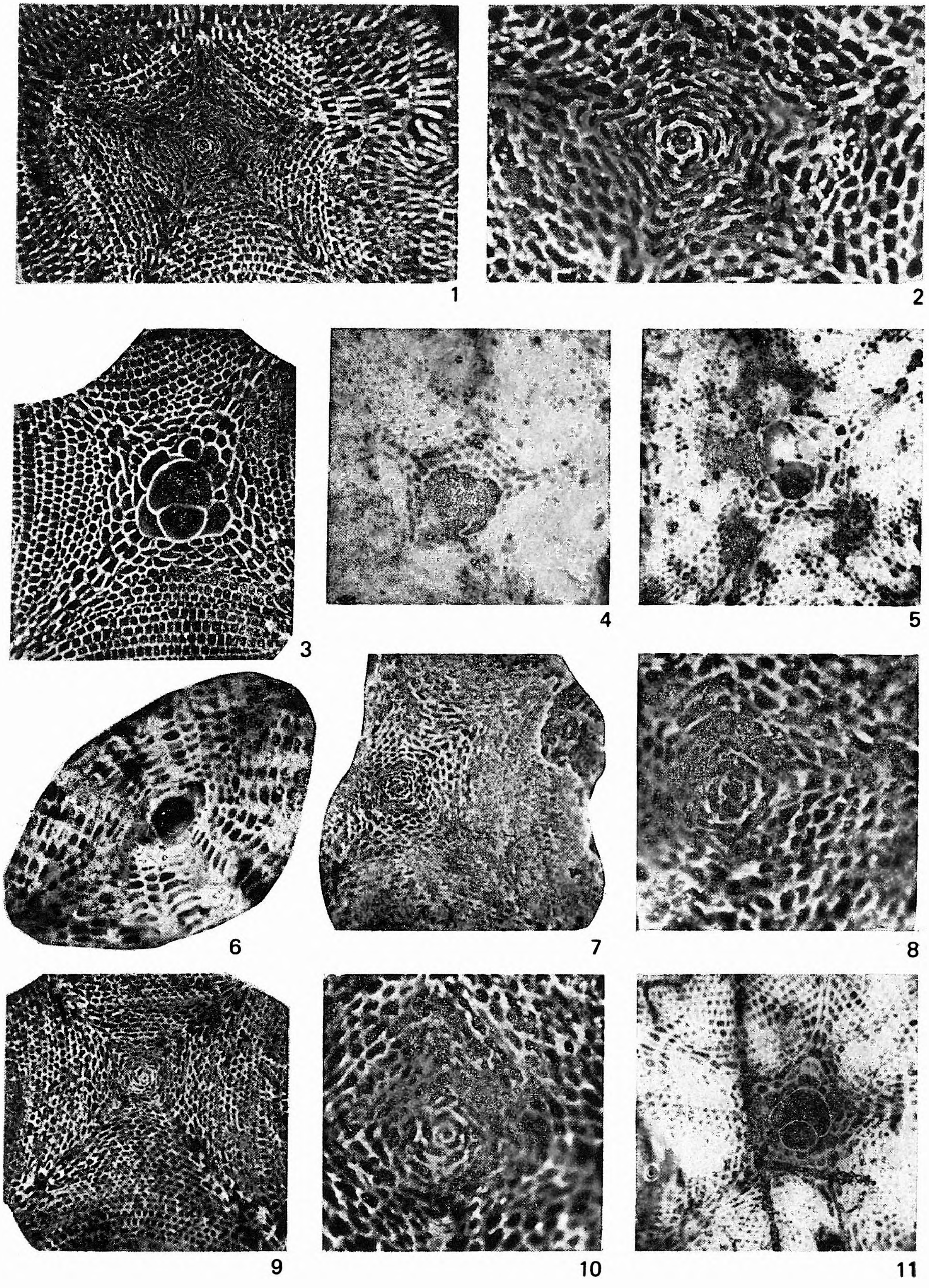
Asterocyclina stellata (D'ARCHIAC) *stellaris* (BRÜNNER in RÜTIMEYER)

1. Form "B", equatorial section, E. 4989, 56×
2. Form "B", equatorial section, E. 4989, 140×
3. Form "A", equatorial section, E. 4987, 56×
Siest, upper part of the Bartonian
4—5. Form "A", equatorial section, *4.:* E. 4981, *5.:* E. 4982, 56×
6. Form "A", axial section, E. 4985, 56×
7., *9.* Form "B", equatorial section, *7.:* E. 4983, *9.:* E. 4984, 56×
8., *10.* Form "B", equatorial section, *8.:* E. 4983, *10.:* E. 4984, 140×
Cauneille, upper part of the Bartonian
11. Form "A", equatorial section, E. 4991, 56×
Mossano, lower part of the Priabonian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XLI. tábla — Plate XLI

