MOLLUSC FAUNA OF THE HUNGARIAN UPPER OLIGOCENE (EGERIAN)

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STUDIES IN STRATIGRAPHY, PALAEOECOLOGY, PALAEOGEOGRAPHY AND SYSTEMATICS

with 55 text figures, 4 tables and 51 plates

by

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AKADÉMIAI KIADÓ, BUDAPEST 1973

Translated by
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Printed in Hungary

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INTRODUCTION

Hungary's Upper Oligocene deposits are rich in mollusc remains. The collection of this fauna, let alone its description and palaeontological evaluation, was heavily hampered by poor preservation. The one exception of some renown is the Eger Fauna, whose elements, excellently preserved and easy to collect, were described in the classic monograph of **Telegdi-Roth** (1914) and in a supplementary study by **Noszky** sen. (1936). Still, although their work provides valuable information as to the molluscs of the Upper Oligocene, these descriptions of a single facies cannot make up for the lack of knowledge concerning molluscs found elsewhere in the country.

It is no wonder that the poor preservation of the molluscs cooled the enthusiasm of my excellent predecessors who mapped the widespread Upper Oligocene sediments exposed on the surface in the Dunazug Mountains and in the North Hungarian Mountains, so much so that they gave shorter or longer lists of fossils only. The far from complete knowledge of the palaeontological material reacted in its turn unfavourably upon stratigraphy, and some of the passion and printer's ink expended in discussion of stratigraphic problems could possibly have been saved in possession of more facts about the fauna. This renders the more valuable the efforts of **Böckh** (1899), **Erdős** (1900), **Majzon** (1933), **Gaál** (1938) and **Méhes** (1942) to supplement their fossil list with descriptions and figures of at least a few mollusc species: their merit is shared of course by **Csepreghy-Meznerics** (1960) whose Pecten monograph includes the Upper Oligocene Pectinids, too. The comprehensive and thorough evaluation by **Seneš** (1958) of the Kováčov mollusc fauna (known earlier as the "Helemba fauna") from the contiguous Slovakian area was a further significant advance.

My own interest in the subject dates back to 1957. Recognizing that a vast amount of novel information was to be extracted from well-collected faunae from localities which, although discovered all right during geological mapping work, were palaeontologically unexploited because of the poor preservation of the fossils, I put a particular emphasis upon collecting work, upon correct collecting procedures. This does not mean, however, that these procedures were in any way new or special. Besides a great deal of patience, the most useful items in my field kit were a quick-setting synthetic resin dissolved in benzene and a simple preparatory tool kit designed for use right on the spot.

Geological reconnaissance and fossil collection often took the form of a collective enterprise. I am particularly grateful in this respect to my colleagues Mrs. I. **Csepreghy-Meznerics** and Mrs. Réka **Nyirő**, who helped me to collect a very rich material on field trips in the Börzsöny and Cserhát regions.

The accumulation of a large volume of data urges towards systematization and synthesis. Besides this I was encouraged to do a review of detail studies scattered in various periodicals and a systematic description of the Upper Oligocene mollusc fauna also by the obligations implicit in the facilities put at my disposal, by the daily needs of practical geology and by the exhortations of my colleagues. This is how the present treatise came to be written.

In both the systematic part and the chapters preceding it, discussion is restricted to fossils inspected and identified by myself. I did not rely on literature in the stratigraphic and ecologic evaluation, either. I have collected myself a large part of the fossil material, most of which is at the Geo-Palaeontological Collection of the Museum of Natural History, Budapest. Still, I have made use of materials from other collections, too.

For brevity, localities and exposures within the bounds of one and the same town or village have been distinguished by numbers. In order to distinguish outcrops from boreholes, likewise denoted by a place name and a number, we have hyphenated name and number in the case of outcrops. Thus Szentendre 2 denotes a borehole, Szentendre-2 an exposure.

There can be no definitely settled matters in any field of scientific endeavour: least of all can the study of the Hungarian Upper Oligocene molluscs be considered in any way completed by the present treatise. The sole aim of my attempt at a synthesis was the evaluation and statement of the current state of our knowledge. It shows up in bold relief all the gaps, all the hiatuses whose filling will take further long and painstaking work. The data in hand are still far from complete and, as far as a *vue d'ensemble* of the available evidence is concerned, often all I could do was to point out the problems raised by conflicting information.

In closing this manuscript (by the 31st December, 1967), it is a pleasant duty to express my sincere gratitude to Professor E. VADÁSZ, who started me off on this subject, and gave my work his attention and the bonus of his advice throughout. I re- ceived valuable help from Drs L. BARTKÓ and L. BOGSCH, both opponents of certain parts of my treatise. I am particularly indebted to Dr L. BOGSCH who initiated me in molluscan studies. Most of the work presented here was carried out at the Geo-Palaeontological Collection of the Museum of Natural History, Budapest. Mrs I. CSEPREGHY-MEZNERICS, Head of this Department, not only gave me her sympathetic support but provided me with freely given advice and also handed over some of her own unpublished collections and data; this treatise could certainly not have been published in its present extent and form without her assistance. The full treatment of the subject was achieved at the Geological Institute of Budapest University, under the guidance of Professor S. VITÁLIS.

My gratitude is further due to institutions and colleagues who contributed unstudied material, first of all valuable new drill cores or other data and observations; besides the Hungarian Geological Institute and the Hungarian Geological Prospecting and Drilling Enterprise, let me personally thank K. BALOGH, F. BARTHA, J. BODA, P. BOHN, L. GIDAI, GY.

Hegedüs, Á. Jámbor, Mrs M. Jámbor-Knesch, I. Jankovich, T. Kecskeméti, J. Kókay, G. Kopek, I. Landesz, L. Majzon, S. Mihály, Mrs Á. Nagy-Gellai, Mrs R. Nyirő, Mrs A. Oravecz-Scheffer, I. Pálfalvy, Gy. Radócz, Miss M. Sallay, Z. Siposs, L. Szeredai, Miss M. Széles, S. Szüts, K. Verebélyi and Miss A. Végh. My work was greatly facilitated by rich comparative material, information and literature, put at my disposal from abroad. For support in and advice on my ecologic studies, special thanks are due to Mr. R. H. Parker (Woods Hole, Mass., USA), Messrs O. L. Bandy, D. S. Gorsline and G. F. Jones (all of Los Angeles, California, USA) and Mr R. L. Merklin (Moscow, USSR).

For making possible the publication of this book I must thank Dr E. Szádeczky-Kardoss, Academician, and Dr J. Fülöp, Corresponding Member of the Academy. The readers of my manuscript, Dr I. Csepreghy-Meznerics and Dr B. Géczy have my sincere gratitude for their painstaking work. Dr B. Balkay was kind enough to take care of the English translation.

I am much indebted to my colleagues: Miss Mária Horváth, assistant paleontologist, for compiling the ”Index”, L. Klinda for preparing the photograps with great skill and Mrs Mária Liszka for the help in preparing the text-figures and compiling the plates.

I. THE CONCEPT OF THE UPPER OLIGOCENE

1. HISTORICAL OUTLINE

The first to recognize the presence of Upper Oligocene deposits in Hungary were **Hantken**, **Hofmann** and **Koch**, shortly after **Beyrich** in 1854 had distinguished the stage he had named the "Upper Oligocene". Following **Mayer** and **Beyrich** — who had deemed **Mayer**'s Aquitanian, established in 1857, to be at least partly contemporaneous with the Upper Oligocene — the great nineteenth-century classics of Hungarian geology identified the Upper Oligocene with the "Aquitanian". **Fuchs** (1893) upset this broad consensus by the statement, irrefutable up to this day, that the Aquitanian, younger than the North German Upper Oligocene, belongs in fact to the Lower Miocene; he proposed for the Upper Oligocene, thus left without a name, the new stage name "Chattian". The Fuchsian interpretation could have served as a durable terminological basis if, simultaneously with **Fuchs** and unaware of his ideas, **Depéret** (1892) had not introduced a third name, "Burdigalian". We must agree with **Csepreghy-Meznerics** (1962, 1964a, b) that this unfortunate historical coincidence was one of the roots of the Chattian-Aquitanian controversy.

In the twentieth century, the terms Chattian and Burdigalian gained much ground in Hungary, just as they did elsewhere in Europe. The term Chattian was used to denote the Upper Oligocene, the term Burdigalian the second — and last — stage of the Lower Miocene. The Aquitanian was regarded by most authors as the first — lower — stage of the Lower Miocene. It was this chronostratigraphic frame that the various authors tried to force upon the stratigraphic sequences of the various Oligo-Miocene basins — the result being a great deal of controversy and rather little success.

In Hungary, just as elsewhere, the authors generally agreed on the identification and succession of the larger biostratigraphic and lithostratigraphic units. The Cyrena-Pectunculus formation and the Eger formation, the formation with Anomia and large Pecten, the terrestrial and lignite seam group, and finally the sandy-schlier formation with Chlamys, units that do not lend themselves to further subdivision, exactly correspond to the terms "Melker Serie", "Eggenburger Serie", "Luschitzer Serie" and "Laaer" or "Carpathian Serie" of the terminology proposed by **Kapounek** et al. (1960), established and confirmed in both Austria and Czechoslovakia. (The expression "Serie" corresponds to the "formation" in English terminology.)

The remaining problem was invariably that of fitting these relatively well-established sequences of formations into a Chattian-Aquitanian-Burdigalian-

Helvetian frame of reference; that is, the problem was one of correlation. It was the recognition of this state of affairs that urged us towards a new departure, towards developing a local frame of reference of regional stages for the Paratethys. In an international effort initiated and coordinated by Papp (Wien) and Seneš (Bratislava), (cf. the series "Chronostratigraphie und Neostratotypen") the above-mentioned "Serien" are being described as stages under the names "Egerian", "Eggenburgian", "Ottnangian" and "Carpathian", on the basis of suitable stratotypes and accessory profiles (faciostratotypes). (For details cf. Cicha and Seneš 1968, Papp 1968, and Báldi 1968.)

For the sake of orientation, the new stage names are listed in the table below, together with earlier terminologies of certain Hungarian authors, as

	Stage	Noszky (1926)	Horusitzky (1940)	Csepreghy-Meznerics (1956)	Báldi (1958—1966)
Vindobonan Upper (II) Mediterranean	Pannonian	Pannonien	Pannonien	Pannonien	Pannonian
	Sarmatian	Sarmatien	Sarmatien	Sarmatien	Sarmatian
	Badenian	Tortonien	Tortonien	Tortonien	Tortonian
	Carpathian	Helvetien	Helvetien + Burdigalien	Helvetien	Upper Helvetian
Lower (I) Mediterranean	Ottnangian	Aquitanien + Burdigalien	Burdigalien	Helvetien	Helvetian s. s.
	Eggenburgian	Chattien	Aquitanien	Burdigalien	Burdigalian
	Egerian	Chattien	Chattien + Aquitanien	Aquitanien ("Kattien" = aquitanien)	Chattian (= Upper Oligocene)

summarized by the Paratethys Working Committee of the C.M.N.S. The need for the above-mentioned new stage names is best documented by a review of the debates which after Fuchs (1893) raged about the correlation of Oligocene-Miocene deposits in Hungary. From 1926 on, Noszky sen. placed into the Chattian besides the so-called Cyrena-Pectunculus formation, and the Törökbálint and Eger formations, constituting the subjects of the present treatise, also the Budafok formation with Anomia and large Pecten. On the other hand, Horusitzky (1941) placed the Budafok formation into the Aquitanian, that is, into the Miocene. Csepreghy-Meznerics (1951, 1953a, b) placed it into the Burdigalian; she consequently relegated to the Aquitanian, besides the Eger fauna also the "Pectunculus sand" of Törökbálint, leaving in the Chattian only the Cyrena beds (Cs.-Meznerics 1956). Today, even Cs.-Meznerics herself considers this arrangement as obsolete. At the time, however, Seneš (1956, 1961, and in Cs.-Meznerics and Seneš 1957) and also Cicha (1961) and Čtyroký (1961) placed the faunae with Pectunculus into the Aquitanian stage of the Lower Miocene, and so did Buday et al. in their comprehensive treatise, as late as 1965. Owing to the indivisibility of the Pectunculus-Cyrena formation and its continuous emergence from the Rupelian Kiscell Clay, the views of Cs.-Meznerics and Seneš have inevitably led, as their investigations gained in depth, to the full elimination of the gradually "shrinking" "Chattian" stage.

The above historical review reveals that, in Hungary, the early chronostratigraphic categories and terms (Chattian, Aquitanian, Burdigalian etc.) were used in a variety of ways to denote a variety of formations, as a natural consequence of the difficulties of correlation. These difficulties and the consequent terminological chaos could be eliminated rather simply by a succession of new, regional stages proposed for the Central Paratethys (Cicha and Seneš 1968, Papp 1968).

2. ON THE SUCCESSION OF STAGES IN THE EUROPEAN OLIGO-MIOCENE

It is necessary first of all to clarify the stage concept, in accordance with the gradually consolidating methodological principles of stratigraphy. In this respect, one cannot do better than to cite Circular No. 11, "Statement of Principles of Stratigraphic Classification and Terminology" (1960) of the International Subcommission on Stratigraphic Terminology of the International Commission on Stratigraphy (to be denoted ICS in the sequel). This circular, provided with just a few supplements since, states the term stage to mean a chronostratigraphic unit, that is, a succession of strata formed during a given span of geological time. More precisely, this signifies that the strata belonging to one and the same stage are connected — in principle — not by the similarity of their lithologic and/or palaeontological features, but solely and exclusively by the fact of deposition within a given time span. Thus — likewise in principle — stage limits not coinciding with litho- or biostratigraphic limits, i.e. cutting litho- or biostratigraphic units in two, could be envisaged. In practice, however, one encounters a fundamentally different approach. Any given span of geohistorical time, or the limits of such a span ("isochrone", "datum surfaces"), are identified on the basis of lithologic and — even more effectively — of palaeontological evidence in various regions of the world. Stage boundaries — despite being defined as datum levels separating chronostratigraphic units — have been, and still are, necessarily identified with the limits of litho- or biostratigraphic units.

In setting up a system of stages, two criteria arise: (1) geohistorical time should be subdivided into stratigraphic time units without gaps or overlaps; (2) it should be possible to identify (correlate) the geohistorical time units represented by the stages over extensive geographical areas, preferably all over the world.

The drive towards a satisfaction of these criteria makes it indispensable to introduce stratotypes as standards of geohistorical time. The above-cited ICS circular states (p. 18):
"The specific interval of geologic time which the rocks of a stage represent is defined by the time-scope of the designated type-section of that stage."

This was further emphasized in Circular No. 14, p. 8. 1964:
" . . . the scope of a Stage appears to be best defined as the rocks anywhere in the world corresponding in age to the total time-interval represented by the rocks between horizons designated as marking the top and the bottom of that Stage in its type section or stratotype."

The clockbeats of relative geohistorical time are the stratotypes; it is in terms of stratotypes that any stratigraphic unit should be defined. In defining a chronostratigraphic unit, it is expedient to start from the fauna of the stratotype. This, however, is fraught with two fundamental difficulties: (1) The lifetime of any species or of the fauna as a whole may have been longer than the time span represented by the stratotype; (2) stratotypes usually represent but a few facies. Recent faunistic analyses tend to prove that the time spans covered by the stratotypes do not by any means represent a gapless, continuous succession (cf. Seneš 1958b). This means that most of the geochronological units which together constitute a gapless subdivision of geohistorical time are longer than the stages defined by the stratotypes. This gives rise to various difficulties and inevitably introduces a subjective element in decisions on boundary problems. In an attempt to avoid this pitfall, the concept of boundary stratotype has been introduced. Still, if we wish to hold on to any pretension of rigour in our science, we cannot possibly dispense with stratotypes, the clockbeats of relative geohistorical time, notwithstanding their ambiguities. As is the case with all systems of units of measurement, the problem of setting up a system of stratotypes is a matter of international convention, and a broadbased international cooperation will be able to do much more than has been done so far in eliminating deficiencies and bridging gaps.

In what was once the basin of the North Sea lies the type designated by Beyrich of the Upper Oligocene, the "Sternberger Gestein". Its fauna (Koch and Wiechmann 1872) agrees with that of the marine sand of Kassel, regarded as the type of the Chattian, a stage name introduced by Fuchs at a later date. The Kassel stratotype, however, fills out (cf. Zöbelein 1960) but the lowermost horizon (Chatt A) of the Chattian, which was subdivided into a Chatt A, B and C on the basis of Pectinid evolution (Hubach 1957, Görges 1951, Anderson 1958a). In the uninterrupted profile of the Doberg near Bünde, it is apparent that the Chattian fauna of Kasselian type persisted into the higher horizons of the Chattian (Chatt B and C). The first important faunal change upwards is apparent in the strata of the Vierlandian stage, emerging in continuity from the "Chatt C" in the Lower Elbe region. Novel, Neogene types make up about 30 percent of its fauna (Sorgenfrei 1940, Anderson 1958b).

The Neogene elements do not yet exceed 10 to 20 percent in the Upper Oligocene of Kassel and of Belgium, according to Görges (1952) and Glibert (1957). This striking change in faunal composition had already been recognized by Beyrich himself; this was his main reason for drawing here the upper limit of the Oligocene. Anderson (1961) is right in pointing out that, by definition, the Oligocene-Miocene limit lies between the Chattian and Vierlandian. According to Anderson (1960) as well as to earlier statements by Gripp (1914) and Sorgenfrei (1940), the Vierlandian is probably contemporaneous with the Aquitanian. The term Upper Oligocene denotes, then, the time between the end of the Rupelian and the beginning of the Vierlandian; it is thus justified to call Upper Oligocene any deposit which demonstrably formed during this time span. The Kassel stratotype would represent a much narrower chronostratigraphic interval; but the Upper Oligocene as defined above should agree by and large with the Upper ("Late") Oligocene in the geochronological sense, because in the Lower Elbe region there is a continuous succession of strata from the Rupelian through the Chattian into the Vierlandian (Anderson 1960).

Another important region where stratotypes have been described is Southwestern France, useful for a definition of the Lower Miocene.

The calcaire grossier à Astérias of the Aquitanian Basin has for the last century been regarded as contemporaneous with the Middle Oligocene (Gaas) fauna of the Adour Basin. Even the latest investigations (Alvinerie et al. 1964) have led to the conclusion that, in the Aquitanian Basin, the Upper Oligocene is either a hiatus or is inseparable from the Rupelian. The situation is different in the Adour Basin. Controversy has lately flared up there about the terms Peyrère formation (Csepreghy-Meznerics 1964c), "couches de Bélus" (Poignant 1964) and "Escornebéou formation" (Szőts et al. 1964) which designate essentially the same marls with molluscs and Lepidocyclina.

As early as 1917, Dollfuss considered these, on the basis of their Pectens, to be older than the Aquitanian type profile of the Aquitanian Basin, and consequently placed them into the Chattian stage of the Upper Oligocene. At the conclusion of his huge Mollusc monograph, Peyrot (1933) finally also placed the Peyrère fauna into the Upper Oligocene. Drooger et al. (1955) drew the same inference from the Miogypsinids found in these strata. At the conclusion of a statistical analysis, Csepreghy-Meznerics (1964c) writes:

". . . la faune de Peyrère (et autres) a un caractère tout à fait différent de celles du Bordelais et du Bazadais. Elle est en effet plus âgée que la faune de ces derniers gisements."

Incidentally, even at an earlier date, Csepreghy-Meznerics (1962) proposed this locality for a neostratotype. According to Szőts et al. (l.c.), the Escornebéou formation; of a thickness exceeding 200 m,

". . . occupent nettement une position intermédiaire entre les calcaires à Astérias et les niveaux de l'Aquitanien-Burdigalien de Saucats-Cestas. Elles représentent le sommet de l'Oligocène."

Hence Eames et al. (1962) are virtually alone in regarding the Bélus strata as Aquitanian, and so is Poignant (1964), who wishes to draw the Oligocene-Miocene limit within this formation. Lack of space forbids to go into details of the somewhat stormy argument among Szőts, Eames et al.,and Drooger. With the only exception of Cox (in Eames et al. 1962), all malacologists unanimously consider the Bélus-Peyrère strata to be Upper Oligocene; this is the standpoint which I have adopted myself in my stratigraphic considerations.

A great majority of invertebrate palaeontologists consider the strata denoted as Aquitanian by Mayer (1857) to represent the beginning of the Miocene in the Aquitanian basin. Mayer's type profile is exposed in the bed of a stream between Saucats and La Brède (" . . . der Rinne des Baches von Saucats und La Brède", Mayer 1857, p.192). Underlying the Aquitanian strata numbered 1 through 7 by Mayer there is a grey limestone with *Ampullina crassatina* (held to be Asterias limestone by Dollfus in 1909). Strata 1 to 7 are in turn overlain by the "couches à Pectens" and the "faluns bleu de Saucats et jaune de Léognan" (strata 8. and 9.) placed by Mayer into the "Mainzische Stufe" succeeding the "Aquitanische Stufe". Later on, Depéret (1892) designated the faluns of Saucats and Léognan as the type of the Burdigalian. One of the sources of all subsequent controversy was that Mayer had designated the type of his Aquitanian stage on the basis of an inadequately known fauna, overemphasizing its very sparse Oligocene elements. The monograph of Cossmann and Peyrot, based on collections more complete even than those of Dollfus (1909) demonstrated beyond doubt the lack of any significant difference in molluscan assemblages between the faluns of Saucats and Léognan on the one hand and the strata underlying them, on the other. This fact has already been exploited by Csepreghy-Meznerics in her latest publications. Besides the similarity in the mollusc faunae, let us emphasize Kaasschieter's statement concerning the small foraminifers: "Nearly all of them were found both in Aquitanian and Burdigalian deposits" (Kaasschieter in Drooger et al. 1955, p.51). Drooger himself writes (ibid., p.48): "The fauna of smaller Foraminifera is so homogeneous throughout . . . that it cannot be used to support any point of view." It would be wrong to attribute too great a significance to unconformities and small hiatuses in a basin-border facies like the Lower Miocene of La Brède. Towards the basin interior, all traces of diastrophic events disappear: it was this circumstance that prompted Vigneaux and his co-workers years ago to contract the Aquitanian and Burdigalian into a stage named "Girundian" (Vigneaux et al. 1954, Gripp and Magne 1956).

We may, then, conclude that the strata of Bélus-Escornebéou-Peyrère in Southern France correspond in all probability to the North German Chattian, that is, to the Upper Oligocene. In the faunae of those strata, Miocene species make up no more than 8 percent (Peyrot 1933), and quite a few of the numerous so-called endemic species have — as far as can be judged from the figures of Cossmann and Peyrot — well-known close relations in the Upper Oligocene of the Boreal province or of the Paratethys. The similarity would therefore emerge much more strikingly, if one were to disregard the exaggerated refinements of Cossmann and Peyrot's systematic subdivision. Both the molluscs and the small foraminifers prove the Lower Miocene to be a single, indivisible stage, comprising both Mayer's Aquitanian and Depéret's Burdigalian. Oligocene elements occurring to the tune of a few percent cannot refute their Miocene age. On the basis of the Miogypsinids, Drooger (in Drooger et al. 1955, 1960) could distinguish four horizons within the Lower Miocene of this region. The Miogypsinids would, then, be suited for a distinction of the two stages (Aquitanian and Burdigalian), but attempts to transfer this distinction to other regions are frustrated by the limited geographical spread of the Miogypsinids. Recent studies by Jenkins (1966) seem to prove the possibility of separating the Aquitanian from the Burdigalian and, indeed, of a finer subdivision of both stages, on the basis of planktonic Foraminifera.

Another region of fundamental significance for Oligo-Miocene boundary problems is Northern Italy. As this region includes no stratotypes relevant to this boundary (except for the Bormidian stage, recently resuscitated by Blow and Smout), the Oligo-Miocene limit is, here too, a question of correlation rather than of definition. Both its abundance of fossils and the state of its examination, most advanced anywhere within the Mediterranean province (Tethys), suggest this region for a basis of correlation with other regions. The formations involved in this correlation include the Schio strata and the deposits known by the name of "Glauconie delli Bellunesi" extending from Lake Garda right down to Friaul; the latter are considered to represent the highest horizon of the Oligocene. These strata include glauconitic molluscan sandstone, limestone with Lepidocyclina and echinids, and marls with Pecten. Whereas some authors were inclined to place the top of the Schio strata, on the basis of the Miocene species in them, into the Lower Miocene (Aquitanian), in the case of Bellardi and Sacco's Ligurian "Tongriano" all that can be discussed is whether it represents an older or a younger Oligocene. Both the malacological studies and the Miogypsinid investigations suggest that part of the "Elveziano" belongs to the Lower Miocene (contemporaneous with the Burdigalian of SW-France), and so does most of the "Aquitaniano". According to Lorenz (1962 and an oral communication), Sacco's "Tongriano" is simply the transgressive basal formation of the Oligocene, whose transgression went on from the Lattorfian to the end of the Chattian. Hence, Cassinelle alone would represent the Chattian, whereas Sassello, Dego, Carcare, etc. would correspond to older Oligocene stages.

3. ON THE UPPER OLIGOCENE OF THE PARATETHYS

As the definition of a stage is an operation involving reference to a type, the drawing of the Oligo-Miocene boundary is, also in the Paratethys region, a matter of correlation rather than of definition — at least in principle. This correlation — to be carried out, under the circumstances of the case, between faraway basins rather thoroughly isolated from one another — must of necessity be based on biostratigraphic considerations.

The stratotype of the Chattian contains 10 to 20 percent Miocene species; hence in the Upper Oligocene of the Paratethys, the percentage of Miocene spacies must not exceed this value. The oldest Paratethyan stratigraphic unit to be regarded as already Miocene by a vast majority of authors, the unit to be called the "Eggenburgian" under the above-outlined program, contains at least 30 percent Miocene elements. (Eggenburger Serie, Kaltenbachgraben, Vág Valley, the large-Pecten strata of Budafok and Salgótarján, Coruş = Korod, etc.) This is in a fair agreement with the Miocene percentages in the Vierlandian, overlying the stratotype of the Chattian and regarded as Aquitanian, as well as in the type profiles of the Aquitanian and Burdigalian in Southwestern France. Any fauna containing more than 50 percent Miocene elements among the *stratigraphically diagnostic* species will be regarded as Lower Miocene.

The number of Neogene species tends to increase as the number of Palaeogene species decreases; in our experience, as soon as the Miocene elements attain 15 to 20 percent, the percentage of Palaeogene species in the fauna drops to a roughly equal value, the rest of the fauna being composed of persistent or endemic forms. These are the "borderline cases", in which the Oligocene and Miocene forms occur in relative abundances of 50—50 percent.

We cannot agree with the view that the advent of new forms necessarily heralds a new era. To assert the converse, e.g. that the Oligocene did not end until all Oligocene forms became extinct, would be just as absurd. From this viewpoint, it would depend purely on the researcher's subjective whim where he would draw the limit of a stratigraphic unit within the long period between the rise of the first "new" and the fall of the last "old" species. It is in order to keep the subjective elements of judgement within bounds that one accepts the yardsticks of stratotypes and the mathematical consideration that, if a fauna contains new and old species in equal proportions, it may be placed with equal right into either the older or the younger stratigraphic unit, that is, it lies just on the border between them. A predominance of Oligocene elements must entail a place in the Upper Oligocene; a preponderance of Miocene ones, a place in the Lower Miocene.

The lower limit of the Upper Oligocene is less of a problem. A large number of ancient, Palaeogene forms had disappeared by the end of the Middle Oligocene, to be replaced by new, Upper Oligocene species. Some of the latter were restricted to the Upper Oligocene proper; others persisted into the Miocene.

4. DEFINITION OF THE TERMS "OLIGOCENE" AND "MIOCENE SPECIES"

These definitions are readily derived from the above conclusions.

Those species are regarded as *Oligocene* which, in the North Sea basin, do not reach higher than the Kassel or Doberg strata or some other contemporaneous deposit (cf. ANDERSON's summary 1961) or whose life span ends in the Bélus-Escornebéou-Peyrère strata in Southwest France, or in the Tongriano, or the Belluno or Schio strata in Northern Italy.

Those species are *Miocene* which do not occur before the Boreal Vierlandian, the Atlantic Lower Miocene (Aquitanian plus Burdigalian), or the

Mediterranean "Aquitaniano", "Elveziano" or "Langhiano". In the Paratethys, Miocene species first arise in the oldest formations generally acknowledged as Miocene, i.e. in the Eggenburgian, or in the Southern Soviet Sakaraul horizon.

Those species are *persistent* whose life spans overlap the Oligocene-Miocene boundary thus defined. There are various degrees of *endemicity* in fossils. In a broader sense of the term, all species are endemic which are restricted in time and space to the Upper Oligocene of the Paratethys (the "Egerian"), i.e. to the faunae of Bad Tölz and Kováčov, to the "Melker Serie", and the South Russian Baygubek horizon (Merklin 1962). In a narrower sense of the term, we may call endemic those species which occur in the Hungarian Upper Oligocene only.

5. ON THE USE OF THE TERMS 'CHATTIAN', 'AQUITANIAN' AND 'BURDIGALIAN'

The meanings of these terms have been clarified above. It has been pointed out that these stages form a temporal sequence without hiatuses or overlaps. Both by definition and by biostratigraphic inference, the Oligo-Miocene boundary is to be drawn between the Chattian and the Aquitanian. Investigations over the last few years into planktonic Foraminifera have further led to the crystallization of the view that the Oligocene-Miocene boundary can be characterized in terms of the Globigerinoides datum level (Fourth Mediterranean Neogene Congress, Bologna 1967). It seems, however, that the Aquitanian and Burdigalian are hard to delimit even in the type area, in the Aquitanian Basin. Thus we cannot but welcome the proposal of the Bologna Congress that the Aquitanian and Burdigalian be subsumed under a single superstage, the Girundian of Vigneaux et al. (1954).

One should now raise the question whether the above stratigraphic sequence (Chattian, Aquitanian, Burdigalian) can, given our present tools of correlation, constitute a frame of reference for the stratigraphic successions of the Central Paratethys. Molluscan studies tend to consolidate the opinion, most consistently voiced by Csepreghy-Meznerics, that within the Central Paratethys only two units can be distinguished as opposed to the threefold Chattian-Aquitanian-Burdigalian subdivision of certain other regions. Hence, in the present author's opinion, the broad international acceptance of the term Girundian (= Aquitanian + Burdigalian) should be most welcome, because this superstage more or less closely corresponds in time to that Paratethyan time unit for which the name Eggenburgian has been proposed and concerning whose Miocene age there is a broad consensus.

One of the aims of the present work is to prove that strata contemporaneous with the Chattian per definition and underlying the Eggenburgian ($\sim$ Girundian) are widespread and identifiable in Hungary and the Central Paratethys. This Paratethyan stratigraphic unit, by and large contemporaneous in my opinion with the Chattian stage, would receive in the new regional sequence of stages discussed above the name Egerian, with the Eger profile, to be described in some detail also in the present book, as its stratotype. The most recent studies on planktonic Foraminifera suggest the Egerian to lie below the Globigerinoides datum level. Consequently, in the present writer's opinion, the newly described stages of the Paratethys stand in the following relations to the "standard" European stages: The Egerian largely corresponds to the Chattian; the Eggenburgian more or less covers the Girundian, which latter is essentially the same as the Aquitanian plus Burdigalian. The Oligocene-Miocene limit should be drawn accordingly between the Egerian and the Eggenburgian.

Let us point out that the Egerian-Eggenburgian limit was defined by means of the first appearance of Loibersdorf-type faunae by CICHA and SENEŠ (1968) and PAPP (1968). Hence, they place the Bretka strata still into the Egerian, with the designation "Upper Egerian". Since, however, these strata have yielded *Miogypsina gunteri* in the neighbourhood of Bretka (PAPP 1958), the Oligo-Miocene limit should, by the above considerations, lie within the Egerian. Be that as it may, the horizon corresponding to the Bretka strata (that is, to the Aquitanian) will not be considered in the present work.

In the geochronological sense, the mollusc faunae to be discussed here lived in the Late Oligocene. It was precisely the chaos in the use and the temporary vagueness concerning the stage names, as well as the divergences of opinion concerning questions of correlation and the fermentation of the entire system of Neogene chronostratigraphy, that prompted me to give my treatise a title containing the rather "open" term Upper Oligocene, with its more geochronological connotations.

II. GEOLOGY

Hungary occupies part of the so-called Carpathian Basin, one of the basins embraced by the Alpine-Carpathian mountain chains. Most of today's Hungarian territory is covered by young (Pliocene-Quaternary) deposits (the Great Plains, the Little Plain, the Pannonian Basin), underlain by basements of crystalline schists and Mesozoic rocks of Alpine-Carpathian type. The western part of the country, called Transdanubia, is traversed by the Transdanubian Mountains, a chain of largely Mesozoic fault blocks (Bakony, Vértes, Gerecse, Pilis and the Buda Mountains). The Northern Mountains in the north of the eastern half on the country (Börzsöny, Cserhát, Mátra, Bükk and the Tokaj Mountains) largely consist of Miocene volcanics (andesites) and Oligo-Miocene deposits, and to a lesser extent of Triassic rocks.

The Upper Oligocene deposits of Hungary occur in basins and grabens intercalated between the fault blocks of the Transdanubian Mountains and in spots of larger areal extent in the Northern Mountains. All these local occurrences fall within an area about 300 km long and 50 to 100 km wide, in which the Upper Oligocene can be traced on the surface and in boreholes despite numerous gaps due to subsequent erosion and structural displacements.

Owing to the considerable variety of Upper Oligocene deposits and mollusc faunae, even a general review must give an account of regional differences. In the following, the field relations, the lithologic and macrofaunistic features of the Upper Oligocene deposits will be described according to palaeogeographical units. The latter (Fig. 1) were distinguished and delimited on the basis of a detailed palaeoecologic analysis of mollusc faunae (Ch. III). At the localities of any palaeogeographical unit, the various facies are arranged in similar vertical successions; that is, the palaeogeographical units are more or less homogeneous facially. The boundaries of the units are, of course, indistinct more often than not.

The palaeoecologic analysis of the macrofaunae (Ch. III) gave rise to the following main palaeogeographical units within the Hungarian Upper Oligocene.

1. Bakony; Terrestrial and limnic faunae.
2. Vértes — Gerecse; Predominantly brackwater deposits with "Cyrena", with intercalated limnic and neritic deposits.
3. Pilis—Western Cserhát; Predominantly shallow sublittoral deposits with "Pectunculus", with brackish "Cyrena-Cerithium" and littoral interbeddings.

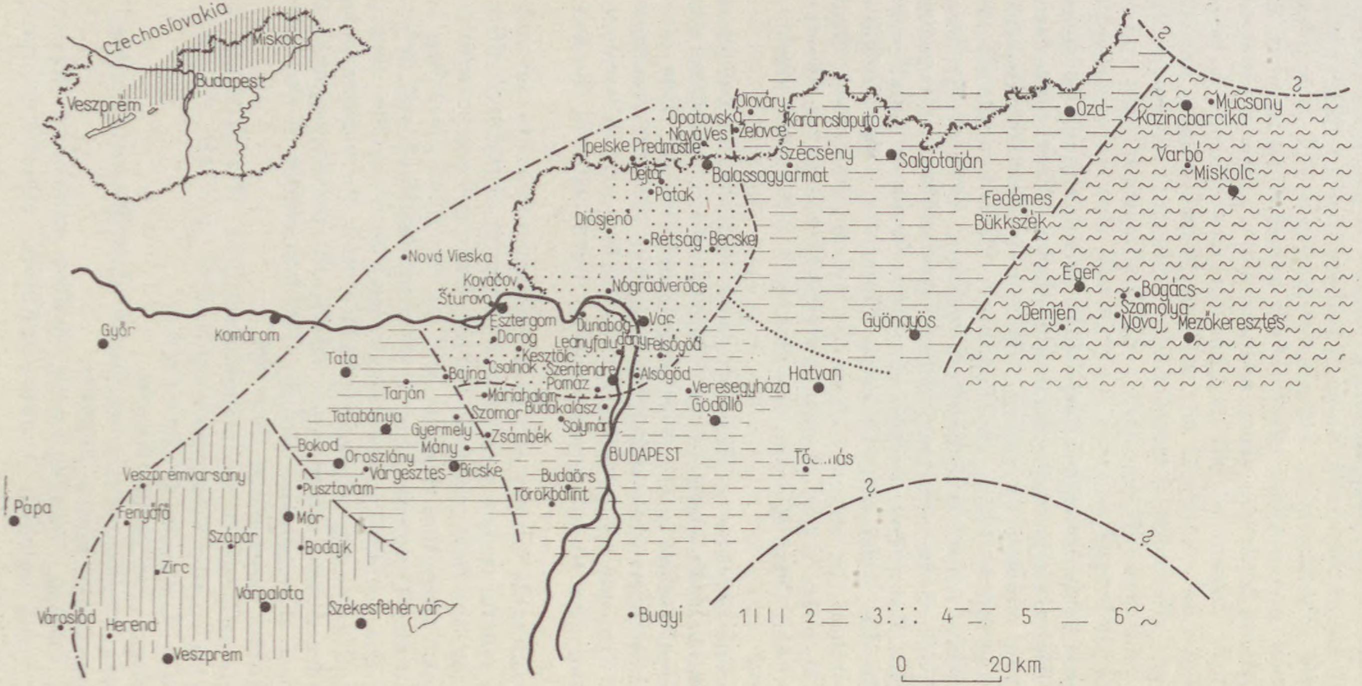


Fig. 1. Subdivision of the Hungarian Upper Oligocene sedimentary basin. Legend: 1. Bakony region (*Viviparus-Brotia* community, exclusive freshwater — oligohaline deposits). 2. Vértes—Gerecse region (dominantly mesohaline lagoon communities with freshwater and shallow sublittoral intercalations). 3. Pilis—Western-Cserhát region (dominantly shallow sublittoral communities with littoral — lagoon and medium-depth sublittoral intercalations). 4. Environs of Budapest (dominantly medium-depth sublittoral communities with shallow sublittoral intercalations, and littoral and lagoon deposits in the top and bottom portions of the successions). 5. Eastern-Cserhát—Ózd Basin region (a little known facies of the basin interior). 6. Eger—Sajó Valley region (deep sublittoral — shallow bathyal at the bottom of the successions; shallow sublittoral and then lagoon — littoral farther up)

4. The Budapest region; Predominantly medium-depth sublittoral deposits; shallow sublittoral interbeddings with "Pectunculus".

5. East Cserhát, Ózd Basin; Little known medium-depth and possibly deep sublittoral deposits of the basin interior.

6. Eger, the Sajó Valley; Marine facies (deep sublittoral and shallower marine faunae) overlain by "Cyrena-Cerithium" beds.

1. BAKONY

Boundaries: roughly the Csákberény—Pusztavám line in the east, the Veszprémvarsány—Városlőd line in west; the southern and northern borders are even more vague.

Literature on the Upper Oligocene of this region is scanty. I. Vitális (1939) gave a comprehensive description of the Szápár brown coal seams; Vadász (1960) gave a good concise description of the Bakony Oligocene, listing also Sümeghy's (1926) Környe-Bodajk fauna. A new survey of the Bakony over the last few years gave the opportunity for an entirely new departure; largely unpublished recent work by Bohn, Jámbor and Korpás was based on copious new evidence on the Bakony Oligocene.

The Upper Oligocene of this region includes silty clay marl, medium-grained biotitic sandstone, conglomerates with clayey and/or calcareous matrix and mottled clays. According to Bohn (1966), the presence of reworked volcanic tuffs is typical. He states that about half of the pebbles in the conglomerates have come from Mesozoic and Eocene limestones, 34 to 45 percent from metamorphic rocks and 10 to 20 percent from Eocene andesite. Along a line joining Dudar, Csetény, Jásd, Szápár, Balinka and Mór, the lower part of the Upper Oligocene includes a brown coal seam complex.

According to drill cores from the boreholes Mór 4, 5, 6, conglomerates occur as interbeddings in the bottom part of the sequence, together with stringers and thin seams of brown coal, corresponding in stratigraphic position to the Szápár seam. Most of the sequence consists of very fine clayey silt and clay, with intercalated beds of biotitic sandstone. The borehole Csatka 1 reveals a similar succession. In the Sur and Dudar boreholes, on the other hand, conglomerates are more abundant, making up about half of the succession.

The Upper Oligocene unconformably overlies the Eocene or the Mesozoic; it is often overlain by nothing but the Pleistocene. Its thickness varies from 40 to 400 metres according to Bohn; but in the borehole Csatka 1 it attains 800 m. It should be emphasized here that the Upper Oligocene age of this entire succession of rather uniform limnic-terrestrial deposits has not been firmly established so far. The upper part of the succession may in some profiles be already Miocene, related to the "gravel with silicified tree trunk fragments of the High Bakony", which was placed into the Helvetian by Vadász (1960). For instance, in the borehole Csatka 1, typical Upper Oligocene limnic-terrestrial faunae are restricted to the depth interval from 460 to 800 m. On the other hand, gravels are not absent from well-documented Upper Oligocene successions, either, which shows that some of the "gravels with tree trunk" belong to this older part of the sequence.

The mollusc fauna of the Upper Oligocene consists exclusively of fresh-water — oligohaline and terrestrial (air-breathing) species (*Viviparus ventricosus*, *Brotia escheri*, *Sphaerium* sp., *Unio inaequiradiatus*, *Pomatias antiquum*, represented by shells and opercula, as well as pulmonate gastropods now under detailed study, including *Coretus*, *Radix*, *Archaeozonites*, *Oestophora*, *Caracollina*, *Triptychia*, *Tropidomphalus*, *Parachlorea*, *Strophostoma*). Only in the neighborhood of the Mór Graben, in the area bordering on the ancient seashore (Pusztavám, Bodajk) will one encounter local mesohaline interbeddings with "*Cyrena*" in the uniform limnic-terrestrial succession. In the Vértes—Gerecse region, the "Cyrena" strata contain intercalated beds with *Brotia* and *Viviparus* with a characteristic Bakony-type fauna. The contemporaneity of the stratigraphic successions in the two regions can thus be regarded as established (Báldi 1965, 1967). As the Cyrena beds are to be considered Upper Oligocene in the Vértes—Gerecse region, — proof will be adduced later on, — this fixes also the age of the limnic-terrestrial sequence of the Bakony region in the Upper Oligocene.

Further arguments for placing most of this succession, or indeed all of it in certain profiles, into the Upper Oligocene include (1) the presence of *Unio inaequiradiatus*, and especially of *Pomatias antiquum*, which is according to Zöbelein (1952) an index fossil of the Chattian; (2) some of the Pulmonates are known from the early Chattian on; others died out at the end of the Chattian; (3) the biotite content, so characteristic of the Upper Oligocene up to Dorog; (4) the complete absence of rhyolite tuff interbeddings. The presence of silicified trunk remains of plane trees is irrelevant to the decision of an Oligocene or Miocene age. The terrestrial mammal remains (*Anthracotherium*, a jawbone found in borehole Mór 6) indicate an Oligocene age.

The Upper Oligocene of the Bakony region might include the limnic-terrestrial "Szolimán Hill conglomerates" of the Herend Basin, a terrestrial, predominantly gravelly deposit with biotitic sands; its Upper Oligocene age was inferred by Kókay (1966) from palynological evidence and lithologic analogies.

2. THE VÉRTES—GERECSE REGION

This region is bounded by the Pusztavám—Csákberény line in the southwest, by the supposed boundary of the sedimentation area (Fig. 1) in the northwest, and by a line joining Bajna, Máriahalom and Zsámbék in the northeast. It includes the Oligocene deposits discussed by Vadász (1960) under the titles "Basins in and south of the Gerecse Mountains", "The Vértes Mountains and the Tatabánya Basin" and partly those described under "The western Palaeo-Neogene cover formations of the Vértes Hills".

The significant data concerning this region can be found in HANTKEN (1861, 1865), LIFFA (1906, 1907), TAEGER (1909—10), TELEGDI-ROTH (1923, 1925, 1927), FERENCZI (1925), VADÁSZ (1940, 1960), JASKÓ (1939, 1943, 1957a, 1957b), ISTVÁN VITÁLIS (1948), SÓLYOM (1953), LANDESZ (1961, 1965), GYÖRGY VITÁLIS (1962) and ORAVECZ-SCHEFFER (1963).

Most of my own observations have already been published in a summary form (BÁLDI 1965, 1967). The Upper Oligocene age of the deposits in question is generally accepted. Observations concerning the stratigraphic positions of the individual facies within the succession have, however, been differently interpreted by the various authors. LIFFA and TAEGER wrote about Pectunculus beds overlying Cyrena beds. On the other hand, JASKÓ and others observed interfingerings of the various facies.

Prospecting for brown coal in 1959—60 in the Nagyegyháza Basin and more recently in the Mány—Zsámbék Basin gave a welcome opportunity to study the Oligocene of these areas. From more than 550 cores of 33 boreholes I could recover and study a macrofauna of 87 species, some of them in relatively good preservation (Columns 2 to 8 of Table I).

The only macrofauna to be yielded by an exposure was collected from a road cut in the Calvary Hill of Tarján (Tarján-1). Here a medium-bedded, somewhat shaly clayey sandstone is overlain by a friable coarse sandstone with clay lenticles. This sandstone contain pockets of washed-together fossils of the *Polymesoda-Tympanotonus* and *Glycymeris latiradiata* communities. (Bryozoa, *Glycymeris latiradiata* s. l., *Ostrea cyathula*, *Polymesoda convexa*, *Laevicardium tenuisulcatum*, *Pitar polytropa*, *Melanopsis impressa hantkeni*, *Tympanotonus margaritaceus*, *Polinices catena* s. l., *Globularia* sp.)

For the boreholes, I have adopted the numbering of the Hungarian Geological Exploration and Drilling Enterprise (cf. BÁLDI 1967).

In evaluating the available evidence, boreholes rich in macrofossils were given greater weight. In four profiles, more than 50 percent of the succession traversed yielded macrofossils, and in seven more this proportion varied from 30 to 50 percent.

The Oligocene in the region under consideration is 100 to 500 m thick, ranging from 200 to 300 m over most of the region. It unconformably overlies various pre-Oligocene formations (Triassic, Eocene) and is unconformably overlain by the Miocene (Upper Badenian, Lower Sarmatian, or a probably Middle Miocene terrestrial complex 50 to 100 m thick) or the Pleistocene. The variations in the thickness of the Oligocene should in our opinion be attributed to a pre-Badenian denudation, which was responsible also for the yellow colour (limonitic weathering) of the topmost Oligocene beds.

The Oligocene deposits are largely silty, friable fine-grained sandstones, clayey silts, silty clays, more seldom clays, coarse sandstones locally with pebbles, and harder calcareous sandstones; these latter are (according to an oral communication by J. BODA) typical of the bottom strata of the Upper Oligocene, which is understandable in view of the dominantly calcareous nature of the Eocene-Triassic rocks by which they are underlain (but is by no means an indication of a Rupelian age!). The abundance of biotite, derived from eroded Upper Eocene volcanics, is typical. VADÁSZ (1960) states "quartz and the dark minerals" to come "undoubtedly from the ancient crystalline basement of the northern, northwestern foreland (the Little Plain area), whereas the biotite is of a presumably volcanic origin". (p. 230) Some beds are rich in coalified plant remains. Richer accumulations of these may constitute brown coal stringers and lenses whose thickness usually ranges from 2 to 30 cm according to I. VITÁLIS (1948). Only in a single case has a seam 1.20 m thick been traversed.

As regards the chronostratigraphic position of this succession, in an earlier paper (BÁLDI 1965) I could not yet exclude the possibility of some nearshore facies of the Rupelian Kiscell Clay being represented in the lower parts of the succession. A wealth of more recent evidence has, however, proved beyond doubt that the Oligocene of the Vértes—Gerecse region is Upper Oligocene (Egerian) in its entirety; even the lowermost horizons contain fossils encountered nowhere in strata older than Upper Oligocene of other regions (e.g. *Mytilus aquitanicus, Pitar undata, Arcopagia subelegans, Angulus planatus ancestralis, Ocinebrina crassilabiata trivaricosa*, etc.).

Remarkably, in the eastern part of the Mány—Zsámbék Basin, part of which belongs to the Budapest region — in the Zsámbék—Szomor—Máriahalom area — macrofaunal assemblages turning up in identical successions in a number of boreholes have permitted a finer subdivision of the Upper Oligocene (cf. BÁLDI 1967). Of course, the boundaries of these horizons do not constitute perfect isochrones, but they undoubtedly provide a stratigraphic orientation within the succession. In the profiles at Mány and Gyermely, immediately to the west of the said area, these horizons cannot, however, be traced any more. Their correlative value is thus restricted to this rather small area, and even a correlation with the Solymár succession would be highly doubtful. I have recently given a detailed description of these horizons (BÁLDI 1967), so that it will be sufficient to give a brief summary here.

1. At the bottom there is a "lower Polymesoda (= Cyrena) horizon", characterized by the dominance of *Polymesoda-Tympanotonus* communities ("P_5"). In most profiles, there is a limnic-terrestrial intercalation with a *Brotia-Viviparus* community.

2. Next follows the "Diplodonta horizon" characterized especially in its lower portion by an excessive abundance of *Taras (= Diplodonta) rotundatus*. Further frequent fossils include *Pitar polytropa, Cardium bojorum* and *Turritella venus*. Around Tök and Zsámbék, the aggregate thickness of the lagoon and littoral deposits marked "P_5" exceeds that of the sublittoral deposits within this horizon. In the most open part of the basin, which reaches over into the Budapest region, the shallow sublittoral facies is prevalent.

3. "Angulus horizon". It is hard to designate any "index fossil" within this colourful faunal assemblage. *Angulus* seems to be most abundant. The dominant facies is shallow sublittoral, with, however, some thinner and thicker lagoon-facies interbeddings ("P_2"). At the base of the hori-

zon there invariably occurs a very persistent Cyrena bed marked "P_3" of 3 to 10 m thickness.

4. At the top, there is the "Incomparabilis horizon" characterized by the ubiquity, without any remarkable abundance, of *Chlamys incomparabilis*. Further frequent fossils of this horizon are: *Laevicardium cyprium, Cardium heeri, Cardita orbicularis subparvocostata, Astarte gracilis degrangei, Dentalium*, bryozoids, *Schizaster*. The medium-deep sublittoral facies is almost exclusive: its features suggest the designation "schlier" ("Chattian schlier"!). The resemblance of this horizon to the Upper Oligocene of Törökbálint and Solymár is remarkable.

As regards its facies, the Vértes—Gerecse region is rather colourful. From the fresh-water oligohaline to the medium-depth sublittoral, one may encounter almost every fossil community. The horizontal and vertical extents of the communities are illustrated in Figs 2 and 3.

A study of the horizontal extent of the fossil communities reveals the aggregate thickness of the brackwater ("Cyrena") deposits of lagoon and littoral facies to decrease eastward, compensated by a corresponding increase in the thickness of the sublittoral strata; that is, the marine deposits grow thicker eastward at the expense of the "Cyrena" and "Cerithium" beds. West of Mány and near Vasztély and Gyermely, deposits of lagoon and littoral facies make up more than 60 percent of the aggregate thickness of all fossil-bearing layers, whereas this proportion is no more than 20 percent near Zsámbék and Máriahalom. Only a small area south of Tök refuses to be fitted into this general pattern.

The eastward-increasing "marinity" of the Upper Oligocene facies has already been emphasized by VADÁSZ (1960). I could confirm this statement on the basis of my own observations in the Dunazug Mountains (BÁLDI 1965). In Fig. 2 I have plotted for comparison also one of the Budapest region profiles (Solymár 72). It is characterized by the prevalence of a medium-depth sublittoral facies. East of the Máriahalom—Zsámbék line, the decreasing thickness of the Cyrena beds is compensated by a thickening not only of the shallow but also of the medium-depth sublittoral facies. This palaeogeographical transition towards the prevalently medium-depth sublittoral Upper Oligocene formation of Solymár and Törökbálint (Budapest region) is convincingly illustrated. This is why we have drawn the boundary between the Vértes—Gerecse and the Budapest regions across the middle of the Mány—Zsámbék Basin, along the Máriahalom—Zsámbék line.

In summary, whereas in the Vértes—Gerecse region the lagoon-facies Polymesoda-Tympanotonus community and the littoral assemblages together make up 40 to 60 percent of the aggregate thickness of the fossil-bearing layers, the beds with shallow sublittoral communities provide only 20 to 40 percent, and those with a *Viviparus-Brotia* community 10 to 30 percent of the aggregate thickness. On the other hand, in the Máriahalom boreholes, which may be included in the Budapest region, these proportions are substantially different (cf. Ch. II.3). The dominant facies of the Vértes—Gerecse region is of the lagoon type, with a Polymesoda-Tympanotonus community.

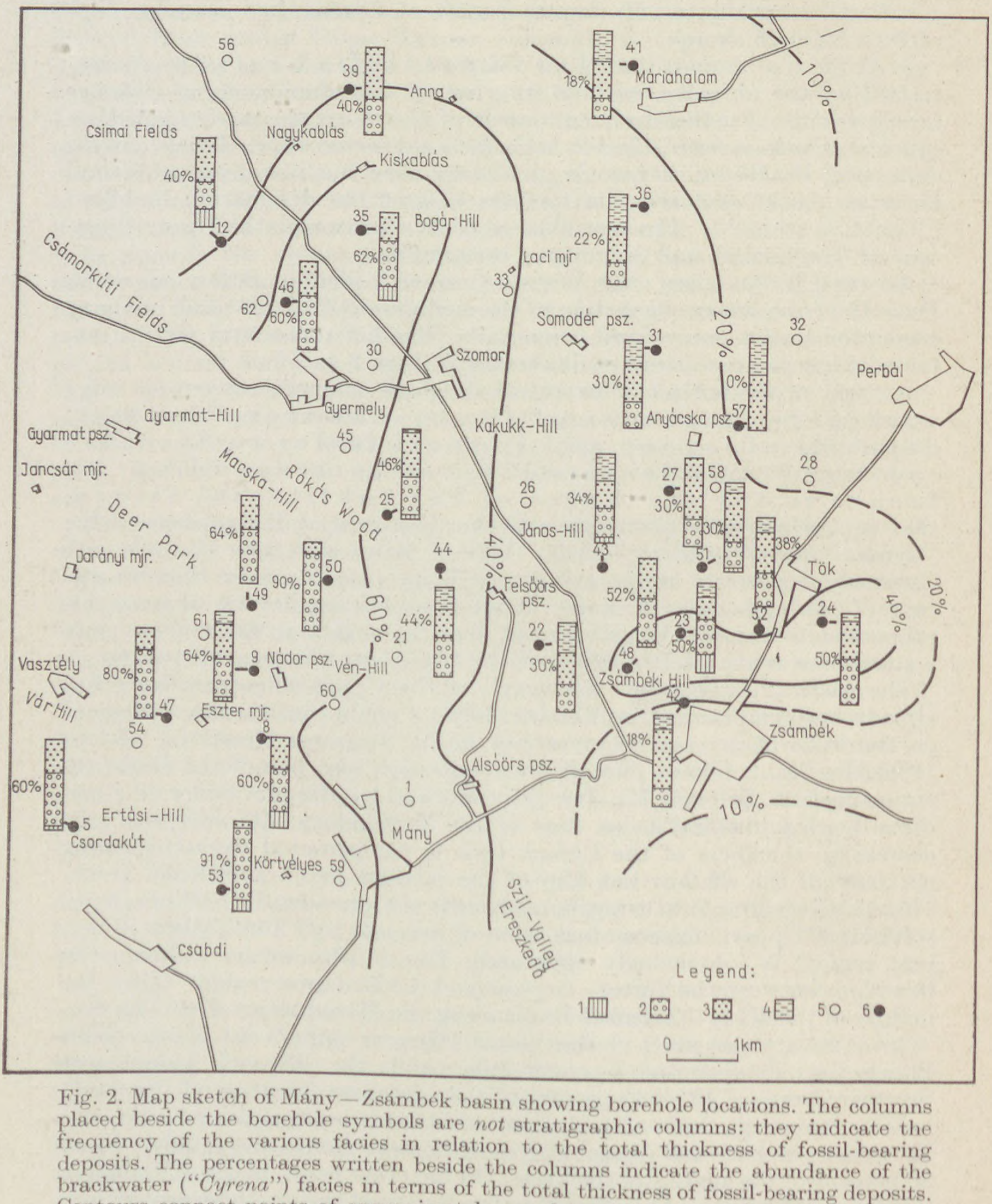


Fig. 2. Map sketch of Mány—Zsámbék basin showing borehole locations. The columns placed beside the borehole symbols are *not* stratigraphic columns: they indicate the frequency of the various facies in relation to the total thickness of fossil-bearing deposits. The percentages written beside the columns indicate the abundance of the brackwater ("*Cyrena*") facies in terms of the total thickness of fossil-bearing deposits. Contours connect points of approximately equal total thickness of the *Cyrena* beds. Legend: 1. Freshwater (lagoon). 2. Brackwater (lagoon and littoral). 3. Shallow sublittoral. 4. Medium-depth sublittoral. 5. Borehole not investigated by the author. 6. Borehole whose Oligocene macrofauna has been examined by the author

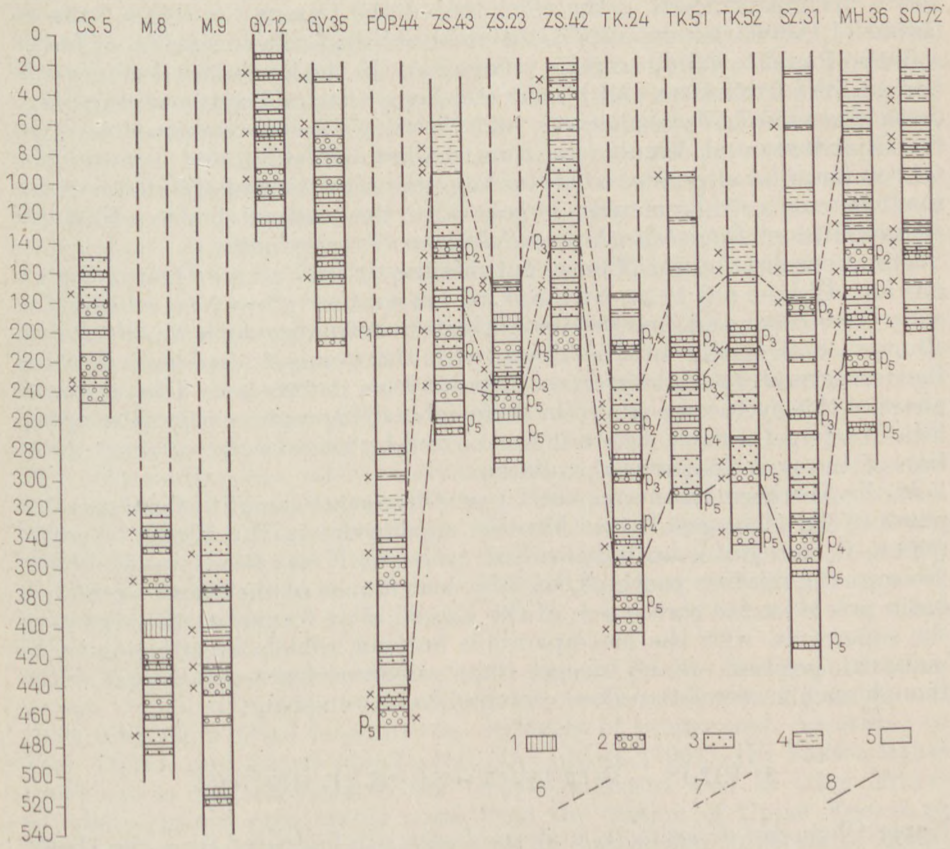


Fig. 3. Profiles of the boreholes richest in Oligocene macrofossils in the Mány—Zsámbék basin, with depth data counted from the ground surface. The profiles show facies established on a macrofossil basis only. The *x* marks depth intervals that have yielded mollusc species not older than Upper Oligocene. P_1, P_2, etc. indicate *Polymesoda* (*Cyrena*) horizons. The profile of borehole Solymár 72 is given as a complement. Legend: Cs: Csordakút, M: Mány, Gy: Gyermely, Főp.: Felsőőrspuszta, Zs: Zsámbék, Tk: Tök, Sz: Szomor, Mh: Máriahalom, So: Solymár. 1. Freshwater (lagoon). 2. Brackwater (lagoon and littoral). 3. Shallow sublittoral. 4. Medium-depth sublittoral. 5. Sample containing no macrofossils or not accessible to the author. 6. Lower boundary of *incomparabilis* horizon. 7. Upper boundary of *Diplodonta* horizon. 8. Lower boundary of same

A first consideration of the vertical spread of the fossil communities revealed a totally irregular alternation of the most varied freshwater, brackwater and marine facies (BÁLDI 1965).

As far as the western part of the region, the Mány—Vasztély—Gyermely area is concerned, this finding has not been invalidated by the large number of boreholes drilled since. In the eastern part, however, where certain horizons could be identified and correlated among the various profiles, and a general decrease in the thickness of the Cyrena-Cerithium beds in favour of the marine deposits could be established, the succession of facies was also found to exhibit certain regularities. In the lowermost Polymesoda horizon, the freshwater and brackwater-lagoon facies are almost exclusive (with *Polymesoda-Tympanotonus* and *Brotia-Viviparus* communities.) In the Diplodonta and Angulus horizons, shallow sublittoral and lagoon-littoral communities alternate, whereas the uppermost (incomparabilis) horizon is almost exclusively marine, largely with the medium-depth sublittoral communities of *Pitar beyrichi* and *Schizaster* cf. *acuminatus*.

The above distribution of facies outlines the transgressive phase of an Upper Oligocene sedimentary cycle, beginning with freshwater and brackwater deposits, continuing with an increasing abundance of marine interbeddings, with the youngest deposits indicating the deepest water and the greatest distance from the seashore. The regressive phase of this cycle is known from the neighbouring regions only (Budapest, Pilis-Western Cserhát), where it was spared by the absence or short duration of the post-Oligocene denudation.

In the Northern Mountains, the Upper Oligocene belongs to the regressive phase of an Oligocene-Lower Miocene supercycle; in the Vértes—Gerecse region, it constitutes an independent cycle. As it has been proved before however the relative youth of the Oligocene faunae of the Mány—Zsámbék basin precludes the correlation of the Kiscell clay, formed at the climax of the supercycle, with the incomparabilis horizon, which latter owing to its marginal position, is no deeper than medium-depth sublittoral, even though such a correlation does certainly look tempting.

3. PILIS — WESTERN CSERHÁT REGION

Upper Oligocene deposits in uniform facies can be traced from the Dorog Basin right to the Galga Valley, across a heterogeneous region rendered structurally and morphologically variable by subsequent changes. The boundaries of this palaeogeographical region are as follows: the line joining Bajna, Máriahalom, Budakalász, and Csomád in the southwest and south; the Csomád—Becske—Zelovce line in the east; and the supposed boundary of the basin of sedimentation in South Slovakia in the northwest. The heterogeneous region thus defined includes the Dorog Basin, the Pilis Mountains, the Szentendre—Visegrád Mountains, the Börzsöny Mountains, the Western Cserhát Hills and the environs of Kováčov (Helemba) in Southern Slovakia. In this region, I have made field trips and collected fossils over several years, besides studying cores from the most recent boreholes.

(a) *Dorog Basin and Pilis Mountains (Fig. 4)*

Information about the geology of the Upper Oligocene is contained in Hantken (1871), Rozlozsnik, Schréter and Telegdi-Roth (1922), Liffa (1903, 1904, 1905), Schafarzik (1884), Telegdi-Roth (1927),

MAJZON (1940), S. VITÁLIS (1939—1945), HEGEDÜS (1951), SCHRÉTER (1953), FERENCZ (1953), MRS CSÁNK and SIPOSS (1963), SIPOSS (1964a, 1964b), MRS CSÁNK (1964), NAGY-GELLAI (1964), BÁLDI (1965). The Slovakian continuation of the Upper Oligocene of the Párkány—Helembaj (Kováčov) region was described by SENEŠ (1958a, 1960, 1964) and ONDREJIČKOVÁ and SENEŠ (1965). The last two authors gave an adequate description of the macrofossils found on the Slovakian side, whereas those found on the Hungarian side have just been mentioned in a few fossil lists, most of them rather short. Besides the previously known dozen or so species of molluscs, I have identified a further 30 species in this area (Table I, Columns 9 and 10).

We have repeatedly been faced in this area with the problem of the peculiar stratigraphic position of the "Cyrena" beds. In contrast with what is usual elsewhere, these beds occur here also *below* the Kiscell Clay. In contrast with the rather unconvincing explanations of HANTKEN and ROZLOZSNIK, research on both sides of the Danube proved that the Dorog Basin has two "Cyrena complexes"; the lower one, underlying the Kiscell Clay with its Rupelian micro- and macrofauna, is a lagoon facies connected with the early Oligocene transgression; the upper one overlies the Kiscell Clay; its age is Aquitanian (Lower Miocene) according to SENEŠ (1958a), "Chattian = Aquitanian" according to ONDREJIČKOVÁ and SENEŠ (1965), and — as I shall go on to prove — Upper Oligocene according to myself. In the present book, discussion will be restricted to the "Upper Cyrena beds".

The Upper Oligocene largely consists here of friable fine-grained sandstones, clayey silts, with interbeddings of coarse sand, gravelly sands and clays with plant fossil imprints and stringers of brown coal. According to MRS CSÁNK and SIPOSS (1963), and MRS CSÁNK (1964), the biotite flakes which are so characteristic of the Upper Oligocene also in other Transdanubian regions presumably come from the erosion of Upper Eocene or Lower Oligocene volcanics. Those authors derive the minerals of metamorphic origin "from a region of crystalline rocks south of the Vepor Mountains".

The Upper Oligocene is underlain by a Rupelian foraminifera-rich clay marl, or the Kiscell Clay, except on the soutwestern margin of the area, where it unconformably overlies some older formations. NAGY-GELLAI (1964) points out that only the oldest four of MAJZON's foraminifer horizons can be identified in the area. On the other hand, SIPOSS's profiles (1964a, p. 209) cannot be consistently interpreted except by assuming a hiatus and a phase of denudation between the Kiscell Clay and the "upper sandy" (Upper Oligocene) deposits. This explains how the Upper Oligocene came to overlie the Triassic here, the Eocene there and the "lower Cyrena beds" elsewhere, as well as the capricious oscillations (from 40 to 428 m) in the thickness of the Rupelian foraminifera-rich clay marl. The higher horizons of the Kiscell Clay are absent from the Dorog Basin. This hiatus and the denudation that took place during it do not, however, fit the concept of the "Infra-Oligocene denudation", proposed by TELEGDI-ROTH (1927) who used this term to include also the period of denudation preceding the "lower Cyrena beds" which he believed to be likewise Upper Oligocene. The late Middle Oligocene denudation had carried off some of the Kiscell Clay; the Upper Oligocene sea flooding this marginal area then covered the remaining rags of Kiscell Clay as well as the pre-Oligocene formations at Csolnok and points farther west. This state of facts resolves at the same time TELEGDI-ROTH's dilemma: (1912): why has the Kiscell Clay no littoral heteropic facies? In this marginal area, the denudation preceding the Upper Oligocene transgression presumably finished off the thin litoral deposits of the Rupelian which were probably restricted to a narrow zone anyhow. In agreement with this hypothesis SENEŠ (1960, 1964) wrote — although he could not convincingly prove a hiatus — of an Upper Oligocene (in his terminology, Aquitanian) transgression introducing a new sedimentary cycle in the adjacent Slovakian area.

The Upper Oligocene is in most places overlain by the Quaternary, except for the southwestern margin facing Perbál of the area, where it is covered by unconformable Upper Badenian or Sarmatian strata. East of Pilisvörösvár, on Garancs Hill, the Oligocene underlies a "Helvetian" (Ottnangian) bentonitized rhyolite tuff and a calcareous sandstone with Chlamys and Bryozoa.

Besides studying the molluscs found in cores of the boreholes Csolnok 695 and Esztergom 40, I made several field and collecting trips in the company of Z. SIPOSS, under a commission by the Dorog Department of the Hungarian Geological Institute.

The most informative exposure with the richest fossil assemblage is in a stream valley (south of Kesztölc) (Kc — 1). It was already mentioned by SCHRÉTER (1953) who enumerated only seven species, however. The succession of strata is, from the bottom upwards (Fig. 4.):

(1) 2 m of coarse sand.

(2) 50 cm of shaly clay with leaf imprints and brown coal stringers.

(3) 2 m of cross-stratified coarse sand with clay pebbles, and with a *Polymesoda-Tympanotonus* community. (*Ostrea cyathula*, *Polymesoda convexa*, *Teredo* sp. *Melanopsis impressa hantkeni*, *Pirenella plicata*, *Tympanotonus margaritaceus*, *Theodoxus pictus*).

(4) 1.5 m of cross-stratified coarse sand with very scarce fossils.

(5) 30 cm of shaly clay with plant fossil impressions (*Cinnamomophyllum*).

(6) 1 m of coarse sand with a thin band of clay containing plant fossil imprints.

(7) 2 m of shaly-lamellar fine-grained sandstone.

An unexposed section of 8 m height is succeeded by

(8) 1 m of coarse-grained sandstone with fine pebbles and molluscs,

(9) 2 m of sand with scarce fossils,

(10) 2 m of coarse sand, locally with small pebbles, with abundant fossils at two levels: a *Glycymeris latiradiata* community below, and a *Turritella* fauna washed together in pockets above representing a transition between the *Pitar polytropa* and *Turritella venus* communities. For a complete fossil list see Column 10 of Table I. The resemblance to certain localities near

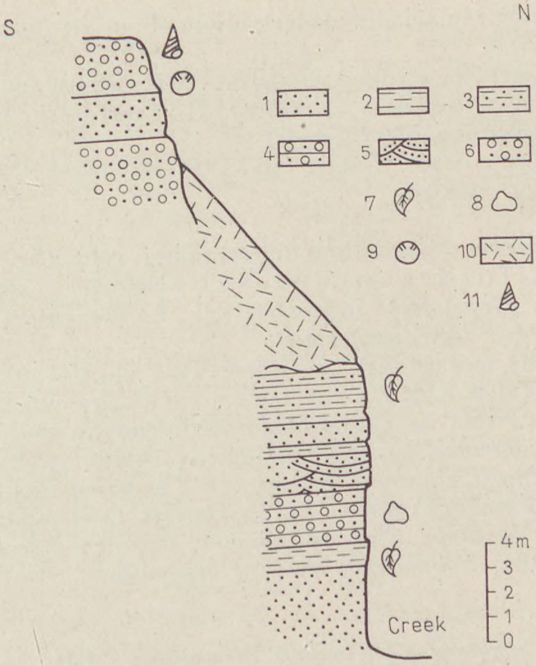


Fig. 4. Exposure in creek valley on southern border of Kesztölc (Kesztölc-1). Legend: 1. Sand, coarse sand. 2. Clay with lignite stringers, shaly, with leaf imprints. 3. Fine sandstone, shaly-lamellar, with leaf imprints. 4. Cross-stratified coarse sand with clay boulders. 5. Cross-stratified coarse sand. 6. Coarse sandstone with fine pebbles and molluscs. 7. Leaf imprints, traces of lignite. 8. A *Polymesoda-Tympanotonus* community. 9. A *Glycymeris latiradiata* community. 10. Talus-covered section. 11. A community transitional between *Pitar polytropa* and *Turritella venus*

Pomáz and Diósjenő and to the Eger fauna is quite striking. Young, Upper Oligocene forms abound, precluding a Rupelian age (*Taras rotundatus*, *Athleta rarispina*, *Babylonia eburnoides umbilicosiformis*, *Venus multilamella*, *Turritella venus*, *Corbula carinata*). A pre-Miocene age is indicated by *Cyprina islandica rotundata*, *Polinices catena achatensis*, *Globularia sancti-stephani*, *Turricula regularis*, *Glycymeris latiradiata* s. l.

Another succession observed at Nagysáp, in the deep cut of a dirt road at the west end of the village, is as follows.

(1) Below 2 m of cross-stratified coarse sand with scarce pebbles, with some large specimens of *Glycymeris latiradiata* s. l. near the bottom.

(2) 1 m of pebbly lumachella exclusively made up of *Polymesoda convexa* shells.

(3) 7 m of clayey fine-grained sandstone, with abundant vegetal debris and a marine fauna. (*Glycymeris latiradiata* s. l., *Laevicardium tenuisulcatum*, *Babylonia eburnoides umbilicosiformis*).

(4) 2 m of pebbly coarse "Cyrena sand". A few valves of *Ostrea cyathula* besides *Polymesoda convexa*.

The Upper Oligocene sandstone outcropping near the Szentkút well at Pélifoldszentkereszt yielded a sparse fauna of poor preservation (*Glycymeris latiradiata* s. l., *Laevicardium tenuisulcatum*, *Babylonia eburnoides umbilicosiformis*).

After closing the manuscript, a new locality of Egerian fauna was discovered by Miss E. HORVÁTH between the villages Uny and Máriahalom. In a sandpit, located near the road, an excellently preserved *Tympanotonus-Pirenella* community occurs in a coarse-grained beach sand. The most common species are *Tympanotonus margaritaceus*, *Pirenella plicata*, *Theodoxus pictus*, *Th. buekkensis*, *Divaricella ornata*, *Linga columbella*, *Ostrea cyathula*, *Corbula carinata*, *Protoma diversicostata*, *Polinices catena helicina*, *Polymesoda convexa brongniarti*.

(b) *Szentendre—Visegrád Mountains (Fig. 5)*

The foundations laid by KOCH (1871a, 1871b, 1871c, 1874, 1877) were succeeded by a number of publications devoting one or more chapters to the Upper Oligocene. SZALAI (1925) wrote of Pomáz, MAJZON (1933, 1952) of Leányfalu, WEIN (1939) of Szentendre, MÉHES (1942) of Dunabogdány and HEGEDŰS (1953) of Visegrád. There are further valuable data in HANTKEN (1867a), ERDŐS (1900) and SZÉKY (1963). Microfossils were treated by MAJZON (1939). Besides more or less extensive fossil lists in need of revision, MAJZON (1933) and MÉHES (1942) made efforts also at the illustration and description of some mollusc species. Still, a monographic treatment of the mollusc fauna according to uniform principles has been lacking up to the present. In the course of systematic field trips undertaken since 1960, I collected 107 Upper Oligocene mollusc species from this area. KOCH (1877) gave a fossil list of round 30 species; MÉHES enumerated the same number from Dunabogdány.

The deposits in question were generally regarded as Upper Oligocene, Chattian, by the above-cited authors. Divergences of opinion were restricted to the overlying beds: the bone of contention being the Lower Miocene or "Helvetian" age and the possible subdivision of the lithologically and faunistically rather uniform beds intercalated between the easily distinguishable Upper Oligocene and the "Tortonian" volcanics. Another much discussed point concerned the relative age of the Pectunculus sands and the field relations of the "Cyrena beds". KOCH (1871a) first wrote that the Pectunculus sands overlie the Cyrena beds. Subsequently he observed a "disorderly alternation" of the two facies, emphasizing that "these cannot be separated from one another" (1877, p. 82). According to Majzon (1933), the Kiscell clay is overlain at Leányfalu by a "Cyrena bed", although he stated the Pectunculus facies to form just a few thin interbeddings in the "thicker brackwater layers characterized by *Potamides*". Wein (1939) reverted in his paper on Szentendre to the idea of an "Upper Oligocene Cyrena clay" overlain by "layers with Pectunculus obovatus and Potamides and transitional layers (Aquitanian)". The profile I compiled from literature for Vadász's "Geology of Hungary" (1960 Fig. 118) essentially reflects the opinions of Majzon and Wein.

The Upper Oligocene is underlain in this area by the Kiscell Clay, from which it emerges gradually. In the borehole Szentendre 2, Jámbor-Knesch (1964) identified all the Majzon horizons of the Kiscell Clay; hence, in contrast to the Dorog Basin, deposition was continuous in the less marginal Szentendre—Visegrád Mountains: in the above-mentioned borehole, the Kiscell Clay containing *Yoldia raulini*, *Malletia degrangei*, *Parvamussium bronni*, *Thyasira vara* and *Rostellaria hungarica* grades at a depth of 506.5 m into the Egerian. At Budakalász, between the brickyard and the village, the transition from the Kiscell Clay to the Upper Oligocene sandstone with scarce fossils is easy to trace, as was already pointed out by Szalai (1925).

In the area strongly uplifted by the andesite laccolith of Csódi Hill near Dunabogdány, the deposit cropping out on the surface is the Rupelian Kiscell Clay according to Koch (1871b) and Méhes (1942), Majzon (1939) believes it to belong to the "deep Chattian", to the group of "Kiscell-clay-like foraminifera-rich clays". He placed into this same group one of the exposures in the valley of Dora (or Rákász or Szénégető) Creek at the west end of Leányfalu, at a few paces from the edge of the forest (Leányfalu-2). The clayey silt of this locality yielded a mollusc assemblage of 16 species enumerated in Column 13 of Table I. Together with the abundant Foraminifera and some Pteropods (*Balantium*) and *Schizaster*, these molluscs indicate a deep sublittoral—shallow bathyal facies (*Hinia-Cadulus* community). The fauna is Upper Oligocene but all its features suggest it to represent the lowermost horizon of the stage, with a gradual transition into the Kiscell Clay.

The Upper Oligocene strata are unconformably overlain by calcareous sandstone with *Chlamys* and *Bryozoa*, sandy limestone, conglomerates with *Balanus* of Carpathian age, with more abundant mollusc assemblages locally (Pismány near Szentendre). No Lower Miocene (Eggenburgian) fossil assemblage has been detected so far. The Miocene faunae of the beds underlying the Badenian andesites are composed — by an oral communication of Csepreghy-Meznerics — exclusively of forms indicating a "Helvetian" age, although some of them contain some large Pecten. In the profile of Messelia (Mesélő) Hill (Fig. 10), the Upper Oligocene, which includes some terrestrial layers is overlain by a coarse sand containing no fossils except fragments of *Crassostrea* sp. and valves of *Anomia*. Its age thus remains undecided. It may correspond to the "strata with coalified plant fossils" at the top of the Upper Oligocene at Diósjenő, directly overlain also there by "Helvetian" (perhaps Ottnangian) deposits.

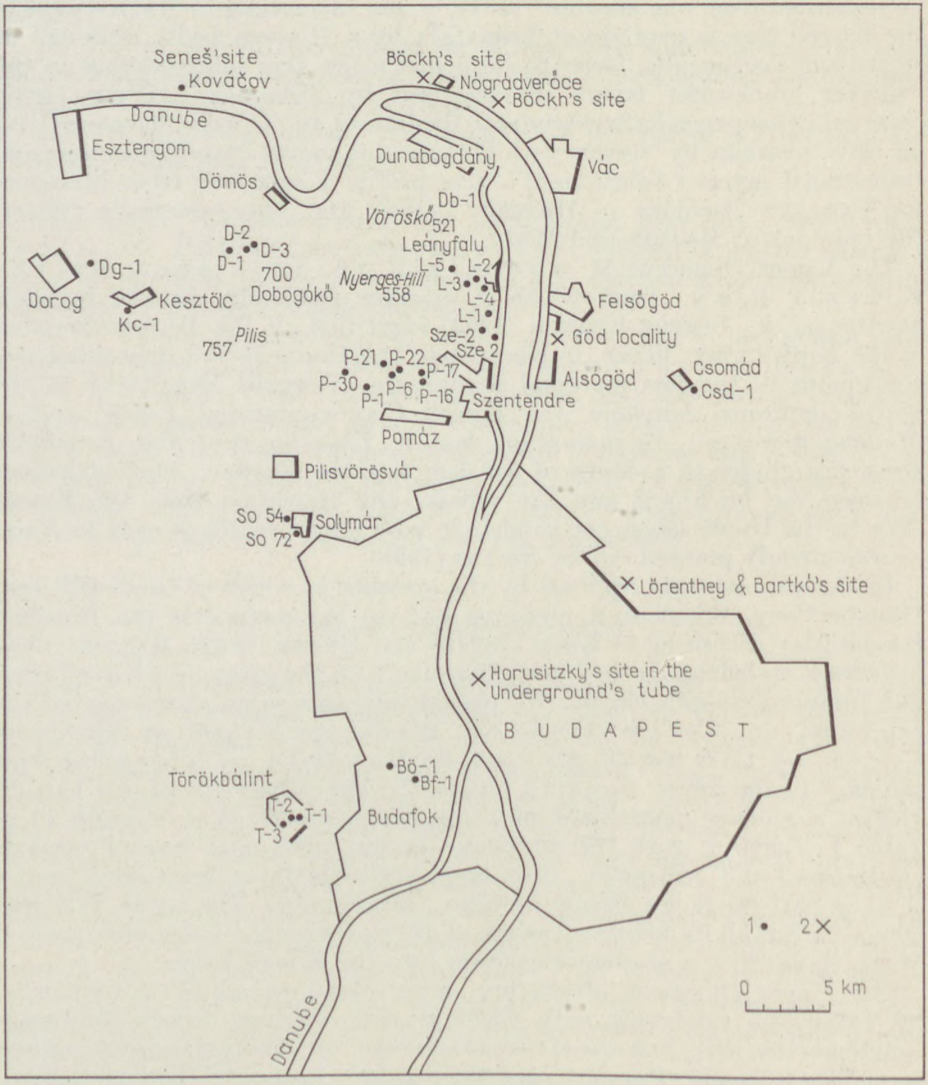


Fig. 5.

Anyhow, as far as we can tell today, no Lower Miocene can be identified in the Szentendre—Visegrád Mountains, the Upper Oligocene being unconformably overlain by Ottnangian or Carpathian deposits.

The thickness of the Upper Oligocene is much greater here than in the marginal Dorog Basin: it exceeds 500 m in the borehole Szentendre. The deposits include clayey silts, fine sands, friable sandstones,

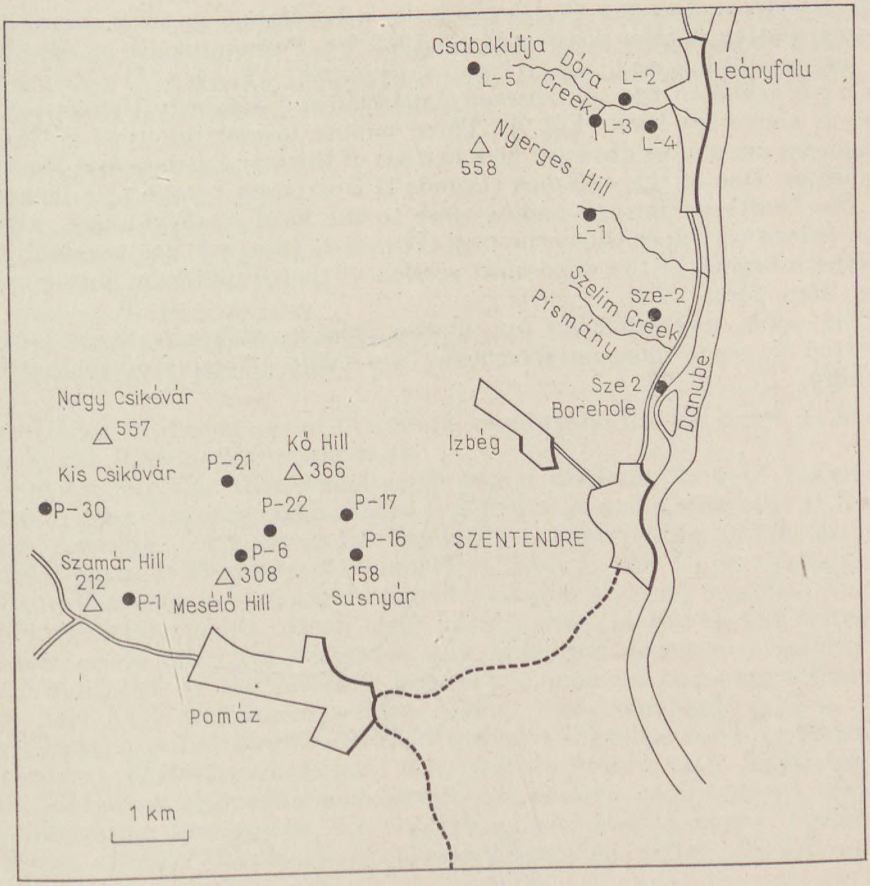


Fig. 5. Map sketch of the Dorog Basin, the Szentendre—Visegrád Mountains and the environs of Budapest, showing the more important fossil sites and boreholes. Inset: enlarged sketch of the area between Pomáz and Leányfalu in the Szentendre—Visegrád Mountains. Legend: 1. Fossil site or borehole. 2. Upper Oligocene site of some importance, described in literature, not re-examined by the present author

numerous interbeddings of gravelly, cross-stratified coarse sand and of clays with coal stringers. The thickness of the stringers and lenses of coal nowhere exceeds 0.25 m, being most often just a few cm, less than in the Vértes—Gerecse region. Jámbor-Knesch (1964) states that the erosion products of the Upper Eocene andesites sould be identified in the Upper Oligocene deposits of this area too. This is how a characteristic high amphibole content came to exist. The detrital component of metamorphic origin is derived from the north also in this instance.

Although some boreholes have been sunk near Pilismarót, Visegrád and Szentendre, I had to rely largely on surface observations in this area. Of the exposures, the one at Dömös is in a borderline position facing the Dorog Basin; it was discovered in 1967 by Palaeontologist S. MIHÁLY. It lies southwest of Dömös, north of the Dobogókő range, close to the col between Árpádvár and Jászhegy Üstöke peaks, 400 m above sea level (Fig. 6). Three minute insular outcrops of Upper Oligocene are almost drowned here in a sea of thick and widespread Miocene andesites. One of the outcrops (Dömös-1) is exposed by the new highway at the "northern spring" issuing close to the head of the Lukács ravine. The other two Upper Oligocene rags (Dömös-2, Dömös-3) are visible in the northern branch of the uppermost section of that well-known outing spot, the Rám gorge.

The fauna was unknown up till the present, although KOCH (1877), averted by some museum specimens, had made attempts at finding the locality.

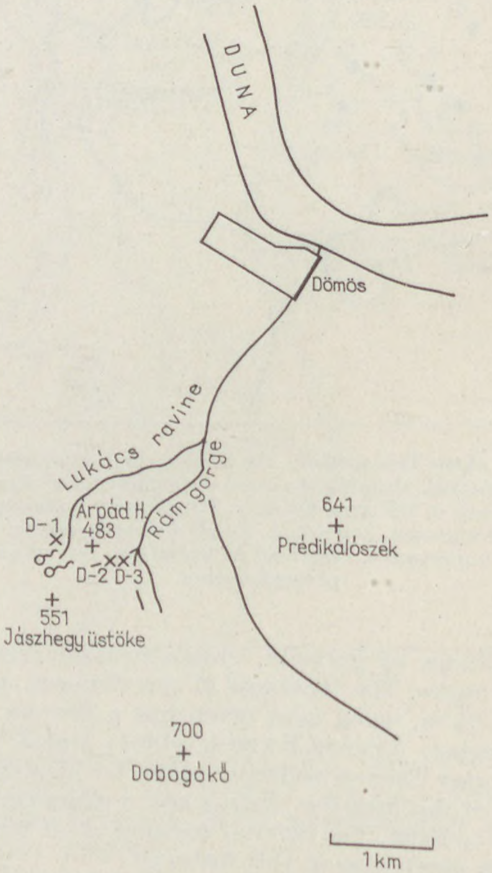


Fig. 6. Map sketch of the Dömös localities.
D-1 = Dömös-1, etc.

Dömös-1 is an exposure of a friable clayey sandstone with plant fossil imprints in a height of 1 to 2 metres, cut at its southeast end by a fault beyond which an andesite agglomerate with abundant xenoliths appears. It has yielded the following *littoral* fauna:

Ostrea cyathula LAMARCK
Cardium sp. indet.
Pitar undata BASTEROT
Theodoxus pictus FÉRUSSAC
Turritella beyrichi HOFMANN
T. archimedis BRONGNIART
Tympanotonus margaritaceus BROCCHI
Pirenella plicata BRUGUIÈRE

The Upper Oligocene age of this fauna requires no further proof. It belongs to the *Pitar undata* community.

Dömös-2. The above-mentioned ravine discloses 7 m of heavily slumped Upper Oligocene beds. There is a grey clay and a silty clay at the bottom, overlain by micaceous fine sand. The bottom portion of this latter yielded a fauna of 33 species (Column 11 of Table I). The Upper Oligocene is also in this case in structural contact with the andesite complex. This shallow sublittoral fauna, which must have thrived in just a few metres of water, could not have withstood any prolonged decrease in salinity. This s indicated by the presence besides the molluscs and some solitary corals even of a fragmentary coral colony! The community is that of *Pitar polytropa*. Affinities towards the Kováčov (Helemba) and Eger faunae are obvious. (*Trisidos schafarziki, Ringicardium buekkianum, Bullia hungarica, Babylonia eburnoides umbilicosiformis, Galeodes semseyiana.*) Some rare, interesting species are worth pointing out: *Arca biangula, Cardita monilifera, Olivella clavula vindobonensis, Chama* sp. indet., *Terebra* sp. indet.

Dömös-3. Here also a clay is overlain by fine sand, but the latter contains very scarce fossils (fragments of *Mytilus* and a few specimens of *Tympanotonus margaritaceus*).

The second southwest-trending branch, counted from the Danube, of the Dora Creek valley, east of the Nyerges (Height 557.8 m) (Leányfalu-3) provides some valuable insight into the variety of the marine facies. In 1933 MAJZON described the then visible profile and gave a short fossil list. The exposure must have considerably improved since, as today the branch discloses, even though with several gaps, more than 200 metres of an Upper Oligocene sequence fairly rich in fossils (cf. BÁLDI 1965). The strata and fossils now exposed are the following, from the bottom upward (Fig. 7) (Column 14 Table I):

1. A fine-grained friable sandstone with scarce marine fossils (*Angulus* sp.)
2. A cross-stratified coarse sand with muscovite and a brackwater fauna. (*Tympanotonus margaritaceus, Pirenella plicata, Polymesoda* sp.)

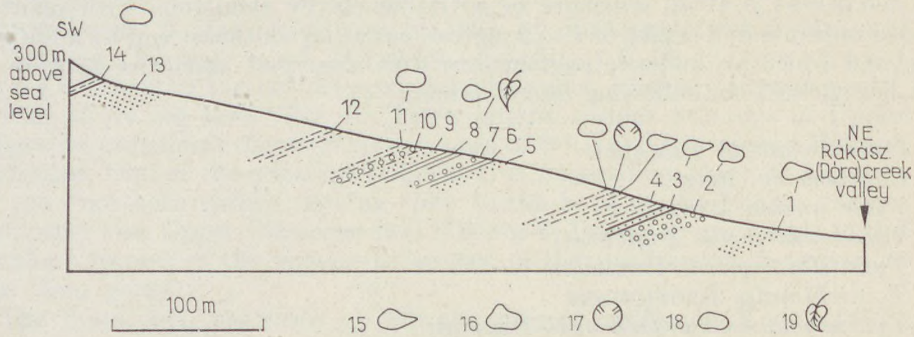


Fig. 7. Geological profile west of Leányfalu, along the second southwest-trending side valley, counted from the Danube of Dora Creek, and east of the elevation Nyerges 557.8 m (symbol: Leányfalu-3). Legend: Nos 1 to 14 are explained in the text. 15. Tellinids. 16. A *Polymesoda-Tympanotonus* community. 17. A *Glycymeris latiradiata* community. 18. A *Pitar polytropa* community. 19. Leaf imprints

3. A ledge of hard sandstone (40 cm), with numerous tubular burrows and some Tellinids.

4. A friable clayey sandstone with large flakes of muscovite. In its upper part there are rather well-preserved macrofossils at three levels: mostly small bivalves below, a *Glycymeris latiradiata* community at the middle and half a meter above it a transition between the *Pitar polytropa* and *P. beyrichi* communities with 29 species. Most of the species have previously been unknown from the Szentendre—Visegrád Mountains. Among the forms proving the Upper Oligocene age of the fauna let us point out the Boreal species *Pitar beyrichi* and *Gari angusta* and the Mediterranean types *Pecten arcuatus* and *Galeodes basilica*. Several species (*Astarte gracilis degrangei*, *Cardita orbicularis subparvocostata*, *Pitar beyrichi* etc.) indicate an affinity towards Törökbálint, whereas *Rostellaria dentata*, *Babylonia eburnoides umbilicosiformis* and *Galeodes basilica* suggest contemporaneity with the Eger, Kováčov and Diósjenő faunae.

5. A cross-stratified coarse sand.

6. A shaly-lamellar sandy clay.

7. A friable sandstone with small pebbles.

8. A light grey sandy marl with leaf imprints and crushed boughs of excellent preservation, with sparse Tellinids and Cardiids.

9. A yellowish-brown fine sand.

10. A lumachella with fine gravel.

11. A friable sandstone with large muscovite scales, and with a fairly well-preserved marine fauna. Besides the typical North Italian Oligocene *Crassatella carcarensis* and the likewise Oligocene *Pitar splendida* it contains also the Miocene *Rostellaria dentata*. The affinity with the Eger, and especially with the Kováčov faunae is underscored by *Crassatella carcarensis*, *Cardium egerense*, *Venus multilamella interstriata*, *Rostellaria dentata*, *Athleta rarispina*.

12. A yellow friable clayey fine-grained sandstone.

13. A yellowish-brown cross-stratified fine-grained sandstone with muscovite, with a string of concretions at its top.

14. A greyish-yellow silty clay. Within its *Pitar polytropa* community *Nucula schmidti* and *Pecten arcuatus* definitely establish an Upper Oligocene age.

A not less abundant locality near Leányfalu, undescribed so far, is the sand pit beside the cemetery (Leányfalu-4), which has yielded 31 species up till now. The exposed sediments include a clayey silt and a friable fine-grained sandstone. At the bottom there is a lumachella 1 to 2 cm thick, indicative of a *Tympanotonus-Pirenella* community. The next half-metre has yielded a *Pitar polytropa* community. This Upper Oligocene, Egerian fauna, which strikingly resembles that of layer Eger-1/k (e.g. *Ringicardium buekkianum*, *Turritella beyrichi percarinata*) is enumerated in Column 15 of Table I.

Leaving aside the localities of Boldogtanya and Csaba-kútja, adequately described by Majzon (1933), let us now discuss another interesting, recently discovered locality which has yielded some new species of *Theodoxus*. The outcrop (Leányfalu-1) is in the valley of Sziklás Creek, above the Boldogtanya locality, on the far side of the masonry bridge, where the andesite complex downfaulted stepwise towards the Danube is brought side by side with the Upper Oligocene by a fault. The profile, described from the bottom upward, is as follows (Fig. 8):

1. A coarse sand with sparse small pebbles and abundant fauna, representing an interesting variety of the *Mytilus aquitanicus* community (Column 12 of Table I). It is dominated by three species of *Theodoxus*, *Mytilus aquitanicus*, *Gari protracta*, *Ostrea*, small *Pirenella plicata* and *Tympanotonus margaritaceus*.
2. 1.5 m of lamellar-shaly sandy clay with a *Polymesoda convexa* community with unusually abundant *Congeria basteroti* and *Melanopsis impressa hantkeni*.
3. 0.15 m of grey sand.
4. 0.30 m of lamellar-shaly clayey sand with *Polymesoda convexa* and large *Melanopsis impressa hantkeni*.
5. 2.0 m of mottled clay with a band of carbonaceous clay.

Another exposure northwest of Pomáz is an open sand pit on an elongate hill east of Szamár Hill (Pomáz-1). Unmentioned so far except for a preliminary description (Báldi 1965), it exhibits the intercalation of a *Cyrena* community between two marine beds. From bottom to top, the profile is (Fig. 9):

1. A micaceous fine sand.
2. A sand with fine pebbles and very numerous *Turritella*, accompanied by *Glycymeris latiradiata*, *Cardium heeri*, *Taras rotundatus*, *Gibbula cf. proxima*, *Cassidaria nodosa*, *Dentalium kickxi* and *Balanus* sp.
3. A friable sandstone with concretions.

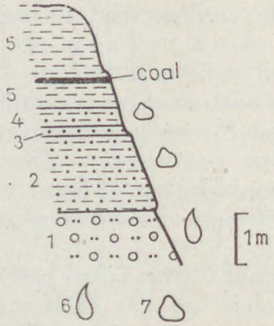


Fig. 8. Exposure southwest of Leányfalu, in the valley of Sziklás Creek, past the Boldog-tanya site and the masonry bridge (symbol: Leányfalu-1). Legend: Nos 1 to 5 see text. 6. A *Mytilus aquitanicus* community. 7. A *Polymesoda-Tympanotonus* community

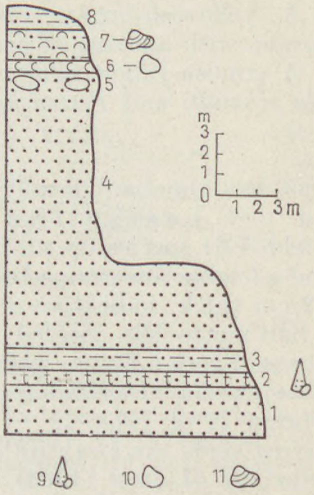


Fig. 9. Profile of open sand pit on hummock running east of Szamár Hill (Pomáz-1) northwest of Pomáz. Legend: Nos 1 to 8 see text. 9. A *Turritella venus* community. 10. A *Polymesoda-Tympanotonus* community. 11. A *Pitar beyrichi* community

4. A cross-stratified micaceous coarse sand.
5. A string of concretions of metre size.
6. A sand with a *Polymesoda convexa* community.
7. A yellow friable fine-grained clayey sandstone, with a fairly abundant fauna belonging to the medium-depth sublittoral assemblage of *Pitar beyrichi*. Most of the species from this locality (Column 18 of Table I) were previously unknown from these mountains. There is a close affinity to the Törökbálint fauna (*Pitar beyrichi, Chlamys incomparabilis,* etc). The Upper Oligocene age of the fauna is proved among others by *Pitar beyrichi, P. splendida, Turricula regularis*. There are further some forms, arising in the Upper Oligocene but more frequent in the Miocene, such as *Pteria phalaenacea, Zozia antiquata, Corbula carinata, Athleta rarispina* etc.

The deep gullies incised in the flank facing the Messelia (Mesélő) Hill of Csikóvár Peak near Pomáz, and the localities of the Kartálja (Kertalja) are long known from literature. Koch (1871a) was the first to publish some shortish fossil lists; it was here that Szalai (1925) discovered the terrestrial beds with *Galactochilus pomiformis*. Erdős (1900) described from here *Galeodes semseyiana*, a new species of the genus Galeodes ("Pyrula"). One of the most revealing outcrops of the Kartálja, beautifully illustrative of the alternation of the beds with "Pectunculus" and "Cyrena", lies north of the edge of the forest, in the second northwest-trending valley branch, about where this latter intersects the 230-metre contour (Pomáz-21). Its succession of strata is as follows (Fig. 10).

1. A friable fine-grained sandstone.

2. A sandy clay with a *Glycymeris latiradiata* community, with some specimens of *Polymesoda convexa* accompanying the large *Glycymeris latiradiata* and *Ostrea cyathula*.

3. A friable micaceous sandstone with clay boulders. It contains a fauna very rich in specimens, recorded in Column 20 of Table I. Besides the species listed there, the fauna includes pulmonate gastropods ("Helix" = *Plebecula cf. ramondi*, *Coretus* sp.), a *Dichobunid* (Suiform) molar and further bone fragments. These remains were presumably washed in by streams flowing off an adjacent land mass. Marine currents coming from the open sea threw logs teeming with teredinids onto the sandy beaches of the lagoon. The dark grey and white tubes of the teredinids were abundantly preserved even after the decaying of the wood. The fauna, one of the most striking examples of the *Polymesoda-Tympanotonus* community, is complemented by worms (*Pomatoceros triqueter*) and fish teeth.

4. A light grey clay of conchoidal fracture, with thin bands of sand along the bedding planes. Some scarce *Tympanotonus margaritaceus* and *Melanopsis impressa hantkeni* indicate a brackish facies similar to that of the underlying layer. There are many tubular sand-filled burrows and excellently preserved leaf imprints (*Sequoia*, *Cinnamomum*, other pine needles and deciduous leaves; also fruits), in the bottom horizon, an accumulation of what probably was driftwood resulted in a few thin coal stringers.

5 — 10. An alternation of clay and sand, with the sand gaining the upper hand upward. The clay contains leaf imprints and life traces: no other fossils have been observed.

11. A hard fine-grained sandstone with casts of *Glycymeris* sp. and *Turritella venus*, indicative of a marine ingression.

12. A friable fine-grained sandstone.

13. A clayey fine sand with a *Tympanotonus-Polymesoda* community similar to that of Layer 3, with *Polymesoda convexa brongniarti*, *Ostrea cyathula*, *Turritella beyrichi*, *Tympanotonus margaritaceus*, as the most abundant fossils.

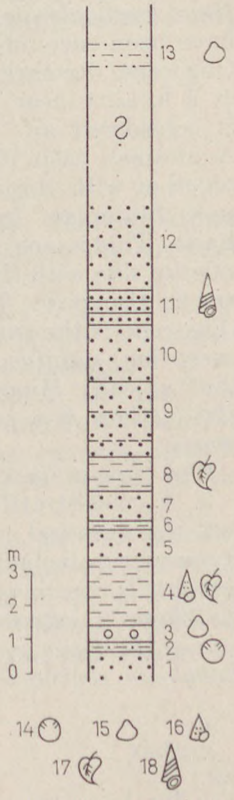


Fig. 10. Exposure in one of the gullies on the Kartálja near Pomáz, north of the forest's edge, where the second northwesterly side valley intersects the 230-metre contour (Pomáz-21) Legend: 1 to 13 see text. 14. A *Glycymeris latiradiata* community. 15. A *Polymesoda-Tympanotonus* community. 16. *Tympanotonus* 17. Leaf imprints. 18 A *Turritella venus* community

There is another most instructive profile on the Kartálja: that of the Zsivanov potok.

This ravine runs along the edge of the forest, in an east-southeasterly direction. It undoubtedly exposes the highest Lower Oligocene (Pomáz-6). The succession of strata (Fig. 11) is as follows.

1. A friable clayey fine-grained sandstone with well enough preserved molluscs belonging to the *Pitar undata* community (Column 19 of Table I.) The fauna is dominated by Miocene forms (*Apolymetis lacunosa, Euthriofusus burdigalensis, Pitar undata*). Faunae of closely similar composition have been encountered also at Diósjenő, at the higher levels of the Upper Oligocene. Remarkably, *Pitar undata*, whose first Paratethyan occurence, at a locality near Diósjenő, was signalled in Báldi et al. (1964a, 1964b) is considered an "Aquitanian index fossil" in recent literature on the Aquitanian basin (Gripp and Magne 1956). However, in Hungary it occurs together with *Ampullina crassatina* which, on the other hand, is regarded as a "Stampian" index fossil, restricted to the Oligocene in the Aquitanian Basin. This is one more instance of more and more Miocene forms arising side by side with the old Oligocene ones near the Oligocene-Miocene boundary in Hungary. The reason for placing this locality still into the Upper Oligocene is the same as at Diósjenő: (a) The Miocene species are, without exception, significantly smaller than, and differ also in other traits from, the typically Miocene specimens; (b) overlying this fauna, in Layers 4 and 5, there is a comeback of an Oligocene fauna with *Crassatella carcarensis*.
2. A fine-grained friable clayey sandstone with scarce fossils.
3. A cross-stratified grey coarse sand.
4. An unsorted, gravelly-clayey coarse sand with a *Glycymeris latiradiata* community, including *Glycymeris latiradiata subfichteli, Ostrea cyathula, Crassatella carcarensis, Taras rotundatus, Laevicardium tenuisulcatum, Venus multilamella interstriata, Corbula carinata, Pholadomya puschi, Turritella venus, Diastoma grateloupi turritoapenninica, Tympanotonus margaritaceus, Babylonia eburnoides umbilicosiformis*. The Oligocene forms of the fauna

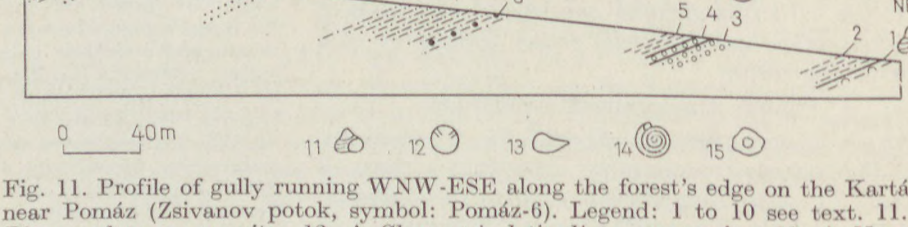


Fig. 11. Profile of gully running WNW-ESE along the forest's edge on the Kartálja near Pomáz (Zsivanov potok, symbol: Pomáz-6). Legend: 1 to 10 see text. 11. A *Pitar undata* community. 12. A *Glycymeris latiradiata* community. 13. A *Nucula-Angulus* community. 14. "*Helix* bed". 15. *Anomia ephippium*

(*Crassatella carcarensis, Diastoma grateloupi turritoappenninica*) prove that this layer still belongs to the Upper Oligocene, despite the Miocene aspect of the fauna in Layer 1.

The typically Miocene forms of Layer 1. are absent from here.

5. A clayey silt with a *Nucula-Angulus* community which here includes the species *Nucula schmidti, Pitar polytropa, Angulus nysti, Turritella cf. venus, Diastoma grateloupi turritoapenninica, Drepanocheilus speciosus*. This fauna likewise looks entirely Oligocene.
6. A sandy clay, presumably indentical with SZALAI's *Helix* layer. Besides frequent shells of *Galactochilus cf. pomiformis* BRAUN we have only found remains of *Chara* here.
7. A greyish green clay.
8. A fine sand with numerous *Anomia ephippium*.
9. A cross-stratified fine sand with concretions.
10. A gravelly sand and sandstone.

Layers 8 to 10 cannot be dated palaeontologically. The Carpathian Chlamys-Bryozoa beds overlie deposits similar to these on the southern slope of Messelia Hill (Fig. 12).

Opposite the mouth of the Zsivanov Potok ravine, at the foot of Kő Hill, a small temporary exposure (the foundation pit of a house, dug in a fine yellow sand) yielded a typical *Pitar undata* community (Pomáz-22). The fauna is listed in Column 21 of Table I. Besides *Pitar undata*, the most abundant species are *Taras rotundatus* and *Turritella archimedis*. Also here, *Pitar undata* is accompanied by older elements such as *Ampullina crassatina* and *Pecten arcuatus*: the latter is typical of the Mediterranean Oligocene.

The fullest image of the Upper Oligocene of this region has been provided by the borehole Szentendre 2. The rich macrofauna of 33 species found in cores from this hole is listed in Column 17 of Table I. The facies profile of the hole (Fig. 13) reveals even more strikingly than the exposure profiles the irregular alternation of marine and brackwater de-

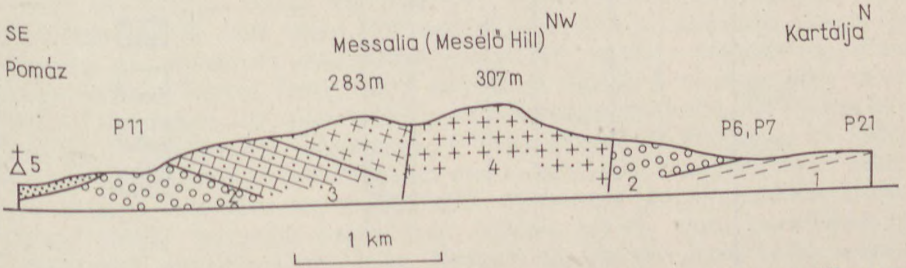


Fig. 12. Profile of Messelia (Mesélő) Hill near Pomáz. Legend: 1. Upper Oligocene succession with alternating *Cyrena* and *Pectunculus* beds and with the "*Helix*" bed on top. 2. Sand, coarse sand and gravel (? Upper Oligocene) with sparse *Anomia* and *Crassostrea*. 3. Calcareous sandstone, conglomerate, sandy limestone with *Bryozoa* and *Chlamys*, locally *Balanus* (Helvetian, "Carpathian"). 4. Andesite tuffs and agglomerates. 5. Quaternary

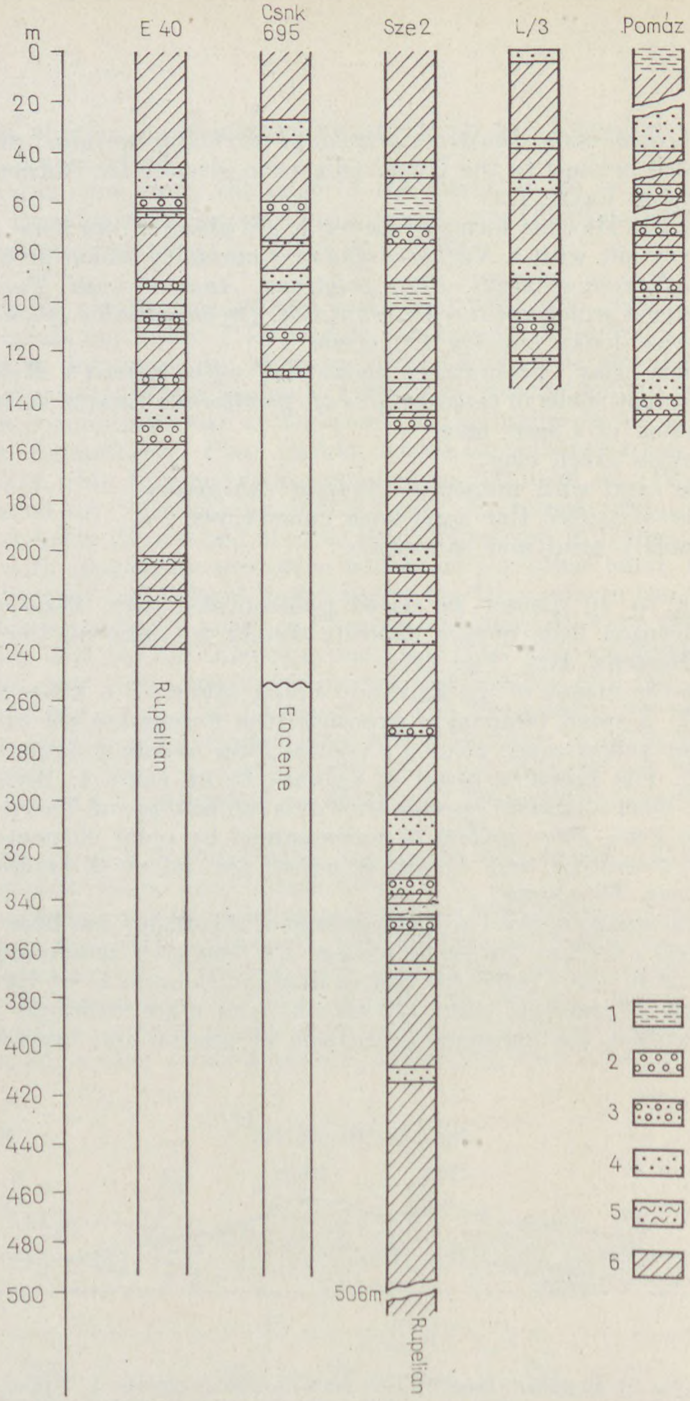


Fig. 13. Facies profiles based on some boreholes sunk in the Dorog Basin and in the Szentendre—Visegrád Mountains, as well as on two rows of exposures. Legend: E: Esztergom, Csnk: Csolnok, Sze: Szentendre, L/3: exposure Leányfalu-3, Pomáz: summary profile of the Kartálja exposures. 1. Freshwater-terrestrial facies. 2. Brackwater-lagoon. 3. Brackwater-littoral. 4. Shallow sublittoral. 5. Medium-depth sublittoral. 6. Unexposed portion or fossil-less sample. Nos 2 and 3 correspond to the "*Cyrena* beds", No. 4 to the *Pectunculus* beds

posits. The terrestrial facies with *Helix* is restricted, however, just as in the surface exposures of the Zsivanov Potok, to the topmost section of the Upper Oligocene. The Helix beds have yielded some pulmonate gastropods not encountered in the Pomáz assemblages (*Archaegopis* ex aff. *discus* THOMAE, *Archaeozonites* cf. *verticilloides* THOMAE).

(c) *The Börzsöny Mountains and the Western Cserhát (Fig. 14)*

This region includes the left bank of the Danube from Nógrádverőce to Göd, whose Oligocene was discussed comprehensively by BÖCKH (1899). This was, incidentally, the first publication to give a monographic treatment accompanied by figures of an Upper Oligocene mollusc fauna from the Hungarian territory of today. Further publications of some importance concerning this same left-bank Oligocene include VADÁSZ (1910), HOLLÓS (1917), KUBACSKA (1926), WEKERLE (1932) and NOSZKY sen. (1940, 1941a). Owing to the poor conditions of exposure now prevailing in the Danube bank strip, I displaced the focal point of my own activity to the Diósjenő area, whose Upper Oligocene constitutes the northern continuation of the left bank localities.

The Diósjenő faunae had claimed the attention even of HANTKEN and HÖRNES. The following lines from HANTKEN (1867b) are worth citing: "To this ravine (at Jenő lake) my attention was called by DR. HÖRNES, who last year on occasion of trips all over part of Hungary had made an excursion also to Diósjenő, and had been much startled by the fauna buried in the deposits there, inasmuch as said fauna consists to a great extent of species widespread also in the German Oligocene formations" (p. 91). Of the subsequent publications, the following are worthy of special mention: GAÁL (1908), SÜMEGHY (1923), LIFFA and VIGH (1937) and NOSZKY sen. (1941), and the more or less comprehensive survey reports of HORUSITZKY (1942) and NOSZKY sen. (1940). BARTKÓ (1961—62) gave a great deal of valuable information on the region in general and on the Upper Oligocene in particular.

Still, the mollusc fauna was unknown except for some scattered incomplete data up till 1964 when, subsequent to field trips and collection in the company of CSEPREGHY-MEZNERICS and NYIRŐ, under a commission of the Hungarian Geological Institute, I identified during a monographic treatment of the fauna 103 species of Upper Oligocene molluscs, describing and figuring a considerable proportion of them (BÁLDI in BÁLDI et. al. 1964). One of the aims of our investigation was to establish the presence or otherwise of the Lower Miocene in the region. SÜMEGHY (1923) and later HORUSITZKY (1942) reported Aquitanian faunae, which were paralleled by HORUSITZKY with the Eger fauna. NOSZKY sen. on the other hand deemed them to be older, Upper Oligocene. Another deposit to be dated was the brown coal indication near Diósjenő.

The Upper Oligocene, Egerian sequence here is fully analogous to that in the Szentendre—Visegrád Mountains: an alternation of clayey silt, fine sand, friable sandstone and coarse sand in an aggregate thickness of almost

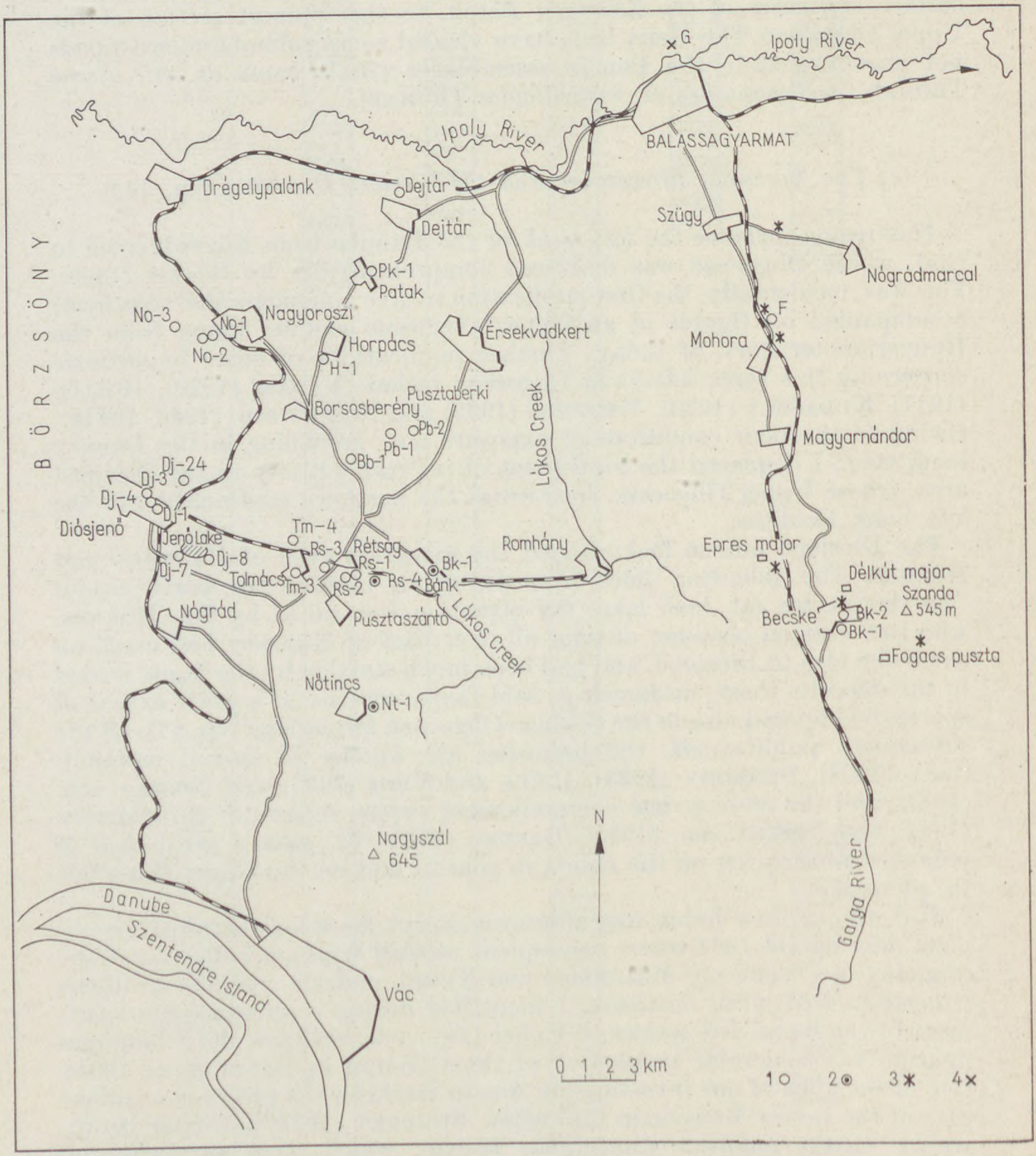


Fig. 14. Map sketch of the eastern border of the Börzsöny Mountains and of the Western Cserhát. Legend: 1. Upper Oligocene macrofossil site of some importance. 2. Exposure of Rupelian deposits. 3. Some of the more important fossil sites and/or exposures of the Lower Miocene (Eggenburgian) beds with Anomia and large Pecten. 4. The site that has yielded GAÁL's Upper Oligocene "Balassagyarmat" fauna, now in Czechoslovakia

500 m. Here too a finer subdivision into horizons turned out to be unfeasible.

The sequence is underlain in the Nógrádverőce—Göd strip as well as near Diósjenő by Middle Oligocene clayey silts and clay marls from which it emerges with continuity. It is overlain by Carpathian ("Upper Helvetian") Chlamys sands, sandstones, calcareous sandstones with Bryozoa, which towards Diósjenő and Nagyoroszi grade into gravels with *Ostrea* and *Balanus*, sandstones with *Paphia* (*Tapes*), and then near Hont into a schlier facies in almost their full thickness. Just as in the Szentendre—Visegrád mountains, no Lower Miocene (Eggenburgian) could be established between the Egerian and Carpathian in this area either.

Our work was seriously hampered by a lack of boreholes. It seems, however, that — in view of the southwesterly and nortwesterly dips observed already by Horusitzky between the uplifted area at Bánk and the eruptive mass of the Börzsöny, the older members of the Upper Oligocene lie along a line joining Rétság with Pusztaberki, and its youngest members lie between Diósjenő and Nagyoroszi. However, a fault of some significance, joining Jenő Lake, Borsosberény, Horpács, Patak and Dejtár, brought the topmost Upper Oligocene of Tolmács side by side with the older members to the west, which latter include the Horpács "mud facies" with a rich microfauna of Törökbálintian features, the Kiscell Clay of Borsosberény, and the Upper Oligocene fauna of Dejtár with some oldish features. On Szőlő Hill at Diósjenő, the youngest members of the Upper Oligocene reappear (Fig. 15).

The exposures will be discussed in the above-indicated order, that is, beginning with the presumably oldest exposures and localities between Rétság and Pusztaberki.

On Gypsy Row southeast of Rétság, a clayey silt exposed in 15 m thickness along the railway (Rétság-1) contains besides coalified plant remains and leaf imprints a poorish macrofauna (*Nucula comta, Angulus nysti, Dentalium* sp.) which presumably, belongs to a deeper Upper Oligocene. Its upper, slightly sandier portion has yielded *Pirenella*

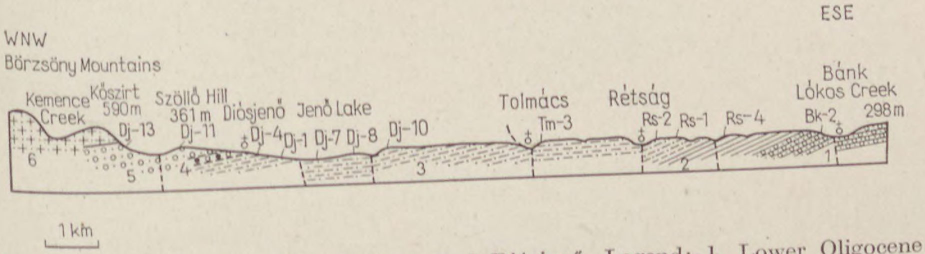


Fig. 15. Profile sketch between Bánk and Diósjenő. Legend: 1. Lower Oligocene sandstones and conglomerates ("Hárshegy Sandstone"). 2. Middle Oligocene foraminiferan clayey silt, silty clay marl. 3. Upper Oligocene clayey silt, clayey fine-grained sandstone, coarse sand, gravelly coarse-grained sandstone. 4. ? Upper Oligocene deposits with lignite traces. 5. Helvetian (Carpathian) sand, sandstone, calcareous sandstone, marl, conglomerate. 6. Andesite complex

plicata, showing how nearshore deposits alternated with marine ones even at the beginning of the Upper Oligocene. This is even more conspicuous at a distance of 150 metres down the dip, in a sand pit with slumped faces (Rétság-2), which had already been described by Horusitzky (1942). The profile (Fig. 16) clearly reveals two thin cerithian layers with *Tympanotonus margaritaceus* and *Pirenella plicata* in the bottom part of the succession. This brackwater community is consequently represented even in the deepest levels of the Upper Oligocene. Horusitzky (1942) placed the clayey silt overlying these sandstones in the Lower Miocene Aquitanian stage, partly because it unconformably overlies a coarse sand, with stringers of brown coal near its top, and partly on the strength of a ten-species mollusc fauna he had found in said clayey silt. The sand pit studied by Horusitzky has slumped in; that part of it which was accessible to us exhibited no stringers of coal nor any unconformity between the cross-stratified coarse sand and the clayey silt. We could not inspect the specimens identified by Horusitzky, but our own collection yielded a macrofauna of 25 species (Column 29 of Table I) from the clayey silt. This distinctly marine fauna, belonging to the *Pitar beyrichi* community particularly rich in Bryozoa (*Lunulites* sp.) contains *Chlamys incomparabilis* as the only species known exclusively from the Miocene. (But then, *Ch. incomparabilis* is also widespread in the Upper Oligocene of the Paratethys.) *Pitar beyrichi*, *P. splendida*, *Dentalium kickxi*, accompanying a number of persistent forms, indicate the Upper Oligocene, which is further confirmed by *Angulus nysti* and *Pholadomya puschi*, both frequent in the Hungarian Upper Oligocene. There is consequently no reason at all to call these beds Lower Miocene. Let us add that southwest of Pusztaberki, in the valley of the Derék creek there is a similar sequence exposed in a sand pit (Pusztaberki-1). The cross-stratified, pebbly coarse sand also includes some thin

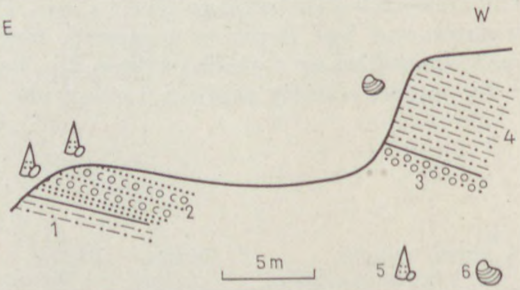


Fig. 16. Profile of the abandoned sand pit near the railway east of Rétság (Rétság-2). Legend: 1. Silt with traces of lignite. 2. Little consolidated medium-grained sandstone with two strips containing fine gravel and "Cerithium". 3. Gravelly crossstratified coarse sand. 4. *Bryozoan* clayey silt with sand lenses and a *Pitar beyrichi* community. 5. A *Tympanotonus-Pirenella* community. 6. A *Pitar beyrichi* community

cerithian bands and is likewise overlain by a clayey silt rich in *Pholadomya puschi*, *Taras rotundatus* and *Textularia deperdita*. This correlation is further upheld by the circumstance that the Pusztaberki exposure lies straight along the strike (that is, in a north-nortwesterly direction) from the Rétság locality.

Another exposure of the deeper Upper Oligocene is the remarkable Dejtár locality, which lies also along the strike from Pusztaberki. The Egerian clayey silt and fine sand with a medium-depth sublittoral *Flabellipecten-Odontocyathus* community rich enough in well-preserved specimens crops out along a cattle track in the Ipoly valley, between the village and the Balassagyarmat railway line, not far from the Czechoslovak frontier. The locality was discovered and its fine assemblage of solitary corals described by Hegedüs (1962). My own collection, carried out partly in the company of Gy. Hegedűs and I. Jankovich, permitted me to identify 36 species of molluscs (Column 31 of Table I). The most abundant forms, in decreasing order of frequency, are *Venus multilamella*, *Flabellipecten burdigalensis*, *Calliostoma elegantulum hegeduesi*, *Thracia ventricosa*, *Musculus philippi*, *Dentalium apenninicum*, *D. fissura*, *Chlamys csepreghymeznericsae*, *Babylonia eburnoides umbilicosiformis*, *Macoma elliptica*, *Cavilucina droueti schloenbachi*, *Volutilithes permulticostata*. Besides the numerous venerids, pectinids and dentaliums, the fauna is most remarkable for the extraordinary abundance of solitary corals. The species represented include, according to Hegedüs (1962), *Cycloseris* sp., *Balanophyllia cylindrica* Micht. var. Duncan, *Trochocyathus cornucopia* Micht., *T. mitratus* Goldf., *Odontocyathus armatus* Micht., *Flabellum* sp. The most abundant forms are *Trochocyathus* and *Odontocyathus*.

The Dejtár fauna is unquestionably Upper Oligocene. Those species, widespread in our Miocene, which occur also in the Dejtár fauna (*Nucula mayeri*, *Pteria phalaenacea*, *Flabellipecten burdigalensis*, *Venus multilamella*, *Macoma elliptica*, etc.) are known from the Mediterranean or Atlantic Oligocene, too. The only exclusively Miocene species is *Zonaria globosa*. In contrast, the fauna includes the following strictly Oligocene species: *Cavilucina droueti schloenbachi*, *Cassidaria nodosa*, *Ficus concinna*, *Uxia granulata*, *Streptochetus elongatus*, *Dentalium apenninicum*, *D. fissura*. Further species indicating Oligocene affinities are *Chlamys csepreghymeznericsae*, *Calliostoma elegantulum hegeduesi*, *Volutilithes permulticostata*, *Dentalium densitextum dejtarense*. The resemblance to the faunae occurring in a similar facies in the glauconitic beds at the bottom of the Eger formation is quite remarkable. There are a number of mollusc and coral species in common between them which are unknown from any other Hungarian Upper Oligocene locality (eg. *Dentalium apenninnicum*) or scarce except at these two localities (*Nucula mayeri*, *Turris coronata*). There are also some Törökbálintian affinities (*Ficus concinna*, *Uxia granulata*, *Streptochtus elongatus*).

The older Upper Oligocene members traceable along the Rétság—Pusztaberki—Dejtár strike line are overlain by 30 m of more coarsely detritic sediment, with frequent Glycymerids among their macrofossils. Opposite the Rétság railway station (Rétság-3) this latter member is represented

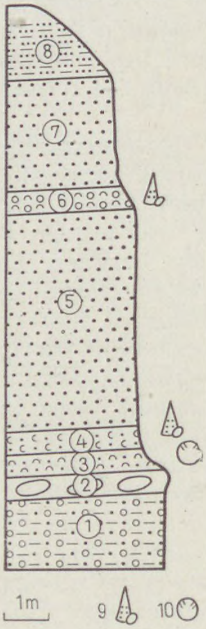


Fig. 17. Sand pit next to the Borsosberény—Rétság highway (Borsosberény-1). Legend: 1. Little sorted clayey sand, with large muscovite flakes washed up in pockets and limonitized-coalified vegetal debris. 2. A string of metre-size concretions. 3. Medium-grained sand with benches composed of giant specimens of *Glycymeris latiradiata*. 4. Coarse sand with lenses of fine pebbles and with a *Tympanotonus-Pirenella* community. 5. Fossil-poor yellow friable medium-grained sandstone. 6. A coarse-sandy lumachella with a *Tympanotonus-Pirenella* community. 7. Medium-grained friable sandstone. 8. Friable clayey sandstone. 9. A *Tympanotonus-Pirenella* community. 10. A *Glycymeris latiradiata* community

by a gravelly coarse sand including pulverulent valves of *Glycymeris* and a finer sand overlying it. Farther north-northeast along the strike, these deposits appear in a big sand pit west of the triangulation mark 251 m along the Borsosberény—Rétság road (Borsosberény-1) (Fig. 17). The dominantly coarse- and medium-grained sand exposed there contains a bed with Glycymerids near its bottom (*Glycymeris latiradiata* s.l.). Directly above the latter there is a cerithian layer (*Tympanotonus margaritaceus, Pirenella plicata*). Six metres above the latter there is a molluscan lumachella with abundant *Tympanotonus* and *Pirenella* and some *Galeodes cf. semseyiana*. Probably identical with these deposits is a dominantly gravelly coarse sandy complex (Patak-1) on a hillside near the wine cellars at the northeast end of Patak village (Fig. 18), in the exact strike of the former localities. In the deeper portions of the profile, *Glycymeris latiradiata* s. l. abounds together with *Pitar beyrichi*. At all three occurrences of this coarse sandy member (Rétság-1, Borsosberény-1, Patak-1), the faunae indicate an Upper Oligocene age.

