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Fish otoliths from the Late Oligocene (Eger and Kiscell Formations) in the Eger area (northeastern Hungary)

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Abstract

Otoliths collected from the Late Oligocene of the Eger area revealed the presence of 52 teleost taxa from subtropical to warm temperate waters. Two successive faunas, which have only three species in common, are identified: the Kiscell Clay fauna, comprising 30 taxa, and the Eger Formation fauna, comprising 25 taxa. Although both belong to distinct stratigraphic horizons, the differences are entirely due to ecological factors. The Kiscell Clay provided an association of deepwater fishes, quantitatively very rich in otoliths of mesopelagic fishes, while the Eger association reflects a continental shelf fauna, in which three distinct assemblages corresponding to the progressive shallowing of the environment can be distinguished. The Late Oligocene teleost fauna from the Eger area shows a striking resemblance with the one from the Late Oligocene (Zone NP25) Saint-Etienne-d'Orthe Clay in the Aquitaine Basin, SW France. Notwithstanding the geographic distance separating both areas, 12 of the 20 nominal species (60%) recorded from the Eger area are also known from Saint-Etienne-d'Orthe. Species from both the Eger and the Kiscell Formations are found together in the Saint-Etienne-d'Orthe association. This can be explained by the depositional environment of the Saint-Etienne-d'Orthe Clay (deep neritic to uppermost slope), the depth of which was intermediate between that of the two Hungarian Formations. It confirms that the marked difference between the Kiscell and Eger otolith associations is ecologically conditioned. Another very important conclusion is that the Late Oligocene (nannoplankton Zones NP 24 and 25) ichthyofauna must have been quite homogeneous from the Paratethys to the Eastern Atlantic. In the neritic component of the fauna studied, the ambassids, sillaginids and leiognatids have an exclusively Indo-West-Pacific Recent distribution (except for some recent Mediterranean intruders through the Suez Canal). Among the deeper dwelling neritic taxa and oceanic fishes, 10 genera or families are not represented in the Recent Mediterranean fauna. This proves that in the Late Oligocene, even marginal deep dependences of this basin were inhabited by more typical oceanic faunas than today. All these data fit very well with the paleogeographic reconstruction of the Late Oligocene Mediterranean realm by RÖGL & STEININGER, which postulates a Paratethys without direct link with the North Sea Basin, but with an open connection with an Indo-Pacific-Atlantic seaway across *the* Mediterranean and a pronounced circum-equatorial current system. Six new species are introduced: *Rhechias nagymarosyi, Opisthoproctus stellaris, Xenodermichthys senesi,* "genus Gonostomatoideorum" *aenigmaticus, Diaphus pristismetallis,* "genus aff. *Raniceps*" *coelorinchoides.*

Key-words: teleostean fishes, otoliths, Late Oligocene, Hungary,

Résumé

L'étude des otolithes provenant de l'Oligocène Supérieur de la région d'Eger a permis d'identifier 52 taxa de téléostéens typiques des eaux subtropicales à tempérées chaudes. Deux faunes successives, n'ayant que trois espèces en commun ont été identifiées: la faune de l'Argile de Kiscell, comptant 30 taxa, et la faune de la Formation d'Eger, comptant 25 taxa. Quoique ces deux faunes appartiennent à des horizons stratigraphiques distincts, les différences sont exclusivement dues à des facteurs écologiques. L'Argile de Kiscell a fourni une association de poissons d'eau profonde à nombreuses otolithes de poissons mésopélagiques, tandis que l'association de la Formation d'Eger reflète une faune de bordure continentale, réunissant trois assemblages qui correspondent au comblement progressif de l'aire de sédimentation. La faune téléostéenne de l'Oligocène Supérieur de la région d'Eger montre une ressemblance surprenante avec celle de l'Argile de Saint-Etienne-d'Orthe, Oligocène Supérieur (Zone NP25), dans le Bassin d'Aquitaine, Sud-Ouest de la France. Malgré la distance géographique séparant les deux régions, 12 des 20 espèces nominales (60%) de la région d'Eger sont également connues à Saint-Etienne-d'Orthe; plusieurs espèces qui en Hongrie ne sont connues que dans de la Formation de Kiscell, ou dans celle d'Eger, sont associées à Saint-Etienne-d'Orthe. Ceci peut être expliqué par le milieu de sédimentation de l'Argile de Saint-Etienne-d'Orthe (néritique profond ou partie supérieure de la pente continentale) qui se situait à une profondeur intermédiaire entre celles estimées pour les deux dépôts hongrois. Ceci confirme que les différences prononcées entre les associations d'otolithes des Formations de Kiscell et d'Eger sont essentiellement dues à des facteurs écologiques. Une autre conclusion importante est que l'ichthyofaune de l'Oligocène Supérieur (Zônes à nannoplancton calcaire NP 24 et 25), a dû être très homogène de la Paratéthys à l'Atlantique est. Parmi les éléments néritiques de la faune étudiée, les ambassidés, sillaginidés et leiognathidés ont une répartition actuelle exclusivement indo-ouest-pacifique (sauf pour ce qui concerne quelques intrusions récentes en Méditerranée par le Canal de Suez). Parmi les taxa du domaine néritique profond et les poissons océaniques, 10 genres ou familles ne sont pas représentés dans la faune méditerranéenne actuelle. Ceci prouve qu'à l'Oligocène Supérieur, même des dépendances marginales du Bassin Méditerranéen furent habitées par une faune plus oceanique qu'actuellement. Ces données s'accordent très bien avec la reconstruction paléogéographique de RÖGL & STEININGER, qui postulent a l'Oligocène Supérieur, une Paratethys sans connection avec le Bassin de la Mer du Nord, mais avec des connections vers l'Atlantique et l'Océan Indien, à travers la Méditerranée, où existait un système de courants circum-équatoriaux. Six espèces nouvelles sont décrites: *Rhechias nagymarosyi, Opisthoproctus stellaris, Xenodermichthys senesi,* "genus Gonostomatoideorum" *aenigmaticus, Diaphus pristismetallis,* "genus aff. *Raniceps*" *coelorinchoides.*

Mots-clefs: poissons téléostéens, otolithes, Oligocène Supérieur, Hongrie.

Introduction

In contrast with what has been achieved in the Aquitaine and North Sea Basins, knowledge of fish faunas from the Hungarian Paleogene is almost nil. Among the few data to be mentioned are the investigations on Oligocene skeletons by WEILER (1933, 1935a, 1935b, 1938), a short note on otoliths by SCHUBERT (1912) describing two species from marginal marine Eocene deposits; a short note on the Egerian fishes (mainly osteological and shark teeth material) from south Slovakia by BRZOBOHATY et al. (1975), and the description of some shark teeth by SOLT (1988).

In the summer of 1989, some test samples resulting from a preliminary exploration by NOLF in the Noszvaj and Eger area revealed that the Kiscell Clay at Noszvaj is rich in deepwater fish otoliths. Therefore, a more intensive collecting trip was organised in 1990, which provided the material for the present study. From the test sample taken in 1989, it already became obvious that the otolith fauna from the Kiscell Clay had many species in common with the Saint-Etienne-d'Orthe Clay in Southern Aquitaine, SW France. Consequently, the latter deposits were also intensively sampled in JUNE 1992, providing a rich collection of perfectly preserved material that proved very helpful as comparative material for the present study.

Stratigraphic data

The Hungarian Paleogene Basin contains autochthonous deposits, ranging from Middle Eocene to Late Oligocene. The Late Oligocene deposits in the "Bükk South and East region" (North Hungary) were studied most intensively. Information about the geology, paleontology and stratigraphy of the area is provided in BALDI (1973, 1986, 1989), BALDI & SENES (1975), BALDI-BEKE & al. (1989) and NAGYMAROSY & BALDI-BEKE (1988), from which papers our data on regional stratigraphy and biostratigrapy are taken (Fig. 1 and 2). The Upper Oligocene of the Bükk South and East region consists of two lithostratigraphic units: the Kiscell Clay, conformably overlain by the Eger Formation.

The Kiscell Clay is a generally grey to greenish grey, unstratified and non-laminated calcareous clay. It usually contains very rich assemblages of foraminifers, ostracods, molluscs and calcareous nannofossils, reflecting upper bathyal depositional conditions (BALDI, 1986); According to NAGYMAROSY & BALDI-BEKE (1988, p.17), the Kiscell Clay belongs to the lower part of the nannoplankton Zone NP24. It is important to note here that the Kiscell Formation constitutes only the upper part of the regional Kiscellian stage, which also includes the underlying Tard Clay and Buda Marl Formations (see Fig.1). Many well preserved otoliths have been collected from the Kiscell Clay at Noszvaj.

The Eger Formation overlies the Kiscell Clay without a marked hiatus, but with relatively sharp sedimentary and faunal changes. Clayey marls with silty and sandy intercalations prevail. They contain rich associations of nannoplankton, foraminifers, lepidocyclines and molluscs. The lower part of this succession is generally interpreted as deep sublittoral, passing upwards into a brackish water series, which characterise the top of the section (BALDI, 1986). The depositional interval corresponds to the upper part of Zone NP24 and the lower part of Zone NP25, but the boundary between both zones cannot be fixed exactly in the Eger region, because of the absence of the main tropical marker species. The upper part of the Egerian stage belongs to the Miocene (Nannoplankton Zone NN1), but this part is missing in the sections at Eger and Novaj (SENES, 1975, p.96; BALDI-BEKE 1989a,b).

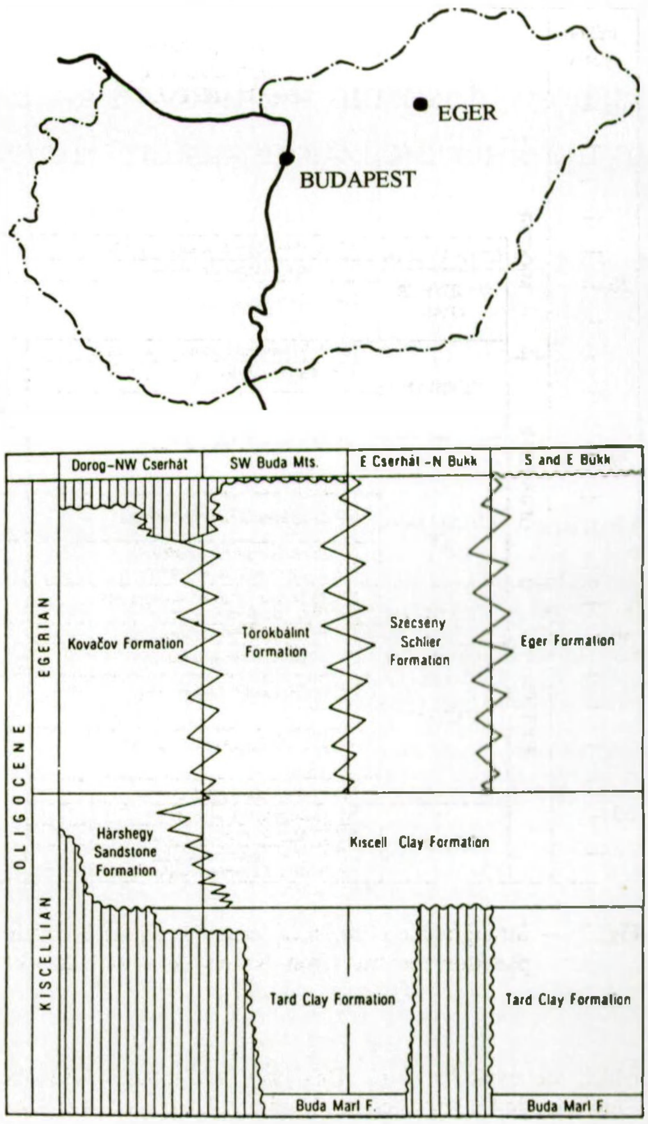

Fig. 1 — Location of Eger and position of the Eger and Kiscell Formations in the regional Oligocene stratigraphy of northern Hungary.

Locality data

EGER, gravel pit NE of Eger.

Map sheet 308-224, Noszvaj 1:10 000; x = 604.800, y = 549.250.