Asterocyclina stellata (D'ARCHIAC) *stellaris* (BRÜNNER in RÜTIMEYER)

1. A-forma, equatoriális metszet, E. 4990, 56×
Mossano, priabonai emelet alsó része

2. A-forma, equatoriális metszet, E. 4996, 56×
Valle Granella, priabonai emelet középső része

3—6. A-forma, equatoriális metszet, *3.*: E. 4993, *4.*: E. 4992, *5.*: E. 4994, *6.*: E. 4995, 56×
Lábatlan, priabonai emelet középső része

Asterocyclina priabonensis GÜMBEL

7—8. A-forma, equatoriális metszet, *7.*: E. 4998, *8.*: E. 4997, 56×
Lábatlan, priabonai emelet középső része

Asterocyclina kecskemetii n. sp.

9. Külső alak, CS minta, E. 5000, 14×

10. Rozetta, CS minta, E. 5000, 35×
Ajka, bartoni emelet alsó része

11. A-forma, equatoriális metszet, E. 4999, 56×
Angoumé, lutéciai emelet felső része

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Asterocyclina stellata (D'ARCHIAC) *stellaris* (BRÜNNER in RÜTIMEYER)

1. Form "A", equatorial section, E. 4990, 56×
Mossano, lower part of the Priabonian

2. Form "A", equatorial section, E. 4996, 56×
Valle Granella, middle part of the Priabonian

3—6. Form "A", equatorial section, *3.*: E. 4993, *4.*: E. 4992, *5.*: E. 4994, *6.*: E. 4995, 56×
Lábatlan, middle part of the Priabonian

Asterocyclina priabonensis GÜMBEL

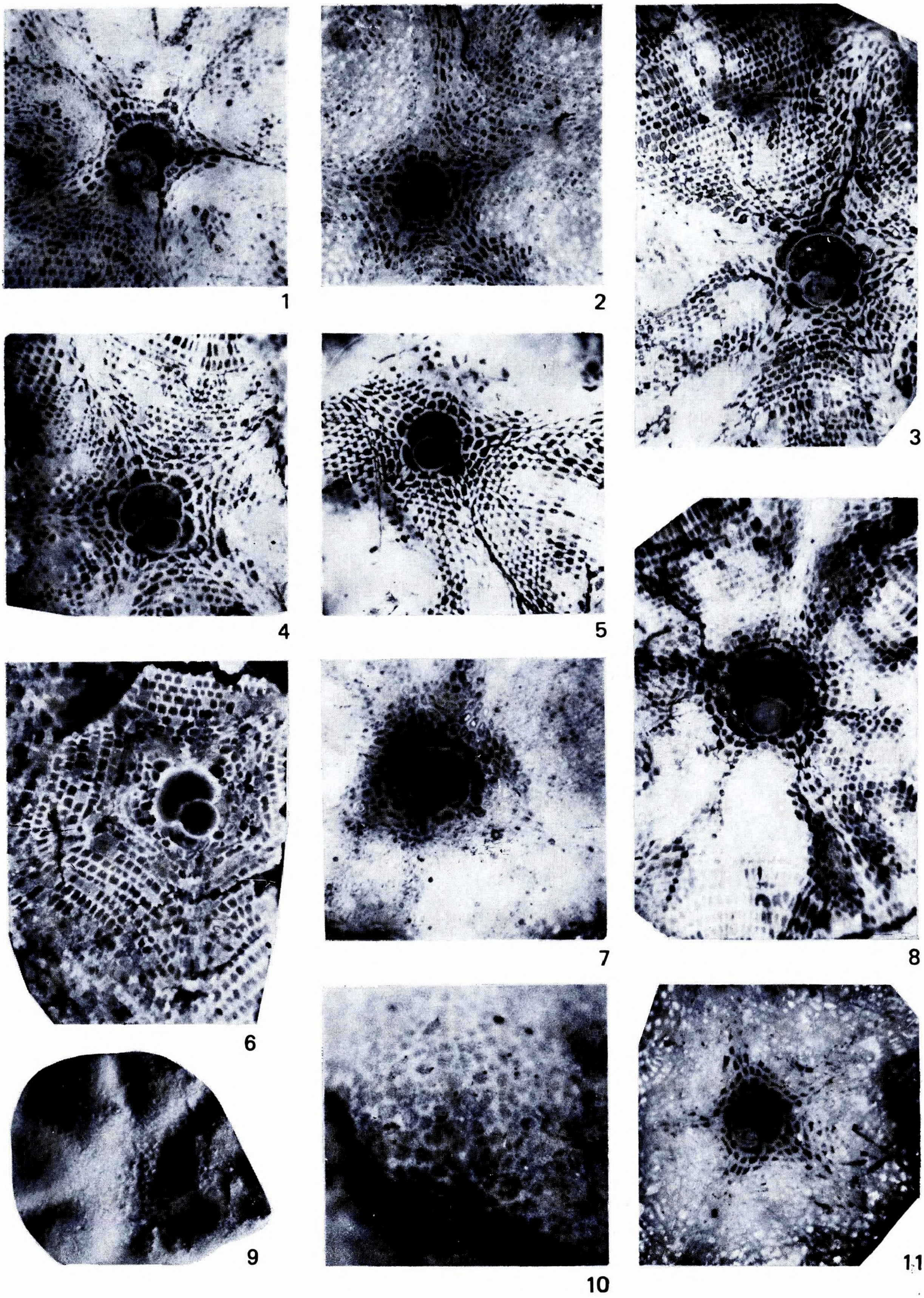
7—8. Form "A", equatorial section, *7.*: E. 4998, *8.*: E. 4997, 56×
Lábatlan, middle part of the Priabonian