Proceeding farther down the dip, we run up at Tolmács against the uppermost member of the Upper Oligocene. In a large exposure at the southeast end of the village, sands and clayey sands are seen to

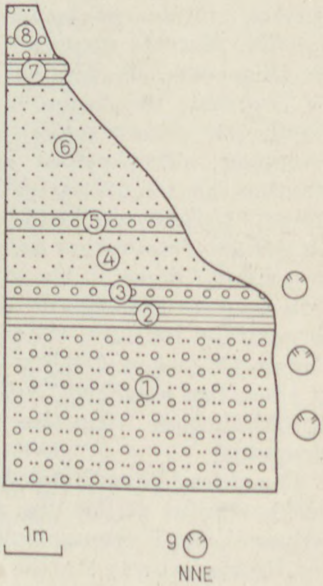


Fig. 18. Exposure on the northeast border of Patak, near the cellars (Patak-1). Legend: 1. Sand with *Glycymeris latiradiata* community. 2. Clay bands with plant debris. 3. A gravel bed with sparse *Glycymeris*. 4. Medium-grained sand. 5. Gravel bed. 6. Medium-grained sand. 7. Brown hard sandstone ledge. 8. Coarse sand with lenses of fine gravel. 9. *Glycymeris latiradiata* community

alternate (Tolmács-3). Near the bottom of the profile there are a bed with *Ostrea cyathula* and a cerithian lumachella (with *Tympanotonus margaritaceus* and *Pirenella plicata*) and not far above it a bed with glycymerids (Fig. 19). These cerithian strata as well as the *Pitar undata* specimens found in a well dug on top of a hillock northeast of this locality both recall the deposits of Temető Hill at Diósjenő, which, cropping out from beneath the Miocene there, represent a young member of the Oligocene. A sand pit near Sziluska-puszta (Tolmács-4) and another at the southwest end of the village (Tolmács-5) have yielded microfaunae of markedly Miocene aspect from quartz sands. Horusitzky (1942) mentions some "Aquitanian" also from Tolmács, but his exposure must have been obliterated since. In the course of our exploration, we found no evidence of Lower Miocene deposits in these parts.

West of Tolmács, the fossil-rich older Upper Oligocene on the shores of Jenő Lake had, even a century ago, attracted the attention of M. Hörnes. True, the exposure described by Hantken (1967b) is not in evidence today, but the bluff at the east-southeastern end of the lake, placed into the "upper level of the Lower Miocene" by Sümeghy (1923) and into the "Aquitanian" by Horusitzky (1942), can still be readily investigated (Fig. 20, Diósjenő-8). We collected altogether 26 species from the deeper-lying clayey silt, the Turritella sand and the overlying glycymerid bed (Column 27 of Table I): they belong to the *Glycymeris latiradiata* and *Turritella venus* communities. The single Miocene species *Euthriofusus burdigalensis* is compensated for by the typical Oligocene forms *Nucula comta*, *Pitar beyrichi* and *Turricula regularis*, quite apart from the large *Globularia* and some endemic forms of the Paretethyan Upper Oligocene which make up the fauna together with some persistent

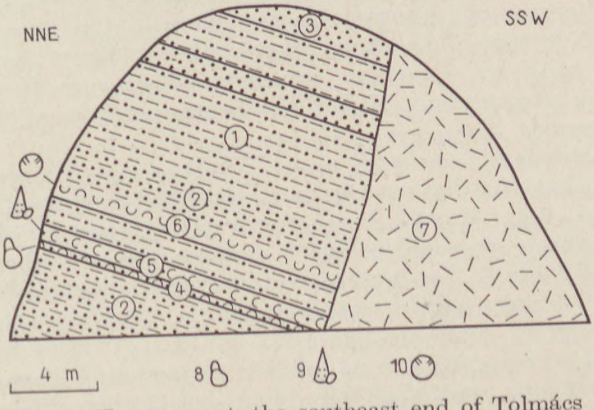


Fig. 19. Exposure at the southeast end of Tolmács (Tolmács-3). Legend: 1. Clayey silt with coalified plant debris. 2. Alternation of sand and clayey silt. 3. Grey medium grained sand. 4. *Ostrea* bed. 5. Clayey sand with a *Tympanotonus-Pirenella* community. 6. A *Glycymeris* bed with a *Glycymeris latiradiata* community. 7. Talus-covered section. 8. *Ostrea* bed. 9. *Tympanotonus*. 10. *Glycymeris*

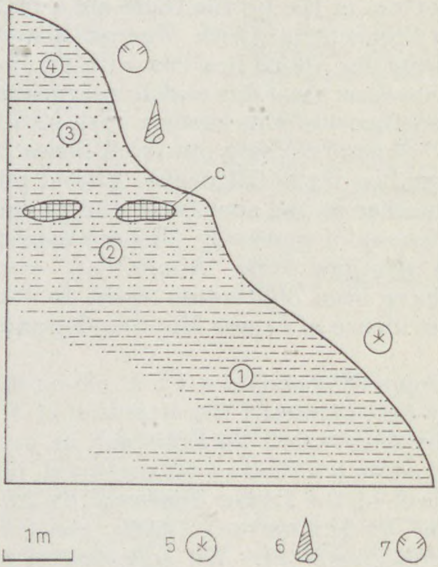


Fig. 20. Profile of bluff at southwest end of Jenő Lake (Diósjenő-8). Legend: 1. Clayey silt with a *Schizaster* cf. *acuminatus* community. 2. Fossil-poor clayey fines and with row (c) of metre-size concretions. 3. Yellow sand with a mixed *Turritella venus* community in washed-up pockets. 4. Grey clayey silt with a *Glycymeris latiradiata* community. 5. A *Schizaster* cf. *acuminatus* community. 6. A *Turritella venus* community. 7. A *Glycymeris latiradiata* community

forms. Speaking in figures, there are 13 percent Oligocene, 4 percent Miocene, 21 percent endemic, 26 percent unsatisfactorily identified, and 36 percent persistent species.

From a clayey fine sand exposed in a small sand pit (Diósjenő-7) on an elongate hillock southwest of Jenő Lake we collected a mollusc fauna of 36 species, a mixture of the *Glycymeris latiradiata* and the *Turritella venus* communities (Column 26 of Table I). This area was mapped as "Chattian" by Horusitzky (1942): the fauna much resembles that of the above-described locality Dj-8; it contains but a few more Egerian species. The stratigraphic analysis of this fauna gave the following percentages: Oligocene, 31; Miocene, 5; endemic, 11; unsatisfactorily identified, 11; and persistent, 42. *Turritella venus* and *Athleta rarispina*, usually regarded as Miocene, are known also elsewhere in the Paratethyan Upper Oligocene. 62 percent of the fauna occurs also at Eger; the affinity is enhanced especially by *Diastoma grateloupi turritoapenninica, Babylonia eburnoides umbilicosiformis, Bullia hungarica, Galeodes cf. basilica, Conus dujardini egerensis.*

There is a rich fauna northeast of Diósjenő, not far from the village, in the cut of a dirt road branching off the Szomolyapuszta highway (Diósjenő-24). From a loose, fine sand overlain by clayey silt with *Pholadomya puschi* we could collect a mollusc fauna numbering 30 species (Column 28 of Table I). The large-sized bivalves and gastropods of the fauna constitute a *Glycymeris latiradiata* community recalling the splendid mollusc assemblages of some shallow sand banks in today's warm seas. The biostratigraphic composition is as follows: 33 percent Oligocene, 10 percent Miocene, 20 percent unsatisfactorily identified, 20 percent endemic and 17 percent persistent. Of the Miocene species, the presence of *Pitar gigas schafferi,* a form very widespread in the Paratethyan Lower Miocene (Eggenburgian), is astonishing as it has not so far been encountered at any other Upper Oligocene locality (except perhaps Kováčov). The fauna resembles also those of Eger and especially of Kováčov (60 percent of the species are common): let it suffice to cite *Trisidos schafarziki, Crassatella* *carcarensis, Cardium egerense, Venus multilamella, Protoma cathedralis, Rostellaria dentata, Zonaria subexcisa*, and *Cassidaria depressa*.

On a southwestern outrunner of Szőlő Hill at Diósjenő we meet once more the higher members of the Upper Oligocene which here dip under the Carpathian, in an east-southeasterly direction. A string of exposures beginning at the cemetery permits to reconstruct a succession complete except for a few small gaps (Figs 21, 22). The faunae collected here were placed into "the upper level of the Lower Miocene" by Sümeghy (1923); on the other hand, Horusitzky (1942) placed the Turritella sand at the bottom into the "Upper Stampian" (Upper Oligocene) and the overlying cerithian beds into the "Aquitanium" (Lower Miocene); he termed the beds overlying these latter the "Lower Budigalian terrestrial succession".

In the environs of the cemetery, there are clayey silts and finer and coarser sands in rather rapid alternation, with a number of intercalated sandstone ledges (Fig. 22). At the bottom of the profile some marine beds appear, with abundant *Nucula comta, Bullia hungarica, Typhis* cf. *pungens, Angulus* sp. *Cardium heeri, Turricula regularis.*

The terminal layer of this marine episode is a fine sand with large numbers of *Turritella venus* swept together in pockets.

The above-named deposits can be studied in the wine cellars at the foot of the church hill, and in the cut of a dirt road leading from the village on to Cemetery Hill (Diósjenő-1). Along this latter road, leaving behind the last houses of Diósjenő one finds a fossil-rich sand bed hardly 1.5 m thick overlying the beds of Diósjenő-1. In the bottom part of the sand bed there is a *Tympanotonus-Pirenella* community: the fossils of its top part constitute a *Mytilus aquitanicus* community. The species (Column 23 of Table I) exhibit the following distribution: Oligocene, 9; Miocene, 23; endemic, 9; unsatisfactorily identified, 23; and persistent, 36 percent. These figures seem to bear out Sümeghy's and Horusitzky's judgment concerning the Miocene age of the fauna. The reason why I have placed it in the Upper Oligocene notwithstanding was the same as in the case of the Pomáz fauna (P-6), of strikingly similar composition; to wit, certain divergences of the Miocene elements from their types and the presence of indiscutably Oligocene assemblages higher up in the succession.

Higher up in the profile, we find some more cerithian strata at the cemetery gate (Diósjenő-3). These have yielded 18 species of mollusc (Column 24 of Table I), in the following distribution: Oligocene, 11; Miocene, 17; endemic, 28; unsatisfactorily identified, 5; persistent, 39 percent. Besides the Oligocene *Ostrea cyathula* and *Ampullina crassatina*, the Miocene element is represented by *Pitar undata, Ocinebrina schöni, O. crassilabiata trivaricosa*. This bed has further furnished several specimens of *Galeodes semseyiana*. Horusitzky (1942), who had also observed this fossil, confused it, however, with *G. lainei* and ascribed to it a great stratigraphic significance. *G. lainei* has not so far been found in Hungary; the Diósjenő specimens do certainly not belong to this species: on the contrary, they agree in all features with the endemic form described by Erdős (1900) from the Cyrena beds of Pomáz.

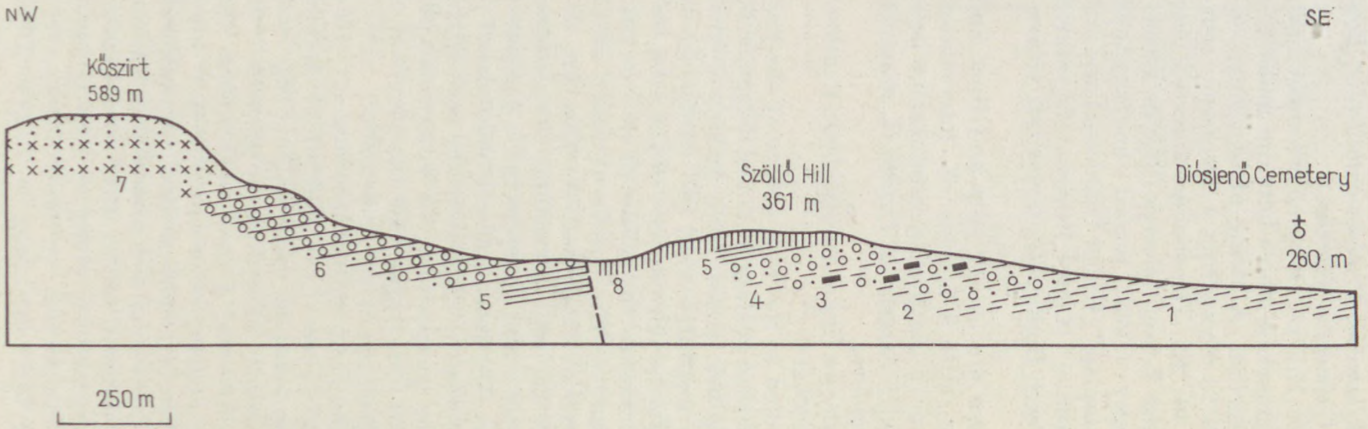
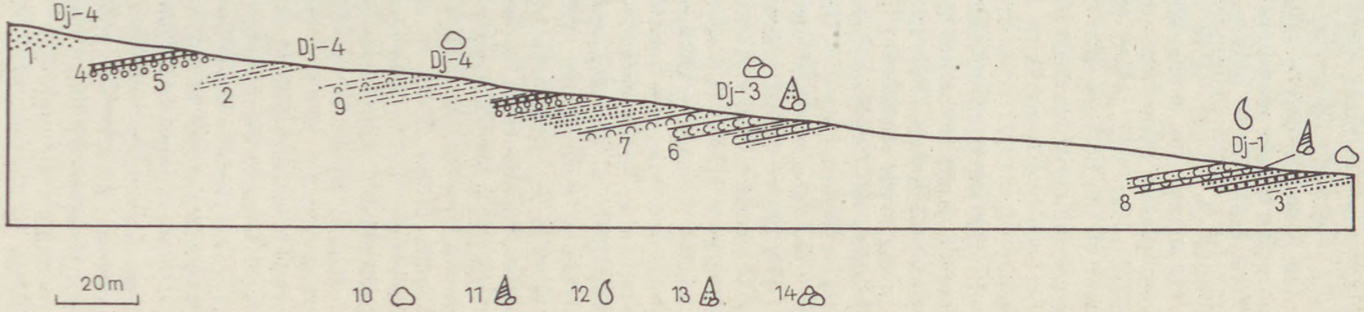


Fig. 21. Profile north of Diósjenő, from Szőlő Hill to Kőszirt Peak. Legend: 1. Upper Oligocene alternating clays, sands and sandstones, all fossil-rich. 2 and 3. ? Upper Oligocene succession with lignite traces: coarse sand with clayey intercalations, stringers of lignite and coalified driftwood, and with a sparse marine fauna. 4. Helvetian ("Carpathian") sandstone, calcareous sand with Tapes (Paphia). 5. Helvetian ("Carpathian") marly silt (Schlier) with siliceous sponge spicules. 6. Helvetian ("Carpathian") coarse sand, sandstone and conglomerate, with a sparsely glauconitic foraminiferan sand, clay-banded, near the bottom, and scarce, well-worn fragments of *Ostrea* and *Balanus* in its top portion. 7. Andesite complex. 8. Quaternary



In the sand directly overlying the cerithian bed there is a *Pitar undata* community of 13 species with the following percentages: Oligocene, 8; Miocene, 16; endemic, 31; and persistent, 45.

Above the Miocene-looking fauna just described, from a higher section of the profile (Diósjenő-4) we collected a marine fauna of 23 species belonging to the *Pitar polytropa* community (Column 25 of Table I). Composed of 35 percent Oligocene, 9 percent endemic, 13 percent unsatisfactorily identified and 43 percent persistent forms, it contains not a single Miocene species. This proves that, despite their faunae of Miocene aspect, no strata older than this one may be considered Miocene. Hence, our findings at both Pomáz and Diósjenő reveal that the Miocene species did not invade all the various Upper Oligocene biotopes at once. In certain littoral biotopes, e.g. those represented by the *Pitar undata* and *Mytilus aquitanicus* communities, Miocene species might have gained the upper hand at a time when the contemporary sublittoral faunae were still typically Oligocene. This state of facts had been clearly recognized by **Böckh** (1899) who emphasized the younger aspect of the brackwater facies as compared with the marine faunae. The fauna of the locality Diósjenő-4, with dominant *Crassatella carcarensis*, *Clavagella oblita* and *Diastoma grateloupi turritoapenninica* much resembles the Eger fauna: 67 percent of its species is common with it.

A microfossil analysis of the more than 30 samples taken on Cemetery Hill (**Nyirő** in **Báldi** et al. 1965) revealed an exclusively Oligocene foraminifer fauna.

The cerithian strata contain assemblages of just a few species with *Ammonia beccarii* and *Nonion*, whereas the upper, marine beds of the profile (Diósjenő-4) are rich in species. Planktonic forms appear even in the cerithian beds, proving the open-sea connexions of these littoral facies.

The above-described Upper Oligocene of Cemetery Hill is overlain by "strata with coal traces" (**Báldi** et al. 1965) which we could examine in the wine cellars at the foot of Szőlő Hill and in a few test pits. It is this complex of strata that was called the "Burdigalian terrestrial succession" by **Horusitzky** (1942). It is composed of well-sorted, homogeneous coarse sand with muscovite or cross-stratified gravelly coarse sand, but not without some clayey intercalations. In the top 30 m of this succession of 100 m total thickness, there are traces of brown coal in the form of irregularly scattered allochthonous lenses at most 10 cm thick and one metre across, recognizably formed out of local accumulations of driftwood.

←

Fig. 22. Profile of Cemetery Hill (southeastern outrunner of Szőllő Hill) at Diósjenő. Enlarged detail of Fig. 21, showing the position of localities Diósjenő-1, -3 and -4. Legend: Yellow or grey sand. 2. Clayey silt, grey clay. 3. Grey clay and yellow sand alternating. 4. Hard brown sandstone ledge. 5. Gravelly coarse sand. 6. Clayey sand with a *Mytilus* aquitanicus community at Dj-1 and a *Tympanotonus-Pirenella* community at Dj-3. 7. Fine sand with a *Pitar undata* community. 10. A *Pitar polytropa* community. 11. A *Turritella venus* community. 12. A *Mytilus aquitanicus* community. 13. A *Tympanotonus-Pirenella* community. 14. A *Pitar undata* community

Micropalaeontology revealed (Nyirő in Báldi et al. 1965) that (1) these beds are far from terrestrial, as they contain rich assemblages of marine foraminifers (we have even found some poorly preserved *Nucula cf. schmidti* at the level of the coal lenses), (2) they are decidedly Oligocene; they may represent the top of the Upper Oligocene here, being unconformably overlain as they are by the Paphia (Tapes) beds of the Carpathian.

Summing up our observations in the Börzsöny Mountains we may state that *Tympanotonus-Pirenella* communities occur at both deeper and higher levels in the Upper Oligocene. Still, in the deeper Upper Oligocene, shallow sublittoral communities are more frequent, often very similar to the fauna of the "k layer" of Eger, and the Törökbálint fauna (Jenő Lake, Rétság, Pusztaberki, Dejtár). They are overlain by a succession of coarse- and medium-grained sands of considerable thickness dominated by the *Glycymeris latiradiata* community (Rétság-3, Borsosberény-1, Patak-1). At the higher levels, the littoral communities gain the upper hand (*Tympanotonus-Pirenella, Mytilus aquitanicus, Pitar undata*); some of the faunae of these upper littoral euryhaline communities bear markedly Miocene features. The shallow sublittoral communities intercalated with them much resemble the Eger fauna and, in contrast with the littoral communities, exhibit markedly Oligocene traits. This level is exposed on the southwestern outrunner of Szőlő Hill at Diósjenő (Dj-1, 3, 4) and at Nagyoroszi (No-1), Tolmács (Tm-3, 4, 5). Finally, the Upper Oligocene ends in some dominantly coarse-sandy, fossil-poor beds with coal traces on Szőlő Hill at Diósjenő.

(d) *The environs of Becske (Fig. 14)*

In the east, the Diósjenő—Rétság Upper Oligocene continues up to the Galga Valley in similar shallow sublittoral and littoral facies. The foundations of our knowledge concerning the Oligocene of Balassagyarmat and of the Galga Valley were laid by Noszky J. sen. (1914, 1917, 1940a,b, 1941c). Mapping this area, Ferenczi (1939a, 1942) and Horusitzky (1939a, 1942a) examined and discussed its Upper Oligocene in some detail. Further valuable data are to be found in Gaál (1938) and in manuscript reports of S. Vitális. Of the publications on the Slovakian continuation, Seneš (1952), with numerous macrofossil lists, is of outstanding value.

Controversies connected with this area arose among others about the age of the Becske coal seam (Noszky identified it with the Salgótarján seams: Horusitzky held it to be Late Oligocene) and about the age of the strata with Anomia and large Pecten: (Noszky placed them into the Upper Oligocene: Horusitzky into the Aquitanian stage of the Lower Miocene). Except for the Balassagyarmat locality, now on Slovakian territory, whose fauna was described in detail by Gaál, the Upper Oligocene mollusc fauna of this area was described in just a few short and incomplete fossil lists. In order to collect some much-needed additional information about the mollusc faunae of this area I mapped the broader environs of Becske and collected its fossils over several weeks in the company of I. Csepreghy-Meznerics and R. Nyirő. The results of this work have not yet been published.

In the environs of Becske, the Upper Oligocene largely consists of clayey silt, with local marly and fine sandy varieties, but with altogether much less coarse detritic interbeddings than in the preceding area. This is due to the palaeogeographical position of the area lying farther offshore, bordering on the deepest part of the sedimentary basin. Still, the areal extent of the not infrequent "cyrena beds" and the frequency of shallow sublittoral facies prove this area to belong still to the shallow sublittoral zone, the Pilis—Western Cserhát unit.

The Upper Oligocene is underlain here by the Kiscell Clay, known only from boreholes in this area. It is overlain by Lower Miocene (Eggenburgian) calcareous conglomerates with *Anomia*, sands and sandstones, locally with large pectinids, e.g. in the road cut between Szügy and Nógrádmarcal, where the *Anomia* and *Ostrea* are accompanied by *Pecten pseudobeudanti*, an Eggenburgian index fossil. We found a somewhat richer Lower Miocene fauna in the *Anomia* conglomerate at Epres-major and in the sand pit between Patkányos and Fogacs-puszta: the Miocene age of the latter is proved by large *Paphia* and *Codakia* species, *Glycymeris cf. fichteli* and *Cardium kuebecki*.

The way the Lower Miocene (Eggenburgian) overlies the Upper Oligocene (Egerian) is most conspicuous in the profile of the Cemetery Hill at Becske (Fig. 23). The foot of the hill is disclosed in cuts behind the houses of east-westerly Kossuth Street and north-southerly Petőfi Street. Behind the houses of Kossuth Street, the Upper Oligocene silty clay marls and sandstones are well visible: their age is fixed by a relatively rich *Glycymeris latiradiata* community found in an exposure behind No. 18 (Becske-2; Column 32 of Table I). The most abundant species are *Nucula schmidti*, *Anadara gümbeli*, *Glycymeris latiradiata*, *Taras rotundatus* and *Turris laticlavia*. On the steep flank surmounting Petőfi Street of Cemetery Hill, the Upper Oligocene clayey silt exposed behind

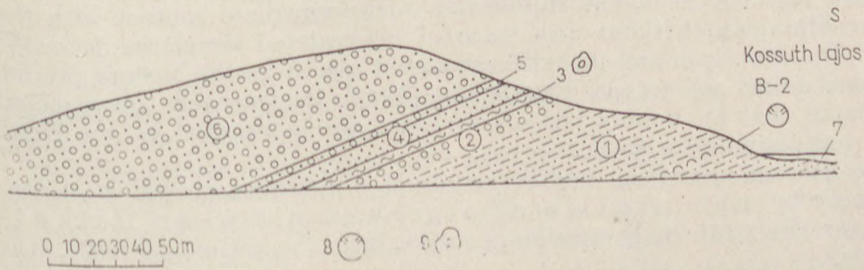


Fig. 23. Profile of Cemetery Hill on the northeast border of Becske (showing position of Upper Oligocene site Becske-2). Legend: 1. Upper Oligocene silty clay, clay marl, clayey silt, with intercalated sparsely pebbly coarse sands, with a *Glycymeris latiradiata* community. 2. Lower Miocene (Eggenburgian) coarse-grained sandstone, with large pebbles, growing coarser upwards. 3. Friable sandstone with marl bands, with small *Anomia ephippium*. 4. Ochre yellow well-sorted homogeneous friable sandstone with sparse *Anomia ephippium*. 5. Calcareous conglomerate ledge with giant pebbles. 6. Poorly exposed well-sorted sand alternating with conglomerate. 2 to 6 Lower Miocene. 7. Recent. 8. A *Glycymeris latiradiata* community. 9. *Anomia ephippium*

No. 21 is overlain in conspicuous conformity by Lower Miocene beds including a well-sorted homogeneous medium-grained sandstone, a brown sandstone, and ledges of calcareous conglomerate with giant pebbles. They contain *Anomia ephippium*, and *Ostrea*, *Laevicardium* and *Polymesoda* species unsuited for a closer identification.

Another exposure where an Oligocene-Miocene contact is to be presumed is a cut of the Mohora road north of Becske. Its profile was first described by FERENCZI (1942), who ascribed a great significance to the "Helix beds" occurring there. In our revision of the exposure we could not, however, collect a fauna rich enough to lend any palaeontological support to FERENCZI's views. Below the Helix bed a micaceous fine-grained sandstone alternates in a height of 4 m with a grey sandy clay which, judging by its lithological features, may well be Upper Oligocene. It is overlain by 2 m of clay with traces of coal and sand with clay lenses containing very poorly preserved *Ostrea*, *Anomia ephippium*, *Polymesoda* sp. indet.

It is here that we should raise the question of the age of the Becske coal seam which HORUSITZKY (1942a) held to be Upper Oligocene and placed, together with the accompanying terrestrial deposits, on the Oligocene-Miocene border as the closing unit of the "Stampian" cycle of sedimentation. He based his opinion on a single fauna collected by S. VITÁLIS from a waste tip, which, quite apart from its mode of collection, cannot be decisive because all the species enumerated by HORUSITZKY, except "*Potamides plicatus*", may occur in strata younger than Eggenburgian. HORUSITZKY's opinion is refuted also by the fact that on the Cemetery Hill at Becske, less than one kilometre from the now abandoned coal mines, the fully conformable Oligo-Miocene sequence bears no trace either of a coal seam, or of the terrestrial deposits which should be at least 20 or 30 metres thick. This intrigued HORUSITZKY himself, who wrote that "... west of the Délkút-major area, on the Cemetery Hill fault block directly adjacent to it, the Aquitanian is in immediate contact with the higher Stampian, without any trace of intercalated terrestrial deposits" (577). The coal seam and its suite are absent also from the Mohora profile, at least unless we accept FERENCZI's (1942) inadequately documented statement that at Mohora the above facies are substituted by the Helix beds, less than 1.5 m thick.

The Miocene age of the Becske coal seam is, however, proved most convincingly by the profile of a gravel pit near Délkút-major (Fig. 24). Its succession of strata, from the bottom upwards, is as follows.

1. A grey terrestrial clay with limonite concretions ("potter's clay"), not disclosed in the gravel pit.
2. A limnic brown coal seam (1 to 2 m below the gravel pit floor).
3. A terrestrial coarse sand.
4. A gravelly coarse sand growing clayey and even less well sorted near the top. Shallow marine molluscs (*Paphia* sp., *Chlamys scabrella*, *Anadara diluvii*) occur in this top part. They recall the Carpathian fauna of the

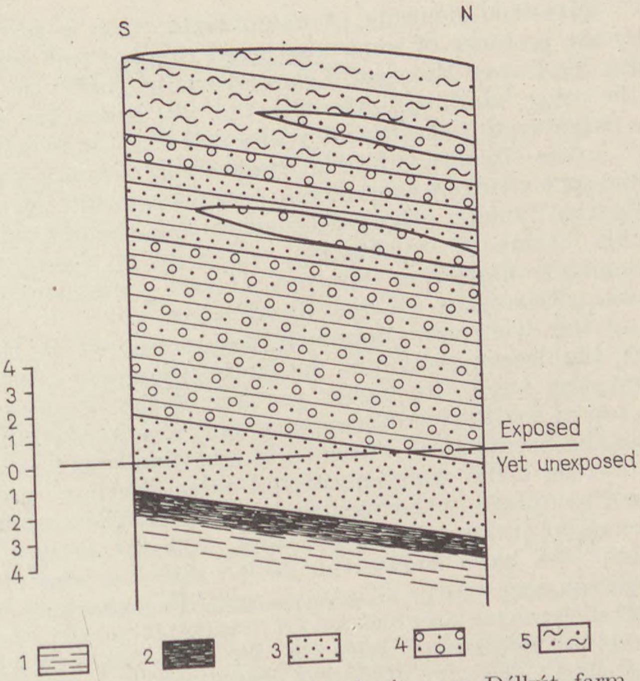


Fig. 24. Profile of the gravel pit near Délkút farm north of Becske. Legend: 1. Grey terrestrial clay with limonitic concretions. 2. A limnic lignite seam that used to be worked earlier in this area. 3. Coarse terrestrial sand. 4. Terrestrial gravelly coarse sand with altered pumice bombs. 5. Light grey silty marl with a gravel interbedding and a marine fauna ("Carpathian" Schlier). 1 to 4, terrestrial Ottnangian (Upper Burdigalian + Helvetian s. s.)

Chlamys sands overlying the coal seams and underlying the schlier formation in the Salgótarján Basin.

5. A few metres of light grey silty marl with a gravel interbedding and a marine fauna consisting of small *Arca*, *Tellina* and *Cuspidaria* specimens defying a closer identification. On a hillside to the northeast of the gravel pit there is an outcrop of some fine sandy and marly beds of Carpathian Schlier with *Arca*, *Nuculana*, *Myrthaea*, *Solen*, *Hinia*, *Conus* and *Aturia*. The similarity in bio- and lithofacies is sufficient proof that layer 5 forms the deepest level of this schlier. Provided there is no significant dislocation between the gravel pit and the hillside to the northeast, even the northerly dip observed at both places is sufficient to prove that the Carpathian ("Helvetian") schlier is the younger deposit.

The coal seam consequently lies, on the strength of what can be seen at Délkút, within the terrestrial succession, which grades into the schlier upwards. Hence, the terrestrial deposits of Becske correspond to the

"Ottnangian" terrestrial deposits of Salgótarján; this is proved among others also by the presence of some weathered rhyolite tuff pebbles, to be correlated with the Lower Miocene "Lower Rhyolite Tuff"; the limnic coal seam is, on the other hand, equivalent to the coal lenses and stringes observed in the Salgótarján terrestrial deposits and with the so-called "underspread seam" in the rhyolite tuff. The Becske coal seam is younger than the Upper Oligocene stringers sporadically occurring within the upper members of the Egerian (among others at Diósjenő), but slightly older than the three workable seams of Salgótarján, which lie at the bottom of the Upper Ottnangian transgressive sequence. It can consequently be placed into the Lower Ottnangian ("Upper Burdigalian").

According to the diastrophic approach, as represented by Horusitzky and Ferenczi, the deeper portion of the Upper Oligocene consisted of the marine Pectunculus sands, its higher portion of the brackwater Cyrena beds, and its top of the terrestrial deposits. This was in contradiction with the practice in the Szentendre—Visegrád Mountains, where — as we have seen — the "Cyrena beds" were considered older. We have proved above that this cannot be upheld in the Szentendre—Visegrád Mountains, because the two facies occur in irregular alternation, with the shallow sublittoral facies dominant. We have shown this to be the case also at Diósjenő. Assigning different ages to the "Cyrena" and "Pectunculus" beds is untenable at Becske, too.

The profile of an abandoned sand pit at the southeast end of Becske (Becske-1) clearly shows that the *Cyrena* fauna occurs lower in the sequence than a marine medium-depth sublittoral community (Fig. 25), that is, the order is the reverse of what was postulated by the Horusitzky—Ferenczi hypothesis. The fossil-bearing layer "a" has yielded *Pirenella plicata, Tympanotonus margaritaceus*; the layer "b", *Ampullina crassatina*. The "c" layer contains a *Polymesoda-Tympanotonus* community (34). From the "d" layer we have collected a rich marine medium-depth sublittoral fauna (Column 32 of Table I). Besides coalified driftwood and compressed boughs, the most frequent fossils are *Laevicardium cyprium* and *Bryozoa*. Among the remaining species, those indicative of an Oligocene age *Pecten arcuatus, Cavilucina droueti schloenbachi* and *Turricula regularis* are worth mentioning.

(e) *Summary*

Our review of the Upper Oligocene in the Pilis—Western Cserhát region leads to the conclusion that besides the delimitation against the Miocene the main problem here was that of the relative positions of the "Pectunculus" and "Cyrena" beds. I have proved above that neither facies is to be assigned a chronological value, as they occur in irregular alternation.

In this region the deposits underlying the Upper Oligocene invariably include the Kiscell Clay which, except for the western border (Dorog Basin), passes gradually into the Upper Oligocene (Egerian). On the eastern border of the region (at Becske), the Upper Oligocene is overlain by deposits of the

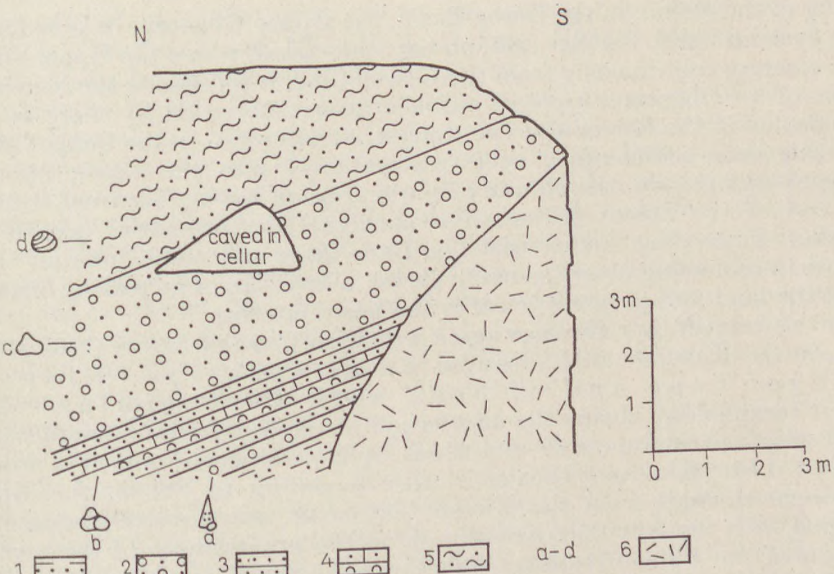


Fig. 25. Profile of abandoned sand pit at the southeast end of Becske (Becske-1). Legend: 1. Fine sand with clay bands. 2. Cross-stratified coarse sand with fine pebbles. 3. Friable fine-grained sandstone. 4. Fossil-bearing fine sandstone overlain by a calcareous sandstone forming a hard ledge. 5. Clayey-silty fine-grained sandstone, silty clay. 6. Talus covering part of the exposure. a = a *Tympanotonus-Pirenella* community, b = *Ampullina crassatina*, c = a *Polymesoda-Tympanotonus* community, d = a *Pitar beyrichi* community

Lower Miocene (Eggenburgian) littoral: elsewhere (in the Szentendre—Visegrád Mountains and in the Börzsöny), it is unconformably overlain by "Helvetian" (Carpathian) deposits.

Of the aggregate thickness of the fossil-bearing layers, 50 to 60 percent is made up by beds with shallow sublittoral communities, that is conditions were dominantly shallow sublittoral in the Pilis and Western Cserhát region.

The subordinate importance of the mesohaline, more or less closed lagoon facies in shown by the fact that beds with *Polymesoda-Tympanotonus* communities constitute no more than 10 to 20 percent of the aggregate thickness. The various littoral communities (*Tympanotonus-Pirenella*, *Mytilus aquitanicus*, *Pitar undata*) make up about the same percentage. The scarce medium-depth and freshwater-oligohaline interbeddings are more or less restricted to the bottom and top portions of the sequence. Wherever the Kiscell Clay grades into the Upper Oligocene, the deepest portion of the latter is likely to include medium-depth or even deeper communities (Rétság-2, Leányfalu-2, Esztergom 40). A gradual regression is indicated by the presence of terrestrial and freshwater communities at the highest levels of the sequences (Pomáz-6, Szentendre-2, Mohora). On the western border of the region, in the Dorog Basin, the Upper Oligocene is a sedimentary cycle in itself. Farther east, on the other hand, where the Upper Oligocene emerges continuously from the Kiscell Clay, it represents the regressive phase of an Oligocene cycle of sedimentation, succeeded by more or less denudation in the Lower Miocene (terrestrial deposits). In the Galga Valley, the Oligocene sedimentary cycle reached over into the Lower Miocene (Eggenburgian), too, the climax of the regression having occurred there at the end of the Lower Miocene (Ottnangian) (the terrestrial deposits at Becske). Proceeding farther east one finds more and more "marine" conditions, a coalescing of sedimentary cycles, a sure sign of increasing distance from the land and progress towards the basin interior.

In this respect, our findings agree well with those of Seneš (1960, 1964) who, in the Kováčov area, observed an alternation of faunae of Eger type and of beds with Pectunculus, which in our terminology means the alternation of the *Glycymeris latiradiata* and *Pitar polytropa* communities and which we have observed ourselves around Pomáz, Leányfalu and Diósjenő. Also according to Seneš, the Upper Oligocene emerges from the Kiscell Clay with transgressive deposits, in keeping with the fact that Kováčov is on the prolongation of the western margin of the Pilis—Western Cserhát region. Seneš, too, found medium-depth sublittoral faunae ("Echinoid schlier") at the deeper levels and a freshwater facies in the topmost beds.

4. THE BUDAPEST REGION (Fig. 5)

In the north, along a line joining Máriahalom, Budakalász and Csomád, it faces the shallow littoral belt; in the west, between Máriahalom and Zsámbék, it contacts the Vértes-Gerecse Upper Oligocene. Its southern and eastern limits are uncertain. If we class here the Oligocene traversed by boreholes at Bugyi and Tóalmás, then it extends to the south and east at least to these villages. In practice, however, this region encompasses the Upper Oligocene of the northern, western and southern slopes of the Buda Mountains, and that of the hummocks east of the Danube (Csomád, Őrszentmiklós, Gödöllő, Annatelep, and the subsoil of Budapest). Since the fundamental work of Hofmann (1871), the Upper Oligocene of the Buda Mountains was treated especially in Fuchs (1893), Halaváts (1910), Koch (1911), Kulcsár (1915), Földvári (1929), Schafarzik (1922), Schafarzik and Vendl (1929), Ferenczi et al. (1939b), Majzon (1939), Csepreghy-Meznerics (1956), Báldi (1958, 1959, 1964), Vadász (1960), Nyirő (1962), Bondor (1963). Concerning the left bank of the Danube, Lőrenthey (1911), Bartkó (1937), Horusitzky (1939b), Rozlozsnik (1939), Schmidt (1939), Majzon (1939, 1942d), Szentes and Bartkó (1947), Szentes (1952), Wekerle (1932), Sz.-Hajós (1955), Mrs Csongrádi et al. (1959), Horusitzky (in Schréter et al. 1958), Vadász (1960) contain information also about the Upper Oligocene.

The Upper Oligocene (Egerian) is 200 m thick south of the Buda Mountains, and also about Solymár and Máriahalom. On the left bank, Mrs

Csongrádi et al. (1959) gave 130 to 260 metres, but farther east in the borehole Csomád 1 and Gödöllő 3, Majzon (1942d) stated the Upper Oligocene to be thicker than 400 or 500 m.

Lithologically this Upper Oligocene is largely composed of silty, fine-sandy clays, clayey silts, clayey fine-grained sandstones, with thinner and less frequent gravelly and coarse sandy interbeddings. Even though coalified plant remains are frequent here, too, brown coal lenses and stringers are restricted to the highest (Budafok-1, Pacsirta Hill) or lowest (Solymár-72) parts of the successions. According to Bondor (1963), the minerals in the Upper Oligocene of Törökbálint came from a metamorphic region to the north and northwest. The dominant heavy minerals are garnet and amphibole-glaucophane. Erosion products of Late Eocene volcanics are rather less abundant in this region. Just as in the regions described above, the carbonate content seldom exceeds 10 percent.

The upper Oligocene most often overlies the Kiscell Clay. At Törökbálint, even the highest of Majzon's Rupelian foraminifer horizons could be identified by Nyirő (1963); also, there is a continuous transition from the Kiscell Clay to the Upper Oligocene (S. Vitális 1941 and Báldi 1958). Similar conditions prevail also on the left bank, as described by Horusitzky and Majzon. On the other hand, on the northern border of the Buda Mountains, between Máriahalom and Szomor, just as in the adjacent Vértes-Gerecse facies region, the Upper Oligocene transgresses over pre-Oligocene rocks. Near Solymár there is the Kiscell Clay beneath the Upper Oligocene, but the brackwater and freshwater interbeddings at the base of the latter indicate the beginning of a new sedimentary cycle and possibly even a hiatus.

The Upper Oligocene is overlain in the southern Buda Mountains and on the hummocks of the left bank, east of the Rákosszentmihály—Csomád line, by coarse sands with *Anomia* and large *Pecten* of the Lower Miocene (Eggenburgian); the finest fauna of this formation is known from Budafok. It was here, in an exposure on Pacsirta Hill (Budafok-1) that I could observe the conformable transition from the Upper Oligocene (Egerian) into the Lower Miocene (Eggenburgian), as had done Schafarzik and Földvári before me.

On Pacsirta Hill at Budafok, rather poorly exposed today, I could on the basis of my observations and collections from 1958 on piece together a fairly complete profile (Báldi 1963) and then fill its gaps in 1967 on the basis of some new exposures. At the base of the succession, the highest Pectunculus beds of the Upper Oligocene are exposed, in the following succession from the bottom upward (Fig. 26):

1. A sandy clay.
2. A yellow coarse-grained friable sandstone with coalified plant remains, and a stringer of brown coal.
3. A fine sand.
4. A fine fossiliferous sand with a rich mollusc fauna counting 35 species (Column 33 of Table I), a condensation (a mixing together owing to slow deposition) of a *Glycymeris latiradiata* and a *Tympanotonus-Pirenella* com-

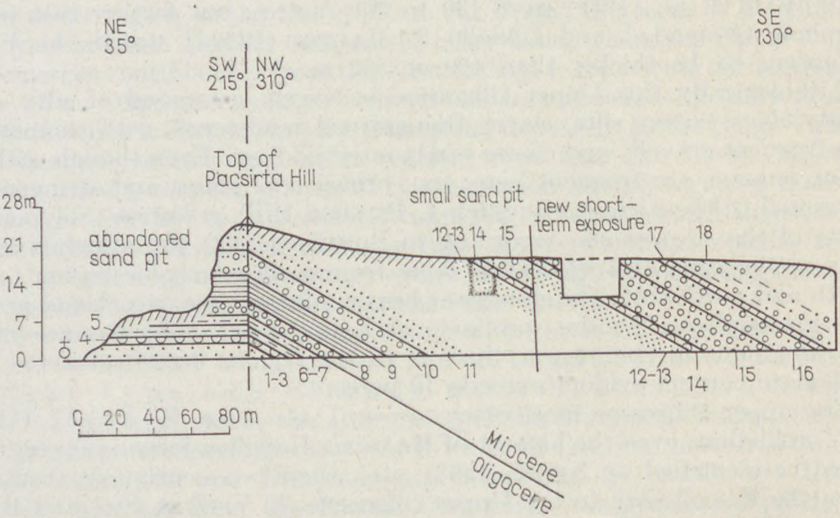


Fig. 26. Profile of Pacsirta Hill at Budafok on the outskirts of Budapest (Budafok-1). Profile in Báldi (1963) complemented by a re-examination in 1967. Numbering of beds unchanged. For explanations see text

munity. The Oligocene species (34 percent) outweigh the Miocene ones (14 percent), which fact determines the age of the deposit. There is a marked similarity to the faunae of the "k layer" of Eger and to the highest Oligocene levels at Kováčov (72 percent). This fauna can be regarded as a Budafokian counterpart of the Eger fauna (e.g. owing to the presence of *Egerea collectiva*).

5. A grey silty clay.

6. The same with poorly preserved molluscs.

7. An alternation of silty clay and clayey fine sand with ostracods and scarce foraminifers.

The strata above Layer 7 are Miocene:

8. A coarse sand with fine pebbles, with very numerous mollusc shells indicative of a seashore environment. Its fauna of 42 species (Table II), contains besides some very scarce Oligocene relics, which should be regarded as more or less persistent forms anyway, 38 percent Miocene elements. The similarity to the faunae of the Eggenburg formation, of the Bavarian molasse (Kaltenbachgraben), of Transylvania (Korod) and of the inseparable Aquitanian and Burdigalian of the Aquitanian Basin also prove Layer 8 to be already Miocene: I have consequently drawn the Oligocene—Miocene limit between layers 7 and 8.

9. A finely stratified shaly clayey fine sand with plant remains (a littoral-mudflat, "watt" deposit, cf. Báldi 1959).

10. A gravelly coarse sand, and a calcareous conglomerate with, among others, *Ostrea edulis* and *Pecten pseudobeudanti*, *Chlamys gigas* and *Ch. opercularis*.

11. A fine sand with concretions.

12. A sandy gravel.

13. A coarse sand with large Pecten (*Chlamys gigas, Ch. scabrella, Ch. opercularis, Anomia ephippium*).

14. A "valve pavement" composed of valves of *Glycymeris fichteli* and *Chlamys gigas*.

15. A coarse sand with *Anomia ephippium*, locally in masses. Less abundant *Chlamys gigas. Ch. opercularis, Ch. scabrella*.

16. A coarse sand with muscovite, and somewhat less abundant *Anomia*.

17. A coarse sand gravel, with lenses of hard grey sandstone and conglomerate, and with bands of lumachella. Its fauna includes *Pecten pseudobeudanti, Chlamys gigas, Anomia ephippium, Ostrea* sp. div., *Turritella terebralis, Phalium subsulcosum, Babylonia eburnoides* etc.

18. A little-sorted clayey and gravelly sand with scarce Ostracods.

The succession from layer 8 to layer 18 is indubitably Lower Miocene (Eggenburgian): Layer 8 was described in the series "Stratotypen und Neostratotypen" as a faciostratotype of the Eggenburgian.

A profile similar to that of Pacsirta Hill, once exposed in the Nagyárok (Great Ravine) of Budafok, is totally buried today.

The alternation of diverse facies is typical also in this region within the Upper Oligocene successions. The percentage distribution of communities is as follows: of the total thickness of the fossiliferous layers, 50 percent is medium-depth sublittoral, 30 percent shallow sublittoral; 10 to 20 percent contains a *Polymesoda-Tympanotonus* community; 0 to 1 percent is littoral or contains a *Viviparus-Brotia* community. In contrast, then, with the shallow-sublittoral belt, the medium-depth sublittoral facies becomes quite widespread here; that is, water depth varied from a 30 metres up to about 120 metres. The *Polymesoda-Tympanotonus* and *Viviparus-Brotia* communities occur on the northwestern margin of the region, which is contiguous with a lagoon belt, but even there they are restricted to the deeper levels of the successions (Máriahalom 36). At these same places, medium-depth sublittoral deposits are fairly frequent at the higher levels. The vertical succession of communities thus outlines an independent cycle of sedimentation, of which, however, only the phase of transgression is preserved; the deposits of the subsequent phases fell prey to a post-Oligocene denudation (cf. Ch. II). This is the case also around Solymár, where the transgressive phase of an independent Upper Oligocene cycle of sedimentation can be recognized (terrestrial and mesohaline interbeddings below, sublittoral communities farther above), although the Upper Oligocene is underlain here by a more or less eroded Kiscell Clay. Farther southeast, in the region of gradual emergence from the Kiscell Clay (Törökbálint, Budafok), where the Upper Oligocene is covered, likewise conformably, by a littoral-shallow sublittoral Lower Miocene, this sedimentary cycle loses its independence and merges into a larger unit. The mesohaline and oligohaline interbeddings of the lower levels drop out; a "schlier" appears instead as a transition towards the Kiscell Clay, most often with a *Schizaster* community (Budaőrs-1). The uppermost levels were not touched by erosion; they contain littoral communities. In the Törökbálint and Budafok areas, then, and on the left bank, the Upper Oligocene deposits merely form part of the great Oligocene—Lower Miocene cycle, an important episode within the regressive phase of the latter.

The best-known, often-cited Upper Oligocene succession of the Budapest region is the one exposed at Törökbálint, often regarded as the type locality of the Pectunculus sands.

The first to treat its abundant fauna was Hofmann (1871), who held it to be Upper Oligocene, that is, Aquitanian after the conception of his time. Upon his activity followed Fuchs's correction (1893), which was of a purely terminological nature and did not affect the correlation performed by Hofmann: indeed, Fuchs himself underscored the contemporaneity of the Kassel and Törökbálint faunae. Although Fuchs designated the Kassel sand as the type of the Chattian stage, in the course of several decades of subsequent controversy, the Pectunculus sands of Törökbálint were also often cited. For a long time, authors agreed that they were Upper Oligocene. The first to question this view was Csepreghy-Meznerics (1956), who placed the Törökbálint fauna into the Lower Miocene Aquitanian stage, deeming it contemporaneous with the Eger fauna. Seneš and Cicha also reached this conclusion, whereas Merklin (1959), pointing out the considerable similarity between the Törökbálint fauna and the fauna of the strata with *Corbula helmerseni* in the southern Soviet Union, emphasized the preponderance of the Oligocene species.

In the course of these discussions the question about the contemporaneity of the Eger and Törökbálint faunae was repeatedly raised. The monographers of the former, Telegdi-Roth (1914) and Noszky sen. (1936) placed both into the Upper Oligocene, but regarded the Eger fauna as somewhat younger. Gaál (1938) and Horusitzky (1940) saw an age difference of stage size between the two faunae, considering the Törökbálint fauna as Upper Oligocene and the Eger fauna as Lower Miocene. Csepreghy-Meznerics (1956) and Seneš (1958) adduced sufficient evidence to prove the contemporaneity of the two faunae.

Another controversial point was the age of the "Budafok beds with large-Pecten" overlying the Pectunculus sands. Although Hofmann (1871), and after him Fuchs (1893), Böckh (1899) and Schafarzik (1922) could clearly distinguish these beds and establish their age as "Lower Mediterranean", Noszky sen. (1926), recognizing their connexion with the Oligocene sedimentary cycle and disregarding the palaeontological evidence, placed also the "large-Pecten beds" into the Upper Oligocene. This view was adopted in part by Földvári (1929) who described these deposits as "transitional Oligo-Miocene". Horusitzky correctly pointed out the Lower Miocene age of the large-Pecten beds of Budafok, placing them first in the Burdigalian (1934), and subsequently in the Aquitanian (1958). Almost as soon as the Noszky—Horusitzky debate (Noszky sen. 1935, Horusitzky 1934) had abated, another memorable controversy flared up when Csepreghy-Meznerics, on the basis of her studies first on the roof (1952) and then on the floor (1953) of the Salgótarján coal measures, established the Burdigalian age of the large-Pecten beds of Budafok (1956).

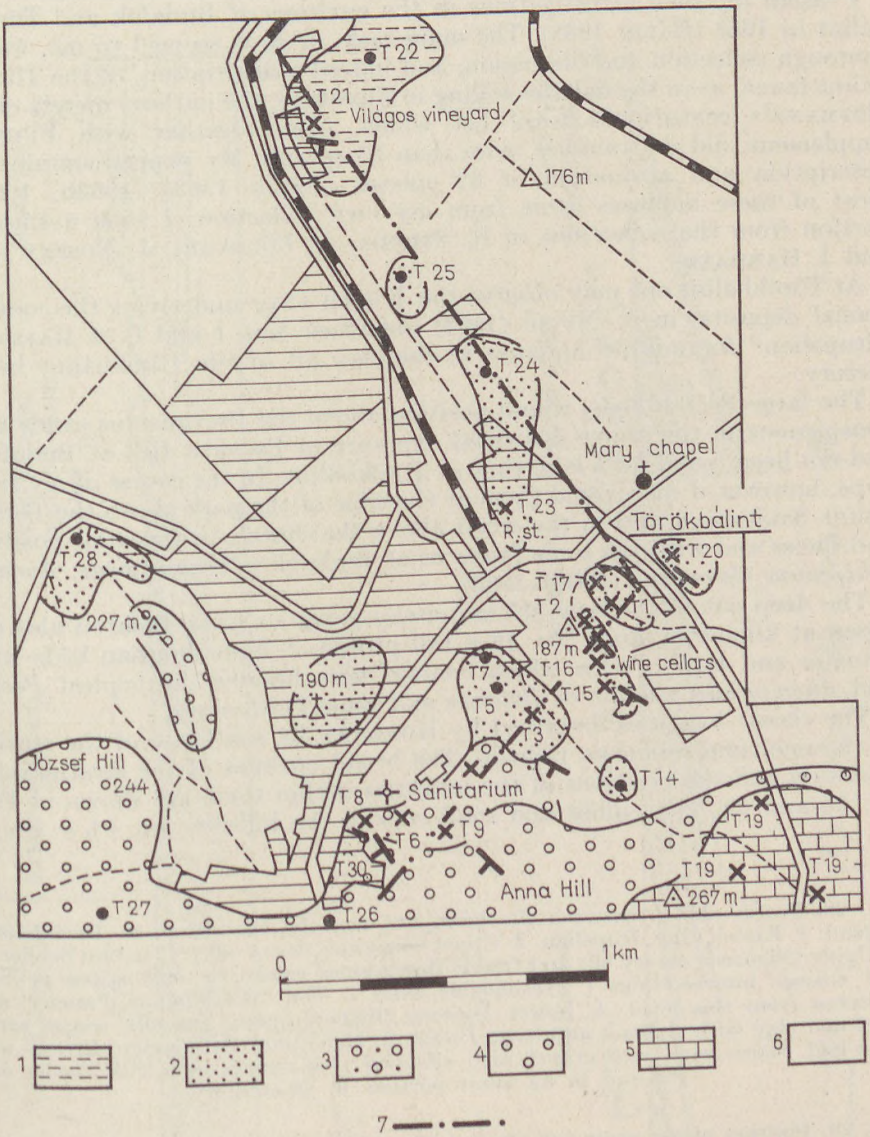


Fig. 27. Map sketch of localities in the environs of Törökbálint. Legend: T-1 = Törökbálint-1, etc. (symbols of localities). 1. Middle Oligocene Kiscell Clay. 2. Upper Oligocene Pectunculus sand, clayey silt. 3. Lower Miocene (Eggenburgian) coarse detritic complex with *Anomia* and large *Pecten*. 4. Helvetian (Ottnangian) river-laid and littoral coarse sand and gravel. 5. Sarmatian calcaire grossier, calcarenite. 6. Quaternary-covered area

I began my own investigations in the environs of Budafok and Törökbálint in 1958 (Báldi 1958). The main task, or so it seemed to me, was a thorough collection and discussion, and indeed a description, of the Törökbálint fauna, as in the debates raging in literature, the authors merely cited Hofmann's century-old fossil list which, even together with Fuchs's supplement, did not number more than 35 species. My papers contain the description and evaluation of 62 species (Báldi 1963a, 1963b, 1964). Most of these molluscs came from my own collection; I took a smaller portion from the collections of R. Streda, A. Földvári, J. Noszky sen. and I. Harmath.

At Törökbálint one may observe the Kiscell Clay underlying the controversial deposits; in it, Nyirő (1963) identified Nos 1 and 0 of Majzon's "Rupelian" foraminifer horizons in the clay pit of the Törökbálint brick factory.

The large-Pecten beds, whose position above the Pectunculus sands was conspicuous in the above described exposure of Pacsirta Hill at Budafok, had not been found for a long time at Törökbálint. In the course of my field trips, however, I discovered them at the edge of the park above the Törökbálint Sanitarium and in the wood above the church, in the same position and facies and with the same fauna as at Budafok (*Chlamys gigas*, *Anomia ephippium*, *Ostrea* sp.) (Báldi 1963).

The deep cut of the new M7 motorway going to Lake Balaton also exposed at kilometre stone No. 16 a tall profile of Eggenburgian beds with *Anomia* and large *Pecten* which contain here besides the typical *Pecten* and *Anomia* also a fauna of *Balanus* and some *Terebratula*.

The classic localities described by Hofmann lie southeast of the station of the one-time suburban railway. The broad outlines of the stratigraphic situation and the positions of the localities within them are shown in Figs 27, 28 and 29. The gullies and road cuts in the hillside at the east

→

Fig. 28. Profile sketch between the brickyard and the sanitarium at Törökbálint. Legend: 1. Kiscell Clay, Rupelian. 2. Upper Oligocene clayey silt ("Chattian Schlier"). 3. Upper Oligocene clayey silt and friable fine-grained sandstone, with sparse pebbles and coarser interbeddings ("Pectunculus sand"). The "Törökbálint Fauna" was collected from this level. 4. Lower Miocene (Eggenburgian) gravelly coarse sand, sand and clay with *Anomia* and large *Pecten*. 5. Helvetian (Ottnangian) littoral and river-laid coarse sand and gravel with silicified tree trunks and with *Ostrea* and *Balanus* in its lower portion. 6. Quaternary

Fig. 29. Position of the more important beds yielding the Törökbálint fauna. Relief and Quaternary deposits have been discarded from this detail profile. Legend: T-1 = Törökbálint-1, etc. (symbols of localities). 1. Coarse sand with intercalations of fine gravel, with a *Glycymeris latiradiata* community. 2. Silty clay. 3. Clay with a *Nucula-Angulus* community, with *Corbula* and leaf imprints. 4. A molluscan fine sand with a *Pitar beyrichi* community, and, at the bottom, a *Glycymeris latiradiata* community. 5. *Turritellan* clayey silt with a *Turritella venus* community. 6. Clayey fine sand. 7. The same with a string of metre-size concretions. 8. A sparsely pebbly fine sand with a *Glycymeris latiradiata* community. 9. A *Glycymeris latiradiata* community. 10. A *Nucula-Angulus* community. 11. A *Pitar beyrichi* community. 12. A *Turritella venus* community. 13. Leaf imprints

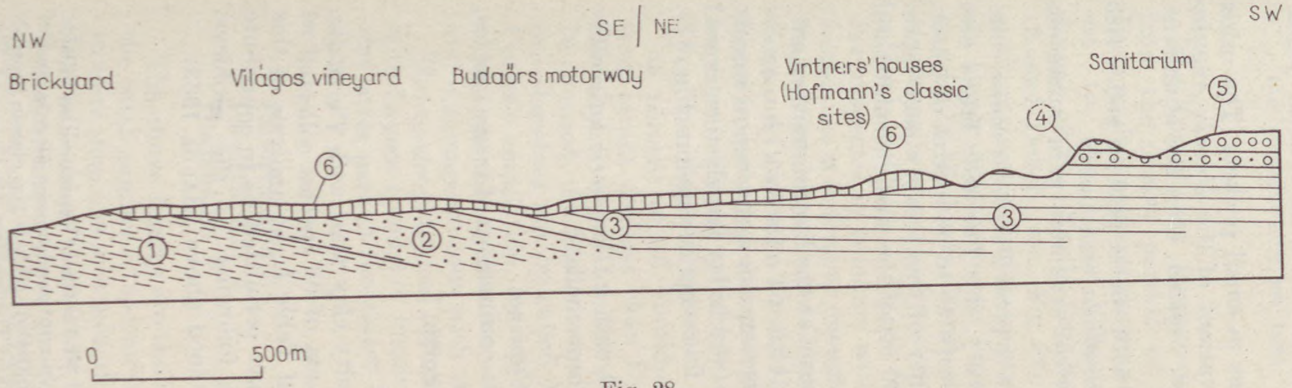

NW
Brickyard
Világos vineyard
Budaörs motorway
SE | NE
Vintners' houses (Hofmann's classic sites)
Sanitarium
SW
①
②
③
④
⑤
⑥
0
500m

Fig. 28.

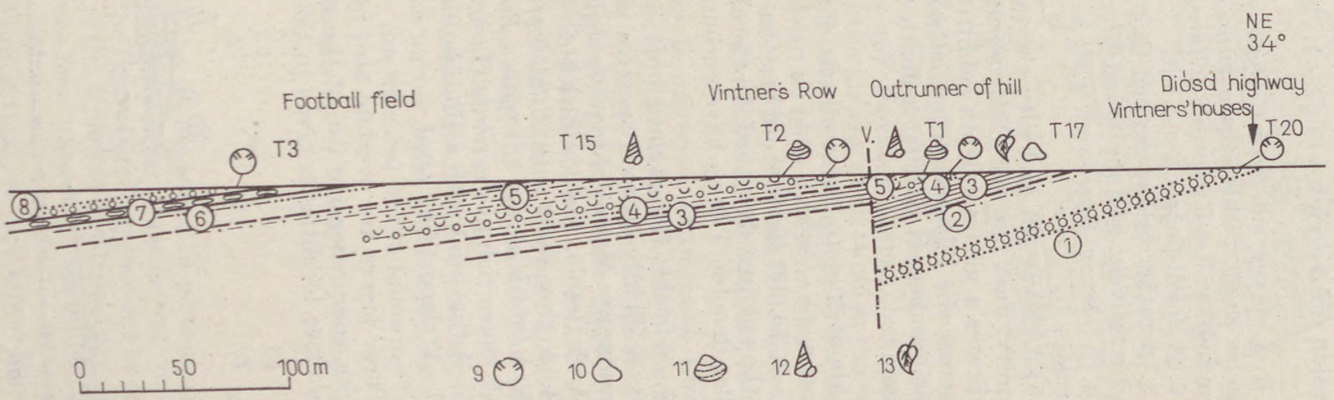

NE
34°
Football field
Vintner's Row
Outrunner of hill
Diósd highway
Vintners' houses
T3
T 15
T2
V.
T1
T17
T20
①
②
③
④
⑤
⑥
⑦
⑧
0
50
100m
9
10
11
12
13

Fig. 29.

end of the town, at the vintners' houses disclose the following succession (Törökbálint - 1, Fig. 30).

1. A clayey silt with *Corbula gibba* valves in small pockets. The other species suggest this sparse fauna to be a variant of the *Nucula-Angulus* community. Leaf imprints (*Cinnamophyllum*, *Sequoia*, etc.) are abundant.
2. A fossil-poor clayey silt.
3. A rather coarse-grained thin sand bed with sparse pebbles and a rich and relatively well-preserved *Glycymeris latiradiata* community.
4. A clayey fine sand with a *Pitar beyrichi* community of numerous species.
5. A clayey silt and silty clay marl with a typical *Turritella venus* community. Just like the *Pitar beyrichi* community, this *Turritella* fauna also indicates a medium-depth sublittoral facies with 50 to 60 metres of water, whereas the *Glycymeris latiradiata* community of this locality may represent the deepest part (at a depth of about 30 m) of the shallow sublittoral region.

About 50 m to the southwest of this exposure, at the foot of another outrunner, the wine cellars behind the vintners' houses (T - 2, 15, 16) likewise expose the Upper Oligocene, in a succession similar to the one just described. In the abandoned (and today largely torn down) cellar denoted T-2 we have encountered the following succession (Fig. 31).

1. A friable fine-grained buff sandstone.
2. A slightly coarser, sparsely pebbly sand with a *Glycymeris latiradiata* community. Masses of bivalve shells form a lumachella.
3. A friable, fine-grained buff sandstone.
4. A grey sand with *Piter beyrichi* and *Cyprina*.
5. A brown clayey silt with a *Pitar beyrichi* community of many species, with lenses rich in *Turritella* (T) near the top.
6. A fine sand with a *Pitar beyrichi* community.
7. A clayey fine sand.

These layers are overlain also here by a silty clay marl with *Turritella*.

The comprehensive list of the mollusc fauna of 62 species collected at these two localities is given in Column 36 of Table I. An analysis of this fauna permitted us to contribute the following to the problems outlined above (BÁLDI 1963).

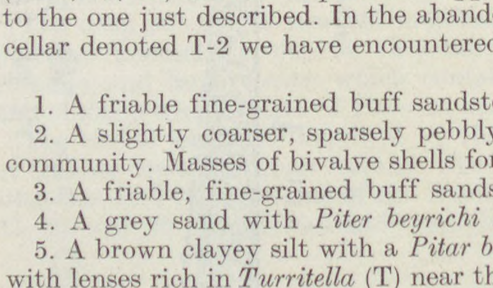
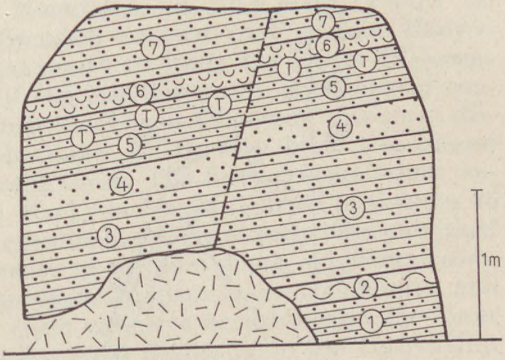


Fig. 30. Profile of exposures on hillside above wintners' houses at east end of Törökbálint (this is the classic locality marked Törökbálint-1). Detail of Fig. 29. For explanations see text and Fig. 29

Fig. 31. Profile of the abandoned and largely caved-in cellar Törökbálint-2. For explanations see text



The Törökbálint fauna comes from the deeper portion of the Pectunculus beds and stands closest to the Upper Oligocene faunae of the North Sea Basin (Kassel, Doberg, etc., Fig. 32). Its similarity to the stratotype proves its Upper Oligocene age beyond any doubt. Within the Paratethys, the fauna is most closely related to the Bad Tölz type fauna of the Bavarian molasse, held to be Upper Oligocene by Hölzl (1962). It has somewhat fewer species in common with the Eger and Kováčov faunae, but the resemblance is still great enough to justify the placing of all three in the same stage. Within the Upper Oligocene, as had been stated long ago by Telegdi-Roth and Noszky, Törökbálint represents an older horizon, whereas the fauna from the topmost part (the fourth layer) of the Pacsirta Hill succession, together with the strikingly similar Eger and Kováčov faunae, represents a younger Upper Oligocene.

35 percent of all Törökbálint species is unknown throughout Europe from strata younger than Upper Oligocene, and there is even one genus, *Dosiniopsis*, which, according to Korobkov, is restricted to the Palaeogene. In contrast, the Miocene species make up but 5 percent of the fauna, which can therefore not be called Miocene. This justifies, then, Hofmann's and Fuchs's correlation, by which the Törökbálint fauna is Upper Oligocene, older than the Aquitanian and Burdigalian stages of the Aquitanian Basin, and contemporaneous with the Boreal Chattian stage.

The zoogeographical affinities of the Törökbálint fauna — in comparison with Layers 4 and 8 of Pacsirta Hill, the former being the latest Oligocene, the latter part of the oldest Miocene — are revealed in the following table.

	Boreal	Mediterranean	Atlantic	Endemic
Pacsirta Hill 8	19	52	54	31
Pacsirta Hill 4	55	62	45	10
Törökbálint	64	35	26	18

The above figures are the numbers of species expressed in percentages of the total number of species in the fauna. Since several species are common to more than one province, the sums of the figures much exceed one hundred. This table shows that at the beginning of the Upper Oligocene a very strong Boreal influence made itself felt, whereas near its end — according to the fauna of Layer No. 4 of Pacsirta Hill — there was a mixing of Boreal and Mediterranean elements in almost equal proportions. By the Lower Miocene, the Boreal influence had all but ceased.

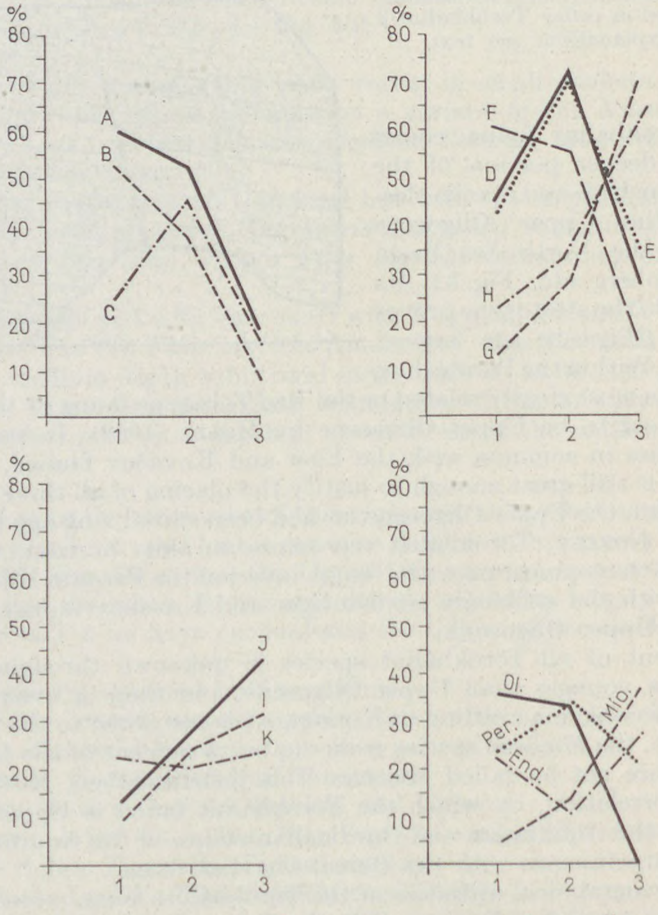


Fig. 32. Variation of the Törökbálint and Budafok mollusc faunae during the Upper Oligocene and Lower Miocene, as compared with some of the more important European Oligocene and Miocene faunae. The curves indicate faunal similarity in terms of common-species percentages. Legend. On abscissa: 1 — Upper Oligocene fauna of Törökbálint(T-1, -2, -3), 2 — Upper Oligocene fauna of Pacsirta Hill, Budafok (B-1/4), 3 — Lower Miocene (Eggenburgian) fauna of Pacsirta Hill, Budafok (B-1/8). The curves reflect percentual similarities towards the following faunae: A — Boreal Chattian, B — Boreal Rupelian, C — Mediterranean and Atlantic Oligocene, D — Eger, E — Kováčov, F — Upper Oligocene of the Bavarian molasse (Bad Tölz, etc.), G — Eggenburgian, H — Kaltenbachgraben (Lower Miocene of Bavarian molasse), I — Aquitanian stage in the Aquitanian Basin, J — Burdigalian stage in the Aquitanian Basin, K — Boreal Lower Miocene (Vierlandian stage). Ol.: Oligocene species; Mio.: Miocene species; Per.: Persistent species; End.: Endemic species

East and northeast of the Buda Mountains, in the environs of Solymár and in the above-discussed eastern part of the Mány—Zsámbék basin (Ch. II. 2), our opportunity to study the Upper Oligocene was due to the coal explorations of the last few years. Although in connexion with a well-digging at Solymár the Upper Oligocene there was discovered early (KOCH 1871a and HOFMANN 1871), very little was known about it up till the drillings of recent times. The forty-species fauna collected from cores of borehole Solymár 72 is listed in Column 35 of Table I. Some of the results of its examination have already been published (BÁLDI 1965). The frequent occurrence of medium-depth sublittoral communities, the absence of the *Polymesoda-Tympanotonus* community and other brackwater communities, or their exclusive occurrence in the lower parts of the successions, as well as the great similarity to the Törökbálint fauna are more enhanced here than even in the eastern part of the Mány—Zsámbék basin (Fig. 3).

The mollusc faunae of the Solymár boreholes also prove an Upper Oligocene age. Besides the numerous Oligocene species, there are some that first appear in the Upper Oligocene and are widespread also in the Miocene (*Pteria phalaenacea, Corbula basteroti, Thracia pubescens, Polinices catena helicina*) and there is Miocene *Chlamys incomparabilis*. These preclude a Rupelian or older Oligocene age.

5. THE EASTERN CSERHÁT AND THE ÓZD BASIN

The western border of this region is the line joining Csomád with Becske and Zelovce; its eastern border more or less coincides with the Darnó thrust; its delimitation towards the south is vague; in the north, it passes over into Czechoslovakia. It consequently embraces the Eastern Cserhát, and the Salgótarján and Bükkszék—Ózd basins.

An adequate knowledge of the Upper Oligocene in this region will require a great deal of further research. Today, our information concerning the macrofauna and other aspects of the subject — including those to be gained from literature — is so sparse as to preclude any valid attack on the numerous unsolved problems.

Despite the lack of data it seems safe to conclude that we are faced here with facies developed far from the shores of the Upper Oligocene basin of sedimentation. This explains also the scarcity of macrofossils in the deposits.

In the best-known Salgótarján Basin, NOSZKY sen. (1912) had, in his first fundamental publication, classed only the "marly and clayey strata" with the Upper Oligocene: these merge upwards into the "Lower Mediterranean glauconitic sandstone group". He had dated the latter on the basis of an abundant Lower Mediterranean fauna included in some younger layers. Subsequently, NOSZKY sen. (1923), placed the glauconitic sandstone — with the exception of the fossil-rich upper section — into the Oligocene. In 1926, despite the Miocene aspect of the "Loibersdorf-type fauna", he already regarded the entire succession as Upper Oligocene, attributing more weight to the fact that these deposits belong to the Oligocene cycle of sedimentation. He considered the terrestrial deposits as the basal layers of the Miocene. **Horusitzky** (1941) on the basis of his studies in the Western Cserhát and in the Budapest region revived **Noszky**'s 1923 hypothesis when he placed the upper fossiliferous portion of the glauconitic beds into the Lower Miocene Aquitanian stage, pointing out its contemporaneity with the Anomia sands of the environs of Budapest.

The **Noszky—Horusitzky** controversy was resolved by the investigations of **Csepreghy-Meznerics** who by a detailed palaeontological research and analysis (1952) proved the Lower Miocene age of the large-Pecten faunae in the upper portion of the glauconitic sandstones, but placed them in the Burdigalian rather than the Aquitanian. This view was adopted also by **Vadász** (1960) and **Bartkó** (1961—1962); on the Slovakian side, **Hano** and **Seneš** (1953) and **Buday** et al. (1965) voiced similar opinions. The age of the lower portion containing scarce fossils of the glauconitic beds is still open to discussion (cf. **Bartkó** 1961, 1962).

The glauconitic sandstone beds are connected in the east, at Ózd and Bükkszék, and in the west, at Szécsény, with clayey silts and marls, which we shall in the following call the Amussium Schlier after an abundant fossil, *Pseudamussium denudatum* **Reuss**. The relation of the glauconitic sandstone to the Amussium Schlier is not fully clear. Data in literature and certain borehole profiles (Jákfalva) make it probable that the glauconitic sandstone lies side by side with, rather than above, the Amussium Schlier. At least this is what is suggested by the glauconitic sandstone interbeddings in the latter. Literature unanimously regards the Amussium Schlier as Upper Oligocene. It was **Csepreghy-Meznerics** (1960) who first hinted at its possible Lower Miocene age, on the strength of the stratigraphic spread of *Pseudamussium denudatum*. (She was kind enough to confirm this in a personal communication.) Cooperating with **Gy. Radócz** I could prove in the Eger—Borsod area that the Amussium Schlier of the borehole Sajókazinc 169 overlies an Upper Oligocene with an Eger type fauna, and is therefore Lower Miocene (**Báldi** and **Radócz** 1965b). This, however, does certainly not mean that every occurrence of Amussium Schlier is Lower Miocene. At Bükkszék, the beds with *Pseudamussium denudatum* directly overlie strata with Rupelian microfaunae (**Majzon** 1940, 1942 and **Schréter** 1942); they were held to be uppermost Rupelian by **Schréter** and lowermost Chattian by **Majzon**.

The problems to be solved are, then, the following:

1. The age of the deeper portion of the glauconitic sandstone beds,
2. The age of the Amussium Schlier at Szécsény and Ózd.

The macrofossils in hand are insufficient to solve these problems; it will be necessary to continue the research in which we are now engaged. The Upper Oligocene is to be expected on the surface first of all in the area uplifted by the andesite laccolith of the Karancs and in its environs. The manuscript maps of **Noszky** sen. indicate a "deeper Chattian" there; this was confirmed more recently by **Ódor** (1962). One very important profile, discovered by **K. Balogh** and myself, lies east of Karancslapujtő. The glauconitic sandstone beds are underlain here by glauconiteless lamellar-shaly limonitic fine sandstone, with large flakes of muscovite and many plant fossil imprints: the latter are underlain in turn by a buff schlierlike clayey silt with fine mica flakes, exposed in a height of five metres by an incised dirt road on the east flank of height 288 m. Here we collected a marine fauna of small-sized species, composed of the following forms: *Cardita orbicularis* s. l., *Psammobia* sp. indet., *Nuculana* sp. indet., *Corbula gibba* and life traces. This same "schlier" has undergone contact metamorphism at the foot of the Karancs: it has turned into a steeply dipping hard black rock. It would be premature to draw far-reaching conclusions from the sparse fauna, but the presence of *Cardita orbicularis* s. l. suggests an Upper Oligocene age. In this profile of Karancslapujtő the Oligocene—Miocene boundary seems to coincide with the appearance of glauconite. This should not, however, be generalized. Near Somoskőújfalu, in the proximity of the Czechoslovak frontier, we could observe the lateral fading out of glauconite.

Examining macrofossils from the cores of some boreholes at Pétervására, unfortunately not more than 100 metres deep, I could establish their age as Lower Miocene (Eggenburgian) on the basis of 29 species. These borings also revealed a close faunistic and lithologic connexion between the glauconitic sandstones and the Amussium Schlier. This state of facts made it obvious that the bentonite here is not Upper Oligocene; nor is, presumably, the Istenmezeje bentonite, either.

In summary, in the region discussed above a mighty succession of dominantly fine detritic sediment came to be deposited from the Middle Oligocene to the end of the Lower Miocene, in the interior of a basin of sedimentation. There is hardly any Upper Oligocene macrofauna in these deposits, and so the delimitation of the Egerian both downwards and upwards is rather uncertain.

6. EGER AND THE SAJÓ VALLEY (Fig. 33)

The boundaries of this palaeogeographic unit are still vague in many respects. The facies succession typical of the region has until recently been known only from the environs of Eger. We have lately identified with Gy. Radócz a fauna and a succession identical with those of Eger in the "deep base" of the Sajó valley lignite seams, thus proving this type to be more widespread than hitherto believed (Báldi and Radócz 1965). Partly for reasons of science history, and partly because of some small differences superimposed on an overall similarity, the Upper Oligocene of Eger and that of the Sajó Valley shall be separately discussed.

(a) *The environs of Eger*

One of the most splendid geohistorical monuments of Hungary, the pit of the Eger (former Wind) Brickyard with its rich fauna, has kept the Upper Oligocene deposits of these parts in the foreground of geological interest. Their significance was compounded by the hydrocarbon explorations of the last decades.

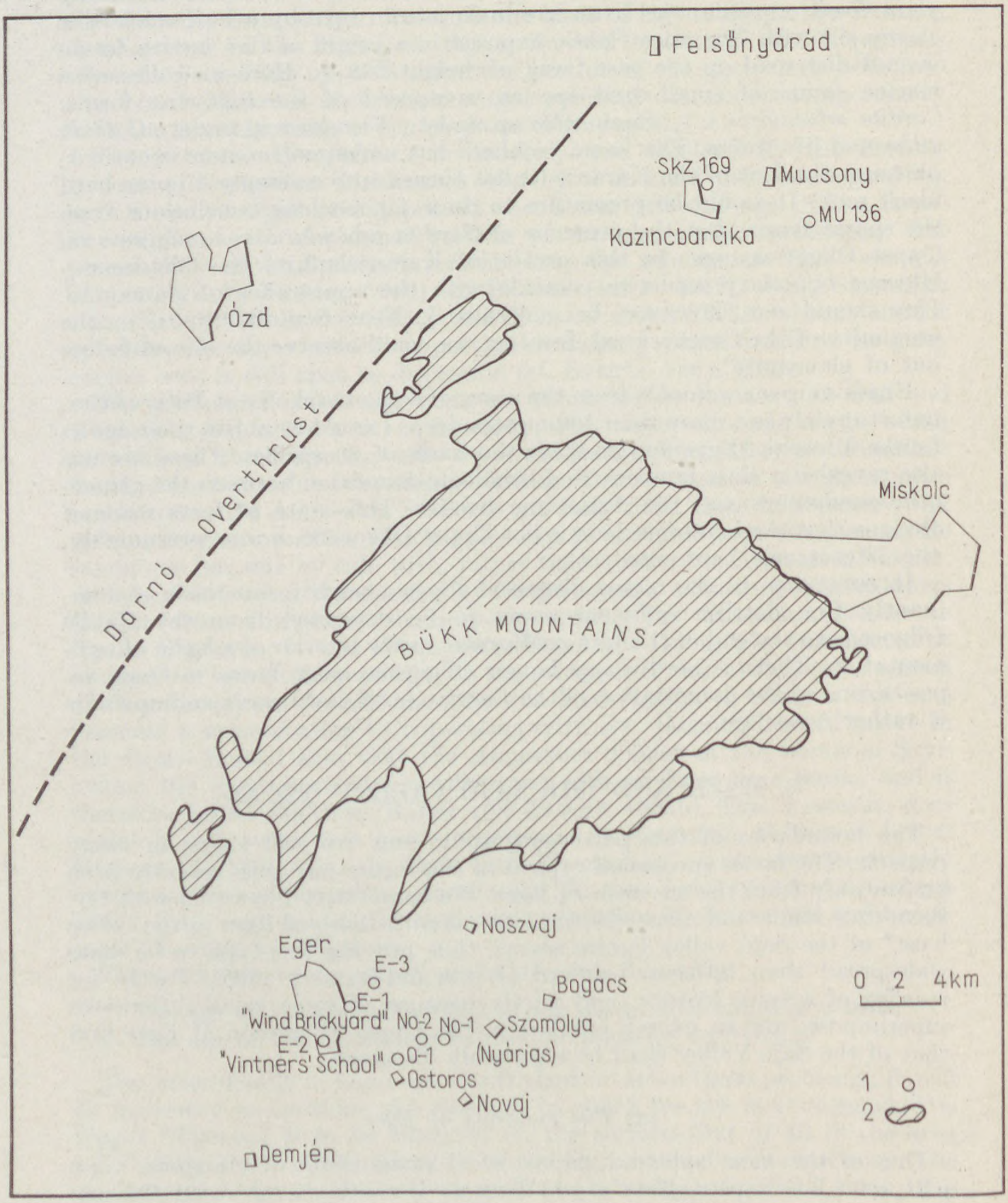


Fig. 33. Map sketch of the Eger—Sajó Valley region. Legend: 1. Exposures and boreholes. 2. Pre-Tertiary

Outline history

Telegdi-Roth's monograph (1914) of unwilting merit contained the exemplary description of 73 mollusc species, the first profile of the Brickyard pit and a stratigraphic evaluation of the data. It was followed by Gábor's (1936) supplementary publication with a description of 17 species unknown up till then from Eger, and by Noszky senior's (1936) synopsis, which is something of an annotated fossil list enumerating 324 forms including many new species and subspecies. The inventory of fossil finds from Eger kept on growing in the meantime, thanks largely to the untiring activity of Collector Ferenc Legányi. In the early fifties J. Noszky sen. reviewed this enriched material, but this work of his remained in manuscript form (Noszky sen. 1952). A publication by Benkő-Czabalay (1958) was largely based on this manuscript. It mentioned 1041 species (!) and varieties from the Eger exposure, without, however, giving as much as an enumeration of the species. As regards accessory data concerning the mollusc fauna, Csepreghy-Meznerics in her Pecten monograph (1960) described seven species from Eger; in my Glycymeris studies I mentioned two species from this locality (Báldi 1962). I have recently published a revision of the mollusc fauna and of the stratigraphic succession in the Eger Brickyard exposures (Báldi 1966a,b). In these papers I have placed a special emphasis on the formerly almost unknown, neglected fauna of the deeper levels.

Besides the molluscs, all other fossil phyla were also submitted to systematic treatment. The foraminifers were discussed and evaluated by Majzon (1942b), the corals by Hegedüs (1962), the Balanus by Kolosváry (in Benkő-Czabalay 1958). The attention of the palaeobotanical fraternity towards the Eger exposures is attested in the work of Andreánszky (1966). A treatise by Mrs Nagy and Pálfalvy (1963) contains also a stratigraphic succession "composed by Noszky sen. from data supplied by Legányi", significantly different from the profile, likewise based on data from Noszky sen., in Benkő-Czabalay. The divergences of the stratigraphic conclusions drawn from analyses of various fossil phyla induced L. Bogsch (1962) to raise and discuss several points of principle. The Paratethys Working Group of the CMNS proposed, at the time of the closing of this manuscript, to choose the Eger profile as the stratotype of the Egerian.

The other Oligocene exposures in the environs of Eger were paid disproportionately less attention than the Brickyard, although the very interesting fauna, collected by I. Lőrenthey, which came to be known as the "Eger Vintners' School Fauna", dates from before the first world war. K. Telegdi-Roth contemplated its study over several decades — we know it from some remarks in his publications and in the unpublished diaries of F. Legányi — but, much to the detriment of science, he never came around to doing it. This deficiency was mitigated to some extent by a discussion of the important few Pecten species of the fauna in Csepreghy-Meznerics (1960). Dobay (1959) in his manuscript B.Sc. thesis identified and/or listed almost 50 species from

Lőrenthey's collection, kept at the Chair of Palaeontology of Budapest University.

Valuable data on the Upper Oligocene, collected in the course of the respective authors' mapping work, are contained in Schréter's reports (1913, 1916, 1939) and in an explanatory notice to a map by Balogh and Rónai (1965). Manganese ore exploration in the Rupelian was described among others by Molnár and Morvai (1961). Hydrocarbon prospect wells in the bounds of Demjén, Bogács, Szomolya and Novaj contributed to our knowledge concerning the deeper levels of the Upper Oligocene. These valuable new findings were published in Majzon (1960) and Csiky (1961). A complex geo-palaeontological examination and evaluation of the outcrops of the Lepidocyclina limestone has been undertaken in connexion with the study of the Novaj profile. The fossils of the Upper Oligocene succession of Novaj, which have attracted a lively international interest since, were treated in a joint monograph by R. Nyirő (for small foraminifers), T. Kecskeméti (for Lepidocyclina), C. W. Drooger (for the stratigraphically important Miogypsinids first described from Hungary there), and the present author (for molluscs) (Báldi et al. 1961). Shorter summary publications on the Novaj profile have also appeared (Drooger 1961, Báldi et al. 1961).

(i) *The Brickyard profile*

In 1966 I published a profile, the most complete up till then, of the Eger brickyard succession (Báldi 1966a,b), based on a 80 m borehole sunk from the brickyard pit floor in 1961; on our joint survey with I. Pálfalvy in 1961; on notes of F. Legányi and on a second survey by myself in 1965. I also made use of a preliminary report by Nyirő (1962) on the microfossils of the borehole cores and of a lithological publication by Bondor (1964).

The succession, from the bottom upwards, is as follows (Fig. 34):

A. SUBSURFACE SECTION TRAVERSED BY THE BOREHOLE

1. A marl with tuffite lenses and an abundant Rupelian microfauna *Clavulinoides szabói, C. cubensis, Cibicides propinquus, "Dentalina" zsigmondyi,* etc. (80.30 to 65.30 m).
2. A marl without tuffite with the same microfossils (65.30 to 50.30 m).
3. A fine-sandy, slightly glauconitic marl with a transitional Rupelian-Chattian foraminifer fauna without *Clavulinoides* (50.30 to 44.80 m).
4. A fine-grained fossil-poor glauconitic sandstone (44.80 to 36.20 m).
5. A strongly glauconitic, tuffitic sandstone (36.20 to 18.30 m) with the following macrofossils:

Flabellipecten burdigalensis Lamarck
Thyasira vara angusta Báldi
Cerithium egerense Gábor
Babylonia eburnoides umbilicosiformis T.-Roth
Dentalium apenninicum Sacco
solitary corals (*Flabellum, Trochocyathus*)
worm tubes

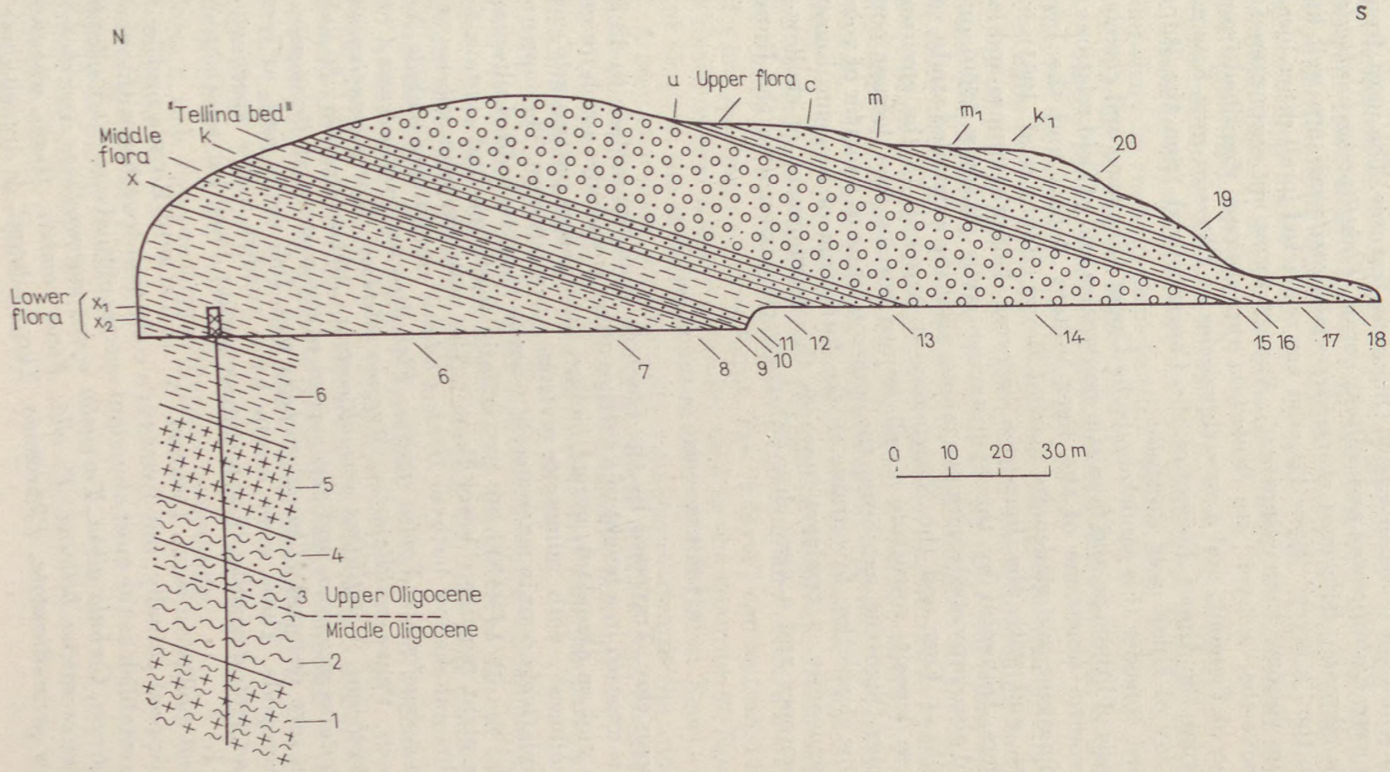


Fig. 34. Exposures of the Wind Brickyard at Eger, and profile of the 80-metre stratigraphic borehole sunk from the pit bottom (Eger-1). For explanations see text

and a Foraminifera fauna of Upper Oligocene features. The most frequent elements were *Flabellipecten* and solitary corals. *Flabellipecten burdigalensis, Cerithium egerense, Babylonia eburnoides umbilicosiformis* are well known also from the "k layer" (layer 11), and are restricted in all other localities to deposits younger than "Rupelian". Ancient forms not encountered anywhere above the "x layer" are *Dentalium apenninicum,* described from the Tongriano of Piemont, and a new subspecies of *Thyasira vara* Korobkov, known from the Upper Eocene of the Caucasus and from the Rupelian Kiscell Clay of Újlak near Budapest.

We must consider this sandstone to be Upper Oligocene and correlate it on the basis of lithologic and faunistic similarities and of field relations with the glauconitic sandstone of the Eger Vinters' School and the Lepidocyclina limestone and glauconite marl of Novaj (Báldi et al. 1961) on the one hand, and with the limestone carrying Lithothamnium and larger foraminifers, traversed by the hydrocarbon wells (Majzon 1960) on the other, and also, provisorily with the faunae awaiting a detailed study, of the Áfrika-dűlő at Eger and the Nagyimány at Noszvaj. In the environs of Eger, these deposits constitute a well-defined horizon, the deepest horizon of the Upper Oligocene, exhibiting the common traits of a scatter of volcanic ash, a slow deposition favourable to the formation of biogenic limestone and of glauconite, a tendency towards the development of shallow-sublittoral biotopes and a very close lithologic connexion with the Rupelian deposits.

B. THE EXPOSURES IN THE BRICKYARD

6. Molluscan clay. Traversed by the borehole from the surface to 18.30 m depth, it is exposed in a height of a further 30 m. It includes a rich foraminifer fauna and an abundant, varied mollusc assemblage particularly rich in "micro-molluscs", with numerous endemic, new species. The uppermost 20 m are relatively poor in macrofossils, whereas the interbedded silts marked "x_1" and "x_2" by Legányi are particularly fossil-rich and contain fairly numerous plant remains ("lower flora"). The most frequent species of the deep sublittoral-shallow bathyal *Hinia-Cadulus* community include *Nuculana psammobiaeformis, Yoldia raulini, Flabellipecten burdigalensis, Crassatella bosqueti, Venus multilamella, Macoma elliptica, Murex paucispinatus, Hinia schlotheimi, Volutilithes permulticostata, Athleta ficulina, Dentalium fissura, Cadulus gracilina,* and also species of *Schizaster* and *Brissopsis,* the chela of a rare decapod (*Thaumastocheles* sp.), fish scales and, at certain levels, Pteropods. These same strata have yielded a few specimens of *Miogypsina septentrionalis.* (For a comprehensive fossil list see Column 38 of Table I.)

7. Silty fine molluscan sand. Denoted "x" in Telegdi-Roth's profile, it is not well exposed actually, but Legányi's collection together with our own suffices to establish as the most abundant species of this layer *Pitar splendida, Pitar polytropa, Corbula gibba, Turritella venus margarethae, Aporrhais callosa, Polinices catena helicina, P. olla, Ficus condita, Hinia schlotheimi, Volutilithes permulticostata, Pleurotoma.* The "x layer" is transitional be-

tween the faunae of the deeper "x_2" and the higher "k layer". It shows no independent features of its own, and will therefore not be discussed separately in the following chapters. Species common with the molluscan clay, but not reaching higher than the "x layer", are *Nuculana psammobiaeformis, Scala amoena, Melanella naumanni, Ringicula auriculata paulucciae,* solitary corals and Pteropods.

8. A succession of clays, 5.30 m thick, with bands of sand, 1 to 5 cm thick. Towards the middle there are loaf-shaped concretions: the topmost, lamellar-shaly 30 cm hold plant fossils ("middle flora").

9. A yellow, micaceous sand (1.00 m).

10. A clayey brown sandstone with lamellar-shaly parting, overlain by a grey clay, in an aggregate thickness of 1.25 m.

11. A more or less limonitic friable sandstone very rich in molluscs ("k layer") (2.00 m). A full list of this mollusc fauna belonging to the *Pitar polytropa* community is given in Table I. The most abundant species (of which more than fifty specimens have been collected so far) are *Nucula mayeri, Nuculana anticeplicata, Ostrea cyathula, Laevicardium tenuisulcatum, Pitar polytropa, Corbula carinata, Turritella venus margarethae, T. beyrichi percarinata, Aporrhais callosa, Drepanocheilus speciosus, Polinices catena helicina, P. olla, Ampullina crassatina, Pirula condita, Typhis pungens, Babylonia eburnoides umbilicosiformis, Bullia hungarica, Hinia schlotheimi, Athleta rarispina, Turricula regularis.* Even a cursory collection will usually yield a few specimens of these forms. The "k layer" can be traced in similar field relations over a fairly extensive area in the environs of Eger (Kerek Hill at Ostoros; the southwestern outrunner of Sík Hill at Eger).

12. A grey clay marl, with limonite concretions towards the middle, with an intercalated marl layer of 10 cm thickness near the top. Fossils are very scarce (LEGÁNYI's "Tellina clay" or "d layer"; 5.00 m).

13. A micaceous clayey friable sandstone, with lamellar parting near the top, with fine plant fossil imprints (5.50 m).

14. Cross-stratified coarse sands and friable coarse sandstones with small pebbles; there are some interbedded clay layers 10 to 20 cm thick, first occurring near and getting denser towards the top, and concretions. No macrofossils. 20.00 m.

15. A limonitic clay with *Polymesoda convexa* and species of *Unio* (TELEGDI-ROTH's "u layer", "Cyrena-Unio clay"; 0.40 m).

16. A finely stratified friable micaceous sandstone and a sandy clay with plant fossil imprints, with lignite lenses (probably composed of driftwood) near the middle. Its splendid plant-fossil assemblage is known as the "upper flora" (1.90 m).

17. A sandy clay and a clayey friable sandstone (4.20 m). The top 20 cm includes a rich *Tympanotonus-Pirenella* community:

Polymesoda convexa
Gari (Psammobia) protracta
Theodoxus pictus bueckkensis
Melanopsis impressa hantkeni
Pirenella plicata
Tympanotonus margaritaceus

This brackwater cerithian deposit, denoted "c" by TELEGDI-ROTH, is a good marker bed in the environs of Eger. It occurs in similar field relations on the southwestern outrunner of Sík Hill, and on the Rakottyás and Nyárjas at Novaj.

18. One metre of micaceous clayey friable sandstone with plant fossil imprints, including a lumachella-like accumulation of a rich fauna:

Anadara diluvii
Mytilus aquitanicus
Ostrea cyathula
Turritella beyrichi s. s.
Tympanotonus margaritaceus
Calyptraea chinensis
Ampullina crassatina

The molluscs indicate a *Mytilus aquitanicus* community. This littoral bed was denoted "m" ("Mytilus layer") by TELEGDI-ROTH.

19. 1.60 m of clay with plant fossil traces, overlain by a limonitic sand and sandstone with *Mytilus aquitanicus* (marked "m_1" in the profile).

20. 0.50 m of clayey, gravelly sand with *Turritella beyrichi*, overlain by 4.80 m of clay and clayey silt with limonite concretions. In the lower section of this latter we have found valves of *Flabellipecten burdigalensis* and *Cyprina islandica rotundata*. This topmost fauna was unknown to TELEGDI-ROTH and LEGÁNYI. We have denoted by "k_1" this marine shallow sublittoral fauna, occurring in a spot rather hard of access, because it has yielded two important forms of the "k layer".

(ii) *Other exposures and localities*

(a) The fauna collected by LŐRENTHEY from the sediment thrown out of the well dug at the Vinters' School (now the Research Institute for Viticulture) (Eger-2). The fauna kept at present at the Chair of Palaeontology of Budapest University numbers 40 species (Column 37 of Table I). The dark green glauconitic sandstone contains besides molluscs also larger foraminifers and *Heterostegina*. The fauna indicates a medium-depth sublittoral *Flabellipecten-Odontocyathus* community, but with certain transitional features towards the shallow sublittoral *Glycymeris latiradiata* community.

(b) The sand pit on Merengő Street, by the Rozália cemetery. Lying next to the Wind Brickyard, it exposes a glauconitic-limonitic sandstone older than the beds of the latter. Its sparse and poorly preserved fauna includes, besides shark teeth and solitary corals, the following molluscs observed by I. DOBAY and myself:

Flabellipecten cf. burdigalensis LAMARCK
Chlamys sp.
Cyprina cf. islandica rotundata AGASSIZ
Ampullina crassatina LAMARCK
Pirula condita BRONGNIART

Diastoma grateloupi turritoapenninica SACCO
Athleta rarispina LAMARCK
Volutilithes permulticostata TELEGDI-ROTH
Turris coronata MÜNSTER in GOLDFUSS
Turricula regularis DE KONINCK
Babylonia eburnoides umbilicosiformis TELEGDI-ROTH

This *Flabellipecten-Odontocyathus* community is undoubtedly contemporaneous with the "Vintners' School" fauna. The higher limonite content of the deposit is due to the weathering of glauconite. These beds are a direct continuation of the glauconitic beds encountered in the Brickyard borehole (Eger 1/5).

(c) The most complete Upper Oligocene succession except for the Brickyard is found on the Nyárjas at Novaj. The Lepidocyclina limestone exposed here was mistaken for an Upper Eocene Orthophragmina limestone by SCHRÉTER (1939). This exposure was called to our attention by I. CSEPREGHY-MEZNERICS. Over a number of years, F. LEGÁNYI collected a relatively abundant material from here; this was supplemented by the crop of our joint collection with T. KECSKEMÉTI.

The locality lies about 5 km to the north of Novaj: the succession to be described below is exposed in a number of erosional furrows in the vineyards on the flank of Nyárjas Hill (Fig. 35).

1. A "Rupelian", slightly glauconitic, sandy marl, with *Clavulinoides szabói* and other Palaeogene foraminifers. It used to be exposed in just a few metres height.

2. Bed No. 1 grades into an Upper Oligocene tuffitic, glauconitic sandstone some 15 m thick. According to L. BONDOR the glauconite is authigenic, whereas the presence of some fresh idiomorphic feldspar indicates a volcanic ash fall simultaneous with the deposition of the sediment. This bed contains an abundant foraminifer fauna; big forms are conspicuous even as they lie about on the ground (frequent *Amphistegina* and *Heterostegina*, rare *Operculina*, *Miogypsina*, *Lepidocyclina*); and some scarce molluscs, largely Pectinids: *Flabellipecten burdigalensis* and *Chlamys csepreghymeznericsae*.

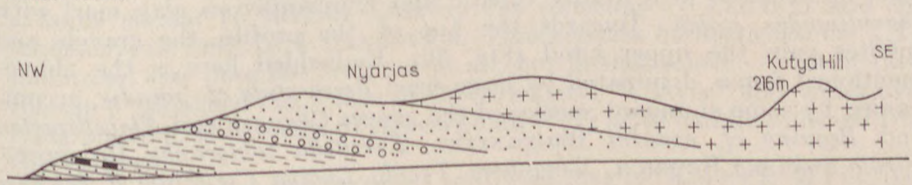


Fig. 35. Profile of the Nyárjas at Novaj (Novaj-1). Legend: 1. Glauconitic, tuffaceous sandstone and marly sandstone, its lowermost few metres still with Rupelian microfossils, and with lenses and intercalations of glauconitic limestone enclosing *Lepidocyclina* and *Lithothamnium* farther up. 2. Grey molluscan clay with limonitic lenses. 3. Fine gravelly micaceous coarse sand. 4. Grey, locally limonitic, friable sandstone with leaf imprints. 5. Rhyolite tuff complex (Ottnangian or younger)

3. A metre and a half of calcareous sandstone and limestone with Lepidocyclina: locally a tuffic-glauconitic limestone and marl. The limestone is biogenic, being almost entirely composed of *Lepidocyclina* tests or of *Lithothamnium*. According to T. Kecskeméti (in Báldi et al. 1961), the *Lepidocyclina* species represented here include: *L. dilatata* Michelotti, *L. tournoueri* Lemoine et Douvillé, *L. raulini* L. et D., *L. morgani* L. et D., *L. hungarica* Kecskeméti.

4. One metre of limonitic-glauconitic sandstone and marl, with exceedingly abundant *Miogypsina septentrionalis* Drooger.

5. 30 to 40 metres of a buff molluscan clay with limonite lenses. Besides a rich assemblage of small foraminifers it contains a very well-preserved mollusc fauna, with a preponderance of small forms (Column 41 of Table I).

The thirty-species *Hinia-Cadulus* community is contemporaneous with the fauna of the molluscan clay in the Wind Brickyard: almost all the species occur there, too. The underlying glauconitic beds correspond, of course, to the tuffitic-glauconitic beds of the Brickyard.

6. A coarse muscovitic sand with fine pebbles.

7. A buff to brown friable limonitic sandstone with poorly preserved plant fossils. It corresponds together with Bed 6 to the younger, more coarsely detritic layers of the Brickyard.

8. The succession ends with a rhyolite tuff fairly widespread in the vicinity.

(d) There is a similar but essentially unexposed succession on Rakottyás Hill at Novaj (Novaj-2), at the north end of which a limonitic sandstone crops out from under the rhyolite tuff; it contains *Ostrea cyathula*, *Turritella beyrichi*, *Tympanotonus margaritaceus* and *Ampullina crassatina*, that is, a fauna corresponding to the "c layer" fauna of the Brickyard. In a still deeper position, towards the middle of this hill range, one encounters also the glauconitic sandstone, which has, however, not yielded for a long time anything beyond a single solitary coral specimen. Lately, on the other hand, I. Jankovich has discovered, here too, the molluscan clay with a rich, hitherto unstudied fauna.

(e) Other faunae awaiting examination are those of the Nagyimány (Noszvaj-1) and the very similar one from the "Áfrika-dűlő" (Eger-3). On Nagyimány, a hill rising directly to the east of Noszvaj, one finds gravel beds intercalated in a locally tuffitic and manganiferous clay marl with *Clavulinoides szabói*. Towards the top of the profile, the gravels and tuffites gain the upper hand (Fig. 36). Embedded here is the above-mentioned fauna, dominated by large-sized *Terebratula cf. grandis*, accompanied by some abundant species of the genera *Chlamys* and *Flabellipecten* and *Beguina cf. arduini* Brongniart, *Turritella catagrapha* Rovereto, *Pirula concinna* Beyrich, *Xenophora*, *Teredo*, *Lucina*, *Cerithium cf. egerense* Gábor. At this same locality, Legányi collected some *Lepidocyclina*. According to Nyirő, the microfauna is typically Upper Oligocene. This horizon with *Terebratula*, molluscs, tuffite, gravels and limonite-cemented ledges is overlain by a glauconitic sandstone; the entire succession is unconformably covered by the rhyolite tuff. Ecologically the fauna stands close to the medium-depth sublittoral *Flabellipecten-Odontocyathus* community, whereas stratigraphically it probably indicates the oldest Upper Oligocene,

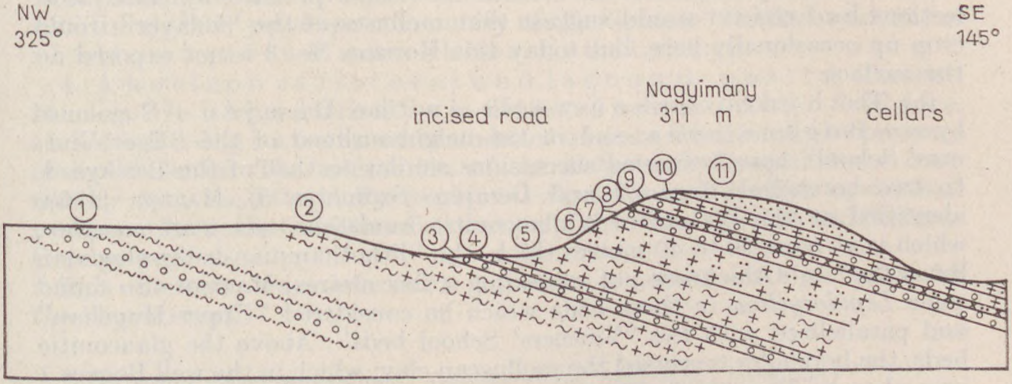


Fig. 36. Profile of the Nagyimány on the eastern outskirts of Noszvaj (Noszvaj-1). Legend. 1. A marly silt with manganiferous linings, gravel lenses, and a bed with lucinids. 2. A grey tuffaceous marly silt with leaf imprints and the molluscs *Parvamussium bronni*, *Malletia* sp., *Corbula* sp. 3. A gravel bed overlain by a limonitic sandstone forming a ledge. 4. Grey tuffaceous silt with abundant mollusc (*Lucina*, *Tellina*, *Cadulus*). 5. Tuffaceous silt and marl. 6. Tuffaceous fine sand with limonitic lenses. 7. Coarse gravel. 8. Tuffaceous quartz sand. 9. Tuffaceous-gravelly silt with a limonitic ledge. 10. Tuffaceous silt and marly tuff with a rich Terebratula and mollusc fauna and sparse Lepidocyclina. (*Flabellipecten-Odontocyathus* community.) 11. Glauconitic sandstone. According to R. Nyirő (verbal communication) the foraminifer fauna is of a Rupelian character up to the fifth bed, with *Clavulinoides szabói*. The foraminifer fauna of the 10th bed is Upper Oligocene. The unconformably overlying Lower Rhyolite Tuff complex (? Ottnangian) lies outside the profile plane

contemporaneous with the glauconitic beds of the Brickyard borehole and of the Novaj profile.

(f) Another string of very poor exposures is on Sík Hill (Eger-4), where the above succession is known merely from the furrows of some vineyards and ploughland lots. On the northern outrunner and on the top of Sík Hill one observes glauconitic, limonitic, tuffitic, marly sandstones, which can be traced along the strike up to the "Áfrika-dűlő", where a fauna similar to that of Noszvaj was collected by Legányi and subsequently, in 1966, by I. Jankovich (*Flabellipecten burdigalensis* etc.). The molluscan clay does not crop out at all, but farther south — that is, down the dip — ploughed-out fossils of the Brickyard "k layer" and, in an overlying position, gastropods of the cerithian ("c") layer can be collected from the furrows.

(g) Yet another poorly exposed profile is that of Kerek Hill (Ostoros-1), north-northeast of Ostoros village. The Upper Oligocene constituting the hill is separated in the north from the rhyolite tuff and some Pannonian strata by a northeast-striking fault (Jankovich 1967). Of the Egerian (Upper Oligocene) proper, one can see outcrops of a molluscan clay with *Crassatella bosqueti*, *Rostellaria bicarinata*, and *Hinia schlotheimi* and, in an overlying position, terrestrial and lagoon deposits, limonitic sandstones, sands and clays. The cross-stratified sands of this topmost level are worked in a small pit near by. Early collections by LEGÁNYI would suggest that molluscs of the "k layer" would crop up occasionally here, but today this Horizon No. 3 is not exposed on the surface.

(h) The hydrocarbon wells in the Demjén — Szomolya — Bogács area and in the neighbourhood of the "Eger Vintners' School" have traversed successions similar to that of the Brickyard. In two boreholes (Bogács-1 and Demjén—Szomolya 5), MAJZON (1960) identified at the bottom of a glauconitic sandstone and marl complex, which is at most 30 to 40 metres thick, the "lithothamnian-heterosteginian limestone" in a thickness not exceeding a few metres. MAJZON also found some *Lepidocyclina* in these beds which he considered "Upper Rupelian" and parallelized with the "Vintners' School beds". Above the glauconitic beds, the boreholes traversed the molluscan clay, which in the well Bogács 1 proved to be 43 m thick. The limestone is lenticular and discontinuous, as revealed by its missing from a number of boreholes, including the one in the Brickyard. The *Corallinaceae* of the limestone were treated by KRIVÁN-HUTTER (1961). Further details are contained in CSIKY (1961).

(iii) *The subdivision of the succession*

A study of the Eger Brickyard profile and of the other profiles in the neighbourhood reveals a conspicuous subdivision in four horizons.

1. Glauconitic-tuffitic sandstone: with thin interbeddings of biogenic limestone in some places and with limonitic and gravelly beds elsewhere. This group of strata, emerging conformably from the "Rupelian", is at most 30 or 40 metres thick. It is characterized by a medium-depth sublittoral community, which may, in the biogenic limestone beds, be accompanied by a *Lepidocyclina-Corallinacea* community with lots of larger foraminifers. The abundant scattering of volcanic ash, the authigenic glauconite and the sublittoral limestone facies make these beds stand alone in the Hungarian Upper Oligocene: the geographically closest occurrence of an isopic facies is in Northern Italy where the facies in question is typical over a large area.

2. Molluscan clay. Approximately 50 m thick and containing less than 20 percent carbonates according to SZALAY and VÉGH (1962), these clays are but seldom interrupted by thin beds of clayey silt. They contain deep sublittoral to shallow bathyal *Hinia-Cadulus* communities, indicative of a deeping sea and the return of the conditions that produced the Kiscell Clay, after the regression revealed by the glauconitic deposits. This similarity must have been the reason which induced TELEGDI-ROTH to identify the molluscan clay with the Kiscell Clay in 1912. I pointed out its ecologic similarity to the "Tortonian" (Badenian) "Baden Clay" in connexion with the Novaj profile (BÁLDI in BÁLDI et al. 1961).

3. Alternating clays and sandstones. The only place where this horizon can be readily studied is in the Brickyard where it encompasses that part of the succession from the bed marked "x" in Fig. 34

to layer No. 13. The tranisitonal fauna of the "x layer" and the shallow sublittoral, *Pitar polytropa* community of the "k layer" mark the advent of shallow marine nearshore conditions.

4. A horizon of littoral and lagoon deposits of varied lithology. It is characterized by a dense alternation of clays, sands and gravels, an abundance of plant fossils and the presence of lignite lenses. The alternation of the *Polymesoda-Tympanotonus* community with the littoral *Tympanotonus-Pirenella* and *Mytilus aquitanicus* communities recalls the facies distribution of the Pilis—Cserhát and Vértes—Gerecse regions.

This uninterrupted, conformable succession is unconformably overlain by the rhyolite tuff.

(iv) *Chronostratigraphic position of the succession (formation)*

1. The glauconitic-tuffitic sandstones. Proof for the Upper Oligocene age of the glauconitic beds traversed in the Brickyard borehole has been adduced in the paragraph on that profile. The examination of the *Lepidocyclina* from the Nyárjas at Novaj led KECSKEMÉTI (In BÁLDI et al. 1961) to state a definitely post-Rupelian, presumably Upper Oligocene age for this horizon. DROOGER (in BÁLDI et al. 1961) identified from the same locality *Miogypsina septentrionalis* DROOGER, representing a primitive stage of Miogypsinid evolution, originally described by him from the Doberg at Bünde and from Astrup. This species is thus known from the stratotype of the Upper Oligocene, which lends a further support to the Upper Oligocene age of the glauconitic horizon. DROOGER considers *M. septentrionalis* to be a substitutive (vicariating) form of *M. complanata*, which latter is known from the Upper Oligocene of Northern Italy and Southwestern France. The glauconitic sandstone of the Nyárjas at Novaj has yielded but a scarce mollusc fauna, in which two *Pecten* species could be identified. *Flabellipecten burdigalensis* is widespread in the North Italian Upper Oligocene and in the Mediterranean and Atlantic Lower Miocene, whereas *Chlamys csepreghymeznericsae*, unknown outside the Hungarian Upper Oligocene, cropped up besides Eger and Novaj also at Törökbálint and Dejtár.

The "Vintners' School" fauna, placed in a variety of stages from the Middle Oligocene (MAJZON) to the Lower Miocene (CSEPREGHY-MEZNERICS), unequivocally indicates an Upper Oligocene age. The only Miocene species are *Rostellaria cf. dentata* and *Athleta rarispina*. A Lower Miocene age is thus out of question to begin with. A Rupelian age is contradicted especially by *Musculus philippi*, *Venus multilamella*, *Globularia gibberosa sanctistephani*, and *Athleta rarispina*. The Miocene species, some of them questionable, make up only 5 percent of the fauna, whereas the percentage of Oligocene species is 35. With 57 percent of the species in common between them, the "Vintners' school" fauna stands close to that of the "k layer" in the Brickyard; it also resembles the Törökbálint fauna (45 percent common species): besides the facial similarity (both faunae are medium-depth sublittoral) this follows also from the stratigraphic position: both faunae are an older Upper Oligocene. The connexion with the Törökbálint fauna is most strikingly revealed by the common occurrence of small *Astarte* and *Cardita* species, rare elsewhere, of *Ostrea gigantea callifera*, of the Glycymerids etc. (For the complete fauna of this horizon see Column 37 of Table I.)

2. The moluscan clay. Its fauna is known from the Eger Brickyard borehole (Eger-16), from Kerek Hill (Ostoros-1), the Nyárjas (Novaj-1) and the Rakottyás (Novaj-2). For an aggregate fossil list see Column 38 of Table I. This fauna had been rather neglected in earlier literature. I could identify 71 species in the Brickyard and 30 in the Nyárjas fauna (Báldi in Báldi et al. 1961, Báldi 1966a,b), whereas Noszky sen. (1936) had marked only 38 forms as occurring also in the "lower clayey levels". At Ostoros, Jankovich and I could find no more than five species in the vineyard furrows, and the Rakottyás material remains unstudied so far.

The molluscan clay in the Brickyard was considered Middle Oligocene by Telegdi-Roth (1912) and subsequently elevated to the Chattian by Majzon (1942) on the basis of his study of the foraminifers. In contradiction with this statement, Majzon described this same clay as belonging to the Rupelian "0 horizon" in the Demjén—Bogács hydrocarbon wells. In his recent book, Majzon (1966, sp. 783) names an "Upper Rupelian" substage in the Chattian!

According to Benkő-Czabalay, 101 species are known from layer "x_1" and 130 from layer "x_2": 58.4 percent of the fauna is Miocene in the first and 63.7 percent in the second. I myself characterized in 1961 the chronologic distribution of the molluscan clay at Novaj as follows: 28 percent Oligocene, 38.4 percent Miocene, 27.4 percent persistent and 7 percent endemic species. Considering this mollusc assemblage as a typical "border fauna", which could be Oligocene with the same right as Miocene, I drew the limit at the top of the Molluscan clay.

A summary evaluation of the data in the table reveals the following:

44 percent of the species is known from elsewhere in the Paratethys,
22 percent is known from the Tethys (Northern Italy),
31 percent is known from the Boreal province,
24 percent is known from the Atlantic province. The above percentages refer to the simple fact of occurrence, and as several cosmopolitic species are known from more than one province, the percentages add up to more than 100.

The fauna is remarkably endemic: no more than half of the species are known outside the Eger—Sajó Valley region. A Boreal affinity is apparent nevertheless. As regards the chronological characteristics of the fauna, I have found the following:

23 percent (15 species) are Oligocene,
3 percent (2 species) are Miocene,
18 percent (24 species) are persistent,
36 percent (50 species) are endemic.

In contrast to two Miocene species, *Limopsis anomala* and the questionable *Athleta ficulina*, the following Oligocene species could be identified:

Nuculana psammobiaeformis, *Yoldia raulini*, *Crassatella bosqueti*, *Cardita ruginosa*, *Mathilda schreibersi*, *Diastoma grateloupi turritoapenninica*, *Erato prolaevis*, *Cassidaria depressa*, *Vexillum peyreirense*, *Asthenotoma obliquinodosa*, *Turricula telegdirothi*, *Niso minor*, *Melanella naumanni*, *Dentalium simplex*, *D. fissura*, quite apart from endemic forms with their roots in the deeper Oligocene, e.g. *Rostellaria bicarinata*, *Acamptochetus clatratus*, *Cuspidaria neoscalarina*, *Turricula ilonae*, *Thyasira vara angusta*, etc.

All in all, the Oligocene fauna of Boreal affinity of the molluscan clay, with 3 percent Miocene elements, is to be correlated with the Törökbálint fauna, likewise of Boreal affinity and with 4.8 percent Miocene elements. Thus the glauconitic sandstone belongs, just as the molluscan clay does, to that deep level of the Upper Oligocene which corresponds perfectly to the deep Upper Oligocene Pectunculus sands of Törökbálint.

Apart from other arguments, a post-Rupelian age is fixed also by the relative abundance of *Hinia*. According to a verbal communication by ANDERSON, the appearance of *Hinia* is one of the criteria distinguishing the Chattian from the Rupelian in the Oligocene type region of the North Sea Basin.

The high-degree endemicity of the fauna may be due to this *Hinia-Cadulus* community being very little known elsewhere in the European as well as in the Hungarian Upper Oligocene. The resemblance between the Molluscan clay and the Kiscell Clay is enhanced by the fact that many of the fossil forms described from the Budapest—Újlak exposures of the Kiscell Clay subsequently evolved into closely related subspecies or species represented in the molluscan clay (e.g. *Nuculana psammobiaeformis*, *Cuspidaria neoscalarina*, *Thyasira vara angusta*, *Rostellaria bicarinata*, *Acamptochetus clatratus*, etc.).

The reason why the evaluation of the Novaj fauna in 1961 (BÁLDI in BÁLDI et al. 1961) gave a contradictory result was because, at that time, totally excluding the Paratethys from our comparisons, we left also the Kiscell Clay occurrence out of consideration: moreover, our knowledge concerning the stratigraphic spread of several species and also the age of some localities used in correlation was enriched since, so as to modify substantially my 1961 findings. According to our present revised ideas the chronological composition of the Novaj fauna is as follows:

10 species, 33 percent of the fauna, are Oligocene,
2 species, 7 percent of the fauna, are Miocene,
9 species, 30 percent of the fauna, are persistent,
9 species, 30 percent of the fauna, are endemic.

The only species to be classified as Miocene are *Turris trifasciata* and *Melanella spina*. The Miocene age of *Athleta ficulina* is questionable; *Conus dujardini egerensis* and *Turritella venus margarethae* should, despite their close links with Miocene fossils, be regarded as endemic. Even if these are added to the Miocene species, though, the percentage of the latter increases to no more than 17 percent, much less than the Oligocene percentage even by the most conservative reckoning.

3. Alternating clays and sandstones. The age of this horizon can be derived from the abundant fauna in the "k layer" of the Brickyard. In earlier literature, the term "Eger fauna" used to mean by and large the fauna of this layer. The good preservation made it highly rewarding to the collectors, of whom F. Legányi should be given special mention. Most of the rich material accumulated over the years, including the fossils published in 1936 by Noszky sen. and those discussed in 1958 by Noszky and Benkő—Czabalay, were devoured by the firebrand which in 1956 burned out the Geo-Palaeontological Collection of the Natural History Museum in Budapest. No revision of this fauna is thus possible.

For the purpose of the present work, I have examined the following collections: Legányi's in the I. Dobó Museum, Eger; R. Streda's in the Palaeontological Collection of the Natural History Museum, Budapest; those of I. Csepreghy-Meznerics and R. Nyirő (ibidem); the collections of Telegdi Roth, Majzon and L. Benkő-Czabalay in the Museum of the Hungarian Geological Institute; and finally, my own collection in the Palaeontological Collection of the Natural History Museum, Budapest. These collections held a total of 109 species from the "k layer" (Column 29 of Table I): this is but one-third of the 324-item fossil list in Noszky (1936). Still, if we subtract from Noszky's list the 28 species marked to have been found in the clay, plus the seven unnamed "transitional forms", and contract the 66 names resulting from Noszky's exaggerated subdivision debatable from both the biological and the stratigraphic viewpoint, then the number of relevant species in Noszky's revised fauna decreases to 218, 65 percent of which cropped up in materials subsequently collected or was available in other collections. Considering that even the collecting activity of several decades did not turn up more than one specimen each for three-quarters of the missing 35 percent, we may state that despite the much-regretted loss of Noszky's material the essential part of the "k layer" fauna was available for revision.

The fauna was placed in the uppermost Upper Oligocene by both Telegdi-Roth (1914) and Noszky sen. (1936) who emphasized its transitional nature both from the chronological and the palaeogeographical aspect. Gaál (1938) and Horusitzky (1940) held it to be Lower Miocene (Aquitanian according to their ideas) by analogies with other regions. Csepreghy-Meznerics (1956) adopted this same view after a stratigraphic analysis of Telegdi-Roth's and Noszky senior's fossil lists. According to Benkő-Czabalay (1958), in the fauna of the "k layer" the Miocene element amounts to 60.5 percent, the Oligocene only to 8.1 percent. Seneš (1958) considered the Eger fauna to be contemporaneous with the Kováčov fauna for which he had established an Aquitanian (Lower Miocene) age.

My own results concerning the regional distribution of the fossils can be summarized as follows:

83 percent of the species are known from elsewhere in the Paratethys,
44 percent are known from the Tethys (Northern Italy),

43 percent are known from the Boreal province, and
27 percent are known from the Atlantic province (Southern France).

The figures indicate, here too, the mere fact of occurrence; species occurring in more than one province result in a total of percentages higher than 100.

There is a well-balanced mixture of Boreal and Mediterranean forms in the "k layer" fauna: the species represented at Eger are encountered in almost equal numbers in the two provinces, as was already recognized by TELEGDI-ROTH (1914). The fauna is much less endemic than that of the molluscan clay; the *Pitar polytropa* community is very widespread all over the European Upper Oligocene.

The fauna has yielded the Miocene forms *Chlamys incomparabilis*, *Rostellaria dentata*, *Natica tigrina*, *Zonaria globosa*, *Euthriofusus burdigalensis*, *Athleta rarispina*. The chronological value of *Strombus coronatus* is dubious; it has been mentioned with a cf. mark also in the Bélus-Peyrère fauna. *Athleta ficulina* was listed by NOSZKY sen. from the Kiscell Clay at Újlak. The species *Lutraria oblonga soror*, *Turritella venus margarethae*, *Melanopsis impressa hantkeni*, *Bittium reticulatum densespiratum*, *Charonia tarbelliana transiens*, *Hinia fortecostata edentata*, *Conus dujardini egerensis*, *Cylichna cylindracea raulini*, are to be regarded as closely related Upper Oligocene forerunners of Miocene species.

The Oligocene species of the "k layer" are the following: *Nucula schmidti*, *Glycymeris pilosa lunulata*, *Ostrea cyathula*, *Cyprina islandica rotundata*, *Isocardia subtransversa abbreviata*, *Pitar splendida*, *Ringicardium bükkianum*, *Turritella beyrichi percarinata*, *Diastoma grateloupi turritoapenninica*, *Ampullina crassatina*, *Globularia gibberosa sanctistephani*, *Cassidaria depressa*, *C. nodosa*, *Typhis cuniculosus*, *Galeodes basilica*, *Babylonella fusiformis pusilla*, *Marginella gracilis*, *Turris selysi*, *T. konincki*, *Turricula regularis*, *T. telegdirothi*, *Cylichna cylindracea raulini*, *Acteon punctatosulcatus*, *Dentalium simplex*.

The chronological composition of the "k layer" fauna is, then, as follows:

24 Oligocene species (23 percent of the fauna),
8 Miocene species including also the two doubtful Oligocene forms (7 percent of the fauna),
36 persistent species (33 percent of the fauna),
41 species endemic in the Paratethyan Upper Oligocene (37 percent of the fauna)

Even adding to the Miocene species the above-listed closely related forerunners does not raise the Miocene element above 14 percent. Of the Oligocene forms, seven subspecies have close relations in the Miocene. Subtracting these reduces the number of Oligocene species to 17. Hence, a most conservative reckoning gives 16 percent for the Oligocene and 14 for the Miocene forms.

4. Most authors used to consider the horizon of littoral and lagoon deposits to be contemporaneous with the "k layer". Its fauna (Column 40 of Table I), all of whose forms have been encountered in deeper-lying beds, does not justify the assumption of a Miocene age. The Oligocene species

Cyprina islandica rotundata, found in the "k_1 layer", that is, at the top of the Brickyard profile, also proves the entire Brickyard succession to be Upper Oligocene.

The Eger profile is one of the finest and most complete Upper Oligocene successions. It covers a considerable facial range, from the shallow bathyal facies, through the calcareous-glauconitic facies with larger foraminifera, to the sublittoral, littoral, brackwater and lagoon facies, all with excellently preserved zoo- and phytofossils. It emerges in continuity from the underlying beds: the overlying formation is unconformable, it is true, in the vicinity of Eger, but in the Sajó valley there is an uninterrupted transition into the Amussium Schlier (cf. Ch. II. 6.b below). The Eger profile thus meets all the criteria of a stratotype. This is why — reviving earlier suggestions to this effect by Roger and Csepreghy-Meznerics (1962) — I proposed (Báldi 1966a, b) to choose the Eger profile as one of the fundamental profiles of the Paratethyan Upper Oligocene. Indeed, this succession could serve as an ideal stratotype of the Egerian stage, to be set up within the regional Paratethyan system of stages now under elaboration (cf. Ch. I 1).

(b) *The Sajó Valley (The Borsod lignite basin)*

Oligocene exposures are few and far between in this region: our relevant knowledge is to be attributed to a surge of drilling activity in the last decade. Penetrating deep below the Lower Rhyolite tuff, the more recent boreholes traversed a thick, finely detritic succession and at Felsőnyárád, also the so-called deep-level brown coal seams.

After the foudations laid by Vadász (1929) and Schréter (1929), the more recent data have been recorded in literature by Alföldi (1959), Jaskó (1959) and Radócz (1960, 1964). However, the problem of the exact place of the Oligocene-Miocene boundary within the thick succession of deposits underlying the Lower Rhyolite Tuff remained open and so did the age of the recently discovered deep-level brown coal seams. We undertook to clarify this situation in a joint effort with Gy. Radócz (Báldi and Radócz 1965b).

The most complete Upper Oligocene succession is that traversed by the borehole Mucsony 136. Its log is as follows:

271.4 m: bottom of the Lower Rhyolite Tuff

271.4 to 384.0 m: a dense alternation of clays, silts and sandstones, with plant fossils and coal stringers. Among its excellently preserved fossils I could identify

Mytilus aquitanicus
Polymesoda convexa
Theodoxus pictus buekkensis
Melanopsis impressa hantkeni
Tympanotonus margaritaceus
Pirenella plicata
Turritella beyrichi s.s.
Polinices catena helicina

The fauna corresponds to the widespread littoral communities of the Upper Oligocene.