A sample of about 100 kg was taken from calcareous clay, laterally from the huge gravel deposits (also of Egerian age)

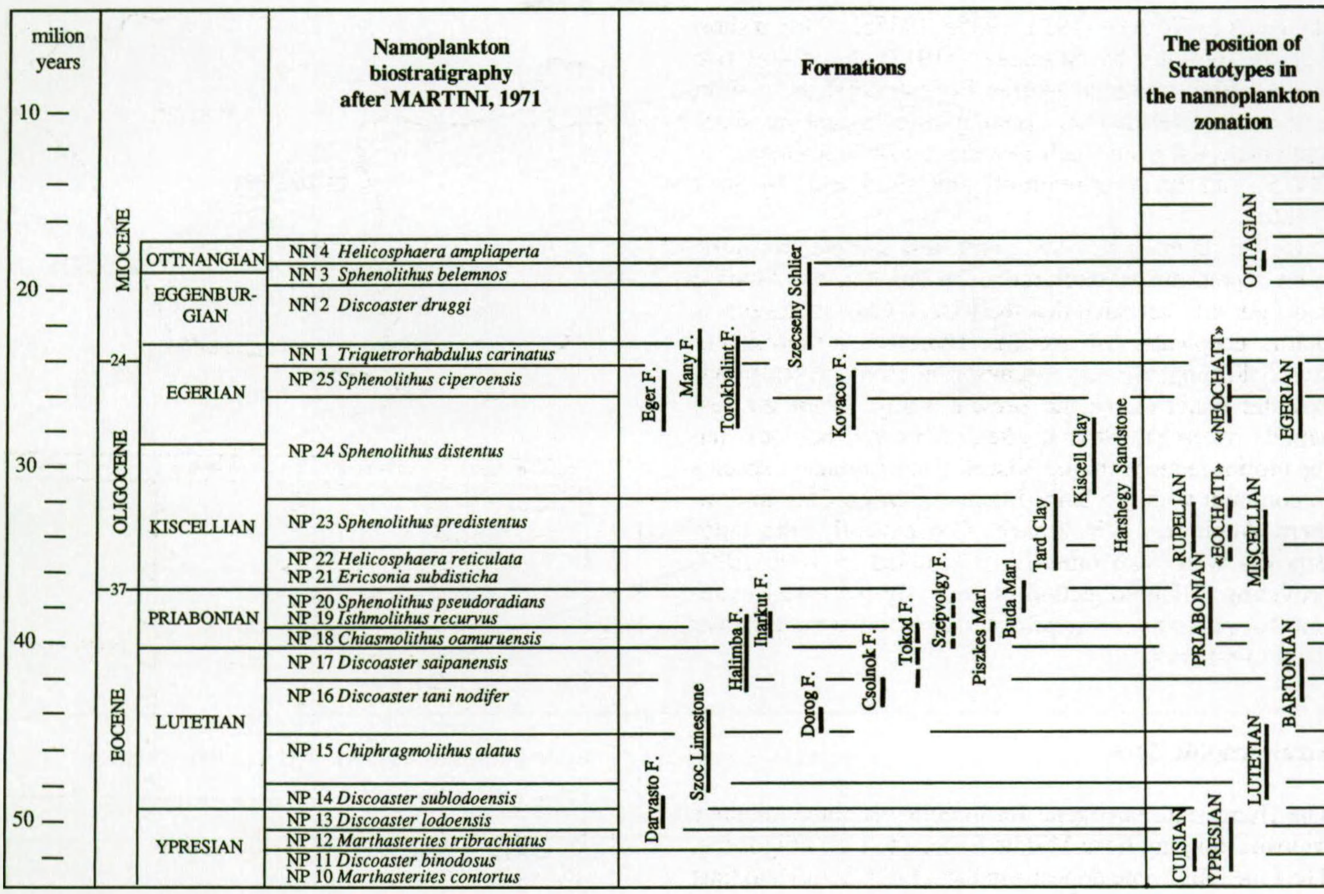

Fig. 2 — Stratigraphic position of some Paleogene Formations of Hungary and of Paleogene stratotypes in the standard nannoplankton zonation (from NAGYMAROSY & BALDI-BEKE, 1988).

which are exploited here. This clay is correlated with the "mollusc clay", bed 3 of the Wind brickyard section at Eger (A. NAGYMAROSY, personal communication).

EGER, Rosalia cemetery
Map sheet 308-241, Eger 1:10 000; x = 600.850, y = 546.450.

A very poor otolith collection was obtained by D. ARPAD (Eger) in the cemetery adjacent to the Wind brickyard. The sample can be correlated with bed 3 (mollusc clay) of this section.

EGER, Wind brickyard
Map sheet 308-241, Eger 1:10 000; x = 601.000, y = 546.500.

This well known outcrop immediately east of Eger has been chosen as the holostratotype of the Egerian stage in the regional Paratethys stratigraphic scale (BALDI & al., 1975). BALDI (1973) and BALDI-BEKE (1989a) provided a drawing of the section, reproduced here as Fig.3. Today, the exposed section ranges down to the glauconitic sandstone 2, because the brickyard has been extended to the north. The most productive level for otolith collecting proved to be the level traditionally named "X-layer", a horizon of very fossiliferous silty sand with many molluscs and some soft sandstone concretions, near to the base of bed 4. The stratigraphic position of the section is the upper part of Zone NP24 and lower part of Zone NP25. The brackish water clays in the upper part of bed 5 (*Cerithium* horizon) do not contain any nannofossils (NAGYMAROSY & BALDI-BEKE, 1988). From bed 1 (glauconitic sandstone), two otoliths only, collected at the surface, were available. Samples of ± 100 kg from bed 3 (mollusc clay); ± 250 kg from the X-layer (near to the base of bed 4); and ± 30 kg from the "*Cerithium* horizon" (bed 5) have been screenwashed, and some additional material from the mollusc clay and the X-layer was provided by two local collectors, D. ARPAD and V. KOVACS.

NOSZVAJ, road cutting on the hill slope E of Noszvaj.
Map sheet 308-224, Noszvaj 1:10 000, x = 607.050, y = 551.180.

A detailed section of this exposure in the Kiscell Clay was provided by BALDI (1986) and is refigured here (Fig.4). We follow his stratigraphic terminology and numbering, although presently a considerable part of the section is no longer accessable. The section figured by BALDI is located on the north wall of a roadside cutting in the hillslope immediately east of Eger. Due to filling in of the entrance to an old wine cellar, excavated in the top zone of bed 5, the whole section below the upper part of this bed is now covered with dumped material, except for a small exposure near the base of bed 3. Bed 1, however is broadly exposed on the opposite side of the road, a few meters downhill from the filled in wine cellar; this is the place where the majority of our material was sampled. The approximate weight of the samples is as follows: 1000 kg from bed 1; 50 kg from the basement of bed 3; 100 kg from the top of bed 5; 35 kg from bed 7; and 35 kg from bed 9.

NOVAJ, Nyarjas Hill
Map sheet 308-24, Eger K, 1:25 000, x=606.000, y=545.300.

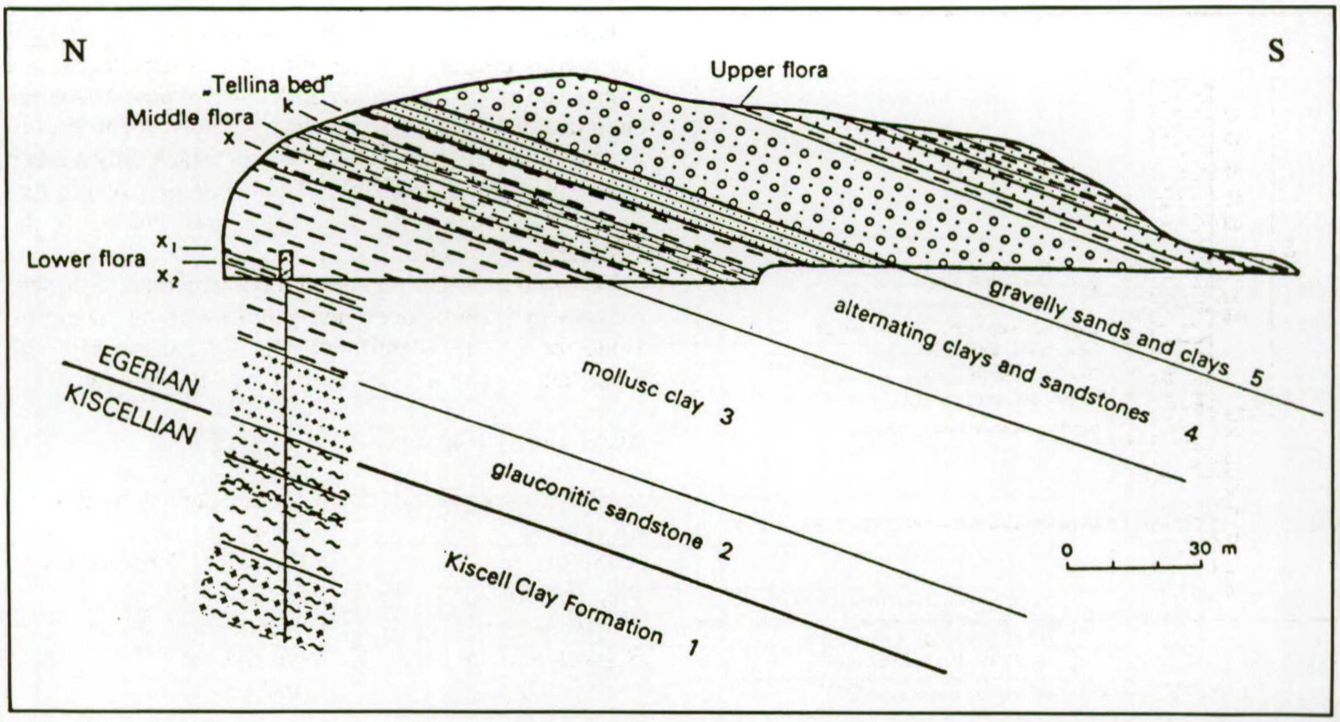

Fig. 3 — Section of the Wind brickyard at Eger, holostratotype of the regional Egerian stage (from BALDI-BEKE, 1989a).

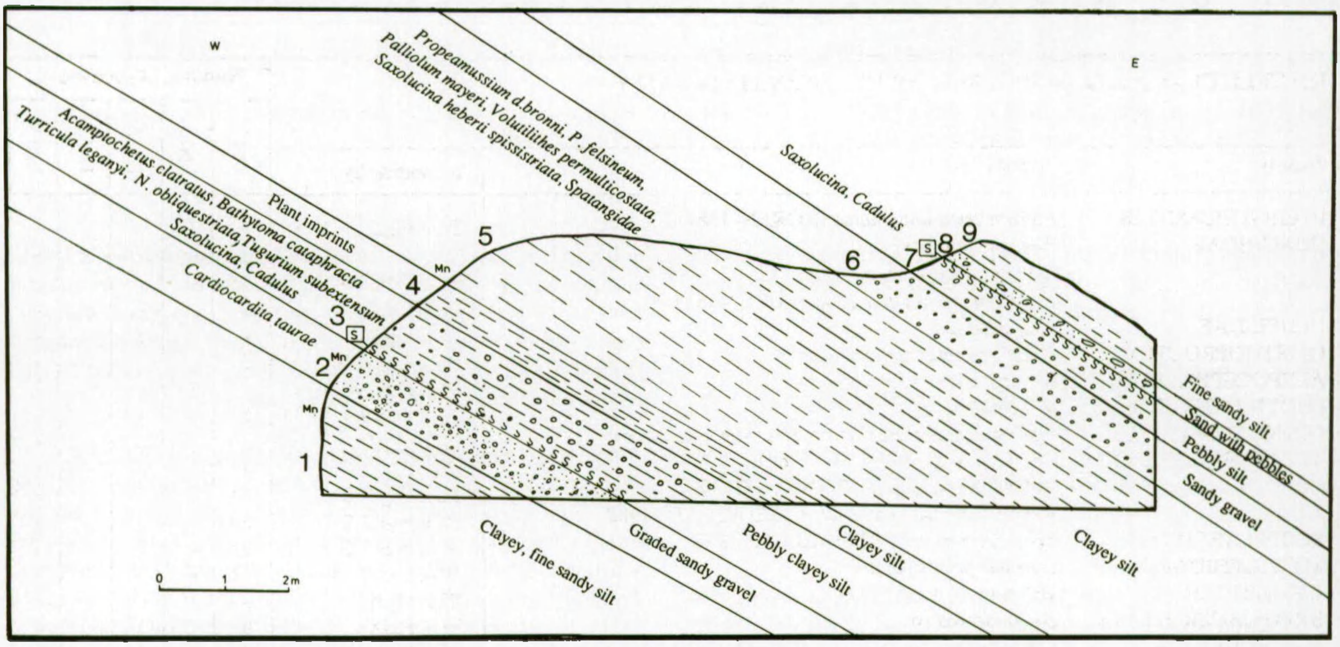

Fig. 4 — Section in the Kiscell Clay at Noszvaj (from BALDI, 1986, modified).

