geologica hungarica

FASCICULI INSTITUTI GEOLOGICI HUNGARIAE
AD ILLUSTRANDAM NOTIONEM GEOLOGICAM
ET PALAEONTOLOGICAM

SERIES PALAEONTOLOGICA

FASCICULUS 42

VIIIth RCMNS
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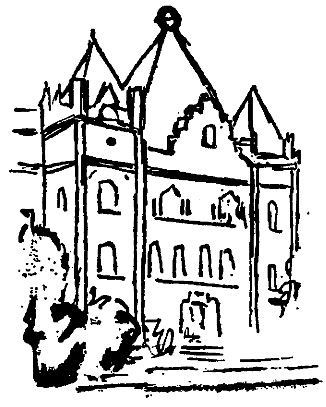

INSTITUTUM GEOLOGICUM HUNGARICUM
BUDAPESTINI, 1984

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FASCICULUS 42

DR. MÜLLER PÁL: A BÁDENI EMELET TÍZLÁBÚ RÁKJAI
DR. PÁL MÜLLER: DECAPOD CRUSTACEA OF THE BADENIAN

To Dr. J. S. Garth
thankfully
Pál Müller

INSTITUTUM GEOLOGICUM HUNGARICUM
BUDAPESTINI, NOVEMBER 1984

Lektor:
DR. DUDICH ENDRE

Szakszerkesztő:
PIROS CHRISTA

Az angol szöveg a szerző munkája

Nyelvi lektor:
DR. MIKLÓS MÜLLER

Technikai szerkesztő:
CSABAY LÁSZLÓNÉ
GARAMSZEGI KÁROLYNÉ

HU ISSN 03 67 4150

A kézirat lezárva 1984. január 15-én

Megjelent a Műszaki Könyvkiadó gondozásában
Budapest, 1984

Felelős kiadó: DR. HÁMOR GÉZA

Műszaki vezető: Kőrizs Károly
Műszaki szerkesztő: Metzker Sándor
A könyv formátuma: A4
Terjedelem: 40 A5 ív
Példányszám: 880
Ábrák száma: 12+fényképtáblák
Betűcsalád és -méret: Extended, gm/gm
Papír minősége: 80 g ofszet és 120 g műnyomó
Azonossági szám: 01486

84.2339 Egyetemi Nyomda, Budapest, 1984
Felelős vezető: Sümeghi Zoltán igazgató

TARTALOM — CONTENTS

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BEVEZETÉS

A tízlábú rákok az ősmaradványanyagban aránylag ritkák, pedig a mai tengeri élővilág fontos, gyakori tagjai. Kevés olyan lelőhely van, ahol húsznál több fajt találtak, ezek nagy része is mezozóos vagy eocén. A neogén nagy kövületgazdagsága ellenére többnyire csak szórványleleteket adott. A Középső Paratethys bádeni emelete kivételes. Ebben eddig 120 különböző alakra bukkantak, ezek közül 102-t lehetett fajra vagy alfajra meghatározni. A gazdagság egyik oka a viszonylag keskeny tengerágakban, tehát jórészt nyugodt körülmények között lerakódott mészkövek nagy mennyisége. Talán ennél is fontosabb, hogy sok jó lelőhely olyan világvárosok közelében (Budapest és Bécs) van, ahol az őslénytani kutatásnak nagy a hagyománya. A kövült rákok vizsgálatának is több mint egy évszázados múltja van itt. A régi közlemények revíziójának időszerű volta mellett a szerző által összegyűjtött anyag is indokolta e munka elkészítését.

A szétszórt lelőhelyekről származó szórványleletek néha gyönyörű példányokat adtak, ezekkel foglalkozik a régebbi közlemények jó része. Ennél fontosabbnak ítélem azt, hogy egyes rétegek alaposan begyűjtött anyagából, számos faj alapján, az egykori együttesekre is tudunk következtetni. Ennek az elvnek alapján néhány ígéretes lelőhelyet sokszor, egyeseket (Rákos, Örs vezér tere, Törökmező, Tétényi-fennsík) száznál is többször meglátogattam, vagy viszonylag rövid idő alatt nagy mennyiségű kőzetanyagot gyűjtöttem, amit aztán később vizsgáltam át (Gross-Höflein). Más, kevésbé ígéretes vagy távolabbi helyeket csak egy-egy, vagy néhány alkalommal vizsgáltam (pl. Mátraverebély—Szentkút, Zebegény, Szob, Deutsch-Altenburg, Grobie). Ezért az összegyűlt anyag némileg egyoldalú. A budapesti felső-bádeni lelőhelyekről sokszorta több anyag gyűlt össze, mint a távolabbi, alsó-bádeni rétegek jó részéből. Ennek ellenére érdemes volt az egész ismert bádeni anyagot egységesen feldolgozni.

Több ezer példány (izolált ollók, carapaxok, más testrészek, ritkán teljes vázak) képezi a monográfia alapját. A 102 meghatározható alak között 21 faj és egy alfaj újnak bizonyult, s négy fajt nem lehetett ismert nemzetségbe sorolni, ezért új genusként írtam le ezeket.

Célom az volt, hogy leírjam vagy revideáljam az összes eddig publikált, gyűjteményekben elérhető, vagy újonnan gyűjtött tízlábú rákot, az elkülönült ujjak kivételével. Az ujjak vizsgálata mindaddig nem ígér sok eredményt, amíg a carapax vagy olló alapján leírt rákokkal nem sikerül azokat azonosítani. Ezért az ujjakat csak akkor vizsgáltam, ha az adott réteg más, felismerhető maradványt is tartalmazott, s az ujjaknak azokkal való faji azonosítása valamilyen módszerrel lehetséges volt.

Cluster-elemzés segítségével értékeltem a rák-együttesekre jellemző ökológiai viszonyokat. Az összetételükben egymáshoz hasonló együttesek csoportjaira jellemző (állandó és hűséges) alakok mai rokonságának igényeiből próbáltam következtetni a bezáró kőzetek lerakódásakor uralkodó viszonyokra, figyelembe véve néhány, üledékkőzettani módszerrel nyert eredményt is. Ősföldrajzi és rétegtani következtetésre is jutottam.

Mind a gyűjtés, mind a kiértékelés munkáját egyedül, szabadidőben végeztem, csaknem harminc éven keresztül. Munkámat azonban családom tagjai, sok barátom, hazai és külföldi kollégám önzetlenül támogatta. Nevüket az angol szövegrészben sorolom fel, s ott köszönöm meg segítségüket.

A BÁDENI EMELET ÉS A KÖZÉPSŐ PARATETHYS

A bádeni emelet regionális rétegtani egység, melynek érvényessége a Középső Paratethysre terjed ki. Radiometrikus adatok alapján nagyjából a 16,5—13,3 millió év közötti időtartamnak felel meg. A Középső Paratethys a Kárpátok ívközi medencéjében és külső előmélyedéseiben levő beltenger, majd tó volt, de elért a Balkán-hegység, Alpok és Dinári Alpok pereméig is. A Földközi-tengerrel (a kutatók egy része ezt még Tethys-nek nevezi) eleinte az ős-Alpok északi pereme mentén húzódó molassz-vályú kapcsolta össze. Ez a tengerág azonban a bádeni korszak kezdetére már végleg elzáródott. Az ősi Adriával viszont valószínűleg összeköttetésben maradt a Középső Paratethys a bádeni korszak végéig. Kelet felé a Keleti Paratethyshez kapcsolódott ez a tenger, mely a mai Balhas-tón is túl ért. A Paratethys két részének élővilága erősen eltérő volt, kimutatható faunavándorlások (Kókay J. szóbeli közlés) ellenére, ami a két tengerrész önállóságát, viszonylagos elszigeteltségét bizonyítja.

A bádeni korszak legnagyobb részében a tenger sótartalma az óceánokéhoz közel állott, amit változatos korall-, tengeri sün- és nagyon gazdag puhatestű fauna bizonyít. A középső- és felső-bádeni alemeletek faunája azonban időleges, néhány ezrelékes sótartalom-ingadozásra utal. Az óceánokéhoz hasonló sótartalom bizonyítja, hogy a világtengerekkel egy vagy több tengerszoros kötötte össze a Középső Paratethyst, amelyeken át az óceáni eredetű víz beáramlott, s egyidejűleg, folyamatosan ömlött ki a felhígult vagy besűrűsödött tengervíz, a mai Gibraltári-szoroshoz hasonlóan. Ezt a kapcsolatot háromféleképpen képzelhetjük el:

1. az Atlanti-óceán felé, a Földközi-tengeren és az ős-Adrián át,
2. az Indiai-óceán felé, a Keleti Paratethysen és a Zagrosz-hegységgel párhuzamos vályún át,
3. az Indiai-óceán felé, feltételezett molassz-vályúkon át, melyek a Balkán-hegység, a Hellenidák, a Tauridák és a Zagrosz-hegység mentén húzódhattak.

A bádeni időszak nagy részében a Keleti Paratethys vize hígabb volt, mint a Középső Paratethysé. Ezért a sótartalmat stabilizáló, óceánvizet szállító kapcsolat semmiképpen sem lehetett erre. Minden valószínűség szerint a Földközi-tengerrel az összeköttetés a bádeni időszak teljes tartama alatt megmaradt, s ez biztosította a víz állandó sótartalmát. A puhatestű faunában olyan nagy a rokonság a két tenger között, hogy elszigeteltségük aligha képzelhető el. Nem zárható ki viszont, hogy ezen kívül egy részben csökkentsósvizű, részben túlsós kapcsolat is megnyílt az indo—nyugat—pacifikus területek felé (Rögl—Steininger—C. Müller 1978).

A BÁDENI EMELET RÁKJAIVAL FOGLALKOZÓ IRODALOM ÁTTEKINTÉSE

A. E. Reuss (1859) említ először egy rákot bécsi-medencei rétegekből, majd Wieliczkából (A. E. Reuss 1867). R. Reuss (1871) szintén egy fajt ír le Baden mellől. Bittner (1877) volt az első, aki több fajt említ egyetlen lelőhelyről, Gamlitzból. Magyarországról először Brocchi (1883) ismertet bádeni rákokat: a budapest-rákosi vasúti bevágásból hat új fajt ír le és egy hetedikhez tartozó ollót is ábrázol. Bittner (1884, 1893) további fajokat ír le különböző lelőhelyekről.

Lőrenthey Imre egyike volt a harmadidőszaki rákok legsikeresebb kutatóinak. (Német nyelvű közleményeiben keresztneve német változatát használta: Emerich.) Figyelmét elsősorban a kissvábhegyi (ma: Martinovics-hegy) páratlanul gazdag és jó megtartású felső-eocén faunára fordította, a bádeni (akkori megnevezéssel: felsőmediterrán) lelőhelyekkel kevesebbet foglalkozott. Mégis számos új fajt írt le ebből is, s újra leírta Brocchi (1883) fajait is (Lőrenthey 1897, 1898a, 1898b, 1898c, 1901a, 1901b). Jó leírásokat adott a lelőhelyekről és rétegekről, modern fejlődéstani elveket vallott s kitűnő formaérzékével a fajon belüli változékonyságokat mindig jól felismerte. Mindezért kora legmodernebb paleontológusai között kell őt számon tartanunk. Hirtelen és korai halál szakította meg munkáját. Befejezetlen, hatalmas kézirata a háborús idők miatt sokáig kallódott, szerzője halála után sok évvel K. Beurlen rendezte sajtó alá (Lőrenthey—Beurlen 1929). Ezt a munkát sok tekintetben kitűnően végezte, de sajnos nem vizsgálta meg a kéziratban talált ábrákat. Lőrenthey életében megjelent cikkeinek rajzait mindig gondosan ellenőrizte, ezek a képek mind körvonalukban, mind részleteikben nagyon hűek. A posztumusz művében leírt új fajok ábráit azonban valószínűleg más rajzolta, mint a régebbieket, s azok, ellenőrzés híján sajnos megbízhatatlanok, sokszor használhatatlanok. Feltehető, hogy éppen azért késlekedett a közléssel, mert újra akarta rajzoltatni ezeket. Például a *Calappa heberti* faj jobb ollójának képe (Lőrenthey—Beurlen 1929, 6. tábla 11) — mely régebbi közleményéből származik — kitűnő, míg a 12. képen bemutatott bal olló alig hasonlít az eredetire (vesd össze a XXXVIII* tábla 4. és 6. képeivel). A műben (Lőrenthey—Beurlen 1929) leírt új fajok szerzőiként az irodalom csaknem kivétel nélkül Lőrentheyt *és* Beurlent idézi. A szövegből azonban egyértelműen megállapítható, hogy a leírásokat Lőrenthey fogalmazta, Beurlen pedig nem változtatta meg azokat (Lőrenthey—Beurlen 1929, p. 8), mivel a megváltoztatott szövegrészeket a könyvben szögletes zárójelbe tette Beurlen, ilyen pedig a bádeni rákok leírásának szövegében nincs. Ezért a Zoológiai Nómenklatúra Nemzetközi Kódexének (Stoll et al. 1961) 50. cikke értelmében egyedül a magyar kutatót illeti meg a szerzőség a következő fajoknál: *Dorippe margaretha, Portumnus tricarinatus, Portunus rakosensis (=Liocarcinus r.), Zozymus mediterraneus (=Chlorodiella m.), Microcorystes latifrons (=Corystes l.), Maia biaensis (=Maja b.), Maia hungarica (=Micippa h.), Calappa praelata* és *Calianassa pseudorakosensis* (=*Callianassa ps.*).

Ezalatt Ausztriában Toula (1904), majd Glaessner (1924, 1928, 1929) foglalkozott bádeni rákokkal, az utóbbi szerző a teljesség igényével. Munkájukat a második világháború után Bachmayer folytatta (Papp et al. 1947, Bachmayer 1953a, 1953b, 1962, Bachmayer—Tollmann 1953, Bachmayer–Küpper 1952). Anyagának jelentős részét egy lelkes amatőr, K. Oroszy gyűjtötte. Az 1950-es évekig tehát a kutatások nagyrészt Magyarországra és Ausztriára korlátozódtak. A hatvanas évektől azonban a vizsgálat a Középső Paratethys egészére kiterjedt (Förster 1979a, 1979b, Janakevics 1969, 1977, Stancu—Andreescu 1968, Müller 1979b), de e sorok írója továbbra is főleg magyarországi anyagon dolgozott (Müller 1974a, 1974b, 1976a, 1976b, 1979a).

A bádeni rákok kutatásának hagyománya tehát jóval több mint száz esztendős. Ennek ellenére kevés szerző foglalkozott a témával, s a közlemények száma sem nagy.

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* Római számmal saját fényképtábláimat jelölöm.

A BÁDENI EMELET RÁKJAINAK GYŰJTEMÉNYI LELŐHELYEI

A régebbi művek revíziója érdekében a típuspéldányokat meg kellett vizsgálnom. Ezért hazai és külföldi gyűjteményeket látogattam meg, vagy ott dolgozókat kértem másolatok küldésére. A nagy valószínűséggel elveszett anyagokon kívül csaknem minden példányt sikerült megvizsgálni. A leíró részben ezt a körülményt „material seen" (látott anyag) szavakkal jelölöm.

Lőrenthey (1897, 1901a, Lőrenthey—Beurlen 1929) anyaga rendezett állapotban a Földtani Intézet gyűjteményében van (az intézmények levélcímét az angol szövegváltozatban adom meg). Saját gyűjtését eredetileg a Pázmány Péter Tudományegyetem (ma Eötvös Loránd Tudományegyetem) Őslénytani Intézetében tartotta, ezt később, részletekben, átadták a Földtani Intézetnek. Annak ellenére, hogy az egyetemi gyűjtemények általában nem bizonyultak biztonságosnak típusanyagok tárolására, a veszteség mérsékelt, különösen, ha külföldi esetekhez hasonlítjuk. A következők vesztek el: *Microcorystes latifrons* holotypus (=*Corystites l.*, még a szerző életében elveszett, l. Lőrenthey—Beurlen 1929, p. 138.), *Portumnus tricarinatus* holotypus, *Maia biaensis* holotypus (de ennek gipszmásolata megvan), és *Calianassa rakosiensis* holotypus. Az elsőként említett két fajból sajnos újabb példány sem került elő azóta. Ezzel szemben Brocchi (1883) példányainak sorsa ismeretlen. Anyagát Hebert és Munier-Chalmas gyűjtötték, s Szabó (1879) még látta a példányokat a Sorbonne gyűjteményében. A két geológus magyarországi gyűjteményének nagy részét megtaláltam a Universite Pierre et Marie Curie-n, az Institut de Macropaléontologie múzeumában (a Sorbonne egyik jogutódja), de egyetlen rák sem volt ott. A példányok valószínűleg elvesztek, más párizsi gyűjteményben sem tudnak róla.

Glaessner (1924, 1928) és Bachmayer (1950, 1953a, 1953b, 1962, Bachmayer—Tollmann 1953, Bachmayer—Küpper 1952) anyagai valószínűleg hiánytalanul megvannak a bécsi Naturhistorisches Museum gyűjteményében, az anyag jelentős részét láttam (lásd a leíró részben). A. E. Reuss (1859, 1867) és R. Reuss (1871) típusanyagai valószínűleg elvesztek. Ezeknek legalább egy része magángyűjteményben volt. Bittner (1877, 1884, 1893) típusainak sem sikerült nyomára bukkanni, kivéve a *Ranidina rosaliae* Bittner 1884-ét, melynek syntypusai a Geologisches Bundesanstalt gyűjteményében vannak (Stojaspal 1975), valamint a *Cancer illyricus* Bittner 1884 holotypusát, melyet az Universität Graz gyűjteményében őriznek. Bittner többi anyaga, legalábbis nagyrészt, szintén a Geologisches Bundesanstalt gyűjteményében volt, a szerző eredeti közlései szerint*. Förster (1979a, 1979b) lengyelországi anyagát az Uniwersytet Warszawski gyűjteményében őrzik, míg Janakevics (Yanakevich 1969, 1977) anyaga Tyiraszpolban, a Goszpedinsztitut-ban van. A Kojumdzsieva gyűjtötte bulgáriai anyagot (Müller 1979b) a Szófiai Egyetem gyűjteményében őrzik. A szerző saját anyagát a Természettudományi Múzeum Föld- és Őslénytárának felügyelete alatt, részben a múzeumban, részben lakásán tartja, mint a Művelődésügyi Minisztérium által védetté nyilvánított gyűjteményt.

Minden elérhető típuspéldányról, de legalább egy syntypusról (a leíró rendszertani részben ezt a körülményt mint „material seen" tüntettem fel) szilikongumi öntőmintát készítettem, kivéve a *Maia oroszyi* (=*Pisa o.*) és a *Necronectes schafferi* törékeny példányait. Ezért, tudományos célra, kérésre, öntvényeket küldök.

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* Lásd az „Addendumot".

MUNKAMÓDSZEREK, PREPARÁLÁS

A legtöbb példányt felszíni feltárásokban gyűjtöttem, melyek közül többet sokszor felkerestem. Lehetőleg nagyobb tömböket feszítettem le kibúvások falából, melyeket aztán 4—5 cm-es darabokra aprítva, binokuláris fejnagyító segítségével (1,5—3×-os nagyítással) átvizsgáltam. A lenyomatokat és töredékeket is eltettem. A szabad szemmel látható kőzettani jellegek alapján elkülöníthető minden egyes réteget külön gyűjtöttem, esetenként azonban, a rétegenkénti gyűjtéstől szigorúan elkülönítve, rézsűlábi törmelékből is vettem anyagot, s később is tekintettel voltam annak kevert voltára. Az egységesnek tekinthető rétegek vastagsága 10 cm és 5 m között változott a gyakorlatban. A későbbi kiértékelés igazolta (4. táblázat), hogy a faunaegyüttesek típusai és a kőzettani jellegek közt szoros kapcsolat van, tehát az üledék jellege függ a leülepedés körülményeitől, melyek viszont az élővilágot szabályozó körülményekkel vannak összhangban. Ezért a praktikus szempont (a réteg helyszíni azonosításának és elkülönítésének lehetősége) az ökológiai feldolgozás igényeit is kielégítette.

Ha a rákpáncél puha, rossz megtartású volt, sokszor nem lehetett a kemény kőzetet róla eltávolítani. Ilyen esetben a lenyomatról tisztítottam le a héj maradványait, s szilikongumival öntvényt készítettem róla. Így ugyanannak a példánynak külső és belső oldalát egyaránt lehetett tanulmányozni. A gumi odatapadásának elkerülésére hígított színtelen nitrozománccal itattam át a lenyomatokat. Ha a héj jó megtartású volt, akkor a szokásos eszközökkel, főleg tűkkel, vibro-tool-lal, csípőfogóval, vésővel preparáltam. A héjakról szintén szilikongumival készíthető negatív öntőminta, amit aztán gipszszel öntöttem ki, másolat készítése céljából. Buborékok képződése ellen mind a folyékony gumit, mind a gipszet finom, de erős sörtéjű ecsettel kentem fel. A gipszöntvényt száradás után hígított zománccal szilárdítani kell, hogy műanyag öntvényekkel egyenlő szilárdságú, de optikailag kedvezőbb, átlátszatlan fehér példányokat kapjunk. Öntvény készítésére még epoxigyanta is alkalmas (a Műanyagipari Kutató Intézet által gyártott FM-4 és T-30 jelű komponensek titándioxid-liszttel keverve kis viszkozitású anyagot adtak, melyet centrifugával lehetett a finom résekbe bejuttatni), szilárdulás után a kőzetanyagot sósavval kell eltávolítani. Ez az eljárás főleg korall-lenyomatok kiöntésére volt alkalmas, de rákok esetében is jól használható. A szilikongumi-öntvényt toluolba vagy toluol-tartalmú nitrohígítóba áztatva mintegy 1,4-szeres torzulásmentes lineáris duzzadást lehet elérni. Az eljárást megismételve, 5—8-szoros méretű öntvények készíthetők.

Ha a kőzetanyag laza (mészhomok, homok) volt, a vázak pedig elég szilárdak, szitálással is gyűjtöttem. Ilyen esetben a kis példányok megtalálásának valószínűsége nagyobb, mint kalapáccsal történő gyűjtésnél, ezért a számszerű kiértékelés érdekében a példányszámokat korrigálni kellett (20. old.).

A FONTOSABB LELŐHELYEK LEÍRÁSA

A lelőhelyeket, illetve a több rétegből álló helyeknél az egyes rétegeket kóddal jelöltem, mely egyúttal a leltári szám első tagja is (1. táblázat). Ugyanez a kód szerepel az együttesek értékelésénél is. Az egyes rétegekből gyűjtött rákfajok felsorolását az angol szövegrészben adom, néhány, kisebb jelentőségű külföldi lelőhely leírása is csak ott szerepel.

A Budapest környéki kibúvások adták a feldolgozott anyag zömét (1. ábra).

A **Tétényi-fennsík** (2. ábra) egri és neogén kőzetekből álló magaslatán a bádeni rétegek, kis vastagságuk miatt, csak kis foltokban és sávokban bukkannak elő. A **Kamaraerdei út** bevágása (MK, 2. ábra) ma is hozzáférhető. Korábban Katona út (Militärstrasse) néven szerepelt (Lőrenthey 1911). Ma csak két réteg látható (3. ábra), az MK jelű 1 m vastag rosszul osztályozott kavicsból álló konglomerátum, melybe korall-lenyomatok (*Tarbellastraea* sp., *Porites* sp., *Siderastraea* sp. és egy *Tarbellastraea*-habitusú, de valószínűleg más nemzetséghez tartozó zátonyépítő korall) települnek lencsésen, kimosott helyzetben. A feltárás északi végén azonban *Porites* sp. élő helyzetben betemetett oszlopai láthatók.

A rákok leírása kapcsán Kókay (in Müller 1976a) felsorolta és kiértékelte a puhatestű faunát. Szerinte a víz 30 méternél lényegesen sekélyebb, jól mozgatott, oxigéndús volt, óceánihoz közelálló sótartalommal. A korallos réteget 1,5 m vastag mészhomokkő fedi (MKF), gyengén diszkordánsan. Kőzettanilag mikroonkoidos váztörmelékes „grainstone". A **Balatoni út** és a **Szabadkai út** csatlakozásánál levő bevágások (MF, 2., 3. ábra) ma is hozzáférhetőek, alapszelvénnyé kiépítve. A rétegsor egy részét, az akkor meglevő, sekélyebb feltárások alapján Schafarzik—Vendl (1929) is ismerteti. A szürke, nagy *Pectinidae* fajokat tartalmazó eggenburgi korú homokot diszkordánsan fedik itt a bádeni rétegek: rosszul osztályozott durva kavics, 20 cm-t elérő nagyságú görgetegekkel, melyek egy részét kagylók fúrták meg. Erre 0,8 m vastag homokos—kavicsos mészkő (MFK) települ, sok *Glycymeris*-lenyomattal. Puhatestűit Kókay vizsgálta (in Müller 1976a). A következő 1,6 m vastag szint puhább és keményebb rétegekből álló, az előbbinél kevésbé kavicsos és homokos mészkő. Ezekből külön nem tudtam gyűjteni rákokat, de a rézsű lábánál talált tömbökből vettem mintákat. Ez a kevert anyag kapta az MFA jelet. A bevágás legfelső rétegét más feltárásban vizsgáltam (MM, MB). A feltárástól nyugatra egy kisebb gödörben kvarchomokkő fedte az előbb említett rétegeket (MA). Kókay idézett leírása, mely az MFK rétegre vonatkozott, az MA és MFA együttesekre is érvényesnek látszik: szerinte az óceánihoz közelálló sótartalmú, erősen mozgatott vizű környezetben rakódott le az üledék, 30 méternél sekélyebb tengerben. A rétegben a kavicsszemek nagysága dél felé csökken, ami valószínűleg azt jelenti, hogy észak felé kavicsos anyagból álló part lehetett (valószínűleg kárpáti korú rétegekből eredő kaviccsal), s a víz enyhén mélyült dél felé. A nem túlságosan nagy hullámenergia a kavicsokat csak néhányszor tíz méter távolságra tudta elhordani, így a délebbi részeken már csak homokkövet találunk.

A kvarcszemcséket tartalmazó rétegek fedője tiszta mészhomokkő, melyben sztromatolitok és onkoidok vannak (MB és MM). A kis gödröket, melyekben ezek fel voltak tárva, már nagyrészt betöltötték, de a felszínen elszórt anyagból még lehet gyűjteni, a sztromatolitok pedig nagy területen a felszínen láthatók. A képződmények kriptalga-Foraminifera eredetűek (Lelkes—Müller in press). A beágyazó kőzetanyag mikroonkoidos „grainstone", sok puhatestű-lenyomattal, főleg *Cerithium*-mal. A réteg vastagsága NyDNy felé csökken, s ugyanarra a fennőtt sztromatolitok helyét fokozatosan gömbszerű, görgetett onkoidok váltják fel, melyek száma, ha továbbhaladunk, egyre csökken. Mindebből partközeli, sekélyvizű tengerrészre gondolhatunk, ahol a fenék dél felé mélyült, hasonlóan ahhoz a helyzethez, amire a fekü homokos—kavicsos kőzetek alapján következtettünk. Kókay (in Müller 1974a, p. 119) a puhatestűek alapján sekély szublitorális tengerre következtetett, 26—28‰-es sótartalommal. A *Cerithium*-ok gyakorisága sűrű alga vagy tengerifű borítást jelez. A tízlábú rákok fajainak száma is növekszik dél felé. A szelvény déli végén a fent említett réteget részben fedi, részben pedig helyettesíti egy finomszemű, rosszul osztályozott szemcsékből képződött mészhomokkő, mely sosem tartalmaz makroonkoidokat (MDG). A rákokon kívül ott talált faunaelemeket Kókay határozta meg (in Müller 1974b, p. 275). Szerinte a víz 30—40 méternél sekélyebb volt, a sótartalom közel állott az óceánihoz, de időnként változott.

Diósdon (2. ábra), a Tétényi-fennsík déli részén kis területen bukkannak ki a bádeni kőzetek az Országos Érc- és Ásványbányák elhagyott kőfejtőjében („krétabánya") és a Tégla- és Cserépipari Tröszt működő homokbányájának felső peremén. A pannóniai homok itt jelentős ugrómagasságú vető mentén érintkezik a bádeni, és az arra erős diszkordanciával települő szarmata mészkövekkel. Az MDZ jelű lelőhely a vető mentén van, a homokbánya peremén. A kemény, tömör mészkő vastagsága két méternél több. *Tarbellastraea* sp., *Porites* sp. s két másik zátonyépítő korallfaj lenyomatának tömegét tartalmazza, mind kimosott helyzetben. A beágyazó anyag zöme rosszul osztályozott, s egyes lencsékben tartalmaz rákmaradványokat, köztük igen nagy példányokat is. A kőfejtő egy másik részén néhány tömb másfajta faunát tartalmazott (MND), mely valószínűleg fiatalabb a korallos rétegnél, de kapcsolatuk fedett.

Bián (1. ábra), a Tétényi-fennsík nyugati nyúlványainál bádeni és szarmata rétegek tűnnek ki a „Nyakaskő" nevű szikla körül. Ezt Strausz (1924) és Schafarzik—Vendl (1929) írták le a legrészletesebben, a korábbi irodalom megemlítésével. A legalsó feltárt réteg a szikla alatti árokban bukkan ki kis felületen: szürke aleurit, aleuritos homok (MNA). E fölött négy méter vastag homokos mészkő következik. Ez gazdag puhatestű faunát tartalmaz lenyomatok formájában (MN).

Budapest keleti részén, a klasszikus rákosi vasúti bevágás környékén van az a lelőhely csoport, mely a Paratethys leggazdagabb és legszebben megtartott rákanyagát adta (1., 4., 5. ábra). A rétegsorokat számos cikk tárgyalja, legújabban, összefoglaló igénnyel Kókay J.—Mihály S.—Müller P. (in press) írták le. Kőbánya-felső és **Rákos** vasútállomások között van a delta alakú bevágás, melyet a múlt században mélyítettek, s azóta is többször bővítettek. A ma is hozzáférhető alapszelvény bádeni és szarmata rétegeket tár fel. Szabó (1879), Franzenau (1881), Vadász (1906), majd a legrészletesebben Schafarzik—Vendl (1929) írták le e szelvényt. Brocchi (1883) faunáját is itt gyűjtötte Hebert és Munier-Chalmas. Az MRC jelű réteg alatti szintek (5. ábra) tufaeredetű ásványokat is bőven tartalmaznak, melyek részben a fekü kárpáti (?alsó-bádeni) „Tari Dácittufa Formáció" anyagának áthalmozásából, részben új kitörésekből származhatnak. A felsőbb, MRF jelű réteg biotitjának kora ugyanis lényegesen fiatalabb (13,4 ± 0,6 millió év a szomszédos, Keresztúri úti feltárás azonos, MEG jelű rétegéből vett minta alapján), mint az MRZ jelű réteggel egyidős *Cepaea*-s tufité (15,6 ± 0,8 millió év, Balogh—Árváné-Sós—Pécskay 1980). Valószínű, hogy a mélyebb szint biotitja csaknem kizárólag a régebbi tufák áthalmozásából ered, a felső rétegé pedig zömmel friss kitörés terméke. A bevágás keleti részén a fekü riolit- vagy dácittufát diszkordánsan *Porites*-es korallzátony fedi, 1,5—2 méter vastag lencse alakjában (MRZ). *Porites*-lenyomatokon kívül mészalgák *(?Neogoniolithon)*, kevés *Bryozoa* és mindössze két töredék *Tarbellastraea* került elő. Az 5—10 cm vastag, 0,5—1 méter magas korallágak eredeti helyzetükben ágyazódtak be a tufitos mészkőbe. A *Porites*-t eredetileg *Millepora*-nak határozták meg (Lőrenthey—Beurlen 1929, p. 35), de *Hydrozoa*-maradvány itt egyáltalán nem került elő. A korallzátonyt részben helyettesíti, részben fedi az MR45 és MR8 jelű homokkő, mely középszemű, erősen bioturbált, rosszul rétegzett. Ebben a rákok kitűnő megtartásúak. A homokkövet homokos mészkő fedi, melynek alsó részében a *Linga columbella* (Lamarck) a leggyakoribb puhatestű, míg felső része osztrigapadokat tartalmaz (MRL, ill. MRO). A kvarc- és egyéb terrigén szemcsék mennyisége felfelé csökken. A vasúti bevágás legvastagabb rétege a mészkőre települő finomszemű, rosszul osztályozott tufitos homokkő (MRF). Ugyanez a réteg a Keresztúri úton is látható (MEG). Jellemző a tömeges *Callianassa*-ásásnyom *(Ophiomorpha)*. Gyakoriak a nagy *Pectinidae* fajok és a szabálytalan sünök.

A homokkövet tiszta mészkő fedi (MRC). Gyakoriak benne a *Cardium* és *Cerithium* fajok. Kőzettanilag mikroonkoidos váztörmelékes „grainstone". Erre kereszt- (ferde) rétegzett mészhomokkő települ, melyben egy 5—15 cm vastag réteg tömegesen tartalmaz makroonkoidokat, melyek elérik a 20 cm-es méretet is (MRS), hasonlóan a Tétényi-fennsík megfelelő rétegéhez (MB). A beágyazó kőzet mikroonkoidos váztörmelékes „grainstone", kevés ooiddal (Lelkes—Müller in press). Az e fölött települő rétegekből még nem került elő rák-maradvány.

Mintegy egy kilométernyire Rákostól az **Örs vezér tere** környékén szintén gazdag lelőhelycsoport volt, de az építkezések befejeztével ezeket mind betemették. Az utóbbi húsz évben sok árkot és alapgödröt ástak itt, de már a húszas években is került elő anyag. A rétegsorokat és faunákat Strausz (1927), Bartkó—Kókay (1966), Mihály (1969), Müller (1976b, 1979a) és Kókay—Mihály—Müller (in press) ismertették. Az alsó homokos rétegek nagyjából egyformák voltak valamennyi feltárásban, míg a felső tiszta mészkövek fáciese helyről helyre változott. A legalsó rák-tartalmú réteg vékony korallos tufás mészkő lehetett, de ezt csak a Kerepesi út mentén mélyített csatornaárokból kidobott anyagban sikerült felismerni. Szegényes rákanyaga az MRZ lelőhelyéhez hasonló. E fölött mintegy 2 m vastag homokos mészkő (MKC) települt, ez a **Kerepesi út** mentén volt feltárva. Ez a rákosi MRL és MRO rétegeknek felelhet meg, de azoknál mozgatottabb, sekélyebb vízből ülepedhetett le. Jellemző puhatestű a *Glycymeris obtusatus* (Bartkó—Kókay 1966). A mészkő fedője 4—5 m vastag laza, középszemű homok, melyet a **Gyakorló úton** (MGY) és a **Sugár** üzletház pincetömbjében (MOH) tártak fel (4., 5. ábra). Megjelenésében ez kvarchomoknak tűnik, de kvarctartalma alig 5%, a többi víztiszta szemcse kőzetüvegnek bizonyult (Ravaszné Baranyai L. szóbeli közlése). $CaCO_3$-tartalma 40% körüli, ezenkívül földpátok, csillámok és agyagásványok mutatkoztak a röntgen-diffraktogramon, tehát sok benne a vulkáni eredetű anyag, de erőteljesen átmosva. A finomabb szemcsék az egykorú MRF réteg anyagában keresendők. Az erőteljes átmosás és az abból következő viszonylag jó osztályozottság nem a hullámenergiának, hanem a bioturbációnak a következménye. Nagy *Pectinidae* fajokat, tengeri sünöket és Foraminiferákat tartalmaz. A rákok aránylag jó megtartásúak voltak, ezért itt szitálással lehetett gyűjteni.

A homokot mészkősorozat fedi, két különböző helyen más-más kifejlődésben. A Gyakorló útnál (5. ábra) a homokra 0,4 m vastag, rákokat nem tartalmazó *Ervilia*-s mészkő települ, ezen pedig a feltárásban 0,5—0,8 m vastagságban látható, *Cerithium*-lenyomatokat tömegesen tartalmazó mészkő (MGF) fekszik, melyben makroonkoidok vannak, mészhomokkő—kavics vagy „black pebble" maggal (Lelkes—Müller in press). A Sugár üzletháznál a homokot vékony tufitréteg fedi. Ezen 2,2 m vastag, részben laza, széteső, részben cementált mészhomokkő (MOE) fekszik (5. ábra), mely a Gyakorló úti MGF mészkővel gyakorlatilag egykorú. Ez váztörmelékes „grainstone", kevés mikroonkoiddal. Jellemzőek a kis osztrigák, *Chlamys* fajok, *Cardium*, szabályos sünök, *Lingula* sp. A rákok megtartása tökéletes, s ahol a kőzetanyag laza volt, ott szitálással lehetett gyűjteni. A Paratethys leggazdagabb ismert rák anyaga innét származik.

A **Mező Imre úton** mélyült a Metró H. 34 sz. fúrása. Negyedidőszaki homok és kavics alatt finomszemű aleuritos homokkő és mészhomokkő váltakozik (Kókay, szóbeli közlés), mely alatt tarka, középső-bádeni agyag és aleurit települ. A felső-bádeni rétegekben 25,8 és 33,0 m között (MH34) találtunk rákokat. A **Telepy utcában** (MTE, 1. ábra) a század elején csatornaárokból egyetlen rák faj került elő. A feltárást Schafarzik (1903) írta le.

Visegrádon (6. ábra), a Fekete-hegy oldalában rosszul feltárt bádeni rétegsor található (Schafarzik—Vendl 1929, Scholz 1970, Báldi—Kókay 1970). Valószínűleg ez volt Reuss (1872) „Nagymaros" megjelölésű koralljainak típuslelőhelye is. Andezittömbös—kavicsos tufitokat alsó-bádeni márgás, tufitos mészkövek takarnak. Ezek alsóbb része (MV) korallos, gyakoribb alakok: *Tarbellastraea* sp., *Favia magnifica* Reuss, *Stylophora subreticulata* Reuss, *Porites* sp. A mészkövek felsőbb része (MVA) vörös-mészalgás. A feltárások hiánya miatt a tényleges rétegsort nem lehetett felvenni. A rákok megtartása mindkét rétegben gyenge, de az MV mészkő faunája fajokban gazdag. **Törökmezőn** (6. ábra) mindmáig nem ismertetett új lelőhelycsoport van a turistaház közelében. Az új út bevágása (MTH) *Heterostegina giganteoformis* Papp óriás Foraminiferát tartalmazó tufás mészkőben van. Innen 500 méterre északra ma már nagyrészt betöltött kis kőfejtő (MTZ) korall-lenyomatokban gazdag mészkövet tárt fel. Mintegy 20 korallfajt lehetett elkülöníteni, gyakori a *Stylophora subreticulata* Reuss, *Tarbellastraea* sp., *Montastraea* sp. és egy vékony, lemezszerű alak, mely Nagyhöflányban (MNH) is előfordul. A rákok megtartása aránylag gyenge. Tovább északra egy anyagnyerő-gödör (a helybeliek megnevezése szerint „murvabánya") (MTM), mintegy 3 m vastagságban tufitos Mollusca-s márgát tár fel. Ennek nannoflórája alsó-bádeni jellegű (Nagymarosi, szóbeli közlés). **Zebegényben,** a bakókúti (bőszobi) kőfejtő (MZZ, 6. ábra) lágy, vörös-mészalgás agyagos mészkövet tár fel, melybe 4 m vastag, kemény, tiszta mészkőréteg települ. Ez a mikrites mészhomokkő tele van egy kicsiny, elágazó ahermatipikus korall lenyomataival, mely egyes mai *Oculina* fajokhoz hasonlít. Kevés *Porites* sp. társul hozzá. A rákok ebben a korallos mészkőben vannak, kisebb lencsékben. A **szobi** (MSZ, 6. ábra) lelőhely a puhatestű maradványokról ismert. Valószínűleg középső-bádeni (Kókay, szóbeli közlés). A Damásdi-patak bevágásában alul szürke, feljebb sárga laza homokkő települ, kb. 6 m vastagságban. Erre 0,1 m vastag lumasella, majd 0,5 m vastag sötétbarna faunás tufit települ. Mindegyik rétegben van rák, de a puhatestűekhez képest nagyon kevés. Eddig csak ollókat találtam.

A Mátra északnyugati vége és a Cserhát csatlakozó része (7. ábra) szintén szép rák anyagot adott. A területet Noszky (1940, pp. 102—113.) és Hámor (in press) írta le. **Mátraverebély—Szentkúton** a Szent László-forrásnál és a Meszes-tető oldalában a Noszky-féle „bázisrétegek", homokkövek, homokos és márgás mészkövek tartalmaznak rákokat. Sámsonházán a Természettudományi Múzeum gyűjteményében levő anyag cédulái szerint két lelőhely van, ezek közül az egyik fekvése ismeretlen: **Halastó-hegy,** bázishomok. A másik lelőhely: **Csúcs-hegy alja,** kis kőfejtő a Kis-Zagyva völgyében, s talán azonos Hojnos (1923, 1933) feltárásával.

Nyirádon (MNN) a falu temetőjétől 500 méterre nyugatra (8. ábra) a Sümeg felé vezető országúton kis bevágás van. Egyetlen réteget, durvaszemű mészhomokkövet tár fel mintegy 2,5 m vastagságban. Ebben nagy puhatestűek és néhány koralltelep lenyomata található. Ezek még nincsenek meghatározva. **Balatonakalin,** a BAK-40. sz. fúrás (BAK) szarmata és bádeni rétegeket tárt fel (Kókay, szóbeli közlés). Ebben a 35—38 m közti szakaszon voltak rákok. A **Mecsek** hegységben, Kishajmás—Szatina és Husztót állomások között az új pályának mély bevágást ástak a 70-es években, ?alsó-bádeni homokkőben. Itt Solt P. gyűjtött rákokat.

Fertőrákoson az FRK-21. sz. fúrás (9. ábra) vastag ?középső-bádeni mészkövet harántolt, melyben alig volt gerinctelen makrofauna, zömmel vörös-mészalgás mészkőből állott a rétegsor, melyben 268 m-nél mintegy 20 cm vastag zátonymaradvány települt (olisztolit?), rákokkal.

A hazai lelőhelyeken kívül azokat a külföldi feltárásokat említem meg, ahol gyűjtöttem. **Nagyhöflányban** (9. ábra) (Gross-Höflein, Burgenland) a ,,Fenk" cég nagy kőfejtőjét (jelenlegi tulajdonos Buchinger) a bádeni lajtamészkövek faciosztratotípusának jelölték ki (Papp et al. 1978, p. 194). A rétegsort Dullo (1983) tanulmányozta részletesen, üledékkőzettani, faciológiai szempontból. Ő négy korallos szintet talált benne, ezek közül alulról a második (,,oberer Korallenkalk", Papp et al. 1978, p. 197) gazdag és jó megtartású rák faunát adott. A réteg koralljai: *Tarbellastraea* sp., *Porites* sp. (ez a kettő kőzetalkotó mennyiségben), *Stylophora* cf. *subreticulata* Reuss, *Acanthastraea* sp. és egy lemezes forma, ami Törökmezőn (MTZ) is gyakori. Bachmayer és Tollmann (1953) rák anyaga valószínűleg szintén kizárólag ebből a rétegből származik, de az ő gyűjteményükből csak egy példányt tudtam megvizsgálni. Ennek ellenére valószínű, hogy az általuk említett rákok többségét megtaláltam. A fejtőt töltik, de a korallos réteget valószínűleg sikerül megvédeni a betakarástól (Steininger, szóbeli közlés). Az **Oszlopon** (Oslip, Ausztria, Burgenland) levő Bauer-féle homokbánya részletes analízisét is Dullo (1983) adja (MOS, 9. ábra). Kövületmentes homok felett mintegy méter vastag *Ophiomorpha*-nyomos (*Callianassa* ásásnyom) homok sok rákollót tartalmaz. Ezt vörös-mészalgás mészkő fedi. A fejtőt ma is művelik. Alsó-Ausztriában, **Deutsch-Altenburg** mellett, a Hundsheimer-hegyen nagy elhagyott, de ma is hozzáférhető kőfejtő van (DAL, 9. ábra). Mezozóos mészkövön, bázis breccsa—konglomerátum fölött mintegy 30 m vastag mészhomokkő van, melybe vékony mohaállatos márga települ (Bachmayer 1953a). A **Grobie**-i [déli Szentkereszt-hegység, Lengyelország (MGR)] lelőhelyet nyomtatott anyagban még nem közölték, csupán Förster (1979a) említi, a R. Wrona által gyűjtött rákok kapcsán. Nincs feltárás, a szántóföldön heverő kövek zöme vörös-mészalgás mészkő, melyek között néhány korallos darab akadt, ebben voltak a rákok.

TAXONÓMIAI ALAPELVEK

A tízlábú rákok — különösen a rövidfarkúak — törzsfejlődése, speciációja gyors folyamat. Az összes ismert, jól leírt pleisztocén faj azonosnak bizonyult ugyan a maiakkal, de a pliocén anyagban már sok kihalt fajt találtak (Glaessner 1929). Az 5—6 millió éves messinai anyag zöme is ma élő alakokból áll (a szerző publikálatlan anyaga), de ezek egy része már alaktani különbségeket mutat a maiakkal összehasonlítva. A bádeni és a velük rokon mai fajok között ezek a különbségek már határozottabbak, például a *Pachygrapsus hungaricus—P. marmoratus;* a *Brachynotus februarius—B. sexdentatus* és *B. foresti;* vagy az *Ebalia eorsi—E. edwardsii* esetében. A mai nemzetségek kialakulása is gyors volt. A legtöbb valószínűleg a miocénben és a pliocénben keletkezett (Müller 1979b). Így a 12—15 millió év előtti, bádeni fajok meghatározásánál óvatosan kell eljárni, ha azokat mai alakokkal hasonlítjuk össze, feltéve, hogy nincs a közben eltelt időből is elegendő adatunk a faj változásának vagy állandóságának bizonyítására. Ilyen folyamatos adatsor azonban csak a *Dardanus arrosor* (Herbst) faj esetében ismert. Ezért minden más bádeni fajnak új nevet adtam, még ha létezett is alaktanilag hasonló mai forma. Ez az új név bizonyos esetekben csak időleges megoldásnak tekinthető.

Hasonló eljárást nem követhettem a nevek esetén. Ezért a mai neveket eredeti formájukban használtam, ha egy bádeni faj a nemzetség mai fajai által megszabott keretbe illett morfológiai szempontból.

Gyűjtőnemzetségek megjelölésére a nevet két szimpla idézőjel ('...') közé tettem. Olyankor használtam ezt a megjelölést, ha a fosszilisan megmaradó testrészek nem teszik lehetővé a biztos generikus meghatározást, de a közeli rokonság biztosra vehető. Közeli hasonlóság híján új genus-t kellett bevezetni. Idézőjelet ("...") olyan fajoknál használtam, melyeket régi szerzők nyilvánvalóan tévesen osztottak be jól ismert, mai nemekbe (pl. „*Cancer*" *carniolicus* Bittner), de a rossz megtartás vagy a típuspéldányok elveszett volta miatt nem lehetett jobb megoldást ajánlani.

Az ollók ujjai erősen meszesek, sokszor tömörek, ezért ezek a rákok leggyakrabban fosszilizálódó részei. Mivel ezek alakját elsősorban a funkció alakítja ki, mely azonos lehet különböző rendszertani egységekben, gyakori a konvergencia. Rendszertani vizsgálatuk mérsékelt sikerrel járt (Bachmayer 1962, Janssen 1972, Förster 1979a, 1979b). A sikertelenség okait Förster (1979b) részletesen elemezte. Hozzá kell tenni, hogy a zoológusok és paleontológusok ritkán adnak leírást vagy használható ábrát az ujjakról, ezért a mai fajokkal való összehasonlítás általában csak múzeumi példányok birtokában lehetséges. Egyéb testrészeket is tartalmazó rétegekből származó ujjakat csak néhány bádeni fajnál ismertettek (Glaessner 1928, Lőrenthey—Beurlen 1929, Bachmayer 1953a).

E munkám egyik célja, hogy az elkülönült testrészek faji azonosságát nyomozzam, beleértve az ujjakat is. E célból mai rokon formákkal hasonlítottam össze azokat (hazai gyűjteményekben, a párizsi Muséum National d'Histoire Naturelle-ben, de legtöbbször külföldről kölcsönbe kapott példányok segítségével). Egy adott rétegben a testrészek relatív gyakorisága támpontot adhat az összetartozásra, feltéve, hogy a betemetődés előtti szelekció nem volt erős. Egyes esetekben az ujjak még az olló többi részével együtt találhatók. Az ollótő (kéztő) díszítése sok csoportban hasonló a carapaxéhoz, s így azonos fajba tartozásuk eldönthető. Ha az olló-ujjak meghatározásához sikerült valamivel közelebb jutni, ennek az lenne a jelentősége, hogy ezek sokszor találhatók olyan rétegekben, ahol rajtuk kívül csak puhatestűek és Foraminiferák gyakoriak, s így új lehetőséget biztosíthatnak rétegtani, ősföldrajzi és paleoökológiai vizsgálatokhoz. A rákok pedig ilyen kutatások céljára nagyon alkalmasak, mert fejlődésük gyors, terjedési lehetőségük mind felnőtt állapotban, mind pelágikus lárvaként jelentős, s így óceánokon (Garth 1974) vagy a rendestől eltérő sótartalmú víziutakon is (Por 1978) keresztül juthatnak. A paleoökológiai vizsgálatok szempontjából pedig előnyös, hogy a mai alakokkal sok, ökológiai adatot is tartalmazó monográfia foglalkozik.

A rendszertani részben (49. old.) a fajokat a Glaessner (1969) által használt beosztásban mutatom be, mert a legtöbb őslénytani munka ezt használta az utóbbi időben. Ennek ellenére meg vagyok győződve arról, hogy Guinot (1977) és de Saint Laurent (1980a, 1980b) utat mutattak a tízlábúak rendszerének jobb megértéséhez.

A fejezetben használt rövidítések:

MNŐ: Természettudományi Múzeum Őslénytára
FI: Földtani Intézet
CA: a szerző anyaga
NHMW: Naturhistorisches Museum, Wien

A rákok testrészeire vonatkozó rövidítések:

ca: carapax
ch: olló
da: dactylus
ff: rögzített ujj

A nemzetségek típusfajait csak akkor adom meg, ha nem szerepelnek Glaessner (1969) munkájában. A szinonima listákban csak azokat a munkákat idézem, melyek a taxonra vonatkozó új adatot vagy emendációt közölnek. Ezért, alapvető jelentőségük ellenére, a Fossilium Catalogus (Glaessner 1929) és a Treatise on Invertebrate Paleontology (Glaessner 1969) idevágó köteteit is csak egyes esetekben említem.

A BÁDENI TÍZLÁBÚ RÁK FAUNA JELLEGZETESSÉGEI

A bádeni rák fauna modern jellegű. Bár a 102 meghatározható alakból csak egyet tekintettünk mai fajhoz tartozónak, a 72 nemzetségből csak 12 bizonyult nagy valószínűséggel kihaltnak, tehát a nemek 85%-ának ma is van élő képviselője. Ezek a számok és arányok óhatatlanul tartalmaznak szubjektív elemeket is, de közelítően érvényesek. Bizonyos archaikus jelleget is tükröz az a tény, hogy régi eredetű családoknak elég jelentős a szerepe *(Calappidae, Dromiidae)* mind a fajok számát, mind a példányszámot tekintve.

A *Callianassidae* család meglepően sok bádeni fajt számlál, ez részben az ollók erősen elmeszesedett vázának, a beásó életmódnak és ebből következőleg a fosszilizálódásra való alkalmasságnak tulajdonítható. A bádeni *'Callianassa'* fajok zöménél (valószínűleg a *'C'. brocchii* kivételével) a jobb és bal olló egyforma volt (homochelia), ellentétben a mai fajokkal. Ez a kérdés további vizsgálatot igényel. A *Galatheidae* és *Porcellanidae* fajok nagyon közel állnak mai rokonaikhoz, ami e régi eredetű családoknál érthető. A *Paguridae* maradványoknál, ahol a közvetlen összehasonlítás lehetséges volt *(Pagurus, Petrochirus, Diogenes, Dardanus arrosor)*, a fosszilis ollók nagyon hasonlóak a maiakhoz.