384.0 to 500.0 m: a molluscan clay with a rich fauna belonging to the *Hinia-Cadulus* community, composed of the species

Yoldia raulini
Limopsis anomala
Angulus postera
Corbula gibba
Thyasira vara angusta
Turritella venus margarethae
Hinia schlotheimi
Vexillum sp.
Volutilithes permulticostata
Roxania burdigalensis
Cylichna cylindracea raulini
Ringicula auriculata s.l.
Turbonilla sp.
Odontostoma sp.
Vaginella sp.
Cadulus gracilina
Fustiaria taurogracilis
Thaumastocheles rupeliensis

500.0 to 587.0 m: A clay marl with foraminifers and scarce macrofossils.

In the knowledge of the Eger profile and faunae it is not hard to recognize the chronostratigraphic position of this conformable succession. The clay marl at the bottom qualifies as "Rupelian", that is, as a Kiscell Clay, on the basis of its foraminifers as studied by R. NYIRŐ. The molluscan clay facies traversed between 384 and 500 m hardly differs in facies from the underlying Kiscell Clay, from which it emerges in continuity. Its mollusc fauna, however, whose species admitting of a closer identification have all been encountered in the Eger molluscan clay, too, indicates a younger age. The abundances of *Hinia schlotheimi*, *Cadulus gracilina* and *Volutilithes permulticostata* are also strikingly similar. Adding these considerations to the micropalaeontological evidence we may state the molluscan clay of Mucsony to be Upper Oligocene and regard its correlation with the molluscan clay of Eger as firmly established. In the littoral and lagoon deposits between 271 and 384 m we perceive a succession similar to the point of confusion in facies and faunal composition to the No. 4 horizon of Eger. Just as at Eger, the Upper Oligocene is unconformably overlain by a rhyolite tuff.

The situation at the top of the Upper Oligocene is somewhat different in the Sajókazinc (Kazincbarcika) borehole Skz 169, described in an unpublished report by L. KOVÁCS et al. (1962). Inspecting their material and reading their report with their kind consent we have found that a cerithian littoral succession with traces of coal, traversed between 544 and 657 m and corresponding to the similar succession traversed by the Mucsony borehole, is directly overlain here by 480 m of monotonous silty marls and clayey calcareous silts. This succession has yielded, especially from its top 150 m, rather abundant fossils (molluscs and solitary corals), whereas the lower parts mostly contain fish scales only. The borehole Szuhakálló 94, drilled close by and stopped in the above "Amussium Schlier with fish scales", yielded a macrofossil assemblage of fair enough preservation with *Pseudamussium denudatum* Reuss as one of the most typical forms, accompanied by further Miocene species including *Basterotia corbuloides* Mayer. Both boreholes provided abundant numbers of *Bathysyphon* sp. (= *Protulites segmentata* Jaskó). These fossils were identified in a manuscript report by Kecskeméti-Körmendy (1959).

We consider the Amussium Schlier with fish scales to be Lower Miocene in all probability (Báldi and Radócz 1965). This is confirmed (1) by the frequent occurrence of *Pseudamussium denudatum* Reuss which, according to Csepreghy-Meznerics, is readily distinguished from its Palaeogene forerunner *Pseudamussium corneum* Sowerby and occurs nowhere below the Lower Miocene in Europe; (2) by the fact that most of the other species represent Miocene types, as far as our actual knowledge of their spread goes; and (3) by the fact that it is underlain by what can be correlated with the topmost littoral-lagoon deposits (Horizon No. 4) of Eger.

The field relations of this region are pretty complicated: at Felsőnyárád, the deep-level coal seams of freshwater facies at the base of the Amussium schlier with fish scales directly overlie the basement without a trace of recognizable Oligocene. We thus have to reckon with an emersion and erosion which removed all of the Oligocene prior to the Lower Miocene transgression in this area. The wedging out of the entire Oligocene sequence within so short a distance is highly unlikely. There is a very striking angular and erosional unconformity between the Lower Rhyolite Tuff and the beds underlying it. The tuff overlies Upper Oligocene deposits eroded to various depths (Varbó 50, Mucsony 136), or the Lower Miocene (Sajókazinc 136, Szuhakálló 94, Felsőnyárád). There is a similar unconformity in the environs of Eger, where the rhyolite tuff spreads over a variety of Upper Oligocene horizons.

(c) *Summary* (*Fig. 37*)

The Upper Oligocene of the Eger—Sajó Valley region is also geared to the great Oligocene cycle of sedimentation. In keeping with the tendency of the sedimentary basin to deepen eastward, about half of the Upper Oligocene succession in this area is made up of deep sublittoral — shallow bathyal clays with *Hinia-Cadulus* communities, close in facies to the Kiscell Clay. In the Sajó valley, the one grades so imperceptibly into the other that we can speak of a perpetuation of the Kiscell Clay facies in the Egerian stage. In the environs of Eger, however, there are medium-depth and shallow sublittoral deposits intercalated between the Kiscell Clay and the Upper Oligocene molluscan clay, thus lending a certain independence, the aspect of a "micro-cycle" to the Upper Oligocene sedimentation. The upper part

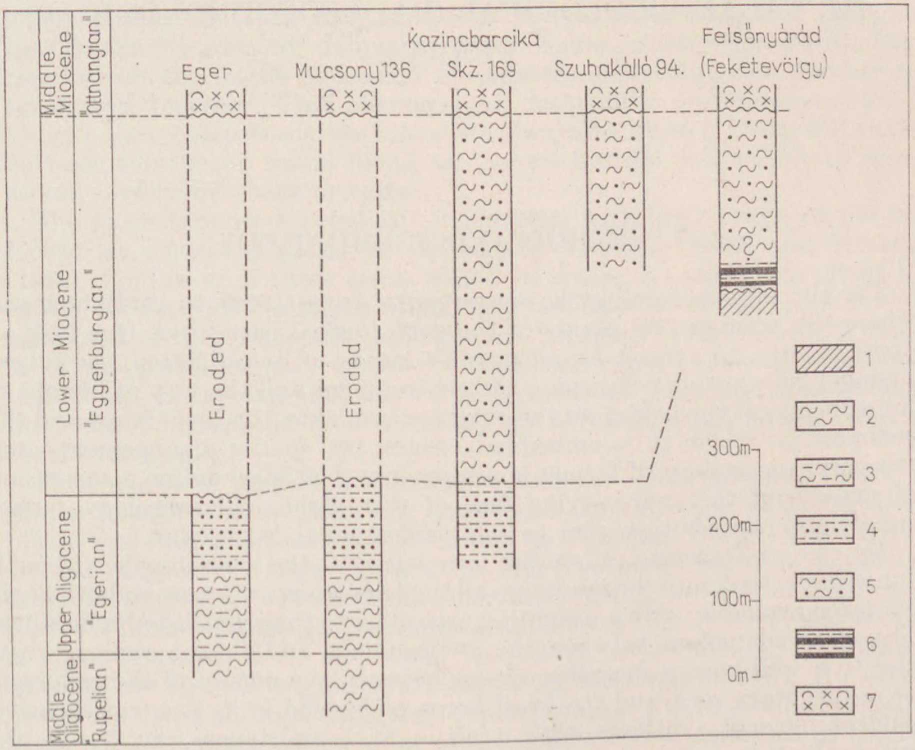


Fig. 37. Comparison of the deposits underlying the Lower Rhyolite Tuff in the environs of Eger and in the Sajó Valley, respectively, on the basis of the Eger-1 site and of several borehole profiles. Legend: 1. Pre-Tertiary. 2. Rupelian Kiscell Clay. 3. Upper Oligocene Molluscan clay with a *Hinia-Cadulus* community. 4. Upper Oligocene shallow sublittoral, littoral and lagoon deposits with *Tympanotonus-Pirenella* and *Mytilus aquitanicus* communities. 5. Lower Miocene (Eggenburgian) marly silt (Schlier) with fish scales and *Amussium*. 6. Deep-level limnic lignite seam complex of Felsőnyárád. 7. Lower Rhyolite Tuff complex (? Ottnangian)

of the Upper Oligocene succession is composed of shallow sublittoral and, still farther up, of littoral and lagoon deposits, and although in the Sajó Valley there is a gradual transition towards the overlying (Eggenburgian) Amussium schlier, this gradual regression, marked with traces of coal, provides a satisfactory delimitation, faunistic as well as lithologic, towards the Miocene. Besides this, the upper, shallow sublittoral and littoral-lagoon deposits of the Eger—Sajó Valley region are highly similar to the Upper Oligocene in the western part of the sedimentary basin (from the Vértes—Gerecse to the Galga Valley).

III. PALAEOECOLOGICAL (PALAEOCOENOLOGICAL) PART

1. METHOD AND TERMINOLOGY

The aim of palaeoecology is, according to Ager (1963), to study how and where the animals and plants of the geohistorical past lived. Our task is, consequently, to extract by all possible means of investigation, the fullest possible information concerning the environment and the way of life of the living beings of the past from the evidence available (the fossil fauna and the sediment in which it is embedded). Since the spatial arrangements and temporal successions of former environments (biotopes) define a succession of aspects of the ever-varying face of this globe, palaeoecology makes significant contribution also to our geohistorical knowledge.

My own palaeoecological studies were based on the macrofossils, although I invariably took into consideration all the micropalaeontologic and lithologic evidence available, with a weighting according to their estimated reliability. The close connexion between the environment and the biocoenose gives rise to a well-known interdependence between the nature of the sediment or sedimentary rock and the fossil fauna embedded in it. A comprehensive palaeoecological synthesis with a claim at completeness can hardly do without lithological examinations. In the exemplary palaeoecological study of the Palaeogene embayment of the Ferghana basin, conducted by Hekker (Hekker et al., 1962), lithological analysis played a substantial part. The Upper Oligocene communities to be described below most often go together with well-defined lithofacies. The lithologic refinement, largely by laboratory methods, of our knowledge concerning these facies lies outside my field of competence, but it will remain an important task of the future.

The concept of the palaeocoenose

Of the rich arsenal of palaeoecological techniques described in Hekker (1957) and Ager (1963), we preferred in our own work the "synecological" (palaeocoenological) method. I studied fossil assemblages in their totality, rather than relying on the authecological analysis of this or that isolated species. The basic subjects of my studies were consequently the palaeocoenoses.

Merklin (1950), who introduced this concept, used the term to designate fossil record of a onetime living community, a biocoenose. Hence, a palaeocoenose is conceptually different from other coenoses, which latter were recently reviewed in Hungarian literature by Dudich jun. (1962). Nor does it cover the concept of the (fossil) fauna occurring in a given bed of a given locality. A fauna may represent several palaeocoenoses. Examples include the "condensed" faunae in areas of slow or interrupted sedimentation, where the fossils of several biocoenoses succeeding one another are telescoped together. This phenomenon, frequently encountered also in today's seas, compels marine biologists always to make a sharp distinction between the species found living on the sea bottom and the forms represented merely by shells or tests.

The palaeocoenose concept is not identical with the concept of the biofacies, let alone the facies, as defined by FRANKE (1963) and SCHÄFER (1962). Confusion of these terms would be wrong among other things because, in FRANKE's interpretation, the biofacies is an abstract notion, composed of the systematic, ecologic and coenologic features of the fauna or of the palaeocoenose, whereas the palaeocoenose proper is a concrete reality; an extrapolation is needed to reconstruct from the palaeocoenose the "aspect" generated by a set of ancient environmental factors, that is, the facies proper.

Palaeocoenoses reflect environments: similar environments result in similar palaeocoenoses. There are, however, no two identical palaeocoenoses, just as two fully identical biotopes cannot be imagined. Despite this variety, I could reduce the varied Upper Oligocene palaeocoenoses of a number of different localities to 14 fundamental types, making use of the dominance relations of the species. It is a common experience that in every biocoenose or palaeocoenose there are some species of overwhelming abundance whereas the rest of the forms are rather sparsely represented. My classification is based on these dominant, typical species. I have grouped together those palaeocoenoses with similar combinations and abundances of species. The abundances in question are often "semiquantitative", i.e. determined by inspection in the course of collection, owing to the poor preservation of the fossils.

In the characterization of dominance relationships, I shall use the following terms.

Typical species: a conspicuous and abundant element of the community type, frequently dominant in most localities. (The term *palaeocoenose* will be replaced in the following by the more current term *community*.) This category includes also all species not known from outside the community type in question.

Frequent companion species: a frequent element of the community type in question, sometimes dominant in some localities.

Other species: all species which do not belong into one or the other of the above two categories.

Substituent species: typical species occurring alternatively in (vicariating among) various localities of the community type in question.

I have named the community types after one or two typical species, or, for brevity, after the relevant genera (for instance: *Polymesoda-Tympanotonus* community). Where the name is based on a single typical species, I have given the specific name as e.g. in the case of the *Glycymeris latiradiata* community. The choice of typical species and of the namesake species among them has been based on the consideration that a community should be easy to recognize in practice, in the course of geological mapping or of borehole core examination.

The one-time biotopes belonging to the individual communities have been reconstructed by a critical application of the principle of uniformitarianism. This method has directed my attention to the living communities of the contemporary seas.

Petersen's statistical community idea

The synecologic analysis of seabottom communities does not have a long past: it has practically begun with Petersen's activity. Petersen's original aim was to deduce the fishery potential of Danish waters from macrofaunal abundances on the sea bottom. Evaluating thousands of samples, he reached the conclusion that vast areas of the sea bottom were inhabited by strikingly uniform combinations of species, some of which are particularly conspicuous by their outstanding abundances. Other areas are inhabited by other combinations of species, but the situation is much the same otherwise. "By means of some 10—12 different species, we learned in course of time to distinguish between 8 animal communities from the deep water of the Skagerrak to the Baltic, each having its separate area or areas, which, it was found, could easily be marked off on an ordinary chart." (Petersen 1918, p. 10). Petersen used the most frequent and most conspicuous species to characterize these communities: "The animals, . . . which compose an important part of the whole mass of the community, owing to number or weight, will presumably be best suited for characterizing the community and must also be considered as giving a good idea of the outer conditions on which the community is dependent." (p. 4.)

Petersen's statistical community idea has turned out to be highly fruitful in marine biology: a host of analogous studies have been prepared for the North Sea, the Northern Atlantic, the Adriatic, and the shores of Japan, Ghana, the Gulf of Mexico, California and New Zealand. Comprehensive treatises were published by Spärck (1935) and Jones (1950); the fundamental synthesis of Thorson appeared in 1957.

The communities defined according to Petersen's ideas are based on the macrofauna: they are characterized by means of a few species, they are mappable and dependent on the environment. We have set up similar criteria for the Upper Oligocene fossil communities which — on the evidence available — are assemblages of the fossil remains of communities similar to those defined by Petersen. The method by which a living and a fossil community can be correlated is the method of isocoenoses.

The isocoenose method

The isocoenose concept has long been used in neoecology. According to Balogh (1953), an isocoenose includes all biocoenoses composed of identical isoecia. An isoecium is the totality of all level-communities composed of species similar in physiognomy but not identical taxonomically, that is, composed of analogous life forms. Thorson (1957) put this as follows: "... the word 'Iso-community' has now and then been used in reference to communities which, though inhabited by other genera, are so closely related to the communities we are going to compare them with, in their morphological structure and their ecological characteristics, that they may be regarded 'ecological parallels'". (p. 504). It was on this basis that Thorson (1957) could develop a system of living communities covering the whole Earth, thanks to the isocoenose method which permits to compare communities not contiguous in space. On this same principle, Parker (1964) could compare the communities of the Gulf of Mexico and the Gulf of California. He stated that "it is not necessary that the genera, or even families are the same for the dominant organisms in these parallel communities, so long as the dominants perform the same function within the community." (p. 93).

Similarity in life forms is a consequence of similar environments. The environments of communities separated in space but belonging to the same isocoenose tend to be highly similar. Thorson (1957) wrote that "... the same types of bottom are everywhere inhabited by series of parallel animal communities, in which different species of the same genera replace one another as characterizing species" (p. 504).

So far, the isocoenose method has exclusively been used in the geographical sense, that is, to bridge spatial gaps. It can, however, be used in our opinion to bridge temporal, geohistorical spans just as well. If a fossil community resembles a living one in structure and life forms, then this similarity is obviously a result of similar-environments. Thus we can derive from the known environment of the living community the unknown ancient environment of the fossil community.

I first applied the isocoenose method to a geohistorical situation in 1959, in connexion with the palaeoecological analysis of the Miocene faunae of Budafok (Báldi 1959). My attention was subsequently called to the antecedents of this method by Dudich jun. (1962) who had termed the phenomenon in question "coenological substitution (vicariation)".

Environmental conditions affecting a community

Of these, the physico-chemical consistency of the sea-bottom sediment is considered most important by Thorson (1957). This relationship had clearly been recognized already by Petersen (1913). Subsequently, Ekman (1947) proved experimentally the regulating effect of seabottom consistency on the areal extent of a community. This is the only possible explanation for the fact that forms thriving between 200 and 400 metres of depth in the Skagerrak live between 35 and 50 metres in Gullmar Fjord: owing to the protection afforded by the fjord, these life forms can find the soft clayey deposits they prefer in relatively shallow water. The larvae, when changing over to benthonic life, select *ab initio* a type of bottom favourable to the fully grown animal: that is, the composition of any sea bottom community is not merely the result of a passive selection (Thorson 1957). The close connexion between sediment and biocoenose is paralleled by the well-known analogous connexion between sedimentary rock and fossil community. As the grain-size distribution of the sediment depends on the turbulency of the water, there is also an indirect connexion between the community and water movement.

Salinity is no dominant factor except in lagoons or more or less closed bays. In the Upper Oligocene of Hungary, its importance must not be underestimated. Of the numerous classifications of salinity, often too refined for palaeoecology, let us adopt that proposed by Ager (1963 p. 26) as the one that is easiest to apply and best fitted to our purpose:

0.5 per mille:	fresh water	
0.5 to 3.0 mille:	oligohaline	brackish water
3.0 to 16.5 mille:	mesohaline	
16.5 to 30.0 mille:	polyhaline	
30.0 mille:	marine	

The influence of the depth of water upon the seabottom communities is indirect, acting through other environmental factors (water movement, sediment, oxygenation, temperature, food). Present-day communities are found to cover broad depth ranges. Nor is it at all astonishing that the Upper Oligocene fossil communities should be connected with certain types of sediment rather than with fixed values of water depth. In want of better, the supposed depth ranges of the fossil communities had therefore to be kept rather broad. The study of the great expeditions' monographs has led me to the conclusion that depth of water does practically not affect the distribution of molluscan genera. Bandy (1958) could state on the basis of his researches in the South Californian Sea that the various species of a given bivalve genus can cover an extremely wide range of depths. This is another point in favour of the synecologic as opposed to the authecologic approach.

The feeding habits of the fossil community are also highly important ecologically. They may shed light on the original organic-matter content of the sediment, and thus indirectly on the degree of oxygenation; on the presence or absence of plant life, and thus indirectly on lighting and depth of water; and on distance from the shore. Parker (1964) laid a particular emphasis on the importance of recognizing feeding types for the characterization of communities. He distinguished:

(1) Suspension-feeders, filtering the fine-grained organic debris from the water by means of a suitably kept-up water circulation. Animals of this group prefer clear, rather agitated water and a hard base.

(2) Deposit-feeders, feeding on the organic matter accumulated in or on the surface of the sediment. They tend to prefer life on or in a finely detritic, soft base.

(3) Predators and scavengers. Represented in all zones, they tend to gain the upper hand at greater depths.

(4) Browsers (alga-eaters), feeding either directly on the plant tissues of the algae or, more often, on the unicellular organisms or the thin film of organic slime adhering to the algal surfaces.

In the matter of marine biotopes we have followed by and large the terminology of **Hedgpeth** (1957), the main lines of which were adopted also by **Ager** (1963). A similar terminology was adopted by the Commission Internationale pour l'Exploration de la Mer Méditerranée in 1957. These terms, long used in oceanography, are becoming firmly entrenched also in recent geological and palaeontological literature. The term "neritic", extensively used earlier, should be restricted to that part of the pelagic biotope overlapping on the continental shelf. The intertidal region (the region between the high and the low tide levels) is called littoral; the contiguous region down to 200 m depth, which coincides more or less with the continental shelf, is termed sublittoral. The bathyal region extends from 200 to 1000 metres depth. The refinement in techniques has justified a further subdivision of the sublittoral region as follows:

shallow sublittoral zone: from 0 to 30 m
medium-depth sublittoral zone: from 30 to 120 m
deep sublittoral zone: from 120 to 200 m

It was at the time of the closure of this manuscript that I received a book by **Davitashvili** and **Merklin** (1966), quite outstanding in its kind, a synopsis, well-nigh complete from the palaeontologist's point of view, of the ecologies of the living bivalve genera. As the data contained in that book had largely been known to me from the original publications, they do not call for any modification of my results: on the contrary, they provide a welcome confirmation and sometimes a rounding out of them.

2. DESCRIPTION OF THE FOSSIL COMMUNITIES

A. LAGOON AND LITTORAL COMMUNITIES

By the definition of **Emery** and **Stevenson** (1957), a lagoon is "a shallow lake or sheet of water connected with the sea or river" (p. 673). Its long axis is parallel to the seashore; it is separated from the open sea by a string of shoals or islands. The decisive ecological factor is salinity, a function of the climate above all: the lagoon tends to be "positive" (recharged largely by precipitations, i.e. brackish) under a humid climate and "negative" (evaporation exceeding recharge by precipitations, i.e. hypersaline) under an arid one. The salinity of a lagoon or an estuary is not constant; it fluctuates in function of the precipitations. "The ecologically significant aspect of salinity in an estuary is not the mean condition but its range on a daily and seasonal basis . . ." wrote **Emery** and **Stevenson** (1957).

When analyzing fossil communities, one cannot sharply distinguish a lagoon from, say, a tidal mudflat, because — as pointed out also by **Hedgpeth** (1957) — lagoons are populated first and foremost by animals of the littoral region. The faunae fairly rich in species of the lagoons of normal or slightly excessive salinity tend to be highly similar to, or indeed identical with, the littoral and shallow-sublittoral mollusc communities.

It is just as difficult to distinguish littoral communities from the fauna of the shallowest part of the sublittoral region, as the remains of animals living in the latter can be washed ashore by the surf and can indeed accumulate on the beach. Because of this phenomenon, known to all who have ever observed a beach, one cannot draw a sharp limit between the littoral and shallow sublittoral communities of the Upper Oligocene, either.

(a) *Viviparus-Brotia communities*

Typical species: *Viviparus ventricosus, Brotia escheri.*

Frequent companions: *Theodoxus crenulatus, Melanopsis cf. hantkeni, Coretus* sp., *Unio inaequiradiatus, Sphaerium* sp., *Pomatias antiquum.*

Other species: pulmonates (*Archaeozonites, Pseudoleacina, Archaegopis,* etc.) which, together with *Pomatias,* were swept in dead from the adjacent terrestrial biotopes.

Distribution: exclusive in the western part of the sedimentary basin (Csatka, Sur, Csernye); fairly frequent in the Vértes and Gerecse; its easternmost occurrences are at Pomáz and Szentendre. Nagyegyháza 2, 3, 4; Csordakút 5; Gyermely 12, Gyermely 35; Csordakút 9; Mór 1, 4, 5, 6; Solymár 72, Zsámbék 23; Mány 8, 9; Tök 51; WÉIN (1939) mentioned it from the environs of Szentendre.

Lithofacies: usually very finely detritic; clay or silty clay.

Neoecologic considerations: According to FRETTER and GRAHAM (1962), *Viviparus* lives in slowly streaming water; very sensitive to increases in salinity in excess of 3 per mille, it is first of all a suspension feeder, but also picks up from rock or plant surfaces organic debris which it consumes with its radula.

Little is known about the ecology of the Melaniids. They are browsers and plant-debris eaters according to GRAHAM (1955). SCHEPMAN (1908—1913) and DOLLFUS (1909) state the *Brotia escheri* group to live today in rivers of the Indonesian Archipelago.

Isocoenoses: It faintly resembles the living *Unio-Anodonta-Dreissena-Cardium-Theodoxus* community described by SENEŠ (1964) from vegetationless sand and silt bottoms along Mediterranean shores. This community lives in waters of 0.5 to 4.0 per mille salinity. Another similar one might be the *Unio* community described by HEKKER et al. (1962) from the Ferghana Palaeogene. According to the latter authors, *Unio* cannot stand salinities above 3 per mille. *Viviparus* communities were described from the Dorog Eocene by BARTHA and KECSKEMÉTI-KÖRMENDY (1963), who stated that in that period *Viviparus* lived in an "oligohaline-brackish" environment (0.5 to 3 per mille salinity).

Palaeoecological conclusions: The *Viviparus-Brotia* community reflects a plant-eating epifauna, finding rich food in the shallow water of 1 to 2 m depth where the bottom was overgrown with plants or at least covered with vegetal debris. Salinity probably fluctuated from 0 to 4 per mille. Such freshwater-oligohaline hydrographic conditions may be envisaged at the upstream ends of estuaries, in the lowermost sections of streams flowing into a lagoon or estuary, in the portions subject to fresh-water recharge of positive lagoons, and in oligohaline lagoons turned into lakes by total isolation from the sea.

This community is a climate indicator, being restricted to regions of humid climate.

Contiguous communities: terrestrial and purely fresh-water communities, not to be discussed here, on the landward side; lagoon communities of *Polymesoda-Tympanotonus* and *Tympanotonus-Pirenella* type on the seaward side.

(b) *Polymesoda-Tympanotonus communities*

Typical species (in decresasing order of abundance): *Polymesoda convexa, Tympanotonus margaritaceus, Ostrea cyathula, Pirenella plicata, Melanopsis impressa hantkeni, Theodoxus pictus, Theodoxus bükkensis, Congeria basteroti, Hydrobia ventrosa.*

Frequent companions: *Gari protracta, Theodoxus crenulatus, Brotia escheri.*

Other species: remains of vertebrates and pulmonate gastropods swept in from the adjacent land; freshwater *Unio*, *Mytilus aquitanicus* entering living or dead from the littoral; *Glycymeris latiradiata, Balanus* sp. and valves of teredinids have been found admixed to certain *Polymesoda* communities.

Distribution: very widespread all over the Hungarian Upper Oligocene, but especially in the Vértes—Gerecse Region, where it is dominant among all communities. Pusztavám 803; Nagyegyháza 2, 3, 4; Csordakút 5, 9; Esztergom 35, 40; Csolnok 695; Kesztölc-1; Nagysáp-2; Pomáz-1, -21; Szentendre 2; Leányfalu-1; Máriahalom 36; Becske-1; Eger-1 ("u" layer); Mucsony 136, and in boreholes near Gyermely, Mány, Vasztély, and Zsámbék.

Lithofacies: varied grain sizes from clays to coarse sands.

Isocoenoses: highly similar communities now live on the shores of the Gulf of Mexico and California. PARKER (1960) calls the analogous communities of the Mexican Gulf "river-influenced, low-salinity assemblages", with the mollusc genera *Rangia*, *Macoma* and *Littoridina* accompanying the typical species *Polymesoda carolinensis* (Bosc.). The latter differs, according to HÖLZL (1957), merely in a few insignificant morphological features from *Polymesoda convexa*; it shuns both fresh water and sea water. According to PARKER (1960), the above-mentioned community of the Mexican Gulf covers river mouths and the shallow and medium-depth zones of the lagoons, where salinity does not exceed 10 per mille.

The isocoenose thriving on the shores of the Gulf of California is called a community of brackwater lagoons and mangrove swamps by PARKER (1964). It includes, besides species of *Ostrea*, *Mytilus* and *Neritina* (=*Theodoxus*), and some cerithids belonging to the *Potamididae*, also eight species of *Polymesoda*, which proves the conditions to be optimal for the *Polymesoda* genus. The similarity between this living community and the Upper Palaeogene fossil community is obvious: most of the genera involved are common to both. PARKER (1964) considers the living community a "good shoreline indicator" restricted to humid climates; it is unknown from semiarid regions.

Palaeoecologic conclusions; the fossil community is made up half-and-half of suspension-feeders (*Polymesoda*, *Ostrea*, *Congeria*) and plant- or vegetal-debris-eaters (*Tympanotonus*, *Pirenella*, *Theodoxus*, *Melanopsis*). Epi- and infaunal elements are likewise mixed. The proportions are approximately those observed in the Gulf of Californa (PARKER 1964).

Most of the genera cannot stand oligohaline or less salty waters (*Tympanotonus*, *Polymesoda*, *Ostrea*): this implies a salinity higher than 4 per mille. On the other hand, the genera for which an oligohaline medium is optimal can well support a mesohaline or even saltier medium (*Melanopsis*, *Theodoxus*, *Brotia*, *Congeria*). It has been supposed that the Tertiary forms of *Melanopsis* (BARTHA and KECSKEMÉTI-KÖRMENDY 1963) and *Congeria basteroti* (SENEŠ 1958) could — in contrast to the living freshwater-oligohaline genera — live in mesohaline and even polyhaline surroundings. *Melanopsis impressa hantkeni* occurs, even though rather scarcely, also in the shallow sublittoral community of Eger. The behaviour of *Theodoxus* towards salinity will be discussed farther below. *Brotia escheri* is known from the mesohaline Miocene faunae of Várpalota and Herend, too. It may thus be supposed that the salinity of waters inhabited by *Polymesoda-Tympanotonus* communities has never sunk below 4 per mille. Since conditions were optimal for *Polymesoda*, and in view of the data referring to the isocoenoses, the salinity probably did not, on the other hand, exceed 10 per mille. The community thus lived between 4 and 10 per mille salinity, that is, in river mouths or in the shallow and medium-depth zones of lagoons.

The depth of this mesohaline water may have been a few meters at most. In some communities, the shells show traces of wear, sorting and transport due to the surf on the lagoon beach. At Pomáz (P-21) the wear on certain *Tympanotonus* shells is remarkably similar to what is observed on today's sandy beaches. This same locality has provided large numbers of *Teredo*, entering this community alien to them in driftwood washed ashore.

The living communities reveal the fossil community to have been connected with a humid climate.

Contiguous communities: the *Viviparus-Brotia* community landward and the *Tympanotonus-Pirenella* community seaward. There are all manner of transitions between these three communities. It is especially hard to draw a line between the *Polymesoda-Tympanotonus* and the *Tympanotonus-Pirenella* communities, as the difference between them is largely restricted to the dropping out of *Polymesoda convexa*. A further difference is that, in the *Polymesoda-Tympanotonus* community, oligohaline species such as *Brotia*, *Congeria*, *Melanopsis* are more abundant and forms requiring a higher salinity, such as *Gari*, *Gibbula* and certain predator gastropods (*Ocinebrina*, *Galeodes*) are scarcer.

(c) *Tympanotonus-Pirenella communities*

Typical species: *Tympanotonus margaritaceus*, *Pirenella plicata*, *Ostrea cyathula*, *Theodoxus pictus*, *Theodoxus buekkensis*, *Gari protracta*, and the rare species restricted to this community, such as *Ocinebrina schönni*, *Ocinebrina crassilabiata trivaricosa*, *Galeodes semseyiana*, *Gibbula affinis protumida*.

Frequent companions: *Polymesoda convexa*, *Calyptraea chinensis*, *Turritella beyrichi*, *Melanopsis impressa hantkeni*.

· Other species: a few scattered *Congeria basteroti* washed in from the adjacent mesohaline community; *Pitar undata*, *Mytilus aquitanicus*, *Ampullina crassatina* etc. from the nearby littoral communities; *Pitar polytropa* and *Polinices catena helicina* swept ashore from the sublittoral region.

Distribution: One of the most widespread communities in the Hungarian Upper Oligocene, it is particularly frequent in the Vértes—Gerecse and Pilis—Western Cserhát regions. In the Budapest region and in the Eger—Sajó Valley region it is restricted to the deeper and higher sections of the successions. Nagyegyháza 3, Csordakút 5, 9; the boreholes of Mány, Gyermely, Szomor, Zsámbék and Tök; Máriahalom 36, 41; Esztergom 35, 40; Dorog-1; Leányfalu-1, -3; Szentendre 2; Diósjenő-3; Borsosberény-1; Budafok-1 (where, telescoped with a *Glycymeris latiradiata* community, it forms a "condensed" fauna); Eger-1 (the Brickyard); Eger—Síkhegy; Novaj-Rakottyás; Mucsony 136; Sajókazinc 169. Of course, in the boreholes it turns up repeatedly in several depth intervals.

Lithofacies: largely fine detritic; silt, clayey silt, clay, fine sand.

Isocoenoses. Essentially an oyster bed accompanied by masses of *Potamides*, this fossil community has some exact parallels off today's tropical shores. (Oyster beds — as stated by LEMCHE (1956) — are common in the tropical littoral regions wherever the surf is not too strong.) It corresponds to the *Mytilus* community of the temperate-boreal seashores. According to OLIVER (1923), a metre-wide bed of *Ostrea cucullata* contours the New Zealand shore, north of 38° lat. south, whereas south of this latitude, under a more temperate climate, a *Mytilus* community has developed. Another *Ostrea* strip is described by GISLÉN (1931) from the Japanese shores. On the northern shores and in the lagoons of the Gulf of Mexico, PARKER (1960) distinguished a "brackwater oyster-bed community" and a "marine oyster-bed community". The former is characterized by the genus *Crassostrea*, the latter by the genus *Ostrea*. The Upper Oligocene communities are closer to the latter; the Lower Miocene *Crassostrea* beds of Budafok are closer to the former (BÁLDI 1959).

The *Potamidae* are typical littoral animals; even the anatomy of their soft parts is modified towards an adaptation to amphibian life: in *Cerithidea* the ctenidium and osphradium have totally disappeared. JOHANNSON (1956) observed a similar tendency on *Tympanotonus fuscatus* (L).

BERRY (1956) described a living *Potamides* community from the Gulf of California in the following terms: "Just below the *Melampus-Salicornia* zone is an extensive area of black mud . . . its surface . . . almost literally paved with quite incredible numbers of the black *Cerithidea mazatlanica* CARPENTER . . ." I could study a similar community at first hand in Upper Newport Bay, Southern California, where a mudflat in the shallow water of a lagoon well protected from the open Pacific was covered by — let me repeat the expression — incredible numbers of *Ceritihidea californica*. In this lagoon of strongly fluctuating salinity, there were also beds of *Ostrea lurida*. This community was, incidentally, described by BARNARD et al. (1959) as an "*Ostrea-Melampus-Cerithidea* association".

Palaeoecological conclusions. The community consists almost exclusively of euryhaline forms, indicative of strong fluctuations in salinity, typical of the nearshore region. The most markedly euryhaline *Ostrea cyathula* is accompanied by the genera *Tympanotonus* and *Pirenella*; according to SENEŠ (1958), the biotope optimal for them is mesohaline water from 10 to 20 per mille salinity, but they will settle in large masses also in more open, polyhaline reaches of the seashore. Most *Theodoxus* species support meso- and polyhaline water quite well, according to SENEŠ (1958) and FRETTER and GRAHAM (1962). The *Tympanotonus-Pirenella* community includes also some distinctly polyhaline forms such as *Gibbula*, *Gari*, *Ocinebrina*, *Calyptraea*, which live even today on protected muddy shores according to FITCH (1953), KEEN (1958), SENEŠ (1958), SORGENFREI (1958), FRETTER and GRAHAM (1962). By the above data, the *Tympanotonus-Pirenella* community is to be regarded as meso- and polyhaline, occupying shallow sea bottoms at any salinity from 10 to 20 per mille. The living isocoenoses show that the fossil *Tympanotonus-Pirenella* community could develop only in lagoons or on little exposed seashores. The communities composed almost entirely of the genera *Tympanotonus*, *Pirenella*, *Ostrea* and *Theodoxus* probably were lagoon communities indicating mesohaline waters (from 10 to 16.5 per mille salinity). The same forms, accompanied by polyhaline-littoral species, indicate a flatmuddy shore where now and then a more frequent mixing with the waters of the open sea turned the water polyhaline (16.5 to 30 per mille). The *Tympanotonus-Pirenella* community of Diósjenő-3, which includes even some planktonic foraminifers (*Globigerina*), proving the influence of the open sea, might have belonged to this latter type.

According to data in HOPWOOD (1944), TURNER (1959), WHITAKER (1951), GRAHAM (1955), FRETTER and GRAHAM (1962) the community consisted to at least two thirds of browsers (*Tympanotonus*, *Pirenella*, *Theodoxus*, *Gibbula*). *Psammobia* (= *Gari*) is, according to YONGE (1949), a transition between suspension- and deposit-feeders, as its siphon is shorter than that of the generally deposit-feeding Tellinids. The only unmitigated suspension-feeders are *Ostrea* and *Calyptraea*. Some scarce predators also appear: *Ocinebrina*, feeding on oysters, and *Galeodes*, feeding on burrowing bivalves; the latter are, however, remarkably scarce, except for *Gari*. All the browsers, suspension-feeders and predators are epifaunal elements.

The lush marine vegetation and its debris, as well as the vegetal debris of the nearby humid land, deposited in the nearshore waters, provided plant-eaters with a well-nigh inexhaustible supply of food and suspension-feeders with no less copious finer debris. The few euryhaline species able to stand the extreme conditions of these lagoons and littorals could attain extreme abundances in this environment glutted with food. Besides the *Polymesoda-Tympanotonus* communities, this type of community probably produced the largest biomass in the Upper Oligocene sea.

Contiguous communities. Just as in the case of living *Potamides* communities large bivalves and gastropods at home in a few metres of water tend to crop up at the lower limit of this littoral community, the Upper Oligocene *Tympanotonus-Pirenella* community was bounded seaward by shallow-sublittoral communities of thick-shelled molluscs (*Glycymeris latiradiata* and *Pitar polytropa*). The transition is very gradual in some cases, and even a centimetre-by-centimetre collection may reveal a condensation due to interrupted sedimentation. It was probably about the 10-per-mille isohaline that the *Tympanotonus-Pirenella* community graded into a *Polymesoda-Tympanotonus* community. There were further close connexions toward the littoral communities of the more exposed and higher-salinity sections of the seashore (*Mytilus aquitanicus* and *Pitar undata* communities.)

(d) *Mytilus aquitanicus communities*

Typical species: *Mytilus aquitanicus, Tympanotonus margaritaceus, Ostrea cyathula, Turritella beyrichi, Ampullina crassatina, Pirenella plicata.*

Frequent companions: *Calyptraea chinensis, Gari protracta, Pitar undata, Anadara diluvii, Taras rotundatus, Cardium bojorum.*

Other forms: *Balanus, Corbula basteroti, Polymesoda convexa, Anomia ephippium, Turricula regularis,* etc.

Distribution: Scarce but ubiquitous all over Hungary. Esztergom 40; Szentendre 2; Diósjenő-1; Leányfalu-1; Eger-1("m") layer; Mucsony 136.

Lithofacies: coarse and medium-grained sand, seldom clayey silt.

Isocoenoses: The *Mytilus edulis* community is regarded by its discoverers, Petersen (1918) and Spärck (1935), as the littoral epifauna of the *Macoma baltica* community. A fine example of such a fauna was described by Larsen (1936) from the brackish waters of Dybsø Fjord, 3 to 6 m deep, where *Mytilus* is accompanied by *Cardium* and *Theodoxus* among others. Seneš (1964) stated that a community fully identical with the above ones required a salinity of 6 to 10 per mille. I have already pointed out above that the *Mytilus* community is a temperate counterpart of the tropical *Ostrea* beds. Seneš (1964) writes that, in the Mediterranean seas, *Mytilus* beds are accompanied by *Ostrea, Cardium* and *Venerids* at depths slightly greater than littoral, in waters of 15 to 18 per mille salinity. This shows how there may be a number of transitions between the climatically controlled *Ostrea* and *Mytilus* communities, so that the two cannot always be separated. According to Mistakidis (1951), the density of *Mytilus edulis* in the German oyster beds is 450 to the sq. m.

Palaeoecological conclusions. This community differs from those with *Polymesoda* and *Potamides* in that the *Ostrea* bed is.accompanied by smaller numbers of *Potamides*, some of which are substituted by colonies of *Mytilus*. The main difference is thus the expansion of the suspension-feeders like *Mytilus*, *Turritella* and *Calyptraea* at the expense of the plant eaters. Even so, however, suspension-feeders do not make up more than half of the community. The only predator is *Ampullina crassatina*. The community is markedly epifaunal, with a striking abundance of sessile benthonic forms. The large number of suspension-feeders, the epifaunal features and the coarse grain of the embedding sediment all go to prove that the biotope was characterized by a rather strongly agitated water entailing a slow and frequently interrupted sedimentation. This is the main difference from the *Tympanotonus-Pirenella* community.

All the typical species and most of the frequent companions are euryhaline. The dominance of polyhaline species, the presence of marine forms implies polyhaline waters (from 16.5 to 30 per mille salinity).

Contiguous communities. This community stands closest to *Tympanotonus-Pirenella*, from which it might be hard to separate occasionally. It probably developed from that community by the multiplication of *Mytilus*, *Turritella* and *Ampullina*, on shore where a livelier water movement entailed a subdued plant life and a slower sedimentation.

(e) *Pitar undata community*

Typical species: *Pitar undata*, *Ampullina crassatina* (small), *Turritella archimedis*, *Taras rotundatus*, further *Angulus planatus ancestralis*, *Apolymetis lacunosa*.

Frequent companions: *Anadara gümbeli*, *Pitar polytropa*, *Theodoxus pictus*, *Ostrea cyathula*, *Pirenella plicata*, *Tympanotonus margaritaceus*, *Mytilus aquitanicus*, *Gari protracta*.

Other species worth mentioning include small *Balanus*, *Cardium bojorum*, *Euthriofusus burdigalensis*, *Calyptraea chinensis*.

Distribution. This is a rare community, occurring exclusively between the Nagyegyháza Basin and Diósjenő. Nagyegyháza 3, Csordakút 5; seldom in the Mány-Zsámbék Basin; Dömös-1; Pomáz-6, -22, Diósjenő-3.

Lithofacies: fine- to almost coarse-grained friable sandstone.

Isocoenoses: none known from today's seas.

Neoecological data. Living *Pitar unicolor* Sowerby, very similar to *Pitar undata*, prefers according to Keen (1958) sandy beaches down to 6 fathoms depth. In the Aquitanian Basin, *Pitar undata* likewise occurs in littoral fossil communities; *Taras rotundatus* now lives at sublittoral depth, but may turn up in the littoral zone, too (Keen 1958 and Seneš 1958).

Palaeoecological conclusions. Most species of the community are polyhaline or decidedly marine. For instance, *Taras rotundatus* is, according to Sorgenfrei (1958), a marine, stenohaline form. This community required a salinity of about 30 per mille that did not drop too often below this value.

Most of the community is made up of suspension-feeders (all bivalves except *Angulus*; the *Turritella*), accompanied by the predator *Ampullina* *crassatina*. Deposit-feeders and browsers are rare. Most of the forms burrowed more or less deep in the soft nearshore sand (infauna), thereby implying a rather exposed shoreline. The rather strong agitation of the water provided the suspension-feeders with ample food and promoted settlement by marine organisms by driving in normal-salinity water from the open sea close inshore. The community could presumably thrive also in a few metres of water in the sublittoral region.

Contiguous communities. There are transitions towards two other littoral communities (*Tympanotonus-Pirenella* and *Mytilus aquitanicus*).

B. SHALLOW SUBLITTORAL COMMUNITIES

In the biotope comprised between the low-tide level and the 30 m isobath, there is surf action and strong turbulence. In the absence of such, thick layers of silt and mud can settle at fast rates. Salinity very seldom decreases below 30 per mille (mainly off the mouths of big rivers). Copious organic matter washed in from the nearby land, together with the algal and Zostera vegetation and the well-oxygenated shallow water warmed by the subtropical sun give rise to a highly favourable biotope, and probably did so also in the Upper Oligocene, because the communities with the largest numbers of species used to thrive in this zone.

(a) *Glycymeris latiradiata communities*

Typical species: *Glycymeris latiradiata* s.l., *Ostrea cyathula*, *Crassatella carcarensis*, *Corbula carinata*, *Globularia gibberosa* s.l., *Babylonia eburnoides umbilicosiformis* and the species restricted to this community: *Linga columbella*, *Pitar gigas schafferi*.

Frequent companions: *Pholadomya puschi*, *Turritella venus*, *Panopea meynardi*, *Polinices catena* s.l., *Venus multilamella* s.s., *Pitar beyrichi*, *Diastoma grateloupi turritoapenninica*, *Anadara gümbeli*, *Laevicardium tenuisulcatum*, *Pecten arcuatus*, *Anomia ephippium*.

Other species: *Tympanotonus margaritaceus*, *Pirenella plicata*, *Mytilus aquitanicus*, occasionally entering, living or dead, from the littoral region.

Distribution. This is one of the most widespread and most conspicuous communities of the Hungarian Upper Oligocene, as shown by the much-used term "Pectunculus sands". (The community proper should not, however, be confused with the formation, embracing a number of Upper Oligocene shallow sublittoral facies, usually denoted "Pectunculus beds".)

Csordakút 5; very seldom in boreholes of the Mány—Zsámbék basin;
Csolnok 695, Esztergom 40, Kesztölc 1/10, Tarján-1 (mixed with a *Tym-*
panotonus-Pirenella community); Nagysáp-2, Péliföldszentkereszt-1, Po-
máz-6, -21 (a certain telescoping with a *Polymesoda-Tympanotonus* com-
munity); Pomáz-1/2 (mixed with a *Turritella venus* community); Leány-

falu 3/4, Diósjenő 7,-8, -24, Tolmács-3, Patak-1, Borsosberény-1 (almost undistinguishable from a *Tympanotonus-Pirenella* community); Becske-2, Máriahalom 36, Budafok-1/4 (mixed with a *Tympanotonus-Pirenella* community); Törökbálint-1, -2, -3, Csomád-1.

Remarkably enough, the community does not appear anywhere to the east of the Galga Valley. It is very scarce in the Vértes—Gerecse region, in contrast to the Pilis—Western Cserhát unit, which is its main region of development.

Lithofacies. Most often a medium- or coarse-grained sand with scarce small pebbles. These pebbles are an almost invariable feature of the lithofacies.

Isocoenoses. Today's Glycymerids most often belong to so-called *Venus* communities (BÁLDI 1962). According to JONES (1950), the "boreal, open-water sand community" living in moderately shallow water on a bottom of coarse sand, gravel or shell debris includes, besides *Glycymeris pilosa*, species of *Nucula*, *Lima*, three species of *Venus*, species of *Paphia*, *Gari*, *Spisula*, *Modiolus*, *Buccinum*. THORSON (1957) names the following typical molluscs of the Venus communities: *Venus*, *Spisula*, *Tellina*, *Thracia*, *Natica*, *Dosinia*, and in the arctic regions also *Astarte* and *Cyprina islandica*.

VATOVA (1940) described a *Venus* community with *Glycymeris cor* thriving off the Laguna of Venice in water 7 to 12 metres deep. There is also a certain resemblance to SMITH's (1932) lumachella community ("Eddystone shell-gravel community"), which includes *Glycymeris glycymeris*, *Astarte*, *Chione* and two species of *Cardium*, in order of decreasing abundance. This community, dominated by suspension-feeders, lives from the low-tide level to 60 m depth in strongly agitated water invariably of normal salinity.

In tropical waters, THORSON (1957) listed *Venus* communities in 2 to 60 metres depth in the Persian Gulf and off Madras, over lumachella bottoms, with large numbers of *Glycymeris* besides venerids and *Spisula*.

On the "intertidal sand beaches and sand flats to 10 metres depth" in the Gulf of California, R.H. PARKER described a community resembling in certain features the Glycymeris community of the Upper Oligocene. This zone is characterized according to PARKER by a strong, turbulent agitation of the water, and the consequent dominance of suspension-feeders and of massive mollusc shells defying the surf. This is the optimal biotope of *Cerithium*, *Natica* (including *Globularia*), *Strombus*, *Olivella*, *Terebra*, *Dosinia* and *Donax*, and also glycymerids, laevicardiids and *Pitaria*. Abundant among the glycymerids of the Gulf of California is huge *Glycymeris gigantea* which according to KEEN (1958) inhabits waters 8 to 14 metres deep and resembles *Glycymeris latiradiata*. This zone is the home also of the largest living venerid, *Megapitaria squalida*, most frequent between the low-tide line and 10 m depth, which resembles *Pitar gigas schafferi*.

POWELL (1937) described from New Zealand a "*Tawera-Glycymeris* community" living on a sandy bottom with lots of shell debris in strongly agitated waters. Its dominant species are the venerid *Tawera* and large-sized *Glycymeris laticosta*.

Another community resembling the *Glycymeris latiradiata* community is the "soobschestvo *Pectunculus*" described by HEKKER et al. (1962) from the Ferghana Palaeogene. The species accompanying *Glycymeris* in the calcareous coarse sands are *Solecurtus*, *Crassatella*, *Cucullaea*, *Lucina*, *Cardita*, *Cardium*, *Pitar* and *Gryphaea*.

Seneš (1958) discussed in much detail the ecology of three fossil communities obviously related to the *Glycymeris latiradiata* community, encountered in the Upper Oligocene of Kováčov. He stated these communities to have thrived in strongly agitated waters of normal salinity (about 30 per mille) in 3 to 15 metres depth.

Palaeoecological conclusions. One of the most important factors of the ancient biotope presumably was — as suggested by the isocoenoses, the sediment and the stratinomic phenomena — the agitation of the water: a more or less intense surf, currents and turbulency. The most strongly agitated waters are indicated by communities consisting almost exclusively of huge, pavement-forming valves of *Glycymeris latiradiata*. The valves are embedded with their convex side up ("gewölbt oben"), thus attesting a strong surf. These *Glycymeris* pavements presumably developed at the lower border of the littoral zone; this is borne out by the occurrence at Pomáz (P-21) and Borsosberény (Bb-1) of littoral communities (*Polymesoda-Tympanotonus* and *Tympanotonus-Pirenella*, respectively) no more than a few centimetres upward in the succession.

The *Glycymeris* communities of Törökbálint are also characterized by accumulations of valves. The single valves, locally heaped up like shingles, and the sparse pebbles all go to show that the *Glycymeris* pavements satisfy the criteria of a lumachella ("Schill") as defined by Müller (1951). However the valves here are often embedded concave side up ("gewölbt unten") which, according to Müller (1951), signals infrequent agitation of the water for brief spans of time. The water was undoubtedly quieter than where the Glycymeris pavements of Pomáz and Borsosberény developed on the border of the littoral and sublittoral zones, but still sufficient to wash out the valves of *Glycymeris*, a clam that does not burrow deep (Yonge 1962). Agitation of the water further resulted in a slow rate of deposition, which permitted a lumachella-like accumulation of valves. The connexion between the rate of sedimentation and the abundance of shells and tests (Phleger's law) can readily be observed also in today's seas (Parker, 1956). The frequent lumachella-like development of the *Glycymeris* communities is thus a consequence of slow sedimentation, that is, of considerable agitation in the water.

On the other hand, in places where much silt is admixed to the sand, smaller and usually double *Glycymeris* valves are accompanied by faunae of many species not forming a lumachella-like concentration; in such places, the probable depth of the sea was 20 m or more.

The features depending on the agitation of the water thus suggest that the *Glycymeris latiradiata* community could thrive at any depth within the shallow sublittoral zone, provided the water at the sea bottom was sufficiently agitated. The community probably did not, however, extend beyond the limits of this zone.

As another consequence of the agitated water the fossil community consisted, similarly to the living isocoenoses, almost exclusively of suspension-feeders in addition to a few predators. The strong oxidation in the turbulent water consumed most of the organic matter in the sediment; this acted repressively on deposit-feeders. On the other hand, the strongly moving water provided an abundant food supply to suspension-feeders. Large-sized predators of the genera *Globularia* and *Natica* often attacked similarly large-sized bivalves. *Babylonia* (= *Latrunculus*) feeds in the shoal waters of the Persian Gulf on decomposing animal remains thrown ashore (MELVILL and STANDEN 1901).

The numerous stenohaline, marine forms prove that salinity never sank durably below 30 per mille.

Contiguous communities. There are many transitions in the shoreward direction; indeed, the slow sedimentation typical of the biotope (see above) often results in telescoping: condensated faunae come to exist (Budafok-1, Tarján-1, etc.). These correspond to the facies called "marin-brack" by HÖLZL (1957) in the Bavarian Upper Oligocene. There are further transitions towards the shallow sublittoral *Pitar polytropa* and the medium-depth sublittoral *Pitar beyrichi* and *Turritella venus* communities.

(b) *Pitar polytropa communities*

Typical species: *Pitar polytropa, Diastoma grateloupi turrito-apenninica, Turritella venus, Laevicardium tenuisulcatum.*

Frequent companions: *Angulus nysti, Aporrhais callosa, Turricula regularis, Bullia hungarica, Corbula carinata, Laevicardium cyprium, Polinices catena helicina, Babylonia eburnoides umbilicosiformis, Drepanocheilus speciosus* s.l., *Athleta rarispina, Cyprina islandica rotundata.*

Other species: This community tends to be richest in species. The fauna of the "k layer" of the Eger Brickyard also belongs here. Some species which pass for rarities at other localities of this community are fairly frequent at Eger: *Typhis pungens, Ficus condita, Polinices olla, Ampullina crassatina, Turritella beyrichi percarinata, Nuculana anticeplicata, Nucula mayeri, Lutraria oblonga soror, Galeodes basilica.* Species occurring at many localities of the community, but nowhere in abundance, include *Solecurtus basteroti, Corbula basteroti, Thracia pubescens* s. l., *Clavagella oblita, Cardium egerense.*

Distribution. Very widespread all over the Hungarian Upper Oligocene sedimentary basin. Nagyegyháza 3; frequent in the boreholes of the Mány—Zsámbék Basin; in several depth intervals in Szomor 3 (telescoped with a *Pitar undata* community in the interval from 191 to 199.4 m); Solymár 72; Solymár 84; Solymár 85; Máriahalom 36; Máriahalom 41; Dömös 2; Szentendre 2; Leányfalu 1; Leányfalu-3/4 (transition towards the *Pitar beyrichi* community), Leányfalu-3/11; Leányfalu-3/14; Diósjenő-4; Eger-1/"k".

Lithofacies. Silty fine-grained sandstone, sandy silt.

Isocoenoses. The fossil community corresponds to the living *Venus* communities as interpreted by THORSON (1957) (for a characterization, see the chapter on the *Glycymeris latiradiata* community). It resembles in many respects the extremely species-rich faunae of the fine-sandy shallow sublittoral tropical sea bottoms. It is further comparable with the "nearshore sand to sand-mud (11 to 26 m)" community described by PARKER (1964) from the Gulf of California. The most frequent genera of those communities are *Terebra, Olivella, Cancellaria, Pitar, Venus, Tellina, Calyptraea, Clavus, Crassispira, Conus, Chlamys, Natica, Laevicardium, Nuculana.* Off the coast of the Gulf of Mexico, living communities resembling fossil *Pitar polytropa* community are also encountered: they include among others species of *Cerithium, Natica, Melongena* (= *Galeodes*), *Marginella, Conus, Terebra, Lucina, Venus, Polinices, Strombus, Chlamys, Chicoreus, Anadara* and *Laevicardium* according to REHDER (1954) and PARKER.

The fauna described by SENEŠ (1958) from his Kováčov 4 locality may represent a transition between the *Pitar polytropa* and *Turritella venus* communities. It indicates according to SENEŠ a salinity of 33 to 35 per mille and a depth from 25 to 40 metres.

Palaeoecological conclusions. Many of the genera composing this community are highly typical of the shallow sublittoral zone. This biotope provides for them a set of optimal conditions: they occur here in the largest numbers with the most species, as revealed besides the monographs of the great expeditions also by the publications of PETERSEN (1913), LEE (1944), FITCH (1953), KEEN (1958), KOHN (1959), CRICHTON (1943), MELVILL and STANDEN (1901) and others. Of the genera in question, let us specially mention *Cyprina, Bullia, Babylonia,* the relatively thick-shelled and large-sized *Laevicardium tenuisulcatum* and *Turricula regularis, Conus* and *Cypraea,* and the genera restricted to this community within the Hungarian Upper Oligocene: *Cerithium, Terebra* and *Strombus* (cf. the fauna of the "k layer" at Eger).

HOPWOOD (1944), GRAHAM (1955), KOHN (1959), CRICHTON (1943), MELVILL and STANDEN (1901), SCHILDER (1936), TURNER (1959) state the following about the feeding habits of the typical species and frequent companions: suspension-filters: *Pitar, Turritella, Laevicardium, Corbula, Cyprina, Clavagella*; browsers: *Diastoma*; deposit-feeders: *Angulus, Aporrhais, Drepanocheilus*; predators: *Turricula, Polinices, Athleta*; scavengers: *Bullia, Babylonia.* This gives approximately 40 percent suspension-filters, 6 percent browsers, 20 percent deposit-feeders and 34 percent predators and scavengers. These figures agree remarkably well with those of the above-mentioned community in the Gulf of California, described from a sandy bottom 11 to 26 metres deep (45 percent suspension-filters, 30 percent predators and scavengers, 19 percent deposit-feeders and 4 percent browsers according to PARKER, 1964).

The high percentage of suspension-filters and the whole rich fauna presupposing a high degree of oxygenation indicate a rather intense agitation. On the other hand the double valves and the finer-grained sediment prove the water to have been quieter than where the *Glycymeris latiradiata* communities lived.

The numerous stenohaline marine organisms indicate a salinity in excess of 30 per mille.

Contiguous communities. There are transitions towards the littoral *Tympanotonus-Pirenella* communities, signalled by a few specimens of *Tympanotonus margaritaceus, Pirenella plicata, Theodoxus pictus* and *Melanopsis impressa hantkeni* in some of the *Pitar polytropa* communities (e.g. Eger 1/k), and by the occasional presence of *Pitar polytropa* in the *Tympanotonus-Pirenella* community (e.g. Diósjenő-3). There are transitions also towards the *Glycymeris latiradiata* communities, settled over bottoms exposed to a stronger surf. In some cases the only difference is the absence or scarcity of *Glycymeris* (this holds in particular for the *Glycymeris* communities between 20 and 30 m depth). There are further transitions towards the *Nucula-Angulus* and *Pitar beyrichi* communities inhabiting best-protected parts of the sublittoral zone, over muddy to clayey bottoms, and the medium-depth sublittoral zone, respectively. One of the Leányfalu communities (L-3/4) stands midway between the *Pitar beyrichi* and *Pitar polytropa* communities. Separation from some *Turritella venus* communities may also be difficult.

(c) *Nucula-Angulus communities*

Typical species: *Nucula schmidti, Angulus nysti, Cultellus budensis, Drepanocheilus speciosus* s. l., *Taras rotundatus, Dentalium fissura* and *Corbula gibba* as the species substituting *Nucula*.

Frequent companions: *Diastoma grateloupi turritoapenninica, Cardium bojorum, Thracia ventricosa, Turritella venus, Polinices catena* s. l., *Nuculana solymarensis, Ensis hausmanni*.

Distribution: Nagyegyháza 3; Csordakút 5; fairly frequent in the Mány—Zsámbék Basin: Máriahalom 36; Esztergom 40; Solymár 72; Szentendre 2; Szentendre-2; Pomáz-17; Törökbálint-17.

Lithofacies. Clay or clayey silt; fine-grained detritic sediments in general.

Isocoenoses. Living communities of similar structure were discussed by Thorson (1957) under the heading "*Syndosmya* communities". They live in protected portions of the sublittoral region, or in estuaries, in water of slightly lower than normal salinity, on muddy bottoms rich in organic matter, between 5 and 75 metres depth. Its typical genera include according to Thorson *Syndosmya, Cultellus, Corbula* and *Nucula*. Vatova (1949) found the same community between 7 and 27 metres depth in the Adriatic: the typical genera are, in the order of decreasing abundance, *Syndosmya, Corbula, Nucula, Angulus, Tellina, Dentalium, Cultellus, Aporrhais*. A fauna observed by Bruun (1940) in the Bay of Tunis between 5 and 13 metres depth, with *Abra* (= *Syndosmya*) and *Nucula* as the dominant genera, might constitute a similar community. Buchanan (1958) described from the Ghanaian shores an "inshore fine sand community" living between 6 and 16 m depth, with *Cultellus, Actaeon* and *Dentalium* as the most typical forms.

Of the fossil communities in the Ferghana Palaeogene, known from Hekker et al. (1962), the "*Tellina-Leda*" and "*Leda-Nucula*" communities resemble the *Nucula-Angulus* community most closely. In addition to *Tellina*, *Nucula* and *Leda*, the Ferghana communities are relatively rich in *Corbula*, *Solecurtus*, *Cultellus*, *Modiolus*, *Lutraria*. According to HEKKER et al. (1962) salinity was at least 29 per mille and the community lived in a rather poorly oxygenated environment, in very tranquil waters. Another possible isocoenose is the "*Leda-Abra*" fossil community of MERKLIN (1950).

Palaeoecological conclusions. The distribution of genera according to feeding habits was as follows. *Angulus* is a deposit-feeder, as are all tellinids (YONGE 1949). *Nucula* and *Nuculana* are also deposit-feeders, although in a different way (YONGE 1939). Further deposit-feeders include *Cultellus* and *Drepanocheilus*. *Taras* is a suspension-feeder, whereas *Dentalium* is a "microphagous" predator. Consequently, 60 percent of the typical genera of the community were deposit-feeders, eating the soft mud rich in organic matter. The richness of organic matter is proved among others by the extraordinary abundance of vegetal debris and plant fossil imprints, especially in deposits containing *Nucula-Angulus* faunae. The vegetal debris is partly due to *Zostera*, the rest being washed in from the adjacent dry land.

The salinity of the water was 28 per mille or higher.

The soft fine-grained bottom, where deposition was obviously fastest anywhere within the shallow sublittoral zone, attracted many burrowing bivalves; the fossil community is of the infauna type. The *Corbula* clay of Törökbálint (T-17) is a variant where *Nucula* is repressed by abundant *Corbula* occurring in small pockets. BOEKSCHOTEN (1963) observed a similar local concentration of *Corbula* in the septarian clay of Winterswijk. He explained this by YONGE's observation (1946) that *Corbula gibba* anchors itself by a byssus to a pebble or a shell. The fossil *Corbula* pockets had presumably come to exist about such solid objects.

The clayey, fine-grained sediment which, judging by the large numbers of deposit-feeders, was very rich in organic matter, had formed in very slowly moving, relatively oxygen-poor waters. The *Nucula-Angulus* community thus indicates the most protected, little oxygenated parts of the shallow sublittoral zone.

Contiguous communities. There are transitional features towards the *Pitar polytropa* and *Pitar beyrichi* community types.

(d) *Corallinacea-Lepidocyclina communities*

Typical species. Red algae (for their description cf. KRIVÁN-HUTTER 1961), *Lepidocyclina* (cf. KECSKEMÉTI in BÁLDI et al. 1961).

Other species. A few scattered fragments of pectinids and *Cardita*, rarely permitting a closer identification.

Distribution. A very rare community; it is known in Hungary only from the environs of Eger (Novaj—Nyárjas and numerous hydrocarbon prospect drills around Eger).

Lithofacies. The only Hungarian Upper Oligocene community to be connected with biogene limestones, which is overwhelmingly composed of fossils belonging to the community.

Isocoenoses. Up to this day, this community is widespread in tropical waters: a characteristic belt of the sublittoral region, the so-called "Corallina zone", it used to be distinguished between 28 and 80 m depth. Similar fossil communities are known from the Hungarian Eocene and Middle Miocene.

An Upper Eocene biofacies with larger foraminifers and Corallinacea has lately been discussed from the palaeoecological viewpoint by MONOSTORI (1965). According to that author, this Upper Eocene community probably thrived in 10 to 25 metres depth, in more or less moving water according as the calcareous algae or the larger foraminifers are dominant. The calcareous algal deposits widespread in our "Tortonian" (Badenian) probably came to exist according to STRAUSZ (1928) in the "shallower neritic zone" (from the littoral zone to 50 or 80 m depth). The Badenian community includes besides calcareous algae Pecten, Echinids and larger foraminifers: any other fossils are very rare.

Palaeoecological conclusions. The red algae belonging to the community did not, in KRIVÁN-HUTTER's opinion (1961), constitute a true reef, and their biotope probably lay on the border of the littoral and sublittoral regions. The Novaj red-algal limestone, however, was not built up of encrusting forms of Corallinaceae characterizing the littoral belt, it indicates, in my opinion, small bioherms similar to those living recently in 10—30 m depth of seawater.

According to MYERS (1943) and NEMKOV (1960), the living larger foraminifers have their optimal biotope in the neighbourhood of the coral and calcareous algal reefs, in the euphotic zone of the sublittoral region, down to 60 m at the most.

This striking occurrence of the *Corallinacea-Lepidocyclina* community in a biogenic limestone just a few metres thick can be explained by the assumption of a temporary slowing down, or indeed full interruption, of detritic sedimentation. This is how a rock-forming accumulation of red algae and larger-foraminifer tests could come about. The deposition of fine-grained terrigene material from the faraway land to the northwest could be inhibited by enhanced turbulency in the water. Currents were probably stronger where the calcareous algae are dominant and weaker where the flat, thin, large-surfaced discs of *Lepidocyclina* gain the upper hand (e.g. at Novaj). These differences may, however, also indicate differences in depth. We feel that a littoral origin is out of the question especially in the case of the *Lepidocyclina* limestone, as the surf would have ground to a calcareous sand the fine tests which are relatively unharmed in the limestone. On account of the light and food requirements of the larger foraminifers and the red algae, the lower limit of their occurrence — at least in rock-forming quantities — could not be much deeper than 30 m (the limit of the shallow sublittoral zone). The red-algal variant of the community could live from 20 to 30 m, the Lepidocyclina variant from 10 to 15, down to at most 30 or 50 metres.

Contiguous communities. Both the floor and the roof of the limestone including the community contains *Flabellipecten-Odontocyathus* communities. Besides the field relations there are also other indications of the close spatial and temporal connexion between the two communities: there are e.g. some scattered larger foraminifers also in the *Flabellipecten-Odontocyathus* communities, and scarce fragments of pectens in the *Corallinacea-Lepidocyclina* communities.

C. SHALLOW AND MEDIUM-DEPTH SUBLITTORAL COMMUNITIES

We shall discuss here those communities which could develop in both zones, i.e. both above and below 30 m.

Turritella venus communities.

Typical species: *Turritella venus*.

Frequent companions: *Drepanocheilus speciosus* s. l., *Turris duchasteli* (in the silty facies), *Polinices catena helicina* and *Ostrea cyathula* (in the coarse sandy facies).

Distribution. In silt: scarce in the Mány—Zsámbék Basin; Solymár 72, Szentendre 2, Törökbálint-1/5, -15, Diósjenő-1; in coarse sand: Szentendre 2, Diósjenő-8/3, Pomáz-1/2, -21/11.

Lithofacies. Detritic sediment from silt to coarse sand size.

Isocoenoses. Similar living communities cover vast areas on today's sea bottoms. Thorson (1957) subsumes under the name "*Amphiura* communities" assemblages which in addition to *Turritella* largely consist of the genera *Amphiura*, *Thyasira*, *Nucula*, *Dentalium*, *Brissopsis*, *Schizaster* and *Echinocardium*. In these communities, living between 15 and 100 m of depth, even a slight increase in sandiness entails, according to Thorson, the dominance of *Turritella* over the deposit-feeders. The "*Turritella* zoocoenoses" described by Vatova (1949) from the Adriatic live between 15 and 70 m near the western shores and between 30 and 80 m on the Dalmatian shores of the Adriatic. The faunae are made up almost exclusively of *Turritella* species, with at most a few scattered specimens of *Aporrhais*, *Nucula*, *Corbula* or *Scala*. *Turritella* is likewise dominant in the "sandy silt community" described by Buchanan (1958) from a depth of 16 to 40 metres, 3 miles of the Ghanaian shores. The Turritella are not evenly distributed; in the places where they are most dense, there may be as many as 500 specimens per 0.1 m^2. Powell (1937) described from New Zealand a *Maoricolpus* (= *Turritella*) community from 3 to 22 metres depth from places with a rather strong current. Palaeogene *Turritella* communities were described from the Ferghana Basin by Hekker et al. (1962) who stated all other genera to be subordinate to *Turritella*.

Palaeoecological conclusions. The community is found in a variety of deposits; this indicates that the community used to inhabit a variety of biotopes. The same has been stated by Hekker et al. (1962) of the *Turritella* facies of the Ferghana basin. Masses of *Turritella* now live in certain parts in the Gulfs of California and Mexico (Parker 1964). The *Turritella* communities of the cross-stratified coarse sand at Pomáz and Diósjenő probably indicate the border of the littoral and sublittoral regions. On the other hand, the *Turritella venus* community of the Törökbálint type, occurring in a silty deposit, probably was medium-depth sublittoral (30 to

60 metres). Other *Turritella* communities merging into the *Pitar polytropa* communities may indicate the shallow sublittoral zone. The depth range of the *Turritella venus* community could thus extend from a few metres to 60 m, and perhaps more.

Yonge (1946) states *Turritella* to be a suspension-filter; this type of feeding must have been dominant in the community. (Thus the community indicates some agitation of the water even where it occurs in a silty deposit.) Predators (*Turris, Polinices*) and deposit-feeders (*Drepanocheilus*) were more or less negligible.

The community is a typical infauna. *Turritella* stays dug in at the same spot for weeks (Yonge 1946, Fretter and Graham 1962). Salinity was "marine", higher than 30 per mille.

Contiguous communities. In some cases, the *Turritella venus* community is hard to distinguish from the *Pitar polytropa* communities. For instance the fauna of the Kováčov-4 locality described by Seneš (1958) represents a complete transition. The *Pitar polytropa* community of the Eger "k layer" is also rich in *Turritella*. Towards the deeper waters the *Turritella* community probably bordered on the *Pitar beyrichi* community.

D. MEDIUM-DEPTH SUBLITTORAL COMMUNITIES

Between 30 and 120 metres of depth one should normally expect less light, weaker agitation, less abundant plant life, normal salinity and, in the case of less extensive seas, deposits somewhat finer-grained than those found closer inshore.

(a) *Pitar beyrichi communities*

Typical species: *Pitar beyrichi, Laevicardium cyprium, Chlamys incomparabilis, Cardita orbicularis subparvocostata, Drepanocheilus speciosus* s. l., *Angulus nysti*, Bryozoa, *Panopea menardi, Lucinoma borealis, Cardium neglectum* and the species restricted to this community, *Dosiniopsis sublaevigata, Gari angusta, Strombopugnellus digitolabrum, Cuspidaria clava, Flabellipecten angustiformis*.

Frequent companion species: *Pholadomya puschi, Nucula schmidti, Nucula comta, Pteria phalaenacea, Isocardia subtransversa* s. l., the *Cardium heeri-egerense* group, *Laevicardium tenuisulcatum, Turritella venus*.

Other species worth mentioning include, *Turricula regularis, Pitar splendida, Corbula carinata, Turris duchasteli, Corbula gibba, Dentalium kickxi, Chlamys csepreghymeznericsae, Nucula laevigata, Zozia antiquata*, small specimens of *Glycymeris latiradiata* s. l., and occasionally *Schizaster*.

Distribution. Most widespread in the environs of Budapest: Törökbálint-1 4, -2/5—6; also at the higher levels, in the eastern part of the Mány—Zsámbék Basin, e. g. Máriahalom 36; Máriahalom 41; Szomor 31; Gyermely 12, 35; Solymár 72; Pomáz-1/7; Rétság-2/4; Becske-1/d.

Lithofacies. Silt, sandy silt, friable fine-grained sandstone.

Isocoenoses. The "*Turritella profunda* zoocoenose" described by VATOVA (1949) from the Adriatic occurs from 59 to 140 m of depth with the following typical genera: *Turritella* (much less abundant than in the *Turritella* community), *Aporrhais, Isocardia, Nucula, Pecten, Cardium*, Bryozoa, spines of echinids, *Thyasira, Solecurtus, Venus, Chlamys incomparabilis* (!), *Ditrupa*.

There is also some affinity towards the *Amphiodia-Cardita* community, the Pacific counterpart of THORSON's (1957) "*Amphiura community*". JONES (1964) described this community from the offshore side of the Southern Californian shelf, between 60 and 90 m of depth; it includes in addition to *Cardita ventricosa* GOULD the typical mollusc genera *Bittium, Axinopsida* (a *Thyasira*-form), *Nucula, Nuculana, Psephidia* (a small form). I participated myself in the examining of some Californian samples which were strikingly similar to the *Pitar beyrichi* community. In a sample from 62,5 m depth we found *Cardita ventricosa*, very close to *Cardita orbicularis subparvocostata*, small lucinids recalling *Lucinoma borealis, Nemocardium centifilosum* corresponding to *Laevicardium cyprium*, small thin-valved pectinids similar to *Chlamys incomparabilis*, bryozoa resembling *Lunulites* and others, *Nuculana*, small fusids (cf. *Streptochetus elongatus*), *Mangelia* and large *Robulus*.

Palaeoecological conclusions. The *Pitar beyrichi* community probably covered the same biotopes in the Upper Oligocene sea as STRAUSZ's (1928) *Bryozoa* facies ("middle zone of the neritic region") in the "Tortonian", Badenian. This is confirmed besides the above data on the isocoenoses also by the authecologies of the living species which occur also in the fossil community. *Chlamys incomparabilis* is according to LOCARD (1898) a rarity in water both less than 30 m and more than 200 m deep: it is most frequent between 120 and 200 metres. *Lucinoma borealis* is most frequent between 20 and 140 metres. *Pteria hirundo*, a close relative of *P. phalaenacea*, is very rare in water shallower than 30 m, being most frequent between 100 and 200 metres. *Laevicardium* is frequent between 30 and 120 metres. The *Pitar beyrichi* community thus obviously thrived between 30 and 120 metres of depth, in the medium-depth sublittoral zone.

As to feeding habits, the typical species are distributed as follows. Suspension-filters: *Pitar, Laevicardium, Chlamys, Cardita*, Bryozoa, *Panopea, Lucinoma, Cardium, Pholadomya, Pteria, Isocardia, Turritella*; deposit-feeders: *Drepanocheilus, Angulus, Nucula*; predators: *Turricula, Turris, Dentalium*. The dominant suspension-filters indicate a relatively slow sedimentation in slowly moving water.

Salinity was about 35 per mille.

Contiguous communities. This community was probably bordered in shallower waters by the *Pitar polytropa* and *Glycymeris latiradiata* communities. In the borehole Solymár 72 there are communities transitional towards the *Pitar polytropa* community, whereas at Törökbálint the shallow sublittoral *Glycymeris latiradiata* community accompanied by an oyster bed directly underlies a *Pitar beyrichi* community which itself contains some small *Glycymeris*. At these places the *Pitar beyrichi* community probably lived at less depth, from 30 to 60 metres. A connexion with the medium-depth sublittoral *Flabellipecten-Odontocyathus* community is indicated by a number of species which are restricted to these two communities in the Hungarian Upper Oligocene: *Musculus philippi, Cavilucina droueti schloenbachi, Ficus concinna, Streptochetus elongatus, Uxia granulata*. The occurrence of Bryozoa and shark teeth in both communites is also noteworthy.

(b) *Flabellipecten-Odontocyathus communities*

Typical species: solitary corals (*Odontocyathus armatus* and *O. perarmatus, Trochocyathus* and *Flabellum*), *Flabellipecten burdigalensis, Chlamys csepreghymeznericsae, C. agriensis, Dentalium apenninicum, Cerithium egerense, Venus multilamella, Musculus philippii, Babylonia eburnoides umbilicosiformis, Streptochetus elongatus, Ficus concinna*.

Frequent companion species: Brachiopods, shark teeth, Bryozoa, *Macoma elliptica*, larger foraminifera (*Operculina, Heterostegina, Lepidocyclina*), *Cassidaria nodosa, Zonaria globosa, Turris coronata, Dentalium fissura*. Species restricted to this community include *Calliostoma elegantulum hegeduesi, Volutilithes multicostata, Hiatella arctica*.

Distribution: Most widespread in the Eger—Sajó Valley region; Máriahalom 36; Dejtár-1; Eger—Brickyard borehole (Eger-1/5); Eger—Rozália-cemetery, Eger—Vintners' school (Eger-2), Eger—Afrika-dűlő (Eger-3); Novaj—Nyárjas (Novaj-1); Novaj—Rakottyás (Novaj-2); Noszvaj—Nagyimány (Noszvaj-1).

Lithofacies: Glauconitic, limonitic sandstone, tuffitic sandstone, tuffitic-gravelly coarse-grained sandstone, silty, friable fine-grained sandstone. This is the only community accompanied by glauconite and volcanic ash in the Hungarian Upper Oligocene.

Neoecological data. According to a review by Wells (1957), solitary corals usually shun the light and prefer tranquil waters and a fine-grained muddy bottom. They are frequent in the deepest parts of the shelf and in the shallow bathyal zone, their optimum biotope being between 160 and 360 metres. Pectinids belong to the epifauna, swimming freely near the bottom or fixing themselves by means of a byssus. They prefer richly oxygenated, agitated water, their optimum depth being between 30 and 120 metres according to the great expeditions (Báldi 1959). *Platinopecten*, resembling *Flabellipecten burdigalensis*, lives according to Fitch (1953) at sublittoral depths (65 to 96 metres) rather far offshore. According to Vaissiére and Fredj (1963), brachiopods are most frequent between 80 and 120 m off the Algerian shores, being rare in shallower water and not occurring at all in water less than 40 m deep. Strausz (1928) mentions brachiopods among the typical fossils of the "Tortonian" (Badenian) "Bryozoa facies", together with *Bryozoa, Echinodermata, Dentalium, Lithothamnium, Chlamys* and foraminifers ("middle zone of the neritic region"). *Musculus* lies about on the bottom between 30 and 200 metres depth, free or fixed by a byssus (Merklin 1950).

Palaeoecological conclusions. The community lived in the medium-depth sublittoral zone, from 30 to 120 metres of depth, in areas where sea currents entailed the slower deposition of coarser-grained sediments. The dominantly epifaunal nature of the community (*Pecten*, solitary corals, brachiopods, *Musculus*, *Calliostoma*, larger foraminifers) and the dominance of suspension-filters (brachiopods, *Pecten*, *Venus*, *Musculus*) suggest just such conditions of deposition. The currents ensured sufficient oxygenation even for the pectens.

It is under similar conditions (slow or interrupted deposition, normal salinity, 20 to 800 metres depth) that glauconite is being formed in today's seas, as laid down unequivocally in modern literature (SHEPARD 1948; TAKAHASHI 1939; CLOUD 1955; PETTIJOHN 1957; SZÁDECZKY-KARDOSS 1953; PRATT 1963). Many authors derive glauconite from volcanic ash. Let us note that, also in the Hungarian Upper Oligocene, the glauconite, autochthonous according to BONDOR (1960), is accompanied by undecomposed volcanic ash.

Contiguous communities. Towards greater depths, this community may grade into a *Hinia-Cadulus* community; the field relations of the deposits including the two communities suggest an intimate connexion. Besides the field relations, the occurrence of some scarce big foraminifers also indicates a connexion with the *Corallinacea-Lepidocyclina* community of the shallow sublittoral zone. The vicinity of the medium-depth sublittoral *Pitar beyrichi* community is indicated by the joint occurrence of *Pecten*, *Bryozoa*, solitary corals, dentalia, shark teeth and *Musculus*.

(c) *Schizaster cf. acuminatus communities*

Typical species: The community consists almost exclusively of *Schizaster* cf. *acuminatus* GOLDFUSS, with some scarce pteropods, dentalia and *Yoldia*.

Distribution. This community is most often connected quite closely both in space and time with the *Hinia-Cadulus* community. It is often difficult to distinguish the one from the other, as, e.g. at Leányfalu-2 or in the 6th layer of the Eger Brickyard, and in some boreholes in the eastern part of the Mány—Zsámbék basin. The *Schizaster* probably lived there deeper than the medium-depth sublittoral zone. Independent and clearly distinct *Schizaster* communities occur at Budaőrs, in the motorway cutting (Budaőrs-1) and at Diósjenő (Dj-8). Here the community is probably, as we shall see, medium-depth sublittoral.

Lithofacies. Silt, clayey silt, clay.

Isocoenoses. According to THORSON (1957), mud-eating echinids are frequent in our days in the "*Amphiura* communities" (15 to 100 m) and in the "*Maldane sarsi-Brissopsis lyrifera* communities" (100 to 300 m). VATOVA (1940, 1949) described a "*Schizaster chiajei* zoocoenose" from the western shores of the Adriatic, from the Gulf of Trieste and off the Laguna of Venice. This community, thriving on a soft bottom from 9.5 to 37 metres depth, includes besides *Schizaster* the genera *Cultellus*, *Tellina*, *Angulus*, *Dosinia*, *Zozia*, *Nucula*, *Dentalium* and *Aporrhais*.

Palaeoecological conclusions. The Budaőrs and Diósjenő communities lived by all the evidence in hand in very well-protected parts of the shallow sublittoral zone, where the water was almost stagnant and fine-grained sediment rich in organic debris could settle in a poorly oxygenated medium. This promoted the proliferation of deposit-feeding echinids. It is known that large numbers of such echinids make life impossible for almost all other living beings, which explains the exclusive presence of *Schizaster*.

Contiguous communities. There are gradual passages towards the *Hinia-Cadulus* community: the two are often hard to separate. The field relations of the deposits show that towards shallower waters the community bordered on the *Pitar polytropa* and *Glycymeris latiradiata* communities.

E. DEEP SUBLITTORAL—SHALLOW BATHYAL COMMUNITIES

Except for some occurrences of the *Schizaster* cf. *acuminatus* community, the only community of the Hungarian Upper Oligocene that lived in water deeper than 120 m was the

Hinia-Cadulus community

Typical species: *Hinia schlotheimi, Cadulus gracilina, Volutilithes permulticostata, Nuculana psammobiaeformis, Yoldia raulini, Cylichna cylindracea raulini, Nucula mayeri*, Pretopods, Schizasters.

Frequent companion species: *Crassatella bosqueti, Athleta ficulina, Turricula ilonae, Dentalium fissura*, Turridae.

Other species: there are many rare species restricted to this community, occurring in just a few specimens. More frequent, but still restricted to a few localities, are *Flabellipecten burdigalensis, F. telegdirothi, Rostellaria bicarinata, Acamptochetus clathratus*.

Distribution: In the Eger—Sajó Valley region it is widespread, and indeed exclusive in deposits of a considerable thickness in the deeper Upper Oligocene. Eger, Wind brickyard (in exposures and in the borehole); Novaj—Nyárjas, Mucsony 136. The only occurrence farther west is at Leányfalu (L-2).

Lithofacies. Clay and clayey silt.

Isocoenoses. The abundance of foraminifers indicates a close relationship with THORSON's (1957) "Foraminifera communities". The number of both specimens and species of foraminifers increases with depth (cf. among others BANDY and ARNAL 1960), which shows this community to be deep sublittoral and bathyal. DAUTZENBERG's (1926) investigations between Norway and the Açores showed the venerids, *Chlamys, Cardium, Turritella, Rissoa*, buccinids, *Anomia, Glycymeris* and tellinids to be abundant down to a depth of 130 m. At greater depth these forms become scarcer, except for *Chlamys*: of the bathyal forms, turrids (pleurotomids), *Cuspidaria, Amussium* and *Limopsis* grow abundant there and so do *Nucula* and *Astarte*, and further down, in the bathyal region, *Actaeon, Cylichna, Dentalium, Cadulus, Yoldia, Eulima, Scala* and certain species of *Thyasira*. Some of these genera are typical of, and some of them are at home in the *Hinia-Cadulus* community. Similar views were put forward by KOEHLER (1896). FUCHS (1901) called attention to the "bathyal fauna" of the Red Sea, which, at depths greater than 200 m, includes *Cuspidaria, Amussium, Limopsis* and turrids. In the Gulf of California, PARKER (1964) mentions from depths exceeding 120 m and from the bathyal region a community of solitary corals, brachiopods, deposit-feeding and scavenging molluscs (*Nucula, Cadulus, Nassaria*); PARKER compared it with FUCH's Red Sea fauna and the fauna of the Tortonian (Badenian) clay at Szokolya (BÁLDI 1960).

HARTMAN (1963) described from some submarine canyons of the South Californian shelf a fauna resembling somewhat the *Hinia-Cadulus* communities, composed in addition to smooth dentalia of *Cadulus, Yoldia, Thyasira, Cuspidaria, Nucula, Brissopsis* (cf. *Schizaster*), small *Tellina, Bittium,Cylichnella,* and locally *Nassarius* (cf. *Hinia*), which can be traced from 100 m downwards to several hundred metres depth, but may reach up to 50 m over clayey bottoms.

Among the fossil communities, the *Hinia-Cadulus* community most probably corresponds to the "*Pleurotoma* clay facies" ("Pleuromentone") of FUCHS (1883). This was provided by FUCHS with the ambiguous adjective "deep-sea", which in his terminology meant all that was deeper than 80 m. STRAUSZ (1928) subsumed under the name "*Pleurotoma* clays", which he considered bathyal, the Miocene Baden Clay and the "Rupelian" Kiscell Clay. We have compared earlier the *Hinia-Cadulus* community of Novaj with the fauna of the Baden Clay of Szokolya and have shown the two to consist of strikingly similar life forms (substitutive genera) (BÁLDI in BÁLDI et al. 1961). According to my earlier investigations (BÁLDI 1960), the Szokolya community lived in unlighted deep sublittoral to shallow bathyal waters and largely consisted of deposit-feeders and predators.

Palaeoecological conclusions. As proved by the numerous living and fossil isocoenoses, the *Hinia-Cadulus* community had developed in the deep sublittoral zone of the Upper Oligocene sea and probably penetrated also the top part of the bathyal region. We can thus place its bathymetric range between 120 and 300 metres. The authecologic data confirm this conclusion, as *Yoldia, Limopsis, Cadulus, Cuspidaria* proliferate from 120 to 200 metres downwards. According to KEEN (1958), *Costelloleda* HERTLEIN et STRONG 1940, similar to the subgenus *Costatoleda* T.-ROTH 1914, thrives between 20 and 130 metres of depth.

The muddy-silty sediment proves the absence of any turbulence near the sea bottom. In the unlighted depths inhabited by the *Hinia-Cadulus* community, there were of course no photosynthesizing plants. The bottom-dwellers had to rely for food on the organic matter brought in by surface currents from the shallower regions. This is why the mollusc fauna consisted largely of predators (*Hinia, Volutilithes, Cadulus, Cylichna, Athleta, Turris*) and deposit-feeders (*Nucula, Nuculana, Yoldia*) (cf. YONGE 1928 and 1939, FRETTER and GRAHAM 1962), accompanied by a few parasites (*Syrnola, Melanella*). The single predator bivalve (*Cuspidaria*) and the mud-eating *Yoldia* indicate according to YONGE (1928, 1937) a soft mud rich in organic matter.

In the molluscan clay of Eger, the *Hinia-Cadulus* community is accompanied by terrestrial plant remains ("lower flora"). According to Mrs NAGY and PÁLFALVY (1963) the preservation of the plant remains and the pollen spectrum indicate a longish transport in water, a considerable distance from the shore. It was pointed out already by FUCHS (1883) that the presence of land plant remains is not incompatible with the deep-water origin of a deposit. He cited besides the example of the Gulf Stream several well-known observations of the great expeditions (cf. e.g. AGASSIZ), which recovered land plant remains from fairly deep water far off the shores. The "lower flora" of Eger should consequently not be regarded as contradicting the above-proposed depth range of the *Hinia-Cadulus* community. On the other hand, it indicates one of the sources of the abundant organic matter in the sediment, which permitted large numbers of deposit-feeders to live there.

Another source of food was pelagic life which played a considerable role in sustaining the benthos living at this depth. The globigerinids, pteropods and last but not least the coccolithiophorids and discoasterids (BÁLDI—BEKE 1960) prove the abundance of plankton. The abundance of plankton fossils embedded in the sediment is ecologically important in itself, because it is proportional to water depth, to shore distance. According to LOCARD (1898), e.g. one pteropod species was found to occur between 10 and 100 metres, four between 100 and 500 metres and seven from 500 to 1000 metres of depth. The abundance of plankton depends sensitively on the vertical currents ("upwellings") rich in nutrients, lifting up considerable amounts of phosphorus from the bottom in their ascending branches and supplying oxygen to the deeper water in their descending branches. These upwellings are consequently important also for the benthos.

Contiguous communities. Field relations and faunal composition both show that the *Hinia-Cadulus* community bordered in shallower waters on the *Schizaster* cf. *acuminatus* and *Flabellipecten-Odontocyathus* communities, towards which one finds some gradual passages.

3. A COMPREHENSIVE EVALUATION OF THE PALAEOECOLOGICAL DATA

(a) *The shores*

The spread and frequency of nearshore communities can be read off Table XI, which shows them to be fairly frequent in the Hungarian Upper Oligocene.

Ecological evidence shows the Upper Oligocene shores to have been fairly flat: there are no communities or lithological situations indicative of rocky shores. This is why littoral communities are so widespread: flat beaches can be several kilometres wide, as opposed to the few metres' width of a cliff. Flat-beach communities have thus a greater probability of turning up in the fossil material.

The flat beaches were usually muddy ("mud flats"), silty and fine-sandy. The much rarer coarse detritus is restricted to more exposed, less well-protected beach sections. Typical of the mud flats was the *Tympanotonus-Pirenella* community, whose frequency is due precisely to the considerable spread of this biotope. This community could well stand salinity changes from 10 to 30 per mille: the few euryhaline plant-eaters could thrive in unlimited numbers on the ample food provided by the debris of land plants and the *Zostera* and algal vegetation of the sea.

In the more exposed beach sections, where silt and fine sand were replaced by a somewhat coarser-grained sediment, suspension-filters gained the upper hand in the more turbulent, clearer water, and the *Tympanotonus-Pirenella* community graded into *Mytilus aquitanicus* and *Pitar undata* communities. The *Mytilus aquitanicus* community is epifaunal, with the sessile benthos dominating, which indicates a firmer bottom, whereas the infauna of the *Pitar undata* community lived buried in loose sandy sediments.

The dominance of the *Tympanotonus-Pirenella* community and of the fine-grained detritic deposits in the littoral region proves that in the Upper Oligocene sea the agitation of the water by surf and currents did not exceed what is usual in smaller seas.

The absence of rocky shores further suggests that the seashore was not bordered by hills but by flat lands with sluggish rivers.

The flat shore was favourable to the development of lagoons. Ecologic analysis has proved that the nearshore mudflats of the Upper Oligocene were accompanied by strings of lagoons. These had formed behind sand bars and were separated from the open sea by low peninsulas or strings of islands.

The decisive ecological feature of a lagoon is its salinity, which depends first and foremost on the local climate. It is difficult to separate littoral and lagoon communities from one another, because the lagoons are populated by immigration from the littoral region (HEDGPETH 1957). Salinities lower than 10 per mille for protracted periods are rather unlikely along a seashore, except near the mouths of streams, i.e. in estuaries, and in lagoons; we should thus regard only the *Polymesoda-Tympanotonus* and *Viviparus-Brotia* communities as true lagoon communities. Of course, littoral and sublittoral communities could also penetrate into the lagoons at times of higher salinity.

The flat-beach and shallow sublittoral deposits of the Upper Oligocene are as variable both horizontally and vertically as are all facially similar deposits. The frequent and often irregular alternation of the littoral communities with shallow sublittoral and lagoon communities — particularly widespread in the Vértes and Gerecse regions — indicates a repeated shifting of the shores and lagoons. These displacements — the repeated returns of littoral and lagoon environments — do not exhibit any definite trend either towards a slow subsidence (transgression) or a slow emersion (regression), except in a very broad outline. The first case is exemplified by the eastern part of the Mány—Zsámbék basin (cf. Ch. II. 2), where the successions reveal a very slow encroachment by shallow and then medium-depth sublittoral environments. A fine example of the second case is, on the other hand, the Eger—Sajó Valley region (cf. Ch. II. 6), where a gradual regression can be traced in the second half of the Upper Oligocene, from deep sublittoral — shallow bathyal facies to *Polymesoda*-type lagoon communities.

The freshwater-oligohaline *Viviparus-Brotia* communities and the lagoon communities with *Polymesoda* and *Tympanotonus*, indicative of 3 to 10 per mille salinity, as well as the littoral *Tympanotonus-Pirenella* and finally the shallow sublittoral communities, which graded into each other laterally and, by WALTHER's law of the succession of facies, also vertically, form successions with frequent repetitions. In quite a few cases, one link or another of the chain is missing, probably owing to a lacuna in deposition, or the absence or non-fossilization of a then living community.

The irregular alternations and returns of communities can be explained in the following two ways.

1. All the above-mentioned communities could settle also in lagoons, where their spread was a function purely of salinity. In a lagoon, salinity will vary in space and time. Under a humid climate, salinity increases seaward and decreases landward. In such lagoons, the limits of the communities will depend on the isohalines, and a high enough salinity may even entail the immigration of shallow sublittoral communities. More abundant precipitations will displace the isohalines seaward, with the consequent expansion and subsequent dominance of freshwater-oligohaline (*Viviparus Brotia*) and *Polymesoda-Tympanotonus* communities. A drier climate entails the landward shifting of the isohalines, with the *Viviparus-Brotia* community being driven back into the rivers and with sublittoral communities like those of *Glycymeris latiradiata* and *Pitar polytropa* showing up on the seaward border of the lagoon.

A. KOCH's (1877) insight into the conditions of origin of the Upper Oligocene strata of Pomáz is so much to the point that — even if it is obsolete in a number of respects — we cannot but cite it here: "Everything points that way that there existed here lagoons and shallow bays of the sea in the Upper Oligocene period, which wêre usually closed off from the open sea and were but inundated time and time again by the waters of the great sea, which then reestablished the purely saline character of the fauna . . ." (p. 82).

Let it suffice to give here only one recent example for the climate-dependence of salinity in lagoons, PARKER's (1955) study on the shores of the Gulf of Mexico.

2. The other explanation of the repeated return of littoral communities and their alternation with shallow sublittoral communities hinges on the assumption that, except for the *Viviparus-Brotia* and *Polymesoda-Tympanotonus* communities, all littoral communities could thrive not only in lagoons, but also on open stretches of beach. In this case, the succession and alterations of the littoral communities could be due to irregular changes in the relative rates of epirogenic subsidence and filling-up. The rates of filling-up are, however, likewise controlled by climatic factors, if the relief energy and the rate of epirogenic subsidence are assumed to be more or less constant. In periods of richer precipitations, the rivers carry more waste, so that the shores may shift significantly seaward. Periods with less abundant precipitations entail the reverse process.

It is usually hard to tell whether the original biotope was of the lagoon or littoral type. Still the alternation of the various communities can be retraced to a single cause in both cases, to changes in the climate (in the abundance of precipitations). This does not, of course, exclude the influence also of other factors. It is, however, more than unlikely that the alternation of facies should have been caused by "oscillations" of the Earth's crust, as it has been assumed in numerous similar cases, often with far-reaching conclusions concerning diastrophic events.

Summary. The shore of the Upper Oligocene sea in Hungary was a sandy-silty tidal flat bordered by strings of lagoons. In the landward direction this beach strip graded into a flat plain with sluggish rivers and their deltas which, owing to the abundant precipitations, had rather high discharges. There was a rich vegetation. The repeated displacements of the littoral strip, the capricious variations of salinity in the lagoons depended first and foremost on the irregular variations in the abundance of precipitations and/or in the changing discharge of the rivers. Deposition was relatively fast.

The lagoon and littoral strips so important for the development of mineral fuels (coal, petroleum) and rock salt raise little hope — despite their considerable areal extent — as far as the Hungarian Upper Oligocene is concerned. The humid climate would suggest coal first of all, but areas where the filling up of lagoons could give rise to swamps of great enough extent were few and far between (Vértessomlyó, Szápár). The fast sedimentation diluted the organic debris sufficiently to preclude the formation of allochthonous seams, so that the abundant organic debris in the Upper Oligocene littoral deposits could at best form small lenses or stringers of coal.

(b) *The sublittoral biotope*

The seaward continuation of the flat beach presumably was a sea bottom also of very gentle slope. Presuming the border of the sedimentary basin to have passed through Komárom and Ipolyság, and a sea depth of 200 m about Eger in the first half of the Upper Oligocene, we obtain a slope angle of 0.15° (0° 9'). This is far below the gradient needed to start submarine slumps or turbidity currents, or the ones presumed for geosynclines or measured in deep-sea trenches. On the other hand, it is in the same range as the world-wide average gradient of shelves according to SHEPARD (0° 7').

All zones of the sublittoral region could be reconstructed on the basis of the fossil communities: indeed, in the Eger—Sajó Valley region the Upper Oligocene sea was of more than sublittoral depth (> 200 m).

Because of these gentle slopes the shallow sublittoral zone was very wide, too; variations in the relative rates of subsidence and sedimentation made it shift frequently landward or basinward. This is indicated by the alternation of littoral and less often of medium-depth sublittoral communities with the shallow sublittoral ones.

The Hungarian Upper Oligocene also bears out the general relationship that the deepening of the sea reduces the variety of communities; the faunae and deposits become more monotonous, the biotope grows more uniform. We know four or even five communities from the shallow sublittoral zone, three (or four) from the medium-depth sublittoral zone and only one or possibly two from the deep sublittoral zone.

The decisive ecological factor in the sublittoral zone is the agitation of the water. Current rates control the type of sediment settling on the bottom, which affect in turn the spread of communities, as well as oxygenation and food supply.

The highest-energy environment of the shallow sublittoral zone between 0 and 30 metres depth was inhabited by the *Glycymeris latiradiata* community. The biotope was characterized by considerable turbulency of the water, a consequent high degree of oxygenation, and slower deposition of more coarser-grained sediments (up to gravel size): most of the community procured its food out of the streaming water (suspension-filters). Slower deposition often resulted in lumachellas or in the telescoping of subsequent communities. The *Corallinacea-Lepidocyclina* community of isolated occurrence lived under similar conditions, but on submarine rises far from the shores. This latter biotope was characterized by an almost total lack of detritic sediment, as a result of strong water movement compounded with a considerable distance from the shores.

The community thriving in the lowest-energy environment was the one named after *Nucula* and *Angulus*. In the more protected parts of the shallow sublittoral zone, in almost stagnating, poorly oxygenated water, a fine-grained sediment rich in organic matter could deposit, in which the *Nucula-Angulus* community of deposit-feeders could thrive. The *Glycymeris latiradiata* and *Corallinacea-Lepidocyclina* communities consisted of epifaunal forms or forms which did not dig deep, whereas the *Nucula-Angulus* community lived dug in the soft mud.

The *Pitar polytropa* community indicates an environment midway between the above two extremes.

The succession *Glycymeris latiradiata—Pitar polytropa—Nucula-Angulus* consequently reflects an order of decreasing agitation of the water, entailing a decreasing grain size of the embedding sediment, a decreasing oxygenation and an increasing abundance of organic matter at the time of deposition. The alternation of the above communities does obviously not necessarily mean a change in depth, but possibly simply a change in agitation, which may be due to any combination of a diversity of factors.

Of course, in the shallow sublittoral zone, where to a depth of 8 to 10 metres agitation is due more to the surf than to currents, the high-energy biotope was the most widespread: the *Glycymeris latiradiata* community was the most common (cf. the term "Pectunculus sands!").

There was a similar division of roles among the medium depth sublittoral communities living between 30 and 120 metres. The *Flabellipecten-Odontocyathus* community of dominant epifaunal traits which inhabited a biotope characterized by a slow and relatively coarse sedimentation (with glauconite in the environs of Eger) proves beyond doubt a more strongly oxygenated, higher-energy environment with stronger currents than either the *Turritella venus* or the *Pitar beyrichi* community. The least agitated water in this zone, and perhaps even below it if there was a suitable slow, monotonous, fine-grained sedimentation (silt, clayey silt), was inhabited by the *Schizaster* cf. *acuminatus* community, which dug itself into and fed on deposits rich in organic matter, owing to the relative scarcity of oxygen in this biotope.

In the deep sublittoral zone and at even greater depths, currents tend to lose most of their turbulency, entailing a uniform deposition of clayey silt and clay. Although SHEPARD (1948) denies the decrease of grain sizes with increasing depth, and even affirms the converse to hold, I feel that his findings concerning open seas and oceans are not necessarily relevant to the Upper Oligocene Paratethys. SHEPARD himself admits that in closed seas (e.g. off the Danube delta) the decrease of grain size with increasing depth is a well-established fact. The *Hinia-Cadulus* community, which can be assigned to the deep sublittoral and shallow bathyal zones, is invariably found in thick, lithologically monotonous clayey and silty deposits rich in remains of foraminifers and of planktonic life forms (coccoliths, *Globigerina*, pteropods). BÁLDI—BEKE (1960) identified 13 nannoplankton species in the Molluscan clay of Eger. The weakness of horizontal currents permits the importance of vertical currents to emerge in this biotope. These carry upward the nutrients needed by an abundant nannoplankton (phosphorus etc.) and dispense oxygen at greater depths. The plankton plays a more and more important role as a source of food to the benthos. Plant-eaters are absent from the unlighted bottom of the sea: predators and scavengers are dominant. The "lower flora" of Eger, which accompanies a *Hinia-Cadulus* community, proves that even this far offshore there can occur vegetal debris transported over a considerable distance, embedded in the sediment and contributing to its organic matter content. At this depth, the monotony of the biotope prevents the formation of more than one or two communities. It is remarkable how little the *Hinia-Cadulus* community of small-sized thin-valved pelecypods and likewise small, predominantly siphonate and predator gastropods has changed its physiognomy over the last 30 to 40 million years (faunae of the Kiscell Clay, Baden Clay, Red Sea, Gulf of California).

(c) *The areal extent of the communities*

It is very hard to delimit the individual communities in space because — as we have pointed it out above — their limits shifted continually and irregularly, not exhibiting any dominant trends over short intervals of geological time. Still, some general relationships can be disentangled, by considering the frequencies of the individual community types.

The relevant frequency data are as follows.

The figures are percentages, with the total thickness of fossil-bearing layers taken as 100 in any region.

These statistics reveal a lateral succession of interdependent facies zones. Their geographical extent is shown in Fig. 1; their enumeration and the detailed description of their geological and palaeontological features have been given in Chapter II. It would of course be false to call one or the other

	Freshwater-oligohaline	Littoral-lagoon	Shallow	Medium-depth	Deep
			sublittoral		
Bakony	90—100	0—10	—	—	—
Vértes—Gerecse	10— 30	40—80	20—40	0—20	—
Pilis—Western Cserhát	0— 10	20—30	50—60	0—20	0—10
Budapest region	—	10—20	20—30	50—60	0—20
Eastern Cserhát—Ózd	Insufficient data				
Eger—Sajó Valley	0— 10	20—30	10—20	10—20	40—50

of these units shallow sublittoral or medium-depth sublittoral; what we can say is at most that this or that environment was dominant or typical in the region in question. The shallow sublittoral zone often turned into a littoral region interspersed with lagoons, while in the Vértes—Gerecse region, previously a littoral area, fresh-water deposits came to exist and, in parts of the medium-depth sublittoral Budapest region, *Glycymeris latiradiata* communities gained a foothold in the shoaling waters. The converse also took place repeatedly. The number of these shifting cannot, however, be gleaned as yet from the data available at the present time.

The distribution of the facies over the palaeogeographical units clearly reveals that the sea used to be deeper in the east and southeast, while littoral and shallow sublittoral communities lorded it in the west and northwest (Fig. 38). This further suggests that the border of the sedimentary basin, the land that was the source of detritus, land plants and fresh water, lay to the west and northwest.

The map (Fig. 1) further reveals that the succession of palaeogeographical units and of depth zones conforms to no rigid pattern. The Bakony and Vértes—Gerecse portions of the sedimentary basin were presumably covered by an extensive lagoon, with shifting isohalines, but west of Mór salinity nowhere rose above 3 per mille. It is remarkable that in the east this facies zone bordered directly on the medium-depth sublittoral Budapest region. This is not unexplained, however, because recent deep drilling in the Mány—Zsámbék basin has explored the transitions (cf. Ch. II. 2). In the

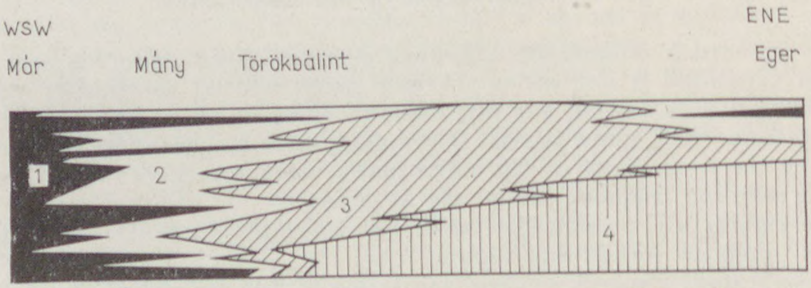


Fig. 38. A summary, schematic profile of Hungarian Upper Oligocene deposits, with subsequent erosion disregarded. Legend: 1. Freshwater-oligohaline, 2. lagoon-littoral and shallow sublittoral, 3. medium-depth sublittoral, 4. deep sublittoral — shallow bathyal facies

Pilis—Cserhát region, where the dominant shallow sublittoral communities are accompanied not infrequently by littoral ones, the freshwater-oligohaline communities are absent or restricted to the top parts of successions, the littoral region was presumably less wide and no extensive lagoon similar to the one in the Bakony and Vértes could develop.

In the environs of Eger and in the Sajó valley we reach the deep sublittoral and even shallow bathyal zones; this was, then, the deepest part of the Hungarian sedimentary basin in the first half of the Upper Oligocene. In the second half of this time span, however, biotopes perfectly similar to those in the western border region developed, indicating a change in the relative rates of subsidence and deposition. However, the shore presumably advanced here in a southerly and southwesterly rather than easterly direction.

The only trait out of harmony with this general idea is the early Upper Oligocene local uplifting in the environs of Eger, which resulted in the appearance of insular shallow and medium-depth sublittoral environments in the basin interior. This submarine rise was presumably due to the likewise local contemporaneous volcanism. The tuffaceous matter observed in the Transdanubian Upper Oligocene was washed in from areas of Upper Eocene volcanics exposed on the Northwestern Land, whereas the tuff in the glauconitic sediments of Eger is the almost undecomposed product of an ash fall (Bondor 1964); indeed, near Noszvaj, even lapilli can be recognized. The considerable distance from the shores resulted in a decrease of detritic sediment which in this shallower sublittoral local environment led to the formation of glauconite and biogenic limestone. The standing apart of these deposits within the Hungarian Upper Oligocene — already emphasized by Majzon (1960) — is due precisely to the uniqueness of the environment, a submarine rise in the middle of the basin.

These conditions might have resembled to some extent those on the Dove Bank ("Secca di Benda Palummo") in today's Bay of Naples; together with several other seccas, this is the abraded rest of a volcano rising to a depth of 50 to 42 metres above a sea bottom 100 to 120 metres deep. On the "bank", the slow sedimentation retarded by currents — according to descriptions by Walther (1910) and Bacci (1946) — results besides reworked tuff largely in biogenic limestone largely composed of colonies of Corallinacea (*Lithothamnium*). The "Bank" is surrounded by sands at lesser and clays at greater depths, with the appropriate living communities in them.

(d) *The Northwestern Land*

The distribution of the fossil communities suggests a land mass to the west and northwest: we shall call it the Northwestern Land for short. It bordered on the sedimentary basin roughly along a line connecting Pápa, Komárom and Ipolyság. At Veszprémvarsány and Fenyőfő there is still some fluviatile Upper Oligocene, whereas at Kisújfalu (Nová Vieska) a deep drilling traversed some Upper Oligocene according to Kőrössy (1958). North of this line there is no Upper Oligocene: the basin border thus defined more or less follows Scheffer's (1965) Rába line, or is at least parallel to it.

As we have discussed it in Chapter II, all lithologic evidence points towards a source of detritus to the north and northwest. A metamorphic region of erosion is assumed by most, and this is confirmed also by the extremely low lime content (less than 10 percent on an average) of the Upper Oligocene deposits. Although this may have had climatic causes, any cooling that could take place could certainly not account in itself for such a striking scarcity of lime. Anyway, the finding that crystalline schists are dominant if not exclusive northwest of the Rába line (Juhász and Kőháti 1966) is in good agreement with the above considerations.

Another remarkable feature of the Hungarian Upper Oligocene is the dominance of silt and fine sands, which suggests most of the Northwestern Land, and especially the shore strip, to have been flat and of low relief energy. Most of the coarse detritus — if the quantities produced were at all significant — probably got sorted out and left behind somewhere on the land, or on the border, still little known today, of the sedimentary basin (possibly to constitute part of the "gravel with tree trunk remains" in the Bakony, cf. Ch. I. 1). According to Shepard (1948), fine detritic deposits of considerable thickness are usually found on today's shelves in front of the mouths of the bigger rivers. We cannot, then, be too wide of the mark if we envisage the Northwestern Land as a deeply eroded, largely crystalline peneplain with big rivers and a lush vegetation.

The importance of this land mass for sedimentation from the "Rupelian" to the end of the "Helvetian" has lately been emphasized by Vass and Tomásek (1963). This land whose long axis extended northeast—southwest consisted in their opinion of crystalline schists belonging to the Veporids and of Triassic rocks. A similar palaeogeographical conclusion was arrived at by Seneš (1963).

(e) *Connexions with tectogenesis*

Even the data now available are sufficient to outline certain connexions between palaeogeographical facts and the events in time and space of tectogenesis.

As regards time, the marginal transgression in Transdanubia and the shoaling in the middle of the basin had put an end to the formation of the Kiscell Clay at the boundary of the Middle and Upper Oligocene probably was connected with a forerunner of the Savian phase of Alpine mountain building. A simultaneous event was the volcanic ash fall about Eger and the development of the short-lived submarine rise.

The main episode of the Savian phase had an important effect on both the Upper Oligocene sedimentary basin and the Northwestern Land. It was at that time that the flysch trough in the foreland of the Western Carpathians was being folded up and uplifted. This important phase of mountain building resulted in an increased abundance of detritic sediments and in a considerable narrowing of the Hungarian sedimentary basin in the Lower Miocene. The Upper Oligocene, Egerian basin can be traced northeastward from the Bakony all along the strike of the Hungarian Mountains, whereas the Lower Miocene (Eggenburgian) deposits are restricted to the area east of the Balassagyarmat—Budapest line. Even the top part of the latter is terrestrial, which further enhances the geocratic nature of this period.

The "parageosynclinal" sedimentary basin was covered by a shelf sea. The shelf itself was probably diversified by troughs and rises. It is remarkable how the palaeogeographical limits shown in Fig. 1 often coincide with structural lines. I have already mentioned the coincidence with or parallelism to the Rába line of the northwestern border of the sedimentary basin. The eastern border of the Eger—Sajó Valley region seems, on the basis of the scarce data available, to follow the Darnó upthrust line. The boundary between the Vértes—Gerecse and the Budapest region follows a geophysically identified structural line in the Mány—Zsámbék Basin. All this goes to prove that these structural trends had existed already in the Upper Oligocene, influencing the processes of epirogenesis and the subdivision of the sedimentary basin.

(f) *Authecological remarks*

The distribution of species and their abundance in the individual communities is shown in Table III. There are many "euryoec" forms (e.g. *Flabellipecten burdigalensis*, *Taras rotundatus*, *Cardium heeri*, *Pitar splendida*, *Angulus nysti*, *Turritella venus*, *Polinices catena helicina*, *Babylonia eburnoides umbilicosiformis*). Other species had much narrower ecological tolerances; these are abundant in one or two biotopes only ("stenoec" forms). The species highly characteristic of — although not absolutely restricted to — the individual depth zones are the following.

Lagoons and littoral region: *Mytilus aquitanicus*, *Ostrea cyathula*, *Polymesoda convexa*, *Congeria basteroti*, *Pitar undata*, *Gari protracta*, *Theodoxus pictus*, *T. buekkensis*, *T. crenulatus*, *Viviparus ventricosus*, *Turritella beyrichi*, *T. archimedis*, *Brotia escheri*, *Melanopsis impressa hantkeni*, *Pirenella plicata*, *Tympanotonus margaritaceus*, *Calyptraea chinensis*, *Ampullina crassatina*, *Galeodes semseyiana*.

Shallow sublittoral biotope: *Nucula schmidti*, *Nuculana anticeplicata*, *Anadara diluvii*, *A. gümbeli*, *Trisidos schafarziki*, *Glycymeris pilosa lunulata*, *G. latiradiata* s. l., *Pecten arcuatus*, *Crassatella carcarensis*, *Isocardia subtransversa*, *Cyprina islandica rotundata*, *Cardium egerense*, *C. neglectum*, *Laevicardium tenuisulcatum*, *Venus multilamella interstriata*, *Pitar polytropa*, *Corbula basteroti*, *C. carinata*, *Turritella venus margarethae*, *T. beyrichi percarinata*, *Protoma cathedralis*, *Diastoma grateloupi turritoapennica*, *Aporrhais callosa*, *Drepanocheilus speciosus*, *Globularia gibberosa sanctistephani*, *Cassidaria depressa*, *Galeodes basilica*, *Bullia hungarica*, *Athleta rarispina*, *Egerea collectiva*, *Marginella gracilis*, *Turricula regularis*, *Conus dujardini egerensis*, *Terebra simplex*.

Medium-depth sublittoral biotope: *Nucula comta*, *Pteria phalaenacaea*, *Musculus philippi*, *Flabellipecten angustiformis*, *F. burdigalensis*, *Chlamys csepreghymeznericsae*, *Chlamys incomparabilis*, *Astarte gracilis degrangei*, *Cardita orbicularis subparvocostata*, *Lucinoma borealis*, *Cavilucina droueti schloenbachi, Laevicardium cyprium, Pitar beyrichi, Panopea menardi, Corbula gibba, Pholadomya puschi, Cassidaria nodosa, Ficus concinna, Turris duchasteli, Turris laticlavia, Dentalium kickxi, Dentalium apenninicum.*

Deep sublittoral biotope: *Nucula mayeri, Nuculana psammobiaeformis, Yoldia raulini, Limopsis anomala, Thyasira vara angusta, Rostellaria bicarinata, Murex paucispinatus, Hinia schlotheimi, Volutilithes permulticostata, Marginella vadászi, Turricula ilonae, Ringicula auriculata paulucciae, Cylichna cylindracea raulini, Cadulus gracilina.*

The same genus can be represented by different species in different depth zones: Such cases of "ecological vicariation" are, e.g. the replacement of littoral *Galeodes semseyiana* by shallow sublittoral *G. basilica*, of the shallow sublittoral *Nucula schmidti, Laevicardium tenuisulcatum, Pitar polytropa, Marginella gracilis* and *Cassidaria depressa* by the medium-depth sublittoral *Nucula comta, Laevicardium cyprium, Pitar beyrichi, Marginella vadászi* and *Cassidaria nodosa.*

IV. PALAEOGEOGRAPHICAL PART

1. THE CLIMATE

The strikingly low lime content of the Hungarian Upper Oligocene could be explained most easily by assuming a cool climate or at least the penetration of cold currents into the Paratethys. The question to be raised here is, how far does the palaeontological evidence confirm such an assumption?

Quite a few of the fossil communities described above may be regarded as climatic indicators: the *Viviparus-Brotia*, *Polymesoda-Tympanotonus* and *Tympanotonus-Pirenella* communities indicate a warm humid climate. The thick-shelled big bivalves and gastropods of the *Glycymeris latiradiata* community, let alone the red algae and big foraminifers of the *Corallinacea-Lepidocyclina* community, cannot be imagined in an environment cooler than subtropical.

Analyzing on the basis of the monographs of the great expeditions the distribution of the Upper Oligocene species that still live today, we find most of these to be rather eurythermal, spread from Norway to the African shores. The exceptions are *Chlamys incomparabilis*, which extends northward up to the Bay of Gascogne, and also *Thracia pubescens* and *Calyptraea chinensis*, which do not occur farther north than the British Isles, whereas in the south they can be traced down to Senegal and Guinea. The southernmost known occurrence of living *Cyprina islandica* is in the Bay of Cadiz. It is consequently, in contrast with the other, subtropical-warm temperate species, a temperate-boreal form. The more massive, bigger valve of the subspecies *rotundata* would suggest, on the other hand, a warmer environment than *Cyprina islandica* s. s.

Of the genera, the following are restricted to the recent tropical belt:

**Trisidos* (Indopacific)
**Beguina*
Crassatella
Polymesoda
Arcopagia
**Apolymetis* (Western Africa)
**Cerithium* s. s.
Tympanotonus (*T. fuscatus* L. resembling *T. margaritaceus* in Western Africa)
Pirenella (Mediterranean and Indopacific genus)
Brotia (Indopacific genus)
Architectonica (Mediterranean)
**Protoma* (Western Africa)

Zonaria
**Rostellaria* (Indopacific)
**Strombus*
**Globularia* (Indopacific *G. fluctuata* of the Philippines resembling *G. gibberosa*)
**Babylonia* (Indopacific)
**Galeodes* (Western India and Indopacific)
Vexillum
**Bullia*
Conus
Terebra
Turricula (*T. javana* resembling *T. regularis* in the Indopacific)
Bathytoma (Indopacific)
Ringicula
Niso (Indopacific)
Hadriana (one living species in the Mediterranean)

The actual Indopacific or West Indian occurrence of tropical Upper Oligocene genera is connected with the dismemberment of the once uninterrupted Tethys (cf. EKMAN 1953). With the numerous tropical genera we can confront only a few Boreal genera:

Yoldia
Limopsis
Astarte
Cyprina
Hiatella
Bonellitia

It is to be pointed out that, owing to the phenomenon of "tropical submergence", the above cold-resistant genera will occur also under warmer climates, at greater depths. *Cyprina* reaches down to the Bay of Cadiz, whereas *Limopsis aurita* occurs according to the observations of the "Talisman" as far south as the Açores and even along the Bermudas.

The generic composition of the Hungarian Upper Oligocene fauna thus indicates a warm, subtropical climate, of the kind now prevailing between 30° of latitude and the tropics. The fact of faunal exchanges with the "Boreal" region does not contradict this assumption, because even according to the latest opinions (GÖRGES 1952, ANDERSON 1961, GRIPP 1961) the fauna then living in the North Sea basin was not boreal in the recent sense of the word, but a subtropical-mediterranean assemblage.

In the list of tropical genera we have marked with asterisks those forms which did not extent north of the Paratethys. Hence, one third of the tropical genera occurring in the Paratethys is missing from the North Sea, which indicates a certain temperature difference. This difference could not have been too significant, however, considering the Mediterranean-subtropical climate of the North Sea, and thus the currents, if any, which came from there could probably not significantly cool the Paratethys.

Consequently, we cannot explain the low lime content of the Upper Oligocene sediments by invoking climatic factors, but much rather by the nature of the region of erosion (cf. Ch. III. 3) as well as by the rapid detritic sedimentation. Wherever these two influences were cancelled in one way or another we do indeed find limestones (on the submarine rise about Eger).

These findings agree well with ANDREÁNSZKY's (1966) ecological analysis of the Upper Oligocene florae of Eger. According to him, a warm climate prevailed throughout the deposition of the succession exposed in the Wind Brickyard; the lower flora is subtropical, the upper flora indicates a "warm subtropical climate at the border of the tropical zone". The mean temperature of the air was 20 or 21°C ± 10°C according to ANDREÁNSZKY.

2. A COMPARISON WITH THE FAUNAL PROVINCES OF THE EUROPEAN OLIGOCENE SEAS

The geographical distribution of the mollusc species constituting the Hungarian Upper Oligocene mollusc fauna according to the synoptic Table IV are shown in Fig. 39.

More than one-third of the fauna consists of endemic species restricted to the Paratethys. The large number of endemic species proves that late in the Oligocene the Paratethys assumed the role of an independent European zoogeographical unit, which justifies its separation from the Mediterranean province.

The number of the cosmopolitic species common all over Europe is 34. They include *Anadara diluvii*, *Pteria phalaenacea*, *Anomia ephippium*, *Taras rotundatus*, *Lucinoma borealis*, *Macoma elliptica*, *Panopea menardi*, *Corbula gibba*, *Pirenella plicata*, *Calyptraea chinensis*, *Polinices olla*, *Polinices catena* s. l. These were "successful" forms with a great deal of adaptability as indicated by the long hemerae of most of them. Indeed, many of them live even now.

There are 47 species known from two provinces and 69 species known from one province in addition to the Paratethys. The latter reflect the Boreal affinities of the Hungarian Upper Oligocene fauna (35 species). The Boreal influence was much stronger than the Mediterranean (18 species), and this must not be left out of consideration when attempting a palaeogeographic reconstruction of the European Upper Oligocene even if the exposures now accessible do not enable us to plot on a map the direct passage between the two.

Incidentally, this Boreal affinity of the fauna has been recognized rather early by a number of authors, including HOFMANN, FUCHS, KOCH, BÖCKH, TELEGDI-ROTH, SORGENFREI (1940) and others.

SENEŠ, too, had made an effort at pinpointing the Upper Oligocene ("Aquitanian") passage between the Paratethys and the North Sea. He subsequently stated, however, the Boreal element in the fauna of the Central Paratethys to be a mere relic, with no direct Upper Oligocene con-

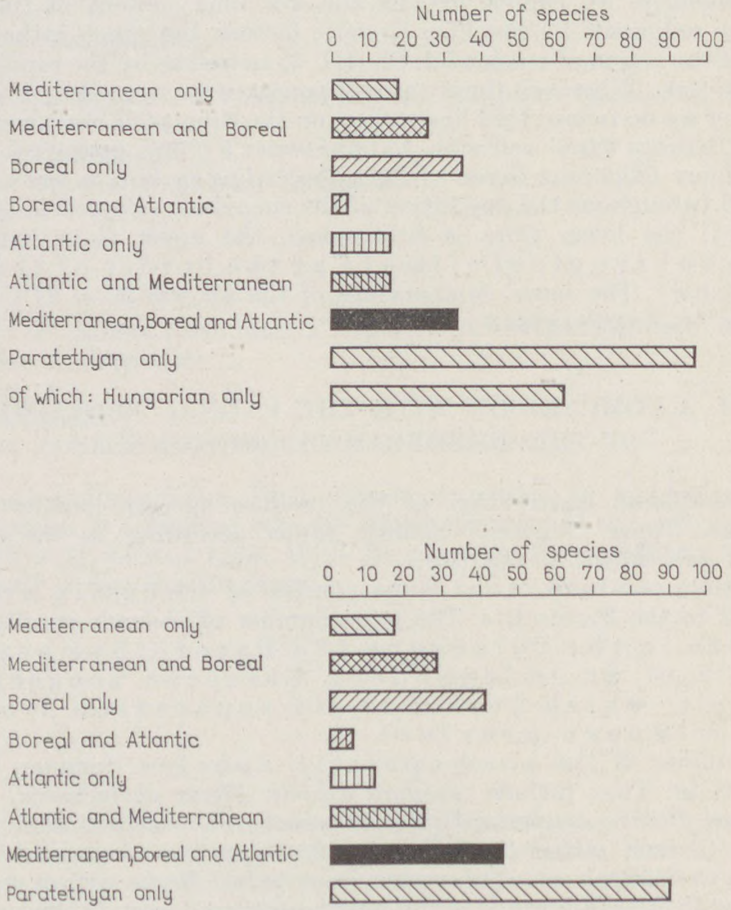


Fig. 39. Distribution of Hungarian Upper Oligocene mollusc species in the marine faunal provinces of Europe. Close relations, contracted in the upper diagram, have not been taken into account in the lower diagram

nexion between the two basins (SENEŠ 1961, 1962, BUDAY et al. 1965). ANDERSON (1961) in an earlier standpoint most decisively refuted any connexion during the Upper Oligocene between the North Sea basin and Southeast Europe: "Die stratigraphische Befunde lassen für eine derartige Meeresverbindung keine Anhaltspunkte erkennen" (130). He felt that this affinity had been stipulated by certain authors on the basis of erroneous correlations and incorrectly identified fossils. In a more recent oral communication, however, he was kind enough to state that he had changed his opinion, precisely on the strength of the Hungarian malacological evidence.

DROOGER (in ANDERSON 1963, p. 121), in a contribution to an earlier lecture of ANDERSON, considered it certain that the North Sea basin had been connected — even if only for a short span of time — with the Mediterranean region. He sought the connexion through Hessen and Bavaria. For proof he adduced the presence at Eger of *Miogypsina septentrionalis* and *Lepidocyclina morgani*.

Anderson (1961) pointed out the lack of Southeast European immigrants in the Chattian fauna of the North Sea: "... behauptete Faunenaustausch sehr einseitig von Norden nach Süden gegangen sein müsste, was nicht sehr wahrscheinlich ist" (130). Still, this one-way north—south migration of the faunae is not so much of a nonsense as it would seem: let us invoke here Anderson's (1961) theory which states the fauna of the Boreal province to be of North Atlantic origin. The southward migration of the North Atlantic fauna was due to the gradual worsening of the climate during the Tertiary. This southward shifting of the climatic zones explains also why a fauna similar to the actual Mediterranean-Lusitanian fauna lived in the North Sea during the Upper Oligocene and the Miocene.

The further analysis of the situation requires a temporal breakdown of the data on geographical distribution. The diagram in Fig. 40 shows the geographical spread during the Upper Oligocene of the species that arose in the Chattian age. It is seen that in the Hungarian Upper Oligocene there are 60 species which first cropped up during the Chattian age also in other faunal provinces. Of these, 25 arose simultaneously in the Hungarian and Boreal Chattian; moreover, most of these (17) do not occur outside the Paratethys except in the Boreal Upper Oligocene (e.g. *Nucula schmidti*, *Musculus philippii*, *Modiolus dunkeri*, *Pitar beyrichi*, *Solecurtus basteroti*, *Siliqua nysti*, *Ensis hausmanni*, *Polinices catena helicina*, *Erato prolaevis*, *Hinia schlotheimi*, *Turris coronata*, *Niso minor*, *Cylichna lineata*). Other species arising simultaneously (in the Upper Oligocene) in the Paratethys, the Mediterranean and Boreal provinces include *Gari angusta*, *Amaea amoena*, *Polinices josephinia olla*, *Calyptraea chinensis*, *Ficus condita*. It would be hard to tell whether these species migrated from north to south or the other way round, as they all emerged within the same age.

In any case, the above-mentioned 25 species that arose in the Upper Oligocene both in the Paratethys and the North Sea cannot any means be regarded as "Rupelian relics" (cf. Seneš). Anyhow, the assumption of a relic fauna merely passes the baby to another, earlier stage, as Boreal relics should have been left behind by a true Boreal fauna. The course of the Middle Oligocene marine passage is, however, as

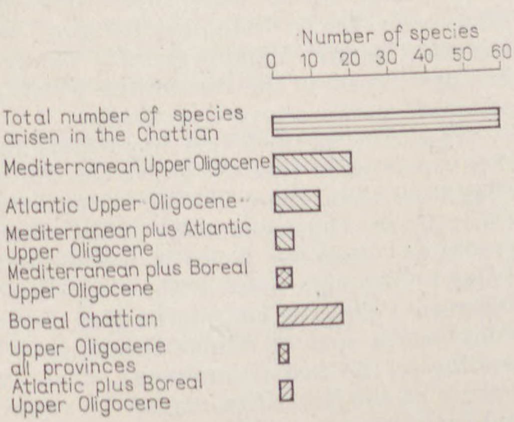


Fig. 40. Distribution over the Upper Oligocene marine faunal provinces of Europe of the species arising in the Upper Oligocene

little known as that of the Upper Oligocene one. This was pointed out by Rutsch (1962) in a thorough study questioning the existence of the Middle Oligocene marine passage along the Rhine (the "Raurachische Meeresstrasse"), which should have connected the Swiss Molasse basin through the South Rhine Graben with the Mainz Basin.

We may agree by and large with Anderson's hypothesis of the southward shift of faunae; a fact in point is that many of the tropical genera could not penetrate into the Upper Oligocene North Sea (cf. Ch. IV. 1). The obstacle to their penetration must have been, however, climatical rather than palaeogeographical. There are also some species which are known in the Mediterranean region from the Oligocene onward, but crop up only in the Miocene in the Boreal province (*Taras rotundatus, Venus multilamella, Macoma elliptica, Thracia pubescens, Architectonica carocollata, Xenophora deshayesi*). We may add those Boreal Miocene species which first appeared in the Upper Oligocene of the Paratethys: *Limopsis anomala, Natica tigrina*. These species migrated from south to north: there was, then, also a "countermigration" of some degree.

Thus, while the excessive number of Boreal species, and the relatively large number of common species arising simultaneously in both regions in the Upper Oligocene, suggest that a direct marine connexion between the North Sea and the Paratethys can be taken for granted, there still remains the problem of the marine passage along which the faunal exchange could take place.

According to all the evidence, the Paratethys was embraced by dry lands in the north: the faunal exchanges within the Paratethys operated west to east and east to west. This is observed also within Hungary (Ch. III). The Swiss Upper Oligocene molasse was purely limnic (Rutsch 1962), so that the basin was closed also in the west. It is thus logical to seek the passage in question in the east, through Poland and the Ukraine, one link in the chain possibly being the Carpathian Flysch belt (Kosmac or Polanica strata, Krosno and Brebu beds). The wide spread of strata corresponding to Merklin's (1962) "Bajgubek horizon" with *Corbula helmerseni* in Southern Russia ("Middle Maikop series") the gradual eastward deepening of the Hungarian part of the Paratethys, which went on also in the Lower Miocene, all confirm the above hypothesis.

Arguments against this hypothesis include among others Anderson's (1961) statement that the North Sea did not reach farther east in the Upper Oligocene than the Cilleborg—Sternberg—Cottbus—Kassel line. On the Early Upper Oligocene maps of Krutzsch et al. (1963) and Ahrens et al. (1963) the open-sea facies is not limited in the east: it extends over to Poland. Although most of the Oligocene known from the deep drillings in Western Poland is considered Rupelian, and the presence of any Upper Oligocene is open to doubt, Poland may be an important link in the chain leading to the east (Gortynska et al. 1962). The problem of the Eastern border of the North Sea cannot be regarded as settled in the light of the evidence now available.