Asterocyclina kecskemetii n. sp.

9. External view, sample CS, E. 5000, 14×

10. Rosette, sample CS, E. 5000, 35×
Ajka, lower part of the Bartonian

11. Form "A", equatorial section, E. 4999, 56×
Angoumé, upper part of the Lutetian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XLII. tábla — Plate XLII

Asterocyclina kecskemetii n. sp.

1. Holotypus, A-forma, equatoriális metszet, E. 5001, 56×
2. A-forma, rozetta, CS minta, E. 5002, 35×
3—4. A-forma, equatoriális metszet, *3.:* 61 740, *4.:* E. 5002, 56×
Ajka, bartoni emelet alsó része
5—6. A-forma, equatoriális metszet, *5.:* E. 5004, *6.:* E. 5003, 56×
Dudar, bartoni emelet középső része

Asterocyclina stella stella (GÜMBEL)

7. A-forma, külső alak, E. 5007., 22×
8. A-forma, külső alak, E. 5006, 35×
9. A-forma, equatoriális metszet, E. 5007, 56×
Cauneille, bartoni emelet felső része

Asterocyclina stella (GÜMBEL) *taramellii* (MUNIER-CHALMAS)

10. A-forma, equatoriális metszet, E. 5005, 56×
Angoumé, lutéciai emelet felső része

Asterocyclina stella (GÜMBEL) *praestellaris* BRÖNNIMANN

11. A-forma, equatoriális metszet, E. 5008, 56×
Mossano, priabonai emelet alsó része
12. A-forma, equatoriális metszet, E. 5009, 56×
Lábatlan, priabonai emelet középső része

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Asterocyclina kecskemetii n. sp.

1. Holotype, form "A", equatorial section, E. 5001, 56×
2. Form "A", rosette, sample CS, E. 5002, 35×
3—4. Form "A", equatorial section, *3.:* 61 740, *4.:* E. 5002, 56×
Ajka, lower part of the Bartonian
5—6. Form "A", equatorial section, *5.:* E. 5004, *6.:* E. 5003, 56×
Dudar, middle part of the Bartonian

Asterocyclina stella stella (GÜMBEL)

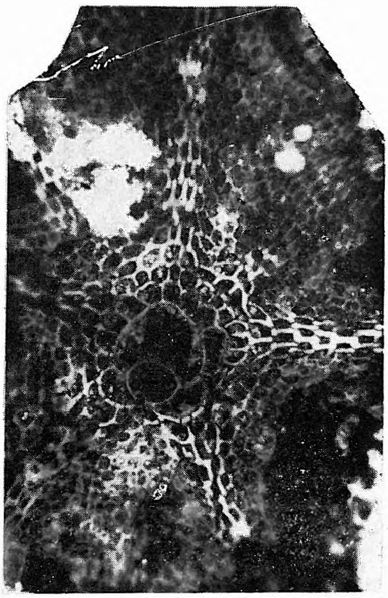
7. Form "A", external view, E. 5007, 22×
8. Form "A", external view, E. 5006, 35×
9. Form "A", equatorial section, E. 5007, 56×
Cauneille, upper part of the Bartonian

Asterocyclina stella (GÜMBEL) *taramellii* (MUNIER-CHALMAS)