Feltűnően nagy a bádeni *Dromioidea* fajok száma (hat), pedig általános nézet volt, hogy neogén fajaik ritkák. Ha a korallzátonyon élőket nem számítjuk, két faj marad, míg a Földközi-tenger sekély vizében ma csak egy él. Az alakok egy része hasonlít mai rokonához, de a *Kerepesia* és a *Dromiidarum?* n. gen. kihalt nemekhez tartozhatnak. Esetleg egy további faj *(?Dorippe carpathica)* tartozik még a *Dromiacea* csoportba. Bár a *Calappidae* fajok száma nem nagy, feltűnően gyakoriak a legtöbb rétegben, ami részben szilárd vázuknak köszönhető, de nagyrészt egykori tényleges gyakoriságukat tükrözi. Az alakok nem különböznek lényegesen mai rokonaiktól, de a *Mursia lienharti* és a *Matuta brocchii* fajok, nemzetségük keretén belül primitívnek tekinthetők rövid oldaltüskéjükkel, bár ilyen fajok ma is élnek mindkét genus-on belül. Érdekes (másodlagos?) jelenség a cirpelőszerv hiánya *Mursia lienharti* fajnál. Nyolc *Leucosidae* fajt találtunk a bádeni faunában, ez a viszonylag magas szám nagyon szilárd carapaxukkal függhet össze, mely a megmaradás valószínűségét növeli. Nagy részük az *Ebalia* nembe tartozik, s ebben a fauna a mediterrán faunára hasonlít, ahol szintén nagy az e nembe tartozó fajok száma. Két vagy három faj kihalt nemzetséghez tartozik.

A bádeni fauna egyik legfeltűnőbb sajátossága a *Majidae* fajok kis száma. Bármelyik mai provinciában az uralkodó családok közé tartozik a tengeri pókoké. Az öt fajból egy zátonylakó. Különösen feltűnő a tengerifű- és algalakó kis alakok hiánya, melyek más kis formákkal együtt, a mai földközi-tengeri és indo—nyugat—pacifikus faunák fontos elemei. A két *Parthenopidae* faj nagyon közel áll a két leggyakoribb földközi-tengeri fajhoz, valószínűleg leszármazási kapcsolatban áll azokkal. A bádeni *Cancroidea* csoport néhány érdekes jellegzetességet mutat. A „*Cancer*" gyűjtőgenus-ba sorolt alakok valószínűleg kihalt csoportot alkotnak. A csoport fajainak száma nagy, különösen, ha a mai Földközi-tengerhez hasonlítjuk, még akkor is, ha ez a szám néhány téves meghatározást is tükröz. A *Portunidae* fajok száma is nagy: legalább 17. A fajok egy része ma is élő nemzetséghez tartozik, de a nemek jelentős része biztosan kihalt. A *Portunus, Liocarcinus, Thalamita* és *Charybdis* fajok hasonlóak ma élő rokonaikhoz, a Földközi-tengerben vagy az Indiai-óceánban. A mai tengerekhez hasonlóan a bádeni *Xanthidae* fajok száma is nagy, különösen a zátonylakóké.

A bádeni fauna csak kis része a világ neogén tízlábú rákjainak. Ezért a csoport törzsfejlődésére csak kevés adatot várhatunk tőle.

Megállapítható, hogy a *Majidae* csoport változása gyors volt a területen a miocéntől máig. Ez a változás (a fajok számának gyors növekedése) egyaránt jelenthet helybeli gyors fejlődést, vagy tömeges bevándorlást. Ennek eldöntéséhez jobban kellene ismerni a késő neogén és pleisztocén európai faunákat. A *Dromiacea* csoport erős csökkenést mutat a bádeni korszaktól máig, de ez a folyamat nagyrészt a korallzátonyok itteni eltűnésének következménye. A *Cancroidea* csoport visszahúzódása, úgy tűnik, tényleges fejlődési folyamat, bár Amerika körüli vizekben szerepük ma is jelentős. A *Xanthidae* csoport regressziója, a *Dromiacea* csoporthoz hasonlóan, a korallzátonyok eltűnésével kapcsolatos. Ha a mai indo—nyugat—pacifikus területhez hasonlítjuk, inkább növekedést tapasztalunk. A csoport gyors fejlődését látszik bizonyítani az is, hogy a bádeni emeletből hiányzik néhány, ma nagyon elterjedt, gyakori nemzetség. A többi család olyan kevés fajjal szerepel, hogy fejlődésükre vonatkozólag semmi adatot nem ad a bádeni fauna.

A BÁDENI RÁKOK RÉTEGTANI ÉRTÉKE

A bádeni emeleten belül három alemeletet különböztetnek meg: az alsó (morva), középső (wieliczkai) és felső (koszovói) egységet. Ezek megkülönböztetése nem egyszerű, ha egyes feltárások, rétegsorok korát vizsgáljuk. Sztratotípusokkal és határsztratotípusokkal határozták meg ezeket (Papp et al. 1978), főleg Foraminiferákra és a nannoflórára alapozva a megkülönböztetést. Ezek a csoportok a rákok zömét adó mészkövekből hiányoznak, vagy jellemző képviselőik nem találhatók meg. Az ezzel kapcsolatos nehézségek ellenére a rák-tartalmú sekélyvízi rétegek korát korrelálhatjuk a Foraminifera-dús mélyebbvízi képződményekéhez. Ehhez geológiai, ősföldrajzi módszereket használhatunk, vagy olyan puhatestűeket vehetünk figyelembe, melyek mindkét kőzettípusban megtalálhatók. Az ősföldrajzi módszer alkalmazását megkönnyíti az a körülmény, hogy a korai és késő-bádeni korszakok között jelentős tektonikai események történtek, gyökeresen átrajzolva az ősföldrajzi térképet a Középső Paratethys nagy részén.

Budapest környékén két olyan terület van, amelyik csak alsó- vagy csak felső-bádeni üledékeket tartalmaz, legalábbis a rákokban gazdag sekélyvízi eredetű kőzetek esetében.

Budapest belterületén és közvetlen környékén (Rákos, Tétényi-fennsík) a mészkövek kora kizárólag felső-bádeni. Ezt a puhatestűek bizonyítják (Bartkó—Kókay 1966), és az a tény, hogy rájuk konkordánsan települnek a szarmata rétegek, legalábbis a terület jó részén. A vékony rétegsor faunája annyira egységes, hogy két alemeletbe sorolása szóba sem jöhet. Az alsóbb kőzetrétegek radiometrikus kora is még a felső-bádeni alemeletre utal (13,4±0,6 millió év, Balogh—Árváné-Sós—Pécskay 1980).

A Pilis északi részén és a Börzsönyben azonban alsó-bádeni üledékeket találunk, csak Szob esetén vetődött föl a középső-bádeni kor lehetősége. A kort mikro-, makro- és nannofosszília is bizonyítja (Báldiné Beke et al. 1980, Nagymarosi 1980 és szóbeli közlés).

A két terület tízlábú rák faunája sok tekintetben eltér egymástól, bár hasonló ökológiai körülmények nyomozhatók mindkét helyen. A leglényegesebb eltérés az, hogy egyes gyakori fajok csak az egyik vagy csak a másik részen találhatók.

Az alsó-bádeni terület legjellemzőbb ilyen fajai:

Dardanus arrosor
Kromtitis koberi
Dynomene emiliae
Calappa praelata
Carpilius antiquus

Csak felső-bádeni lelőhelyeken kerültek elő:

Petrochirus priscus
Dardanus substriatiformis
Dromia eotvoesi
Calappa heberti
Matuta brochii

Az alsó-, illetve felső-bádeni faunák közötti különbség akkor a legszembetűnőbb, ha a korallzátonyok rákjait hasonlítjuk össze. Az élőhelyek nyilvánvalóan hasonlóak voltak mindkét alemeletben: folt-zátonyok kis kiterjedésben, sekély, aránylag védett öblökben. Az uralkodó korallok egyformán *Tarbellastraea* sp. és *Porites* sp. A különbségeket a 2. táblázat mutatja be. Bár a lista nem tekinthető véglegesnek, az eltérés elég jelentős, s feltételezhető, hogy oka rétegtani, vagyis a korkülönbség. A nagyhöflányi (Gross-Höflein, MNH) fauna minden tekintetben átmeneti jellegű az említett két Budapest környéki fauna között. Steininger és Papp (in Papp et al. 1978, p. 199) szerint a korallzátony fölött néhány méterrel települő márga a felső-bádeni emelet legalsó részébe tartozik.

Így az MNH fauna vagy szintén a felső-bádeni alsó részéhez vagy — ami valószínűbbnek látszik — már a középső-bádenihez tartozik. Így a korallzátonyok faunája alapján három biozónát különböztethetünk meg feltételesen (2. táblázat).

Egy negyedik, legfelső zóna létezése nyilvánvaló a Budapest környéki és balatonakali faunák alapján. Ezt az jellemzi, hogy a 3. zónában nagyon gyakori alakok jelentős része hiányzik (*Callianassa munieri*, *C. chalmasii*, *Petrochirus priscus*, *Dromia eotvoesi*, *Calappa heberti*, *Thalamita fragilis* és minden, zátonyhoz kötött faj, mert korallzátonyt ebben a szintben már nem találunk). A harmadik és negyedik zónát az is megkülönbözteti, hogy az alsóban sokszor uralkodó terrigén anyag a felsőből gyakorlatilag hiányzik, ami éghajlatváltozást jelenthet. Legvalószínűbbnek az látszik, hogy a 3. zónát félig száraz, az eróziónak kedvező éghajlat jellemezte, mely később nedvesbe fordult, s erózióvédő erdő telepedett meg a lejtőkön (KÓKAY—MIHÁLY—MÜLLER in press).

A négy zónát tehát fajok jelenlétével vagy hiányával jellemezzük (3. táblázat) s feltételesen ”assemblage zone”-nak tekinthetők. További vizsgálatot igényel, vajon általánosnak tekinthető-e ez a beosztás a Középső Paratethysben, vagy csak helyi viszonyokat tükröz.

ŐSFÖLDRAJZI KÖVETKEZTETÉSEK

A bádeni emeletre jellemző, gyakori nemzetségek közül elég sok ma már csak az indo—nyugat—pacifikus faunatartományban él. Ezt már Glaessner is hangsúlyozta (1928, p. 205), s később más szerzők is megerősítették (Förster, 1979a, p. 104, Müller 1979c, p. 865). Az említett mai faunatartomány területéről alig ismerünk miocén rákokat, így a közvetlen összehasonlítás ma még lehetetlen. Az említett jelenség könnyen megmagyarázható úgy is, hogy a ma csak keleten élő nemzetségek a bádeni emelet után kihaltak a Paratethysből és az ahhoz kapcsolódó Földközi-tengerből és keleti Atlanti-óceánból. A korallzátonyokhoz kötött nemek kipusztulása elkerülhetetlen volt a zátonyképző korallok eltűnésével. Az említett nemzetségek miocén jelenléte a Paratethysben alsó-miocén faunakicserélődéssel is magyarázható. Általánosan elfogadott, hogy az eggenburgi korszakban a keleti kapcsolatok még nyitottak voltak. A mai helyzet tehát annak köszönhető, hogy a harmadidőszak végi és pleisztocén lehűlés sokkal jobban érintette az Európa körüli vizeket, mint az Ázsiától délre levő óceánokat, ahol tehát refugium, ,,menedékhely'' alakult ki.

Az indo—nyugat—pacifikus tartományban ma is élő, bádeni nemzetségek a következők: *Matuta, Micippa, Macrophthalmus, Crossotonotus, Schizophrys* és *Actumnus* (ezek egy része, a Jóreménységfokát megkerülve, Afrika nyugati partjain is él, de ez a terjedés valószínűleg negyedidőszaki). Néhány nemzetség elsősorban indo—nyugat—pacifikus, de egy-egy fajjal másutt is képviselve van: *Mursia, Trapezia, Daira, Chlorodiella, Carpilius, Dorippe, Pilumnopeus* és *Achaeus*. A bizonytalanul meghatározott nemeket (pl. *Pilodius, Glabropilumnus*) kihagytam a felsorolásból. Az elsőnek említett hat nemzetségből mindegyik ismert a felső-, míg négy csak az alsó-bádeni alemeletből. A második listából (8 nemzetség) hat felső-, négy alsó-bádeni. Korábbi nézetek ellenére (Müller 1979c) nem bizonyítható az indo—nyugat—pacifikus rokonságú nemek számának növekedése a bádeni emelet során, mert az összes ismert felső-bádeni nem száma (53) nagyobb, mint az alsó-bádeniből ismerteké (36). A keleti rokonságú nemek aránya tehát gyakorlatilag állandó.

Három bádeni faj, vagy nagyon közeli rokonaik előfordulnak a Fidzsi szigetek pliocén rétegeiben (Rathbun 1945). Ezek közül kettő (*Dardanus hungaricus* és *Daira speciosa*) az 1. és 3. számú zónában található (2. táblázat), míg a *Dynomene emiliae* fajt az 1. és 2. zónában találjuk. Így ezeknek a bizonyítottan indo—nyugat—pacifikus rokonságú alakoknak a száma még valamelyest csökken is a bádeni korszak folyamán.

Mindebből arra lehet következtetni, hogy az indo—nyugat—pacifikus rokonságú alakok egy közös Tethys-fauna utódai, s később haltak ki a nyugati vizekben. Így a bádeni tenger és az Indiai-óceán összeköttetése ma kevésbé látszik valószínűnek, mint néhány évvel ezelőtt. Ennek ellenére nem lehet kizárni egy olyan tengeri kapcsolat létét, mely néhány euryhalin alak átvándorlását lehetővé tette, de erre faunisztikai bizonyítékunk még nincs. Vitathatatlannak látszik az, hogy a bádeni fauna lényegében azonos maradt a teljes korszak során, s a bádeni tenger óceánihoz közelálló sótartalmát a Földközi-tenger felől beáramló víz biztosította. Sajnos a bádenivel egykorú (serravalli és langhi) mediterrán rák fauna alig ismert. Mégis tudjuk, hogy legalább négy bádeni rák faj előfordul a mediterrán miocénben, míg hat másiknak közeli rokonát találjuk ott.

Egy figyelemreméltó tény magyarázatával még várni kell. Kizárólag a 3. számú zónától kezdve (2. táblázat) található néhány nagyon gyakori faj: *Petrochirus priscus, Dromia eotvoesi, Calappa heberti, Matuta brocchii, Micippa hungarica, Thalamita fragilis, 'Pisa' oroszyi, Actumnus telegdii.* Gyakoriságuk valószínűvé teszi, hogy nagy részük tényleg hiányzik az alsó-bádeniből, nem csupán annak kevésbé ismert volta miatt maradt ki a listákból. E fajok nagy része eltűnik a 3. és 4. zóna határán, mások ritkábbá válnak. Egy lehetséges magyarázat szerint e fajok érzékenyek voltak a klímára vagy a sótartalomra, ezért haltak ki a 4. zóna kezdetén, a feltételezett éghajlatváltozás hatására. Bevándorlásuk feltételezése szükségessé teszi eredetük helyének feltételezését is. Ez a hely aligha lehetett az indo—nyugat—pacifikus területen, hiszen nagyrészt sztenohalin fajokról van szó, melyek onnét nem vándorolhattak át, mert a jelenlegi ősföldrajzi ismereteink szerint a köztes tengerrészek részben csökkent-, részben túlsós vizűek voltak. Eredhettek volna a Földközi-tenger délebbi területeiről is, de onnét eddig csak a *Petrochirus priscus* fajt (Glaessner 1928) ismertették közülük.

ÖKOLÓGIAI KÉRDÉSEK

A bádeni emelet különböző típusú rák-együtteseket adott. Ezeket szubjektív módszerekkel is csoportosíthatjuk. A csoportok valószínűleg elsősorban az egykori környezet körülményeit tükrözik. Objektívebb csoportosítást kaphatunk analitikus módszerekkel. RAJCZY M. végezte a cluster-analízis számításait. Az egyes együttesek (lelőhelyek, ill. rétegek) hasonlóságát bináris (jelenlét-hiány) és kvantitatív függvények segítségével számítottuk. Kvantitatív módszereket ritkán alkalmaznak a makropaleontológiában, főleg akkor, ha nem szitált vagy iszapolt, hanem kézzel gyűjtött anyagról van szó, hiszen az ilyen minták reprezentatív voltában joggal kételkedhetünk. Az alább bemutatott megfontolások és az eredmények meggyőző volta azonban bizonyítani látszik a kézzel gyűjtött minták számszerű kiértékelésének jogosultságát is.

Még a legnagyobb gondossággal végzett kézi gyűjtés esetén is fellép egyfajta statisztikai torzítás. Al gyűjtő a kőzetet adott átlagméretű darabokra töri. A kőzetdaraboknál kisebb kövületek rejtve maradhatnak, ha a darabok belsejében vannak. Ezért a kisebb példányok megtalálásának valószínűsége csökken. Tegyük fel azonban (ez a rákok esetén megengedhető, mert a maradványoknak csak elenyésző tört részét teszik), hogy a kőzet a fosszíliák helyétől független helyeken törik el, így annak valószínűsége, hogy egy kövületet észreveszünk,

$$p = 1 - \frac{(r-f)^3}{r^3} \qquad (p_{\max} = 1)$$

esz, ahol p az f méretű maradvány megtalálásának valószínűsége r méretű darabokra tört kőzetben, feltéve, hogy mind a kövületek, mind a kőzetdarabok nagyjából izometrikusak. Ezzel a képlettel korrigáltuk a szitált minták darabszámait, hogy azok a (jóval számosabb) kézzel gyűjtött minta darabszámaihoz hasonlóan torzuljanak. Így az eloszlási függvények már összehasonlíthatóvá váltak. Bár egyfajta torzítás hatását így redukáltuk, mások elkerülhetetlenül megmaradnak, pl. szelektív beágyazódás, fosszilizálódás, téves határozás következtében.

Az így korrigált adatokat használtuk a hasonlóság kiszámítására, bináris (SØRENSEN 1948, SOKAL—MICHENER 1958) és kvantitatív (HORN 1966, CZEKANOWSKI 1909, PINKHAM—PEARSON 1976, HUMMON 1974) egyenletekkel. A csoportképzéshez súlyozott átlagszámításos módszert használtunk. A számítások alapjául először a nemzetségek, majd a fajok példányszámait, ill. jelenlétét—nemlétét vettük. E két számításnál teljesen azonos dendrogramokat kaptunk, ami érthető, mert a legtöbb nemzetség csak egy fajjal szerepelt.

A cluster-analízis fő célja az volt, hogy az egyedi lelőhelyekből, illetve rétegekből csoportokat képezzünk, melyekben a hasonló faji összetétel hasonló ökológiai viszonyokra enged következtetni. A csoportokból kiválasztottuk a leghűségesebb és legállandóbb fajokat s ezek mai rokonainak ökológiai igénye alapján következtettem tovább. Nyilvánvaló, hogy egy-egy csoportra a legjellemzőbbek a hűséges és állandó alakok. A csoportokat vagy halmazokat (clusterek) úgy nyerhetjük, hogy a számítás eredményeképpen kapott dendrogramokat (12. ábra) egy adott szinten vízszintes vonallal elvágjuk. E szint megválasztása bizonyos mértékig önkényes, ezért a módszer sem mentes szubjektív elemektől. Ezt a szubjektivitást erősen csökkenti, ha az egymástól eltérő módszerek végeredménye hasonló. Négy csoportot kaptunk a SØRENSEN, HUMMON, SOKAL—MICHENER és HORN-módszer alapján, s öt, többé-kevésbé homogén csoportot a PINKHAM—PEARSON és a CZEKANOWSKI-függvénnyel (11. ábra, 4. táblázat). További hierarchikus szintek nem mutatkoztak, sem alacsonyabb, sem magasabb szinten. Az előzetesen legkoherensebbnek ítélt zátonyokat (MRZ csoport, lásd alább) a függvények többsége egybe sorolta, a PINKHAM—PEARSON és a SOKAL—MICHENER-módszer mégis kettéosztotta. Négy eltérő módszer — a SØRENSEN, CZEKANOWSKI, HORN és HUMMON-függvény — csaknem teljesen azonos eredményt adott. Csupán néhány lelőhely, illetve réteg helyzete változott a módszertől függően, ezek: MKC, WEG és MDN. Ezek közül az első valóban átmeneti jellegű, míg a másik kettő mintája nagyon kevés elemből állott, mivel ezek kevéssé begyűjtött lelőhelyek. Az eredmények jól egybevágnak a kőzetek üledéktani jellegeivel, a szemnagysággal, de főleg az onkoidok meglétével vagy hiányával és a zátonyszerű kifejlődésekkel, valamint a terrigén anyag mennyiségével (4. táblázat).

A legegységesebbnek mutatkozó csoport (MGY) még az MRO, MRF, MR8, MR45, MA, MOH, MEG és MFA rétegeket tartalmazza (a csoportoknak az egyik, jellemzőnek ítélt elem jelét tartottam meg), s a dendrogramok egy részében az MKC is idekerült. Az alsó-bádeni Mátraverebély—Szentkút és Nyírád (MNU) lelőhelyek is hasonló együttest adtak, melyben a *Calappa hebertit* a *C. praelata* helyettesíti. Ezek mintáinak kis elemszáma miatt nem vontuk be őket az analízisbe. Ezeket az együtteseket a *'Callianassa'*, *Calappa*, *Matuta*, *Mursia*, *Thalamita*, *Dromia eotvoesi* és *Portunus (Portunus)* taxonok gyakorisága jellemzi, míg *Albunea* és *Portunus (Monomia)* csak egy-két helyen került elő. Ezek a taxonok hűségesek, az első hat pedig állandó is, mert minden egyes elemben előfordul.

A *'Callianassa'* fajok sokasága (de Saint Laurent—le Leuff 1979) a 10—30 méter közötti vízmélységnek tulajdonítható, mert a ma élő *Callianassa* és *Callichirus* fajok ezt a mélységet kedvelik, bár egyesek előfordulnak az árapályövben, mások pedig 100 méternél mélyebben is. A helyek egy részénél egy nagy méretű faj *(C. munieri)* gyakorisága homogén üledéket jelez. A *Matuta* fajok zöme sekély vízben él (Sakai 1976), de a bádeni fajhoz leginkább hasonló *M. curtispina* 35—80 m között, homokos fenéken él. A *Mursia* fajok lágy aljzatot kedvelnek, 50—150 m mélységben (Sakai 1976), de a *M. cristimana* fajt 17 méterből is jelezték (Barnard 1950). A *Thalamita fragilis*-hez hasonló *Th. crenata* egészen sekély vízben él, iszapon vagy lágy homokon. Más fajok 80 méterig szállnak le (Sakai 1976). Az egyes *Calappa* fajok eltérő mélységet kedvelnek, 10—150 méter között (Sakai 1976). A *Calappa praelata*-hoz hasonló *C. granulata* 30—150 m között él (Zariquiey Alvarez 1968). A *Portunus (Portunus)* fajok sekély vízben élnek, 20—30 méterig. Az *Albunea carabus* lágy homokos fenéken él, általában 30—50 méterig (Zariquiey Alvarez 1968).

Az adatok aktualisztikus értelmezése szerint a csoportba tartozó rétegek zöme 20—30 méter mély vízben keletkezett. Ahol az üledék homogén volt (MRF, MR8, MR45), ott a nagy *Callianassa* fajok domináltak, másutt a kis. *C. pseudorakosensis* élt tömegesen (MFA, MFK). A *Calappidae* fajok sokfélesége és gyakorisága normális sótartalmat, meleg—mérsékelt éghajlatot jelez. Az *Albunea* időnkénti gyakorisága (MGY, MRF) 30 méternél valamivel mélyebb vizet jelenthet. A csoport rétegei néhány rákfajt megosztanak más csoportokkal, főleg az MOE-vel (lásd alább). Ezek közül a *Maja* a legfontosabb, melynek mélységigénye 15—30 m közötti, ritkán 10—200 m között él (Sakai 1976). Az európai *Maja squinado* 2—73 m közt él (Ingle 1980). A *Dorippe* fajok 15—50 m közt (Sakai 1976) vagy 40—100 m között (Zariquiey Alvarez 1968) élnek. A *Liocarcinus* fajok a parttól 220 méterig terjedő zónát osztják föl egymás között (Ingle 1980).

Az MOE csoport még az MDG, MDN réteget tartalmazza, valamint a klasszifikációk egy részében a DAL és WEG jelűt is. A csoport jellemző alakjai, melyek állandóak és hűségesek: *Micippa hungarica*, *Ebalia* fajok, *'Lissocarcinus'*, *Liocarcinus*. A jobban begyűjtött lelőhelyeken ehhez társul az *Achaeus*, *Actumnus*, *Dorippe*, *Maja*, *Parthenope*, *Cancer*, *Xantho*, *Palicus*. A *Micippa hungarica*-hoz közelálló *M. thalia* 20—100 m között él, homokon vagy héjtörmeléken (Sakai 1976). A legtöbb *Achaeus* faj 10—50 m között él, de egyesek sekélyebb vízben is előfordulnak. Az *Ebalia* fajok nagyon változó mélységből kerültek elő: kettőtől több száz méteres mélységig (Ingle 1980). A *Palicus* fajok általában 50 méter alatt élnek (Sakai 1976, Zariquiey Alvarez 1968). A *Cancer* fajok a parttól 1000 méterig találhatók (Rathbun 1930). A *Parthenope* fajok 10 és 40 m között gyakoriak (Zariquiey Alvarez 1968). A mai *Actumnus* fajok általában mélyebben élnek, mint a *Pilumnus* alakok, általában 20—35 m alatt, de két alak árapályövben él (Sakai 1976). Ezek az adatok a gyakoribb és állandóbb fajok adatait nagyobb súllyal véve, 20 méternél valamivel nagyobb vízmélységet sugallnak, hasonlóan az előző csoporthoz. Lényeges különbség a nagy és közepes méretű *Callianassa* fajok hiánya, amit az inhomogén üledéknek tulajdoníthatunk. A *Calappa*, *Dromia*, *Thalamita*, *Portunus* fajok hiánya, a *Matuta* és *Mursia* ritkasága lehűlést és valamelyest változó sótartalmat jelez, mert ezek a nemek ma elsősorban trópusi és meleg—mérsékelt zónákban, rendes sótartalmú vízben élnek. Mint említettem, az MOE csoportot terrigén anyag hiánya jellemzi (18. old.), ami éghajlatváltozást jelenthet.

Az MB jelű csoport nagyon érdekes, mert olyan környezetet képvisel, ami fosszilisan nagyon ritkán marad meg. A kőzetek mindig tartalmaznak onkoidokat, vagy sztromatolitokat (Lelkes—Müller in press). Ez nagyon sekély vizet jelez. A következő egységek tartoznak ide: MRS, MGF, MB, MBK, MBH, MJL, MM és fenntartásokkal a DAL és WEG. Jellemzője a *Pisidia kokayi*, *'Pisa' oroszyi* és *Pachygrapsus hungaricus*, melyek ritkák másutt, a legtöbb csoportban teljesen hiányoznak. Jellemző még a *Brachynotus februarius* kizárólagos jelenléte, valamint a *Pilumnus mediterraneus* és *Xantho moldavicus* gyakorisága. Az utolsónak említett két faj kivételével ezek mind hűséges alakok, s meglehetősen állandóak is, tehát az együttesre nagyon jellemzőek. A mai *Pachygrapsus* fajok a sziklás árapályövre jellemzőek (Pérès—Picard 1964), ami ezt a leletet különösen érdekessé teszi. A mai *Brachynotus* fajok leginkább 0,5—2 m mélység között találhatók (Zariquiey Alvarez 1968). A legtöbb *Pisidia* faj szintén ilyen körülmények között él, de néha mélyebben is előfordul. Mindhárom említett alak búvóhelyeket igényel: sziklahasadékokat, vagy kövek alatt, *Upogebia*-járatokban keres menedéket (Pesta 1918). A *Pisa* fajok 1 és 90 méter közt élnek, kedvelik a szilárd aljzatot (Ingle 1980). A *Xantho* és *Pilumnus* fajok meglehetősen igénytelenek, nagyon sekély vízben is előfordulnak. A fentiek szerint az MB típusú rétegek nagyon sekély, parti sávban rakódtak le. Az onkoidok és sztromatolitok szilárd aljzatot jelentettek s búvóhelyet is. Időnkénti regressziók, tengerszint-ingadozások következtében sziklás-köves árapályövvé vált ez a terület.

A rákok mai rokonai zömmel euryhalin szervezetek: *Xantho, Pilumnus, Brachynotus, Pisidia, Liocarcinus, Pachygrapsus* fajok ma is élnek a Fekete-tenger féligsós vizében (Pesta 1918), míg néhány *Leucosidae* faj áthatolt a Szuezi-csatorna túlsós vizein, mások pedig a Márvány-tengerben élnek (Holthuis—Gottlieb 1958, Por 1978). Ez összhangban van azzal a ténnyel, hogy az árapályöv közelében mindig változó a sótartalom, de különösen így lehetett ez a bádeni emelet vége felé, amikor a Keleti Paratethys csökkent sótartalmú vizének beáramlását kell feltételezni (Kókay in Kókay—Mihály—Müller in press).

Az MRZ csoport (korallzátonyok) az MDZ, MK, MV, MTZ és MNH helyekből áll. A zátonyépítő korallok jelenlétéről a kőzettípus azonnal felismerhető. Ezek részben élő helyzetben, részben kimosva temetődtek be, de mennyiségük mindegyik helyen kőzetalkotó. A betemetődés módja néha egészen rövid távon, néhány méteren megváltozik (lásd az MK lelőhely leírásánál). Egész sor nemzetség és faj kizárólag ezeken a helyeken fordul elő: minden *Chlorodiella* faj, *Trapezia, Carupa, Rakosia, Daira speciosa, Carpilius, Charybdis (Goniosupradens), Dynomene, Dromia neogenica, Actaea, 'Pilodius', Haydnella, Crossotonotus, Schizophrys, Petrolisthes.* (Ritkaságként egy-egy példány *Chlorodiella mediterranea* és *Dromia neogenica* került elő az MKC rétegből, mely bizonyos mértékig átmeneti jellegű.) A felsorolt nemek mai képviselőinek többsége zátonylakó: *Charybdis (Goniosupradens), Daira perlata, Chlorodiella,* a legtöbb *Dynomene* faj, *Carpilius, Trapezia* (Sakai 1976, Taylor 1968). Mások nem kizárólagos zátonylakók, de szilárd aljzatot igényelnek, ezért zátonyon is élnek *(Schizophrys, Carupa, Daira americana, Crossotonotus).* Kevésbé érthető a *Panopeus* és *Cancer* jelenléte. A mai *Panopeus* fajok jó része lágy aljzatot kedvel, de alkalmilag zátonyon is előfordul, ezzel szemben *Cancer* fajt zátonyról nem jeleztek, elterjedésük sem esik egybe a zátonyokkal (Rathbun 1930). *Calappa heberti* is került elő ezekről a lelőhelyekről, mai *Calappa* fajok is élnek alkalmilag zátonyon. Jellemző, hogy a másutt gyakori alakok közül néhány következetesen hiányzik a nagyon gazdag, jól begyűjtött MRZ típusú anyagból: *Parthenope, Mursia, Leucosiidae.* Ezek mai képviselői ritkák a zátonyokon, vagy teljesen hiányzanak (Taylor 1968). Két helyen (MDZ és MRZ) a *Pisidia kokayi* és *Pachygrapsus hungaricus* is előfordul, jelezve, hogy ezek a zátonyok időnként az árapályövbe kerültek, amit üledéktani bélyegek (gyökérnyomok és száradási repedések) is jeleznek az MRZ lelőhelyen. A korallzátonyok jelenléte óceánihoz közelálló sótartalmat és meleg—mérsékelt vagy trópusi éghajlatot jelent. A korall nemzetségek számának csökkenése a bádeni emelet során (mintegy 20-ról négyre vagy ötre, lásd 2. táblázat) arra utal, hogy a sótartalom a felsőbb részek keletkezésekor már nem volt mindig teljesen állandó, de az éghajlat romlására is utalhat. A zátonyok mérete viszont a felső-bádeni emeletben sem kisebb, mint az alsóban, ami inkább a sótartalom változásának hatását támasztja alá.

Különleges együttest ismertem meg legújabban az MZZ (Zebegény) rétegben (6. ábra). Ez még nem került be a cluster-analízisbe. A finomszemű mikrites kőzet egy kis nem-zátonyépítő, ágas-bogas telepes korallfaj tömegeit tartalmazza, mely *Oculina*-ra emlékeztet. Ahermatipikus korallból álló mezőket a legkülönbözőbb mélységekben és klímákon találunk, egy métertől több száz méter mélységig, a trópusoktól a hideg-mérsékelt övig. A *?Porites* genus jelenléte viszont azt jelenti, hogy itt a víz nem lehetett mélyebb húsz—harminc méternél. A rák fauna hasonlít a zátonyokéhoz, de kevesebb fajt tartalmaz. Érdekes a két *Ebalia* faj jelenléte, mert a zátonyokon egyetlen *Leucosiidae* fajt sem találtam. A *Portunidae* és *Dromioidea* fajok viszont hiányzanak a harminc példányból álló mintából.

A fenti négy típuson kívül egy ötödik körvonalait sejteti néhány szórványlelet. Több lelőhelyen került elő *Goneplax* faj, Oriakhovóban (Bulgária) *Miocyclus bulgaricus*-szal, Soossban (Baden mellett) *„Cancer" szontaghi vindobonensis*-szel együtt. Egy *Geryon* fajt adott a budapesti Z-2. sz. fúrás. Mindezek agyagból vagy finom aleuritból származnak. A recens *Goneplax rhomboides* 40—760 m között, a *Geryon tridens* 770—1500 m között él az Adriában (Pesta 1918). *Ranidina rosaliae* két helyről került elő, Borbolyán *„Cancer" bittneri*-vel együtt. A *Raninidae* fajok zöme is mély szublitorális életet él. A felsorolt leletek tehát mélyebb szublitorális és sekélybatiális körülményekre utalnak.

Bár természetesen sírközösségeket vizsgáltunk, a rákok páncéljának törékenysége és az eredmények aránylag ellentmondás-mentes volta valószínűvé teszi, hogy ezek jól tükrözik az egykori élőhelyek közösségeinek összetételét.

A fejezetben ismertetett következtetések elég jól egyeznek más gerinctelenek vizsgálatával kapott eredményekkel (lásd a lelőhelyek leírását) és az üledéktani megfontolásokkal. Ilyen vizsgálatok még kevés helyen történtek, ezek eredményeit több cikk tárgyalja (Müller 1974a, 1974b, 1976a, 1979a, Kókay—Mihály—Müller in press, Lelkes—Müller in press).

Szintén Rajczy M. segítségével kaptuk meg a minták Shannon-féle diverzitási („sokféleségi") indexeit. Az egyes csoportokra vonatkozó szélső értéket H′ $\log_2$ formájában a következőkben adom:

MGY csoport: H′ = 2,18–3,66
MOE csoport: H′ = 3,25–4,00
MRZ csoport: H′ = 2,10–3,63
MB csoport: H′ = 1,24–2,83

Néhány árapályövi és sekély infralitorális tízlábú rák-közösség diverzitását Abele (1974) vizsgálta. Bár ő a mintákat a meleg-mérsékeltövi és trópusi tengerekből vette — melyek hőmérséklete valószínűleg magasabb, mint amilyen a bádeni tengeré lehetett —, legmagasabb értéke ($H' \log_2 = 4{,}346$) nem lényegesen nagyobb, mint a mi általunk kapott maximális adat. Igaz ugyan, hogy a fosszilis minták több élőhelyből összemosott példányokat is tartalmazhatnak, ami megnövelheti a fajszámot, de ez a hatás a rákoknál valószínűleg elhanyagolható.

A diverzitási érték érdekes egyirányú változását figyelhettük meg a Tétényi-fennsíkon. Az MB csoport lelőhelyein belül a diverzitás észak felől (MM réteg, H′ = 1,24) dél felé (MBH réteg, H′ = 2,93) növekszik, majd még tovább dél felé, az MDG lelőhelyen még nagyobb (H′ = 3,25) értéket kaptunk. E rétegek valószínűleg egykorúak, ezért az is valószínű, hogy a H′ növekedése a növekvő vízmélységet tükrözi, egy, a partra nagyjából merőleges szelvényben. Ez az eredmény némileg ellentmond Abele (1974) egyik megállapításának. Ő ugyanis az egyik legmagasabb értéket a sziklás árapályövre kapta, míg a mi esetünkben a sziklás árapályövi MM élőhely értéke éppen a legalacsonyabb. Abele viszont csupán egyetlen infralitorális együttest vizsgált, egy *Pocillopora*-asszociációt, melynek diverzitása is nagy volt (H′ = 4,346). Ha a bádeni együttesekre kapott értékek megbízhatónak bizonyulnak a kis elemszámú minták adta határon belül, akkor megállapíthatjuk, hogy nem a korallzátonyok rákjaira kaptuk a legmagasabb értékeket (MRZ csoport), hanem egy infralitorális csoportra, az MOE jelűre, mely erősen összetett aljzaton (mészhomokkő, osztriga-padok, ép kagylóhéjak, héjtörmelék) élt együtteseknek felel meg. Abele végkövetkeztetése az volt, hogy a diverzitási érték legjobban az aljzat összetett voltával, komplexitásával korrelál. E tekintetben tehát eredményeink egybehangzanak az övéivel, mert az MOE típusú sokrétű aljzat komplexitás tekintetében egyenértékű lehet egy korallzátonnyal.

DECAPOD CRUSTACEA OF THE BADENIAN

SUMMARY

120 species and subspecies of anomuran and brachyuran decapods have been found in Badenian (Middle Miocene, Central Paratethys, Central and Eastern Europe) layers of which one hundred were determined to the species level. Four new genera, 21 new species and one new subspecies are described. The new genera are: *Kromtitis (Dromiidae)*, *Corystites (Corystidae)*, *Rakosia*, *Miopipus (Portunidae)* and *Haydnella (Xanthidae)*. The new species or subspecies are: *'Callianassa' szobensis (Callianassidae)*, *?Pagurus turcus*, *'Pylopagurus' leganyii*, *Diogenes matrensis*, *Paguristes cserhatensis (Paguridae)*, *Petrolisthes magnus*, *P. haydni (Porcellanidae)*, *Schizophrys visegradensis (Majidae)*, *Parthenope tetenyensis (Parthenopidae)*, *Portunus (Monomia) miocaenicus*, *Charybdis (Goniosupradens) mathiasi*, *Rakosia carupoides*, *'Xaiva' bachmayeri (Portunidae)*, *Actaea turcocampestris*, *Chlorodiella mediterranea tetenyensis* (n. ssp.), *Chlorodiella loczyi*, *Ch. juglans*, *Haydnella steiningeri*, *Panopeus wronai*, *Pilumnopeus paratethyensis*, *'Pilumnopeus' tetenyensis (Xanthidae)* and *Crossotonotus diosdensis (Palicidae)*. The decapod associations were assigned to four stratigraphic zones which could be correlated tentatively to substages of the Badenian. Primarily by cluster-analyis, these associations were divided into five clusters reflecting differing paleoecological conditions. Rocky intertidal, reefal, shallower and deeper infralittoral and circalittoral habitats were recognised.

INTRODUCTION

The decapod crustacea represent a major and important element of marine biota. Many of these organisms have well calcified crusts. In spite of this the fossil record reflects their importance only very incompletely. In any of the recent tropical seas their species number several hundreds. Even in a warm-temperate sea, e.g. the Mediterranean some two hundred species are present, from which ninety belong to the group brachyura.

In contrast to this only few decapod localities, generally of tropical origin, yielded more than 20 or 30 fossil species. Such outstanding localities are mostly Mesozoic or Eocene. Most Neogene formations yielded only sporadic specimens. Rich associations are unfrequent. The Badenian of the Central Paratethys is one of the exceptional cases. The unusually high number of detected species, over hundred, may be attributed to the long tradition of study of fossil crabs in this area as well as to the good localities that are situated in the vicinity of the university towns, Budapest and Vienna. A need to revise previous publications and the availability of new material motivated our study.

The wealth of material permits the description of whole communities of Badenian decapods which can be correlated with paleoecological conditions. The factors controlling these associations will be tentatively characterized.

As far as this was possible the type- and other specimens of previous studies were located and revised. I visited several times some easily accessible and promising localities, e.g. Rákos, Örs vezér tere, Tétény, Gross-Höflein, which yielded rich and ecologically evaluable associations. Other, less promising or more remote localities, e.g. Mátraverebély–Szentkút, Zebegény, Szob, Deutsch-Altenburg or Grobie were visited only once or twice.

Inevitably, the material is somewhat one-sided. Upper Badenian localities yielded many times more specimens than Lower or Middle Badenian ones. In spite of this, a monographical evaluation of the whole known Badenian decapod fauna seemed to be warranted.

Several thousands of specimens (isolated carapaces, chelae, rarely entire tests) were studied and determined. 120 different forms were recognized, of which 102 were determined to species or even lower level. Most of the specimens were found in more or less rich associations. Four new genera, 21 new species and one new subspecies were recognized.

Our aim was the description or revision of all known Badenian decapods with the exception of isolated fingers the study of which is generally not very promising at the present level of our knowledge. To promote such studies in the future, however, I tried to identify isolated fingers too, if these were found in layers where carapaces and chelae were also present.

The associations, and in some cases the individual findings too, were evaluated ecologically, with the aid of cluster-analysis, taking into account the ecological requirements of recent forms allied to the Badenian ones. The Leythakalks, yielding the bulk of the decapods, were among the less studied Badenian deposits. In many cases it was only the crabs which gave evidence about paleoecological conditions. In some instances, the molluscan and foraminiferal faunas were elaborated by colleagues yielding further information about environments.

The associations were tentatively evaluated from paleogeographic and stratigraphic points of view as well.

Acknowledgements

Before all, I owe thank all of the members of my family who tolerated with patience the mess and disruptions in our home for which my studies on fossils were responsible. My son, Miklós helped with photography, my wife Éva, my brother Miklós, my cousin, Dr. Gábor Szikla, my aunt, Mrs. Éva Marsovszky supported my trips to foreign localities or museums.

In the Geological Institute, especially Drs. Géza Hámor and György Zsilák supported this work in several ways. My colleagues, Dr. Sándor Mihály, Mrs. Margit Papajcsik and Mr. Péter Solt helped me either in fieldwork or by locating material in collection. I received similar assistance from Drs. Tibor Kecskeméti, László

Forró and Henrik Farkas of the Natural History Museum, and from Dr. Jenő Boda of the University of Budapest. I am indebted to many friends who brought me specimens of crabs from various seas, Drs. Margit H. Deák, István Sárváry, Ödön Rádai, Gyula Radócz, Mrs. Zsuzsa Maros, Mr. Gábor Maros, and others. I express my gratitudes for advices and gift of material for experiments of casting technics to Drs. Attila Vörös and Ferenc Cser and also for precious advices about photography to Mr. István Försönits jun. My friends and colleagues, Drs. József Kókay and György Lelkes provided many unpublished results of their field so useful in this work. Dr. József Kókay also gave me material he collected, in fact some of the most valuable crabs discussed were obtained through his courtesy. Dr. Miklós Rajczy helped in a generous way by giving advice and carrying out numerical computations in cluster analysis and of diversity indices. I am especially indebted for the extremely careful review of my manuscript to Dr. Miklós Müller, my brother and to Dr. Endre Dudich.

Sincere thanks are due to Dr. Fritz Steininger for those precious days he devoted to helping my field-work in Burgenland, Austria. Dr. Friedrich Bachmayer helped me in visiting a locality in Austria and the Natural History Museum of Vienna. Drs. Lorette Wittibschläger and Ortwin Schulz helped me to locate or to study type-specimens in Austrian collections. I am indebted to specialists for providing me with specimens of extant crabs or advices, expecially to Drs. Danièle Guinot and L. B. Holthuis who both helped to elucidate systematical problems. Similarly I thank for sending specimens or casts to Drs. J. S. H. Collins, John Garth, Arie Janssen, Pierre Moisette, Jean-Paul Saint Martin, A. Fenninger, G. E. Groot and others. Drs. Emilia Kojumdgieva and Wilhelm Krach conveyed fine specimens for study from the Badenian of their countries. I am grateful to Drs. Luis Voa Boada, Sylvie Secretan and R. V. Ingle for advices or other helps.

THE BADENIAN STAGE AND THE CENTRAL PARATETHYS

The Badenian stage is a regional stratigraphical unit. Its applicability is confined to the Central Paratethys. Both terms were defined in PAPP et al. 1978. The lower boundary of the Badenian coincides with the appearance of the planctonic foraminiferan *Praeorbulina Olson*. If this event was synchronous everywhere, the beginning of the Badenian should correspond to that of the Langhian, Mediterranean stage, a part of the Middle Miocene.

The upper boundary of the Badenian is less clearly defined because the Paratethys separated, probably gradually, from the oceans which led to enhanced endemism of the biota. Therefore this boundary was defined as the appearence of the highly endemic Sarmatian fauna and the extinction of the euhaline elements. The synchronicity of this event is in question and its global correlation is also problematic. According to PAPP, SENEŠ and STEININGER (in PAPP et al. 1978, p. 57) this event can be correlated to the Middle Serravallian, Mediterranean stage. It is still worth remembering that an erroneous correlation of the Badenian to the Tortonian was generally accepted in the period from 1928 to about 1968, introducing an error of some five or six millions of years. Although in the earlier literature there was a notable trend toward a more correct correlation (e.g. LŐRENTHEY 1909), SCHAFFER (1927) placed the layers in question in the Tortonian stage without providing any evidence. Unfortunately, his view was generally accepted with only a few exceptions (e.g. STRAUSZ 1966, who continued to use the old term Upper Mediterranean Stage). This discrepancy made it difficult to correlate the Badenian to other European or Global stages for half a century. The term Tortonian (for Badenian layers) keeps appearing occasionally in recent papers.

The Badenian period extends from 13.3 to 16.5 million years B. P., according to VASS, BAGDASARYAN and STEININGER (in PAPP et al. 1978, pp. 35—46). These dates are based on local radiometric data and on their correlation to the global radiometric scale.

The Central Paratethys was an inland sea that occupied the foredeep and the inner-arc basin of the Carpathians, but also extended toward the Alps and the Dinarids and around the Northern slopes of the Balkan Mountains. The Paratethys was connected with the western Mediterranean by a molasse-deep north of the Alps. This connection has definitely closed before the beginning of the Badenian. A connection to the eastern Mediterranean through the Palaeo-Adriatic Sea might have existed until the end of the Badenian.

The Eastern Paratethys was an extended system of seas reaching as far as the area of the recent Balkhas Lake. It was probably connected with the Central Paratethys during the whole Badenian but striking differences in the facies and biota of these seas argue for their high grade of independence.

The oceanic salinity of the Badenian sea indicates that one or more open sea-ways to oceans permitted the outflow of the diluted or concentrated water of the sea and the simultaneous influx of oceanic water. The almost euhaline character of the Badenian Sea is supported by the diversity of corals, echinoids and many other organisms though a deviation of the salt-content within the limits of a few permilles was evident in the Middle Badenian and in the second part of the Late Badenian at least. The connections might correspond to one or more of the following:

1. to the Atlantic, through the Mediterranean and the Proto-Adriatic Sea,

2. to the Indian Ocean, through the Eastern Paratethys and through a hypothetical through running parallel to the Zagros-Chain,

3. to the Indian Ocean, through a highly hypothetical molasse-sea running along the Hellenids, Taurids and Zagros.

According to the correlation of Eastern Paratethyan stages to their western counterparts, as proposed by PAPP and SENEŠ (in PAPP et al. 1978, p. 53), the Tarkhanian of the Eastern sea corresponds to the Lower Badenian (Moravian). In Tarkhanian faunas an impoverishment of the biota indicates a slightly brachyhaline character of its water. During Tshokrakian and Karaganian, corresponding to the uppermost Moravian and the Middle Badenian (Wieliczian), this impoverishment is even more accentuated indicating a gradual closing of the connection with the oceans. During the

Konkian of the Eastern Paratethys, which might correspond to the Upper Badenian (Kosovian), a new but restricted marine invasion indicates a stabilised salinity which was not as high as that of the Upper Badenian Sea, however.

Based on the above mentioned hypothetical ideas it is highly probable that a firm euhaline connection of the Central Paratethys and the Mediterranean existed during the whole Badenian. The character of the biota of these seas is essentially the same. The possibility of an Indo-West-Pacific connection through a partly brachyhaline, partly hypersaline sea-way can not be ruled out for the Late Badenian, however (RÖGL–STEININGER–C. MÜLLER 1978). The persistence of a western link remains doubtless, however.

The Miocene Paratethys was in a crucial location during the separation of the Indo-West-Pacific and East-Atlantic-Mediterranean faunal provinces. The last massive faunal exchanges between the both realms might have taken place during the Early Miocene but some episodic and restricted connections might have occurred during the Late Middle Miocene, too.

PREVIOUS STUDIES ON BADENIAN DECAPODS

Some of the earliest papers mentioning Badenian Crabs describe sporadic findings. The very first paper of this kind mentiones the occurrence of the Mediterranean species *Lobocarcinus sismondai (=Cancer s.)* in the Vienna Basin (A. E. Reuss 1859). This was followed by the description of *Microdium nodulosum* from Wieliczka (A. E. Reuss 1867). Some years later R. Reuss (1871) published a paper on *Phymatocarcinus speciosus (=Daira speciosa)*, based on an internal mould of the crab from Baden Rauchstallbrunngraben.

Bittner's paper (1877) was the first to mention more than one species from a single locality, giving a detailed description of *Phymatocarcinus speciosus* from Gamlitz, Steiermark; he also mentiones *Carpilius* sp. and *Titanocarcinus* sp. (probably *Xantho*) but without description. From other localities he mentiones a chela of a portunid and *Macrophthalmus* sp. This latter came from a Carpathian layer.

In 1883 Brocchi published a paper about the Rákos (now part of Budapest) fauna. He described six new species, *Pagurus priscus* (=Petrochirus pr.), *Calianassa munieri* (=Callianassa m.), *C. chalmasii*, *Calappa heberti*, *Matuta inermis* (=M. brocchii) and *Portunus pygmeus (Miopipus p.)* and also presented an illustration of a portunid (in French: Portunien) chela *(=Thalamita fragilis)*. Unfortunately the Rákos section comprises several layers which are not indicated in Brocchi's paper. As the type specimens are probably lost forever, we do not even have the matrices to indicate what layers contained the specimens. A year later Bittner (1884) published a paper on crabs from strata of various geologic ages, including the following Badenian forms: *Cancer styriacus, C. illyricus* and *C. carniolicus.* Bittner later (1893) described several crabs, including Badenian ones, from the Tertiary of Pannonia (meaning Hungary and Croatia together at that time). He mentioned *Neptunus* cf. *granulatus* (?=*Portunus monspeliensis*) from the vicinity of Kolozsvár, Transylvania. From Walbersdorf (Borbolya, now Burgenland, Austria) a new species, *Ranidina rosaliae* is described and specimens of *Cancer* cf. *illyricus* (?="*Cancer*" *bittneri*) are enumerated.

Imre Lőrenthey, Hungarian paleontologist and geologist (in papers published in German language he used his name's German version, Emerich Lőrenthey) was one of the most successful investigators of Tertiary crabs. He focused his efforts, however, on the diverse and well preserved Upper Eocene fauna of Kissvábhegy (now Martinovics-hegy), Budapest and much less on the Badenian ("Obermediterran" in those times) decapods. Nevertheless, he redescribed Brocchi's species and described a series of new ones, providing good indications of localities and layers, whenever this was possible. Also in this respect he was among the most up to date paleontologists of his time.

Early and sudden death disrupted his studies. He left an unfinished but voluminous manuscript which was published posthumously by K. Beurlen several years later. Although Beurlen did this in an excellent manner, unfortunately he did not check the drawings in the manuscript. Lőrenthey himself was in the habit to scrutinise the figures before publication. Consequently all figures published during his life are extremely reliable to their finest details and to the outlines as well. Several new species are described in this posthumous work but the figures of the type specimens are incorrect and practically useless. For example, the figure of the right chela of *Calappa heberti* (Lőrenthey and Beurlen 1929, pl. 6, fig. 11), borrowed from Lőrenthey's former publications is extremely reliable, while that of the left chela (fig. 12) is incorrect (pl. XXXVIII, figs. 4, 6 in this volume).