Besides the largely boreal affinities the Mediterranean-Atlantic affinities must not be neglected, either; if we consider the species that first appeared during the Chattian (Fig. 40), we find that there are 20 species which arose at the same time also in the Mediterranean, and supposing the Atlantic species reached us through the Mediterranean, we can put at 35 the number of species that appeared simultaneously, that is, in the Upper Oligocene, in the Atlantic-Mediterranean region as well as in the Paratethys, while missing at the same time from the Boreal region. Let us point out, however, that some of the "Tongriano" species — which are regarded here as Upper Oligocene in their totality — might actually be older (cf. LORENZ 1962). The species common between the Paratethys and the Mediterranean province in the Upper Oligocene strata are the following: *Chlamys northamptoni, Cardita arduini, Isocardia subtransversa abbreviata, Ringicardium buekkianum, Zozia antiquata, Gari protracta, Corbula carinata, Thracia pubescens, Thr. pubescens bellardii, Clavagella oblita, Gibbula affinis protumida, Turritella beyrichi percarinata, T. archimedis, Protoma cathedralis, Architectonica carocollata, Diastoma grateloupi turritoapenninica, Xenophora deshayesi, Galeodes basilica, Dentalium apenninicum, D. simplex, Marginella gracilis*. These are complemented by species which, in addition to the above two provinces, occurred also in the Atlantic Chattian: *Pecten arcuatus, Flabellipecten burdigalensis, Crassatella carcarensis, Venus multilamella*. The species which arose in the Upper Oligocene both in the Paratethys and the Atlantic province are the following: *Nucula mayeri, Astarte gracilis degrangei, Cardita monilifera, C. ruginosa, Globularia gibberosa sanctistephani, Vexillum peyreirense, Clavus venustus, Cylichna cylindracea raulini, Roxania burdigalensis, Fustiaria taurogracilis, Cadulus gracilina*, and a species that had emerged in the earlier Oligocene, *Linga columbella*. Let us emphasize that, of the above-mentioned Mediterranean-Atlantic Oligocene species represented also in the Paratethys, not one can be found in the Boreal Oligocene! All this proves that there was a lively faunal exchange also with the Mediterranean in the Upper Oligocene. The geographical position of the marine passage between the Mediterranean and the Paratethys is, however, just as problematical as in the case of the North Sea. It would be most logical to seek a connexion through Northern Croatia and Northern Slovenia, towards Northern Italy, as suggested by the Krapina-Radoboj and Zagorje localities of the Oligocene, and as it has been assumed by SENEŠ (1960).

The Hungarian Upper Oligocene fauna as a whole reveals a Boreal dominance. This is not the case, however, with all the separate vertical subdivisions of the fauna (Ch. V). We have carried out so far the appropriate analysis on two successions: those of Törökbálint—Budafok and Eger. We have found in both cases that at the deeper levels of the Upper Oligocene the Boreal element is highly preponderant, whereas at the higher levels these are accompanied by numerous Mediterranean (but still Oligocene) species, making up the fauna about half-and-half. This is summarized below.

		Boreal	Medi-terranean
		percent	
Higher Upper Oligocene	Eger, "k layer"	43	44
	Budafok, Pacsirta Hill, layer No. 4.	55	62
Deeper Upper Oligocene	Eger, Molluscan clay	31	22
	Törökbálint fauna	64	35

Expressing the intensity of the Boreal influence by proportions, we get the following results.

$$\text{higher Upper Oligocene:} \quad \frac{\text{Boreal}}{\text{Mediterranean}} = 0.85$$

$$\text{deeper Upper Oligocene:} \quad \frac{\text{Boreal}}{\text{Mediterranean}} = 1.75$$

The enrichment of data may one day permit to approximately date within the Upper Oligocene a mollusc fauna merely by making use of the above index.

So much is clear from the foregoing that at the beginning of the Upper Oligocene a strong Boreal influence was felt and the North Sea species were predominant. In the second half of the Upper Oligocene, an increasing Mediterranean influence appeared: mixed Boreal-Mediterranean faunae came to exist. For the beginning of the Upper Oligocene we must assume a direct marine connection between the Paratethys and the Nort Sea. This connection might have broken already towards the end of the Upper Oligocene but it certainly did not survive the turn of the Oligocene-Miocene. In the Upper Oligocene, the immigration of Mediterranean species signals the opening of a marine passage towards the Mediterranean. In the Lower Miocene (Eggenburgian) this probably was the only passage to remain open, as besides a few scarce Northern relics most of the Miocene species are of Mediterranean origin. The floral changes in the Wind brickyard profile (Eger) suggest an attractive hypothesis. According to Andreánszky (1966), the "upper flora" signals a somewhat warmer climate than the plant remains at the lower levels. We may thus assume that the Mediterranean species were absent early in the Upper Oligocene for climatical rather than geographical reasons: their immigration would then be due to a "warming up" at the end of the Upper Oligocene.

The geographic position of the connecting marine passages is entirely uncertain. The connection with the North Sea might have been through East Rumania—Southern Russia—Poland, whereas for the connection with the Mediterranean we may, with Seneš assume a passage from Northern Italy (Schio and Belluno beds) through Slovenia and Croatia (Krapina, Radoboj).

V. STRATIGRAPHIC PART

1. CORRELATION BETWEEN THE PALAEOGEOGRAPHIC UNITS WITHIN HUNGARY

In the following we shall prove the contemporaneity of the successions discussed in detail in Chapter II. This problem has repeatedly been raised before in connexion with the correlation of the Eger fauna and the Pectunculus sands, and with the search for the continuation of the Pectunculus sands "disappearing" at the Galga valley (cf. Ch. II). The comparative diagrams of Fig. 41 are based on Table I. They reveal the considerable zoogeographical uniformity of the Hungarian Upper Oligocene.

The only striking fact is the independence of the Eger—Sajó Valley region (more than one-third of the species are known from no other Hungarian locality). One of the reasons for this is that the deep sublittoral — shallow bathyal facies is exceedingly rare elsewhere; another reason is the greater richness of the Eger fauna; the number of species common with other regions ranges from 0 to 54 percent; in the faunae composed of fewer species of the other regions the percentage of Eger forms is 53 to 64.

Disregarding the Eger—Sajó Valley faunae in our comparisons, the species of the Vértes—Gerecse region occur to the extent of 25 to 100 percent, those of the Pilis—Cserhát region from 54 to 84 percent, those of the Budapest region from 40 to 74 percent in the other regions. The species restricted to a single palaeogeographical unit make up from 0 to 13 percent of the species.

All this shows the Hungarian Upper Oligocene fauna to be rather uniform: the environs of Eger stand apart merely because of the large number of species and some facial peculiarities, which in the past have led to some erroneous chronological conclusions. With the exception of the Bakony, at least half of the faunae of the other palaeogeographical units are composed of species that occur also at Eger: the rare and interesting species of Eger tend to crop up one by one also in other regions, as more and more material is being accumulated (e.g. the occurrence of *Bullia hungarica* or *Egerea collectiva* in layer No. 4 of Pacsirta Hill at Budafok). All this is sufficient proof of contemporaneity.

2. CORRELATION WITH THE EXTRA-HUNGARIAN FAUNAE OF THE PARATETHYS

The contemporaneity of the South Slovakian Helemba (Kováčov) fauna with the Hungarian Upper Oligocene can be taken for certain (Ch. II). Most of the beds regarded by Buday et al. (1965) as

Aquitanian are contemporaneous with our Upper Oligocene and belong into the Egerian stage. The exceptions include the Miogypsina beds of Bretka (Papp 1960, Vaňova 1959) and possibly some faunae with *Amussium*. In the Carpathian foredeep, Velké Pavlovice is the only macrofaunal locality (Ctyroký, 1961) which, by the presence of *Glycymeris latiradiata* among others, can be said to be contemporaneous with the Hungarian Upper Oligocene. At this same locality, Cicha could on a micropalaeontological basis distinguish a Chattian and an Aquitanian stage (in the Zdanice-Hustopece succession: Buday et al. 1965). No "Chattian" macrofauna could, however, be identified anywhere in Czechoslovakia over and above the mollusc faunae called "Aquitanian" and formerly held to be Lower Miocene by the Czechoslovak specialists (and Upper Oligocene by me). At present, the faunae in question are placed in the Egerian, this newly established stage being regarded as transitional, Oligo-Miocene unit.

In Austria, in the molasse of the Alpine foredeep it is the Melker Serie in the sense of Kapounek et al. (1960) that corresponds to the Hungarian Upper Oligocene. The cited authors regard this sequence as Upper-Oligocene in its lower part and Lower Miocene, i.e. Aquitanian in its upper part. The macrofauna of the Melker Serie is relatively little known (Ellison 1940). On the basis of a review by Sieber (1953), the faunistical identity

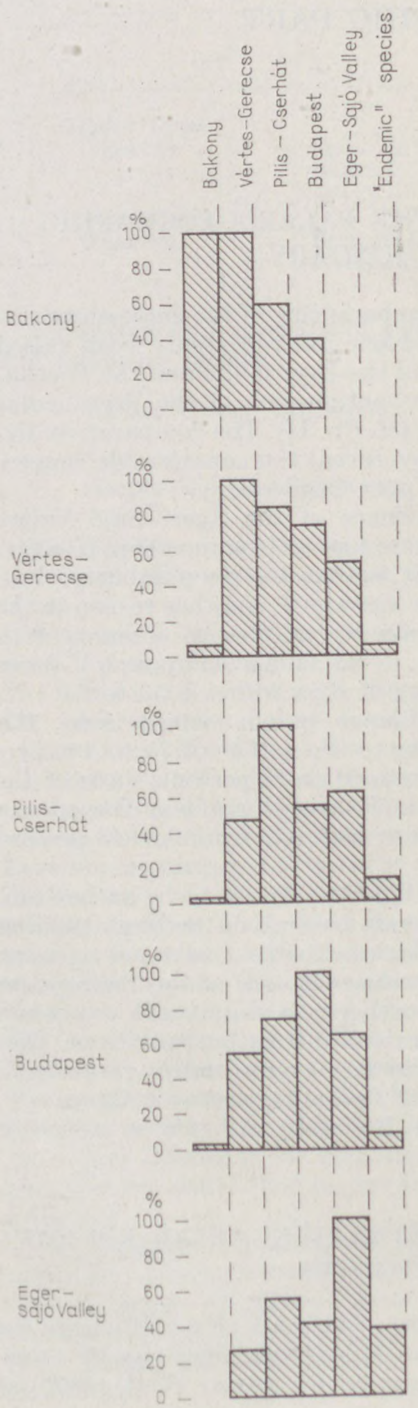


Fig. 41. Faunistic relations between the palaeogeographical units of the Hungarian Upper Oligocene sedimentary basin, in terms of common-species percentages. The little-known Central Cserhát—Ózd region has been left out of consideration. "Endemic species" here means a form restricted to the given region

of the Hungarian Upper Oligocene with the Melker Serie can be convincingly established. At present, this "Serie" is placed into the Egerian by the Austrian authors (PAPP 1968). After closing my manuscript STEININGER and RÖGL have published a fauna including *Miogypsina formosensis* from Plesching bei Linz, proving the Egerian age of the "Linzer sande".

The kinship between the macrofaunae of the Bavarian Molasse and the Hungarian Upper Oligocene has already been emphasized by FUCHS (1893), WOLFF (1897), TELEGDI-ROTH (1914), NOSZKY sen. (1936) and HÖLZL (1962). The last-cited monograph by HÖLZL on the faunae of the Bad Tölz beds and other contemporaneous strata is a further proof of this similarity. The number of the common species is 88, which is one-third of the Hungarian Upper Oligocene fauna and almost half of the Bavarian fauna of altogether 200 species. The Bad Tölz type fauna is considered Upper Oligocene by HÖLZL himself, but the "classic" fauna of the Thalberggraben near Traunstein is somewhat of a problem. The results of a re-study by HÖLZL have not been published so far; we have only WOLFF's (1897) monograph and the preliminary fossil lists of HÁGN and HÖLZL (1952) to go on. There undoubtedly are many affinities with the Hungarian Upper Oligocene (e.g. *Glycymeris latiradiata* has been described from there), but in HAGN and HÖLZL's lists the number of Miocene species is much larger than in the Hungarian Upper Oligocene faunae. After a kind verbal information of Mr. STEININGER, the Thalberg fauna includes also the *Miogypsina formosensis,* which new discovery confirms the earlier presumptions on the Upper Oligocene age of this locality, which can now be regarded as Egerian.

Proceeding towards the southwest, the Croatian fauna of Krapina-Radoboj-Golubovec, restudied by ANIĆ (1952), is contemporaneous with the Hungarian Upper Oligocene. In these strata, called "Sotzka beds" by HOERNES (1874), ANIĆ has identified such "Hungarian" species as *Babylonia eburnoides umbilicosiformis* and *Turritella beyrichi percarinata.* Almost all the forms occur also in the Hungarian Upper Oligocene. The Croatian Upper Oligocene transgressively overlies the Triassic just as its Hungarian counterpart in the Vértes—Gerecse area. The "Sotzka beds" overlie the basement also in Slovenia, about Trifail and Sagor (BITTNER 1884). According to PAPP (1959), the "Sotzka beds" are overlain here by 300 metres of clays with *Lepidocyclina tournoueri* and *Miogypsina* cf. *formosensis*: these strata should be regarded as still Upper Oligocene ("Chattian"). Earlier, PAPP (1954) held these clays to be contemporaneous with the Hungarian Kiscell Clay on the basis of *Clavulinoides szabói* occurring in it: he was wont to regard the "Sotzka beds" as "pre-Chattian" in 1954. MAJZON (1958) assumed them on the same basis to be contemporaneous with the lower Cyrena beds of Dorog, likewise a deeper Oligocene. Even if an older Oligocene age should be definitely established for the "Sotzka" beds at Zagorje, this would by no means apply also to the Krapina-Radoboj deposits which lie far from and are also otherwise independent of the Slovenian locality; the Upper Oligocene age of the latter can be regarded as firmly established on a macrofaunal basis.

In Transylvania, the Fellegvár deposits with *Corbula* and the Zsombor and Pusztaszentmihály localities described by KOCH (1894), all with largely brackwater faunae, should at least in part be considered continuations of the Hungarian Upper Oligocene. The number of common species is especially large in the Pectunculus sandstone observed by Hofmann (in Koch 1894) "in the area of the united rivers Szamos and Lápos". A deep sublittoral clayey facies also occurs here. In the beds underlying the Lower Miocene Korod fauna re-studied by Raileanu and Negulescu (1964), the Upper Oligocene with *Ampullina crassatina*, *Tympanotonus margaritaceus*, *Pirenella plicata* is present just as in the Zsil Valley; the first monographer of the latter (Hofmann 1870) described from there *Melanopsis hantkeni* among others.

The above-enumerated successions of the Central and Western Paratethys, contemporaneous with the Hungarian Upper Oligocene, would under the proposals and program mentioned farther above be subsumed under the heading of the Egerian stage.

In the Eastern Carpathians, the Krosno and Polyanitsa beds are presumably Upper Oligocene (Vialov 1964).

It was Merklin (1962) who called attention to the similarity between the South Russian and Hungarian Upper Oligocene. The stratigraphic unit comprehensively termed the Baygubek horizon, of a "Chattian-Aquitanian" age according to Merklin, includes the upper *Corbula* beds of Achalcik in Grusia, the Zelenchuk beds of the Northern Caucasus, the Karagin beds of the Southern Mangyshlak in addition to the Baygubek sands and sandy clays of the Ust-Urt. It corresponds further to the "middle Maikop series". The faunae of the overlying Upper Maikop, Sakaraul and Olgin beds are fully identical with those of the Eggenburgian in the Central and Western Paratethys, with the Hungarian Lower Miocene (Budafok, Salgótarján) and with the Korod fauna. The "Askania beds" about the Black Sea constitute a welcome connecting link towards the Carpathians (Nosovskij 1962).

3. THE PROPORTION OF OLIGOCENE TO MIOCENE SPECIES IN THE HUNGARIAN UPPER OLIGOCENE

Definitions of Oligocene and Miocene species have been given in Chapter I. Analyzing the Hungarian Upper Oligocene fauna in its entirety we obtain the result stated in the diagrams of Fig. 42.

Two-thirds of the species are stratigraphically "indifferent", persistent and endemic. The chronologically relevant one-third of the fauna reveals a decisive majority of Oligocene species. From the data given by Glibert (1957) I have computed that also the Belgian Upper Oligocene contains 10 percent Miocene elements; the percentage is even higher in the stratotype.

Miocene species, or species whose close relatives are known from the Miocene, are the following: *Limopsis anomala*, *Glycymeris latiradiata subfichteli*, *Mytilus aquitanicus*, *Chlamys incomparabilis*, *Pitar undata*, *Pitar gigas schafferi*, *Venerupis* ex aff. *basteroti*, *Arcopagia subelegans*, *Apolymetis lacunosa*, *Angulus planatus ancestralis*, *Theodoxus grateloupianus*, *Turritella*

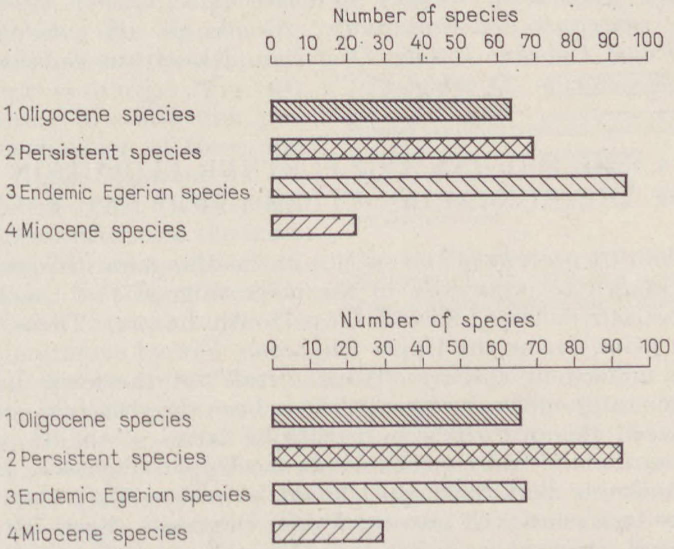


Fig. 42. Distribution according to their hemerae of the Hungarian Upper Oligocene mollusc species. (For the concepts of Oligocene and Miocene species see Chapter I. 4.) Close relations, mainly subspecies, contracted in the lower diagram, have not been taken into account in the upper diagram

venus, *Bittium reticulatum densespiratum*, *B. spina agriense*, *Strombus coronatus*, *Rostellaria dentata*, *Natica tigrina*, *Zonaria globosa*, *Ocinebrina crassilabiata trivaricosa*, *O. schönni*, *Babylonia eburnoides umbilicosiformis*, *Hinia fortecostata edentata*, *Euthriofusus burdigalensis*, *Fasciolaria plexa*, *Olivella clavula vindobonensis*, *Athleta rarispina*, *A. ficulina*, *Turris trifasciata*, *Conus dujardini egerensis*, *Melanella spina*.

Oligocene species or closely related forms include *Nucula comta*, *N. schmidti*, *Nuculana psammobiaeformis*, *Yoldia raulini*, *Glycymeris latiradiata obovatoides*, *Modiolus dunkeri*, *Pecten arcuatus*, *Chlamys* ex. aff. *decussata*, *Ostrea gigantea callifera*, *O. cyathula*, *Crassatella carcarensis*, *C. bosqueti*, *Cardita ruginosa*, *C. arduini*, *Cyprina islandica rotundata*, *Taras fragilis*, *Cavilucina droueti schloenbachi*, *Thyasira vara angusta*, *Ringicardium buekkianum*, *Pitar splendida*, *Dosiniopsis sublaevigata*, *Gari protracta*, *G. angusta*, *Siliqua nysti*, *Ensis hausmanni*, *Clavagella oblita*, *Thracia pubescens bellardii*, *Cuspidaria clava*, *C. neoscalarina*, *Calliostoma elegantulum hegeduesi*, *Turritella beyrichi*, *T. beyrichi percarinata*, *Mathilda schreiberi*, *Diastoma grateloupi turritoapenninica*, *Rostellaria bicarinata*, *Globularia gibberosa*, *G. gibberosa sanctistephani*, *G. gibberosa callosa*, *Ampullina crassatina*, *Erato prolaevis*, *Zonaria subexcisa*, *Cassidaria depressa*, *C. nodosa*, *Ficus concinna*, *Galeodes basilica*, *Streptochetus elongatus*, *Vexillum peyreirense*, *Volutilithes multicostata*, *V. proxima*, *Uxia granulata*, *Marginella gracilis*, *Turris selysii*, *T. konincki*, *Turricula regularis*, *Clavus venustus*, *Asthenotoma* *obliquinodosa*, *Raphitoma roemeri agriensis*, *Niso minor*, *Melanella naumanni*, *M. naumanni depressosuturata*, *Syrnola* ex. aff. *subulata*, *Actaeon punctatosulcatus*, *Cylichna lineata*, *Dentalium densitextum dejtarense*, *D. fissura*, *D. apenninicum*, *D. simplex*.

4. THE ORIGINS AND FURTHER EVOLUTION OF THE HUNGARIAN UPPER OLIGOCENE FAUNA

No more than 21 percent of the species in the Hungarian Upper Oligocene fauna are known to occur also in the older Oligocene of the Paratethys (South Bavarian molasse, Kiscell Clay, South Russia). These 52 species lived on in place during the Upper Oligocene. Faunal evolution within the Paratethys underwent a sharp "faunal break" at the lower limit of the Egerian. One cause of this break must have been the sharp change in facies, which replaced the overwhelmingly bathyal facies of the Rupelian with shallower marine and nearshore facies in the Upper Oligocene. It is nevertheless remarkable that the break should be rather sharp even where the Kiscell Clay facies survived into the Upper Oligocene (Eger—Sajó Valley). The abundant appearance of *Hinia* in the molluscan clay of Eger, which hardly differs in facies from the Kiscell Clay, is a case in point. It is interesting to note that in the North Sea region the emergence of *Hinia* is considered one of the criteria of the Rupelian/Chattian limit.

The remaining 79 percent of the Hungarian Upper Oligocene fauna had immigrated at the beginning of the Chattian (Egerian) or developed locally during the Upper Oligocene.

At the present time, we know 20 species as certain immigrants from some other European faunal province, more precisely from the North Sea in most of the cases; the species in question had already occurred in the Rupelian there, and cropped up only from the Upper Oligocene on in the Paratethys. This confirms rather nicely our palaeogeographical conclusions in point Ch. IV. 2.

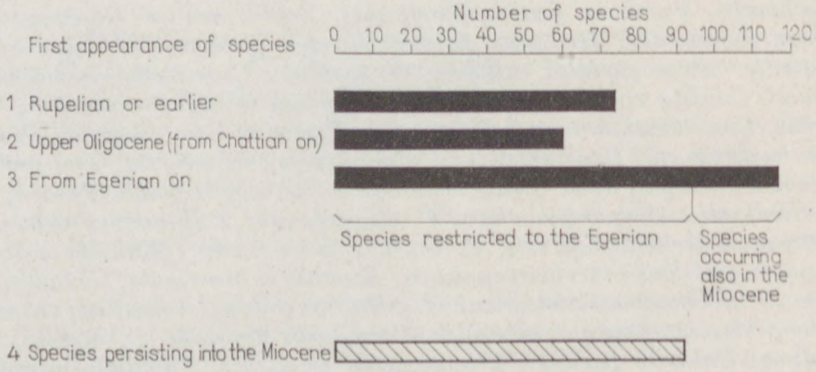


Fig. 43. Distribution of Hungarian Upper Oligocene mollusc species according to date of first appearance and persistence into the Miocene

We know 60 species (24 percent) which arose in the Upper Oligocene simultaneously in Hungary and elsewhere in Europe (Fig. 43). It is interesting to study the geographical distribution of these species in the Upper Oligocene (cf. Ch. IV. 2): it reveals that these simultaneous appearances raise the indispensable condition of a marine passage between the Mediterranean and the North Sea through the Paratethys.

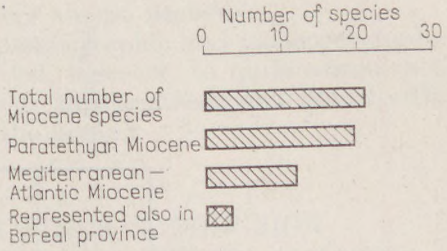


Fig. 44. Distribution over the European Miocene of the Miocene species represented in the Hungarian Upper Oligocene

Lastly, 116 species appear first in the Upper Oligocene of the Paratethys (the Egerian) and have not so far been found anywhere in deposits of the other Upper Oligocene basins of Europe. A great majority (94 species) of these species of doubtlessly local evolution did not survive into the Miocene: as far as we are able to tell at present, they either died out or mutated at the end of the Upper Oligocene. The remaining 22 species are, on the other hand, known also from the Miocene: their distribution in the Miocene sheds some light upon their trends of migration (Fig. 44). Almost all of them remain established in the Paratethys, but more than half of them expand into the Mediterranean-Atlantic province. However, none of them occurs in the Boreal Miocene alone. Hence, the species of Egerian origin which did not transgress the boundaries of the Paratethys until the Miocene did not find their way into the Boreal province, or did so only with a Mediterranean-Atlantic detour, as the northern communication got severed by the end of the Upper Oligocene or even earlier (cf. Ch. IV. 2).

The total number, disregarding the time of first appearance, of the species surviving into the Miocene is 91, more than one-third of the entire fauna. The correlation table (Fig. 45) shows the geographical distribution of the species surviving in the Miocene to be the following:

Paratethys	77
Mediterranean province	55
Boreal province	46
Atlantic province	58

The same table reveals a striking Boreal-Mediterranean affinity among the Oligocene and persistent species, and a not less striking Mediterranean-Atlantic affinity among the Oligocene species surviving into the Miocene.

The above findings imply that

(1) the "past" of the Paratethyan Upper Oligocene fauna within the bounds of the Paratethys was rather short and uneventful, so that the fauna in its overall aspect seems to stand closer to the Miocene fauna than

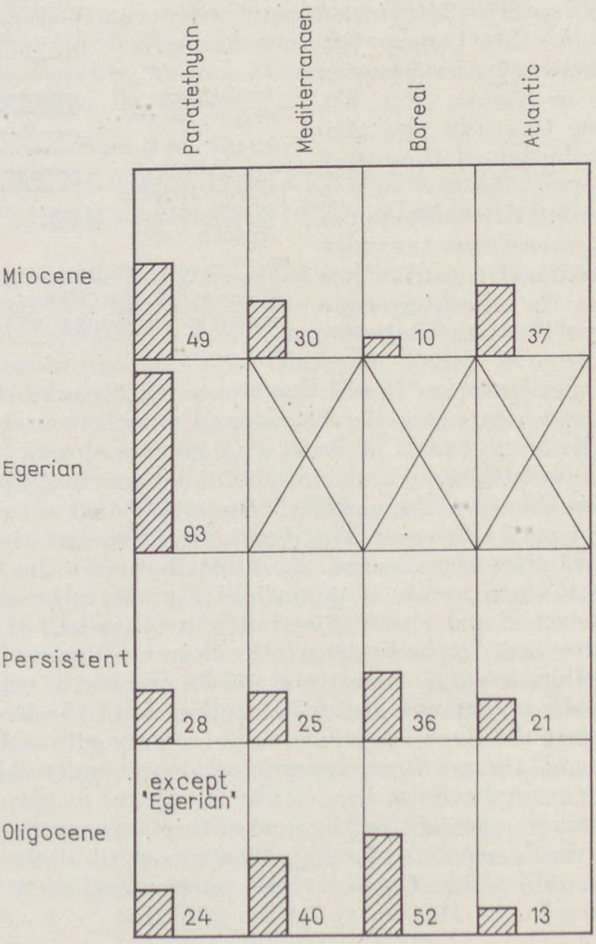


Fig. 45. "Space-time" correlation diagram of Hungarian Upper Oligocene mollusc species. The pigeon-holes show numbers of species and a column of proportionate height. For instance, of the total number of 249 species, 52 occur in the Boreal Oligocene, 37 in the Atlantic Miocene, and 49 in the Paratethyan Miocene

to the older Oligocene faunae of the Paratethys. This was the main cause of the Chattian/Aquitanian controversy in this region.

(2) Oligocene Boreal affinities are very strong and Oligocene-Mediterranean affinities are not much weaker: it was the recognition of these that had served as a basis for the correct correlations of more than a century ago.

(3) The Miocene Mediterranean affinities were somewhat weaker than those in the Oligocene, and there were significant Miocene Atlantic affinities, which further contributed to the Chattian/Aquitanian controversy.

(4) The Miocene Boreal affinities were almost negligible.

The detailed complex analysis on a stratigraphic and palaeogeographic basis of the above overall image has led, however, to quite unequivocal findings both regarding the simultaneous Mediterranean and Boreal affinities and the Upper Oligocene age of the fauna.

5. THE PROBLEM OF A FINER SUBDIVISION OF THE HUNGARIAN UPPER OLIGOCENE ON A MACROFAUNISTIC BASIS

We have had but a few extensive, uninterrupted fossil-rich profiles which permitted a layer-to-layer study of the proportions of Oligocene and Miocene species. In the Szentendre—Visegrád Mountains and in the Eastern Börzsöny, near Diósjenő, Miocene species make up no more than 8 to 10 percent of the faunae in the deeper Upper Oligocene, beside 20 to 30 percent Oligocene species: on the other hand, in some topmost faunae, the number of Miocene species may surpass that of the Oligocene ones (almost 20 percent Miocene beside 10 percent Oligocene: for details see Ch. II). We have observed that the Miocene preponderance is restricted to littoral, brackwater communities (*Mytilus aquitanicus*, *Pitar undata* and *Tympanotonus-Pirenella* communities), while in the sublittoral facies the Oligocene species kept their majority even in deposits overlying some littoral deposits of Miocene aspect. These successions with alternating "Oligocene" and "Miocene" faunae undoubtedly indicate a border region and, given the present tools of correlation, it would be hard to tell whether these beds are contemporaneous with the lowermost horizon of the Aquitanian type profile or with the top of the Doberg profile at Bünde. All this confirms Böckh's (1899) excellent observation that "the brackisher the deposit, the more abundant the Miocene species. In the Göd fauna they have just attained a majority. These strata could be considered straight Miocene, if it were not for the stratigraphic position which places it beyond doubt that the beds in question correspond to the Pectunculus sands . . ." (37).

The Törökbálint—Budafok and Eger profiles indicate a gradual increase in the abundance of Miocene species, but one that is insufficient to surpass the Oligocene figures.

		Oligocene	Miocene
		percent	
Higher Upper Oligocene	Eger, "K layer"	25 (18)	7 (15)
	Budafok, Pacsirta Hill, layer No. 4.	34	14
Deeper Upper Oligocene	Eger, Molluscan clay	23	3
	Törökbálint fauna	35	5

The relative proportions of the Oligocene and Miocene species can on an average be characterized by the following figures:

$$\text{Higher Upper Oligocene: } \frac{\text{Oligocene}}{\text{Miocene}} = 2.3$$

$$\text{Deeper Upper Oligocene: } \frac{\text{Oligocene}}{\text{Miocene}} = 7.3$$

We cannot speak of an overpowering "invasion" of Miocenes species: gradual increases in their number are to be expected on the basis of the data now available also in other successions. This may serve as a basis for a further subdivision of the Upper Oligocene at a later date. In contrast to the gradual increase of Miocene element during the Egerian, a real "invasion" of Mediterranean—Miocene taxa occur at the upper boundary of this stage. The new, allochtonous fauna of "Loibersdorf-type" opens a new age at the Egerian/Eggenburgian boundary.

VI. SYSTEMATIC PART

This part contains descriptions of 240 taxa. Of these, ten are described here for the first time; further 31 species or subspecies have been first described in some of my earlier publications. The number of Hungarian Upper Oligocene species previously unidentified or unfigured (not counting my own publications since 1961) is round 150. Of these, at least 50 species have not even been included in the fossil lists. Also in the case of known species, erroneous identifications or nomenclature had often to be corrected. Many species turned out to be much more widespread in the Hungarian Upper Oligocene than hitherto believed. Let me repeat that all the material treated below consists of forms personally inspected and studied by me: most of them I have collected myself. As regards the molluscs from earlier collections (Telegdi-Roth, Legányi, Streda, Csepreghy-Meznerics Benkő—Czabalay) and from borehole cores kindly placed at my disposal, I have examined only those for which not only the locality, but also the precise layer of origin was known. In literature — especially in Noszky sen. (1936) — a number of species are mentioned which I could not find in the collections, in most of the cases owing to the firebrand that had devastated the Geo-Palaeontological Collection of the Museum of Natural History in 1956. These species do not figure in the present book. Anyway, as has been proved by repeated recent collections at the same localities, the species in question must have been extraordinary rarities in the Hungarian Upper Oligocene, and so untypical as to be negligible even, in the foregoing synoptic chapters.

In the description of the individual species I have adhered to the following order:

(a) List of synonyms; enumeration of the most important synonyms, with reference to some fundamental last-century monographs and the most modern publications.

(b) Brief description, restricted to the traits of decisive importance: its length is often limited by poorish preservation (that is, by the small number of identifiable traits).

(c) Dimensions, for the only purpose of giving a rough idea of the size of the fossil; the dimensions given refer to the figured specimen unless otherwise stated.

(d) Remarks concerning variability; deviations from type if any; enumeration of specific and subspecific differences; remarks on nomenclature, taxonomy and controversial points.

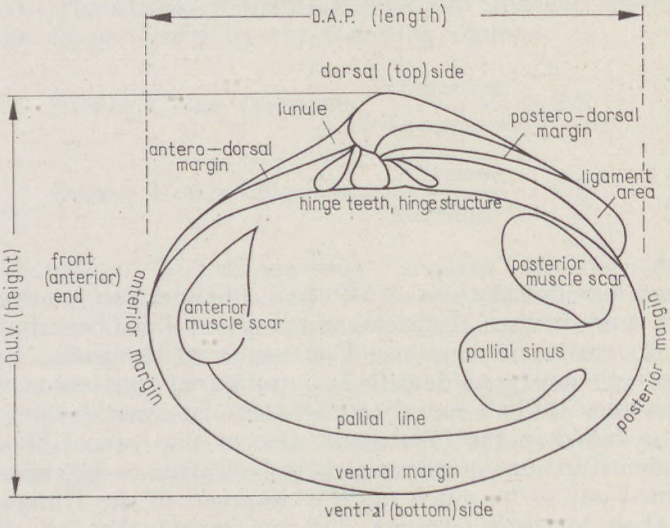


Fig. 46. Terminology used in describing bivalve shells (largely after ANDERSON 1959)

(e) Palaeoecological remarks (with brief references to the known ecological and coenological features of the species in an Upper Oligocene context).

(f) Enumeration of the Hungarian Upper Oligocene occurrences of the species (in terms of the surface localities and boreholes discussed in detail in Chapter II, using the symbols introduced there: in the case of exposures, the locality name is hyphenated with the serial number, whereas in the case of boreholes it is not).

(g) Distribution in time and space (a brief outline of hemera and areal, without too many details).

The terminology used here for bivalves does not differ from the usual (cf. Figs 46 and 47).* For the gastropods, I have adopted Cox' (1964) terminology (Fig. 48).

My taxonomical attitude is opposed to the exaggerated subdivision of mollusc species that was the mode at the turn of the century. I set up no intraspecific taxa even where there was a sufficient morphological justification if the biometric, geographical and stratigraphic justification was missing — as contrary to SACCO, whose principal follower in Hungary was J. NOSZKY sen.

In taxonomic nomenclature, I have accepted the rules and recommendations of the ICZN, being convinced that this is the only way to develop a "common language" and to avoid subjectivity. The continual changes

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* Let us point out however the following usage of terms. *Convex* invariably refers to the entire shell, i.e. it indicates some degree of bulbosity. Convexity of outline or margin is indicated by the adjective *rounded*. *Concave* is used as the opposite of both convex and rounded; in any particular case, its meaning is made clear by the context.

in nomenclature reflect an ever-increasing state of consciousness concerning and knowledge of the subject matter, both fossil and written, of palaeontology, a continual evolution of our science. Keeping up with changes in nomenclature is indeed hard on the non-specialist (as has been pointed out in various papers by L. STRAUSZ), but it is, in my opinion, not an impossible thing to demand.

As regards systematics, I have made use of THIELE (1931—35), WENZ (1938—44), KOROBKOV (1954—55), KEEN (1958), EBERSIN (1960), PCHELINZEV and KOROBKOV (1960) and the relevant volume of the Treatise: cf. COX (1964).

The fossil material has been inventoried and is kept almost without exception (the described, measured and figured material in its totality) in Budapest, at the Geo-Palaeontological Collection of the Natural History Museum.

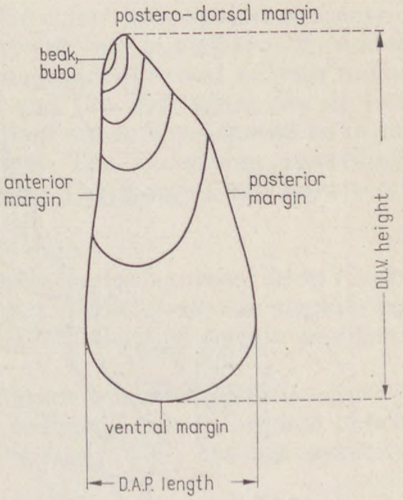

Fig. 47. Terminology used in describing anisomyarian shells

Mollusca
Bivalvia
Taxodonta

Nuculacea

Nuculidae

Genus: NUCULA LAMARCK, 1799

Nucula schmidti GLIBERT, 1955

Pl. I, figs 3—4

1884 *Nucula compressa* PHIL. — SPEYER et KOENEN, Pl. 16, figs 9—16
1836 *Nucula compressa* PHIL. — NOSZKY p. 86
1942 *Nucula compressa* PHIL. — HEERING, p. 13, Pl. 3, figs 14—17, and 21—22
1952 *Nucula compressa* PHIL. — GÖRGES, p. 10
1955 *Nucula schmidti* nom. nov. — GLIBERT
1957 *Nucula schmidti* GLIB. — GLIBERT, p. 9, Pl. 1, fig. 1
1962 *Nucula schmidti* GLIB. — HÖLZL, p. 42, Pl. 1, fig. 5

Oval valve with a beak displaced far back. (In the case of Nuculacea the usual shell-morphology of bivalves is reversed.) The long, slightly rounded antero-dorsal margin meets the strongly rounded ventral margin in a rounded acute angle. The short, slightly rounded posterodorsal margin continues in an angular dorsal margin. The outer surface of the valve is

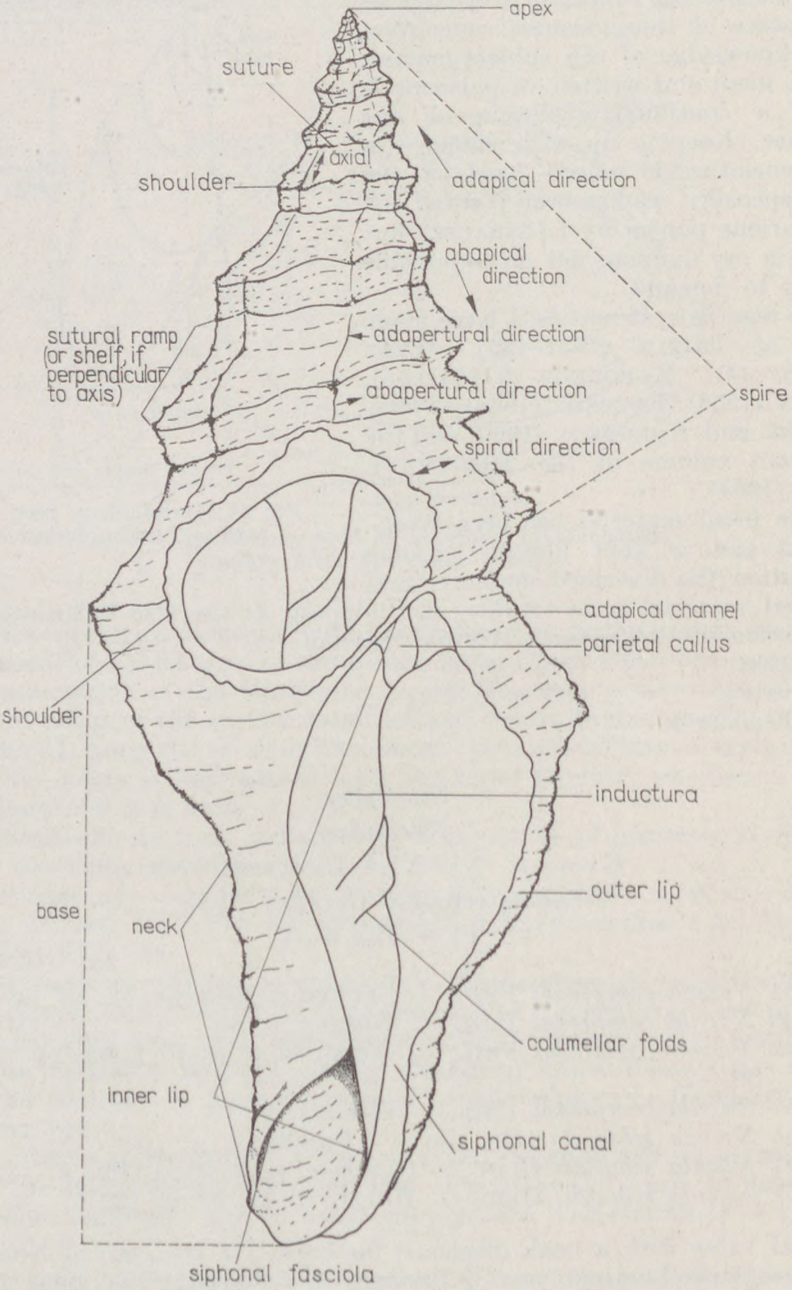

Fig. 48. Terminology used in describing gastropod shells (largely after Cox 1960)

smooth, sometimes a little shiny; except for a few wide-spaced concentric depressions, no concentric ornament or growth line is visible even under a magnifying glass. On the other hand, the glass will reveal a dense radial ribbing issuing from the beak. The broad and flat individual ribs do not rise above the outer surface of the valve: they are so close-spaced as to be separated by furrows looking like thin lines. The underlying mother-of-pearl layer shows no trace of this structure. The margins are serrate on the internal side.

Dimensions. Height: 11 mm; length: 14 mm.

Hölzl (1962) pointed out how it can readily be distinguished from *Nuculoma laevigata*: the latter has no radial ribbing visible under the magnifying glass and no marginal serration. Glibert (1955) clarified certain problems of nomenclature.

Nucula is a genus of deposit-feeding protobranchs burrowing into a muddy bottom. They prefer fine-grained detritic sediment rich in organic debris and can stand relatively poor oxygenation fairly well, but are sensitive to significant changes in salinity.

N. schmidti is typical of the shallow sublittoral *Nucula-Angulus* community. It sometimes crops up also in other sublittoral communities.

Hungarian Upper Oligocene localities: Mány 9, Szomor 31, Zsámbék 23, 42, 43, Tök 52, Solymár 72 Pomáz-1, -6, Szentendre 2, -2, Diósjenp-4, -7, Eger-1/k.

Distribution: It is restricted to the Upper Oligocene of the Paratethys and of the Boreal region.

Nucula mayeri Hörnes, 1870

Pl. I, figs 1—2

1870 *Nucula Mayeri* Hoern. — Hörnes, p. 296, Pl. 38, fig. 1
1912 *Nucula Mayeri* Hoern. — Cossmann et Peyrot, p. 219, T. 5, figs 21—24
1936 *Nucula Mayeri* Hörn. — Noszky, p. 86
1958 *Nucula mayeri* Hörn. — Seneš, p. 27

The hardly rounded, almost trigonal valve differs from that of *N. schmidti* in the following traits: the beak is less displaced backward; the anterodorsal margin is consequently shorter and steeper, hardly rounded. The slightly rounded posteriodorsal margin is much longer. The posterior part of the valve bears a marked fold running from the beak to the concurrence of the posterior and the ventral margins, thus defining a semicircular area. The surface ornament of the valve is much the same as that of *N. schmidti*, but the radial ribs are somewhat narrower in *N. mayeri* and the ribbing is consequently somewhat denser.

Dimensions. Height: 14 mm; length: 16 mm.

Typical of the *Hinia-Cadulus* community, this species preferred a greater depth of water. It occurs, however, occasionally also in the *Flabellipecten-Odontocyathus* and *Pitar polytropa* communities.

Hungarian Upper Oligocene occurrences: Leányfalu-2, Dejtár, Eger-1.

Distribution: Within the Paratethys, it occurs in the Upper Oligocene and continues up to the Badenian in the Carpathian Basin. In the Atlantic province, it likewise appears in the Upper Oligocene (Peyrère fauna) and is known also from the Lower Miocene.

Nucula comta Goldfuss, 1837

Pl. I, fig. 5

1884 *Nucula comta* Goldf. — Speyer et Koenen, Pl. 16, figs 17—26
1899 *Nucula comta* Goldf. — Böckh, p. 19, Pl. 5, fig. 4
1942 *Nucula comta* Goldf. — Heering, p. 12, Pl. 3, Fig. 23
1943 *Nucula comta* Goldf. — Albrecht et Valk, p. 107, Pl. 9, figs 316—319
1952 *Nucula comta* Goldf. — Görges, p. 9
1957 *Nucula comta* Goldf. — Glibert, p. 10, Pl. 1, fig. 2
1958 *Nucula comta* Goldf: — Senes, p. 26
1962 *Nucula comta* Goldf. — Hölzl, p. 39, Pl. 1, figs 2—3
1963 *Nucula comta* Goldf. — Báldi, p. 71, Pl. 1, fig. 1

Its shape recalls *N. mayeri*, but the valve bears besides the radial ribbing also some close-spaced, narrow concentric ribs well visible to the naked eye. This dense concentric ribbing permits it to be distinguished at first sight also from *N. schmidti*. In some extreme specimens the radial ribbing is so strong as to suggest a transition towards *N. piligera* Sandberger, 1863.

Dimensions. Height: 14 mm; length: 17 mm; convexity 5 mm.

Typical of the *Pitar beyrichi* community, *N. comta* occurs sporadicalyl also in shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Mány 8, 9, Gyermely 12, Máriahalom 36, 41, Zsámbék 42, 43, Felsőőrspuszta 44, Tök 51, Törökbálint-1, -2, Diósjenő-8.

Distribution: Known from the Paratethys and the Boreal province, it invariably occurs in Middle and Upper Oligocene deposits.

Genus: NUCULOMA Cossmann, 1907

Nuculoma laevigata Sowerby, 1818

1866 *Nucula peregrina* Desh. var. — Speyer, p. 42, Pl. 5, figs 3—5
1884 *Nucula peregrina* Desh. — Speyer et Koenen, Pl. 16, figs 1—7
1925 *Nucula laevigata* Sow. — Kautsky, p. 21, Pl. 2, figs 8—9
1942 *Nucula laevigata* Sow. — Ijpeert, p. 21, Pl. 1, fig. 3
1942 *Nucula peregrina* Desh. — Heúring, p. 11, Pl. 3, figs 18—20
1945 *Nucula laevigata* Sow. — Glibert, p. 9, Pl. 1, fig. 1
1952 *Nucula peregrina* Desh. — Görges, p. 10
1957 *Nucula peregrina* Desh. — Glibert, p. 11, Pl. 1, fig. 5

1958 *Nucula laevigata* Sow. — Hölzl, p. 38, Pl. 1, fig. 4
1958 *Nucula laevigata* Sow. — Seneš, p. 27
1958 *Nucula peregrina* Desh. — Seneš, p. 26
1959 *Nucula laevigata* Sow. — Anderson, p. 70, Pl. 13, fig. 2
1962 *Nucula laevigata* Sow. — Hölzl, p. 40, Pl. 1, fig. 4
1963 *Nucula laevigata* Sow. — Steininger, p. 12, Pl. 1, fig. 4
1963 *Nucula laevigata* Sow. — Báldi, p. 72, Pl. 1, fig. 2
1964 *Nuculoma laevigata* Sow. — Anderson, p. 125
1965 *Nucula peregrina* Desh. — Ondrejičková et Seneš, p. 181

A flat, oval, lengthwise elongate valve with a beak displaced very far backward, with a long rounded antero-dorsal margin, a broadly arcuate anterior and a rounded ventral margin. The posterior margin is slightly concave, remarkably short. The area is negligibly small as compared with those of the other species. *N. laevigata* differs from all the previous *Nucula* species in that it exhibits no ornament at all; even the growth lines are very weak. The inner margins are smooth, unserrate.

Dimensions. Height: 13 mm; length: 18 mm; convexity: 4 mm.

Anderson (1959) states it to be undistinguishable from *N. peregrina* Deshayes, 1858.

The only community where it is fairly abundant is that of *Pitar beyrichi*. It occasionally crops up in shallow sublittoral communities, too.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, ? Diósjenő-8.

Distribution: a persistent species frequent from the Middle Oligocene to the Pliocene, it is restricted to the Paratethys and the Boreal region.

Nuculanidae

Genus: NUCULANA Lamarck, 1799

Nuculana anticeplicata (Telegdi-Roth, 1914)

Pl. II, figs 1—2

1914 *Leda anticeplicata* n. sp. — T.-Roth, p. 60, Pl. 6, figs 4—5
1936 *Leda anteplicata*,T.-Roth — Noszky, p. 86
1936 *Leda anteplicata* T.-Roth var. *curta* T.-Roth — Noszky, p. 86
1964 *Nuculana anticeplicata* T.-Roth — Báldi, p. 147, Pl. 1 fig. 1

A slightly inequilateral valve with a beak little displaced in the posterior direction. The antero-dorsal margin is rather strikingly concave. The valve is ornamented by a dense concentric ribbing visible to the naked eye. On the posterior half of the valve, a strong edge runs from the beak to the ventral margin. This is the feature that distinguishes it from the otherwise very similar *N. gracilis* (Deshayes, 1860). The anterior part of the valve tapers to a curved point.

Dimensions. Height: 4 mm; length: 7 mm.

Nuculana and *Yoldia* are deposit-feeding burrowing bivalves resembling *Nucula*, living in a sea-bottom sediment rich in organic matter which is usually rather fine-grained.

The only community in which *N. anticeplicata* occurs in fairly large numbers is that of *Pitar polytropa*.

Hungarian Upper Oligocene occurrences: Budafok-1/4, Eger-1/k.

Distribution: This is an endemic species, not known so far outside the Hungarian Upper Oligocene. *N. gracilis*, a closely related, possibly substituent, species inhabited the Boreal Oligocene.

Nuculana solymarensis n. sp.

Pl. II, Figs 4—5

Locus typicus: Borehole Zsámbék 42.; depth interval from 162.70 to 165.80 m.

Stratum typicum: Upper Oligocene, Egerian (a clayey silt).

Derivatio nominis: I found the first specimens of this species in borehole No. 72 at Solymár (a village near Budapest). It was, however, preferable to designate as the holotype a better-preserved specimen found subsequently in the Zsámbék borehole core.

The larger specimens of this species are more equilateral and produced than those of *N. anticeplicata*; the beak is displaced farther back: the antero-dorsal margin is straight (and not concave as in *N. anticeplicata*): the much less marked ornament of the valve consists of closer-spaced concentric lines visible only under a magnifying glass. There is a very weak flat double fold running from the beak to the lower part of the well-rounded posterior margin. The valve tapers towards the anterior margin and ends in a sharp point (Fig. 49).

Dimensions of the holotype: height 6 mm, length 11 mm.

Hungarian Upper Oligocene occurrences: Nagyegyháza-3, Csordakút 5, Zsámbék 42, Solymár 72.

Distribution: This is an endemic species not known so far outside the Hungarian Upper Oligocene.

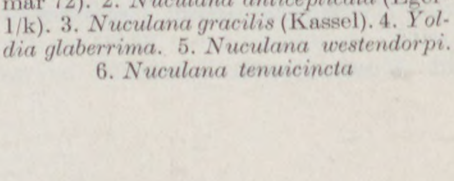

Fig. 49. 1. *Nuculana solymarensis* (Solymár 72). 2. *Nuculana anticeplicata* (Eger-1/k). 3. *Nuculana gracilis* (Kassel). 4. *Yoldia glaberrima*. 5. *Nuculana westendorpi*. 6. *Nuculana tenuicincta*

Subgenus: COSTATOLEDA Telegdi-Roth, 1914

Nuculana (Costatoleda) psammobiaeformis Telegdi-Roth, 1914

Pl. II, fig. 8

1914 *Leda psammobiaeformis* n. sp. — T.-Roth, p. 61, Pl. 6, figs 10—15
1936 *Leda psammobiaeformis* T.-Roth — Noszky, p. 85
1939 *Leda psammobiaeformis* T.-Roth nov. var. prisca — Noszky, p. 51, Pl. 2, fig. 9
1961 *Nuculana psammobiaeformis* T.-Roth — Báldi (in Báldi et al.) p. 93

A relatively large, lengthwise elongate, flat species of Nuculana, with an almost straight postero-dorsal margin, a strongly rounded posterior and less markedly rounded ventral margin; a straight or slightly concave anterior margin meets the concave antero-dorsal margin at right angles. The beak is hardly displaced backward. Most of the valve surface carries weak, concentric growth lines, except for the anterior part which exhibits a peculiar ornament: four strong spiny radial ribs running in concave arcs from the beak to the anterior margin. There may be weaker ribs intercalated between these strong ones. In this same region, the concentric lines swell into a strong ribbing: the concentric ribs grow spine-like prominences where they cross the radial ribs. The radially ribbed part of the valve is completely flat and indeed slightly concave in the region between the ribs.

Dimensions. Height 12 mm; length 24 mm.

A species indicating a deep sublittoral or bathyal facies, known exclusively from the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Eger-1/6, -1/7, Novaj-1.

Distribution: endemic, known so far only from the Hungarian Oligocene, including the Middle Oligocene Kiscell Clay in addition to the above-named Upper Oligocene localities.

Genus: YOLDIA Möller, 1842

Yoldia raulini Cossmann et Peyrot, 1912

Pl. II, figs 6—7

1912 *Yoldia Raulini* nov. sp. — Cossmann et Peyrot, p. 235, Pl. 6, figs 17—20
1939 *Leda* cfr. *nitida* Br. — Noszky, p. 53 (non Brocchi)
1939 *Leda nitida* Br. cfr. var. *pliogenei* Sacc. — Noszky, p. 53

A small, slightly inequilateral, thin and shiny valve. Its surface carries an ornament of flat, broad, weak concentric ribs separated by very thin furrows. The slightly concave antero-dorsal and the hardly rounded anterior margin meet in a rather sharp corner. The ventral margin is slightly rounded; the posterior margin is well-rounded.

Dimensions. Height: 4 mm, length: 7 mm.

This species differs from the Miocene form *Y. nitida* (Brocchi, 1814) in its more elongate shape and more eccentric beak, and from *Y. glaberrima* (Münster, 1835) and *Y. varians* Wollf, 1897 in its smaller size, in the concavity of the antero-dorsal margin, and in its less inequilateral valve. It stands closer to *Y. pellucidaeformis* (Hoernes, 1874) (Ottnangian Schlier), from which it differs only in minute morphological features, in its smaller size and less dense concentric ribbing. It cannot be confused with the deeper Oligocene *Y. perovalis* (Koenen, 1865), because the latter has a more orbicular shape, a denser concentric ornament and a larger number of teeth.

This is a facies-index fossil, a typical species of, and restricted to, the deep sublittoral — bathyal *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Leányfalu-2, Eger-1/6, Mucsony 136.

Distribution: In Hungary, it occurs also in the Rupelian Kiscell Clay. Outside Hungary, it is known only from the Atlantic province (the Upper Oligocene Peyrère beds).

Yoldia glaberrima varians Wolff, 1897

Pl. II, fig. 3

1897 *Leda varians* n. sp. — Wolff, p. 234, Pl. 21, figs 9—11
1936 *Leda varians* Wolff — Noszky, p. 86
1939 *Leda varians* Wolff — Noszky, p. 53
1962 *Yoldia glaberrima* Münst. — Hölzl, p. 45, Pl. 1, fig. 10

The only specimen at my disposal has an oval valve with its beak almost in the median line. The totally straight antero-dorsal margin gently slopes to where it meets the anterior margin in a rounded angle. The valve bears very weak concentric ribs visible only under a magnifying glass.

Dimensions. Height: 5 mm; length: 8 mm.

It has seemed indicated to contract Wolff's (1897) Thalberggraben species with Boreal *Y. glaberrima* in the manner shown above. Even Wolff has signalled a close relationship, with differences restricted to just a few traits (a slightly greater convexity, a slightly more eccentric beak, a slightly smaller umbilical angle).

Hungarian Upper Oligocene occurrences so far only in the borehole Csolnok-695.

Distribution: the subgenus is restricted to the Paratethys, besides the Hungarian occurrence, this includes the Upper Oligocene and Thalberggraben deposits of the Bavarian molasse. *Y. glaberrima* (Münster, 1835) s. s. is a frequent Boreal Oligocene and Miocene species.

Arcacea

Arcidae

Genus: ARCA LINNÉ, 1758

Arca biangula LAMARCK, 1805

Pl. III, figs 7—8

1860 *Arca Sandbergeri* DESH. — DESHAYES, I., p. 868, Pl. 68, figs 1—3
1860 *Arca biangula* LAM. — DESHAYES, I., p. 867
1863 *Arca Sandbergeri* DESH. — SANDBERGER, p. 351, Pl. 29, fig. 2
1898 *Arca* cf. *biangula* LAM. et var. div. — SACCO, p. 6, Pl. 1, figs 23—30
1910 *Arca biangula* LAM. et var. div. — SCHAFFER, p. 52, Pl. 25, figs 1—7
1912 *Arca biangulina* ORB. — COSSMANN et PEYROT, p. 262, Pl. 7, figs 15—20, 24—25
1922 *Arca* cf. *Sandbergeri* DESH. — COSSMANN, p. 140, Pl. 8, figs 61—64

An *Arca* species of medium to small size, with a strongly elongate, inequilateral valve; its beak is shifted to the anterior third of the dorsal margin. The valve is well-rounded; the beak is twisted inward and forward. The short anterior and posterior margins are straight or slightly arcuate, the ventral margin is nearly straight and slightly undulous, with the trace of a concave constriction in its anterior third. The dorsal margins are concave. The hinge plate is long and straight, with numerous small teeth. The broad, depressed ligament area bears 2 or 3 chevron grooves close to the beak. The ornament is a dense radial ribbing, resolved into nodes and plaques by similarly dense, fine concentric ribs and furrows. The most convex part of the valve is a very convex ridge running from the beak to the postero-ventral angle which is occasionally rather sharp. Above it, the valve suddenly becomes flat or even concave. On this part of the surface, the radial ribs are somewhat stronger and wider-spaced.

Dimensions. Height: 12 mm; length: 22 mm (right valve).

It is smaller and has a denser ribbing than Neogene *A. noe* LINNÉ, 1758, and is more elongate than likewise Neogene *A. tetragona* POLI, 1795. It differs only minutely from *A. biangulina* ORBIGNY, 1852 of the Atlantic Miocene, which I shall regard as a synonym. The separation of the Mediterranean-Atlantic *A. biangula* from the Boreal Oligocene *A. sandbergeri* DESHAYES, 1860 is hardly possible or justified.

Our specimen was found in a shallow sublittoral *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Dömös-2.

Distribution: widespread all over Europe from the deeper Oligocene to the end of the Lower Miocene.

Genus: ANADARA GRAY, 1847

Anadara diluvii LAMARCK, 1805

Pl. III, figs 1—2

1870 *Arca diluvii* LAM. — HÖRNES, p. 333, Pl. 44, figs 3—4
1898 *Anadara diluvii* LAM. — SACCO, p. 20, Pl. 4, figs 7—12
1899 *Arca diluvii* LAM. — BÖCKH, p. 21 (partim)
1912 *Arca diluvii* LAM. — COSSMANN et PEYROT, p. 269, Pl. 8, figs 3—6; Pl. 10, fig. 53
1914 *Arca diluvii* LAM. — TELEGDI-ROTH, p. 62
1925 *Arca diluvii* LAM. — KAUTSKY, p. 15, Pl. 1, fig. 7
1936 *Arca diluvii* LAM. — NOSZKY, p. 85
1942 *Arca diluvii* LAM. — HEERING, p. 22, Pl. 3, figs 24—27; Pl. 4, figs 1—4
1945 *Arca diluvii* LAM. — GLIBERT, p. 35, Pl. 1, fig. 12
?1952 *Arca diluvii* LAM. — ANIĆ, p. 29, Pl. 5, figs 2—3
1955 *Arca diluvii* LAM. — ACCORDI, p. 48, Pl. 4, fig. 5
1958 *Arca diluvii* LAM. — STEININGER, p. 63, Pl. 3, fig. 12
1958 *Arca diluvii diluvii* LAM. — SENEŠ, p. 34, Pl. 1, fig. 13
1959 *Anadara diluvii* LAM. — ANDERSON, p. 81, Pl. 13, fig. 6
1962 *Anadara diluvii* LAM. — HÖLZL, p. 46, Pl. 1, fig. 11
1964 *Anadara diluvii* LAM. — ANDERSON, p. 131
1964 *Arca diluvii* LAM. — RAILEANU et NEGULESCU, p. 166, Pl. 1, figs 1—5

A convex, inequilateral, somewhat obliquely elongate valve with a prosogyral beak displaced rather far forward. Except for the straight hinge plate, the margins are all well-rounded. The surface of the valve bears an ornament of 29 slightly angular, flat radial ribs and furrows about as wide as the ribs. The internal margins are deeply serrate, in correspondence with the ribbing. The rib surfaces are granulate at the intersections with the growth lines.

Dimensions. Height: 13 mm; length: 20 mm, convexity: 6 mm.

Our specimens do not exhibit the splitting of the ribs characteristic of, and are thus readily distinguished from, *A. speyeri* SEMPER, 1861.

Arca is a suspension-feeder preferring a more or less solid or sandy bottom to which it is attached by a byssus. It cannot stand considerable changes in salinity.

A. diluvii, similarly to all *Anadara* species, lived also in the Upper Oligocene in littoral and nearshore waters: it occurs in certain littoral communities, but most often in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Tök 24, Anyácsapuszta 27, Máriahalom 36, Szentendre 2, Dömös-2, Budafok-1/4, Eger-1/k.

Distribution: A common species widespread all over Europe, it is ubiquitous in the Boreal and Atlantic provinces from the Upper Oligocene on, in the Mediterranean Basin from the Lower Miocene on: it lives today in the Mediterranean and along the West African shores.

Anadara guembeli (MAYER, 1868)

Pl. I, fig. 6; Pl. III, figs 3—6

1897 *Arca Gümbeli* MAY.—EYM. — WOLFF, p. 238, Pl. 21, figs 13—14
?1897 *Arca intercedens* n. sp. — WOLFF, p. 237, Pl. 21, figs 15—17
1899 *Arca diluvii* LAM. — BÖCKH, p. 21 (partim), Pl. 7, fig. 1; (non LAMARCK) Pl. 9, fig. 1
1964 *Arca gümbeli* MAY. — BÁLDI (in BÁLDI et al.) p. 159, Pl. 1, fig. 6

A markedly convex, thick valve, truncate at its posterior end. Its straight posterior margin meets the ventral margin at an angle. In front of the prosogyral beak, displaced forward, there is an almost horizontal broad ligament area with 5 to 4 ligament grooves. Its 24 to 25 flat radial ribs carry granula corresponding to the intersections with the growth lines. The ribs are as wide as the furrows. It differs from *A. diluvii* in its more convex, shorter valve, its higher ligament area and the longer teeth of its hinge.

Dimensions. Height: 15 mm; length: 20 mm; convexity: 8 mm.

Despite the differences mentioned, distinction from *A. diluvii* is rather uncertain, particularly in view of the latter's range of variations according to IJSPEERT (1942). In our specimens, however, the height of the ligament area is not by far correlated as closely with the size of the valve as stated by IJSPEERT. The position of *A. intercedens* (WOLFF, 1897) is even more problematic; our larger specimens almost completely agree with this species. *A. guembeli* might be a juvenile form of *A. intercedens*. From Miocene *A. turonica* (DUJARDIN, 1837), which presumably belongs to the *guembeli-intercedens* form circle, our species differs in its less dense radial ribbing.

Indicative of a littoral or shallow sublittoral facies, the species is typical of the *Glycymeris latiradiata* community, but is not rare in other shallow sublittoral communities, nor in the *Pitar undata* community.

Hungarian Upper Oligocene occurrences: ? Tök 51, Pomáz-6, ? Pomáz-22, Csolnok 695, Dömös-2, Diósjenő-24, Becske-2, Eger-1/k.

Distribution: sporadic in the Upper Oligocene of the Western and Central Paratethys.

Genus: TRISIDOS BOLTEN in RÖDING, 1798

Trisidos schafarziki (HORUSITZKY, 1927)

1927 *Parallelepipedum Schafarziki* nov. sp. — HORUSITZKY, p. 63, Pl. 1
1958 *Parallelepipedum schafarziki* HORU. — SENEŠ, p. 41, Pl. 1, figs 20—22; Pl. 2, figs 23—30
1964 *Trisidos schafarziki* HORU. — BÁLDI (in BÁLDI et al.), p. 169

This species described from Helemba (Kováčov) is represented by poorly preserved but readily identifiable fragments from Diósjenő and Dömös.

Besides the above localities (Diósjenő-24, Dömös-2) it has been mentioned from Esztergom (SCHRÉTER 1953) and is frequent at the type locality, Kováčov. So far it has only turned up in shallow sublittoral communities. This rare genus is represented in the Mediterranean Palaeogene (*T. bellunensis* Oppenheim, 1903 from the green sand of Belluno) and with several species in the Atlantic Lower Miocene. There are three living species about the Philippines and in the China Sea.

Glycymeridae

Genus: GLYCYMERIS Da Costa, 1787 (= *Pectunculus* Lamarck, 1799)

Glycymeris pilosa lunulata (Nyst, 1836)

Textfig. 50

1962 *Glycymeris pilosa lunulata* Nyst — Báldi, p. 112, Pl. 8, figs 1—5 and 7 cum syn.
1962 *Glycymeris pilosa lunulata* Nyst — Hölzl, p. 48, Pl. 1, fig. 14

A usually small, rounded-oval, convex valve with a relatively low ligament area. The teeth are short as related to the size of the valve: the anterior ones number 8.

Dimensions. Height: 38 mm; length: 37.5 mm; convexity: 14 mm.

Smaller, more rounded, more nearly equilateral and thinner-shelled than Miocene *G. pilosa deshayesi* (Mayer 1868). Also, its ligament-area index is less and its ligament grooves are closer-spaced. According to Glibert (1957), *G. lunulata* is identical with *G. philippii* (Deshayes 1860). Anderson and Hölzl also agree with this, and so do I (Báldi 1962). *G. inflatoides* (Telegdi-Roth 1914), described from Eger, is also identical with *G. lunulata* (Heering 1942, Báldi 1962). *G. oblita* (Michelotti in Sacco 1898) from the Northern Italian Tongriano also belongs here (Báldi 1962). *G. p. lunulata* is readily distinguished from the group of *G. obovata* (*G. obovata*, *G.*

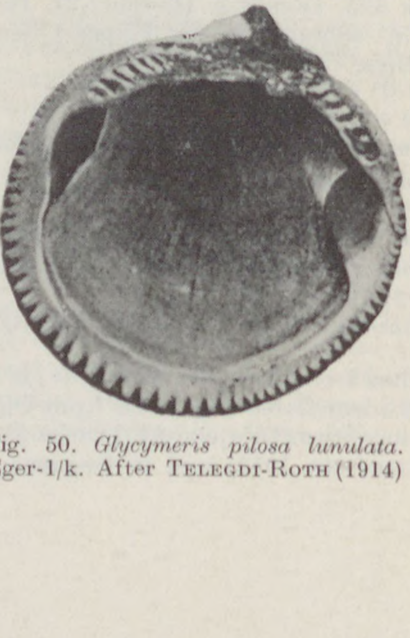

Fig. 50. *Glycymeris pilosa lunulata*. Eger-1/k. After Telegdi-Roth (1914)

latiradiata, *G. fichteli*) by its thinner shell, and much shorter teeth even relative to the shell size (tooth-length index not exceeding 74). The outer surface of the valve is not furrowed (Fig. 50).

Glycymerids live on sandy bottoms, and do not burrow deep. Suspension-filters preferring those parts of the sea bottom where the water is rather intensely agitated, they are stenohaline marine organisms that cannot stand significant changes in salinity.

G. p. lunulata occurs sporadically in shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Budafok-1/4, Diósjenő-7, -4, -28, Pomáz-21, Eger-1/k, Becske-Fogacspuszta (UNGÁR 1951).

Distribution: widespread all over the Boreal Oligocene, it is restricted to the Upper Oligocene in the Paratethys and in the Mediterranean Basin. It nowhere survives into the Miocene; at the base of the Miocene it is already replaced by a mutated form, *G. p. deshayesi*. *G. pilosa* s. s is a living species.

Glycymeris latiradiata (SANDBERGER in GÜMBEL, 1861) s. l.

1899 *Pectunculus obovatus* LAM. — BÖCKH, p. 20, Pl. 5, fig. 5 (non LAMARCK)

1899 *Pectunculus Philippi* DESH. — BÖCKH, p. 20, Pl. 6, fig. 2 (non DESHAYES)

1942 *Pectunculus* nova sp.? — MÉHES, p. 78, Pl. 1, fig. 1

Specimens not preserved well enough or not sufficiently numerous to permit subspecific identification, but belonging beyond doubt to the species *G. latiradiata* are subsumed here under *G. latiradiata* s. l.

The main features of *G. latiradiata* s. l. are as follows: rounded-oval, very slightly inequilateral, most often thick and strongly convex valves. The diameter index usually falls between 92 and 98; that is, the length of the valve hardly exceeds its height. The ligament area is high; the ligament area index is considerable; the number of ligament grooves is 4 to 8. The teeth are long and strong; there are 6 to 8 anterior teeth, one more than posterior ones; the anterior teeth are also longer and less inclined, often horizontal and broken in their posterior third or quarter. On the outer surface of the valve, near the beak, there often are wide-spaced deep radial furrows. On weathered and corroded shells, the characteristic radial structure of the shell is often visible.

G. latiradiata differs from Lower and Middle Oligocene *G. obovata* (LAMARCK, 1891), with which it used to be confused in Hungary, in its larger size, slightly lower ligament area, the smaller number of its ligament grooves, teeth longer as related to valve size and in a horizontal disposition, and a characteristic radial grooving on the outer surfaces of numerous specimens.

It differs from Lower Miocene *G. fichteli* (DESHAYES, 1852) in its smaller, more convex and less inequilateral valve, higher ligament area with a larger number of grooves, slightly shorter and, on the average, more inclined teeth. A tabulation of the above differences gives the following results:

	1	2	3	4	5	6	7
G. fichteli	77	34	13	84	6.5	8.0	111
G. latiradiata	55	45	14.3	104	6.0	7.2	101
G. obovata	50	35	17.3	166	8.3	6.3	94

1 = mean length
2 = mean convexity index (M) = convexity over length, times 100
3 = mean ligament area index = height over length of ligament area, times 100
4 = mean ligament-groove index = number of grooves over valve length, times 1,000
5 = mean number of ligament grooves
6 = mean number of anterior teeth
7 = mean tooth-length index (length of longest anterior tooth over valve length, times 1,000).

The phylogenetic connections with older *G. obovata* and younger *G. fichteli* are beyond doubt. The three forms constitute an evolutionary chain (BÁLDI 1962). The juvenile specimens of the three species are quite impossible to tell apart.

G. latiradiata is the most typical and most abundant species of the community named after it. It occurs sporadically, in the form of small specimens also in the *Pitar polytropa* and *Pitar beyrichi* communities, and very seldom even in littoral communities. It is to be regarded as a shallow sublittoral facies index.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 9, Gyermely 12, Máriahalom 36, Tök 51, Tarján-1, Nagysáp, Páliföldszentkereszt, Kesztölc-1, Csolnok 695, Pomáz-1, Leányfalu-3, Leányfalu-4, Diósjenő-7, -19, -24, Becske-2, Patak-1, Dunabogdány.

It is very widespread and abundant in the Upper Oligocene of the Carpathian Basin ("Pectunculus sands").

Distribution: restricted to the Upper Oligocene of the Western and Central Paratethys; it has its westernmost occurrence in the Thalberggraben beds.

Glycymeris latiradiata obovatoides BÁLDI, 1962

Pl. I, figs 7—8

1872 *Pectunculus obovatus* LAM. — HOFMANN, p. 229, non LAMARCK
1893 *Pectunculus obovatus* LAM. — FUCHS, p. 149 non LAMARCK
1958 *Glycymeris hungaricus* M. BÁNYAI nov. sp. — HORUSITZKY (in SCHRÉTER et al.), Pl. 4, fig. 37, nomen nudum
1960 *Glycymeris obovata* LAM. — VADÁSZ, p. 275, Pl. 41, fig. 2 non LAMARCK
1962 *Glycymeris latiradiata obovatoides* n. subsp. — BÁLDI, p. 103, Pl. 1, fig. 2; Pl. 4, figs 1—6; Pl. 5, figs 1—5; Pl. 8, fig. 6

It differs from the Thalberggraben type of *G. latiradiata* in its higher ligament area index and in the larger number of its ligament grooves. The valves are more massive and more convex, with the deep radial furrows missing. It is to be regarded as a transitional form between *G. latiradiata* and *G. obovata*; it resembles the latter in many features.

Dimensions. Height (mean): 58.1 mm; length (mean): 59.6 mm; convexity (mean): 23.3 mm.

Found so far exclusively in *Glycymeris latiradiata* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, -3, -20, Budafok-1/4.

Not known from any other locality.

Glycymeris latiradiata subfichteli Báldi, 1962

1914 *Pectunculus obovatus* Lam. — Telegdi-Roth, p. 63, non Lamarck

1936 *Pectunculus obovatus* Lam. — Noszky, p. 85, non Lamarck

1936 *Pectunculus* cfr. *Lugensis* Fuchs — Noszky, p. 85, non Fuchs

1958 *Glycymeris* ex gr. *obovatus* Lam. var.? — Seneš, p. 42, Pl. 3—8

1962 *Glycymeris latiradiata subfichteli* n. subsp. — Báldi, p. 106, Pl. 1, fig. 3; Pl. 5, fig. 6; Pl. 6, figs 1—3 and 7

This subspecies stands between the type of *G. latiradiata* and *G. l. obovatoides*; its size, convexity index and ligament area index are less than those of *G. l. obovatoides*, but greater than those of *G. latiradiata* s. s. Numerous specimens carry near their beaks the deep radial furrows of the type. The variation-statistical data of the intraspecific subunits of *G. latiradiata* are given in the table below.

	1	2	3	4	5	6	7
G. latiradiata s. str. . . .	47	13	13	85	4	7	100
G. l. subfichteli	57	36	14	105	5.8	8	106
G. l. obovatoides	60	40	16.6	144	8.6	5.7	95

The column headings mean the same as in the previous table (p. 170).

G. l. subfichteli occurs in shallow sublittoral, seldom littoral communities, but most often as a typical species of the *G. latiradiata* community.

Hungarian Upper Oligocene occurrences: Pomáz-6, -21, Diósjenő-8, Eger-1/k.

Distribution: known outside the above Hungarian localities only from the type locality, Kováčov.

Limopsidae

Genus: LIMOPSIS SASSI, 1827

Limopsis anomala (EICHWALD, 1830)

Pl. IV, figs 1—2

1870 *Limopsis anomala* EICHW. — HÖRNES, p. 312, Pl. 39, figs 2—3
1898 *Pectunculina anomala* EICHW. — SACCO, p. 41, Pl. 10, figs 11—23
1912 *Limopsis minuta* PHIL. — COSSMANN et PEYROT, p. 321, Pl. 7, figs 9—12
1939 *Limopsis anomala* EICHW. cum var. div. — NOSZKY, p. 48
1942 *Limopsis anomala* EICHW. — IJSPEERT, p. 59, Pl. 4, figs 7—8
1958 *Limopsis anomala* EICHW. — SORGENFREI, p. 69, Pl. 4, fig. 16
1964 *Limopsis anomala* EICHW. — ANDERSON, p. 132, Pl. 1, fig. 13

Small, oblique, inequilateral valve, with rounded margins. The surface is ornamented by a grid pattern of thin radial and broader concentric ribs. The radial ribs are interrupted at each concentric rib. On the inner margin of the valve there are some low prominences.

Dimensions. Height: 4.8 mm; length: 5.2 mm.

This species differs from *L. aurita* (BROCCHI, 1814) in the following traits: a smaller, non-triangular ligament area, an eccentric ligament depression; the posterior row of teeth is longer than the anterior one; finally, the radial ribbing is much stronger and more marked than in *L. aurita*. ANDERSON (1964) — contrary to HEERING's (1942) and GLIBERT's (1957a) proposal — separates from *L. anomala* the species *L. retifera* SEMPER, 1861, enumerating the following specific differences: *L. retifera* is smaller and less oblique; the prominences on the inner margin of the valve, and the internal ribs, respectively, are absent. On the basis of the Lower Rhine specimens of *L. retifera* available to me, I cannot but agree with ANDERSON: furthermore, I have become convinced that the Hungarian specimens belong to *L. anomala*. Also, I consider the name *L. minuta* (PHILIPPI, 1836) a synonym, in agreement with ANDERSON (1964).

In the Hungarian Upper Oligocene, *L. anomala* belongs to the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Eger-1/6, Mucsony 136.

Distribution. A living species represented in every zoo-geographical province of Europe. If one accepts NOSZKY senior's (1939) statement, then its oldest occurrence is in the Paratethyan Middle Oligocene (Kiscell Clay), but in all other basins it is known only from the Miocene on; I have therefore regarded it as a "Miocene" species in my stratigraphic evaluations.

Anisomyaria

Mytilacea

Mytilidae

Genus: MYTILUS LINNÉ, 1758

Mytilus aquitanicus MAYER, 1958

Pl. IV, fig. 7

1897 *Mytilus aquitanicus* MAY.—EYM. — WOLFF, p. 232, Pl. 21, figs 23 and 29
1899 *Mytilus* cf. *aquitanicus* MAY.—EYM. — BÖCKH, p. 18, Pl. 4, fig. 3; Pl. 6, fig. 1
1914 *Mytilus aquitanicus* MAY.—EYM. — TELEGDI-ROTH, p. 65
1914 *Mytilus aquitanicus* MAY. — COSSMANN et PEYROT, p. 8, Pl. 11, figs 13—14
1936 *Mytilus aquitanicus* MAY. — NOSZKY, p. 84
1952 *Mythilus aquitanicus* MAY. — ANIĆ, p. 30, Pl. 5, figs 4—5; Pl. 6, fig. 1
1958 *Mytilus aquitanicus* MAY. — HÖLZL, p. 54

A large, elongate valve with a markedly concave anterior and a rounded posterior margin. The valve is strongly incurved towards the umbonal area. It is most markedly convex near the anterior margin, and parallel to it, getting flatter towards the ventral margin. The valve surface exhibits growth lines, some stronger than the others: these latter are spaced 1 to 2 cm apart. The well-preserved specimens exhibit under the magnifying glass a fine radial grooving perpendicular to and bounded by the growth lines. Even poorly preserved shells are easily recognized by the lamellar layer's falling apart into sheaves of lamellae.

Dimensions. Height: 133 mm; length: 62 mm.

COSSMANN and PEYROT (1914) give a detailed enumeration of the traits distinguishing this species from *M. haidingeri* HÖRNES, 1870. In any case, the less marked widening of the valves in the Hungarian specimens is a feature absent from *M. haidingeri*. The only difference from the type of *M. aquitanicus* is that the Hungarian specimens have somewhat more incurved valves.

A suspension-feeding epifaunal euryhaline species fixed to the bottom by a byssus, it occurs almost exclusively in littoral communities, especially in the one named after it.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 9, Szomor 31, Törökbálint-1, Szentendre 2, Leányfalu-1, Diósjenő-1, Diósjenő-33, Eger-1/m, Mucsony 136.

Distribution: Known from the Paratethys and the Atlantic province, the species arose in the former already in the Upper Oligocene, in the latter only in the Miocene, as far as we know today.

Genus: ARCOPERNA CONRAD, 1865

Arcoperna micans (BRAUN, 1851)

Pl. IV, fig. 6

1863 *Modiola micans* BRAUN — SANDBERGER, p. 364, Pl. 31, fig. 1
1884 *Modiola micans* BRAUN — SPEYER et KOENEN, Pl. 22, figs 1—6
1897 *Modiola micans* BRAUN — WOLFF, p. 233, Pl. 20, fig. 17
?1898 *Arcoperna* cf. *micans* BRAUN — SACCO, p. 44, Pl. 12, fig. 10
1952 *Arcoperna micans* BRAUN — GÖRGES, p. 18
1957 *Arcoperna micans* BRAUN — GLIBERT, p. 16
1958 *Arcoperna micans* BRAUN — HÖLZL, p. 56, Pl. 3, fig. 2
1962 *Arcoperna micans* BRAUN — HÖLZL, p. 50, Pl. 1, fig. 16

A relatively small, fragile, thin, highly convex valve, obliquely elongate in the postero-ventral direction. Its margins are rounded, except for a section, truncated in an almost straight line, of the anterior margin. The most convex part runs from the beak to the ventral margin near the middle of the valve, somewhat closer to the posterior margin. Even fragmentary specimens exhibit a fine radial ribbing on the entire valve surface.

Dimensions. Height: 14 mm, length: 11 mm; convexity: 5 mm.

A close Miocene relative is *A. sericea* (BRONN, 1831) from which *A. micans* differs according to GLIBERT (1957) and HÖLZL (1958) in its flatter valve, stronger radial ribbing and weaker beak. *A. sericea* is — as opposed to *A. micans* — much taller in its posterior than in its anterior part.

A. micans occurs sporadically in the *Pitar polytropa* community and in certain medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Tök 51, Bajót 30, Leányfalu-4, Diósjenő-8.

Distribution: in the Paratethys — in the Bavarian molasse region — it occurs from the Rupelian to the Lower Miocene, whereas in the Boreal and presumably in the Mediterranean province it is restricted to the Oligocene.

Genus: MUSCULUS BOLTEN in RÖDING, 1798 (= *Modiolaria* BECK, 1838)

Musculus philippii (MAYER in WOLFF, 1897)

Pl. IV, fig. 3

1884 *Modiola* sp. ind. — SPEYER et KOENEN, Pl. 22, figs 14—15
1897 *Modiola Philippii* MAY.—EYM. — WOLFF, p. 232, Pl. 20, figs 15—16
1899 *Modiola* cf. *Philippii* MAY.—EYM. — BÖCKH, p. 18, Pl. 3, fig. 3
?1900 *Modiola incompta* ROV. — ROVERETO, p. 73, Pl. 4, fig. 10
1952 *Musculus penndorfi* n. sp. — GÖRGES, p. 18, Pl. 1, figs 3—5
1958 *Musculus philippi* MAY. in WOLFF — HÖLZL, p. 55, Pl. 3, fig. 1
1962 *Musculus philippi* MAY. in WOLFF — HÖLZL, p. 52, Pl. 1, fig. 18

An elongate, rounded trigonal, convex valve. The anterior and posterior margins are almost straight; the ventral margin is markedly rounded. The dorsal margin meets the posterior margin in a strongly rounded arc. The beak is small, flat. The most convex part of the valve, strongly prominent, runs from the beak to the concurrence of the posterior and the ventral margins. Along this convex ridge, the valve forms a dome with a depression on its anterior side. The shell is very thin, fragile, most often only the mother-of-pearl layer or a cast is preserved. The undeteriorated shell remains reveal the valves to be smooth with growth lines as the only ornament. These thin shells have often undergone plastic deformation. This sometimes overemphasizes the above-mentioned convex ridge, giving rise to an even more bulbous valve.

Dimensions. Height: 44 mm; length: 25 mm; convexity: 10 mm.

According to GÖRGES (1952), *M. philippi* differs from *M. penndorfi* GÖRGES, 1952 only in that the sharp crest running along its valve, hardly broadened, reaches tongue-fashion beyond the ventral margin. This difference I am wont to attribute to the frequent plastic deformation of *M. philippii*. For instance, at Rétság and Dejtár the two forms occur together, with transitions corresponding to different degrees of plastic deformation. A double-valved specimen from Rétság exhibits a broad flat crest recalling *M. penndorfi* on its left valve and a very sharp and well-marked one reaching down to the ventral margin (as on the type of *M. philippii*) on its right valve. For these reasons, I do not consider *M. penndorfi* an independent species.

The species is typical of the medium-depth sublittoral zone where it used to be an epifaunal element over harder, sandy bottoms. It is a marine, stenohaline form.

Hungarian Upper Oligocene occurrences: Anyácsapuszta 27, Tök 51, Solymár 72, Rétság-2, Dejtár.

Distribution: known in the Western and Central Paratethys regions from the Middle Oligocene to the end of the Lower Miocene, and from one locality (Kassel) of the Boreal Upper Oligocene.

Genus: MODIOLUS LAMARCK, 1799 (= *Modiola* LAMARCK, 1801)

Modiolus dunkeri (KOENEN, 1884)

Pl. IV, figs 4—5

1884 *Modiola Dunkeri* n. sp. — SPEYER et KOENEN, Pl. 31, fig. 7
1952 *Modiolus dunkeri* KOEN. — GÖRGES, p. 19, Pl. 1, fig. 6

A medium-sized to large, relatively flat, ovally elongate valve. The long, straight anterior margin issues vertically downward from an insignificant beak. The likewise straight or hardly arcuate posterior margin diverges at an angle from the anterior margin. The valve is thus broadest in its ventral quarter. The ventral margin is well-rounded. The dorsal margin above the beak is even more rounded, almost pointed. The most convex part of the valve runs from the beak to the concurrence of the posterior and ventral margins, whereas the central portion of the valve is entirely flat. The shell is very thin, fragile, usually a fragmentary remain on a cast. Besides the growth lines, which are strongest along the posterior margin, one observes under a magnifying glass fine radial lines near the anterior and the ventral margins.

Dimensions. Height: 50 mm; length: 28 mm; convexity: 6 mm.

It differs somewhat from the type described by Görges (1952) in that it is slightly smaller and its valve exhibits a stronger ventral broadening: there is a complete similarity in all other traits. It can be readily distinguished from *Musculus philippii* by the flatness of the shell and by the absence of the convex crest.

It occurs in medium-depth sublittoral biotopes.

Hungarian Upper Oligocene occurrences: Anyácsapuszta 57, Dejtár, ? Törökbálint-1, Solymár 72.

Distribution: in addition to the above localities, only one specimen (the holotype) was known from the Upper Oligocene of Kassel.

Pteriacea

Pteriidae

Genus: PTERIA Scopoli, 1777 (= *Avicula* Bruguière, 1792)

Subgenus: PINCTADA Bolten in Röding, 1798

Pteria (Pinctada) phalaenacea (Lamarck, 1819)
Pl. V, fig. 2

1868 *Avicula stampiniensis* Desh. — Koenen, p. 234, Pl. 27, fig. 4; Pl. 28, fig. 2
1884 ? *Avicula stampiniensis* Desh. — Speyer et Koenen, Pl. 22, fig. 17
1897 *Avicula phalaenacea* Lam. — Wolff, p. 230, Pl. 20, fig. 1
1898 *Avicula hirundo* (latu senso) var. *phalaenacea* Lam. — Sacco, p. 23, Pl. 6, fig. 9
1910 *Avicula hirundo* L. var. *phalaenacea* Lam. — Schaffer, p. 45, Pl. 23, figs 1—3
1914 *Meleagrina phalaenacea* Lam. — Cossmann et Peyrot, p. 52, Pl. 12, figs 1—3
1939 *Avicula hirundo* L. cfr. var. *phalaenacea* Lam. — Noszky, p. 45
1945 *Pteria phalaenacea* Lam. — Glibert, p. 56, Pl. 2, fig. 10
1952 *Pteria hirundo phalaenacea* Lam. — Görges, p. 21
1953 *Pteria phalaenacea* Lam. — Cs.-Meznerics, p. 45, Pl. 5, fig. 8
1959 *Pteria phalaenacea* Lam. — Anderson, p. 94, Pl. 14, fig. 4
1962 *Pteria phalaenacea* Lam. — Hölzl, p. 54, Pl. 2, fig. 1
1963 *Pteria phalaenacea* Lam. — Báldi, p. 73, Pl. 2, fig. 2
1964 *Pteria phalaenacea* Lam. — Anderson, p. 136

A medium-sized obliquely elongate shell, with a beak displaced forward, and with rounded margins, except for the straight dorsal margin, which meets the anterior margin in a pointed ear. The most convex part of the valve runs obliquely near the anterior margin. The outer surface exhibits fine concentric growth lines only. There was no complete specimen in the fossil material at our disposal. The top layer of the shell is usually spalled off, exposing the underlying mother-of-pearl layer.

Dimensions. Height: about 33 mm; length: about 40 mm.

The valve of *P. hirundo* LINNÉ, 1758 is much more oblique and its hinge plate is drawn out farther in the posterior direction.

Typical of the Upper Oligocene medium-depth sublittoral facies, it is particularly frequent in the *Pitar beyrichi* community. It was an epifaunal element.

Hungarian Upper Oligocene occurrences: Solymár 72, Törökbálint-2, Pomáz-1, Diósjenő-4, Rétság-2, Dejtár.

Distribution. In the Paratethys and in the Boreal province it occurs from the Upper Oligocene (according to NOSZKY sen., 1939 even from the Rupelian Kiscell Clay) to the Middle Miocene. In the Mediterranean and Atlantic provinces it is restricted to the Miocene.

Pectinacea

Pectinidae

Genus: PECTEN KLEIN in OSBECK, 1765

Pecten arcuatus (BROCCHI, 1814)

Pl. VI, figs 1—2

1897 *Pecten arcuatus* BROCC. et var. div. — SACCO, p. 65, Pl. 21, figs 14—36
1900 *Pecten arcuatus* BROCC. et var. div. — ROVERETO, p. 68
1903 *Pecten vezzanensis* n. sp. — OPPENHEIM, p. 173, Pl. 9, figs 6—7
1910 *Janira arcuata* BROCC. — KRANZ, p. 209
1937 *Pecten arcuatus* BROCC. — VENZO, p. 145, Pl. 10, figs 1—2
1955 *Pecten arcuatus* BROCC. — ACCORDI, p. 49, Pl. 4, fig. 14
1959 *Pecten arcuatus* BROCC. — VAŇOVA, p. 156, Pl. 20, fig. 8
1964 *Pecten arcuatus* BROCC. ex aff. *vezzanensis* OPP. — BÁLDI, p. 148, Pl. 1, fig. 3

A medium- to small-sized pectinid with a strongly convex right valve and a flat or slightly concave left valve. Both valves carry about 21 smooth, rounded, strong radial ribs. The ribs on the right valve are close-spaced, with furrows narrower than the ribs. The ribs on the left valve are somewhat flatter and no wider than the furrows. There is no other ornament; the growth lines are hardly visible if at all; the furrows between the ribs are smooth. The auricles of the right valve exhibit scaly radial ribs.

Dimensions. Height: 23 mm; length: 23 mm; convexity: 9 mm (right valve).

It stands close to *P. fuchsi styriacus* HILBER, 1879, which is common in the Hungarian Lower Miocene, but its shape, more elongate dorsoventrally, its more swollen and more tapering umbo, smaller umbonal angle and the somewhat larger number of ribs on the left valve are sufficiently distinctive features. *P. vezzanensis* Oppenheim, 1903 of the Schio strata should, on the other hand, be considered a synonym; the Hungarian specimens form a transition between *P. arcuatus* and *P. vezzanensis*. Some of the features in which *P. vezzanensis* differs from *P. arcuatus*, viz. the narrower and more prominent ribs on the left valve and the almost total absence of growth lines, can be observed also on the Hungarian form.

The pectinids are typical epifaunal bivalves, freely swimming or fixed to the sea bottom by a byssus. They prefer a well-oxygenated, more or less strongly agitated water of normal salinity.

P. arcuatus is known exclusively from shallow sublittoral facies: it is typical of the *Glycymeris latiradiata* community.

Hungarian Upper Oligocene occurrences: Budafok-1/4, Pomáz-22, Leányfalu-3, Becske-1, Vác (fide Kubacska 1926).

Distribution. Restricted to the Upper Oligocene in the Central Paratethys, and in the Mediterranean and Atlantic provinces, it is an excellent stage-level index fossil of southern origin, absent from the Boreal province.

Genus: FLABELLIPECTEN Sacco, 1897

Flabellipecten burdigalensis (Lamarck, 1809)

Pl. V, figs 7—8; Pl. VII, fig. 4

1870 *Pecten Burdigalensis* Lam. — Hörnes, p. 418, Pl. 65
1897 *Amussiopecten burdigalensis* Lam. — Sacco, p. 53, Pl. 15, figs 1—7
1903 *Pecten burdigalensis* Bast. — Oppenheim, p. 166, Pl. 10, fig. 3
1914 *Pecten burdigalensis* Lam. var. *minor* nov. var. — Telegdi-Roth, p. 65, Pl. 5, figs 12—14
1914 *Pecten burdigalensis* Lam. — Cossmann et Peyrot, p. 90, Pl. 14, figs 18—21
1936 *Pecten burdigalensis* Lam. var. *minor* T.-Roth — Noszky, p. 84
?1937 *Chlamys pseudo-pasinii* n. sp. — Venzo, p. 152, Pl. 10, figs 17—19
1955 *Flabellipecten burdigalensis* Lam. — Accordi, p. 50, Pl. 4, fig. 7
?1955 *Aequipecten pseudopasinii* Venzo — Accordi, p. 51, Pl. 4, figs 10—11
?1959 *Pecten* cf. *burdigalensis* Lam. — Čtyroký, p. 84, Pl. 9, fig. 1
1960 *Flabellipecten burdigalensis* Lam. — Csepreghy-Meznerics, p. 16, Pl. 9, figs 1—2; Pl. 10, figs 1—2; Pl. 11, figs 1—4
1961 *Flabellipecten burdigalensis* Lam. — Báldi (in Báldi et al.) p. 91

A medium-sized, rounded, slightly inequilateral, flattish valve, with 16 flat smooth rounded ribs, more or less weakening towards the margin. The furrows are as wide as the ribs. There is no other ornament except the growth lines, which are strongly developed on some specimens. The anterior auricle of a right valve from Dejtár exhibits three radial ribs, granulated by strong growth lines. There is a similar ornament on the posterior auricle: its lower part bears four weak radial ribs, but its upper part is smooth. A similar auricular ornament has been observed on a juvenile specimen from Novaj.

Dimensions. Height: 54 mm, length: 57 mm.

The name *F. burdigalensis minor* T.-ROTH, 1914, should be regarded as a synonym, as the Eger specimens are not significantly smaller than the type. It would be justified to declare for the giant *F. burdigalensis* specimens of the Budafok Lower Eggenburgian a new subspecies distinct from the type. *F. burdigalensis* stands very close to certain species, hard to distinguish from the genus *Flabellipecten*, of the *Ch. rotundata* group (ROGER 1939), e.g. from the Mediterranean Lower Miocene species *Chlamys rotundata* LAMARCK, 1819, but the valves of *F. burdigalensis* are much flatter. *Chlamys gigas* SCHLOTHEIM, 1813, a stage-level index fossil frequent also in the Hungarian Lower Miocene, cannot be confused with *F. burdigalensis* because of its larger size, its more convex valve and stronger ribbing.

F. burdigalensis is typical of the medium-depth sublittoral facies, in particular of the *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrences: Szomor 31, Máriahalom 36, Dejtár, Eger-1/5, -1/6, -1/k, -1/20, Eger-2, Eger-3, Novaj-1.

Distribution. Known from the Upper Oligocene to the beginning of the Middle Miocene in the Paratethys and in the Mediterranean province, and from the Miocene in the Atlantic province, it is a persistent Mediterranean species.

Flabellipecten angustiformis BÁLDI, 1963
Pl. V, figs 4—5

1963 *Flabellipecten burdigalensis angustiformis* n. subsp. — BÁLDI, p. 74, Pl. 1, figs 3—4

Relatively small, flat valves with 14 to 16 rounded, rather flat ribs as wide as the furrows between them. The ribs tend to grow weaker towards the margins of the larger specimens, but not to the extent observed in *F. burdigalensis*. The height is slightly greater than the length. Larger specimens show four very weak radial lines in the furrows near the margins.

Dimensions. Height: 40 mm for the largest specimen, which is incomplete, however; height: 26.5 mm; length: 25.5 mm; convexity: 6 mm.

This species differs from *F. burdigalensis* in that it is smaller, less rounded, higher with a much smaller umbonal angle. These differences are about equally marked on all specimens, without transitional forms, so that it is justified to regard *F. angustiformis* as an independent species although it could be squeezed into the broad range of variability (in SACCO's sense) of *F. burdigalensis*. It is readily distinguished from *Chlamys agriensis* by its narrower and more numerous ribs. It stands close to or might even be identical with the "*Chlamys* sp." described from Eger by CSEPREGHY-MEZNERICS (1960, Pl. 20, figs 11—12).

Mainly in medium-depth sublittoral facies, particularly in the *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrences: Gyermely 39, Máriahalom 41, Zsámbék 43, Törökbálint-2, Budafok-1/4, Eger-1/k.

Distribution: An endemic species known exclusively from the above-named Hungarian Upper Oligocene localities.

Flabellipecten telegdirothi Csepreghy-Meznerics, 1960
Pl. VI, fig. 4

1960 *Flabellipecten telegdi-rothi* n. sp. — Csepreghy-Meznerics
p. 16, Pl. 11, figs. 6—8

Medium-sized, rounded flat valve ornamented by 18 radial ribs that are sharp, prominent triangular near the beak, and flat obtuse triangular in the middle region; near the ventral and lateral margins they flatten so far as to merge into a smooth valve surface. The furrows are very narrow, because the gently sloping sides of the ribs take up much space. There is a typical dense, finely sculptured scaly concentric ornament which covers the valve surfaces everywhere except on the crests of the radial ribs. The two auricles bear very weak traces of radial ribs besides this scaly ornament. The byssal sinus is extraordinarily wide and deep.

No dimensions can be given on the basis of the fragmentary specimens available.

Most frequent in the *Hinia-Cadulus* community; its presence indicates a substantial depth of water.

Hungarian Upper Oligocene occurrences: Dejtár, Eger-1/6, -1/x, -1/k.

Distribution: An endemic species, known from nowhere except the above Upper Oligocene localities.

Genus: CHLAMYS Bolten in Röding, 1798

Subgenus: AEQUIPECTEN Fischer, 1887

Chlamys (Aequipecten) northamptoni Michelotti, 1839
Pl. VI, fig. 3

1879 *Aequipecten Northamptoni* Micht. — Sacco, p. 16, Pl. 4, figs. 1—16, Pl. 5, figs 1—8

1937 *Chlamys Northamptoni* var *laevitransiens* — Venzo, p. 159, Pl. 11, fig. 14

1939 *Chlamys northamptoni* Micht. — Roger, p. 48, Pl. 2, fig. 11; Pl. 7, figs 1—2 and 8—9

1955 *Chlamys northamptoni* Micht. — Accordi, p. 55, Pl. 5, fig. 1

1955 *Chl. northamptoni* var *laevitransiens* Sacco—Accordi, p. 55, Pl. 5, figs 2 and 4

1959 *Chlamys northamptoni* Micht. — Čtyroký, p. 91, Pl. 9, figs 2—3; Pl. 10, figs 1 and 3; Pl. 11, fig. 1; Pl. 18, figs 1—3

1960 *Chlamys northamptoni* Micht. — Csepreghy-Meznerics, p. 30, Pl. 20. figs 1—5

The single fragmentary left valve from Törökbálint at my disposal is relatively small, fairly convex: its surface bears an ornament of 14 strong rounded radial ribs. There are but very weak traces of secondary radial ribs and spines at some points of the valve. The growth lines are fairly strong. The anterior auricle bears four weak radial ribs: the posterior auricle is smooth, with only the growth lines visible. Its relatively small umbonal angle, its shape, convexity and ribbing fit well enough into the broad range of variability of this species. Sacco (1897) and also Roger (1939) have described varieties without spines or secondary ribbing.

Dimensions. Height: 40 mm; convexity: 10 mm.

In shallow and medium-depth sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-2, Eger-1/k, Patvarc (fide Pálfy 1900).

Distribution: A persistent Oligocene-Miocene species widespread in the Paratethys and in the Mediterranean province.

Chlamys (Aequipecten) csepreghymeznericsae Báldi, 1961

Pl. VI, figs 5—6

1960 *Chlamys* nov. sp. 2 — Csepreghy-Meznerics, p. 31, Pl. 20, figs 13—14

1961 *Chlamys csepreghy-meznericsae* n. sp. — Báldi (in Báldi et al.) p. 90, Pl. 3, figs 6—7

1963 *Chlamys csepreghymeznericsae* Báldi — Báldi, p. 74

Medium-sized valves with 17 to 19 prominent but well-rounded ribs, slightly narrower than the furrows between them; the umbonal angle of the more mature specimens approximates that of *F. burdigalensis*. The intercostal furrows and the sides of the ribs bear 3 to 5 weak, scaly, secondary radial ribs, but the backs of the primary ribs are smooth. The broad, large posterior auricle carries 4 to 8 weak scaly radial ribs. The size and ornament of the anterior auricle are similar; the byssal sinus is broad and very shallow. On some mature specimens the auricles are almost smooth.

Dimensions (of the juvenile holotype): height 24 mm, length 23 mm.

Easily distinguished from *Chl. deleta* Michelotti, 1861 — and presumably from the entire *Chl. opercularis group* — by its broad, shallow byssal sinus; it probably belongs to the kinship of Roger's (1939) *Chl. northamptoni* group with traits transitional (flatter valves, weakening of the ribs towards the margins) towards the genus *Flabellipecten*. It is on the basis of these features that it can be distinguished from *Chl. northamptoni*.

This is a species indicative of a medium-depth sublittoral facies, typical of the *Flabellipecten-Odontocyathus* community but represented sparsely also in the *Pitar beyrichi* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-2, Dejtár, Eger-1/5, -1/k, Eger-3, Novaj-1.

Distribution: fairly frequent in the Hungarian Upper Oligocene, but known from nowhere else so far.

Chlamys (Aequipecten) schréteri Noszky, 1936

Pl. V, fig. 6

1936 *Pecten Schréteri* n. sp. — Noszky, p. 84, Pl. 5, fig. 3
1960 *Chlamys schréteri* Noszky — Csepreghy-Meznerics, p. 30, Pl. 20, figs 7—9

Small, fairly convex valve: height greater than length. Its 12 strongly prominent, radial ribs of semicircular cross section are about as wide as the furrows between them. The backs of the ribs exhibit a dense parallel striation under a magnifying glass. In each of the deep intercostal furrows there are 4 to 6 scaly secondary radial ribs. Both valves are fragmentary, poorly preserved.

Dimensions. Height: 30 mm; length: 29 mm.

Its typical ornament, the smaller number of its ribs and the difference in shape make it easy to distinguish from *Chl. northamptoni*.

It has been found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k

Distribution: known only from the above locality so far.

Subgenus: FLEXOPECTEN Sacco, 1897

Chlamys (Flexopecten) agriensis Csepreghy-Meznerics, 1960

Pl. VII, fig. 3

1960 *Chlamys agriensis* nov. sp. — Csepreghy-Meznerics, p. 31, Pl. 20, figs 15—16

A medium to small, fairly flat valve with 12 rounded flat broad ribs, particularly broad and strong near the middle of the valve, and wider than the furrows separating them. There is no concentric ornament other than some weak growth lines. The posterior auricle is fairly small and smooth; on the anterior auricle there is a deep byssal sinus and some weak radial ribs. The umbonal angle is relatively small.

Dimensions. Height: 39 mm; length: 35 mm.

It presumably belongs to the kinship of Roger's (1939) *Chlamys flexuosa* group and within it to the series of *Chl. palmata* Lamarck 1819. Still, by its narrower and more numerous ribs it can be distinguished with certainty from *Chl. palmata*.

It was found in a medium-depth sublittoral *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrence: Eger-2 (glauconitic sandstone horizon).

Distribution. Known only from the above locality so far.

Subgenus: CAMPTONECTES MEEK, 1864

Chlamys (Camptonectes) incomparabilis (RISSO, 1826)

Pl. V, fig. 3; Pl. VII, fig. 2

1897 *Palliolum incomparabile* RISSO — SACCO, p. 45
1899 *Pecten textus* Phil. — BÖCKH, p. 13, Pl. 2, fig. 2 (non Philippi)
1914 *Chlamys textus* Phil. — TELEGDI-ROTH, p. 66, Pl. 6, fig. 2 (non Philippi)
1936 *Chlamys textus* Phil. — NOSZKY, p. 84 (non Philippi)
1939 *Chlamys incomparabilis* RISSO — ROGER, p. 204, Pl. 20, fig. 7; Pl. 21, fig. 2
1959 *Chlamys decussata* Goldf. — VAŇOVA, p. 157, Pl. 20, figs 10—12 (non Goldfuss)
1960 *Chlamys texta* Phil. — CSEPREGHY-MEZNERICS, p. 37 (non Philippi)
1962 *Chlamys incomparabilis* RISSO — HÖLZL, p. 58, Pl. 2, fig. 3
1963 *Chlamys incomparabilis* RISSO — STEININGER, p. 17, Pl, 2. figs 2—3
1963 *Chlamys incomparabilis* RISSO — BÁLDI, p. 73, Pl. 1, figs 5—8

A small flat valve; a shiny brownish translucent shell. The magnifying glass reveals a typical Camptonectes ornament: a very dense skein of 130 to 140 fine radial ribs issuing from the beak, curving in soft arcs towards the anterior and posterior margins and dichatomizing between the two. This species bears no other ornament than the Camptonectes ribbing just mentioned, and the growth lines, even weaker than the ribbing. The posterior auricle is rather large with a deep byssal sinus and 4 to 6 not quite uniform scaly radial ribs. The anterior auricle is much smaller and smooth except for the Camptonectes ornament.

Dimensions. Height: 14 mm; length: 13 mm. The average valve is somewhat smaller.

The valves at my disposal, identified by ANDERSON, of *Chlamys decussata* (MÜNSTER in GOLDFUSS 1834) (= *Chl. texta* PHILIPPI 1843) are totally different from the Hungarian form earlier described as "*Chl. textus*". The latter is smaller and exhibits no ornament other than the Camptonectes ribbing, that is, the radial ribbing typical of *Chl. decussata* is missing. Thus ANDERSON (1958) and later HÖLZL (1962) were justified in pointing out that the Hungarian specimens do not belong to Boreal *Chl. decussata*.

Typical of and frequent in the *Pitar beyrichi* community, this species usually indicates a medium-depth sublittoral facies, being rare in shallower water.

Hungarian Upper Oligocene occurrences. It is fairly widespread, in the Upper Oligocene: Mány, 9, Felsőőrspuszta 22, Zsámbék 23, 42, 43, Gyermely 25, Szomor 31, Tök 52, 24, Máriahalom 36, Solymár 72, Törökbálint-1, -2, Pomáz-1, Leányfalu-3, Göd, Rétság-2, Eger-1/k.

Distribution: widespread in the Upper Oligocene but very scarce in the Lower Miocene of the Western and Central Paratethys (Eggenburgian of Fels am Wagram and Ordaspuszta in Cserhát); lataly it has been found also in the Carpathian of the Cserhát Mountains, remarkably enough it occurs outside the Paratethys only in the Pliocene of the Mediterranean province. It lives to this day in the Mediterranean (Adriatic). Our ideas of the vertical extent of the species are thus fairly incomplete.

Chlamys (Camptonectes) ex aff. decussata (MUNSTER in GOLDFUSS, 1843) Pl. VII, fig. 1

1963 *Chlamys* ex aff. *decussata* GOLDF. — BÁLDI, p. 74, Pl. 1, fig. 9

Our single specimen from Törökbálint is much more elongate dorsoventrally than the Lower Rhine specimens of *Chl. decussata*. The ribbing is also denser. The close relationship of the two is not in doubt, however. Its larger size, thicker shell and stronger, wider-spaced radial ribbing permit it to be distinguished at once from *Chl. incomparabilis*.

Dimensions. Height: 19 mm; length: 17 mm; convexity: 3 mm.

It was found in a *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrence: Törökbálint-2.

Distribution: *Chl. decussata* s.s. is an index fossil of the Boreal "Eochatt" (lowermost Chattian).

Chlamys (Camptonectes) hertlei (BITTNER, 1884)

1884 *Pecten Hertlei* n.sp. — BITTNER, p. 518, Pl. 10, fig. 19

1960 *Chlamys hertlei* BITTN. — CSEPREGHY-MEZNERICS, p. 37, Pl. 34, figs 5—6

1963 *Chlamys hertlei* BITTN. — BÁLDI, p. 74

Besides and independently of the dichotomizing Camptonectes ornament typical of *Chl. incomparabilis*, this species carries a stronger radial ribbing of 60 to 70 ribs. From *Chl.* ex aff. *decussata* it differs in that the latter bears no Camptonectes ornament.

Dimensions. Height: 18 mm, length: 18 mm.

It was found in *Pitar beyrichi* and *Pitar polytropa* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Eger-1/k.

Distribution: A rare species restricted to the Paratethys, it is known only from the above two Hungarian localities in addition to the type locality (the Oligocene beds of Trifail and Sagor in Northern Slovenia).

Anomiacea

Anomiidae

Genus: ANOMIA LINNÉ, 1758

Anomia ephippium LINNÉ, 1758

Pl. V, fig. 1

1866 *Anomia Goldfussi* DESH. — SPEYER, p. 49, Pl. 3, figs 7—9
1884 *Anomia Goldfussi* DESH. — SPEYER et KOENEN, Pl. 23, figs 7—8; Pl. 24, figs 6—10
1897 *Anomia costata* BROCC. — WOLFF, p. 231, Pl. 20, figs 9—10
1897 *Anomia ephippium* L. et var. div. — SACCO, p. 31, Pl. 10
1899 *Anomia ephippium* var. *costata* BROCC. — BÖCKH, p. 15, Pl. 2, fig. 5; Pl. 3, fig. 4
1910 *Anomia ephippium* L. et var. div. — SCHAFFER, p. 22, Pl. 12, figs 1–14
1952 *Anomia goldfussi* DESH. — GÖRGES, p. 27
1958 *Anomia ephippium* L. cum var. div. — SENEŠ, p. 51, Pl. 11, figs 130–133
1958 *Anomia ephippium* L. et var. div. — HÖLZL, p. 62, Pl. 4, fig. 5
1959 *Anomia ephippium* L. — ANDERSON, p. 103, Pl. 14, fig. 11
1964 *Anomia ephippium* L. — ANDERSON, p. 145, Pl. 2, fig. 28

Small to medium-sized, fairly convex, irregularly rounded valves with a horny or pearly lustre, with a fine dense radial ribbing visible only under a magnifying glass on some specimens. The shape and size of the valve and the thickness of the shell are highly variable.

According to ANDERSON (1959), *A. ephippium* cannot be distinguished from *A. goldfussi* DESHAYES 1860.

A shallow sublittoral species cropping up sporadically also in littoral communities, it is most frequent in the *Glycymeris latiradiata* community. An epifaunal element, it preferred flowing, agitated water and could not stand significant changes in salinity.

Hungarian Upper Oligocene occurrences: Csordakút 5, Gyermely 12, 35, Tök 24, 51, 52, Anyácsapuszta 27, Szomor 31, Zsámbék 43, Vasztély 49, Solymár 72, 85, Törökbálint-1, Budafok-1/4, Szentendre 2, Pomáz-16, Leányfalu-3.

Distribution: common all over the Paratethys from the Lower Oligocene to the Middle Miocene, it is particularly abundant in the Hungarian Lower Miocene ("Anomia beds"). In the boreal province, too, it is known from the Lower Oligocene on, whereas in the Mediterranean and Atlantic provinces it has been signalled from the Miocene onwards, up to this day. It is a common species of considerable vertical and horizontal spread.

Ostreacea

Ostreidae

Genus: OSTREA LINNÉ, 1758

Ostrea cyathula LAMARCK, 1806

Pl. VII, figs 5—7; Pl. VIII, fig. 3

1863 *Ostrea cyathula* LAM. — SANDBERGER, p. 379, Pl. 34, fig. 1; Pl. 35, fig. 2
1897 *Ostrea cyathula* LAM. et var. *carcarensis* SACC. — SACCO, p. 11
1897 *Ostrea cyathula* LAM. — WOLFF, p. 231, Pl. 20, figs 4—8
1899 *Ostrea digitalina* DUB. — BÖCKH, p. 16, Pl. 4, fig. 1 (non DUBOIS)
1910 *Ostrea cyathula* LAM. — KRANZ, p. 206
1914 *Ostrea cyathula* LAM. — TELEGDI-ROTH, p. 67, Pl. 6, figs 8 and 16—20
1936 *Ostrea cyathula* LAM. — NOSZKY, p. 83
1952 *Ostrea cyathula* LAM. — ANIĆ, p. 31, Pl. 6, fig. 2
1958 *Gryphaea* cf. *cyathula cyathula* LAM. — SENEŠ, p. 56, Pl. 11, figs 122—127
1958 *Ostrea* cf. *digitalina* DUB — SENEŠ, p. 54, Pl. 10, figs 113—121
1962 *Ostrea cyathula* LAM. — HÖLZL, p. 60, Pl. 2, fig. 5
1963 *Ostrea cyathula* LAM. — BÁLDI, p. 76, Pl. 1, fig. 13

This name serves to denote a highly variable group of oysters that would merit a separate treatise. Its main features are as follows: medium, sometimes small size; valves elongated dorsoventrally; left valve usually strongly convex. The forward displacement of the beak, and the more or less backward-twisted form of the valve result in an asymmetric shape. The resilifer is a moderately elongate triangular depression with a twisted backward tip. Its height invariably exceeds its width. It bears strong transverse ribs. The anterior margin is slightly arcute, the ventral margin strongly rounded, the posterior margin more or less concave. The surface of the left valve is covered by flat broad radial ribs whose width does not usually exceed that of the furrows between them. Some undulous growth lines, spaced at irregular intervals, are stronger than the others.

Dimensions. Height: 62 mm; length: 53 mm; convexity: 23 mm.

Height: 97 mm, length: 66 mm; convexity: 27 mm.

The density of the radial ribbing, the width of the ribs and the height of the resilifer are highly variable and so are the size and shape of the valve. The smaller and more strongly twisted valves of *O. frondosa* DE SERRES, 1829 are more asymmetrical, with a stronger and denser ribbing. *O. cyathula* hardly differs, however, from *O. digitalina* DUBOIS, 1831.

O. cyathula was one of the most frequent euryhaline forms of the littoral and shallow sublittoral waters of the Hungarian Upper Oligocene sea. In the littoral region and in the lagoons the species was abundant enough to form oyster beds, but it was not absent from the shallow sublittoral zone, either, where it preferred to mix with the *Glycymeris latiradiata* community. At medium sublittoral depth it was pretty scarce, however. It could stand strong fluctuations of salinity (10 to 35 per mille).

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, 4, Csordakút 5, Mány 6, 8, Gyermely 12, 35, 50, Felsőőrspuszta 22, 44, Tök 24, 51, 52, Anyácsapuszta 27, Szomor 31, Máriahalom 36, 41, Zsámbék 42, 43, 48, Vasztély 49, Csolnok 695, Törökbálint-1, -2, -3, Budafok-1/4, Pomáz-1, -6, -21, -22, Szentendre 2, Dömös-2, Leányfalu-1, -4, Diósjenő-3, -8, -24, Becske-1, -2, Eger-1, -2.

Distribution: it has been identified only in Oligocene beds thus far. Typical of the Upper Oligocene in the Paratethys, it is known in the Mediterranean province also from the "tongriano". In the Boreal basin it extends over the Middle and Upper Oligocene.

Subgenus: GIGANTOSTREA SACCO, 1897

Ostrea (Gigantostrea) gigantea callifera LAMARCK, 1819

Pl. VIII, figs 1—2; 4—5

1863 *Ostrea callifera* LAM. — SANDBERGER, p. 377, Pl. 34, fig. 6; Pl. 35, fig. 1
1884 *Ostrea callifera* LAM. — SPEYER and KOENEN, Pl. 23, figs 9—10; Pl. 24, fig. 11; Pl. 25, figs 2—4; Pl. 26, fig. 1
1893 *Ostrea callifera* LAM. — KOENEN, p. 1008, Pl. 63, figs 1—2
1897 *Ostrea callifera* LAM. — WOLFF, p. 231, Pl. 20, figs 2—3
1943 *Ostrea callifera* LAM. — ALBRECHT et VALK, p. 121, Pl. 24, figs 951—952
1952 *Ostrea callifera* LAM. — GÖRGES, p. 28
1957 *Pycnodonte callifera* LAM. — GLIBERT, p. 22
1959 *Ostrea callifera* LAM. — VAŇOVA, p. 162, Pl. 23, figs 29—30
1962 *Ostrea callifera* LAM. — HÖLZL, p. 59
1963 *Ostrea gigantica callifera* LAM. — BÁLDI, p. 75, Pl. 1, figs 11—12; Pl. 2, fig. 1

Medium-sized, round broad valves. The left valve is highly convex, the right valve slightly concave. The beak and the obliquely elongate triangular resilifer, twisted backwards at its top, are slightly displaced forward in an asymmetric position. The muscle scar is at the middle of the valve, slightly farther back than the beak. The surface of the left valve is but slightly scaly; traces of a radial ribbing are very weak.

Dimensions: height 64 mm, length 61 mm.

It stands very close to *O. gigantea* SOLANDER in BRANDER 1766 from which our specimens differ in the following traits: they are smaller, somewhat more inequilateral: the muscle scar is slightly concave from above and displaced in an asymmetric position. True, these traits of the Hungarian form are close also to *O. callifera*. It therefore occupies a transitional position between two geographically vicariating forms: Boreal *O. callifera* and Mediterranean *O. gigantea*. Therefore we accept the difference between the two forms as merely subspecific. Another close relative is the Lower Miocene species *O. sacyi* COSSMANN and PEYROT 1914: the difference may be only subspecific also in this case. Still, according to STEININGER (1963), *O. sacyi* can be distinguished easily from *O. gigantea*.

The Hungarian specimens have been collected from *Glycymeris latiradiata* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2 Becske.

Distribution: widespread all over the Paratethys in Middle and Upper Oligocene deposits, it is common in the Boreal province from the Eocene to the end of the Oligocene. The geographical substituent species, *O. gigantea* is known from the Mediterranean and Atlantic Oligocene.

Schizodonta

UNIONACEA

Unionidae

Genus: UNIO RETZIUS, 1788

Unio inaequiradiatus GÜMBEL, 1864

1897 *Unio inaequiradiatus* GÜMB. — WOLFF, p. 260, Pl. 28, figs 21—25

An oval valve slightly elongate lengthwise. The beak is displaced to the anterior third of the valve. Most of the specimens at our disposal are fragmentary and poorly preserved, but their typical thick mother-of-pearl layer is easy to recognize. The typical irregular radial ribbing on the posterodorsal part of the valve is rarely apparent.

Dimensions: Height: 26 mm; length: 45 mm.

Restricted to fresh waters (rivers, lagoons), whose salinity never exceeded 3 per mille. It mixed with the *Viviparus-Brotia* community, although a few, presumably washed-in specimens have been found in *Polymesoda-Tympanotonus* communities.

Hungarian occurrences: frequent in the limnic Upper Oligocene of the Bakony (Csatka, etc. between Mór and Zirc), and in the limnic interbeddings of the Upper Oligocene in the Szentendre—Visegrád Mountains, Mány 6, Gyermely 35, Pomáz-21, ? Eger-1, ? Mucsony 136.

Distribution: known so far only from the Oligocene of the Paratethys.

Heterodonta

Astartacea

Astartidae

Genus: ASTARTE SOWERBY, 1816

Astarte gracilis degrangei COSSMANN et PEYROT, 1912

Pl. XIII, figs 4—6

1912 *Astarte Degrangei* n. sp. — COSSMANN et PEYROT, p. 143, Pl. 1, figs 47—50

1958 *Astarte concentrica concentrica* GOLDF. — SENEŠ, p. 61, Pl. 15, figs 170—171 (non GOLDF)

1963 *Astarte gracilis degrangei* COSSM. et PEYR. — BÁLDI, p. 76, Pl. 2, figs 3—4

A small triangular valve ornamented by strong round-backed concentric ribs numbering 12 on the average. The ribs are wider than the furrows between them.

Dimensions: Height: 7 to 11 mm (mean range); length: 8 to 12 mm (mean range) (Törökbálint specimens).

It stands closest to the Boreal subspecies *A. gracilis goldfussi* HINSCH, 1952 (= *A. concentrica* GOLDFUSS, 1837; non CONRAD, 1834). The differences between the two subspecies are as follows: in *A. gracilis degrangei*, the ribs are wider than the furrows separating them; their number is less, and the ribs are rounded. The forms *A. gracilis* (MÜNSTER, 1835) and *A. goldfussi* were contracted by ANDERSON (1959). I have placed into the subspecies *A. gracilis degrangei* also the specimens found in the well of the Eger Vintners' School that differ from the above description in a slightly more quadrangular outline, and somewhat wider intercostal furrows; the ribs disappear near the posterior margin; indeed, in some specimens, they are developed only near the beak, whereas the rest of the valve exhibits growth lines only.

Hungarian Upper Oligocene occurrences: Mány 9, Felsőőrspuszta 22, Szomor 31, Tök 52, Törökbálint-1, -2, Leányfalu -3, Diósjenő-7, Eger-2.

Distribution: known so far only from the Carpathian Basin and the Upper Oligocene of the Adour Valley (Atlantic province). Some close relatives (the form circle of *A. gracilis*) are frequent in the Boreal Oligocene and Miocene.

Crassatellidae

Genus: CRASSATELLA LAMARCK, 1799

Subgenus: EUCRASSATELLA IREDALE, 1924

Crassatella (Eucrassatella) carcarensis MICHELOTTI, 1847

Pl. XI, figs 5—6; Pl. XIII, figs 2—3

1899 *Crassatella carcarensis* MICHT. et var. div. — SACCO, p. 28, Pl. 6, figs 39—40; Pl. 7, figs 1—6

1900 *Crassatella carcarensis* MICHT. — ROVERETO, p. 85

1900 *Crassatella protensa* MICHT. — ROVERETO, p. 87, Pl. 5, fig. 15

1910 *Crassatella carcarensis* MICHT. — KRANZ, p. 215, Pl. 4, fig. 3; Pl. 6, figs 13—14; text fig. 1

1912 *Crassatella Raulini* nov. sp. — COSSMANN et PEYROT, p. 124 Pl. 1, figs 1—4

1958 *Crassatella carcarensis carcarensis* MICHT. — SENEŠ, p. 63, Pl. 14, figs 157—165; Pl. 15, figs 168—169

1958 *Crassatella carcarensis* mut. *protensa* MICHT. — SENEŠ, p. 63, Pl. 15, figs 166—167

A large, thick, not very convex valve, slightly elongate. Shape trigonal, rounded. The anterior and ventral margins are rounded, the posterior margin is almost straight, the postero-dorsal margin is slightly concave. There is an obtuse edge running from the beak to the angular concurrence of the posterior and ventral margin. The growth lines are much stronger on the anterior part of the valve. On some specimens, there are some stronger concentric folds. The hinge teeth are big and strong. Tooth 3b on the right valve and tooth 2 on the left valve are tall, massive slabs, with vertical grooves on both sides. Behind 3b and 4b there is a deep triangular resilifer. There are no lateral teeth. The lunule is relatively narrow and deep, the escutcheon even more so.

Dimensions. The largest specimens are fragmentary. The measurable height of these is 56 mm. The data of the smaller, entire specimens from Budafok are: height: 27 mm; length: 34 mm.

An excellent index of the shallow sublittoral zone, it is not known from any other biotope. Its massive, large valves could withstand considerable agitation of the water. It is typical of the *Glycymeris latiradiata* community and frequent also in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Budafok-1/4, Pomáz-6 Leányfalu-3, Diósjenő-4, -7, -24, Novaj-1.

Distribution: This is an Atlantic-Mediterranean, Oligocene form, frequent besides the above-named Hungarian localities also at another Paratethyan locality, Kováčov in South Slovakia.

Subgenus: CRASSATINA LOEBBECKE and KOBELT, 1881

Crassatella (Crassatina) bosqueti KOENEN, 1893

Pl. XI, figs 1—4

1893 *Crassatella Bosqueti* KOEN. — KOENEN, p. 1204, Pl. 82, figs 5—7
?1939 *Crassatella* cfr. *Bosqueti* KOEN. — NOSZKY, p. 58
1961 *Crassatella bosqueti minor* n. subsp. — BÁLDI (in BÁLDI et al.), p. 93, Pl. 3, fig. 4; Pl. 4, fig. 1

A small, oval valve, with a beak displaced slightly forward. The outline of the valve is well rounded all around, nowhere angular, the margins are all more or less rounded, except for the straight postero-dorsal margin. The lunule is half-moon-shaped: the escutcheon is insignificant. There is a dense ornament of flat concentric ribs which, however, disappears in the posterior region of the valve: only some weak growth lines are visible there. Tooth 2 is strong, prominent, slightly broadening downwards. 4b is smaller, narrow and platy, with a triangular resilifer impressed deep in the shell. There are narrow, sharp, straight long lateral teeth; two anterior and one posterior on the right valve and one posterior and two anterior on the right valve.

Dimensions.

Height: 7 mm; length: 9 mm; convexity: 2 mm
Height: 10 mm; length: 13.5 mm convexity: 3.7 mm

This small *Crassatella* had inhabited deep sublittoral and shallow bathyal waters, as a typical member of the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Eger-1/6, 2/a, Novaj-1, Ostoros-1.

Distribution: known earlier only from the deeper Oligocene of the Boreal province. NOSZKY signalled it with a question mark from the Kiscell Clay, but its presence in the Hungarian Upper Oligocene is certain.

Carditacea

Carditidae

Genus: CARDITA BRUGUIÉRE, 1792

Subgenus: CYCLOCARDIA CONRAD, 1867

Cardita (Cyclocardia) orbicularis subparvocostata BÁLDI, 1963

Pl. XII, fig. 6

1963 *Cardita orbicularis subparvocostata* n. subsp. — BÁLDI, p. 77, Pl.2, figs 6—8 and 11

A small, convex, thick, rounded valve, ornamented by 12 to 16 radial ribs dissected by concentric rings. The ribs are generally broader than the furrows between them. The second hinge tooth of the left valve is strongly elongate anteriorally.

Dimensions. Height: 8.2 mm; length: 8.0 mm.

This subspecies is transitional between *C. orbicularis* SOWERBY, 1825 and *C. parvocostata* HÖLZL, 1962. The valve is more convex than in *C. orbicularis*: also, its ribs are broader but less numerous. It differs from *C. parvocostata* in the larger number of its ribs.

This small *Cardita* species is typical of the medium-depth sublittoral zone of the *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrences: Mány 9, Felsőőrspuszta 22, 44, Szomor 31, Zsámbék 42, Tök 52, Solymár 72, 93, Törökbálint-1,-2, Leányfalu-3.

Distribution: the subgenus is known so far from the Hungarian Upper Oligocene only. The form circle of *C. orbicularis* is frequent in the Boreal Oligocene and Miocene.

Cardita (Cyclocardia) monilifera DUJARDIN, 1837

Pl. XII, figs 1—3: 8—9

1912 *Venericardia monilifera* DUJ. — COSSMANN et PEYROT, p. 186, Pl. 3, figs 9—12

A trigonal-oval valve slightly elongate in the posterior direction, with a slightly asymmetric beak and rounded corners. The most convex part of the valve runs diagonally to the concurrence of the posterior and ventral margins. Farther backward, the shell flattens out rather suddenly. The ornament is composed of 16 to 18 radial ribs, knotted on the anterior part and near the beak, smooth, convex, round-topped on the ventral and posterior parts.

The ribs are hardly broader than or as broad as the furrows between them. On the posterior, flattened part of the valve, they are wider-spaced and some of them are weaker. The hinge comprises a weak 3a and a very strong triangular 3b, elongate backward: the side of the latter is grooved and separated by a deep furrow from the ligament area. Tooth 2 is massive, prominent, strong: it lies right below the beak. It is flanked by distinct but weak A II on the anterior side and long, narrow, tall 4b on the posterior side.

Dimensions. Height: 11 mm; length: 14.5 mm.

The only slight difference from the type is that the ribs are knotted only on the anterior part and near the beak, and smooth elsewhere, and further that, owing to the wider spacing of the ribs on the posterior part, there are fewer ribs by one or two. *C. pinnuloides* COSSMANN, 1922, described from the Stampian of Gaas, is similar, but the smaller number of its ribs precludes the identification of the two species.

In the shallow sublittoral *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Dömös-2.

Distribution: An Atlantic species, it occurs in France from the Peyrère level (Upper Oligocene) to the Middle Miocene.

Subgenus: MEGACARDITA SACCO, 1899

Cardita (Megacardita) arduini BRONGNIART, 1823

Pl. XII, fig. 4; Pl. XIII, fig. 1

1870 *Cardita Arduini* BRONG. — FUCHS, p. 66, Pl. 2, fig. 16

1899 *Megacardita Arduini* BRONG. et var. div. — SACCO, p. 11, Pl. 4, figs 1—3

1937 *Venericardia arduini* BRONG. — VENZO, p. 128, Pl. 8, figs 25—27

1955 *Megacardita arduini* BRONG. — ACCORDI, p. 47, Pl. 4, fig. 8

A medium-sized species of *Cardita*, with an inequilateral valve markedly produced lengthwise. The beak is shifted far forward. The dorsal and ventral margins are slightly rounded; the posterior margin is well-rounded. The valve bears 15 broad and strong but rather flat-backed radial ribs much broader than the furrows between them. The ribs are broadest on the most prominent, most convex, umbono-ventroposterioral region of the valve. The growth lines are relatively strong, well-developed.

Dimensions. Height: 17 mm; length: 26 mm.