10. Form "A", equatorial section, E. 5005, 56×
Angoumé, upper part of the Lutetian

Asterocyclina stella (GÜMBEL) *praestellaris* BRÖNNIMANN

11. Form "A", equatorial section, E. 5008, 56×
Mossano, lower part of the Priabonian
12. Form "A", equatorial section, E. 5009, 56×
Lábatlan, middle part of the Priabonian



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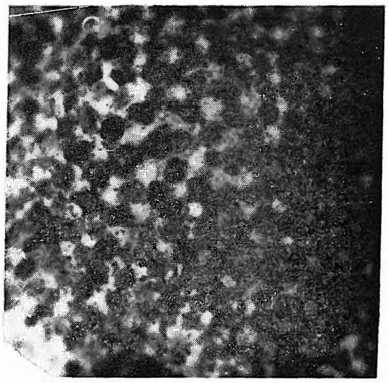

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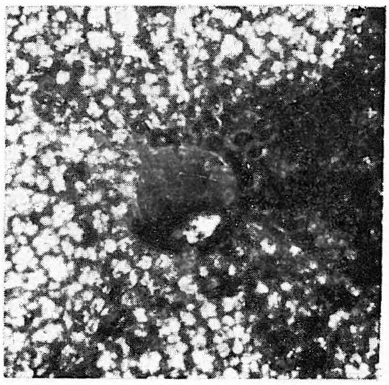

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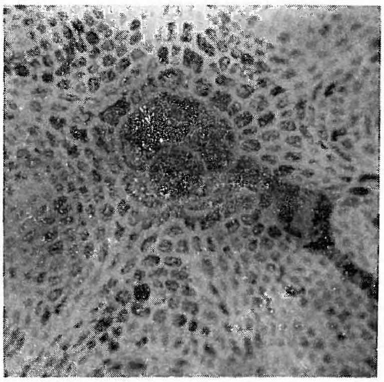

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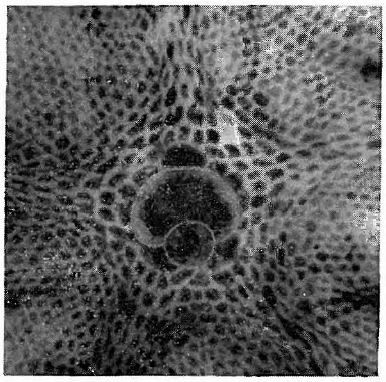

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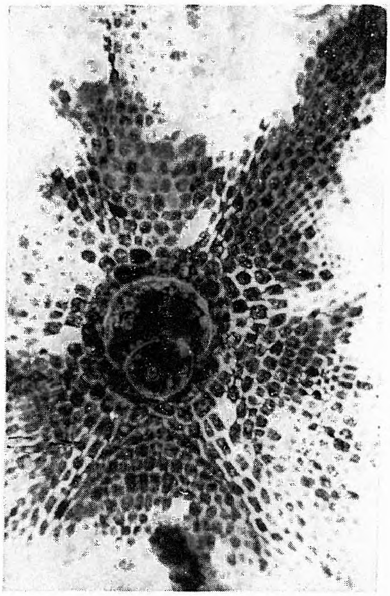

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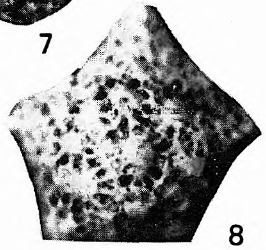

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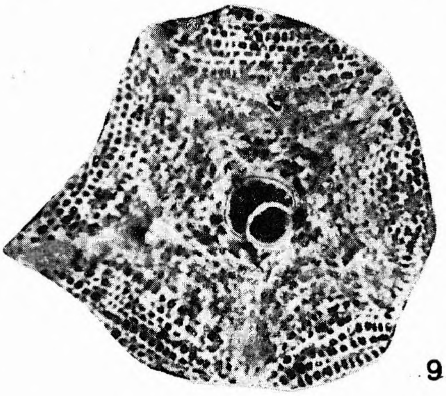

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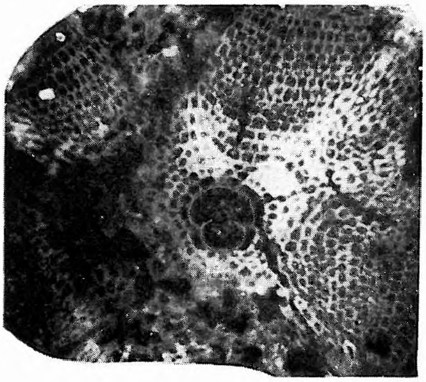