Lőrenthey's first papers were published in parallel Hungarian and German versions with identical contents. He presented the same data in preliminary publications without figures (Lőrenthey 1897 and 1898a), and in definite papers with excellent figures and detailed descriptions (Lőrenthey 1898b, c). The short definitions of new species, given in the first two papers satisfy articles 11 and 12 of the International Code of Zoological Nomenclature (ICZN, Stoll et al. 1961). Consequently 1897 is the date of first publication of the species *Cancer szontaghii, Calianassa rákosiensis (=Callianassa rakosiensis), C. brocchii, Pilodius mediterraneus (=Pilumnus r.).* He also mentions *Lambrus* sp. (=*Parthenope* sp.) and *Neptunus* cf. *granulatus (=Portunus monspeliensis)* and redescribes Brocchi's species. The name of *Portunus pygmeus* is erroneously spelled as *P. pygmaeus*, an error which remained uncorrected in the subsequent literature. *Andorina elegans* was described again in two parallel papers (Lőrenthey 1901a, b).

Lőrenthey (1911, 1913) described some Neogene localities from the environs of Budapest. In both the Hungarian and German versions, he mentiones and names several new Badenian decapods without providing any description or figures. Thus the following names do not satisfy article 12 and 16 of the ICZN (Stoll et al. 1961) and should be regarded as nomina nuda: *Dorippe margaretha, Portumnus tricarinatus, Portunus rákosiensis (=Liocarcinus rakosensis), Zozymus mediterraneus (=Chlorodiella mediterranea), Microcorystes latifrons (=Corystites l.).*

The mentioned species were described later (Lőrenthey–Beurlen 1929) together with some other Badenian species: *Maia biaensis (=Maja b.), Maia hungarica (Micippa h.), Calappa praelata* and *Calianassa pseudorákosensis (=Callianassa pseudorakosensis).* As mentioned above the figures of the new species are incorrect. The text reveals that the descriptions were written by Lőrenthey and were left unaltered by Beurlen (Lőrenthey–Beurlen 1929, p. 8). Consequently, according to article 50 of ICZN (Stoll et al. 1961) the names should be attributed to Lőrenthey alone.

In Austria, Toula (1904), in connection with the description of a new species, *Cancer bittneri (="Cancer" b.),* enumerates all Badenian forms known. After the First World War, Glaessner begun the study of Badenian decapods with the aim of completeness. In his first paper on this topic (Glaessner 1924) he did describe only a Carpathian ("Helvet") form, *Macrophthalmus vindobonensis.* In a subsequent publication (Glaessner 1928) he presents a monographic account of all known Neogene species of Austria and introduces the following Badenian forms: *Callianassa norica, Necronectes schafferi, Titanocarcinus vulgaris (='Pilodius' v.), Carpilius antiquus.* In a volume of Fossilium Catalogus (Glaessner 1929) he summarized our knowledge of systematics of fossil decapods. Later he had to leave Europe thus the study of Badenian crabs was interrupted for two decades.

Glaessner's work was followed by Bachmayer. In his paper on injured fossil gastropods (in Papp et al. 1947), he analysed a rich collection of isolated fingers determining them to family or genus level. We have to remember here an amateur collector, K. Oroszy, whose collection provided material for the description of the extremely rich Deutsch-Altenburg fauna (Bachmayer 1953a). In the same year a paper on the Gross-Höflein fauna appeared (Bachmayer–Tollmann 1953a). The authors concentrated mainly on the description of a new species, *Dromilites koberi (=Kromtitis k.),* but mentioned the occurrence of many other forms including new ones. In other publications Bachmayer dealt with sporadic findings (Bachmayer 1950, 1953b, Bachmayer–Küpper 1952) and with the calappids of the Vienna Basin (Bachmayer 1962).

As shown above, most studies until the 1950-s were confined to Hungary and Austria. This tradition was broken, however, in the seventies. Förster (1979a, b) obtained a rich material, mostly isolated fingers but also some carapaces, from Poland. The most interesting localities were Grobie and Korytnica. Yanakevich (1969, 1977) described a new species, *Medaeus moldavicus (=Xantho m.)* and published figures of excellently preserved specimens of *Daira speciosa.* Both species came from reefal structures of Moldavia.

I reported mainly on Hungarian material (Müller 1974a, b, 1976a, b, 1979a) but also on a fine collection obtained from E. Kojumdgieva, Bulgaria (Müller 1979b).

Other papers (e.g. Beurlen 1939, Schouppé 1949, Stancu–Andreescu 1968) contributed by mentioning known Badenian species from new localities.

Two more papers must be mentioned (Hojnos 1923, 1933), which describe a small decapod fauna from an area lying between the northern parts of the Cserhát and the Mátra mountains, but without stating the exact locality. The author of them enumerates *Calianassa desmarestiana, C. subterranea, Gonoplax* sp., *Calappa heberti, Maia miocaenica* and describes a new variety, *Calianassa spinosa* Lőrenthey var. *cserhática.* Unfortunately this material was lost and the determinations can not be checked. The short description of *C. spinosa* var. *cserhática,* without figure, does not permit any further speculations.

The tradition of the study of Badenian decapods dates back for more than a century. In spite of this and in contrast to the presence of some excellent localities, the papers dealing with this topic are not numerous, and even the number of the authors is surprisingly low.

DEPOSITORIES OF BADENIAN DECAPODS

In order to revise previous studies I made attempts to locate the type specimens. Lőrenthey's material is preserved in the Hungarian Geological Survey in good order (Magyar Állami Földtani Intézet, Budapest XIV., Népstadion út 14. H 1142 Pf. 106). The specimens he collected were originally kept at the Palaeontological Institute of the Pázmány Péter University, Budapest (now Eötvös Loránd Tudományegyetem), but later his material was transferred to the Survey. The loss of types was moderate although universities are usually unsuited for preservation of such material. The following losses occurred: *Microcorystes latifrons (=Corystites l.)* the holotype was broken and lost while Lőrenthey was still alive (Lőrenthey–Beurlen 1929, p. 138), *Portumnus tricarinatus*, holotype, and *Maia biaensis (=Maia b.)*, holotype, but the plaster cast of which is extant, and *Callianassa rakosiensis* holotype.

In contrast, the fate of Brocchi's (1883) specimens is unknown. The material described by him was collected by Hebert and Munier-Chalmas, paleontologists of the Sorbonne. Their collection, which includes a high number of specimens from Hungary, is still held at the Université Pierre et Marie Curie, Institut de Macropaléontologie, Paris 7. 2 Place Jussieu, France. With the kind help of professor Pajot, I unsuccessfully tried to locate Brocchi's specimens in this collections. The material was not found in the Muséum National d'Histoire Naturelle, Paris, either. The specimens are most likely lost.

All of Glaessner's and Bachmayer's material is preserved in excellent order in the Naturhistorisches Museum in Vienna (Burgring 7 A. 1014 Wien, Austria). Professor Bachmayer kindly permitted me to study a good portion of them. The type-specimen of *Phymatocarcinus speciosus (=Daira speciosa)* however, was lost (Glaessner 1928, p. 191). The fate of *Microdium nodulosum* is unknown. Many of Bittner's types were also lost. In the inventory of the Geologischer Bundesanstalt, Wien (Rasumofskigasse 23, 1031 Wien, Austria) only *Ranidina rosaliae* is listed as extant (Stojaspal 1975), though according to Bittner (1884, p. 30) some specimens of *Cancer carniolicus* and the holotype of *C. styriacus* should also be kept there*. The holotype of *Cancer illyricus* Bittner is kept at the Institut für Geologie und Paläontologie of the Universität Graz (Heinrichstrasse 26, A-8010 Graz, Austria) as professor A. Fenninger kindly communicated.

The specimens described by Förster (1979a, b) are kept in the collection of the Warsaw University (Universitet Warszawski, Wydział Geologii, Aleja Żwirki i Wigury 93. 02-089 Warszawa, Poland). Yanakevich' specimens are kept in State Teachers College, Tiraspol (Tiraspolski Gosudarstvenni Pedagogitsheski Institut im. Shevchenko, Tiraspol, Moldavian S.S.R., exact address unknown).

Specimens collected by Kojumdgieva (Müller 1979b) are deposited in the Museum of Sofia University (boulevard Ruski 15. Sofia 1000. Bulgaria).

The specimens I collected are owned and supervised by the Palaeontological and Geological Department of the Hungarian Natural History Museum (Természettudományi Múzeum, Föld- és Őslénytár, Múzeum körút 14–16. H-1088 Budapest, Hungary). They are deposited either in the Natural History Museum or are kept by the author (Pál Müller, Káplár u. 11. H-1024 Budapest, Hungary).

The author possesses rubber moulds of all type-specimens he was able to study and indicated as "material seen" in the descriptive chapter. He is prepared to supply casts for scientific study. The only exceptions are *Maia oroszyi (Pisa o.)* and *Necronectes schafferi* the preservation of which did not allow to make a mould.

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* See „Addendum"

METHODS USED IN FIELD-WORK, PREPARATION OF THE MATERIAL

Most of the specimens were collected in open-air exposures. Efforts were made to visit the good outcrops repeatedly, ten to hundred times, to obtain a possibly complete record of the communities. This effort was helped by the circumstance that many of such localities are situated within Budapest or in its close vicinity. If it was possible, I removed bigger blocks from walls of exposures. The blocks were broken with hammer and chisel to pieces of an average size of four to five cm. All pieces were scrutinised with the help of head-band magnifiyng glasses. All recognisible fragments of decapods were retained, including moulds.

The generally poor preservation of the shells often precluded their cleaning up. In such cases we did not attempt to remove the rock covering the shell, but cleaned the external mould of the remnants of the shell and filled it with silicone rubber. After setting, the cast was pulled out cautiously. This procedure permitted the study of both inner and outer surfaces of the same specimen. To prevent sticking, porous rocks were impregnated with diluted warnish before applying the rubber. If shells were well preserved and hard, the common methods of cleaning were used as vibro-tool, needle, chisels, hippers, etc. Dark or shiny specimens were coated with vapour of ammonium chloride before photography. Silicone rubber is highly suitable for making casts or duplicates. Fine-grained plaster of Paris offers many advantages over plastics for making casts. After setting and drying, the casts were impregnated with diluted colourless varnish. To avoid bubble formation both rubber and plaster were applied with fine but strong brushes.

In some cases, e.g. for specimens with thin or narrow parts, epoxy resins might be preferred because of their strength. A resin of low viscosity was used. Its components were mixed with titanium oxide powder to achieve an opaque white cast. A highly suitable resin, fabricated by the Research Institute for Industry of Plastics (Műanyagipari Kutatóintézet, Hungária körút 114. H-1143 Budapest, Hungary) was used. Its components are designated FM-4 and T-30.

Casting with silicone rubber is described by KELLY–MCLACHLAN (1980). This paper defines the terms "cast" and "mould" which are frequently confused, and introduces the idea that casts can be enlarged treating with toluene. This method was independently developed by us. A linear increase of 50% without any distortion can be obtained after a bath in toluene for several hours. Repeating this procedure a linear magnification of 5 to 8 can be obtained.

In some cases the rock was sufficiently friable and the shells well preserved to permit sieving. The use of magnifiyng glasses while sorting the sieved material assures recognition of fossils of all sizes. In comparing such samples with hand-picked ones, a bias-factor was used to correct the number or proportion of small specimens.

DESCRIPTION OF THE LOCALITIES

I describe here those localities where I collected (Table 1.). Sections are given if outcrops were surveyed by us. In other cases I refer to literature. Localities yielding only one or few species are presented in the systematic part. The codes given for the individual layers of the sections are those used in our inventory system in which the first group of letters and numbers refers to the layer itself, regarded as a unit, the second group refers to the serial number of the given species, and the third one is the serial number of individuals.

Outcrops in Budapest or in his closest vicinity were studied most intensively. Most of these localities are Upper Badenian. In subsurface position Middle Badenian rocks occur also but these yielded no decapods so far (Fig. 1).

Tétény-plateau (Tétényi-fennsík, Fig. 2). This upland of moderate height is built up of Egerian and Neogene rocks. The Upper Badenian rocks are exposed in small patches and as a narrow strip near to the northern edge of the height. The total thickness of Badenian layers seldom exceeds six meters.

The roadcut of the **Kamaraerdei út** (MK on Fig. 2) is still accessible. In earlier literature it was known as Katona út or Militärstrasse (Lőrenthey 1911, 1913, Lőrenthey–Beurlen 1929, Strausz 1923). Stratum MK is exposed as a 1 meter layer (Fig. 3) containing moulds and recristallized remnants of corals. At the southern end of the exposure, *Tarbellastraea* sp., *Porites* sp. and *Siderastraea* sp. colonies were found in removed position. A species similar in shape to *Tarbellastraea* but probably belonging to another genus was also found. About 10 meters apart, in the northern part of the cut a small *Porites*-reef occurred, mainly in living position. The matrix is a conglomerate of ill-sorted grains and blocks. The layer was mentioned by us (Müller 1976a), in which paper Kókay (p. 507) enumerated and interpreted the Molluscs. Kókay argued for a well areated, agitated water of a depth much less than 30 meters. The salinity was near to the oceanic one. Decapods of the layer MK: *Dardanus hungaricus* (Lőrenthey), *Petrolisthes magnus* n. sp., *Charybdis (Goniosupradens) mathiasi* n. sp., *Xantho moldavicus* (Yanakevich), *Chlorodiella mediterranea* (Lőrenthey) and *Daira speciosa* (Reuss).

The coral-bearing layer is covered by a calcarenite with abundant remnants of *Cerithium* (layer MKF), by a faint unconformity. Macroscopically, this 1.5 meter layer is a microoncoidal-skeletal grainstone. Decapods: *Pisidia kokayi* (Müller), *Pisa oroszyi* (Bachmayer), *Xantho moldavicus* (Yanakevich), *Pilumnopeus tetenensis* n. sp. and *Brachynotus februarius* Müller.

Roadcut of the streets **Balatoni út** and **Szabadkai út** (MF on Fig. 2). The exposure is accessible. A medium to coarse-grained dark grey sand (Eggenburgian) is unconformly overlain by Upper Badenian layers. The lowermost one is an ill-sorted gravel with blocks up to 20 cm with some bivalve boreholes. A sandy limestone (MFK) (Fig. 3) covers the preceeding layer which is an ill-sorted quartz-sand and gravel-bearing packstone and contains abundant moulds of a *Glycymeris* species and other molluscs. Its thickness is about 0.8 meter. Its fauna was studied by Kókay (quoted by Müller 1976a, p. 506; for *Stylophora* sp. read *Tarbellastraea* sp.).

The following layer is an 1.6 m thick limestone comprising a lower, softer and an upper, harder part, both containing quartz grains. These layers were not studied in details, nevertheless samples were collected from the debris at the foot of the cut, containing blocks of all layers. This mixed material got the code (MFA). The uppermost layer of the cut was studied at another spot be described below (MM and MB). The sequence is illustrated on Fig. 3. A quartz-bearing sandstone appeared at the base of a pit, situated westward of the cut (MA). Kókay's quoted description fits to the units MA and MFA as well. He argued for a depository environment with an agitated water of a salinity similar to that of the oceans. The water-depth did not exceed 30 m but probably it was shallower. The size of quartz grains of these layers decrease toward south suggesting the presence of a shore north of the site built up of sands and gravels (probably coming from Carpathian layers) and a bottom gently sloping southwards.

Table 1

Index of Badenian decapod localities

Country	Locality Layer, Site	Zone	Page
Hungary	Budapest, Tétény-plateau		
	MK	3	36
	MKF	4	36
	MF	3	36
	MFA	3	36
	MFK	3	36
	MA	3	36
	MB	4	39
	MM	4	39
	MDG	4	39
	MJL	4	39
	MBH	4	39
	MUO	4	39
	Diósd		
	MDZ	3	39
	MDN	?4	40
	Bia		
	MNA	3	40
	MN	3	40
	Budapest, Rákos		
	MR	3	40
	MRZ	3	40
	MR45	3	40
	MR8	3	40
	MRL	3	41
	MRO	3	41
	MRF	3	41
	MRC	4	42
	MRS	4	42
	Budapest, Kerepesi út		
	MKC	3	42
	Budapest, Gyakorló út		
	MGY	3	42
	MGF	4	43
	Budapest, Örs vezér tere		
	MOH	3	42
	MOE	4	43
	Budapest, Mező I. út drilling H-34		
	MH34	3	43
	Budapest, Telepy utca		
	MTE	?3	43
	Visegrád		
	MV	1	44
	MVA	1	44
	Nagymaros–Törökmező		
	MTH	1	44
	MTZ	1	44
	MTM	1	44
Hungary	Zebegény, quarry		
	MZZ	?1	44
	Szob, Damásdi patak		
	MSZ	?1 ?2	44
	Mátraverebély–Szentkút		
	Szent László-forrás	1	44
	Meszes-tető	1	44
	Sámsonháza–Halastó-hegy		
	"Bázishomok"	1	44
	Sámsonháza, Kis-Zagyva völgye		
	"Csúcs-hegy alja"	1	44
	Nyirád		
	MNU	1	44
	Balatonakali, drilling BAK-40		
	BAK	3+4	45
	Kishajmás		
	railway-cut	?1	45
Austria	Gross-Höflein, Fenkquarry		
	MNH	2	45
	Deutsch-Altenburg, quarry		
	DAL	?4	47
	Oslip, sand-pit		
	MOS	?2	47
Poland	Grobie		
	MGR	?1	47
	Węglinek		
	WEG	4	47
USSR (Moldavian SSR)	Koban, Shepteban, Varatik, Gorodishtshe, Bolotino	3	47
Bulgaria	Iasen	?1 ?2	47
	Gorna Mitropolia	?1	47
	Krivodol	?1	47
	Oriakhovo	?3	47
Romania	Transsylvania		
	Tasádfő	?	47
Jugoslavia	Slovenia		
	Zagor	?	47

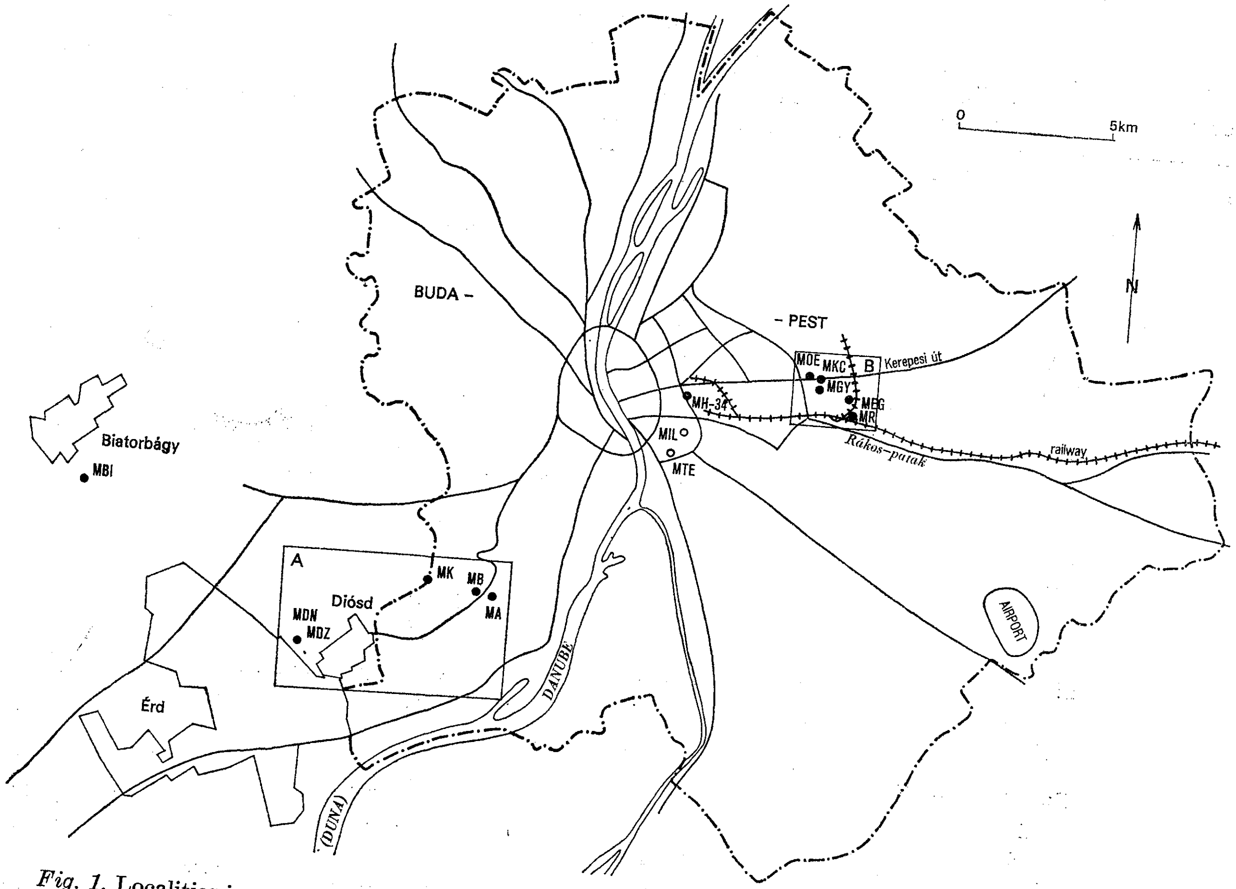

Fig. 1. Localities in and around Budapest. Areas indicated with letters A and B are shown on Figs. 2, 4

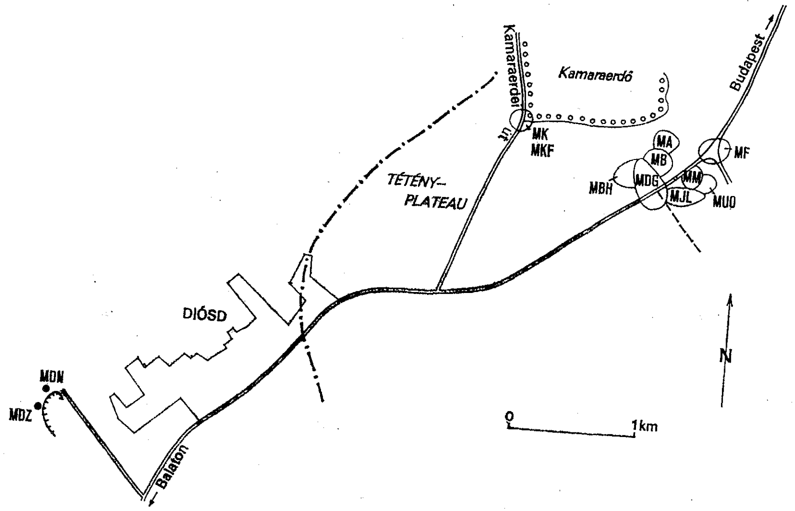

Fig. 2. Sites on Tétény-plateau with the codes of decapod-bearing layers

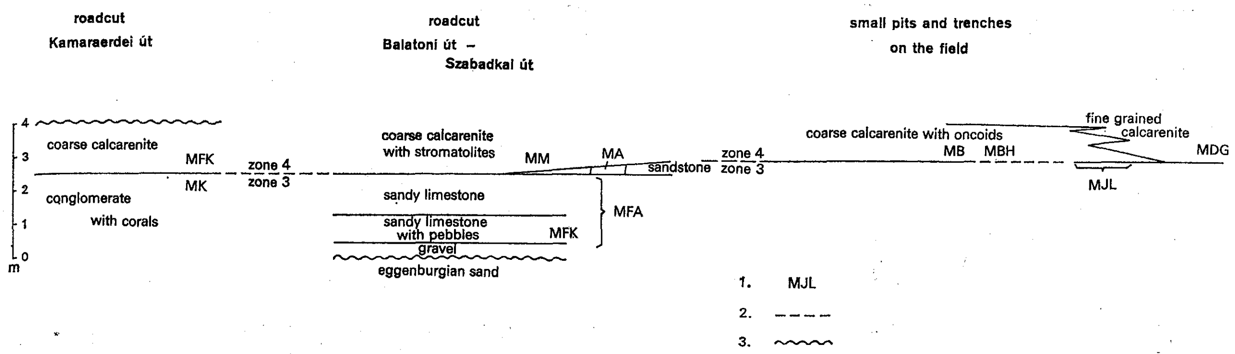

Fig. 3. Simplified section of sites on the Tétény-plateau (horizontally not to scale)
1. Codes of decapod-bearing layers, *2.* boundary of biozones, *3.* unconformity

Almost the same species were found in layers MA, MF and MFK: *Callianassa munieri* Brocchi, *C. pseudorakosensis* Lőrenthey, *C. kerepesiensis* Müller, *Dardanus substriatiformis* (Lőrenthey), *Petrochirus priscus* (Brocchi), *Dromia eotvoesi* (Müller), *Calappa heberti* Brocchi, *Matuta brocchii* Glaessner, *Maja biaensis* Lőrenthey, *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey) and *Micippa hungarica* (Lőrenthey).

The layer covering the quartz-bearing limestones is pure calcarenite containing oncoids and stromatolites and it is almost totally depleted of quartz-grains (MB and MM). The small pits where these rocks were exposed are mostly filled now, but collecting is still possible on the surface or in the road-cut. The oncoids and stromatolites are of cryptalgal and foraminiferal origin (Lelkes–Müller in press). The matrix is microoncoidal grainstone which contains molluscs, predominantly Cerithium. Its thickness decreases toward WSW, with the sessile stromatolitic structures giving place to subglobular oncoids which occur in decreasing number toward WSW. All this suggest a paleoenvironment with a shallow nearshore site where the bottom gently sloped toward south similarly to the presumed situation when the underlying layers were deposited. The molluscs were determined by Kókay (quoted by Müller 1974a, p. 119) suggesting an environment of a shallow sublittoral sea of about 26 to 28‰ salinity. The abundance of *Cerithium* indicates a dense cover of algae or seagrasses.

The diversity of the decapod fauna increases toward south. At the northern part of the section (MM) four species were found: *Pisa oroszyi* (Bachmayer), *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey) and *Brachynotus februarius* Müller. Further south at MB, MUO, MJL and MBH the following species occurred: *Callianassa* sp., *Pisidia kokayi* (Müller), *Pagurus albus* Müller, *Anapagurus marginatus* Müller, *Galathea weinfurteri* Bachmayer, *Matuta brocchii* Glaessner, *'Ebalia' hungarica* Müller, *Parthenope tetenyensis* n. sp., *Pisa oroszyi* (Bachmayer), *Micippa hungarica* (Lőrenthey), *Liocarcinus kuehni* (Bachmayer), *L. rakosensis* (Lőrenthey), *Miopipus pygmeus* (Brocchi), *?Thalamita* sp., *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey), *'Pilumnopeus' tetenyensis* n. sp., *Brachynotus februarius* Müller and *Pachygrapsus hungaricus* Müller.

At the southernmost part of the section the discussed layer is partly covered, partly replaced by a fine-grained ill-sorted calcarenite, probably a packstone, which contains no macrooncoids (MDG). The non-decapod fauna was determined by Kókay (quoted by Müller 1974b, p. 275). According to him the depth of the water was shallower than 30 to 40 meter, the salinity was, at least temporarily, slightly instable, but close to the oceanic one. The rock is exposed in some still accessible shallow trenches. Decapods: *Callianassa* sp. (? = *Semiranina oroszyi* Bachmayer), *Upogebia* sp., *Galathea weinfurteri* Bachmayer, *Anapagurus marginatus* Müller, *Paguridarum* div. sp., *Kerepesia viai* Müller, *Mursia lienharti* (Bachmayer), *Dorippe margaretha* Lőrenthey, *'Ebalia' hungarica* Müller, *Trachypirimela grippi* (Müller), *Miopipus pygmeus* (Brocchi), *Liocarcinus rakosensis* (Lőrenthey), *'Lissocarcinus' szoeraenyiae* (Müller), *Parthenope szaboi* Müller, *P. tetenyensis* n. sp., *Micippa hungarica* (Lőrenthey), *Pisa oroszyi* (Bachmayer), *Xantho moldavicus* (Yanakevich), *Actumnus telegdii* (Müller) and *Pilumnus mediterraneus* (Lőrenthey).

Localities at **Diósd** (Fig. 2). In the southern parts of the Tétény-plateau there is a small outcrop of Badenian rocks. These are exposed in an abandoned quarry and at the edge of a sandpit, along a fault, which tectonically connects Pannonian sands to Badenian and Sarmatian limestones. Site MDZ is situated along this fault on the upper part of the sand-pit that is still worked making the locality accessible. A compact hard limestone contains here abundant moulds of *Tarbellastraea* sp., *Porites* sp. and two other species of reefbuilding corals, mostly in removed position. The matrix is generally ill-sorted and abundant in crab-remnants. The locality was not yet mentioned in the literature. Decapods found: *Pisidia kokayi* (Müller), *Petrolisthes magnus* n. sp., *Galathea weinfurteri* Bach-

Mayer, *Dromia neogenica* (Müller), *Calappa heberti* Brocchi, *Rakosia carupoides* n. gen. n. sp., *Charybdis mathiasi* n. sp., *'Necronectes' schafferi* Glaessner, *Micippa hungarica* (Lőrenthey), *Panopeus wronai* n. sp., *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey), *Chlorodiella mediterranea* (Lőrenthey), *Ch. juglans* n. sp., *?Glabropilumnus* sp., *Crossotonotus diosdensis* n. sp. and *Cancer styriacus* Bittner.

Elsewhere in the just mentionned quarry (Fig. 2) some blocks contained a fauna (MND) which is probably younger than that of MDZ but the contact of the two layers is covered. Decapods: *Callianassa* sp., *Paguridarum* sp., *Pagurus albus* Müller, *Pagurus rakosensis* Müller, *Mursia lienharti* (Bachmayer), *Dorippe margaretha* Lőrenthey, *Parthenope szaboi* Müller, *'Lissocarcinus' szoeraenyiae* (Müller), *Liocarcinus rakosensis* (Lőrenthey), *Miopipus pygmeus* (Brocchi), *Actumnus telegdii* (Müller).

Bia. At the western edge of an upland connected to Tétény-plateau, Badenian and Sarmatian strata are exposed along a valley-side. The name of the site is "Nyakaskő", and it was described among others by Strausz (1924) and by Schafarzik–Vendl (1929). At the lower part of the section there is a silt-layer (MNA) (Table 1.). The silt contains deformed, abundant moulds of *Turritella* sp. and other molluscs. Decapods found: *Callianassa munieri* Brocchi, *Mursia lienharti* (Bachmayer), *Maja biaensis* Lőrenthey, *Portunus* cf. *monspeliensis* (A. Milne-Edwards). The silty layer is covered by four to five meter thick sandy limestone. This contains a rich mollusc fauna, mostly in the form of moulds (MN) (Table 1.). Decapods: *Callianassa munieri* Brocchi, *C. pseudorakosensis* Lőrenthey, *Dromia eotvoesi* (Müller), *Calappa heberti* Brocchi, *Matuta brocchii* Glaessner, *Mursia lienharti* (Bachmayer), *Maja biaensis* Lőrenthey, *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey).

A group of sites (Figs. 1, 4, 5), which yielded the most diverse and best preserved known crab fauna of the Paratethys, is situated in the eastern part of Budapest, in and around the classic site Rákos. The sequences in this area were described in several publications and was recently summarized by Kókay–Mihály–Müller (in press.).

Rákos. This exposure is a railway-cut excavated in the second half of the last century and subsequently deepened and widened several times. The still accessible exposure consists of several layers of Badenian and Sarmatian age (see section in Fig. 5). The section was described by Szabó (1879), Franzenau (1881), Vadász (1906) and by Schafarzik and Vendl (1929). Brocchi's (1883) fauna came from here. Layers below MRC (see section, Fig. 5) contain tuffaceous minerals which are partly reworked from Upper Carpathian dacitic tuffs erstwhile covering slopes and hills eastwards. Some eruptions might have occurred during the deposition of layer MRF, since the potassium-argon age of this layer is much younger (13.4 ± 0.6 MYBP) than that of a slightly lower one (layered tuffite below MR8, age: 15.6 ± 0.8 MYBP, Balogh–Árva-Sós–Pécskay 1980). Most likely the biotite of the lower layer originated exclusively from older tuffs, while that of MRF got crystals from a new eruption as well.

A *Porites*-reef (MRZ) in the eastern part of the cut forms a 1.5–2.0 meter thick lens. It was a patch-reef built mainly by *Porites* sp. which was preserved as moulds, mostly in living position. Few specimens of *Tarbellastraea* was also found. The 5–10 cm thick and 0.5–1.0 m tall coral branches are embedded in a tuffaceous limestone. Some of the corals are encrusted by calcareous red algae, probably by *Neogoniolithon* sp. Occasionally bryozoans participated in the building. The *Porites* was earlier erroneously determined as *Millepora* (Lőrenthey–Beurlen 1929, p. 35) but in fact no *Hydrozoa* remnants were found so far.

A more or less monospecific coral reef indicates a muddy, shallow environment. *Porites* is one of the corals resistant to fast sedimentation and to muddy water. The matrix, rich in fine particles, argues for a muddy water, too. Decapods (MRZ): *Callianassa munieri* Brocchi, *Pisidia kokayi* (Müller), *Petrolisthes magnus* n. sp., *Galathea weinfurteri* Bachmayer, *Dromia neogenica* Müller, *Calappa heberti* Brocchi, *Matuta brocchii* Glaessner, *Pisa oroszyi* (Bachmayer), *Rakosia carupoides* n. gen. n. sp., *Charybdis mathiasi* n. sp., *Thalamita* n? sp., *Daira speciosa* (Reuss), *Chlorodiella mediterranea* (Lőrenthey), *Ch. mediterranea tetenyensis* n. ssp., *Ch. loczyi* n. sp., *Pilumnopeus paratethyensis* n. sp., *?Glabropilumnus* sp., *Pilumnus mediterraneus* (Lőrenthey), *Xantho moldavicus* (Yanakevich), *?'Necronectes'* cf. *schafferi* Glaessner and *Pachygrapsus hungaricus* Müller.

Sandstone layers MR45 and MR8. These sandstones partly replace, partly cover the just described reef. These rocks are medium-grained, strongly bioturbated, ill-layered and nodular. Most decapods are well preserved but disarticulated. In contrast, aragonite-shelled molluscs are rare, probably their moulds collapsed before the diagenesis of rock. Decapods: *Callianassa munieri* Brocchi, *C. chalmasii* Brocchi, *C. pseudorakosensis* Lőrenthey, *C. rakosiensis* Lőrenthey, *C. kerepesiensis* Müller, *Petrochirus priscus* (Brocchi), *Pagurus rakosensis* Müller, *'Anapagurus' miocenicus* Müller, *Upogebia* sp., *Albunea asymmetrica* (Müller), *Dromia eotvoesi* (Müller), *Calappa heberti* Brocchi, *Mursia lienharti* (Bachmayer), *'Ebalia' hungarica* Müller, *Parthenope szaboi* Müller, *P. tetenyensis* n. sp., *Thalamita fragilis* Müller and *Pilumnus mediterraneus* (Lőrenthey).

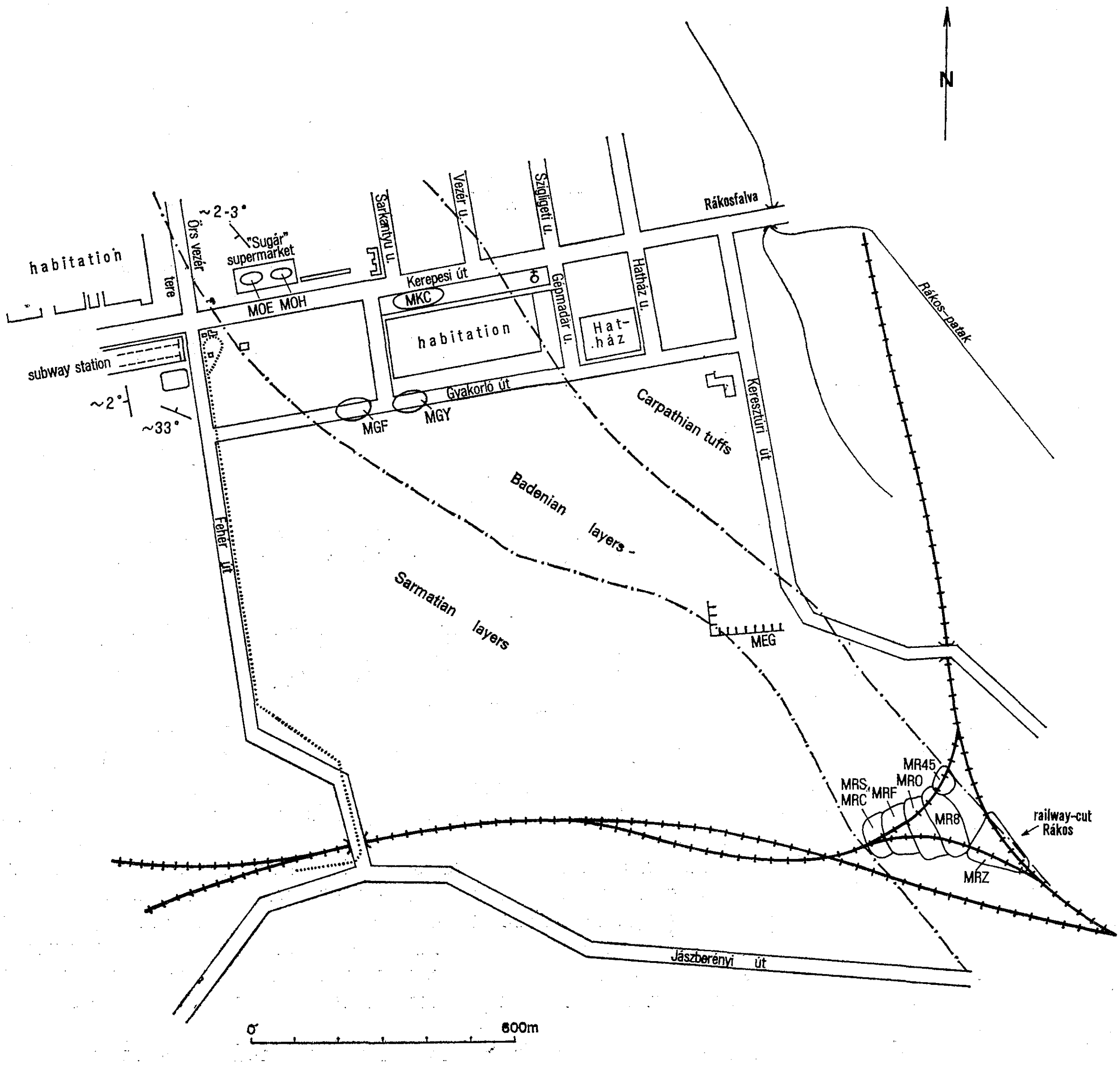

Fig. 4. Localities near Rákos

MR8 limestone is overlain by a sequence of sandy limestone layers. The lower layer is characterized by the abundance of *Linga columbella* (MRL), the upper one (MRO) contains oyster beds. The proportion of quartz grains and tuffigenous particles decreases upwards. The rock of the upper bed is a sandy foraminiferal-molluscan biosparite (Lelkes pers. comm.). Decapods of the both layers: *'Callianassa' pseudorakosensis* Lőrenthey, *'C'. chalmasii* Brocchi, *'C.'* sp., *Upogebia* sp., *Dromia eotvoesi* (Müller), *Calappa heberti* Brocchi, *Matuta brocchii* Glaessner, *'Ebalia' hungarica* Müller, *Petrochirus priscus* (Brocchi), *Thalamita fragilis* Müller, *Portunus (Monomia) miocaenicus* n. sp., and *Pilumnus mediterraneus* (Lőrenthey).

The thickest layer in the railway-cut is a fine-grained ill-sorted sandstone (MRF). Most of the grains are volcanic. The same layer is exposed also at **Keresztúri út** (MEG, Fig. 3). Big pectinids and irregular sea urchins are abundant. The ill-layered sandstone is characterized by dense Callianassid burrows *(Ophiomorpha)*. Decapods: *'Callianassa' munieri* Brocchi, *'C.' chalmasii* Brocchi, *Petrochirus priscus* (Brocchi), *Dardanus* sp., *Pagurus concavus* Müller, *P. rakosensis* Müller, *'Anapagurus' miocenicus* Müller, *Diogenes* cf. *pugilator* Roux, *Albunea asymmetrica* (Müller), *Dorippe margaretha* Lőrenthey, *Calappa heberti* Brocchi, *Matuta brocchii* Glaessner, *Dromia eotvoesi* (Müller), *Parthenope tetenyensis* n. sp., *P. szaboi* Müller, *Mursia lienharti* (Bachmayer), *Pisa* cf. *oroszyi* (Bachmayer), *Liocarcinus rakosensis* (Lőrenthey), *Portunus monspeliensis* (A. Milne-Edwards), *Miopipus pygmeus* (Brocchi), *Pilumnus mediterraneus* (Lőrenthey) and *Actumnus telegdii* (Müller).

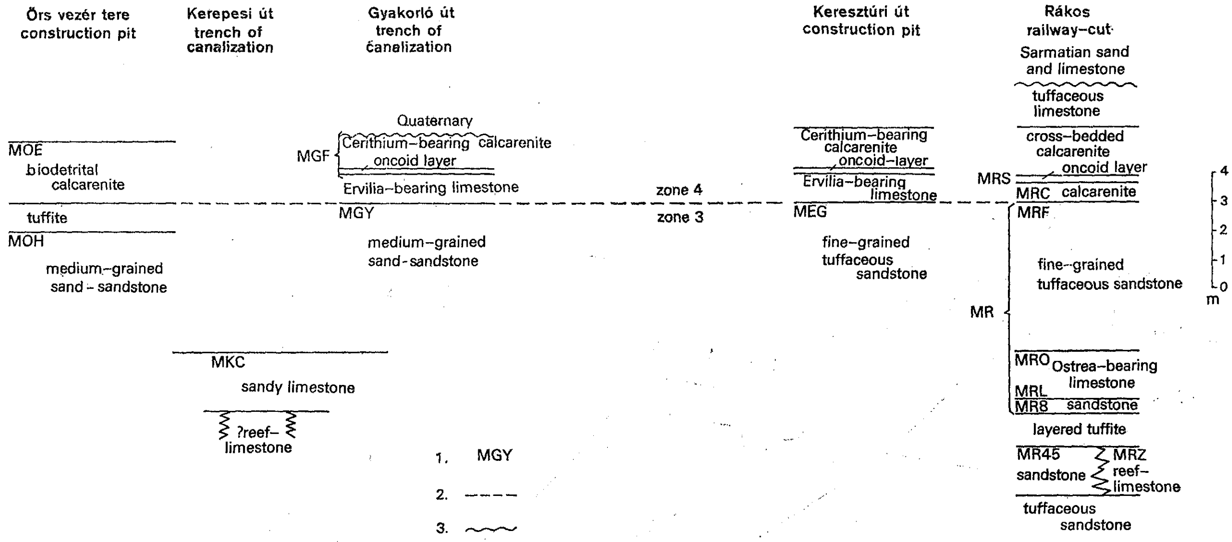

Fig. 5. Simplified section along the localities near Rákos (horizontally not to scale)
1. Code of decapod-bearing layers, *2.* boundary of biozones, *3.* unconformity

This sandstone is covered by a porous mollusc-bearing limestone virtually depleted of terrigenous material (MRC). Its most characteristic molluscs are *Cardium* and *Cerithium* species. Decapods: *Callianassa* cf. *kerepesiensis* Müller, *Dromiidarum* sp. (?Kerepesia), *Matuta brocchii* Glaessner, *Pilumnus mediterraneus* Lőrenthey and *Xantho moldavicus* (Yanakevich).

The limestone is covered by a 0.1–0.2 m thick macrooncoid-bearing layer (MRS); the oncoids are embedded in microoncoidal-ooidal grainstone matrix, containing decapods (Lelkes–Müller in press.). Decapods: *Parthenope tetenyensis* n. sp. '*Pilumnopeus*' *tetenyensis* n. sp., *Pachygrapsus hungaricus* Müller and *Brachynotus februarius* Müller. The oncoidal layer is overlain by a crossbedded calcarenite which did not yield decapods yet.

Another group of localities is situated at a distance of about 1 km from Rákos, around the square **Örs vezér tere** (Fig. 3). Numerous trenches and pits were excavated here in the last twenty years. The sites are described by Strausz (1927), Bartkó–Kókay (1966), Mihály (1969), Müller (1976b, 1979a) and by Kókay–Mihály–Müller (in press.). The most interesting exposures were in trenches along the Kerepesi út, Gyakorló út and in the construction-pit of the "Sugár" supermarket (Fig. 3). The lower layers were almost identical in all exposures, while the upper ones differed from place to place.

The lowest crab-bearing layer was a tuffaceous limestone which contained corals. Its fauna did not differ from that of MRZ in Rákos. A tuffaceous sandy limestone occurred at the corner of the streets **Kerepesi út** and Sarkantyú út (now Gyakorló köz). This 2 m limestone (MKC) corresponds to layers MRC and MRO of Rákos but is was deposited from a more agitated water than it was the case at Rákos (Bartkó–Kókay 1966). Decapods: *Callianassa munieri* Brocchi, *C. kerepesiensis* Müller, *Pagurinae* ?n. sp., *Petrochirus priscus* (Brocchi), *Dardanus substriatiformis* (Lőrenthey), *Galathea weinfurteri* Bachmayer, *Dromia neogenica* Müller, *D. eotvoesi* (Müller), *Kerepesia viai* Müller, *Calappa heberti* Brocchi, *Matuta brocchii* Glaessner, *Mursia lienharti* (Bachmayer), '*Ebalia*' *hungarica* Müller, *Parthenope szaboi* Müller, *P. tetenyensis* n. sp., *Thalamita fragilis* Müller, *Portunus* sp., *Liocarcinus rakosensis* (Lőrenthey), *Miopipus pygmeus* (Brocchi), *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey), *Chlorodiella* sp., *Pisa oroszyi* (Bachmayer), *Maja biaensis* Lőrenthey and *Micippa hungarica* (Lőrenthey).

The cover of the limestone, a four to five meter thick medium-grained sand, was exposed along the street **Gyakorló út** (MGY) and in the construction-pit of **"Sugár"** supermarket (MOH, Fig. 5). It had the appearance of quartz-sand, though its quartz-content was only 5%, the clear particles were mostly glasses. The $CaCO_3$ content was about 40%. Other cristalline minerals were mostly feldspars, mica and clay-minerals. The sand contained big *Pectinids (Flabellipecten leythaianus, Pecten aduncus)*, sea urchins and foraminifers (*Borelis melo* dominated). The crabs were usually well preserved and only moderately fragile, thus they could be collected from sieved material. Decapods found: *Upogebia* sp., *Callianassa kerepesiensis* Müller, *C. chalmasii* Brocchi, *C. rakosiensis* Lőrenthey, *C. pseudorakosensis* Lőrenthey, *C. brocchii* Lőrenthey, *Dardanus substriatiformis* (Lőrenthey), *Diogenes* cf. *pugilator* Roux, *Galathea weinfurteri* Bachmayer, *Dromia eotvoesi* (Müller), *Calappa heberti* Brocchi, *Matuta brocchii* Glaessner, *Mursia lienharti* (Bachmayer), *Maja biaensis* Lőrenthey, *Portunus neogenicus* Müller, *Liocarcinus rakosensis* (Lőrenthey), *Miopipus pygmeus* (Brocchi), *Mioxaiva psammophila* Müller, *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey), *Actumnus telegdii* (Müller) and *?Ocypode* sp.

This tuffaceous sand is covered by a limestone-complex composed of different rocks at different places. At Gyakorló út (Fig. 5) the sand is covered by *Ervilia*-bearing limestone. Its thickness was about 0.4 m. It was covered by a 0.5 m thick *Cerithium*-limestone (MGF). This contained big oncoids with calcarenite-pebble or black pebble nuclei (Lelkes–Müller in press.). Decapods found: *Callianassa* sp., *Pisa oroszyi* (Bachmayer), *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey), *Pachygrapsus hungaricus* Müller.

At Örs vezér tere in the construction-pit of "Sugár" supermarket sand MOH is covered by a tuffaceous layer of moderate thickness (0.5 m). A calcarenite (MOE), which is probably contemporaneous with layer MGF at Gyakorló út, covers the tuffite. The thickness of this limestone is about 2.2 meters. The rock is skeletal grainstone with sparce microoncoids, characterised by small oysters, *Chlamys*, regular and spatangid sea urchins and *Lingula* sp. Due to extremely favourable conditions for preservation, its decapod fauna is the richest known from the Paratethys: *Callianassa kerepesiensis* Müller, *C.* sp., *?Upogebia* sp., *Pagurus rakosensis* Müller, *P. concavus* Müller, *P. albus* Müller, *'Anapagurus' marginatus* Müller, *Dardanus substriatiformis* (Lőrenthey), *Galathea weinfurteri* Bachmayer, *Kerepesia viai* Müller, *Matuta brocchii* Glaessner, *Mursia lienharti* (Bachmayer), *Dorippe margaretha* Lőrenthey, *Palicus* n. sp., *Cancer styriacus* Bittner, *Trachypirimela grippi* (Müller), *Parthenope szaboi* Müller, *P. tetenyensis* n. sp., *Maja biaensis* Lőrenthey, *Micippa hungarica* (Lőrenthey), *Pisa oroszyi* (Bachmayer), *Achaeus magnus* Müller, *'Lissocarcinus' szoeraenyiae* (Müller), *'Xaiva' bachmayeri* n. sp., *Liocarnicus rakosensis* (Lőrenthey), *Miopipus pygmeus* (Brocchi), *Ebalia oersi* Müller, *Palaeomyra globulosa* (Müller), *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey), *Actumnus telegdii* (Müller).

Drilling H-34 in **Mező Imre út,** Budapest (MH34, Fig. 1). Below a layer of quaternary sand and gravel an alternating sequence of fine-grained silty sandstone and calcarenite is present (Kókay pers. comm.), which is underlain by a variegated clay-silt deposit of Middle Badenian. In 25.8–33.0 meter depth, the following decapods were found in Upper Badenian sandstones and limestones: *Callianassa* sp., *Calappa heberti* Brocchi, *Liocarcinus rakosensis* (Lőrenthey), *Pilumnus mediterraneus* (Lőrenthey) and *Macrophthalmus vindobonensis* Glaessner.

At **Telepy utca** (MTE, Fig. 1) a trench was excavated at the beginning of the century. It exposed Badenian limestones, described by Schafarzik (1903). The site yielded one decapod species: *Andorina elegans* Lőrenthey.

Visegrád (Fig. 6). There are poorly exposed layers on a hill-side (Fekete-hegy). The sequence was described by Schafarzik—Vendl (1929), Scholz (1970) and Báldi—Kókay (1970). Probably this is the type-locality of numerous hermatypic corals described by Reuss (1872) as Nagymaros specimens. Tuffaceous layers with blocks of andesite are covered by Lower Badenian marly limestones

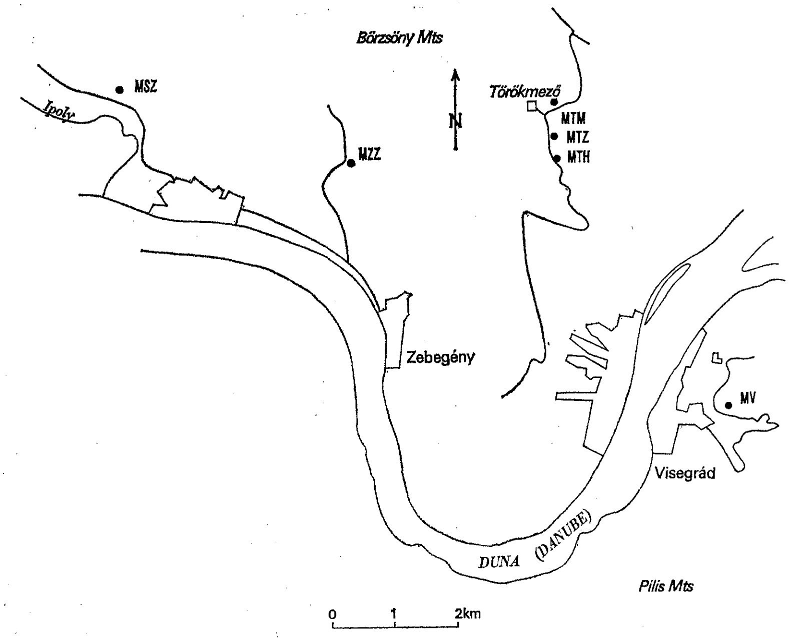

Fig. 6. Localities in the Börzsöny and Pilis Mountains

which contain corals in the lower layers, and calcareous red algae in the upper ones. Fossils can be collected from blocks scattered on the surface. The lack of good exposures precludes exact surveying of the section. Moderately preserved crabs were found in the coral-bearing layer (MV) together with *Tarbellastraea* sp., *Porites* sp., *Stylophora subreticulata* Reuss etc: *Pisidia* aff. *kokayi* Müller, *Galathea weinfurteri* Bachmayer, *Kromtitis koberi* (Bachmayer), *Dynomene emiliae* Müller, *Schizophrys visegradensis* n. sp., *Chlorodiella mediterranea tetenyensis* n. ssp., *Xantho* cf. *moldavicus* (Yanakevich), *Daira speciosa* (Reuss), *Trapezia glaessneri* Müller, *Haydnella steiningeri* n. sp., *Portunus* cf. *monspeliensis* (A. Milne-Edwards), *Carupa* cf. *tenuipes* Dana, *Charybdis mathiasi* n. sp. and *Carpilius antiquus* Glaessner.