In shallow and medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Pomáz-1 (juvenile specimens), Pomáz-30 (juvenile form), Dunabogdány, Eger-3 (Áfrika-dűlő, Noszvaj-1 (Nagyimány).

Distribution. A Mediterranean Oligocene species; within the Paratethys it is limited to Hungary so far.

Subgenus: GLANS Megerle von Mühlfeld, 1811

Cardita (Glans) ruginosa (Cossmann et Peyrot, 1912)
Pl. XII, figs 5, 7

1912 *Cardita ruginosa* (1) n.sp. — Cossmann et Peyrot, p. 170, Pl. 2, figs 39—44

A small, strongly convex valve, with a beak displaced very slightly forward but twisted markedly inward and forward. The margins of our specimens are broken off. The valve bears 26 narrow radial ribs thinner than the furrows between them. The ribs bear prominent knots that grow spiny and scaly on the posterior part of the valve. The hinge structure is as follows. 3a is not well visible on our specimen; 3b is strong, trigonal, elongate backward; P I is very weak. Well-developed 2 is flanked by weak A II forward and thin, long 4b backward.

No meaningful dimensions could be established.

C. oligocaenica Cossmann, 1922 is a rather close relative.

In the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: frequent in the Upper Oligocene of the Aquitanian Basin (Peyrère); it has not been signalled from elsewhere.

Cyrenacea

Cyrenidae

Genus: POLYMESODA Rafinesque, 1820

Polymesoda convexa (Brongniart, 1822)
Pl. IX, figs 1—2, 7; Pl. LI, fig. 11

1863 *Cyrena semistriata* Desh. — Sandberger, p. 307, Pl. 22, fig. 19; Pl. 26, figs 3—4

1870—75 *Cyrena semistriata* Desh. — Sandberger, p. 309, Pl. 20, fig. 2

1897 *Cyrena semistriata* Desh. — Wolff, p. 249, Pl. 22, figs 17—23

1899 *Cyrena semistriata* Desh. — Böckh, p. 25, Pl. 7, fig. 4; Pl. 8, fig. 2

1900 *Cyrena sirena* Brongn. et var. div. — Sacco, p. 61, Pl. 14, figs 12—24

1943 *Corbicula semistriata* Desh. — Albrecht et Valk, p. 126, Pl. 11, figs 398—400

1952 *Cyrena semistriata* Desh. — Anić, p. 25, Pl. 2, figs 7—8; Pl. 3, figs 1—3

1957 *Polymesoda convexa* Brongt. et var. div. — Hölzl, p. 10—20, Pl. 1, figs 1—11; Pl. 2, figs 1—7; Pl. 4, fig. 6; Pl. 7, fig. 1

1962 *Polymesoda convexa* Brongt. — Hölzl, p. 68

1963 *Polymesoda convexa* Brongt. — Báldi, p. 77

1965 *Polymesoda convexa* Brongt. — Ondrejičkova et Seneš, p. 185, Pl. 6, figs 60—61

A rounded trigonal valve, with a beak displaced forward; posterior margin straight, obliquely truncated, meeting the rounded ventral margin at a more or less rounded acute angle. The anterior margin passes in a strongly rounded arc into the ventral margin, but its dorsal part is straight, truncate. The hinge structure is typical of the genus: three hinge teeth, with well-developed long lateral teeth. The valve surface is covered by close-spaced thin concentric ribs. Some specimens from Pomáz-21 and Mány have retained also the colour ornament, which consists of more or less thin brown lines and bands emerging radially from the beak or disposed concentrically. This ornament, whose preservation is a rarity, much resembles the colour ornament described by HÖLZL (1957) from certain specimens of the Bavarian Molasse.

Dimensions. Height: 27 mm; length: 32 mm; convexity: 10 mm.

HÖLZL (1957) on the basis of some earlier remarks by DESHAYES and NYST identified the species described by BRONGNIART in 1822 by the name "*Cytherea ? convexa*" with "*Cyrena semistriata*" DESHAYES, 1831. BRONGNIART's name is thus a subjective synonym.

The numerous specimens at my disposal exhibit a considerable variability, whose range at the various levels may have some stratigraphic significance. To find out about that would, however, require a separate study into variation statistics. Anyhow, to pick out certain extreme specimens from a population and to attribute to them separate names — even if only at the subspecific or varietal level — seems to me biologically unjustified, stratigraphically superfluous, and nomenclaturally burdensome. For this reason I have considered many names as superfluous synonyms.

The *Polymesoda* now live on the Atlantic and Pacific shores of North America, in brackish lagoons. They had inhabited similar surroundings also in the Upper Oligocene. In their optimal biotope, salinity fluctuated from 3 to 10 per mille, rising but seldom above the latter figure. This is why the *Polymesoda* are — particularly if present in large numbers — excellent lagoon-facies indicators. They occur in masses especially in the *Polymesoda-Tympanotonus* communities, but they have been found also in other littoral assemblages.

Hungarian Upper Oligocene occurrences: Nagyegyháza-3, 4, Csordakút 5, 9, Mány 6, 8, Gyermely 12, 25, 39, 46, 50, Zsámbék 23, 42, 43, 48, Tök 24, 51, 52, Anyácsapuszta 27, Szomor 31, Máriahalom 36, Felsőőrspuszta 44, Vasztély 47, 49, Csolnok 695, Nagysáp-1, Tarján-1, Kesztölc-1/3, Szentendre 2, Pomáz-21, -1, Leányfalu-1, Törökbálint-1, Csesztve and Mohora, Eger-1/15, -1/17, Mucsony 136.

Distribution: frequent from the deeper Oligocene to the Lower Miocene in the brackwater deposits of the Paratethys and the Boreal province, it is present also in the Mediterranean Oligocene. In the Atlantic province, it is substituted by *P. convexa brongniarti*. According to HÖLZL (1957), its hemera extends from the Eocene to the Helvetian.

Polymesoda convexa brongniarti (BASTEROT 1825)

Pl. IX, fig 3, 5

1870—75 *Cyrena Brongniarti* BAST. — SANDBERGER, p. 338, Pl. 20, fig 17
1910 *Cyrena Brongniarti* BAST. — COSSMANN et PEYROT, p. 449, Pl. 19, figs 32—34
1957 *Polymesoda brongniarti* BAST. et var. div. — HÖLZL, p. 20—24, Pl. 2, fig. 8; Pl. 3, figs 1—5; Pl. 4, figs 1—5

Differs from *P. convexa* s.s. in its much larger size, its beak shifted farther forward, its more rounded anterior and ventral margins. Its concentric ribbing is somewhat stronger and less close-spaced.

Dimensions. Height: 39 mm; length: 46 mm.

A littoral-facies index; its ecology is the same as that of *P. convexa*.

Hungarian Upper Oligocene occurrences: Nagyegyháza-4, Csordakút 5, Máriahalom 36, Vasztély 47, 49, Pomáz-21, Leányfalu-3, Diósjenő-3, Becske-1.

Distribution: besides the Oligocene and Lower Miocene deposits of the Paratethys it occurs also in the Atlantic province from the Stampian (Middle Oligocene) of Gaas to the Lower Miocene.

Isocardiacea

Isocardiidae

Genus: ISOCARDIA LAMARCK, 1799

Isocardia subtransversa d'ORBIGNY, 1852

Pl. IX, fig. 6

1863 *Isocardia subtransversa* ORB. — SANDBERGER, p. 316, Pl. 25, fig. 3
1870 *Isocardia subtransversa* ORB. — HÖRNES, p. 166, Pl. 20, fig. 3
1884 *Isocardia subtransversa* ORB. — SPEYER et KOENEN, Pl. 6, figs 7—12; Pl. 7, figs 1—3
?1900 *Isocardia* cf. *subtransversa* ORB. — SACCO, p. 4
1900 *Isocardia subtransversa* ORB. — ROVERETO, p. 98
1952 *Isocardia subtransversa* ORB. — GÖRGES, p. 37
1957 *Isocardia subtransversa* ORB. — GLIBERT, p. 31, Pl. 6, fig. 11
1958 *Isocardia subtransversa* ORB. — HÖLZL, p. 69, Pl. 5, fig. 1
1962 *Isocardia subtransversa* ORB. — HÖLZL, p. 70, Pl. 2, figs 12—13

A medium-sized or relatively large valve, slightly elongate lengthwise. Striking on its outline is a prominent, almost pointed anterior margin; the posterior and posterodorsal margins are also rounded, the ventral margin less so. The beak is slightly displaced forward, strongly prosogyral. There are two divergent, very obtuse ridges running from the beak to the posterior margin. The portion of the valve flanked by them is slightly concave. The surface of the thin shell is smooth; even the growth lines are but weakly visible.

Dimensions. Height: 26 mm; length: 36 mm.

In shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Tök 24, Szomor 31, Solymár 72, Törökbálint 1, Leányfalu-3, -4, Diósjenő-24, Rétság-2.

Distribution: in the Boreal and Mediterranean provinces, this species is restricted to and typical of the Oligocene, but in the Paratethys it crops up also in the Miocene, Eggenburgian (Bavarian Molasse, Kaltenbachgraben beds).

Isocardia subtransversa abbreviata SACCO, 1900

Pl. IX, fig. 4

1900 *Isocardia* cf. *subtransversa* var. *abbreviata* — SACCO, p. 4, Pl. 1, fig. 6
1914 *Isocardia subtransversa* ORB. — TELEGDI-ROTH, p. 56
1936 *Isocardia subtransversa* ORB. — NOSZKY, p. 89
1963 *Isocardia subtransversa abbreviata* SACCO — BÁLDI, p. 78, Pl. 3, figs 6—7

Differs from *I. subtransversa* s.s. in its much shorter valve, rounded-quadrate shape.

Dimensions. Height: 31 mm; length: 32 mm; convexity: 11 mm.

VENZO (1937) does not distinguish the subspecies *abbreviata*. In my experience, however, the populations of some localities are typically short-valved and this justifies the distinction of a subspecies.

Hungarian Upper Oligocene occurrences: Felsőőrspuszta 44, Törökbálint-1, -2, Pomáz-1, Eger-1/k.

Distribution: Known from the Mediterranean Oligocene, this species is so far restricted within the Paratethys to the Hungarian Upper Oligocene.

Cyprinacea

Cyprinidae

Genus: CYPRINA LAMARCK, 1812

Cyprina islandica rotundata (BRAUN in AGASSIZ, 1845)

Pl. X, figs 1—2

1863 *Cyprina rotundata* BRAUN — SANDBERGER, p. 313, Pl. 25, fig. 1
1884 *Cyprina rotundata* BRAUN et var. div. — SPEYER et KOENEN, Pl. 9, figs 2—4; Pl. 10, figs 1—8; Pl. 11, figs 1—5; Pl. 12, figs 1—4
1897 *Cyprina rotundata* BRAUN — WOLFF, p. 251, Pl. 23, fig. 1 and 6
1899 *Cyprina rotundata* BRAUN — BÖCKH, p. 24, Pl. 8, fig. 1
1914 *Cyprina rotundata* BRAUN — TELEGDI-ROTH, p. 55
1936 *Cyprina rotundata* BRAUN — NOSZKY, p. 88
1937 *Cyprina rotundata* BRAUN — VENZO, p. 98, Pl. 6, figs 14—17
1943 *Cyprina rotundata* BRAUN — ALBRECHT et VALK, p. 127, Pl. 13, figs 423—426

1952 *Cyprina rotundata* AGASS. — GÖRGES, p. 38
1952 *Cyprina rotundata* BRAUN — ANIĆ, p. 25, Pl. 3, figs 4—5
1957 *Cyprina rotundata* BRAUN — GLIBERT, p. 31, Pl. 6, fig. 18
1958 *Cyprina rotundata* BRAUN — SENEŠ, p. 67
1962 *Cyprina islandica rotundata* BRAUN — HÖLZL, p. 68, Pl. 3, figs 1—2
1963 *Cyprina islandica rotundata* BRAUN — BÁLDI, p. 78, Pl. 2, fig. 12; Pl. 3, fig. 5

A thick-shelled, rounded, large convex valve. Its margin is rounded everywhere and smooth on the inner side. The beak is displaced forward, and twisted forward and downward. On the right valve, 3a is thin, trigonal, prominent; 3b is broad, almost horizontal, with a depression at its middle. The two teeth are separated by a narrow, deep triangular pit. There is a long narrow channel between 3b and the broad flat platform-like ligament area. A I is short, massive, and so is P I. The valve surface is covered by weak growth lines. In the middle region there are rows of small pits, 1 to 2 mm wide, along concentric lines spaced 1 to 2 cm apart.

Dimensions. Height: 87 mm; length: 90 mm; convexity: 32 mm.

According to GLIBERT (1945), *rotundata* differs from the Neogene to Recent Boreal species *C. islandica* (LINNÉ 1767) in the shorter and more rounded posterior margin, the more rounded ventral margin, the less pronounced convexity of the valve, and, besides lesser differences in lunule and hinge structure, in the presence of the concentric rows of pits. ANDERSON (1959) feels this to be a merely subspecific difference. According to STEININGER (1963), Lower Miocene *C. girondica* BENOIST in COSSMANN and PEYROT, 1912 differs from *C. rotundata* in shape and hinge structure and in the absence of concentric pit rows.

In shallow and medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Szomor 31, Törökbálint-1, -2, Eger-1/k, -2, ?Novaj-1, Leányfalu-3.

Distribution: *C. rotundata* s.s. is widespread in the Oligocene of the Paratethys, and of the Boreal and Mediterranean provinces. It nowhere transgresses the Oligocene-Miocene boundary. *C. islandica* s. str. has been living from the Neogene to this day.

Dreissenacea

Dreissenidae

Genus: CONGERIA PARTSCH, 1835

Congeria basteroti DESHAYES, 1836

1870 *Congeria Basteroti* DESH. — HÖRNES, p. 370, Pl. 49, figs 5—6
1870—75 *Dreissenia Basteroti* DESH. — SANDBERGER, p. 337, Pl. 20, fig. 10
1897 *Dreissensia Basteroti* DESH. — WOLFF, p. 234, Pl. 20, figs 11—12
1914 *Congeria Basteroti* DESH. — COSSMANN et PEYROT, p. 41, Pl. 11, figs 24—26; Pl. 15, fig. 14
1950 *Dreissena basteroti* DESH. — HEERING, p. 25, Pl. 6, figs 131—132

1952 *Congeria basteroti* Desh. — Anić, p. 30, Pl. 5, fig. 6
1958 *Congeria basteroti* Desh. — Hölzl, p. 71
1958 *Congeria basteroti* Desh. — Seneš, p. 68, Pl. 11, fig. 138
1964 *Congeria basteroti* Desh. — Anderson, p. 147, Pl. 3, fig. 32

An umbonoventrally elongate, small valve, with a prosogyral, often prominent beak, a straight or slightly concave anterior margin which drops away vertically from the beak. The slightly rounded upper part of the posterior margin forms an obtuse angle in its upper third and continues in an almost straight line parallel to the anterior margin down to the strongly rounded ventral margin. The most convex part of the valve is right behind the anterior margin, parallel to it, whereas near the posterior margin the valve suddenly flattens. The surface is smooth. Some specimens of exceptional preservation exhibit a colour ornament of 4 to 5 interrupted brown lines running from the beak towards the ventral margin, or concentric brown lines parallel to the growth lines. A similar colour ornament was observed by Kókay (1966) on "Tortonian" (Badenian) specimens from Herend and Márkó.

Dimensions. Height: 14,0 mm; length: 7.6 mm.

Congeria basteroti differs from likewise Oligocene *C. brardi* (Brongniart 1823) in its larger size, more produced form, more pointed, less blown-up beak. Cossmann and Peyrot (1914) had enumerated some more internal features to prove the difference between the two species, but we could not identify these on our specimens of indifferent preservation.

C. basteroti was an epifaunal element fixed to the sea bottom with a byssus. It is an excellent lagoon-facies index, occurring almost invariably in the *Polymesoda-Tympanotonus* community. The salinity of its optimal environment thus probably was 3 to 10 per mille. It is exceptional in other communities.

Hungarian Upper Oligocene occurences: Nagyegyháza 3, 4, Csordakút 5, Gyermely 25, 35, 39, 46, 50, Zsámbék 42, Szentendre 2, Leányfalu-1.

Distribution: this species of considerable vertical and horizontal spread occurs in all palaeogeographical provinces of Europe. In the Paratethys and the Boreal province (Mainz Basin) it is found in the Oligocene and Miocene alike, but in the Mediterranean and Atlantic provinces it has been signalled from the Neogene only.

Lucinacea

Ungulinidae

Genus: TARAS Risso, 1826 (= *Diplodonta* Bronn, 1831)

Taras rotundatus (Montagu, 1803)

Pl. XIV, figs 7—8

1870 *Diplodonta rotundata* Montg. — Hörnes, p. 216, Pl. 32, fig. 3
1901 *Diplodonta rotundata* Montg. et var. div. — Sacco, p. 62, Pl. 15, figs 12—18

1910 *Diplodonta rotundata* Montg. — Schaffer, p. 102, Pl. 46, figs. 15—17
1911 *Diplodonta rotundata* Montg. — Cossmann et Peyrot, p. 241, Pl. 26, figs 26—30
1914 *Diplodonta rotundata* Montg. — Telegdi-Roth, p. 59
?1921 *Diplodonta parilis* n. sp. — Cossmann, p. 90, Pl. 5, figs 26—29
1936 *Diplodonta rotundata* Montg. — Noszky, p. 86
1939 *Diplodonta rotundata* Montg. — Noszky, p. 66
1945 *Taras rotundatus* Montg. — Glibert, p. 150, Pl. 10, fig. 2
1954 *Diplodonta rotundata* Montg. — Csepreghy-Meznerics, p. 83, Pl. 11, figs. 13 and 20
1958 *Diplodonta rotundata rotundata* Montg. — Seneš, p. 69, Pl. 15, fig. 183
1962 *Taras rotundatus* Montg. — Hölzl, p. 72, Pl. 4, fig. 1
1964 *Taras rotundatus* Montg. — Raileanu et Negulescu, p. 169, Pl. 8, fig. 5
1964 *Taras rotundatus* Montg. — Anderson, p. 160, Pl. 5, fig. 47

A medium-sized to small, thin-shelled, slightly inequilateral, convex valve. The postero-dorsal margin is straight, emerging almost horizontally from the beak. The antero-dorsal margin is also straight, and as long as the postero-dorsal one, but it slopes obliquely down to the slightly prominent anterior margin. The ventral and posterior margins are slightly arcuate; their concurrence is hardly angular. The most convex part of the valve, a flat ridge, connects the beak with this point of concurrence. The valve is smooth apart from concentric growth lines.

Dimensions Height: 14.7 mm; length: 21.1 mm.

According to Cossmann's (1921) figure *T. parilis* differs from *rotundatus* merely in its smaller size. No specific difference from this "Stampian" form is likely.

Frequent in littoral and shallow sublittoral facies, especially in the *Pitar undata*, *Pitar polytropa* and *Nucula-Angulus* communities. It could not stand prolonged decreases of salinity.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 6, Zsámbék 23, 42, 43, 48, Tök 24, 51, 52, Gyermely 25, 39, 50, Anyácsapuszta 27, Szomor 31, Máriahalom 36, Felsőőrspuszta 44, Vasztély 47, 49, Szentendre 2, Pomáz-1, -6, -22, Dömös-2, Leányfalu-3, -4, Diósjenő -1, -4, -3, Rétság-2, Becske-1, Kesztölc-1, Eger-1/k. This is one of the most widespread Upper Oligocene bivalves of Hungary.

Distribution: A species of considerable horizontal and vertical spread, it has been found in the Paratethys, the Boreal and (?) Atlantic provinces from the Deeper Oligocene, in the Mediterranean province from the Lower Miocene, to this day.

Taras fragilis (Braun in Walchner, 1851)

Pl. XIV, figs 5—6

1863 *Diplodonta fragilis* Braun — Sandberger, p. 324, Pl. 26, fig. 9
1884 *Diplodonta lunularis* Phil. — Speyer et Koenen, Pl. 31, figs 5—6

1952 *Diplodonta fragilis* BRAUN — GÖRGES, p. 39, Pl. 1, figs 15—16
1957 *Diplodonta fragilis* BRAUN — GLIBERT, p. 32
1962 *Taras fragilis* BRAUN — HÖLZL, p. 71

A small, fragile, very slightly trigonal, almost circular, flat valve. Its beak is in the median position. The dorsal margins are oblique: the posterior one is straight, the anterior one is hardly arcuate. The posterior margin is straight or slightly rounded, obliquely truncate. The anterior and ventral margins are rounded. The surface is smooth apart from the growth lines.

Dimensions. Height: 8 mm; length: 9 mm.

Our specimens are somewhat smaller than the type. The steeper dorsal margins and more trigonal shape of *T. trigonulus* (BRONN, 1831) preclude confusion with *T. fragilis*.

In the littoral *Mytilus aquitanicus* community.

Hungarian Upper Oligocene occurrence: Leányfalu-1.

Distribution: known within the Paratethys only from the Rupelian and Chattian beds of the Bavarian Molasse in addition to Leányfalu; also from the Boreal Oligocene.

Lucinidae

Genus: LINGA GREGORIO, 1885

Linga columbella (LAMARCK, 1818)

Pl. XIV, fig. 2

1870 *Lucina columbella* LAM. — HÖRNES, p. 231, Pl. 33, fig. 5
1901 *Linga columbella* LAM. — SACCO, p. 91, Pl. 20, figs 54—57
1911 *Phacoides columbella* LAM. -et var. div. — COSSMANN et PEYROT, p. 321, Pl. 28, figs 64—65; 71—74 and 87—89
1921 *Linga oligocaenica* nov. sp. — COSSMANN, p. 104, Pl. 4, figs 38—41
1964 *Phacoides columbella* LAM. — BÁLDI, p. 148, Pl. 1, fig. 8

The slightly oval rounded valve exhibits a conspicuously prosogyral beak; a broad lunula and escutcheon limited by a deep groove, both of them sharply defined, flat surfaces on the valve. The dorsal margin shows a concave re-entrant where it meets the groove delimiting the escutcheon. There is a similar re-entrant where the anterior margin meets the lunule. The valve surface is ornamented by 20 to 22 evenly spaced sharp concentric ribs, much narrower than the furrows between them. This ornament continues also on the escutcheon, but it is very weak on the lunule. As to hinge structure, the strong short lateral teeth typical of the genus are well visible also on my specimens.

Dimensions. Height: 9 mm; length: 9 mm.

Except for their smaller size, my specimens do not differ at all from the type. The convexity of juvenile Miocene specimens of similar size is not greater, either. I consider this species to be identical with *L. oligocaenica* (COSSMANN 1921) known from the Stampian (Middle Oligocene) of Gaas.

Restricted to the shallow sublittoral *Glycymeris latiradiata* community.

Hungarian Upper Oligocene occurrences: Budafok-1/4, Diósjenő-7.

Distribution. Identified so far only in the Miocene of the Paratethys, apart from the above two localities. Known from the Atlantic Oligocene and Miocene, and from the Mediterranean Miocene. In the latter province, it is an abundant living species.

Genus: LUCINOMA DALL, 1901

Lucinoma borealis (LINNÉ, 1767)

Pl. XIV, fig. 1

1868 *Lucina praecedens* KOEN. — KOENEN, p. 246, Pl. 28, fig. 8
1870 *Lucina borealis* L. — HÖRNES, p. 229, Pl. 33, fig. 4.
1884 *Lucina praecedens* KOEN. — SPEYER et KOENEN, Pl. 31, fig. 2
1897 *Lucina borealis* L. — WOLFF, p. 244, Pl. 22, fig. 1
1901 *Dentilucina borealis* L. et var. div. — SACCO, p. 80, Pl. 18, figs 23—32
1911 *Phacoides borealis* L. — COSSMANN et PEYROT, p. 309, Pl. 27, figs 1—2; Pl. 28, fig. 47
1939 *Lucina borealis* L. cfr. var. *oligobliqua* SACCO — NOSZKY, p. 66
1945 *Lucinoma borealis* L. — GLIBERT, p. 155, Pl. 8, fig. 3
1950 *Phacoides borealis* L. — HEERING, p. 27, Pl. 4, figs 68, 72, 76, 80—81
1952 *Phacoides borealis* L. — GÖRGES, p. 40
1955 *Phacoides borealis* L. — ACCORDI, p. 46, Pl. 2, fig. 9—11, 13
1957 *Lucinoma borealis praecedens* KOEN. — GLIBERT, p. 34
1958 *Lucinoma borealis* L. — HÖLZL, p. 76, Pl. 5, fig. 3
1958 *Phacoides borealis borealis* L. — SENEŠ, p. 71
1959 *Phacoides borealis* L. — ANDERSON, p. 126, Pl. 16, fig. 6
1959 *Phacoides borealis borealis* L. — VAŇOVA, p. 163, Pl. 23, fig. 31
1962 *Phacoides borealis* L. — HÖLZL, p. 74, Pl. 4, fig. 2.
1962 *Phacoides borealis praecedens* KOEN — HÖLZL, p. 74, Pl. 4, fig. 3
1963 *Lucinoma borealis* L. — STEININGER, p. 24, Pl. 2, fig. 4
1963 *Phacoides borealis* L. — BÁLDI, p. 78, Pl. 2, fig. 5
1964 *Lucinoma borealis* L. — ANDERSON, p. 158

A small valve slightly longer than it is tall. The antero-dorsal margin is slightly concave; the postero-dorsal margin, which meets the dorsal margin in a hardly rounded obtuse angle, is but slightly arcuate. The anterior, posterior and ventral margins are rounded in broad arches. The beak is displaced slightly backward. There is a vague weak edge running from the beak to the posterior margin. The valve is flatter above it than below it. The valve surface bears close-spaced, thin but strong concentric ribs (about 30). The furrows are hardly broader than the ribs.

Dimensions. Height: 7.4 mm; length: 8.0 mm.

According to GLIBERT (1957), *L. praecedens* (KOENEN, 1867) is a separate subspecies, whereas GÖRGES (1952) and ANDERSON (1959) consider it a synonym of *L. borealis*. The Hungarian Upper Oligocene specimens are much smaller than the Miocene specimens of *L. borealis* (e.g. those from Szob). This size difference does not, however, justify a separation.

Typical of the *Pitar beyrichi* community, the subspecies can be regarded a medium-depth sublittoral facies index. It is rare in shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Gyermely 12, 35, Eger-2, Solymár 72, 84, Törökbálint-2, Diósjenő-7, Rétság-2, Becske-2.

Distribution: living from the early Oligocene to this day, this species occurs all over Europe in a considerable vertical and horizontal spread.

Genus: CAVILUCINA FISCHER, 1887

Subgenus: MESOMILTHA CHAVAN, 1938

Cavilucina (Mesomiltha) droueti schloenbachi (KOENEN, 1868)
Pl. XIV, figs 3—4

1868 *Lucina Schloenbachi* KOEN. — KOENEN, p. 247, Pl. 28, fig. 9
1884 *Lucina Schloenbachi* KOEN. — SPEYER et KOENEN, Pl. 11, figs 6—7; Pl. 12, figs 5—6
1925 *Lucina Schloenbachi* KOEN. — KAUTSKY, p. 33, Pl. 3, figs 17—18
1952 *Phacoides schloenbachi* KOEN. — GÖRGES, p. 40
1957 *Cavilucina droueti schloenbachi* KOEN. — GLIBERT, p. 33, Pl. 3, fig. 9
1958 *Phacoides schloenbachi* KOEN. — SENEŠ, p. 70

A valve smaller than even that of *Lucinoma borealis*; length usually not exceeding height. The antero-dorsal margin bears a hump near its middle; the postero-dorsal margin is short and straight. The dorsal margin is straight, truncate, meeting the strongly rounded ventral margin in a hardly softened obtuse angle. The anterior margin is likewise rounded. The beak is in the median position. The valve surface bears a dense, fine concentric ribbing, much closer-spaced than on *Lucinoma borealis*.

Dimensions: Height: 7.3 mm; length: 7.4 mm.

A medium-depth sublittoral facies index, it is frequent in the *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrences: Solymár 72, Dejtár, Becske-1.

Distribution: This is an Oligocene Boreal species occurring also in the Paratethyan Upper Oligocene.

Thyasiriidae

Genus: THYASIRA LAMARCK, 1818 (= *Axinus* SOWERBY, 1823)

Thyasira vara angusta BÁLDI, 1966
Pl. XV, fig. 5

1966 *Thyasira vara angusta* n. subsp. — BÁLDI, p. 85, Pl. 1, fig. 4

Differs from *Thyasira vara* Korobov s.s., collected from the Kiscell Clay, in its smaller size, narrower, more produced valve, and slightly more regular ribbing.

Dimensions. Height: 11.7 mm; length: 10.7 mm.

A deep-sublittoral to bathyal species found in the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/5.

Distribution: the subspecies is not known from anywhere else. *T. vara* s.s. occurs in the deeper Oligocene of the Paratethys and in the South Russian Eocene.

Cardiacea

Cardiidae

Genus: LAEVICARDIUM Swainson, 1840

Laevicardium cyprium (Brocchi, 1814)

Pl. XV, fig. 4

1863 *Cardium comatulum* Bronn — Sandberger, p. 320, Pl. 27, fig. 8
1864 *Cardium comatulum* Bronn var. — Speyer, p. 301, Pl. 41, fig. 10
1868 *Cardium comatulum* Bronn — Koenen, p. 244, Pl. 29, figs 1—2
1870 *Cardium fragile* Brocc. — Hörnes, p. 178, Pl. 30, fig. 6 (non Brocchi)
1884 *Cardium comatulum* Bronn — Speyer et Koenen, Pl. 8, figs 10—11
1899 *Laevicardium cyprium* Brocc. — Sacco, p. 52, Pl. 12, figs 1—3
1914 *Cardium comatulum* Bronn — Telegdi-Roth, p. 59
1925 *Cardium cyprium* Brocc. — Kautsky, p. 37, Pl. 4, fig. 7
1936 *Laevicardium fragile* Brocc. — Bogsch, p. 52, Pl. 2, figs 4—7 (non Brocc.)
1936 *Cardium comatulum* Bronn — Noszky, p. 87
1939 *Cardium cyprium* Br. aff. var. *taurolaevis* Sacco — Noszky, p. 57
1940 *Cardium subturgidum* Orb. — Sorgenfrei, p. 21, Pl. 4, fig. 7
1950 *Laevicardium cyprium* Brocc. — Heering, p. 30, Pl. 6, figs 124—126 and 137
1952 *Laevicardium cyprium* Brocc. — Görges, p. 43
1954 *Laevicardium cyprium* Brocc. — Csepreghy-Meznerics, p. 89, Pl. 12, fig. 13
1957 *Laevicardium cyprium comatulum* Bronn — Glibert, p. 37, Pl. 4, fig. 2
1958 *Laevicardium cyprium* Brocc. — Sorgenfrei, p. 100
1958 *Cardium cyprium* Brocc. — Seneš, p. 79
1959 *Laevicardium cyprium* Brocc. — Anderson, p. 128, Pl. 16, fig. 7
1962 *Laevicardium cyprium comatulum* Bronn — Hölzl, p. 81, Pl. 4, fig. 9
1963 *Laevicardium cyprium* Brocc. — Báldi, p. 79, Pl. 3, figs 3—4
1964 *Laevicardium cyprium* Brocc. — Anderson, p. 166

A relatively small, almost equilateral, fragile, shiny, thin-shelled valve, resembling *L. tenuisulcatum* in shape. Its surface is covered by close-spaced, very flat, fine radial ribs (most often visible under a magnifying glass only). Their number is 100 to 120; they are slightly stronger in the posterior region. The growth lines are slightly weaker than the radial ribs.

Dimensions. Height: 14 mm; length: 16 mm.

KAUTSKY (1925) and GÖRGES (1952) identify *L. cyprium* with *L. comatulum* (BRONN, 1850). According to ANDERSON (1959), the form described by HÖRNES (1870) and BOGSCH (1936) by the name *L. fragile* (?non BROCCHI) can likewise be identified with *L. cyprium*. The "Tortonian" specimens from Szob and Nógrádszakál fully agree with the Upper Oligocene ones from Eger and Törökbálint.

In a superficial way, *L. cyprium* and juvenile *L. tenuisulcatum* are much alike. The differences have been pointed out in some detail by TELEGDI-ROTH(1914) and GÖRGES (1952).

Typical of the medium-depth sublittoral facies, primarily of the *Pitar beyrichi* community; very scarce in shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Mány 9, Felsőőrspuszta 22, 44, Szomor 31, Máriahalom 36, Zsámbék 42, Gyermely 50, Tök 51, 52, Solymár 72, 91, Csordakút 5, Törökbálint-1, -2, Leányfalu-3, Becske-1, Diósjenő-4, Eger-1/k, -2.

Distribution: this species that emerged in the early Oligocene still lives today. It is widespread all over Europe.

Laevicardium tenuisulcatum (NYST, 1836)

Pl. XV, figs 1—3

1870 *Cardium cingulatum* GOLDF. — HÖRNES, p. 177, Pl. 25, fig. 1

1884 *Cardium cingulatum* GOLDF. et var. div. — SPEYER et KOENEN, Pl. 7, figs 4—7; Pl. 8, figs 1—9

1897 *Cardium cingulatum* GOLDF. — WOLFF, p. 247, Pl. 22, figs 5—7

1899 *Cardium cingulatum* GOLDF. — BÖCKH, p. 22, Pl. 5, fig. 3; Pl. 6, fig. 6; Pl. 7, fig. 5

1899 *Laevicardium* cf. *tenuisulcatum* NYST — SACCO, p. 53

1900 *Cardium tenuisulcatum* NYST ? — ROVERETO, p. 90

1912 *Laevicardium cingulatum* GOLDF. — SCHAFFER, p. 68, Pl. 29, figs 14—15; Pl. 30, fig. 1

1914 *Cardium cingulatum* GOLDF. — TELEGDI-ROTH, p. 58

1936 *Cardium cingulatum* GOLDF. — NOSZKY, p. 87

1937 *Cardium cingulatum* GOLDF. — VENZO, p. 107, Pl. 7, fig. 6

1937 *Cardium tenuisulcatum* NYST — VENZO, p. 107, Pl. 7, figs 1—4

1943 *Laevicardium cingulatum* GOLDF. — ALBRECHT et VALK, p. 131, Pl. 13, figs 429—431

1952 *Cardium cingulatum* GOLD. — ANIĆ, p. 26, Pl. 4, fig. 1

1952 *Laevicardium cingulatum* GOLDF. — GÖRGES, p. 42

1953 *Cardium cingulatum* GOLDF. — CSEPREGHY-MEZNERICS, p. 49

1957 *Laevicardium tenuisulcatum* NYST — GLIBERT, p. 36

1958 *Cardium cingulatum* Goldf. — Seneš, p. 78, Pl. 15, fig. 181
1958 *Laevicardium cingulatum* Goldf. — Hölzl, p. 90
1959 *Laevicardium cingulatum* Goldf. — Anderson, p. 131
1962 *Laevicardium cingulatum* Goldf. — Hölzl, p. 80, Pl. 4, figs 7—8
1963 *Laevicardium tenuisulcatum* Nyst — Báldi, p. 79, Pl. 3, figs 1—2

A relatively large and thick, slightly inequilateral shell, with rounded ventral and anterior margins, and an almost straight posterior margin. The surfaces of complete specimens bear 60 to 70 flat, very weak radial ribs, somewhat wider than the furrows between them: these grow gradually stronger towards the posterior margin. Near the ventral margin the ribs are doubled by shallow furrows appearing along their median lines. Weathered, corroded specimens reveal the radial structure of the shell, resembling that of *Glycymeris latiradiata*. The identification of specimens of poor preservation therefore requires much caution. The best safeguard is a glance at the hinge structure.

Dimensions. Height: 55 mm; length: 54 mm; convexity: 21 mm.

This species was, as early as 1868, contracted by Koenen with *L. cingulatum* (Goldfuss 1837). According to Glibert (1957), Nyst's name has priority over that of Goldfuss.

L. tenuisulcatum is typical of the shallow sublittoral facies, being particularly abundant in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Mány 9, Gyermely 12, 25, 39, Máriahalom 36, Zsámbék 42, 43, Vasztély 49, Tök 51, 52, Solymár 72, Törökbálint-1, -2, Szentendre 2, Budafok-1/4, Pomáz-6, Leányfalu-3, Diósjenő-24, Rétság-2, Eger-1/k, -2.

Distribution: ubiquitous in the Paratethys from the Lower Oligocene to the end of the Lower Miocene, as well as in the Boreal and Mediterranean provinces.

Laevicardium kovacovense (Seneš, 1958)

Pl. XV, fig. 7

1958 *Cardium kováčovense* n. sp. — Seneš, p. 79, Pl. 15, fig. 182
?1958 *Laevicardium johanna* n. sp. — Hölzl, p. 93, Pl. 7, fig. 7
1964 *Laevicardium kováčovense* Sen. — Báldi (in Báldi et al.), p. 158, Pl. 1, fig. 3

A medium-sized to small, almost equilateral valve, slightly elongate lengthwise. Its radial ribs are broad, flat; their number is not more than 25 to 35. It consequently differs from the form circle of *L. tenuisulcatum* in its stronger, much broader and less numerous ribs. The radial ribs of *L. kübecki* (Hauer 1847) and *L. sandbergeri* (Gümbel, 1861) are, on the other hand, round-backed. Differences between *L. kovacovense* and *L. johanna* Hölzl, 1958 are evanescent, however, so that the two names are presumably synonymous.

Dimensions. Height: 19 mm; length: 21 mm.

In the shallow sublittoral *Glycymeris latiradiata* community.

Hungarian Upper Oligocene occurrence: Diósjenő-8.

Distribution: known besides Diósjenő-8 exclusively from the type locality, Kováčov in Southern Slovakia. Supposing, however, that it is identical with *L. johanna*, its spread extends also to the Lower Miocene Bavarian Molasse.

Genus: CARDIUM Linné, 1758

Subgenus: CERASTODERMA Mörch, 1853

Cardium (Cerastoderma) thunense Mayer, 1887

1897 *Cardium thunense* May.-Eym. — Wolff, p. 248, Pl. 21, figs 31—32
1899 *Cardium thunense* May.-Eym. — Böckh, p. 24, Pl. 6, fig. 3
1959 *Cardium thunense* May.-Eym. — Vaňova, p. 164, Pl. 23, fig. 32

A small to medium-sized, rounded valve, somewhat angular in the posterior region in some specimens: beak in the median position, slightly bulbous. Height hardly less than length. Smooth, rounded, the number of radial ribs is 17 to 20; these are as wide as or but slightly narrower than the furrows separating them. Of the fragile, corroded specimens at my disposal none is well-preserved; their thinner ribs and greater smoothness as compared to the type are somewhat of an optical illusion, due to the erosion of the concentric lines, as has already been pointed out by Wolff (1897).

Dimensions. Height 10 mm; length: 12 mm.

Cardium is as a rule a genus of suspension-filters, burrowing to a rather small depth in the seabottom sediment; numerous species are euryhaline. *C. thunense* is scarce but ubiquitous from the littoral region to the medium-depth sublittoral zone. It presumably was a euryhaline species (salinity range, 10 to 35 per mille).

Hungarian Upper Oligocene occurrences: Anyácsapuszta 27, Máriahalom 36, Tök 51, Szentendre 2, Pomáz-1, Leányfalu-3, Rétság-2.

Distribution: Known from the Upper Oligocene of the Western and Central Paratethys.

Subgenus: ?TRACHYCARDIUM Mörch, 1853

Cardium (?Trachycardium) egerense Telegdi-Roth, 1914

Pl. XV, fig. 6

1914 *Cardium egerense* n.sp. — Telegdi-Roth, p. 57, Pl. 6, figs 6—7
1936 *Cardium egerense* T. -R. — Noszky, p. 87

A medium-sized, strongly convex, equilateral, entirely rounded valve, with a bulbous beak in the median position. It has a dense ornament of about 30 sharp radial ribs of triangular section. The furrows between them are narrow and pitted: the pits are arranged along concentric lines.

Dimensions. Height: 19 mm; length: 20 mm.

This is a shallow sublittoral, marine-stenohaline form.

Hungarian Upper Oligocene occurrences: Felsőőrspuszta 22, Tök 24, Anyácsapuszta 27, Máriahalom 41, Solymár 72, Leányfalu-3, Diósjenő-24, Eger-1/k.

Distribution: endemic in the Hungarian Upper Oligocene.

Cardium (?Trachycardium) heeri MAYER, 1887

1897 *Cardium Heeri* MAY.-EYM. — WOLFF, p. 246, Pl. 22, figs 2 and 8
1962 *Cardium heeri* MAY. — HÖLZL, p. 84, Pl. 4, fig. 10

The mostly corroded shells or deformed casts at my disposal permit to state this form to be somewhat less convex and perhaps slightly more inequilateral than *C. egerense*: its ribs are less sharp, flat-convex, vaguely knotted, hardly broader than the intercostal furrows: their number is 28 to 35. However, the ribbing and dimensions of corroded, poorly preserved specimens of *C. egerense* fully agree with those of poorly preserved specimens of *C. heeri*. Hence, in a state of insufficient preservation, the two species are rather hard to distinguish.

Dimensions. Height: 20 mm; length: 16.7 mm.

This is a shallow and medium-depth sublittoral, marine species, stenohaline, more frequent in the *Pitar polytropa* and *Pitar beyrichi* communities than elsewhere.

Hungarian Upper Oligocene occurrences: Zsámbék 23, 42, Szomor 31, Máriahalom 36, 41, Pomáz-1, Leányfalu-3, Rétság-2, Becske-1.

Distribution: know from the Upper Oligocene of the Western and Central Paratethys.

Cardium (?Trachycardium) neglectum HÖLZL, 1962
Pl. XVI, figs 1, 3—4; Pl. LI, fig. 9

1962 *Cardium neglectum* n.sp. — HÖLZL, p. 82, Pl. 4, fig. 12
1964 *Cardium neglectum* HÖLZL — BÁLDI, (in BÁLDI et al.), p. 159, Pl. 1, fig. 4

This form differs from the form circle of *C. egerense-heeri* in its somewhat flatter, slightly less equilateral shape: also, it is very angular in the posterior region. Its posterior margin is almost straight; its 23 to 28 ribs are round-backed in the middle region of the valve, but sharp-crested, trigonal in the anterior and posterior regions. The width of the intercostal furrows attains that of the ribs.

Dimensions. Height: 12 mm; length: 14 mm.

Typical of the shallow sublittoral zone; a marine-stenohaline species particularly frequent in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Mány 9, 8, Gyermely 12, 25, Felsőőrspuszta 22, 44, Tök 24, 52, Anyácsapuszta 27, Szomor 31, Máriahalom 36, Zsámbék 42, 48, Vasztély 49, Solymár 72, 84, Leányfalu-3, Diósjenő-7, -8, -24.

Distribution: known from the Upper Oligocene of the Western and Central Paratethys.

Cardium (?Trachycardium) neglectum intersulcatum n. subsp.

Locus typicus: Borehole Solymár 72, depth interval 81.4 to 83.1 m.

Stratum typicum: Upper Oligocene, Egerian (clayey silt).

Derivatio nominis: inter = between, sulcatum = grooved (of the grooves halving the furrows).

Diagnosis. Differs from *C. neglectum* Hölzl, 1962 s.s. in that there is a narrow groove in the median line of each intercostal furrow.

Dimensions. Height: 11 mm; length: 14 mm.

Known from the *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrences: Solymár 72, Zsámbék 43, Tök 52.

Distribution: Known so far from the Hungarian Upper Oligocene only.

Subgenus: ACANTHOCARDIA Gray, 1851

Cardium (Acanthocardia) bojorum Mayer, 1887

Pl. XVI, fig. 2

1897 *Cardium Bojorum* May.-Eym. — Wolff, p. 248, Pl. 21, fig. 38
1899 *Cardium Bojorum* May.-Eym. — Böckh, p. 22, Pl. 5, fig. 2

Medium-sized to small valves highly variable in shape: ranging from more rounded and less inequilateral forms to more inequilateral ones, angular in the posterior region. Its 22 sharp, trigonal ribs bear on their crests nodes that presumably mark the points of adherence of spines, whereas on the rib lanks and in the furrows there are small pits arranged along concentric lines. Let us point out that the ribs are flatter, roundbacked near the beak.

Dimensions. Height approx. 27 mm; length approx. 29 mm.

Frequent in littoral and shallow sublittoral communities, this euryhaline species could stand fluctuations of salinity between 10 and 30 per mille.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Mány 6, 8, 9, Gyermely 12, 35, 46, 50, Zsámbék 23, 42, 43, 48, Tök 24, 51, 52, Szomor 31, Felsőőrspuszta 44, Vasztély 47, Solymár 72, Szentendre 2, Leányfalu-1, Diósjenő-3.

Distribution: in the Upper Oligocene of the Central and Western Paratethys.

Subgenus: PARVICARDIUM MONTEROSATO, 1884

Cardium (Parvicardium) praepapillosum BÁLDI, 1966
Pl. XVI, fig. 5

1966 *Cardium praepapillosum* n. sp. — BÁLDI, p. 86, Pl. 1, fig. 12

This species differs from related *C. papillosum* POLI, 1791 in the following features: its dorsal margin is shorter, the hinge plate is more arched; the valve is more trigonal on the whole. The ribs are flatter, somewhat broader, and entirely smooth, without nodes or any other ornament.

Dimensions. Height: 5.0 mm; length: 5.1 mm.

So far only in the deep sublittoral — shallow bathyal *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: known only from this one locality sor far.

Genus: RINGICARDIUM FISCHER, 1887

Ringicardium buekkianum (TELEGDI-ROTH, 1914)
Text fig. 51; Pl. XVI, fig. 6

1914 *Cardium bükkianum* n. sp. — TELEGDI-ROTH, p. 57, Pl. 5, figs 5—8
1936 *Cardium bükkianum* T.-R. — NOSZKY, p. 87
1937 *Cardium bükkianum* T.-R. — VENZO, p. 102, Pl. 7, fig. 5
1955 *Ringicardium bükkianum* ROTH — ACCORDI, p. 44
1958 *Cardium bükkianum* T.-R. — SENEŠ, p. 80

A large inequilateral, strongly convex alate valve, with about 30 ribs. Near the anterior margin, the ribs are trigonal, becoming more and more rounded and flat towards the median region. In the latter, the ribs are very broad, flat: the furrows between them are narrow, having less than half the width of the ribs. The furrows are not entirely flat but slightly convex, with on either side a weak groove along the line of contact with the adjacent rib. The growth lines are very strong in the furrows but vague on the ribs. The thin, fragile shells are most often fragmentary: the only relatively complete specimen is from Eger. Fortunately, however, identification even of the fragmentary specimens is easy (Fig. 51).

Dimensions. Height: 66 mm; length: 80 mm (TELEGDI-ROTH, Pl. 5, Fig. 5).

In the shallow sublittoral zone, most often in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Szentendre 2, Leányfalu-4, Eger-1/k, Dömös-2.

Distribution. In addition to the Upper Oligocene of the Paratethys, it has been identified also in the Mediterranean (North Italian) Oligocene.

Fig. 51. *Ringicardium buekkianum.* Eger-1/k.
After Telegdi-Roth (1914)

Veneracea

Veneridae

Genus: VENUS Linné, 1758

Subgenus: VENTRICOLA Roemer, 1867

Venus (Ventricola) multilamella (Lamarck, 1818)

Pl. XVIII, figs 1—3, 5

1870 *Venus multilamella* Lam. — Hörnes, p. 130, Pl. 15, figs 2—3
1900 *Ventricola multilamella* Lk. et var. div. — Sacco, p. 30, Pl. 8, figs 1—18
1910 *Venus multilamella* Lam. — Schaffer, p. 86, Pl. 40, figs 8—9
1910 *Chione multilamella* Lam. — Cossmann et Peyrot, p. 373, Pl. 13, figs 26—28
1936 *Ventricoloidea multilamella* Lk. — Noszky, p. 88
1945 *Venus multilamella* Lam. — Glibert, p. 186, Pl. 11, fig. 5
1950 *Venus multilamella* Lam. — Heering, p. 37, Pl. 7, figs 163—165; Pl. 8, figs 195—196
1958 *Venus multilamella* Lam. — Sorgenfrei, p. 111, Pl. 18, fig. 55
1958 *Venus multilamella multilamella* Lam. — Seneš, p. 92
1958 *Venus multilamella* Lam. — Hölzl, p. 124
1959 *Venus multilamella* Lam. — Anderson, p. 139, Pl. 17, fig. 3
1963 *Venus multilamella* Lam. — Steininger, p. 32

1964 *Venus multilamella* LAM. — RĂILEANU et NEGULESCU, p. 176, Pl. 9, fig. 2

1964 *Venus multilamella* LAM. — ANDERSON, p. 169, Pl. 8, fig. 58

An oval, rounded, convex valve, with rounded margins, a beak displaced slightly forward, with a lunule forward of it. Its surface bears a dense platy concentric ribbing. The platy ribs are of approximately uniform width, narrower than the furrows between them. The hinge structure exhibits the conspicuous anterior lateral teeth (A I, II, III) typical of the subgenus.

Dimensions.

Height: 21 mm; length: 23 mm; convexity 7 mm (Dejtár)

Height: 19 mm; length: 10 mm; convexity 7 mm (Eger-1/6)

The height-to-length ratio of the valve is very variable and so is the number of platy, concentric ribs. Diósjenő has furnished some specimens markedly produced lengthwise. The mean number of ribs is 35 on the Eger specimens, 42 on those from Dejtár. This marked variability recalls that which is exhibited on the figures and by the varieties of SACCO (1900).

Easy to confuse with some Lower Miocene venerids, it is much smaller than *V. burdigalensis* MAYER, 1858; its ribbing is more uniform, finer; its valve is more convex. It is much smaller than *V. aquitanica* COSSMANN et PEYROT, 1910: it is more produced and its hinge structure is also different. It stands close to *V. haidingeri* HÖRNES, 1848, but is smaller and more convex even than that species. It has on its left valve a much stronger A II tooth than *V. kaltenbachensis* HÖLZL, 1958.

This species inhabited shallow sublittoral to shallow bathyal biotopes in the Upper Oligocene and Miocene seas. In the Hungarian Upper Oligocene, however, it was most abundant in the shallow sublittoral *Glycymeris latiradiata* community.

Hungarian Upper Oligocene occurrences: Kesztölc-1, Diósjenő-24, Dejtár, Eger-1/6, -2.

Distribution: In the Paratethys, in the Mediterranean and Atlantic basins, it is ubiquitous from the beginning of the Upper Oligocene onward and frequent also in the Miocene. It did not, however, reach the North Sea Basin until the Miocene.

Venus (Ventricola) multilamella interstriata (TELEGDI-ROTH, 1914)

Pl. XVIII, fig. 4

1914 *Chione multilamella* LAM. var. *interstriata* nov. var. — TELEGDI-ROTH, p. 52, Pl. 5, figs 1—4

1936 *Ventricoloidea multilamella* LAM. var. *interstriata* T.-R. — NOSZKY, p. 88

1937 *Chione multilamella* LAM. var. *interstriata* ROTH — VENZO, p. 85, Pl. 5, fig. 4

1958 *Venus multilamella* Lk. var. (?) *interstriata* T.-R. — SENEŠ, p. 94, Pl. 16, figs 211—213

1964 *Venus multilamella interstriata* T.-R. — BÁLDI (in BÁLDI et al.), p. 163, Pl. 2, fig. 3

This subspecies differs from *V. multilamella* s.s. in that its dense concentric ribbing is more finely sculptured, less platy; on the other hand, it bears some prominent, remarkably strong and sharp concentric ribs spaced 2 to 3 mm apart, flanking several weaker ribs.

Dimensions. Height: 20 mm; length: 22 mm.

In the shallow sublittoral Pitar polytropa community.

Hungarian Upper Oligocene occurrences: Pomáz-6, Leányfalu-3, Diósjenő-4, Eger-1/k.

Distribution: it has been described in addition to the Central Paratethyan also from the Mediterranean Upper Oligocene (Schio and Belluno).

Meretricidae

Genus: PITAR ROEMER, 1857 (= *Pitaria* DALL, 1902)

Subgenus: Cordiopsis COSSMANN, 1909

Pitar (Cordiopsis) gigas schafferi (KAUTSKY, 1936)

Pl. XIX, figs 1—2

1870 *Venus umbonaria* LAM. — HÖRNES, p. 118, Pl. 12, figs. 1—6

1910 *Amiantis gigas* LAM. — SCHAFFER, p. 81, Pl. 37, figs 14—16; Pl. 38, fig. 1

1936 *Pitaria Schafferi* n. sp. — KAUTSKY, p. 4, Pl. 1, figs 1—2

1958 *Pitaria schafferi* KAUT. — HÖLZL, p. 109, Pl. 10, figs 2—4

1958 *Pitaria* cf. *schafferi* KAUT. — SENEŠ, p. 87, Pl. 16, figs 203

1964 *Meretrix gigas* LAM. — RĂILEANU et NEGULESCU, p. 170, Pl. 10, fig. 1

1964 *Pitar gigas schafferi* KAUT. — BÁLDI (in BÁLDI et al.), p. 169, Pl. 1, fig. 8

Besides the thick shell fragments at our disposal, all of which suggest a large size, there are also the liberated hinge structures of one left and one right valve to prove the presence of this species in the Upper Oligocene of Diósjenő. Still, there is some doubt whether these do not represent some gigantic variety of *Pitar polytropa*. The example of *P. polytropa solida* (SANDBERGER, 1863) proves that this species can also produce thick-shelled, larger-sized varieties in certain environments. The Diósjenő form seems, however, larger and longer than even this extreme variety.

From *P. gigas* (LAMARCK, 1818) s. s. the subspecies *schafferi* differs according to KAUTSKY (1936) in that it is smaller; its lateral tooth A II is rudimentary; its shell is thicker and its beak is displaced farther forward. To my mind, however, these are merely subspecific differences. Atlantic Lower Miocene *P. intercalaris* (COSSMANN and PEYROT, 1910) is a probable synonym. The rudimentary lateral tooth A II is a safe distinctive criterion from the Bavarian Upper Oligocene *P. böhmi* HÖLZL, 1962, although the close relationship is beyound doubt.

The *Pitar* species are infaunal suspension-filters. They cannot usually stand protracted decreases in salinity, although two at least of the Upper Oligocene species seem to be markedly euryhaline.

P. gigas schafferi lived, as witness its thick, massive shell, in streaming, agitated sea water. It was a stenohaline species, connected with the *Glycymeris latiradiata* communities.

Hungarian Upper Oligocene occurrence: Diósjenő-24.

Distribution: its deepest occurrences seem to be in the Paratethyan Upper Oligocene (Kováčov, Diósjenő). It is typical and abundant in the Lower Miocene of the Paratethys. The group of *P. gigas* occurs in the Mediterranean and Atlantic Miocene.

Pitar (Cordiopsis) polytropa Anderson, 1958

Pl. XVII, figs 1—2

1863 *Cytherea incrassata* Sow. et var. div. — Sandberger, p. 300, Pl. 23, fig. 11; Pl. 24, figs 1—3

1870 *Cytherea incrassata* Sow. var. *transilvanica* — Hofmann, p. 22, Pl. 3, fig. 2

1884 *Cytherea incrassata* Sow. et var. div. — Speyer et Koenen, Pl. 5, figs 14—18; Pl. 6, figs 1—5

1894 *Cytherea incrassata* Sow. — Koenen, p. 1259, Pl. 86, figs 12—13; Pl. 87, figs 1—3

1897 *Cytherea incrassata* Sow. — Wolff, p. 252, Pl. 23, figs 13—14

1899 *Cytherea incrassata* Sow. — Böckh, p. 26, Pl. 7, fig. 3

1900 *Amiantis* cf. *incrassata* Sow. et var. div. — Sacco, p. 21, Pl. 4, figs 31—33

?1910 *Meretrix* cf. *incrassata* Sow. — Cossmann et Peyrot, p. 407, Pl. 17, fig. 5—7; Pl. 18, figs 14—16 and 30

1910 *Cytherea incrassata* Sow. — Kranz, p. 219, Textfig. 2

1914 *Meretrix incrassata* Sow. — Telegdi-Roth, p. 53, Pl. 5, figs 10—11

1936 *Meretrix incrassata* Sow. — Noszky, p. 89

1937 *Meretrix incrassata* Sow. — Venzo, p. 92, Pl. 5, fig. 21

1939 *Cytherea incrassata* Sow. et var. div. — Noszky, p. 69

1943 *Pitaria incrassata* Sow. — Albrecht et Valk, p. 133, Pl. 14, figs 443—445

1952 *Pitaria incrassata suborbicularis* Goldf. — Görges, p. 44

1953 *Pitaria incrassata* Sow. — Csepreghy-Meznerics, p. 49

1955 *Meretrix incrassata* Sow. — Accordi, p. 43

1957 *Cordiopsis incrassata* Sow. — Glibert, p. 38, Pl. 3, fig. 13

1958 *Pitaria incrassata* Sow. — Hölzl, p. 107, Pl. 10, fig. 1

1958 *Pitaria incrassata* Sow. et var. div. — Seneš, p. 85—86, Pl. 16, figs 201—202 and 205—206

1959 *Pitar polytropa* nom. nov. cum var. div. — Anderson, p. 135, Pl. 17, fig. 1

1959 *Pitar incrassata incrassata* Sow. — Vaňova, p. 167, Pl. 23, fig. 34

1962 *Pitar polytropa* And. et *P. p. suborbicularis* Goldf. — Hölzl, p. 95, Pl. 5, figs 2—5

1963 *Pitar polytropa* And. — Báldi, p. 81, Pl. 3, figs 9—11

1965 *Pitaria polytropa* And. — Ondrejičková et Seneš, p. 187

The medium-sized, oval valve is highly variable as to its height-to-length ratio. On large specimens from Törökbálint, with their well-rounded ventral margins, the two dimensions are almost equal. The ventral margins of the lengthwise elongate valves from Eger are less rounded. The almost straight antero-dorsal margin stands in a marked contrast to the roundedness of the other margin sections. The valve surface bears growth lines only, without any ribbing. The anterior lateral tooth A II is present on all left valves, irrespective of their shape.

Dimensions. Height: 27 mm; length: 33 mm; convexity: 18 mm (Eger-1/k).

If one accepts Görges's (1952) ideas, then the Hungarian specimens cannot be identified with *P. polytropa suborbicularis* (Goldfuss, 1840), owing to the presence of the lateral tooth A II. It should be pointed out, however, that Glibert (1957) has lately contracted the subgenus *suborbicularis* with the British Lower Oligocene type.

Ubiquitous from the littoral region to the medium-depth sublittoral zone, it is most abundant in the shallow sublittoral *Pitar polytropa* community, of which it is the most typical species. The scattered specimens in the littoral region, particularly in the *Tympanotonus-Pirenella* community, could stand significant decreases in salinity (down to 10 per mille).

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 6, 8, 9, Gyermely 12, 35, 39, 46, 50, Zsámbék 23, 42, 43, 48, Tök 24, 51, 52, Anyácsapuszta 27, Szomor 31, Máriahalom 36, Felsőőrspuszta 44, Vasztély 47, 49, Solymár 72, 84, 85, Dömös-2, Csolnok 695, Kesztölc-1, Törökbálint-1, Szentendre 2, Pomáz-6, Leányfalu-3, -4, Diósjenő-1, -3, Rétság-2, Eger-1/k. Common in the Hungarian Upper Oligocene.

Distribution: ubiquitous in all European seas and faunal provinces from the Eocene to the end of the Lower Miocene.

Subgenus: PARADIONE Dall, 1909

Pitar (Paradione) beyrichi (Semper, 1861)

Pl. XVII, fig. 3

?1866 *Cytherea reussi* n. sp. — Speyer, p. 36, Pl. 4, figs 7—9
1884 *Cytherea beyrichi* Semp. — Speyer et Koenen, Pl. 5, figs 3—11
1897 *Cytherea Beyrichi* Semp. — Wolff, p. 253, Pl. 23, fig. 9
?1897 *Cytherea erycina* L. — Wolff, p. 252, Pl. 23, fig. 7
?1897 *Cytherea subarata* Sandb. — Wolff, p. 251, Pl. 23, fig. 8
1899 *Cytherea Beyrichi* Semp. — Böckh, p. 26, Pl. 7, fig. 2
1952 *Pitaria beyrichi* Semp. — Görges, p. 46
?1952 *Meretrix erycinoides* Lam. — Anić, p. 24, Pl. 2, fig. 6
?1957 *Pitaria dubia* n. sp. — Hölzl, p. 64, Pl. 7, fig. 4
1957 *Callista beyrichi* Semp. — Glibert, p. 41, Pl. 3, fig. 15
1958 *Pitaria beyrichi postera* nov. var. — Hölzl, p. 115, Pl. 11, fig. 7
1958 *Pitaria beyrichi rotundata* nov. var. — Hölzl, p. 116, Pl. 11, fig. 8
1958 *Pitaria beyrichi* Semp. — Seneš, p. 88, Pl. 16, figs 192—193
1962 *Pitaria beyrichi* Semp. — Hölzl, p. 90, Pl. 5, figs 6—8
1963 *Pitar beyrichi* Semp. — Báldi, p. 80, Pl. 4, figs 1—4

A medium-sized to small, lengthwise elongate oval valve. Beak displaced forward to the anterior third of the valve. Apart from the slightly concave antero-dorsal and the almost straight postero-dorsal margin, the outline is well-rounded, and so are in particular the anterior and the posterior margin. The surface is covered in its whole length with rather strong, round-backed concentric ribs, somewhat wider than the furrows between them. The hinge structure is typical of the subgenus.

Dimensions. Height: 22 mm; length: 32 mm.

Several highly similar species are known from both the Oligocene and the Miocene. *P. beyrichi* differs from *P. subarata* (SANDBERGER, 1863) in its larger size and more produced shape, stronger and slightly wider-spaced concentric ribbing. The concentric ribbing of *P. reussi* (SPEYER, 1866) is weaker and more irregular than that of *P. beyrichi*. It is, however, doubtful whether the difference is great enough to be specific, especially in the latter case. Even more doubtful is the independence of *P. dubia* (HÖLZL, 1957). The smaller-sized specimens of *P. beyrichi* are indistinguishable from *P. dubia*. The size and shape of the valve and the density of the ribbing are highly variable, so that slight differences in these features are not necessarily specific; *P. dubia* may be an ecologic variety of *P. beyrichi*, adapted to somewhat lower than normal salinity. Let us add that *P. dubia* HÖLZL 1957 is a junior homonym of "*Meretrix* (*Callista*) *dubia*" MICHELOTTI, 1861 (non HÖLZL, 1957) from the Italian Tongriano. The name in the sense meant by HÖLZL is thus invalid, but I refrain from proposing a new name owing to the doubtful independence of HÖLZL's species.

Whereas the distinction from the above-named Oligocene species is open to doubt, separation from the similar Miocene species is easier, thanks to differences in hinge structure. *P. beyrichi* differs from Lower Miocene *P. lilacinoides* (SCHAFFER, 1910) besides its significantly smaller size also in that the lateral tooth A I of its left valve is much longer and narrower. There is, however, an undeniable phylogenetic connexion, as has already been pointed out by HÖLZL (1958).

The bifid tooth 2 a makes the phylogenetic series of *P. beyrichi-lilacinoides* easy to distinguish from the series of *P. erycinoides* (LAMARCK, 1806) — *P. italica* (DEFANCE, 1818) — *P. chione* (LINNÉ, 1758). On *P. beyrichi xesta* ANDERSON, 1959, the concentric ribs disappear near the ventral margin.

P. beyrichi was a marine, more or less stenohaline form, ubiquitous from the shoreline to the lower limit of the medium-depth sublittoral region. It was, however, most frequent in the medium-depth sublittoral *P. beyrichi* community of which it is one of the most typical species. The small specimens recalling *P. dubia* found in the littoral region could probably stand lower-than-normal salinities.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 6, Gyermely 12, 35, Tök 24, Anyácsapuszta 27, Szomor 31, Máriahalom 36, Zsámbék 42, 43, 48, Vasztély 47, Solymár 72, Csolnok 695, Kesztölc-1, Törökbálint-1, -2, Pomáz-1, Szentendre 2, Leányfalu-1, -3, Diósjenő-7, -8, -24, Patak-1, Rétság-2, Dömös-2.

Distribution. Known from the Boreal region and from the Paratethys; its presence in the deeper Oligocene is doubtful owing to the above mentioned taxinomic incertitudes. Ubiquitous in the Upper Oligocene, it passed the Oligocene—Miocene boundary only in the Paratethys, where it is known from the Lower Miocene of the Bavarian Molasse and of Southern Slovakia.

Pitar (Paradione) splendida (MERIAN, 1858)

Pl. XVII, fig. 4; Pl. XVIII, fig. 8

1863 *Cytherea splendida* MER. — SANDBERGER, p. 303, Pl. 24, fig. 4
1864 *Cytherea splendida* MER. var. — SPEYER, p. 299, Pl. 43, figs 4—5
1884 *Cytherea splendida* MER. — SPEYER et KOENEN, Pl. 5, figs 12—13
1897 *Cytherea splendida* MER. — WOLFF, p. 251
1900 *Callista cf. splendida* MER. et var. div. — SACCO, p. 17, Pl. 4, figs 6—9
1900 *Meretrix splendida* MER. — ROVERETO, p. 99, Pl. 7, fig. 6
1910 *Cytherea splendida* MER. — KRANZ, p. 223, Textfig. 3
1914 *Meretrix splendida* MER. — TELEGDI-ROTH, p. 54
?1921 *Callista Tournoueri* n. sp. — COSSMANN, p. 59, Pl. 3, figs 42—48
1936 *Meretrix splendida* MER. — NOSZKY, p. 89
1937 *Meretrix splendida* MER. — VENZO, p. 95, Pl. 6, figs 1—4
1943 *Venus splendida* MER. — ALBRECHT et VALK, p. 134, Pl. 14, figs 440—442
1952 *Pitaria splendida* MER. — GÖRGES, p. 45
1952 *Meretrix splendida* MER. — ANIĆ, p. 23, Pl. 2, figs 4—5
1958 *Pitaria splendida* MER. — SENEŠ, p. 88, Pl. 16, figs 194—197
1962 *Pitaria splendida* MER. — HÖLZL, p. 93, Pl. 5, fig. 13

A smooth glistening valve which, despite its variable height-to-length ratio, is never so produced lengthwise as is *P. beyrichi*. On the entirely smooth shell surface, the growth lines are hardly visible even under a magnifying glass. Still, some specimens exhibit concentric lines or depressions at intervals of 3 to 4 mm, indicating phases of rest in shell building. The hinge structure is typical of the subgenus and differs from that of *P. beyrichi* only in that the lateral tooth A I of the left valve is shorter and more prominent.

Dimensions. Height: 21 mm; length: 28 mm; convexity: 6 mm (Budafok-1/4).

Presumably identical with the Middle Oligocene species *P. tournoueri* (COSSMANN, 1921) from Gaas.

This is a stenohaline-marine species inhabiting shallow and medium-depth sublittoral biotopes, most frequent in the *Pitar polytropa* and *P. beyrichi* communities.

Hungarian Upper Oligocene occurrences: Mány 6, Máriahalom 41, Solymár 72, Budafok-1/4, Pomáz-1, Leányfalu-3, Diósjenő-7, -8, Rétság-2, Eger-1/k.

Distribution. An Oligocene species, it occurs besides the Paratethys in the Boreal and Mediterranean and probably also in the Atlantic province.

Pitar (Paradione) undata (Basterot, 1825)

Pl. XVII, fig. 7; Pl. XVIII, figs 6—7

1910 *Meretrix undata* Bast. — Cossmann et Peyrot, p. 405, Pl. 15, figs 20—22
?1959 *Pitar undatus* Bast. — Vaňova, p. 166
1964 *Pitar undata* Bast. — Báldi (in Báldi et al.), p. 170

The small valve tapering in the posterior direction has rounded anterior and ventral margins, whereas the posterior margin is long, steep and almost straight. It meets the ventral margin in a hardly rounded angle. The beak is shifted slightly forward. The anterior region bears broad flat concentric ribs overlapping shingle fashion: these grow subdued in the median region, so much so that the posterior part of the valve is smooth. The right valve bears a somewhat trigonal, strong hinge tooth No. 1. separated by a deep narrow furrow from the almost parallel, platy tooth 3a. The elongate, oblique tooth 3b is separated from No. 1 by a deep trigonal pit. Flat A I and A III flank a long deep oval depression.

Dimensions. Height: 9.2 mm; length: 11.4 mm.

The Hungarian specimens fully agree in both ornament and hinge structure with the specimens at my disposal from the Aquitanian Lower Miocene (Lariey). The only difference is the smaller average size of the Hungarian form. The characteristic ornament and the somewhat trigonal shape make distinction from the juvenile specimens of *P. beyrichi* (the forms resembling *P. dubia* Hölzl 1957) rather easy.

A species indicating a littoral facies, it is the most typical form of the *P. undata* community. It presumably could stand significantly decreased salinities (down to 10 per mille).

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Csordakút 5, Mány 6, 8, Tök 24, 52, Szomor 31, Zsámbék 43, 48, Vasztély 49, Gyermely 50, Pomáz-6, -22, Leányfalu-4, Diósjenő-3, -19, Eger-3, Dömös-1.

Distribution. Within the Paratethys it is known so far only from the Hungarian Upper Oligocene. It has been described in addition also from the Lower Miocene of the Atlantic region (the Aquitanian Basin).

Genus: VENERUPIS Lamarck, 1818

Subgenus: PULLASTRA Sowerby, 1826

Venerupis (Pullastra) ex aff. basteroti (Mayer in Hörnes, 1870)

Pl. XIX, fig. 3

?1870 *Tapes Basteroti* May. — Hörnes, p. 113, Pl. 10, figs 8—9
?1910 *Tapes Basteroti* May. — Schaffer, p. 86, Pl. 40, figs 10—14
?1910 *Tapes Basteroti* May. — Cossmann et Peyrot, p. 330, Pl. 13, figs 1—3

A medium-sized to small, broad valve with a beak displaced slightly forward, and with well-rounded margins. The typical ornament consists of a lattice of fine thin concentric and radial ribs. The latter are strongest in the median region.

Dimensions. Height: approx. 10 mm; length: approx. 15 mm.

Differs from the Lower Miocene form circle of *V. basteroti-astensis* in its much smaller size, and in its inequilateral and higher shape. The poor preservation of our specimens does not permit to propose a new subspecific name, but the significant differences existing despite a close relationship do not permit full identification with *V. basteroti*, either.

Found in a littoral community. Euryhaline.

Hungarian Upper Oligocene occurrence: Felsőőrspuszta 44 (376.5 to 379.0 m).

Distribution. *V. basteroti* s. s. is an Atlantic-Mediterranean species that occurs also in the Paratethys, but has been found so far only in the Miocene.

Genus: DOSINIOPSIS CONRAD, 1864

Dosiniopsis sublaevigata (NYST, 1843)

Pl. XVII, figs 5—6

1884 *Venus ? lens* PHIL. — SPEYER et KOENEN, Pl. 6, fig. 6

1891 *Cytherea cyprinaeformis* n. sp. — LIENENKLAUS, p. 63, Pl. 1, fig. 3

1952 *Macrocallista cyprinaeformis* LIEN. — GÖRGES, p. 47, Pl. 1, figs 19—20

1957 *Dosiniopsis sublaevigata* NYST — GLIBERT, p. 39

1963 *Dosiniopsis sublaevigata* NYST — BÁLDI, p. 81, Pl. 4, figs 6—8

A flat, oval, almost round valve with concentric growth lines, some of which are stronger than the rest. The oblique lateral tooth A I is separated by a deep trench from A III. Immediately behind it there are the almost parallel 3 a and 1. Long, thin 3 b is perpendicular to both.

Dimensions. Height: 36 mm; length: approx. 40 mm.

GLIBERT (1957) considers *D. cyprinaeformis* (LIENENKLAUS, 1891) to be identical with NYST's species.

In the *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, ?Zsámbék 23.

Distribution: besides the above localities, it has been signalled within the Paratethys from the South Russian Middle Oligocene; it further occurs in the Oligocene of the Boreal province. It is a Boreal Oligocene species.

Mactracea

Mactridae

Genus: LUTRARIA LAMARCK, 1799

Lutraria oblonga soror MAYER, 1867

Pl. XIX, fig. 5

1897 *Lutraria soror* MAY. — WOLFF, p. 255, Pl. 23, fig. 13

1899 *Lutraria* cf. *soror* MAY. — BÖCKH, p. 27, Pl. 8, fig. 5
1914 *Lutraria lutraria* L. — TELEGDI-ROTH, p. 49 (non LINNÉ)
1936 *Lutraria lutraria* L. — NOSZKY, p. 89 (non LINNÉ)
1936 *Lutraria oblonga* CHEMN. — NOSZKY, p. 89
1958 *Lutraria soror* MAY. — SENEŠ, p. 105, Pl. 18, fig. 245
1964 *Lutraria oblonga soror* MAY. — BÁLDI (in BÁLDI et al.), p. 170

A flat, inequilaterally elliptical valve, strongly produced lengthwise. The beak is shifted far forward. The ventral margin is well rounded, the postero-dorsal margin almost straight. The anterior and posterior margins are also well-rounded. The valve is broadest in the median region, somewhat backward of the beak. The anterior part is tapering; the posterior region is shovel-shaped. The surface bears growth lines and folds only.

Dimensions. Height: 38 mm; length: 83 mm; convexity: 10 mm.

Miocene *L. oblonga* (CHEMNITZ, 1782), s. s. is usually larger and higher. *L. sanna* BASTEROT, 1825, contracted by HÖLZL (1962) with *L. soror* is, in my opinion, an independent species, from which the Hungarian form is readily distinguishable by its more produced, slenderer shape, the much greater length of the posterior, behind-the-beak part of the valve, and finally in its larger size. There is full agreement with WOLFF's figure, although in the case of the numerous specimens from Eger the plastic deformation referred to by HÖLZL seems to be out of question. Also, our specimens fully agree with MAYER's original-diagnosis. *L. lutraria* (LINNÉ, 1758), the form TELEGDI-ROTH (1914) had identified the Eger specimens with, is different both as to size and shape. *L. soror*, however, undeniably stands very close to *L. oblonga*: this is why we have distinguished it only at the subspecific level.

This is a suspension-filtering burrowing stenohaline-marine bivalve of shallow and medium-depth sublittoral communities; it is most frequent in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Gyermely 42, 46, Tök 24, 52, Zsámbék 42, Solymár 72, Leányfalu-3, Diósjenő-7, Eger-1/k.

Distribution: the subspecies is known from the Upper Oligocene deposits of the Western and Central Paratethys. *L. oblonga* s. s. is known in addition to the Paratethyan Miocene also from the Mediterranean Oligocene and Miocene.

Tellinacea

Psammobiidae

Genus: ZOZIA WINCKWORTH, 1930

Zozia antiquata (PULTNEY, 1799)

Pl. XIX, fig. 6

1870 *Psammosolen coarctatus* GMEL. — HÖRNES, p. 21, Pl. 1, fig. 18
1901 *Azor antiquatus* PULTN. — SACCO, p. 15, Pl. 4, figs 9—11
1901 *Azor proantiquatus* SACC. — SACCO, p. 16, Pl. 4, figs 12—13
1909 *Solenocurtus antiquatus* PULTN. mut. *miocaenica* n. mut. — COSSMANN et PEYROT, p. 235, Pl. 4, figs 29—32

?1910 *Azor coarctatus* GMEL. — SCHAFFER, p. 91, Pl. 42, figs 5—8
1936 *Solenocurtus antiquatus* PULTN. mut. *miocaenica* C. et P. — BOGSCH, p. 61, Pl. 2, fig. 9
?1939 *Azor* cfr. *proantiquata* SACC. — NOSZKY, p. 74
1950 *Solenocurtus antiquatus* PULTN. — HEERING, p. 38, Pl. 6, figs 147—150
1955 *Solenocurtus antiquatus* PULTN. var. *miocaenica* C. et P. — ACCORDI, p. 40, Pl. 3, fig. 6
1958 *Solenocurtus antiquatus* mut. *miocaenica* C. et P. — SENEŠ, p. 107, Pl. 17, fig. 224
1964 *Solenocurtus antiquatus miocaenicus* C. et P. — ANDERSON, p. 181, Pl. 10, fig. 68

A relatively convex, lengthwise elongate valve of rounded rectangular outline. Beak displaced slightly forward. Anterior and posterior margin almost equally well-rounded; ventral margin straight and even slightly concave near its middle. Posterodorsal margin straight, parallel to the ventral margin. Antero-dorsal margin likewise straight but slightly oblique sloping towards the anterior margin. The surface exhibits growth lines but no other ornament.

Dimensions. Height: 11 mm; length: 24 mm.

I do not consider *Z. proantiquata* (SACCO, 1901), described from the Tongriano of Dego, an independent species, as it differs from the Neogene type merely in its smaller size. Our specimens are also smaller than the type.

This burrowing bivalve feeding on the organic matter of the seabottom sediment is a stenohaline marine form. It was found in medium-depth sublittoral *Pitar beyrichi* communities.

Hungarian Upper Oligocene localities: Pomáz-1, -16.

Distribution. Known in the Central Paratethys from the Upper Oligocene onward, it is frequent in the Miocene. Outside the Paratethys, it is known from the Mediterranean Oligocene and Neogene and from the Atlantic and Boreal Miocene. It lives today in the Atlantic from Norway to Angola and in the Mediterranean.

Genus: SOLECURTUS BLAINVILLE, 1824 (= *Solenocurtus* auctorum)

Solecurtus basteroti DES MOULINS, 1832

Pl. XIX, fig. 8

1866 *Psammosolen Philippii* n. sp. — SPEYER, p. 31, Pl. 4, figs 4—5
1884 *Psammosolen Philippii* SPEY. — SPEYER et KOENEN, Pl. 1, figs 6—7
?1901 *Solenocurtus* cf. *Basteroti* MOUL. — SACCO, p. 15, Pl. 4, figs 1—3
1909 *Solenocurtus Basteroti* MOUL. — COSSMANN et PEYROT, p. 231, Pl. 4, figs 24—28
1945 *Solenocurtus basteroti* MOUL. — GLIBERT, p. 199, Pl. 12, fig. 3
1950 *Solenocurtus basteroti* MOUL. — HEERING, p. 38, Pl. 5, fig. 112
1952 *Solenocurtus philippii* SPEY. — GÖRGES, p. 50
1957 *Solenocurtus philippii* SPEY. — GLIBERT, p. 42

1958 *Solenocurtus basteroti* Moul. — Hölzl, p. 146, Pl. 14, fig. 7
1958 *Solenocurtus philipii* Spey. — Seneš, p. 108
1959 *Solecurtus basteroti* Moul. — Anderson, p. 142, Pl. 17, fig. 6
1962 *Solecurtus basteroti* Moul. — Hölzl, p. 105, Pl. 6, fig. 10
1964 *Solecurtus basteroti* Moul. — Răileanu et Negulescu, p. 171, Pl. 10, fig. 6; Pl. 11, fig. 1
1964 *Solecurtus basteroti* Moul. — Báldi (in Báldi et al.), p. 171, Pl. 1, fig. 9

A flat valve of rounded rectangular shape, elongate lengthwise. Beak displaced slightly forward. Anterior and posterior margin rounded. Dorsal margin straight, hardly sloping. The surface is ornamented besides growth lines by broad flat transverse bands arranged shingle-fashion. These latter start at the posterior margin horizontally and bending down at a slightly acute angle run to the ventral margin. Proceeding towards the anterior margin, we find bands in which this angle is greater: it finally attains 180° (i.e. these bands are straight), and the transverse bands run from the postero-dorsal margin without bending, obliquely to the ventral margin. This ornament grows subdued and disappears in the anterior region of the valve.

Dimensions. Height: 10 mm, length: 21 mm.

Anderson (1959) contracted *S. basteroti* with *S. philippii* (Speyer 1866).

This stenohaline-marine burrowing bivalve usually turns up in the shallow sublittoral *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Leányfalu-3, Diósjenő-4.

Distribution. It appears in the Paratethys and the Boreal province at the beginning of the Upper Oligocene and is still present in the Miocene. In the Atlantic and Mediterranean provinces it has not been found outside the Miocene so far.

Genus: GARI Schumacher, 1817 (= *Psammobia* Lamarck, 1818)

Gari protracta (Mayer, 1893)

Pl. XX, figs 1, 4

1897 *Psammobia protracta* May. — Wolff, p. 254, Pl. 23, figs 3—5
1901 *Psammocola protracta* May. — Sacco, p. 11, Pl. 2, fig. 7
1952 *Psammobia aquitanica* May. — Anić, p. 22, Pl. 1, figs 5—7
1958 *Psammobia protracta* May. — Seneš, p. 106, Pl. 18, figs 240—243
1964 *Psammobia protracta* May. — Báldi (in Báldi et al.), p. 170, Pl. 1, fig. 2

A flat, oval, lengthwise elongate valve, with a beak slightly displaced forward. The dorsal margins are slightly arcuate, almost horizontal. The anterior and posterior margins are both well rounded, the anterior margin even more so. The posterior margin is very gently broken. There is a flat, often almost indiscernible fold running from the beak to this break. The surface is covered with fine growth lines; it is smooth otherwise.

Dimensions. Height: 24 mm; length: 48 mm; convexity: 5 mm.

G. protracta differs from *G. aquitanica* (Mayer, 1858) in the following traits: it is more inequilateral, and the beak is displaced farther forward, so that the posterior region is somewhat extended at the expense of the anterior region. The posterior fold is usually more pronounced. It stands much closer to *G. labordei* (Basterot, 1825). The only difference of any significance is in size. Even the largest specimens of *G. protacta* are not larger than half the size of *G. labordei*.

The *Psammobia* species are sediment-feeding bivalves burrowing deep in the seabottom sediment.

Abundance of *G. protracta* is invariably a shoreline indicator. It is most frequent in the lagoon-facies *Polymesoda-Tympanotonus* and littoral *Tympanotonus-Pirenella* communities. It occasionally turns up also in the shallow sublittoral zone. Its euryhalinity is documented by its occurrence in surroundings from 3 to 35 percent of salinity.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Mány 6, 8, Gyermely 12, 35, 39, 50, Felsőőrspuszta 22, 44, Zsámbék 23, 42, 43, Tök 24, 52, Anyácsapuszta 27, Szomor 31, Máriahalom 36, Csordakút 5, Szentendre 2, Leányfalu-1, Diósjenő-3, -7, -19, Eger-1/17.

Distribution: the species is widespread in the Upper Oligocene of the Paratethys and of the Mediterranean province.

Gari angusta (Philippi, 1843)

Pl. XX, fig. 2

1884 *Psammobia angusta* Phil. ? — Speyer et Koenen, Pl. 4, figs 16—19
1952 *Psammobia angusta* Phil. — Görges, p. 49, Pl. 1, figs 23—24
1957 *Sanguinolaria angusta* Phil. — Glibert, p. 41, Pl. 3, fig. 17
1958 *Psammobia angusta* Phil. — Seneš, p. 107
1962 *Psammobia angusta* Phil. — Hölzl, p. 101, Pl. 6, fig. 6
1963 *Psammobia angusta* Phil. — Báldi, p. 82, Pl. 4, fig. 5

A lengthwise elongate valve, broad in the posterior and tapering in the anterior region, with a beak shifted forward. The postero-dorsal margin is straight, horizontal, the antero-dorsal margin is also straight, but much shorter and steeply sloping towards the vaguely tapering, strongly rounded anterior margin. The ventral margin is rounded more strongly in its anterior than in its posterior portion. The posterior margin is broadly arcuate. The surface is covered with fine growth lines but smooth otherwise.

Dimensions. Height: 14 mm; length: 24 mm.

It is entirely different in shape from *G. protracta*.

This stenohaline-marine form turns up occasionally in shallow and medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, Leányfalu-3.

Distribution: This is an Oligocene species, known outside the Paratethys also from the Boreal and Mediterranean provinces.

Tellinidae

Genus: ARCOPAGIA LEACH in BROWN, 1827

Arcopagia subelegans (D'ORBIGNY, 1852)

Pl. XX, fig. 7

1901 *Arcopagia subelegans* ORB. — SACCO, p. 112, Pl. 24, fig. 5
1910 *Arcopagia subelegans* ORB. — COSSMANN et PEYROT, p. 266, Pl. 9, figs 17—20
?1958 *Arcopagia* cf. *faba* SANDB. — SENEŠ, p. 110
?1962 *Arcopagia faba* SANDB. — HÖLZL, p. 107, Pl. 6, fig. 13
1963 *Arcopagia subelegans* ORB. — STEININGER, p. 33, Pl. 2, fig. 6

A flat, thin-shelled, oval valve. Beak displaced slightly backward. Margins well-rounded. The surface is covered by extremely dense fine platy concentric ribs.

Dimensions. Height: 13.5 mm; length: 16.5 mm.

Differs from *A. faba* (SANDBERGER, 1863), as shown on SANDBERGER's figure in the more inequilateral position of its beak. On this basis, provided *A. faba* is an independent species at all, the Hungarian specimens belong to *A. subelegans* and so, probably, does also HÖLZL's (1962) figured specimen from the Heuberggraben.

This species occurs mainly in shallow sublittoral facies; it could not stand any protracted decrease of salinity.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 8, 9, Gyermely 12, Tök 24, 52, Szomor 31.

Distribution: An Atlantic-Mediterranean Miocene species, it turns up in the Paratethys already in the Upper Oligocene. *A. faba*, a closely related or possibly identical species, is a Boreal Oligocene form.

Genus: MACOMA LEACH, 1819

Macoma elliptica (BROCCHI, 1814)

Pl. XX, figs 5—6, 8

1875 *Tellina ottnangensis* n. sp. — HOERNES R., p. 370, Pl. 13, figs 1—4
1901 *Macomopsis elliptica* BROCC. — SACCO, p. 107, Pl. 22, figs 36—40
1910 *Macoma elliptica* BROCC. — COSSMANN et PEYROT, p. 281, Pl. 9, figs 33—35
?1910 *Macoma leognanensis* n. sp. — COSSMANN et PEYROT, p. 283, Pl. 10, figs 7—8 and 10—11
1914 *Tellina donacina* L. — TELEGDI-ROTH, p. 51 (non LINNÉ)
1936 *Tellina donacina* L. — NOSZKY, p. 91 (non LINNÉ)
1939 *Tellina elliptica* BROCC. — NOSZKY, p. 72
1945 *Macoma elliptica* BROCC. — GLIBERT, p. 204, Pl. 12, fig. 7
1950 *Macoma elliptica* BROCC. — HEERING, p. 40, Pl. 8, figs 189—190
1954 *Macoma elliptica ottnangensis* R. HOERN. — CSEPREGHY-MEZNERICS, p. 104, Pl. 13, fig. 18

1964 *Macoma elliptica* Brocc. — Anderson, p. 174, Pl. 8, fig. 62
1964 *Macoma elliptica* Brocc. — Báldi (in Báldi et al.), p. 171

A nearly elliptical flattish valve with a small, hardly prominent beak, displaced slightly backward. The anterior margin is well-rounded, the posterior margin less so. The ventral margin is also rounded, whereas the more steeply sloping posterodorsal margin is straight. The left valve exhibits a very shallow, hardly perceptible double fold running from the beak to the concurrence of the ventral and posterior margins. The valve carries an ornament of very fine and dense concentric ribs invisible except under a magnifying glass (Fig. 52).

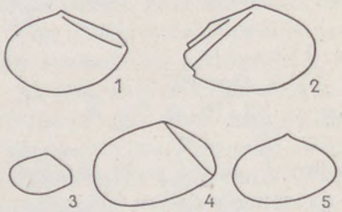

Fig. 52. 1. *Angulus aquitanicus*. 2. *Angulus planatus lamellosus*. 3. *Macoma elliptica* (type). 4. *Macoma elliptica* (Dejtár). 5. *Macoma elliptica* (Eger-1)

Dimensions. Height: 12 mm; length: 20 mm.

Telegdi-Roth's (1914) "*Tellina donacina*" was revealed by a study of its hinge structure and an examination of certain comparative specimens to be a *Macoma elliptica* rather than a member of the genus *Angulus*.

This is a stenohaline-marine, sediment-feeding, burrowing bivalve, sparse but ubiquitous from the shallow to the deep sublittoral zone.

Hungarian Upper Oligocene occurrences: Felsőőrspuszta 44, Tök 52, Leányfalu-2, Diósjenő-4, Dejtár, Eger-1/6, -1/k.

Distribution: present in all European faunal provinces, it arose in the Paratethys in the deeper Oligocene (Noszky mentions it from the Kiscell Clay) and in the Tongriano of the Mediterranean province, whereas in the Boreal and Atlantic provinces it is unknown from deposits older than Miocene.

Genus: APOLYMETIS Salisbury, 1929 (= *Capsa* Lamarck, 1799 non Humpry, 1797)

Apolymetis lacunosa (Chemnitz, 1782)

Pl. XIX, fig. 4

1870 *Tellina lacunosa* Chemn. — Hörnes, p. 91, Pl. 9, fig. 1
1910 *Capsa lacunosa* Chemn. — Cossmann et Peyrot, p. 284, Pl. 10, figs 14—20
?1910 *Tellina lacunosa* Chemn. var. *tumida* Brocc. — Schaffer, p. 103, Pl. 47, fig. 47
1954 *Capsa lacunosa* Chemn. — Csepreghy-Meznerics, p. 103, Pl. 15, fig. 1
1958 *Iphigenia lacunosa* Chemn. — Hölzl, p. 141, Pl. 14, fig. 3
1964 *Capsa lacunosa lacunosa* Chemn. — Răileanu et Negulescu, p. 173, Pl. 12, fig. 2

A lengthwise highly elongate valve of rounded outline; beak displaced backward. Anterior and posterior margins well-rounded, ventral margin hardly so. The beak is connected with the concurrence of the ventral and posterior margins by a very flat, rounded ridge. It is along this line that the valve is most convex. Close behind this ridge and parallel to it there is another, weaker ridge. Behind it, the valve drops rather sharply away towards the posterior margin. The valve surface is smooth except for some weak, irregular growth lines.

Dimensions. Height: 22 mm; length: 17 mm; convexity: 5 mm.

Differs from the Miocene type of *A. lacunosa* merely in its somewhat more elongate shape and in the slightly more asymmetrically located beak. The juvenile specimens at my disposal from the rich Middle Miocene material of Bántapuszta do not, on the other hand, differ at all from the Oligocene specimens of Pomáz.

Restricted to littoral communities in the Upper Oligocene, this species could stand up rather well to slight decreases in salinity. The living representatives of the genus inhabit similar surroundings on the West African coast.

Hungarian Upper Oligocene occurrences: Szomor 31, Pomáz-6, Diósjenő-19, Dömös-2.

Distribution: A Mediterranean-Atlantic species, it is widespread also in the Miocene of the Paratethys. Its oldest known occurrence is in the higher Upper Oligocene of Hungary, at the above-listed localities.

Genus: ANGULUS Megerle von Mühlfeld, 1811

Subgenus: PERONIDIA Dall, 1900

Angulus (Peronidia) nysti (Deshayes, 1860)

Pl. XXI, figs 1—2, 4

1863 *Tellina Nystii* Desh. — Sandberger, p. 294, Pl. 23, fig. 6
1884 *Tellina Nysti* Desh. — Speyer et Koenen, Pl. 4, fig. 15
1897 *Tellina Nystii* Desh. — Wolff, p. 254, Pl. 23, figs 11—12
1899 *Tellina Nystii* Desh. — Böckh, p. 27, Pl. 9, fig. 2
1936 *Tellina Nysti* Desh. — Noszky, p. 90
1952 *Angulus nysti* Desh. — Görges, p. 51
1952 *Tellina nysti* Desh. — Anić, p. 21, Pl. 1, fig. 10
1957 *Angulus nysti* Desh. — Glibert, p. 43, Pl. 4, fig. 1
1958 *Angulus nysti* Desh. — Hölzl, p. 151, Pl. 15, fig. 2
1958 *Angulus nysti nysti* Desh. — Seneš, p. 111, Pl. 17, figs 219
?1958 *Angulus nysti regularis* — Seneš, p. 112, Pl. 17, fig. 217
1962 *Angulus nysti* Desh. — Hölzl, p. 111, Pl. 6, figs 15—18
1963 *Angulus nysti subfallax* n. ssp. — Báldi, p. 82, Pl. 4, fig. 9—12
1965 *Angulus nysti* Desh. — Ondrejičková et Seneš, p. 188

The almost equilateral, flat valve exhibits growth lines only. The beak is in a nearly or wholly symmetrical position. The straight or slightly convex dorsal margins drop away from it with rather steep slopes. The anterior margin is broadly, conspicuously rounded; the posterior margin is somewhat angular (Fig. 53).

Dimensions. Heigth: 21 mm; length: 32 mm.

Easy to distinguish from the most closely-related species, Boreal Miocene *A. fallax* (LEHMANN, 1893), by its smaller size, less inequilateral valve, and less steeply sloping postero-dorsal margin. *A. nysti regularis* SENEŠ, 1958 and *A. nysti pseudofallax* HÖLZL, 1958 are probable synonyms. Nor has the distinction of *A. nysti subfallax* BÁLDI, 1963 been borne out by the subsequent, more copious finds.

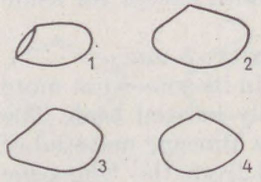

Fig. 53. 1. *Angulus donacinus*. 2. *Angulus posterus*. 3. *Angulus fallax*. 4. *Angulus nysti* (Törökbálint)

Angulus is a genus of sediment-feeding stenohaline-marine infaunal bivalves. *A. nysti* is frequent in the shallow sublittoral *Nucula-Angulus* community and in the medium-depth sublittoral *Pitar beyrichi* community.

Hungarian Upper Oligocen occurrences: Mány 6, 8, 9, Zsámbék 23, 42, 43, Tök 24, 51, 52, Gyermely 25, 35, Anyácsapuszta 27, Máriahalom 36, Felsőőrspuszta 44, Nagyegyháza 2, Solymár 72, 84, 93, Dömös-2, Szentendre-2, 2, Pomáz-1, -6, Leányfalu-3, Törökbálint-1, -2, Diósjenő-4, -7, -8, Rétság-2, Eger-1/k.

Distribution: Restricted in the Boreal province to the Oligocene, it has lately cropped up in the Lower Miocene of the Western and Central Paratethys (Bavarian molasse and Southern Slovakia).

Angulus (Peronidia) posterus (BEYRICH, 1867)
Pl. XXI, fig. 3

1884 *Tellina postera* BEYR. — SPEYER et KOENEN, pl. 31, fig. 8
1925 *Tellina postera* BEYR. — KAUTSKY, p. 43, Pl. 4, fig. 14
1945 *Angulus posterus* BEYR. — GLIBERT, p. 205, Pl. 12, fig. 8
1952 *Moerella postera* BEYR. — GÖRGES, p. 51, Pl. 1, figs 25—27
1957 *Angulus postera* BEYR. — GLIBERT, p. 43
1958 *Angulus posterus* BEYR. — SENEŠ, p. 113
1962 *Angulus posterus* BEYR. — HÖLZL, p. 109, Pl. 6, figs 21—22

A medium-sized flat elliptical valve, elongate lengthwise, with a steeply sloping, straight posterodorsal margin and a beak displaced rather far backward. The posterior portion of the valve is rather sharply tapering, almost angular, whereas its anterior end is well-rounded. Ornament is restricted to a few weak growth lines.

Dimensions. Height: 9 mm; length: 15 mm.

Differs from *A. nysti* in its much more inequilateral shape and in the posterioral tapering of the valve.

Sporadic but ubiquitous in all sublittoral facies.

Hungarian Upper Oligocene occurrences: Mány 9, Zsámbék 43, Tök 52, Diósjenő-7, Rétság-2, Eger-1/6, Leányfalu-4.

Distribution: within the Paratethys it has so far been encountered in the Oligocene only but in the Boreal province it is a persistent Oligocene—Miocene species.

Angulus (Peronidia) minor (Telegdi-Roth, 1914)

1914 *Tellina aquitanica* May. var. *minor* n. var. — Telegdi-Roth, p. 51, Pl. 5, fig. 9
1936 *Tellina aquitanica* May. var. *minor* T. — R. — Noszky, p. 91

All I can do here is to refer to Telegdi-Roth's figure and description, because no specimen other than the holotype kept in the collection of the Hungarian Geological Institute has cropped up since. My examination of the holotype has convinced me, however, that it is a distinct form, probably an independent species, rather than a variety of *A. aquitanicus* (Mayer).

Hungarian Upper Oligocene occurrence: Eger-1/k.

No other occurrence is known, because the specimen described by Seneš (1958) from Kováčov as "*A. aquitanicus* var. (?) *minor* T.-R." (p. 110, Pl. 17, Fig. 227) does not belong to this species, but probably to *A. nysti*.

Angulus (Peronidia) planatus ancestralis n. subsp.
Pl. XX, fig. 3

?1957 *Tellina langeckeri* n. sp. — Hölzl, p. 65, Pl. 7, fig. 6

Locus typicus: Pomáz-22.

Stratum typicum: Upper Oligocene, Egerian (a friable sandstone)

Derivatio nominis: ancestralis = ancestral, precursory. A small-sized, ancestral form of the group of *A. planatus*.

A slightly inaequilateral, flat valve. The beak is in an almost symmetrical, slightly anterioral position. The anterior margin is well-rounded; the rear end of the valve is tapering. The ventral margin is rounded, the postero-dorsal margin is straight, rather steeply sloping. The left valve exhibits a groove running from the beak to the tapering rear end of the valve. The surface is covered by a dense, concentric ribbing.

Dimensions: Heigth: 12 mm, length: 28 mm (holotype, inventory number M 65.647).

Its more marked concentric ornament, distinctly smaller size and steeper postero-dorsal margin make it easy to distinguish from *A. planatus* (Linné, 1758) a living Neogene species. From Lower Miocene *A. planatus lamellosus* (Dollfus, Cotter et Gomez, 1903) — of which it is an indisputable precursor — it differs only in its incomparably smaller size.

A species indicative of a littoral facies, it is unknown from the deeper regions. In contrast to the *Angulus* species discussed so far, it is euryhaline; it could stand salinities as low as ten per mille. It is particularly characteristic of the *Pitar undata* community.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 8, Szomor 31, Felsőőrspuszta 44, Vasztély 49, Tök 52, Pomáz-22, Diósjenő-3.

Distribution: the subspecies is not known outside the above-named localities. The form circle of living *A. planatus*, however, is wide-spread in the Neogene of the Paratethys and of the Mediterranean-Atlantic area, where it still lives today.

Solenacea

Solenidae

Genus: SILIQUA Megerle von Mühlfeld, 1811

Siliqua nysti Deshayes, 1860

Pl. XIX, fig. 9

1884 *Siliqua Nysti* Desh. — Speyer et Koenen, Pl. 1, fig. 5
1952 *Siliqua nysti* Desh. — Görges, p. 53, Pl. 1, fig. 30

A lengthwise elongate, nearly elliptical, flat valve, with a beak displaced forward. The anterior margin is well-rounded, the posterior margin less so. The postero-dorsal margin is slightly angular. The ventral margin is slightly rounded. The postero-dorsal margin is long, straight, hardly sloping. There is a tall, angular internal rib running from the beak region towards but not quite reaching the ventral margin. On our specimen of incomplete preservation, the valve surface appears to be smooth.

Dimensions. Height: 5 mm; length: 12 mm.

It is of a more elongate shape than *S. bavarica* Mayer (in Gümbel, 1861): also, the rear part of the valve is more tapering; the posterior margin is somewhat more pointed. Other differences amount to very little and the distinction of the two types is somewhat less than fully justified. The Hungarian specimens seem, at any rate, to stand closer to *S. nysti*.

A sediment-feeding, stenohaline marine bivalve; sporadic in the shallow-sublittoral *Nucula-Angulus* community.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Tök 24 Zsámbék 42.

,Distribution: Known outside the Paratethys also from the Boreal Oligocene. The closely related if not identical species *S. bavarica* occurs in the Upper Oligocene of the Western Paratethys.

Genus: ENSIS Schumacher, 1817

Ensis hausmanni (Schlotheim, 1820)

1884 *Solen Hausmanni* Schloth. — Speyer et Koenen, Pl. 1, figs 1—4
1952 *Ensis hausmanni* Schloth. — Görges, p. 53
1957 *Ensis hausmanni* Schloth. — Glibert, p. 44

A long, narrow, slightly arcuate, flat valve. The arching is concave on the postero-dorsal margin and convex on the ventral margin, but the two are not quite parallel: the valve is somewhat broader about its middle. The beak is shifted as far forwards as possible. Posterior margin rounded; anterior margin somewhat angular in its lower portion. The valve surface is smooth.

Dimensions. Height: 4 mm; length: 31 mm.

According to Anderson (1959), it differs only in its hinge structure from *E. ensis* (Linné, 1758) of which it is obviously a direct precursor.

Found in shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Zsámbék 42, Felsőörspuszta 44, Gyermely 50, Tök 52.

Distribution: An Upper Oligocene form, it is known outside the Paratethys also from the Boreal province.

Genus: CULTELLUS Schumacher, 1817

Cultellus budensis n. sp.

Pl. XIX, fig. 7

Locus typicus: borehole Solymár 72: depth interval 77.8 to 79.8 m.

Stratum typicum: Upper Oligocene, Egerian (clayey silt).

Derivatio nominis: from the Buda Mountains (budensis = Budaian), where the borehole yielding the holotype had been sunk.

A lengthwise produced elliptical valve. The beak is very weak, hardly prominent, displaced far forward. The anterior margin is somewhat more tapering than the posterior one: both are well-rounded. The postero-dorsal margin is more rounded than the ventral margin. The parts of the dorsal margin about and in front of the beak are straight, however: they gently slope towards the anterior margin. The surface is smooth, but the magnifying glass reveals some indistinct growth lines (Fig. 54).

Dimensions. Height: 5 mm; length: 13 mm.

C. papyraceus (Reuss, 1867) is more broadened posteriorally; *C. pellucidus* (Pennant, 1777) is larger and more produced lengthwise. *C. bavaricus* Hölzl, 1952 is stockier and smaller. The slimmer valve of Lattorfian *C. roemeri* Koenen, 1894 is slightly arcuate, similarly to that of *Ensis*, and differs therein from *C. budensis*.

This stenohaline-marine sediment-feeding bivalve that burrowed deep in the bottom sediment is restricted to the shallow sublittoral *Nucula-Angulus* community.

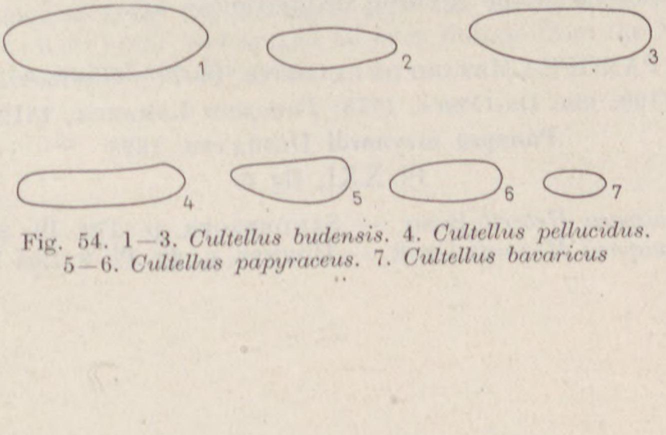

Fig. 54. 1—3. *Cultellus budensis*. 4. *Cultellus pellucidus*. 5—6. *Cultellus papyraceus*. 7. *Cultellus bavaricus*

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Mány 8, Zsámbék 23, 43, 48, Solymár 72.

Distribution: Known only from the above-named localities thus far.

Saxicavacea

Genus: HIATELLA DAUDIN in BOSC, 1801 (= *Saxicava* FLEURIAU DE BELLEVILLE, 1802)

Hiatella arctica (LINNÉ, 1767)

Pl. XXI, fig. 5

1863 *Saxicavia bicristata* SANDB. — SANDBERGER, p. 277, Pl. 21, fig. 6
1864 *Saxicava bicristata* SANDB. — SPEYER, p. 294, Pl. 41, fig. 11
1870 *Saxicava arctica* L. — HÖRNES, p. 24, Pl. 3, figs 1, 3—4
1884 *Saxicava jeurensis* — COSSMANN et LAMBERT, p. 68, Pl. 1, fig. 7
1884 *Saxicava arctica* L. — SPEYER et KOENEN, Pl. 1, fig. 8
1901 *Saxicava arctica* L. et var. div. — SACCO, p. 47, Pl. 13, figs 1—8
1909 *Saxicava arctica* L. — COSSMANN et PEYROT, p. 203, Pl. 3, figs 20—27
1943 *Saxicava arctica* L. — ALBRECHT et VALK, p. 135, Pl. 24, figs 953—956
1945 *Saxicava arctica* L. — GLIBERT, p. 209, Pl. 11, fig. 7
1950 *Saxicava arctica* L. — HEERING, p. 43, Pl. 6, figs 133, 146
1952 *Saxicava arctica* L. — GÖRGES, p. 54
1957 *Saxicava arctica* L. — GLIBERT, p. 44
1958 *Saxicava arctica* L. — SORGENFREI, p. 125, Pl. 20, fig. 66
1959 *Saxicava arctica* L. — ANDERSON, p. 149, Pl. 18, fig. 2

A small valve with a beak displaced far forward. The dorsal margin is strongly rounded, the ventral margin less so. The anterior margin is obliquely truncated along a straight line. The posterodorsal margin is somewhat concave. The valve surface is covered by strong irregular concentric ribs. It further exhibits two straight ridges diverging at an angle, running from the beak towards the posterior margin and bearing small spines.

Dimensions. Height: 1.8 mm; length: 3.0 mm.

Found in a medium-depth sublittoral community of the Hungarian Upper Oligocene.

Hungarian Upper Oligocene occurrence: Eger-2.

Distribution: It has lived to this day, from the Middle Oligocene in the Paratethys, from the Upper Oligocene in the Boreal province, and from the Miocene in the Atlantic-Mediterranean area.

Genus: PANOPEA MENARD DE LA GROYE, 1807 (= *Glycimeris* LAMARCK, 1799; non DA COSTA, 1778; *Panopaea* LAMARCK, 1812)

Panopea meynardi DESHAYES, 1828

Pl. XXI, fig. 6

1863 *Panopaea Heberti* BOSQ. — SANDBERGER, p. 279, Pl. 21, fig. 8
1870 *Panopaea Menardi* DESH. — HÖRNES, p. 29, Pl. 2, figs 1—3

1884 *Panopaea Heberti* Bosq. — Speyer et Koenen, Pl. 1, figs 9—12, Pl. 2, figs 1—3
1897 *Panopaea Meynardi* Desh. — Wolff, p. 256, Pl. 24, figs 1—3
1899 *Panopaea Heberti* Bosq. — Böckh, p. 28, Pl. 8, figs 3—4
1901 *Glycymeris Menardi* Desh. — Sacco, p. 43, Pl. 12, fig. 4
1909 *Glycymeris Menardi* Desh. — Cossmann et Peyrot, p. 195, Pl. 3, figs 40—41
1910 *Glycimeris Ménardi* Desh. — Schaffer, p. 96, Pl. 45, fig. 4; Pl. 46, figs 1—2
1945 *Panopea menardi* Desh. — Glibert, p. 211, Pl. 12, fig. 9
1952 *Panopea meynardi* Desh. — Görges, p. 54
1952 *Glycimeris heberti* Bosq. — Anić, p. 21, Pl. 1, figs 3—4
1957 *Panopea menardi* Desh. — Glibert, p. 45, Pl. 4, fig. 6
1958 *Panopea menardi* Desh. — Hölzl, p. 160
1958 *Panopea meynardi meynardi* Desh. — Seneš, p. 116, Pl. 17, figs 228—229; Pl. 18, figs 233—237
1959 *Panopea meynardi* Desh. — Anderson, p. 150, Pl. 18, fig. 3
1962 *Panopea meynardi* Desh. — Hölzl, p. 117, Pl. 7, figs 7—8
1963 *Panopea meynardi* Desh. — Steininger, p. 34, Pl. 6, fig. 2
1963 *Panopea menardi* Desh. — Báldi, p. 83, Pl. 4, fig. 14
1964 *Panopea meynardi* Desh. — Anderson, p. 187

A lengthwise elongate, large valve of rounded oblong rectangular shape, with a beak displaced to the front third of the valve. The beak is twisted inward and slightly forward. The valve is most convex about the beak. The ventral margin is slightly rounded: the dorsal margins are somewhat concave. The valve very gently tapers posteriorally and exhibits a conspicuous gape. The anterior and posterior margins are well-rounded. The surface bears besides growth lines some flat, broad concentric ribs about the beak.

Dimensions. Height: 50 mm; length: 105 mm; convexity: 15 mm.

The forms described by the names *P. angusta* Nyst, 1836 and *P. héberti* Bosquet, 1852 represent earlier stages in the ontogeny of the animal. Both names are considered synonyms of *P. meynardi* by Wolff, Görges, Glibert, Anderson and Hölzl.

This stenohaline-marine burrowing bivalve preserved in shallow and medium-depth sublittoral communities is most frequent in the *P. beyrichi* community.

Hungarian Upper Oligocene occurrences: Gyermely 12, Máriahalom 36, 41, Törökbálint-1, -2, Budafok-1/4, Szentendre 2, Pomáz-1, Leányfalu-4, Diósjenő-7, -8, -24, Rétság-2, Eger-1/k, Kesztölc-1.

Distribution: widespread all over Europe from the Middle Oligocene to the end of the Miocene.

Desmodonta

Myacea

Corbulidae

Genus: CORBULA Bruguière, 1792 (= *Aloidis* Megerle von Mühlfeld, 1811)

Corbula basteroti Hörnes, 1870

Pl. XXII, fig. 8

?1863 *Corbula subarata* Sandb. — Sandberger, p. 285, Pl. 22, figs 8, 11
1870 *Corbula Basteroti* Hörn. — Hörnes, p. 39, Pl. 3, fig. 10
1884 *Corbula Henckeliusiana* Nyst? — Speyer et Koenen, Pl. 2, figs 9—11
1884 *Corbula rugulosa* Koen. — Speyer et Koenen, Pl. 3, figs 1—2, 7
1894 *Corbula subaequivalvis* Sandb. — Koenen, p. 1306, Pl. 91, figs 11—12
1909 *Corbula Basteroti* Hörn. — Cossmann et Peyrot, p. 169, Pl. 2, figs 69—72
?1921 *Corbula Grateloupi* Ben. — Cossmann, p. 21, Pl. 1, figs 47—58
1936 *Corbula Basteroti* Hörn. — Noszky, p. 92
1945 *Aloidis basteroti* Hörn. — Glibert, p. 214, Pl. 3, fig. 9
1952 *Aloidis subaequivalvis* Boettg. — Görges, p. 56, Pl. 1, figs 31—34
1958 *Aloidis basteroti basteroti* Hörn. — Seneš, p. 121, Pl. 15, fig. 186
1959 *Corbula basteroti* Hörn. — Anderson, p. 153, Pl. 18, fig. 5
1961 *Corbula basteroti* Hörn. — Báldi (In Báldi et al.), p. 95
1962 *Corbula basteroti* Hörn. — Hölzl, p. 120, Pl. 7, fig. 12
1964 *Corbula basteroti* Hörn. — Răileanu et Negulescu, p. 174, Pl. 12, fig. 6

This is a small valve of trapezoidal shape, with a beak in a slightly asymmetrical (anterioral) position. The anterior margin is strongly rounded, the ventral margin hardly so. The dorsal margins are slightly concave. The rear part of the valve is obliquely truncate: the straight dorsal margin and the ventral margin concur at an acute angle. There is an edge running to this angle from the beak: behind it, the valve drops away rather suddenly. This slightly concave area-like surface bears a dense fine concentric ribbing with some irregular, bifurcating ribs. The ribbing is very weak near the beak, and grows stronger towards the ventral margin. The shells are almost perfectly equivalve, with a slight difference in the strength of the above-mentioned edge.

Dimensions. Height: 7.5 mm; length: 10.0 mm.

Differs from *C. carinata* in its more towering shape, flatter valve, much weaker and denser ribbing, and in the absence of a bird's-beak-like prominence on its rear portion.

The *Corbula* species first burrow rather shallow holes in the mud and then fix their valves to the sediment by a byssus. They are suspension-feeding and most often stenohaline-marine organisms.

C. basteroti occurs in every facies from the littoral to the medium-depth sublittoral, being most frequent in the *Pitar polytropa* community (a shallow sublittoral facies).

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 9, Gyermely 12, Tök 24, 51, Szomor 31, Solymár 72, Leányfalu-1, Diósjenő-4, Rétság-2, Eger-1/k, Novaj-1.

Distribution: widespread from the beginning of the Oligocene to the end of the Miocene, in the Paratethys as well as in the Boreal and Atlantic provinces.

Corbula gibba Olivi, 1792

Pl. XXI, fig. 7

1863 *Corbula subpisiformis* Sandb. — Sandberger, p. 288, Pl. 22, fig. 14
1870 *Corbula gibba* Olivi — Hörnes, p. 34, Pl. 3, fig. 7
1884 *Corbula gibba* Ol. — Speyer et Koenen, Pl. 2, figs 4—7
1897 *Corbula gibba* Ol. — Wolff, p. 258
1901 *Corbula gibba* Ol. et var. div. — Sacco, p. 34, Pl. 9, figs 1—11
1909 *Corbula gibba* Ol. — Cossmann et Peyrot, p. 176, Pl. 2, figs 2, 98—101; Pl. 5, fig. 22
1914 *Corbula gibba* Ol. — Telegdi-Roth, p. 50
1921 *Corbula subpisum* Orb. — Cossmann, p. 25, Pl. 1, figs 81—82
1936 *Corbula gibba* Ol. — Noszky, p. 92
1943 *Aloidis gibba* Ol. — Albrecht et Valk, p. 138, Pl. 15, figs 457—462
1945 *Aloidis gibba* Ol. — Glibert, p. 215, Pl. 3, fig. 10
1950 *Aloidis gibba* Ol. — Heering, p. 45, Pl. 5, figs 101—102, 109
1952 *Aloidis gibba* Ol. — Görges, p. 55
1957 *Corbula gibba* Ol. — Glibert, p. 46
1958 *Aloidis gibba gibba* Ol. — Seneš, p. 119
1958 *Aloidis gibba* Ol. — Hölzl, p. 163
1958 *Varicorbula gibba* Ol. — Sorgenfrei, p. 129, Pl. 23, fig. 69
1959 *Varicorbula gibba* Ol. — Anderson, p. 154, Pl. 18, fig. 6
1962 *Varicorbula gibba* Ol. — Hölzl, p. 122
1963 *Varicorbula gibba* Ol. — Báldi, p. 83, Pl. 4, fig. 15
1964 *Corbula gibba* Ol. — Anderson, p. 187
1964 *Corbula gibba* Ol. — Răileanu et Negulescu, p. 173, Pl. 12, fig. 7

Small, stocky, rather convex valves. The right valve is larger and more convex than the left one. The beak is strong, gibbous, prominent. It occupies a median position. Antero-dorsal margin convex; anterior margin strongly rounded; ventral margin less so. The postero-dorsal and posterior margins are almost straight, meeting at an angle; there is another angle where the posterior margin concurs with the ventral margin. There is a very weak edge running from the beak to this latter point of concurrence. The surface bears an ornament of broad concentric ribs groving stronger towards the ventral margin. The ribs are separated by narrow furrows. The ornament of the left valve is much weaker or indeed absent, but the edge on the posterior portion of the valve is stronger.

Dimensions. Height: 4.0 mm, length: 4.5 mm.

The Hungarian Oligocene specimens are very small, much smaller on an average than the Miocene specimens.

Present in every facies from the littoral to the medium-depth sublittoral; it is only in the medium-depth sublittoral *Pitar beyrichi* community that it attains any abundance.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Felsőőrspuszta 22, 44, Tök 51, 52, Solymár 72, Törökbálint-1, -2, Budafok-1/4, Pomáz-1, Leányfalu-3, Becske-1, Eger-1/k, Novaj-1, Dejtár.

Distribution: A persistent, cosmopolitic species, ubiquitous all over Europe, living from the early Oligocene to this day. Its present geographical range covers the Atlantic from Norway to the Bay of Cadiz and the Mediterranean.

Corbula carinata DUJARDIN, 1837

Pl. XXII, fig. 7

1870 *Corbula carinata* DUJ. — HÖRNES, p. 36, Pl. 3, fig. 8
1897 *Corbula carinata* DUJ. — WOLFF, p. 259, Pl. 22, figs 11—12
1909 *Corbula carinata* DUJ. mut. Hoernesi Ben. in litt. — COSSMANN et PEYROT, p. 167, Pl. 2, figs 61—65
1914 *Corbula carinata* DUJ. — TELEGDI-ROTH, p. 50
1936 *Corbula carinata* DUJ. — NOSZKY, p. 92
1950 *Aloidis carinata* DUJ. var. — HEERING, p. 45, Pl. 5, figs 97—98
1952 *Corbula carinata* DUJ. — ANIĆ, p. 20, Pl. 1, fig. 2
1958 *Aloidis carinata* DUJ. — HÖLZL, p. 162
1962 *Corbula carinata* DUJ. — HÖLZL, p. 121, Pl. 7, fig. 14
1964 *Varicorbula carinata* DUJ. — BÁLDI, p. 141, Pl. 1, fig. 6

The markedly convex right valve has well-rounded anterior and ventral margins; the posterior portion of the valve tapers to a point. There is a strong fold running from the beak to the pointed concurrence of the ventral and posterior margins. Breaking along this fold, the valve steeply drops down from there to the posterior margin. The surface is covered with very strong concentric ribs somewhat broader than the furrows separating them. The somewhat smaller left valve has much the same shape as the right one but is less convex; its concentric ornament is also weaker.

Dimensions. Height: 7 mm; length: 11 mm.

Besides its larger size and more inequilateral shape it is easily distinguishable from *C. gibba* also by its more pronounced lengthwise elongation and tapering rear portion.

Represented in every facies from the littoral to the medium-depth sublittoral, it is rather scarce except in the shallow sublittoral communities (*Glycymeris latiradiata* and *Pitar polytropa*).

Hungarian Upper Oligocene occurrences: Csordakút 5, Gyermely 35, Felsőőrspuszta 44, Vasztély 47, Kesztölc-1, Budafok-1/4, Pomáz-1, -6, Leányfalu-3, -4, Diósjenő-3, -7, -8, Eger-1/k.

Distribution: It arises in the Oligocene of the Paratethys and of the Mediterranean. Common in the Miocene all over Europe.

Pandoracea

Pholadomyidae

Genus: PHOLADOMYA Sowerby, 1823

Pholadomya puschi Goldfuss, 1837

Pl. XXII, figs 5—6

1884 *Pholadomya Puschi* Goldf. — Speyer et Koenen, Pl. 4, fig. 20
1897 *Pholadomya Puschi* Goldf. — Wolff, p. 257, Pl. 24, figs 4—6
1900 *Pholadomya Puschi* Goldf. — Rovereto, p. 126
1901 *Pholadomya Puschi* Goldf. et var. div. — Sacco, p. 141, Pl. 23, figs 1—8
1914 *Pholadomya Puschi* Goldf. — Telegdi-Roth, p. 49
1921 *Pholadomya Puschi* Goldf. — Cossmann, p. 17, Pl. 1, figs 24—28
1936 *Pholadomya Puschi* Goldf. — Noszky, p. 89
1939 *Pholadomya Puschi* Goldf. var. *virgula* Micht. — Noszky, p. 79
1952 *Pholadomya puschi* Goldf. — Görges, p. 58
1955 *Pholadomya puschi* Goldf. var. *virgula* Micht. — Accordi, p. 37, Pl. 3, fig. 3
1958 *Pholadomya puschi* Goldf. — Seneš, p. 124, Pl. 19, figs 249—253; Pl. 20, figs 254—262
1958 *Pholadomya puschi* Goldf. — Hölzl, p. 168
1962 *Pholadomya puschi* Goldf. — Hölzl, p. 7, 125, Pl. 7, figs 9—10
1963 *Pholadomya puschi* Goldf. — Báldi, p. 83, Pl. 4, fig. 13

This is a markedly inaequilateral, more or less arcuate, posteroventrally elongate, convex valve, with a prominent beak displaced forward and twisted inward. All its margins are well-rounded except for the straight or slightly concave postero-dorsal margin. The anterodorsal margin is so short as to be almost nonexistent. Immediately below the beak the anterior margin starts, bending backward. The entire surface is covered with concentric growth lines or folds; moreover, the median region exhibits also some prominent radial ribs, running obliquely from the beak to the ventral margin and gradually broadening in the process. In the anterior and posterodorsal regions no such radial ribs are developed. The shell is thin, with a shiny external layer that tends to exfoliate. Most specimens are ornamented casts. Some of them have undergone some plastic deformation. The height-to-length ratio is very variable.

Dimensions. Height: 51 mm; length: 58 mm; convexity: 36 mm.

A stenohaline-marine burrowing bivalve restricted to fine detritic deposits. Scarce in the shallow sublittoral communities; frequent in the medium-depth sublittoral *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrences: Mány 8, Felsőőrspuszta 22, Gyermely 25, Szomor 31, Máriahalom 41, Zsámbék 43, Solymár 72, Törökbálint-1, -2, Budafok-1/4, Pomáz-1, -6, Leányfalu-3, -4, Diósjenő-4,-7, -8, Rétság-2, Becske-1, Dejtár, Eger-1/k.

Distribution: common all over the Paratethyan Upper Oligocene, it persists into the Helvetian in the Bavarian molasse. In the Mediterranean province it also occurs in the Miocene as well as in the Oligocene, being traceable up to and into the Elveziano. In the Boreal and Atlantic provinces, however, it is unknown outside the Oligocene.

Thraciidae

Genus: THRACIA LEACH in BLAINVILLE, 1824

Thracia pubescens (PULTNEY, 1799)

Pl. XXII, fig. 1

1901 *Thracia pubescens* PULTN. et var. div. — SACCO, p. 134, Pl. 27, figs 7—11
?1909 *Thracia* cf. *pubescens* PULTN. — COSSMANN et PEYROT, p. 119
1910 *Thracia pubescens* PULTN. — SCHAFFER, p. 104, Pl. 47, fig. 11
1936 *Thracia pubescens* PULTN. — NOSZKY, p. 91
1958 *Thracia pubescens* PULTN. — HÖLZL, p. 169, Pl. 16, fig. 6
1962 *Thracia pubescens* PULTN. — HÖLZL, p. 128, Pl. 8, fig. 1
1963 *Thracia pubescens* PULTN. — STEININGER, p. 36, Pl. 3, fig. 5

A lengthwise elongate, somewhat convex valve, with a slightly opisthogyral beak in median position. The straight postero-dorsal margin gently slopes towards a likewise straight, obliquely truncate posterior margin. The other margins are rounded. There is a flat ridge running from the beak to, and getting weaker towards, the concurrence of the ventral and posterior margins. There is not other ornament than the growth lines.

Dimensions. Height: 32 mm; length: 55 mm; convexity: 9.5 mm.

Th. elongata SANDBERGER, 1863 is much smaller and more elongate.

The *Thracia* species are stenohaline-marine burrowing bivalves. *Th. pubescens* occurs sporadically in shallow and medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Zsámbék 43, Gyermely 46, Törökbálint-2, Solymár 72, 84, Diósjenő-8, Eger-1/k.

Distribution: the species arises in the Upper Oligocene in the Central and Western Paratethys. It is frequent in the Miocene. In the Boreal and Atlantic provinces, on the other hand, it is known only from the Miocene.

Thracia pubescens bellardii (PICTET, 1855)

Pl. XXII, figs 2—3

1901 *Thracia cf. Bellardii* PICT. — SACCO, p. 135, Pl. 27, figs 13—14
1964 *Thracia pubescens bellardi* PICT. — BÁLDI (in BÁLDI et al.) p. 171

This subspecies differs from *Th. pubescens* s. s. only in that it is somewhat more elongate and that its surface bears strong concentric folds particularly about the beak.

Dimensions. Height: 28 mm; length: 50 mm.

Found in the *Glycymeris latiradiata* community.

Hungarian Upper Oligocene occurrences: Diósjenő-4, -7, ? -8.

Distribution: Besides the above-named localities, it is known only from the Mediterranean Oligocene (the Tongriano).

Thracia ventricosa Philippi 1843

Pl. XXII, fig. 4

1870 *Thracia ventricosa* Phil. — Hörnes, p. 48, Pl. 3, fig. 15
1884 *Thracia Speyeri* Koen. n. sp. — Speyer et Koenen, Pl. 3, figs 13—14; Pl. 4, figs 1—6
1900 *Thracia convexa* ? Wood — Rovereto, p. 124, Pl. 7, fig. 19
? 1901 *Thracia convexa* Wood — Sacco, p. 136, Pl. 27, figs 21—23
1901 *Thracia* cf. *Speyeri* Koen. — Sacco, p. 138, Pl. 27, fig. 29
1925 *Thracia ventricosa* Phil. — Kautsky, p. 49, Pl. 5, fig. 5
1936 *Thracia* cf. *Speyeri* Phil. — Noszky, p. 91
1936 *Thracia convexa* Wood — Noszky, p. 91
1939 *Thracia convexa* Wood cfr. var. *oligantiqua* Sacc. — Noszky, p. 80
1945 *Thracia ventricosa* Phil. — Glibert, p. 219, Pl. 3, fig. 7
1952 *Thracia speyeri* Koen. — Görges, p. 59
1957 *Thracia ventricosa* Phil. — Glibert, p. 47, Pl. 4, fig. 3
1958 *Thracia ventricosa* Phil. — Hölzl, p. 170, Pl. 16, fig. 7
1958 *Thracia speyeri* Koen. — Seneš, p. 125, Pl. 17, figs 220—221
1959 *Thracia ventricosa* Phil. — Anderson, p. 158, Pl. 18, fig. 9
1962 *Thracia speyeri* Koen. — Hölzl, p. 129, Pl. 8, figs 2—3

This is a much more convex, gibbous valve, less elongate and squatter than *Th. pubescens*. The beak is also gibbous, markedly opisthogyral, displaced slightly backward. The strongly tapering posterior portion of the valve is bounded by a straight, truncate posterior margin. The anterior and ventral margins are more rounded than in *Th. pubescens*. It is in its anterior portion that the valve is most convex. Behind a flat ridge running from the beak to the concurrence of the ventral and posterior margins, the valve drops away suddenly and then flattens out. There are also some other weaker edges in this region: these also issue from the beak.

Dimensions. Height: 29 mm; length: 41 mm; convexity: 9 mm.

According to Glibert (1957), *Th. speyeri* Koenen, 1884 is indistinguishable from *Th. ventricosa*. The younger specimens of the latter agree in all respects with the type of *Th. speyeri*.

Encountered in shallow and medium-depth sublittoral surroundings, it attains some abundance only in the medium-depth sublittoral *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrences: Csordakút 5, Gyermely 35, Zsámbék 43, Felsőőrspuszta 44, Tök 51, Kesztölc-1, Leányfalu-3, Diósjenő-7, -24, Dejtár, Eger-1/k.

Distribution: from the deeper Oligocene to the end of the Miocene in the Paratethys and in the Boreal and Mediterranean provinces.

Clavagellacea

Clavagellidae

Genus: CLAVAGELLA Lamarck, 1818

Subgenus: STIRPULINA Stoliczka, 1870

Clavagella (Stirpulina) oblita Michelotti, 1861

Pl. XXIII, fig. 1

1900 *Clavagella oblita* Micht. — Rovereto, p. 127, Pl. 7, fig. 23
1901 *Stirpulina oblita* Micht. — Sacco, p. 147, Pl. 14, figs 47—49
1914 *Clavagella* cf. *oblita* Micht. — Telegdi-Roth, p. 48
1936 *Clavagella oblita* Micht. — Noszky, p. 92
1964 *Clavagella oblita* Micht. — Báldi (in Báldi et al.), p. 171

Thin-walled straight tubes of calcium carbonate, most of them fragmentary, coalesced with minute valves at their proximal ends. The anterior margins of the valves are drawn out, ending in a typical wreath of small tubules. The valves exhibit growth lines only. Most tubes are smooth, but some specimens from Diósjenő exhibit an oblique annular grooving, similar to that on Sacco's figure. Disregarding these grooves, the species differs from *C. bacillum* (Brocchi, 1814) virtually in its smaller size only.

This is a typical burrowing bivalve, most frequent in the shallow sublittoral *Pitar polytropa* community, but sporadically present also in the deeper facies of the sublittoral zone.

Hungarian Upper Oligocene occurrences: Leányfalu-3, Diósjenő-4, Eger-1/k, -1/6.

Distribution: Known from the Oligocene of the Central Paratethys and of the Mediterraneaen province.

Poromyacea

Cuspidariidae

Genus: CUSPIDARIA Nardo, 1840 (= *Neaera* Gray, 1834 non Robineau, 1830)

Cuspidaria clava (Beyrich, 1848)

1868 *Neaera clava* Beyr. — Koenen, p. 264, Pl. 30, fig. 6
1897 *Neaera clava* Beyr. — Wolff, p. 258, Pl. 22, fig. 10
1939 *Neaera clava* Beyr. — Noszky, p. 81
1952 *Cuspidaria clava* Beyr. — Görges, p. 61
1962 *Cuspidaria clava* Beyr. — Hölzl, p. 130, Pl. 8, fig. 4

Our specimens are satisfactorily identified but defy photography. Small, very convex, gibbous, thin, fragile shells carrying weak growth lines only. The rostrum is well-developed, rather broad.

Dimensions. Height: 4.3 mm; length: 7.5 mm.

It differs from its descendant, Neogene and living *C. cuspidata* (Olivi, 1792) in its broader and shorter rostrum.

Cuspidaria is the only genus of carnivores among the bivalves. These animals prefer a fairly deep sea bottom, where, moving about in the fine mud, they suck living animalcules into their mantle cavities by means of their septibranch gills. *C. clava* has turned up most often in the *P. beyrichi* community.

Hungarian Upper Oligocene communities: Szomor 31, Zsámbék 43, Leányfalu-2.