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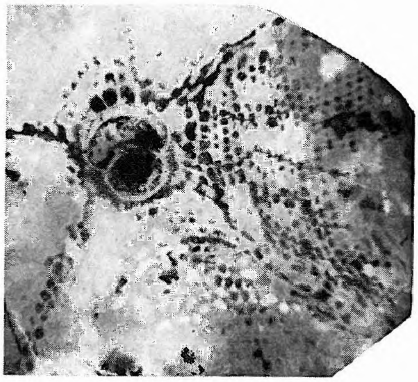

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XLIII. tábla — Plate XLIII

Asterocyclina schweighauseri n. sp.

1. A-forma, külső alak, E. 5013, 18×
2. A-forma, equatoriális metszet, E. 5013, 35×
Caupenne, lutéciai emelet alsó része
3—4. A-forma, equatoriális metszet, *3.*: E. 5011, *4.*: E. 5010, 35×
5. B-forma, külső alak, E. 5012., 17×
7. B-forma, equatoriális metszet, E. 5012, 56×
8. B-forma, equatoriális metszet, E. 5012, 200×
Saint-Barthélémy, lutéciai emelet alsó része
6. Holotypus, A-forma, equatoriális metszet, E. 5014, 35×
Montfort, lutéciai emelet középső része

Asterocyclina alticostata (Nuttall) *gallica* n. ssp.

9. A-forma, külső alak, E. 5017, 20×
10. A-forma, külső alak, E. 5018, 22×
11. A-forma, equatoriális metszet, E. 5017, 35×
Gibret, lutéciai emelet középső része
12. Holotypus, A-forma, equatoriális metszet, E. 5015, 35×
Nousse, lutéciai emelet középső része

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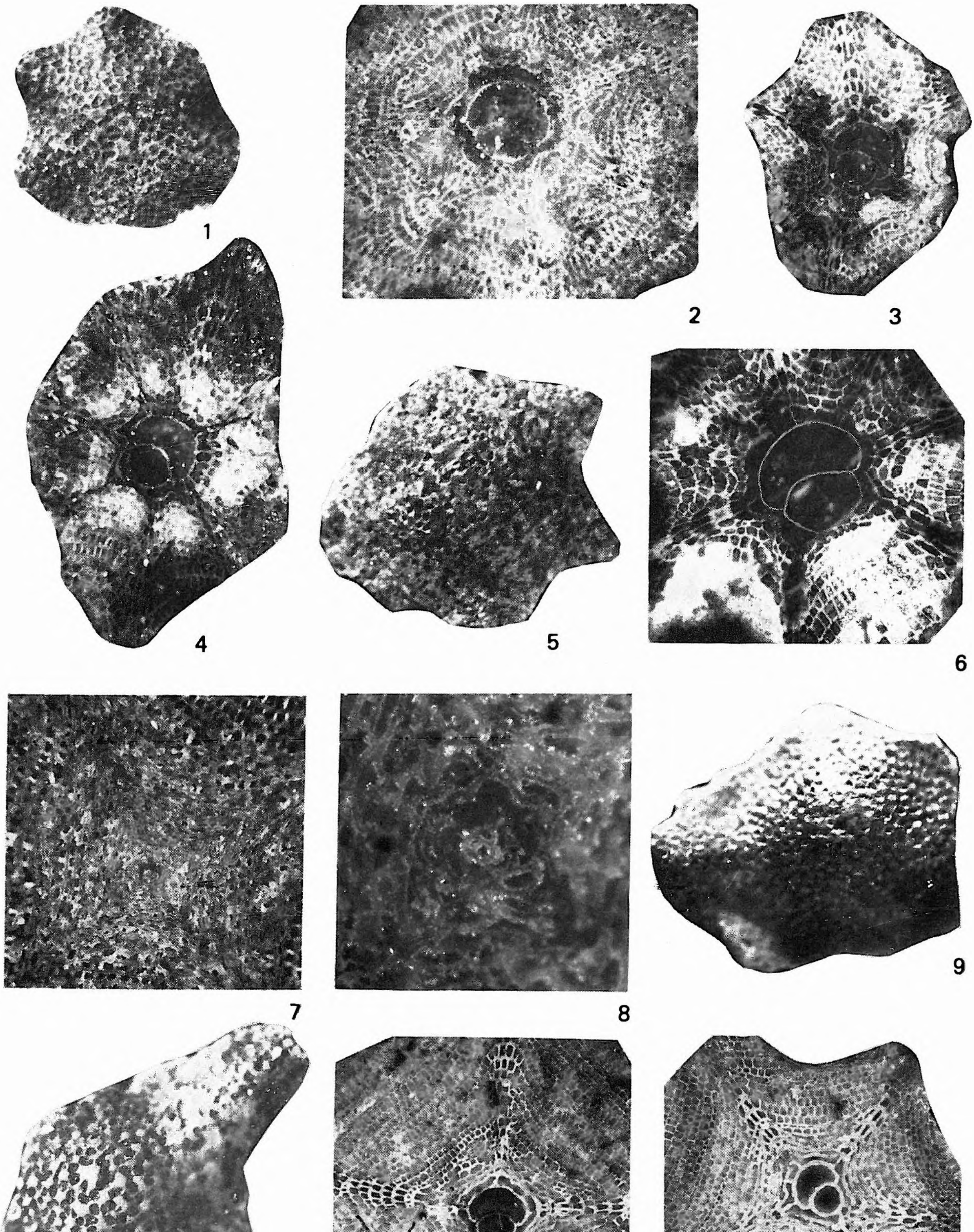
Asterocyclina schweighauseri n. sp.