Some meters farther uphill a calcareous red algae bearing limestone (MVA) yielded the following decapods: *Paguridarum* sp., *Calappa praelata* Lőrenthey.

Törökmező (Fig. 6). A group of new exposures, not described yet, are situated near the hotel "Törökmező". The cut of a new road exposes a marly tuffaceous limestone containing the giant foraminifer *Heterostegina gigantaeoformis* Papp which is characteristic for Lower Badenian deposits (MTH). Decapods found: *Dardanus arrosor* (Herbst) and *Calappa praelata* Lőrenthey. 500 meter north a small quarry operated in the past. The visible thickness of the only exposed layer is only 0.5 meter (MTZ). This limestone contains abundant moulds of a diverse coral-fauna. The specimens were embedded in removed position. The fine-grained micritic limestone contains poorly preserved decapods: *Pagurus turcus* n. sp., '*Pylopagurus*' sp., *Pisidia* aff. *kokayi* Müller, *Dynomene emiliae* Müller, *Dromia neogenica* Müller, *Dromiidarum* ?n. sp., *Schizophrys visegradensis* n. sp., *Charybdis mathiasi* n. sp., *Trapezia* cf. *glaessneri* Müller, *Daira speciosa* (Reuss), *Actaea turcocampestris* n. sp., *Panopeus wronai* n. sp., *Carpilius antiquus* Glaessner, *Chlorodiella mediterranea* (Lőrenthey), *Ch. mediterranea tetenyensis* n. ssp., *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey), '*Glabropilumnus*' ?n. sp., *Haydnella steiningeri* n. gen. n. sp.

A small pit further north is excavated in a marl-layer which contains molluscs (MTM). The visible thickness of the only layer is about 3 meter. The relation of this marl to the previously mentioned limestones is unknown because the exposures are small and separated. All layers belong to the Lower Badenian substage at Törökmező. This age is supported by studies on calcareous mannoflora (pers. comm. by Nagymarosi). The molluscs have not been studied yet. Decapods: *Ebalia* ?n. sp., *?Calappa* sp.

Quarry at **Zebegény** (MZZ, Fig. 6). A huge quarry is under operation in the Southern Börzsöny Mountains, named as "Bakókút" or as "Bőszob". A soft calcareous red algae bearing limestone is intercalated by a 4 m thick hard layer. This hard micritic calcarenite is full of moulds of a small, branching ahermatypic coral, resembling *Oculina*. Few moulds of *Porites* sp. were also found. Decapods: *Galathea* cf. *weinfurteri* Bachmayer, *Petrolisthes haydni* n. sp., *Callianassa* cf. *munieri* Brocchi, *Chlorodiella mediterranea* (Lőrenthey), *Xantho* cf. *moldavicus* (Yanakevich), '*Pilodius*' *vulgaris* (Glaessner), *Actumnus* ?n. sp., *Ebalia* n. sp. 1 and n. sp. 2.

Szob (MSZ), a site well-known of its molluscs, yielded only few chelae and fingers. The section is situated above a small creek. The lowest layer is a grey and yellow sandstone (about 6 m thick) with sporadic molluscs. It is covered by a 0.1 m thick lumachella-like sand and by a 0.5 m thick brown tuffaceous silt. All layers yielded some decapods: '*Callianassa*' *szobensis* n. sp., *C.* cf. *chalmasii* Brocchi, *Calappa praelata* Lőrenthey, *Cancer* sp.

A group of Badenian outcrops, situated at the northwestern ends of Mátra Mountains, yielded mostly chelae and fingers. The area is described by Noszky (1940, pp. 102–113, 203–205) and by Hámor (in press).

Mátraverebély-Szentkút (Szent László-forrás, Fig. 7). The crab-bearing layers are sandstones. They cover a volcanic sequence. Decapods: *Callianassa pseudorakosensis* Lőrenthey, *C. kerepesiensis* Müller, *Diogenes matrensis* n. sp., *Dardanus hungaricus* (Lőrenthey), '*?Pylopagurus*' cf. *leganyii* n. sp., *?Paguristes* sp., *Calappa praelata* Lőrenthey, *Maja* cf. *biaensis* Lőrenthey, *Parthenope* sp., *Portunidarum* ind. sp., *Liocarcinus rakosensis* (Lőrenthey) and *Pilumnus mediterraneus* (Lőrenthey).

Two sites are situated near **Sámsonháza** (Fig. 7). The exact location of one of these, named on labels as "Halastóhegy-bázishomok" is unknown. The presumed position is shown on Fig. 7. Decapods collected by Harmat: *Callianassa pseudorakosensis* Lőrenthey, *Paguristes cserhatensis* n. sp.

The other site is a small quarry in the valley of the creek Kis-Zagyva. This might be identical with Hojnos' locality (1923, 1933). Decapods: '*Pylopagurus*' *leganyii* n. sp., *Pilumnus* cf. *mediterraneus* Lőrenthey.

Nyirád (MNU Fig. 8). A roadcut is situated 500 meter west of the cemetery of the village Nyirád (Bakony Mountains) along the highway leading to Sümeg. A single 2.5 m layer of limestone is exposed, which is a coarse-grained calcarenite containing abundant moulds of big molluscs and some corals. The non-decapod fossils are not determined yet. Palaeogeographic considerations suggest a Lower Badenian age for the site (Kókay pers. comm.). Decapods found: *Calappa praelata* Lőrenthey, *Palaeomyra globulosa* (Müller) and *Maja biaensis* Lőrenthey.

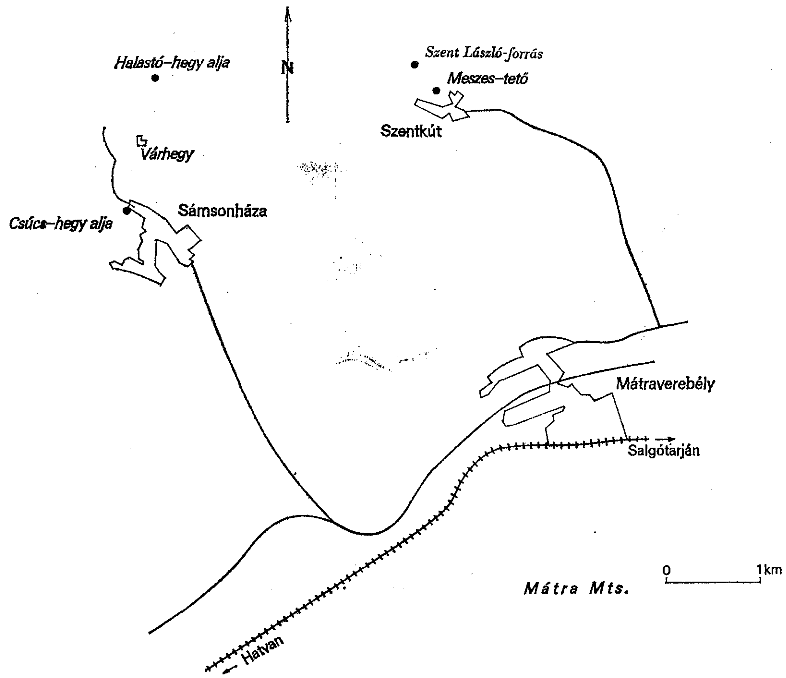

Fig. 7. Localities near Mátraverebély

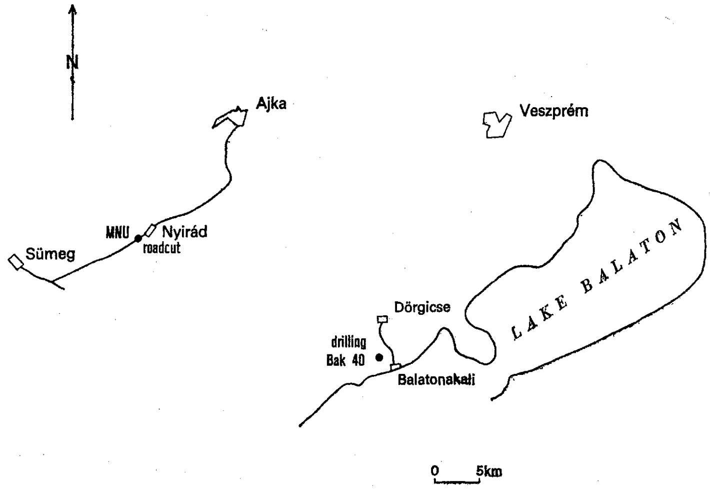

Fig. 8. Sites at Nyirád and Balatonakali

Balatonakali, drilling BAK-40 (Fig. 8). The drilling explored Sarmatian and Upper Badenian layers. In Badenian limestones, the following decapods were found: at 35.0 m, *Matuta brocchii* Glaessner, at 35.5 m, *Callianassa munieri* Brocchi, and at 37.3 m, *Callianassa pseudorakosensis* Lőrenthey, *Pilumnus mediterraneus* (Lőrenthey) and *Actumnus telegdii* (Müller).

Kishajmás, Mecsek Mountains. An exposure of (Lower?) Badenian sandstones is situated in a deep railway-cut between the stations Husztót and Kishajmás-Szatina, along the line Budapest–Pécs. Decapods: six specimens of *Portunus monspeliensis* (A. Milne-Edwards) were collected by P. Solt.

Fertőrákos, drilling FRK-21 (Fig. 9). A thick sequence of (Middle?) Badenian limestone, almost depleted of macroinvertebrates was explored (Hámor and Bohn-Havas pers. com.). A 20 cm thick reef limestone was found at 268 m, which contained decapods: *Galathea* cf. *weinfurteri* Bachmayer, *Porcellanidarum* sp. *(?Pisidia)*, *Actaea turcocampestris* n. sp. and *Haydnella steiningeri* n. gen. n. sp.

Gross-Höflein (Burgenland, Austria, in Hungarian: Nagyhöflány), quarry "Fenk" (MNH, Fig. 9). This quarry, situated in the Leitha-Mountains, was chosen as the facio-stratotype of Badenian limestones, the so-called "Leithakalks" (Steininger and Papp in Papp et al. 1978, p. 194). The

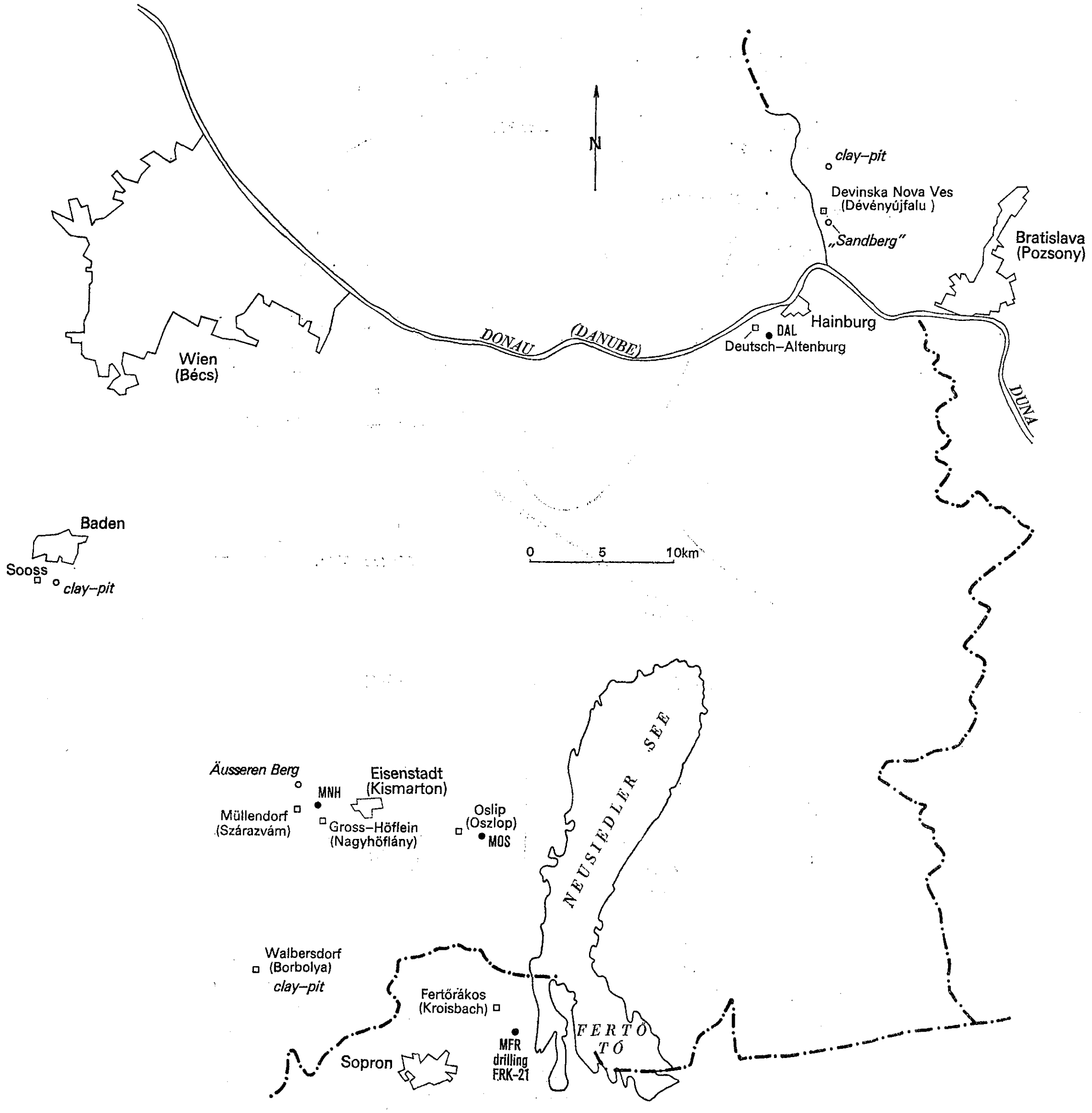

Fig. 9. Localities in the Vienna-basin

sequence was studied and described in details by Dullo (1983). He observed four horizons with reef-building corals. The second horizon from below ("oberer Korallenkalk" of Steininger and Papp in Papp et al. 1978, p. 197) contains a diverse and well-preserved decapod fauna. During a stay of two days, I collected some 200 remnants of crabs. Decapods are most frequent in the upper 0.5 meter of the 2 m thick reef. All species described by Bachmayer–Tollmann (1953) probably originated also from this layer. Corals: *Tarbellastraea* sp. and *Porites* sp. (both in reef-building quantity), *Stylophora* cf. *subreticulata* Reuss, *Acanthastraea* sp. and a thin foliaceous form that occurs also at Törökmező. Decapods (my collection): *Petrolisthes haydni* n. sp., *Dardanus substriatiformis* (Lőrenthey), *Kromtitis koberi* (Bachmayer and Tollmann), *Dromiidarum* ?n. gen. n. sp., *Dynomene emiliae* Müller, *?Maja* sp., *Rakosia carupoides* n. gen. n. sp., *Daira speciosa* (Reuss), *?Carpilius* sp., *Xantho moldavicus* (Yanakevich), *'Pilodius' vulgaris* (Glaessner), *Haydnella steiningeri* n. gen. n. sp., *Panopeus wronai* n. sp. and *Chlorodiella mediterranea* (Lőrenthey).

Decapods, collected and described by Bachmayer–Tollmann (1953): *Callianassa* cf. *rakosensis*, Galathea sp. ind., *Dromilites koberi* n. sp. *(=Kromtitis k.)*, Maia sp. ind., *Necronectes schafferi* Glaessner, *Chlorodopsis mediterranea* Lőrenthey, *Daira speciosa* (Reuss) and *Titanocarcinus vulgaris* Glaessner. Unfortunately it was not possible for me to check these determinations. I could study only the holotype-specimen of *Dromilites koberi*. The matrix of this specimen contained some carapaces and chelae of *Chlorodiella mediterranea* (Lőrenthey). For statistical reasons it seems probable, however, that the list of my collection covers most of the species of Bachmayer and Tollmann.

Deutsch-Altenburg, Niederösterreich, Austria (DAL, Fig. 9). An abandoned quarry is situated on the Hundsheimer Berg (Bachmayer 1953a). Over a basal breccia-conglomerate, which overlays Mesozoic carbonates, a thick layer (about 30 m) of calcarenite is situated, intercalated by a thin layer of bryozoa-marl. The exposure is still accessible. Decapods, described by Bachmayer: *Callianassa* cf. *jahringensis* Glaessner, *C.* cf. *pseudorakosensis* Lőrenthey, *C.* cf. *rakosensis* Lőrenthey, C. sp. ind., *Pagurites substriatiformis* Lőrenthey *(=Dardanus s.)*, *Galathea weinfurteri* Bachmayer, *Ebalia van-straeleni* Bachmayer, *Maia austriaca* n. sp. *(=Micippa hungarica)*, *Maia oroszyi* n. sp. *(Pisa o.)*, *Phrynolambrus weinfurteri* n. sp. *(=Micippa hungarica)*, *Cancer sismondai* H. v. Meyer (? =*C. styriacus*), *Portunites kühni* n. sp. *(=Liocarcinus kuehni)*, *Carcinides oroszyi* n. sp. *(=Liocarcinus o.)*, Carpilius sp. ind. (=Dromiidarum sp. ind.), *Daira speciosa* (Reuss), *Chlorodopsis mediterranea* Lőrenthey *(=Pilumnus mediterraneus)*, Eriphia sp. ind. (? =*Necronectes schafferi*), *Titanocarcinus vulgaris* Glaessner *(=Xantho moldavicus)* and *Pilumnoplax carnuntinus* n. sp.

Oslip (Burgenland, Austria, in Hungarian: Oszlop), sand-pit (Sandgrube Bauer, MOS, Fig. 9). A detailed description and paleoenvironmental analysis is given by Dullo (1983). Over a sand-layer, apparently depleted of fossils, a one meter thick *Ophiomorpha* (*Callianassa* burrows) sand contains many fragments of chelae. The sand is covered by a red-algae bearing limestone. Decapods found during a stay of an hour: *Calappa praelata* Lőrenthey, *Parthenope tetenyensis* n. sp. and *Liocarcinus* cf. *rakosensis* (Lőrenthey).

Other Austrian decapod-bearing sites are described by Glaessner 1928.

Grobie, Holy Cross Mountains, Southern Poland. Described by Förster (1979a). There is no exposure, blocks of red algal limestone are scattered on cultivated terrain. A remnant of a patch-reef of *Tarbellastraea* sp. yielded the crab-fossils (collected by R. Wrona), according to Förster: *?Eriphia* sp. C. *(=Daira speciosa)*, *Pilumnus* sp. (fingers ? =*Pilumnus* sp., carapaces =*Dynomene emiliae*), *?Eriphia* sp. D. *(=Panopeus wronai)*.

Węglinek, Eastern Poland. Described and collected by Krach (1981). A small abandoned quarry yielded decapods, some others were found on cultivated terrain. Decapods: *Callianassa* sp., *Maja biaensis* Lőrenthey, *Xantho moldavicus* (Yanakevich), *Pilumnus mediterraneus* (Lőrenthey) and *Liocarcinus rakosensis* (Lőrenthey).

Other decapod-bearing localities in Poland are described by A. E. Reuss (1867) and by Förster (1979a, b).

Yanakevich (1969, 1977) gave a monographical account about Upper Badenian reefal limestones. In localities at villages **Koban, Shepteban, Varatik, Gorodishtshe** and **Bolotino** (Moldavian SSR.) he collected the following decapods: *Daira speciosa* (Reuss) and *Medaeus moldavicus* n. sp. (=Xantho m.).

Bulgarian sites (Müller 1979b) are described by Kojumdgieva (1975). These are: **Iasen** (yielded *Dynomene emiliae* Müller), **Gorna Mitropolia** (*Ranidina rosaliae* Bittner), **Krivodol** (*Liocarcinus* sp.) and **Oriakhovo** (*Miocyclus bulgaricus* Müller, *Goneplax* cf. *gulderi* Bachmayer).

Tasádfő (Transsylvania, now Romania) a site, described by Lőrenthey (1898b, c) yielded "*Cancer*" *szontaghii* Lőrenthey. No detailed description is available about the sequence of layers.

Zagor (Jugoslavia, Slovenia) a locality, which yielded *Cancer illyricus* Bittner 1884, was not described in details yet.

I visited most of the above mentioned localities, while in other cases I could revise their material. Other, not visited localities, which yielded only sporadic specimens, are mentioned in the descriptive part.

Speciation of *Brachyura* is rather rapid. All known, well-described Pleistocene species are identical with recent ones, but the Pliocene record contains several extinct species (Glaessner 1929). The development of recent genera was also fast. Most of them probably originated in the Miocene or Pliocene (Müller 1979b). Related Badenian and extant species often show defined morphological differences, e.g. *Pachygrapsus hungaricus* vs. *P. marmoratus*, or *Ebalia oersi* vs. *E. edwardsi*. Consequently identification of 12–15 million year old species with extant ones should be done with caution if no link is known from intermediary times. Therefore, even when Badenian forms have morfologically similar recent counterparts, new names were given. In certain cases this is clearly a temporary compromise.

The same approach is not possible on generic level thus we used the names of recent genera without comments if a miocene species falls within the range of variation of recent species of the genus. Single quotation marks ('.....') were used to denote collective genera i.e. when generic determination was not possible due to the incomplete preservation of fossil forms, but relationship with the nominate genus is probable. When no significant similarity with any recent or fossil genus was seen, new generic names were given to new species. Quotation marks (".....") were used for species which were erroneously placed in well-known genera but due to poor preservation or loss of types (e.g. "*Cancer*" *carniolicus*) could not be assigned to the correct genus.

Fingers are the most frequent remnants of fossil crabs. These functionally important organs are generally well calcified and robust. Attempts of their systematic study (Bachmayer 1962, Janssen 1972, Förster 1979a, b) gave only moderate success. The reason for this was discussed in detail by Förster (1979b, p. 254). It should be mentioned that zoologists and paleontologists often neglect to provide detailed descriptions or figures of fingers, making the study of a specimen impossible if original specimens of related forms are not available. Fingers found in carapace-bearing layers, assuring their determination on a higher level of probability, were depicted only for a limited number of species (e.g. Glaessner 1928, Lőrenthey–Beurlen 1929, Bachmayer 1953a). One of the main purposes of my study was to attempt the identification of individual parts, including fingers, of disarticulated decapods. For this reason I compared them with related recent forms. The relative frequency of the pieces in a given layer gives indication about their relation, too. In some localities fingers were found attached to palms. Decoration of carapaces are often similar to that of palms of the same species, which permits determination of isolated chelae. If the mentioned goal was achieved to some extent, a step was made toward the utilization of individual fingers so frequently found in sites from which only molluscs or few other invertebrates have been described so far. It is expected that information on decapods will significantly contribute to stratigraphic, palaeoecologic and palaeogeographic studies. The usefulness of such information comes from the mentioned fast evolution of some decapod groups and the ability for rapid migration of many species (e.g. "Lessepsian migration", Por 1978) due to mobility of adults to a rather prolonged pelagic larval stage of development, making even transoceanic migrations possible (Garth 1974).

SYSTEMATICAL PART

In the following part the species will be presented in the systematic order given by GLAESSNER (1969), for the sake of convenience. This or similar systems were used in most of the palaeontological works during the last decade, therefore a comparison will be eased using GLAESSNER's system. In spite of this the author is fully convinced that GUINOT (1977) and DE SAINT-LAURENT (1980a, b) showed the way to a better understanding of the systematics of *Brachyura.*

In the systematic part the synonym lists will enumerate works containing new data or any other emendations of the given taxon. Consequently, Fossilium Catalogus (GLAESSNER 1929) and Treatise on Invertebrate Paleontology (GLAESSNER 1969) will not be mentioned in spite of their fundamental importance unless they modify the taxonomic status of the species in question.

Abbreviations used in this part, for collections: NMŐ: Department of Natural History Museum of Budapest (p. 34), FI: Geological Survey of Hungary, CA: my collection, NHMW: Natural History Museum in Vienna. Other collections are not abbreviated. The inventory numbers of collection CA, refers to the codes as defined in chapter: "Description of localities" (Table 1).

Abbreviations for parts of crabs: ca.: carapace, ch.: chela, da.: dactylus, ff.: fixed finger.

The type-species of the genera are not given unless they are included in GLAESSNER (1969).

Ordo **DECAPODA** LATREILLE, 1803
Subordo **PLEOCYEMATA** BURKENROAD, 1963
Infraordo ANOMURA H. MILNE-EDWARDS, 1832
Superfamilia **Thalassinoidea** LATREILLE, 1831
Familia **Laomediidae** BORRADAILE, 1903
Genus *Jaxea* NARDO, 1847

Jaxea kuemeli BACHMAYER, 1954

1954. *Jaxea kümeli* n. sp. — BACHMAYER: 64—66, pl. 1, figs. 1, 2.

Material not seen: holotype, ca. 68/1954 ?ch. Martinsdorf: NHMW.

Description: According to BACHMAYER, the body is elongated, rather narrow. The cervical furrow is strong, and situated posteriorly, the linea thalassinica is visible. Some segments of the abdomen are preserved, these are elongated. A left chela, probably belonging here, bears small spines on its surface.

Remarks: According to BACHMAYER, the species is extremely close to *J. nocturna* NARDO. The recent species is more slender.

Familia **Callianassidae** DANA, 1852

Remarks: In conventional classification (GLAESSNER 1969 pp. R477–R478) this family includes not only *Callianassa* and related forms but *Upogebia* as well. The convincing studies of DE SAINT-LAURENT–LE LOEUFF (1979) argued, however, for the phylogenetic independence of the mentioned two genera.

Genus *'Callianassa'* Leach, 1814

Remarks: The most abundant of all fossil decapods are remnants of isolated chelae similar to those of some recent *Callianassid*-genera, as *Callichirus* and *Callianassa* (de Saint-Laurent–le Loeuff 1979). The chelae are highly adapted for digging in having sharp edges. The chelae bear many characteristic features, consequently species are easily distinguished from each other, but the carapace is far less characteristic and rarely preserved as fossil. Most of recent *Callianassids* are strongly heterochelous. Surprisingly, in the diverse Badenian material no evidence of heterochely was observed, as right and left chelae are found in same proportion and in same size as well, with the exception of *C. brocchii.*

Consequently the genus *'Callianassa'* is regarded as a collective taxon.

Recent *Callianassa* species occur in any depth from the littoral zone down to some hundreds of meters, so the presence of their chelae or burrows *(Ophiomorpha* Lundgren*)* are by no means indicators for intertidal conditions (Weimer–Hoyt 1964).

'Callianassa' munieri Brocchi, 1883

Pl. I, figs. 1–7, pl. II, figs. 1, 2.

1883. *Calianassa munieri* n. sp. — Brocchi: 5, pl. 5, figs. 5, 6.
1897. *Calianassa munieri* Brocchi — Lőrenthey: 150, 168.
1898a. *Calianassa munieri* Brocchi — Lőrenthey: 93, 105, 114.
1898b. *Calianassa munieri* Brocchi — Lőrenthey: 105, 132, 155.
1898c. *Calianassa munieri* Brocchi — Lőrenthey: 104.
1904a. *Callianassa munieri* Brocchi — Lőrenthey: 161.
1904b. *Callianassa munieri* Brocchi — Lőrenthey: 30.
1911. *Calianassa munieri* Brocchi — Lőrenthey: 522.
1913. *Calianassa munieri* Brocchi — Lőrenthey: 322.
1929. *Calianassa munieri* Brocchi — Lőrenthey: 33, 62, 63, 64, pl. 2, figs. 19–23, not: fig. 24.
partim 1929. *Portunus rákosensis* n. sp. (merus only!) — Lőrenthey: 173, pl. 12, figs. 22, 23.
1979a. *Callianassa munieri* Brocchi — Müller: 274.

Material not seen, probably lost: syntypes, at least 2 ch. Rákos: ?Sorbonne.

Material seen: 14 ch. Rákos, Kamaraerdő, Bia: NMŐ. About 100 ch. Rákos, Budaörs, Bia: FI. 31 ch. MR-5, 15 ch. MR8-1, 1 ch. MR45-2, 18 ch. MRF-1, 2 ch. MKC-5, 4 ch. MEG-2, 12 ch. MFA-3, 1 ch. drilling BAK-40 m, 1 ch. MZZ-9: CA.

Description: Both right and left chelae are found frequently. The palm is approximately square, slightly longer than high and converging distally. The upper margin is keeled on its proximal 1/3 and bears two small teeth on its distal part. The lower edge is sharp. Small pores are situated along its inner side. The palm is decorated with numerous tubercles confined to two areas on both sides. The dactylus is rounded on its upper margin while keeled on the lower one, where it bears a tooth-like, elongated elevation. At some specimens the dactylus is uncommonly high and stout. The carpus is decorated with a row of teeth on upper edge. Meri were not found in connection with other articles, but they are typically *Callianassa*-like and their size rules out any other species than *C. munieri.*

Stratigraphically it seemed to be restricted to Upper Badenian, zone 3. (see p. 103), but recently a specimen was found in Zebegény (code MZZ), in Lower Badenian stratum. Ecologically the species is bound to fine homogenous sands, it is rather rare or absent in medium-to-coarse grained calcarenites. Known from Budapest, Bia, Balatonakali and Zebegény.

'Callianassa' chalmasii Brocchi, 1883

Pl. II, figs. 3–7.

1883. *Calianassa chalmasii* n. sp. — Brocchi: 6, 7, pl. 5, figs. 7, 8.
1897. *Calianassa chalmasii* Brocchi — Lőrenthey: 150, 160, 168.
1898a. *Calianassa chalmasii* Brocchi — Lőrenthey: 93, 105, 114.
1898b. *Calianassa chalmasii* Brocchi — Lőrenhey:9,129, 130, 155.
1898c. *Calianassa chalmasii* Brocchi — Lőrenthey 102.
1904a. *Callianassa chalmasii* Brocchi — Lőrenthey: 161.
1913. *Calianassa chalmasii* Brocchi — Lőrenthey: 322.
1929. *Calianassa chalmasii* Brocchi — Lőrenthey in Lőrenthey—Beurlen: 33, 65, pl. 2, figs. 15a–15b.
1961. *Callianassa espichelensis* n. sp. — Veiga Ferreira: 479–481, pl. 1, figs. 1–11.
1979a. *Callianassa chalmasii* Brocchi — Müller: 274, pl. 1, fig. 5.

Material not seen, probably lost: syntypes, at least 2 ch. Rákos: ?Sorbonne.

Material seen: about 100 ch. Rákos: FI. 12 ch. Rákos: NMŐ. 53 ch. MR-6, 19 ch. MR8-2, 4 ch. MR45-1, 44 ch. MRF-2, 1 ch. MRO-2, 1 ch. MEG-1, 5 ch. MOH-1, 20 ch. MGY-9: CA.

Description: Both right and left chelae are similarly frequent. The palm is converging distally. Both upper and lower edge sharp. On the inner side, parallel to the edges two rows of pores of setae are present. The upper ones are arranged perpendicular to the longitudinal axis of the limb as they are elongated. Their number is 8 to 9. The lower ones are more numerous as they extend to the immovable finger as well. On the outer side of the fixed finger there is a ridge leading toward the palm. On the cutting edge there is a tooth. The dactylus is moderately stout and bears characteristic pores along two rows.

The species is frequently found in coarser sands and calcarenites too, in contrast to *C. munieri*. Its stratigraphic range is Upper Badenian to Tortonian (in Portugal). Known from Budapest and Portugal.

'Callianassa' rakosiensis Lőrenthey, 1897

Pl. III, figs. 1, 2.

1897. *Calianassa rákosiensis* n. sp. — Lőrenthey: 160, 161, 168, 169.
1898a. *Calianassa rákosiensis* Lőrenthey — Lőrenthey: 105, 114, 115.
1898b. *Calianassa rákosiensis* Lőrenthey — Lőrenthey: 131, 132, pl. 9, fig. 4.
1898c. *Calianassa rákosiensis* Lőrenthey — Lőrenthey: 103–104, pl. 9, fig. 4.
1929. *Calianassa rákosensis* (sic!) Lőrenthey — Lőrenthey in Lőrenthey—Beurlen: 33, 66, 67, pl. 2, fig. 14.
1979a. *Callianassa rákosensis* Lőrenthey — Müller: 274, 276, pl. 1, fig. 4.

Material not seen, probably lost: holotype, 1 ch. Rákos: ?FI.

Material seen: 2 ch. MR-7, 2 ch. MR8-6, 3 ch. MGY-6: CA.

Description: The palm is converging distally. Its upper edge is almost straight, sharp. On the inner side there is a row of 9 to 10 pores. Its lower edge is slightly curved, proximally the curvature is stronger than distally. The lower edge is sharp and keeled. A ridge is situated on the outer surface of the fixed finger, which is curved and its portion on the palm is subparallel to the longitudinal axis, more proximally it is bended upwards. Around the proximal end of this ridge the surface is decorated by tiny tubercles.

Remarks: The species is remarkably similar to *C. chalmasii* in its general form, size and the distribution of pores. The form of the ridge on the finger and the position of the tooth is completely different in the two species and no trend was observed toward a transitional form. Thus their independence seems highly probable though a close relation is likely.

Callianassa brocchii Lőrenthey, 1897

Pl. III, fig. 3.

1897. *Calianassa brocchii* n. sp. — Lőrenthey: 161, 168, 169.
1898a. *Calianassa brocchii* Lőrenthey — Lőrenthey: 106, 114, 115.
1898b. *Calianassa brocchii* Lőrenthey — Lőrenthey: 132–134, 155, pl. 9, fig. 5.
1898c. *Callianassa brocchii* Lőrenthey — Lőrenthey: 104–105, pl. 9, fig. 5.
1929. *Calianassa brocchii* Lőrenthey — Lőrenthey in Lőrenthey—Beurlen: 33, 64, pl. 2, fig. 13.
1979a. *Callianassa brocchii* Lőrenthey — Müller: 274.

Material seen: holotype, ch. Rákos, M2329: FI. 2 ch. Budafok: FI. 3 ch. MGY-24: CA.

Description: All known specimens are right chelae suggesting heterochely in this single Badenian species. The palm is rather convex on its outer surface while flat on the inner one. Its outline is close to a square. The upper edge is not sharp while the lower one is decorated with a characteristic saw-like row of small denticules. Just on the inner surface of this edge there is a row of pores situated densely on the palm sparcely on the finger. The cutting edge of the fixed finger is denticulated with sharp teeth. The dactylus is strong, rather stout.

Remarks: The species, because of its probable heterochely and by the form of its finger is closer to some recent forms (e.g. *Callianassa gilchristi*, *C. natalensis*, cf. Barnard 1950, p. 510) than any of the other Badenian forms. The saw-like lower edge, however, separates it from the mentioned species.

'Callianassa' pseudorakosensis Lőrenthey in Lőrenthey—Beurlen 1929

Pl. III, figs. 4, 5, pl. IV, figs. 1–6, pl. V, figs. 1–4.

1929. *Calianassa pseudorákosensis* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 33, 67, 68, 69, pl. 4, figs. 16, 17, 18.
?1953. *Callianassa* cf. *pseudorakosensis* Lőrenthey — Bachmayer: 241.
1976a. *Callianassa pseudorakosensis* Lőrenthey — Müller: 507.

Material seen: lectotype, designated herein: right ch. with dactylus, Rákos, M 139 pl. 3, figs. 4, 5 pl. 4, fig. 1. Paralectotype: ch. Felménes, Transsylvania, M 2334: FI.

Material not seen, probably lost: paralectotypes: 9 ch. Rákos, 1 ch. Budafok, 10 ch. Bia, 26 ch. Felménes, numerous ch. Mátraverebély–Szentkút (?Szent László-forrás).

Material seen: 33 ch. Mátraverebély–Szentkút, M83/164, 1 ch. Mátraverebély–Szentkút, M83/160, 13 ch. M83/152: NMŐ. 19 ch. MR-4, 6 ch. MR8-5, 3 ch. MRO-1, 6 ch. MGY-7, 22 ch. MFA-1, 22 ch. MFK-1, 7 ch. MA-3, 5 ch. Bántapuszta, Várpalota, Carpathian stage, ch. BAK-40, 37.3 m: CA.

Description: There are two distinct forms, occurring on both right or left chelae, most probably due to a dimorphism. The palm is the same at both forms. It is rectangular, rather thick. The upper edge is keeled on its proximal half while rounded on the distal one. The lower edge is sharp, straight or slightly curved. There is a row of pores along this edge. The index is short and stout. The two forms differ in the existence or absence of a tooth on the index. Anterior this tooth the cutting edge is finely denticulated. The dactylus is curved, stout, its cross-section is circular. It bears a strong basal tooth.

Ecology: The species is most abundant in rather coarse sands and occurs frequently also in limestones. Probably its robust chela fits for digging sediments containing big particles.

Stratigraphically the species is characterised by a long record since it is known from the Carpathian to the Upper Badenian, zone 3. The Carpathian and the Lower Badenian specimens are much bigger than the Upper Badenian ones.

'Callianassa' kerepesiensis Müller, 1979

Pl. VI, figs. 1–6.

1976a. *Callianassa* sp. nov.? — Müller: 508, pl. 1, figs. 1–4.
1976b. "*Callianassa*" *kerepesiensis* n. sp. — Müller: 149, 150, 154, pl. 1, figs. 1–5.
?1979a. *Callianassa kerepesiensis* Müller — Förster: 90, text-fig. 1, pl. fig. 5.
1979a. *Callianassa kerepesiensis* Müller — Müller: 274, 276, pl. 1, figs. 1–3.

Material seen: holotype, pl. VI, fig. 1–2, MKC-2-1: CA. Paratypes, 2 ch. MA-2, 100 ch. MKC-2: CA. 2 ch. MA-2, 50 ch. MOE-11, 30 ch. MGY-8: CA.
1 ch. Mátraverebély–Szentkút, M83/153: NMŐ.

Description: The palm is rectangular, slightly elongate at some specimens. Both lower and upper edges are sharp. There is a characteristic undulating region on the inner surface near the lower edge. The fixed finger is rather slender. It bears two teeth, one, almost rudimentary, is situated near the proximal end of the finger, the bigger one is near to its end. There is a denticulated cutting edge between the two teeth, at least this is observable on bigger specimens. The dactylus is slender and it bears two rows of pores.

Stratigraphically, the species was found near the beginning of the Badenian (Szentkút) as well as at its end (MOE). Ecologically it was a tolerant species as it was found in many different types of sediments.

'Callianassa' cf. **kerepesiensis** Müller 1979

Pl. VII, figs. 1, 2.

1979a. *Callianassa kerepesiensis* Müller — Förster: 90, text-fig. 1, pl. 1, fig. 5.

Material not seen: right ch. with carpus, Nawodzice: Coll. Univ. of Warsaw.

Material seen: ch. MOE-12: CA.

Remarks: As Förster stated, the species is remarkably similar to *C. kerepesiensis*, but its fixed finger bears only one, rudimentary tooth near its end, and the undulated region lacks on the inner side of the palm.

'Callianassa' cf. jahringensis Glaessner 1928*

1928. *Callianassa* cf. *jahringensis* n. sp. — Glaessner: 166–167.

Material not seen: ch., 3 da. Vöslau: NHMW.

Remarks: According to Glaessner, the palm is square but the two edges are rather convex. On the other hand the specimen, as far as this is possible to be observed on figures, is not very much like *C. jahringensis*, Carpathian species. Most probably it belongs to a new species. Stratigraphically it is confined to Lower Badenian.

'Callianassa' sismondai A. Milne-Edwards 1860

1928. *Callianassa sismondai* A. Milne-Edwards — Glaessner: 168, giving the former synonyms.

Material not seen: 2 ch., da. Spielfeld: NHMW.

'Callianassa' norica Glaessner 1928

1928. *Callianassa norica* n. sp. — Glaessner: 169–170, text-fig. 1., pl. 3, figs. 3, 4.

Material not seen: 5 ch., 1 fixed finger, 8 da. Spielfeld, holotype 1860/V/8 b: NHMW.

Remarks: The species is different from any Badenian forms as its palm is converging proximally.

Callianassa sp. ind.

Pl. V, figs. 5, 6.

1954. *Semiranina* n. gen. *oroszyi* n. sp. — Bachmayer: 66, 67, pl. 1, figs. 4, 5.
1974b. *Callianassa oroszyi* (Bachmayer) — Müller: 276, pl. 1, fig. 3.

Material not seen: holotype of *Semiranina oroszyi*, ca. Deutsch-Altenburg, 69/1954: NHMW.

Material seen: 3 ca. MDG-1: CA.

Description: The specimens represent the anterior parts of carapaces of Callianassa, being a semicylindrical, smooth part situated before the cervical groove.

Remarks: The specimens do not offer any possibility for a determination beyond the generic level as any carapace of this kind is essentially the same.

?Callianassa szobensis n. sp.

Pl. VII, figs. 3, 4, ?figs. 5, 6.

Material seen: holotype, ch. MSZ-1-1. Other, ?da. MSZ-2-1: CA.

Locus typicus: Szob, Börzsöny Mountains (Fig. 6), Nagyfeltárás.

Stratum typicum: Lower Badenian NN 5 Nannozone (pers. comm. A. Nagymarosi).

Derivatio nominis: From the village Szob, near the type-locality.

Diagnosis: Long, flat, rectangular palm decorated by big granulae near the base of the fixed finger.

Description: The palm of the left chela is twice as long as high, quadratic. The upper and the lower margins are sharp, moderately convex on the ends. On the inner side, along the margins there are rows of pores. Characteristic is the decoration on the outer side. Near the base of the fixed finger there are strong tubercles scattered around a horizontal line. This line can be followed up to the proximal 3/5 of the total length of the palm. The fixed finger is moderately long. There is a prominent tooth on it. Between the base of the finger and this tooth the cutting edge is denticulated. A finger, probably a dactylus was found in the same layer, characterised by rows of tubercles.

Remarks: The peculiar decoration on the outer side does not suggest any closer relationship with recent or fossil *Callianassids*, though the species might belong to other families as well.

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* After closing the manuscript, I studied the material. The specimens belong to *'C'. pseudorakosensis* Lőrenthey.

Familia **Upogebiidae** Borradaile, 1903

Remarks: According to de Saint-Laurent–le Loeuff (1979), the groups of *Callianassa* and *Upogebia* should be regarded as different families as the similarities among them are due to convergency owing to their similar habits.

Genus *Upogebia* Leach, 1814

Upogebia sp. (div.?)

Pl. VIII, fig. 1, ?figs. 2–6.

1974b. *Upogebia scabra* n. sp. — Müller: 276, 283, pl. 1, figs. 1, 2.
1979a. *Upogebia radula* (error!) — Müller: 274.
1979a. *Upogebia* sp. — Müller: pl. 2, figs. 1–3.

Material seen: holotype of *Upogebia scabra,* MDG-3-1: NMŐ. 2 ch. MDG-3, ch. MRO-5, 3 ch. MOE-10, 6 ch. MGY-10: CA.

Description: The carapace is typically that of *Upogebia* but offers little if any possibility for a determination beyond generic level. Only the precervical part was calcified in an extent making possible fossilisation. The posterior half of this part is elliptical while the anterior is slightly diverging. Three furrows are arranged longitudinally. The surface between the furrows is rough.

Remarks: As in the case of *Callianassa,* the carapace of *Upogebia* is rather uniform making specific separations impossible. The chelae are probably better for determination but at present the scarce material does not allow descriptions. Possibly two or even more species occurred in Badenian seas.

Superfamilia **Paguroidea** Latreille, 1803
Familia **Paguridae** Latreille, 1802
Subfamilia *Pagurinae* Latreille, 1802
Genus *Pagurus* Fabricius, 1775

Remarks: This abundant and widespread genus was rarely recognised as a fossil but numerous species was described under its name, partly because the confusion of *Pagurus* and *Dardanus,* partly because the wellknown name was used as a collective one.

Ecology: *Pagurus*-species generally avoid shallow waters and intertidal regions. Most species live below 40 meters down to several hundreds of meters. Presumably most species are euhaline.

Pagurus rakosensis Müller, 1979

Pl. X, figs. 1–5.

1979a. *Pagurus rakosensis* n. sp. — Müller: 274, 277, 286, pl. 5, fig. 3, pl. 6, fig. 1.

Material seen: holotype, ch. MR-1-1. Paratypes, 3 ch. MGY-11, 14 ch. MOE-6. Others, 2 ch. MR8-6, ch. MEG-5: CA.

Description: The palm of the right chela is elliptical in cross-section. Its upper margin is straight, slightly flattened, decorated by scattered tubercles. On the median part of the outer surface there is a row of tubercles. Between the upper edge and the median line there is a slightly depressed area. The lower edge of the palm and fixed finger forms an arc the curvature of which is stronger near the proximal end. On this edge there are medium-sized tubercles. The other parts of the outer surface are covered with smaller tubercles. The inner side of the palm is decorated with short transverse ridges of squamae-like protuberations. The tip of the fixed finger is hard, strongly calcified.

Remarks: The species is close to *P. bernhardus* (L.) but its decoration is less coarse. An other similar species, *P. variabilis* (A. MILNE-EDWARDS–BOUVIER) has an even finer granulation on surface.

Ecology: The species is known from localities of finer or coarser quartz-sand or of calcarenite with shell-debris. It was not found either in deposits of shallow sublittoral environments, or in coral-reefs.

Pagurus concavus MÜLLER, 1979

Pl. IX, figs. 1–6.

1979a. *Pagurus concavus* n. sp. — MÜLLER: 274, 277, 286, pl. 7, figs. 1–5.

Material seen: holotype, ch. MOE-1-1. Paratypes, 23 ch. MOE-1. Others, 130 ch. MOE-1, 1 ch. MEG-4, 2 ch. MOH-3: CA.

Description: Both of the right and left chelae are known. Both are characterised by three strong finely denticulated carinae on the outer side of the palm. Consequently two depressed longitudinal areas are delimited. The upper margin of the palm of the right (crusher) chela is flattened. The upper and the median carinae are parallel to each other while the lower one is situated at the lower margin and is arched. The outer and upper surfaces are densely covered by small granulae. The fixed finger is triangular in cross-section. The left (nipper) chela is much smaller and more slender than the other. The upper carina is less developed. The decoration is the same as that of the right chela. The index is relatively long. The teeth of the cutting edges, according to their role, differ on both sides as shown in the illustrations.

Remarks: The chelae are rather similar to those of *P. alatus*, a recent species, but the latter has an arched upper margin on the right palm. The depressions are much deeper in the recent species. *P. sculptimanus* has a strongly denticulated upper margin on the palm. The Badenian species is closely related to *P. alatoides* SECRETAN, Burdigalian species from Courennes, France (PHILIPPE-SECRETAN 1971, p. 15). The Burdigalian species has dentated carination on both chelae, on the upper and on the median carinae there are 5 to 6 prominent teeth.

Ecologically and stratigraphically *P. rakosensis* and *P. concavus* seem to be close to each other.

'Pagurus' albus MÜLLER, 1979

Pl. XI, figs. 1–3.

Material seen: holotype, ch. MOE-2-1. Paratypes, 5 ch. MOE-2. Others, ?ch. MR-3, ch. MJL-2: CA.

Description: The right chela is rather stout. The outer surface is densely covered with tubercles which are spiniform on the upper margin and at the distal end of the lower one. The tuberculae are rather irregularly scattered on the surface. The lower margin is strongly curved, its outline is circular. The fixed finger is turned upwards.

Remarks: The only species which reveals similarities with *P. albus* is *P. sculptimanus* (ZARIQUIEY ALVAREZ 1968, p. 234.) with similar decoration and outline. The deep furrows are absent from the Badenian species, however.

Genus *Anapagurus* HENDERSON, 1886

Remarks: The recent genus includes several species having simple chelae with few diagnostically useful features. Unfortunately, good illustrations lack in the literature. Consequently the two Badenian species can not be compared properly with recent ones.

'Anapagurus' miocenicus MÜLLER, 1979

Pl. XI, figs. 4–9.

1979a. *Anapagurus miocenicus* n. sp. — MÜLLER: 274, 277–278, 286, pl. 6, figs. 2–5.

Material seen: holotype, ch. MGY-1-1. Paratypes, MGY-1. Others, 6 ch. MR8-9, ch. MEG-6: CA.

Description: Few characteristic features are on the chela. Even on SEM micrographs only a small protuberance was found on the proximal end of the palm. The teeth of the cutting edge are characteristically *Pagurinae*-like, bifurcating proximally. The palm is extremely stout. The lower edge is strongly curved.

Remarks: This featureless species is similar to its recent relatives, which have generally more slender chelae.

'Anapagurus' marginatus Müller, 1979

Pl. XII, figs. 1–5.

1979a. *Anapagurus marginatus* n. sp. — Müller: 274, 278, 286–287, pl. 4, figs. 1–3.

Material seen: holotype, ch. MOE-3-1. Paratypes, 8 ch. MOE-3, ch. MJL-3, 6 ch. MDG-5: CA.

Description: The palm of the species is rather variable in its general form, there are rather stout and more slender specimens. The lower margin is slightly curved and there is a carina on its outer part. The carinae consist of very fine tubercles. There is a proximal elongated tooth on the upper part of the palm. The outer surface is rather smooth, on some specimens a rudimentary granulation is visible. The teeth on the cutting edge are typically Pagurinae-like.

Remarks: The chelae are more characteristic than those of *A. miocenicus*, having a characteristic carina on the lower edge. Probably this feature separates this species from other *Pagurinae* species.

?Pagurus turcus n. sp.

Pl. XII, fig. 6, pl. XIII, figs. 1–4.

Material seen: holotype ch. MTZ-17-1. Paratype, 2 ch. MTZ-17: CA.

Locus typicus: Nagymaros–Törökmező, southern Börzsöny Mountains, small quarry, code MTZ.

Stratum typicum: Lower Badenian.

Derivatio nominis: The name of the locality, Törökmező, means "meadow of Turks", lat.: Turcus, campus.

Diagnosis: Right chelae decorated by randomly scattered tubercles.

Description: The right chelae are moderately stout. Their upper edge is straight, the lower one curved. There are no rows on the surface, instead the tubercles are apparently randomly distributed on the surface. Their size varies within a narrow range. The smaller ones are distributed among the others mainly at the base of the fixed finger. The inner surface is decorated with asymmetrical, bigger elevations resembling scales.

Remarks: The chela is unlike any other fossil Pagurids by its peculiar decoration. On the other hand it was by no means possible to compare it with all living species as most illustrations are diagrammatic, offering few possibilities for comparison with fossil species. No similar form lives in the Mediterranean.

Genus *Pylopagurus* A. Milne-Edwards–Bouvier, 1891

'Pylopagurus' leganyii n. sp.

Pl. XIV., figs. 1–3., ?figs, 4, 5.

Material seen: holotype, ch. M62/3253. Sámsonháza–Csúcs-hegy alja: NMŐ. ?internal moulds of 3 ch. MTZ-18: CA.

Locus typicus: Sámsonháza, Csúcs-hegy alja (Noszky 1940).