Distribution: This is an Oligocene species found in the Paratethys and in the Boreal province.

Cuspidaria neoscalarina Báldi, 1966

Pl. XXIII, fig. 2

1966 *Cuspidaria neoscalarina* n. sp. — Báldi, p. 86, Pl. 1, fig. 9

Characteristic features: the roundedness of the anterior margin, the oblique umbonal axis, the strong, rounded, relatively wide-spaced ribs growing progressively weaker towards the rear end of the valve, and an ornament of regular, fine threads about equally dense on both the ribs and the intercostal furrows.

Dimensions. Height: 8.0 mm; length: 12.4 mm.

C. scalarina (Mayer in Gümbel, 1861) presumably was a deeper Oligocene ancestor of the Eger form. The latter differs from the former, as revealed by an examination of Dreger's (1903) figure and description, in its more elongate, less rounded shape, in its oblique umbonal axis and in the different position of its beak (Fig. 55).

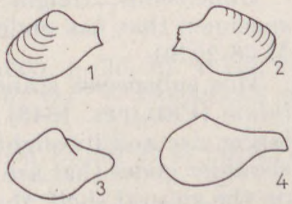

Fig. 55. 1. *Cuspidaria neoscalarina*. 2. *Cuspidaria scalarina*. 3. *Cuspidaria clava*. 4. *Cuspidaria cuspidata*

This deep sublittoral — shallow bathyal species has turned up in the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: No other occurrence has so far been recorded.

Gastropoda (excl. Pteropoda et Pulmonata)

Prosobranchia

Archaeogastropoda

Trochacea

Trochidae

Genus: CALLIOSTOMA Swainson, 1840 (= *Zizyphinus* Gray, 1847)

Subgenus: AMPULLOTROCHUS Monterosato, 1890

Calliostoma (Ampullotrochus) elegantulum hegeduesi n. subsp.

Pl. XXIII, figs 4—5

Locus typicus: Dejtár

Stratum typicum: Upper Oligocene, Egerian (a friable fine-grained sandstone).

Derivatio nominis: in honour of Geologist Dr. Gyula HEGEDÜS, discoverer of the Dejtár locality and first collector of the subspecies.

This is a medium-sized *Calliostoma* with a slightly coelochonoid, conical shell. The last whorl carries a prominent shoulder: the broad sutural shelf is flat or slightly concave. Each whorl is covered by the succeeding coil up to its shoulder, but the shoulder itself remains visible. The ornament consists of two spiral edges running along the shoulder, the upper one of which carries strong, somewhat spiny nodes. The lower one is almost smooth. The sutural shelf exhibits three strong spiral rows of nodes; the adapical one is somewhat stronger than the other two, but somewhat weaker than the row of nodes on the shoulder. There is a dense, weak, very strongly prosocline axial ribbing on both the sutural shelf and the shoulder. Each rib connects a node on the carina with one or more on the shelf. The base is covered with sharp concentric (spiral) ribs. Part of the umbilicus is covered by a narrow inductura. None of the specimens at my disposal has an unharmed aperture.

Dimensions. Height: 19 mm; diameter: 17 mm (for the holotype, a specimen that has undergone some plastic deformation: inventory number, M 68/2079).

This subspecies stands closest to the Kassel species *Calliostoma elegantulum* (PHILIPPI, 1843) s. s. from which it differs only in its ornament, its larger size and its slightly different shape. Our subspecies has wider-spaced shoulder nodes that are also weaker and less pointed. Of the strings of nodes on the sutural shelf, the adapical one is stronger, although SPEYER's (1869) figures are somewhat vague in this respect. *C. oligocenica* (SACCO 1896), described from the Italian Tongriano is probably another close relative of, but distinct from, my subspecies, as revealed by the difference in ornament obvious even on SACCO's imperfect drawing.

Found in a medium-depth sublittoral *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrence: Dejtár.

Distribution: Known only from this one locality thus far. (The form group of *C. elegantulum* used to inhabit the Boreal Upper Oligocene.)

Genus: JUJUBINUS MONTEROSATO, 1884

Jujubinus multicingulatus praestrigosus BÁLDI, 1966

Pl. XXIII, fig. 7

1936 *Trochus striatus* PENN. var. *colligens* SACCO — NOSZKY, p. 55

1936 *Trochus strigosa* GMEL. cf. var. *simulans* STEF. — NOSZKY, p. 56

1966 *Jujubinus multicingulatus praestrigosus* n. subsp. — BÁLDI, p. 87, Pl. 6, fig. 3

The five hardly convex whorls of this conical shell carry 10 to 20 spiral ribs; the furrows separating these exhibit oblique growth lines. The umbilicus is absent or reduced to a very narrow slit. There is a weak tooth on the collumellar lip.

Dimensions. Height: 7.6 mm; diameter: 5.5 mm.

This subspecies differs from Mediterranean Pliocene *J. strigosus* (GMELIN in CHEMNITZ, 1777) in its smaller size: the incomplete descriptions and poor figure permit no other difference to be safely established. In his description of *J. multicingulatus*, SANDBERGER (1963) makes no mention of the weak tooth on the columellar lip. Our form is presumably a transition between the Oligocene and the Neogene species.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution: The subspecies is known only from this one locality so far. (The form group of *J. multicingulatus* occurs in the Boreal Oligocene and in the Mediterranean Oligocene and Neogene.)

Genus: GIBBULA LEACH in RISSO, 1826

Gibbula affinis protumida SACCO, 1896

Pl. XXIII, fig. 6

1896 *Gibbula affinis* var. *protumida* SACC. — SACCO, p. 36, Pl. 4, fig. 11

? 1915 *Gibbula Eichwaldi* C. et P. race *avitensis* n. var. — COSSMANN et PEYROT, p. 276, Pl. 4, figs 6—9

1964 *Gibbula affinis protumida* SACCO — BÁLDI (in BÁLDI et al.) p. 171, Pl. 2, fig. 9

The small-sized squat conical shell is made up of five whorls that are slightly concave and somewhat inflated along the impressed sutures. The whorl surfaces bear 4 or 5 spiral grooves. The base is delimited by a sharp, strong shoulder. The spiral grooves transgress upon the base, too. The ornament is complemented by oblique growth lines and axially elongate pale brown spots.

Dimensions. Height: 6.6 mm; diameter: 7.3 mm.

This subspecies differs from *G. affinis* (EICHWALD, 1852) s. s. in the sharp, strong shoulder delimiting the base and in the generally flatter, slightly concave outline of the whorls.

The *Gibbula* species are herbivorous, often euryhaline gastropods. *G. affinis protumida* is a euryhaline littoral facies index, known from the *Tympanotonus-Pirenella* and *Mytilus aquitanicus* communities.

Hungarian Upper Oligocene occurrences: Szentendre 2, Diósjenő-1, -3.

Distribution: Within the Paratethys, the subspecies is restricted to the above-named localities, whereas in the Mediterranean province it occurs in both the Oligocene and Miocene. The form circle of *G. affinis* is widespread in the Miocene of both the Mediterranean and the Paratethys.

Gibbula proxima Hölzl, 1962

1962 *Gibbula proxima* n. sp. — Hölzl, p. 137, Pl. 8, fig. 8

A small-sized shell of five whorls, the shape of a flattened cone, with a spire of almost smooth outline. The last whorl bears six spiral ribs. There is a deep open umbilicus and an almost flat base.

Dimensions. Height: 6.5 mm; diameter: 8.5 mm.

Readily distinguished from the foregoing species by its larger and flatter shell and broad deep umbilicus.

Found in a shallow sublittoral environment.

Hungarian Upper Oligocene occurrence: Pomáz-1.

Distribution: A rare species restricted so far to the Upper Oligocene of the Central and Western Paratethys.

Gibbula dubia n. sp.

Pl. XXIII, figs 3, 8

Locus typicus: borehole Nagyegyháza 3, depth interval 46.2, to 47.6 m.

Stratum typicum: Upper Oligocene, Egerian (a friable, fine-grained sandstone).

Derivatio nominis. Dubia = doubtful, on account of its similarity to the species *G. proxima.*

The small shell having the shape of a very low flat cone comprises four rapidly expanding whorls. The whorls are flat. The shoulder of the last whorl is sharp. Ornament includes 6 to 8 spiral ribs either of uniform strength, or arranged in an alternation of stronger and weaker ones.

Dimensions. Height: 3.2 mm; diameter: 5.5 mm. (Holotype, inventory number M 65/964.)

Very close to *G. proxima,* but incomparably smaller and lower. It seems, however, to agree fully with the specimen figured by Cossmann and Peyrot (1915) by the name *Gibbula* (*Tumulus*) sp. (p. 284, Pl. 4, Figs 26—28).

This is a stenohaline-marine species known from shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Csordakút 5, Gyermely 39.

Distribution: known only from the above-named localities thus far.

Skeneidae

Genus: TEINOSTOMA Adams, 1853 (= *Tinostoma* Fischer, 1885)

Teinostoma egerensis (Báldi, 1966)

Pl. XXIV, figs 5—6

1966 *Tinostoma egerensis* n. sp. — Báldi, p. 86, Pl. 2, fig. 5

The three fairly rapidly expanding whorls are entirely smooth: only above the rounded shoulder of the last whorl are there two very close-spaced and very weak spiral lines. The aperture is pear-shaped. The inner lip is callous but the callus does not cover up the umbilicus. Very small.

Dimensions. Height: 1.0 mm, diameter: 1.8 mm.

Differs from *T. woodi* (HÖRNES, 1856) in its smaller size and taller spire. It also differs from all Oligocene *Teinostoma* significantly in one or more features.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: An endemic form, not known thus far from anywhere else.

Neritacea

Neritidae

Genus: THEODOXUS MONTFORT, 1810

Subgenus: VITTOCLITHON BAKER, 1923

Theodoxus (Vittoclithon) pictus (FÉRUSSAC, 1825)

Pl. XXIV, figs 1—2, 7

1856 *Neritina picta* FÉR. — HÖRNES, p. 535, Pl. 47, fig. 14
1870—75 *Neritina picta* FÉR. — SANDBERGER, p. 480
1896 *Puperita picta* var. *taurinensis* SACC. — SACCO, p. 51, Pl. 5, fig. 52
1899 *Neritina picta* FÉR. — BÖCKH, p. 29, Pl. 9, fig. 4
1912 *Neritina picta* FÉR. — SCHAFFER, p. 170, Pl. 54, fig. 33
1917 *Neritina picta* FÉR. — COSSMANN et PEYROT, p. 51, Pl. 8, figs 4—14
1958 *Clithon pictus pictus* FÉR. — SENEŠ, p. 129
1965 *Clithon pictus* FÉR. — ONDREJIČKOVÁ et SENEŠ, p. 169
1966 *Neritina picta* FÉR. — STRAUSZ, p. 58, Pl. 49, figs 13—17

A small shell, almost spherical or truncated conical with markedly prosocline aperture and base (also septa). There is a colour ornament. The inductura, slightly callous in the proximity of the inner lip, covers most of the base in a broad crescent. The sharp edge of the inner lip is dentate, with alternating pairs of weaker and stronger teeth. The last whorl often exhibits a somewhat concave band on the truncated conical specimens. Above and below this band there are strongly convex, inflated zones. The colour ornament consists of shorter or longer loosely spaced oblique zigzagging dark brown lines. In another ornamental variety, which is something of a transition towards *Th. buekkensis*, the last whorl is covered with heavier, sickle- or boomerang-shaped squiggles and close-spaced fine axial lines that cover the entire whorl except for the bights of the boomerang squiggles.

Dimensions. Height: 7 mm; diameter: 6 mm.

Theodoxus is herbivorous, euryhaline; it usually shuns sea water of normal salinity.

Th. pictus is an excellent littoral and lagoon facies index, occurring in masses in the *Polymesoda-Tympanotonus* and *Tympanotonus-Pirenella* communities. It covers a salinity range from 3 to 30 per mille.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 6, 8, Felsőőrspuszta 22, 44, Zsámbék 23, 43, 42, 48, Szomor 31, Máriahalom 36, Gyermely 39, 50, Vasztély 49, Tök 51, 52, ? Pomáz-22, ? Diósjenő-19, Dömös-1, -2.

Distribution: An Oligocene-Miocene species widespread all over Europe.

Theodoxus (Vittoclithon) buekkensis (Telegdi-Roth, 1914)

Pl. XXIV, figs 3, 8—9

1914 *Neritina picta* Fér. var. *bükkensis* n. var. — Telegdi-Roth, p. 47, Pl. 3, figs 4—8
1936 *Nerita picta* Fér. var. *bükkensis* T.-R. — Noszky, p. 56
1958 *Clithon pictus* var. (?) *bükkensis* T.-R. — Seneš, p. 130

Its shape and aperture are identical with those of *Th. pictus*. The main difference is that on many specimens, the heavy, zigzagging blackish brown lines do not extend to the somewhat concave, caved-in median band of the last whorl; they are replaced by very close-spaced fine parallel axial lines there. Further differences from *Th. pictus* include a smaller size, and an altogether denser and finer colour ornament.

Dimensions. Height: 4 mm; diameter: 4 mm.

This is a littoral species attached to the *Tympanotonus-Pirenella* community. It presumably preferred salinities from 10 to 30 per mille.

Hungarian Upper Oligocene occurrences: Nagyegyháza 4, Mány 6, Szentendre 2, Pomáz-21, Diósjenő-3, Eger-1/17, -3, Mucsony 136, Sajókazinc 169.

Distribution: Upper Oligocene of the Central Paratethys.

Theodoxus (Vittoclithon) pilisensis n. sp.

Pl. XXIV, fig. 4

1897 *Neritina picta* Fér. — Wolff, p. 263 (partim), Pl. 25, tantum fig. 10

Locus typicus: Leányfalu-1

Stratum typicum: Upper Oligocene, Egerian (fine-grained sandstone).

Derivatio nominis. Pilisensis = Pilisian (after the Pilis Mountain, on a slope of which the locality is situated).

Its shape and aperture are — disregarding its smaller size — like those of *Th. pictus*, but the brown-black colour ornament is consistently different. The upper and lower band of the last whorl bear heavy sickle-shaped or procumbent vee-shaped squiggles, adaperturally convex or pointed. The two spiral bands which carry these squiggles do not quite reach either the suture or the base. The surface outside of these bands is covered densely by pale thin slightly undulous axial lines. The distinction on a specific level from *Th. pictus* may be open to doubt, just as it is in the case of *Th. buekkensis*. In both cases the difference may be subspecific as well.

Dimensions. Height: 5 mm, diameter: 4 mm (holotype, inventory number M 65/793).

A littoral species found in a *Mytilus aquitanicus* community.

Hungarian Upper Oligocene occurrence: Leányfalu-1.

Distribution: An endemic form not known so far from anywhere else.

Theodoxus (Vittoclithon) supraoligocaenicus n. sp.

Pl. XXVI, figs 1—2

Locus typicus: Leányfalu-1.

Stratum typicum: Upper Oligocene, Egerian (a fine-grained sandstone).

Derivatio nominis. Supraoligocaenicus: Upper Oligocene; after the typical deposit.

A rounded spherical-ovoidal form. The spire emerges hardly if at all. The last whorl bears three brown spiral lines. Between the lowermost line and the base on the one hand, and between the uppermost line and the adapical suture on the other, there are somewhat oblique, zigzagging brown axial lines. The space between the two inner radial lines is filled with weaker but much closer-spaced oblique axial lines. The aperture — as far as the state of preservation permits it to be established — resembles that of *Th. pictus*.

Dimensions. Height: 6 mm; diameter = 6 mm (holotype, inventory number M 65/805).

This species stands closest to a frequent Pannonian (Pliocene) species, *Th. vetracini* (BRUSINA 1902), but the persistent quadruple radial lining, the brown colour and arrangement of the colour ornament, the presence and disposition of axial colour lines clearly justify the distinction from the Pannonian species.

A littoral species found in a *Mytilus aquitanicus* community.

Hungarian Upper Oligocene locality: Leányfalu-1.

Distribution: Not known so far outside the type locality.

Subgenus: THEODOXUS S. S.

Theodoxus (Theodoxus) grateloupianus (FÉRUSSAC, 1821)

Pl. XXV, figs. 1—2

1856 *Nerita Grateloupana* FÉR. — HÖRNES, p. 533, Pl. 47, fig. 13

1870—75 *Neritina Grateloupiana* FÉR. — SANDBERGER, p. 510, Pl. 25, fig. 29

1896 *Tripaloia ? grateloupana* FÉR. — SACCO, p. 52, Pl. 5, fig. 61
1917 *Neritina Grateloupiana* FÉR. — COSSMANN et PEYROT, p. 54, Pl. 8, figs 15—20
1958 *Theodoxus grateloupianus* FÉR. — HÖLZL, p. 176, Pl. 17, fig. 5
1966 *Neritina grateloupiana* FÉR. — STRAUSZ, p. 59, Pl. 49, figs 21—22

A medium-sized to large *Theodoxus* with an unusually inflated, large last whorl; entirely involute. The diameter of the shell is greater than its height. The large semicircular aperture and the septum covering most of the base are markedly prosocline. The flat septum of the inner lip is covered by a white semicircular inductura. The adapertural part of the septum bears folds perpendicular to the sharp edge of the inner lip, which lend the inner lip a vaguely dentate look. The colour ornament is a light brown foundation with a few dark brown axial lines and, on some specimens, a regular white dotting.

Dimensions. Height: 7 mm; diameter: 11 mm.

A lagoon species encountered in *Polymesoda-Tympanotonus* communites.

Hungarian Upper Oligocene occurrences: Csordakút 5, Pomáz-21.

Distribution: a Miocene species widespread all over Europe except for the Boreal province; its oldest known occurrence is in the Hungarian Upper Oligocene.

Theodoxus (Theodoxus) crenulatus (KLEIN, 1853)

Pl. XXV, figs 3—8

1870—75 *Neritina crenulata* KL. — SANDBERGER, p. 571, Pl. 28, fig. 13
1897 *Neritina picta* FÉR. — WOLFF, p. 263 (partim), Pl. 25, tantum fig. 9

A medium- to large-sized *Theodoxus* of strongly rounded forms. The rapidly growing, large last whorl, much broader than that of *Th. pictus*, almost covers the entire spire. The flat septum is covered by a well-defined semicircular white inductura. The septum bears very weak folds perpendicular to the inner lip and growing stronger towards it. The colour ornament is very variable. The most widespread type consists of dark brown spiral belts of varied width and strength, combined with irregular white specks of nearly uniform or varied size. Quite often the entire shell bears a dark brown foundation with contrasting white specks. Small sickle- or boomerang-shaped squiggles very close-spaced on a white foundation also occur.

Dimensions. Height: 10 mm; diameter: 11 mm.

It is often hard to distinguish from *Th. grateloupianus* (STRAUSZ 1966). The shape of the shell and of the aperture and also the ornament are rather similar. Distinction is made possible by a weak tooth on the inner lip of *Th. crenulatus*, by its relatively greater height as compared to its diameter, and its strong speckled ornament. (In *Th. grateloupianus*, the inner lip is weakly dentate but the single tooth typical of *Th. crenulatus* is missing;

the last whorl of *Th. grateloupianus* is even broader, its shell is flatter, and lastly, its ornament is paler; a white speckling is a rarity.)

This is a species indicative of a lagoon facies; it could live in fresh water, too. It could not, on the other hand, stand salinities above 10 per mille. It was, consequently, the most pronouncedly "freshwater" type among all Upper Oligocene *Theodoxus* species. Most abundant in the *Polymesoda-Tympanotonus* community, it is not rare in the *Viviparus-Brotia* community, either.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, 4, Csordakút 5, Mány 6, 8, 9, Gyermely 12, 50, Tök 24, Zsámbék 42, Felsőőrspuszta 44, Pomáz-21, sporadically between Mór and Zirc.

Distribution: widespread all over Europe except in the Atlantic province, it emerges already in the Oligocene in the Paratethys and in the North Sea Basin.

Mesogastropoda

Littorinacea

Pomatiasidae

Genus: POMATIAS STUDER, 1789 (= Cyclostoma DRAPARNAUD, 1801)

Pomatias antiquum (BRONGNIART, 1823)

Pl. XXVI, fig. 3

1863 *Cyclostoma bisulcatum* ZIETEN — SANDBERGER, p. 7, Pl. 1, fig. 3
1864 *Cyclostoma antiquum* BRONG. — DESHAYES, p. 881, Pl. 58, figs 1—4
1870—75 *Cyclostomus antiquus* BRONG. — SANDBERGER, p. 411, Pl. 23, fig. 28
? 1897 *Cyclostoma* cf. *bisulcatum* ZIET. — WOLFF, p. 289, Pl. 28, fig. 9

A shell composed of five whorls of circular cross section with a fairly rapidly growing spire. The penultimate whorl bears at least ten sharp narrow spiral ribs spaced farther apart than their own width. On the last whorl there are at least twice as many ribs, and some intercostal furrows may even exhibit weaker secondary ribs. Growth lines are weak. Even the largest specimen does not exceed one centimetre in height. The holostomatous aperture is circular. The operculum, which usually crops up independently of the shell, is brown, thin, concave, with 4 or 5 "whorls" and with a slightly thickened rim. The space between the spiral ribs is taken up by very strongly leaning, dense tangential growth lines. In a single case (Mór 6/13.5 m), the operculum was found in its place in the aperture of the shell.

Dimensions. Height: 9 mm; diameter: 8 mm (shell), 4 mm (operculum).

In my earlier reports, on the basis of the insufficient material available I described this form by the name *Palaeocyclotus obtusicosta* (SANDBERGER, 1852), (BÁLDI 1967). The operculum of this cyclophorid is, however, entirely different, despite the similarity in shell features.

This is an air-breathing dry-land species. Its occurrence is consequently restricted to the freshwater *Viviparus-Brotia* community, to which it was admixed after death. It originally must have belonged to a dry-land community.

Hungarian Upper Oligocene occurrences: Csatka 1, Sur 1, 2, Mór 4, 5, 6, Mány 8, Gyermely 12, Solymár 72, 84. Ubiquitous in the Upper Oligocene of the Bakony Hills.

Distribution. According to Zöbelein (1952) it is a Chattian index fossil in the Western Paratethys region, in the Bavarian molasse. It further occurs also in the Oligocene of the Mainz and Paris basins and possibly also in the Oligocene of Southwestern France.

Viviparacea

Viviparidae

Genus: VIVIPARUS Montfort, 1810 (= *Paludina* Lamarck, 1816; *Vivipara* Sowerby, 1813)

Viviparus ventricosus (Sandberger, 1870—75)

Pl. XXVI, figs 4—5

1870—75 *Paludina ventricosa* Sandb. — Sandberger, p. 709, Pl. 27, fig. 2

? 1870—75 *Paludina soricinensis* Noul. — Sandberger, p. 303, Pl. 18, fig. 3

A thin shell composed of five inflated, convex whorls with impressed sutures. The surface exhibits slightly oblique growth lines only; towards the last whorl these grow into very weak ribs. The last whorl is as high as the spire. The whorls are most convex in the adapical zone, where their surfaces are inturned towards the axis. The base is slightly concave near the umbilicus; the latter is covered by a narrow parietal inducture. The aperture is circular, holostomatous.

Dimensions. Height: 22 mm; diameter: 20 mm.

It differs merely in its larger size from the Lower Oligocene species *V. soricinensis* Noulet, 1854. *V. pachystoma* (Sandberger, 1863) from the Mainz Basin is somewhat slenderer with a taller spire, less inflated whorls and thicker shell.

This is a herbivorous fresh-water snail that could not stand water of more than 3 per mille salinity. It is therefore restricted to the *Viviparus-Brotia* community that lived in lagoons highly diluted with fresh water or in the estuaries of rivers.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 6, 8, Nagyegyháza 2, Gyermely 12, 35, Máriahalom 36, Zsámbék 43; it is further abundant in the limnic Upper Oligocene of the Bakony Hills where it has turned up in a number of recent borings, e.g. Csatka 1, and others in the environs of Mór, Bodajk, etc.

Distribution. SANDBERGER described this species from the Pliocene but its probable identity with *V. soricinensis* suggests a wider stratigraphic spread.

Rissoacea

Hydrobiidae

Genus: HYDROBIA HARTMANN, 1821

Hydrobia ventrosa (MONTAGU, 1803)

Pl. XXVI, fig. 6

1856 *Paludina acuta* DRAP. — HÖRNES, p. 584, Pl. 47, fig. 20
1863 *Litorinella acuta* DRAP. — SANDBERGER, p. 82, Pl. 6, fig. 9
1870—75 *Hydrobia ventrosa* MONT. — SANDBERGER, p. 489, Pl. 25, fig. 6
1897 *Hydrobia ventrosa* MONT. — WOLFF, p. 289
1917 *Hydrobia ventrosa* MONT. — COSSMANN et PEYROT, p. 401, Pl. 26, figs 7—8
1943 *Hydrobia acuta* DRAP. — ALBRECHT et VALK, p. 24, Pl. 16, figs 550—553
1966 *Hydrobia stagnalis ventrosa* MONT. — STRAUSZ, p. 63, Pl. 47, fig. 14

A minute shell of seven whorls. Outline of the spire straight, fusiform; apex pointed; whorls flat. The last whorl, which takes up more than half of the total shell height, is markedly convex in its middle zone. The oblique, oval aperture ends in a short siphonal canal. The shell is entirely smooth with at most a few weak growth lines.

Dimensions. Height: 4 mm; diameter: 1.6 mm.

This is a herbivorous mesohaline species, a lagoon facies index occurring in the *Polymesoda-Tympanotonus* community. Its salinity requirements may be put at 3 to 10 per mille.

Hungarian Upper Oligocene occurrences: Mány 8, Zsámbék 42, Szentendre 2.

Distribution. Its hemera extends from the Middle Oligocene to this day: its geographical range covers all European faunal provinces.

Turritellacea

Turritellidae

Genus: TURRITELLA LAMARCK, 1799

Subgenus: HAUSTATOR MONTFORT, 1810

Turritella (Haustator) venus d'ORBIGNY, 1852

Pl. XXVIII, figs 1—2

1897 *Turritella Sandbergeri* MAY.-EYM. — WOLFF, p. 266, Pl. 25, fig. 24
• 1899 *Turritella* cf. *Sandbergeri* MAY.-EYM. — BÖCKH, p. 30, Pl. 9, fig. 8
1921 *Turritella Venus* ORB. — COSSMANN et PEYROT, p. 31, Pl. 2, figs 31—32

1936 *Turritella Sandbergeri* MAY. — NOSZKY, p. 57
1952 *Turritella venus* ORB. — ANIĆ, p. 37, Pl. 9, figs 10—11
1958 *Turritella venus* ORB. — SENEŠ, p. 130, Pl. 21, figs 263—268
1962 *Turritella venus* ORB. — HÖLZL, p. 139, Pl. 8, figs 11—12
1963 *Turritella venus* ORB. — BÁLDI, p. 84, Pl. 5, figs 1—3

A medium-sized *Turritella* with well-rounded whorls whose most convex section is closer to the abapical suture. The first few whorls carry three main ribs, but further growth renders the secondary ribs fully as heavy as the primary ones; the last few whorls thus carry 6 or 7 ribs of uniform strength, with very weak spiral lines between them.

Dimensions. Diameter: 13 mm.

It was COSSMANN and PEYROT (1921) who pointed out the identity of *T. venus* and *T. sandbergeri* MAYER, 1866. Owing to its much smaller and slenderer shell, *T. geinitzi* SPEYER, 1866 can be considered a distinct species, although its ornament fully agrees with that of *T. venus*.

The turritellids are very sluggish gastropods that burrow in the sea-bottom mud and, staying in the same spot for weeks, filter out for food the organic material suspended in the seawater. They usually occur in groups and even great masses ("gregarious" tendency).

T. venus is unknown from any littoral facies but abundant in the shallow and medium-depth sublittoral facies; a stenohaline-marine species, it is particularly characteristic of the *Pitar polytropa* and *Turritella venus* communities.

Hungarian Upper Oligocene occurrences: Csordakút 5, Mány 8, 9, Gyermely 12, 50, Zsámbék 23, 42, 43, Tök 24, 51, 52, Anyácsapuszta 27, Szomor 31, Felsőőrspuszta 44, Solymár 72, Törökbálint-1, -2, Budafok-1/4, Szentendre 2, Pomáz-1, -6, Leányfalu-3, -4, Kesztölc-1, Becske-2, Rétság-2, Diósjenő-1, -7, Eger-2.

Distribution: frequent from the Middle Oligocene of the Western and Central Paratethys to the end of the Upper Oligocene; very rare in the Lower Miocene, when it occurs also in the Atlantic. Its Boreal vicariating (substituent) species is presumably Oligocene *T. geinitzi*.

Turritella (Haustator) venus margarethae GAÁL, 1937—38

Pl. XXVIII, fig. 3

1914 *Turritella Sandbergeri* MAY. — TELEGDI-ROTH, p. 43, Pl. 4, figs 21—24 and Textfig. 3
1936 *Turritella Sandbergeri* MAY. var. A T.-R. — NOSZKY, p. 57
1937—38 *Turritella Sandbergeri* MAY. var. *Margarethae* GAÁL — GAÁL, p. 5
? 1938 *Turritella turris* var. *cattiana* — VENZO, p. 194, Pl. 9, fig. 7
? 1955 *Turritella turris* BAST. var. *cattiana* VENZO — ACCORDI, p. 31, Pl. 2, fig. 14
1961 *Turritella venus margarethae* GAÁL — BÁLDI (in BÁLDI et al.) p. 96, Pl. 4, figs 2—3

This subspecies differs from *T. venus* s. s. in that the secondary ribbing of the early whorls does not attain the strength of the primary ribbing even on the late whorls, so that the entire spire bears 3 or 4 main ribs alternating with weaker secondary ribs.

Dimensions. Height: 45 mm; diameter: 13 mm.

Similarly to *T. venus* s. s., the number and development of ribs is highly variable. Our above diagnoses apply to the average. For detailed descriptions of the variations cf. TELEGDI-ROTH (1914) and SENEŠ (1958).

Some extreme specimens of the subspecies whose secondary ribbing is very weak stand close to *T. turris* BASTEROT, 1825. The taller whorls and slenderer shape of the latter, however, — as had been pointed out already by TELEGDI-ROTH (1914) — permit a sure distinction. This does not, however, hold for *T. turris cattiana* VENZO, 1938, which with its squatter whorls and shape is presumably identical with the Hungarian subspecies.

This is a stenohaline species abundant only in the shallow sublittoral *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Leányfalu-3, Göd, Eger-1/6, -1/k, Novaj-1, Mucsony 136.

Distribution: The subspecies presumably occurs also in the Mediterranean Upper Oligocene besides the Upper Oligocene of the Paratethys.

Turritella (Haustator) beyrichi HOFMANN, 1870

Pl. XXVIII, figs 4—5

1870 *Turritella Beyrichi* n. sp. — HOFMANN, p. 25, Pl. 3, fig. 4
1936 *Turritella Beyrichi* HOFM. — NOSZKY, p. 57
1958 *Turritella beyrichi beyrichi* HOFM. — SENEŠ, p. 132
1963 *Turritella beyrichi* HOFM. — BÁLDI, p. 85

Its shape and dimensions resemble those of *T. venus*, but its whorls exhibit angular carina on their shoulders which is not far above the abapical suture. The sutural ramp is hardly convex, almost flat. The strongest spiral rib runs along the shoulder. There are four main ribs above it and only one immediately below it. The main ribs grow slightly weaker adapically. In the adapical whorl section, an occasional weak rib is seen in the grooves between the strong radial ribs.

Dimension. Diameter: 13 mm.

A homonymy existing between this species and *T. beyrichi* KOENEN, 1891: non HOFMANN, 1870, has been eliminated by the introduction of the name *T. koeneni* BÁLDI, 1963 to designate the North German Lower Oligocene type of KOENEN.

T. beyrichi s. s. is a euryhaline species which could well stand decreases in salinity even to 10 per mille. It is therefore usual in littoral facies, in the *Mytilus aquitanicus* community in particular: it is a great rarity in sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Dömös-1, -2, Pomáz-10, -21, Szentendre 2, Eger-1/18, -2, -3, Mucsony 136.

Distribution: known thus far only from the Upper Oligocene of the Central Paratethys.

Turritella (Haustator) beyrichi percarinata TELEGDI-ROTH, 1914
Pl. XXVIII, figs 6—8

1914 *Turritella Beyrichi* HOFM. var. *percarinata* n. var. — TELEGDI-ROTH, p. 45, Pl. 4, figs 18—20; Pl. 3, fig. 20
1936 *Turritella Beyrichi* HOFM. var. *percarinata* T.-R. — NOSZKY, p. 57
1937 *Turritella beyrichi* HOFM. var. *percarinata* T.-R. — VENZO, p. 61, Pl. 3, figs 20—22
1952 *Turritella beyrichi* HOFM. var. *percarinata* ROTH — ANIĆ, p. 37, Pl. 9, figs 6—7
1955 *Turritella beyrichi* HOFM. var. *percarinata* ROTH — ACCORDI, p. 32
1958 *Turritella beyrichi* var. (?) *percarinata* T.-R. — SENEŠ, p. 132, Pl. 21, fig. 269

It differs from *T. beyrichi* s. s. in that all its spiral main ribs are rudimentary, very weak, except for the one running along the carina.

Dimensions. Height: 55 mm; diameter: 15 mm.

Restricted to the shallow sublittoral *Pitar polytropa* community, it presumably was — in contrast to *T. beyrichi* s. s. — a stenohaline-marine gastropod.

Hungarian Upper Oligocene occurrences: Leányfalu-4, Eger-1/k.

Distribution: In the Upper Oligocene of the Central Paratethys and of the Mediterranean province.

Subgenus: Archimediella SACCO, 1895

Turritella (Archimediella) archimedis BRONGNIART, 1823
Pl. XXVIII, fig. 10

1856 *Turritella Archimedis* BRONGN. — HÖRNES, p. 424 (partim)
1895 *Archimediella Archimedis* BRONGN. et var. div. — SACCO, p. 12, Pl. 1, figs 36—38
1912 *Turritella Archimedis* BRONG. — SCHAFFER, p. 163, Pl. 53, figs 11—12
? 1952 *Turritella* cf. *thetis* ORB. — ANIĆ, p. 36, Pl. 9, fig. 5
? 1956 *Turritella archimedis* BRONG. — RASMUSSEN, p. 53, Pl. 4, fig. 2
1962 *Turritella Archimedis laevicrassa* SACCO — HÖLZL, p. 138, Pl. 8, figs 9—10

A relatively smaller-sized, slender Turritella; it bears a single strong spiral rib on its early whorls. Below that rib, a gradually strengthening No. 2 main rib appears farther down the spire. On the later whorls the strong rib pair in question occupies the lower, abapical shoulder part of the whorl surface. Above them, the sutural ramp is flat, hardly convex, even concave on the early whorls. This sutural ramp bears a pair of very weak spiral ribs.

Dimension. Diameter: 7 mm.

The early whorls permit a ready distinction from the form circles of *T. venus* and *T. turris*, the early whorls of which carry three main ribs. It can also be distinguished from the form circle of *T. erronea* COSSMANN whose early whorls carry two main ribs. It differs from the group of *T. bicarinata* and *T. subarchimedis* in the thinner, finer aspect of its ribs and in the smaller size of the shell.

This is an excellent littoral-facies index. Its remarkable euryhalinity permitted it to live in waters from 3 to 35 per mille salinity. It is most abundant in the *Pitar undata* community.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Csordakút 5, Mány 6, Vasztély 49, Gyermely 50, Tök 52, Pomáz-6, -22, Diósjenő-3, -19.

Distribution. Besides the Paratethyan Upper Oligocene it is known from the Oligocene and Miocene of the Atlantic and Mediterranean provinces.

Genus: PROTOMA BAIRD, 1870

Protoma cathedralis (BRONGNIART, 1823) s.l.

Pl. XXVIII, fig. 12

1856 *Turritella cathedralis* BRONG. — HÖRNES, p. 419, Pl. 43, fig. 1
1894 *Protoma cathedralis* var. *paucicincta* — SACCO, p. 32, Pl. 3, fig. 17
? 1900 *Protoma excathedralis* n. denom. — ROVERETO, p. 144
1912 *Protoma cathedralis* BRONG. var. *paucicincta* SACCO — SCHAFFER, p. 164, Pl. 53, figs 17—21
1921 *Protoma cathedralis* BRONG. — COSSMANN et PEYROT, p. 53, Pl. 2, figs 1—2
? 1937 *Protoma excathedralis* ROV. var. *bellunensis* n. var. — VENZO, p. 64, Pl. 3, fig. 25
1954 *Protoma cathedralis paucicincta* SACCO — CSEPREGHY-MEZNERICS, p. 17, Pl. 1, figs 15, 22
1958 *Protoma cathedralis paucicincta* SACCO — HÖLZL, p. 185
1958 *Protoma cathedralis* var. (?) *paucicincta* SACCO — SENEŠ, p. 135, Pl. 21, figs 271—272
1959 *Protoma cathedralis* BRONG. — ČTYROKÝ, p. 73
1966 *Protoma cathedralis* BRONG. — STRAUSZ, p. 110, Pl. 78, fig. 5

Our best-preserved specimen is a fragment comprising three whorls. The whorls are concave in their lower two-thirds but fairly swollen in their upper third. Below this swollen band there are three flat spiral ribs, the lowest one along the abapical suture proper.

Dimensions. Height: 17 mm; diameter: 32 mm (fragment).

Within this variable species, the Hungarian Upper Oligocene specimens can be satisfactorily identified with the subspecies *P. cathedralis paucicincta* SACCO, 1895.

This large, massive marine-stenohaline species turned up in the shallow sublittoral *Glycymeris latiradiata* community.

Hungarian Upper Oligocene occurrences: Pomáz-30, Diósjenő-24.

Distribution: the species lived from the Upper Oligocene to the end of the Tortonian (Badenian) in the Central Paratethys; in the Oligocene and Miocene of the Mediterranean province; and in the Lower Miocene of the Atlantic province.

Protoma quadricanaliculata (SANDBERGER in GÜMBEL, 1861)
Pl. XXVIII, figs 9, 13

1897 *Proto quadricanaliculata* SANDB. — WOLFF, p. 268, Pl. 25, figs 25—26
1899 *Turritella quadricanaliculata* SANDB. — BÖCKH, p. 30, Pl. 9, fig. 7
1952 *Protoma quadricanaliculata* SANDB. — ANIĆ, p. 38, Pl. 10, fig. 5
1962 *Protoma diversicostata* SANDB. — HÖLZL, p. 141, Pl. 8, fig. 14 (non SANDBERGER)

A shell smaller than that of *P. cathedralis* with flat or hardly convex whorls carrying two pairs of spiral ribs. The abapical pair is considerably stronger. The adapical pair is very close-spaced and rather far apart from the other pair. The later whorls exhibit also some weak spiral lines.

Dimension. Diameter: 12 mm.

On a cursory inspection it may be mistaken for *T. archimedis*. The early whorls are almost fully identical. *T. archimedis* is slenderer, however, with more convex and lower whorls and much weaker adapical ribs. It differs from the form circle of *P. cathedralis* besides its smaller size also in the peculiar pairwise disposition of the ribs. Still, even in this respect it stands close to *P. cathedralis quadricincta* SCHAFFER, 1912 of said form group. The only reason why we have not incorporated SCHAFFER's subspecies into our synonymy is that on the latter, the upper rib of the adapical pair invariably runs directly beside the adapical suture: in *P. quadricincta* they are somewhat farther apart. — It can be readily distinguished from *P. diversicostata* by the differences in ornament.

This is a euryhaline, littoral species known from the *Tympanotonus-Pirenella* community.

Hungarian Upper Oligocene occurrences: Nagyegyháza 2, 3, Göd.

Distribution: In the Upper Oligocene of the Western and Central Paratethys.

Protoma diversicostata (SANDBERGER in GÜMBEL, 1861)
Pl. XXVIII, fig. 11

1897 *Turritella diversicostata* SANDB. — WOLFF, p. 267, Pl. 25, fig. 23

A small, very slender, elongate turriculate shell with flat whorls whose angular shoulder is immediately above the abapical suture. The ornament consists of 6 spiral ribs, the one along the abapical angle being slightly stronger than the rest.

Dimension. Diameter: 8 mm (fragment).

Readily distinguished from the form circle of *P. cathedralis* by its incomparably smaller size, slenderer shape and different ornament. It is much easier to confuse with *Turritella venus*, notably with the juvenile specimens of that species. Still, its much flatter whorls and slenderer shape permit a sure distinction. The specimens at my disposal are all fragmentary and corroded.

This is a euryhaline species that has turned up in a littoral facies.

Hungarian Upper Oligocene occurrences: Budafok-1/4, Pomáz-21, Gyermely 25, Anyácsapuszta 27.

Distribution: Known from the Paratethyan Upper Oligocene.

Mathildidae

Genus: MATHILDA SEMPER, 1865

Mathilda schreiberi KOENEN, 1894

Pl. XXVI, figs 7—8

1894 *Mathilda Schreiberi* KOEN. — KOENEN, p. 1407, Pl. 101, fig. 4

1895 *Mathilda Schreiberi* var. *pseudocarinata* SACCO — SACCO, p. 34, Pl. 3, fig. 25

1904 *Mathilda Schreiberi* KOEN. var. *pseudocarinata* SACC. — SACCO, p. 125, Pl. 25, fig. 34

1961 *Mathilda schreiberi* KOEN. — BÁLDI (in BÁLDI et al.), p. 95, Pl. 4, fig. 5

A small turriculate shell. The Hungarian specimens are in possession of the protoconch which is missing from KOENEN's type: it is heterostrophic, including an angle of about 315° with the teleoconch. The four rather convex whorls of the teleoconch carry four spiral ribs, the uppermost of which is much weaker than the other three. On the third and fourth whorls there is a weaker spiral thread in each of the intercostal furrows. The ornament is complemented by axial ridges overriding even the spiral ribs. Flat, longish nodules are observed at the intersections of the spiral ribs with the axial ridges.

Dimensions. Height: 4.3 mm; diameter: 2 mm.

The difference in protoconch and ornament make distinction from *M. sandbergeri* (F. E. KOCH, 1876) rather easy.

Known exclusively from deep sublittoral — shallow bathyal facies in Hungary.

Hungarian Upper Oligocene occurrences: Eger-1/6, Novaj-1.

Distribution. This is an Oligocene species known in addition to the above-named, Paratethyan occurrences also from the Boreal and Mediterranean provinces.

Architectonicidae

Genus: ARCHITECTONICA BOLTEN in ROEDING, 1798 (= *Solarium* LAMARCK, 1799)

Architectonica carocollata (LAMARCK, 1822)

Pl. XXVII, figs 7—8

1856 *Solarium carocollatum* LAM. — HÖRNES, p. 462, Pl. 46, figs 1—2
1892 *Solarium carocollatum* LAM. et var. div. — SACCO, p. 40, Pl. 1, figs 35—44
1918 *Solarium carocollatum* LAM. — COSSMANN et PEYROT, p. 658, Pl. 15, fig. 18—20
1925 *Solarium carocollatum* LAM. — KAUTSKY, p. 64, Pl. 6, fig. 10
1958 *Solarium carocollatum* LAM. — HÖLZL, p. 187, Pl. 18, fig. 3
1958 *Solarium carocollatum* LAM. — SORGENFREI, p. 162, Pl. 29, fig. 100
1960 *Architectonica carocollata* LAM. — ANDERSON, p. 46, Pl. 8, fig. 3
1966 *Solarium carocollatum* LAM. — STRAUSZ, p. 115, Pl. 52, fig. 7

A flat conical shell with a slightly convex base. There are at most six whorls one of which is taken up by the smooth protoconch. The whorls of the teleoconch bear the following ornament. There is one flat nodose spiral rib along the adapical margin of each whorl and two similar ones along the abapical margin. In the zone between these, 2 to 4 spiral furrows are observed. The nodes disappear on the sixth and sometimes even on the fifth whorl, and the ribs themselves grow weaker. Down to the fourth whorl, a weak collabral ribbing is also visible: crossing the spiral ornament, it gives rise to its nodosity. The basal ornament consists of sharp radial ribs running from the umbilicus towards the periphery, growing gradually weaker towards it; they are bisected by a spiral groove parallel to the umbilical margin. There is a weak spiral rib below the periphery.

Dimension. Diameter: 15.1 mm.

The Eger specimens differ from the Miocene specimens of *A. carocollata* (e.g. from Várpalota) in their slightly smaller size and flatter shape, and somewhat more granulate ornament.

Known exclusively from deep sublittoral facies in the Hungarian Upper Oligocene.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: it arises already in the Oligocene in the Mediterranean province. It is ubiquitous in the European Miocene.

Architectonica mariae (BÁLDI, 1961)

Pl. XXVII, figs 5—6

1961 *Solarium mariae* n. sp. — BÁLDI (in BÁLDI et al.), p. 97, Pl. 4 fig. 10

A very small shell with a hardly emergent spire of slightly coeloconoid outline. The whorl and half taken up by the protoconch is entirely smooth, with a submerged nucleus. Comprising two and a half whorls, the teleoconch bears a marked ornament. Immediately above the nodose shoulder of the last whorl there is another, weaker string of nodes visible also on some whorls before the last. There is another such spiral string of nodes below the adapical suture. In the zone between the two strings there are collabral ribs, cut up into nodes by 4 or 5 spiral grooves. This ornament lends a granulate look to the spire surface. Immediately below the periphery, the highly convex base bears a very weak spiral string of nodes, and another, stronger one somewhat farther inward. The base further bears 15 radial folds issuing from teeth on the umbilical margin, growing weaker and locally bifurcating in the direction of the periphery. In the umbilicus proper there is a nodose spiral rib.

Dimensions. Height: 1.5 mm; diameter: 3.2 mm.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Novaj-1.

Distribution: Not known so far from any other locality.

Melaniacea

Melanatriidae

Genus: BROTIA ADAMS, 1866

Subgenus: TINNYEA HANTKEN, 1887

Brotia (Tinnyea) escheri (BRONGNIART, 1823)

Pl. XXVII, fig. 4

1856 *Melania Escheri* BRONG. — HÖRNES, p. 602, Pl. 49, fig. 16
1863 *Melania Escheri* BRONG. — SANDBERGER, p. 89, Pl. 6, figs 14—15
1870—75 *Melania Escheri* BRONG. et var. div. — SANDBERGER, pp. 323, 340, 451, 486, 520, 572, 689, Pl. 17, fig. 17; Pl. 20, figs 18—19; Pl. 28, fig. 14
1897 *Melania Escheri* MERIAN var. *bicincta* SANDB. — WOLFF, p. 290, Pl. 28, fig. 12
1909 *Melania Escheri* BRONG. — DOLLFUS, pp. 97—116, Pl. 3—4
1940 *Brotia escheri grossecostata* — WENZ, p. 687, textfig. 1975
1952 *Brotia escheri grossecostata* KLEIN — ANIĆ, p. 35, Pl. 9, fig. 3
1958 *Melanatria escheri aquitanica* NOUL. — HÖLZL, p. 188
1966 *Brotia escheri* BRONG. — STRAUSZ, p. 124, Pl. 4, figs 10—18

The specimens at my disposal are all more or less poorly preserved. Still, the diagnostic features are clearly visible: a tall, turriculate shell with concave whorls, and a very narrow concave sutural shelf visible only on the later whorls. The shell is covered with strong rounded axial ribs, somewhat sharper on the earlier whorls, usually narrower than the spaces between them. On the margin of the sutural shelf, these ribs rise up to form somewhat spiny adapically pointed prominences, whereas on the shelf itself the ribs are very weak. There are 4 or 5 weaker spiral ribs in the furrows between the axial ribs and also on the axial ribs proper.

Dimensions. Height: 44 mm; diameter: 29 mm.

DOLLFUS' (1909) excellent review permits the Hungarian Upper Oligocene form to be placed with assurance into this variable species.

This was a herbivorous freshwater-oligohaline species which probably lived in the Upper Oligocene in water of invariably less than 10 per mille salinity. It occurred very sporadically also in the *Polymesoda-Tympanotonus* communities. It was, on the other hand, one of the most abundant and most typical species of the *Viviparus-Brotia* community. Its optimal milieu was beyond doubt in waters of less than 3 per mille salinity.

Hungarian Upper Oligocene occurrences: Nagyegyháza 2, 3, 4, Mány 6, 8, 9, Gyermely 12, 35, 50, Zsámbék 23, Szomor 31, Máriahalom 36, Pomáz-21, Szentendre, as well as in boreholes sunk in the Bakony (Csatka, Sur, Nagyveleg, Bakonycsernye etc.) and about Mór (Mór, Csákberény, Bodajk etc.).

Distribution. The group of *B. escheri* has lived from the Upper Cretaceous to this day. It now lives in tropical rivers of the Indo-Pacific province. The species *B. escheri* proper lived from the Stampian (Middle Oligocene) to the end of the Miocene.

Melanopsidae

Genus: MELANOPSIS FÉRUSSAC, 1807

Melanopsis impressa hantkeni HOFMANN, 1870

Pl. XXVII, figs 1—3

1870 *Melanopsis Hantkeni* n. sp. — HOFMANN, p. 26, Pl. 3, fig. 5
? 1863 *Melanopsis callosa* BRAUN — SANDBERGER, p. 88, Pl. 6, fig. 14
1897 *Melanopsis Hantkeni* HOFM. — WOLFF, p. 291, Pl. 28, figs 13—51
1899 *Melanopsis Hantkeni* HOFM. — BÖCKH, p. 31, Pl. 9, fig. 11
1914 *Melanopsis Hantkeni* HOFM. — TELEGDI-ROTH, p. 42
1936 *Melanopsis Hantkeni* HOFM. — NOSZKY, p. 58
1952 *Melanopsis hantkeni* HOFM. — ANIĆ, p. 36, Pl. 9, fig. 4

A fusiform shell of five whorls. The pointed conical spire is composed of flat whorls. The adapical zone of the last whorl is slightly concave. The last whorl is four times as high as the spire. The sutures are very shallow but well visible. The somewhat oblique, oval aperture ends in a short siphonal canal at its bottom and in a very narrow adapical channel at its top. The well-defined inductura of the inner lip forms a callous mount in the parietal region.

Dimensions. Height: 16 mm; diameter: 7.6 mm.

Differences from *M. impressa* KRAUSS, 1852 s. s. are at best subspecific — they include a smaller size, a less gibbous last whorl, a more pointed spire of straight outline and flatter whorls.

This was a herbivorous, extremely euryhaline species, an excellent lagoon and littoral facies index, present in some abundance in any community inhabiting these facies (including even the freshwater *Viviparus-Brotia* community). Still, it is most abundant in the *Polymesoda-Tympanotonus* community. It could, then, stand salinity fluctuations from 0 to 35 per mille, but presumably preferred 3 to 10 per mille. A few sporadic specimens have turned up in shallow sublittoral facies.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, 4, Csordakút 5, Mány 6, 8, Gyermely 12, 35, 39, 46, 50, Zsámbék 23, 42, 43, 48, Tök 24, 51, 52, Felsőőrspuszta 44, Vasztély 47, 49, Csolnok 695, Dorog-1, Tarján-1, Kesztölc-1, Dömös-1, -2, Pomáz-21, -30, Leányfalu-1, -4, Szentendre 2, Göd, Diósjenő-3, Becske-1, Eger-1/k, -1/17, Eger-3, Novaj-2, Ostoros-1, Mucsony 136, Sajókazinc 169.

Distribution. The subspecies is known from the Paratethyan Upper Oligocene. *M. impressa* s. s. occurs besides the Paratethys also in the Mediterranean and Atlantic provinces, mainly in the Miocene (although in the Atlantic province it arises already in the Oligocene).

Cerithiacea

Potamididae

Genus: PIRENELLA Gray, 1847 (= *Granulolabium* Cossmann, 1889)

Pirenella plicata (Bruguière, 1792)

Pl. XXIX, fig. 3

1856 *Cerithium plicatum* Brug. — Hörnes, p. 400, Pl. 42, fig. 6
1863 *Cerithium plicatum* Brug. et var. div. — Sandberger, p. 96, Pl. 8, fig. 6; Pl. 9, figs 1—7
1866 *Cerithium plicatum* Brug. — Deshayes, p. 196, Pl. 55, figs 5—9
1867 *Cerithium plicatum* Brug. var. *Galeottii mucronatus* Spey. — Speyer, p. 215, Pl. 24, figs 2—4
1895 *Granulolabium plicatum* Brug. et var. div. — Sacco, p. 58, Pl. 3, figs 45—47
1897 *Potamides plicatus* Brug. — Wolff, p. 270, Pl. 25, fig. 29
1899 *Potamides plicatus* Brug. — Böckh, p. 32, Pl. 9, fig. 13
1912 *Cerithium plicatum* Brug. et var. div. — Schaffer, p. 151, Pl. 51, figs 36—40
1914 *Potamides plicatus* Brug. — Telegdi-Roth, p. 41
1921 *Pirenella plicata* Brug. — Cossmann et Peyrot, p. 267, Pl. 5, figs 99—101; Pl. 6, figs 42—44
1923 *Potamides plicatus* Brug. var. *gaáli* n. v. — Sümeghy, p. 33, text-fig. 2
1936 *Potamides plicatus* Brug. — Noszky, p. 58
1943 *Potamides plicatus* Brug. — Albrecht et Valk, p. 33, Pl. 17, figs 633—643
1952 *Pirenella plicata* Brug. — Anić, p. 41, Pl. 11, fig. 2
1953 *Potamides plicatus* Brug. — Csepreghy-Meznerics, p. 51
1956 *Potamides plicatus* Brug. — Strausz, p. 274, Pl. 40, figs 1—15
1958 *Pirenella plicata* Brug. — Hölzl, p. 191

A slender turriculate shell with flat whorls and impressed sutures. The whorls are covered with strong axial ribs, each dissected by 3 (or 4) deep spiral furrows into four (or five) nodes. The axial ribs are somewhat wider than the spaces between them. The nodes thus formed are elongate perpendicularly to the axis, being wider than their height. The base bears further spiral strings of nodes, but these nodes are closer-packed and axially elongate or rounded, alternating with similar but much weaker strings of nodes. No intact aperture has turned up. The ornament of the first whorls was described in some detail by Strausz (1956).

Dimensions. Height: 40 mm; diameter: 12 mm.

It is unjustified to separate *P. plicata gaáli* (Sümeghy, 1923) because its weaker abapical strings of nodes are present on all specimens; whether they are visible or not depends exclusively on how far each whorl is covered by the next one.

This is an extremely euryhaline, herbivorous species; its occurrence in masses indicates a flat, silty beach or — if in the company of *Polymesoda* — a brackwater lagoon. Most abundant in the *Polymesoda-Tympanotonus* or *Tympanotonus-Pirenella* communities, it occurs sporadically also in some shallow sublittoral facies, but in none of the freshwater-oligohaline ones. It must have preferred salinities between 10 and 30 per mille.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, 4, Csordakút 5, Mány 6, 8, 9, Gyermely 12, 25, 35, 50, Zsámbék 23, 42, 43, 48, Tök 24, 51, 52, Szomor 31, Máriahalom 41, Felsőőrspuszta 44, Vasztély 47, 49, Csolnok 695, Tarján-1, Kesztölc-1, Solymár 72, Budafok-1/4, Szentendre 2, Pomáz-1, -21, -22, -30, Leányfalu-1, -4, Dunabogdány, Göd, Dömös-1, Diósjenő-1, -3, -7, -8, Nagyoroszi-1, Borsosberény-1, Tolmács-3, Becske-1, Eger-1/k, -1/17, Eger-3, Novaj-2, Mucsony 136, Sajókazinc 169.

Distribution. It has not been signalled outside the Oligocene in the Boreal and Mediterranean provinces, whereas in the Paratethys and the Atlantic region it occurs also in the deeper Miocene. It is unknown, however, from deposits younger than Helvetian or Eggenburgian.

Genus: TYMPANOTONUS Schumacher, 1817

Tympanotonus margaritaceus (Brocchi, 1814)

Pl. XXIX, figs 1—2

1856 *Cerithium margaritaceum* Brocc. — Hörnes, p. 404, Pl. 42, fig. 9

1863 *Cerithium margaritaceum* Brocc. et div. sp. — Sandberger, p. 106, Pl. 7, figs 2—3

1895 *Tympanotonus margaritaceus* Brocc. et var. *cingulatior* Sacco — Sacco, p. 45, Pl. 3, fig. 13

1895 *Tympanotonus calcaratus* Grat. et var. div. — Sacco, p. 47, Pl. 3, figs 14—18

1897 *Potamides margaritaceus* Brocc. — Wolff, p. 270, Pl. 25, figs 18—21

1899 *Potamides margaritaceus* Brocc. — Böckh, p. 31, Pl. 9, fig. 12/b

1899 *Potamides submargaritaceus* Braun — Böckh, p. 32, Pl. 9, fig. 12/a

1912 *Cerithium margaritaceum* Brocc. cum var. div. — Schaffer, p. 154, Pl. 52, figs 1—2

1914 *Tympanotomus margaritaceus* Brocc. — Telegdi-Roth, p. 40
1921 *Tympanotonus margaritaceus* Brocc. et var. div. — Cossmann et Peyrot, p. 248—253, Pl. 6, figs 60, 64, 67; Pl. 7, figs 1—2, 6, 7
1936 *Tympanotomus margaritaceus* Brocc. cum var. div. — Noszky, p. 58
1943 *Tympanotonus margaritaceus* Brocc. — Albrecht et Valk, p. 35, Pl. 17, figs 627—628; Pl. 18, figs 658—660
1952 *Tympanotonus margaritaceus* Brocc. — Anić, p. 40, Pl. 10, figs 10—12
1956 *Potamides margaritaceus* Brocc. — Strausz, p. 279, Pl. 40, figs 16—24
1958 *Tympanotonus margaritaceus* Brocc. — Hölzl, p. 192
1958 *Tympanotonus margaritaceus* Brocc. cum var. div. — Seneš, p. 138, Pl. 21, fig. 280
1962 *Tympanotonus margaritaceus* Brocc. — Hölzl, p. 143
1965 *Tympanotonus margaritaceus* Brocc. et f. *calcarata* — Ondrejičková et Seneš, p. 175, Pl. 4, figs 42—45

Stockier than *Pirenella plicata*. The whorls of the conispiral-turriculate shell are low and flat. The ornament is composed of three strong spiral strings of nodes resembling strings of pearls (hence the name margaritaceus). The strongest string runs on the adapical side of each whorl, below the impressed suture. Its nodes, very close-packed, are somewhat elongate axially. There is one very weak secondary string of nodes on either side of this strong string (the one on the adapical side runs along the sutural groove). The other two main strings of nodes are closer together: they are both slightly weaker than the adapical string, but the abapical member of this pair is also slightly weaker than the other one; its nodes are somewhat elongate obliquely and are often connected with the round ones of the middle string by collabral ribs. The base bears a further 5 or 6 weaker spiral strings of nodes in addition to the above-described ones. An intact aperture is a great rarity. The exceptional specimens in possession of one reveal a slightly callous inner lip with two folds. The aperture ends in a broad short siphonal canal and adapical channel, respectively. The ornament of the first whorls was described by Strausz (1956).

Dimensions. Height: 39.3 mm; diameter: 18.0 mm.

The considerable variability of the species (the shape and spininess or otherwise of the nodes in the upper string) would merit a separate treatise. A statistical study of variation trends from the Middle Oligocene to the end of the Lower Miocene might reveal some stratigraphically meaningful intraspecific categories.

Its ecologic and coenologic traits are by and large the same as those of *Pirenella plicata*. Its occurrence in masses invariably indicates a seashore or a lagoon.

Hungarian Upper Oligocene occurrences: Nagyegyháza 2, 3, 4, Csordakút 5, Mány 6, 8, 9, Gyermely 12, 35, 39, 46, 50, Felsőőrspuszta 22, 44, Zsámbék 23, 42, 43, 48, Tök 24, 51, Anyácsapuszta 27, Szomor 31, Máriahalom 36, 41, Vasztély 47, 49, Csolnok 695, Tarján-1, Kesztölc-1, Solymár 72, Budafok-1/4, Szentendre 2, Pomáz-1, -6, -21, -22, -30, Leányfalu-1, -4, Göd, Dömös-1, -2, Diósjenő-1, -3, -7, -8, Nagyoroszi-1, Borsosberény-1, Becske-1, Tolmács-3, Eger-1/k, -1/17, -1/18, -3, Novaj-2, Mucsony 136, Sajókazinc 169.

Distribution: ubiquitous in Europe from the beginning of the Oligocene to the end of the Lower Miocene, except for the Boreal province where it is restricted to the Oligocene.

Bittiidae

Genus: BITTIUM LEACH in GRAY, 1847

Bittium reticulatum densespiratum BÁLDI, 1966

Pl. XXIX, fig. 6

1966 *Bittium reticulatum densespiratum* n. subsp. — BÁLDI, p. 87, Pl. 2, fig. 3

Differs from *B. reticulatum* (DA COSTA, 1779) in its denser and finer spiral ribbing. A weak secondary rib may insert itself between main ribs 4. and 5.

Dimensions. Height: 8.3 mm; diameter: 2.6 mm (holotype).

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution. The subspecies is not known so far from any other locality. *B. reticulatum* s. s. occurs in the Miocene of the Paratethys and of the Atlantic and Mediterranean provinces.

Bittium spina agriense BÁLDI, 1966

Pl. XXIX, fig. 5

1966 *Bittium spina agriense* n. subsp. — BÁLDI, p. 87, Pl. 2, fig. 4

Agrees in all traits with the type, *B. spina* (HÖRNES, 1856), except that it is smaller-sized and that its whorls are almost totally flat.

Dimensions. Height: 3.8 mm; diameter: 1.2 mm.

Found in a deep sublittoral — shallow bathyal *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. The subspecies is not known from any other locality. *B. spina* s. s. occurs in the Miocene of the Paratethys and of the Boreal province.

Cerithiidae

Genus: CERITHIUM BRUGUIÈRE, 1789

Cerithium egerense GÁBOR, 1936

Pl. XXIX, fig. 4

1936 *Cerithium egerense* n. sp. — GÁBOR, p. 2, Pl. 1, fig. 5

1936 *Cerithium egerense* GÁBOR — NOSZKY, p. 59

A tall turriculate shell with whorl outlines slightly broken in the median zone, which bears strong broad round-backed wide-spaced axial ribs, narrower than the spaces between them. These ribs grow weaker in the adapical, concave sutural ramp zone, fading out before reaching the adapical suture. They are strongest in the median zone of the whorl. They number ten on the penultimate whorl. The entire spire, including the backs of the axial ribs, bears close-spaced spiral ribs. The penultimate and last whorl each bear two varices.

Dimensions. Height: 51 mm; diameter: 18 mm.

This was a herbivorous, stenohaline-marine species occurring in the *Flabellipecten-Odontocyathus* and *Pitar polytropa* communities (shallow and medium-depth sublittoral zones).

Hungarian Upper Oligocene occurrences: Eger-1/5, -1/k, -2, Noszvaj-1.

Distribution: Not known from any other locality so far.

Diastomidae

Genus: DIASTOMA DESHAYES, 1861

Diastoma grateloupi turritoapenninica SACCO, 1895

Pl. XXIX, figs 7—8

1895 *Diastoma Grateloupi* ORB. var. *turritoapenninica* SACCO — SACCO, p. 75, Pl. 2, fig. 123

1914 *Diastoma Grateloupi* ORB. var. *turritoappenninica* SACCO — TELEGDI-ROTH, p. 41, Pl. 4, figs 10—11

1936 *Diastoma Grateloupi* ORB. var. *turritoappenninica* SACCO — NOSZKY, p. 60

1939 *Diastoma Grateloupi* ORB. var. *turritoapenninica* SACCO — NOSZKY, p. 13

1958 *Diastoma grateloupi* var. *turritoapenninica* SACCO — SENEŠ, p. 139

1961 *Diastoma grateloupi turritoapenninica* SACCO — BÁLDI (in BÁLDI et al.), p. 98

1962 *Diastoma grateloupi turritoapenninica* SACCO — HÖLZL, p. 142, Pl. 8, fig. 15

1964 *Diastoma grateloupi turritoapenninica* SACCO — BÁLDI (in BÁLDI et al.), p. 163, Pl. 1, fig. 10; Pl. 2, fig. 5

A very tall turriculate shell with convex whorls and impressed sutures. The whorls bear slightly leaning, sometimes slightly arched, strong round-backed axial ribs as wide as or somewhat wider than the spaces between them. The ornament is complemented by a dense spiral ribbing covering both the axial ribs and the furrows between them. Six to eight of these spiral ribs are stronger than the others: they alternate with weaker ones (one to three per furrow). The axial ribs fade out towards the base, which thus bears the spiral ornament only.

Dimensions. Height: 22.5 mm; diameter: 6.4 mm.

The subspecies differs according to Sacco (1895) from *D. grateloupi* D'Orbigny, 1852 s. s. in its slenderer, more turriculate shape and somewhat weaker ribbing.

In shallow and medium-depth sublittoral deposits: most abundant in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Mány 9, Zsámbék 23, Anyácsapuszta 27, Szomor 31, Máriahalom 36, Solymár 72, 84, 85, 91, Szentendre 2, Pomáz-6, Leányfalu-4, Dömös-2, Diósjenő-4, -8, -7, -24, Eger-1/x, -1/k, -2.

Distribution: In the Mediterranean as well as in the Western and Central Paratethyan Oligocene.

Scalacea

Scalidae

Genus: AMAEA H. et A. Adams, 1853

Subgenus: ACRILLA Adams, 1860

Amaea (Acrilla) amoena (Philippi, 1843)

Pl. XXIX, fig. 10

1856 *Scalaria amoena* Phil. — Hörnes, p. 479, Pl. 46, fig. 11
1891 *Acrilla amoena* Phil. et var. div. — Sacco, p. 61, Pl. 2, figs 51—56

The only specimen available has 7 whorls covered with platy axial ribs slightly arched at their adapical ends. They number 20 on the last whorls. A tendency to form varices is apparent. Each intercostal furrow exhibits 6 or 7 spiral ribs.

Dimensions. Height: 6 mm; diameter: 2.8 mm.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: known in addition to the Paratethys also from the Mediterranean and Boreal provinces; in all these regions it covers both the Oligocene and the Miocene.

Calyptraeacea

Calyptraeidae

Genus: CALYPTRAEA Lamarck, 1799

Calyptraea chinensis (Linné, 1758)

Pl. XXXI, figs 1—2

1856 *Calyptraea Chinensis* L. — Hörnes, p. 632, Pl. 50, figs 17—18
1870 *Calyptraea Chinensis* L. — Speyer, p. 192, Pl. 21, fig. 5
1870 *Calyptraea depressa* Lam. — Speyer, p. 194, Pl. 21, figs 6—7
1896 *Calyptraea chinensis* L. et var. div. — Sacco, p. 29, Pl. 4, fig. 6
1897 *Calyptraea sinensis* L. — Wolff, p. 264, Pl. 25, fig. 8

1899 *Calyptraea chinensis* L. — Böckh, p. 29, Pl. 9, fig. 5
1912 *Calyptraea chinensis* L. — Schaffer, p. 168, Pl. 54, figs 20—21
1917—18 *Calyptraea chinensis* L. var. *taurostriatellata* Sacco — Cossmann et Peyrot, p. 271, Pl. 13, figs 9—12
1936 *Calyptraea striatella* Nyst — Noszky, p. 60
1952 *Calyptraea chinensis* L. — Görges, p. 80
1952 *Calyptraea chinensis* L. — Anić, p. 34
1958 *Calyptraea chinensis* L. — Hölzl, p. 198
1958 *Calyptraea chinensis* L. — Sorgenfrei, p. 180, Pl. 33, fig. 114
1958 *Calyptraea chinensis chinensis* L. — Seneš, p. 140
1962 *Calyptraea chinensis* L. — Hölzl, p. 144
1963 *Calyptraea chinensis* L. — Steininger, p. 52
1964 *Calyptraea chinensis* L. — Anderson, p. 223, Pl. 18, fig. 145
1964 *Calyptraea chinensis* L. — Răileanu et Negulescu, p. 175, Pl. 13, fig. 2
1966 *Calyptraea chinensis* L. — Strausz, p. 209, Pl. 77, figs 1—2

This is a depressed conical shell with a slightly eccentric apex (which is, however, still central on smaller-sized specimens). Nucleus very small: the shell essentially consists of the cap-shaped last whorl which is convex and smooth, except for some weak growth lines.

Dimensions. Height: 8 mm; diameter: 23 mm.

A rarely moving, euryhaline suspension-feeder, it occurs in almost all littoral and shallow sublittoral communities, being most abundant in the littoral *Mytilus aquitanicus* community. It could stand a salinity range from 10 to 35 per mille.

Hungarian Upper Oligocene occurrences: Mány 8, Gyermely 35, Máriahalom 36, Budafok-1/4, Szentendre 2, Leányfalu-3, Diósjenő-1, -3, Eger-1/k, -1/18, -3.

Distribution. Ubiquitous all over Europe, it arose everywhere in the Oligocene and has lived to this day. Actually it occurs from England to the Senegalese and Guinean coasts, and also in the Mediterranean.

Calyptraea pseudodeformis Báldi, 1966
Pl. XXIX, figs 9, 11

1966 *Calyptraea pseudodeformis* n. sp. — Báldi, p. 88, Pl. 2, fig. 6

A tall, rather conical shell resembling the subgenus *Bicatillus* Swainson, 1840, except that the axis of the smooth protoconch comprising a whorl and a half is almost perpendicular to the apertural plane. It differs in this same feature from *C. deformis* Lamarck, 1822.

Dimensions. Height: 5.6 mm; diameter: 11.2 mm.

Found in a shallow sublittoral deposit (*Pitar polytropa* community).

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution: Not known so far outside this locality.

Xenophoracea

Xenophoridae

Genus: XENOPHORA Fischer-Waldheim, 1807

Xenophora deshayesi (Michelotti, 1847)

Pl. XXXIII, figs 8—9

1856 *Xenophora Deshayesi* Micht. — Hörnes, p. 442, Pl. 44, fig. 12
1896 *Xenophora Deshayesi* Micht. an *X. burdigalensis* Grat. — Sacco, p. 20, Pl. 2, fig. 20
1914 *Xenophora Deshayesi* Micht. — Telegdi-Roth, p. 46
1917—18 *Xenophora Deshayesi* Micht. — Cossmann et Peyrot, p. 261, Pl. 13, figs 7—8
? 1917—18 *Xenophora burdigalensis* Grat. — Cossmann et Peyrot, p. 257, Pl. 17, figs 105—106
1925 *Xenophora Deshayesi* Micht. — Kautsky, p. 63, Pl. 6, fig. 9
1936 *Xenophora Deshayesi* Micht. — Noszky, p. 60
1952 *Xenophora deshayesi* Micht. — Glibert, p. 67, Pl. 5, fig. 3
1958 *Xenophora Deshayesi* Micht. — Sorgenfrei, p. 181, Pl. 34, fig. 115
1958 *Xenophora deshayesi* Micht. — Seneš, p. 142
1962 *Xenophora deshayesi* Micht. — Hölzl, p. 146, Pl. 8, fig. 18; Pl. 9, fig. 1
1963 *Xenophora deshayesi* Micht. — Báldi, p. 85
1964 *Xenophora deshayesi* Micht. — Anderson, p. 224, Pl. 18, fig. 147
1966 *Xenophora deshayesi* Micht. — Strausz, p. 214, textfig. 93

A conical shell of straight outline, with flat whorls, a slightly concave base and weak sutures. The spire is taller than the last whorl. Slightly worn large sand grains of 2 to 3 mm size are agglutinated along the sutures. The surface is rough; the growth lines are exceedingly oblique. So is the aperture which is practically in the basal plane. The base is smooth with a shiny inductura near the inner lip.

Dimensions. Height: 21 mm; diameter: 38 mm; apical angle: 65°.

The Upper Oligocene *Xenophora* from Budafok fully agrees with the type, whereas the Eger and especially the Törökbálint specimens exhibit transitional features towards the Oligocene species *X. scrutaria* (Philippi, 1843), as had already been pointed out by Telegdi-Roth (1914). The Eger specimen, for instance, agglutinates smaller grains, and its base lacks the ornament of concentric lines. The Törökbálint specimen has a strikingly great apical angle (90°), as compared with that of *X. deshayesi* (60 to 70°). The independence of *X. burdigalensis* Grateloup, 1847 is questionable; the minute differences in the basal ornament are hardly relevant.

Invariably sporadic; in shallow and medium-depth sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, Budafok-1/4, Eger-1/k, Leányfalu-3.

Distribution. It arises in the Paratethyan and Mediterranean Oligocene and persists into the Miocene. Not known outside the Neogene in the Boreal and Atlantic provinces.

Strombacea

Aporrhaidae

Genus: APORRHAIS DA COSTA, 1778 (= *Chenopus* PHILIPPI, 1836)

Aporrhais callosa (TELEGDI-ROTH, 1914)

Pl. XXX, figs 1—2

? 1863 *Chenopus speciosus* SCHLOTH. — SANDBERGER, p. 188 (partim), tantum Pl. 10, fig. 9

1914 *Chenopus callosus* n. sp. — TELEGDI-ROTH, p. 38, Pl. 4, figs 12—15

1936 *Chenopus callosus* T.-R. — NOSZKY, p. 60

1936 *Chenopus callosus* T.-R. nov. var. *latialatus* — NOSZKY, p. 60

1958 *Aporrhais callosus* T.-R. — SENEŠ, p. 145

A relatively massive shell, each whorl of which exhibits a break in outline in its lower third. Along the shoulder thus formed there is a carina bearing heavy, broad nodes. The flat sutural shelf subtends a right angle with the flat or slightly concave whorl surface below the shoulder. Every whorl bears a weak spiral ornament consisting of alternating stronger and weaker ribs. Traces of weak collabral ribs issuing from the shoulder nodes are largely restricted to the early whorls. The base ending in a pointed rostrum bears two heavy spiral ribs right below the periphery. A remarkable feature of the aperture is the extensive callosity of both the inner and the outer lip. The callus issuing from the inner lip, which covers almost half of the shell, is thickest between the shoulder of the last whorl and the rostrum and, although it covers half of the spire, too, it grows thinner adapically. The wing issuing from the outer lip is also excessively thickened, callous.

Dimensions. Height: 25.3 mm; diameter: 19.6 mm (with a somewhat damaged wing).

The shape and ornament of the whorls permit easy distinction from the form circle of *Drepanocheilus speciosus*. The more massive build of *A. callosa*, its well-developed sutural ramp and shoulder, as well as the string of shoulder nodes running along its entire teleoconch are all striking features. In *Drepanocheilus speciosus*, on the other hand, the sutural ramp and the shoulder string of nodes are visible only on the last (plus, sometimes, the penultimate) whorl, not on the earlier ones. The latter carry dense thin leaning axial ribs. Moreover, the callosity of *Drepanocheilus speciosus* is much less pronounced. — *A. callosa* differs from *A. alata* (EICHWALD, 1830) in its more massive form, greater callosity and different digitation.

The *Aporrhais* and *Drepanocheilus* specimens are stenohaline-marine gastropods feeding on plant debris, burrowing to a small depth if at all into the seabottom sediment.

A. callosa is a shallow sublittoral facies index characteristic of the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Leányfalu-4, Diósjenő-4, Eger-1/k.

Distribution. Known so far only from the Upper Oligocene of the Central Paratethys.

Genus: DREPANOCHEILUS MEEK, 1864

Drepanocheilus speciosus (SCHLOTHEIM, 1820) s. s.

Pl. XXX, figs 3—4; Pl. XXXI, figs 3—4

1863 *Chenopus speciosus* SCHLOTH. — SANDBERGER, p. 188, Pl. 20, fig. 5

1863 *Aporrhais speciosa* BEYR var. *megapolitana* — SPEYER, p. 166, Pl. 31, figs 1—2

1891 *Aporrhais speciosa* SCHLOTH. — KOENEN, p. 695, Pl. 50, figs 11—12

1897 *Aporrhais speciosa* SCHLOTH. — WOLFF, p. 272, Pl. 26, figs 1—2

1914 *Chenopus speciosus* SCHLOTH. var. *megapolitana* BEYR. — TELEGDI-ROTH, p. 37, Pl. 4, figs 16—17

1925 *Chenopus speciosus* SCHLOTH. — KAUTSKY, p. 85

1936 *Chenopus speciosus* SCHLOTH. var. *megapolitana* BEYR. — NOSZKY, p. 61

1943 *Arrhoges speciosa* SCHLOTH. — ALBRECHT et VALK, p. 50, Pl. 1, figs 24—25

1952 *Drepanocheilus speciosus megapolitana* BEYR. — GÖRGES, p. 82

1957 *Drepanocheilus speciosus* SCHLOTH, s. s. — GLIBERT, p. 55, Pl. 5, figs 1a, b

1958 *Aporrhais speciosus megapolitana* BEYR. — HÖLZL, p. 205, Pl. 18, fig. 15

1958 *Drepanocheilus speciosus* aff. var. *megapolitanus* BEYR. — SENEŠ, p. 144

1962 *Aporrhais speciosa* SCHLOTH. — HÖLZL, p. 148

1963 *Drepanocheilus speciosus megapolitanus* BEYR. — STEININGER, p. 54, Pl. 10, fig. 6

The shell has 6 or 7 whorls. The earlier whorls are convex, with a dense ornament of slightly arcuate, leaning axial ribs and spiral ridges. The spiral ornament is strong between the axial ribs and weaker or interrupted on their backs. There is a sutural ramp on the upper third of the penultimate and last whorls. On the penultimate whorl the axial ribs bear nodular thickenings on the shoulder. There are no axial ribs on the last whorl; in compensation, the fine, dense spiral ribbing is more conspicuous. The sutural ramp is slightly concave here, with a string of nodes on the shoulder, and two weaker strings of nodes on its abapical side. The inductura of the inner lip and the wing attached to it reach up to the second whorl before the last. The callosity of the inductura is not excessive. The wing forms a broad flat sheet with a rather pointed upper corner, from which there emerges a single adapically pointed finger. The rostrum is very short.

Dimensions. Height: 25.0 mm; diameter: 23.2 mm (together with wing).

Present in all sublittoral facies; most typical in the *Pitar polytropa* and *Nucula-Angulus* communities.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Csordakút 5, Mány 8, 9, Szomor 31, Zsámbék 43, Felsőőrspuszta 44, Vasztély 49, Tök 52, Solymár 72, 84, Törökbálint-1, -2, Szentendre 2, Pomáz-6, Leányfalu-3, -4, Eger-1/6, -1/k, -2.

Distribution: In the Paratethys and the Boreal province, from the deeper Oligocene to the end of the Lower Miocene.

Drepanocheilus speciosus digitatus (TELEGDI-ROTH, 1914)

Pl. XXX, figs 5—6

1914 *Chenopus speciosus* SCHLOTH. var. *digitata* n. var. — TELEGDI-ROTH, p. 38, Pl. 4, figs 7—8
1936 *Chenopus speciosus* SCHLOTH. var. *digitata* T.-R. — NOSZKY, p. 60
1958 *Drepanocheilus speciosus* var. *digitatus* T.-R. — SENEŠ, p. 143
1962 *Aporrhais speciosa digidata* T.-R. — HÖLZL, p. 149

Differs from *D. speciosus* in the presence of one shorter and two very long, slightly arched fingers issuing obliquely, abaxially from the wing. There is an agreement in all other features.

Dimensions. Height: 24.0 mm; diameter: 26.4 mm (together with wing).

Exclusively in shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Törökbálint-l, Szentendre 2, Eger-1/k.

Distribution. The subspecies is restricted to the Paratethyan Upper Oligocene.

Drepanocheilus speciosus margerini (DE KONINCK, 1837)

1952 *Drepanocheilus speciosus margerini* KON. — GÖRGES, p. 81
1957 *Drepanocheilus speciosus margerini* KON. — GLIBERT, p. 55, Pl. 5, figs 1 c—f

Larger than *D. speciosus* s. s. The strings of nodes coalesce to form a sharp keel on the last whorl. One finger is in contact with the last three to five whorls; the upper corner of the wing projects another, single, enormously long finger. All in all, the wing of *D. speciosus* bears no abaxial finger at all; that of *D. speciosus digitatus* bears two long abaxial fingers and there is just one abaxial finger on *D. speciosus margerini*.

Dimensions. Height: 25 mm; diameter: 24 mm (with wing).

Found in a *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrence: Törökbálint-1.

Distribution. Known in addition to the above locality also from the Boreal Oligocene.

Genus: STROMBOPUGNELLUS KOCH, 1911

Strombopugnellus digitolabrum KOCH, 1911

Pl. XXXI, figs 5—6

1911 *Strombopugnellus digitolabrum* — KOCH, p. 549, Pl. 3, fig. 2
1940 *Strombopugnellus digitolabrum* KOCH — WENZ, p. 914, textfig. 2688
1963 *Strombopugnellus digitolabrum* KOCH — BÁLDI, p. 86, Pl. 5, fig. 8

A large, *Drepanocheilus*-like shell with four and a half convex whorls on the specimen available to me (not Koch's holotype). The last and penultimate whorls exhibit a flat, weak shoulder with a slightly concave sutural ramp above it. The earlier whorls are covered with strong, round-backed collabral ribs, whose adapical ends are somewhat bent in the adapertural direction. On the penultimate and last whorls, the collabral ribs are reduced to huge nodes on the shoulder. Almost half of the shell, up to the fourth whorl before last, is covered by a thick inductura, which on the base passes into a rounded, thick callus. The outer lip is missing together with the wing. There is no spiral ornament.

The species may be regarded — as had been pointed out by Koch (1911) himself — also as a large-sized, heavily callous relative of *D. speciosus margerini*. Wenz' (1940) decision to place it in the family *Aporrhaidae* should thus be approved. The exceptional size, different ornament and callosity certainly do justify the retention of Koch's generic name.

Dimensions. Height: 51 mm; diameter: 30 mm (incomplete specimen).

Found in a *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrence: Törökbálint-1.

Distribution: not known from any other locality.

Strombidae

Genus: STROMBUS Linné, 1758

Strombus coronatus Defrance, 1827

Pl. XXXIV, figs 7—8

1856 *Strombus coronatus* Defr. — Hörnes, p. 187, Pl. 17, fig. 1

1893 *Strombus coronatus* Defr. — Sacco, p. 7, Pl. 1, figs 19—27

1912 *Strombus coronatus* Defr. var. *praecedens* Schff. — Schaffer, p. 149, Pl. 51, figs 21—22

?1922 *Strombus* cf. *coronatus* Defr. — Cossmann et Peyrot, p. 257

1936 *Strombus coronatus* Defr. — Noszky, p. 61

1954 *Strombus coronatus* Defr. — Csepreghy-Meznerics, p. 30, Pl. 3, figs 9—10

1966 *Strombus coronatus* Defr. — Strausz, p. 222, textfig. 102

A shell smaller than the Miocene type, with a pointed spire of coeloconoid outline. The last whorl takes up two thirds of shell height. Each whorl bears an adapical keel which in turn bears long strong thorns on the later whorls, corresponding to axial ribs on the earlier whorls. There is further a weak spiral ribbing on the earlier whorls and on the sutural ramp of the last whorl.

Dimensions. Height: 41 mm; diameter: 30 mm.

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution. A Miocene species widespread in the Paratethys and in the Mediterranean and probably also in the Atlantic province, it turns up already towards the end of the Oligocene in the Paratethys and probably also in the Atlantic province.

Genus: ROSTELLARIA LAMARCK, 1799 (= *Tibia* BOLTEN, 1798)

Rostellaria dentata GRATELOUP, 1833

Pl. XXXIV, figs 1—2

1856 *Rostellaria dentata* GRAT. — HÖRNES, p. 192, Pl. 18, fig. 1
1914 *Rostellaria dentata* GRAT. — TELEGDI-ROTH, p. 36
1922 *Rostellaria dentata* GRAT. — COSSMANN et PEYROT, p. 265, Pl. 9, fig. 12
1936 *Rostellaria dentata* GRAT. — NOSZKÝ, p. 61
1958 *Rostellaria dentata dentata* GRAT. — SENEŠ, p. 146, Pl. 24, figs 319—322
1966 *Rostellaria dentata* GRAT. — STRAUSZ, p. 220, Pl. 23, figs 5—9

None of the specimens available is complete. The fragment from Eger to be discussed here comprises four whorls. The spire is long, pointed, conical. The whorls are smooth, hardly convex, almost flat. The sutures are sharply impressed. The last whorl is about as tall as the rest of the spire. Opposite the aperture it bears a hump connected with a hidden varix. The base exhibits an ornament of spiral ribs. The callous inductura reaches to the adapical suture, with a single weak tooth in the parietal region. Outer lip and wing broken off.

Dimension. Diameter: 20 mm.

Restricted to the shallow sublittoral zone (*Glycymeris latiradiata* and *Pitar polytropa* communities).

Hungarian Upper Oligocene occurrences: Leányfalu-3, -4, Diósjenő-24, Eger-1/k.

Distribution. Its earliest occurrence is in the Upper Oligocene of the Central Paratethys; it is widespread in the Miocene of the Mediterranean and Atlantic provinces and of the Paratethys.

Rostellaria bicarinata BÁLDI, 1966

Pl. XXXIV, fig. 3

1966 *Rostellaria bicarinata* n. sp. — BÁLDI, p. 88, Pl. 4, fig. 5

The entirely smooth protoconch comprises 5 whorls. The first two whorls of the teleoconch are slightly convex, with a gradually emerging typical ornament: 12 to 24 narrow spiral grooves with small round regularly spaced pits in them, separated by broad, very flat ribs. The last two whorls on the teleoconch at our disposal are angular. Slightly above the median line of the whorls there is one spiral keel; another runs immediately above the abapical suture. Both keels bear a strong spiral rib. The ornament is otherwise much the same as on the preceding whorls of the teleoconch, but the grooves are wider, which entails a collabral elongation of the small pits.

Dimensions. Height: 19 mm; diameter: 9 mm (fragmentary specimen).

The species of this form circle belong to the deeper Oligocene. *R. bicarinata* differs from the species *R. hungarica* NOSZKY, 1940 (Kiscell clay) and

R. excelsa GIEBEL, 1864 and *R. haueri* DREGER, 1892 (Häring beds) in the angular outline of the last whorls and in its two strong spiral ribs.

Known exclusively from deep sublittoral — shallow bathyal deposits.

Hungarian Upper Oligocene occurrences: Eger-1/6, Ostoros-1 (Kerek Hill).

Distribution: not known from any other locality so far.

Naticacea

Naticidae

Genus: POLINICES MONTFORT, 1810 (= *Polynices* HERRMANNSEN, 1847)

Subgenus: LUNATIA GRAY, 1847

Polinices (Lunatia) catena (DA COSTA, 1778) s. l.

I have included here specimens of which no more is known than their belonging to this form circle, their subspecific identification being precluded by a poor state of preservation.

The *Polinices* species are carnivorous gastropods burrowing in a sandy sea bottom. They are mostly stenohaline-marine, although some species are euryhaline.

Specimens of *Polinices catena* unsuited for a closer identification have turned up in littoral and shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Zsámbék 23, Gyermely 35, Máriahalom 36, Felsőőrspuszta 44, Tök 52, Nagyegyháza 3, Solymár 84, 85, Pomáz-1, -21, Tarján-1.

Distribution: *P. catena* s. l. has lived from the early Oligocene to this day and is widespread all over Europe.

Polinices (Lunatia) catena achatensis (RÉCLUZ in DE KONINCK, 1837)
Pl. XXXIII, fig. 5

1870 *Natica dilatata* PHIL. — SPEYER, p. 79, Pl. 13, figs 7—9 (non PHILIPPI)
1891 *Natica catena* var. *prohelicina* SACCO — SACCO, p. 67, Pl. 2, fig. 38
1891 *Natica achatensis* KON. — KOENEN, p. 581, Pl. 41, figs 1—4
1900 *Natica achatensis* RÉCL. — ROVERETO, p. 134
1937 *Natica achatensis* RÉCL. — VENZO, p. 45, Pl. 2, figs 34—36
1943 *Polynices achatensis* RÉCL. — ALBRECHT et VALK, p. 53, Pl. 4, figs 91—96
1952 *Lunatia achatensis* KON. — GÖRGES, p. 83
1957 *Natica achatensis* KON. — GLIBERT, p. 57, Pl. 6, fig. 12
1958 *Polynices achatensis* KON. — SENEŠ, p. 147, Pl. 21, figs 284—285
1960 *Polinices catena achatensis* KON. — ANDERSON, p. 84, Pl. 2, fig. 1

1962 *Polinices catena achatensis* Kon. — Hölzl, p. 154, Pl. 8, figs 22—23
1963 *Polinices catena achatensis* Kon. — Báldi, p. 88, Pl. 5, figs 9—10

It can be distinguished from *P. catena helicina* on the basis of its lower spira, squatter build and somewhat more convex, more gibbous whorls.

Dimensions. Height: 12 mm; diameter: 11 mm.

It was pointed out by Sacco (1891) that *P. nysti*, *achatensis* and *dilatata* were varieties of the form circle of *P. catena*. Anderson (1960) described *P. achatensis* as a subspecies of *P. catena*, from which *P. catena helicina* had developed during the Upper Oligocene.

Associated most often with the medium-depth sublittoral *Pitar beyrichi* community, it is much rarer in the shallow sublittoral zone.

Hungarian Upper Oligocene occurrences: Kesztölc-1, Törökbálint -1, -2, ? Budafok-1/4, Eger-2.

Distribution. A subspecies restricted to the Oligocene, it is known outside the Paratethys also from the Boreal and Mediterranean provinces.

Polinices (Lunatia) catena helicina (Brocchi, 1814)

Pl. XXXIII, fig. 1

1856 *Natica helicina* Brocc. — Hörnes, p. 525, Pl. 47, figs 6—7
1870 *Natica Nystii* var. *micromphalus* Sandb. — Speyer, p. 78, Pl. 13, fig. 6a, b (non Sandb.)
1891 *Natica catena* var. *helicina* Brocc. — Sacco, p. 70, Pl. 2, fig. 43
1897 *Natica helicina* Brocc. — Wolff, p. 265, Pl. 25, fig. 15; Pl. 28, figs 7—8
1899 *Natica helicina* Brocc. — Böckh, p. 31, Pl. 9, fig. 6
1914 *Natica helicina* Brocc. — Telegdi-Roth, p. 31
1917—18 *Natica helicina* Brocc. — Cossmann et Peyrot, p. 228, Pl. 11, figs 39—41; Pl. 12, figs 29, 54
1925 *Natica pulchella* var. *alderi* — Kautsky, p. 69
1936 *Natica helicina* Brocc. — Noszky, p. 61
?1936 *Natica Adleri* Forbes — Noszky, p. 61
1952 *Natica helicina* Brocc. — Anić, p. 33, Pl. 9, fig. 1
1952 *Polynices catena* f. *helicina* Brocc. — Glibert, p. 69, Pl. 5, fig. 8
1956 *Polynices helicina* Brocc. — Rasmussen, p. 58, Pl. 4, fig. 6
1958 *Polinices catena* Da Costa — Hölzl, p. 206, Pl. 18, figs 16—17
1958 *Natica catena* Da Costa — Sorgenfrei, p. 185, Pl. 34, fig. 117
1960 *Polinices catena helicina* Brocc. — Anderson, p. 84, Pl. 2, fig. 2
1961 *Polinices* cfr. *catena helicina* Brocc. — Báldi (in Báldi et al.), p. 100
1963 *Lunatia catena helicina* Brocc. — Steininger, p. 50, Pl. 10, fig. 8
1964 *Natica catena helicina* Brocc. — Răileanu et Negulescu, p. 175, Pl. 13, figs 5—6
1966 *Natica catena helicina* Brocc. — Strausz, p. 228, Pl. 48, figs 13—16; Pl. 49, figs 1—8

A medium to small-size *Polinices* with a tall convex last whorl and a low spire. The parietal portion exhibits a well-defined thick inductura which fills out half of the narrow umbilicus.

Dimensions. Height: 17 mm; diameter: 16 mm (for an exceptionally big shell from Eger).

Sorgenfrei (1958) regards *Polinices catena* and *P. helicina* as synonyms, because according to him Brocchi's type fits quite well into the form circle of *P. catena*.

It lived all over the Upper Oligocene sea from the shores to bathyal waters. It is most abundant in the *Glycymeris latiradiata*, *Pitar polytropa* and *Turritella venus* communities (shallow and medium-depth sublittoral facies). Its occurrence in the littoral *Tympanotonus-Pirenella* communities suggests some degree of euryhalinity.

Hungarian Upper Oligocene occurrences: Solymár 72, Leányfalu-4, Dömös-2, Diósjenő-4, -7, -8, Dejtár, Eger-1/6, -1/k, Mucsony 136, Novaj-1.

Distribution. A subspecies widespread all over Europe, usually turning up in the Neogene, that arose in the Paratethys and the North Sea basin already in the Upper Oligocene.

Subgenus: NEVERITA Risso, 1826

Polinices (Neverita) josephinia olla (De Serres, 1829)

Pl. XXXIII, figs 2—4

1856 *Natica Josephinia* Risso — Hörnes, p. 523, Pl. 47, figs 4—5
1866 *Natica Josephina* Risso — Speyer, p. 27, Pl. 3, fig. 2
1891 *Neverita Josephinia* Risso — Sacco, p. 83, Pl. 2, fig. 54
1897 *Natica Josephinia* Risso — Wolff, p. 265, Pl. 9, fig. 6
1912 *Natica Josephinia* Risso var. *Manhartensis* Schff. — Schaffer, p. 166, Pl. 54, figs 15—16
1914 *Natica Josephinia* Risso — Telegdi-Roth, p. 31
1917—18 *Natica olla* De Serr. — Cossmann et Peyrot, p. 215, Pl. 12, figs 5—7
1925 *Natica Josephinia* Risso — Kautsky, p. 71, Pl. 6, fig. 23
1936 *Natica Josephinia* Risso — Noszky, p. 61
1952 *Polynices olla* De Serr. — Glibert, p. 72, Pl. 5, fig. 11
1958 *Natica Josephinia* Risso — Sorgenfrei, p. 194, Pl. 39, fig. 126
1958 *Polinices josephinia* Risso — Hölzl, p. 207, Pl. 18, fig. 18
1960 *Polinices olla* De Serr. — Anderson, p. 81, Pl. 1, fig. 3
1962 *Polinices olla* De Serr. — Hölzl, p. 152, Pl. 9, fig. 3
1963 *Neverita olla manhartensis* Schff. — Steininger, p. 49, Pl. 10, fig. 10
1963 *Polinices olla* De Serr. — Báldi, p. 88, Pl. 5, fig. 11
1964 *Polinices olla* De Serr. — Răileanu et Negulescu, p. 175, Pl. 13, fig. 10
1966 *Natica josephinia olla* De Serr. — Strausz, p. 232, Pl. 49, figs 9—12

A flat conical shell with an insignificant, hardly emerging spire, and a large, very broad last whorl. The adapical portion of the latter is hardly convex, almost flat, more or less collinear with the spire outline. Its basal and peripheral portions are, on the other hand, quite convex. There is a characteristic callous inductura which fills most of the deep umbilicus with a well-defined spheroidal callus. The surface exhibits weak growth lines only.

Dimensions. Height: 17 mm; diameter: 24.5 mm.

According to SORGENFREI (1958), *P. olla* and living *P. josephinia* (RISSO, 1826) are to be regarded as one and the same species; the only difference, the more eminent spira of *P. olla* is probably less significant than it has been believed earlier.

This is a stenohaline-marine species indicative of and restricted to the shallow sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Leányfalu-4, Eger-1/k.

Distribution. The subspecies, widespread all over Europe, had arisen besides the Paratethyan also in the Mediterranean and Boreal Oligocene and persisted all through the Neogene. *P. josephinia* s. s. is a living species.

Genus: NATICA SCOPOLI, 1777

Natica millepunctata tigrina DEFRANCE, 1825

Pl. XXXIII, fig. 6

1856 *Natica millepunctata* LAM. — HÖRNES, p. 518 (partim)
1891 *Natica millepunctata* var. *tigrina* DEFR. — SACCO, p. 49, Pl. 2, figs 11—12
1897 *Natica millepunctata* LAM. — WOLFF, p. 264, Pl. 25, fig. 14
1912 *Natica millepunctata* LAM. — SCHAFFER, p. 165, Pl. 54, figs 5—7
1917—18 *Natica tigrina* DEFR. — COSSMANN et PEYROT, p. 190, Pl. 11, figs 1 and 9—10
1925 *Natica hanseata* — KAUTSKY, p. 66, Pl. 6, figs 14—15
1925 *Natica Beyrichi* KOEN. — KAUTSKY, p. 66, Pl. 6, fig. 17 (non BEYRICH)
1952 *Natica tigrina* DEFR. — GLIBERT, p. 74, Pl. 5, fig. 13
1958 *Natica millepunctata tigrina* DEFR. — HÖLZL, p. 212, Pl. 19, fig. 3
?1958 *Natica* cf. *millepunctata millepunctata* LAM. — SENEŠ, p. 147
1960 *Natica tigrina* DEFR. — ANDERSON, p. 90, Pl. 4, fig. 1
1963 *Natica tigrina* DEFR. — BÁLDI, p. 87, Pl. 5, fig. 12
1964 *Natica millepunctata* LAM. — RĂILEANU et NEGULESCU, p. 175, Pl. 13, fig. 11
1966 *Natica millepunctata* LAM. — STRAUSZ, p. 225, Pl. 48, figs 5—12

A shell of four whorls with a very low spire, impressed sutures, an inflated, large last whorl, a spacious deep uncovered umbilicus with a very flat and weak funicle. The parietal region exhibits a weak inductura. The shell surface is smooth except for the growth lines.

Dimensions. Height: 21 (20) mm; diameter: 22 (19) mm.

STRAUSZ (1966) contracts it with living N. *millepunctata*. A stenohaline-marine form known from the shallow sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, Budafok-1/4, Eger-1/k.

Distribution. The subspecies is known from all over the European Neogene. *N. millepunctata* s. s. is living in the Mediterranean and the Atlantic. The earliest occurrence of the subspecies *tigrina* is at the abovenamed Paratethyan Upper Oligocene localities.

Ampullinidae

Genus: GLOBULARIA SWAINSON, 1840 (= *Cernina* GRAY, 1842)

Globularia gibberosa (GRATELOUP, 1827) s. l.

1891 *Globularia gibberosa* GRAT. — SACCO, p. 3, Pl. 1, fig. 1
1910 *Natica gibberosa* GRAT. — KRANZ, p. 237, textfig. 8
1910 *Natica auriculata* GRAT. — KRANZ, p. 240, Textfig. 9
1958 *Globularia auriculata* GRAT. — SENEŠ, p. 148, Pl. 21, figs 286—287

I have subsumed under this title the specimens which defy subspecific identification. Such specimens were found at Diósjenő-24.

In addition to the Paratethyan Oligocene, the group of *G. gibberosa* is known also from the Mediterranean and Atlantic Oligocene.

Globularia gibberosa sanctistephani (COSSMANN et PEYROT, 1917)

Pl. XXXII, figs 4—5

1870 *Natica auriculata* GRAT. — FUCHS, p. 171, Pl. 10, figs 23—24
?1891 *Globularia gibberosa* var. *postpatula* SACC. — SACCO, p. 5, Pl. 1, fig. 4
1914 *Ampullina auriculata* GRAT. — TELEGDI-ROTH, p. 32, Pl. 3, figs 9 and 18—19
1917—18 *Ampullina Sancti-Stephani* n. sp. — COSSMANN et PEYROT, p. 245, Pl. 12, figs 30—33
1936 *Ampullina Telegdi Rothi* n. sp. — GÁBOR, p. 1, Pl. 1, fig. 1
1936 *Ampullina Telegdi Rothi* GÁB. — NOSZKY, p. 62
1936 *Ampullina auriculata* GRAT. — NOSZKY, p. 61
1964 *Globularia gibberosa sanctistephani* C. et P. — BÁLDI (in BÁLDI et al.), p. 172, Pl. 2, fig. 4

A large shell with a hardly emergent spire of 3 or 4 whorls, and a considerably inflated, huge last whorl. The umbilicus is uncovered or half-covered: the inductura is weakly callous parietally. There is a flat spiral thickening (fasciole) about the umbilicus. Aperture pear-shaped. Shell surface smooth apart from the growth lines.

Dimensions. Height: 44 m; diameter: 47 mm.

The extent to which the umbilicus is covered is rather variable. On this basis, *G. gibberosa* and *G. auriculata* (GRATELOUP, 1827) do not probably represent different species: nor do we consider *G. telegdirothi* (GÁBOR, 1936) an independent taxon. — *G. gibberosa sanctistephani* differs from *G. gibberosa* s. s. in its broader, more inflated last whorl and in its stronger parietal callus.

This is a shallow sublittoral facies index occurring in the *Glycymeris latiradiata* and *Pitar polytropa* communities.

Hungarian Upper Oligocene occurrences: Kesztölc-1, Budafok -1/4, Diósjenő-7, Eger-1/k, -2.

Distribution. Besides the Atlantic and probably also the Mediterranean Upper Oligocene it is known from the above-named Central Paratethyan Upper Oligocene localities.

Globularia gibberosa callosa (NOSZKY, 1936)

Pl. XXXII, figs 1—2

1936 *Ampullina Telegdi Rothi* GÁB. nov. var. *callosa* — NOSZKY, p. 62, Pl. 5, fig. 14

1964 *Globularia gibberosa callosa* n. ssp. — BÁLDI (in BÁLDI et al.), p. 172, Pl. 2, fig. 4

Differs from *G. gibberosa sanctistephani* in that its umbilicus is invariably covered and its parietal callus is much stronger.

Dimensions. Height ~ 43 mm; diameter ~ 55 mm.

In shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Diósjenő-8, Eger-1/k.

Distribution. Known only from the above-named localities.

Globularia rothi (COSSMANN, 1925)

Pl. XXXII, figs 6—7

1914 *Ampullina compressa* BAST. — TELEGDI-ROTH, p. 33, Pl. 3, figs 14—15 (non BASTEROT)

1925 *Cernina Rothi* nobis — COSSMANN, p. 37

1936 *Ampullina compressa* BAST. — NOSZKY, p. 62 (non BASTEROT)

1963 *Globularia ovata* n. sp. — BÁLDI, p. 87, Pl. 5, figs 13—14

There is a striking difference from the group of *G. gibberosa*, consisting in a smaller size, a less inflated last whorl and less broad shell. The inductura is less well-defined, less callous, but the umbilicus is invariably covered.

Dimensions. Height: 33 mm; diameter: 33 mm (Törökbálint); height: 44 mm; diameter: 42 mm (Eger).

Differs from *G. compressa* (BASTEROT, 1825) in its lower spire, broader last whorl and in the shape of the aperture.

The deviations of the Törökbálint and Eger specimens from *G. compressa* had prompted me to distinguish the Hungarian form by the name *G. ovata*. It was only later that I stumbled upon an earlier correction buried in one of the enormous "essays" of COSSMANN, in which that author had proposed for TELEGDI ROTH's figured specimen from Eger the name *Cernina Rothi*, which has priority over my name *G. ovata*. The rejection of the name "*ovata*" is made necessary also by the fact that a form belonging to the form circle of *G. compressa* was given this same name by GRATELOUP in 1840. This form is considered a variety of *G. compressa* by SACCO. *G. ovata* BÁLDI, 1963 is thus an objective synonym as well as a junior homonym.

This is a shallow sublittoral facies index present in the *Glycymeris latiradiata* and *Pitar polytropa* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Eger -1/k.

Distribution: known so far only from the above-named localities.

Genus: AMPULLINA BOWDICH, 1822 (= *Megatylotus* FISCHER, 1885)

Ampullina crassatina (LAMARCK, 1804)

Pl. XXXII, fig. 3; Pl. XXXIII, fig. 7; Pl. LI, fig. 10

1863 *Natica crassatina* LAM. — SANDBERGER, p. 161, Pl. 13, fig. 1
1891 *Megatylotus crassatinus* Lk. et var. div. — SACCO, p. 13
1900 *Globularia crassatina* LAM. — ROVERETO, p. 137
1910 *Natica crassatina* LAM. — KRANZ, p. 242, Pl. 5, fig. 6
1914 *Ampullina crassatina* LAM. — TELEGDI-ROTH, p. 33, Pl. 3, fig. 2
1936 *Ampullina crassatina* LAM. — NOSZKY, p. 62
1937 *Ampullina crassatina* LAM. — VENZO, p. 176, Pl. 1, fig. 2
1939 *Megatylotus crassatinus* LAM. et var. *longiuscula* SACCO — NOSZKY, p. 12
1958 *Ampullina crassatina* LAM. — SENEŠ, p. 146
1961 *Megatylotus crassatinus* LAM. — BÁLDI (in BÁLDI et al.), p. 100
1962 *Ampullina crassatina* LAM. — HÖLZL, p. 157, Pl. 9, fig. 7
1964 *Ampullina crassatina* LAM. — BÁLDI (in BÁLDI et al.), p. 160, Pl. 1, fig. 7

Except for some giant specimens from Eger, these are medium-sized shells with low spires of 4 or 5 whorls. The tall last whorl is flat, broadening towards the base and meeting it in a strongly convex shoulder. This shoulder is most conspicuous, almost angular on the smaller specimens. The base and aperture are oblique, prosocline. The suture is canaliculate with a deep narrow channel. The flat oblique base is covered with a broad semicircular inductura, slightly callous at the inner lip. The pear-shaped aperture ends in a minute adapical channel at its top. The shell is smooth except for the growth lines.

Dimensions. Height: 30 mm; diameter: 30 mm (an average specimen from Eger).

The dimensions are highly varied. Specimens of exceptional size (100 mm) are known from Eger and the borehole Solymár 72. The specimens from the locality Pomáz-6 are, on the other hand, significantly smaller than the average.

This is a littoral and shallow sublittoral euryhaline species, particularly characteristic of the *Pitar undata* community. Its distribution reveals, however, that it could not stand salinities less than 10 per mille.

Hungarian Upper Oligocene occurrences: Nagyegyháza 3, Zsámbék 23, Vasztély 49, Solymár 72, Budafok-1/4, Dömös-2, Pomáz-6, -22 Leányfalu-4, Diósjenő-1, -3, -7, -24, Eger-1/k, -1/18, -2, Novaj-1.

Distribution. A Palaeogene species widespread all over Europe, it nowhere passes the Oligocene-Miocene limit.

Cypraeacea

Eratoidae

Genus: ERATO Risso, 1826

Erato prolaevis Sacco, 1894

Pl. XXXIV, fig. 5

1862 *Erato laevis* Don. — Speyer, p. 106, Pl. 18, fig. 16 (non Donovan)
1894 *Erato prolaevis* Sacc. — Sacco, p. 58
1952 *Hesperato prolaevis* Sacco, — Görges, p. 82, Pl. 2, figs 59—60

A small smooth shell with a low spire on which no sutures are visible. The last whorl is tall, somewhat inflated, convex. The aperture is long, narrow. The inner lip exhibits weak columellar folds growing stronger downwards, whereas the outer lip, swollen like a varix, is smooth on its inner side.

Dimensions. Height: 5.5 mm; diameter: 3.6 mm.

Differs from Miocene *E. laevis* (Donovan, 1799) in its smaller size. Comparison with Miocene specimens has revealed no other difference.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: known besides the above locality also from the Boreal Upper Oligocene.

Cypraeidae

Genus: ZONARIA Jousseaume, 1884

Zonaria globosa (Dujardin, 1835)

Pl. XXXIV, figs 4, 6

1856 *Cypraea globosa* Duj. — Hörnes, p. 64, Pl. 7, fig. 5
1894 *Zonaria globosa* Duj. et var. div. — Sacco, p. 15, Pl. 1, figs 27—31
1914 *Cypraea globosa* Duj. — Telegdi-Roth, p. 40

1922 *Cypraea subglobosa* GRAT. — COSSMANN et PEYROT, p. 304, Pl. 10, figs 18—20

1936 *Cypraea globosa* DUJ. — NOSZKY, p. 62

1958 *Erronea subglobosa* GRAT. — SENEŠ, p. 149, Pl. 21, figs 282—283

An ovate, apparently entirely involute shell. The large specimens are somewhat slimmer than the rather squat juvenile ones. On the large specimens, there is a shallow depression about the enamel-covered apex. The aperture, fairly wide in its full length, is even wider near the bottom where it ends in a siphonal canal. Its adapical end is adaxially bent. The outer lip bears 20 to 25 teeth, the inner one bears 13 to 17. The rim of the siphonal canal consists of a single, abapically deflected rib.

Dimensions. Height: 43 mm, diameter: 27 mm; height: 27 mm, diameter: 20 mm (juvenile specimen, form "subglobosa").

According to COSSMANN and PEYROT (1922), *Z. subglobosa* (GRATELOUP, 1840) differs from *Z. globosa* in its squatter, less tapering form. This distinction does not, however, seem to be borne out by the material from Eger. The form subglobosa might be a juvenile stage of *Z. globosa*: in the Eger material both forms are present and hard to distinguish.

Found in shallow sublittoral communities (*Glycymeris latiradiata* and *Pitar polytropa*).

Hungarian Upper Oligocene occurrences: Kesztölc-1, Dejtár, Eger-1/k

Distribution. A Mediterranean-Atlantic Miocene species present also in the Paratethys, it has its earliest known occurrence in the Upper Oligocene of the Central Paratethys.

Zonaria subexcisa (BRAUN, 1850)

Pl. XXXVI, fig. 3

1863 *Cypraea subexcisa* BRAUN — SANDBERGER, p. 255, Pl. 19, fig. 9

1894 *Zonaria subexcisa* BRAUN et var. div. — SACCO, p. 14, Pl. 1, figs 22—26

1900 *Cypraea subexcisa* BRAUN var. *explendens* — ROVERETO, p. 157

?1936 *Cypraea subexcisa* BRAUN var. *explendens* SACCO — NOSZKY, p. 62

1964 *Zonaria subexcisa* BRAUN — BÁLDI (in BÁLDI et al.), p. 172

Can be distinguished from *Z. globosa* at a first glance by its aperture which is very narrow even as related to its size. The height-to-diameter ratio is highly varied. There are some markedly elongate, slender specimens.

Dimensions. Height: 27.6 mm; diameter: 17 mm.

The *Zonaria* are epifaunal, stenohaline-marine predators feeding largely on tunicates.

Z. subexcisa has turned up in shallow sublittoral *Glycymeris latiradiata* communities.

Hungarian Upper Oligocene occurrences: Diósjenő-24, ? Eger-1/k.

Distribution. A Boreal-Mediterranean Oligocene species, it is known from no Paratethyan locality other than the above ones.

Doliacea

Cassididae

Genus: CASSIDARIA Lamarck, 1812

Cassidaria nodosa (Solander in Brander, 1766)

Pl. XXXV, figs 1—2

1854 *Cassidaria Buchii* Boll — Beyrich, p. 484, Pl. 9, figs 2—3
1863 *Cassidaria Buchii* Boll et var. div. — Speyer, p. 162, Pl. 30, figs 1—9
1889 *Cassidaria nodosa* Sol. — Koenen, p. 257, Pl. 21, fig. 14
1897 *Cassidaria Buchii* Boll — Wolff, p. 273, Pl. 26, fig. 8
1914 *Cassidaria nodosa* Sol. var. *Buchii* Boll — Telegdi-Roth, p. 29, Pl. 3, fig. 3
1936 *Cassidaria nodosa* Sol. var. *Buchii* Boll — Noszky, p. 62
1937 *Cassidaria nodosa* Sol. var. *Buchii* Boll — Venzo, p. 38, Pl. 2, figs 22—23
1940 *Echinophoria nodosa* Sol. et var. *Buchii* Boll — Noszky, p. 20
1943 *Cassidaria nodosa* Sol. — Albrecht et Valk, p. 56 (partim), Pl. 4, figs 97—98
1952 *Cassidaria nodosa* Sol. — Görges, p. 85 (partim)
1958 *Cassidaria nodosa* Sol. var. *Buchii* Boll — B.-Czabalay, Pl. 31, fig. 1
1958 *Cassidaria nodosa nodosa* Sol. — Seneš, p. 150
1958 *Cassidaria nodosa* var. (?) *buchii* Boll. — Seneš, p. 150
1962 *Phalium nodosum* Sol. — Hölzl, p. 158, Pl. 9, fig. 5
1963 *Cassidaria nodosa* Sol. — Báldi, p. 89, Pl. 6, fig. 4

Spire very short, pointed, gradate. The last whorl which makes up most of the shell bears four spiral rows of strong and pointed spines. Somewhat elongate in the spiral direction, these spines number 9 in the adapical row of the last whorl. The abapical rows of spines are weaker. The shell surface is covered with fine spiral threads except on the sutural shelf. The inner surfaces of the aperture are smooth, shiny. There is a broad crescent-shaped inductura as high as the entire last whorl. The outer lip is swollen varix-fashion.

Dimensions. Height: 39 mm; diameter: 37 mm.

The *Cassidaria* species are stenohaline-marine predators feeding on echinoderms.

C. nodosa occurs in both shallow and medium-depth sublittoral facies, but it only attains some abundance in the *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrences: Solymár 72, Törökbálint-2, Pomáz-1, Diósjenő-4, -7, Dejtár, Eger-1/k.

Distribution. A Boreal-Mediterranean species frequent also in the Paratethys; arisen in the Eocene, it is highly typical of the Oligocene; it nowhere passes the Oligocene-Miocene boundary.

Cassidaria depressa Buch, 1831

Pl. XXXV, figs 3—5

1854 *Cassidaria depressa* Buch — Beyrich, p. 482, Pl. 9, fig. 1
1863 *Cassidaria depressa* Buch — Sandberger, p. 195, Pl. 19, fig. 7
1914 *Cassidaria nodosa* Sol. var. *depressa* Buch subvar. *minor* n. subvar. — Telegdi-Roth, p. 28, Pl. 4, figs 1—2
1936 *Cassidaria nodosa* Sol. var. *depressa* Buch subvar. *minor* T.-R. — Noszky, p. 62
1936 *Cassidaria nodosa* Sol. n. var. *semicostata* — Noszky, p. 62, Pl. 5, fig. 17
1952 *Cassidaria nodosa* Sol. — Görges, p. 85 (partim)
1957 *Cassidaria depressa* Buch — Glibert, p. 59, Pl. 6, fig. 13

Spire low, gradate. The tall, convex last whorl bears six spiral strings of nodes. Further ornament includes fine spiral threads and ribs. The adapical parts of the whorls bear a narrow, concave sutural shelf. The aperture ends in a short backward-twisted canal. There is a thick inductura, and the outer lip is developed varix-fashion. The inner lip surfaces are smooth, shiny.

Dimensions. Height: 29 mm; diameter: 22 mm.

Koenen (1867) regarded the forms described by the names *C. nodosa*, *C. depressa* and *C. buchi* Boll, 1851 as one and the same species. His view was shared by Görges (1952) and Hölzl (1962). However, as I have pointed out earlier (Báldi 1963), there are the following fundamental differences, unbridged by any transitions, between *C. depressa* and *C. nodosa* (= *C. buchi*): the last whorl of *C. nodosa* invariably bears four or at most five strings of nodes. The nodes are spiny and number 11 per whorl. Any other spiral ornament is subordinate. On the last whorl of *C. depressa*, on the other hand, there are 5 to 6 rows of nodes; these are smaller, more rounded, not spiny, and number 15 to 19 per whorl. The secondary spiral ornament is much stronger. At Eger, for instance, both species occur without the slightest transition, as had already been stated by Telegdi-Roth (1914).

More frequent in shallow sublittoral communities (mainly *Pitar polytropa*) than anywhere else. A smoother, smaller-sized variety has turned up in the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Diósjenő-24, Eger-1/6,-1/k.

Distribution: known in addition to the Paratethys also from the Boreal Upper Oligocene. It nowhere passes the Oligocene-Miocene boundary.

Charoniidae

Genus: CHARONIA Gistel, 1848 (= *Tritonium* Link, 1807: = *Triton* Montfort, 1810)

Subgenus: SASSIA Bellardi, 1872

Charonia (Sassia) tarbelliana transiens n. subsp.

Pl. XXXV, figs 6—7

1914 *Tritonium Tarbellianum* Grat. var. — Telegdi-Roth, p. 14, Pl. 1, figs 5—6

1936 *Tritonium Tarbellianum* GRAT. var. — NOSZKY, p. 63

Locus typicus: Eger, Wind Brickyard (Eger-1/k).

Stratum typicum: Upper Oligocene, Egerian (fine-grained sandstone).

Derivatio nominis: transiens: transitional. The name refers to the transitional position between Oligocene *Ch. flandrica* and Miocene *Ch. tarbelliana*.

Diagnosis. Spire gradate, somewhat less tall than the broad last whorl. Concave sutural ramp overlooking a shoulder running along the approximate median line of the whorl. The massive, broad axial ribs do not continue on the sutural ramp or grow very weak if they do. They number 11 on the last whorl. The spiral ornament includes threads covering also the sutural ramp, and very close-spaced spiral ribs. The last whorl bear five broader spiral ribs separated by grooves. On the abapertural side of each varix there are four small pits, each corresponding to one of these grooves. The outer lip bears six teeth on its inner side. There are vague irregular folds on the abapical portion of the inner lip.

Dimensions. Height: 25 mm; diameter: 15 mm (holotype, inventory number M 68/2095).

The new subspecies differs from *Ch. tarbelliana* (GRATELOUP, 1840) s. s. in its smaller average size, and the strong, non-fading ornament of the last whorl. The difference from *Ch. flandrica* (DE KONINCK, 1838) is that on the abapertural side of each varix there are rounded pits corresponding to the spiral grooves. It was on the strength of this feature that TELEGDI ROTH (1914) distinguished it from *Ch. flandrica* and placed it into *Ch. tarbelliana*. At the same time he correctly recognized the difference from the latter and therefore applied the designation "var.". — The subspecies from Eger is, then, a transition between the two species, the close genetic connexion of which has already been pointed out by SANDBERGER, SPEYER and HOERNES and AUINGER. The question of the identity of the two species could also be raised with some justification. Still, GLIBERT (1957) perceives the following difference: *Ch. tarbelliana* is smaller, less nodose with less convex whorls than *Ch. flandrica*. He does not mention the roundish pits on the sides of the varices, and these are in fact missing from his figures.

Known from shallow and medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Eger-1/k, -2.

Distribution. The subspecies is known from the above-named two localities only. *Ch. flandrica* is widespread in the Boreal Oligocene, *Ch. tarbelliana* in the Boreal and Atlantic Miocene.

Ficidae

Genus: FICUS BOLTEN in RÖDING, 1798 (= *Pirula* LAMARCK, 1799)

Ficus concinna BEYRICH, 1854

Pl. XXXVI, figs 4—5

1854 *Pyrula concinna* BEYR. —. BEYRICH, p. 775, Pl. 15, figs 7—8

1863 *Pyrula concinna* BEYR. — SPEYER, p. 184, Pl. 33, fig. 15
1897 *Ficula concinna* BEYR. — WOLFF, p. 274, Pl. 26, fig. 11
1952 *Ficus concinnus* BEYR. — GÖRGES, p. 86
1957 *Ficus concinnus* BEYR. — GLIBERT, p. 60
1962 *Pirula concinna* BEYR. — HÖLZL, p. 162, Pl. 9, fig. 9
1963 *Pirula concinna* BEYR. — BÁLDI, p. 89, Pl. 6, fig. 1

Pear-shaped shell with low rounded spire; large, inflated last whorl. Sutures adpressed, insignificant. Last whorl most convex about median line. There is no sutural shelf or ramp. Ornament cancellate, a dense net of flat spiral and axial ribs thinner than the spaces between them. Axial ribs hardly narrower than spiral ones; the two are of almost equal strength. The space limited by one pair each of spiral and axial ribs is approximately square. There is no secondary ribbing.

Dimensions. Height ~ 32 mm, diameter ~ 21 mm.

In Boreal Miocene *F. simplex* BEYRICH, 1854 the spiral ribbing is stronger and denser: the ribs are broader than the spaces between them. Mediterranean Miocene *F. geometra* BORSON, 1825 is larger and of a different shape with an even lower spire. Boreal *F. reticulata* LAMARCK, 1822 has a wider-spaced spiral ribbing alternating with weaker secondary ribs.

Ficus is a genus of stenohaline-marine carnivores usually feeding on bivalves. *F. concinna* is restricted to the medium-depth sublittoral zone.

Hungarian Upper Oligocene occurrences: Máriahalom 36, Felsőőrspuszta 44, Törökbálint-2, Dejtár.

Distribution. Unknown from the Miocene, it occurs in the Boreal and Paratethyan Oligocene.

Ficus condita (BRONGNIART, 1823)

Pl. XXXVI, figs 1—2

1856 *Pyrula condita* BRONG. — HÖRNES, p. 270, Pl. 28, figs 4—6
1863 *Pyrula reticulata* LAM. — SPEYER, p. 185 (partim), Pl. 33, tantum fig. 14 (non LAMARCK)
1891 *Ficula condita* BRONG. — SACCO, p. 23, Pl. 1, fig. 27
1897 *Ficula condita* BRONG. — WOLFF, p. 275, Pl. 26, fig. 10
1900 *Pirula condita* BRONG. — ROVERETO, p. 159
1912 *Pyrula condita* BRONG. — SCHAFFER, p. 138, Pl. 40, figs 25—26, 28
1914 *Pyrula condita* BRONG. — TELEGDI-ROTH, p. 29, Pl. 4, fig. 9
1922 *Pirula condita* BRONG. — COSSMANN et PEYROT, p. 333, Pl. 10, fig. 46
1936 *Pyrula condita* BRONG. — NOSZKY, p. 63
1940 *Ficula condita* BRONG. — NOSZKY, p. 22
1952 *Pyrula condita* BRONG. — ANIĆ, p. 43, Pl. 11, fig. 7
1952 *Pirula condita* BRONG. — GLIBERT, p. 89, Pl. 7, fig. 4
1955 *Pirula condita* BRONG. — ACCORDI, p. 35, Pl. 2, fig. 18
1956 *Pyrula condita* BRONG. — RASMUSSEN, p. 65, Pl. 5, fig. 5

1957 *Ficus conditus* BRONG. — GLIBERT, p. 61
1958 *Pyrula condita* BRONG. — SORGENFREI, p. 200, Pl. 41, fig. 131
1958 *Ficus conditus* BRONG. — HÖLZL, p. 220
1959 *Ficus conditus* BRONG. — ČTYROKÝ, p. 75, Pl. 1, figs 1—2
1962 *Pirula condita* BRONG. — HÖLZL, p. 162, Pl. 9, fig. 10
1964 *Ficus conditus* BRONG. — RĂILEANU et NEGULESCU, p. 178, Pl. 15, figs 4—5
1966 *Pirula condita* BRONG. — STRAUSZ, p. 254, Pl. 57, figs 4-6

Pear-shaped shell. Spire very low, almost fully covered by the inflated last whorl. This latter is most convex in the adapical region, where the broad, almost horizontal sutural shelf bends down towards the base without a well-defined shoulder. Ornament cancellate; flat axial ribs somewhat narrower than the spaces between them intersect wide-spaced spiral ribs. The space between one pair each of spiral and axial ribs is a rectangular oblong. The points of intersection of the two sets of ribs bear very weak nodes. In each spiral furrow there are two to three weak secondary spiral ribs.

Dimensions. It is abundant at Eger only, where the specimens tend to be rather small. A specimen of about average size has a height of 25 mm, and a diameter of 18 mm. The "k" layer at Eger yielded one specimen of exceptional size (height: 58 mm; diameter: 43 mm).

Easy to distinguish from *F. concinna* both by shape (lower spire, the presence of a sutural shelf), and by ornament (wide-spaced spiral ribbing with secondary ribs in the furrows).

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Csolnok 695, Eger-1/k.

Distribution. Widespread all over Europe, abundant especially in the Neogene, it appears also in the Upper Oligocene, in the Paratethys and also in the Boreal and Mediterranean provinces, but not in the Atlantic.

Neogastropoda

Muricacea

Muricidae

Genus: MUREX LINNÉ, 1758

Subgenus: HAUSTELLUM BRUGUIÈRE, 1792

Murex (Haustellum) paucispinatus TELEGDI-ROTH, 1914

Pl. XXXVII, figs 6—7

1914 *Murex paucispinatus* n. sp. — TELEGDI-ROTH, p. 12, Pl. 1, figs 8—10
1936 *Murex paucispinatus* T.-R. — NOSZKY, p. 64
1961 *Murex paucispinatus* T.-R. — BÁLDI (in BÁLDI et al.), p. 101, Pl. 4, fig. 8

A relatively small muricid with gradate spire and long siphonal canal. The three whorls of the protoconch are smooth. The first two whorls of the teleoconch bear a cancellate ornament of axial ribs and 3 or 4 thin spiral ribs. The remaining four whorls show an outline that is broken in the median line or slightly below it. Every fourth axial rib is stronger than the others. From these, flat spines emerge along the shoulder. There are 16 axial ribs per whorl, so that there are altogether four stronger, spiny ribs per whorl. The spiral ribbing continues also on the backs of the axial ribs and extends also to the base.

Dimensions. Height: 26.2 mm; diameter: 13.2 mm.

Stands closest to Miocene *M. partschi* HÖRNES, 1958, as had already been pointed out by TELEGDI-ROTH (1914). According to this latter author, the species from Eger differs merely in its ornament, particularly in its spiny varices, from *M. partschi*. Another difference is the smaller size of *M. paucispinatus*.

The muricids are epifaunal predators: *M. paucispinatus* occurs in the *Hinia-Cadulus* and *Pitar polytropa* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, -1/k, Novaj-1.

Distribution. Not known from outside the above-named localities.

Genus: CHICOREUS MONTFORT, 1810

Subgenus: FOVEOMUREX IREDALE, 1936

Chicoreus (Foveomurex) trigonalis (GÁBOR, 1936)

Pl. XXXVI, fig. 6; Pl. XXXIX, figs 1—2

1936 *Murex trigonalis* n. sp. — GÁBOR, p. 4, Pl. 1, fig. 7
1936 *Murex trigonalis* n. sp. var. *spinatus* n. var. — GÁBOR, p. 5, Pl. 1, fig. 11
1936 *Murex trigonalis* GÁB. — NOSZKY, p. 63
1936 *Murex trigonalis* GÁB. var. *spinosus* GÁB. — NOSZKY, p. 63
1936 *Murex trigonalis* GÁB. nov. var. *nudus* — NOSZKY, p. 63

A medium-sized muricid with a low, somewhat gradate spire occupying one third of total shell height. Whorls strongly convex. Sutural shelf hardly discernible. The broad round-backed axial ribs and varices are wide-spaced, numbering 3 to 5 on the last whorl, where varices alternate with weaker axial ribs. The ornament is complemented by a very dense spiral ribbing of alternating stronger and weaker ribs. Aperture round, inductura insignificant. The inner side of the outer lip is covered with short horizontal folds. The siphonal canal is short, somewhat prosocline, abapically broadening.

Dimensions. Height: 41 mm; diameter: 25 mm.

As had already been stated by GÁBOR (1936), it may be related to Miocene *Ch. borni* (HÖRNES, 1856), from which it is, however, readily distinguished by its squatter shape and certain deviations in ornament.

Known from a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution. Not known so far outside the above-named locality.

Genus: HEXAPLEX PERRY, 1811

Subgenus: MURICANTHA SWAINSON, 1840

Hexaplex (Muricantha) deshayesi (NYST, 1836)

Pl. XXXVIII, figs 1—2

1854 *Murex capito* PHIL. — BEYRICH, p. 750, Pl. 13, figs 4—6
1856 *Murex capito* PHIL. — HÖRNES, p. 226, Pl. 23, fig. 10
1863 *Murex Deshayesii* NYST — SANDBERGER, p. 211, Pl. 18, fig. 3
1863 *Murex capito* PHIL. — SPEYER, p. 175, Pl. 32, figs 1—10 and 14
1866 *Murex capito* PHIL. var. — SPEYER, p. 17, Pl. 1, fig. 10
1889 *Murex Deshayesi* NYST — KOENEN, p. 61, Pl. 3, fig. 1
1912 *Murex Deshayesii* NYST var. *capito* PHIL. — SCHAFFER, p. 143, Pl. 50, figs 16—17
1914 *Murex Deshayesi* NYST var. *capito* PHIL. — TELEGDI-ROTH, p. 13, Pl. 3, fig. 1
1936 *Murex Deshayesi* NYST var. *capito* PHIL. — NOSZKY, p. 64
1940 *Murex Deshayesi* NYST — NOSZKY, p. 27
1952 *Hexaplex deshayesi deshayesi* NYST — GÖRGES, p. 87, Pl. 2, figs 65—66
1952 *Hexaplex deshayesi capito* PHIL. — GÖRGES, p. 88, Pl. 2, figs 63—64
1957 *Aspella deshayesi* NYST f. *deshayesi* s. s. — GLIBERT, p. 63
1957 *Aspella deshayesi* NYST f. *capito* PHIL. — GLIBERT, p. 64
1958 *Hexaplex deshayesi* NYST — HÖLZL, p. 225, Pl. 20, fig. 4
1958 *Murex deshayesi* var. (?) *capito* PHIL. — SENEŠ, p. 151
1962 *Hexaplex deshayesi* NYST — HÖLZL, p. 163, Pl. 9, figs 11—12
1962 *Hexaplex deshayesi capito* PHIL. — HÖLZL, p. 164
1963 *Trophon deshayesi* NYST — TEMBROCK, p. 314, Pl. 2, fig. 6; Pl. 3, figs 4—5; Pl. 5, fig. 7; Pl. 6, fig. 1
1963 *Trophon capito* PHIL. — TEMBROCK, p. 315, Pl. 2, fig. 5; Pl. 3, figs 6—7; Pl. 5, figs 8—9; Pl. 6, figs 2—4
1963 *Hexaplex deshayesi* NYST — BÁLDI, p. 90, Pl. 6, fig. 3
?1966 *Trophon capito* PHIL. — STRAUSZ, p. 269, Pl. 32, figs 7—8

Shape and ornament of this shell composed of a relatively low, more or less gradate spire and a voluminous last whorl are highly distinctive. The well-defined broad sutural ramp is slightly concave, whereas the last whorl below the shoulder is strongly convex. The very sharp, narrow collabral ribs bear spines on the shoulder; they number 7 on the last whorl. The spines are conspicuous by being oblique and sometimes twisted. The plane of each collabral rib intersects the axis at an angle. The whorl portion below the shoulder bears a weak spiral ribbing interrupted by each collabral rib. The sutural ramp is entirely smooth. Siphonal canal elongate, broad.