1. Form "A", external view, E. 5013, 18×
2. Form "A", equatorial section, E. 5013, 35×
Caupenne, lower part of the Lutetian
3—4. Form "A", equatorial section, *3.*: E. 5011, *4.*: E. 5010, 35×
5. Form "B", external view, E. 5012, 17×
7. Form "B", equatorial section, E. 5012, 56×
8. Form "B", equatorial section, E. 5012, 200×
Saint-Barthélémy, lower part of the Lutetian
6. Holotype, form "A", equatorial section, E. 5014, 35×
Montfort, middle part of the Lutetian

Asterocyclina alticostata (Nuttall) *gallica* n. ssp.

9. Form "A", external view, E. 5017, 20×
10. Form "A", external view, E. 5018, 22×
11. Form "A", equatorial section, E. 5017, 35×
Gibret, middle part of the Lutetian
12. Holotype, form "A", equatorial section, E. 5015, 35×
Nousse, middle part of the Lutetian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XLIV. tábla — Plate XLIV

Asterocyclina alticostata (NUTTALL) *gallica* n. sp.

1. B-forma, equatoriális metszet, E. 5016, 56×
2. B-forma, equatoriális metszet, E. 5016, 140×
Nousse, lutéciai emelet középső része

Asterocyclina alticostata (NUTTALL) *cuvillieri* (NEUMANN)

3., *6.* A-forma, equatoriális metszet, *3.:* E. 5019, *6.:* E. 5020, 35×
Angoumé, lutéciai emelet felső része

4., *7—9.* A-forma, equatoriális metszet, *4.:* E. 5021, *7.:* E. 5022, *8.:* E. 5023, *9.:* 61 744, 35×
5. A-forma, equatoriális kamrák, E. 5021, 125×
Ajka, bartoni emelet alsó része

Asterocyclina alticostata alticostata (NUTTALL)

10. A-forma, külső alak, DS 5-ös minta, E. 5026, 14×
11. A-forma, rozetta, D 7-es minta, E. 5024, 35×
Dudar, bartoni emelet középső része

* * *

Asterocyclina alticostata (NUTTALL) *gallica* n. ssp.