Stratum typicum: Lower Badenian.

Derivatio nominis: From F. Legányi, amateur palaeontologist, who collected the type-specimen.

Diagnosis: Stout right chela densely covered by blunt tubercles.

Description: The chela is very stout, but flattened near the lower distal part. The lower margin is strongly curved, especially at the fixed finger. The upper margin is straight, flattened. The outer surface is decorated with an extremely dense array of blunt tubercles, scattered irregularly. The cutting edge of the fixed finger is very wide, having teeth on its both sides. The fixed finger is bended inward.

Remarks: In its general form, the chela is like recent *Pylopagurus* species, as *P. liochele*, *P. ungulatus* but similarity fails in details.

Pagurinae sp. n.? div.

Pl. XV, figs. 1–5.

Material seen: ch. MKC-11, ch. MRF-12: CA.

Remarks: Two right chelae, belonging to two different species certainly distinct from any other Badenian species by their peculiar decoration. Since no fixed fingers were found they will not be described here as new species yet.

Subfamilia *Diogeninae* ORTMANN, 1892
Genus *Diogenes* DANA, 1851

Diogenes matrensis n. sp.

Pl. XVI, figs. 1–3.

Material seen: holotype, ch. Mátraverebély–Szentkút, M61/2633, leg. Streda: NMŐ.

Locus typicus: Mátraverebély–Szentkút (Fig. 7), probably the lowest layer at the spring "Szent László-forrás".

Stratum typicum: Lower Badenian.

Derivatio nominis: From the Mátra Mountains situated in the vicinity of the type-locality.

Description: The palm is flattened, high, short. The lower edge is gently curved, convex proximally, slightly concave distally. It is rather sharp, the keel is formed by a row of dense teeth. The upper edge is also slightly convex decorated with three rows of rather irregularly arranged tubercles. The outer side of the palm is tuberculated near to the upper edge but smooth on the rest of the surface. The fixed finger is remarkably short and stout. At the half of its length it bears a big tooth while smaller teeth are situated before and behind the big one.

Remarks: The species is quite distinct from the Mediterranean species of the genus but similar to some African species. The similarity is most striking with *D. extrictatus* STEBBING (BARNARD 1950, p. 441.) but fails in the length of the fixed finger.

Diogenes cf. **pugilator** (ROUX, 1828)

Pl. XVI, figs. 4, 5.

Material seen: ch. drilling "Váci út 120" 17 m. Budapest, ch. MR8-21, 3 ch. MGY-26: CA.

Description: The left chela is rather stout, convex on both sides. Both edges are more or less rounded. The upper edge is decorated with irregularly scattered granulae. The rest of the surface is rather smooth as far as it was possible to observe this on the corroded specimens. The finger is moderately long, directed downwards.

Remarks: The species is remarkably similar to *Diogenes pugilator*, a recent Mediterranean species, but its decoration is much poorer. Probably, when better specimens are available a new species will be recognised in it.

Genus *Dardanus* PAULSON, 1875

Dardanus arrosor (Herbst, 1796)

Pl. XVII, fig. 5.

1803. *Pagurus striatus* n. sp. — Latreille: 163.
1861. *Pagurus substriatus* n. sp. — A. Milne-Edwards in E. Sismonda: 20.
1891. *Pagurus arrosor* (Herbst) — Ristori: 23.

Material seen: moulds of ch. MTZ-5, ch. MTH-1: CA.

Description: The chela is characterised by the peculiar sloping ridges which cover the whole outer surface.

Remarks: As mentioned in the chapter dealing with taxonomic questions (p. 48.), the identification of a Badenian species with a recent one is risky if the species has no record from intermediate times. *Dardanus arrosor* is the only species recorded from all stages between Badenian and today. In contrast to Milne-Edwards' opinion no observable change occurred within this period.

Dardanus substriatiformis (Lőrenthey in Lőrenthey—Beurlen, 1929)

Pl. XVII, figs. 1–4.

1929. *Pagurites substriatiformis* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 34, 73, pl. 3, fig. 3.
1953. *Pagurites substriatiformis* Lőrenthey — Beurlen—Bachmayer: 242.
1976a. "*Paguristes*" *substriatiformis* (Lőrenthey) — Müller: 508.
1979a. *Dardanus substriatiformis* (Lőrenthey) — Müller: 274.

Material seen: lectotype designated herein, ch. M24: FI.

Material not seen, probably lost: 3 ch. Rákos and Bia.

Material seen: 4 ch. MOE-9, ch. MR-8, 9 ch. MKC-7, ch. MER-3, 2 ch. MFA-4, ch. MNH-16: CA.

Description: The outer surface of the palm and fixed finger is densely striated. On the inner side the outer striae are prolonged but they do not reach the median part. The palm is moderately stout, the upper and the lower edges are slightly convex. The striae are perpendicular to the longitudinal axis and they are finely denticulated. Every second ridge is stronger and longer than the intermediate ones.

Dardanus hungaricus (Lőrenthey in Lőrenthey—Beurlen, 1929)

Pl. XVIII, figs. 1–5.

1929. *Pagurites hungaricus* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 34, 72, pl. 3, fig. 4.
?1945. *Dardanus lauensis* n. sp. — Rathbun: 373, pl. 54, figs. c–h.
1976a. "*Paguristes*" *hungaricus* (Lőrenthey) — Müller: 508.
1979a. *Dardanus hungaricus* (Lőrenthey) — Müller: 274.

Material seen: lectotype designated herein, ch. without fingers M32: FI. Others, 3 ch. MK-3, ch. MTZ-18: CA. Ch. Mátraverebély–Szentkút, M61/2569: NMÖ.

Description: Only the chelae are known. The palm is rather stout, convex transversely, its height slightly decreases in proximal direction. The lower part of the palm is adorned with 6 or 7 smooth striae, almost perpendicular to the long axis and are separated from each other by deep furrows. On the proximal part the striae are longer. The upper part is decorated with tubercles which gradually fuse downward into the striae, which are almost perpendicularly arranged to the longitudinal axis.

Remarks: No recent species is similar to *D. hungaricus*, but Rathbun described *D. lauensis* from the Pliocene of Fiji, which is identical with the Badenian species in all details visible on Rathbun's figure. Unfortunately a request for casts of Rathbun's specimens was refused by the Curator of the material in order to protect the fragile specimens.

Stratigraphy: Lower to Upper Badenian, ?Pliocene.

Ecologically the species is probably bound to coral-reefs.

Genus *Paguristes* Dana, 1851

Paguristes cserhatensis n. sp.

Pl. XIX, figs. 1–4.

Material seen: holotype, ch. Sámsonháza, Halastópuszta, M61/3907: NMŐ.

Locus typicus: Sámsonháza, Halastópuszta, "bázisrétegek" (NOSZKY 1940).

Stratum typicum: Lower Badenian.

Derivatio nominis: The type locality is situated in the Cserhát Mountains.

Diagnosis: The left chela is decorated with rows of tubercles decreasing in size upwards.

Description: The only known specimen, a left chela, without dactylus. The palm is very short, stout, its outer side is densely covered with relatively big tubercles arranged in rows slightly irregularly. The size of the tubercles decreases upwards while the distance between the individual tubercles and between the rows increases. The fixed finger is short and strong. Its cutting edge is triangular, with small teeth on both sides. The upper edge is covered by a group of calcite crystals.

Remarks: The species is remarkably similar to *P. rosaceus* BARNARD (BARNARD 1950, p. 419.), but the tubercles are larger in the recent species.

Genus *Petrochirus* STIMPSON, 1859

Remarks: The two recent species of this genus are notable for their unusual size. The Caribbean species, *P. diogenes* (L.) was reported from depth of 23–53 meters (HOLTHUIS 1959, p. 151), but several specimens were collected in a depth of 2 or 3 meters by L. CSILLING (pers. comm.).

Petrochirus priscus (BROCCHI, 1883)

Pl. XIX, fig. 5, pl. XX, figs. 1–5, pl. XXI, figs. 1–3.

1883. *Pagurus priscus* n. sp. — BROCCHI: 7, pl. 5, fig. 9.
1897. *Pagurus priscus* BROCCHI — LŐRENTHEY: 150, 161, 168.
1898a. *Pagurus priscus* BROCCHI — LŐRENTHEY: 93, 106, 114.
1898b. *Pagurus priscus* BROCCHI — LŐRENTHEY: 109, 134–136, pl. 9, figs. 6, 7.
1898c. *Pagurus priscus* BROCCHI — LŐRENTHEY: 106–107, pl. 9, figs. 6, 7.
1928. *Petrochirus priscus* (BROCCHI) — GLAESSNER: 173, 206, text-fig. 2.
1929. *Pagurus priscus* BROCCHI em. LŐRENTHEY — LŐRENTHEY in LŐRENTHEY—BEURLEN: 34, 70, 71, pl. 3, figs. 1, 2.
?1965. *Petrochirus* cf. *priscus* BROCCHI — VEIGA FERREIRA: 6–7, pl. 2, figs. 7–9, 11–12.
1968. *Daira* sp., — STANCU-ANDREESCU: 466, pl. 7, fig. 84.
1976a. "*Pagurus*" *priscus* BROCCHI — MÜLLER: 508.
1979a. *Petrochirus priscus* (BROCCHI) — MÜLLER: 274.

Material not seen, probably lost: syntypes, 2? ch. Rákos: ?Sorbonne.

Material not seen: 64 ff., 3 da. Pöls, Baden-Rauchstallbrunngraben, Vöslau, Kalksburg, Devinska Nova Ves, Oued Tiflout (Atlas): NHMW.
Da. Rugi, Romania.
2 ch., 1 index, ? ca. Portugal: Coll. Serv. Geol. Port.

Material seen: numerous ch. Rákos: FI.
5 ch. Rákos, M60/5961 and M83/134: NMŐ.
6 ch. MR-2, 3 ch. MR8-7, 10 ch. MRF-3, 2 ch. MKC-10, 1 ch. MRO-7, 1 ch. MEG-3, 5 ch. MFA-5: CA.

Description: The palm of the giant chelae is elliptical in cross-section, more or less rectangular in lateral view. The whole chela is densely covered with tubercles of subequal size. On the upper margin there is an irregular row of bigger tubercles or teeth. The both fingers are extremely robust. The cutting edges are different on the right vs. left chelae. On the right chela there are strong teeth on the fingers in one row at the distal end, diverging proximally. On the left side the dactylus bears also one row of teeth but these are smaller, while the fixed finger is flat, triangular, with two rows of small teeth on the edges.

Remarks: The species is surprisingly similar to *P. diogenes* (LINNAEUS) in its form and in the arrangement of the teeth as well. The decoration on the surface is slightly different. The tubercules on the recent form are compound and bigger, while simple and smaller on *P. priscus*.

Ecology: The species was bound to the presence of empty shells of giant *Gastropods*, e.g. *Galeodes, Strombus* or *Murex* in Badenian waters, the remnants of which are restricted to some layers.

Superfamilia **Galatheoidea** SAMOUELLE, 1819
Familia **Galatheidae** SAMOUELLE, 1819
Subfamilia *Galatheinae* SAMOUELLE, 1819
Genus *Galathea* FABRICIUS, 1793

Galathea weinfurteri BACHMAYER, 1950

Pl. XXI, figs. 4, 5, pl. XXII, figs. 1–5.

?1928. *Galathea* sp. — GLAESSNER: 164, 206, pl. 3, fig. 1.
1950. *Galathea weinfurteri* n. sp. — BACHMAYER: 135–137, pl. 1, figs. 2–4.
1953. *Galathea weinfurteri* BACHMAYER — BACHMAYER: 242, 243, pl. 5, figs. 3, 4, 6.
1974b. *Galathea weinfurteri* BACHMAYER — MÜLLER: 276, pl. 1, fig. 4.
1976b. *Galathea weinfurteri* BACHMAYER — MÜLLER: 516.
1979a. *Galathea* cf. *weinfurteri* BACHMAYER — MÜLLER: 274.

Material not seen: holotype, Furth: ?NHMW.

Material seen: 18 ca, 1 sternum, 1 merus, Deutsch-Altenburg: NHMW.
5 ca., 2 ch. MOE-33, 3 ca. MDG-4, 3 ca. MJL-5, 6 ca. MB-8, ca., 2 ch. MKC-9, ca. MEG-20, ca. MFK-5, 18 ca., 2 ch. MRZ-1, 24 ca., 2 ch. MV-2, 8 ca, 2 ch. MTZ-2: CA.

Description: In spite of some earlier doubts on the unity of the taxon it seems that all specimens belong to BACHMAYER's species. The carapace is elongated, striated. Its rostrum is relatively bigger on smaller specimens but its form is similar to that of the bigger ones. Its base is triangular covered by some granulae. The long spines of the rostrum diverge anteriorly. Behind the rostrum there is a spiny ridge but the spines are very small or even rudimentary on some specimens. A specimen was found infected by *Bopyrids* (pl. XXII. fig. 5).

Remarks: The species is close to *G. strigosa*, a recent form, but the postfrontal ridge is much less spinose on *G. weinfurteri*.

Stratigraphy: Known from the whole time-span of the Badenian. In Messinian limestones of Kriti, Greece, a similar form occurs (GEORGIADES–DIKEOULIA–MÜLLER in press.).

Familia **Porcellanidae** HAWORTH, 1825
Genus *Petrolisthes* STIMPSON, 1858

Stratigraphy: As far only one fossil species was recorded from Fiji (RATHBUN 1945). In the shape of its carapace it resembles some Lower Cretaceous *Galatheids*, e.g. *Galatheites troyoi* VAN STRAELEN.

Ecology: *Petrolisthes* species invariably live in shallow waters, some of them are restricted to reefs. At least some *P.* species have a bioerosional activity on reefs.

Petrolisthes magnus n. sp.

Pl. XXIII, figs. 1–4, pl. XXIV, figs. 1–4, pl. XXV, figs. 4–5.

Material seen: holotype, ca. MRZ-2-1, pl. XXIII. figs. 1., 2. Paratypes, 98 ca., 59 ch. MRZ-2, 2 ca., 2 ch. MKK-2: CA.

Locus typicus: Budapest, railway-cut of Rákos.

Stratum typicum: Upper Badenian.

Derivatio nominis: Magnus, big (Lat.), because the species is one of the biggest *Porcellanid* known.

Description: The carapace is subcircular in outline, but smaller specimens have subparallel lateral margins. The rostrum is triangular, with two faint incisions. The orbital margins are rather elevated. The whole surface is striated, the small ridges are generally short but on the mesogastric field there are some longer ones. On the lateral margins there are sharp, entire keel-like ridges ending in one hepatic spine. The carpus is adorned on its upper edge with teeth separated from each other by deep incisions. On the chelae there are characteristic granulations on both sides tending to be arranged in rows. No median ridge occurs on the chelae.

Remarks: ORTMANN's key (1897) led to the group of *P. galathinus* when it was used in the determination of this Badenian species. The only similar species within this group is *P. boscii* AUDOIN, even if one considers the newly described species (HAIG 1981). The specimens of *P. boscii* kindly sent me by GUINOT and DE SAINT-LAURENT, are indeed very close to the Badenian species. As no good figure of *P. boscii* was found in the literature some photographs are included here (pl. XXIII, fig. 5, pl. XXV, figs. 1–3.) for comparison. The carapax is essentially the same in both species, probably that of the recent one is slightly more narrow, and the orbital margins are less elevated. The differences are more accentuated on the cheliped. The elevations on the carpus are saw-like in the recent species, while the decoration on the inner side of the chela is much coarser than in *P. magnus*.

Petrolisthes haydni n. sp.

Pl. XXVI, figs. 1–5.

Material seen: holotype, ca. 1984/40/7, pl. 26 fig. 1: NHMW.
Paratypes, 10 ca., 5 ch., 2 carpus, MNH-1, ca. Fertőrákos, drilling FRK-21 268 m, 2 ca. 2 ch. MTZ-16, ch. MZZ-1: CA.

Locus typicus: Gross-Höflein (Hung. Nagyhőflány), near Eisenstadt, Burgenland, Austria.

Stratum typicum: Middle Badenian or lowermost Upper Badenian.

Derivatio nominis: Named after the great componist, JOSEPH HAYDN who worked in Eisenstadt.

Description: The carapace is rounded square with a prominent triangular rostrum. The edge of the front is denticulated, its surface is finely granulated. The anterior part of the lateral margin is uninterrupted, forming a continuous carina, while the posterior half of this edge is cut into three individual spiniform teeth. On the postfrontal region there is a steplike transversal ridge cut into two parts by a median notch. The two parts of the ridge form an angle of about 150°. The surface of the carapace is finely striated with short lines which tend to unify behind the postfrontal ridge and at a narrow area near the anterior parts of the laterial margin. No *Bopyrid* infected specimen was found.

The carpus of the cheliped is serrated on its anterior edge. 5 or 6 teeth consitute the serration, the upper edges of the teeth form an angle of about 20° with the longitudinal axis. The outer surface of the palm is granulated by rounded granulae. About the median line the tubercles fuse into a ridge-like elevation which is parallel to the lower edge. The inner surface is also granulated. Near the median part the tubercles fuse into numerous oblique short ridges.

Remarks: The species is closely related to *P. boscii* and to the other Badenian species. The presence of three teeth on the lateral margin is a diagnostic feature helping in the distinction. This species is much smaller than *P. magnus*. The serration on the carpus is different from that of the two other species. The ridge on the outer surface of the palm lacks on the other species.

Ecology: The species was found in remnants of coral reefs, but one specimen occurred in Zebegény, in a layer full of colony-forming but ahermatypic *(Oculina?)* corals.

Stratigraphy: The species is known in Lower and Middle (or lowermost Upper) Badenian layers.

Genus *Pisidia* LEACH, 1820

Typus-species: *Pisidia linneana* LEACH = *Pisidia longicornis* (LINNAEUS, 1767).

Pisidia kokayi (MÜLLER, 1974)

Pl. XXVII, figs. 1–5.

1974a. *Porcellana (Pisidia) kokayi* n. sp. — MÜLLER: 121, 124, 126, pl. 1, figs. 1–4.
1979a. *Porcellana kokayi* MÜLLER — MÜLLER: 274.

Material seen: holotype, ca. MB-2-1: NMÖ.
Paratypes: ca. MKF-1, 3 ca. MB-2: CA.
Others: 8 ca. MJL-18, ca. MB-2, 3 ca. MRZ-18, 3 ca. MDZ-1, ?ca. MZZ-2: CA.

Description : The outline of the carapace is a rounded square. The trilobated front is not very prominent. The cervical furrow is moderately deep. On the branchial regions the decoration consists of more or less long weak ridges while the other parts are covered with short ridges or tubercles. The lateral margin bears four teeth. The postfrontal ridges are rather long.

Remarks : The species is close to *P. longicornis* and *P. longimana* but is characterised by its shape being closer to a square. *P. blutely* is different by its prominent and wide frontal region.

Pisidia cf. **kokayi** (Müller, 1974)

Pl. XXVII, fig. 6, pl. XXVIII, figs. 1, 2, ?3.

Material seen: 8 ca. 2 ch. MTZ-1, 18 ca. MV-3: CA.

Remarks : The form is similar to *P. kokayi* but its frontal part is more prominent, the cervical furrow is deeper and the postfrontal ridges are shorter and almost perpendicular to the longitudinal axis. Unfortunately well-preserved specimens were not found, thus a detailed description would be premature.

Superfamilia **Hippoidea** Latreille, 1825
Familia **Albuneidae** Stimpson, 1858
Genus *Albunea* Weber, 1795

Ecology : Similarly to *Raninidae Albunea* species dig themselves into different kinds of sediments, predominantly into sands. A striking grade of convergence occurs to *Raninids* owing to similar habits.

Albunea asymmetrica (Müller, 1979)

Pl. XXVIII, figs. 4–6.

1979a. *Mioranina asymmetrica* n. gen. n. sp. — Müller: 274, 278, 279, 287, pl. 9, 10.

Material seen: holotype, ca. MGY-2-1: CA.
Paratype, 8 ca., carpus, ch. MGY-2: CA.
Others, 5 ca. MOH-4, 4 ca., ch. MR8-16: CA.

Description : The carapace is subhexagonal in outline, convex is cross-section, nearly straight in lateral view. The fronto-orbital margin is very narrow, deeply notched. The margins outside of the orbits are ornamented with characteristic spines forming a comb-like feature. The lateral borders are nearly straight and parallel. The anterolateral borders converge posteriorly. The surface is decorated by step-like ridges forming a striking pattern. The decoration is slightly asymmetrical. The palm of the chela is triangular, decorated by ridges similar to those of the carapace. The carpus is covered by tubercles.

Remarks : Unfortunately the remnants were attributed to a new *Raninid* genus, *Mioranina*. The species, regarding its frontal decoration, is close to *A. steinitzi*, a recent form (Serène 1965). The decoration of the recent form is composed of teeth of uniform size while at *A. asymmetrica* the size of the individual teeth varies, there is even a double tooth on it. *Albunea carabus* has less spines which are shorter than those of *A. asymmetrica.*

Ecology : The species is apparently confined to sediments composed of sands without many shell-debris or other coarse particles which could hinder burrowing. It is absent from limestones.

Infraordo BRACHYURA Latreille, 1803
Sectio DROMIACEA de Haan, 1833
Superfamilia **Dromioidea** de Haan, 1833
Familia **Dromiidae** de Haan, 1833
Genus *Dromia* Weber, 1795

Ecology: Most *D.* species are sublittoral, some were found in depth down to 150 meters (Sakai 1976, p. 8).

Stratigraphy: Some Eocene species attributed to *Dromilites* may belong here.

Dromia neogenica Müller, 1979

Pl. XXIX, figs. 1–6.

1979a. *Dromia neogenica* n. sp. — Müller: 274, 278, 287, pl. 8, fig. 1.

Material seen: holotype, internal mould of ca. MKC-4-1: CA. Others, ch. MRZ-16, 5 ca., 2 ch. MDZ-3: CA.
Ch. Souk el Khemis, Algeria, Orania, Messinian, leg. Saint-Martin: coll. Saint-Martin.

Description: One of the biggest Badenian crabs. The carapace is strongly convex in both directions. The surface is smooth. The front consists of three short teeth, the median one is situated in a lower level. The orbits are of medium size. The supraorbital tooth is weak. The extraorbital tooth is well developed, situated on an upper level than the anterolateral teeth. The cervical groove is faint. The two extraorbital teeth situated before the last one are close to each other though with increasing age this distance increases as well.

The palm is rather long but its upper edge is short and it is adorned with faintly visible tubercles arranged in a row.

Remarks: The species is similar to *D. personata* (Linnaeus), but its supraocular teeth are rudimentary while in the recent species they are developed. At *D. personata* a well-developed cardiac furrow is present, while this furrow is visible only on the medium part of the carapace of the Badenian species. The arrangement of the anterolateral teeth and the shape of the chela are also different at the two forms.

Stratigraphy: Known from the Lower Badenian to the Messinian.

Ecology: All but one specimen were found in remnants of reefs.

Dromia eotvoesi (Müller, 1976)

Pl. XXIX, figs. 8, 9, pl. XXX, figs. 1–7.

1976a. *Dromilites eotvoesi* n. sp. — Müller: 508, 509, 512, pl. 1, fig. 5, pl. 2, figs. 1, 4.
1976c. *Dromilites eotvoesi* Müller — Müller: 150, pl. 2, figs. 1, 2.
1979a. *Dromilites eotvoesi* Müller — Müller: 274.

Material seen: holotype, ca. MFA-1-1: CA.
Paratypes, ca. MA-4, ca. MKC-12: CA.
Others, 17 ca. MKC-12, 3 ca. MA-4, 7 ca., 2 ch. MR8-11, ch. MRC-2, ch. MRO-3, 7 ca. MEG-7, 2 ca. MOH-6, 12 ca., 2 ch. MGY-12, ca. Bia, unknown layer: CA.
Ca. Rákos, leg. Stoczek, 3 ca. Kerepesi út, leg. Mihály: FI.

Description: The carapace is semiglobular. On the front there are two prominent spines on both sides. The extraorbital spine is directed below the orbit. The mesogastric region bears a rounded elevation, which is divided by a median notch. On the inner anterior part of the branchial field there are elevations on both sides. The other parts of the carapace are rather smooth. The branchiocardiac groove is shallow.

The palm of the chela is rather long, its upper edge is ornamented with four or five small teeth. The fixed finger is bent downwards. It bears 4 teeth. The distal end of the finger is spoon-like. The dactylus is strongly curved and longer than the index.

Remarks: The species was originally placed in the genus *Dromilites* H. Milne-Edwards. It is, however, closer to some recent *Dromia*-species than to *Dromilites bucklandi*, the type species of its genus, since there is no additional groove among the cervical and branchiocardical ones at the Badenian species. This feature might be of high diagnostic value. On the other hand, *D. eotvoesi* is close to *D. intermedia* Laurie (Sakai 1976, pl. 1, fig. 3.). The frontal teeth are much longer on the Hungarian species. The difference of the two Badenian species is striking.

Ecology: The species is absent from reefal structures. Generally occurs together with *Calappa heberti*.

Stratigraphy: Known only from the lower part of the Upper Badenian layers in Budapest.

Genus *Kromtitis* n. gen.

Typus-species: *Dromilites koberi* BACHMAYER — TOLLMANN, 1953 by monotypy.

Derivatio nominis: Phantasy name, a variation of *Dromilites* caused by a printing error. Used because it occurred in former literature as nomen nudum in STEININGER—PAPP (in PAPP et al. 1978, p. 199).

Diagnosis: The outline of the carapace is circular. The urogastric, mesogastric and epibranchial regions are adorned with elevations. The protogastric, hepatic, meso- und metabranchial regions are covered by small tubercles.

Remarks: The species and consequently the genus is rather different from any recent or fossil *Dromids*. *Dromilites lamarcki* is similarly strongly decorated but its overall form is different. Also, some recent *Petalomera* species, as *P. nodosa* SAKAI or *Cryptodromia areolata* have similar decoration but the outline of their carapace is dissimilar.

Kromtitis koberi (BACHMAYER — TOLLMANN, 1953)

Pl. XXXI, figs. 1–4.

1953. *Dromilites koberi* n. sp. — BACHMAYER—TOLLMANN: 312, 313, pl. 1, figs. 2, 2a.
1976b. *Dromilites koberi* BACHMAYER — TOLLMANN—MÜLLER: 520.
1978. *Kromtitis koberi* BACHMAYER — TOLLMANN—STEININGER—PAPP in PAPP et al. 1978: 199.

Material seen: holotype, ca. Gross-Höflein, 61/1953: NHMW.
Others, 6 ca. MV-5, 3 ca. MNH-3: CA.

Description: The carapace is subcircular in outline. The anterolateral margin bears 6 teeth, one of which is situated on the posterolateral margin if properly designated. On the posterolateral margin there are two big tubercles near to the posterior margin. The surface is densely covered with bigger and smaller tubercles described in the diagnosis of the genus.

Remarks: As mentioned in the description of the genus, no similar *Dromid* species is known. Its place among *Dromids* is beyond any doubt, although some similarly decorated *Trachycarcinus* are also known.

Ecology: The species was found only in fossil coral-reefs.

Stratigraphy: Lower and Middle (or lowermost Upper) Badenian.

Genus *Kerepesia* MÜLLER, 1976

Typus-species: *Kerepesia viai* MÜLLER, 1976 by monotypy.

Remarks: The genus was introduced as a Dromioidea incertae sedis. Actually it is a *Dromid.* Similar patterns of the anterolateral margin was observed at *Dromidiopsis excavata,* for instance. Its dromid affinities were confirmed by R. V. INGLE (pers. comm.), too.

Kerepesia viai MÜLLER, 1976

Pl. XXXI, figs. 5–7, pl. XXXII, figs. 1–2, ? 3, 4.

1976c. *Kerepesia* n. gen. *viai* n. sp. — MÜLLER: 150, 151, 155, pl. 3, figs. 1–3., pl. 2, fig. 4.
1979a. *Kerepesia viai* MÜLLER — MÜLLER: 274.

Material seen: holotype, MKC-3-1: CA.
Paratypes, 3 ca. MKC-3: CA.
Others, ca. MKC-3, 2 ca. MDG-7, ca., ch. MOE-30: CA.

Description: Only the anterior parts of the carapace, including small regions of the branchial regions, are known. Probably other parts were less calcified. The anterior parts are moderately convex in both directions. The surface is smooth. The sides strongly converge in front of the last anterolateral tooth. Behind this tooth the sides are subparallel to each other. There are two frontal and two supraorbital spines. The anterolateral margin, consisting of four spiny teeth is hidden below the surface of the carapace, because above the genuine margin a false margin appears formed by the carapace that is strongly bended downwards in the plane of the orbits. Consequently the row of the anterolateral teeth is directed below the orbits.

On the locality MOE a typical *Dromid* chela was found. It is very much like the hand of *Cryptodromia, Petalomera, Hypoconcha.* All other Upper Badenian *Dromids* have different chelae. Consequently the illustrated hand can be attributed to *Kerepesia.*

Ecology: The species was found in layers formed in infralitoral environments not very close to surface. The bottom was sandy with abundant shells. The species most probably used these shells as a shield much like its presumed recent relatives do.

Dromiidarum n? gen. n. sp.

Pl. XXXII, figs. 5–7.

Material seen: 2 ca. MTZ-23, ca. MNH-2: CA.

Remarks: Only fragments of the median part and frontal region were found thus the species cannot be described. It does not belong to any of the Badenian crabs. The frontal region is typically *Dromid*-like, the presence of two deep parallel furrows (cervical and branchiocardiac) is an additional proof of the systematical position among *Dromioidea.*

Familia **Dynomenidae** ORTMANN, 1892
Genus *Dynomene* LATREILLE in DESMAREST, 1825

Remarks: This frequent and widespread recent genus remained unrecognized in fossil form because of the similarity of its carapace to some *Xanthids*. Its front and the peculiar linear structure on the medium part of the cervical furrow are very characteristic features of this genus which is so important in phylogenetic speculations.

Dynomene emiliae MÜLLER, 1979

Pl. XXXIII, figs. 1–6.

?1945. *Xantho acutispinis* n. sp. — RATHBUN: 382, pl. 62, A.
1979. *Pilumnus* sp. — FÖRSTER: 95, 103, text-fig. 7, pl. 2, fig. 2.
1979b. *Dynomene emiliae* n. sp. — MÜLLER: 4, pl. 1, fig. 1.

Material seen: holotype, ca. Iasen, Bulgaria, leg. KOJUMDGIEVA, coll. University Sofia, Nt 531.

Material seen as cast: ca. Grobie, Poland, leg. WRONA, coll. University Warsaw.

Material seen: 3 ca. MV-4, 2 ca. MTZ-4, 3 ca. MNH-4: CA.

Description: Only the carapace is known. It is moderately convex in both directions. The orbits are elongated, the upper orbital margins touch medially, forming a triangular, slightly rounded extension of the carapace in place of a front. There are five anterolateral teeth, since the outer orbital margin does not form any tooth or spine. The mesogastric region is well delimited posteriorly by a V shaped cervical groove. Immediately behind the cervical groove there is a rudiment of the postcervical groove. On partly decorticated specimens the carapace is finely granulated but the upper layer is smooth with fine pores.

Remarks: The species is similar to *D. pilumnoides* though it is wider than the recent form. It is also close to *D. hispida* but the surface of the miocene species is smooth and the recent one displays only some indistinct tubercules. The posterior margin is wider at *D. emiliae* than on its recent relatives. The most similar form is *Dynomene acutispinis* (RATHBUN) (=*Xantho acutispinis)* from the Pliocene of Fiji. Unfortunately a direct comparison was impossible just as mentioned for *Dardanus hungaricus.*

Ecology: All specimens but the Iasen one were found in coral-reefs, but in Iasen, corals occur in the close vicinity of the locality.

Sectio OXYSTOMATA H. MILNE-EDWARDS, 1834
Superfamilia **Dorippoidea** DE HAAN, 1841
Familia **Dorippidae** DE HAAN, 1841
Subfamilia *Dorippinae* DE HAAN, 1841
Genus *Dorippe* WEBER, 1795

Dorippe margaretha Lőrenthey in Lőrenthey—Beurlen, 1929

Pl. XXXIV, figs. 1–5.

1911. *Dorippe margaretha* nom. nud. — Lőrenthey: 528.
1913. *Dorippe margaretha* nom., nud. — Lőrenthey: 326.
1929. *Dorippe margaretha* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 34, 135, 136, pl. 6, fig. 1, a rather inaccurate drawing.
?1965. *Dorippe* aff. *lanata* Linnaeus — Veiga Ferreira: 10, pl. 1, figs. 5, 6.
1979a. *Dorippe margaretha* Lőrenthey — Müller: 279, 287, pl. 13, fig. 4.

Material seen: holotype, ca. (internal mould), Rákos, M25: FI.
Others, 2 ca. MEG-12, 12 ca. MOE-22, ca. MDG-14: CA.

Description: Only the carapace is known. It is rather wide, pyriform. The surface is divided by deep furrows. There are spiniform teeth on the branchial and on the hepatic border (broken down on the illustrated specimens). The rather smooth branchial region is wide and is decorated with a tubercle. On some specimens three faint ridges leave this tubercle. On the cardiac region there are two ridges diverging anteriorly, forming an angle of about 50–60°.

Remarks: The species is close to *Dorippe lanata*. The recent form is slightly wider than the Badenian one. Consequently the mentioned ridges on the cardiac region form a rectangle at *D. lanata*. Also the decoration on the branchial region is stronger, but rather variable. The Indo-West-Pacific species *D. frascone* is unlike *D. margaretha* at all.

?Dorippe carpathica (Förster, 1969)

1969a. *Dorippe? carpathica* n. sp. — Förster: 91–93, text. fig. 3, pl. 2, fig. 3.

Material not seen: holotype, ca. Niskowa, Poland; coll. Univ. Warsaw.

Description: According to Förster, the carapace is subquadrangular. The posterior margin is bilobated. The regions are well-defined. On the meso/protogastric region there are three protuberances. Epibranchial and hepatic regions are modified by longitudinal grooves and depressions, and are separated from meso- and metabranchial regions by a groove. There is a prominent ridge on meso/metabranchial region, which is subparallel to the groove.

Remarks: The species reveals similarities to *Dorippids*, but, as Förster pointed out, the distinct grooves are absent on the epibranchial and hepatic regions of any *Dorippid*. Similar grooves are present on some *Cymonomus* (and even at some *Tymolus*) species though there are obvious differences between the mentioned recent and Badenian forms.

Superfamilia **Calappoidea** de Haan, 1833
Familia **Calappidae** de Haan, 1833
Subfamilia *Calappinae* de Haan, 1833
Genus *Calappa* Weber, 1795

Calappa praelata Lőrenthey in Lőrenthey—Beurlen, 1929

Pl. XXXV, figs. 1, 2, 7, ?figs. 3–6, ? pl. XXXVI, fig. 6.

partim? 1928. *Calappa heberti* Brocchi — Glaessner: 174–175.
1929. *Calappa praelata* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 132, 133, pl. 6, fig. 3.
?1958. *Calappa heberti* Brocchi — Veiga Ferreira: 203–207, text-fig. 1–3, pl. 1, figs. 1–3.
?1959. *Calappa* cf. *heberti* Brocchi — Galopim da Carvalho: 79, pl. 2, figs. 4–6.
1961. *Calappa heberti* sp. 2. — Bachmayer: 41, pl. 2, fig. 1.
?1961. *Calappa* aff. *granulata* Linné — Bachmayer: 42.
1979b. *Calappa* aff. *heberti* Brocchi — Förster: 255, 257, pl. 1, figs. 2, 4.

Material seen: holotype, ca. Mátraverebély–Szentkút, Szent László-forrás, leg. Noszky, M27: FI.
Others, da. Korytnica, Poland, leg. Baluk, 3 da. MSZ-2, ch. Szob–Kerékhegy, ch., ca. MTH-2, ca. MVA-1, ca. MNU-1, 3 da. Oslip, sand-pit, ca. Mátraverebély–Szentkút, Meszestető: CA.

Description: The carapace is strongly convex, subpentagonal in outline. The median regions (mesogastric, urogastric, cardiac) are markedly delimited from other regions by deep longitudinal furrows. This longitudinal elevation is ornamented with 5 or 6 bigger and numerous smaller tubercles. On the anterior part of the branchial region an area is covered with 7–8 big, densely packed tubercles. On other parts of the carapace there are numerous regularly arranged small tubercles. The posterolateral angle is decorated with angular lobes, each of which are medially carinated by ridges. The widest part of the carapace is characteristically situated at its anterior one-third, but this feature is not as striking as it appears on Lőrenthey's idealized figure.

The chela is known as fragments. The dactylus is typical *Calappa*-like, the only diagnostic feature on it is the proximal lobe situated on its almost symmetrical upper margin.

Remarks: The species is highly similar to *C. granulata* Linnaeus. Since few illustration exist in the literature showing the sculpture, photographs are presented to show the carapace, chela and right dactylus (leg. P. Solt, Sicily) pl. XXXVI. figs. 1–5. The similarity is indeed striking. The anterolateral lobe is more extended, however, in *C. granulata,* consequently it bears 6 big lobes instead of 4. The proximal lobe on the right dactylus is bent in proximal direction. As it can be observed on the figures, *C. heberti* differs from the other species.

Stratigraphy: The few data available suggest that the species does not occur in Upper Badenian layers. The species lived longer in the Mediterranean where it was perhaps the ancestor of *C. granulata.*

Ecology: In contrast to *C. heberti,* this species has not been found in reefs yet.

Calappa heberti Brocchi, 1883

Pl. XXXVII, figs. 1–7, pl. XXXVIII, figs. 1–6.

1883. *Calappa heberti* n. sp. — Brocchi: 2, pl. 4, fig. 3.
1897. *Calappa heberti* Brocchi — Lőrenthey: 150, 159, 166.
1898a. *Calappa heberti* Brocchi — Lőrenthey: 93, 103, 104, 112.
1898b. *Calappa heberti* Brocchi — Lőrenthey: 109, 113–116, 151, pl. 8, figs. 1–3, pl. 9, fig. 1.
1898c. *Calappa heberti* Brocchi — Lőrenthey: 88–90, pl. 8, figs. 1–3, pl. 9, fig. 1.
1911. *Calappa heberti* Brocchi — Lőrenthey: 523.
1913. *Calappa heberti* Brocchi — Lőrenthey: 318.
partim? 1928. *Calappa heberti* Brocchi — Glaessner: 174–175.
1929. *Calappa heberti* Brocchi — Lőrenthey in Lőrenthey—Beurlen: 34, 130–132, pl. 6, figs. 2, 9–12.
1976a. *Calappa heberti* Brocchi — Müller: 509.
1976c. *Calappa heberti* Brocchi — Müller: 152.
1979a. *Calappa heberti* Brocchi — Müller: 274.

Material not seen, probably lost: syntypes, ca., ch. Rákos: ?Sorbonne.

Material seen: about 100 ca., ch., merus, carpus, Rákos: FI.
4 ca. M59/2369, 2 ca. M61/5790-91, Rákos: NMÖ. 8 ca. MR8-12, 4 ca. MR45-4, 3 ca., 10 ch. MR-10, 3 ca. MRF-5, 38 ca. MKC-14, 4 ca. MOH-7, 5 ca. MGY-14, 2 ca., ch. MRL-3, 2 ca. MEG-19, 4 ca. MFA-6, 3 ca., 5 ch. MFK-4, 10 ca. MA-6, ca. MRZ-3, 2 ca., da. MER-5, ca. MDZ-5, ca. MH34: CA.

Description: The subpentagonal carapace is convex in both directions. A longitudinal median region is delimited by two deep furrows. The anterior part of the carapace is adorned with tubercles, the posterior with short ridges. There are transitional forms of these decorations in intermediate areas. Near the posterolateral angle the margin is composed of lobes which are not very prominent. The chelae are characteristically decorated with rows and groups of tubercles. The dactylus bears a proximal lobe directed distally.

Remarks: The species is higly characteristic and differs from all living species of *Calappa. C. hepatica* (Linnaeus) and *C. gallus* (Herbst) have similar ornaments on their carapace but the outline of them is unlike that of *C. heberti.* It can be hardly understood why this characteristic species was so often reported from the Neogene of the Mediterranean since all figures published are dissimilar from the Badenian form (cf. literature given at *C. praelata*).

Ecology: The species was found in various types of sediments, fine and coarse calcarenites, conglomerates, tuffites, further in remnants of Coral-reefs.

Stratigraphy: The species seems to be confined to the lower level of Upper Badenian layers.

Genus *Calappilia* A. Milne-Edwards 1873 (=*Paracyclois* Miers 1866)

Calappilia matzkei (BACHMAYER, 1961)

1961. *Calappa matzkei* n. sp. — BACHMAYER: 43–45, text-fig. 1, pl. 3, fig. 1.
1979c. *Calappilia matzkei* (BACHMAYER) — MÜLLER: 866.

Material not seen: holotype, ca. (internal mould), Brunn, Austria: coll. ?Matzke*.

Description: According to BACHMAYER, the internal mould of the only known carapace is wider than long, its greatest width is in the middle. The lateral margins are adorned with numerous spines, or spiniform tubercles. The outline of the carapace is ovoid. On the hinder part of the anterolateral border there were spines which were broken off.

Remarks: According to BACHMAYER the species is similar to *Calappa praelata* LŐRENTHEY. The general form of the carapace, its decoration and the spines on the anterolateral border all reveal close similarities to *Calappilia dacica* BITTNER, however.

Stratigraphy: The presence of a *Calappilia*-species in the Badenian stage is not surprising since, according to GLAESSNER (1969, p. R494), the still living Indo-West-Pacific *Paracyclois milneedwardsi* MIERS should be ranged among *Calappilia*-species.

Genus *Mursia* DESMAREST, 1823

Mursia lienharti (BACHMAYER, 1961)

Pl. XXXIX, figs. 1–6, pl. XL, figs. 1–3, 5–6.

1961. *(?)Calappa lienharti* n. sp. — BACHMAYER: 41–42, pl. 2, fig. 2.
?1964. *Calappa* sp. — GRIPP: 55, text-fig. 1.
1972. *Calappa lienharti* BACHMAYER — JANSSEN: 93, text-fig. 39.
1974b. *Parthenope loczyi* n. sp. — MÜLLER: 277, 281, 283, pl. 1, fig. 7.
1976b. *Mursia loczyi* (MÜLLER) — MÜLLER: 149, 151, 152, 155, pl. 4, figs. 3–4, pl. 5, figs. 1–4.
1979a. *Mursia loczyi* (MÜLLER) — MÜLLER: 274.
In press *Mursia lienharti* (BACHMAYER) — JANSSEN—MÜLLER.

Material not seen: holotype, da. Nussdorf, Austria 456/1962: NHMW.

Material seen: holotype of *Parthenope loczyi*, ca. MKC-1-1: NMŐ.
Others, da. MOE-33, 2 ca., 5 ch., 4 da. MR8-20, ca. MRF-7, 17 ca., 2 ch. MKC-1, ca. MGY-17, 2 ca., 2 ch. MFK-2, 3 ca. MNA-5, ca. MN-5: CA.

Description: The anterior part of the carapace is circular in outline, the posterior one converges posteriorly. The front is prominent, trilobated. The orbits are deep, their upper margin is cut by two notches. The anterolateral margin is adorned with 9 to 10 blunt lobes. The row of these lobes is closed posteriorly by a lateral spine of moderate size which is directed slightly backwards. The posterolateral margin is slightly concave. The posterior margin is convex, delimited by two corners which are prominent, tooth-like in large specimens. The whole surface is decorated by tubercles. On the branchial and hepatic regions there are two rows of big tubercles on both sides. The inner rows are subparallel to the longitudinal axis, while the outer ones diverge posteriorly.

The palm is flattened, rather high. The outer surface is adorned with rows of tubercles.

The dactylus described by BACHMAYER as *Calappa lienharti* is a typical *Mursia* member, but the stridulating ridge is absent on the inner side. In its general form and adornement it is like *Mursia armata* (pl. XL. fig. 4.). As the dactylus and other remnants were found in the same group of layers, in the absence of other candidate species, very likely they belong to the same species.

Remarks: The Badenian species is close to *M. hawaiiensis,* but posterolateral margins bear no teeth at *M. lienharti.* Recently beautyful specimens undoubtedly of the same species were collected in Ramsel, Belgium (JANSSEN–MÜLLER in press.).

Stratigraphy: Though the species was found only in Upper Badenian layers in Hungary, the Ramsel locality is Hemmoorian in age (JANSSEN personal comm.), thus it is older than Lower Badenian.

Subfamilia *Matutinae* McLEAY, 1838
Genus *Matuta* FABRICIUS, 1798

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* Holotype kept in the Heimatmuseum, Neunkirchen (Niederösterreich. BACHMAYER, pers. comm.).

Matuta brocchii GLAESSNER, 1969

Pl. XLI, figs. 1–6., pl. XLII, figs. 1–5.

non 1882. *Matuta inermis* n. sp. — MIERS: 256, pl. 26, fig. C.
1883. *Matuta inermis* n. sp. — BROCCHI: 5, pl. 4, fig. 1.
1897. *Matuta inermis* BROCCHI — LŐRENTHEY: 150, 159, 166.
1898a. *Matuta inermis* BROCCHI — LŐRENTHEY: 93, 104, 112.
1898b. *Matuta inermis* BROCCHI — LŐRENTHEY: 109, 116, 152.
1898c. *Matuta inermis* BROCCHI — LŐRENTHEY: 91.
1904a. *Matuta inermis* BROCCHI — LŐRENTHEY: 161.
1904b. *Matuta inermis* BROCCHI — LŐRENTHEY: 30.
1913. *Matuta inermis* BROCCHI — LŐRENTHEY: 322.
1929. *Matuta inermis* BROCCHI — LŐRENTHEY in LŐRENTHEY—BEURLEN: 34, 134, 135, pl. 6, figs. 14–18.
1969. *Matuta brocchii* nom. nov. — GLAESSNER: R495.
1979a. *Matuta brocchii* GLAESSNER — MÜLLER: 274.

Material not seen, probably lost: syntypes or holotype, ca. Rákos: ?Sorbonne.

Material seen: others, about 100 ca. Rákos, Budafok: FI. 2 ch. M83/136, ca. M83/125, Rákos: NMŐ. 2 ca. MOE-23, ca. MGF-3, ca. MB-10, 1 ca., 5 ch. MR-11, 8 ca., 10 ch. MR8-15, ca., 2 ch. MR45-2, 3 ca., 3 ch. MRF-6, 132 ca. MKC-13, 2 ca. MRC-4, 5 ca. MRO-4, 16 ca., ch. MEG-8, 9 ch. MOH-8, 6 ca., ch. MER4, numerous ca., ch. MGY-13, ca. MFA-10, 4 ca. MFK-3, ch. MA-8, ca., ch. MRZ-15, ca. BAK-40: CA.

Description: The carapace is subhexagonal, rather smooth. The epigastric, mesogastric, urogastric and branchial regions are decorated with big tubercles, the relative size of which decreases with increasing size of the animal. The palm is decorated by big tubercles. On the inner side of it there are stridulating ridges.

Remarks: The only known fossil species of the genus. It is remarkably similar to *M. inermis* MIERS, but its carapace is wider (although narrow carapace occurs also in Badenian material) and the denticulation on the anterior 1/3 of the anterolateral border is finer in *M. brocchii*. *Matuta curtispina* SAKAI is also similar but its anterolateral denticulation is different.

Familia Leucosiidae SAMOUELLE, 1819
Genus *Ebalia* LEACH, 1817

Ebalia vanstraeleni BACHMAYER, 1953

Pl. XLIII, figs. 1, 2.

1953. *Ebalia van-straeleni* n. sp. — BACHMAYER: 243, 244, pl. 2, figs. 1, 4, 4a.
1979a. *Ebalia vanstraeleni* BACHMAYER — MÜLLER: 279, 288.

Material seen: holotype, ca. (internal mould), Deutsch-Altenburg: NHMW

Material not seen: paratypes, 2 ca. (internal moulds), Deutsch-Altenburg: NHMW.

Description: The carapace (internal moulds) is flat, subhexagonal. According to BACHMAYER, the median regions are well developed. The mesogastric region bears two elevations. The urogastric region is adorned with two small tubercles. On the metagastric region there is a strong tubercle, while the branchial region bears two of them.

Remarks: The species is similar to some European *E.* species. Probably *E. granulosa* is the closest form but the strong ornament of the branchial region and the extended hepatic region are distinctive at *E. vanstraeleni*.

Ebalia oersi MÜLLER, 1979

Pl. XLIII, figs. 3–7. ?fig. 8.

1979a. *Ebalia oersi* n. sp. — MÜLLER: 279, 288, pl. 13, figs. 1–3.

Material seen: holotype, ca. MOE-4-1: CA.
Paratypes: 2 ca. MOE-4: CA.
Others: 18 ca. MOE-4; ?ca. drilling "Váci út 120": CA.

Description: The carapace is flat, shield-like, subpentagonal. The whole surface is covered with granulation which is rather even but in the median parts slightly coarser. The lateral and posterior borders have sharp edges. The median regions are elevated, especially the cardiac one, which is round. On the branchial region there is one, not striking, smooth elevation. The posterior margin bears two lobes but at some specimens the margin is rather straight.

Remarks: The species is most probably closest to *E. edwardsi* Costa, but is much less wide. From *E. vanstraeleni* it differs by the weaker decoration and by the less extended hepatic regions.

Ebalia sp. div., nov.?

Pl. XLIV, figs. 1–4.

Material seen: ca. MTM-1, 2 different ca. MZZ-2 and MZZ-3: CA.

The specimens are rather incomplete or poorly preserved. They belong to three different species and they differ from any other Badenian species, though the Törökmező specimen is close to *E. oersi.*

'Ebalia' hungarica Müller, 1974

Pl. XLIV, fig. 5, pl. XLV, figs. 1–5.

1974a. *Ebalia hungarica* n. sp. — Müller: 121, 126, pl. 1, figs. 5–7.
1974b. *Ebalia hungarica* Müller — Müller: 276.
1979a. *Ebalia hungarica* Müller — Müller: 274.

Material seen: holotype, ca. MB-3-1: NMŐ.
Paratypes, 2 ca. MB-3: CA.
Others, 10 ca. MDG-12, 14 ca. MJL-11, 3 ca. MBH-5, 6 ca. MB-3, ca. MUO-1, ca. MBK-2, 2 ca. MKC-24, 2 ca. MRO-6, ca. MR8-18: CA.

Description: The carapace is close to an elongated hexagon, convex laterally and longitudinally. The whole surface is densely tuberculated. The median regions (gastric and cardiac) are elevated. All regions are well delimited by depressions. There are some bigger tubercles near the lateral angle. The posterior margin is bilobated, but the lobes fuse in some specimens. All transitions exist between the fused and bilobated forms.

Remarks: Though the species was originally compared with *E. tuberculosa* H. Milne-Edwards, it is highly peculiar and no similar form occurs either in the fossil or in the zoological record. Most probably the species belongs to a new genus.

Genus *Andorina* Lőrenthey, 1901

Andorina elegans Lőrenthey, 1901

Pl. XLVI, figs. 1–4.

1901a. *Andorina elegans* n. gen. n. sp. — Lőrenthey: 833–835, pl. 1, fig. 1.
non 1901a. *Andorina? elegans?* n. sp. — Lőrenthey: pl. 1, fig. 2. (Parthenope!)
1901b. *Andorina elegans* Lőrenthey — Lőrenthey: 330–332, pl. 1, fig. 1.
non 1901b. *Andorina? elegans?* — Lőrenthey: pl. 1, fig. 2.
1929. *Andorina elegans* Lőrenthey — Lőrenthey in Lőrenthey—Beurlen: 34, 139–140, pl. 8, fig. 2. Non! fig. 3.

Material seen: holotype, ca. Telepy utca, Budapest, M30: FI.

Description: The carapax is elongated, elliptical in its outline, since posterior margin is absent. The surface is densely adorned with tubercles predominantly of two different sizes. On the postfrontal and hepatic regions only the tubercles of smaller size are present. The hepatic region is rather extended. The cardiac region is elevated.

Remarks: Though described as an *Oxyrhynch*, the species is a typical leucosid (Müller 1979a, p. 279, 287). No similar form was found in the zoological literature, however.