The small village of Novaj is located about 7 km SE from Eger. A surface outcrop on the slope of Nyarjas Hill (3.5 km NNE from Novaj) was cleaned on the occasion of the XXIst European Micropaleontological colloquium in 1989 and shows a complete section from the Kiscell Clay to the mollusc clay of the Eger Formation (Fig.5). A small otolith association was obtained by screenwashing about 100 kg sediment from level 11 in the Egerian mollusc clay. A sample of about 10 kg from bed 6 (*Lepidocyclina* marl) provided no otoliths.

Systematic paleontology

Introduction

The classification followed is the one proposed by NOLF (1985). The reader is referred to that paper for general information and for the morphological nomenclature of otoliths.

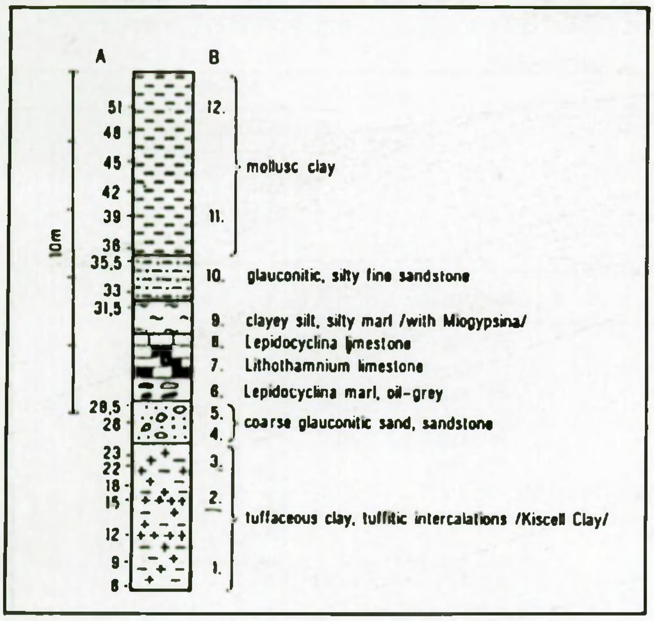

Fig. 5 — Section in the Kiscell and Eger Formations at Novaj, Nyarjas Hill (from BALDI-BEKE, 1989b).

Because the faunas from the Kiscell Clay and the Eger Formation constitute quite different assemblages, the faunas are listed separately in Tables 1 and 2. All the cited taxa have been figured, except for the *Rhynchoconger* species from the Kiscell Clay, for which only a much worn specimen is available. The separation of the two assemblages is maintained in the Plates, but not in the systematic comments.

To avoid needless repetition, taxa which are represented only by juvenile or eroded otoliths without diagnostic value for specific identification or for comparison with other faunas, will not be commented on. These are:

KISCELL CLAY FORMATION

Rhynchoconger sp.
Clupeidae
Bythitinae ind.
Bregmaceros sp.
Merluccius sp.
Hoplostethus sp.
"genus Trachichthyidarum" sp.
"genus aff. *Pontinus*" *sp.*
Peristedion sp.
Percoidei ind.
Bembrops sp.
Lepidopus sp.

Table 1 — Otolith-based fish taxa represented in the Late Oligocene (Zone NP24) Kiscell Clay Formation in the Eger area.

KISCELL CLAY (LATE OLIGOCENE, NP 24), NOSZVAJ LOCALITY			**Number of specimens**				
Family	**Species**	**Iconography**	bed 1	bed 3	bed 5	bed 7	bed 9
PTEROTHRISSIDAE	*Pterothrissus umbonatus* (KOKEN, 1884)	Pl.1, Fig.1	-	1	-	-	-
CONGRIDAE	*Rhynchoconger* sp.		1	-	-	-	-
	Rhechias nagymarosyi n.sp.	Pl.1, Figs.3-6	18	-	-	-	-
	Pseudophichthys elongatus (SULC, 1932)	Pl.1, Fig.2	2	-	-	-	-
CLUPEIDAE	Clupeidae ind.	Pl.1, Fig.7	-	-	1	-	-
OPISTHOPROCTIDAE	*Opisthoproctus stellaris* n.sp	Pl.1, Figs.8-10	2	-	-	-	-
ALEPOCEPHALIDAE	*Xenodermichthys senesi* n.sp.	Pl.2, Figs.5-12	-	1	-	-	-
PHOTICHTHYIDAE	*Vinciguerria* sp.	Pl.3, Figs.9-11	5	-	1	-	-
GONOSTOMATIDAE	«genus Gonostomatoideorum» *aenigmaticus* n.sp.	Pl.3, Fig.2	1	-	-	-	-
STERNOPTYCHIDAE	*Argyripnus* sp.	Pl.3, Fig.1	1	-	-	-	-
	Polyipnus weitzmani STEURBAUT, 1982	Pl.4, Figs.7-8	111	2	1	-	-
	Valenciennellus brzobohatyi STEURBAUT, 1982	Pl.3, Figs.5-8	23	-	2	-	-
SCOPELARCHIDAE	*Scopelarchus nolfi* STEURBAUT, 1982	Pl.4, Figs.1-6	13	-	2	-	1
MYCTOPHIDAE	*Diaphus pristismetallis* n.sp.	Pl.4, Figs.9-14	31	4	3	1	-
BYTHITIDAE	Bythitinae ind.	Pl.5, Fig.6	3	-	-	-	-
BREGMACEROTIDAE	*Bregmaceros* sp.	Pl.5, Fig.8	9	1	1	-	-
MACROURIDAE	*Coelorinchus coelorhincus* (RISSO, 1810)	Pl.5, Figs.1-5	47	1	2	-	-
MERLUCCIIDAE	*Merluccius* sp.	Pl.5, Fig.7	1	-	-	-	-
TRACHICHTHYIDAE	*Hoplostethus* sp.	Pl.5, Figs.10-12	12	-	-	-	-
	«genus Trachichthyidarum» sp.	Pl.5, Fig.9	1	-	-	-	-
SCORPAENIDAE	«genus aff. *Pontinus* sp.	Pl.6, Fig.8	1	-	-	-	-
TRIGLIDAE	*Peristedion* sp.	Pl.6, Fig.9	1	-	-	-	-
EPIGONIDAE	*Epigonus* sp.	Pl.6, Fig.4	2	-	-	-	-
ACROPOMATIDAE	*Parascombrops* aff. *brzobohatyi* NOLF, 1988	Pl.6, Figs.1-2	7	7	-	-	-
	«genus Acropomatidarum» *ordinatus* (BRZOBOHATY, 1967)	Pl.6, Figs.5-6	-	1	-	-	-
	«genus Acropomatidarum» sp.	Pl.6, Fig.3	-	-	1	-	-
PERCOIDEI ind.	Percoidei ind.	Pl.6, Fig.7	1	-	1	-	-
PERCOPHIDAE	*Bembrops* sp.	Pl.6, Figs.10	1	-	-	-	-
TRICHIURIDAE	*Aphanopus* sp.	Pl.6, Figs.11	1	-	-	-	-
	Lepidopus sp.	Pl.6, Figs.12	1	-	-	-	-

Table 2 — Otolith-based fish taxa represented in the Late Oligocene (Zone NP24-25) Eger Formation in the Eger area.

EGER FORMATION (LATE OLIGOCENE, NP24), EGER AREA			Number of specimens						
			Eger, Wind Brickyard						
Family	Species	Iconography	bed 2 glauconitic sandst.	bed 3 mollusc clay	bed 4 x-layer	bed 5 (top) *Cerithium* horizon	Rosalia cimetery mollusc clay	Gravel pit NE of Eger. mollusc clay	Novaj, Bed 11 mollusc clay
PTEROTHRISSIDAE	*Pterothrissus umbonatus* (KOKEN, 1884)	Pl.7, Fig.1	-	-	15	-	-	-	-
CONGRIDAE	*Rhynchoconger pantanellii* (BASSOLI & SCHUBERT, 1906)	Pl.7, Figs.2-3	1	5	17	-	-	12	14
CLUPEIDAE	«genus Clupeidarum» sp.	Pl.7, Fig.12	-	-	2	-	-	-	-
ARGENTINIDAE	*Argentina* sp.	Pl.7, Fig.13	-	-	-	-	-	-	1
MYCTOPHIDAE	*Diaphus* sp.	Pl.7, Figs.4-5	-	1	3	-	2	25	23
CARAPIDAE	*Echiodon* sp.	Pl.7, Fig.6	-	-	3	-	-	-	2
OPHIDIIDAE	Neobythitinae ind.	Pl.7, Fig.7	-	-	2	-	-	-	-
BREGMACEROTIDAE	*Bregmaceros* sp.	Pl.7, Figs.8-9	-	10	-	-	1	3	8
MERLUCCIIDAE	*Merluccius* sp.	Pl.7, Fig.14	-	3	1	-	-	-	-
GADIDAE	*Phycis* sp.	Pl.7, Figs.10-11	-	-	2	-	-	-	-
	«genus aff. *Raniceps*» *coelorinchoides* n.sp.	Pl.8, Figs.1-6	1	2	84	-	-	-	2
AMBASSIDAE	«genus Ambassidarum» sp.	Pl.8, Figs.7-9	-	-	-	30	-	-	-
APOGONIDAE	*Apogon moyesi* STEURBAUT, 1982	Pl.8, Fig.10		1	-	-	-	-	-
	«genus aff. *Apogon*» sp.	Pl.8, Fig.12	-	-	-	3	-	-	-
ACROPOMATIDAE	*Parascombrops* aff. *brzobohatyi* NOLF, 1988	Pl.8, Fig.11	-	-	-	-	1	-	2
SILLAGINIDAE	*Sillago* cf. *hassovicus* (KOKEN, 1891)	Pl.9, Fig.1	-	-	1	-	-	-	-
LEIOGNATHIDAE	*Gazza orthensis* STEURBAUT, 1982	Pl.9, Figs.2-3	-	-	3	-	-	-	-
SPARIDAE	*Dentex* aff. *gregarius* (KOKEN, 1891)	Pl.9, Fig.11	-	-	12	-	-	-	-
	Pagellus sp.	Pl.9, Fig.4	-	-	3	-	-	-	-
	Spicara sp.	Pl.9, Fig.9	-	-	1	-	-	-	-
	Sparidae ind.	Pl.9, Fig.13	-	-	1	-	-	-	-
SCIAENIDAE	*Sciaena* sp.	Pl.9, Fig.10	-	-	1	-	-	-	-
CEPOLIDAE	*Cepola* aff. *rubescens* LINNAEUS, 1766	Pl.9, Figs.6-8	-	1	3	-	-	-	-
GOBIIDAE	«genus aff. *Lesueurigobius*» sp.	Pl.9, Figs.14-16	-	17	101	6	-	2	18
CITHARIDAE	*Citharus* sp.	Pl.9, Fig.12	-	-	8	-	-	-	1

EGER FORMATION

"genus Clupeidarum" sp.
Argentina sp.
Echiodon sp.
Neobythitinae ind.
Bregmaceros sp.
Merluccius sp.
Phycis sp.
"genus Ambassidarum" sp.
"genus aff. *Apogon*" sp.
Pagellus sp.
Spicara sp.
Sparidae ind.
Sciaena sp.
Citharus sp.

Description of new species and remarks on taxa requiring comments.

Family PTEROTHRISSIDAE

Pterothrissus umbonatus (KOKEN, 1884)
Pl. 1, Fig. 1; Pl. 7, Fig. 1

Material. - One otolith from the Kiscell Clay and 15 otoliths from the Eger Formation.

Remarks. - This species is known from many localities in the European Tertiary (Aquitaine Basin, Northern Italy and the North Sea Basin). It first appears in the Early Lutetian of Belgium and its last occurrence is recorded from Tortonian deposits in Northern Italy.

Family CONGRIDAE

Pseudophichthys elongatus (SULC, 1932)
Pl. 1, Fig. 2

Material. - Two otoliths from the Kiscell Clay.

Remarks. - Our specimens seem to be identical with those described by SULC (1932, p. 61) from the Priabonian of Biarritz. In the Aquitaine Basin, the range of *P. elongatus* extends into the Langhian part of the Marls of Saubrigues (STEURBAUT, 1984; NOLF, 1988).

Rhechias nagymarosyi n. sp.
Pl. 1, Figs. 3-6

Type material. - Holotype: a left otolith (Pl. 1, Fig. 4) (IRSNB P 5980); 17 paratypes of which three are figured (Pl. 1, Figs. 3,5,6) (IRSNB P 5977-5979).

Dimensions of the holotype.- Length: 3,3 mm; height: 2,5 mm; thickness: 1,0 mm.

Stratum typicum. - Bed 1 of the Kiscell Clay at Noszvaj, Hungary, Late Oligocene.

Derivatio nominis. - This species is dedicated to A. NAGYMAROSY (University of Budapest, Hungary).