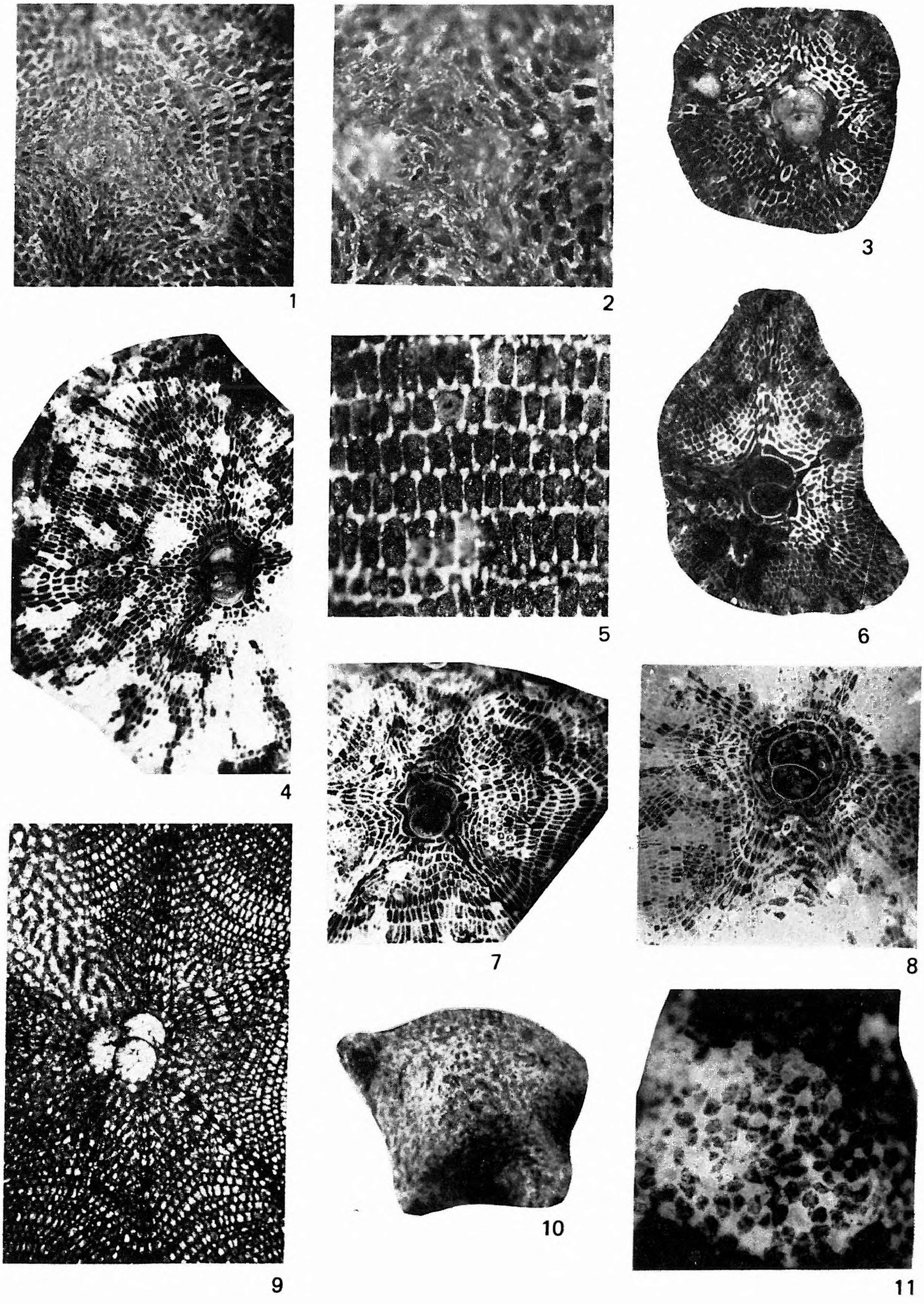
1. Form "B", equatorial section, E. 5016, 56×
2. Form "B", equatorial section, E. 5016, 140×
Nousse, middle part of the Lutetian

Asterocyclina alticostata (NUTTALL) *cuvillieri* (NEUMANN)

3., *6.* Form "A", equatorial section, *3.:* E. 5019, *6.:* E. 5020, 35×
Angoumé, upper part of the Lutetian
4., *7—9.* Form "A", equatorial section, *4.:* E. 5021, *7.:* E. 5022, *8.:* E. 5023, *9.:* 61 744, 35×
5. Form "A", equatorial chambers, E. 5021, 125×
Ajka, lower part of the Bartonian

Asterocyclina alticostata alticostata (NUTTALL)

10. Form "A", external view, sample DS 5, E. 5026, 14×
11. Form "A", rosette, sample D 7, E. 5024, 35×
Dudar, middle part of the Bartonian



XLV. tábla — Plate XLV

Asterocyclina alticostata alticostata (NUTTALL)

1—3. A-forma, equatoriális metszet, *1.*: E. 5024, *2.*: E. 5026, *3.*: E. 5025, 35×
Dudar, bartoni emelet középső része

Asterocyclina alticostata (NUTTALL) *danubica* n. ssp.