Genus *Palaeomyra* A. Milne-Edwards 1861

1979a. *Ebalites* n. gen., typus-species *Ebalia globulosa* Müller — Müller: 279, 287.

'Palaeomyra' globulosa (Müller, 1976)

Pl. XLVII, figs. 1–7.

1976a. *Ebalia globulosa* n. sp. — Müller: 509, 510, 512, pl. 2, figs. 2, 3, 5.
1979a. *Ebalites globulosus* (Müller) — Müller: 279, 287, pl. 14.

Material seen: holotype, ca. MA-1-1: CA.
Others, 27 ca., ch. MOE-14, ca. MRF-14, ca. MNU-2: CA.

Description: The carapace is elongated, subglobose, all but the cardiac regions are ill-delimited. The whole surface is granulated except the smooth postfrontal region. The lateral margins are completely circular, but a slight variation occurs in their curvature. There are two characteristic spiniform extensions on the posterior margin which are either flattened or rather narrow on different individuals. The chela found in the same layer where numerous carapaces occurred, is elongated. The slender fixed finger is directed downwards.

Remarks: The species is similar to *Palaeomyra bispinosa* A. Milne-Edwards, but the median ridge is absent from the Badenian form. The posterior spines are also different, much wider in *P. globulosa* than on the figure of Milne-Edwards. Many old drawings are idealised, and the Italian specimen was an internal mould. Unless its type will not be found, the relationship of the two species remains doubtful.

Superfamilia **Raninoidea** de Haan, 1841
Familia **Raninidae** de Haan, 1841
Genus *Ranidina* Bittner, 1893

Ranidina rosaliae Bittner, 1893*

Pl. XLVI, fig. 6.

1893. *Ranidina* n. gen. *rosaliae* n. sp. — Bittner: 33–46, pl. 2, fig. 2.
1929. *Ranidina rosaliae* Bittner — Lőrenthey in Lőrenthey—Beurlen: 121–122, pl. 5, fig. 8.
1975. *Ranidina rosaliae* Bittner — Stojaspal: A190.
1979b. *Ranidina rosaliae* Bittner — Müller: 4–5, pl. 3, fig. 2.

Material not seen: syntypes, 5 ca. Walbersdorf: Geolog. Bundesanstalt, Wien.

Material seen: ca. Gorna Mitropolia, Bulgaria, leg. Kojumdgieva: coll. Univ. Sofia.

Description: The carapace is elongate, smooth, hexagonal in outline. It is convex transversally while less so longitudinally. There are two lateral spines, two extraorbital and one frontal spine on the carapace. The two parallel ridges present on Bittner's reconstruction were not observable on the Bulgarian specimen. Anterolateral margins are convex while the posterolateral ones are straight. The upper margin of the chela is spinose.

Remarks: The position of the species within the recent *Raninids* remains doubtful until better specimens will not be found. Its independence is likely, however.

Sectio OXYRHYNCHA Latreille, 1803
Familia **Majidae** Samouelle, 1819
Subfamilia *Majinae* Samouelle, 1819
Genus *Maja* Lamarck, 1801

Maja biaensis Lőrenthey in Lőrenthey—Beurlen, 1929

Pl. XLVIII, figs. 1–6, pl. XLIX, figs. 1–3.

?1854. *Maja orbigniana* nom. nud. — Millet: 152.
?1865. *Maja orbigniana* n. sp. — Millet: 1.
?1873. *Maja* sp. — Woodward: 325.

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* See Addendum.

?1907. *Maia miocenica* n. sp. — Lőrenthey: 237.
?1908. *Maja orbigniana* Millet — Couffon: 2, 3, pl. 1, figs. 1–4.
?1910. *Maja orbigniana* Millet — Couffon: 130, fig. 4.
1929. *Maia biaensis* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 34, 148–150, pl. 7, fig. 1. (idealised!)
1976a. *Maja biaensis* Lőrenthey — Müller: 510, pl. 3, fig. 2.
1979a. *Maja biaensis* Lőrenthey — Müller: 274.

Material seen: plaster cast of holotype, ca. Bia: FI.
Others: ca. (fragment) WEG, (leg. Krach), ca. (fragment) MNU-3, 1 ca. MNA-1, 2 ca., ch., carpus MFA-7, ca. MKC-23, 2 ca., ch. MOE-20, 6 ca. MOH-9, 3 ca. MGY-23, 2 ca. MN-1: CA.

Description: The carapace is elongated, pyriform, strongly tuberculated and spinose. The frontal spines are particularly long and the lateral ones are more slender and sharp. On the median line there are some big tubercles, while on the other parts there are groups of bigger or smaller tubercles.

Remarks: *Maja orbigniana* Millet is very similar to our form. The only difference is that the tubercles are slightly bigger and closer to each other on the French form. Whether this is due to individual variability cannot be decided at moment. Also, *M. miocaenica* Lőrenthey is similar to the Budapest specimens. Woodward's Maltese specimen is still preserved in the British Museum of Natural History (pers. comm. of Dr. Collins) though Lőrenthey's Sardinian specimen was most probably lost. Probably all the Miocene *Maja* species of this restricted area were closely related or even identical with each other. Comparing the Miocene species with *M. squinado,* it can be stated that the median spines are bigger in the Miocene form. Seen from the side *M. squinado* has an elliptical outline, while *M. biaensis* (and *M. orbigniana* also) is depressed between the meso- and urogastric fields.

Genus *Schizophrys* White, 1848

Schizophrys visegradensis n. sp.

Pl. XLIX, figs. 4, 5, pl. L, figs. 1–3.

1976b. *Libinia?* sp. — Müller: 516.

Material seen: holotype, ca. MTZ-20-1: CA.
Paratypes, 2 ca. MTZ-20, 10 ca. MV-8: CA.

Locus typicus: Nagymaros, Törökmező.

Stratum typicum: Lower Badenian.

Derivatio nominis: From the first known locality, Visegrád.

Diagnosis: Rather flat, pyriform carapace with short frontal spines.

Description: The pyriform carapace is rather flat. The decoration on the surface is sparce. The cardiac region is well delimited. The cervical groove is moderately deep. The two simple frontal spines are rather short. On the anterolateral margin there are spines. The two well preserved are double. The other spines were short and simple. On the mesobranchial region there are five tubercles in a transverse row. On the branchial region there are also tubercles, their total number is about 15 on each side. Between the tubercles the surface is smooth.

Remarks: The species is close to *Schizophrys aspera,* recent Indo-West-Pacific species. The anterolateral teeth are simple in the recent form, while the frontal ones are compound and longer than that of the Miocene form.

Subfamilia *Inachinae* McLeay, 1838
Genus *Achaeus* Leach, 1815

Achaeus magnus Müller, 1979

Pl. L, figs. 4–6, pl. LI, figs. 1, 2.

1979a. *Achaeus magnus* n. sp. — Müller: 274, 279, 280, 288, pl. 15.

Material seen: holotype, ca. MOE-5-1: CA.
Paratypes: 2 ca., 2 ch. MOE-5: CA.
Others, 12 ca. MOE-5: CA.

Description: The outline of the carapace is triangular, it is convex transversely. There are two short rostral spines with slightly upwards directed tips. Behind the orbits there is a neck-like narrow part. The height of the carapace decreases gradually posteriorly. On the mesogastric region there is an erect spine. The mesogastric and cardiac regions are well delimited laterally by deep furrows. On the cardiac region there are two smooth, rounded protuberances near each other.

The palm of the chela is elongated but rather convex. The index is long, narrow, inward directed. The chela is similar to that of the modern *Achaeus* species. Other *Majids* of the locality have different chelae.

Remarks: The Mediterranean-East-Atlantic species of *Achaeus* are quite different, generally smaller. Among the Indo-West-Pacific forms *A. tuberculatus* has similar erect spines, but two instead of one.

Subfamilia *Pisinae* DANA, 1852
Genus *Pisa* LEACH, 1814

'Pisa' oroszyi (BACHMAYER, 1953)

Pl. LI, figs. 3–6, pl. LII, figs. 1–3.

1953. *Maia oroszyi* n. sp. — BACHMAYER: 245–247., pl. 2, fig. 3.
1974a. *Pisa oroszyi* (BACHMAYER) — MÜLLER: 122, 124, pl. 2, figs. 1–3.
1979a. *Pisa oroszyi* (BACHMAYER) — MÜLLER: 274, 274, 275.

Material seen: holotype, ca. Deutsch-Altenburg, leg. K. OROSZY: NHMW.
Others: 21 ca. MM-1, 46 ca., ch. MB-12, 2 ca. MDG-20, 8 ca, MGF-2, ca. MRZ-17, ca. MOE-13, 2 ca. MKF-2, 2 ca. MRS-3, 45 ca. MJL-13, 11 ca. MBH-4, 4 ca. MBK-3, ca. MKC-22, ca. MEG-14: CA.

Description: The carapace is subtriangular, its widest part is at the posterior 1/3, if the rostrum is omitted. The carapace is convex transversely, moderately so longitudinally. The two, strongly diverging rostral spines are almost as long as one half of the carapace. On the hepatic margin there are two spiny teeth. A pointed supraocular spine is also present. The branchial regions are adorned with three tubercles. The regions are well delimited. The cervical groove is the deepest one, but the hepatic region is delimited from the protogastric one by a deep furrow.

Remarks: It was not an easy decision to range this species among Pisa forms, where V shaped rostral spines are uncommon. Instead, spines of this type are present in *Rochinia* and various other forms. All other features, including shape the chela, and the well developed praeorbital spine are typical for *Pisa*. Perhaps this form is close to a hypothetical common ancestor of *Pisa* species.

Ecology: The species is most abundant where *Pachygrapsus* and *Brachynotus* occurs and where stromatolites or oncoides are present. All this indicates a shallow infralittoral or even an eulittoral environment. In contrast recent *Pisa* species live generally in a slightly deeper water, down to 100 meters, though *P. tetraodon* was reported from shallow waters too (1 meter, INGLE 1980. p. 139).

Subfamilia *Mithracinae* BALSS, 1929
Genus *Micippa* LEACH, 1817

Micippa hungarica (LŐRENTHEY in LŐRENTHEY—BEURLEN, 1929)

Pl. LII, figs. 4–6, pl. LIII, figs. 1–4.

1929. *Maia hungarica* n. sp. — LŐRENTHEY in LŐRENTHEY—BEURLEN: 34, 150, 151, pl. 7, fig. 2. (highly inaccurate!)
1953. *Maia austriaca* n. sp. — BACHMAYER: 244–245, pl. 2, fig. 3.
1953. *Phrynolambrus weinfurteri* n. sp. — BACHMAYER: 247–248, pl. 3, fig. 4.
1974b. *Micippa austriaca* (BACHMAYER) — MÜLLER: 277, pl. 1, figs. 5, 6.
1979a. *Micippa hungarica* (LŐRENTHEY) — MÜLLER: 274.

Material seen: holotype, Bia M 2330: FI.
Others, ca. Rákos, leg. FRANZENAU, M60/5964: NMŐ. 32 ca. MOE-17, 19 ca. MDG-19, 3 ca. MKC-21, 5 ca. M8-11, 2 ca. MBH-3, ca. MFK-6, 2 ca. MDZ-14: CA.

Description: The carapace is extremely convex in both directions. It is stout, not much longer than wide. The frontal part is directed downwards. There is a median longitudinal furrow on this part. The rostrum is subterminally bifurcated and terminates in two diverging short spines. The orbits are rather big, spiny, directed outwards. On all margins there are acute spines. The surface is strongly and almost evenly tuberculated. At the mesobranchial region there is an elevation decorated by an upward directed spiniform tubercle. A specimen from Rákos (pl. LII. figs. 5, 6) is apparently smoother than the others, but this can be attributed to a different preservation.

Remarks: With the very kind help of Dr. Guinot it was possible to compare the species with recent forms. The Badenian form is beyond any doubt quite similar to *M. thalia*, but the tubercles are closer on the surface of *M. thalia* Herbst, and individual variations might be even larger. The only argument against the fusion of the two species is that there are no links from intermediate geologic times (p. 48).

Ecology: The species is rare or absent in layers deposited in extremely shallow waters or on reefs. This is in accord with the fact that *M. thalia* lives in depth of about 20–100 meters (Sakai 1976, p. 257) though other *M.* species prefer shallower waters or reefs.

Familia **Parthenopidae** McLeay, 1838
Subfamilia *Parthenopinae* McLeay, 1838
Genus *Parthenope* Weber, 1795

Parthenope szaboi Müller, 1974

Pl. LIII, fig. 5, pl. LIV, figs. 1–9.

?1895. Lambrus sp. ind. — Crema: 674, fig. 14.
partim 1928. *Lambrus* sp. — Glaessner: 198.
1974b. *Parthenope szaboi* n. sp. — Müller: 277, 283, pl. 1, figs. 8, 9.
1976c. *Parthenope szaboi* Müller — Müller: 152, pl. 4, fig. 2.
1979a. *Parthenope szaboi* Müller — Müller: 274.

Material seen: holotype, ca. MDG-9-1 (=MG-2-1): NMŐ.
Paratypes, 4 ca. MDG-9: CA.
Others, 22 ca., 22 ch. MOE-15, 2 ch. MR-16, 16 ch. MR8-13, 4 ch. MRF-8, 2 ca., 6 ch. MKC-8, 5 ch. MGY-19: CA.

Description: The outline of the carapace is rhomboidal, rounded. The front consists of a trilobated rostrum. The anterolateral border is double. Between the hepatic and branchial parts there is a notch. This margin is adorned with even teeth, only the last one is slightly bigger. The median regions are elevated, the cardiac one is hump-like covered with numerous tubercles. Smaller and bigger tubercles are scattered on the whole surface, only the front is smooth.

The cross-section of the chela is triangular, all edges are covered with teeth or tubercles. The dactylus is curved. On its upper proximal part there is a flattened region delimited by spines.

Remarks: The species is extremely close to *P. angulifrons* extant form. Until intermediate forms are known their fusion would be risky.

Ecology: The species occurs in various rocks, but is rare in those deposited in shallow water. It was never found in reefal formations.

Parthenope tetenyensis n. sp.

Pl. LV, figs. 1–7, pl. LVI, figs. 1–7.

1897. Lambrus sp. ind. — Lőrenthey: 161.
1898a. Lambrus sp. ind. — Lőrenthey: 106.
1898b. Lambrus sp. ind. — Lőrenthey: 117, 152.
1898c. Lambrus sp. ind. — Lőrenthey: 91.
partim 1901a. *Andorina elegans?* — pl. 1, fig. 2.
partim 1901b. *Andorina elegans?* — pl. 1, fig. 2.
partim 1928. *Lambrus* sp. — Glaessner: 128.
1929. *Andorina elegans* Lőrenthey — Lőrenthey in Lőrenthey—Beurlen: pl. 8, fig. 3.
1979a. *Parthenope* sp. nov? — Müller: pl. 11, fig. 3, pl. 12, fig. 3.

Material seen: holotype, ca. MOE-16-1: CA.
Paratypes: 14 ca., 31 ch. MOE-16, 14 ca. MDG-8, ca., ch. MJL-6, 3 ch. MR-17, ca. MGY-18, ch. MR8-14, ca. MBH-11, 2 ca. MUO-2, 9 ch. MRF-9, 3 ca. MEG-11, da. MOS: CA.

Locus typicus: Budapest, Örs vezér tere, construction-pit.

Stratum typicum: Upper Badenian.

Derivatio nominis: Its first known occurrence was on the Tétény-plateau.

Diagnosis: Subtriangular carapace, strongly elevated median regions.

Description: The outline of the carapace is subtriangular, rounded at the lateral edges. The frontal part is rather wide, directed downwards. There is a deep median furrow on it. The median regions are highly elevated forming a structure resembling to the number 8. The branchial regions are also strongly elevated. The lateral margin is bordered by compound, flat lobe-like teeth. The species is strongly heterochelous, the right, crusher one is high, the other elongated. Their cross-section is four-sided.

The dactylus is flattened on its upper proximal part. The flat region is surrounded by tubercles.

Remarks: The species is similar to *P. massena*, a highly variable extant species, which has a tendency to being smooth, depleted of tubercles. No similar trend was observed at *P. tetenyensis*, nevertheless the range of their variability overlap. This species can be distinguished from *P. szaboi* even on the basis of a fragment of a chela, the cross-section of which is triangular at the former, four-sided at the other.

Stratigraphy: The species is known from the Upper Badenian. As the age of Oslip-locality is probably Middle Badenian, the species' range is longer. Perhaps the form is near to the ancestor of *P. massena*, extant species.

Sectio CANCRIDEA Latreille, 1803

Familia **Corystidae** Samouelle, 1819

Genus *Corystites* nom. nov., pro *Microcorystes* Lőrenthey in Lőrenthey–Beurlen 1929, nom. praeocc.

non 1893. *Microcorystes* n. gen. — Fritsch.
1929. *Microcorystes* n. gen. — Lőrenthey in Lőrenthey—Beurlen: 137, typus-species: *M. latifrons* n. sp., by monotypy.
1969. *Microcorystes* Lőrenthey, non Fritsch — Glaessner: R532.

Corystites latifrons (Lőrenthey in Lőrenthey—Beurlen, 1929)

1904a. *Microcorystes latifrons* nom. nud. — Lőrenthey: 161.
1904b. *Microcorystes latifrons* nom. nud. — Lőrenthey: 30.
1929. *Microcorystes latifrons* n. gen. n. sp. — Lőrenthey in Lőrenthey—Beurlen: 137–138, pl. 8, fig. 4.

Material not seen, broken and lost: ca. Budafok.

Description: Lőrenthey's figure shows a carapace which is elliptical, convex in both directions. The cardiac, branchial and mesogastric regions are well delimited from each other. The anterolateral margin bears 5 or 6 teeth. The rostrum is bilobed.

Remarks: As the specimen was found as early as 1904 or even earlier, one can hope that it was drawn by the artist who completed Lőrenthey's first figures which are all correct.

Indeed the shape of the species reveals similarities with *Micromithrax holsaticus* Nötling (Gripp 1967, pl. 1, fig. 2, and Gripp 1964, p. 123, pl. 21, fig. 8.) on one hand and with Jonas, extant genus, on the other.

Familia **Cancridae** Latreille, 1803

Subfamilia *Cancrinae* Latreille, 1803

Genus *Cancer* Linnaeus, 1758

Cancer sismondai (Meyer, 1843)

1859. *Lobocarcinus sismondai* Meyer — A. E. Reuss: 41. pl. 9, figs. 1–2.
?1884. *Cancer illyricus* n. sp. — Bittner: 26–27, pl. 1, fig. 7.
?1905. „Hand eines Cancer" — Toula: 163.
1924. *Cancer sismondae* Meyer — Glaessner: 115.
1928. *Cancer sismondai* v. Mey. — Glaessner: 176–177.

?1928. *Cancer* cf. *sismondai* v. MEY. — GLAESSNER: 177–178.
?1929. *Cancer* sp. — LŐRENTHEY in LŐRENTHEY—BEURLEN: 162, pl. 8, fig. 7.
1982. *Cancer sismondai* MEYER — BONFIGLIO—DONADEO: 255–296, pl. 36–44. (exhaustive literature).

Material seen: almost entire specimen. Bruck: NHMW. ?ch. (lost?) Dévényújfalu, Devinska Nova Ves: ?coll.

Remarks: The species is described in great detail by BONFIGLIO and DONADEO (1982). REUSS' specimen belongs most probably to this wide-spread and frequent Mediterranean species known from Miocene and Pliocene layers. An interesting point is, however, its rarity in the Paratethys. An exchange of label by REUSS, an extremely careful naturalist is by no means possible.

Cancer styriacus BITTNER, 1884

Pl. LVII, figs. 1–4, pl. LVIII, figs. 1–2.

1884. *Cancer styriacus* n. sp. — BITTNER: 25–26, pl. 1, fig. 6.
1928. *Cancer styriacus* BITTNER — GLAESSNER: 178.
?1953. *Cancer sismondai* H. v. MEYER — BACHMAYER: 248, 249.

Material not seen, probably lost: holotype, ca. Aigen bei Fehring, Austria: ?Geol. Bundesanst.

Material seen: ca., fragment of ca., 2 ch. MOE-27, 4 ca. MDZ-4: CA.

Description: The carapace is rather narrow, convex. The frontal region is narrow, there are three teeth on it between the intraorbital ones. The median region is depressed. The anterolateral margin consists of nine finely denticulated lobes. The regions are moderately well delimited, the deepest furrow is located on the sides of the urogastric and cardiac regions. The posterolateral margin is straight or slightly concave. The chela is stout, and its ridges consisting of small tubercles are low.

Remarks: The Hungarian specimens are identical to BITTNER's figure except that the concavity of the anterolateral margin was most probably exagerated by BITTNER's artist. This feature is variable, however. The form differs from all extant *Cancers* by its extreme narrowness. Probably *Cancer amphioetus* is similarly narrow (RATHBUN 1930), but it is strongly ornamented.

Ecology: The recent *C.* species live predominantly in moderately deep waters (some tens of meters). The species is frequent on MDZ locality of reef origin.

Cancer illyricus BITTNER, 1883

Pl. LVIII, fig. 3.

1884. *Cancer illyricus* n. sp. — BITTNER: 26–27, pl. 1, fig. 7.
non 1893. *Cancer* cf. *illyricus* BITTNER — BITTNER: 32, 33.

Material seen as cast: holotype, ca. Zagor, Yugoslavia: coll. Univ. Graz.

Remarks: The probably only specimen is slightly compressed laterally. Disregarding this distortion, the specimen is remarkably similar to small specimens of *C. sismondai* H. v. MEYER. (BONFIGLIO—DONATEO 1982, pl. 41, fig. 3N.) In small specimens a tubercular ornamentation of the protogastric region is clearly visible but is absent from the bigger ones. In this and other aspects there is no difference between the two forms of *Cancer*.

Genus *Microdium* A. E. REUSS, 1867

Typus-species: *Microdium nodulosum* REUSS, 1867, by monotypy.
1929. *Cancer* — GLAESSNER: 104, 256.

Microdium nodulosum A. E. REUSS, 1867

1867. *Microdium nodulosum* n. gen. n. sp. — A. E. REUSS: 173–176, pl. 8, figs. 7–8.
1929. *Cancer nodulosus* (REUSS) — GLAESSNER: 104.
?1929. Cancer sp. ind. — LŐRENTHEY in LŐRENTHEY—BEURLEN 1929: 161, pl. 8, fig. 6.

Material not seen: holotype, ca. Wieliczka: NHMW.
Others: ?ch. Wieliczka: coll.?
?ch. Felménes: lost.

Remarks: REUSS' description and figures well represent the species but it is prudent not to fuse the genera *Microdium* and *Cancer* in spite of all similarities until the holotype or new specimens are found.

Genus *Miocyclus* MÜLLER, 1979

Typus-species: *Miocyclus bulgaricus* MÜLLER, 1979, by monotypy.

Miocyclus bulgaricus MÜLLER, 1979

Pl. LVIII, *figs.* 4–6, Fig. 10.

1979b. *Miocyclus bulgaricus* n. sp. — MÜLLER: 5, pl. 2, figs. 1–3, pl. 3, fig. 1.

Material seen: holotype, Oriakhovo, Bulgaria, leg. KOJUMDGIEVA, Nt533/a: coll. Univ. Sofia.
Paratype, same data, Nt533/b.

Description: The carapace is flat, ornamented with small evenly distributed tubercles on the surface. The anterolateral margin is decorated with eight undistinct lobes of different sizes. Instead of the last, ninth lobe there is a spine. The front is wide, cut into six lobes. The mesogastric region is wide, the furrows delimiting this and the cervical furrow are shallow but distinct.

Remarks: The species is a quite peculiar representative either of the *Cancrids*, which is more likely, or the *Atelecyclids*. The wide mesogastric region is characteristic of the *Cancroidea*. The flat smooth surface rules out its identity with any of the Badenian *Cancroidea* species which are usually more adorned. The rather smooth surface of the *Cancer* carapaces is slightly similar to that of *M. bulgaricus*, but the wide frontal region rules out any closer relationship.

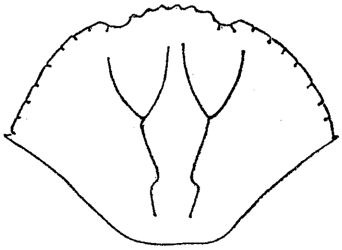

Fig. 10. Miocyclus bulgaricus
1× Oriakhovo

Genus "*Cancer*" as nomen collectivum*.

Remarks: The name was widely used for fossil species as it was among the best known genus of recent Crabs. Having no better solution, it will be used for a variety of species described by three authors. Some of these species were transferred later to other, partly new genera.

"Cancer" szontaghii LŐRENTHEY, 1897*

Pl. LIX, figs. 1–5, pl. LX, figs. 1, 2.

1897. *Cancer Szontaghii* n. sp. — LŐRENTHEY: 159, 160, 167, 168.
1898a. *Cancer Szontaghii* LŐRENTHEY — LŐRENTHEY: 104, 113, 115.
1898b. *Cancer Szontaghii* LŐRENTHEY — LŐRENTHEY: 120–126, 153, pl. 8, fig. 4.
1898c. *Cancer Szontaghi* LŐRENTHEY — LŐRENTHEY: 94–99. pl. 8, fig. 4.
1929. *Atelecyclus szontaghi* LŐRENTHEY — LŐRENTHEY in LŐRENTHEY—BEURLEN: 156–158, pl. 8, fig. 9.
1958. *Cyclocancer szontaghi* (LŐRENTHEY) — BEURLEN: 15.
1969. *Atelecyclus szontaghi* LŐRENTHEY — GRIPP: 86, 87, pl. 3, fig. 1.
In press *Tasadia szontaghii* (LŐRENTHEY) — JANSSEN–MÜLLER.

Material seen: holotype, complete specimen, Tasádfő, M35: FI.
Others, a specimen in the same piece of rock than the holotype: FI.
2 ca. Ramsel, Hemmorian, Belgium (loan from A. JANSSEN).

Material not seen: ca. Segrahn, B. R. D.

Description: The carapace is densely ornamented. All regions are delimited from each other by deep furrows. The front was probably decorated with four spiniform tubercles (including the

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* See Addendum.

intraorbital teeth), but the presence of a median tooth can not be ruled out. The teeth of the anterolateral borders are composed of smaller tubercles. The ornament of the surface consists of bigger, compound tubercles and smaller, simple ones. The chelae are covered with rows of tubercles. The basis-ischium of the third maxilliped is *Cancer*-like.

Remarks: The species was found in great number in Ramsel, Belgium. DR. A. JANSSEN kindly offered a joint study of this material which will probably elucidate the systematical position of this interesting species (JANSSEN–MÜLLER in press.). The third maxilliped is clearly *Cancer*-like, unlike that of *Atelecyclus*, thus a transitional position between the two genera is ruled out.

"Cancer" szontaghii vindobonensis (BACHMAYER—KÜPPER 1952)*

1952. *Atelecyclus szontaghi vindobonensis* nov. subspec. — BACHMAYER—KÜPPER: 2–6, text-figs. 1, 2.

Material seen: holotype, ca. Baden-Sooss: NHMW.

Remarks: The subspecies is described in details by the two authors. The species is much less decorated than LŐRENTHEY's. The outlines of the carapace are unknown. The problem of the Badenian "*Cancer*" species will be discussed later.

"Cancer" carniolicus BITTNER, 1884*

Material not seen, probably lost: syntypes, 4 ca. Stein, Yugoslavia, ca. Plesko, Yugoslavia: ?Geol. Bundesanstalt.

Remark: There is no reason to repeat BITTNER's description until some specimens will be found again.

"Cancer" bittneri TOULA, 1905*

?1893. *Cancer* cf. *illyricus* BITTNER — BITTNER: 32, 33.
1905. *Cancer Bittneri* n. sp. — TOULA: 161–168, text-figs. 1–5.

Material not seen, probably lost: holotype, Kalksburg: ?Technische Hochschule, Wien.
Others: ca. Sooss at Baden, numerous ca. Walbersdorf (Borbolya): NHMW and Geol. Bundesanstalt, Wien.

Remarks: Though TOULA's figures seem reliable, no definitive conclusions can be drawn. General remarks about the "*Cancer*" species*. Four different "taxa" were presented under this dubious generic name. Unfortunately most specimens were lost or at least unavailable to me. Others are poorly preserved. Only "*C.*" *szontaghii* has a well-preserved extant holotype-specimen. BITTNER had serious doubts about the independence of his two species *C. illyricus* and *C. carniolicus* as early as in 1893. Later GLAESSNER assigned the walbersdorf specimens, described by BITTNER as *C.* cf. *illyricus*, to *C. bittneri*. All authors pointed out the similarities in superficial ornament of all these species. As the matter stands, it is almost impossible to draw any conclusions concerning these "species". In fact it is not likely that a limited space and time-span could contain so many species from the same group.

Familia **Pirimelidae** ALCOCK, 1899
Genus *Pirimela* LEACH, 1816

Pirimela lorentheyi (MÜLLER, 1974)

Pl. LX, figs. 3–5.

1974a. "*Carcinus*" *lőrentheyi* n. sp. — MÜLLER: 122, 126, pl. 2, figs. 4, 5.
1979a. *Pirimela lorentheyi* MÜLLER — MÜLLER: 274.

Material seen: holotype, ca. MB-4-1: NMŐ.

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* See Addendum.

Description: The carapace is rather narrow, convex transversely and longitudinally. Its surface is almost smooth. The mesogastric and cardiac regions are fused but well delimited from the other ones. The cervical furrow is also developed. On the hepatic and epibranchial regions there are elevations. The protogastric region is limited anteriorly by a step-like inclination. The front is trilobated, not counting the intraorbital lobes. The anterolateral teeth are not preserved.

Remarks: On my inquiry Dr. L. B. Holthuis suggested the transfer of the species from the *Portunidae* to *Pirimela*. Comparison with specimens of *P. denticulata* and the literature (Ingle 1980, pl. 15, fig. b.) provided convincing reasons for this move. The posterolateral margin of *P. lorentheyi* is straight while concave in the extant form. The frontal lobes are much more acute in *P. denticulata*. According to the article 31 c/i of the ICZN (Stoll et al. 1961) the original Hungarian spelling Lőrenthey should be modified by omitting the accents.

Genus *Trachypirimela* Müller, 1974

Typus-species: *Trachypirimela radula* Müller, 1974 (=*Micromithrax grippi* Müller, 1974).

Trachypirimela grippi (Müller, 1974)

Pl. LXI, figs. 1–6.

1974a. *Trachypirimela radula* n. sp. — Müller: 278, 279, 283, 284, pl. 2, figs. 5–6.
1974b. *Micromithrax grippi* n. sp. — Müller: 279, 284, pl. 2, figs. 1–2.
1979a. *Trachypirimela grippi* (Müller) — Müller: 274.

Material seen: holotype, ca. MA-1-1 (=MDG-15-1): NMŐ.
Holotype of *Trachypirimela radula*, ca. MDG-15-2 (=MG-3-1): NMŐ.
Paratypes, 3 ca. MDG-15: CA.
Others: 4 ca. MDG-15, ca. MJL-12, ca. MUO-3, 2 ca. MOE-28: CA.

Description: The carapace is pentagonal, rather flat at young specimens while convex at older ones. The regions are well defined. The mesogastric and cardiac fields are well delimited laterally. The cervical groove is rather deep. The front is not wide, trilobated, but all specimens are damaged at this area. The anterolateral margin bears five unequal teeth. The extraorbital tooth is double. The surface is finely striated, and some bigger tubercles occur on the branchial region.

Remarks: The allometric growth of the species and the poor preservation of the type-specimen of *Micromithrax grippi* led to the introduction of two species which were even attributed to separated genera. Transitional specimens do occur, however. The species is similar to *Sirpus*, especially to *S. monodi* Gordon but it has acute frontal spines. No allometric growth occurs in *Sirpus*.

Sectio BRACHYRHYNCHA Borradaile, 1907
Superfamilia **Portunoidea** Rafinesque, 1815
Familia **Portunidae** Rafinesque, 1815
Subfamilia *Portuninae* Rafinesque, 1815
Genus *Portunus* Weber, 1795

Portunus monspeliensis (A. Milne-Edwards, 1860)

Pl. LXII, figs. 1, 2.

non 1834. *Lupea granulata* H. Milne-Edwards (=*Portunus granulatus* H. Milne-Edwards)
1860. *Neptunus monspeliensis* n. sp. — A. Milne-Edwards: 232.
1860. *Neptunus monspelliensis* n. sp. — A. Milne-Edwards: pl. 4, fig. 1, pl. 5, fig. 1.
1860. *Neptunus granulatus* n. sp. — A. Milne-Edwards: 241, pl. 3, fig. 1, pl. 7, fig. 2.
?1893. *Neptunus* cfr. *granulatus* A. Milne-Edwards — Bittner: 11–12.
1897. *Neptunus* cf. *granulatus* A. Milne-Edwards — Lőrenthey: 159.
1898a. *Neptunus* cf. *granulatus* A. Milne-Edwards — Lőrenthey: 94, 113.
1898b. *Neptunus* cf. *granulatus* A. Milne-Edwards — Lőrenthey: 110, 153, pl. 9, figs. 2–3.
1898c. *Neptunus* cf. *granulatus* A. Milne-Edwards — Lőrenthey: 92, pl. 9, figs. 2–3.
1928. *Neptunus granulatus* A. Milne-Edwards — Glaessner: 183, 184.
1929. *Neptunus granulatus* A. Milne-Edwards — Glaessner: 267, references.

1929. *Neptunus granulatus* A. MILNE-EDWARDS — LŐRENTHEY in LŐRENTHEY—BEURLEN: 188, pl. 13, figs. 3–4, pl. 14, figs. 1, 4.
1968. *Neptunus granulatus* A. MILNE-EDWARDS — STANCU—ANDREESCU: 466, pl. 7, fig. 85.
1979a. *Portunus granulatus* A. MILNE-EDWARDS — FÖRSTER: 94, further references from the Paratethys.
1979a. *Portunus monspelliensis* A. MILNE-EDWARDS — MÜLLER: 274, 280, 288, pl. 18.

Material seen: holotype, Montpellier: Muséum Natl. Hist. Nat. Paris.
Others, 2 ca., sternum Mátraverebély-Szentkút, M61/8686 and M62/3152: NMŐ.
Ca. Rákos: FI.
6 ca., partly with sternum, Kishajmás, Mecsek (MKS-1), 2 ch. MRF-13, 2 ch. MR-12: CA.

Description: A detailed description of this well known and wide-spread form is unnecessary. Two important features deserve mention. The carapace is moderately wide, consequently the anterolateral resp. the posterolateral margins enclose a rectangle. The shape of the front is characteristic (PHILIPPE—SECRETAN 1971, p. 9), with its six subequal teeth separated by similarly subequal notches.

Remarks: The species should be separated from *Portunus viai* SECRETAN in PHILIPPE—SECRETAN, a Burdigalian form which occurs in the Hungarian Eggenburgian as well in Budafok, Budapest, and was determined by LŐRENTHEY as *Neptunus granulatus* (LŐRENTHEY—BEURLEN 1929, p. 189, 7th paragraph).

Portunus neogenicus MÜLLER, 1979

Pl. LXII, figs. 3, 4.

1979a. *Portunus neogenicus* n. sp. — MÜLLER: 280, 281, 288, pl. 19.

Material seen: holotype, ca. MGY-3-1: CA.

Description: Though the specimen is fragmented, diagnostic features are present. The carapace is extremely wide, consequently the lateral margins form an angle of about 60°. The last lateral tooth is long, spiniform, directed forwards. The other teeth are arranged radially i.e. the anterior ones are directed more and more anteriorly. The shape of the teeth is characteristic.

Remarks: The species is similar to *P. sanguinolentus*, but the lateral spine is directed forwards unlike in the extant form. Furthermore, there is only a rudimentary ridge on its carapace at the last tooth, while this ridge is developed in the Indo-West-Pacific form. No other similar *Portunid* was described.

Subgenus **Monomia** GISTEL, 1848

Portunus (Monomia) miocaenicus n. sp.

Pl. LXII, fig. 5.

Material seen: holotype, ca. MRO-10-1.

Locus typicus: Budapest, railway-cut Rákos.

Stratum typicum: Upper Badenian.

Derivatio nominis: From the age Miocene.

Diagnosis: Rather wide front with two lobes between the intraorbital ones.

Description: The carapace is hexagonal, moderately wide. The front is bilobated between the intraorbital lobes. The orbits are well-developed, the orbital margins are elevated. The anterolateral margin is almost straight. The last tooth is long, directed outwards. A long ridge leaves this tooth which is bended forwards. Two more ridges are on the epigastric regions.

Remarks: The form is a characteristic Monomia species. This subgenus has not been found yet as fossil. Considering the overall shape of the carapace, *P. (M.) gladiator* is the closest extant species. Its front is, however, trilobated and the lobes are more acute than those of the new form. The shape of the front is close to that of *P. (M.) brocki*, its general form is quite different, however. The surface of the carapace is rather smooth in contrast of most *M.* species.

Genus *Charybdis* DE HAAN, 1833
Subgenus **Goniosupradens** LEENE, 1938

Charybdis (Goniosupradens) mathiasi n. sp.

Pl. LXIII, *figs.* 1–4, pl. LXIV, *figs.* 1–5, Pl. LXVII, *figs.* 3–5.

1976b. *Charybdis* n. sp. — Müller: 516.

Material seen: holotype, ca. MRZ-5-1; CA.
Paratypes, 12 ca., 8 ch. MRZ-5, ca. MV-7, 3 ca., ch. MDZ-6: CA.

Locus typicus: Budapest, railway-cut Rákos.

Stratum typicum: Upper Badenian.

Derivatio nominis: From the Hungarian king Mathias, whose favorite spot was Visegrád, the first known locality of the species.

Diagnosis: Five big and two small anterolateral teeth. On the front there are six densely packed lobes.

Description: The carapace is octogonal, slightly convex transversely. At the proximity of the margins it is flattened. The front is broad, consists of 8 lobes including the extraorbital ones, which are situated higher than the others. The outer two of the six inner lobes are semicircular, the inner lobes are square and the intermediate, two are transitional in their shape. The orbits are big, their upper margin is denticulated. The anterolateral margin bears 7 teeth, two of them, the 2nd and 4th, are small, almost rudimentary, fused to the base of the preceeding ones. The posterolateral margin is slightly concave. The branchial ridges are gently curved. They reach the border of the mesogastric region. The protogastric ridges are straight. The postfrontal ridges are replaced by ill-delimited elevated areas with clusters of small granulae. Similarly ornamented areas are situated on the outer anterior parts of the protogastric areas.

Chelae were found attached to a carapace. This male specimen displayed a marked heterochely, uncommon in *Charybdis* species: one chela had a slender palm and fingers, while the fingers of the other one were robust. Whether heterochely is confined to males or not, can not be proven now (pl. LXIV figs. 3–5, pl. LXVII figs. 3–5).

Remarks: The new species is rather distinct from most extant *Ch.* forms. *Ch. (G.) obtusifrons* Leene is the closest extant form, but its frontal lobes are arranged less densely to each other.

Ecology: The species was found exclusively in fossil Coral-reefs. In Rákos it is rather abundant.

Stratigraphy: The species occurs in Lower and in Upper Badenian strata.

Genus *Thalamita* Latreille, 1829

Thalamita fragilis Müller, 1979

Pl. LXV, figs. 1–2, 4—5, ?pl. LXV, fig. 3, pl. LXVI, figs. 1–7.

1883. *Portunien* sp. (*=Portunidae*) — Brocchi: pl. 5, fig. 4b.
partim 1929. *Portunus rákosensis* n. sp. — Lőrenthey in Lőrenthey—Beurlen: pl. 12, figs. 20, 21, pl. 15, fig. 4.
1976a. *Charybdis?* sp. — Müller: 510, pl. 3, fig. 3.
1979a. *Thalamita fragilis* n. sp. — Müller: 274, 281, 289, pl. 17, figs. 1–3.

Material seen: holotype, ca. MGY-4-1: CA.
Paratypes, 2 ca. MGY-4, 5 ca. MKC-15, ca. MA-5: CA.
Others, 8 ch. MR-15, ca., 2 ch. MR8-17, ca., 4 ch. MRF-10, 2 ca. MKC-15, ch. MRL-6, ch. MRO-8, 6 ca., ch. MEG-10, 2 ch. MGY-4, 2 ch. MFA-9, 3 ca. MA-5: CA. ch. Rákos, two fixed fingers MOH-11, M83/162: NMŐ.

Description: The carapace is hexagonal, moderately broad, rather flat. The front is eight-lobed, between the big intraorbital lobes there are six densely arranged blunt lobes. The anterolateral margin consists of 5 teeth which are generally subequal but in one specimen the 4th teeth were much smaller than the others. The anterolateral margin is rather oblique thus the front is not very wide. There are well-developed epibranchial, metagastric and protogastric ridges (Stephenson—Hudson 1957). The chelae are slender. On the outer side of the palm there are ridges which are almost invisible on some specimens. The upper edge of the palm is spinose.

Remarks: The species is closer to *Th. crenata* (Latreille) than to any other extant form (no other fossil forms are known). Nevertheless the protogastric ridges are longer in *Th. fragilis*. The front of the Miocene species is comparatively shorter therefore the anterolateral margins are more oblique. One specimen (pl. LXV. fig. 5) differs from the others by its shorter 4th anterolateral tooth and by its less oblique margin.

Thalamita n? sp.

Pl. LXVII, figs. 1–2.

Material seen: ca. (internal mould) MRZ-13: CA.

Remarks: One carapace was found, which is similarly ornamented than that of *Th. fragilis.* It is however, much more convex and its epigastric ridge is cut into two parts by a notch.

Genus *Rakosia* n. gen.

Typus-species: *Rakosia carupoides* n. sp., by monotypy.

Derivatio nominis: From one of its localities, Rákos, Budapest.

Diagnosis: A wide smooth carapace with lobated front, 8 anterolateral teeth and an epibranchial ridge.

Remarks: No similar *Portunid* is known. The form is highly peculiar by its general shape resembling *Charybdis,* but its chela is much unlike it. Some features are similar to those of *Carupa* but the general shape is quite different suggesting the systematic position of the Miocene form among *Portuninae* rather, than among *Catoptrinae. Necronectes* differs by a spinose front, though probably is related.

Rakosia carupoides n. gen. n. sp.

Pl. LXVIII, figs. 1–7.

Material seen: holotype, ca. 1984/40/2: NHMV.
Paratypes: 4 ca. MNH-6, 15 ca., 10 ch. MRZ-14, ca. MDZ-7: CA.

Locus typicus: Gross-Höflein (Nagyhöflány), Burgenland, Austria, quarry "Fenk".

Stratum typicum: Middle (or lowermost Upper) Badenian.

Derivatio nominis: The species resembles *Carupa,* Indo-West-Pacific genus of *Portunidae.*

Diagnosis: See the generic diagnosis.

Description: The carapace is hexagonal, rather flat, smooth. The front is bilobated, the lobes are wide and undulated. The intraorbital lobe is separated from the frontal ones by a notch. The orbits are big, circular, their upper margin is cut by two notches each. The oblique anterolateral margin is ornamented with eight teeth. The last tooth is not much bigger than the others. An epibranchial ridge originates at this tooth. The posterolateral margin is almost straight. The chelae are slender, extremely smooth. The cross-section of the palm is elliptical. The fingers are adorned with furrows. The dactylus bears a big proximal (crusher) tooth on one side at least.

Remarks: As mentioned in the description of the genus the species is quite peculiar. Probably some fragments were earlier determined as *Necronectes* but its front is quite different.

Genus *Necronectes* A. MILNE-EDWARDS, 1881

Necronectes schafferi GLAESSNER, 1928

Pl. LXVI, figs. 8, 9, ? pl. LXIX, fig. 1.

1928. *Necronectes schafferi* n. sp. — GLAESSNER: 179–182, text-fig. 4, pl. 3, fig. 6.

Material seen: holotype, ca. Müllendorf (Szárazvám), Austria (probably the quarry at Äusseren Berg of "Müllendorfer Kreide A. G.", cf. DULLO 1983), No 1927 I 1: NHMW.
Others, ca. MDZ-10, ?3 ch. MRZ-19: CA.

Remarks: In addition to GLAESSNER's detailed description and figures it can be stated that the frontal spines illustrated by dotted lines on the original drawing are indeed present on the Diósd specimen, they are acute and directed slightly outwards.

Subfamilia *Polybiinae* Ortmann, 1893 (=*Macropipinae* Stephenson—Campbell, 1960)
Genus *Liocarcinus* Stimpson—Pourtalès, 1870 (partim =*Macropipus* Prestrandrea, 1833)

Remarks: The old genus *Macropipus* (=*Portunus* Fabricius, non Weber) was recently split into two genera: *M.* and *Liocarcinus.* According to Holthuis (pers. comm.) the latter is still heterogenous. The miocene species attributed to *Macropipus* actually belong to *Liocarcinus* and to a new genus described below.

The recent *L.* species live mostly in the East-Atlantic-Mediterranean realm, one species is widespread as occurs in the Indo-West-Pacific area, too. The species of the genus live generally in shallow waters, mostly from five to hundred meters, but some occur almost intertidally (Zariquiey Alvarez 1968, Pesta 1918). Some of them are euryhaline.

Liocarcinus rakosensis (Lőrenthey in Lőrenthey—Beurlen, 1929)

Pl. LXIX, figs. 2–6, pl. LXX, figs. 1–8.

1911. *Portunus rakosiensis* nom. nud. — Lőrenthey: 529.
1913. *Portunus rakosensis* nom. nud. — Lőrenthey: 326.
1929. *Portunus rakosensis* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 171–174, pl. 13, fig. 1. (false reconstruction).
non 1929. *Portunus rakosensis* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 172–173, pl. 12, figs. 20–21. (=*Thalamita fragilis*), pl. 12, figs. 22–23. (=*Callianassa munieri*).
?1968. *Portunus rakosensis* Lőrenthey — Stancu—Andreescu: 466.
1974b. *Macropipus rakosensis* (Lőrenthey) — Müller: 280, pl. 3, figs. 2–6.
1979a. *Portunidae* gen. sp. ind. — Förster: 94–95, text-fig. 6, pl. 3, fig. 4.
1979b. *Portunidae* gen. sp. ind. — Förster: 257–259, pl. 2, figs. 1, 5, pl. 3, figs. 1, 2.
1979a. *Macropipus rakosensis* (Lőrenthey) — Müller: 274.

Material seen: lectotype designated herein, ca. Rákos, M2328/a: FI.
Paralectotype, ca. Rákos, M2328/b: FI.
Others, da. Węglinek, leg. Krach, 20 ca., 20 ch. MOE-21, 25 ca., 10 ch. MDG-17, 10 ca. MJL-10, 5 ca. MB-15, 4 ca. MKC-16, 5 ca., 2 ch. MEG-15, ch. MOH-10, 3 ca., 2 ch. MGY-16, ca. Mátraverebély–Szentkút, Szent László-forrás: CA.

Material not seen: ?ca. Rugi, Transsylvania: ?coll.

Description: The carapace is hexagonal, strongly decorated, slightly convex. The front is finely denticulate, almost straight but on most specimens with a faint median lobe. The anterolateral margin consists of five teeth (in contrast to Lőrenthey's figure), these are more or less sharp-pointed depending on the molt-cycle. The regions are extremely well defined, densely covered with short ridges. There is a characteristic T shaped protuberance on the cardiac region. The palm bears 5 ridges on the outer and upper surfaces, the lowest of these runs to the fixed finger. The fixed finger and the dactylus are pentagonal in cross-section. There is a heterochely visible on the teeth of the cutting edges. Generally, but not invariably, the right chela is the crusher.

Remarks: The species is close to *L. corrugatus* but its front is not trilobated. Other ornamented species, e.a. *L. depurator*, *L. puber* differ in their front.

Ecology: The species occurs in most localities except of those of reefal or extremely shallow-water-origin.

Stratigraphy: Occurs in Lower and Upper Badenian rocks.

Liocarcinus oroszyi (Bachmayer, 1953)

Pl. LXXI, figs. 1, 2.

1953. *Carcinides oroszyi* n. sp. — Bachmayer: 251–252, pl. 2. figs. 5, 5a.

Material seen: holotype, ca. Deutsch-Altenburg, leg. Oroszy: NHMW.

Description: The carapace is slightly convex in two directions. It was probably subhexagonal, rather broad, but all specimens are incomplete. The front is absent on all specimens. The anterolateral margin is slightly arched, bears five teeth with forward directed points. The surface seems almost smooth to bare eyes, but actually it is adorned with small tubercles. The anterior median parts of the branchial region, near to the cervical groove, are strongly elevated.

Remarks: The species is closer to *Liocarcinus* than to *Carcinus.* The anterior extension of the mesogastric region is invisible in *Carcinus* species but is developed in *L. oroszyi.* The arrangement of all regions coincides with that of *L. arcuatus.* The elevated branchial region, however is the same as in *L. depurator*.

Carcinus is probably a Pliocene immigrant to its recent areal in the East-Atlantic—Mediterranean realms. Its former presence here has not been proven (HOLTHUIS 1949), known for a certainty from Icenian, Lower Pleistocene, but was reported from the Coralline Crag (Pliocene) of England.

Liocarcinus kuehni (BACHMAYER, 1953)

Pl. LXXI, figs. 3, 4.

1953. *Portunites kühni* n. sp. — BACHMAYER: 249–251, pl. 2, fig. 2.

Material seen: holotype, ca. Deutsch-Altenburg, leg. OROSZY: NHMW.
Others: 2 ca. MJL-9: CA.

Description: The carapace is hexagonal, moderately convex. The front lacks on all specimens. The anterolateral margin is also damaged but the presence of five teeth is doubtless. The regions are well delimited. The whole surface is densely covered with ridges.

Remarks: The species is close to *L. depurator* and to other *L.* species. Its dense adornement is a characteristic feature. From *L. rakosensis* differs by a denser decoration and by a more convex carapace. The specimens from MJL (Tétény) are even more convex than the holotype.

Genus *Miopipus* n. gen.

Typus-species: *Portunus pygmeus* BROCCHI, 1883.

Derivatio nominis: Composition of the name of the age Miocene and of *Macropipus*, a related genus.

Diagnosis: Small elongated carapace, strongly elevated mesogastric and cardiac region, smooth surface.

Remarks: The genus is much unlike *Liocarcinus* or *Macropipus* in its strongly elevated, rounded, smooth regions, the prominent frontal part is also peculiar. No similar form was found in the zoological literature. In fact the surface resembles that of *Psammocarcinus* as it was pointed out by BEURLEN or LŐRENTHEY (LŐRENTHEY–BEURLEN 1929, p. 174, last paragraph).

Miopipus pygmeus (BROCCHI, 1883)

Pl. LXXII, figs. 1–4.

1883. *Portunus pygmeus* (sic!) n. sp. — BROCCHI: 1., pl. 5, fig. 4.
1897. *Portunus pygmaeus* (sic!) BROCCHI — LŐRENTHEY: 150.
1898a. *Portunus pygmaeus* BROCCHI — LŐRENTHEY: 93, 104.
1898b. *Portunus pygmaeus* BROCCHI — LŐRENTHEY: 109, 117.
1898c. *Portunus pygmaeus* BROCCHI — LŐRENTHEY: 91, 92.
non 1924. *Portunus pygmaeus* BROCCHI — GLAESSNER: 115–116.
1929. *Portunus pygmaeus* BROCCHI — LŐRENTHEY—BEURLEN 1929: 174–175, pl. 15, fig. 1.
1974b. *Macropipus pygmaeus* (BROCCHI) — MÜLLER: 279, pl. 3, fig. 1.
1979a. *Macropipus pygmeus* (BROCCHI) — MÜLLER: 274.

Material not seen, probably lost: holotype, ca. Rákos: ?Sorbonne.

Material seen: 2 ca. MOE-24, 7 ca. ?6 ch. MDG-16, ca. MJL-7, ca. MBH-8, 6 ca. MKC-17, 5 ca. MEG-16, ca. MGY-15: CA.

Description: The carapace is rather narrow, its outline is close to a pentagon. The trilobate front is narrow, prominent. The orbits are large, there are two undistinct notches on their upper margin. There are five distinct, sharp anterolateral teeth. The anterolateral margin is long, but the posterolateral one is even longer. The posterior margin is short. The surface is strongly adorned with the presence of the distinct areas but it is smooth. The mesogastric and cardiac areas are very convex.