Diagnosis. - Otoliths of this species are massive and thick, with slightly convex inner and strongly convex outer faces. In a transverse section, both ventral and dorsal rims are sharp. The outer face bears no ornamentation and has a relatively flat medial area. The inner face is nearly smooth, with a very concave dorsal area. Several specimens show slight depressions below the central and anterior portions of the sulcus. The sulcus is straight, well incised, and has a regular and undivided colliculum, which in most specimens shows a sharp antero-dorsally directed narrowing in its anterior portion. Well preserved specimens show a clear ventral furrow near their ventral rim.

Discussion. - Otoliths of this species are very similar to those of *Rhechias semiaperta* (BRZOBOHATY, 1967) from the Lower Oligocene of Moravia, but the colliculum is relatively shorter and its narrow anterior portion shows a very characteristic antero-dorsal orientation.

Rhynchoconger pantanellii
(BASSOLI & SCHUBERT, 1906)
Pl. 7, Figs. 2-3

Material. - 51 otoliths from the Eger Formation.

Remarks. - This species is represented by otoliths of mainly juvenile fishes in many samples from the Eger Formation. It is also fairly common in many Miocene and Pliocene marine deposits of Southern Europe. It often has been classified in the genus *Hildebrandia* JORDAN & EVERMAN, 1927, which according to D.G. SMITH (1989) should be synonymised with *Rhynchoconger* JORDAN & HUBBS, 1925.

Family OPISTHOPROCTIDAE

Opisthoproctus stellaris n.sp.
Pl. 1, Figs. 8-10

Material. - Two otoliths from the Kiscell Clay at Noszvaj, bed 1.

Type material. - This species, of which we found only two otoliths in our material from Noszvaj, is represented by abundant and better preserved material in the Saint-Etienne-d'Orthe Clay, Late Oligocene of Southern Aquitaine, where we preferred to choose most of our type series. Holotype: a left otolith (Pl. 1, Fig. 9) (IRSNB P 5982); 16 paratypes of which one is figured (Pl. 1, Fig. 10) (IRSNB P 5984) from the Saint-Etienne-d'Orthe Clay; two paratypes of which one is figured (Pl.1, Fig. 8) (P5983) from the Kiscell Clay at Noszvaj, bed 1.

Dimensions of the holotype. - Length: 2,0 mm; height: 2,2 mm; thickness: 0,5 mm.

Stratum typicum. - Saint-Etienne d'Orthe Clay at Saint-Etienne d'Orthe, Lestelle farm (Aquitaine, South-western France), Chattian.

Derivatio nominis. - Alludes to the locality name "Lestelle", meaning "the star" in Occitanian.

Diagnosis. - This species is characterised by otoliths that are higher than long; the ventral outline is V-shaped with a sharp central angle. Well preserved specimens show a clear rostrum and antirostrum. The deep excisura is nearly right-angled. In transverse sections, the posterior and dorsal rims are rounded, while the ventral and anterior rims are sharp. The outer face is smooth and convex, the strongest convexity being located in the central part of the otolith, along a dorso-ventral axis; in their anterior and posterior portion, the otoliths are markedly thinner.The inner face is nearly flat, with a very shallow depression in the dorsal area. The sulcus consists of a wide but short ostium, with a verry thin, somewhat irregular colliculum, and a long cauda, the posterior end of which curves slightly dorsally. The cauda lacks a crista superior and shows no clear upper delimitation. Near the crista inferior a strong collicular crest is present. The ventral area shows a very shallow longitudinal depression slightly below the crista inferior and parallel to it.

Affinities. - Otoliths of this species resemble those of the Recent *Opisthoproctus soleatus* VAILLANT, 1888 (see NOLF, 1985, fig.42C, p.50) but are easily distinguished from these by their V-shaped ventral rim, by the lack of a crista superior and by their lesser thickness.

Family ALEPOCEPHALIDAE

Xenodermichthys senesi n.sp.
Pl. 2, Figs. 5-12

Material. - One otolith from the Kiscell Clay at Noszvaj, bed 3.

Type material. - This species, of which we found only a single otolith at Noszvaj, is represented by abundant and better preserved material in the Saint-Etienne-d'Orthe Clay, Late Oligocene of Southern Aquitaine, where we preferred to choose most of the type series. Holotype: a left otolith (Pl. 2, Fig. 5) (IRSNB P 5985); 7 paratypes of which 6 are figured (Pl. 2, Figs. 6-11) (IRSNB P 5986-5991) from the Saint-Etienne-d'Orthe Clay; one paratype (Pl. 2, Fig. 12) (P5992) from the Kiscell Clay at Noszvaj, bed 3.

Dimensions of the holotype. - Length: 3,4 mm; height: 2,6 mm; thickness: 0,7 mm.

Stratum typicum. - Saint-Etienne d'Orthe Clay at Saint - Etienne d'Orthe, Lestelle farm (Aquitaine, South-western France), Chattian.

Derivatio nominis. - This species is named after the late Professor J. SENES (Bratislava), in commemoration of his excellent work on Tertiary paleontology.

Diagnosis. - This species is characterised by otoliths with a general rhomboidal outline and a well marked rostrum. The antirostrum is blunt and the excisura forms more or less a right angle. All rims are relatively sharp ; only the posterior one is somewhat blunt in the middle part. The outer face is relatively smooth and convex,with some radial groves, mainly in the dorsal portion. In most specimens, the umbo appears as a slightly prominent structure, with a smooth prolongation towards the rostrum.

In the largest specimens, the dorsal and ventral rims bear irregular small lobes or spines and the otolith becomes thinner in these portions. The sulcus is divided into a deep ostium with a V-shaped outline and a poorly delimited cauda. The ostium is filled with irregular colliculum of which the ventral margin forms a crest. Just below this crest, a furrow-like depression occurs, widening towards the rostrum. There is no ostial crista inferior. The cauda is marked only by a very low crista inferior; its dorsal and posterior delimitations are not bounded by cristae. Near the posterior rim of the otolith, the cauda is slightly deeper than in the anterior portion.

Affinities. - The otoliths described here show a reasonable resemblance with those of the recent species *Xenodermichthys copei* (GILL 1884) (Pl. 2, Fig. 1-4). Fossil *Xenodermichthys* otoliths have never been recognised as such, but one species from the Miocene of Moravia based on juvenile otoliths and described by BRZOBOHATY (1986) as "genus Searsidarum" *kotthausi* probably belongs to the genus.

Suborder GONOSTOMATOIDEI

Family incertae sedis

"genus Gonostomatoideorum" *aenigmaticus* n.sp.

Pl. 3, Fig. 2

Type material. - Holotype and only specimen: a left otolith (Pl. 3, Fig. 2) (IRSNB P 5994).

Dimensions of the holotype. - Length: 2,2 mm; height: 2,0 mm; thickness: 0,6 mm.

Stratum typicum. - Bed 1 of the Kiscell Clay at Noszvaj, Hungary, Late Oligocene.

Derivatio nominis. - *Aenigmaticus, a, um*: aenigmatic; alludes to the unclear affinities of this otolith to those of any of the gonostomatoid families.

Diagnosis. - The holotype is a small, subcircular otolith, slightly truncate in its anterodorsal and posterodorsal outline. There is a well marked rostrum but no clear antirostrum. The outer face is clearly convex, bears numerous very fine growth lines, and an umbo developed as a well marked, somewhat ventrally located elevation. The inner face is slightly convex and nearly flat in its ventral portion. The broad sulcus is very deeply incised, and filled with collicular concretions near the caudal crista inferior. The ostium and the cauda are of about equal width, the ostium being somewhat wider anteriorly. The cauda is more than twice as long as the ostium. The dorsal area bears two shallow parallel and longitudinal depressions.

Discussion. - The otolith described here does not show close relationships with those of any Recent fish taxon. The only reasonable affinity that can be found is with an extinct taxon from the Late Oligocene Saint-Etienne-d'Orthe Clay, figured at Pl. 3, Fig. 4. This comparative material also has a very deeply incised sulcus and a somewhat comparable convexity and shape, but its rostrum is very prominent. These otoliths from the Saint-Etienne-d'Orthe Clay also represent a new species and show reasonable similarity to those of gonostomatoid fishes. However, it is not possible to attribute them to a Recent family in that suborder.

Family STERNOPTYCHIDAE

Argyripnus sp.

Pl. 3, Fig. 1

Material. - One otolith from the Kiscell Clay, bed 1 at Noszvaj.

Remarks. - This single small otolith shows enough morphological evidence to attribute it to the genus *Argyripnus* GILBERT & CRAMER, 1897 (see WEITZMAN, 1974, p. 371, fig. 43A, for comparative Recent material).

Polyipnus weitzmani STEURBAUT, 1982

Pl. 4, Figs. 7-8

Material. - One hundred and four otoliths from the Kiscell Clay at Noszvaj.

Remarks. - This species is also fairly common in the Saint-Etienne-d'Orthe Clay (Late Oligocene) and the Haut-Bernet Clay (Aquitanian) of Aquitaine.

Valenciennellus brzobohatyi STEURBAUT, 1982

Pl. 3, Figs. 5-8

Material. - Twenty-five otoliths from the Kiscell Clay at Noszvaj.

Remarks. - This species is relatively common in mesopelagic otolith associations of the Paratethys and Southern Europe (Aquitaine, Northern Italy, Western Alps), where it occurs from the Priabonian (NP20) to the Chattian (NP24) (NOLF, 1988; STEURBAUT, 1982; STEURBAUT, 1984; NOLF, unpublished data). In the Paratethys, it has been recorded from the Egerian by BRZOBOHATY et al. (1975, p. 465), under the name *Argyropelecus polzi* SCHUBERT, 1908 (see STEURBAUT, 1982, p. 39, for synonymy).

Family PHOTICHTHYIDAE

Vinciguerria sp.
Pl. 3, Figs. 9-11

Material. - Six otoliths from the Kiscell Clay at Noszvaj.

Remarks. - These otoliths exhibit a morphology suggesting affinities with the Recent species *Vinciguerria poweriae* (COCCO, 1838) (see STEURBAUT, 1984, pl. 6, fig. 24). However, we have otoliths only of very few individuals from both the Recent and the fossil taxa. Moreover, the Hungarian sample may not be homogeneous at the species level. Therefore, the taxon is treated in open nomenclature.

Family SCOPELARCHIDAE
Scopelarchus nolfi STEURBAUT, 1982
Pl. 4, Figs. 1-6

Material. - 16 otoliths from the Kiscell Clay at Noszvaj.

Remarks. - This species was originally described on the basis of a juvenile otolith. Newly collected material from the type area at Saint-Etienne-d'Orthe, however, provided many other specimens illustrating considerable ontogenetic changes. In adult specimens, the anterior portion becomes relatively higher, and acquires spines or lobes at the rostrum and the antero- and posteroventral angles. There also appears a clear angle at the junction of the caudal and ostial part of the crista inferior. In Pl. 4, Figs. 1-3 and 4-6, growth series are illustrated with otoliths from respectively the Saint-Etienne-d'Orthe Clay and the Kiscell Clay.

Another species, described on juvenile material from the Pouzdrany Marl (Early Oligocene NP 22) by BRZOBOHATY (1982) as *Scopelarchus moravicus,* could be conspecific, but there are no adult specimens in the newly collected material from Pouzdrany.

Family MYCTOPHIDAE
Diaphus pristismetallis n.sp.
Pl. 4, Figs. 9-14

Type material. - Holotype: a left otolith (Pl. 4, Fig. 9) (IRSNB P 6012); 38 paratypes of which five are figured (Pl. 4, Figs.10-14) (IRSNB P 6013-6017).

Dimensions of the holotype. - Length: 2,8 mm; height: 2,2 mm; thickness: 0,7 mm.

Stratum typicum. - Bed 1 of the Kiscell Clay at Noszvaj, Hungary, Late Oligocene.

Derivatio nominis. - *Pristismetallis* = Hack-saw; alludes to the very dense fine serration at the ventral rim of the otoliths.

Diagnosis. - This species has otoliths characterised by a general elliptical outline with a very smooth posterodorsal angle. The truncated part of the outline behind the angle, typical for many *Diaphus* species, is only slightly marked. The ventral rim is regularly curved, with 12 or more very regularly disposed little spines. The salient rostrum, the small antirostrum and the slightly marked excisura are also typical for the species. In most specimens, the outer face shows a few shallow radial grooves near the rims, with a trend to tuberculation of the areas between the grooves. The inner face is regularly convex in both directions, but viewed ventrally, the outer face is convex in its posterior portion and slightly concave in its anterior part. The ostium is nearly twice as long as the cauda. Most specimens also show a narrow ventral furrow, located relatively high in the ventral area.

Remarks. - *D. pristismetallis* has also been observed in samples from the Saint-Etienne-d'Orthe Clay, Chattian of Aquitaine (unpublished data).