Dimensions. Height: 41 mm; diameter: 28 mm.

KOENEN (1867) had already contracted it with *H. capito* (PHILIPPI, 1843). According to GÖRGES (1952), the difference between the two forms is that the spire of *H. deshayesi* is gradate. All Hungarian specimens would, then, correspond to *H. deshayesi* s. s. A painstaking analysis by TEMBROCK (1963) also distinguishes the two forms. According to her, *H. capito* is broader with different early whorls and a large round open umbilicus.

Known from *Pitar polytropa* and *P. beyrichi* communities (shallow and medium-depth sublittoral facies).

Hungarian Upper Oligocene occurrences: ? Szomor 31, Törökbálint-1, -2, Szentendre 2, Eger-1/k, -2.

Distribution: widespread in the Paratethys and in the Boreal province, arisen in the deeper Oligocene and traceable to the end of the Lower Miocene.

Genus: HADRIANA BUCQUOI, DAUTZENBERG et DOLLFUS, 1882

Hadriana egerensis (GÁBOR, 1936)

Pl. XXXVII, figs 4—5

1936 *Murex egerensis* n. sp. — GÁBOR, p. 3, Pl. 1, fig. 10
1936 *Murex egerensis* GÁB. — NOSZKY, p. 63
1936 *Murex* cfr. *craticulatus* LAM. — NOSZKY, p. 64

The conical, stepped spire occupies one-quarter of total shell height. The ornament on the rather well-defined flat broad sutural ramp is the same as on the rest of the whorl. The last whorl is broadest along the shoulder bordering the ramp. The round-backed axial ribs of the earlier whorls are about equally strong, but the last whorl exhibits an alternation of 5 stronger and 5 weaker axial ribs (varices). The spiral ornament, independent of the axial ribs, is an alternation of stronger and weaker thin ribs. Inductura rather restricted. The inner side of the outer lip is covered with laths. The rather long siphonal canal is slightly deflected abaxially.

Dimensions. Height: 35 mm; diameter: 22 mm.

Stands close to *H. craticulata* (BROCCHI, 1814) (and not to *Murex partschi*, as had been erroneously stated by GÁBOR (1936), since the long siphonal canal of *Murex partschi* is a generic difference from *H. egerensis*). Still, I perceive a specific difference from *H. craticulata* in the whorls of *H. egerensis* that are not so conspicuously gradate, in its shoulder that is rounded rather than sharp and in the alternation of stronger and weaker axial ribs on its last whorls: also, it is more phaneromphalous.

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution: known only from the above-named locality.

Genus: OCINEBRINA JOUSSEAUME, 1880

Ocinebrina crassilabiata trivaricosa BÁLDI, 1964

Pl. XXXVII, figs 1—2

1879 *Murex crassilabiatus* HILB. — HOERNES et AUINGER, p. 219 (partim), Pl. 26, tantum fig. 20 (non HILBER)

1897 *Murex conspicuus* Braun — Wolff, p. 278, Pl. 26, fig. 24 (non Braun)
1912 *Murex crassilabiatus* Hilb. — Schaffer, p. 143, Pl. 1, figs 13—15 (non Hilber)
?1952 *Murex conspicuus* Braun — Anić, p. 41, Pl. 11, fig. 4 (non Braun)
1964 *Ocinebrina crassilabiata trivaricosa* n. subsp. — Báldi (in Báldi et al.), p. 173, Pl. 2, figs 6—8

Only one-fifth of the rather squat shell of five convex whorls is made up by the slightly gradate spire. The ornament of the spire is composed strong round-backed axial ribs and more close-spaced spiral ribs (6 or 7). The last whorl carries three strong varices. Between each pair of these there are 2 to 4 somewhat weaker axial ribs. Varix No. 3 is at the outer lip. The spiral ribbing passes unchanged over the backs of the axial ribs and varices. The inner lip is smooth. The outer lip bears seven teeth growing smaller abapically.

Dimensions. Height: 25 mm; diameter: 16 mm.

Differs from the Gamlitz type of *O. crassilabiata* (Hilber, 1879) s. s. in its smaller size, the much more convex whorls of the spire and the three strong varices on the last whorl. Our specimens do agree well, on the other hand, with the figured specimens of Schaffer (1912) from the Lower Miocene of Dreieichen. The subspecies *trivaricosa* is to be distinguished from *O. sublavata* (Basterot, 1825) on account of its strong varices, its longer siphonal canal and the absence of a sharp shoulder. There is a phylogenetic connexion with *O. conspicua* (Braun, 1840) known from the Rupelian of the Mainz and Paris basins, the difference being in the larger size, more emphatic spiral ornament, squatter and less pronouncedly gradate spire of the subspecies *trivaricosa*. In any case, the subspecies is to be regarded as a transitional form between Oligocene *O. conspicua* and Miocene *O. crassilabiata* s. s.

This was a littoral euryhaline predator, an excellent littoral facies index occurring in the *Tympanotonus-Pirenella*, *Mytilus aquitanicus*, and *Pitar undata* communities. It presumably could stand rather well salinity fluctuations between 10 and 30 per mille.

Hungarian Upper Oligocene occurrences: Máriahalom 36, Vasztély 49, Tök 52, Sárisáp, Dorog-1, Dömös-2, Diósjenő-1, -3.

Distribution: the subspecies is known from the Upper Oligocene and Lower Miocene of the Central and Western Paratethys.

Ocinebrina schönni (Hörnes, 1856)
Pl. XXXVII, fig. 3

1856 *Murex Schönni* Hörn. — Hörnes, p. 235, Pl. 24, fig. 12
1912 *Murex Schönni* Hörn. — Schaffer, p. 143, Pl. 50, figs 20—21
1964 *Ocinebrina schönni* Hörn. — Báldi (in Báldi et. al.), p. 173, Pl. 2, fig. 12

Differs from *O. crassilabiata trivaricosa* in its more elevated, slenderer spire, stronger but wider-spaced spiral ribs: moreover, there is only one strong varix at the outer lip. *O. sublavata* (Basterot, 1825) differs in shape: its axial and spiral ribs are flatter, broader and wider-spaced.

No meaningful dimensions can be given.

Found in a littoral *Tympanotonus-Pirenella* community.

Hungarian Upper Oligocene occurrence: Diósjenő-3.

Distribution: known in addition to the above-named locality also from the Lower Miocene of the Central Paratethys.

Genus: TYPHIS Montfort, 1810

Typhis pungens (Solander in Brander, 1766)

Pl. XXXVIII, figs 3—5

1854 *Tiphys pungens* Sol. — Beyrich, p. 761, Pl. 14, figs 4—5
1856 *Murex horridus* Brocc. — Hörnes, p. 260, Pl. 26, fig. 9
1863 *Tiphys pungens* Sol. — Speyer, p. 179, Pl. 33, figs 3—4
1889 *Typhis pungens* Sol. — Koenen, p. 75, Pl. 7, figs 10—11
1904 *Typhis horridus* Brocc. — Sacco, p. 17, Pl. 4, figs 15—16
1914 *Typhis horridus* Brocc. — Telegdi-Roth, p. 11
1923 *Typhis horridus* Brocc. — Cossmann et Peyrot, p. 236, Pl. 15, figs 17—18
1936 *Typhis horridus* Brocc. — Noszky, p. 65
1936 *Typhis pungens* Sol. — Noszky, p. 65
1943 *Typhis pungens* Sol. — Albrecht et Valk, p. 61, Pl. 5, figs 118—121
1952 *Typhis pungens* Sol. — Görges, p. 89
1952 *Typhis horridus* Brocc. — Glibert, p. 96, Pl. 7, fig. 13
1957 *Typhis pungens* Sol. — Glibert, p. 62, Pl. 5, fig. 3
1958 *Typhis* aff. *horridus* Brocc. — Hölzl, p. 228, Pl. 20, fig. 6
1962 *Typhis pungens* Sol. — Hölzl, p. 165
1963 *Typhis pungens* Sol. — Tembrock, p. 328, Pl. 7, figs 9—10; Pl. 8, fig. 8, 17; Pl. 10, fig. 9
1963 *Typhis horridus* Brocc. — Tembrock, p. 330, Pl. 7, fig. 12; Pl. 8, fig. 11; Pl. 10, fig. 11
1964 *Typhis pungens* Sol. — Anderson, p. 241, Pl. 20, fig. 175
1964 *Typhis horridus* Brocc. — Răileanu et Negulescu, p. 177, Pl. 14, fig. 11

A shell of six whorls. The last whorl exhibits a broad, prominent vertical band, above and below which the whorl outline is flat or slightly concave. On both edges of the band there are pairs of strong long spines; moreover, there is a third weaker and wider-spaced row of spines on the base. Every other spine in the adapical one of the two main rows of spines has its end cut off and is thus revealed to be cavernous, perforate. Each whorl of the spire is covered by the next whorl up to about the middle of the vertical band, so that only the upper row of spines is visible. The spire is gradate.

The oblique, long siphonal canal is entirely covered: this lends the round aperture a holostomatous appearance.

Dimensions. Height: 27 mm; diameter: 16 mm.

According to Glibert (1957), *T. horridus* (Brocchi, 1914) is an independent species which differs in its more robust build, taller whorls and straighter spines from *T. pungens*. Anderson (1964), on the other hand, contracts the two, by the name *T. pungens* according to the rules of priority. Most Eger specimens are robust enough to resemble *T. horridus*, but some of them correspond to *T. pungens*. This transition has prompted me to consider *T. horridus* a synonym, sharing Anderson's opinion.

Found in shallow sublittoral facies (*Pitar polytropa* community).

Hungarian Upper Oligocene occurrences: Eger-1/k, -2.

Distribution: an Oligocene-Miocene species widespread all over Europe that had in places arisen already in the Eocene.

Typhis cuniculosus (Nyst, 1843)

Pl. XXXVIII, figs 6—7

1854 *Tiphys cuniculosus* Nyst — Beyrich, p. 767, Pl. 14, fig. 6
1863 *Tiphys cuniculosus* Nyst — Speyer, p. 181, Pl. 33, figs 5—8
1863 *Typhis cuniculosus* Nyst — Sandberger, p. 204, Pl. 18, fig. 8
1897 *Tiphys cuniculosus* Nyst — Wolff, p. 280, Pl. 26, fig. 28
?1936 *Typhis* cfr. *cuniculosus* Nyst — Noszky, p. 65
1943 *Lyrotyphis cuniculosus* Nyst — Albrecht et Valk, p. 60, Pl. 20, figs 788—791
1952 *Siphonocheilus cuniculosus* Nyst — Görges, p. 90
1957 *Typhis cuniculosus* Nyst — Glibert, p. 63
1958 *Typhis cuniculosus* Nyst — Hölzl, p. 229, Pl. 20, fig. 8
1962 *Typhis cuniculosus* Nyst — Hölzl, p. 166
1963 *Lyrotyphis cuniculosus* Nyst — Tembrock, p. 320, Pl. 7, figs 1—2; Pl. 8, figs 7—16; Pl. 10, fig. 7
1963 *Typhis cuniculosus* Nyst — Báldi, p. 90, Pl. 6, fig. 11

A small-sized *Typhis* species of six or seven convex whorls and strong axial ribs. The later are sharp, narrow and uniform on the earlier whorls, whereas on the latter whorls they are round-backed and broader (as broad as the spaces between them). On the last whorl, the axial ribs are not uniformly heavy; every other one is slightly weaker. They number 11 here. At the adapical end of every other rib there is a round hole, as wide as the rib itself, immediately beside the suture. The rib at the outer lip is inflated varix-fashion. The aperture ends in a short siphonal canal.

Dimension. Height: 13 mm; diameter: 6 mm.

Known from *Pitar polytropa* and *P. beyrichi* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Eger -1/k.

Distribution. This is a Boreal Oligocene species generally known also from the Paratethyan Oligocene but its only Lower Miocene occurrence known so far is in the Bavarian Molasse.

Buccinacea

Columbellidae

Genus: MITRELLA Risso, 1826

Mitrella solitaria Báldi, 1966

Pl. XXXIX, fig. 8

1966 *Mitrella solitaria* n. sp. — Báldi, p. 88, Pl. 3, fig. 7

The shiny shell of eight whorls is entirely smooth: there are just a few spiral grooves in the siphonal region. The spire is slightly gradate, coeloconoid in outline. The hardly convex, almost flat whorls are bounded by deep canaliculate sutures. Outer lip and siphonal canal broken off.

Dimensions. Height: 17.7 mm; diameter: 7.5 mm.

Stands close to *M. nassoides* (Grateloup, 1840), especially to some extreme specimens of that species, but its sutures are more deep, profoundly canaliculate, its size is smaller, its outline coeloconoid and its whorls less rounded. It differs in these same features also from *M. pronassoides* Sacco, 1890.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: known only from this one locality so far.

Buccinidae

Genus: PISANELLA Koenen, 1867

Pisanella doboi (Noszky, 1936)

Pl. XL, figs 7—8; Pl. XLI, figs 4—5

1936 *Chrysodomus Dobói* n. sp. — Noszky, p. 66, Pl. 5, fig. 5
1963 *Neptunea doboi* Noszky — Báldi, p. 91, Pl. 6, fig. 2

The specimens at my disposal are fragmentary, without a protoconch, but even so they permit to observe a slightly gradate spire of somewhat convex whorls occupying less than half of total shell height. The whorl outline exhibits a break somewhat above the median line, forming a not too pronounced shoulder. The sutural ramp is hardly concave. The broad flat oblique axial ribs are as wide as the spaces between them. They number 17 to 20 on the last whorl. They die out at the shoulder and do not transgress on to the sutural ramp. Also, they grow gradually weaker adaperturally. The weak axial ribs of the later whorls are dissected into nodes by the spiral ribbing. This dense spiral ribbing covers the sutural ramp, too. It consists of an alternation of broad flat grooved ribs with finer threads. The siphonal canal is broad, short, oblique. The typical inductura is narrow, well-defined, restricted of extent. It carries two weak oblique columellar folds.

Dimension. Diameter: 16 mm.

The placing of this species into the genus *Neptunea* (= *Chrysodomus*) (Noszky, 1936, Báldi, 1963) is wrong. The ornament and particularly the two columellar folds do not conform with *Neptunea* and stand closer to the genus *Pisanella*. It differs from the very scarce few specimens known so far of KOENEN's genus only in its slightly longer siphonal canal, somewhat larger size and more inflated last whorl. Thus *P. doboi* is the first representative outside the North Sea basin of this Boreal Oligocene genus.

Found in *Pitar polytropa* and *P. beyrichi* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-2, Eger -1/k.

Distribution. Known from the above two localities only.

Genus: BABYLONIA SCHLÜTER, 1838 (= *Eburna* LAMARCK, 1822; = *Latrunculus* GRAY, 1847; non *Eburna* LAMARCK, 1801)

Babylonia eburnoides umbilicosiformis (TELEGDI-ROTH, 1914)

Pl. XXXIX, fig. 7; Pl. LI, fig. 7

1914 *Latrunculus eburnoides* MATH. var. *umbilicosiformis* n. var. — TELEGDI-ROTH, p. 24, Pl. 1, figs 29—32

1936 *Latrunculus eburnoides* MATH. var. *umbilicosiformis* ROTH — NOSZKY, p. 69

1952 *Babylonia eburnoides* MATH. var. *umbilicosiformis* ROTH — ANIĆ, P. 42, Pl. 11, figs 8—9

1964 *Babylonia eburnoides umbilicosiformis* T.-R. — BÁLDI (in BÁLDI et al.), p. 160, Pl. 2, fig. 7

More than two-thirds of the six-whorl teleoconch is taken up by the last whorl. The whorls are hardly convex, inflated only next to the impressed suture. The whorl surfaces are smooth except for the growth lines; a very weak spiral shading of lines is visible only on the last whorls of well-preserved shells. In the continuation of the short siphonal canal, which is bent strongly backward, there is a siphonal fasciole covered with growth lines parallel to the outline of the canal. The umbilicus is covered with a smooth white inductura. There is a pseudumbilicus at the contact with the siphonal fasciole.

Dimensions. Height: 37 mm; diameter: 23 mm.

Closely related forms include larger-sized Miocene *B. eburnoides* (MATHERON, 1842) s. s., in which the umbilical region is so fully covered by the callus that there remains no pseudumbilicus. Palaeogene *B. caronis* (BRONGNIART, 1823) is smaller and of a different shape; the umbilicus is covered by a callus. *B. apenninica* (BELLARDI, 1882) is broadly, deeply phaneromphalous.

The height-to-diameter ratio is highly variable. At Diósjenő e.g. (24) some remarkably squat shells with highly convex whorls also occur.

The *Babylonia* are scavenging stenohaline-marine gastropods. *B. eburnoides umbilicosiformis* has been encountered from normal-salinity waters of the littoral zone to the deep sublittoral zone. It is most abundant in the shallow sublittoral *Glycymeris latiradiata* and *Pitar polytropa* and in the medium-depth sublittoral *Flabellipecten-Odontocyathus* communities.

Hungarian Upper Oligocene occurrences: Péliföldszentkereszt, Kesztölc-1, Dömös-2, Leányfalu-3, -4, Pomáz-6, Budafok-1/4, Törökbálint -3, Diósjenő-1, -3, -7, -8, -24, Patak-1, Dejtár, Eger-1/5, -1/k, -2, Novaj-1.

Distribution. The subspecies, widespread in the Upper Oligocene of the Central Paratethys, has not so far been encountered elsewhere.

Genus: PHOS MONTFORT, 1810

Phos hevesensis BÁLDI, 1966

Pl. XLI, fig. 6

?1936 *Phos* cfr. *citharella* BRONG. var. C SACC. — NOSZKY, p. 67

1966 *Phos hevesensis* n. sp. — BÁLDI, p. 89, Pl. 2, fig. 13

Differs from closely related *Phos pygmaeus* (SCHLOTHEIM, 1820) in the following characters: the axial ribbing is stronger, wider-spaced; the spiral ribbing is wider-spaced: there are no strong teeth on the inner side of the outer lip.

Dimensions. Height: 10 mm; diameter: 5 mm.

Found in a *Pitar polytropa* and a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Eger-1/6, -1/k.

Distribution: not known outside the above-named locality.

Genus: ACAMPTOCHETUS COSSMANN, 1901

Acamptochetus clatratus BÁLDI, 1966

Pl. XXXIX, fig. 3

1966 *Acamptochetus clatratus* n. sp. — BÁLDI, p. 89, Pl. 3, fig. 11

The protoconch comprises three flat smooth whorls. The teleoconch is weakly gradate. The first two of its five whorls exhibit three spiral keels which carry small spines at their points of intersection with the close-spaced sharp axial ribs. On the later whorls there are further weaker spiral threads or ribs intercalated between the three spiral keels. These, however, cross the backs of the axial ribs uninterrupted, without forming nodes. The spaces between both the axial and spiral ribs are much wider than the respective ribs themselves. Aperture elongate, with 23 minute laths on the inner side of the outer lip. Inner lip smooth.

Dimensions. Height: 18.2 mm; diameter: 6.8 mm.

The form described by NOSZKY (1940) from the Kiscell clay of Buda-Újlak by the name "*Metula reticulata* BELL." (probably non BELLARDI) is doubtless some remote relation of the Eger species, but the latter has a last whorl lower as related to the spire; its whorls are weakly gradate; its axial ribs are markedly arched in their upper third, and its spiral ribs are not equally strong.

Encountered in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Eger-1/6, Ostoros-1.

Distribution. Known so far only from the above localities.

Galeodidae

Genus: GALEODES Bolten in Röding, 1798 (= *Melongena* Schumacher, 1817)

Galeodes semseyiana (Erdős, 1900)

Pl. XL, figs 1—2; Pl. LI, fig. 8

1900 *Pyrula Semseyiana* — Erdős, p. 262, Pl. 1
?1952 *Melongena lainei* Bast. — Anić, p. 43, Pl. 11, figs 5—6 (non Bast.)
1964 *Galeodes semseyiana* Erdős — Báldi (in Báldi et al.), p. 174, Pl. 2, fig. 10

A large shell whose strongly gradate spire occupies hardly one-third of shell height. The whorls exhibit a sharp shoulder, at which their outline breaks in an almost acute angle: this is why the spire is so strikingly gradate. The sutural shelf is horizontal. The shell is covered with strong concentric ribs: even on the sutural shelf proper there are four strongly prominent, angular spiral ribs. The number of well-developed spines along the shoulder is 10 on the last whorl. There is another row of spines low on the base.

Dimensions. Height: 138 mm; diameter: 90 mm.

Ornament is the same as in *G. lainei* (Basterot, 1825). Their shape, however, differs in the following features: the sutural shelf is replaced in *G. lainei* by a sutural ramp. The ramps of the successive whorls more or less coalesce so that the spire outline of *G. lainei* is non-gradate, smooth. *G. semseyiana* differs from *G. basilica* in both shape and ornament because *G. basilica* exhibits a smooth sutural ramp rather than a shelf, and its ornament is generally weaker all over the shell.

The *Galeodes* are predators feeding on burrowing bivalves. *G. semseyiana* is a euryhaline species indicative of littoral facies, connected with the *Tympanotonus-Pirenella* community.

Hungarian Upper Oligocene occurrences: Pomáz, Dömös-2, Diósjenő-3.

Distribution. In the Central Paratethyan Upper Oligocene.

Galeodes basilica (Bellardi, 1872)

Pl. XL, figs 3—4

1872 *Myristica basilica* Bell. — Bellardi, p. 158, Pl. 10, figs 4—5
1900 *Melongena basilica* Bell. — Rovereto, p. 170
1914 *Melongena basilica* Bell. var. — Telegdi-Roth, p. 16, Pl. 1, fig. 7; Pl. 2, figs 8—10
1936 *Melongena basilica* Bell. var. — Noszky, p. 67
1936 *Melongena Lainei* Bast. cfr. var. *tauropermagna* Sacco — Noszky, p. 67
1937—38 *Melongena Noszkyi* n. sp. — Gaál, p. 7, textfig. 2
1940 *Melongena basilica* Bell. — Noszky, p. 26
?1958 *Galeodes lainei lainei* Bast. — Seneš, p. 154, Pl. 23, figs 312—318

Also on this species, the whorls have sharp shoulders, with 10 strong spines on the shoulder of the last whorl. The tips of the spines are slightly bent in the abapertural direction. It differs, however, from *G. semseyiana* in that the sutural shelf is replaced by a ramp leading up to the ramp of the previous whorl. The spire is thus hardly gradate if at all. Another difference is the much weaker spiral ribbing, quite vague or lacking on the sutural ramp.

Much similar in shape to *G. lainei* (Basterot, 1825), but the weak spiral ornament permits easy distinction from this Lower Miocene species. Close relationship is not, however, in doubt.

Dimensions. Height: 60 mm; diameter: 45 mm.

A stenohaline-marine species indicative of a shallow sublittoral facies, it occurs in *Pitar polytropa* communities.

Hungarian Upper Oligocene occurrences: Leányfalu-3, Diósjenő -7, Eger-1/k.

Distribution: in the Central Paratethyan and Mediterranean Oligocene.

Nassidae

Genus: HINIA Leach in Gray, 1847 (= *Hima* Leach, 1852)

Hinia schlotheimi (Beyrich, 1854)

Pl. XLI, figs 1—3

1854 *Buccinum Schlotheimi* Beyr. — Beyrich, p. 456, Pl. 7, figs 7—9
1913 *Nassa Schlotheimi* Beyr. — Harder, p. 76, Pl. 6, figs 4—5
1914 *Nassa Schlotheimi* Beyr. — Gripp, p. 19, Pl. 2, figs 8—12
1925 *Nassa Neuvillei* n. sp. — Cossmann et Peyrot, p. 174, Pl. 3, figs 90—93
1925 *Nassa Schröderi* n. sp. — Kautsky, p. 109, Pl. 8, fig. 11
1936 *Nassa Neuvillei* Peyr. — Noszky, p. 68
1936 *Nassa Neuvillei* Peyr. nov. var. *elongata* — Noszky, p. 68
1936 *Nassa miranda* Peyr. — Noszky, p. 68
?1936 *Nassa* cfr. *turbinella* Brocc. et var. *occidentalis* Peyr. — Noszky, p. 69
?1936 *Nassa* cfr. *restituana* Font. — Noszky, p. 69
1940 *Nassa Schlotheimi* Beyr. — Sorgenfrei, p. 44, Pl. 6, fig. 6
1958 *Nassa Schlotheimi* Beyr. — Sorgenfrei, p. 216, Pl. 45, fig. 148
1961 *Hinia schlotheimi noszkyi* n. subsp. — Báldi (in Báldi et al.), p. 101, Pl. 4, figs 6—7

A medium-sized to small *Hinia* with a smooth protoconch of 3 whorls and a half. The 3 or 4 whorls of the teleoconch bear an ornament of close-spaced spiral grooves and axial ribs narrower than the spaces between them. The axial ribs number 17 on the last whorl. The uppermost spiral groove is wider than the rest: truncating the ends of the axial ribs, it gives rise to a string of nodes immediately below the adapical suture. The other spiral grooves are conspicuous only in the furrows between the axial ribs, being hardly discernible on their backs. The ornament of the last whorl is usually weaker; it will sometimes fade out entirely in the median zone of the whorl. The oval aperture ends in a short siphonal canal. There is a moderate varix at the outer lip, with weak teeth on its inner side. The inner lip exhibits an inductura. There is no columellar fold.

Dimensions. Height: 10 mm; diameter: 4.8 mm.

The distinction of *H. schlotheimi noszkyi* BÁLDI, 1961, based merely on the slenderer build of the subspecies, has not been borne out by subsequent investigations. The synonymy of *H. neuvillei* COSSMANN et PEYROT, 1925 and *H. schröderi* KAUTSKY, 1925 was demonstrated by SORGENFREI (1940, 1958). Despite a superficial resemblance, *H. schlotheimi* differs from *H. hörnesi* MAYER, 1864 in its smaller size, larger and slenderer protoconch, wider-spaced, stronger axial ribs and weaker spiral grooves.

The *Hinia* are highly mobile burrowing, scavenging gastropods. *H. schlotheimi* is a deep sublittoral — shallow bathyal facies index. One of the most typical species of the *Hinia-Cadulus* community, it is sporadic in shallower marine facies.

Hungarian Upper Oligocene occurrences: Leányfalu-2, Eger-1/6, -1/k, Ostoros-1, Novaj-1, Mucsony 136.

Distribution. Known in addition to the Upper Oligocene of the Central Paratethys also from the Boreal Upper Oligocene and Miocene and from the Atlantic Miocene.

Hinia fortecostata edentata BÁLDI, 1966
Pl. XLI, fig. 9

1936 *Nassa* cfr. *exasperata* WOLFF — NOSZKY, p. 67 (non WOLFF)
1936 *Nassa Borelliana* BELL. var. *brevispira* SACCO — NOSZKY, p. 69
1966 *Hinia fortecostata edentata* n. subsp. — BÁLDI, p. 90, Pl. 2, fig. 14

Differs from the South Bavarian Lower Miocene species *H. fortecostata* HÖLZL, 1958 exclusively in that the dentition on the inner surface of the outer lip is very weak at best.

Dimensions. Height: 7.8 mm; diameter: 4.2 mm.

Represented in most of the facies, but rare everywhere.

Hungarian Upper Oligocene occurrences: Mány 6, Gyermely 35, Máriahalom 36, Zsámbék 42, Felsőőrspuszta 44, Eger-1/6, -1/k.

Distribution. The subspecies is known from the above localities only.

Genus: BULLIA GRAY, 1833

Bullia hungarica (GÁBOR, 1936)
Pl. XXXIX, figs 4—6

?1897 *Buccinum Flurli* GÜMB. — WOLFF, p. 276, Pl. 26, figs 21—22
1936 *Cominella* (= *Buccinum*) *hungarica* n. sp. — GÁBOR, p. 3, Pl. 1, fig. 4

1936 *Cominella hungarica* Gáb. et nov. var. div. — Noszky, p. 67, Pl. 6, figs 4, 6
?1936 *Dorsanum* cfr. *ruidum* Peyr. — Noszky, p. 69
?1952 *Buccinum* cf. *flurli* Gümb. — Anić, p. 42, Pl. 11, fig. 3
1963 *Cominella flurli hungarica* Gáb. — Báldi, p. 91, Pl. 6, fig. 13

The largest shells comprise 8 or 9 convex whorls. There is a narrow, concave sutural shelf below the adapical suture. The ornament consists of broad strong axial ribs plus a weak spiral ribbing. Somewhat narrower than the spaces between them, the axial ribs are parallel to the axis or very slightly leaning; their adapical ends are slightly bent in the adapertural direction. Numbering 12 on the last whorl, they fade out on the sutural shelf. Both lips are smooth inside. There is a broad short siphonal canal, bent backward. The spiral ribbing crosses the backs of the axial ribs without interruption or weakening.

Dimensions. Height: 33 mm; diameter: 16 mm (largest specimen); height: 28 mm; diameter: 14 mm (average specimen).

Distinction from *B. flurli* (Gümbel, 1861) is problematic.

The *Bullia* are scavengers feeding on remains of worms, crabs and fish. *B. hungarica* is typical of the shallow sublittoral facies but has been found sporadically also in littoral and medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Máriahalom 36, Zsámbék 43, Tök 52, Törökbálint-2, Pomáz-21, ? Leányfalu-3, Dömös-2, ?Dejtár, Diósjenő-7, Becske-2, Eger-1/k.

Distribution: no certain occurrence is known outside the Upper Oligocene of the Central Paratethys.

Fasciolariacea

Fusidae

Genus: EUTHRIOFUSUS Cossmann, 1901

Euthriofusus burdigalensis (Defrance, 1820)

Pl. XLII, figs 1—2

1856 *Fusus burdigalensis* Bast. — Hörnes, p. 296, Pl. 32, figs 13—14
1884 *Tudicla burdigalensis* Defr. — Bellardi, p. 7
1904 *Euthriofusus burdigalensis* Defr. — Sacco, p. 27, Pl. 8, figs 6—8
1914 *Euthriofusus burdigalensis* Bast. var. *involuta* nov. var. — Telegdi-Roth, p. 15, Pl. 1, fig. 18
1928 *Euthriofusus burdigalensis* Defr. — Cossmann et Peyrot, p. 56, Pl. 6, figs 1—6; Pl. 9, fig. 39
?1928 *Euthriofusus peyrerensis* n. sp. — Cossmann et Peyrot, p. 60, Pl. 6, figs 26—28
1936 *Euthriofusus burdigalensis* Bast. var. *involuta* T.-R. — Noszky, p. 70
1964 *Euthriofusus burdigalensis* Bast. — Răileanu et Negulescu, p. 177, Pl. 11, fig. 2; Pl. 14, fig. 1

1966 *Euthriofusus burdigalensis* DEFR. — STRAUSZ, p. 355, Pl. 54, figs 5—8

A shell of five whorls with a squat conical spire, a long siphonal canal and a broad last whorl.

There is a sharp keel in the upper third of the last whorl. Whorl outline is strongly convex below the shoulder. The shoulders of the specimens from Eger bear flatly elongate, weak nodes (var. *involuta* TELEGDI-ROTH, 1914), whereas those from Pomáz exhibit the stronger nodes of the type. The spire is hardly gradate if at all. The sutural ramp bears 5 or 6 weak flat spiral ribs. There is a similar ornament on the base, but the ribs are very close-spaced there. The adapical end of the siphonal canal throws a weak fold on the inner lip.

Dimensions. Height: 33.5 mm; diameter: 18 mm.

The independence of *E. peyrerensis* COSSMANN et PEYROT, 1928 of the Upper Oligocene Peyrère horizon on the basis of the minute differences designated by those authors is questionable.

In littoral and shallow sublittoral facies. Could presumably not stand prolonged decreases in salinity.

Hungarian Upper Oligocene occurrences: Pomáz-6, Diósjenő-1, -8, Eger-1/k.

Distribution. An Atlantic-Mediterranean Miocene species, it is more abundant in the Paratethyan Miocene than in the Oligocene. The above-named Upper Oligocene localities are its earliest known occurrences.

Euthriofusus szontaghi NOSZKY, 1936

Pl. XLII, fig. 3

1936 *Euthriofusus Szontaghi* n. sp. — NOSZKY, p. 70, Pl. 5, fig. 2
1936 *Euthriofusus Szontaghi* n. sp. n. var. *alternans* — NOSZKY, p. 70, Pl. 5, fig. 4

Fusiform shell with a weakly gradate spire occupying one-third of total height, and an inflated, broad last whorl. There is a well-discernible although diffusely outlined concave sutural ramp in the upper thirds of the whorls. The strong massive axial ribs, as wide as the spaces between them, do not transgress upon the sutural ramp and grow weaker adaperturally. All whorls are covered with a fine, dense spiral ribbing independent of the axial ribs. The round aperture is restricted at the entrance of the oblique, narrow siphonal canal by a weak tooth on the inner lip.

Dimensions. Height ~ 36 mm; diameter: 20 mm.

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution. Known only from this one locality.

Fasciolariidae

Genus: STREPTOCHETUS COSSMANN, 1889

Subgenus: STREPTODICTYON TEMBROCK, 1961

Streptochetus (Streptodictyon) elongatus (NYST, 1845)

Pl. XLII, fig. 5; Pl. XLIII, fig. 3

1863 *Fusus elongatus* NYST — SPEYER, p. 193, Pl. 34, figs 7—8
1863 *Fusus elongatus* NYST — SANDBERGER, p. 219, Pl. 17, fig. 5; Pl. 19, fig. 1
1889 *Fusus elongatus* NYST — KOENEN, p. 185, Pl. 15, figs 1—2
1897 *Fusus elongatus* NYST — WOLFF, p. 281, Pl. 26, fig. 30
1936 *Fusus elongatus* NYST — GÁBOR, p. 5
1936 *Fusus elongatus* NYST — NOSZKY, p. 71
?1940 *Fusus* cfr. *elongatus* NYST — NOSZKY, p. 29
1952 *Streptochetus elongatus* NYST — GÖRGES, p. 91.
1957 *Streptochetus elongatus* NYST — GLIBERT, p. 71, Pl. 5, fig. 19
1962 *Streptochetus elongatus* NYST — HÖLZL, p. 176, Pl. 9, fig. 14
1963 *Streptochetus elongatus* NYST — BÁLDI, p. 91, Pl. 6, figs 5—7
1965 *Streptochetus cheruscus elongatus* NYST — TEMBROCK, p. 433, fig. 2

A tall fusiform shell with eight convex whorls. The last whorl is as tall as the spire. The teleoconch whorls exhibit round-backed strong axial ribs slightly broader than the spaces between them. They number 11 on the penultimate whorls. The adapical ends of the ribs are slightly bent in the adapertural direction on some specimens. The entire teleoconch is covered with a dense spiral ribbing, with the individual ribs broader than the spaces separating them. The spiral ribs are of uniform strength on the axial ribs and in the furrows between them. The aperture ends in a siphonal canal. No undamaged specimen has turned up at the Hungarian localities.

Dimensions. Height ~ 21 mm; diameter: 9 mm.

A species indicative of a medium-depth sublittoral facies, restricted to the *Pitar beyrichi* and *Flabellipecten-Odontocyathus* communities.

Hungarian Upper Oligocene occurrences: Törökbálint-2, Dejtár, Eger-1/k, -2.

Distribution: ubiquitous in the Paratethyan and Boreal Oligocene, it nowhere passes the Miocene boundary.

Genus: AQUILOFUSUS KAUTSKY, 1925

Aquilofusus loczyi (NOSZKY, 1936)

Pl. XL, figs 5—6; Pl. XLII, fig. 4

1936 *Fusus Lóczyi* n. sp. — NOSZKY, p. 71, Pl. 5, fig. 1
1936 *Fusus Lóczyi* n. sp. nov. var. *densicostatus* — NOSZKY, p. 71

Tall fusiform shell with convex whorls; spire lower than last whorl; siphonal canal fairly long. There is no sutural ramp; the sutures are impressed. The first whorl succeeding the two and a half or three smooth whorls of the protoconch bears six spiral laths, crossed by very wide-spaced thin axial ribs. The further 7 whorls of the teleoconch are covered with broad, round-backed axial ribs and a dense spiral ribbing. The spiral ribbing is either of uniform strength or exhibits an alternation of stronger and weaker ribs. The axial ribbing is independent of the spiral, but growth lines lend a fine granulation to the ribs.

Dimensions. Height ~ 40 mm; diameter: 17 mm.

Stands closest to Boreal Oligo-Miocene *A. waeli* (NYST, 1852), which belongs to the "alpha-Aquilofusus group" of HINSCH (1952).

Found in *Pitar polytropa* and *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, -1/k.

Distribution: known from the above locality only.

Genus: FASCIOLARIA LAMARCK, 1799

Fasciolaria plexa (WOLFF, 1897)

Pl. XLII, fig. 8

1897 *Fusus plexus* n. sp. — WOLFF, p. 282, Pl. 27, fig. 4; Pl. 26, fig. 9
1914 *Fasciolaria plexa* WOLFF — TELEGDI-ROTH, p. 15, Pl. 1, figs 13—15
1936 *Fasciolaria plexa* WOLFF — NOSZKY, p. 70
1958 *Fasciolaria plexa* WOLFF — HÖLZL, p. 248, Pl. 21, fig. 4
1963 *Fasciolaria plexa* WOLFF — BÁLDI, p. 92, Pl. 6, fig. 12

The species is figured in WOLFF (1897), TELEGDI-ROTH (1914) and HÖLZL (1958). All three figures show incompletely preserved specimens no two of which are alike. The few poorly preserved specimens at my disposal from Törökbálint and Eger do not permit a revision of the species.

Found in *Pitar beyrichi* and *P. polytropa* communities.

Hungarian Upper Oligocene occurences: Törökbálint-2, Eger-1/k.

Distribution: in the Paratethyan Upper Oligocene and Lower Miocene.

Volutacea

Olividae

Genus: OLIVELLA SWAINSON, 1835

Subgenus: LAMPRODOMA SWAINSON, 1840

Olivella (Lamprodoma) clavula vindobonensis CSEPREGHY-MEZNERICS, 1954

Pl. XLIV, figs 7—8

1856 *Oliva clavula* LAM. — HÖRNES, p. 49, Pl. 7, fig. 1 (non LAMARCK)
1954 *Olivella clavula vindobonensis* n. subsp. — CSEPREGHY-MEZNERICS, p. 44, Pl. 6, figs 3, 9

1966 *Olivella clavula vindobonensis* Cs.-M. — Strausz, p. 360, Pl. 72, fig. 6

A tall slender shell of five whorls, with a tall last whorl. A depressed spire of straight and even coeloconoid outline can be established even though the shell is corroded. The whorls are flat, the sutures impressed, well-marked. The last whorl is slightly convex; the tall narrow aperture exhibits a siphonal notch. Our specimen has seven oblique, well-defined strong columellar folds, the first and last one of which are somewhat stronger than the rest. There is a narrow siphonal fasciole above the columellar folds, and another, somewhat wider fasciole farther up.

Dimensions. Height: 16.3 mm; diameter: 5.6 mm.

Differs from *O. clavula* (Lamarck, 1810) s. s. in its lower spire, broader last whorl and stands in this respect closer to the subspecies figured by Hörnes and distinguished by the subspecific name *vindobonensis* by Csepreghy-Meznerics. It differs, however, also from this latter in its somewhat smaller size and less pointed spire.

Found in a shallow sublittoral facies.

Hungarian Upper Oligocene occurrence: Dömös-2.

Distribution: the subspecies used to be known from the Paratethyan Miocene. Its earliest occurrence is doubtless that at Dömös. *O. clavula* s. s. occurs in the Mediterranean-Atlantic Miocene and has not so far been signalled from the Oligocene.

Genus: TORTOLIVA Conrad, 1865

Tortoliva subcanalifera (d'Orbigny, 1852)

Pl. XLIV, figs 5—6; Pl. LI, fig. 6

1856 *Ancillaria canalifera* Lam. — Hörnes, p. 53, Pl. 6, fig. 3 (non Lamarck)
1882 *Ancillarina suturalis* Bon.—Bellardi, p, 217, Pl. 12, fig. 38
1882 *Ancillarina apenninica* Bell. — Bellardi, p. 219, Pl. 12, fig. 39
?1889 *Ancillaria canalis* Koen. — Koenen, p. 268, Pl. 23, figs 5—7
1914 *Ancilla suturalis* Bon. — Telegdi-Roth, p. 25
1925 *Ancilla suturalis* Bon. — Kautsky, p. 136
1928 *Tortoliva subcanalifera* Orb. — Cossmann et Peyrot, p. 190, Pl. 12, figs 13—14
1936 *Ancilla suturalis* Bon. — Noszky, p. 71
1940 *Ancillaria canalifera* Desh. — Noszky, p. 41
?1943 *Ancilla canalis* Koen. — Albrecht et Valk, p. 70, Pl. 6, fig. 151
1958 *Ancilla suturalis* Bon. — Seneš, p. 157
1964 *Ancilla canalifera* Lam. — Báldi, p. 148, Pl. 1, fig. 9 (non Lamarck)
1966 *Tortoliva subcanalifera* Orb. — Strausz, p. 359, Pl. 72, figs 1—5

A small to medium-sized, tall, slim shell on which very little except the last whorl is visible. The exceedingly low, obtusely pointed spire is made up of five whorls. The whorl outlines are flat; surfaces are smooth but for the leaning growth lines. The last whorl is slightly convex adapically, hardly so abapically. The base exhibits siphonal fascioles: the growth lines on these follow the abapical outline of the aperture. Next to the adapical siphonal fasciole there is a broader or narrower furrow; the lowermost siphonal fold transgresses onto the columella. The aperture weakly tapers upwards, with a broad notch for the inhalant siphon at its bottom.

Dimensions. Height: 26 mm; diameter: 10.5 mm.

According to COSSMANN and PEYROT (1928), *T. suturalis* (BONELLI in D'ORBIGNY 1852) is fully identical with *T. subcanalifera* (D'ORBIGNY, 1852) of Southwestern France. On the other hand, they enumerate numerous differences between *T. subcanalifera* = *suturalis* and the Eocene species *T. canalifera* (LAMARCK, 1802).

The distinctive features include the different height of the spire and a spiral constriction on the adapical part of the last whorl in *T. canalifera*. There are only traces of this constriction in *T. subcanalifera*: for instance, on the last whorl of the specimens from Eger there is just a sharp abapertural bend of the growth lines immediately below the suture. The phylogenetic connexion with the Eocene species is not, then, in doubt, but it does not seem justified to contract the two.

In shallow sublittoral communities.

Hungarian Upper Oligocene occurrences: Budafok-1/4, Eger-1/k.

Distribution. This is a Mediterranean-Atlantic Oligocene-Miocene species, represented probably also in the Boreal Oligocene.

Mitridae

Genus: VEXILLUM BOLTEN in RÖDING, 1798

Subgenus: CONOMITRA CONRAD, 1865

Vexillum (Conomitra) peyreirense (COSSMANN et PEYROT, 1928)

Pl. XLV, fig. 3

1928 *Conomitra peyreirensis* n. sp. — COSSMANN et PEYROT, p. 128. Pl. 7, figs 8—9

1961 *Vexillum peyreirense* C. et P. — BÁLDI (in BÁLDI et al.), p. 103, Pl. 4, fig. 11

A small fusiform shell. The paucispiral protoconch consists of two whorls, The six whorls of the teleoconch are slightly convex. The shell surface is smooth and shiny except for a single spiral groove below the adapical suture. The last whorl, on the other hand, exhibits weak traces of a spiral ornament that grow stronger towards the base. The inner lip bears four strong folds the abapical ones of which are more steeply leaning than the adapical ones. The inner side of the outer lip carries 13 parallel, horizontal laths.

Dimensions. Height: 8.5 mm; diameter: 3.5 mm.

Can be readily distinguished from *V. söllingensis* SPEYER, 1864 by its slenderer shape and more pointed spire.

Found in *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, Novaj-1.

Distribution. Known besides the above localities only from the Upper Oligocene of the Atlantic province.

Volutidae

Genus: VOLUTILITHES SWAINSON, 1829

Volutilithes multicostata BELLARDI, 1890

Pl. XLIII, figs 4—5

1890 *Volutilithes multicostata* BELL. et var. div. — BELLARDI, p. 10, Pl. 1, fig. 7
1900 *Volutilithes multicostata* BELL. — ROVERETO, p. 173
1910 *Voluta multicostata* BELL. — KRANZ, p. 266
1940 *Volutilithes multicostata* BELL. cum var. div. — NOSZKY, p. 36

Most of the shell of six whorls is covered by the last whorl. Whorls are convex. The penultimate and last whorls exhibit a narrow, concave sutural ramp. The shell is covered with strong axial ribs as wide as the spaces between them, numbering 16 on the last whorl. Tapering to somewhat pointed nodes on the shoulder, these ribs suddenly weaken there and continue in this weaker form on the ramp proper. There is no spiral ornament, except for the base, where spiral ribs appear first in the intercostal furrows, and farther downward even on the backs of the axial ribs. On the inner lip there are three slightly leaning, rather strong folds and, moreover, one pair of weaker folds on either side of the most adapical strong fold. On the outer lip there are 20 folds, discontinued in the median zone of the last whorl.

Dimensions. Height: 39 mm; diameter: 18 mm.

The *Volutilithes* are predators feeding on bivalves, and possibly also scavengers. *V. multicostata* has turned up in the medium-depth sublittoral *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrence: Eger-2.

Distribution. This is a Mediterranean Oligocene species, sporadically represented also in the Oligocene of the Paratethys.

Volutilithes proxima SACCO, 1904

Pl. XLV, fig. 6

1890 *Volutilithes consanguinea* BELL. — BELLARDI, p. 11, Pl. 1, fig. 9
1904 *Volutilithes proxima* SACC. — SACCO, p. 90
1940 *Volutilithes proxima* SACC. — NOSZKY, p. 35
1958 *Volutilithes proxima* SACC. — SENEŠ, p. 159, Pl. 24, figs 325—326
1964 *Volutilithes proxima* SACC. — BÁLDI, p. 148

My only fragmentary specimen from Budafok differs in the following traits from the foregoing species (*V. multicostata*): it is somewhat smaller;

the sutural ramp is somewhat wider; the axial ribbing is somewhat sharper, wider-spaced; and, what is most important, there are deep narrow spiral grooves incised into the whole shell surface including the axial ribs below the shoulder of the last whorl.

Dimensions. Height ~ 35 mm.

Fully identical with SENEŠ' (1958) Kovácov specimen, but both forms differ somewhat in the slightly stronger spiral ornament and less gradate spire from the type from Cassinelle.

Known from a shallow sublittoral facies.

Hungarian Upper Oligocene occurrence: Budafok-1/4.

Distribution. Known in addition to the Paratethyan also from the Mediterranean Oligocene.

Volutilithes permulticostata TELEGDI-ROTH, 1914
Pl. XLIII, figs 6—7

1914 *Volutilithes permulticostata* n. sp. — TELEGDI-ROTH, p. 26, Pl. 4, figs 3—5

1936 *Voluthilites permulticostata* T.-R. — NOSZKY, p. 72

?1940 *Volutilithes* cfr. *permulticostata* T.-R. — NOSZKY, p. 37

1961 *Volutilithes permulticostata* T.-R. — BÁLDI (in BÁLDI et al.), p. 103

A relatively small shell of six whorls. The protoconch occupies the first three smooth whorls. The whorls of the teleoconch are convex, with a narrow concave sutural ramp. The shell is covered with dense axial ribs hardly narrower than the spaces between them. The axial ribs bear weak nodes on the shoulder and are very weak on the sutural ramp. The ornament is complemented by very shallow wide-spaced spiral grooves that grow somewhat stronger on the base only. On the weak obscure inductura, there are 2 or 3 weak columellar folds very deep in the aperture.

Dimensions. Height: 25 mm; diameter: 11 mm (large specimen), height: 18 mm; diameter: 8 mm (average specimen).

At a first glance, it resembles *V. multicostata*, but there are the following fundamental differences: *V. permulticostata* is much smaller, with a fragile shell; its axial ribbing is much denser; the ribs are weakly nodose along the shoulder; the spiral ribbing, although weak, covers the entire shell. Also there are no folds on the inner side of the outer lip and the folds on the inner lip are much weaker and less numerous.

A deep sublittoral and bathyal facies index, frequent in the *Hinia-Cadulus* community, it occurs sporadically also in the medium-depth sublittoral *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrences: Leányfalu-2, Dejtár, Eger-1/6, -1/k, Novaj-1, Mucsony 136.

Distribution. Known only from the above-named occurrences so far. In the deeper marine facies of the Hungarian Upper Oligocene it play the role of an "index fossil" together with *Hinia schlotheimi* and *Cadulus gracilina*.

Genus: ATHLETA CONRAD, 1853

Athleta rarispina (LAMARCK, 1811)

Pl. XLII, figs 6—7

1856 *Voluta rarispina* LAM. — HÖRNES, p. 91, Pl. 9, figs 6—10
1890 *Volutilithes rarispina* LAM. — BELLARDI, p. 18, Pl. 1, fig. 22
1914 *Volutilithes rarispina* LAM. — TELEGDI-ROTH, p. 26, Pl. 2, figs 1—3, 5, 12
1928 *Volutilithes ficulina* LAM. var. *rarispina* LAM. — COSSMANN et PEYROT, p. 155, Pl. 11, figs 18—22
1936 *Voluthilites rarispina* LAM. — NOSZKY, p. 72
1937—38 *Voluthilites Telegdyi* n. sp. — GAÁL, p. 9, textfig. 3
?1940 *Volutilithes* cfr. *rarispina* LAM. — NOSZKY, p. 38
1954 *Volutilithes ficulina rarispina* LAM. — CSEPREGHY-MEZNERICS, p. 49, Pl. 7, figs 3, 5
1958 *Athleta rarispina* LAM. — SENEŠ, p. 160, Pl. 22, figs 294—303
1958 *Athleta telegdyi* GAÁL — SENEŠ, p. 160, Pl. 22, figs 288—293
1961 *Athleta rarispina* LAM. — BÁLDI (in BÁLDI et al.), p. 104
1966 *Voluta ficulina rarispina* LAM. — STRAUSZ, p. 372, (partim) Pl. 64, fig. 12; Pl. 65, fig. 7; Pl. 66, figs 1—2

A medium- to large-size massive shell covered almost entirely by the tall last whorl. Of the spire only the pointed small apex of 2 or 3 whorls is visible, emerging above the common convex sutural ramp of the last and penultimate whorls. This broad ramp bends down without a sharp shoulder towards the base. In the region where a boundary between the gradually merging sutural ramp and the base can be tentatively drawn, there are wide-spaced pointed nodes (5 or 6) growing weaker adaperturally. Ornament includes besides the growth lines and folds weak spiral ribs growing gradually stronger downward on the base. Aperture tall, broad. The shiny, smooth surface of the strongly callous, massive inductura is in the same prosocline plane as the aperture. The inductura covers a significant portion of the last whorl: indeed, in young specimens, it may reach up as far as the apex. Inside the aperture, the inductura exhibits four columellar folds, the abapical ones of which are more oblique than the adapical ones.

Dimensions. Height: 45 mm; diameter: 32 mm.

According to GAÁL (1937—38), *A. telegdyi* (GAÁL, 1937—38) differs from *A. rarispina* in that the inner side of its outer lip is smooth, edentate. This, however, is at best a subspecific difference, because vague traces of this dentition can be observed even on those few Hungarian Upper Oligocene specimens with undamaged outer lips. Precisely for the practical reason of the frequent missing of the outer lip, I feel even the subspecific distinction of the Hungarian form to be superfluous.

This is a typical shallow sublittoral species, abundant in the *Glycymeris latiradiata* and *Pitar polytropa* communities.

Hungarian Upper Oligocene occurrences: Keszölc-1, Dömös-2, Budafok-1/4, Pomáz-1, Leányfalu-3, -4, Diósjenő-7, -24, Eger-1/k, Novaj-1.

Distribution. This is a Mediterranean-Atlantic Miocene species known also from the Paratethyan Miocene whose earliest known occurrence is in the Central Paratethyan Upper Oligocene.

Athleta ficulina (Lamarck, 1811)

Pl. XLIII, figs 1—2

1856 *Voluta ficulina* Lam. — Hörnes, p. 92, Pl. 9, figs 11—12
1890 *Volutilithes ficulinus* Lam. et var. div. — Bellardi, p. 16
1897 *Voluta ficulina* Lam. — Wolff, p. 284, Pl. 27, fig. 14
1914 *Volutilithes ficulina* Lam. — Telegdi-Roth, p. 27, Pl. 2, figs 4, 6—7, 11
1928 *Volutilithes ficulina* Lam. — Cossmann et Peyrot, p. 151, Pl. 10, figs 14—17; Pl. 11, fig. 11
1936 *Voluthilites ficulina* Lam. et var. *sulcata* Grat. — Noszky, p. 72
1936 *Volutilithes ficulina* Lam. n. var. *bistriata* — Noszky, p. 72, Pl. 5, fig. 77
?1940 *Volutilithes* cfr. *ficulina* Lam. — Noszky, p. 38
1958 *Athleta ficulina ficulina* Lam. — Seneš, p. 159, Pl. 22, figs 304—311
1961 *Athleta ficulina* Lam. — Báldi (in Báldi et al.), p. 104
1962 *Athleta ficulina* Lam. — Hölzl, p. 183, Pl. 10, fig. 3
1964 *Volutilithes ficulina* Lam. — Răileanu et Negulescu, p. 178, Pl. 15, figs 1—3
1966 *Voluta ficulina rarispina* Lam. — Strausz, p. 372 (partim), Pl. 64, figs 13—14; Pl. 65, figs 1, 4, 8, 9; (non Lamarck)

A large shell with a very low, coeloconoid spire and a voluminous last whorl. The outline of the last whorl exhibits an obtuse shoulder in its adapical sixth. This shoulder bears 10 squat massive spines. The basal portion of the last whorl is slightly concave, and covered with broad flat spiral ribs separated by narrow intercostal spaces. The sutural ramp is smooth, slightly concave, covered with adaperturally strengthening growth lines only. The whorls of the spire are covered up to their spiny shoulders by the respective subsequent whorls. A substantial part of the last whorl is covered by a thick shiny half-elliptical inductura which on its portion inside the aperture exhibits four oblique folds. These folds weaken adapically. The pinched adapical end of the elongate aperture reaches almost up to the apex.

Dimensions. Height: 66 mm; diameter: 45 mm.

Sporadic in all sublittoral facies.

Hungarian Upper Oligocene occurrences: Diósjenő-8, Eger-1/6, -1/k, Novaj-1.

Distribution. Widespread all over the European Miocene, it arises in the Central and Western Paratethys as early as the Upper Oligocene.

Cancellariidae

Genus: EGEREA Gábor, 1936

Egerea collectiva Gábor, 1936

Pl. XLIV, figs 1—4

1936 *Egerea collectiva* n. gen. et n. sp. — Gábor, p. 7, Pl. 1, fig. 13

1936 *Egerea collectiva* Gáb. et nov. var. *pyruloides* et *nassaeformis* — Noszky, p. 73, Pl. 5, fig. 12

1940 *Trigonostoma* (*Egerea*) *collectivum* Gáb. — Wenz, p. 1359, textfig. 3844

A squat fusiform, rather massive shell, with a hardly emergent low pointed spire of not more than 3 or 4 whorls and a large-sized last whorl. The spire whorls have no sutural ramp, but the last whorl exhibits a narrow, flat, gently sloping one that grades into the base without a sharp shoulder. Likewise on the last whorl, somewhat above the median line and below the rounded shoulder just mentioned, there is a slightly concave spiral band. The last whorl and, in fact, the entire shell is widest right below this concave zone. The last whorl exhibits a more or less strong spiral ornament of flat ribs and fine threads. The ornament on the Budafok specimen is much stronger than on the ones from Eger. Axially there are just the growth lines, although on the sutural ramp of the last whorl there are irregular collabral folds strengthening adaperturally. The oval aperture tapers to a point at its top and ends in a backward-bent, very short and narrow siphonal canal at its bottom. In the continuation of this latter there is a strong siphonal fasciole running around the inductura-covered umbilicus. The inductura itself is thin, extensive on the last whorl and sharply delimited. The inner lip exhibits two short oblique columellar folds. The outer lip is sharp, and smooth on the inside.

Dimensions. Height: 34 mm (large, damaged specimen); Height: 30 mm; diameter 29 mm.

Found in shallow sublittoral facies.

Hungarian Upper Oligocene occurrences: Budafok-1/4, Eger-1/k.

Distribution: found so far only at the above-named localities.

Genus: UXIA Jousseaume, 1887

Uxia granulata (Nyst, 1843)

Pl. XLV, fig. 5

1856 *Cancellaria granulata* Nyst — Beyrich, p. 567, Pl. 26, figs 7—9

1867 *Cancellaria granulata* Nyst — Speyer, p. 179, Pl. 16, figs 6—8

1889 *Cancellaria granulata* Nyst — Koenen, p. 135, Pl. 9, figs 4—6

1943 *Uxia granulata* Nyst — Albrecht et Valk, p. 75, Pl. 7, figs 179—184

1953 *Uxia granulata* Nyst — Görges, p. 97

1957 *Uxia granulata* Nyst — Glibert, p. 74

1958 *Cancellaria granulata* NYST — SENEŠ, p. 161
1963 *Uxia granulata* NYST — BÁLDI, p. 92, Pl. 6, fig. 10

A fusiform spire of five whorls, with an ornament of strong sharp axial ribs thinner than the spaces between them numbering 10 on the last whorl. The ribs are slightly oblique, with an adapertural bend to the adapical ends of some of them. There are weak spiral threads that cross also the backs of the axial ribs. The spire is about as tall as the last whorl.

Dimensions. Height: 18 mm; diameter: 8 mm.

In medium-depth sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-2, Dejtár.

Distribution. A Boreal Oligocene species, it turns up sporadically also in the Upper Oligocene of the Central Paratethys.

Genus: BONELLITIA JOUSSEAUME, 1887

Bonellitia evulsa (SOLANDER in BRANDER, 1766)

Pl. XLI, figs 7—8

1856 *Cancellaria evulsa* SOL. — BEYRICH, p. 556, Pl. 26, figs 2—5
1863 *Cancellaria evulsa* SOL. var. *γ postera* BEYR. — SANDBERGER, p. 257, Pl. 20, fig. 4
1867 *Cancellaria evulsa* SOL. var. *γ postera* BEYR. — SPEYER, p. 177, Pl. 16, figs 1—4
1889 *Cancellaria evulsa* SOL. et var. *minor* — KOENEN, p. 117, Pl. 10, figs 1—4
1894 *Bonellitia evulsa* BRAND. et var. div. — SACCO, p. 45, Pl. 3, figs 12—19
1914 *Admete evulsa* SOL. var. *postera* BEYR. — TELEGDI-ROTH, p. 40
1925 *Admete evulsa* SOL. — KAUTSKY, p. 143
1936 *Admete evulsa* SOL. cum var. div. — NOSZKY, p. 73—74
1952 *Bonellitia evulsa* SOL. — GÖRGES, p. 97
1957 *Admete evulsa* SOL. — GLIBERT, p. 74, Pl. 6, fig. 2
1962 *Bonellitia evulsa* SOL. — HÖLZL, p. 186, Pl. 10, fig. 5
1963 *Bonellitia evulsa* SOL. — BÁLDI, p. 92, Pl. 6, figs 8—9

A squat fusiform shell of six whorls; spire occupying one-quarter of total shell height. Last whorl strongly convex, inflated. Surface covered with strong, round-backed, somewhat leaning axial ribs with adapical ends adaperturally bent. The dense spiral ribbing independent of the axial ribbing is an alternation of weaker and stronger ribs and threads. There is a substantial inductura of semicircular outline, bearing seven oblique columellar folds within the aperture.

Dimensions: Height: 21 mm; diameter: 14 mm.

The density of the spiral ribbing is variable. The Hungarian form differs from the North German specimens in that its inductura is somewhat more extensive. According to SACCO (1894) and KAUTSKY (1925), it is identical with *B. bellardii* (MICHELOTTI 1847).

Known from shallow and medium-depth sublittoral communities.

Hungarian Upper Oligocene occurrences: Solymár 84, 85, Törökbálint-1, Leányfalu-4, Dejtár, Eger-1/k.

Distribution: this Boreal-Mediterranean species first arises in the Eocene and is ubiquitous up to the end of the Miocene in the Boreal province and — provided it is truly identical with *B. bellardii* — also in the Paratethys and the Mediterranean province.

Genus: BABYLONELLA CONRAD, 1865

Babylonella fusiformis pusilla (PHILIPPI, 1843)

Pl. XLV, fig. 4

1856 *Cancellaria pusilla* PHIL. — BEYRICH, p. 573, Pl. 28, figs 1—2
1867 *Cancellaria subangulosa* WOOD — SPEYER, p. 179, Pl. 16, figs 10—13
1952 *Babylonella fusiformis pusilla* PHIL. — GÖRGES, p. 98, Pl. 2, fig. 74
1957 *Admete fusiformis* CANTR. — GLIBERT, p. 75
?1962 *Admete* aff. *fusiformis pusilla* PHIL. — HÖLZL, p. 188, Pl. 10, fig. 7

A small slender shell whose spire is twice as high as the last whorl. The whorls of the five-whorl teleoconch are strongly convex with a narrow sutural ramp and a vague shoulder. There is a strong axial ribbing, with ribs hardly narrower than the spaces between them numbering 15 on the last whorl. The 6 to 7 thin but strong spiral ribs continue also on the backs of the axial ribs. Together they constitute a cancellate ornament. Some specimens exhibit weaker spiral ribs alternating with the above-mentioned stronger ones. The inner lip bears two columellar folds.

Dimensions. Height: 8 mm; diameter: 3.5 mm.

GLIBERT (1957) does not distinguish *B. fusiformis* (CANTRAINE, 1836) from *B. pusilla*.

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution: the subspecies is sporadic in the Paratethyan Upper Oligocene and in the Boreal Oligocene. *B. fusiformis* s.s. occurs in the Boreal and Mediterranean Miocene.

Marginellidae

Genus: MARGINELLA LAMARCK, 1799

Marginella gracilis FUCHS, 1870

Pl. XLV, fig. 1

1870 *Marginella gracilis* n.sp. — FUCHS, p. 147, Pl. 4, figs 6—8
1936 *Marginella gracilis* FUCHS — NOSZKY, p. 74

A slender shell of four whorls; spire hardly lower than last whorl. Sutures hardly visible. Whorls convex, except for a narrow, slightly concave band below the adapical suture. The shell is entirely smooth without a trace of an ornament. Of its four strong columellar folds, the adapical one is horizontal; the others become more and more oblique downwards. The outer lip forms a strong varix.

Dimensions. Height: 11 mm; diameter: 4.5 mm.

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution. Known in addition to the above-named locality also from the Mediterranean Oligocene.

Marginella vadaszi Báldi, 1961

Pl. XLV, fig. 2

1961 *Marginella vadaszi* n.sp. — Báldi (in Báldi et al.), p. 104, Pl. 4, fig. 12

A three-whorl shiny smooth squat shell with a very low spire and an obtuse rounded apex. Sutures rather obscure. Adapical zones of whorls slightly concave: the last whorl is, however, markedly convex below the concave zone. The inner lip bears four strong oblique columellar folds.

Dimensions. Height: 5.2 mm; diameter: 2.4 mm.

Differs from *M. pergracilis* Koenen, 1890 in whorl outline.

Found in *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, Novaj-1.

Distribution: known from the above-named localities only.

Conacea

Turridae

Genus: TURRIS Bolten in Röding, 1798 (= *Pleurotoma* Lamarck, 1799)

Subgenus: FUSITURRIS Thiele, 1929

Turris (Fusiturris) duchasteli (Nyst, 1836)

Pl. XLVI, figs 1—4

1863 *Pleurotoma Duchastelii* Nyst — Sandberger, p. 237, Pl. 15, fig. 13

1866 *Pleurotoma Duchasteli* Nyst — Deshayes, p. 377, Pl. 99, figs 21—22

1887 *Pleurotoma Duchastelii* Nyst et var. div. — Speyer, p. 191, Pl. 20, figs 6—13; Pl. 21, figs 1—3

1897 *Pleurotoma Duchastelii* Nyst var. *amblyschisma* Sandb. — Wolff, p. 288, Pl. 27, figs 21—22

1914 *Pleurotoma Duchastelli* Nyst — Telegdi-Roth, p. 17, Pl. 1, figs 1—3

1936 *Pleurotoma Duchastelli* Nyst et var. div. — Noszky, p. 75

1936 *Pleurotoma Duchastelli* Nyst n. var. *incostata* — Noszky, p. 75, Pl. 5, fig. 19

1936 *Pleurotoma flexicostata* Gieb. n.var. *ventricosa* — Noszky, p. 75 Pl. 6, fig. 10

1952 *Turris duchasteli* Nyst — Görges, p. 103
1957 *Turris duchasteli* Nyst — Glibert, p. 77, Pl. 6, fig. 8
1958 *Fusiturris Duchastelii* Nyst — Sorgenfrei, p. 258, Pl. 54, fig. 177
1958 *Turris duchasteli* Nyst — Seneš, p. 164
1958 *Turris duchasteli flexiplicata* Nyst — Hölzl, p. 269, Pl. 22, fig. 3
1962 *Turris duchasteli* Nyst — Hölzl, p. 191
1963 *Turris duchasteli* Nyst — Báldi, p. 93, Pl. 7, figs 4—6

This is a small to medium-sized slender turrid whose spire is longer than the last whorl. None of the specimens at our disposal has an undamaged protoconch. The teleoconch consists of 10 whorls on the largest specimens. Whorls hardly convex, with a sinus in the median zone. Down to about the 6th or 7th whorl of the teleoconch there is a dense pattern of thin collabral ribs. On the later whorls, the axial ribs grow gradually weaker adaperturally, merging into the growth lines. The ornament is complemented by a fine spiral ribbing, stronger in the furrows between the collabral ribs.

Dimensions. Height: 26 mm; diameter: 9 mm.

There is considerable variety in size and in the strength of the collabral ribbing. At Törökbálint, for instance, most specimens have just 6 or 7 whorls with a strongly marked ribbing. In some extreme variants from Eger and Törökbálint, the collabral ribbing is restricted to the earliest whorls and is weak even there, whereas the rest of the shell just bears the fine spiral ribs. These varieties correspond to the Hemmoor form *T. duchasteli flexiplicata* (Kautsky 1925).

The turrids (pleurotomids) are specialized predators (*Toxoglossa*) of whose feeding habits and ways of life precious little is known. They are stenohaline-marine forms without exception. Wherever they are represented in a fauna by numerous species, a rather deep-water, deep sublittoral or bathyal facies can be presumed. *T. duchasteli* proper occurs, however, in shallow and medium-depth sublittoral facies.

Hungarian Upper Oligocene occurrences: Tök 52, Solymár 72, Törökbálint-1, -2, Diósjenő-7, Eger-1/k.

Distribution. A Boreal Oligo-Miocene species, widespread in the Paratethyan Oligocene, it occurs also in the Lower Miocene of the Western Paratethys.

Turris (Fusiturris) selysi (Koninck, 1837)

Pl. XLVII, figs 9—10

1863 *Pleurotoma Selysii* Kon. — Sandberger, p. 236, Pl. 15, fig. 12; Pl. 16, fig. 4
1867 *Pleurotoma Selysii* Kon. — Speyer, p. 189, Pl. 20, figs 1—5
1877 *Pleurotoma Selisi* Kon.? — Bellardi, p. 31
1904 *Pleurotoma Selisi* Kon. — Sacco, p. 42, Pl. 11, fig. 36
1914 *Pleurotoma Selysii* Kon. — Telegdi-Roth, p. 19, Pl. 1, figs 19—21
1936 *Pleurotoma Selysii* Kon. — Noszky, p. 76
1940 *Pleurotoma Selysii* Kon. — Noszky, p. 42

1952 *Turricula selysi polytropa* Koen. — Görges, p. 100
1957 *Turris selysi* Kon. — Glibert, p. 78, Pl. 6, fig. 9
1958 *Clavatula selysii* mut. *polytropa* Koen. — Seneš, p. 164
1962 *Turricula selysi* Kon. — Hölzl, p. 194, Pl. 10, fig. 11
1963 *Turris selysi* Kon. — Báldi, p. 94, Pl. 7, figs 9—10

None of the specimens we possess of this rare species is entirely undamaged. This is a medium-sized turrid with a slender, tall shell and a tall, gradate spire. Sutural ramp markedly concave, shoulder near the median line of the whorl. Sinus on the shoulder (this is a generic character!). The shoulder bears 11 to 13 strong, rounded nodes. These nodes continue downward on the whorls in broad, flat, abapically weakening collabral ribs. Spiral ornament subordinate, largely restricted to the early whorls, in the form of a wide-spaced weak ribbing. The late whorls bear no spiral ornament at all, except on the base.

Dimension. Diameter: 11 mm (largest specimen from Törökbálint).

Found in shallow and medium-depth sublittoral deposits.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, Eger-1/k.

Distribution: A Boreal-Mediterranean Oligocene species, rather widespread also in the Paratethyan Oligocene, it nowhere passes the Oligocene-Miocene boundary.

Turris (Oxytropa) konincki (Nyst, 1843)

Pl. XLVI, figs 5—6

1867 *Pleurotoma Koninckii* Nyst — Speyer, p. 186, Pl. 18, figs 1—10
1877 *Pleurotoma Konincki* Nyst — Bellardi, p. 31, Pl. 1, fig. 19
1890 *Pleurotoma Konincki* Nyst — Koenen, p. 355, Pl. 27, figs 1—3
1914 *Pleurotoma Koninckii* Nyst — Telegdi-Roth, p. 20, Pl. 1, figs 16—17
1936 *Pleurotoma Konincki* Nyst — Noszky, p. 76
1940 *Pleurotoma Konincki* Nyst — Noszky, p. 42
1952 *Turricula konincki* Nyst — Görges, p. 101
1957 *Turris konincki* Nyst — Glibert, p. 76, Pl. 6, fig. 4
1962 *Turris konincki* Nyst — Hölzl, p. 190, Pl. 10, fig. 10
1963 *Turris konincki* Nyst — Báldi, p. 94, Pl. 7, fig. 8

A slender medium-sized turriculate shell with a tall spire. On our specimens the protoconch is poorly preserved or broken off. Sutural ramp concave; shoulder a fairly broad band coinciding with the deep and narrow sinus (generic character!). The axial ornament, if any, is restricted to the earlier whorls: it consists of short flat close-spaced ribs on the shoulder. There is, however, a very fine spiral ornament covering the entire shell. The growth lines are also sharp and well-defined throughout.

Dimensions. Height ~ 35 mm; diameter: 11 mm.

Found in shallow and medium-depth sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Eger-1/k.

Distribution. This is a Boreal-Mediterranean Oligocene species that nowhere passes the Oligocene-Miocene boundary.

Subgenus: GEMMULA WEINKAUFF, 1876

Turris (Gemmula) coronata (MÜNSTER in GOLDFUSS, 1844)
Pl. XLVI, fig. 11

1856 *Pleurotoma coronata* MÜNST. — HÖRNES, p. 355, Pl. 52, fig. 9
1862 *Pleurotoma coronata* MÜNST. — SPEYER, p. 80
1867 *Pleurotoma coronata* MÜNST. — KOENEN, p. 89
1904 *Pleurotoma coronata* MÜNST. et var. div. — SACCO, p. 41, Pl. 11, figs 27—33
1914 *Pleurotoma coronata* MÜNST. var. *lapugyensis* H. et A. — TELEGDI-ROTH, p. 18, Pl. 1, figs 22—23
1936 *Pleurotoma coronata* MÜNST. var. *lapugyensis* H. et A. — NOSZKY, p. 76
?1936 *Pleurotoma odontophora* KOEN. — NOSZKY, p. 76
1940 *Pleurotoma coronata* BELL. n. var. *erecta* (?) — NOSZKY, p. 42
1953 *Clavatula coronata* MÜNST. — CSEPREGHY-MEZNERICS, p. 10, Pl. 2, figs 9—12
1954 *Turris coronata* MÜNST. — GLIBERT, p. 7, Pl. 2, fig. 4
1960 *Turris coronata* MÜNST. — BÁLDI, p. 78
1961 *Turris coronata* MÜNST. — BÁLDI (in BÁLDI et al.), p. 105, Pl. 4, fig. 14
1964 *Gemmula coronata* MÜNST. — ANDERSON, p. 282, Pl. 32, fig. 227
1966 *Pleurotoma trifasciata* HÖRN. — STRAUSZ, p. 419 (partim, non HÖRNES)

A small slender turrid with a protoconch of four smooth whorls and a teleoconch of six whorls. In the median line or somewhat below it there is a narrow shoulder bearing a very close-spaced pair of densely nodose spiral ribs. The adapical part of the concave sutural ramp bears a single spiral keel. There is a similar spiral keel below the shoulder. The entire whorl surface is covered with dense spiral threads. Sinus deep and narrow, situated on the shoulder (generic character).

Dimensions. Height: 12.5 mm; diameter: 4 mm.

Frequent in the deep sublittoral — shallow bathyal facies, it is a rarity in communities inhabiting shallower waters.

Hungarian Upper Oligocene occurrences: Leányfalu-2, Dejtár, Eger-1/6, -1/k, Novaj-1.

Distribution: Sporadic in the Boreal and perhaps also in the Atlantic Oligocene ("*Pleurotoma rotata* BROCC. mut, *peyrerensis* COSSMANN et PEYROT, 1931"), as well as in the Boreal and Mediterranean Miocene. In the Paratethys, it arises in the Upper Oligocene and persists to the end of the Middle Miocene (Badenian).

Turris (Gemmula) trifasciata (HÖRNES, 1856)
Pl. XLVI, fig. 7

1856 *Pleurotoma trifasciata* HÖRN. — HÖRNES, p. 354, Pl. 38, fig. 17
1877 *Pleurotoma trifasciata* HÖRN. — BELLARDI, p. 18, Pl. 1, fig. 8

1925 *Pleurotoma trifasciata* HÖRN. — KAUTSKY, p. 164, Pl. 11, fig. 12
1953 *Clavatula trifasciata* HÖRN. — CSEPREGHY-MEZNERICS, p. 11, Pl. 2, figs 1—4
1960 *Turris trifasciata* HÖRN. — BÁLDI, p. 77
1961 *Turris trifasciata* HÖRN. — BÁLDI (in BÁLDI et al.), p. 106, Pl. 4, fig. 15
1966 *Pleurotoma trifasciata* HÖRN. — STRAUSZ, p. 419 (partim), Pl. 17, figs 15—17

On this shell, recalling *T. coronata* but much larger and squatter, the shoulder is below the median line of the whorls. The narrow shoulder is bounded by two spiral ribs. It bears weak wide-spaced nodes which grow even weaker adaperturally. On the markedly concave sutural ramp there is a stronger spiral keel near the adapical suture. There is another similar keel below the shoulder, close to the abapical suture. A weak secondary spiral ribbing covers the entire shell. The narrow, deep sinus is on the shoulder.

Dimensions. Height ~ 21—22 mm; diameter: 10 mm.

GLIBERT (1954) and STRAUSZ (1966) contract it with *T. coronata*. As for myself, I have in agreement with CSEPREGHY-MEZNERICS (1953) perceived (BÁLDI 1960), and still do perceive, a specific difference between the two types. *T. coronata* is much smaller and slimmer. The shoulder is most often in the median position; the nodosity of the shoulder is closer-spaced. In contrast, *T. trifasciata* is larger and squatter; its shoulder is below the median line, often quite close to the abapical suture, and its nodes are wider-spaced. The definitive settling of this point will, however, require a much more copious material than is at present available.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Novaj-1.

Distribution: Known from the Paratethyan, Mediterranean and sporadically the Boreal Miocene, it has not been encountered in Oligocene localities other than the above-named ones.

Turris (Gemmula) laticlavia (BEYRICH, 1848)

Pl. XLVI, figs 8—9

1867 *Pleurotoma laticlavia* BEYR. — SPEYER, p. 187, Pl. 19, figs 1—7
1877 *Pleurotoma laticlavia* BEYR.? — BELLARDI, p. 32
1890 *Pleurotoma laticlavia* BEYR. — KOENEN, p. 360, Pl. 28, fig. 4
1897 *Pleurotoma laticlavia* BEYR. — WOLFF, p. 287, Pl. 27, fig. 20
1904 *Pleurotoma laticlavia* BEYR. — SACCO, p. 42, Pl. 11, figs 37—38
?1940 *Pleurotoma* cfr. *laticlavia* BEYR. — NOSZKY, p. 42
1943 *Turris laticlavia* BEYR. — ALBRECHT et VALK, p. 84, Pl. 8, figs 235—238
1952 *Turris laticlavia* BEYR. — GÖRGES, p. 104
1957 *Turris laticlavia* BEYR. — GLIBERT, p. 75, Pl. 6, fig. 3

1958 *Turris laticlavia* BEYR. et var. div. — HÖLZL, p. 271, Pl. 22, figs 4–5
1962 *Turris laticlavia* BEYR. — HÖLZL, p. 191
1963 *Turris laticlavia* BEYR. — BÁLDI, p. 93, Pl. 7, fig. 11

A small, slender turrid whose spire is somewhat taller than its last whorl. The protoconch is not preserved on our specimens. The whorls of the teleoconch bear a broad shoulder whose upper border coincides with the median line. Sutural ramp markedly concave. Each border of the shoulder bears a spiral rib. On the sutural ramp there is a somewhat weaker spiral rib close to the adapical suture. The spiral ornament is complemented by weak threads. The base likewise bears spiral ribs. Any collabral ribbing is restricted to the broad shoulders of the early whorls, where it covers the space between the two borders on the shoulder. It lends a vaguely nodose look to the spiral ribbing there. The sinus is on the shoulder.

Dimensions. Height: 21 mm; diameter: 9 mm.

Oligocene specimens from Kassel and the Lower Rhine, have a stronger secondary spiral ornament than the Hungarian form. There is, however, full agreement with a specimen from the Rupelian Hermsdorf clay.

Found in medium-depth sublittoral facies.

Hungarian Upper Oligocene occurrences: Törökbálint-1, -2, Anyácsapuszta 27, Becske-2.

Distribution: A Boreal-Mediterranean Oligocene species widespread also in the Paratethyan Oligocene, it has been discovered at a single Miocene locality, in the South Bavarian Molasse.

Turris egerensis (TELEGDI-ROTH, 1914)

Pl. XLVI, fig. 10

1914 *Pleurotoma egerensis* n. sp. — TELEGDI-ROTH, p. 20, Pl. 1, figs 11–12
1936 *Pleurotoma egerensis* T.-R. — NOSZKY, p. 76

A turrid somewhat squatter than the ones discussed so far, with a spire as tall as the last whorl. A broad flat shoulder covers the entire abapical half of all the whorls except the last one. Sutural ramp convex at the adapical suture but concave next to the shoulder. Sinus on the shoulder. Collabral ribbing not significant except on the early whorls; restricted even there to the shoulder and the convex zone of the sutural ramp. The growth lines are strong, however, growing weaker on the last whorl only. The entire shell is covered with a dense fine spiral ribbing which lends the axial ribs and growth lines a somewhat granulate look.

Dimensions. Height: 22 mm; diameter: 9 mm.

Found in *Pitar polytropa* and *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, -1/k.

Distribution: Not known outside the above-named locality.

Genus: BATHYTOMA Harris et Burrows, 1891 (= *Dolichotoma* Bellardi, 1875)

Bathytoma cataphracta (Brocchi, 1814)

Pl. XLIX, fig. 6

1856 *Pleurotoma cataphracta* Borcc. — Hörnes, p. 333, Pl. 36, figs 5—9
1863 *Pleurotoma subdenticulata* Münst. — Sandberger, p. 239, Pl. 16, fig. 9
1867 *Pleurotoma turbida* Sol. — Speyer, p. 184, Pl. 19, figs 8—11
1877 *Dolichotoma cataphracta* Brocc. et var. div. — Bellardi, p. 230, Pl. 7, fig. 20
1897 *Pleurotoma subdenticulata* Münst. — Wolff, p. 285, Pl. 27, fig. 24
1900 *Genotia cataphracta* Brocc. (an *G. turbida* Sol.) — Rovereto, p. 181
1904 *Bathytoma cataphracta* Brocc. et var. div. — Sacco, p. 50, Pl. 13, figs 21—23
1914 *Bathytoma cataphracta* Brocc. var. *humilis* n. var. — Telegdi-Roth, p. 23, Pl. 1, fig. 28
1925 *Bathytoma cataphracta* Brocc. — Kautsky, p. 179, Pl. 11, fig. 33
1932 *Bathytoma cataphracta* Brocc. et var. div. — Cossmann et Peyrot, p. 16—19, Pl. 8, figs 45—47, 50—51
1936 *Bathytoma cataphracta* Brocc. et var. div. — Noszky, p. 79—80
1936 *Bathytoma turbida* Sol. — Noszky, p. 80
1936 *Bathytoma* cfr. *Degrangei* Peyr. — Noszky, p. 80
1936 *Bathytoma anodon* Koen. — Noszky, p. 80
1940 *Dolichotoma cataphracta* (= *Pleurotoma turbida* Lam.) — Noszky, p. 44
?1940 *Dolichotoma* cfr. *subdenticulata* Münst. et n. var. *reticingulata* — Noszky, p. 43, Pl. 2, fig. 23
1943 *Moniliopsis subdenticulata* Münst. — Albrecht et Valk, p. 88, Pl. 8, figs 259—262
1952 *Epalxis subdenticulata* Münst. — Görges, p. 105
1957 *Bathytoma crenata* Nyst—Glibert, p. 79, Pl. 6, fig. 17
1962 *Bathytoma cataphracta* Brocc. — Hölzl, p. 195
1962 *Bathytoma subdenticulata* Münst. — Hölzl, p. 195, Pl. 10, fig. 12
1963 *Bathytoma cataphracta subdenticulata* Münst. — Báldi, p. 95, Pl. 7, fig. 7
1966 *Moniliopsis cataphracta* Brocc. — Strausz, p. 428, Pl. 18, figs 11—15

A fusiform, slightly squat shell. The protoconch comprises three smooth whorls succeeded by a half-whorl covered with weak axial ribs. In the median line of the 5 or 6 whorls of the teleoconch, or slightly below it, there is a swollen but not sharp shoulder. The sutural ramp is strongly concave. There is a dense weak spiral ribbing all over the whorls. There are short, weak axial ribs on the shoulder. The growth lines are rather strong, sufficiently so to render the spiral ornament granular on some large specimens. The sinus is on the shoulder.

Dimensions. Height: 32 mm; diameter: 14 mm.

Numerous characters are rather variable, including slenderness (H/D ratio) of the shell, position of the shoulder, strength of the ornament, granulation of the spiral ribbing. This is why the separation of *B. cataphracta humilis* Telegdi-Roth, 1914, is not justified; nor is that of *B. cataphracta* from *B. subdenticulata* (Münster in Goldfuss 1843). It is usual to distinguish the last two types on the basis of the following characters; *B. subdenticulata* is smaller, squatter, with axial ribs on one or two whorls (rather than just a half whorl) of the protoconch; the spiral ribbing is not granulate. In the Törökbálint specimens, the protoconch resembles *B. cataphracta* whereas its shape and ornament fully agree with that of *B. subdenticulata*. Similar specimens have turned up also at Eger, accompanied by larger, somewhat slenderer specimens with granulate ornament. The distinctive features thus tend to occur in various cross-combinations on the Hungarian specimens.

Sporadic but ubiquitous from the shallow sublittoral to the bathyal facies, it is more typical of the deeper facies.

Hungarian Upper Oligocene occurrences: Törökbálint-1, Dejtár, Eger-16/, -1/k.

Distribution: ubiquitous all over Europe from the deeper Oligocene to the end of the Miocene, it is a rather variable species. The form *cataphracta* s.s. is typical of the Mediterranean-Atlantic Oligocene and Miocene, the form *subdenticulata* of the Boreal Oligocene.

Genus: TURRICULA Schumacher, 1817 (= *Surcula* Adams, 1853)

Turricula regularis (Koninck, 1837)

Pl. XLVII, figs 1—5, 8

1863 *Pleurotoma regularis* Ben. — Sandberger, p. 235
1863 *Pleurotoma belgica* Münst. — Sandberger, p. 233, Pl. 15, fig. 10
1866 *Pleurotoma belgica* Münst. — Deshayes, p. 353, Pl. 99, figs 13—14
?1890 *Surcula Beyrichi* Phil. — Koenen, p. 305, Pl. 25, figs 8—11
1897 *Pleurotoma regularis* Kon. — Wolff, p. 286, Pl. 27, figs 17—19
1914 *Surcula regularis* Kon. — Telegdi-Roth, p. 21, Pl. 1, figs 24—25; Pl. 3, figs 10—13
1936 *Surcula* cfr. *Beyrichi* Phil. — Noszky, p. 77
1936 *Surcula Beyrichi* Phil. n. var. *gracilis* — Noszky, p. 77, Pl. 5, fig. 20
1936 *Surcula Beyrichi* Phil. n. var. *simplex* — Noszky, p. 77, Pl. 6, fig. 8
1936 *Surcula Lőrentheyi* n. sp. — Noszky, p. 77, Pl. 5, fig. 16
1936 *Surcula regularis* Kon. et var. div. — Noszky, p. 77—78
1936 *Surcula regularis* Kon. n. var. *robusta* — Noszky, p. 78, Pl. 6, fig. 3
1936 *Surcula regularis* Kon. n. var. *arcuatospirata* — Noszky, p. 78, Pl. 6, fig. 9
1936 *Surcula regularis* Kon. n. var. *bulbiformis* — Noszky, p. 79, Pl. 6, fig. 1
1936 *Surcula bulbosa* n. sp. — Noszky, p. 79, Pl. 6, fig. 2

1937 *Surcula regularis* Kon. — Venzo, p. 25, Pl. 2, fig. 3
1943 *Clavatula regularis* Kon. — Albrecht et Valk, p. 82, Pl. 21, figs. 804—807
?1943 *Clavatula beyrichi* Phil. — Albrecht et Valk, p. 82, Pl. 7, figs 198—199
1952 *Surcula regularis* Kon. — Anić, p. 44, Pl. 11, fig. 12
1952 *Turricula regularis* Kon. — Gőrges, p. 99
1957 *Turricula regularis* Kon. — Glibert, p. 79, Pl. 6, fig. 10
1958 *Clavatula regularis* Kon. et var. div. — Seneš, pp. 162—163
1962 *Turricula regularis* Kon. — Hölzl, p. 192, Pl. 10, fig. 9
1963 *Turricula regularis* Kon. — Báldi, p. 95, Pl. 7, figs 1—3

A medium- or large-sized fusiform shell. The spire is as tall as or slightly lower than the last whorl. The protoconch of our specimens is missing or corroded: in the latter case it comprises 2 or 3 whorls. On the whorls of the teleoconch there is a concave sutural ramp, with a shoulder in the median zone or lower third of the whorls. The part of the whorl below the rounded shoulder is convex. The sinus is somewhat above the shoulder, on the sutural ramp (this is a generic character!). On the early whorls of the teleoconch, there are broad flat collabral ribs below the shoulder, which gradually fade out towards the later whorls. The early whorls of some specimens exhibit weak spiral threads or ribs. Aperture elongate, siphonal canal long, straight.

Dimensions. Height: 62.5 mm; diameter: 29.2 mm (specimen inventoried under M 63/2039).

It is in order to discuss here the considerable variability of the species, which has tempted taxonomists to much superfluous name-giving. Of the variable features, let us mention size first and foremost. So much can be stated that giant specimens tend to be restricted to the higher horizons of the Upper Oligocene.

Further variable features include the width of the last whorl, its degree of inflation, and the height of the spire that tends to vary inversely as the height of the last whorl. The development of the sutural ramp is also variable, so much so that it is altogether missing from some specimens. Finally there is variability in the strength (or sometimes the total absence) of the collabral ribbing on the early whorls, the presence or absence of the spiral ornament, ranging from entirely smooth, unornamented forms (frequent at Eger) to heavily ornamented ones (Törökbálint).

Owing to this considerable variability it is just as difficult to distinguish it from its precursor, Lower Oligocene *T. beyrichi* Philippi, 1846 as from its descendant, Boreal Miocene *T. steinworthi* Semper, 1861. It differs according to Glibert (1954) from *T. steinworthi* in that the sutural ramp is absent or at least much less marked. Owing to the considerable variability of this feature, however, the independence of *T. steinworthi* is much in doubt.

Typical, abundant in the shallow sublittoral *Glycymeris latiradiata* and *Pitar polytropa* communities, it is entirely absent from the littoral, the deep sublittoral and the bathyal facies.

Hungarian Upper Oligocene occurrences: Kesztölc-1, Solymár 72, 84, Törökbálint-1, 2, Budafok-1/4, Pomáz-1, Leányfalu-4, Szentendre 2, Diósjenő-1, -4, -7, -24, -8, ? Rétság-2, Becske-1, Eger-1/k, -2, Novaj-1.

Distribution. Widespread in the Paratethyan and Boreal, and sporadic in the Mediterranean, Oligocene. It nowhere passes the Oligocene-Miocene boundary, even though, if contracted with hard-to-distinguish *T. steinworthi*, its hemera extends to the Miocene, too.

Turricula ilonae Báldi, 1966

Pl. XLVII, figs 6—7

1961 *Turricula regularis* Kon. — Báldi (in Báldi et al.), p. 106, pl. 4, fig. 13 (non Koninck)

1966 *Turricula ilonae* n. sp. — Báldi, p. 90, Pl. 3, figs 2—3

A small, very slender, fusiform shell of 7 or 8 whorls. The two smooth whorls of the protoconch are succeeded by teleoconch whorls which have a shoulder in the median line. The sutural ramp is markedly concave. It bears next to the adapical suture a strong swollen spiral rib. The region below the shoulder is slightly concave, almost plane. It bears flat collabral ribs weakening downwards. This collabral ribbing tends to fade or indeed to disappear towards the last whorl. Spiral ribbing is largely restricted to the base, being very weak or nonexistent elsewhere. The sinus is on the sutural ramp immediately above the shoulder.

Dimensions. Height: 6.2 mm; diameter: 3.4 mm.

I have earlier considered a single specimen from the molluscan clay of Novaj to be a juvenile specimen of *T. regularis* (Báldi in Báldi et al., 1961). The rich material from Eger has revealed the form to be an independent species, however, with close relations in the deeper German and Low Countries Oligocene. *T. ilonae* differs from *T. berendti* (Koenen 1890) in addition to its missing or rudimentary spiral ornament also in the fact that its protoconch comprises two whorls only. Moreover, the type figured by Koenen (1890) has no shoulder. True, the *T. berendti* figured by Albrecht and Valk (1943) exhibits a shoulder, but their specimens have much shorter siphonal canals.

A deep subblittoral to bathyal species.

Hungarian Upper Oligocene occurrences: Eger-1/6, Novaj-1.

Distribution: not known outside the above localities.

Turricula telegdirothi (Noszky, 1936)

Pl. XLVII, fig. 11

1936 *Surcula Telegdi-Rothi* n. sp. — Noszky, p. 77, Pl. 5, fig. 10

1961 *Turricula telegdi-rothi* Noszky — Báldi (in Báldi et al.), p. 107, Pl. 4, fig. 16

A medium-sized, rather less slender *Turricula* species with a gradate spire. The adapical band of its highly concave sutural ramp bears three thin weak spiral ribs forming a cancellate ornament together with the growth lines of about equal strength. On the abapical band of the ramp, directly above the shoulder, only these strong growth lines are visible: it is here that they form a sinus. This position of the sinus places the species into the genus *Turricula*. The whorl portions below the shoulder are strongly convex, ornamented by broad round-backed axial ribs and finer narrow spiral ribs passing over the axial ones. The number of the axial ribs is 17.

Dimensions. Height ~ 30 mm; diameter: 15 mm.

Found in a *Pitar polytropa* and a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Eger-1/k, Novaj-1.

Distribution: known from the above localities only.

Subgenus: KNEFASTIA DALL, 1919

Turricula (Knefastia) tricarinata (TELEGDI-ROTH, 1914)

1914 *Surcula tricarinata* n. sp. — TELEGDI-ROTH, p. 22, Pl. 1, figs 26—27
1936 *Surcula tricarinata* T.-R. — NOSZKY, p. 79

No specimen identifiable with any degree of certainty has turned up since TELEGDI-ROTH's holotype (1914), now being kept at the Hungarian Geological Institute. Hence, desisting from a description here, I refer the reader to TELEGDI-ROTH's monograph.

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrences: Eger-1/k and a doubtful specimen from Dejtár.

Distribution. Known so far only from Eger and possibly Dejtár.

Turricula (Knefastia) legányii BÁLDI, 1966
Pl. XLVIII, figs 2—3

1966 *Turricula legányii* n. sp. — BÁLDI, p. 91, Pl. 3, figs 18—19

The protoconch comprises three smooth whorls. The gradate teleoconch of at least eight whorls bears broad strong round-backed somewhat oblique axial ribs numbering 12 on the last whorl. The upper third of each whorl is occupied by a slightly convex sutural ramp on which the axial ribs do not continue. The portion below the rounded, obtuse shoulder is convex. It bears besides the axial ribs also a spiral ornament consisting of the following elements: three main spiral ribs on the early whorls, five on the late ones, alternating with weaker secondary ribs. On the sutural shelf there is merely a system of weak spiral lines. The spiral ornament is equally strong on the backs of and in the spaces between the axial ribs.

Dimensions. Height: 19.9 mm; diameter: 7.0 mm (juvenile specimen).

Differs from its closest relative, *T. tricarinata* (TELEGDI-ROTH, 1914) merely in its squatter build and the spiral ornament of the sutural shelf (which in *T. tricarinata* is smooth but for one or two spiral grooves). Another closely related species is Miocene *T. lamarcki* (BELLARDI, 1847) from which the species from Eger differs in its narrower more closer-spaced axial ribs and finer spiral ornament.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. Known only from this one locality so far.

Genus: CLAVUS MONTFORT, 1810

Subgenus: CRASSISPIRA SWAINSON, 1840

Clavus (Crassispira) oligocenicus (NOSZKY, 1936)

Pl. XLVIII, fig. 9

1936 *Drillia crispata* JAN var. *oligocenica* — NOSZKY, p. 74, Pl. 6, fig. 12

Even though rather indifferently preserved in most cases, the protoconch bears features sufficiently discernible to place the species into the subgenus *Crassispira* (cf. GLIBERT 1954, Pl. 1). The teleoconch of 7 whorls is gradate, with a more or less sharp shoulder in the median zone of each whorl, and with a slightly concave sutural ramp. This latter exhibits 0 to 8 spiral lines, somewhat weaker than the 2 to 6 ones observed below the shoulder. Axial ribs strong, thick, round-backed, numbering 10 to 13 on the penultimate whorl. The axial ribs are weaker on the sutural ramp and bent so as to follow the sinus. The spaces between the ribs are as wide as the ribs themselves.

Dimensions. Height: 16.5 mm; diameter: 5.5 mm.

Differs from its closest relative, *Cl. undatellus* (PHILIPPI 1843) in the following; its axial ribs are much weaker on the sutural ramp, and bent so as to follow the sinus. The "double triangular" ornament (SPEYER, 1867) is thus missing. The protoconch permits a safe distinction from *Pleurotomoides luisae* (SEMPER, 1861), whose teleoconch is otherwise highly similar to that of *Cl. oligocenicus*. There is no relation at all, on the other hand, to the rather distant species "*Drillia*" *crispata* JAN.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: Known only from this one locality thus far.

Subgenus: BRACHYTOMA SWAINSON, 1840

Clavus (Brachytoma) venustus (PEYROT, 1932)

Pl. XLVIII, fig. 8

1932 *Daphnella venusta* n. sp. — COSSMANN et PEYROT, p. 71, Pl. 7, figs 6—7

1963 *Clavus venustus* PEYR. — BÁLDI, p. 96, P. 7, fig. 15

A small rather squat shell. The protoconch comprises two and a half smooth whorls and a half-whorl covered with thin axial ribbons. The three whorls of the teleoconch are gradate. The spira is hardly taller than the last whorl. The shoulder lies somewhat above the median line. The sutural ramp is concave. The very shallow sinus is on the ramp. The ornament equally covers the ramp and the portion below the shoulder.

Dimensions. Height: 4.5 mm; diameter: 2.1 mm.

Found in a *Pitar beyrichi* community.

Hungarian Upper Oligocene occurrence: Törökbálint-1.

Distribution. Known in addition to the above locality from the Atlantic Upper Oligocene (Peyrère).

Clavus (Brachytoma) obeliscus (DESMOULINS, 1842)

Pl. XLVIII, figs 4—5

1897 *Pleurotoma obeliscus* DESMOUL. — WOLFF, p. 286, Pl. 28, figs 1—2
1931 *Drillia obeliscus* DESM. — COSSMANN et PEYROT, p. 94, Pl. 7, fig. 59, 61
1952 *Clavus obeliscus* DESM. — GÖRGES, p. 102, Pl. 3; fig. 76
1956 *Turris obeliscus* DESM. — RASMUSSEN, p. 87, Pl. 8, fig. 4
1958 *Inquisitor obeliscus* DESM. — SORGENFREI, p. 268, Pl. 56, fig. 189

A small fusiform, highly elongate, slender shell. The spire is significantly taller than the last whorl. The protoconch is broken off the specimens at our disposal. The teleoconch comprises six whorls. Shoulder poorly developed: the ill-defined sutural ramp is slightly concave and reaches down to about the median line of the whorl. There are strong broad round-backed axial ribs that fade out on the ramp. The sinus is on the ramp. Very weak traces only of a spiral ornament, visible mainly on the last whorl, except for a flat spiral rib on the ramp, next to the adapical suture. Siphonal canal short.

Dimensions. Height: 15 mm; diameter: 5 mm.

Cl. allionii (HOERNES et AUINGER 1879) that had been earlier confused by HÖRNES (1856) with our species, differs in addition to its larger size also in its heavier ornament (CSEPREGHY-MEZNERICS 1953).

Represented in the *Pitar polytropa* community (a shallow sublittoral facies).

Hungarian Upper Oligocene occurrences: Dömös-2, Eger-1/k.

Distribution. An Atlantic-Boreal species that arises in the Boreal Province as early as the Upper Oligocene and occurs in both provinces in the Miocene. A probable geographical vicariating species is closely related *Cl. allionii* in the Mediterranean and in the Paratethyan Miocene.

Genus: MICRODRILLIA CASEY, 1903

Microdrillia hungarica BÁLDI, 1966

Pl. XLIX, fig. 1

1966 *Microdrillia hungarica* n. sp. — BÁLDI, p. 91, Pl. 3, fig. 5

A small, elongate, fusiform shell. The protoconch comprises 4.5 whorls, the 2.5 earliest of which are smooth, whereas the next two bear fine curved axial laths. On the teleoconch of six whorls the slightly concave sutural ramp occupies the upper third of each whorl. There is no prominent shoulder, although there is a sharp keel running along the abapical border of the ramp. Another spiral rib runs on the ramp next to the adapical suture. On the convex portion of the whorls, below the keel, there are three equally strong sharp narrow spiral ribs on the early whorls and five of the same (including the keel abapically bounding the ramp) on the later ones. The total number of spiral ribs on the last whorl is thus 6. There is no trace of any strong axial ornament, but all whorls of the teleoconch bear a dense ornament of fine collabral laths.

Dimensions. Height: 11.5 mm; diameter: 3.7 mm.

Stands close to Upper Oligocene — Lower Miocene *M. helicoides* (Edwards, 1838), from which it differs on the basis of Koenen's (1890) description and figures in that its sutural ramp is narrower and that it has two more spiral ribs on the last whorl. There is a superficial resemblance to *Asthenotoma crispata* (Jan, 1832) well-known also from the Badenian of the Paratethys, whose protoconch, however, is entirely different, typical of the genus *Asthenotoma*. Its relative among the Badenian species is thus *M. adelae* (Hoernes et Auinger 1879) which however, has a string of nodes along its carina.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. Known only from this one locality thus far.

Genus: ASTHENOTOMA Harris et Burrows, 1891

(= *Oligotoma* Bellardi, 1875)

Asthenotoma obliquinodosa (Sandberger, 1863)

Pl. XLVIII, fig. 10

1863 *Pleurotoma obliquinodosa* — Sandberger, p. 240, Pl. 16, fig. 6
1867 *Borsonia decussata* Beyr. — Koenen, p. 97, Pl. 1, fig. 11
1867 *Pleurotoma obliquinodosa* Sandb. — Speyer, p. 198, Pl. 22, figs 8—11
1952 *Asthenotoma obliquinodosa* Sandb. — Görges, p. 105
1957 *Asthenotoma obliquinodosa* Sandb. — Glibert, p. 81, Pl. 6, fig. 7
?1962 *Asthenotoma* aff. *obliquinodosa* Sandb. — Hölzl, p. 199, Pl. 10, fig. 15
1965 *Pleurotoma obliquinodosa* Sandb. — Ondrejičkova et Seneš, p. 180

A small elongate fusiform shell with a spire taller than the last whorl. Of the two and a half whorls of the protoconch, two are smooth; the remaining half-whorl bears fine axial laths. The six-whorl teleoconch is gradate, with narrow convex sutural ramps which pass without a sharp shoulder into the convex portion occupying the lower two-thirds of the whorls. There are 11 to 13 slightly leaning strong round-backed axial ribs per whorl, as wide as the spaces between them. These do not extend to the ramp. There is a spiral ornament of fine threads that is weaker on the ramp.

The last whorl also bears axial ribs, in contrast to certain Boreal specimens.

Dimensions. Height: 13.3 mm; diameter: 4 mm.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. This is a Boreal Oligocene species, sporadically represented also in the Paratethyan Oligocene.

Asthenotoma noszkyi BÁLDI, 1966

Pl. XLIX, fig. 3

1966 *Asthenotoma noszkyi* n. sp. — BÁLDI, p. 92, Pl. 3, fig. 13

A small fusiform shell with a teleoconch of five whorls and a protoconch of two smooth ones. In the upper third of each teleoconch whorl, there is a shallow depression, it fades out towards the later whorls. The ornament of the whorls is a network of spiral ribs and threads and dense collabral laths. The spiral threads are stronger below the depression. At their intersections with the axial laths they carry small, vaguely spiny tubercles. They are otherwise uniformly strong on the axial laths and between them. Independently of said laths, the early whorls bear in their portions below the depression obscure traces of broad flat-backed axial ribs. The spiral ribs and threads number 7 or 8 on the penultimate whorl.

Dimensions. Height: 12.6 mm; diameter: 5.2 mm.

Differs significantly in both shape and ornament, and is readily distinguished, from the most closely related species, Miocene *A. ornata* (DEFRANCE, 1826) and Oligocene *A. bicingulata* (SANDBERGER, 1863).

Found in *Pitar polytropa* and *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, -1/k.

Distribution. Known from this one locality so far.

Genus: MITROMORPHA CARPENTER, 1865

Mitromorpha telegdirothi BÁLDI, 1966

Pl. XLIX, fig. 4

1966 *Mitromorpha telegdirothi* n. sp. — BÁLDI, p. 92, Pl. 3, fig. 10

On the small, rather elongate, fusiform shell three smooth protoconch whorls are succeeded by five teleoconch whorls bearing an ornament of leaning axial ribs fading out on the last whorl, plus spiral ribs weakening towards the abapical suture. There is no sutural ramp or shoulder: only vague traces of the latter are visible on the early whorls.

Dimensions. Height: 7.9 mm; diameter: 3.0 mm.

Stands close in its ornament to the Upper Oligocene Peyrère species *M. raulini* COSSMANN et PEYROT, 1928 from which it differs in its more elongate shape, its longer siphonal canal, its stronger axial ribs on the early whorls, the entirely smooth inside of its outer lip and its weak and very flat two columellar folds.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: known from the above locality only.

Genus: MANGELIA Risso, 1826 (= *Raphitoma* Cossmann, 1896; non Bellardi, 1848)

Mangelia bogschi Báldi, 1961

Pl. XLVIII, fig. 7

1961 *Mangelia bogschi* n. sp. — Báldi (in Báldi et al.), p. 107, Pl. 4, fig. 17

A small, slender shell, with a spire tall in relation to the last whorl and a short siphonal canal. The protoconch comprises three smooth whorls. The four whorls of the teleoconch bear wide-spaced sharp axial ribs. These number 13 on the last whorl, including varices, one of which is at the outer lip. The hardly convex, vague sutural ramp occupies the adapical half of the whorl: the shoulder is very vague, obtuse. The axial ribs are somewhat bent in the shoulder region, and continue without change on the ramp. There is no spiral ornament at all except on the base. The broad shallow sinus is on the shoulder.

Dimensions. Height: 5.1 mm; diameter: 1.9 mm.

It differs significantly in both shape and ornament from a number of related Lower Miocene species (Báldi in Báldi et al. 1961).

Found in deep sublittoral — shallow bathyal *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, Novaj-1.

Distribution. Known from the above-named localities only.

Genus: RAPHITOMA Bellardi, 1848 (= *Homotoma* Bellardi, 1875)

Raphitoma valdecarinata Báldi, 1966

Pl. XLVIII, fig. 1

1966 *Raphitoma valdecarinata* n. sp. — Báldi, p. 93, Pl. 3, fig. 1

A small slender fusiform shell with a strongly gradate spire. The protoconch occupies one smooth whorl and a half. The six whorls of the teleoconch bear a remarkably sharp keel in about the median line. The whorl forms a weakly concave sutural ramp above it and a weakly convex portion below it. Below the shoulder there are leaning, abapically weakening broad axial ribs that suddenly end almost tubercle-like on the shoulder. In their continuation on the ramp there are weak collabral ribs following the curve of the sinus. All whorls carry wide-spaced spiral ribs whose number is 12 on the last whorl.

Dimensions. Height: 8.7 mm; diameter: 4.9 mm.

Differs in shape and ornament from closely related Italian Neogene *R. spinifera* (BELLARDI, 1847) and Lower Oligocene "*Drillia*" *oxystoma* KOENEN, 1890.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. Known only from this one locality so far.

Raphitoma roemeri agriensis BÁLDI, 1966

Pl. XLIX, fig. 2

1936 *Raphitoma erecta* KOEN. — NOSZKY, p. 80 (non KOENEN)
1966 *Raphitoma roemeri agriensis* n. subsp. — BÁLDI, p. 93, Pl. 3, fig. 15

A small, very slender shell: spire taller than last whorl. The protoconch comprises 2.5 to 3 smooth whorls and another half-whorl covered with curved axial ribs. The teleoconch consists of five whorls on the largest specimen. These latter are covered with slightly leaning axial ribs several times thinner than the spaces between them. Weak traces of a sutural ramp are restricted to the early whorls, which lends this part of the spire a somewhat gradate outline. An alternation of strong and weak lines, the spiral ornament is somewhat weaker on the ramp. The shell exhibits the fine granulation typical of the subfamily *Mangelliinae*.

Dimensions. Height: 7.2 mm; diameter: 4.2 mm.

Differs from *R. roemeri* (PHILIPPI, 1843) in its denser spiral ornament, more elongate siphonal canal and in that its protoconch comprises one whorl more.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: Known from this one locality only.

Raphitoma pseudonassoides BÁLDI, 1966

Pl. XLVIII, fig. 6

1966 *Raphitoma pseudonassoides* n. sp. — BÁLDI, p. 94, Pl. 3, fig. 16

A small elongate fusiform shell. The conical protoconch comprises three smooth whorls. Each of the four whorls of the teleoconch exhibits 17 thin sharp collabral ribs, parallel with the sinus, narrower than the spaces between them. Very weak traces of a sutural ramp. Spiral ribbing weak and restricted to the abapical portions of the late whorls.

Dimensions. Height: 6.2 mm; diameter: 2.3 mm.

It differs from "*Drillia*" *nassoides* KOENEN, 1890 as defined by KOENEN's (1890) description and figure in its substantially shallower and differently disposed sinus. It differs from superficially similar *Mangelia bogschi* BÁLDI, 1961 in its much denser axial ribbing, relatively strong axial ornament, larger size, slenderer shape and longer siphonal canal.

Found in a *Hinia-Cadulus* community.
Hungarian Upper Oligocene occurrence: Eger-1/6.
Distribution. Known only from this one locality.

Conidae

Genus: CONUS Linné, 1758

Subgenus: CONOLITHUS Hermannsen, 1847

Conus (Conolithus) dujardini egerensis Noszky, 1936

Pl. XLV, figs 7—8

1914 *Conus Dujardini* Desh. var. — Telegdi-Roth, p. 35, Pl. 4, fig. 6
1936 *Conus Dujardini* Desh. var. — *egerensis* T.-R. — Noszky, p. 81
1936 *Conus Dujardini* Desh. — Noszky, p. 80
1936 *Conus Dujardini* Desh. n. var. *brevispiratus* — Noszky, p. 81, Pl. 5, fig. 13
1952 *Conus dujardini* Desh. — Glibert, p. 132, Pl. 10, fig. 3
1964 *Conus dujardini egerensis* Noszky — Báldi (in Báldi et al.), p. 163, Pl. 2, fig. 11

A biconical shell with a tall, somewhat coeloconoid, very pointed spire of small apical angle. On the last whorl, a narrow concave sutural ramp is separated from a flat or hardly convex base by a well-marked although rounded shoulder. Each whorl of the spire is covered by the next one up to this shoulder, so that only the sutural ramp remains visible. Those whorls older than the third or fourth before the last have in the shoulder region short collabral ribs that do not extend on to the ramp. On these same whorls, there is also a spiral ornament. Both types of ornament fade out towards the younger whorls; these are entirely smooth. The lower portion of the base bears spiral furrows. The base of one specimen from Eger is twisted sideways in a remarkable fashion. (Pl. XLV, Fig. 8.)

Dimensions. Height: 50.0 mm; diameter: 18.0 mm.

Telegdi-Roth (1914) in view of the ornament on the early whorls considered the Eger specimen a transition between *Conus dujardini* Deshayes, 1831 and *Conus antediluvianus* Bruguière, 1792; he expressed this by marking the form a "var." in his nomenclature. Later on, Noszky (1936) gave the name "*egerensis*" to this variety. Kautsky (1925) and Glibert (1952) gave a detailed list of differences between *C. dujardini* and *C. antediluvianus*, and emphasized the separateness of the two species. The Hungarian Upper Oligocene form stands doubtless closer to *C. dujardini*, but its distinction at a subspecific level may well be justified. It should be pointed out, however, that vague traces of an ornament on the early whorls are sometimes visible also on *C. dujardini* s. s. This is particularly the case with the forms figured by Glibert (from the Belgian Boldérien and Anversien): that is why I have inserted Glibert's data in my synonymy. There are several known relatives in the deeper Boreal Oligocene (*C. beyrichi* Koenen, 1865 and *C. plicatilis* Koenen, 1890). These differ, however, in several characters, especially in the much lower height of the last whorl as related to the spire.

Conids are toxoglossate predators (provided with a modified radula connected with a lethal poison gland) feeding largely on annelids.

C. dujardini egerensis is most abundant in shallow sublittoral deposits, in the *Pitar polytropa* community in particular, but was presumably represented also at greater depths.

Hungarian Upper Oligocene occurrences: Diósjenő-4, -7, Eger-1/6, -1/k, Novaj-1.

Distribution: The subspecies is not known so far outside the above-named localities. *C. dujardini* s. s. is a species widespread in the Boreal, Mediterranean and Paratethyan Miocene.

Terebridae

Genus: TEREBRA Bruguière, 1789

Subgenus: MYURELLINA Bartsch, 1923

Terebra (Myurellina) simplex Telegdi-Roth, 1914

Pl. XLV, fig. 9

1914 *Terebra simplex* n. sp. — Telegdi-Roth, p. 33, Pl. 3, figs 16—17
1936 *Terebra simplex* T.-R. — Noszky, p. 81
1958 *Terebra simplex* T.-R. — Seneš, p. 166

A remarkably slender, turriculate shell with a very low last whorl. Spire straight in outline; whorls flat, with diameter 1.3 times height. In their adapical third there is a spiral groove. They are otherwise smooth except for growth lines; these latter are prosocline below the furrow and bent somewhat abaperturally in their top parts. The lower portion of the inner lip exhibits a single columellar fold.

Dimensions. Height ~44 mm; diameter: 8 mm.

Stands closest to the form group of Miocene *T. acuminata* Borson, 1830, of which it might be a subspecies. The difference is that *T. acuminata* bears two columellar folds rather than the single one of the Eger species.

The Terebra are stenohaline littoral and shallow-sea carnivorous gastropods that live buried in the sand, most typical of the littoral sands of the tropics.

T. simplex occurs in the *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution: besides the above locality, it has been signalled from Kováčov by Seneš (1958)

Terebra ex aff. fuscata (Brocchi, 1814)

A single fragment from the locality Budafok-1/4 may belong to this species. *T. fuscata* is widespread all over Europe, particularly in the Miocene, but it had according to all inferences arisen already by the Upper Oligocene in the Boreal province and the Central Paratethys.

A third *Terebra* species, unidentifiable so far, has been found at Dömös-2.

Opisthobranchia
Pyramidellacea
Melanellidae
Genus: NISO RISSO, 1826
Niso minor (PHILIPPI, 1843)
Pl. XLIX, fig. 10

1870 *Niso minor* PHIL. — SPEYER, p. 72, Pl. 12, figs 9—10
1952 *Niso minor* PHIL. — GÖRGES, p. 75

A small, very elongate conical shell. In our ten-whorl specimen, the spire is of straight outline; the whorls are hardly convex, almost flat and entirely smooth, shiny. The last whorl, whose height is insignificant as compared with that of the spire, exhibits a rather sharp shoulder delimiting the base; this latter is separated by another sharp edge from the deep round umbilicus.

Dimensions. Height: 6.5 mm; diameter: 3 mm.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution: This is a Boreal Oligocene species.

Genus: MELANELLA BOWDICH, 1822 (= *Eulima* RISSO, 1826)

Subgenus: POLYGYREULIMA SACCO, 1892 (= *Acicularia* MONTEROSATO, 1884)

Melanella (Polygyreulima) spina (GRATELOUP, 1838)
Pl. XLIX, fig. 8

1917—18 *Eulima spina* GRAT. — COSSMANN et PEYROT, p. 70, Pl. 8, figs 51—52
1961 *Melanella spina* GRAT. — BÁLDI (in BÁLDI et al.), p. 99, Pl. 4, fig. 4

The six whorls of this fragmentary specimen are slightly convex, especially in their abapical portions. Sutures very little marked, although clearly discernible. Shell smooth, shiny. Height of whorl equal to two-thirds of width.

Dimension. Diameter: 1.6 mm.

Closely related to *M. eichwaldi* (HÖRNES, 1856), to which SACCO (1892) has indeed relegated it as a subspecies. According to COSSMANN and PEYROT (1917—18), *M. spina* has taller and more convex whorls, more marked sutures, a taller aperture and a more callous columella. Moreover, it is significantly smaller.

The *Melanella* are parasites attached to echinoderms.

M. spina has been found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Novaj-1.

Distribution. This is the oldest known occurrence of this species otherwise known from the Atlantic and Paratethyan Miocene.

Melanella naumanni (KOENEN, 1867)

Pl. XLIX, fig. 11

1867 *Eulima Naumanni* KOEN. — KOENEN, p. 104, Pl. 2, fig. 19
1870 *Eulima Naumanni* KOEN. — SPEYER, p. 68, Pl. 11, figs 12—13
1891 *Eulima Naumanni* KOEN. — KOENEN, p. 635, Pl. 42, fig. 16
1943 *Melanella naumanni* KOEN. — ALBRECHT et VALK, p. 40, Pl. 3, figs 40—43
1952 *Melanella naumanni* KOEN. — GÖRGES, p. 73

A very small slender turriculate shell, smooth and shiny on the outside. Sutures marked, well visible; whorls entirely flat.

Dimensions. Height: 4.5 mm; diameter: 1.2 mm.

Stands close to *M. eichwaldi* (HÖRNES, 1856) from which it differs in its smaller and slenderer build, and in its flat whorls. Also, its last whorl is lower as related to spire height. Can be readily distinguished from *M. spina* by its stronger sutures and entirely flat whorls.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. This is a Boreal Oligocene species.

Melanella naumanni depressosuturata BÁLDI, 1966

Pl. XLIX, fig. 5

1966 *Melanella naumanni depressosuturata* n. subsp. — BÁLDI, p. 94, Pl. 4, fig. 9

Differs from *M. naumanni* s. s. in that there is along the sutures a very weak constriction, a depression, not by far so strong, however, as on *M. spina*.

Dimensions. Height: 5 mm; diameter: 1.5 mm.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. The subspecies is known from this one locality only.

Pyramidellidae

Genus: SYRNOLA ADAMS, 1860

Syrnola laterariae BÁLDI, 1966

Pl. XLIX, fig. 7

1966 *Syrnola laterariae* n. sp. — BÁLDI, p. 94, Pl. 4, fig. 10

A small turriculate shell. The squat protoconch of one whorl and a half is followed by nine teleoconch whorls. Of these, the later ones are hardly convex, the earlier ones not at all. Whorl width 1.75 times whorl height. Sutures impressed. Whorl surfaces entirely smooth except for slightly leaning growth lines.

Dimensions. Height: 4.1 mm; diameter: 1.1 mm.

Of the many close relatives, it differs from *S. subulata* (Merian, 1851) in its much squatter protoconch, from *S. colpodes* (Cossmann et Peyrot, 1917—18) in its smaller and slenderer build, from *S. innexa* (Koenen, 1891) in its somewhat more convex whorls and more impressed sutures.

The *Syrnola* just as the *Odostomia* are parasites attached to bivalves. *S. laterariae* has been found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. Known only from this one locality so far.

Syrnola ex aff. subulata (Merian, 1851)

The whorls of our four-whorl fragment are hardly convex, smooth, with sharply defined sutures. The penultimate whorl is somewhat higher than one-half of its width. The inner lip exhibits a single strong columellar fold.

Dimension. Diameter: 1.3 mm.

Stands closest to *S. subulata* s. s. The only difference is that the whorls of our specimen are slightly convex in outline.

Found in a *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrence: Eger-1/6.

Distribution. *S: subulata* s. s. is known from the Boreal Oligocene.

Actaeonacea

Actaeonidae

Genus: ACTAEON Montfort, 1810 (= *Tornatella* Lamarck, 1812)

Actaeon punctatosulcatus (Philippi, 1843)

Pl. L, fig. 5

1863 *Tornatella limneiformis* Sandb. — Sandberger, p. 265, Pl. 14, fig. 9

1870 *Actaeon punctato-sulcatus* Phil. — Speyer, p. 186, Pl. 20, figs 7—16

1892 *Tornatella punctatosulcata* Phil. — Koenen, p. 925, Pl. 60, figs 18—19

1936 *Actaeon punctato-sulcatus* Phil. — Noszky, p. 81

1943 *Actaeon punctatosulcatus* Phil. — Albrecht et Valk, p. 96, Pl. 9, figs 284—287

1952 *Actaeon punctatosulcatus* Phil. — Görges, p. 112

A small ovate shell with a very low spire, a pointed apex and convex whorls. The surface bears flat spiral ribs separated by narrow grooves. These latter are dissected into small pits by growth lines. The lower portions of the whorls are almost smooth, with the spiral ornament very weak, and so is the last whorl in a narrow band somewhat above its median line.

Dimension. Diameter: 3.5 mm.

Stands closest to Boreal Miocene *A. sorgenfreii* GLIBERT, 1962, but the strong columellar fold, well visible even on our fragmentary specimen, permits ready distinction at a glance. Separation from Mediterranean-Atlantic Miocene *A. semistriatus* (FÉRUSSAC, 1822) is uncertain, however.

Found in a *Pitar polytropa* community.

Hungarian Upper Oligocene occurrence: Eger-1/k.

Distribution. This is a Boreal Oligocene species, although the distinction of the Hungarian form from Mediterranean-Atlantic Miocene *A. semistriatus* is uncertain.

Ringiculidae

Genus: RINGICULA DESHAYES, 1838

Ringicula auriculata paulucciae MORLET, 1878

Pl. L, fig. 3

1856 *Ringicula buccinea* BROCC. — HÖRNES, p. 86 (partim), Pl. 9, tantum fig. 4
1862 ? *Ringicula auriculata* MÉN. — SPEYER, p. 110, Pl. 18, fig. 18
1914 *Ringicula striata* PHIL. — TELEGDI-ROTH, p. 34 (non PHILIPPI)
1932 *Ringicula Tournoueri* MORL. — COSSMANN et PEYROT, p. 143, Pl. 11, figs 7, 11—13, 18—25, 37, 54, 61
1952 *Ringicula ventricosa* SOW. — GLIBERT, p. 142, Pl. 10, fig. 14
1952 *Ringicula striata* PHIL. — GÖRGES, p. 114 (partim non PHILIPPI)
1954 *Ringicula auriculata paulucciae* MORL. — BERGER, p. 115, Pl. 7, figs 3—18
1958 *Ringicula auriculata paulucciae* MORL. — HÖLZL, p. 281, Pl. 22, fig. 10
1963 *Ringicula auriculata paulucciae* MORL. — STEININGER, p. 56, Pl. 12, fig. 15

A small five-whorl shell. Height of spire and of last whorl about equal. Whorls convex, last whorl markedly so, more or less inflated. There is an ornament of spiral grooves numbering about 15 on the last whorl. The base of the last whorl and its portion about the inner lip are covered by a thick callous inductura exhibiting three very strong columellar folds. The adapical fold begins somewhat farther back, in the apertural plane. The outer lip is thickened varix-fashion, callous, swollen in its median portion.

Dimensions. Height: 5.0 mm; diameter: 3.0 mm.

The Hungarian Upper Oligocene specimens belong doubtless to the species *R. auriculata* MENARD, 1811 s. l.. SPEYER (1862) had also described this species from Kassel, but GÖRGES (1952) later on contracted the Kassel specimens with *R. striata*. He kept an open mind, however, about certain Kassel specimens close to *R. auriculata*. Within *R. auriculata*, the Hungarian specimens approximate the subspecies [in BERGER's (1954) interpretation] *R. auriculata paulucciae* and *R. auriculata elongata* MORLET, 1878. *R. auriculata elongata* differs only in size from *paulucciae*, and has but conditionally been separated by BERGER himself. We have therefore identified our specimens with the subspecies *R. a. paulucciae* (= *R. tournoueri* MORLET 1878).

This subspecies is readily distinguished from Boreal Oligocene *R. striata* PHILIPPI, 1843 by the different modelling of its inner lip, and by the greater extent of its inductura. From another close relative, *R. sandbergeri* MORLET, 1878 (= *R. acuta* SANDBERGER, 1863) it differs in its larger size and wider-spaced spiral ornament. From *R. auriculata buccinea* BROCCHI, 1814, represented also in the Hungarian Miocene, it differs besides its smaller and slenderer build also in that its spire is taller in relation to its last whorl. Distinction from *R. ventricosa* SOWERBY, 1824 is less easy. The only difference is that the last whorl of the Hungarian form is somewhat less inflate, slenderer.

Typical of deep-sublittoral — shallow bathyal facies; abundant in the *Hinia-Cadulus* community.

Hungarian Upper Oligocene occurrences: Eger-1/6, Mucsony 136.

Distribution. *R. auriculata* s. l. is widespread all over the European Neogene. The first, sporadic occurrences are in the Boreal Chattian and at the above-named Paratethyan Upper Oligocene localities. The subspecies *paulucciae* has so far been known mainly from the deeper Paratethyan Miocene (outside the Atlantic province), but according to the above-said it had made its first appearance in the Upper Oligocene.

Scaphandridae

Genus: CYLICHNA LOVEN, 1846 (= *Bullina* RISSO, 1826 = *Bullinella* NEWTON, 1891)

Cylichna cylindracea raulini (COSSMANN et PEYROT, 1932)

Pl. L, figs 1—2

1932 *Bullinella pseudoconvoluta* ORB. var. *raulini* an sp. distingu. — COSSMANN et PEYROT, p. 185, Pl. 13, figs 43, 45

1936 *Bulla* cfr. *convoluta* BROCC. — NOSZKY, p. 82

A small, tall cylindrical slim involute shell. The last whorl is hardly convex, indeed flat on most specimens outside the apical and basal regions. The diameter does not increase abapically. The surface is covered with very fine and dense spiral grooves visible only under a magnifying glass. These are somewhat stronger in the basal and apical regions. The aperture is narrow at the top, voluminous at the bottom. The very narrow inductura partly or entirely hides an insignificant umbilicus.

Dimensions. Height: 9.2 mm; diameter: 3.3 mm.

The subspecies differs from *C. cylindracea* (PENNANT, 1777) [= *C. convoluta* (BROCCHI, 1814) = *C. pseudoconvoluta* (D'ORBIGNY, 1852)] in that its surface exhibits that fine spiral grooving. It further differs from Boreal Oligocene *C. minima* (SANDBERGER, 1863) in its larger and somewhat slenderer build and its spiral grooving.

A frequent, typical species of the deep sublittoral *Hinia-Cadulus* community, it is rare in shallower facies.

Hungarian Upper Oligocene occurrences: ? Leányfalu-2, Eger-1/6, -1/k, Mucsony 136.

Distribution. The subspecies is known outside the above localities also from the Atlantic Oligocene (Peyrère beds). *C. cylindracea* is widespread all over the European Neogene.

Cylichna lineata (PHILIPPI, 1843)

1870 *Bulla lineata* PHIL. — SPEYER, p. 173, Pl. 18, figs 13—14
1952 *Cylichna lineata* PHIL. — GÖRGES, p. 116
1962 *Cylichna lineata* PHIL. — HÖLZL, p. 203, Pl. 10, fig. 18
1964 *Cylichna lineata* PHIL. — BÁLDI, p. 148, Pl. 1, fig. 11

A cylindrical, involute shell, with a slightly convex last whorl that results in a slightly swollen outline in the median region. The adapical and basal regions exhibit strong spiral grooves, whereas the median region is smooth, in contrast to the type.

Dimensions. Height: 13 mm; diameter: 6 mm.

Found in a *Glycymeris latiradiata* community.

Hungarian Upper Oligocene occurrence: Budafok-1/4.

Distribution: A Boreal Oligocene species, it occurs also in the Oligocene of the Western Paratethys.

Genus: ROXANIA LEACH, 1847

Roxania burdigalensis D'ORBIGNY, 1852

Pl. L, fig. 4

1932 *Roxania burdigalensis* ORB. — COSSMANN et PEYROT, p. 194, Pl. 13, figs 10, 12—14, 27
1936 *Bulla adjecta* KOEN. — NOSZKY, p. 82

A relatively small, cylindrical, involute shell with an immersed apex. The last whorl is slightly convex, somewhat broadening downward, somewhat swollen in the middle, where shell diameter is greatest. The aperture is as tall as the shell; it is narrow at the top and voluminous at the bottom. There is a weak narrow inductura low on the base. The outer surface of the shell bears spiral grooves that are weakest in the middle region, growing stronger more rapidly upward than downward. Groove spacing is a feature of rather considerable variability.

Dimensions. Height: 11.5 mm; diameter: 5.5 mm.

COSSMANN and PEYROT (1932) describe in some detail the differences between *R. burdigalensis* and *R. semistriata* DESHAYES, 1864. Since the Hungarian form exhibits spiral grooves on its entire surface, it should be placed into *R. burdigalensis*. It differs significantly also from more inflated, squatter *R. utriculus* BROCCHI, 1814 (= *R. striata* BROCCHI, 1814) which latter is, moreover, grooved on half of its surface only. Differences from "*Bulla*" *adjecta* KOENEN, 1892 are slight, however.

Found in *Pitar polytropa* and *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Leányfalu-4, Eger-1/6, Eger-1/k, Mucsony 136.

Distribution. Represented in the Atlantic province from the Upper Oligocene (Peyrère) to the Helvetian, it is not known from Paratethyan occurrences other than the above-named.

Scaphopoda

Dentaliidae

Genus: DENTALIUM LINNÉ, 1758

Dentalium kickxi NYST, 1843

Pl. L, figs 6—7.

1860 *Dentalium Kickxi* NYST — DESHAYES, p. 207, Pl. 3, figs 1—4
1863 *Dentalium Kickxi* NYST — SANDBERGER, p. 182, Pl. 14, figs 1—6
1870 *Dentalium Kickxi* NYST — SPEYER, p. 199, Pl. 21, figs 8—11
1897 *Dentalium Kickxi* NYST — WOLFF, p. 262, Pl. 25, figs 1—2
1900 *Dentalium Kickxi* NYST — ROVERETO, p. 129
1952 *Dentalium kickxi* NYST — GÖRGES, p. 117, Pl. 3, figs 104—107
1962 *Dentalium kickxi* NYST — HÖLZL, p. 132, Pl. 8, fig. 6
1963 *Dentalium kickxi* NYST — BÁLDI, p. 83, Pl. 7, fig. 13

A relatively large, slightly curved tubular shell, with flat-backed longitudinal ribs fading in the anterior direction. Ribbing rather dense, with stronger and narrower, weaker ribs alternating. This phenomenon is not persistent, however, nor is the number and strength of the ribs the same on all specimens.

Closely related Miocene *D. badense* PARTSCH in HÖRNES, 1856 is considered a descendant of *D. kickxi*. The differences between the two species are as follows. *D. kickxi* is somewhat smaller, less curved. The growth lines of *D. badense* are much stronger, which lends its longitudinal ribbing a granulate appearance. This permits the distinction even of fragments. It is worth mentioning that the subspecies *D. kickxi transiens* STEININGER, 1963 is considered a transition between *D. kickxi* and *D. badense*.

Dimension. Maximum diameter: 5 mm.

Dentalia are burrowing organisms preferring loose sediment, feeding largely on foraminifers. They are stenohaline-marine without exception.

D. kickxi is frequent in the *Pitar beyrichi* community, rare in the shallow sublittoral facies, and missing from littoral and deep sublittoral communities.