Subfamilia *Carcininae* McLEAY, 1838
Genus *Portumnus* LEACH, 1814

Portumnus tricarinatus Lőrenthey in Lőrenthey—Beurlen, 1929

1911. *Portumnus tricarinatus* nom. nud. — Lőrenthey: 529.
1913. *Portumnus tricarinatus* nom. nud. — Lőrenthey: 326.
1929. *Portumnus tricarinatus* n. sp. — Lőrenthey in Lőrenthey—Beurlen: 167–168, pl. 15, fig. 3.
1979a. *Portumnus tricarinatus* Lőrenthey — Müller: 274.

Material not seen, lost: holotype, ca. Rákos: ?Univ. Budapest.

Remarks: Lőrenthey gave a detailed description of this species, his figure, however, possibly is not reliable (p. 32) but reveals some similarities with *'Xaiva' bachmayeri* (see below), regarding the shape of the carapace.

Genus *Xaiva* McLeay, 1838

Remark: The genus is regarded here as a nomen collectivum.

'Xaiva' bachmayeri n. sp.

Pl. LXXII, figs. 5–7, ?fig. 8.

Material seen: holotype, ca. MOE-26-1: CA.
Paratype, ca. MOE-26-2: CA.

Locus typicus: Budapest, Örs vezér tere.

Stratum typicum: Upper Badenian.

Derivatio nominis: From Prof. Friedrich Bachmayer, Vienna, researcher of fossil decapods.

Diagnosis: Subpentagonal carapace, strongly delimited mesobranchial and cardiac regions.

Description: The outline of the carapace is subpentagonal. The anterior part is more rounded than the posterior one. The carapace is moderately convex in both directions. The front is rather short, decorated with three acute teeth of equal size, situated at a line anterior to the intraorbital angles. The orbits are semicircular, moderately deep. There are two shallow notches on their upper margin. The anterolateral margin bears five teeth. The first, extraorbital and the third teeth are bigger than the others. The fifth is slightly damaged probably it was also big. The posterolateral margin is slightly concave at its anterior 1/3 length, while the posterior part is straight. A *Xaiva*-like chela was found in the same locality.

Remarks: *'Xaiva' bachmayeri,* as far as it is possible to judge from a carapace, is close to extant *Xaiva* species. *Xaiva mcleayi* is similar in respect of its anterolateral teeth (the third one bigger than the adjacent ones), but its shape is different due to its more prominent frontal region. It must be added that the extant *X.* species are rather dissimilar. *'X.' bachmayeri* differs from Lőrenthey's figure of *Portumnus tricarinatus* in his longer front (but Lőrenthey remarked that the front of his specimen was damaged) and more importantly, in the shape of the furrows delimiting the mesogastric and cardiac regions. One can hardly imagine an artist making such errors.

Genus *Mioxaiva* Müller, 1979

Typus-species: *Mioxaiva psammophila* Müller, 1979, by monotypy.

Remarks: The position of the genus among *Carcininae* is doubtful. The genus is probably closer related to other, primitive genera of *Portunidae* than to *Xaiva.* The question remains open, however, since the single damaged carapace available proves only the independence of the genus, since no similar front is known among the members of the family.

Mioxaiva psammophila MÜLLER, 1979
Pl. LXXIII, figs. 1–3.

1979a. *Mioxaiva* n. gen. *psammophila* n. sp. — MÜLLER: 274, 281, 289, pl. 16, figs. 1–3.

Material seen: holotype, ca. MGY-5-1: CA.

Description: The right anterior part of a carapace is preserved, broken behind the last anterolateral tooth. The outline of the frontal and anterolateral parts is almost subcircular. The surface is flat, only the branchial regions are deflected. The front is trilobate, the median lobe is sharp, the lateral ones, corresponding to the intraorbital lobes, are blunt and finely denticulated on their inner edges. The denticulation fades out medially. The inner orbital margin is convex, the extraorbital tooth is acute. The upper orbital margin is cut by two rudimentary notches. A sharp infraorbital tooth is also present. The five anterolateral teeth are sharp, they decrease in size posteriorly. The surface of the carapace was probably smooth but it is somewhat eroded obscuring the finest details. The regions are almost invisible.

Subfamilia *Catoptrinae* BORRADAILE, 1903
Genus *Carupa* DANA, 1851

?Carupa cf. tenuipes DANA, 1851
Pl. LXXIII, fig. 7.

Material seen: 3 ca. MV-6: CA.

Remarks: The specimens were compared with those preserved in the Mus. Natl. Histoire Naturelle, Paris. All features seen on the Visegrád specimens were very much like in the recent and fossil crabs. The lobulation of the front was the most convincing of the similarities.

Subfamilia *Caphyrinae* ALCOCK, 1899
Genus *Lissocarcinus* ADAMS and WHITE, 1849

Remark: The name is used in a collective sense.

'Lissocarcinus' szoeraenyiae (MÜLLER, 1974)
Pl. LXXIII, figs. 4–6.

1974b. *Thia szoeraenyiae* n. sp. — MÜLLER: 278, 283, pl. 2, figs. 3–4.
1979a. *Lissocarcinus szoeraenyiae* (MÜLLER) — MÜLLER: 274, 281, 282, 289.

Material seen: holotype, ca. MDG-18-1 (=MD-1-1): NMŐ.
Others, 2 ca. MDG-18, 2 ca. MDN-3, ca. MOE-25: CA.

Description: Only the carapace is known. It is subpentagonal, flat and smooth. The front is prominent, faintly trilobate. The orbits are small. The anterolateral margin is adorned with five lobes separated from each other by shallow notches. The regions are ill-delimited, only the unified meso-urogastric and cardiac region is separated laterally from the others by shallow furrows. The anterolateral and frontal margins are sharp.

Remarks: The species was unfortunately assigned to the genus *Thia*. On my inquiry DR. L. B. HOLTHUIS suggested me to transfer the species among the *Portunids*. Indeed, compared with specimens or figures of *Lissocarcinus orbicularis* (the specimens collected by L. BÍRÓ, on New Guinea, figures of STEPHENSON—CAMPBELL 1960, pl. 3, fig. 2.) only minute differences were observed. The fossil form has no epibranchial ridge, present on *L. orbicularis*. The anterolateral lobes are separated from each other by deeper notches in *L. szoeraenyiae*. The extant *L.* species are, however, very small due to their commensal mode of living. In this case the size could be an important taxonomic character.

Superfamilia **Xanthoidea** Dana, 1851

Familia **Xanthidae** Dana, 1851

Remarks: The subdivision of this familia seems still unsatisfactory according to Glaessner's (1969, p. R515) opinion. Consequently the genera will be presented in an alphabetical order except the evidently natural group of *Pilumnus* and related forms, which will be described together.

Genus *Actaea* de Haan, 1833

Remarks: The old genus *Actaea* was recently split into numerous genera on solid basis. Our species probably belongs to *A.* sensu stricto, cf. Guinot (1969). Most of *A.* species live in shallow waters, some of them are restricted to coral-reefs.

Actaea turcocampestris n. sp.

Pl. LXXIV, figs. 1–5.

Material seen: holotype, ca. (pl. LXXIV figs. 1, 2) MFR-1-1: CA.
Paratypes, 3 ca., 2 ch. MTZ-10: CA.

Locus typicus: Fertőrákos, near Sopron.

Stratum typicum: Badenian (probable Middle B.).

Derivatio nominis: From one of the localities, Törökmező (Lat.: Turcus Campus).

Diagnosis: Elliptical shape, short anterolateral teeth.

Description: The anterior parts of the carapace form an ellipsis. It is moderately convex. The front is narrow, almost straight, cut into two parts by a notch. The anterolateral margin is rounded, it is adorned with five small, but distinct teeth, the last of them is situated far behind the largest section of the carapace. The regions are well delimited by deep furrows. The epigastric region is cut into two parts by a longitudinal groove. The inner of these parts is half as wide as the outer one. The whole surface is covered with small tubercles. The chela is stout, strongly tuberculated. The upper proximal part of the dactylus is also covered with tubercles.

Remarks: In its overall shape, because of its concave posterolateral margin, the species is close to *A. savignyi*, the type-species of the genus. The tubercules covering the surface of this recent form are much coarser.

Ecology: The species was found on coral-reefs, in accord with the habits of most extant *A.* species.

Genus *Carpilius* Leach in Desmarest, 1825

Carpilius antiquus Glaessner, 1928

Pl. LXXV, figs. 1–5.

1877. *Carpilius* sp. — Bittner: 436.
1928. *Carpilius antiquus* n. sp. — Glaessner: 191–193, text-figs. 5–6, pl. 3, fig. 13.
1968. *Carpilius antiquus* Glaessner — Guinot: 323.
1976b. *Carpilius* cf. *antiquus* Glaessner — Müller: 516.

Material seen: holotype, Baden-Rauchstallbrunngraben, No. 1860 V 8: NHMW.
Others, 8 ca., ch. MV-11, ca. MTZ-21: CA.
Right ch., Grosshöflein (as MNH), in an Austrian private collection.

Description: The carapace is ovoid, very smooth, moderately convex. The frontal margin is undulate, composed of two round intraorbital and wide median lobes. The anterolateral margin is smooth. Its curvature increases toward the lateral angle. There is only a rudimentary lateral tooth.

Remarks: GLAESSNER made a reconstruction of the holotype, based on additional specimens. The holotype is however, in all details identical the Hungarian ones, which have but the rudiment of a tooth on the lateral margin. This feature is in contrast to all extant *C.* species. The miocene species is in other details extremely similar to *C. convexus* (FORSKÅL).

Genus *Chlorodiella* RATHBUN, 1897

Remarks: The genus was reported from the Miocene of Java (*Chlorodius junghuhni* MARTIN, 1880). Its extant species live in the Indo-West-Pacific, and one in the Caribbean.

Chlorodiella mediterranea (LŐRENTHEY in LŐRENTHEY—BEURLEN, 1929)

Pl. LXXVI, figs. 1–6, pl. LXXVII, figs. 1–4.

1911. *Zozymus mediterraneus* nom. nud. — LŐRENTHEY: 529.
1913. *Zozymus mediterraneus* nom. nud. — LŐRENTHEY: 326.
1929. *Zozymus mediterraneus* n. sp. — LŐRENTHEY in LŐRENTHEY—BEURLEN: 34, 215–216, pl. 11, fig. 9. (false reconstruction!).
non 1976a. "*Zosimus*" *mediterraneus* LŐRENTHEY — MÜLLER: 507, 510, pl. 3, figs. 1, 4. (n. ssp., see below).
non 1976b. "*Zosimus*" *mediterraneus* LŐRENTHEY — MÜLLER: 516, 520. (n. ssp., see below).
1979a. *Chlorodiella mediterranea* (LŐRENTHEY) — MÜLLER: 274, 282, 289.

Material seen: lectotype designated herein, Rákos M 2327/a: FI.
Paralectotypes, Rákos M 2327/b, c, d, e: FI.
Others, 250 ca. numerous ch. MRZ-6, 25 ca. MDZ-10, ca. MTZ-22, 4 ca. MZZ-5, 20 ca. MNH-5: CA.
5 ca., 2 ch. Gross-Höflein (in matrix of holotype of *Dromilites koberi*): NHMW.

Description: The wide carapace is elliptical. The front is wide, cut into two parts by a notch. The frontal margin is double, with a horizontal furrow between the two edges. The orbits are round. The orbital region is slightly elevated. The convex anterolateral margin is adorned with four rudimentary teeth, only the last one is slightly larger. The surface is smooth covered with very small tubercles in partly decorticated specimens. The regions are not separated. There is a postfrontal and an epigastric ridge, and a slight elevation behind the outer part of the cervical groove. On some specimens this elevation is almost invisible.

The species is heterochelous, usually the right hand is bigger. The palm is elongate, its height gradually increases distally. Its surface is smooth. The fixed finger and the dactylus are also long, the finger-tips are spooned.

Remarks: LŐRENTHEY compared his species to *Zozymus* (recte: *Zosimus*) *laevis* DANA, a species which is identical with *Neoliomera insularis* WHITE (ODHNER 1925). The similarity is superficial, however, DR. L. B. HOLTHUIS kindly drew my attention to the similarities between LŐRENTHEY's species and *Chlorodiella.* Indeed, the wide and double front, the long chelae with spooned fingertips are common in both forms. The carapace is round at the Miocene species while more angular in the recent ones. The epibranchial ridges are also more angular in extant *Ch.* species.

Ecology: The species was found invariably in reefal or coral-bearing (MZZ) layers.

Chlorodiella mediterranea (LŐRENTHEY) **tetenyensis** n. ssp.

Pl. LXXVII, figs. 5–7.

1976a. "*Zosimus*" *mediterraneus* LŐRENTHEY — MÜLLER: 507, 510, pl. 3, figs. 1–4.
1976b. "*Zosimus*" *mediterraneus* LŐRENTHEY — MÜLLER: 516, 520.

Material seen: holotype, ca. MRZ-19-1: CA.
Paratypes, 2 ca. MRZ-19, 11 ca. MKK-7, 30 ca. MV-13: CA.

Locus typicus: Rákos, railway-cut, Budapest.

Stratum typicum: Upper Badenian.

Derivatio nominis: After the name of the locality Tétény, its first known occurrence.

Diagnosis: Strong epibranchial, hepatic and epigastric ridges.

Description: The carapace bears a strong ornament, the ridges on the epibranchial, hepatic and epigastric regions are accentuated, but rounded in their cross-section.

Remarks: The new form is similar to *Ch. mediterranea,* but the ornament of the carapace is much stronger. Transitional forms are rare. Though the two forms were found together, they are clearly separated. Some localities (MKK, MV) yielded exclusively this subspecies, while at Rákos it is rare, 3 specimens for 250 of *Ch. mediterranea.* At MZZ LŐRENTHEY's form occurs exclusively.

Ecology: This subspecies substitutes LŐRENTHEY's form in localities where the petrographical conditions indicate agitated waters during the deposition.

Chlorodiella loczyi n. sp.

Pl. LXXVIII, figs. 1–4.

Material seen: holotype, ca. MRZ-7-1: CA.
Paratypes, 14 ca. MRZ-7: CA.

Locus typicus: Rákos, railway-cut, Budapest.

Stratum typicum: Upper Badenian.

Derivatio nominis: In honour of the great Hungarian geologist, LAJOS LÓCZY senior.

Diagnosis: Comparatively narrow front ornamented with pits.

Description: The carapace is ovoid, rather wide. The front is not very wide. The orbits are big. The main regions are well delimited especially the gastric and hepatic regions are bordered by deep furrows. The frontal region is adorned with pits arranged in horizontal rows. Five to nine pits compose each of the individual rows. The uneven furrow that gives the front a doubled appearance, also contains pits.

Remarks: The species differs from extant *Ch.* forms by its narrow front, in this respect it is close to *Ch. junghuhni* MARTIN (Miocene of Java) a species which is much more convex however. From the badenian species it differs by its narrow front and by the pits on the frontal region. The decoration of the surface and of the anterolateral margin are similar to that of *Ch. mediterranea tetenyensis.*

Chlorodiella juglans n. sp.

Pl. LXXVIII, figs. 5, 6.

Material seen: holotype, ca. MDZ-11-1: CA.
Paratypes, 4 ca. MTZ-11: CA.

Locus typicus: Diósd, sand-pit.

Stratum typicum: Upper Badenian.

Derivatio nominis: The name of the locality (Diósd) originates from the Hungarian name of walnut or walnut-tree, Juglans in Latin.

Diagnosis: Four strong but blunt anterolateral teeth, wide hepatic lobe.

Description: The carapace is suboctogonal, the fronto-orbital margin is extremely wide due to the big orbits. There are four strong but blunt teeth on the anterolateral margin. The gastric regions are well delimited. The postfrontal, epigastric and hepatic ridges are high, step-like but not sharp. The hepatic ridge is far from the cervical groove, consequently the hepatic region is wide.

Remarks: The species is even closer to extant *Ch.* species than the other Badenian forms are. The overall shape the anterolateral teeth and the ridges are similar to those of *Ch. nigra.* The front of the Miocene species is narrower and the number of its anterolateral teeth is inferior, however. From the Miocene species it differs by the presence of the anterolateral teeth and by its well-delimited gastric regions.

Genus *Daira* DE HAAN, 1833

1871. *Phymatocarcinus* n. gen. — REUSS: 326.

Daira speciosa (Reuss, 1871)

Pl. LXXIX, figs. 1–6, pl. LXXX, figs. 1–2.

1871. *Phymatocarcinus speciosus* n. gen. n. sp. — Reuss: 326, figs. 1–4.
1877. *Phymatocarcinus speciosus* Reuss — Bittner: 437, pl. 1.
1928. *Daira speciosa* (Reuss) — Glaessner: 191.
1929. *Daira speciosa* (Reuss) — Lőrenthey in Lőrenthey—Beurlen: 197–198, 12, figs. 10, 11.
1949. *Daira speciosa* (Reuss) — Schouppé: 139.
1969. *Daira speciosa* (Reuss) — Yanakevich: 25–26, pl. 1, figs. 1–3.
1976a. *Daira speciosa* (Reuss) — Müller: 511.
1976b. *Daira speciosa* (Reuss) — Müller: 516.
1977. *Daira speciosa* (Reuss) — Yanakevich: 79–80, pl. 10, figs. 5, 6.
1979a. *?Eriphia* sp. C. — Förster: 98, text-fig. 12, pl. 1, fig. 2.
1979a. *Daira speciosa* (Reuss) — Müller: 275.

Material not seen, lost (Glaessner 1928, p. 191): holotype, ca. Baden-Rauchstallbrunngraben.

Material seen: others, 2 ca. MRZ-12, 10 ca. MKK-6, 6 ca., 3 ch. MV-12, 5 ca., 2 ch. MTZ-6, 2 ca., ch. MNH-8: CA.

Description: The carapace is elliptical, moderately convex. The front is adorned with four teeth. The orbits are small. The anterolateral margin is long, extending far behind the widest part of the carapace. It bears numerous teeth, the anterior ones are smaller, the posterior ones larger, but this feature is variable. The regions are not well visible since the ornament is dense, the whole surface is covered with round tubercles, which are larger on the anterior, smaller on the posterior parts. The test is extremely solid due to the peculiar structure described in details by Guinot (1967, figs. 7, 8).

The chela is robust, tuberculated. The tubercles are much bigger on its upper surface than on the lower one. The inner surface is partly smooth.

Remarks: Morphologically it is almost impossible to distinguish the form from *D. perlata* (Herbst), (Guinot 1967, fig. 3), or from its fossil specimens from the Pliocene of Fiji (Rathbun 1945, pl. 59, figs. E, F, G, H). The species is common in the Messinien of the surroundings of Oran (pers. comm. of Saint-Martin).

Ecology: The species is found invariably in reefal structures in the Paratethys and in the Mediterranean Miocene.

Genus *Haydnella* n. gen.

Typus-species: *Haydnella steiningeri* n. sp., by monotypy.

Derivatio nominis: From the great componist, Joseph Haydn, who worked in Eisenstadt (Kismarton), near to the type-locality.

Diagnosis: A narrow xanthid carapace, straight front, round epibranchial lobe.

Remarks: In its overall, narrow shape it is somewhat similar to *Paraxanthias* and *Xanthias*, but these genera have *Xantho*-like, transversely elongated epibranchial subregion, and a more extended hepatic region. This latter is rather narrow at the new form. It reveals similarities with *Monodaeus* but the carapace is narrower in the Miocene form. "*Titanocarcinus*" *pulchellus* has some common features with it but, as far as it is possible to see on Milne-Edwards' figure (the type is lost), the relationship fails in details. Milne-Edwards' form might not belong to *Titanocarcinus* with its Cretaceous type-species.

Haydnella steiningeri n. sp.

Pl. LXXX, figs. 3–5, pl. LXXXI, figs. 1–4.

partim 1928. *Titanocarcinus vulgaris* Glaessner: pl. 3, fig. 10.
1976b. *Titanocarcinus* aff. *sismondae* Milne-Edw. — Müller: 516, 520.

Material seen: holotype, ca. 1984/40/5: NHMW.
Paratypes, 6 ca., 2 ch. MNH-9, ca. MTZ-16, 10 ca. MV-15: CA.
Ch. Baden-Rauchstallbrunngraben: NHMW.

Locus typicus: Gross-Höflein (Nagyhőflány), Burgenland, Austria, Quarry "Fenk" (Buchinger).

Stratum typicum: Badenian (Middle or lowermost Upper).

Derivatio nominis: From Prof. Fritz Steininger, Vienna, whose help was essential in the study of this and other species and localities.

Description : The form of the carapace is subhexagonal, with rounded sides. The carapace is moderately convex latitudinally, more convex longitudinally. The front is straight, bilobated, the lobes are separated by a notch. The interior orbital angles are separated from the front by notches, too. The frontal margin is double as there is a horizontal fissure among two keel-like denticulated ridges. On the anterolateral margin there are five blunt teeth, including the extraorbital one which is even blunter than the others. The posterolateral margin is slightly convex. The regions are well delimited from each other. The epigastric regions are wide. The epibranchial region is peculiarly narrow, and the hepatic one is restricted to a small area.

The chelae are tuberculated, most tubercles are arranged in rows. The fingers are rather slender.

Remarks : As it was told the form is distinct from any extant or fossil species as far as it is possible to judge from the figures and from a limited number of comparison made in the Mus. Natl. Hist. Nat. Paris.

Genus *Panopeus* H. Milne-Edwards, 1834

Panopeus wronai n. sp.

Pl. LXXXI, figs. 5, 6, pl. LXXXII, figs. 1–4, pl. LXXXIII, figs. 1–4.

1979a. *?Eriphia* sp. D. — Förster: 98–99, text-fig. 13, pl. 1, fig. 1.

Material seen: holotype, ca. 1984/41/1: NHMW.
Paratypes, 2 ca., ch. MNH-10, 5 ca. MTZ-9, ca. MDZ-2: CA.

Material seen as cast: paratype, ca. Grobie, Poland: Univ. Warsaw.

Locus typicus : Gross-Höflein, Burgenland, Austria.

Stratum typicum : Badenian.

Derivatio nominis : Dr. R. Wrona, University of Warsaw, found the first specimen in Grobie.

Description : The outline of the carapace is hexagonal, its upper surface is rather flat. The front is straight, cut by a median incision. The orbits are small. The upper orbital margin is denticulated. The anterolateral margin is ornamented with three teeth, the last of which is rudimentary and situated behind the widest part of the carapace. In place of the first two teeth, there is a keel-shaped edge. There are four pairs of transverse ridges on the frontal parts of the epigastric, protogastric, hepatic and epibranchial regions. These ridges consist of fine tubercles. There are two transverse grooves on the epibranchial region, which are better visible on internal moulds. The legs are preserved in two Gross-Höflein specimens, which is an exceptional case. The ambulatory legs are rather slender. The chelae are robust, the right one is much larger than the other. The palms are smooth. On the proximal part of the dactylus of the left chela there is an elongated crusher tooth.

Remarks : As Förster (1969a, p. 99) observed the species is close to *Panopeus*. The chelae, found together with other parts, are typically *Panopeus*-like, including the degree of heterochely, the smooth and robust palm and the form of the crusher tooth. The four pair of ridges on the carapace are also typical for *Panopeus*. The two pairs of grooves on the branchial part, however, are absent from extant forms as emphasized by Förster. These are, however, almost invisible on the outer surface and probably are of inferior systematic value in differentiation on species-level. All extant *P.* species have two teeth instead of a keel on the anterior end of their anterolateral margin. These tend to fuse, however in *P. herbstii*, which is similar to *P. wronai* in other respects, too.

Genus *Pilodius* Dana, 1852 (=*Chlorodopsis* A. Milne-Edwards, 1873)

The genus is used here as a collective taxon.

'Pilodius' vulgaris (Glaessner, 1928)

Pl. LXXXIII, figs. 5, 6, pl. LXXXIV, figs. 1–4.

partim, only the holotype! 1928. *Titanocarcinus vulgaris* n. sp. — Glaessner: 185–189, pl. 3, fig. 9, non: pl. 3, figs. 10–12.

non 1953. *Titanocarcinus vulgaris* Glaessner — Bachmayer: 254–257, pl. 4, figs. 1–9, pl. 5, figs. 1–2.

Material seen: holotype, ca. Baden-Rauchstallbrunngraben, No 1927 I 2: NHMW.
Others, 11 ca., 5 ch. MZZ-7, ca. MNH-12: CA.

Description: Strongly areolated, elliptical carapace. The frontal margin is composed of many tubercles and tends to be double, much like *Chlorodiella*. There are five anterolateral teeth, the last ones are directed outwards. At Zebegény (MZZ) this is the most frequent *Xanthid,* and the most frequent chela from there is similar to the carapace in ornament and size. The carapace is decorated with tubercles which are coarse around the lateral teeth, on the hepatic and on the epibranchial parts, and near the front. The palm of the chela is similarly tuberculated as seen on the figures.

Remarks: As it was emphasized earlier (Müller 1974a, p. 123), *Titanocarcinus vulgaris* is a compound species. Its holotype bears features lacking from other *Xanthids* so frequent in Badenian deposits (see below, *Xantho moldavicus*). These are the coarse granulation near the margins, the compound front and granulation of the chela. The species reveals similarities with *Pilodius* species in the ornament of the chela and in the overall shape of the carapace. Unfortunately, the tip of the finger, which could provide clues for systematic position of the species, has not been observed yet. (Serène—Van Luom, 1958, 1959.)

Genus *Trapezia* Latreille, 1828

Trapezia glaessneri Müller, 1976

Pl. LXXXIV, figs. 5, 6, pl. LXXXV, figs. 1–4.

1976b. *Trapezia glaessneri* n. sp. — Müller: 517, 518, 521, pl. 1, fig. 3, pl. 2, figs. 1–3.

Material seen: holotype, ca. MV-1-1: CA.
Paratypes, 3 ca. MV-1: CA.
Others, 8 ca., ch., merus and carpus MV-1, ca. MTZ-11: CA.

Description: The carapace is flat, smooth, suboctogonal. The front is undulate, it has three blunt lobes on each side. The notches between the lobes are shallow only the median one is slightly deeper. The orbits are comparatively deep, inner part of the orbital margin is gently elevated. The anterolateral margins are slightly curved, subparallel to each other. The posterolateral margin is also curved.

A short merus of a right cheliped was found. It is a typical *T.* merus. Only its inner surface is visible. On its upper margin there are five teeth. The proximal one is small, the three subsequent ones are larger, while the distal tooth is twice as big as the previous one, and it is cut into two parts by a shallow notch.

Remarks: In the original description the species was compared to *T. cymodoce* and to *T. digitalis.* With the merus, it can be stated that the form is even closer to *T. wardi* (Serène 1971, p. 138) with its similar short merus and undulate front. The merus of *T. maculata* is also similar, but its front is different.

Ecology: The species was found in localities where *Stylophora subreticulata* Reuss, a seriatoporid coral is also present. It is known that *T.* species are commensal with seriatoporid corals (Garth 1974), explaining their absence from the Caribbean.

Stratigraphy: The species was found only in Lower Badenian layers. The genus, however, was reported from the Upper Eocene, too (Müller 1974b). The Eocene species is transitional between *Trapezia* and *Tetralia* and should be attributed to a new genus.

Genus *Xantho* Leach, 1804

Xantho moldavicus (Yanakevich, 1977)

Pl. LXXXV, figs. 5–8, Pl. LXXXVI, figs. 1–5, pl. LXXXVII, fig. 1.

partim! 1928. *Titanocarcinus vulgaris* n. sp. — Glaessner: 185, 189, non pl. 3, fig. 9, nec fig. 10, ? fig. 11.
non 1928. *Titanocarcinus vulgaris armatus* n. ssp. — Glaessner: 189–190, pl. 3, fig. 12.
1953. *Titanocarcinus vulgaris* Glaessner — Bachmayer: 254–257, pl. 4, figs. 1–9, pl. 5, figs. 1–2.
?1968. *Titanocarcinus* aff. *vulgaris* Glaessner — Stancu—Andreescu: 466.
1969. *Medaeus* sp. — Yanakevich: 26–27, pl. 1, figs. 4–6.
1974a. *Xantho* cf. *incisus* Leach — Müller: 123, pl. 3, figs. 1–2.
1974b. *Xantho* cf. *incisus* n. ssp? — Müller: 280.
1976a. *Xantho* cf. *incisus* Leach — Müller: 510.

1976c. *Xantho* cf. *incisus* LEACH — MÜLLER: 152.
1977. *Medaeus moldavicus* n. sp. — YANAKEVICH: 80–81, pl. 10, fig. 4.
1979a. *Xantho* cf. *incisus* LEACH — MÜLLER: 274, pl. 20, figs. 1–5.
1979a. *Xantho* cf. *vulgaris* (GLAESSNER) — FÖRSTER: 100–101, text-fig. 14, 15, pl. 3, figs. 1–3, pl. 4, figs. 1–4.
1979b. *Xantho* cf. *vulgaris* (GLAESSNER) — FÖRSTER: 263–264, text-fig. 11, pl. 3, fig. 4. (plates exchanged!).

Material not seen, unavailable: holotype, ca. Shepteban, Moldavia, USSR, No 1084-Ya: coll. Gos. Ped. Inst. Tiraspol.

Material seen: numerous fingers, Korytnica, Lychów, Węglinek, Poland, leg. BAŁUK and KRACH, 2 ca. WEG-5, 7 ca., 5 ch. MOE-31, 25 ca., 4 ch. MGF-6, ca. MKF-3, ca. MM-3, 6 ca. MDG-22, ca. MRC-3, ca. MRS-6, 30 ca. MJL-15, 4 ca. MBH-10, 15 ca. MB-13, 4 ca. MUO-6, 4 ca. MBK-5, ch. MR-15, 9 ca. MKC-19, 4 ca. MOH-14, ca. MA-7, 13 ca. MRZ-11, 4 ca. MKK-3, 4 ca. MTZ-12, ca. MDZ-8: CA.
2 ca. Deutsch-Altenburg, leg. OROSZY: NHMW.

Description: The carapace is hexagonal, broad. The front is straight or slightly bent forwards, rather narrow. The orbits are of medium size. The anterolateral margin bears five teeth, with forward directed tips. The posterolateral margin is straight. All regions are well delimited. The epibranchial region is transversely elongated, the hepatic is moderately extended. The surface is either smooth or finely denticulated on some parts. The small tubercles tend to fuse into short ridges. The palm is either smooth or denticulated proximally. The fingers are of moderate length, smooth and strongly spooned. On the upper outer surface of the dactylus there is a more or less developed furrow.

Remarks: The problem of this most puzzling Crab of the Paratethys has not been solved yet. The fingers occurring together with the carapaces are invariably spooned, thus "*Titanocarcinus*" *vulgaris armatus* with its pointed finger-tips might not belong here. The earliest available name was that of YANAKEVICH. Indeed, many specimens (e.g. from MDZ, pl. LXXXVI, fig. 4) fully corresponds to YANAKEVICH' figures. Some others, as the Węglinek one, deviates in its stronger adornement. Intermediate forms occur, however, but not in the direction of the ornament of '*Pilodius*' *vulgaris*, which may be a good species. Considering the mutual similarity of so many extant *Xanthids* it is still possible that *X. moldavicus* is a compound taxon and not a single species.

Group of *Pilumnus* LEACH, 1815

Remarks: This is a coherent group, as discussed by BALSS (1933). It is easily recognisible by an extremely wide gastric field, a feature not mentioned by zoologists, but useful for palaeontologists. The existence of this group can be traced back to the Eocene (unpublished findings of the author).

Genus *Pilumnus* LEACH, 1815

Pilumnus mediterraneus (LŐRENTHEY, 1897)

Pl. LXXXVII, figs. 2–5, pl. LXXXVIII, figs. 1–5.

1897. *Pilodius mediterraneus* n. sp. — LŐRENTHEY: 160, 167, 169.
1898a. *Pilodius mediterraneus* LŐRENTHEY — LŐRENTHEY: 105, 113, 115.
1898b. *Pilodius mediterraneus* LŐRENTHEY — LŐRENTHEY: 126–129, pl. 8, figs. 5, 6.
1898c. *Pilodius mediterraneus* LŐRENTHEY — LŐRENTHEY: 99–101, pl. 8, figs. 5, 6.
partim? 1928. *Pilumnus* sp. — GLAESSNER: 190.
1929. *Chlorodopsis mediterraneus* (LŐRENTHEY) — LŐRENTHEY in LŐRENTHEY—BEURLEN: 34, 225–227, pl. 12, figs. 13–17, 19.
1953. *Chlorodopsis mediterranea* (LŐRENTHEY) — BACHMAYER: 253, pl. 3, fig. 5.
?1953. *Chlorodopsis mediterranea* (LŐRENTHEY) — BACHMAYER—TOLLMANN: 314.
1974a. "*Pilodius*" *mediterraneus* LŐRENTHEY — MÜLLER: 122, pl. 3, fig. 3.
1974b. *Pilumnus mediterraneus* (LŐRENTHEY) — MÜLLER: 280.
1976a. *Pilumnus mediterraneus* (LŐRENTHEY) — MÜLLER: 510.
1976c. *Pilumnus mediterraneus* (LŐRENTHEY) — MÜLLER: 152.
1979a. *Pilumnus mediterraneus* (LŐRENTHEY) — MÜLLER: 274, pl. 21, fig. 3.
1979a. *Eriphia* sp. — MÜLLER: pl. 21, figs. 1–2.
1979b. *Pilumnus* sp. — FÖRSTER: 260, 261, pl. 3, fig. 6, pl. 5, fig. 1, 3, text-figs. 8, 9.

Material seen: lectotype designated herein, ca. Rákos, M31/a: FI.
Paralectotype, ca. Rákos, M31/b: FI.
Others, ch. Rákos, M61/5634: NMŐ.

60 ca., 35 ch. MOE-18, 8 ca., 4 ch. MGF-6, 10 ca., 6 ch., MM-2, 5 ca., 2 ch. MDG-24, numerous specimens MJL-14, 25 ca. MBH-9, 48 ca. MB-14, ca. MUO-5, 5 ca., ch. MBK-6, ca., 3 ch. MR-14, ca., 2 ch. MR8-19, ca. MRF-11, 10 ca., 5 ch. MKC-18, 2 ca., ch. MRO-9, 6 ca., 2 ch. MEG-18, 10 ch. MOH-12, 2 ca., MFA-9, 2 ca. MRZ-8, ca. MTZ-7, ch. Mátraverebély–Szentkút, Meszestető: CA.

Description: The outline of the carapace is elliptical, convex. The front is tetra-lobate, the two inner ones are wide, the outers rudimentary, separated from the inner orbital angle by notches. There are five anterolateral teeth, the second one is small, but invariably present. The regions are either well- or ill-defined on various specimens. The young ones are generally better areolated. Behind the orbits, at their inner side there is a protuberance. The anterior and anterolateral parts are tuberculated, but the tuberculae are in some cases almost invisible. The chelae are moderately stout, the palm is either smooth or tuberculated. The fingers are also moderately stout, the upper proximal part of the dactylus bears usually some tubercles. The left chela is generally more slender than the other and in most cases it is better adorned.

Remarks: The form is extremely close to recent Mediterranean species. Using the key of ZARIQUIEY ALVAREZ (1968, p. 390) the Miocene form is closest to *P. spinifer* regarding its chelae, but even closer to *P. hirtellus* judging from the carapace. Probably *P. mediterraneus* was close to the common ancestor of the numerous, but variable mediterranean species, a part of which is regarded by some authors as a variety or subspecies (PESTA 1918).

Ecology: The species is probably the most common crab in the Badenian. It occurs in all types of biotopes studied, even in reefs, but it is the most abundant in very shallow, almost eulittoral environments.

Stratigraphy: *P. mediterraneus* occurs in all substages of the Badenian.

Genus *Actumnus* DANA, 1851

Actumnus telegdii (MÜLLER, 1974)

Pl. LXXXIX, figs. 1–5, pl. XC, figs. 1–5.

1974b. *Pilumnus telegdii* n. sp. — MÜLLER: 280, 281, 284, pl. 2, figs. 7–8.
1979a. *Actumnus telegdii* (MÜLLER) — MÜLLER: 274, 282, pl. 22, figs. 1–3.

Material seen: holotype, ca. MDG-23-1 (=MG-4-1): NMŐ.
Paratypes, 2 ca. MDG-23: CA.
Others, 2 ca. MDG-23, 28 ca., numerous ch. MOE-19, ca. MEG-17, 7 ch. MOH-13, 7 ca. MGY-20: CA.

Description: The carapace is very convex, its outline is elliptical. The front seems to be bilobated at first sight but there is a rudimentary lobe between the median one and the intraocular angle. On the anterolateral margin there are five teeth, but the second one is very small. The teeth consist of groups of tubercles. The main regions are well delimited, the gastric ones are very wide. On the anterior parts of the metagastric, frontal, hepatic and metabranchial regions there are groups of tubercles, but the regions near the posterior margin bear also such ornaments.

The chelae and the fingers are stout. The palms are covered with tubercles, but the lower side of the right hand is almost smooth. Heterochely is distinct. In some cases the left chela is stronger.

Remarks: The species can not be confused with *Pilumnus mediterraneus* due to its adornement. Its fingers are much stouter than those of LŐRENTHEY's species. The species is close to *A. squamosus* and *A. setifer*, extant forms. The carapaces of *A. telegdii* and *A. setifer* are similar, but their chelae are slightly different. (CAMPBELL—STEPHENSON 1970, p. 283.)

Ecology: Usually the species is rarer than *P. mediterraneus,* but in deposits of deeper water they are abundant.

Actumnus n? sp.

Pl. XC, figs. 6, 7.

Material seen: ca. MZZ-5: CA.

Remarks: The only known carapace is damaged in its frontal part. Otherwise it is similar to *A. telegdii*, but its decoration is the most marked near the posterolateral border, in contrast to the other form. Probably it belongs to a new species.

Genus *Glabropilumnus* BALSS, 1932

Remark: The name is used as a collective one.

'Glabropilumnus' n. sp.

Pl. XCI, figs. 1–3.

Material seen: 3 ca. MTZ-8, ?ca. MRZ-9: CA.

Description: Unfortunately no specimen is complete, the front is invariably damaged. The preservation is moderate. The carapace is moderately convex, rather smooth, but on the hepatic and epigastric regions there are fine tubercles. The regions are ill-defined except the mesogastric one. The extraorbital angle bears no tooth. There are three teeth on the anterolateral margin, but there is a hiatus between the orbit and the first tooth.

Genus *Pilumnopeus* A. MILNE-EDWARDS, 1863

Pilumnopeus paratethyensis n. sp.

Pl. XCII, figs. 1–5.

Material seen: holotype, ca. MRZ-10-1: CA.
Paratypes, 16 ca. MRZ-10: CA.
?Others, ?2 ch. MRZ-10: CA.

Locus typicus: Rákos, railway-cut, Budapest.

Stratum typicum: Upper Badenian.

Derivatio nominis: From the name of the sea in which the species lived: Paratethys.

Description: The carapace is convex in both directions, especially longitudinally. Its outline is elliptical. The front is bilobate, the lobes are directed downwards. The orbits are big, the inner part of the orbital region is delimited from the frontal lobes by a deep furrow. The anterolateral margin is adorned with a lobe-like, flat first tooth, and three other teeth. The outline of the posterolateral margin is slightly convex. A step-like epibranchial ridge leaves the last anterolateral tooth, which ridge is broken twice. At the anterior end of the protogastric region, behind the front, there is also a step-like ridge. The mesogastric region is well delimited, while the others are not.

Remarks: The species is extremely similar to *Pilumnopeus vauquelini*, Indo-West-Pacific form. The only constant difference is that the branchial ridge is much sharper in the recent form. Other *P. species*, as *P. indica* and *P. makiana* are less close to the Miocene form, as there are more ridges on their carapaces.

'Pilumnopeus' tetenyensis n. sp.

Pl. XCI, figs. 4, 5.

Material seen: holotype, ca. MB-16-1: CA.
Paratypes, ca. MB-16, 2 ca. MRS-5: CA.

Locus typicus: Tétény-plateau, Budapest.

Stratum typicum: Upper Badenian.

Derivatio nominis: From the locality, Tétény.

Diagnosis: Small, subglobular carapace, a deep notch behind the lateral angle.

Description: The small carapace is convex. Its front is wide, bilobate. The interior orbital angles are separated from these lobes by moderately deep furrows. The anterolateral margin forms a sharp keel on its anterior one-third, elsewhere it bears three subequal teeth. Most regions are ill-delimited except the most anterior part of the protogastric lobe. A faint outline of the very wide metagastric region is visible. There is a characteristic depression behind the lateral angle resulting in a comparatively narrow posterior part of the carapace. The surface is smooth.

Remarks: The shape of the carapace is peculiar with the depression on its posterior part. No similar feature was observed in other *Pilumnus*-related forms. The extremely wide gastric region is characteristic for this group.

Ecology: The species was found in layers containig oncoids, deposited from extremely shallow waters.

Familia **Geryonidae** COLOSI, 1924

Genus *Geryon* KRÖYER, 1837

Geryon cf. latifrons VAN STRAELEN, 1936

Pl. XCIII, fig. 1.

?1936. *Geryon latifrons* n. sp. — VAN STRAELEN: 477–478.
?1955. *Geryon latifrons* VAN STRAELEN — VIA BOADA: 217–222.
1979a. *Geryon* cf. *latifrons* VAN STRAELEN — MÜLLER: 275, 282.

Material seen: ca., drilling Z-2, 36.3 m, leg. KÓKAY: CA.

Remarks: The specimen belongs undoubtedly to *Geryon*, but the frontal parts lack, where the diagnostic features of VAN STRAELEN's species are located, leaves the determination doubtful. The material of the sample (fine-grained sandy silt) and other fossils *(Amussium cristatum)* suggests a deeper sublittoral environment.

Familia **Goneplacidae** McLEAY, 1838
Subfamilia *Goneplacinae* McLEAY, 1838
Genus *Goneplax* LEACH, 1814

Goneplax gulderi BACHMAYER, 1953

?Pl. XCIII, figs. 2, 3.

1953b. *Goneplax gulderi* n. sp. — BACHMAYER: 143–145, pl. 9, figs. 1–3.
?1979b. *Goneplax* cf. *gulderi* BACHMAYER — MÜLLER: 6, pl. 1, figs. 2–3.

Material not seen: holotype, ca. Baden-Sooss, Austria: NHMW.

Material seen: other, ?ca. Oriakhovo, Bulgaria, leg. KOJUMDGIEVA: coll. Univ. Sofia.

Remarks: As PESTA (1918, p. 437) pointed out, *Goneplax rhomboides* is extremely variable. Thus the remnants from Carpathian (unpublished findings of the author) and Badenian remnants require revision.

Subfamilia *Carcinoplacinae* H. MILNE-EDWARDS, 1852
Genus *Pilumnoplax* STIMPSON, 1858

"Pilumnoplax" carnuntinus BACHMAYER, 1953

1953. *Pilumnoplax carnuntinus* n. sp. — BACHMAYER: 257–258, pl. 3. fig. 2.

Material seen: holotype, Deutsch-Altenburg, Austria, leg. OROSZY: NHMW.

Description: The frontal region and a part of the gastric region is preserved. The mesogastric region is delimited by a deep furrow. The frontal region is prominent, it is cut by a longitudinal groove. The front consists of two straight parts, separated by a notch.

Remark: The species most probably belongs to *Carcinoplacinae* though its generic position can not be clarified on the basis of a single damaged specimen.

Familia **Grapsidae** McLEAY, 1838
Subfamilia *Grapsinae* McLEAY, 1838
Genus *Pachygrapsus* RANDALL, 1839

Pachygrapsus hungaricus Müller, 1974

Pl. XCIII, fig. 4, pl. XCIV, figs. 1–3, 5–7.

1974a. *Pachygrapsus hungaricus* n. sp. — Müller: 123–124, 126–127, pl. 4, figs. 1–3, pl. 5, fig. 1.

Material seen: holotype, ca. MB-5-1: NMŐ.
Paratypes, 8 ca. MB-5: CA.
Others, ca. MB-5, 12 ca. MJL-17, 17 ca., 2 ch. MRZ-4, 9 ca. MGF-7, 12 ca. MRS-7, 2 ca. MDZ-9, 2 ca. MBH-12, 3 ca. MBK-7: CA.

Description: The carapace is almost square, slightly convex. Its front is very wide, virtually straight but faintly rounded at the inner orbital angles. The orbits are wide, open, externally delimited by teeth the axis of which diverges from the longitudinal axis of the carapace. The angle of this diversion decreases with increasing age of the individuals. There are two smaller teeth on the lateral margin. The posterior margin is wide, slightly shorter than the front. The chela is smooth, the fixed finger is spooned.

Remarks: The species is closely allied to *P. marmoratus*, an extant form. There is a slight but well defined difference between them. The extraorbital tooth is more diverging in individuals of the same size in the Badenian form than in the extant one. For sake of comparison a photo of *P. marmoratus* is given (Pl. XCIV, fig. 4). The specimen is of same size than its Badenian counterpart on fig. 5. The Badenian form is slightly narrower at the posterior part of its carapace than the extant one.

Ecology: The genus *P.* is well known for its eu- and supralittoral life on rocky shores. Beyond doubt its fossil representative lived also in similar habitats. It was found near to stromatolites or among oncoids, both usually intertidal features. *P.* occurred in reef-structures as well. At Rákos, there is sedimentological evidence for a temporal desiccation e.g. traces of roots, crashes. Rocky surfaces were present on the reefs and among oncoids.

The extremely poor preservational potential of eulittoral crabs makes this finding of special interest.

Subfamilia *Varuninae* H. Milne-Edwards, 1852
Genus *Brachynotus* de Haan, 1833

Brachynotus februarius Müller, 1974

Pl. XCV, figs. 1–5.

1974a. *Brachynotus februarius* n. sp. — Müller: 123, 124, 127, pl. 5, figs. 2–4.
1979a. *Brachynotus februarius* Müller — Müller: 275.

Material seen: holotype, ca. MB-6-1: NMŐ.
Paratypes, 2 ca. MB-6, ca. MKF-5, ca. MM-4: CA.
Others, 16 ca. MB-6, 8 ca. MRS-8, 6 ca. MJL-16: CA.

Description: The outline of the carapace is square. The front consists of two median lobes with sinusoid shape and of two intraocular teeth. The orbits are large, deep. The anterolateral margin bears three teeth, the last one is situated at the widest cross-section of the carapace. The posterolateral margins gently converge posteriorly. The surface is remarkably smooth. The median part of the cervical groove is well developed. No other grooves are visible. There is a faint epibranchial ridge originating from the last lateral tooth.

Remarks: The species is closely allied to *B. sexdentatus* and to *B. foresti*. In recent forms the widest part of the carapace is situated at the 2nd tooth, but at the third one in *B. februarius*. The epibranchial ridge is far less sharp at the fossil form.

Ecology: The species occurs together with *Pachygrapsus hungaricus* in accordance with the fact that extant *B.* species live in the highest infralittoral parts of the seas, and look for shelter under stones or in burrows of *Upogebia* (Pesta 1918, p. 450), but *Brachynotus februarius* was not found in reef-structures. Actually this species prefers bottoms of loose sediments while *Pachygrapsus* shelters in crevices of solid rocks.

Superfamilia **Ocypodoidea** Rafinesque, 1815
Familia **Ocypodidae** Rafinesque, 1815
Subfamilia *Ocypodinae* Rafinesque, 1815
Genus *Ocypode* Weber, 1795

?Ocypode sp.

1979a. *Ocypode?* sp. — Müller: 275, 282, pl. 23, figs. 1, 2.
1980. *Ocypode?* sp. — Via Boada: 60. fig. 1.

Material seen: 2 ch. MGY-22: CA.

Remarks: The outline of the chelae is similar to that of *Ocypode* species, but stridulating ridges are absent from the inner surface of palm. Some grapsid species, e.g. *Sesarma* forms have similar chelae, too.

Subfamilia *Macrophthalminae* Dana, 1852
Genus *Macrophthalmus* Desmarest, 1823

Macrophthalmus vindobonensis Glaessner, 1924

Pl. XCV, fig. 6, pl. XCVI, figs. 1–2, 4–5, ?fig. 3.

?1879. *Macrophthalmus aquensis* n. sp. — A. Milne-Edwards—Brocchi: 115.
1924. *Macrophthalmus vindobonensis* n. sp. — Glaessner: 109–114, text-figs. 1–2.
1928. *Macrophthalmus vindobonensis* Glaessner — Glaessner: 196–197.
?1952. *Macrophthalmus aquensis* Milne-Edwards — Brocchi—Remy: 27–39, text-fig. 1.
1979a. *Macrophthalmus vindobonensis* Glaessner — Förster: 102, text-fig. 16, pl. 2, fig. 6.
1980. *Macrophthalmus vindobonensis* Glaessner — Via Boada: 5–6, pl. 1, figs. 1–2.

Material seen: types, ca. Carpathian: NHMW.
Others, 3 ca. Niskowa, Poland: coll. Univ. Warsaw.

Material seen: others, 3 ca. MH34-1: CA.
?Syntypes of *Macrophthalmus aquensis*, 5 ca: Mus. Natl. Hist. Nat. Paris, a specimen from Teiritzberg, the type-locality, leg. Steininger.

Remarks: The Badenian forms do not differ from *M. aquensis* from France except for the fact that the surface of the best preserved type-specimen (external mould, casted with silicone rubber) is coarser granulated than that of the Badenian ones. This is, however, a variable feature, and also influenced by the state of preservation (Remy 1952). The type- and other specimens from Teiritzberg are usually somewhat narrower, than those from Hungary and France, also their lateral margins are somewhat shorter making the orbital margins more oblique than in our specimens. All these features are variable, even on the both sides of one and the same specimen (pl. XCVI, fig. 1). The (possibly only) European fossil *Macrophthalmus* species is remarkably similar to some extant forms, e.g. *M. barnesi* (Serène 1971, p. 918), which also belongs to the subgenus *Venitus*.

Ecology: Most *M. species* live in muddy eulittoral environments, some in Mangrove-swamps. Some species live however, in deep infralittoral regions, too. *M. (Venitus) latreillei* was reported from depth of 10 to 20 meters (Sakai 1976, p. 616).

Superfamilia uncertain
Familia Palicidae Bouvier, 1898
Genus *Palicus* Philippi, 1838

Palicus sp.

Pl. XCVII, figs. 6, 7.

Material seen: 2 ca. MOE-32: CA.

Remarks: The overall shape of the carapace and the ornament of the branchial regions is very much like that of *P. caronii*. The anterolateral margin is sharp, however, and cut by a notch into lobes, without teeth. The preservation of the specimen is rather poor at the margin, thus it is not impossible that the lobe-like feature might represent a fracture.

Genus *Crossotonotus* A. Milne-Edwards, 1873

Crossotonotus diosdensis n. sp.

Pl. XCVII, figs. 1–5, Fig. 11.

Material seen: holotype, ca. MDZ-15-1: CA.
Paratype, ca. MDZ-15: CA.

Locus typicus: Diósd, south from Budapest.

Stratum typicum: Upper Badenian.

Derivatio nominis: From the name of the locality.

Diagnosis: More or less hexagonal carapace, lateral teeth flat and branching.

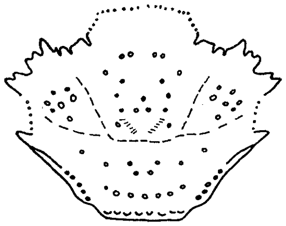

Fig. 11. Crossotonotus diosdensis 3× Diósd

Description: The carapace is strongly adorned, uneven, moderately convex. The front is damaged on both specimens. The orbits are big, cut by two notches. The anterolateral margin is adorned with four big teeth, two of which are branching. The cervical furrow is very deep. The epibranchial region is delimited from the more or less unified group of the cardiac, meta- and posterobranchial regions. All regions bear rather large regularly arranged tubercles.