Besides the type material described here, there are more than 1100 additional *Diaphus* otoliths in our samples from the Kiscell Clay at Noszvaj. These are eroded or juvenile specimens, not diagnostic at the species level, although nearly all of them probably belong to *D. pristismetallis.*

Diaphus sp.
Pl. 7, Figs. 4-5

Material. - 54 otoliths from the Eger Formation; see table 2 for locality data.

Remarks. - In the Eger Formation, *Diaphus* otoliths are scarce; only imperfectly preserved or juvenile otoliths are available. At least two types of otoliths occur (Pl. 7, Figs. 4 and 5) representing two species, but the quality of the material does not allow us to name them formally.

Family GADIDAE

"genus aff. ***Raniceps***" ***coelorinchoides*** n.sp.
Pl. 8, Figs. 1-6

Type material. - Holotype: a left otolith (Pl. 8, Fig. 2)

(IRSNB P 6055); 88 paratypes of which five are figured (Pl. 8, Figs. 1 and 3-6) (P6056-6060).

Dimensions of the holotype. - Length:4,2 mm; height: 2,7 mm; thickness: 1,2 mm.

Stratum typicum. - Eger Formation, X-layer at Wind's brickyard, Eger, Hungary; Late Oligocene.

Derivatio nominis. - Alludes to a superficial resemblance with otoliths of the macrourid genus *Coelorinchus*.

Diagnosis. - The otoliths of this species presents a general triangular, somewhat elongate outline, with a very blunt rostral part and a lanceolate posterior end. In juveniles, the outer face shows deep radial grooves and a well developed tuberculation. This feature progressively disappears in the otoliths of older specimens, which have a smooth outer face and unlobated rims. The inner face is slightly convex, nearly flat. The sulcus is well incised and presents massive collicula. The ostial-caudal division of the sulcus is marked by strong angles. The ostium is slightly shorter than the cauda; it does not open clearly to the anterior rim. The cauda narrows towards its posterior end and is very weakly curved ventrally. The crista superior is accentuated by a very shallow depression in the dorsal area, just above the crista.

Family MACROURIDAE

Coelorinchus coelorhincus (RISSO, 1810)
Pl. 5, Figs. 1-5

Material. - Fifty otoliths frome the Kiscell Clay at Noszvaj.

Remarks. - Otoliths of the *Coelorinchus* population from the Late Oligocene at Noszvaj show no significant differences from those of Recent north-eastern Atlantic and Mediterranean populations of *C. coelorhincus*. It is remarkable that in the nearly contemporaneous Saint-Etienne-d'Orthe Clay of the Aquitaine Basin, this Recent species does not occur, but the genus *Coelorinchus* is represented by an extinct and undescribed species; its otoliths indicate fishes of about the same size as in the Noszvaj population.

Family APOGONIDAE

Apogon moyesi STEURBAUT, 1982
Pl. 8, Fig. 10

Material. - One otolith from the Eger Formation at Eger.

Remarks. - This species is also represented in the Late Oligocene Saint-Etienne-d'Orthe Clay and in the Burdigalian Poyartin Marls of the Aquitaine Basin.

Family EPIGONIDAE

Epigonus sp.
Pl. 6, Fig. 4

Material. - Two otoliths from the Kiscell Clay at Noszvaj.

Remarks. - This species seems to be characterised by very thick and robust otoliths, with a strongly incised sulcus, but more material is required for an adequate description.

Family ACROPOMATIDAE

Parascombrops* aff. *brzobohatyi NOLF, 1988
Pl. 6, Figs. 1-2; Pl. 8, Fig. 11

Material.- Three otoliths from the Eger Formation at Eger and 14 otoliths from the Kiscell Clay at Noszvaj.

Remarks.- The morphology of these otoliths corresponds fairly well with that of *P. brzobohatyi*, a species originally described from the Priabonian of the Aquitaine Basin. Unfortunately, only juvenile material is available; otoliths of adult fishes from both the Aquitaine Basin and Hungary are required to decide on the specific identity.

"genus Acropomatidarum" ordinatus
(BRZOBOHATY, 1967)
Pl. 6, Figs. 5-6

Material.- One otolith from the Kiscell Clay at Noszvaj.

Remarks.- A well preserved otolith with a slightly eroded ventral rim (Pl. 6, Fig. 6) corresponds perfectly to the holotype of "genus Acropomatidarum" *ordinatus* (Pl. 6, Fig. 5).

"genus Acropomatidarum" sp.
Pl. 6, Fig. 3

1967 *Ot*. (Percidarum) sp., aff. *opinatus* PROCHAZKA, 1893 - BRZOBOHATY, p. 143, pl. 7, fig. 10.

Material.- One very well preserved otolith with a partially broken rostrum from the Kiscell Clay at Noszvaj.

Remarks.- This specimen certainly belongs to the same species as the otolith from the Pouzdrany wine cellar locality (Early Oligocene of Moravia) cited in the synonymy. The material known only allows an identification at the family level.

Family SILLAGINIDAE

Sillago cf. ***hassovicus*** (KOKEN, 1891)
Pl. 9, Fig. 1

Material.- One otolith from the Eger Formation at Eger.

Remarks.- This incomplete specimen probably belongs to *S. hassovicus*, a species originally described from the Middle Oligocene of Waldböckelheim, Germany. Otoliths of *S.hassovicus* are less elongate than those of *S. schwarzhansi* STEURBAUT, 1984 from the Burdigalian of Aquitaine. They are more elongate and have a less expanded antero-ventral area than those of *S. ventriosus* STEURBAUT, 1984 from the Late Oligocene of Aquitaine.

Family LEIOGNATHIDAE

Gazza orthensis STEURBAUT, 1982
Pl. 9, Figs. 2-3

Material.- Three otoliths from the Eger Formation at Eger.

Remarks.- This species also occurs in the Late Oligocene Saint-Etienne-d'Orthe Clay in Aquitaine, whence it was originally described.

Family SPARIDAE

Dentex aff. ***gregarius*** (KOKEN, 1891)
Pl. 9, Fig. 11

Material.- Twelve otoliths from the Eger Formation at Eger.

Remarks.- *Otolithus* (Sparidarum) *gregarius* was described by KOKEN (1891, p. 128) on the basis of material from several Middle and Late Oligocene localities in Germany. A lectotype from the Middle Oligocene "Meeressand" at Waldböckelheim, Mainz Basin, was subsequently designated by ZILCH (1965, p. 473). Otoliths of this species show very close relationships with those of the Recent *Dentex maroccanus* VALENCIENNES, 1830, and we doubt if the otoliths of both taxa are really diagnostic for specific distinction. *D. maroccanus* is an extremely common species on the North African shelf and upper slope, from Gibraltar to the Gulf of Guinea. From the Gulf of Guinea to Angola, a vicariant species, *D. angolensis* POLL & MAUL, 1953 occurs, and again, it is hard to decide if the otoliths of both vicariants can be distinguished.

The problem can only be solved after careful study of extensive series of otoliths of *D. gregarius* from the type locality, from all the Tertiary basins where it is known to occur, and from Recent populations of *D. maroccanus* and *D. angolensis*. This is the reason why we prefer to treat all the "*D. gregarius*-like" otoliths from the various European Oligo- Miocene basins as a species-group that we call *D.* aff. *gregarius*.

In the Paratethys, *D.* aff. *gregarius* is known from the Late Oligocene to the Middle Miocene (WEILER, 1950; NOLF, 1981; RADWANSKA, 1992); in the North Sea Basin, from the Middle Oligocene to the Middle Miocene (KOKEN, 1891; WEILER, 1942; NOLF, 1977); in the Aquitaine Basin from the Early Oligocene to the Middle Miocene (STEURBAUT, 1984), and in Portugal it is extremely common in Middle Miocene associations (STEURBAUT & JONET, 1981), reflecting a similar ecological niche to the one occupied by the Recent *D.maroccanus* on the North African Atlantic shelf.

Family CEPOLIDAE

Cepola aff. ***rubescens*** LINNAEUS, 1766.
Pl. 9, Figs. 6-8

Material.- Four otoliths from the Eger Formation at Eger.

Remarks.- This taxon is also known from the Late Oligocene Escornebéou Marls and Saint-Etienne-d'Orthe Clay in the Aquitaine Basin (STEURBAUT, 1984, p. 96, as *Cepola* aff. *macrophthalma*).

Family GOBIIDAE

"genus aff. ***Lesueurigobius***" sp.
Pl. 9, Figs. 14-16

Material.- 140 otoliths from the Eger Formation at Eger.

Remarks.- This taxon is also known from the Late Oligocene of the Aquitaine Basin (STEURBAUT, 1984, p. 104).

Family TRICHIURIDAE

Aphanopus sp.
Pl. 6, Fig. 11

Material.- One otolith from the Kiscell Clay at Noszvaj.

Remarks.- This slightly eroded adult otolith shows reasonable similarity to those of the Recent *Aphanopus carbo* LOWE, 1839 (Pl. 6, Fig. 13) and undoubtedly belongs to the same genus. It is noteworthy that the only other fossil record of *Aphanopus* is from the Late Oligocene Saint-Etienne-d'Orthe Clay in the Aquitaine Basin.

Conclusions

Paleo-environmental data

The otoliths collected from the Late Oligocene of the

Eger area revealed the presence of 52 teleost taxa from subtropical to warm temperate waters. Two successive faunas, which have only three species in common are identified (Table 3): the Kiscell Clay fauna, comprising 30 taxa, and the Eger Formation fauna, comprising 25 taxa. Although both faunas belong to distinct stratigraphic horizons, the differences are entirely ecologically conditioned. The Kiscell Clay provides an association of deepwater fishes, quantitatively very rich in otoliths of mesopelagic fishes, while the Eger association reflects a continental shelf fauna.

Fig. 6 provides a bathymetric analysis of the Kiscell Clay association from Noszvaj, according to the method proposed by NOLF & CAPPETTA (1989) and extensively discussed by NOLF & BRZOBOHATY (in press). The analysis is based on a table giving the bathymetric spread of all Recent genera (or species) represented in the association. Because many taxa show a very extensive bathymetric

Table 3 — Stratigraphic range of fish taxa in the Late Oligocene of the Eger area.

STRATIGRAPHIC RANGE OF TELEOSTEAN TAXA IN THE LATE OLIGOCENE OF THE EGER AREA.
Eger Formation only
Rhynchoconger pantanellii (BASSOLI & SCHUBERT, 1906)
«genus Clupeidarum» sp.
Argentina sp.
Diaphus sp.
Echiodon sp.
Neobythitinae ind.
Merluccius sp.
2"genus aff. *Raniceps*» *coelorinchoides* n.sp.
«genus Ambassidarum» sp. *
Apogon moyesi STEURBAUT, 1982
«genus aff. *Apogon*» sp. *
Sillago cf. *hassovicus* (KOKEN, 1891)
Gazza orthensis STEURBAUT, 1982
Dentex aff. *gregarius* (KOKEN, 1891)
Pagellus sp.
Spicara sp.
Sparidae ind.
Sciaena sp.
Cepola aff. *rubescens* LINNAEUS, 1766
«genus aff. *Lesueurigobius*» sp.
Citharus sp.
* = only in bed 5 at Eger (lagoonal deposit at the top of the formation)
Common to Eger and Kiscell Formations
Pterothrissus umbonatus (KOKEN, 1884)
Bregmaceros sp.
Parascombrops aff. *brzobohatyi* NOLF, 1988
Kiscell Formation only
Rhynchoconger sp.
Rhechias nagymarosyi n.sp.
Pseudophichthys elongatus (SULC, 1932)
Clupeidae ind.
Opisthoproctus stellaris n.sp
Xenodermichthys senesi n.sp.
Vinciguerria sp.
«genus Gonostomatoideorum» *aenigmaticus* n.sp.
Argyripnus sp.
Polyipnus weitzmani STEURBAUT, 1982
Valenciennellus brzobohatyi STEURBAUT, 1982
Scopelarchus nolfi STEURBAUT, 1982
Diaphus pristismetallis n.sp.
Bythitinae ind.
Coelorinchus coelorhincus (RISSO, 1810)
Merluccius sp.
Hoplostethus sp.
«genus Trachichthyidarum» sp.
«genus aff. *Pontinus* sp.
Peristedion sp.
Epigonus sp.
«genus Acropomatidarum» *ordinatus* (BRZOBOHATY, 1967)
«genus Acropomatidarum» sp.
Percoidei ind.
Bembrops sp.
Aphanopus sp.
Lepidopus sp.

Table 4 — Faunal assemblages within the Eger Formation. *= Taxa that occur only in one level of the Formation.