Hungarian Upper Oligocene occurrences: Szomor 31, Törökbálint-2, Pomáz-1, Diósjenő-4, -7, Rétság-2.

Distribution. A Boreal Oligocene species, known sporadically to occur also in the Mediterranean province, it has turned up in the Paratethyan Oligocene and, with a subspecific modification, also in the oldest Miocene.

Dentalium apenninicum (Sacco, 1897)

Pl. L, fig. 8

1897 *Entalis* cf. *acuta* ? var. *apenninica* Sacc. — Sacco, p. 106, Pl. 9, figs 14—16

1900 *Dentalium appenninicum* (Sacco) Rov. — Rovereto, p. 128, Pl. 9 fig. 15

1936 *Dentalium acuta* Hab. var. *appenninica* Sacco — Noszky, p. 83

A slightly curved, relatively large, thick-walled tubular shell of rapidly increasing diameter. The ornament consists of strong convex round-backed longitudinal ribs, close-spaced, with very narrow grooves between them. Some ribs exhibit very weak furrows in their median lines. Growth lines readily discernible although they do not divide up the ribs into granules to the same degree as in *D. badense*.

Dimension. Maximum diameter: 9 mm.

Stands closer in size and shell thickness to *D. badense* Partsch in Hörnes, 1856 than to *D. kickxi*. It differs from this latter also in that its growth lines are stronger. The difference from *D. badense* includes weaker growth lines not subdividing the longitudinal ribs, denser ribbing, flatter ribs, pronounced taper.

A typical medium-depth sublittoral species represented in the *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrences: Eger-1/5, Dejtár.

Dentalium densitextum dejtarense n. subsp.

Pl. L, fig. 9

Locus typicus: Dejtár

Stratum typicum: Upper Oligocene

Derivatio nominis: after the type locality

The slightly curved shell bears an ornament of very fine and dense longitudinal ribs. A magnifying glass will reveal the ribs to be subdivided into minute granules.

Dimension. Maximum diameter: 5.6 mm (holotype).

The new subspecies stands between the deeper Oligocene species *D. densitextum* Noszky, 1940 and *D. haeringense* Dreger, 1892. From the form described by Noszky (1940) by the name "*D. haeringense* Dreger n. var. *densitexta*", which I consider to be a separate species, the Upper Oligocene type from Dejtár differs in the following: its longitudinal ribbing is closer-spaced, the granulation is more marked, the granules on the ribs are stronger, better-developed.

Found in a medium-depth sublittoral *Flabellipecten-Odontocyathus* community.

Hungarian Upper Oligocene occurrence: Dejtár.

Distribution. The subspecies is known from the type locality only. *D. densitextum* s. s. occurs in the deeper Paratethyan Oligocene (Kiscell Clay).

Dentalium fissura Lamarck, 1818
Pl. LI, figs 1—2

1860 *Dentalium fissura* Lam. — Deshayes, p. 213, Pl. 1, figs 24—25, 28
1860 *Dentalium Sandbergeri* Bosq. — Deshayes, p. 215, Pl. 3, figs 8—10
1863 *Dentalium Sandbergeri* Bosq. — Sandberger, p. 183, Pl. 14, fig. 5
1870 *Dentalium fissura* Lam. — Speyer, p. 201, Pl. 21, figs 12—13
1936 *Dentalium* cfr. *rubescens* Desh. — Noszky, p. 83 (non Desh.)
1952 *Dentalium fissura* Lam. — Görges, p. 118
1962 *Dentalium fissura* Lam. — Hölzl, p. 132
1963 *Dentalium fissura* Lam. — Báldi, p. 84, Pl. 7, fig. 12

A rather strongly curved shell of uniform taper. But for very fine growth lines, the shell is entirely smooth.

Dimensions. Length: 8.3 mm; maximum diameter: 1.8 mm.

The difference between *D. fissura* and its Miocene successor, *D. rubescens* Deshayes, 1825, is largely one of size. The smaller size of the Hungarian Upper Oligocene form places it into the species *D. fissura*.

Widespread from the shallow sublittoral to the bathyal facies, it is most abundant in the *Nucula-Angulus* and *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Csordakút 5, Zsámbék 43, 42, Csolnok 695, Törökbálint-2, Dejtár, Eger-1/6. It is probably much more widespread than that, since fragments of smooth-shelled small dentalia are fairly ubiquitous in the Hungarian Upper Oligocene, but the specific identification of these fragments is most often uncertain.

Distribution. Widespread in the Boreal province from the Eocene to the end of the Oligocene. In the Paratethys, it has also been encountered from the Southern Soviet Union to Bavaria. It nowhere passes the Oligocene-Miocene boundary.

Dentalium simplex Michelotti, 1861
Pl. LI, fig. 3

1897 *Entalis simplex* Micht. — Sacco, p. 106, Pl. 9, figs 1—6
1900 *Dentalium simplex* Micht. — Rovereto, p. 128
1936 *Dentalium simplex* Micht. — Noszky, p. 83
1940 *Entalis simplex* Micht. — Noszky, p. 51

An almost untapering, smooth-surfaced shell, very gently curved if at all. The only difference from the type is the smaller size.

Dimension. Maximum diameter: 2.3 mm.

Found in *Pitar polytropa* and *Hinia-Cadulus* communities.

Hungarian Upper Oligocene occurrences: Eger-1/6, -1/k.

Distribution. It occurs besides the above-named Paratethyan occurrence also in the Mediterranean Oligocene.

Genus: FUSTIARIA Stoliczka, 1868

Fustiaria taurogracilis (Sacco, 1897)

Pl. LI, fig. 4

1897 *Gadilina triquetra* var. *taurogracilis* — Sacco, p. 114, Pl. 10, figs 44—46

1915 *Fustiaria taurogracilis* Sacco — Cossmann et Peyrot, p. 174, Pl. 1, figs 50—52

1936 *Dentalium Jani* Hörn. — Noszky, p. 83 (non Hörnes)

A gently curved, medium- to small-sized, slender shell. Taper considerable. Cross section somewhat oval, but not trigonal as in *F. triquetra* (Brocchi, 1814). Surface smooth, glittering, shiny; a magnifying glass will reveal the concentric transverse rings typical of the genus, which grow weaker towards the anterior end of the shell, and then fade out entirely. This is another difference, in addition to those in size and shape, from Miocene *F. jani* (Hörnes, 1856).

Dimensions. Diameter: 1.5 mm; length: 12.4 mm.

Restricted to the *Hinia-Cadulus* community, it invariably indicates a considerable depth of sea.

Hungarian Upper Oligocene localities: Eger-1/6, Mucsony 136.

Distribution. Known besides the above places from the Atlantic Upper Oligocene (Peyrère beds) and from the Mediterranean Miocene.

Genus: CADULUS Philippi, 1843

Cadulus gracilina (Sacco, 1897)

Pl. LI, fig. 5

1897 *Gadila gadus* var. *gracilina* — Sacco, p. 117, Pl. 10, figs 86—87

1915 *Gadila gracillina* Sacco — Cossmann et Peyrot, p. 183, Pl. 2, figs 4—7

A medium- to small-sized, rather strongly curved, shiny shell, with its greatest diameter slightly behind the aperture.

Dimensions. Length: 15.4 mm, diameter: 2.6 mm.

One of the most frequent fossils of the *Hinia-Cadulus* community, it invariably indicates, like its living relatives, a rather considerable depth of sea.

Hungarian Upper Oligocene occurrences: Leányfalu-2, Eger-1/6, Ostoros-1, Mucsony 136.

Distribution. It occurs in addition to the above localities also in the Atlantic Oligocene (Peyrère) and in the Atlantic and Mediterranean Miocene.

TABLES

TABLE I

The Hungarian Upper Oligocene mollusc fauna. Distribution of species over the Hun-

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Nucula schmidti Glibert	—	—	—	+	—	+	+	—	—	—	—	—	—	—	—
N. mayeri Hörnes	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—
N. comta Goldfuss	—	—	—	+	+	+	+	+	—	—	—	—	—	—	—
Nuculoma laevigata Sowerby	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nuculana anticeplicata T.-Roth	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Nuculana solymarensis n. sp.	—	+	+	—	—	+	—	—	—	—	—	—	—	—	—
N. psammobiaeformis T.-Roth	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Yoldia raulini Cossmann et Peyrot	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—
Y. glaberrima varians Wolff	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
Arca biangula Lamarck	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—
Anadara diluvii Lamarck	—	—	—	—	—	—	+	—	—	—	+	—	—	—	—
A. guembeli Mayer	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—
Trisidos schafarziki Horusitzky	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—
Glycymeris pilosa lunulata Nyst	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
G. latiradiata Sandberger in Gümbel s. l.	—	—	+	+	+	—	+	—	+	+	—	—	—	+	+
G. latiradiata subfichteli Báldi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
G. latiradiata obovatoides Báldi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Limopsis anomala Eichwald	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mytilus aquitanicus Mayer	—	—	+	+	—	—	—	—	—	—	—	+	—	—	—
Arcoperna micans Braun	—	—	—	—	—	—	+	—	—	—	—	—	—	—	+
Musculus philippii Mayer in Wolff	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—
Modiolus dunkeri Koenen	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pteria phalaenacea Lamarck	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pecten arcuatus Brocchi	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Flabellipecten burdigalensis Lamarck	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
F. angustiformis Báldi	—	—	—	—	+	+	—	—	—	—	—	—	—	—	—
F. telegdirothi Csepreghy-Meznerics	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chlamys northamptoni Michelotti	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ch. csepreghymeznericsae Báldi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ch. schreteri Noszky	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ch. agriensis Csepreghy-Meznerics	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ch. incomparabilis Risso	—	—	—	+	+	+	+	+	—	—	—	—	—	+	—
Ch. ex aff. *decussata* Münster in Goldfuss	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ch. hertlei Bittner	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Anomia ephippium Linné	—	—	+	—	+	+	+	—	—	—	—	—	—	+	—
Ostrea cyathula Lamarck	—	+	+	+	+	+	+	+	+	—	+	+	—	—	+
O. gigantea callifera Lamarck	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Unio inaequiradiatus Gümbel	+	—	—	+	+	—	—	—	—	—	—	—	—	—	—
Astarte gracilis degrangei Cossmann et Peyrot	—	—	—	+	—	—	+	+	—	—	—	—	—	+	—
Crassatella carcarensis Michelotti	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
C. bosqueti Koenen	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cardita orbicularis subparvocostata Báldi	—	—	—	+	—	+	+	+	—	—	—	—	—	+	—
C. monilifera Dujardin	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—

Legend: **1:** Bakony Mts. – Vértes—Gerecse region: **2:** Nagyegyháza 2, 3, 4; **3:** Csor-
24, 51, 52; **8:** Felsőőrspuszta 22, 44. Pilis—Western-Cserhát region: **9:** Csolnok,
14: Leányfalu-3; **15:** Leányfalu-4; **16:** Szentendre 2; **17:** Szentendre-2; **18:** Pomáz-1; **19:**
jenő-4; **26:** Diósjenő-7; **27:** Diósjenő-8; **28:** Diósjenő-24; **29:** Rétság-2; **30:** Patak, Tol-
lom 36, 41; **35:** Solymár 72; **36:** Törökbálint-1, -2, -3. Eger—Sajó Valley region:
(zone 4); **41:** Novaj-1, -2 **42:** Mucsony 136

garian localities of some importance

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
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dakút 5; **4:** Mány 6, 8, 9; **5:** Gyermely 12, 25, 35, 39, 50; **6:** Zsámbék 23, 42, 43, 48; **7:** Tök
Esztergom, Dorog; **10:** Kesztölc-1; **11:** Dömös-1, -2, -3; **12:** Leányfalu-1; **13:** Leányfalu-2;
Pomáz 6; **20:** Pomáz-21; **21:** Pomáz-22; **22:** Göd; **23:** Diósjenő-1; **24:** Diósjenő-3; **25:** Diós-
mács; **31:** Dejtár; **32:** Becske-1, -2. ENVIRONS OF BUDAPEST: **33:** Budafok-1/4; **34:** Máriaha-
37: Eger-1/5, -2, -3 (zone 1); **38:** Eger-1/6 (zone 2); **39:** Eger-1/k (zone 3); **40:** Eger-1/17, -1/18

TABLE I *(continued)*

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C. arduini BRONGNIART	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C. ruginosa COSSMANN et PEYROT	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polymesoda convexa BRONGNIART	—	+	+	+	+	+	+	+	+	+	+	—	—	—	—
P. convexa brongniarti BASTEROT	—	+	+	+	—	—	—	—	—	—	—	—	—	+	—
Isocardia subtransversa ORBIGNY	—	—	—	—	—	—	+	—	—	—	—	—	—	+	+
I. subtransversa abbreviata SACCO	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—
Cyprina islandica rotundata BRAUN in AGASSIZ	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Congeria basteroti DESHAYES	—	+	+	—	+	+	—	—	—	—	—	+	—	—	—
Taras rotundatus MONTAGU	—	—	+	+	+	+	+	+	—	+	+	—	—	+	+
T. fragilis BRAUN in WALCHNER	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—
Linga columbella LAMARCK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Lucinoma borealis LINNÉ	—	—	—	—	+	—	—	—	—	—	—	—	—	—	—
Cavilucina droueti schloenbachi KOENEN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Thyasira vara angusta BÁLDI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Laevicardium cyprium BROCCHI	—	—	+	+	+	+	+	+	—	—	—	—	—	+	+
L. tenuisulcatum NYST	—	+	+	+	+	+	+	—	—	—	—	—	—	+	—
L. kovacovense SENEŠ	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cardium thunense MAYER	—	—	—	—	—	—	+	—	—	—	—	—	—	+	—
C. egerense T.-ROTH	—	—	—	—	—	—	+	+	—	—	—	—	—	+	—
C. heeri MAYER	—	—	—	—	—	+	—	—	—	—	—	—	—	+	—
C. neglectum HÖLZL	—	—	—	+	+	+	+	+	—	—	—	—	—	+	—
C. neglectum intersulcatum n. subsp.	—	—	—	—	—	+	+	—	—	—	—	—	—	—	—
C. bojorum MAYER	—	+	—	+	+	+	+	+	—	—	—	+	—	—	—
C. praepapillosum BÁLDI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ringicardium buekkianum T.-ROTH	—	—	—	—	—	—	—	—	—	—	+	—	—	—	+
Venus multilamella LAMARCK	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—
V. multilamella interstriata T.-ROTH	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Pitar gigas schafferi KAUTSKY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
P. polytropa ANDERSON	—	—	+	+	+	+	+	+	+	+	+	—	—	+	+
P. beyrichi SEMPER	—	—	+	+	+	+	+	—	+	+	+	+	—	+	—
P. splendida MERIAN	—	—	—	+	—	—	—	—	—	—	—	—	—	+	—
P. undata BASTEROT	—	+	+	+	+	+	+	—	—	—	+	—	—	—	+
Venerupis ex aff. *basteroti* MAYER in HÖRNES	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—
Dosiniopsis sublaevigata NYST	—	—	—	—	—	?	—	—	—	—	—	—	—	—	—
Lutraria oblonga soror MAYER	—	—	—	—	+	+	+	—	—	—	—	—	—	+	—
Zozia antiquata PULTNEY	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Solecurtus basteroti DES MOULINS	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Gari protracta MAYER	—	+	+	+	+	+	+	+	—	—	—	+	—	—	—
G. angusta PHILIPPI	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Arcopagia subelegans ORBIGNY	—	—	+	+	+	—	+	—	—	—	—	—	—	—	—
Macoma elliptica BROCCHI	—	—	—	—	—	—	+	+	—	—	—	—	+	—	—
Apolymetis lacunosa CHEMNITZ	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—
Angulus nysti DESHAYES	—	+	—	+	+	+	+	+	—	—	+	—	—	+	—
A. posterus BEYRICH	—	—	—	+	—	+	+	—	—	—	—	—	—	—	+
A. planatus ancestralis n. subsp.	—	—	+	+	—	—	+	+	—	—	—	—	—	—	—
Siliqua nysti DESHAYES	—	+	—	—	—	+	+	—	—	—	—	—	—	—	—
Ensis hausmanni SCHLOTHEIM	—	—	—	—	+	+	+	+	—	—	—	—	—	—	—
Cultellus budensis n. sp.	—	+	—	+	—	+	—	—	—	—	—	—	—	—	—
Hiatella arctica LINNÉ	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Panopea meynardi DESHAYES	—	—	—	—	+	—	—	—	—	+	—	—	—	—	+
Corbula basteroti HÖRNES	—	—	+	+	+	—	+	—	—	—	—	+	—	—	—

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
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Pholadomya puschi GOLDFUSS	—	—	—	+	+	+	—	+	—	—	—	—	—	+	+
Thracia pubescens PULTNEY	—	—	—	—	+	+	—	—	—	—	—	—	—	—	—
Th. pubescens bellardii PICTET	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Th. ventricosa PHILIPPI	—	—	?	—	+	+	+	+	—	+	—	—	—	+	—
Clavagella oblita MICHELOTTI	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Cuspidaria clava BEYRICH	—	—	—	—	—	+	—	—	—	—	—	—	+	—	—
C. neoscalarina BÁLDI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Calliostoma elegantulum hegeduesi n. subsp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Jujubinus multicingulatus praestrigosus BÁLDI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Gibbula affinis protumida SACCO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
G. proxima HÖLZL	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
G. dubia n. sp.	—	+	+	—	+	—	—	—	—	—	—	—	—	—	—
Teinostoma egerensis BÁLDI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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Pomatias antiquum BRONGNIART	+	—	—	+	+	—	—	—	—	—	—	—	—	—	—
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Hydrobia ventrosa MONTAGU	—	—	—	+	—	+	—	—	—	—	—	—	—	—	—
Turritella venus ORBIGNY	—	—	+	+	+	+	+	+	—	+	—	—	—	+	+
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P. quadricanaliculata SANDBERGER in GÜMBEL	—	+	—	—	+	—	—	—	—	—	—	—	—	—	—
P. diversicostata SANDBERGER in GÜMBEL	—	—	—	—	+	—	—	—	—	—	—	—	—	—	—
Mathilda schreiberi KOENEN	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Architectonica carocollata LAMARCK	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
A. mariae BÁLDI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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Xenophora deshayesi MICHELOTTI	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Aporrhais callosa T.-ROTH	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
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TABLE I *(continued)*

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
D. speciosus digitatus T.-Roth	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D. speciosus margerini Koninck	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Strombopugnellus digitolabrum Koch	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Strombus coronatus Defrance	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Rostellaria dentata Grateloup	—	—	—	—	—	—	—	—	—	—	—	—	—	+	+
R. bicarinata Báldi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Polinices catena Da Costa s. l.	—	+	—	—	+	+	+	+	—	+	+	—	—	—	+
P. catena achatensis Récluz in Koninck	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—
P. catena helicina Brocchi	—	—	—	—	—	—	—	—	—	—	+	—	—	—	+
P. josephinia olla De Serres	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+
Natica millepunctata tigrina Defrance	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Globularia gibberosa Grateloup s. l.	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—
Globularia gibberosa sanctistephani Cossmann et Peyrot	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—
G. gibberosa callosa Noszky	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
G. rothi Cossmann	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ampullina crassatina Lamarck	—	+	—	—	—	+	—	—	—	—	+	—	—	—	+
Erato prolaevis Sacco	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Zonaria globosa Dujardin	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—
Z. subexcisa Braun	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cassidaria nodosa Solander in Brander	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
C. depressa Buch	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Charonia tarbelliana transiens n. subsp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ficus concinna Beyrich	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—
F. condita Brongniart	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—
Murex paucispinatus T.-Roth	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chicoreus trigonalis Gábor	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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Hadriana egerensis Gábor	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ocinebrina crassilabiata trivaricosa Báldi	—	—	—	—	—	—	+	—	+	—	+	—	—	—	—
O. schönni Hörnes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Typhis pungens Solander in Brander	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
T. cuniculosus Nyst	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Mitrella solitaria Báldi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pisanella doboi Noszky	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Babylonia eburnoides umbilicosiformis T.-Roth	—	—	—	—	—	—	—	—	+	+	+	—	—	+	+
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Acamptochetus clatratus Báldi	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Galeodes semseyiana Erdős	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—
G. basilica Bellardi	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—
Hinia schlotheimi Beyrich	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—
H. fortecostata edentata Báldi	—	—	—	+	+	+	—	+	—	—	—	—	—	—	—
Bullia hungarica Gábor	—	—	—	—	—	+	+	—	—	—	+	—	—	?	—
Euthriofusus burdigalensis Defrance	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
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Olivella clavula vindobonensis Cs.-Meznerics	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—
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—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	+
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	+	—	—	+
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	+	—	—	+

TABLE I *(continued)*

List of species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Dentalium kickxi NYST	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D. apenninicum SACCO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D. densitextum dejtarense n. subsp.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D. fissura LAMARCK	—	—	+	—	—	+	—	—	+	—	—	—	—	—	—
D. simplex MICHELOTTI	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Fustiaria taurogracilis SACCO	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cadulus gracilina SACCO	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—

TABLE II

Lower Miocene (Eggenburgian) mollusc fauna of the 8th layer of Pacsirta Hill (Bu-

List of species	E	1	2	3	4	5	6	7	8
1. *Arca fichteli* DESHAYES	7	—	—	+	+	—	+	×	—
2. *A. moltensis* MAYER	1	—	—	—	—	—	—	—	+
3. *Glycymeris fichteli* (DESHAYES)	6	—	—	—	—	—	—	—	+
4. *G. pilosa deshayesi* (MAYER)	2	×	×	+	+	+	+	+	—
5. *Crassostrea gryphoides* (SCHLOTHEIM) ex aff. *C. aginensis* (TOURNOUER)	3	—	—	+	+	—	+	+	—
6. *Polymesoda brongniarti* (BASTEROT)	2	×	+	+	—	×	+	—	—
7. *Diplodonta rotundata* (MONTAGU)	2	—	+	+	+	+	+	+	—
8. *Cardium moeschanum* MAYER	3	—	—	—	—	—	—	—	+
9. *Laevicardium tenuisulcatum* (NYST)	1	+	+	+	—	+	—	×	—
10. *L. kübecki* (HAUER)	3	—	—	—	—	—	—	—	+
11. *Ringicardium hoernesianum* (GRATELOUP in sched.)	1	—	—	—	—	—	—	—	+
12. *Pitar schafferi* KAUTSKY	1	—	—	—	—	—	—	—	+
13. *P. islandicoides* (LAMARCK)	3	—	—	+	+	—	+	+	—
14. *P.* cf. *lilacinoides* (SCHAFFER)	4	—	—	—	—	—	—	—	○
15. *P. raulini* (HÖRNES) ex aff. *P. subnitidula* (D'ORBIGNY)	1	—	—	×	—	—	×	—	+
16. *Venus burdigalensis* (MAYER)	2	—	—	+	+	—	+	—	—
17. *Paphia benoisti praecedens* KAUTSKY	1	—	—	—	—	—	—	—	+
18. *P. declivis* (SCHAFFER)	3	—	—	—	—	—	—	—	+
19. *Dosinia* cf. *exoleta* (LINNAEUS)	1	—	—	○	○	—	○	○	—
20. *Arcopagia subelegans* (D'ORBIGNY)	1	—	—	+	—	—	+	+	—
21. *Gastrana fragilis* (LINNAEUS)	1	—	—	+	+	—	+	+	—

Legend: E: number of specimens. 1. Middle Oligocene. 2. Upper Oligocene. 3. Lower Miocene. 4. Middle Miocene. 5. Boreal province. 6. Atlantic province. 7. Mediterranean province. 8. Endemic species restricted to the Paratethys. + = same species or subspecies, × = close relative, subspecific difference, ○ = uncertain identification

16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
—	—	+	—	—	—	—	—	—	+	+	—	—	+	—	—	—	—	—	—	+	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	+	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	—	+	—	+	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	+	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	+
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	+	—	—	—	+

dafok-1/8)

List of species	E	1	2	3	4	5	6	7	8
22. *Turritella terebralis* LAMARCK	11	—	—	+	—	—	+	+	—
23. *T. terebralis gradata* MENKE in HÖRNES	2	—	—	×	—	—	×	×	+
24. *T. terebralis inaequicingulata* HÖLZL	1	—	—	×	—	—	×	×	+
25. *T. vermicularis* (BROCCHI) s. str.	1	—	—	+	+	—	+	+	—
26. *Protoma cathedralis paucicincta* SACCO	2	—	—	+	+	—	×	+	—
27. *P. cathedralis* ex aff. *quadricincta* SCHAFFER	2	—	—	×	×	—	×	×	+
28. *Tympanotonus margaritaceus* (BROCCHI)	5	+	+	+	—	+	+	+	—
29. *Xenophora deshayesi* MICHELOTTI	2	—	+	+	+	+	+	+	—
30. *Natica tigrina* DEFRANCE	5	—	—	+	+	+	+	+	—
31. *Polinices olla* (DE SERRES)	3	—	+	+	+	+	+	+	—
32. *Phalium subsulcosum* (HOERNES et AUINGER)	2	—	—	—	—	—	—	—	+
33. *Ficopsis burdigalensis spinulosa* (GRATELOUP)	2	—	—	+	—	—	+	+	—
34. *Pirula cingulata* BRONN in HÖRNES	3	—	—	+	+	—	+	×	—
35. *P. condita* BRONGNIART	3	—	+	+	+	—	×	+	—
36. *Murex partschi* HÖRNES	1	—	—	—	+	—	×	+	—
37. *Babylonia eburnoides* (MATHERON)	3	—	—	+	—	—	+	+	—
38. *Galeodes cornuta* (AGASSIZ)	3	—	—	+	+	—	+	+	—
39. *Ancilla glandiformis* (LAMARCK)	8	—	+	+	+	+	+	+	—
40. *Olivella clavula* (LAMARCK)	3	—	—	+	—	—	+	+	—
41. *Tudicla rusticula* (BASTEROT)	2	—	—	+	+	—	+	+	—
42. *Athleta ficulina* (LAMARCK)	3	—	+	+	+	—	+	+	—

TABLE III

Distribution of the Hungarian Upper Oligocene mollusc species over the 14 fossil mollusc community types. The heavy line marks an abundant, typical occurrence

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Nucula schmidti GLIBERT			—			—	—	**—**			—			
N. mayeri HÖRNES							—					—		**—**
N. comta GOLDFUSS						—	—				**—**			
Nuculoma laevigata SOWERBY						—	—				**—**			
Nuculana anticeplicata T.-ROTH						—	**—**							
Nuculana solymarensis n. sp.								—						
N. psammobiaeformis T.-ROTH														**—**
Yoldia raulini COSSMANN et PEYROT													—	**—**
Y. glaberrima varians WOLFF								—						
Arca biangula LAMARCK							—							
Anadara diluvii LAMARCK				—		—	**—**			—				
A. guembeli MAYER					—	**—**	—							
Trisidos schafarziki HORUSITZKY						—								
Glycymeris pilosa lunulata NYST		—				**—**	—					—		
G. latiradiata SANDBERGER in GÜMBEL s. l.		—		—		**—**	—			—	—	—		
G. latiradiata obovatoides BÁLDI						**—**					—			
G. latiradiata subfichteli BÁLDI		—				**—**	—							
Limopsis anomala EICHWALD														—
Mytilus aquitanicus MAYER		—		**—**	—	—								
Arcoperna micans BRAUN							—				—	—		
Musculus philippii MAYER in WOLFF											—	**—**		
Modiolus dunkeri KOENEN											—	**—**		
Pteria phalaenacea LAMARCK							—				**—**	—		
Pecten arcuatus BROCCHI						**—**	—							
Flabellipecten burdigalensis LAMARCK						—	—		—			**—**		**—**
F. angustiformis BÁLDI						—					**—**			
F. telegdirothi CSEPREGHY-MEZNERICS							—					—		**—**
Chlamys northamptoni MICHELOTTI							—				—			
Ch. csepreghymeznericsae BÁLDI											—	**—**		
Ch. schreteri NOSZKY							—							
Ch. agriensis CSEPREGHY-MEZNERICS												**—**		
Ch. incomparabilis RISSO							—				**—**			
Ch. ex aff. *decussata* MÜNSTER in GOLDFUSS											—			
Ch. hertlei BITTNER											—			

Anomia ephippium Linné			—	—		**—**	—				—			
Ostrea cyathula Lamarck		**—**	**—**	**—**	—	**—**	—			—		—		
O. gigantea callifera Lamarck						—					—	—		
Unio inaequiradiatus Gümbel	—	—												
Astarte gracilis degrangei Cossmann et Peyrot						—	—				**—**	—		
Crassatella carcarensis Michelotti						**—**	**—**					—		
C. bosqueti Koenen														**—**
Cardita orbicularis subparvocostata Báldi							—				**—**	—		
C. monilifera Dujardin							—							
C. arduini Brongniart						—			—		—	**—**		
C. ruginosa Cossmann et Peyrot														—
Polymesoda convexa Brongniart		**—**	—	—										
P. convexa brongniarti Basterot		—	—											
Isocardia subtransversa Orbigny						—	—				—			
I. subtransversa abbreviata Sacco						—	—				—			
Cyprina islandica rotundata Braun in Agassiz						—	**—**				—	—		
Congeria basteroti Deshayes		**—**	—											
Taras rotundatus Montagu			—	—	**—**	—	**—**	**—**			—	—		
T. fragilis Braun in Walchner				—										
Linga columbella Lamarck						—								
Lucinoma borealis Linné						—	—	—			**—**	—		
Cavilucina droueti schloenbachi Koenen											—	**—**		
Thyasira vara angusta Báldi														—
Laevicardium cyprium Brocchi							—	—			**—**	—		
L. tenuisulcatum Nyst						—	**—**	—			—	—		
L. kovacovense Seneš						—								
Cardium thunense Mayer			—				—				—			
C. egerense T.-Roth						—	—							
C. heeri Mayer							**—**				**—**			
C. neglectum Hölzl						—	**—**				—			
C. neglectum intersulcatum n. subsp.											—			
C. bojorum Mayer			—	—	—		**—**	—						

Legend: 1. *Viviparus-Brotia.* 2. *Polymesoda-Tympanotonus.* 3. *Tympanotonus-Pirenella.* 4. *Mytilus aquitanicus.* 5. *Pitar undata.* 6. *Glycymeris latiradiata.* 7. *Pitar polytropa.* 8. *Nucula-Angulus.* 9. *Lepidocyclina-Corallinaceae.* 10. *Turritella venus.* 11. *Pitar beyrichi.* 12. *Flabellipecten-Odontocyathus.* 13. *Schizaster* cf. *acuminatus.* 14. *Hinia-Cadulus.* 1. = Freshwater-oligohaline, 2—5. = more or less brackish, 6—14. = marine; 1—2. = lagoon, 3—5. (possibly 3—8.) = lagoon or littoral, 6—9. = shallow sublittoral (0 to 30 m depth), 10. = shallow or medium-depth sublittoral, 11—13. = medium-depth sublittoral (30 to 120 m depth), 14. (possibly 13—14.) = deep sublittoral — shallow bathyal (120 to 300 m depth)

TABLE III (*continued*)

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13	14
C. praepapillosum Báldi														—
Ringicardium buekkianum T.-Roth							**—**	—						
Venus multilamella Lamarck						**—**						**—**		—
V. multilamella interstriata T.-Roth							—							
Pitar gigas schafferi Kautsky						—								
P. polytropa Anderson			—	—	—	—	**—**	—			—	—		
P. beyrichi Semper				—	—	—	—			—	**—**			
P. splendida Merian						—	**—**			—	**—**			
P. undata Basterot			—	—	**—**									
Venerupis ex aff. *basteroti* Mayer in Hörnes							—							
Dosiniopsis sublaevigata Nyst											—			
Lutraria oblonga soror Mayer						—	**—**			—	—			
Zozia antiquata Pultney											—			
Solecurtus basteroti Des Moulins							—							
Gari protracta Mayer		**—**	**—**	—	—	—	—							
G. angusta Philippi							—				—			
Arcopagia subelegans Orbigny							—	—			—			
Macoma elliptica Brocchi							—					—		—
Apolymetis lacunosa Chemnitz				—	—									
Angulus nysti Deshayes						—	—	**—**		—	**—**			
A. posterus Beyrich						—	—				—			—
A. planatus ancestralis n. subsp.			—		**—**									
Siliqua nysti Deshayes								—						
Ensis hausmanni Schlotheim								—						
Cultellus budensis n. sp.								**—**						
Hiatella arctica Linné												—		
Panopea meynardi Deshayes						—	—	—		—	**—**	—		
Corbula basteroti Hörnes				—	—		**—**				—			
C. gibba Olivi			—			—	—	—			**—**	—		
C. carinata Dujardin			—		—	**—**	**—**				—			
Pholadomya puschi Goldfuss						—	—				**—**	—		
Thracia pubescens Pultney						—	—				—			
Th. pubescens bellardii Pictet						—						—		
Th. ventricosa Philippi						—	—	—				**—**		

Clavagella oblita Michelotti							━					—		—
Cuspidaria clava Beyrich											—			
C. neoscalarina Báldi														—
Calliostoma elegantulum hegeduesi n. subsp.												—		
Jujubinus multicingulatus praestrigosus Báldi							—							
Gibbula affinis protumida Sacco			—	—										
G. proxima Hölzl										—	—			
G. dubia n. sp.								—	—					
Teinostoma egerensis Báldi														—
Theodoxus pictus Férussac		━	━	—	—									
Th. buekkensis T.-Roth		—	━											
Th. pilisensis n. sp.				—										
Th. supraoligocaenicus n. sp.				—										
Th. grateloupianus Férussac		—												
Th. crenulatus Klein	—	━												
Pomatias antiquum Brongniart	━	—	—											
Viviparus ventricosus Sandberger	━													
Hydrobia ventrosa Montagu		━												
Turritella venus Orbigny						—	━	—		━	—	—		
T. venus margarethae Gaál							━							—
T. beyrichi Hofmann		—	—	━			—				—	—		
T. beyrichi percarinata T.-Roth							━							
T. archimedis Brongniart		—	—	—	━									
Protoma cathedralis Brongniart						—								
P. quadricanaliculata Sandberger in Gümbel			—	—	━									
P. diversicostata Sandberger in Gümbel					—	—								
Mathilda schreiberi Koenen														━
Architectonica carocollata Lamarck														—
A. mariae Báldi														—
Brotia escheri Brongniart	━	—												
Melanopsis impressa hantkeni Hofmann	—	━	—	—			—							
Pirenella plicata Bruguière		━	━	—	—	—	—							
Tympanotonus margaritaceus Brocchi		━	━	—	—	—	—							
Bittium reticulatum densespiratum Báldi							—							
B. spina agriense Báldi														━
Cerithium egerense Gábor							—					━		
Diastoma grateloupi turritoapenninica Sacco						—	━	—			—	—		
Amaea amoena Philippi														—

TABLE III *(continued)*

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calyptraea chinensis LINNÉ		—	—	**—**	—	—	—							
C. pseudodeformis BÁLDI							—							
Xenophora deshayesi MICHELOTTI							—				—			
Aporrhais callosa T.-ROTH							**—**							
Drepanocheilus speciosus SCHLOTHEIM s. str.							**—**	**—**		—	—	—		—
D. speciosus digitatus T.-ROTH							—	—						
D. speciosus margerini KONINCK							—				—			
Strombopugnellus digitolabrum KOCH											—			
Strombus coronatus DEFRANCE							—							
Rostellaria dentata GRATELOUP						—	**—**							
R. bicarinata BÁLDI														**—**
Polinices catena DA COSTA s. l.		—	—		—	—	—	—		—	—	—		—
P. catena achatensis RÉCLUZ in KONINCK						—					**—**	—		
P. catena helicina BROCCHI			—		—	**—**	**—**	—		**—**		—		—
P. josephinia olla DE SERRES						—	—							
Natica millepunctata tigrina DEFRANCE						—	—				—			
Globularia gibberosa GRATELOUP s. l.						—	—					—		
Globularia gibberosa sanctistephani COSSMANN et PEYROT						**—**	**—**					—		
G. gibberosa callosa NOSZKY						—	—							
G. rothi COSSMANN											—			
Ampullina crassatina LAMARCK		—	—	—	**—**	—	**—**			—		—		
Erato prolaevis SACCO														—
Zonaria globosa DUJARDIN						—	—				—			
Z. subexcisa BRAUN						—								
Cassidaria nodosa SOLANDER in BRANDER						—	—			—	**—**	—		
C. depressa BUCH						—	**—**					—		—
Charonia tarbelliana transiens n. subsp.							—					—		
Ficus concinna BEYRICH											—	—		
F. condita BRONGNIART							—					—		
Murex paucispinatus T.-ROTH							—							**—**
Chicoreus trigonalis GÁBOR							—							
Hexaplex deshayesi NYST							—				—	—		
Hadriana egerensis GÁBOR							—							

Ocinebrina crassilabiata trivaricosa Báldi			—	—										
O. schönni Hörnes			—											
Typhis pungens Solander in Brander							—					—		
T. cuniculosus Nyst							—				—	—		
Mitrella solitaria Báldi														—
Pisanella doboi Noszky							—				—			
Babylonia eburnoides umbilicosiformis T.-Roth				—	—	**—**	**—**			—		**—**		—
Phos hevesensis Báldi							—							—
Acamptochetus clatratus Báldi														—
Galeodes semseyiana Erdős			—				—							
G. basilica Bellardi						—	**—**							
Hinia schlotheimi Beyrich							—						—	**—**
H. fortecostata edentata Báldi				—			—							—
Bullia hungarica Gábor			—				**—**	—			—	—		
Euthriofusus burdigalensis Defrance				—	—		—							
E. szontaghi Noszky							—							
Streptochetus elongatus Nyst											—	—		
Aquilofusus loczyi Noszky							—							—
Fasciolaria plexa Wolff							—				—			
Olivella clavula vindobonensis Cs.-Meznerics							—							
Tortoliva subcanalifera Orbigny						—	—							
Vexillum peyreirense Cossmann et Peyrot														—
Volutilithes multicostata Bellardi												—		
V. proxima Sacco						—								
V. permulticostata T.-Roth							—					—		**—**
Athleta rarispina Lamarck						**—**	**—**				—	—		
A. ficulina Lamarck						—	—							—
Egerea collectiva Gábor						—	—							
Uxia granulata Nyst											—	—		
Bonellitia evulsa Solander in Brander						—	—				—	—		
Babylonella fusiformis pusilla Philippi							—							
Marginella gracilis Fuchs							—							
M. vadaszi Báldi														—
Turris duchasteli Nyst						—	—			—	**—**			
T. selysi Koninck							—				—			
T. konincki Nyst							—				—			
T. coronata Münster in Goldfuss							—					—		**—**
T. trifasciata Hörnes														—
T. laticlavia Beyrich											**—**			

TABLE III *(continued)*

List of species	·1	2	3	4	5	6	7	8	9	10	11	12	13	· 14
T. egerensis T.-ROTH														—
Bathytoma cataphracta BROCCHI							—				—	—		+
Turricula regularis KONINCK						—				—	—	—		
T. ilonae BÁLDI							—							—
T. telegdirothi NOSZKY														—
T. tricarinata T.-ROTH							—							
T. legányii BÁLDI														—
Clavus oligocenicus NOSZKY														—
C. venustus PEYROT											—			
C. obeliscus DES MOULINS							—							
Microdrillia hungarica BÁLDI														—
Asthenotoma obliquinodosa SANDBERGER														—
A. noszkyi BÁLDI							—							—
Mitromorpha telegdirothi BÁLDI														—
Mangelia bogschi BÁLDI														—
Raphitoma valdecarinata BÁLDI														—
R. roemeri agriensis BÁLDI														—
R. pseudonassoides BÁLDI														—
Conus dujardini egerensis NOSZKY						—	—							—
Terebra simplex T.-ROTH							—							
T. ex aff. *fuscata* BROCCHI						—								
Niso minor PHILIPPI														—

Melanella spina Grateloup														—
M. naumanni Koenen														—
M. naumanni depressosuturata Báldi														—
Syrnola laterariae Báldi														—
S. ex aff. *subulata* Merian														—
Actaeon punctatosulcatus Philippi							—							
Ringicula auriculata paulucciae Morlet														—
Cylichna cylindracea raulini Cossmann et Peyrot							—							—
C. lineata Philippi						—								
Roxania burdigalensis Orbigny							—							—
Dentalium kickxi Nyst							—				—			
D. apenninicum Sacco												—		
D. densitextum dejtarense n. subsp.												—		
D. fissura Lamarck								—			—	—	—	—
D. simplex Michelotti							—							—
Fustiaria taurogracilis Sacco														—
Cadulus gracilina Sacco														—

TABLE IV

Distribution in space and time of Hungarian Upper Oligocene mollusc taxa over

List of species	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Nucula schmidti GLIBERT	—	+	—	—	—	+	—	—	—	+	—	—	—
N. mayeri HÖRNES	—	+	+	+	—	+	+	—	—	—	—	+	+
N. comta GOLDFUSS	+	+	—	—	+	+	—	—	—	+	—	—	—
Nuculoma laevigata SOWERBY	+	+	+	+	—	+	+	—	—	+	+	—	—
Nuculana anticeplicata T.-ROTH	—	—	—	—	—	+	—	—	—	—	—	—	—
Nuculana solymarensis n. sp.	—	—	—	—	—	*	—	—	—	—	—	—	—
N. psammobiaeformis T.-ROTH	+	+	—	—	+	+	—	—	—	—	—	—	—
Yoldia raulini COSSMANN et PEYROT	+	+	—	—	+	+	—	—	—	—	—	+	—
Y. glaberrima varians WOLFF	—	×	×	×	—	+	—	—	—	×	×	—	—
Arca biangula LAMARCK	+	+	+	—	—	+	+	+	+	+	—	+	+
Anadara diluvii LAMARCK	—	+	+	+	—	+	+	—	+	+	+	+	+
A. gumbeli MAYER	—	—	—	—	—	+	—	—	—	—	—	—	—
Trisidos schafarziki HORUSITZKY	—	—	—	—	—	+	—	—	—	—	—	—	—
Glycymeris pilosa lunulata NYST	+	+	×	×	—	+	×	+	×	+	×	—	×
G. latiradiata SANDBERGER in GÜMBEL s. l.	×	×	×	—	—	+	×	—	—	×	—	—	—
G. latiradiata obovatoides BÁLDI	×	×	—	—	—	*	—	—	—	×	—	—	—
G. latiradiata subfichteli BÁLDI	—	—	×	—	—	+	×	—	—	—	—	—	—
Limopsis anomala EICHWALD	?	—	+	+	?	+	+	—	+	—	+	—	+
Mytilus aquitanicus MAYER	—	—	+	—	—	+	+	—	—	—	—	—	+
Arcoperna micans BRAUN	+	+	+	—	+	+	+	?	—	+	—	—	—
Musculus philippii MAYER in WOLFF	—	+	+	—	+	+	+	—	—	+	—	—	—
Modiolus dunkeri KOENEN	—	+	—	—	—	+	—	—	—	+	—	—	—
Pteria phalaenacea LAMARCK	+	+	+	+	+	+	+	—	+	+	+	—	+
Pecten arcuatus BROCCHI	—	+	—	—	—	+	—	+	—	—	—	+	—
Flabellipecten burdigalensis LAMARCK	—	+	+	—	—	+	+	+	+	—	—	—	+
F. angustiformis BÁLDI	—	—	—	—	—	*	—	—	—	—	—	—	—
F. telegdirothi CSEPREGHY-MEZNERICS	—	—	—	—	—	*	—	—	—	—	—	—	—
Chlamys northamptoni MICHELOTTI	—	+	+	+	—	+	+	+	+	—	—	—	—
Ch. csepreghymeznericsae BÁLDI	—	—	—	—	—	*	—	—	—	—	—	—	—
Ch. schreteri NOSZKY	—	—	—	—	—	*	—	—	—	—	—	—	—
Ch. agriensis CSEPREGHY-MEZNERICS	—	—	—	—	—	*	—	—	—	—	—	—	—
Ch. incomparabilis RISSO	—	—	+	—	—	+	+	—	+	—	—	—	—
Ch. ex aff. *decussata* MÜNSTER in GOLDFUSS	—	×	—	—	—	*	—	—	—	×	—	—	—
Ch. hertlei BITTNER	—	—	—	—	—	+	—	—	—	—	—	—	—
Anomia ephippium LINNÉ	+	+	+	+	+	+	+	—	+	+	+	—	+
Ostrea cyathula LAMARCK	+	+	—	—	—	+	—	+	—	+	—	—	—
O. gigantea callifera LAMARCK	+	+	—	—	+	+	—	×	—	+	—	×	—
Unio inaequiradiatus GÜMBEL	—	—	—	—	—	+	—	—	—	—	—	—	—

Legend: OLIGOCENE: **1:** Middle; **2:** Upper. MIOCENE: **3:** Lower; **4:** Middle. PARATETHYS: **5:** Oligocene; **6:** Egerian; **7:** Miocene. MEDITERRANEAN: **8:** Oligocene; **9:** Miocene. BOREAL: **10:** Oligocene; **11:** Miocene. ATLANTIC: **12:** Oligocene; **13:** Miocene.

+ = Same species or subspecies; × = close relative, mostly a subspecific difference only, * = known only from Hungary within the Egerian stage of the Paratethys the European faunal provinces

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13
Astarte gracilis degrangei Cossmann et Peyrot	—	+	×	×	—	+	—	—	—	×	×	+	—
Crassatella carcarensis Michelotti	—	+	—	—	—	+	—	+	—	—	—	+	—
C. bosqueti Koenen	+	—	—	—	?	+	—	—	—	+	—	—	—
Cardita orbicularis subparvocostata Báldi	×	×	×	×	—	+	—	—	—	×	×	—	—
C. monilifera Dujardin	—	+	+	+	—	+	—	—	—	—	—	+	+
C. arduini Brongniart	—	+	—	—	—	+	—	+	—	—	—	—	—
C. ruginosa Cossmann et Peyrot	—	+	—	—	—	+	—	—	—	—	—	+	—
Polymesoda convexa Brongniart	+	+	+	+	+	+	+	+	—	+	—	×	×
P. convexa brongniarti Basterot	+	+	+	×	×	+	+	×	—	×	—	+	+
Isocardia subtransversa Orbigny	+	+	+	—	+	+	+	+	—	+	—	—	—
I. subtransversa abbreviata Sacco	×	+	×	—	×	+	×	+	—	×	—	—	—
Cyprina islandica rotundata Braun in Agassiz	+	+	×	×	+	+	—	+	—	+	×	—	—
Congeria basteroti Deshayes	+	+	+	+	—	+	+	—	+	+	+	—	+
Taras rotundatus Montagu	+	+	+	+	+	+	+	—	+	+	+	×	+
T. fragilis Braun in Walchner	+	+	—	—	+	+	—	—	—	+	—	—	—
Linga columbella Lamarck	+	+	+	+	—	+	+	—	+	—	—	+	+
Lucinoma borealis Linné	+	+	+	+	+	+	+	+	+	+	+	—	+
Cavilucina droueti schloenbachi Koenen	+	+	—	—	—	+	—	—	—	+	—	—	—
Thyasira vara angusta Báldi	×	—	—	—	×	*	—	—	—	—	—	—	—
Laevicardium cyprium Brocchi	+	+	+	+	+	+	+	—	+	+	+	+	+
L. tenuisulcatum Nyst	+	+	+	—	+	+	+	+	—	+	+	—	—
L. kovacovense Seneš	—	—	—	—	—	+	—	—	—	—	—	—	—
Cardium thunense Mayer	—	—	—	—	—	+	—	—	—	—	—	—	—
C. egerense T.-Roth	—	—	—	—	—	+	—	—	—	—	—	—	—
C. heeri Mayer	—	—	—	—	—	+	—	—	—	—	—	—	—
C. neglectum Hölzl	—	—	—	—	—	+	—	—	—	—	—	—	—
C. neglectum intersulcatum n. subsp.	—	—	—	—	—	*	—	—	—	—	—	—	—
C. bojorum Mayer	—	—	—	—	—	+	—	—	—	—	—	—	—
C. praepapillosum Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Ringicardium buekkianum T.-Roth	—	+	—	—	—	+	—	+	—	—	—	—	—
Venus multilamella Lamarck	—	+	+	+	—	+	+	+	+	—	+	+	+
V. multilamella interstriata T.-Roth	—	+	×	×	—	+	×	+	×	—	×	×	×
Pitar gigas schafferi Kautsky	—	—	+	—	—	+	+	—	×	—	—	—	×
P. polytropa Anderson	+	+	+	—	+	+	+	+	—	+	+	—	?
P. beyrichi Semper	?	+	+	—	—	+	+	—	—	+	—	—	—
P. splendida Merian	+	+	—	—	—	+	—	+	—	+	—	×	—
P. undata Basterot	—	—	+	—	—	+	—	—	—	—	—	—	+
Venerupis ex aff. *basteroti* Mayer in Hörnes	—	—	×	×	—	*	×	—	×	—	—	—	×
Dosiniopsis sublaevigata Nyst	+	+	—	—	+	+	—	—	—	+	—	—	—
Lutraria oblonga soror Mayer	—	×	×	×	—	+	×	×	×	—	—	—	—
Zozia antiquata Pultney	—	+	+	+	—	+	+	+	+	—	+	—	+
Solecurtus basteroti Des Moulins	—	+	+	+	—	+	+	—	+	+	+	—	+
Gari protracta Mayer	—	+	—	—	—	+	—	+	—	—	—	—	—
G. angusta Philippi	—	+	—	—	—	+	—	+	—	+	—	—	—
Arcopagia subelegans Orbigny	?	?	+	—	—	+	+	—	+	×	—	—	+
Macoma elliptica Brocchi	+	+	+	+	+	+	+	+	+	—	+	—	+

TABLE IV *(continued)*

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13
Apolymetis lacunosa Chemnitz .	—	—	+	+	—	+	+	—	+	—	—	—	+
Angulus nysti Deshayes	+	+	+	—	+	+	+	—	—	+	—	—	—
A. posterus Beyrich	+	+	+	+	+	+	—	—	—	+	+	—	—
A. planatus ancestralis n. subsp.	—	—	×	×	—	+	×	—	×	—	—	—	×
Siliqua nysti Deshayes	—	+	—	—	—	+	—	—	—	+	—	—	—
Ensis hausmanni Schlotheim .	—	+	—	—	—	+	—	—	—	+	—	—	—
Cultellus budensis n. sp.	—	—	—	—	—	*	—	—	—	—	—	—	—
Hiatella arctica Linné	+	+	+	+	+	+	+	—	+	+	+	—	+
Panopea meynardi Deshayes ..	+	+	+	+	+	+	+	+	+	+	+	—	+
Corbula basteroti Hörnes	+	+	+	+	—	+	+	—	—	+	+	+	+
C. gibba Olivi	+	+	+	+	+	+	+	+	+	+	+	+	+
C. carinata Dujardin	—	+	+	+	—	+	+	+	+	—	+	—	+
Pholadomya puschi Goldfuss ..	+	+	+	+	+	+	+	+	+	+	—	+	—
Thracia pubescens Pultney	—	+	+	+	—	+	+	+	+	—	+	—	+
Th. pubescens belardii Pictet ...	—	+	×	×	—	+	×	+	×	—	×	—	×
Th. ventricosa Philippi	+	+	+	+	+	+	—	+	+	+	+	—	—
Clavagella oblita Michelotti ...	—	+	—	—	—	+	—	+	—	—	—	—	—
Cuspidaria clava Beyrich	+	+	—	—	+	+	—	—	—	+	—	—	—
C. neoscalarina Báldi	×	—	—	—	×	*	—	—	—	—	—	—	—
Calliostoma elegantulum hegeduesi n. subsp.	—	×	—	—	—	*	—	—	—	×	—	—	—
Jujubinus multicingulatus praestrigosus Báldi	×	×	×	×	—	*	—	×	×	×	—	—	—
Gibbula affinis protumida Sacco	—	+	+	×	—	+	×	+	+	—	—	—	—
G. proxima Hölzl	—	—	—	—	—	+	—	—	—	—	—	—	—
G. dubia n. sp.	—	—	—	—	—	*	—	—	—	—	—	—	—
Teinostoma egerensis Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Theodoxus pictus Férussac	+	+	+	+	+	+	+	—	+	+	+	+	+
Th. buekkensis T.-Roth	—	—	—	—	—	+	—	—	—	—	—	—	—
Th. pilisensis n. sp.	—	—	—	—	—	*	—	—	—	—	—	—	—
Th. supraoligocaenicus n. sp. ...	—	—	—	—	—	*	—	—	—	—	—	—	—
Th. grateloupianus Férussac ..	—	—	+	+	—	+	+	—	+	—	—	—	+
Th. crenulatus Klein	—	+	+	+	—	+	+	—	+	+	+	—	—
Pomatias antiquum Brongniart	—	+	—	—	—	+	—	—	—	+	—	—	—
Viviparus ventricosus Sandberger	?	—	—	+	—	+	—	—	—	—	—	?	+
Hydrobia ventrosa Montagu	+	+	+	+	—	+	+	—	+	+	+	+	+
Turritella venus Orbigny	—	—	+	—	+	+	+	—	—	—	—	—	+
T. venus margarethae Gaál	—	?	—	—	—	+	—	?	—	—	—	—	—
T. beyrichi Hofmann	—	×	—	—	—	+	—	×	—	—	—	—	—
T. beyrichi percarinata T.-Roth	—	+	—	—	—	+	—	+	—	—	—	—	—
T. archimedis Brongniart	—	+	+	+	—	+	—	+	+	—	—	—	+
Protoma cathedralis Brongniart	—	+	+	+	—	+	+	+	+	—	—	—	+
P. quadricanaliculata Sandberger in Gümbel	—	—	—	—	—	+	—	—	—	—	—	—	—
P. diversicostata Sandberger in Gümbel	—	—	—	—	—	+	—	—	—	—	—	—	—
Mathilda schreiberi Koenen	+	+	—	—	—	+	—	+	—	+	—	—	—
Architectonica carocollata Lamarck	—	+	+	+	—	+	+	+	+	—	+	—	+
A. mariae Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Brotia escheri Brongniart	+	+	+	+	—	+	+	—	—	+	—	+	+

TABLE IV *(continued)*

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13
Melanopsis impressa hantkeni Hofmann	—	×	×	×	—	+	×	—	×	—	—	×	×
Pirenella plicata Bruguière	+	+	+	—	+	+	+	+	—	+	—	+	+
Tympanotonus margaritaceus Brocchi	+	+	+	—	+	+	+	+	+	+	—	+	+
Bittium reticulatum densespiratum Báldi	—	—	×	×	—	*	×	—	×	—	—	—	×
B. spina agriense Báldi	—	—	×	×	—	*	×	—	—	—	×	—	—
Cerithium egerense Gábor	—	—	—	—	—	*	—	—	—	—	—	—	—
Diastoma grateloupi turritoapenninica Sacco	—	+	—	—	—	+	—	+	—	—	—	—	—
Amaea amoena Philippi	—	+	+	+	—	+	+	+	—	+	+	—	—
Calyptraea chinensis Linné	—	+	+	+	—	+	+	+	+	+	+	+	+
C. pseudodeformis Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Xenophora deshayesi Michelotti	—	+	+	+	—	+	+	+	+	—	+	—	+
Aporrhais callosa T.-Roth	—	—	—	—	—	+	—	—	—	—	—	—	—
Drepanocheilus speciosus Schlotheim s. str.	+	+	+	—	+	+	+	—	—	+	+	—	—
D. speciosus digitatus T.-Roth	—	—	—	—	—	+	—	—	—	—	—	—	—
D. speciosus margerini Koninck	+	+	—	—	—	+	—	—	—	+	—	—	—
Strombopugnellus digitolabrum Koch	—	—	—	—	—	*	—	—	—	—	—	—	—
Strombus coronatus Defrance	—	?	+	+	—	+	+	—	+	—	—	?	?
Rostellaria dentata Grateloup	—	—	+	+	—	+	+	—	+	—	—	—	+
R. bicarinata Báldi	×	—	—	—	×	*	—	—	—	—	—	—	—
Polinices catena Da Costa s. l.	+	+	+	+	+	+	+	+	+	+	+	—	—
P. catena achatensis Récluz in Koninck	+	+	×	×	+	+	×	+	—	+	—	—	—
P. catena helicina Brocchi	×	+	+	+	×	+	+	×	+	+	+	—	—
P. josephinia olla de Serres	—	+	+	+	—	+	+	+	+	+	+	—	+
Natica millepunctata tigrina Defrance	—	—	+	+	—	+	+	—	+	—	+	—	+
Globularia gibberosa Grateloup s. l.	+	+	—	—	—	+	—	+	—	—	—	+	—
Globularia gibberosa sanctistephani Cossmann et Peyrot	×	+	—	—	—	+	—	×	—	—	—	+	—
G. gibberosa callosa Noszky	×	×	—	—	—	*	—	×	—	—	—	×	—
G. rothi Cossmann	—	—	—	—	—	+	—	—	—	—	—	—	—
Ampullina crassatina Lamarck	+	+	—	—	+	+	—	+	—	+	—	+	—
Erato prolaevis Sacco	—	+	—	—	—	+	—	—	—	+	—	—	—
Zonaria globosa Dujardin	—	—	+	+	—	+	+	—	+	—	—	—	+
Z. subexcisa Braun	+	+	—	—	—	+	—	+	—	+	—	—	—
Cassidaria nodosa Solander in Brander	+	+	—	—	+	+	—	+	—	+	—	—	—
C. depressa Buch	+	+	—	—	—	+	—	—	—	+	—	—	—
Charonia tarbelliana transiens n. subsp.	×	×	×	×	×	*	×	—	—	×	×	—	×
Ficus concinna Beyrich	+	+	—	—	+	+	—	—	—	+	—	—	—
F. condita Brongniart	—	+	+	+	—	+	+	+	+	+	+	+	+
Murex paucispinatus T.-Roth	—	—	—	—	—	*	—	—	—	—	—	—	—
Chicoreus trigonalis Gábor	—	—	—	—	—	*	—	—	—	—	—	—	—
Hexaplex deshayesi Nyst	+	+	+	—	+	+	+	—	—	+	+	—	—
Hadriana egerensis Gábor	—	—	—	—	—	*	—	—	—	—	—	—	—

TABLE IV *(continued)*

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13
Ocinebrina crassilabiata trivaricosa Báldi	—	—	+	×	—	+	+	—	—	—	—	—	—
O. schönni Hörnes	—	—	+	—	—	+	+	—	—	—	—	—	—
Typhis pungens Solander in Brander	+	+	+	+	—	+	—	+	+	+	+	—	+
T. cuniculosus Nyst	+	+	+	—	+	+	+	—	—	+	—	—	—
Mitrella solitaria Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Pisanella doboi Noszky	—	—	—	—	—	*	—	—	—	—	—	—	—
Babylonia eburnoides umbilicosiformis T.-Roth	—	—	×	—	—	+	×	×	×	—	—	×	×
Phos hevesensis Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Acamptochetus clatratus Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Galeodes semseyiana Erdős	—	—	—	—	—	*	—	—	—	—	—	—	—
G. basilica Bellardi	—	+	—	—	—	+	—	+	—	—	—	—	—
Hinia schlotheimi Beyrich	—	+	+	—	—	+	—	—	—	+	+	—	+
H. fortecostata edentata Báldi	—	—	×	—	—	*	×	—	—	—	—	—	—
Bullia hungarica Gábor	—	—	—	—	—	+	—	—	—	—	—	—	—
Euthriofusus burdigalensis Defrance	—	—	+	+	—	+	+	—	+	—	—	—	+
E. szontaghi Noszky	—	—	—	—	—	*	—	—	—	—	—	—	—
Streptochetus elongatus Nyst	+	+	—	—	+	+	—	—	—	+	—	—	—
Aquilofusus loczyi Noszky	—	—	—	—	—	*	—	—	—	—	—	—	—
Fasciolaria plexa Wolff	—	—	—	—	—	+	—	—	—	—	—	—	—
Olivella clavula vindobonensis Cs.-Meznerics	—	—	+	+	—	+	+	—	×	—	—	—	×
Tortoliva subcanalifera Orbigny	?	+	+	+	—	+	+	?	+	+	+	+	+
Vexillum peyreirense Cossmann et Peyrot	—	+	—	—	—	+	—	—	—	—	—	+	—
Volutilithes multicostata Bellardi	+	+	—	—	+	+	—	+	—	—	—	—	—
V. proxima Sacco	+	+	—	—	+	+	—	+	—	—	—	—	—
V. permulticostata T.-Roth	—	—	—	—	—	*	—	—	—	—	—	—	—
Athleta rarispina Lamarck	—	—	+	+	—	+	+	—	+	—	—	—	+
A. ficulina Lamarck	?	—	+	+	?	+	+	—	+	—	—	—	+
Egerea collectiva Gábor	—	—	—	—	—	*	—	—	—	—	—	—	—
Uxia granulata Nyst	+	+	—	—	—	+	—	—	—	+	—	—	—
Bonellitia evulsa Solander in Brander	+	+	+	+	+	+	×	+	×	+	+	—	—
Babylonella fusiformis pusilla Philippi	—	+	×	×	—	+	—	—	×	+	—	—	—
Marginella gracilis Fuchs	+	—	—	—	—	+	—	+	—	—	—	—	—
M. vadaszi Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Turris duchasteli Nyst	+	+	+	+	+	+	+	—	—	+	+	—	—
T. selysi Koninck	+	+	—	—	+	+	—	+	—	+	—	—	—
T. konincki Nyst	+	+	—	—	—	+	—	+	—	+	—	—	—
T. coronata Münster in Goldfuss	—	+	+	+	—	+	+	—	+	+	+	?	—
T. trifasciata Hörnes	—	—	—	+	—	+	+	—	+	—	+	—	—
T. laticlavia Beyrich	+	+	+	—	+	+	+	+	—	+	—	—	—
T. egerensis T.-Roth	—	—	—	—	—	*	—	—	—	—	—	—	—
Bathytoma cataphracta Brocchi	+	+	+	+	+	+	+	+	+	+	+	+	+
Turricula regularis Koninck	+	+	?	—	+	+	—	+	—	+	?	—	—
T. ilonae Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
T. telegdirothi Noszky	—	—	—	—	—	*	—	—	—	—	—	—	—
T. tricarinata T.-Roth	—	—	—	—	—	*	—	—	—	—	—	—	—
T. legányii Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—

TABLE IV *(continued)*

List of species	1	2	3	4	5	6	7	8	9	10	11	12	13
Clavus oligocenicus Noszky	—	—	—	—	—	*	—	—	—	—	—	—	—
C. venustus Peyrot	—	+	—	—	—	+	—	—	—	—	—	+	—
C. obeliscus Des Moulins	—	+	+	+	—	+	?	?	?	+	+	—	+
Microdrillia hungarica Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Asthenotoma obliquinodosa Sandberger	+	+	—	—	+	+	—	—	—	+	—	—	—
A. noszkyi Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Mitromorpha telegdirothi Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Mangelia bogschi Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Raphitoma valdecarinata Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
R. roemeri agriensis Báldi	×	×	—	—	—	*	—	—	—	×	—	—	—
R. pseudonassoides Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
Conus dujardini egerensis Noszky	—	—	×	×	—	+	×	—	×	—	×	—	—
Terebra simplex T.-Roth	—	—	—	—	—	+	—	—	—	—	—	—	—
T. ex aff. *fuscata* Brocchi	—	×	×	×	—	*	×	—	×	×	×	—	×
Niso minor Philippi	—	+	—	—	—	+	—	—	—	+	—	—	—
Melanella spina Grateloup	—	—	+	+	—	+	+	—	—	—	—	—	+
M. naumanni Koenen	+	+	—	—	—	+	—	—	—	+	—	—	—
M. naumanni depressosuturata Báldi	×	×	—	—	—	*	—	—	—	×	—	—	—
Syrnola laterariae Báldi	—	—	—	—	—	*	—	—	—	—	—	—	—
S. ex aff. *subulata* Merian	×	×	—	—	—	*	—	—	—	×	—	—	—
Actaeon punctatosulcatus Philippi	+	+	?	—	—	+	—	—	?	+	—	—	?
Ringicula auriculata paulucciae Morlet	—	+	+	—	—	+	+	×	×	+	+	—	+
Cylichna cylindracea raulini Cossmann et Peyrot	—	+	×	×	—	+	×	—	×	—	×	+	—
C. lineata Philippi	—	+	—	—	—	+	—	—	—	+	—	—	—
Roxania burdigalensis Orbigny	—	+	+	+	—	+	—	—	—	—	—	+	+
Dentalium kickxi Nyst	+	+	×	—	+	+	×	+	—	+	—	—	—
D. apenninicum Sacco	—	+	—	—	—	+	—	+	—	—	—	—	—
D. densitextum dejtarense n. subsp.	×	—	—	—	×	*	—	—	—	—	—	—	—
D. fissura Lamarck	+	+	—	—	+	+	—	—	—	+	—	—	—
D. simplex Michelotti	—	+	—	—	—	+	—	+	—	—	—	—	—
Fustiaria taurogracilis Sacco	—	+	+	—	—	+	—	—	+	—	—	+	—
Cadulus gracilina Sacco	—	+	+	—	—	+	—	—	+	—	—	+	+

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PLATES

PLATE I

1–2. *Nucula mayeri* HÖRNES — Eger-1/6; 2.7×; M 69/202
3. *Nucula schmidti* GLIBERT — Szentendre-2; 2.7×; M 65/728
4. *Nucula schmidti* GLIBERT — Szentendre-2; 2.7×; M 65/713
5. *Nucula comta* GOLDFUSS — Törökbálint-2; 2.6×; M 62/9309
6. *Anadara guembeli* MAYER — Pomáz-6; 1.7×; M 65/665
7–8. *Glycymeris latiradiata obovatoides* BÁLDI — Törökbálint-1; 0.75×; M 61/8467

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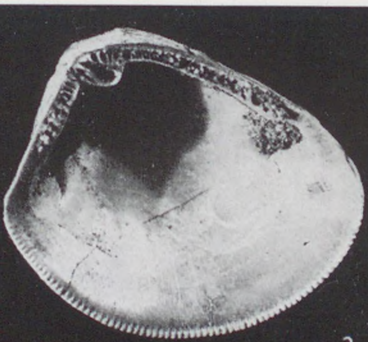

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PLATE II

1. *Nuculana anticeplicata* Telegdi-Roth — Eger-1/k; 7.5×; M 63/6576
2. *Nuculana anticeplicata* Telegdi-Roth — Eger-1/k; 5.6×; M 63/6576
3. *Yoldia glaberrima varians* Wolff — Csolnok 695: 26—33 m; 6.5×; M 68/2082
4. *Nuculana solymarensis* n. sp. (holotype) — Zsámbék 42; 162—165 m; 5.1×; M 68/2081
5. *Nuculana solymarensis* n. sp. — Solymár 72: 50—52 m; 8.7×; M 68/2088

6—7. *Yoldia raulini* Cossmann et Peyrot — Eger-1/6; 7×; M 68/1983

8. *Nuculana psammobiaeformis* Telegdi-Roth — Eger-1/6; 2.1×; M 69/247


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PLATE III

1—2. *Anadara diluvii* Lamarck — Eger-1/k; 2.3×; M 63/6596
3—4. *Anadara guembeli* Mayer — Göd; 1.5×; M 63/8823
5—6. *Anadara guembeli* Mayer — Eger-1/k; 2.3×; M 63/6597
7. *Arca biangula* Lamarck — Dömös-2; 2.3×; M 69/198
8. *Arca biangula* Lamarck — Dömös-2; 2.6×; M 69/198

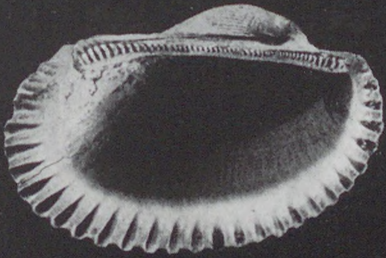
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PLATE IV

1—2. *Limopsis anomala* EICHWALD — Eger-1/6; 6.8×; M 69/206
3. *Musculus philippii* MAYER — Dejtár; 1×; M 68/1985
4. *Modiolus dunkeri* KOENEN — Anyácsapuszta 57: 173 m; 1.8×; M 68/2073
5. *Modiolus dunkeri* KOENEN — Dejtár; 1×; M 68/1986
6. *Arcoperna micans* BRAUN — Leányfalu-4; 3.3×; M 68/2080
7. *Mytilus aquitanicus* MAYER — Eger-1/18; 0.75×; M 69/241

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PLATE V

1. *Anomia ephippium* Linné — Solymár 72: 40—41 m; 0.75×; M 68/2100
2. *Pteria phalaenacea* Lamarck — Törökbálint-2; 1.5×; M 62/9320
3. *Chlamys incomparabilis* Risso — Törökbálint-2; 3.4×; M 62/9317
4. *Flabellipecten angustiformis* Báldi — Törökbálint-1; 1.1×; M 62/9312
5. *Flabellipecten angustiformis* Báldi — Törökbálint-1; 1.2×; M 62/9312
6. *Chlamys schreteri* Noszky — Eger-1/k; 1.5×; M 59/2846
7. *Flabellipecten burdigalensis* Lamarck — Dejtár; 0.75×
8. *Flabellipecten burdigalensis* Lamarck — Eger-1/k; 0.9×; M 66/341

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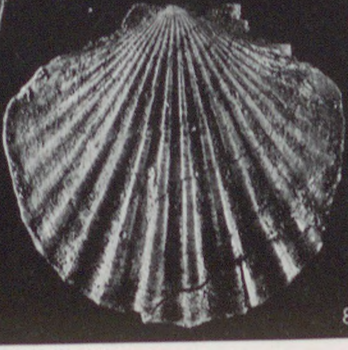

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PLATE VI

1. *Pecten arcuatus* Brocchi — Budafok-1/4; 1.8×; M 63/4400
2. *Pecten arcuatus* Brocchi — Budafok-1/4; 3.8×; M 63/4400
3. *Chlamys northamptoni* Michelotti — Törökbálint-2; 1.5×; M 62/9314
4. *Flabellipecten telegdirothi* Csepreghy-Meznerics — Eger-1/6; 1.3×; M 59/2841
5. *Chlamys csepreghymeznericsae* Báldi — Dejtár; 2×; M 68/2085
6. *Chlamys csepreghymeznericsae* Báldi — Novaj-1; 1.5×; M 60/10787

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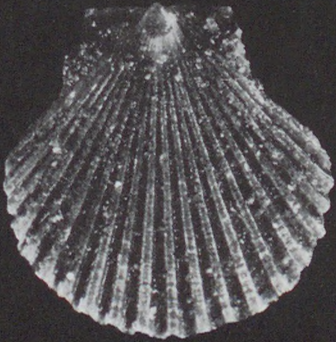

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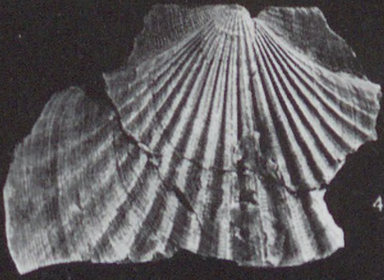

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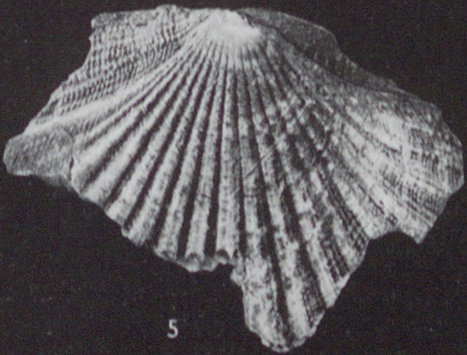

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PLATE VII

1. *Chlamys* ex aff. *decussata* Goldfuss — Törökbálint-2; 2.3×; M 62/9315
2. *Chlamys incomparabilis* Risso — Zsámbék 23: 172 m; 2.7×
3. *Chlamys agriensis* Csepreghy-Meznerics — Eger-2; 1.1×; M 66/342
4. *Flabellipecten* ex aff. *burdigalensis* Lamarck — Dejtár; 1.2×; M 68/2092
5. *Ostrea cyathula* Lamarck — Törökbálint-1; 1×; M 62/9321
6. *Ostrea cyathula* Lamarck — Leányfalu-1; 1×; M 65/800
7. *Ostrea cyathula* Lamarck — Leányfalu-1; 0.9×; M 65/800

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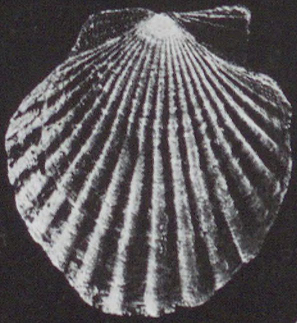

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PLATE VIII

1—2. *Ostrea gigantea callifera* Lamarck — Törökbálint-1; 0.75×; M 62/9322
3. *Ostrea cyathula* Lamarck — Pomáz-21; 0.6×; M 65/677
4—5. *Ostrea gigantea callifera* Lamarck — Törökbálint-1; 0.6×; M 62/9324

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PLATE IX

1. *Polymesoda convexa* Brongniart — Pomáz-21; 1.3×; M 65/712
2. *Polymesoda convexa* Brongniart — Zsámbék 43; 2.3×; M 69/620
3. *Polymesoda convexa brongniarti* Basterot — Pomáz-21; 0.9×; M 65/621
4. *Isocardia subtransversa abbreviata* Sacco — Eger-1/k; 1.0×; M 62/9330
5. *Polymesoda convexa brongniarti* Basterot — Mány 61: 339—343 m; 1.1×; M 69/242
6. *Isocardia subtransversa* Orbigny s. str. — Szomor 31: 191—199 m; 1.3×; M 68/2070
7. *Polymesoda convexa* Brongniart — Pomáz-21; 1.5×; M 65/712

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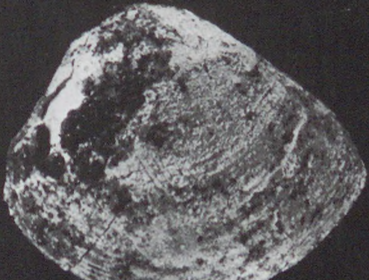

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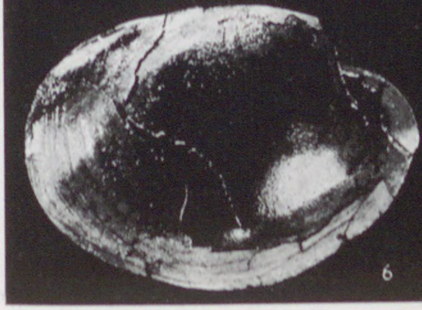

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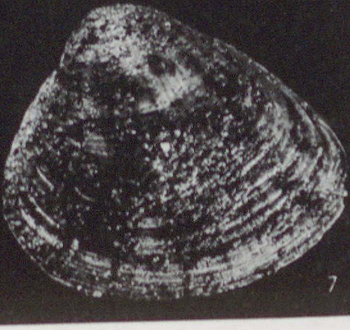

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PLATE X

1—2. *Cyprina islandica rotundata* Braun in Agassiz — Eger-1/k; 0.9×; M 68/2089

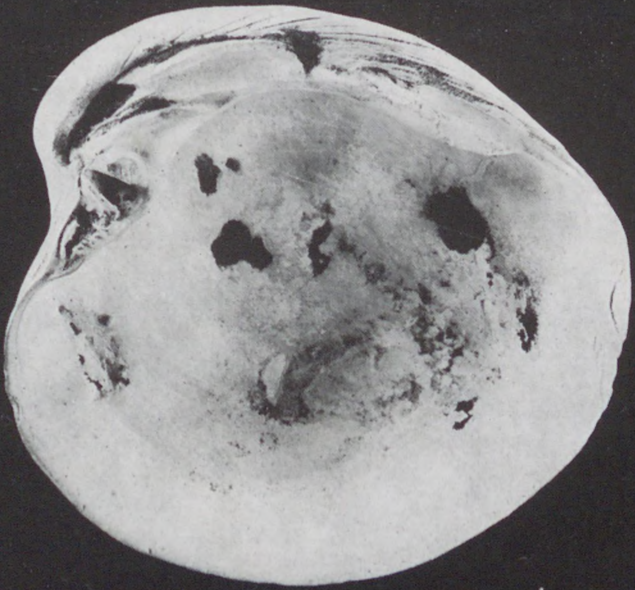

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PLATE XI

1. *Crassatella bosqueti* Koenen — Eger-1/6; 4.9×; M 69/222
2. *Crassatella bosqueti* Koenen — Eger-1/6; 5.0×; M 69/222
3. *Crassatella bosqueti* Koenen — Eger-1/6; 3.8×; M 69/222
4. *Crassatella bosqueti* Koenen — Eger-1/6; 3.8×; M 69/222

5—6. *Crassatella carcarensis* Michelotti — Budafok-1/4; 1.5×; M 63/4406

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PLATE XII

1. *Cardita monilifera* Dujardin — Dömös-2; 3×; M 69/200
2. *Cardita monilifera* Dujardin — Dömös-2; 3.7×; M 69/200
3. *Cardita monilifera* Dujardin — Dömös-2; 3.6×; M 69/200
4. *Cardita arduini* Brongniart — Noszvaj-1 (Nagyimány); 1.7×; M 69/187
5. *Cardita ruginosa* Cossmann et Peyrot — Eger-1/6; 7.5×; M 68/2074
6. *Cardita orbicularis subparvocostata* Báldi — Törökbálint-2; 5.5×; M 62/9328
7. *Cardita ruginosa* Cossmann et Peyrot — Eger-1/6; 7.5×; M 68/2074
8. *Cardita monilifera* Dujardin — Dömös-2; 4.8×; M 69/200
9. *Cardita monilifera* Dujardin — Dömös-2; 4.8×; M 69/200

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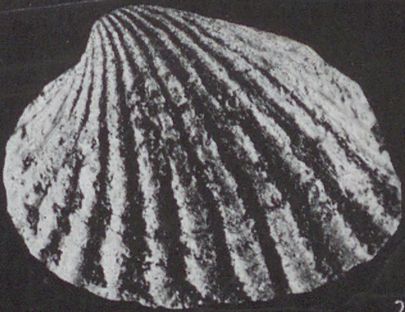

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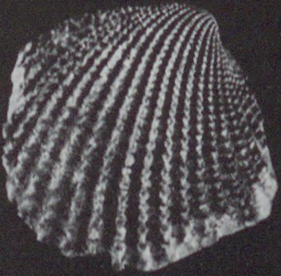

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PLATE XIII

1. *Cardita arduini* BRONGNIART juv. — Pomáz-1; 4.1×; M 65/581
2. *Crassatella carcarensis* MICHELOTTI — Budafok-1/4; 0.75×; M 68/1973
3. *Crassatella carcarensis* MICHELOTTI — Budafok-1/4; 1×; M 68/1973
4. *Astarte gracilis degrangei* COSSMANN et PEYROT — Törökbálint-2; 4.2×; M 62/9326
5. *Astarta gracilis degrangei* COSSMANN et PEYROT — Eger-2; 3.6×; M 68/1993
6. *Astarte gracilis degrangei* COSSMANN et PEYROT — Eger-2; 3.8×; M 68/1993

7—8. ? *Grotriana* n. sp. (an nov. gen.) — Eger-1/6; 7.1×; M 69/208


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PLATE XIV

1. *Lucinoma borealis* LINNÉ — Törökbálint-2; 5.5×; M 62/9314
2. *Linga columbella* LAMARCK — Budafok-1/4; 4.4×; M 63/4407
3. *Cavilucina droueti schloenbachi* KOENEN — Dejtár; 4.5×; M 69/196
4. *Cavilucina droueti schloenbachi* KOENEN — Dejtár; 6.1×; M 69/196

5—6. *Taras fragilis* BRAUN in WALCHNER — Leányfalu-1; 4.9×; M 65/797

7. *Taras rotundatus* MONTAGU — Eger-1/k; 2.2×; M 63/6687
8. *Taras rotundatus* MONTAGU — Pomáz-22; 3.0×; M 65/671

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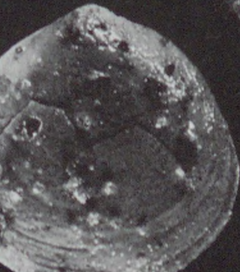

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PLATE XV

1–2. *Laevicardium tenuisulcatum* NYST — Törökbálint-1; 0.8×; M 62/9338
3. *Laevicardium tenuisulcatum* NYST — Eger-1/k; 0.75×; M 63/6572
4. *Laevicardium cyprium* BROCCHI — Eger-1/k; 2.6×; M 63/6582
5. *Thyasira vara angusta* BÁLDI — Eger-1/5; 2.8×; M 65/1079
6. *Cardium egerense* TELEGDI-ROTH — Eger-1/k; 1.9×; M 63/8558
7. *Laevicardium kovacovense* SENEŠ — Diósjenő-8; 2.3×; M 63/9523

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PLATE XVI

1. *Cardium* cf. *neglectum* Hölzl — Solymár 72; 3.4×
2. *Cardium bojorum* Mayer — Leányfalu-1; 1.9×; M 65/798
3. *Cardium neglectum* Hölzl — Diósjenő-7; 3.4×; M 65/821
4. *Cardium neglectum* Hölzl — Solymár 72; 3.6×
5. *Cardium praepapillosum* Báldi — Eger-1/6; 8.0×; M 65/1080
6. *Ringicardium buekkianum* Telegdi-Roth — Eger-1/k; 2.6×; M 63/6519

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PLATE XVII

1—2. *Pitar polytropa* Anderson — Eger-1/k; 1.3×; M 63/6580
3. *Pitar beyrichi* Semper — Törökbálint-2; 1.5×; M 62/9334
4. *Pitar splendida* Merian — Eger-1/k; 1.4×; 63/6571
5. *Dosiniopsis sublaevigata* Nyst — Törökbálint-1; 1.1×; M 62/9344
6. *Dosiniopsis sublaevigata* Nyst — Törökbálint-1; 3.8×; M 62/9343
7. *Pitar undata* Basterot — Pomáz-22; 3×; M 65/651


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PLATE XVIII

1. *Venus multilamella* Lamarck — Eger-1/6; 2.1×; M 69/219
2. *Venus multilamella* Lamarck — Dejtár; 2.0×
3. *Venus multilamella* Lamarck — Eger-1/6; 2.8×; M 69/212
4. *Venus multilamella interstriata* Telegdi-Roth — Eger-1/k; 2.2×; M 63/6574
5. *Venus multilamella* Lamarck — Eger-1/6; 2.0×; M 69/219
6. *Pitar undata* Basterot — Pomáz-22; 3.8×; M 65/651
7. *Pitar undata* Basterot — Pomáz-22; 3.0×; M 65/651
8. *Pitar splendida* Merian — Budafok-1/4; 1.8×; M 63/4409

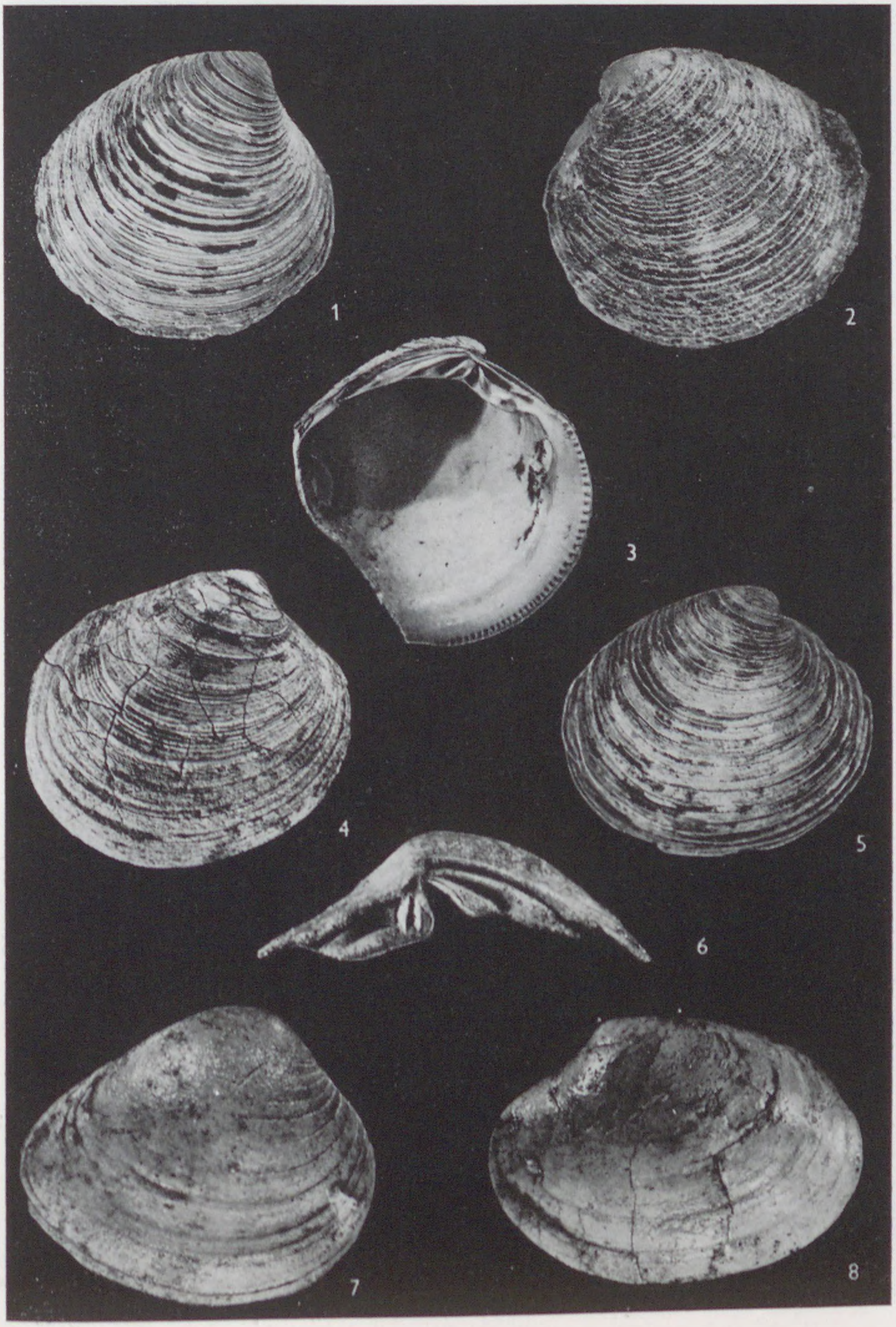
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PLATE XIX

1—2. *Pitar gigas schafferi* KAUTSKY — Diósjenő-24; 0.9×;
3. *Venerupis* ex aff. *basteroti* MAYER — Felsőőrspuszta 44: 376—379 m; 2.3×; M 68/2090
4. *Apolymetis lacunosa* CHEMNITZ — Pomáz-6; 1.9×; M 65/656
5. *Lutraria oblonga soror* MAYER — Eger-1/k; 0.7×; M 63/6594
6. *Zozia antiquata* PULTNEY — Pomáz-6; 1.9×; M 65/611
7. *Cultellus budensis* n. sp. — Solymár 72: 77—79 m; 3.4×
8. *Solecurtus basteroti* DES MOULINS — Diósjenő-4; 2.7×; M 63/9471
9. *Siliqua nysti* DESHAYES — Nagyegyháza 3: 113—114 m; 4.4×; M 65/960


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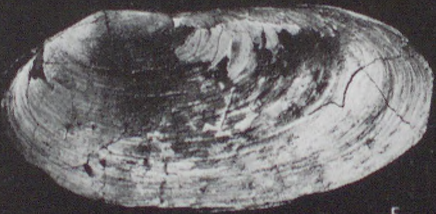
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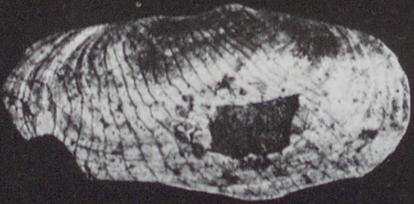
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PLATE XX

1. *Gari protracta* Mayer — Leányfalu-1; 1.1×; M 65/807
2. *Gari angusta* Philippi — Törökbálint-2; 2.0×; M 62/9354
3. *Angulus planatus ancestralis* n. subsp. — Pomáz-22; 2.5×; M 65/647
4. *Gari protracta* Mayer — Diósjenő-7; 1.5×
5. *Macoma elliptica* Brocchi — Dejtár; 2.3×; M 68/1987
6. *Macoma elliptica* Brocchi — Eger-1/6; 2.6×
7. *Arcopagia subelegans* Orbigny — Csordakút 5: 156—160 m; 2.7×; M 65/929
8. *Macoma elliptica* — Brocchi — Eger-1/6; 2.4×

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PLATE XXI

1. *Angulus nysti* Deshayes — Solymár 93: 89—90 m; 2.7×; M 68/1990
2. *Angulus nysti* Deshayes — Törökbálint-2; 1.5×; M 62/9353
3. *Angulus posterus* Beyrich — Leányfalu-4; 4.0×; M 68/1991
4. *Angulus nysti* Deshayes — Szentendre-2; 2.8×; M 65/719
5. *Hiatella arctica* Linné — Eger-2; 16×; M 68/1989
6. *Panopea meynardi* Deshayes — Eger-1/k; 0.5×; M 63/6587
7. *Corbula gibba* Olivi — Eger-1/k; 9.2×; M 63/6599


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PLATE XXII

1\. *Thracia pubescens* Pultney — Eger-1/k; 1.0×; M 63/6589
2—3. *Thracia pubescens bellardi* Pictet — Diósjenő-7; 1.1×; M 68/2097
4\. *Thracia ventricosa* Philippi — Eger-1/k; 1.2×; M 63/6593
5\. *Pholadomya puschi* Goldfuss — Törökbálint-2; 0.75×
6\. *Pholadomya puschi* Goldfuss — Rétság-2; 0.9×
7\. *Corbula carinata* Dujardin — Budafok-1/4; 4.5×; M 63/4425
8\. *Corbula basteroti* Hörnes — Novaj-1; 4.6×; M 60/10777

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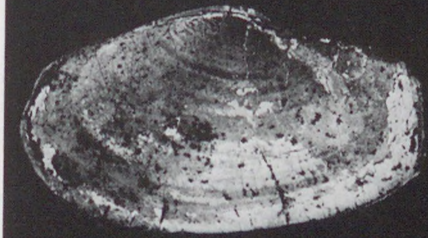

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PLATE XXIII

1. *Clavagella oblita* Michelotti — Eger-1/k; 1.9×; M 63/6586
2. *Cuspidaria neoscalarina* Báldi — Eger-1/6; 3.0×; M 60/1081
3. *Gibbula dubia* n. sp. (holotype) — Nagyegyháza 3: 46—47 m; 7.7×; M 65/964

4—5. *Calliostoma elegantulum hegeduesi* n. subsp. — Dejtár; 2.5×; M 68/2079

6. *Gibbula affinis protumida* Sacco — Diósjenő-3; 5.2×
7. *Jujubinus multicingulatus praestrigosus* Báldi — Eger-1/k; 5.7×; M 64/104
8. *Gibbula dubia* n. sp. — Nagyegyháza 3: 46—47 m; 11.5×; M 65/964

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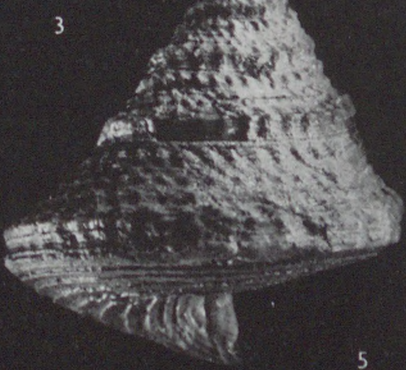

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PLATE XXIV

1. *Theodoxus pictus* Férussac s. str. — Csordakút 5: 159—160 m; 10×; M 65/902
2. *Theodoxus pictus* Férussac s. str. — Csordakút 5: 159—160 m; 9.2×; M 65/902
3. *Theodoxus buekkensis* Telegdi-Roth — Eger-1/17; 2.7×; M 63/3117
4. *Theodoxus pilisensis* n. sp. (holotype) — Leányfalu-1; 9.5×; M 65/793

5—6. *Teinostoma egerensis* Báldi — Eger-1/6; 21×; M 65/1082

7. *Theodoxus pictus* Férussac s. str. — Szentendre 2: 145—147 m; 4.6×
8. *Theodoxus buekkensis* Telegdi-Roth — Eger-1/17; 2.6×
9. *Theodoxus buekkensis* Telegdi-Roth — Eger-1/17; 7.6×

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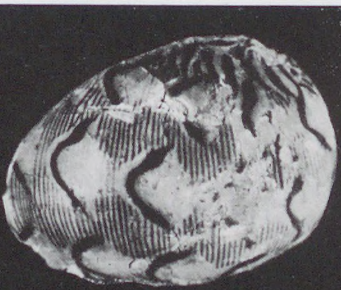

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PLATE XXV

1—2. *Theodoxus grateloupianus* Férussac — Pomáz-21; 5.4×; M 65/709
3—4. *Theodoxus crenulatus* Klein — Zsámbék 42: 179—181 m; 6×; M 68/2076
5—6. *Theodoxus crenulatus* Klein — Pomáz-21; 4.0×; M 65/711
7—8. *Theodoxus crenulatus* Klein — Zsámbék 42: 146—148 m; 7.0×; M 68/2077

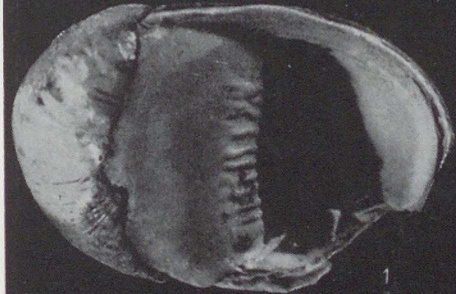

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PLATE XXVI

1. *Theodoxus supraoligocaenicus* n. sp. (holotype) — Leányfalu-1; 9.2×; M 65/805
2. *Theodoxus supraoligocaenicus* n. sp. — Leányfalu-1; 10×; M 65/805
3. *Pomatias antiquum* Brongniart (operculum) — Sur 1: 63 m; 10×; M 68/1992

4—5. *Viviparus ventricosus* Sandberger — Csatka 1: 787 m; 2.0×; M 69/188

6. *Hydrobia ventrosa* Montagu — Zsámbék 42: 143—146 m; 13.0×; M 68/2078
7. *Mathilda schreiberi* Koenen — Novaj-1; 10.5×; M 60/10774
8. *Mathilda schreiberi* Koenen — Eger-1/6; 16×

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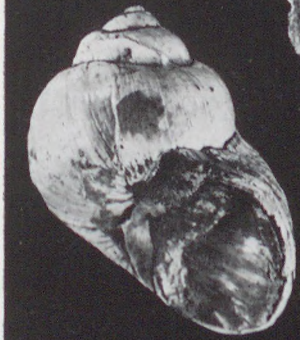

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PLATE XXVII

1—2 *Melanopsis impressa hantkeni* Hofmann — Eger-1/k; 3.3×; M 69/189
3. *Melanopsis impressa hantkeni* Hofmann — Pomáz-21; 2.5×; M 69/190
4. *Brotia escheri* Brongniart — Gyermely 35; 1.4×
5—6. *Architectonica mariae* Báldi — Novaj-1; 13×; M 60/10777
7—8. *Architectonica carocollata* Lamarck — Eger-1/6; 2.8×; M 69/243


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PLATE XXVIII

1—2. *Turritella venus* Orbigny — Törökbálint-1; 1.7×; M 62/9350
3. *Turritella venus margarethae* Gaál — Eger-1/k; 1.8×; M 69/217
4—5. *Turritella beyrichi* Hofmann s. str. — Törökbálint-1; 1.5×; M 62/9351
6—7. *Turritella beyrichi percarinata* Telegdi-Roth — Eger-1/k; 1.1×; M 63/7115
8. *Turritella beyrichi percarinata* Telegdi-Roth — Eger-1/k; 1.7×; M 69/191
9. *Protoma quadricanaliculata* Sandberger — Göd; 1.3×; M 63/8836
10. *Turritella archimedis* Brongniart — Pomáz-6; 2.1×; M 65/662
11. *Protoma diversicostata* Sandberger — Budafok-1/4; 3.1×; M 63/4412
12. *Protoma cathedralis* Brongniart — Pomáz-6; 1.5×; M 63/8302
13. *Protoma quadricanaliculata* Sandberger — Göd; 1.4×; M 63/8836


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PLATE XXIX

1. *Tympanotonus margaritaceus* Brocchi — Csordakút 5; 1.1×
2. *Tympanotonus margaritaceus* Brocchi — Pomáz-21; 1.1×; M 63/8648
3. *Pirenella plicata* Bruguière — Diósjenő-3; 1.3×; M 69/195
4. *Cerithium egerense* Gábor — Eger-1/k; 1.2×; M 63/3118
5. *Bittium spina agriense* Báldi — Eger-1/6; 14.5×; M 65/1083
6. *Bittium reticulatum densespiratum* Báldi — Eger-1/k; 6.4×; M 65/1084
7. *Diastoma grateloupi turritoapenninica* Sacco — Diósjenő-4; 3.5×
8. *Diastoma grateloupi turritoapenninica* Sacco — Eger-1/k; 2.4×; M 63/6611
9. *Calyptraea pseudodeformis* Báldi — Eger-1/k; 3.2×; M 65/1085
10. *Amaea amoena* Philippi — Eger-1/6; 7.8×; M 69/201
11. *Calyptraea pseudodeformis* Báldi — Eger-1/k; 2.8×; M 65/1085


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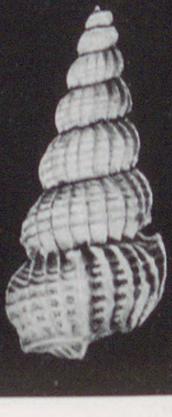
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PLATE XXX

1–2. *Aporrhais callosa* Telegdi-Roth – Eger-1/k; 2.0×; M 63/6665

3. *Drepanocheilus speciosus* Schlotheim s. str. – Eger-1/k; 2.1×; M 63/7137

4. *Drepanocheilus speciosus* Schlotheim s. str. – Eger-1/k; 2.3×; M 63/7137

5–6. *Drepanocheilus speciosus digitatus* Telegdi-Roth – Eger-1/k; 1.9×; M 63/7136


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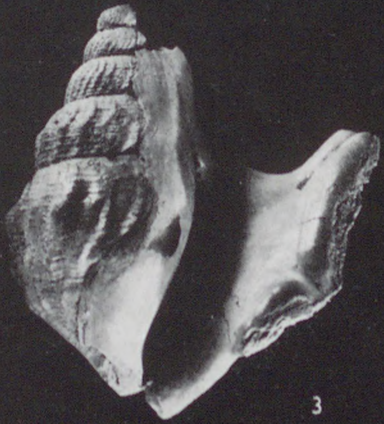
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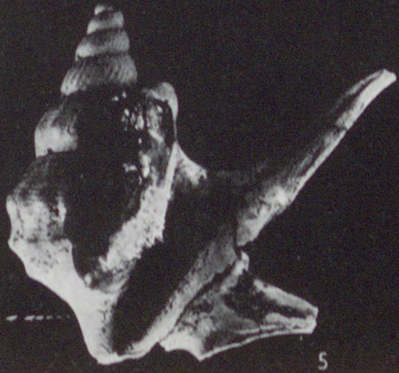
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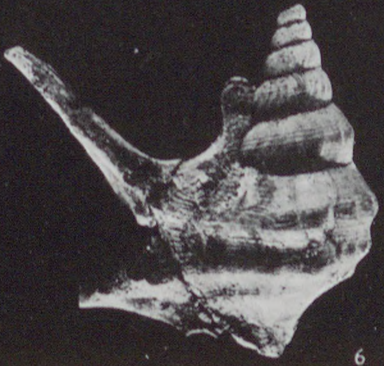
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PLATE XXXI

1–2. *Calyptraea chinensis* Linné – Diósjenő-1; 1.8×; M 63/9470
3. *Drepanocheilus speciosus* Schlotheim s. str. – Eger-1/k; 2.3×; M 63/7137
4. *Drepanocheilus speciosus* Schlotheim s. str. – Törökbálint-1; 1.1×; M 62/9359
5–6. *Strombopugnellus digitolabrum* Koch – Törökbálint-1; 1.15×; M 62/9360

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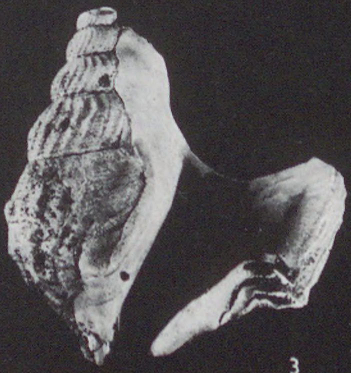

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PLATE XXXII

1–2. *Globularia gibberosa callosa* NOSZKY — Diósjenő-8; 0.9×; M 68/2096
3. *Ampullina crassatina* LAMARCK — Eger-1/k; 0.8×; M 63/6607
4. *Globularia gibberosa sanctistephani* COSSMANN et PEYROT — Eger-1/k; 1.0×; M 69/184
5. *Globularia gibberosa sanctistephani* COSSMANN et PEYROT — Eger-1/k; 1.1×; M 63/6672
6. *Globularia rothi* COSSMANN — Törökbálint-1; 1.5×; M 62/9365
7. *Globularia rothi* COSSMANN — Eger-1/k; 1.0×; M 68/2071


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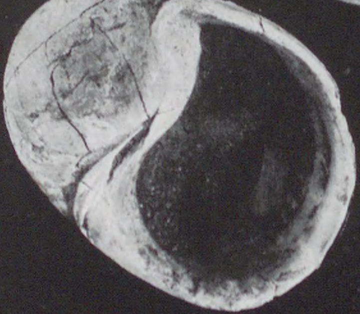
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PLATE XXXIII

1. *Polinices catena helicina* Brocchi — Eger-1/k; 2.7×; M 63/6699
2. *Polinices josephinia olla* De Serres — Eger-1/k; 2.0×
3. *Polinices josephinia olla* De Serres — Eger-1/k; 1.4×; M 69/192
4. *Polinices josephinia olla* De Serres — Eger-1/k; 1.3×; M 63/7134
5. *Polinices catena achatensis* Récluz — Törökbálint-2; 3.8×; M 62/9367
6. *Natica millepunctata tigrina* Defrance — Eger-1/k; 2.1×; M 63/3077
7. *Ampullina crassatina* Lamarck — Eger-1/k; 1.4×; M 63/6607
8. *Xenophora deshayesi* Michelotti — Eger-1/k; 1.6×; M 63/6674
9. *Xenophora deshayesi* Michelotti — Budafok-1/4; 0.75×; M 63/4416


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PLATE XXXIV

1—2. *Rostellaria dentata* GRATELOUP — Eger-1/k; 1.2×; M 63/3043

3. *Rostellaria bicarinata* BÁLDI — Eger-1/6; 2.3×; M 65/1087

4. *Zonaria globosa* DUJARDIN (forma *subglobosa*) — Eger-1/k; 1.8×; M 63/3093

5. *Erato prolaevis* SACCO — Eger-1/k; 8.6×; M 69/224

6. *Zonaria globosa* DUJARDIN — Eger-1/k; 1.3×; M 69/185

7. *Strombus coronatus* DEFRANCE — Eger-1/k; 1.0×; M 68/1982

8. *Strombus coronatus* DEFRANCE juv. — Eger-1/k; 1.5×; M 68/2086

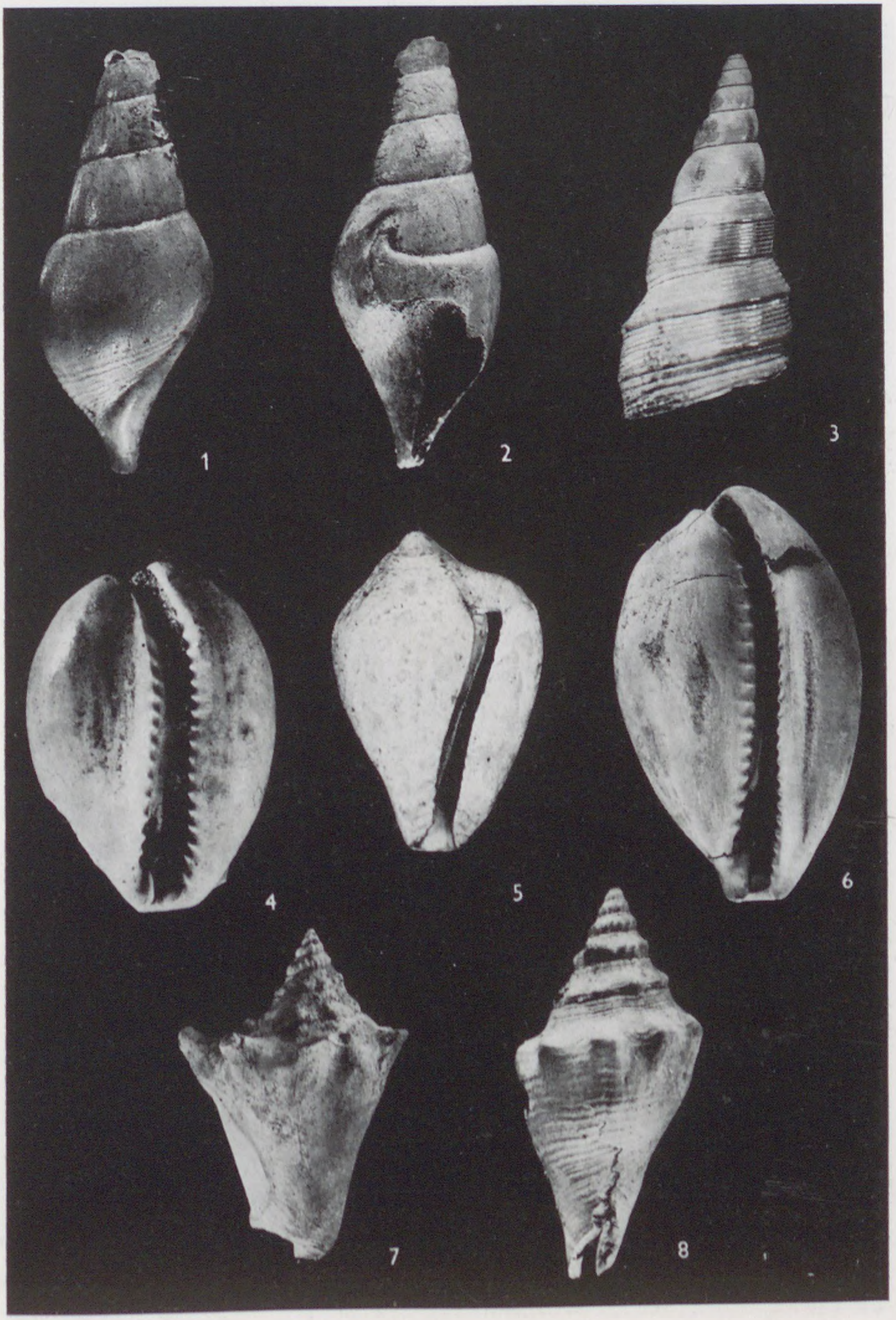
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PLATE XXXV

1—2. *Cassidaria nodosa* Solander in Brander — Eger-1/k; 1.1×; M 68/2072

3. *Cassidaria depressa* Buch juv. — Eger-1/6; 2.8×

4—5. *Cassidaria depressa* Buch — Eger-1/k; 1.5×; M 63/6681

6—7. *Charonia tarbelliana transiens* n. subsp. (holotype) — Eger-1/k; 2.3×; M 68/2095


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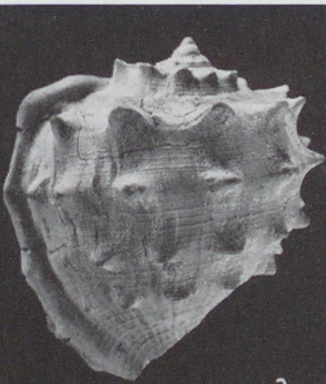
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PLATE XXXVI

1. *Ficus condita* Brongniart — Eger-1/k; 2.0×; M 63/3071
2. *Ficus condita* Brongniart — Eger-1/k; 0.85×; M 69/183
3. *Zonaria subexcisa* Braun — Diósjenő-24; 2.3×
4. *Ficus concinna* Beyrich — Törökbálint-2; 1.8×; M 62/9368
5. *Ficus concinna* Beyrich — Törökbálint-2; 3.0×; M 62/9368
6. *Chicoreus trigonalis* Gábor — Eger-1/k; 1.5×; M 69/197

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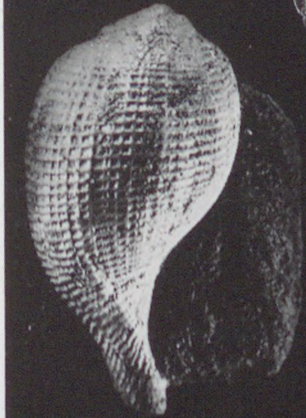

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PLATE XXXVII

1–2. *Ocinebrina crassilabiata trivaricosa* Báldi – Sárisáp; 2.3×; M 55/730
3. *Ocinebrina schoenni* Hörnes – Diósjenő-3; 2.8×
4–5. *Hadriana egerensis* Gábor – Eger-1/k; 1.5×; M 63/6686
6–7. *Murex paucispinatus* Telegdi-Roth – Eger-1/k; 2.0×; M 69/193


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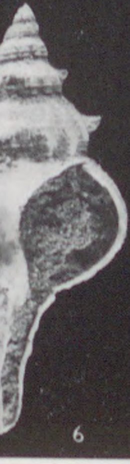
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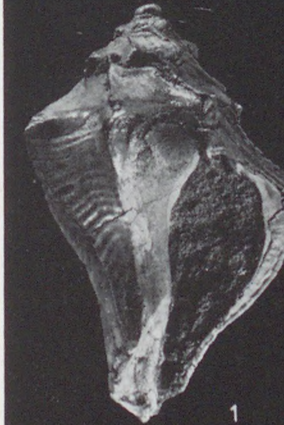
PLATE XXXVIII

1—2. *Hexaplex deshayesi* Nyst — Eger-1/k; 1.3×; M 68/2099
3. *Typhis pungens* Solander in Brander — Eger-1/k; 2.1×; M 63/7140
4—5. *Typhis pungens* Solander in Brander (forma *horridus*) — Eger-1/k; 1.5×; M 64/106
6—7. *Typhis cuniculosus* Nyst — Törökbálint-1; 4.0×; M 62/9370



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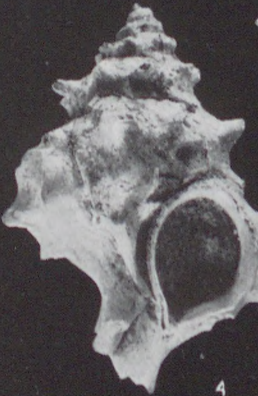

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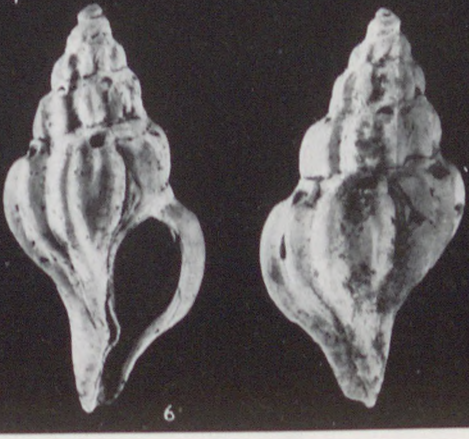

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PLATE XXXIX

1—2. *Chicoreus trigonalis* Gábor — Eger-1/k; 1.5×; M 63/3046

3. *Acamptochetus clatratus* Báldi — Eger-1/6; 3.0×; M 65/1089

4—5. *Bullia hungarica* Gábor — Eger-1/k; 1.7×; M 63/7128

6. *Bullia hungarica* Gábor — Eger-1/k; 1.5×; M 63/6684

7. *Babylonia eburnoides umbilicosiformis* Telegdi-Roth — Eger-1/k; 1.3×; M 63/6694

8. *Mitrella solitaria* Báldi — Eger-1/6; 3.0×; M 65/1088

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PLATE XL

1—2. *Galeodes semseyiana* Erdős — Pomáz-6; 0.38×; M 69/226
3—4. *Galeodes basilica* Bellardi — Eger-1/k; 0.85×; M 63/7131
5—6. *Aquilofusus loczyi* Noszky — Eger-1/k; 1.5×; M 68/2098
7—8. *Pisanella doboi* Noszky — Eger-1/k; 1.7×; M 68/2093

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PLATE XLI

1. *Hinia schlotheimi* Beyrich — Eger-1/6; 6.1×; M 69/214
2. *Hinia schlotheimi* Beyrich — Eger-1/6; 5.8×; M 69/214
3. *Hinia schlotheimi* Beyrich — Eger-1/6; 5.4×; M 69/214
4—5. *Pisanella doboi* Noszky — Eger-1/k; 1.7×; M 63/3038
6. *Phos hevesensis* Báldi — Eger-1/6; 6.0×; M 65/1090
7—8. *Bonellitia evulsa* Solander in Brander — Eger-1/k; 2.3×; M 63/6609
9. *Hinia fortecostata edentata* Báldi — Eger-1/6; 5.5×; 65/1091


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PLATE XLII

1. *Euthriofusus burdigalensis* Defrance — Eger-1/k; 1.8×; M 68/2091
2. *Euthriofusus burdigalensis* Defrance — Pomáz-6; 1.7×; M 63/8268
3. *Euthriofusus szontaghi* Noszky — Eger-1/k; 1.6×; M 63/3099
4. *Aquilofusus loczyi* Noszky — Eger-1/6; 2.6×; M 69/215
5. *Streptochetus elongatus* Nyst — Törökbálint-1; 3.5×; M 62/9376
6. *Athleta rarispina* Lamarck — Eger-1/k; 1.1×; M 63/3109
7. *Athleta rarispina* Lamarck — Eger-1/k; 1.0×; M 63/6602
8. *Fasciolaria plexa* Wolff — Törökbálint-2; 3.8×; M 62/9374

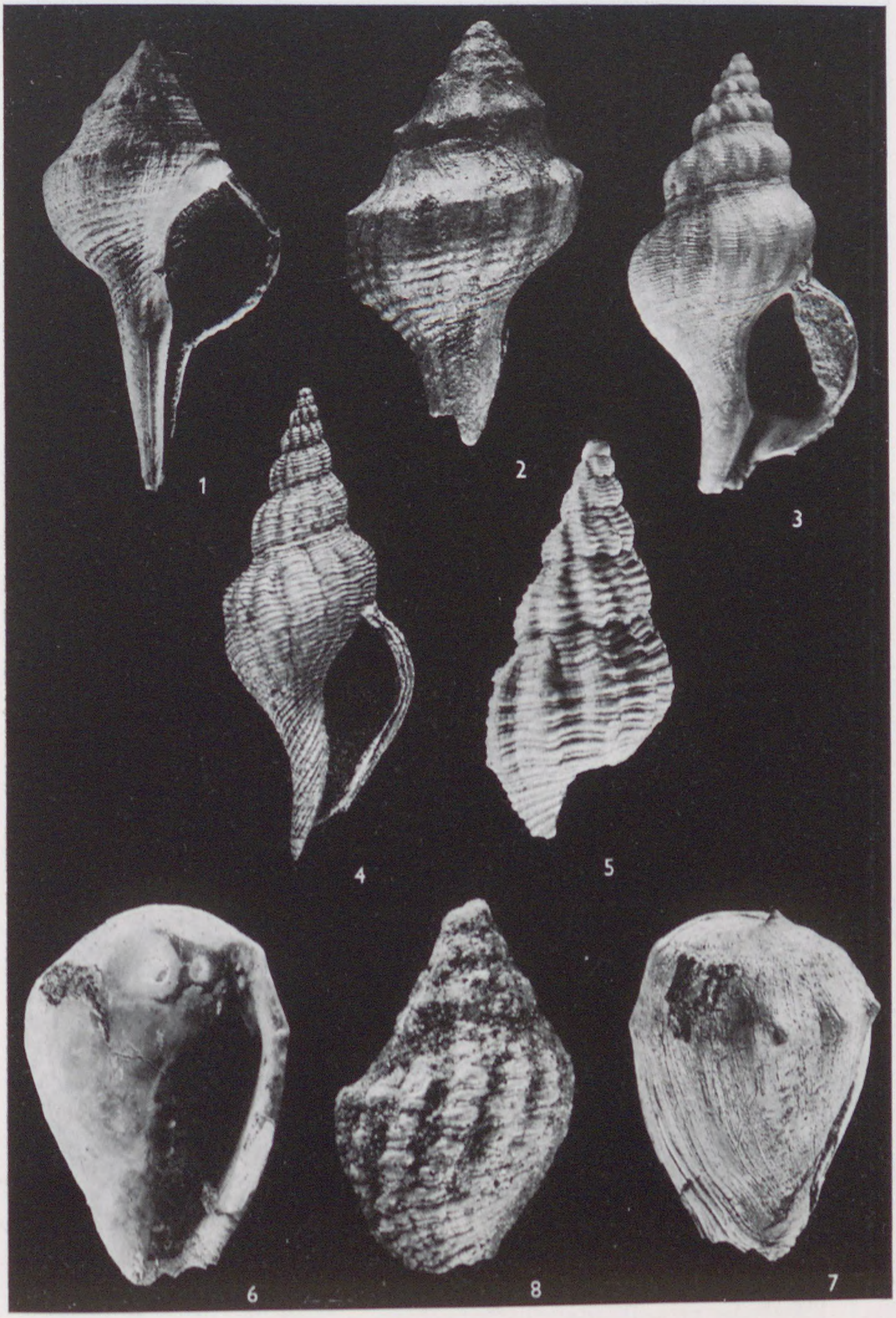
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PLATE XLIII

1–2. *Athleta ficulina* LAMARCK — Eger-1/k; 0.9×; M 68/1974
3. *Streptochetus elongatus* NYST — Törökbálint-2; 3.1×; M 62/9376
4–5. *Volutilithes multicostata* BELLARDI — Eger-2; 1.5×; M 68/1988
6–7. *Volutilithes permulticostata* TELEGDI-ROTH — Eger-1/k; 1.8×; M 63/3112

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PLATE XLIV

1—2. *Egerea collectiva* Gábor — Budafok-1/4; 1.5×; M 67/04
3. *Egerea collectiva* Gábor — Eger-1/k; 1.6×; M 63/6624
4. *Egerea collectiva* Gábor — Eger-1/k; 1.8×; M 63/6624
5—6. *Tortoliva subcanalifera* d'Orbigny — Eger-1/k; 2.1×; M 64/107
7—8. *Olivella clavula vindobonensis* Csepreghy-Meznerics — Dömös-2; 3.6×; M 69/199


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PLATE XLV

1. *Marginella gracilis* FUCHS — Eger-1/k; 8.2×; M 68/1981
2. *Marginella vadaszi* BÁLDI — Eger-1/6; 6.6×; M 69/211
3. *Vexillum peyreirense* COSSMANN et PEYROT — Eger-1/6; 6.1×; M 69/209
4. *Babylonella fusiformis pusilla* PHILIPPI — Eger-1/k; 7.1×; M 68/1975
5. *Uxia granulata* NYST — Törökbálint-2; 3.1×; M 62/9378
6. *Volutilithes proxima* SACCO — Budafok-1/4; 1.1×; M 63/4391
7. *Conus dujardini egerensis* NOSZKY — Eger-1/k; 1.2×; M 63/7123
8. *Conus dujardini egerensis* NOSZKY (forma aberrans) — Eger-1/k; 1.6×; M 69/194
9. *Terebra simplex* TELEGDI-ROTH — Eger-1/k; 1.4×; M 63/6623

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PLATE XLVI

1. *Turris duchasteli* Nyst — Eger-1/k; 1.8×; M 63/6690
2. *Turris duchasteli* Nyst — Eger-1/k; 1.9×; M 63/6690
3. *Turris duchasteli* Nyst — Törökbálint-1; 3.6×; M 62/9383
4. *Turris duchasteli* Nyst — Törökbálint-1; 3.4×; M 62/9383
5. *Turris konincki* Nyst — Eger-1/k; 1.6×; M 63/6622
6. *Turris konincki* Nyst — Eger-1/k; 1.6×; M 63/6622
7. *Turris trifasciata* Hörnes — Novaj-1; 2.9×; M 60/10760
8. *Turris laticlavia* Beyrich — Törökbálint-2; 3.3×; M 62/9382
9. *Turris laticlavia* Beyrich — Törökbálint-2; 2.8×; M 62/9381
10. *Turris egerensis* Telegdi-Roth — Eger-1/k; 3.6×; M 68/2094
11. *Turris coronata* Münster in Goldfuss — Eger-1/6; 4.2×; M 69/218

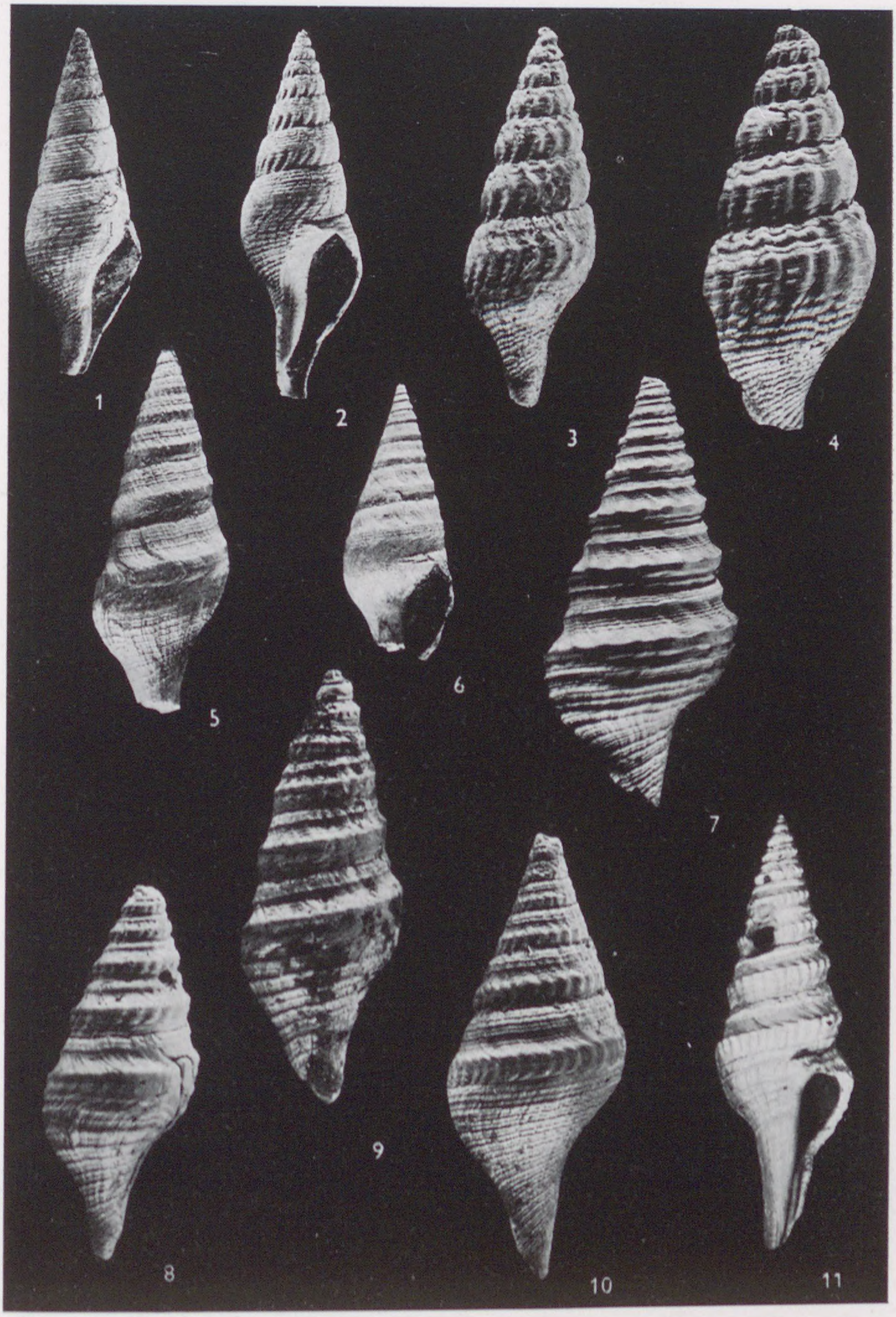
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PLATE LXVII

1. *Turricula regularis* Koninck — Eger-1/k; 1.3×; M 63/7139
2. *Turricula regularis* Koninck — Eger-1/k; 1.3×; M 63/7139
3. *Turricula regularis* Koninck — Eger-1/k; 1.2×; M 63/3082
4. *Turricula regularis* Koninck — Eger-1/k; 1.3×; M 63/3082
5. *Turricula regularis* Koninck — Eger-1/k; 0.9×; M 63/2039

6—7. *Turricula ilonae* Báldi — Eger-1/6; 9.5×; M 65/1092

8. *Turricula regularis* Koninck — Eger-1/k; 0.85×; M 63/6006
9. *Turris selysi* Koninck — Törökbálint-2; 3.3×; M 62/9388
10. *Turris selysi* Koninck — Törökbálint-2; 3.1×; M 62/9389
11. *Turricula telegdirothi* Noszky — Novaj-1; 2.1×; M 60/10759

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PLATE XLVIII

1. *Raphitoma valdecarinata* Báldi — Eger-1/6; 7.2×; M 65/1097
2. *Turricula leganyi* Báldi — Eger-1/6; 2.1×; M 65/1093
3. *Turricula leganyi* Báldi — Eger-1/6; 2.7×; M 69/210
4—5. *Clavus obeliscus* Desmoulins — Eger-1/k; 3.4×; M 68/2087
6. *Raphitoma pseudonassoides* Báldi — Eger-1/6; 7.2×; M 65/1099
7. *Mangelia bogschi* Báldi — Novaj-1; 10.5×; M 60/10755
8. *Clavus venustus* Peyrot — Törökbálint-2; 10.5×; M 62/9393
9. *Clavus oligocenicus* Noszky — Eger-1/6; 3.4×; M 69/221
10. *Asthenotoma obliquinodosa* Sandberger — Eger-1/6; 4.5×; M 69/223

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PLATE XLIX

1. *Microdrillia hungarica* Báldi — Eger-1/6; 5.1× M 65/1094
2. *Raphitoma roemeri agriensis* Báldi — Eger-1/6; 8.4×; M 65/1098
3. *Asthenotoma noszkyi* Báldi — Eger-1/6; 4.4×; M 65/1095
4. *Mitromorpha telegdirothi* Báldi — Eger-1/6; 7.0×; M 65/1096
5. *Melanella naumanni depressosuturata* Báldi — Eger-1/6; 12×; M 65/1100
6. *Bathytoma cataphracta* Brocchi — Eger-1/6; 1.8×; M 69/244
7. *Syrnola laterariae* Báldi — Eger-1/6; 13×; M 65/1101
8. *Melanella spina* Grateloup — Novaj-1; 11×; M 60/10753
9. *Turbonilla* sp. — Eger-1/6; 6.9×
10. *Niso minor* Philippi — Eger-1/6; 7.4×; M 68/1978
11. *Melanella naumanni* Koenen — Eger-1/6; 10×; M 68/2084

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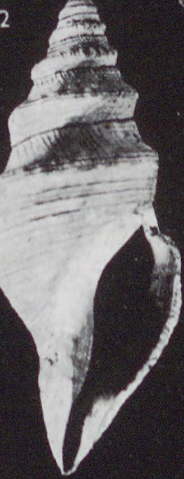

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PLATE L

1. *Cylichna cylindracea raulini* Cossmann et Peyrot — Eger-1/6; 7.0×; M 68/1979
2. *Cylichna cylindracea raulini* Cossmann et Peyrot — Eger-1/6; 5.5×; M 68/1979
3. *Ringicula auriculata paulucciae* Morlet — Eger-1/6; 12×; M 68/2083
4. *Roxania burdigalensis* d'Orbigny — Eger-1/6; 4.9×; M 68/1976
5. *Actaeon punctatosulcatus* Philippi — Eger-1/6; 7.2×; M 68/1980
6. *Dentalium kickxi* Nyst — Törökbálint-2; 3.3×; M 62/9395
7. *Dentalium kickxi* Nyst — Niederrhein (GFR), Chattian; 2.9×
8. *Dentalium apenninicum* Sacco — Eger-1/5; 1.6×; M 69/246
9. *Dentalium densitextum dejtarense* n. subsp. — Dejtár; 5.0×; M 68/2075

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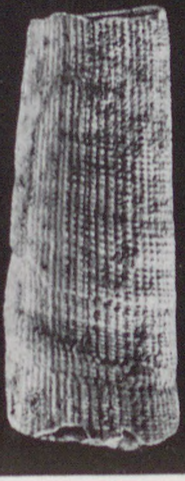

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PLATE LI

1. *Dentalium fissura* Lamarck — Törökbálint-2; 3.7×; M 62/9394
2. *Dentalium fissura* Lamarck — Eger-1/6; 2.7×; M 68/1984
3. *Dentalium simplex* Michelotti — Eger-1/6; 4.0×; M 69/204
4. *Fustiaria taurogracilis* Sacco — Eger-1/6; 3.4×; M 69/207
5. *Cadulus gracilina* Sacco — Eger-1/6; 3.1×; M 69/216
6. *Tortoliva subcanalifera* d'Orbigny juv. — Eger-1/x; 5.1×
7. *Babylonia eburnoides umbilicosiformis* Telegdi-Roth — Sárisáp; 0.75×; M 63/9238
8. *Galeodes semseyiana* Erdős — Diósjenő-3; 0.85×
9. *Cardium neglectum* Hölzl — Zsámbék 42: 124–128 m; 1.5×
10. *Ampullina crassatina* Lamarck — Pomáz-6; 1.9×; M 65/654
11. *Polymesoda convexa* Brongniart — Gyermely 46: 102–105 m; 1.1×


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INDEX

Names of taxa in italics are either objective or subjective synonyms

T. BÁLDI • MOLLUSC FAUNA OF THE HUNGARIAN UPPER OLIGOCENE/EGERIAN/