4. A-forma, rozetta, RA minta, E. 5029, 35×
5. Holotypus, A-forma, equatoriális metszet, E. 5027, 35×
6—7. A-forma, equatoriális metszet, *6.*: E. 5029, *7.*: E. 5028, 35×
8—9. B-forma, equatoriális metszet, *8.*: E. 5030, *9.*: E. 5031, 56×
10—11. B-forma, equatoriális metszet, *10.*: E. 5031, *11.*: E. 5030, 140×
Lábatlan, priabonai emelet középső része

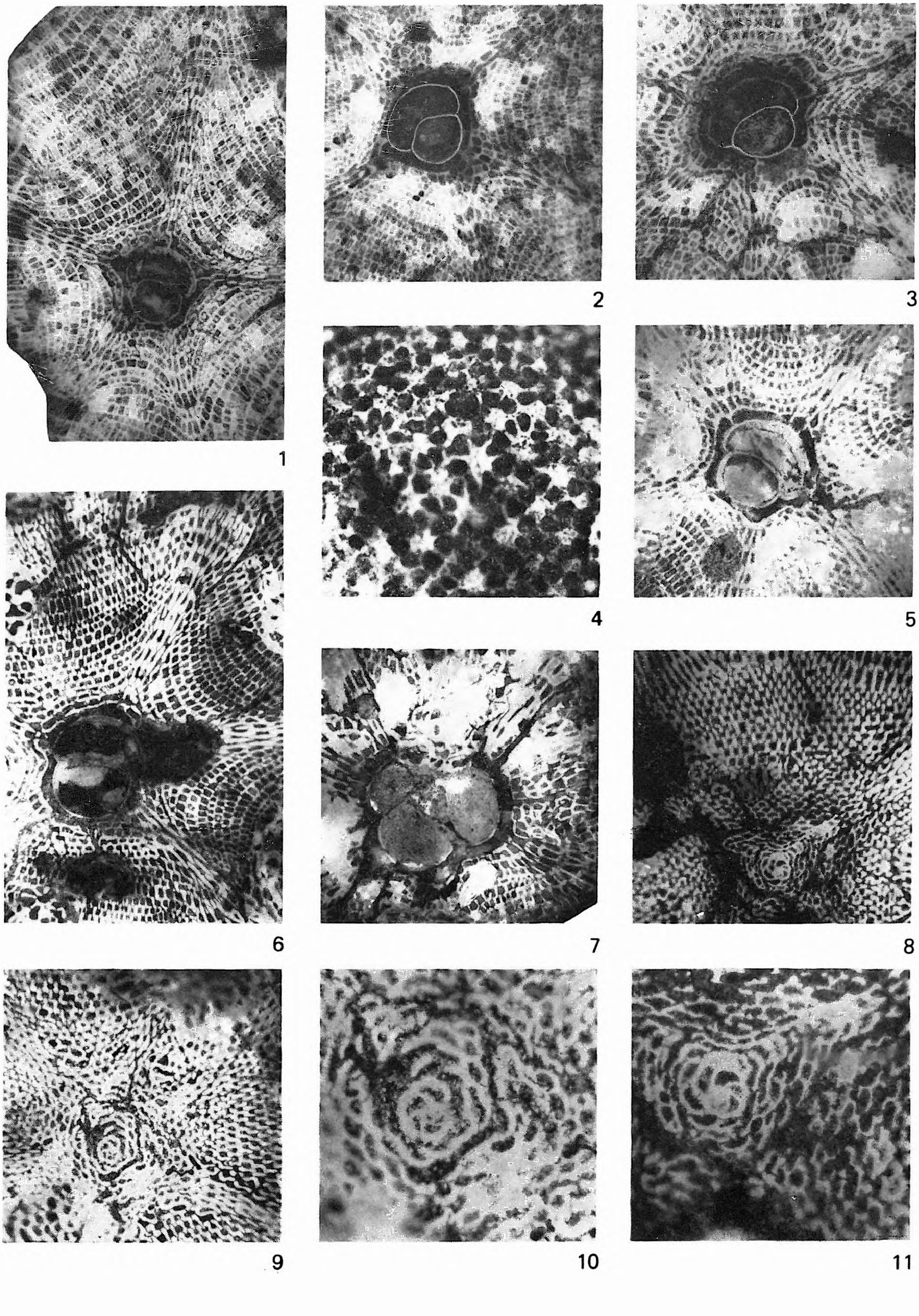
* * *

Asterocyclina alticostata alticostata (NUTTALL)

1—3. Form "A", equatorial section, *1.*: E. 5024, *2.*: E. 5026, *3.*: E. 5025, 35×
Dudar, middle part of the Bartonian

Asterocyclina alticostata (NUTTALL) *danubica* n. ssp.

4. Form "A", rosette, sample RA, E. 5029, 35×
5. Holotype, form "A", equatorial section, E. 5027, 35×
6—7. Form "A", equatorial section, *6.*: E. 5029, *7.*: E. 5028, 35×
8—9. Form "B", equatorial section, *8.*: E. 5030, *9.*: E. 5031, 56×
10—11. Form "B", equatorial section, *10.*: E. 5031, *11.*: E. 5030, 140×
Lábatlan, middle part of the Priabonian



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