SUCCESSIVE FAUNAL ASSOCIATIONS IN THE EGER FORMATION * = taxon only recorded from the concerned unit
Fauna of the mollusc clay
Rhynchoconger pantanellii (BASSOLI & SCHUBERT, 1906)
* *Argentina* sp.
Diaphus sp.
Echiodon sp.
Bregmaceros sp.
Merluccius sp.
«genus aff. *Raniceps*» *coelorinchoides* n.sp.
* *Apogon moyesi* STEURBAUT, 1982
* *Parascombrops* aff. *brzobohatyi* NOLF, 1988
Cepola aff. *rubescens* LINNAEUS, 1766
«genus aff. *Lesueurigobius*» sp.
Citharus sp.
Fauna of the X-layer
* *Pterothrissus umbonatus* (KOKEN, 1884)
Rhynchoconger pantanellii (BASSOLI & SCHUBERT, 1906)
* «genus Clupeidarum» sp.
Diaphus sp.
Echiodon sp.
* Neobythitinae ind.
Merluccius sp.
* *Phycis* sp.
«genus aff. *Raniceps*» *coelorinchoides* n.sp.
* *Sillago* cf. *hassovicus* (KOKEN, 1891)
* *Gazza orthensis* STEURBAUT, 1982
* *Dentex* aff. *gregarius* (KOKEN, 1891)
* *Pagellus* sp.
* *Spicara* sp.
* *Sparidae* ind.
* *Sciaena* sp.
Cepola aff. *rubescens* LINNAEUS, 1766
«genus aff. *Lesueurigobius*» sp.
Citharus sp.
Fauna of the *Cerithium* horizon
* «genus Ambassidarum» sp.
* «genus aff. *Apogon*» sp.
«genus aff. *Lesueurigobius*» sp.

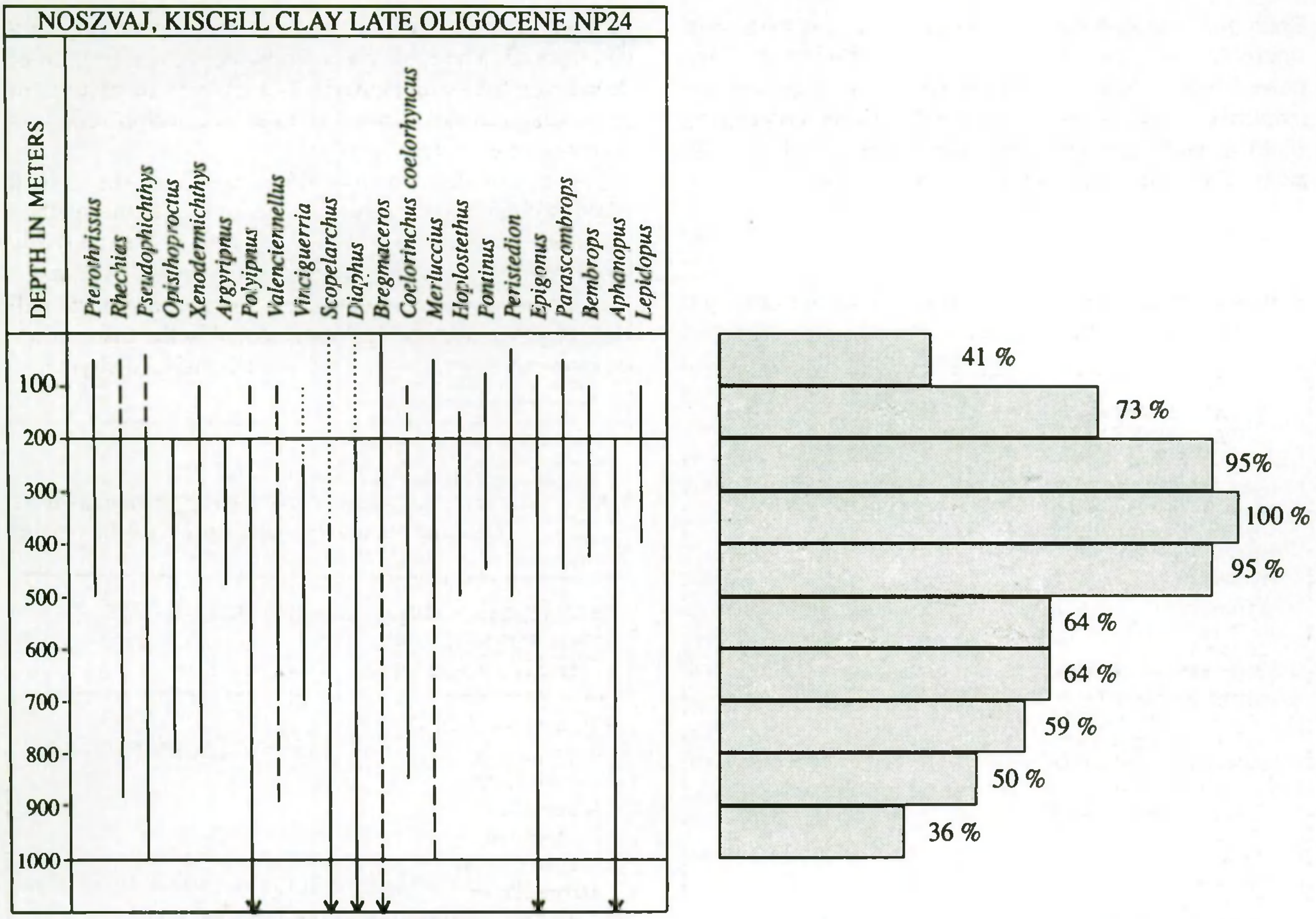

Fig. 6 — Recent bathymetric distribution of teleost taxa represented in the Kiscell Clay at Noszvaj; dotted lines represent nightly presence of some mesopelagic species at the surface and interrupted lines represent less regular presence at the corresponding depth. See main text for explanation of methodology, and see NOLF & BRZOBOHATY (1993) for bibliographic references on bathymetric distribution of Recent fishes.

spread, the interpretation of the chart looks difficult at first glance. In order to deduce the bathymetry for which the association is most indicative, we count the total number of potential presences in each 100 m interval and express this as a percentage of the total number of taxa in the analysis. Those percentages are given in the form of a graph at the right side of the chart. In these calculations, the nightly presences at the surface (pointed lines in the table) of mesopelagic fishes were not taken into account, because this would exaggerate the importance of the neritic component in the association by addition of forms that do not really belong in this environment.

The graph for the Kiscell Clay association shows very high maxima of potential presences in the depth interval between 200 and 500 m, reaching the value of 100% between 300 and 400 m. In the case analysed, the resulting depth can be accredited much confidence, because the association is completely devoid of any typical nearshore taxon. Therefore, the depositional environment for the Kiscell Clay at Noszvaj can be defined as that of an upper slope, at some distance from the continental shelf edge. This is in fair agreement with the data of BALDI & BALDI BEKE (1985, p.14), who postulate an average depth of 400-800 m for the "Kiscellian" of the Hungarian Basin. Data obtained from foraminifers indicate depths to 500 m for southern Slovakia (SUTOVSKA, 1990) and 250-500 m in the area of Estergom, northern Hungary (HORVATH-KOLLANYI & NAGY-GELLAI, 1989).

The 25 taxa recorded from the Eger Formation consist of three distinct assemblages (Table 4), corresponding with the progressive shallowing of the environment. In each association, the taxa that do not occur in other levels of the formation have been marked with an asterisk in the table, and it is very obvious that the number of such exclusive taxa is high in each of the associations.

The method of bathymetric analysis applied for the Kiscell Clay Formation is essentially suited to true deep-water associations, but provides no good results for the neritic realm, especially if the associations are restricted in constituent taxa, as in the Eger Formation. In the latter case, a glance at the exclusive taxa in each association is more instructive. Although genera like *Argentina* and *Parascombrops* (molluscan clay fauna) may occur as shallow as 50 m, they are rather characteristic for deep neritic to upper slope environments. *Apogon* occurs from 0 to 200 m, but most species are confined to shallow water. However, the species concerned, *Apogon moyesi*, is a fossil that was originally described from the Saint-Etienne-d'Orthe Clay in Aquitaine, a deep neritic to upper slope deposit. Therefore, we think that a water depth of at least 50 m should be accepted for the mollusc clay. The estimate of BALDI & al. (1975, p. 101) of 100-200 m for the mollusc clay is not in contradiction with our data, but the resolution attainable with the restricted otolith material collected does not allow us to state more than a minimal depth of 50 m; it does not, however exclude a much deeper zone of the continental platform. KVACEK & HABLY (1991, p.50) qualify the mollusc clay as "deep littoral to bathyal", but in our opinion, the qualification "bathyal" is in disagreement with the scarcity of myctophid otoliths.

Although the X-layer (basement of bed 4) association contains several taxa ranging currently as deep as 200 m, genera like *Sillago* and *Gazza* are inhabitants of very shallow inshore waters; both taxa even dwell in brackish or mangrove areas and *Sillago* may swim up river mouths for considerable distances. The sparids, centracanthids, sciaenids and the high numbers of gobies are also indicative of shallow water, suggesting a definite nearshore environment, probably less than 50 m, for the X-layer. Finally, the restricted fauna from the *Cerithium* horizon (upper part of bed 5 at Eger, Wind Brickyard) is dominated by an ambassid, a typical euryhaline family, occurring only in marginal marine environments with a considerable influx of fresh water.

Comparison with Oligocene faunas from other European basins

Very few Oligocene otolith faunas are suited for direct comparison with the associations studied here. In fact, the only comparisons that make sense are with the Pouzdrany Marls in southern Moravia, and with the Late Oligocene deposits of southern Aquitaine, but our otolith studies for both of these areas are still in progress. In Table 5, the occurrence in more or less contemporaneous European deposits that are relevant for comparison is given for all the nominal species recorded from the Eger and Kiscell Formations.

The fauna of the Brown Pouzdrany Marls (Early and Middle Oligocene, nannoplankton Zones NP21-23) was studied by BRZOBOHATY (1967 and 1982), but several identifications are in need of revision, and additional material from Pouzdrany collected by BRZOBOHATY & NOLF in 1989 and 1991 remains to be studied. Therefore, our comparison is restricted to the citation of nominal taxa from the Pouzdrany Marls also occurring in the Eger area.

The Pouzdrany Marls have no species in common with the Eger Formation, but share at least 4 of the 13 nominal species from the Kiscell Clay; it is clear that this similarity is mainly due to the comparable facies of both deposits. It is hazardous to put much value on stratigraphic ranges resulting from such limited data.

Table 5 — Nominal species of teleosts from the Late Oligocene of the Eger area, and their distribution in contemporaneous strata outside Hungary.

NOMINAL SPECIES	Pouzdrany Marl	Saint-Etienne-d'Orthe Clay	Oligocene, North Sea Basin	Miocene, various basins
Eger Formation only				
Rhynchoconger pantanellii (BASSOLI & SCHUBERT, 1906)	-	-	-	M
«genus aff. *Raniceps*» *coelorinchoides* n.sp.	-	-	-	-
Apogon moyesi STEURBAUT, 1982	-	S	-	M
Sillago cf. *hassovicus* (KOKEN, 1891)	-	-	N	-
Gazza orthensis STEURBAUT, 1982	-	S	-	-
Dentex aff. *gregarius* (KOKEN, 1891)	-	S	N	M
Cepola aff. *rubescens* LINNAEUS, 1766	-	S	-	M
Common to Eger and Kiscell Formations				
Pterothrissus umbonatus (KOKEN, 1884)	-	S	N	M
Parascombrops aff. *brzobohatyi* NOLF, 1988	P	S	-	-
Kiscell Formation only				
Rhechias nagymarosyi n.sp.	-	-	-	-
Pseudophichthys elongatus (SULC, 1932)		-	-	-
Opisthoproctus stellaris n.sp.	S	-	-	
Xenodermichthys senesi n.sp.	-	S	-	-
«genus Gonostomatoideorum» *aenigmaticus* n.sp.	-	-	-	-
Polyipnus weitzmani STEURBAUT, 1982	-	S	-	M
Valenciennellus brzobohatyi STEURBAUT, 1982	-	S	-	-
Scopelarchus nolfi STEURBAUT, 1982	?	S	-	-
Diaphus pristismetallis n.sp.	P	S	-	-
Coelorinchus coelorhincus (RISSO, 1810)		-	-	M
«genus Acropomatidarum» *ordinatus* (BRZOBOHATY, 1967)	P	-	-	-

The most relevant similarity shown by the Late Oligocene teleost fauna of the Eger area is certainly with the one from the Late Oligocene (Zone NP25) Saint-Etienne-d'Orthe Clay of the Aquitaine Basin, a mainly deep neritic deposit containing a very diverse otolith assemblage. STEURBAUT (1984, p. 122) listed 36 species from this deposit, but intensive new sampling of additional localities in the vicinity of Saint-Etienne-d'Orthe by NOLF & BRZOBOHATY in 1992 resulted in the discovery of many more species. Some of these occur also in the Eger area and are consequently described here. Notwithstanding the geographic distance separating the two areas, 12 of the 20 nominal species (60%) recorded from the Eger area are also known from Saint-Etienne-d'Orthe. A comparison of Table 3 with Table 5 is very instructive. While the first table stresses the very strong differences between the Kiscell and Eger associations, the second demonstrates that species from both formations occur together at Saint-Etienne-d'Orthe. This is explained easily by the depositional environment of the Saint-Etienne-d'Orthe Clay (deep neritic to uppermost slope), which was intermediate in depth between those we reconstructed for the two Hungarian formations. This confirms our statement that the strong difference between the Kiscell and Eger otolith associations is ecologically conditioned. Another important conclusion is that the Late Oligocene (nannoplankton Zones NP 24 and 25) ichthyofauna must have been quite homogeneous from the Paratethys to the Eastern Atlantic (Bay of Biscay). Such a fauna can be of derable biostratigraphic value, but its time range has to be tested by studies of otolith associations from Middle Oligocene and Early Miocene deep neritic and upper slope deposits in the Paratethys, Mediterranean and Eastern Atlantic realm.