Remarks: The species is close to the extant *C.* forms in the peculiar arrangement of the regions, the tubercles, grooves. The anterolateral teeth are bigger, however, than those of any known form. No other fossil form of this genus is known. The most closely allied extant species is *Crossotonotus gardineri* (Rathbun) which has lateral spines tending to be flat and even branching in the case of the third one. The teeth are much finer at the extant species than at *C. diosdensis.*

GENERAL CHARACTERISTICS OF THE BADENIAN DECAPOD FAUNA

The Badenian decapod fauna is modern in its character. Only 12 of its 72 genera can be regarded as extinct thus about 85% of the genera still have living representatives. These numbers and ratios inevitably depend on certain subjective taxonomic decisions but support the above statement. Some archaic features of this fauna must not be overlooked, however. Callianassids are surprisingly diverse partly due to their good preservational potential. The probable homochely of the Badenian forms contrasts with the heterochely of most extant related forms. This situation requires further studies.

Galatheids and porcellanids are close to their recent relatives, in conformity with the high age of these groups. The same consideration applies to pagurids as well. In cases where direct comparison was possible, the fossil chelae were found not to differ substantially from those of their extant relatives *(Pagurus, Petrochirus* or *Dardanus arrosor). Albunea asymmetrica* is very similar to some extant species of its genus.

Uncommonly high is the number of Badenian dromioid species. Six different forms were detected although it was generally accepted that Neogene dromioids are rare. If forms bound to coral-reefs are omitted only two species remain, however, still more than the Mediterranean shallow-water forms. One, possibly homoloid species *(?Dorippe carpathica)* might be added to the list of *Dromiacea.*

Although calappid forms are not very numerous, their number still exceeds that found in the Mediterranean because genera recently confined to the Indo-West-Pacific are also present. The species do not differ substantially from their extant relatives, though *Mursia* and *Matuta* species represent primitive forms within their genera as indicated by their short lateral spines. Such presumably primitive species persist, however, in the Indo-West-Pacific. The phylogenetic significance of lateral spines is discussed by IMAIZUMI (1958). The leucosids are represented by eight species, five of which were determined to species level. The diversity of *Ebalia* species is high, similar to that observed in the Mediterranean. Two or three species belong to extinct genera or are of uncertain affinity.

A striking feature of the Badenian decapod fauna is the low number of majid species. Only five species are known, one of which was an inhabitant of reefs. There is a curious absence of see-grass-dwelling small forms, which, together with other small species, represent a major component of the Mediterranean crab-fauna. Three of the species belong to genera still present in the Mediterranean while the remaining two, including the reef-dwelling one, have extant Indo-West-Pacific relations. Of all crab species discussed the two parthenopids of the Badenian are most closely related to common Mediterranean forms.

The cancroids of the Badenian show several peculiar features. Forms belonging to the group of "*Cancer*" *szontaghii* seem not to have close extant relatives. The total number of cancroid species is rather high, especially in comparison to their number in the Mediterranean, even if this number inevitably includes also some erroneous identifications as well. The number of portunid species is similarly high, at least 17. Some of the species belong to modern genera, others belong to extinct ones. *Portunus, Liocarcinus, Thalamita* and *Charybdis* species are similar to their Mediterranean or Indo-West-Pacific counterparts. This family is important in modern faunas thus the rate observed in the Badenian record is moderate. As in modern seas, the number of xanthids is high, especially that of reef-dwelling ones.

The Badenian record represents only a small sample of the Neogene decapods of the World. Thus only few conclusions can be drawn about the evolution of this group on the basis of these data. It can be stated that evolution, at least in this area, was rather rapid for majids from the Miocene until today. Whether this fast change reflects immigrations or evolutionary changes in situ, cannot be decided yet. The *Dromiacea* display a regression in the area but this process depended on the disappearence of reefs which provided a habitat for most Miocene species of this group. Regression of cancroids seems a real process of evolution. The group plays still an important role in American waters, however. The regression of xanthids, similarly to that of dromids, is connected with the extinction of coral reefs in European waters. If one compares their number with that of the Indo-West-Pacific forms, no regression is evident. The absence of some widespread recent groups from the Badenian record suggest a rapid evolution of this family. Other families are represented by low number of species thus do not permit speculations about evolution.

STRATIGRAPHIC SIGNIFICANCE OF BADENIAN DECAPODS

Three subunits are distinguished within the Badenian, an early (Moravian), a middle (Wieliczian) and a late (Kosovian) substage. The distinction between them is usually not easy if individual sections are considered. These substages are defined by stratotypes and by boundary stratotypes (Papp et al. 1978), based mainly on foraminifers or on nannoflora. These fossils or at least the most characteristic forms are absent from limestones which provide the bulk of fossil decapods. Such difficulties notwithstanding, the crab-bearing rocks can be age-correlated to plancton or benthic foraminifer-bearing strata through the use of geological, palaeogeographical methods or of molluscs which occur in both types of sedimentary rocks. The use of the former methods is facilitated by significant tectonic events occuring between the Early and Late Badenian times which changed the palaeogeographic pattern of a large part of the Central Paratethys. Of the two different areas, containing rich crab-faunas in the vicinty of Budapest one is of Upper, the other is of Lower Badenian in age.

Attribution of the limestones occurring within Budapest and in its closest vicinity (Rákos, Tétény-plateau and Bia, cf. chapter "Description of localities") to Upper Badenian is supported by its molluscs (Bartkó–Kókay 1966) and by the fact that they are covered by Sarmatian layers without disconformity. The radiometric age of rocks at Rákos (Balogh–Árváné-Sós–Pécskay 1980) is 13.4 ± 0.6 million year B.P. which strongly supports their Upper Badenian age.

On the other hand, an area in the Pilis- and Börzsöny Mountains, at both sides of the Danube (Visegrád, Törökmező, Zebegény, p. 43) contains sedimentary rocks of Lower Badenian age, confirmed by their micro- and macrofossils (Báldi-Beke et al. 1980, Nagymarosi 1980).

The decapod faunas of these two areas differ from each other in several aspects due to their different age. Ecologically similar conditions were present in both areas. The most marked difference between them is the mutually exclusive presence of some abundant species. The most common of these are in Lower Badenian sites:

Dardanus arrosor
Kromtitis koberi
Dynomene emiliae
Calappa praelata
Carpilius antiquus

Exclusively in Upper Badenian rocks were found:

Petrochirus priscus
Dardanus substriatiformis
Dromia eotvoesi
Calappa heberti
Matuta brocchii

The differences between Upper and Lower Badenian faunas are the most obvious if one considers coral-reef dwelling forms. The well-known habitats of these remained quite similar ecologically. Table 2 presents these differences.

Though the list is not definitive, especially not for group 2, the differences in a number of species are sufficient to support the possibility of a stratigraphically determined change. According to Papp and Steininger (in Papp et al. 1978, p. 199) marly layers situated in the vicinity of the Fenk-quarry in Gross-Höflein are of lowermost Upper Badenian age. These marly layers can be parallelized with some equally marly ones in the Fenk-quarry itself. As these are situated higher in the sequence as the decapod-yielding reef ("Oberer Korallenkalk"), this latter might belong to the uppermost Middle Badenian or to the lowermost Upper Badenian substage. Thus there are three biozones in Badenian layers which can be differentiated on the basis of reef-dwelling decapods and partly of corals.

Table 2

Corals and decapods of groups of reef-origin decapod localities

Number of group (biozone)	1	2	3
Corals			
Porites sp.	+	+	+
Tarbellastraea sp.	+	+	+
Acanthastraea sp.	+	+	−
Stylophora subreticulata	+	+	−
Other hermatypic forms	+	−	−
Decapods			
Petrolisthes haydni	+	+	−
Petrolisthes magnus	−	−	+
Dardanus arrosor	+	−	−
Dardanus substriatiformis	−	+	+
Dardanus hungaricus	+	−	+
Kromtitis koberi	+	+	−
Dynomene emiliae	+	+	−
Dromia neogenica	+	−	+
Calappa heberti	−	−	+
Charybdis mathiasi	+	−	+
Carupa cf. *tenuipes*	+	−	−
Rakosia carupoides	−	+	+
Panopeus wronai	+	+	+
'Pilodius' vulgaris	+	+	−
Xantho moldavicus	+	+	+
Pilumnus mediterraneus	+	?	+
Pilumnopeus paratethyensis	−	−	+
Haydnella steiningeri	+	+	−
Chlorodiella juglans	−	−	+
Chlorodiella mediterranea	+	+	+
Chlorodiella mediterranea tetenyensis	+	+	+
Actaea turcocampestris	+	?	−
Carpilius antiquus	+	?	−
Daira speciosa	+	+	+
Trapezia glaessneri	+	−	−

Group 1: Lower Badenian sites in the Börzsöny- and Pilis Mountains
Group 2: Gross-Höflein, "Oberer Korallenkalk"
Group 3: Upper Badenian localities in Budapest and Diósd

Table 3

Tentative correlation of decapod zones to substages of Badenian

Decapod zones	Substages
4	Upper Badenian
3	
2	Middle Badenian
1	Lower Badenian

The presence of a fourth uppermost zone is evident in the Upper Badenian sequence in Budapest and Balatonakali. This zone is characterized by the absence of many species, extremely common in layers contemporary with the zone 3, i.e. *Callianassa munieri*, *C. chalmasii*, *Petrochirus priscus*, *Dromia eotvoesi*, *Calappa heberti*, *Thalamita fragilis* and all reef-bound species. Reefs are no longer present in this uppermost Badenian strata. The lower layers (indicated in section on Figs. 4, 5 as zone 3, i.e. MR8, MRO, MRL, MGY, MR45, MA etc.) are characterized by their rock rich in terrigenous and vulcanogenous material: gravel, sand, tefra, pumice. These layers are also characterized by intercalated lenses of reefs belonging to zone 3 (MRZ, MK, MDZ). They are covered by a series of layers virtually depleted of terrigenous material thus consisting of pure limestones (indicated on Figs. 4, 5 as zone 4, MRS, MOE, MB, MDG etc.).

The extinction of several decapods and the abrupt change in sedimentological character were contemporous and might be connected with climatic changes. Semiarid conditions might cause fast erosion resulting in a high rate of terrigenous material in sediments. In the subsequent humid climate dense forests might cover the slopes and hinder erosion. A connected slight change in salinity and decreasing temperature of seawater might be responsible for the extinction of corals and some decapods.

The four zones tentatively characterized by presence or absence of species of decapods, could represent assemblage zones. Future studies will have to clarify whether these are general in the Central Paratethys or reflect only local patterns. Based on the above, decapod zones can be correlated to substages of Badenian as shown in Table 3.

PALAEOGEOGRAPHIC IMPLICATIONS

Numerous decapod genera common in Badenian are recently confined to the Indo-West-Pacific realm. This fact was stressed by GLAESSNER as early as 1928 (p. 205) and subsequently confirmed by others (FÖRSTER 1979a, p. 104, MÜLLER 1979c, p. 865). The Miocene decapods of the Indo-West-Pacific realm are poorly known making a comparison of Miocene faunas of that area and of the Paratethys impossible. The presence in the Badenian of genera which are now confined to the Indo-West-Pacific can easily be attributed to their post-Miocene extinction in the Mediterranean and in the eastern Atlantic subsequent to their disappearance from the Paratethys at the end of the Badenian. The extinction of coral-reef-bound species was inevitable in these waters with the disappearance of hermatypic corals. It is well known that the deterioration of the climate at the end of Tertiary was not so severe in South Asia than in Europe or in the Atlantic making the Indian and Pacific Oceans a natural refuge.

Genera, abundant in the Badenian, but recently confined to the Indo-West-Pacific are: *Matuta, Micippa, Macrophthalmus, Crossotonotus, Schizophrys* and *Actumnus* (some of them extended to a restricted area in the southeastern Atlantic, too). Some genera live elsewhere, too, but are predominantly Indo-West-Pacific, e.g. *Mursia, Trapezia, Daira, Chlorodiella, Carpilius, Dorippe, Pilumnopeus* and *Achaeus.* Genera determined with some uncertainity, e.g. *Pilodius, Glabropilumnus,* were not included in the above lists. Of the first list (six genera) all six occur in the Upper, while three or four in the Lower Badenian. From the second list (8 genera) six are Upper, and four Lower Badenian, while a genus is represented in older layers of Western Europe, too *(Mursia).* In contrast to earlier suggestions (MÜLLER 1979c), no or only slight temporal increase can be discerned in the proportion of Indo-West-Pacific-related forms, if we consider that the total number of known Upper Badenian genera is higher (53) than that of Lower Badenian ones (36).

Three species require special consideration. These, or very closely allied forms occur in the Pliocene of Fiji (RATHBUN 1945). Two of these (*Dardanus hungaricus* and *Daira speciosa*) occurred in zones 1 and 3 (Table 3) while *Dynomene emiliae* was found in zones 1 and 2 only. Thus the number of these species, presumably most closely related to Indo-West-Pacific forms, seems to decrease with time.

Consequently the forms with eastern relationships derived most probably from a common Tethyan fauna and subsequently vanished from European seas. Thus a connection of the Badenian see with the Indian Ocean seems less probable now than some years ago. Nevertheless the existence of a sea-way permitting migration of certain euryhaline elements cannot be ruled out. The term euryhaline must be stressed, as such a way might have existed through the Eastern Paratethys to a sea somewhere in the Middle-East (Upper Fars series?). The salinity of the former sea was most probably inferior, and of the latter superior to that of the Oceans (RÖGL–STEININGER–C. MÜLLER 1978; STEININGER, RÖGL and C. MÜLLER in PAPP et al. 1978). Neither can another, though less probable, connection be ruled out along some unknown, partly molasse-like basins along the Hellenids, Taurids and Zagros, but our present knowledge of Miocene seas of these areas is highly controversial.

One point seems to be indisputable, however. The general character of the fauna remained constant for the whole Badenian thus the connection ensuring the oceanic (or nearly oceanic) salinity, i.e. the connection with the Mediterranean, also must have remained unchanged. At least four Badenian species are identical, while six others are almost identical with Mediterranean Miocene species.

A remarkable fact still awaits its interpretation. Certain highly abundant species are present exclusively in layers of the zone 3 (Table 3): *Petrochirus priscus, Dromia eotvoesi, Calappa heberti, Matuta brocchii, Micippa hungarica, Thalamita fragilis.* The abundant occurrence of these suggest that most of them are indeed absent from older strata. The majority of them vanished at the beginning of zone 4, others, as *Matuta,* are rarer in upper layers than in zone 3. One possible explanation is that these species were highly dependent on climate and/or on salinity. This is consistent with the supposed climatic change at the boundary of zones 3 and 4, causing regression or extinction of sensitive, probably stenohaline species. Their probable immigration at the beginning of zone 3 requires the assumption of a source for these species. An Indo-West-Pacific source seems highly improbable as stenohaline species could hardly penetrate seas of abnormal salinity (cf. above). Perhaps these forms were present in southern parts of the Mediterranean during Early Badenian times but so far only *Petrochirus priscus* was recorded from this area (GLAESSNER 1928).

ECOLOGY

Various decapod sites of the Badenian yielded different types of associations which can be grouped even on a subjective basis. The clusters obtained in this way might reflect ecological conditions. To achieve a more objective clustering, an analitical investigation was carried out by dr. M. Rajczy, Natural History Museum of Budapest. The similarity of individual associations (layers in our case) was computed by binary (absence vs. presence) and quantitative methods. Quantitative methods are used infrequently in macropaleontological investigations, especially for hand-picked samples, since the representative nature of such a sample can be questioned. Certain considerations (see below) and our rather convincing results support the reliability of quantitative evaluation of such collections, however. In hand-sampled collections for obvious reasons the sample will be distorted statistically. The rock is fragmented by the collector into pieces of a given average size. Specimens smaller than these pieces will remain hidden if located inside. Assuming that fragmentation is statistically independent of the position of fossils within the matrix, the probability that a fossil of given size will be observed:

$$p = 1 - \frac{(r-f)^3}{r^3} \qquad (p_{\max} = 1)$$

where p is the probability of detection of a fossil of size f, and r is the average size of the pieces of fragmented rock. This formula was used to provide comparable distributive functions of sieved and of hand-picked collections. Although one cause of distortion was thus reduced, others, due to selective embedding, fossilization, incorrect determination etc., still remained. The data, corrected in this way, were used for computing similarities by binary (Sørensen 1948, Sokal–Michener 1958) and by quantitative (Horn 1966, Czekanowski 1909, Pinkham-Pearson 1976, Hummon 1974) functions. For clustering, the method of weighted averages was used. Calculations were based either on quantity of specimens of genera or of species. The results obtained by either approach were similar since few genera contained more than one species.

The main goal of the cluster-analysis was to define sets of individual sites and layers which can be studied subsequently together as groups. The most fidel and the most constant species of such groups can be discerned and used in further studies. Evidently such forms will provide more reliable basis for ecological considerations than those found in one or few sites only. The groups or clusters might be obtained from dendrograms by cutting them on a given level of similarity. The choice of this level is arbitrary to some extent thus the method is inevitably subjective. The subjectivity will be reduced if different methods give similar results. The Badenian decapods yielded four groups based on functions of Sørensen, Hummon, Sokal–Michener and Horn and five more or less homogeneous clusters based on dendrograms prepared according to the methods of Pinkham–Pearson and Czekanowski (Fig. 12, Table 4). Further levels of hierarchy were not evident. Localities of reef-origin formed a coherent cluster. The Pinkham–Pearson and Sokal–Michener functions separated this group into two parts, however. The clustering by four different methods based on functions of Sørensen, Czekanowski, Horn and Hummon gave almost identical results for most sites. The position of some layers, however, varied according the function used. These are: limestone at Kerepesi út (MKC), Węglinek (WEG) and one of the Diósd localities (MDN). The first seems transitional in many respects, while the two others are poorly collected. The results were consistent with the main petrologic character of rocks, i.e. presence or absence of oncoids or reefal structures. The groups were designated according to one of their constituents and an attempt will be made to evaluate the conditions under which the layers of these groups were formed (Table 4).

The most coherent cluster (MGY) includes layers MRO, MRF, MR8, MR45, MA, MOH, MEG, MFA and in certain dendrograms MFK. Mátraverebély–Szentkút and Nyírád (Lower Badenian localities, MMS resp. MNU) yielded similar associations, too with *Calappa praelata* replacing *C.*

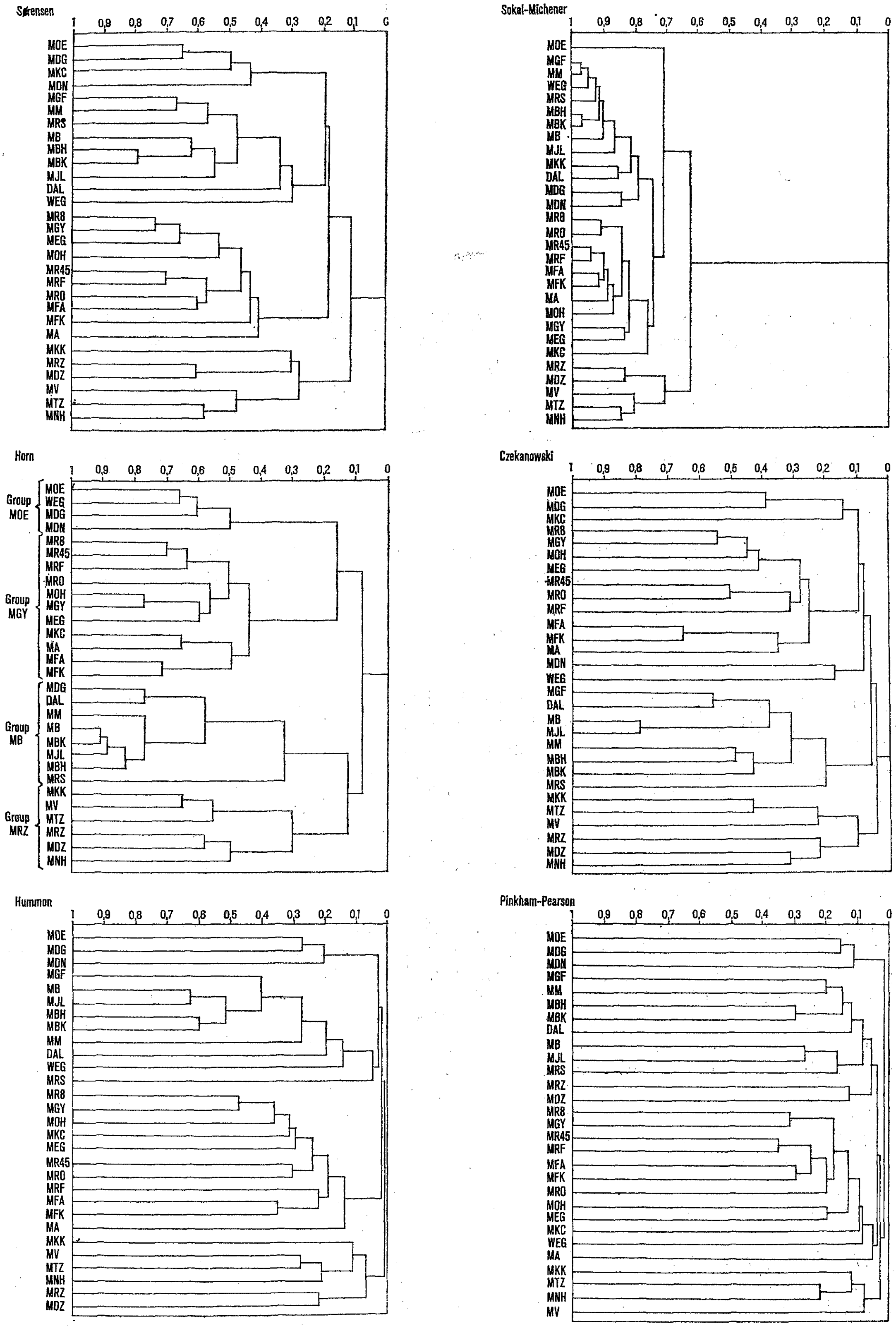

Fig. 12. Dendograms showing similarities of species assemblages based on cluster-analysis. [Codes of assemblages (layers) are explained on pages 36—47]

Table 4

Clusters of decapod localities

Name	Sites of layers	Abundant and constant forms	Occasional forms	Inferred conditions in habitat	Matrix
MGY	MGY, MRF, MR8, MRO, MR45, MA, MOH, MEG, MFA, (MFK)* (Mátraverebély–Szentkút), (MNU), (MOS)	*Calappa* *Matuta* *Mursia* *Thalamita* *Dromia eotvoesi* *Portunus (Portunus)*	*Albunea* *Portunus (Monomia)* *Maja* *Dorippe*	Depth: 20–30 m ± oceanic salinity Loose substrate Warm-temperate climate	Sandstone, sandy limestone
MOE	MOE, MDG, MDN, (DAL), (WEG)	*Micippa* *Ebalia* '*Lissocarcinus*' *Liocarcinus* *Actumnus* *Parthenope*	*Maja* *Cancer* *Dorippe* *Palicus* *Palaeomyra*	Depth >20 m Slightly changing salinity Inhomogeneous, partly hard substrate Temperate climate	Fine or coarse calcarenite without oncoids
MB	MB, MRS, MGF, MBK, MBH, MJL, MM, (DAL)	*Pisidia* '*Pisa*' *Pachygrapsus* *Brachynotus* *Pilumnus*	*Xantho*	Depth 0–2 m Changing salinity Inhomogeneous, partly hard substrate, oncoids, crevices Temperate climate	Coarse calcarenite with oncoids or stromatolites
MRZ	MRZ, MDZ, MK, MV, MTZ, MNH, (MZZ)	*Chlorodiella* *Daira* *Charybdis (Goniosupradens)* *Pilumnopeus* *Petrolisthes* *Galathea* *Dromia neogenica*	*Carpilius* *Panopeus* *Cancer* *Pachygrapsus* *Crossotonotus*	Depth <10 m ± oceanic salinity Patch-reefs Warm-temperate climate	Corals in rock-building quantity in various matrices (marl, sandstone, calcarenite)
Sooss	Sooss, (Budapest drilling Z-2), (Walbersdorf), (Oriakhovo)		*Ranidina* *Geryon* *Goneplax* "*Cancer*" *szontaghii vindobonensis*	Depth >50 m ± oceanic salinity Soft, muddy substrate	Silt, clayey silt, rarely calcarenite

*** Designation within brackets: were assigned here only in certain dendrograms, or assigned here subjectively.**

heberti, but the low number of species found did not allow their inclusion in the numerical study. These associations are characterized by the abundance of *Calappa, Matuta, Mursia, Thalamita, Dromia eotvoesi* and *Portunus (Portunus)*, while *Albunea* and *Portunus (Monomia)* were found in few sites only. These genera are rare or absent in other clusters thus they are fidel. The first five are constant as they are present in virtually all localities of this group.

The high diversity of *'Callianassa'* forms (Saint Laurent–Le Loeuff 1979) can be attributed to a depth of 10 to 30 meter, as most extant *Callianassa* and *Callichirus* species prefer such conditions, though few species live intertidally, while some others descend below 100 meter. In some sites the presence of big species *(C. munieri)* indicates homogeneous sands on bottom. Most *Matuta* species live in shallow waters (Sakai 1976), but *M. curtispina,* morphologically similar to *M. brocchii,* live on sands in depth of 35 to 80 meter. *Mursia* species prefer soft bottom in depth of 50 to 150 meter (Sakai 1976), while *M. cristimana* was reported from shallow waters, too (17 m. Barnard 1950). *Thalamita crenata* (similar to *Th. fragilis*) lives in extremely shallow water, on mud or soft sand. Other *Th.* species descend to 80 meter (Sakai 1976). *Calappa* species live from 10 to 150 meter. Preference of depth depends on species (Sakai 1976). *C. granulata,* similar to *C. praelata,* lives in depth of 30 to 150 meter (Zariquiey Alvarez 1968). *Portunus (Portunus)* species live in shallow water, down to 20 or 30 meter. *Albunea carabus* lives on soft sandy bottom, in depth of 30 to 50 meter generally (Zariquiey Alvarez 1968).

The actualistic interpretation of the mentioned data suggest a depth of 20 to 30 meter for most localities of this group. Where the sediments were homogeneous (MRF, MR8, MR45), big callianassids were abundant, in other places the smaller *'Callianassa' pseudorakosensis* lived in masses (MFA, MFK). Abudance and diversity of calappid species suggest euhaline conditions and a warm-temperate climate. The occasional abundance of *Albunea* (MGY, MRF) may suggest water slightly deeper than 30 meter. The localities of this cluster share a set of species with other groups, mostly with MOE, as discussed below. The most important of these are *Maja,* with a preference for depth of 15 to 30 meter, or rarely of 10 to 200 meter (Sakai 1976). *Maja squinado,* a European species, lives in depth of 2 to 73 meter (Ingle 1980). Extant *Dorippe* species live in depth of 15 to 50 meter (Sakai 1976) or of 40 to 100 meter (Zariquiey Alvarez 1968). Various *Liocarcinus* species live in different zones from the shoreline down to 220 meter (Ingle 1980).

Another cluster, MOE, includes also MDG, MDN, and in part of classifications, Deutsch-Altenburg and Węglinek as well. The sites of this group are characterized by abundance of *Micippa hungarica, Ebalia* species, *'Lissocarcinus', Liocarcinus,* and in cases of better known localities, by the presence of *Achaeus, Actumnus, Dorippe, Maja, Parthenope, Cancer, Xantho, Palicus. Micippa thalia,* extant species, which is closely related to *M. hungarica,* lives in depth of 20 to 100 meter, on sand or broken shells (Sakai 1976). Most *Achaeus* forms live between 10 to 50 meter, but some of them live in shallower habitats, too. *Ebalia* species live in various depths, they are reported from two to several hundreds of meters (Ingle 1980). *Palicus* species live mostly below 50 meter (Sakai 1976, Zariquiey Alvarez 1968). *Cancer* forms live in various depth (Rathbun 1930), from the shore down to 1000 meter. *Parthenope* species are common between 10 to 40 meter (Zariquiey Alvarez 1968). Extant *Actumnus* species live generally in deeper environments than *Pilumnus* forms, generally below 20 or 35 meter, but two forms occur intertidally as well (Sakai 1976).

These data suggest a depth slightly greater than 20 meter similarly to the case of group MGY. One difference is the lack of big callianassids. This can be attributed to inhomogeneous sediments. Lack of *Calappa, Dromia, Thalamita, Portunus,* rarity of *Matuta, Mursia,* genera predominantly occurring under warm-temperate or tropical climates and in euhaline water, suggest climatic deterioration and slightly changing salinity of sea-water. As it was stated (p. 104), the MOE localities are characterized by lack of terrigeneous sediments, probably related to a change of climate at the boundary of zones 3 resp. 4 (p. 105). Molluscs, studied by Kókay (Kókay–Mihály–Müller in press) suggest also a sea deeper than 20 or 30 meter.

Probably the most interesting cluster is MB as it represents an environment rarely preserved. Petrologically, its rocks contain oncoids, stromatolites or similar structures (Lelkes–Müller in press), suggesting extremely shallow environments. The group contains the following sites or layers: MRS, MGF, MB, MBK, MBH, MJL, MM and with certain reservations two additional ones, Węglinek and Deutsch-Altenburg. Faunistically, it is characterized by the abundance of *Pisidia kokayi, 'Pisa' oroszyi* and *Pachygrapsus,* which all are rare or absent elsewhere, by the exclusive presence of *Brachynotus februarius,* and by abundance of *Pilumnus mediterraneus* and *Xantho moldavicus. Pachygrapsus* species are typical eulittoral crabs living on rocky shores (Pérès–Picard 1964) which makes their occurrence particularly interesting. *Brachynotus* forms live mostly between 5 to 2 meter of depth (Zariquiey Alvarez 1968). Most *Pisidia* species also live in such habitats but some occur on deeper bottoms as well. The last three forms prefer bottoms rich in shelters. *Pisa* species live in depth between one to 90 meter, prefer hard grounds (Ingle 1980). *Xantho* and *Pilumnus* forms are rather ubiquious and also occur in extremely shallow water.

According to these data MB type layers were deposited in extremely shallow shore regions. Oncoids and stromatolites provided hard ground offering shelters while temporary regressions resulted in rocky intertidal conditions on shores covered with oncoids. Extant relatives of most forms are euryhaline organisms, as *Xantho, Pisidia, Pachygrapsus, Liocarcinus* and *Brachynotus* species live in the Black Sea (PESTA 1918), while some leucosids live either in the Marmara Sea (HOLTHUIS–GOTTLIEB 1958, p. 80), or crossed the hyperhaline barrier of the Suez Canal (POR 1978). This fact is consistent with changing salinities in high sublittoral and eulittoral environments.

The group MRZ representing coral-reef habitats is characterized by the nature of rock-containing hermatypic corals in rock-building quantity preserved either in living position or as removed blocks embedded in matrix. A series of genera or species is restricted to these sites: all species of *Chlorodiella, Daira speciosa, Carpilius, Charybdis (Goniosupradens), Dynomene, Dromia neogenica, Actaea, 'Pilodius', Haydnella, Crossotonotus, Schizophrys, Petrolisthes.* Most of their extant relatives are reef-dwellers, as *Charybdis (Goniosupradens), Daira perlata, Chlorodiella,* most *Dynomene* species, *Carpilius, Trapezia* (SAKAI 1976, TAYLOR 1968). Others are not exclusively restricted to reefs but prefer hard bottom thus occassionally occur on reefs, too *(Schizophrys, Carupa, Daira americana, Crossotonotus)*. Unexplained is the presence of *Panopeus* and *Cancer* in sites of reef-origin. *Panopeus wronai* occurs in various sites while *Cancer* only in Diósd (MDZ). Extant *Panopeus* species occur occasionally on reefs but prefer soft bottom while *Cancer* species were never found on reefs (RATHBUN 1930). *Calappa heberti,* though rarely, occurs also on reefs similarly to some extant *C.* species. Few specimens of *Matuta* were also found in rocks of reef-origin (MRZ). Characteristic is the consistent absence of some crabs abundant elsewhere, as *Parthenope,* leucosids, *Mursia* in agreement with the fact that these are absent or rare on extant reefs (TAYLOR 1968). In two of these sites (MDZ and MRZ) *Pisidia kokayi* and *Pachygrapsus hungaricus* occur indicating temporary emersions as proven also by sedimentological features (root-prints, desiccation cracks). The presence of coral-reefs points to euhaline water and to warm-temperate or tropical climate. The decrease of number of coral-genera (Table 3) with time suggests slight perturbations in salinity in upper parts of Badenian.

An association of a peculiar facies recently found in Zebegény (MZZ) (Fig. 6) was not yet included in the cluster-analysis. A fine-grained micritic matrix includes plentiful colonies of a small ahermatypic branching colonial coral-species similar to *Oculina.* Fields of ahermatypic corals may be found at different depths from one to several hundreds of meters, both in tropical or cold-temperate seas. Scarce presence of *?Porites* indicates, however, a depth less than a few tens of meters. The decapods found are similar but less diverse than those found in reef-limestones. Interesting is the presence of two leucosid species, since leucosids are absent from Badenian reefs. Portunids and dromids are also absent from the sample taken comprising 30 specimens.

The existence of a fifth type of habitat is indicated from various localities, most of which did not yield more than one or two forms determinable to species level. Two localities yielded *Goneplax* species. In Oriakhovo it was found together with *Miocyclus bulgaricus,* in Sooss at Baden with *"Cancer" szontaghii vindobonensis.* A *Geryon* species was found in drilling Z-2. Budapest. *Goneplax* (40 to 760 meter, PESTA 1918), and *Geryon* (776 to 1500 meter, PESTA 1918) live in deeper sublittoral and bathyal environments. *Ranidina rosaliae* was found in two sites, in Walbersdorf (Borbolya) it occurred together with *"Cancer"* cf. *bittneri.* Decapods of deep sublittoral environments with soft bottom are thus known from sporadic findings.

The results presented above are in accord with those obtained by analysis of invertebrates other than decapods and by sedimentological methods (Table 4). Preliminary results of such studies are presented in various publications (MÜLLER 1974a, 1974b, 1976a, 1979a; KÓKAY–MIHÁLY–MÜLLER in press; LELKES–MÜLLER in press).

Shannon diversity indices were calculated for the samples analysed above, also by M. RAJCZY. The extreme values, expressed as H $\log_2$ for groups of sites are as follows:

Group MGY: $H'=2.18–3.66$
Group MOE: $H'=3.25–4.00$
Group MRZ: $H'=2.10–3.63$
Group MB: $H'=1.24–2.83$

The diversity of some intertidal and shallow subtidal crab-assotiations was studied by ABELE (1974). Though his samples were taken from warm-temperate and tropical seas of higher temperatures than those suggested for Badenian seas, his highest value, $H' \log_2=4.346$ does not exceed significantly our highest values. Fossil samples might also contain specimens from more than one habitat which could increase diversity. Whether this effect was significant in Badenian localities cannot be a priori decided. Nevertheless a post-mortem transport of decapod remnants is less likely than that of most fossil invertebrates.

An interesting pattern of diversity was revealed along a section on the Tétény-plateau. For localities of the group MB (Fig. 2) diversity clearly increased from layer MM, presumably situated closest to the shore, toward south, i. e. the open sea, from a value of H′ $\log_2 = 1.24$ through H′ = 2.93 (MBH) to H′ = 3.25, value of site MDG. Since these layers were deposited more or less simultaneously, it is likely that the observed increase of H′ reflects increasing depth in a section normal to the shore. This result is somewhat in disagreement with ABELE (1974) who found some of the highest values in rocky intertidal habitats, while such a habitat (MM) yielded our lowest value. ABELE did investigate only one subtidal community, however, namely a *Pocillopora* association of high diversity, H′ $\log_2 = 4.346$. If the results concerning Badenian associations are correct (at least at a level limited by the restricted size of samples), not the values for coral-reef (MRZ) associations are the highest ones (2.10–3.63), but those for sublittoral communities which lived on a complex bottom with shells, calcareous sand, oyster-beds (MOE, H′ $\log_2 = 4.00$). ABELE concluded (1974) that diversity correlated best with complexity of the substrate. In this respect our results are in agreement with ABELE, as a sublittoral environment like MOE may complete even with a coral-reef being similarly complex.

ADDENDUM

After closing this manuscript I had the opportunity to study some material in collections in Vienna and make additional collections at Austrian localities. This has led to some taxonomical changes.

Study of the type-series of *Cancer carniolicus* BITTNER, 1884 (kept in the Naturhistorisches Museum, lectotype designated herein: pl. 1 fig. 8a in BITTNER, 1884, seen by the courtesy of dr. BACHMAYER) and that of some new specimens of *Cancer szontaghii* LŐRENTHEY, 1897 from its type-locality, demonstrated convincingly their identity. *Cancer bittneri* TOULA, 1904 (holotype kept also in the NHMW), though its carapace is slightly smoother and wider than that of BITTNER's and LŐRENTHEY's specimens, belongs also here. In JANSSEN—MÜLLER (in press) MÜLLER described a new monotypical genus, *Tasadia*, for *Cancer szontaghii* LŐRENTHEY (here mentioned as nomen nudum). Thus the name *Tasadia carniolica* (BITTNER, 1884) should be used for all of the mentioned forms after the appearance of JANSSEN—MÜLLER (in press).

Seven new specimens of *Atelecyclus szontaghii vindobonensis* BACHMAYER—KÜPPER, 1952 were collected at the type-locality (Baden-Sooss, clay-pit, leg. P. PERVESLER and me). This form, though having many features in common with *Tasadia carniolica* (outline of the carapace, presence of tuberculated elevations on the main regions), differs from it by the much smaller relative size of these elevations and by the much smoother inter-elevation surface, as it was mentioned by its author. Thus the subspecies should be maintained under the name *Tasadia carniolica vindobonensis*.

Poorly preserved specimens from Walbersdorf (coming from a layer of Lower Badenian age, RÖGL, pers. comm.), kept at the Geologische Bundesanstalt and in the NHMW (mentioned by BITTNER, 1893 p. 32 as *Cancer* cfr. *illyricus* and by GLAESSNER, 1928 p. 178 as *Cancer bittneri*) belong either to *Tasadia carniolica* (BITTNER) or are transitional between the nominal subspecies and ssp. vindobonensis.

The type-series (10 specimens) of *Ranidina rosaliae* BITTNER, 1893 is deposited in the collection of the Geologische Bundesanstalt. Lectotype, designated herein, pl. 2 fig. 2 (non fig. 2a) in BITTNER (1893).

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LIST OF SPECIES

PLATES

Scanning electron micrographs were taken by MRS. B. TAKÁCS. All other photographs were made by the author.

Abbreviations of collections: FI: Geological Institute, Budapest; NMŐ: Palaeontological Department of Natural History Museum Budapest; CA: author's collection; NHMW: Naturhistorisches Museum Wien. Codes of layers are explained in chapter "Description of localities" (p. 36).

PLATE I

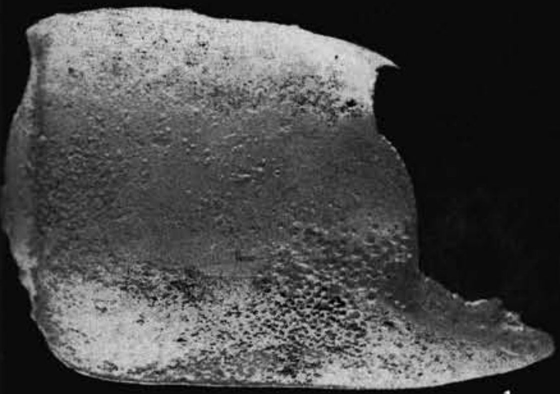
1, 4. *'Callianassa' munieri* Brocchi
Rákos, MR-5-1, right propodus 2.5×

2—3. *'Callianassa' munieri* Brocchi
Rákos, MR-5-4, right dactylus 4.7×

5. *'Callianassa' munieri* Brocchi
Rákos, FI, leg. Schafarzik, unidentified layer, three articles of left cheliped 2.5×

6. *'Callianassa' munieri* Brocchi
Rákos, MR-5-2, left carpus 4×

7. *'Callianassa' munieri* Brocchi
Rákos, unidentified layer, FI, leg. Stoczek, merus of left cheliped 4.9×



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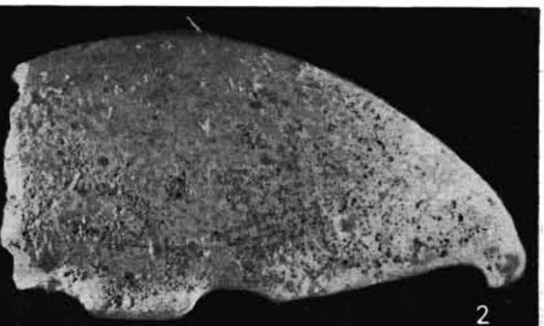

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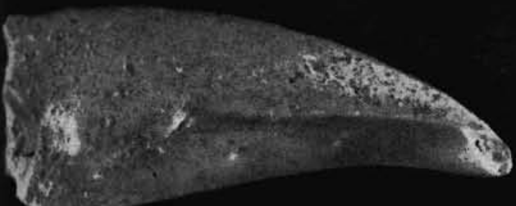

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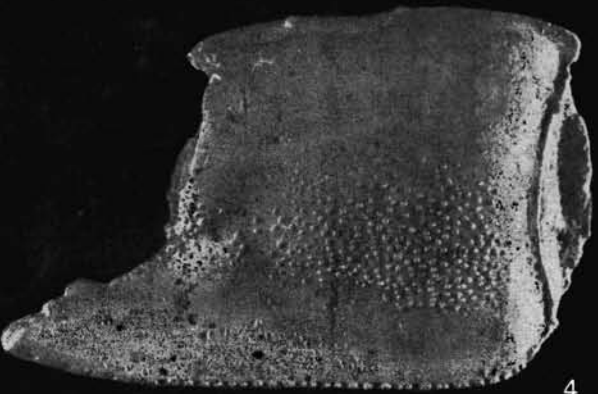

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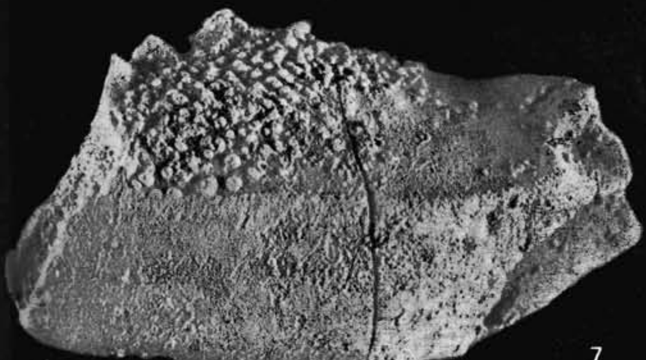

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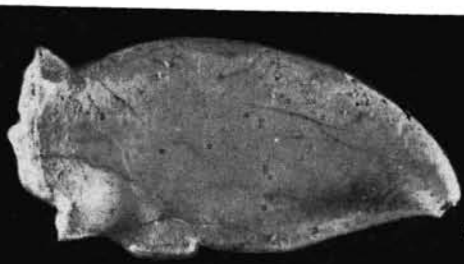
PLATE II

1. *'Callianassa' munieri* Brocchi
Rákos, MR-5-5, right dactylus 4.6×
2. *'Callianassa' munieri* Brocchi
Rákos, MR-5-6, left dactylus 3.2×
3. *'Callianassa' chalmasii* Brocchi
Gyakorló út, MGY-9-3, left propodus 5.6×
4. *'Callianassa' chalmasii* Brocchi
Gyakorló út, MGY-9-2, left propodus 5.5×
5—7. *'Callianassa' chalmasii* Brocchi
Gyakorló út, MGY-9-1, right chela 4.6×

1



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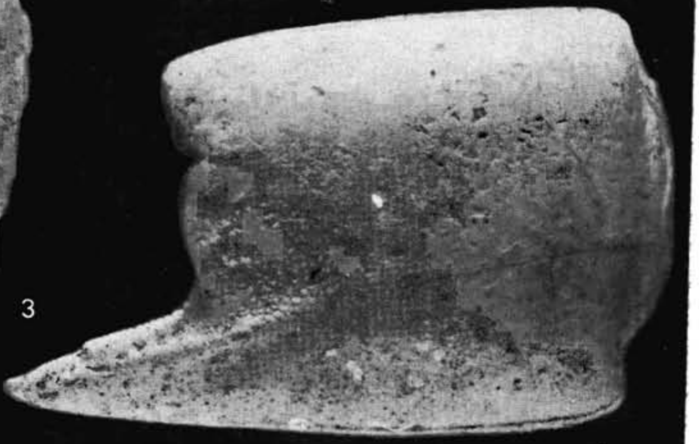

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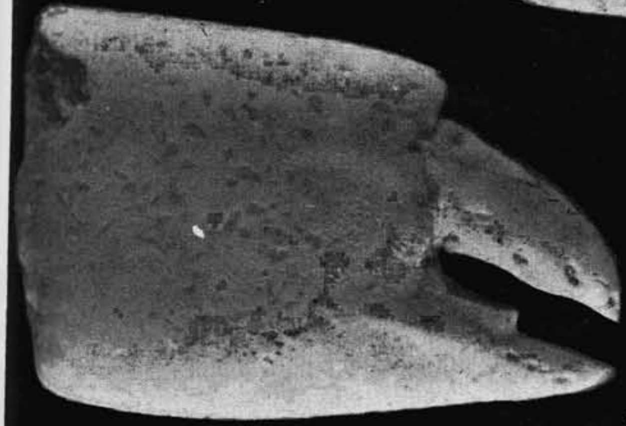

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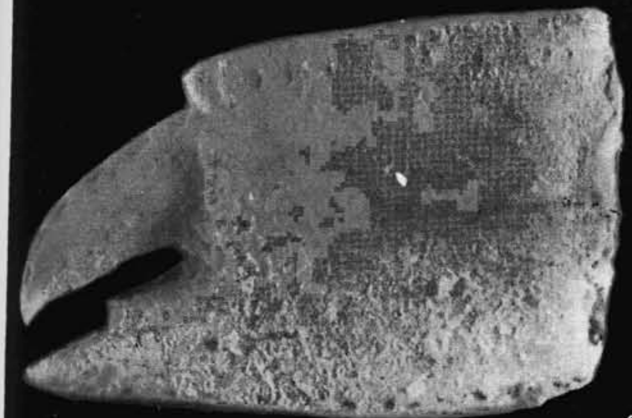

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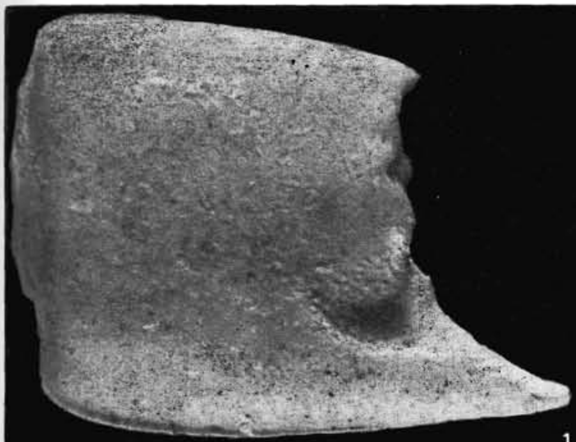
PLATE III

1—2. *'Callianassa' rakosiensis* Lőrenthey
Gyakorló út, MGY-6-1, right propodus 6.2×
3. *Callianassa brocchii* Lőrenthey
Gyakorló út, MGY-24-1, right propodus 7.3×
4—5. *'Callianassa' pseudorakosensis* Lőrenthey Lectotype
Rákos, unidentified layer, leg. Lőrenthey, M 139, FI, right chela 8.5×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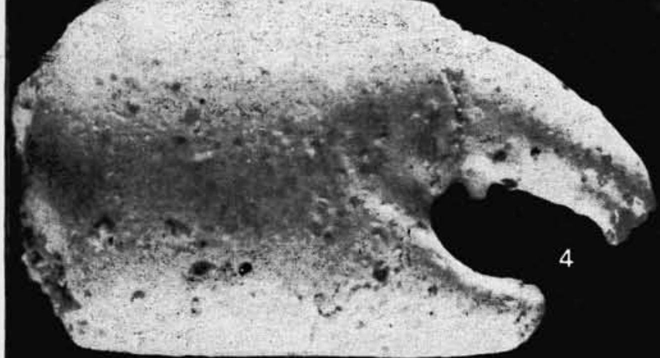
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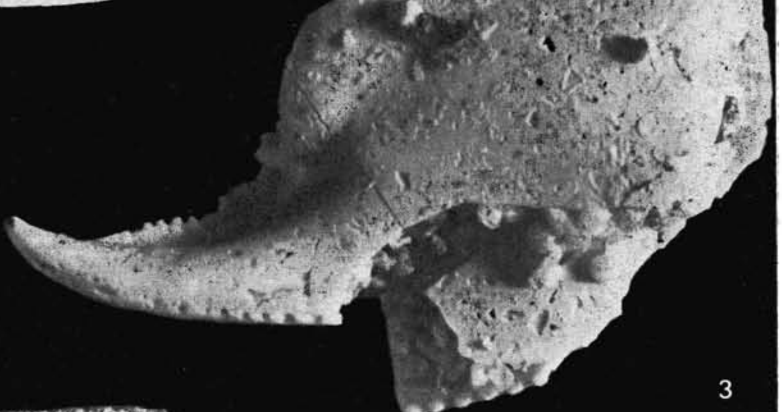
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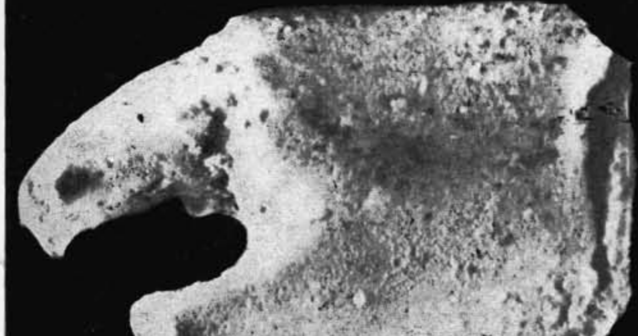
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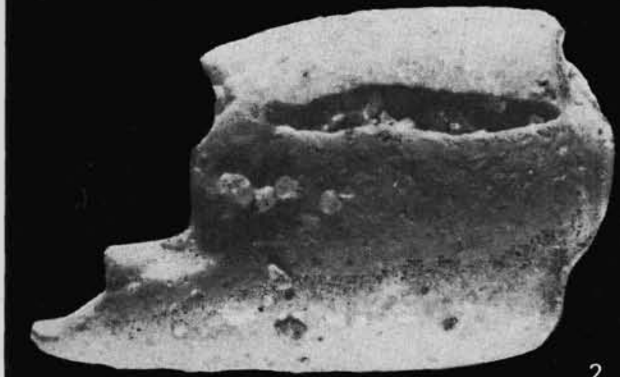
PLATE IV

1—2. *'Callianassa' pseudorakosensis* LŐRENTHEY Lectotype
Rákos, unidentified layer, leg. LŐRENTHEY, M 139, FI 8.5×

3. *'Callianassa' pseudorakosensis* LŐRENTHEY
Gyakorló út, MGY-7-2, left propodus 6.8×

4—6. *'Callianassa' pseudorakosensis* LŐRENTHEY
Gyakorló út, MGY-7-3, right propodus 7.5×


1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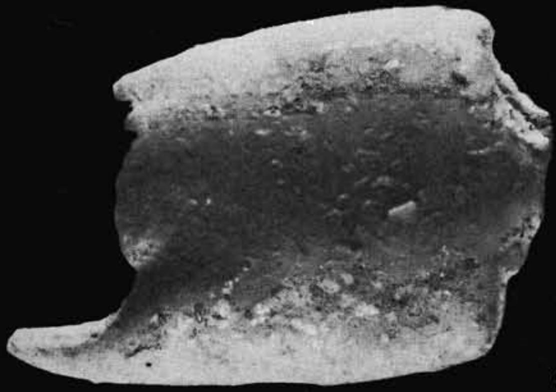
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PLATE V

1—3. *'Callianassa' pseudorakosensis* LŐRENTHEY
Szentkút, leg. STREDA?, M 61/2633 NMŐ, left dactylus 9×

4. *'Callianassa' pseudorakosensis* LŐRENTHEY
Szentkút, MSZ-1-1, right merus of cheliped 11.5×

5—6. *Callianassa* sp. (*Semiranina oroszyi* BACHMAYER)
Tétény-plateau, MDG-1-1, anterior part of carapace 10×

7—8. *'Callianassa'* sp.
Örs vezér tere, MOE-34-1 and 34-2 9×