Another striking fact revealed by Table 5 is that the Late Oligocene fauna from the Eger area has almost no species in common with the North Sea Basin Oligocene. The last column of Table 5, finally, shows that only 7 (=35%) species are found in the Miocene. This number is rather low, but as already stated, further research on early Miocene otoliths from relatively deep water deposits is required before we can make further inferences.

Palaeogeographic indications

In the neritic component of the fauna studied, the ambassids, sillaginids and leiognatids have an exclusively Indo-West-Pacific distribution (except for some recent Mediterranean intruders through the Suez Canal). Among the deeper dwelling neritic taxa and oceanic fishes, *Rhynchoconger, Rhechias, Opisthoproctus, Xenodermichthys, Argyripnus, Polyipnus, Scopelarchus*, the acropomatids, *Bembrops* and *Aphanopus* are not represented in the Recent Mediterranean fauna. This proves that in the Late Oligocene, even marginal oceanic dependences of this basin were inhabited by more typical oceanic faunas than today. This aspect of Mediterranean paleobiogeography was already mentioned for an Early Oligocene (Zone NP21) deepwater otolith association from northern Italy (NOLF & STEURBAUT, 1988, p. 229). What is more, until the end of the Pliocene, the deep sea fauna of the Mediterranean had a more open oceanic character than today (NOLF & CAPPETTA, 1989).

All these data fit very well with the paleogeographic reconstruction of the Late Oligocene Mediterranean realm by RÖGL & STEININGER (1983, 1984a, 1984b) (Fig.7), which postulates a Paratethys without direct link with the North Sea Basin, but an open connection with an Indo-Pacific-Atlantic seaway across the Mediterranean, and a pronounced circum-equatorial current system.

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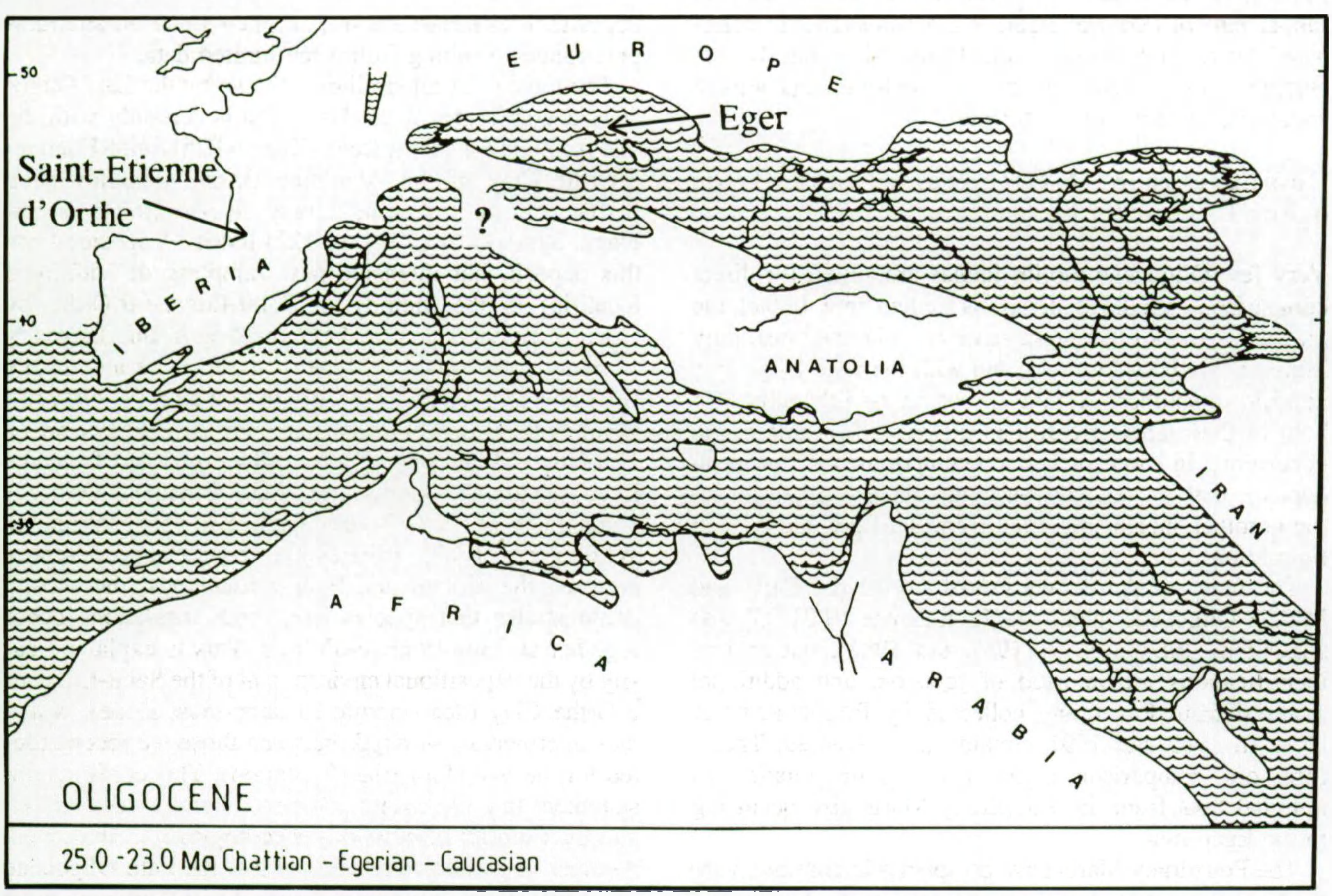

Fig. 7 — Palinspastic reconstruction of the Circum-Mediterranean Region in the Late Oligocene and location of Eger and Saint-Etienne-d'Orthe (after RÖGL & STEININGER, 1983, modified).

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Explanation of the plates

All figured specimens are deposited in the collections of the Institut Royal des Sciences Naturelles de Belgique (IRSNB),with the exception of the holotype of "genus Acropomatidarum" *ordinatus*, which belongs to the collection of the Moravian Country Museum in Brno (MZM, geol.). The fossil otoliths bear numbers of the collection of type and figured fossil fish specimens of the IRSNB. The Recent otoliths are part of the reference collection of Recent otoliths at the same Institution. The latter collection is arranged in systematic order without numbering; therefore,such specimens, when figured, bear only the notation "coll. IRSNB".

The abbreviations F and R in the upper right corner of each compartment of the plates indicate if the figured specimens in that compartment are fossil (F) or Recent (R). In the captions, L stands for left otolith and R for right otolith. The notations Fig. a, b and c are used to indicate respectively ventral, inner (=mesial) and posterior views. Figures with only numbers and no letter show inner views.

PLATE 1

Fig. 1 — *Pterothrissus umbonatus* (KOKEN, 1884). L (IRSNB P 5975); Kiscell Clay, Noszvaj, bed 3.
Fig. 2 — *Pseudophichthys elongatus* (SULC, 1932). L (IRSNB P 5976); Kiscell Clay, Noszvaj, bed 1.
Fig. 3-6 — *Rhechias nagymarosyi* n.sp. 3&5=L; 6=R, paratypes (IRSNB P 5977-5979); 4=L, holotype (IRSNB P 5980); Kiscell Clay, Noszvaj, bed 1.
Fig. 7 — Clupeidae ind. R (IRSNB P 5981); Kiscell Clay, Noszvaj, bed 5
Fig. 8-10 — *Opisthoproctus stellaris* n.sp. 9=L; holotype (IRSNB P 5982); 8=L, 10=R, paratypes (IRSNB P 5983, P 5984); 9-10= Saint-Etienne-d'Orthe Clay, Lestelle, at Saint-Etienne-d'Orthe (Aquitaine, France); 8= Kiscell Clay, Noszvaj, bed 1.

Plate 2

Fig. 1-4 — *Xenodermichthys copei* (GILL, 1884). L (coll. IRSNB); Recent, Bay of Biscay.
Fig. 5-12 — *Xenodermichthys senesi* n.sp. 5=L, holotype (IRSNB P 5985); 6-8=L, paratypes (IRSNB P 5986-5988); 9-12=R, paratypes (IRSNB 5989-5992); 5-11= Saint-Etienne-d'Orthe Clay, Lestelle, at Saint-Etienne-d'Orthe (Aquitaine, France), 12= Kiscell Clay Noszvaj, bed 3.

Plate 3

Fig. 1 — *Argyripnus* sp. L (IRSNB P 5993); Kiscell Clay, Noszvaj, bed 1.
Fig. 2 — "genus Gonostomatoideorum" *aenigmaticus* n.sp. L, holotype (IRSNB P 5994); Kiscell Clay, Noszvaj, bed 1.
Fig. 3-4 — "genus Gonostomatoideorum" sp. 3=L, 4=R (IRSNB P 5995, P 5996); Saint-Etienne-d'Orthe Clay, Lestelle, at Saint-Etienne-d'Orthe (Aquitaine, France).
Fig. 5-8 — *Valenciennellus brzobohatyi* Steurbaut, 1982. L (IRSNB P 5997-6000); Kiscell Clay, Noszvaj, bed 1.
Fig. 9-11 — *Vinciguerria* sp. L (IRSNB P 6001-6003); Kiscell Clay, Noszvaj, bed 1.

Plate 4

Fig. 1-6 — *Scopelarchus nolfi* Steurbaut, 1982. 1-3=L (IRSNB P 6004-6006); Saint-Etienne-d'Orthe Clay, Lestelle, at Saint-Etienne-d'Orthe (Aquitaine, France); 4-6=R (IRSNB P 6007-6009); Kiscell Clay, Noszvaj, bed 1.
Fig. 7-8 — *Polyipnus weitzmani* Steurbaut, 1982. 7=L (IRSNB P 6010), 8=R (IRSN P 6011); Kiscell Clay, Noszvaj, bed 1.
Fig. 9-14 — *Diaphus pristismetallis* n.sp. 9=L, holotype (IRSNB P 6012), 10-11=L, paratypes (IRSB P 6013, P 6014), 12-14=R, paratypes (IRSNB P 6015-6017); Kiscell Clay, Noszvaj, bed 1.

Plate 5

Fig. 1-5 — *Coelorinchus coelorhincus* (RISSO, 1810). L (IRSNB P 6018-6022); Kiscell clay, Noszvaj, bed 1.
Fig. 6 — Bythitinae ind. R (IRSNB P 6023); Kiscell Clay, Noszvaj, bed 1.
Fig. 7 — *Merluccius* sp. L (IRSNB P 6024), Kiscell Clay, Noszvaj, bed 1.
Fig. 8 — *Bregmaceros* sp. L (IRSNB P 6025); Kiscell Clay, Noszvaj, bed 1.
Fig. 9 — "genus Trachichthyidarum" sp. R (IRSNB P 6026), Kiscell Clay, Noszvaj, bed 1.
Fig. 10-12 — *Hoplostethus* sp. R (IRSNB P 6027-6029); Kiscell Clay, Noszvaj, bed 1.

Plate 6

Fig. 1-2 — *Parascombrops* aff. *brzobohatyi* Nolf, 1988. R (IRSNB P 6030, P 6031); Kiscell Clay, Noszvaj; 1= bed 3; 2= bed 1.
Fig. 3 — "genus Acropomatidarum" sp. R (IRSNB P 6032; Kiscell Clay, Noszvaj, bed 5.
Fig. 4 — *Epigonus* sp. R (IRSNB P 6033); Kiscell Clay, Noszvaj, bed 1.
Fig. 5-6 — "genus Acropomatidarum" *ordinatus* (Brzobohaty, 1967). 5=L, holotype (MZM geol. 14620), Pouzdrany Marls, Pouzdrany, wine cellar; 6=L (IRSNB P 6034), Kiscell Clay, Noszvaj, bed 3.
Fig. 7 — Percoidei ind. L (IRSNB P 6035); Kiscell Clay, Noszvaj, Bed 5.
Fig. 8 — "genus aff. *Pontinus*" sp. L (IRSNB P 6036); Kiscell Clay, Noszvaj, bed 1.
Fig. 9 — *Peristedion* sp. R (IRSNB P 6037); Kiscell Clay, Noszvaj, bed 1.
Fig. 10 — *Bembrops* sp. L (IRSNB P 6038); Kiscell Clay, Noszvaj, bed 1.
Fig. 11 — *Aphanopus* sp. L (IRSNB P 6039); Kiscell Clay, Noszvaj, bed 1.
Fig. 12 — *Lepidopus* sp. L (IRSNB P 6040); Kiscell Clay, Noszvaj, bed 1.
Fig. 13 — *Aphanopus carbo* LOWE, 1839. L (coll. IRSNB); Recent, off N Ireland.

Plate 7

Fig. 1 — *Pterothrissus umbonatus* (Koken, 1884). R (IRSNB P 6041); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 2-3 — *Rhynchoconger pantanellii* (Bassoli & Schubert, 1906). L (IRSNB P 6042, P 6043); Eger Formation, Eger, Wind brickyard; 2= bed 3; 3= x-layer.

Fig. 4-5 — *Diaphus* sp. 4= L (IRSNB P 6044); Eger Formation, Rosalia cemetery at Eger, Mollusc Clay; 5=R (IRSNB P 6045); Eger Formation, gravel pit NE of Eger.
Fig. 6 — *Echiodon* sp. L (IRSNB P 6046); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 7 — Neobythitinae ind. R (IRSNB P 6047); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 8-9 — *Bregmaceros* sp. R (IRSNB P 6048, P 6049); Eger Formation, Eger, Wind brickyard, bed 3.
Fig. 10-11 — *Phycis* sp. L (IRSNB P 6050, P 6051); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 12 — "genus Clupeidarum" sp. L (IRSNB P 6052); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 13 — *Argentina* sp. L (IRSNB P 6053); Eger Formation, Novaj, Mollusc Clay, bed 11.
Fig. 14 — *Merluccius* sp. R (IRSNB P 6054); Eger Formation, Eger, Wind brickyard, bed 3.

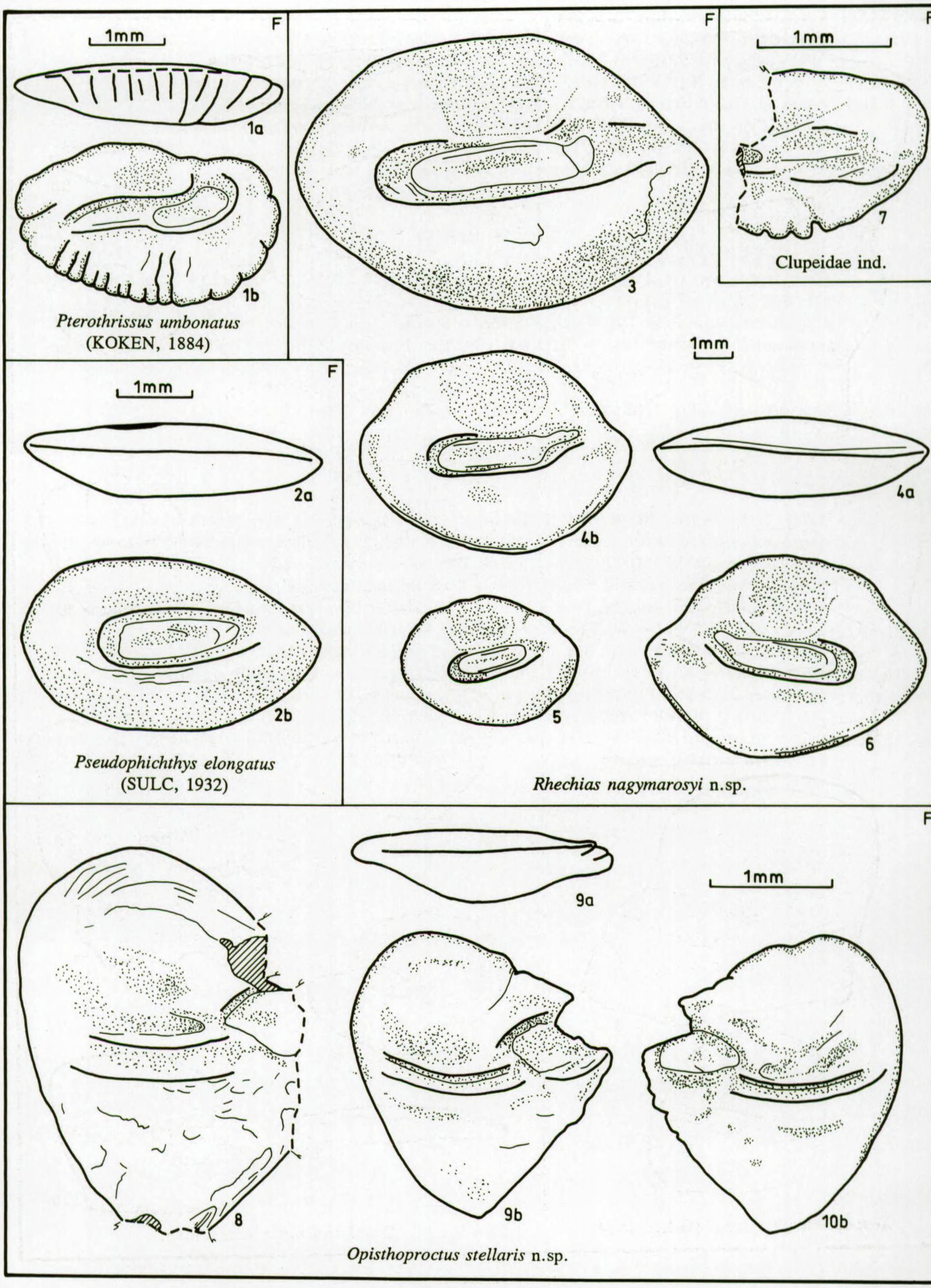
PLATE 8

Fig. 1-6 — "genus aff. *Raniceps*" *coelorinchoides* n.sp. 2=L, holotype (IRSNB P 6055); 1 and 3-6: L, paratypes (IRSNB P 6056-6060), Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 7-9 — "genus Ambassidarum" sp. 7=L; 8-9=R (IRSNB P 6061-6063); Eger Formation, Eger, Wind brickyard, bed 5.
Fig. 10 — *Apogon moyesi* STEURBAUT, 1982. R (IRSNB P 6064), Eger Formation, Eger, Wind brickyard, bed 3.
Fig. 11 — *Parascombrops* aff. *brzobohatyi* NOLF, 1988. R (IRSNB P 6065) Eger Formation, Rosalia cemetery at Eger, Mollusc Clay.
Fig. 12 — "genus aff. *Apogon*" sp. L (IRSNB P 6066); Eger Formation, Eger, Wind brickyard, bed 5.

PLATE 9

Fig. 1 — *Sillago* cf. *hassovicus* (KOKEN, 1891). R (IRSNB P 6067); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 2-3 — *Gazza orthensis* STEURBAUT, 1982. L (IRSNB P 6068, P 6069); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 4 — *Pagellus* sp. L (IRSNP P 6070); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 5 — *Pagellus erythrinus* (LINNAEUS, 1758). L (coll. IRSNB); Recent, Barcelona.
Fig. 6-8 — *Cepola* cf. *rubescens* LINNAEUS, 1766. R (IRSNB P 6071-6073); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 9 — *Spicara* sp. L (IRSNB P 6074); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 10 — *Sciaena* sp. L (IRSNB P 6075); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 11 — *Dentex* aff. *gregarius* (KOKEN, 1891). L (IRSNB P 6076); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 12 — *Citharus* sp. L (IRSNB P 6077); Eger Formation, Novaj, Mollusc Clay, bed 11.
Fig. 13 — Sparidae ind. R (IRSNB P 6078); Eger Formation, Eger, Wind brickyard, x-layer.
Fig. 14-16 — "genus aff.*Lesueurigobius*" sp. 15=L (IRSNB P 6079), 14 and 16 = R (IRSNB P 6080, P 6081); Eger Formation, Eger, Wind brickyard, x-layer.

Plate 1



Pterothrissus umbonatus (KOKEN, 1884)

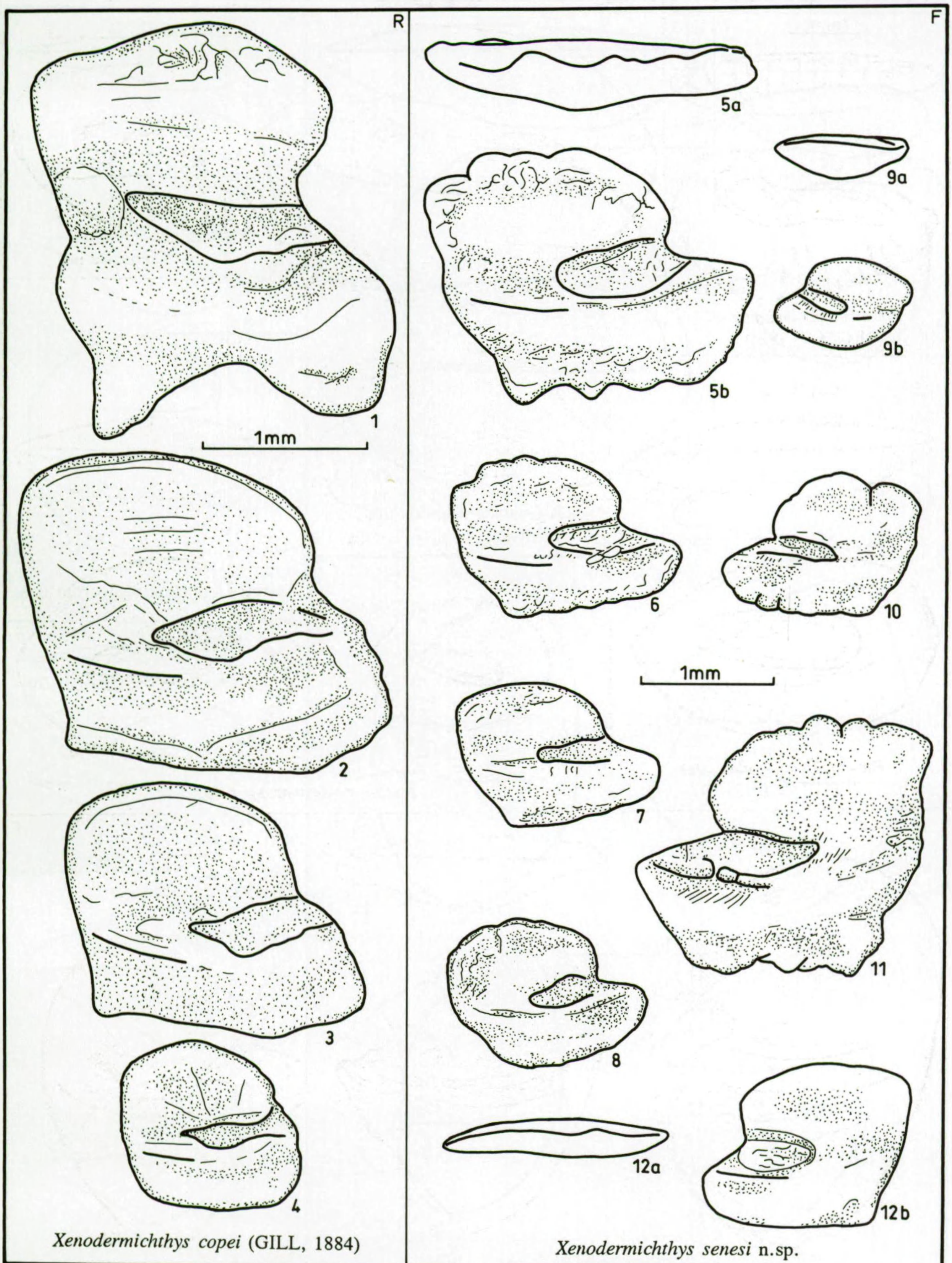
Clupeidae ind.

Pseudophichthys elongatus (SULC, 1932)

Rhechias nagymarosyi n.sp.

Opisthoproctus stellaris n.sp.

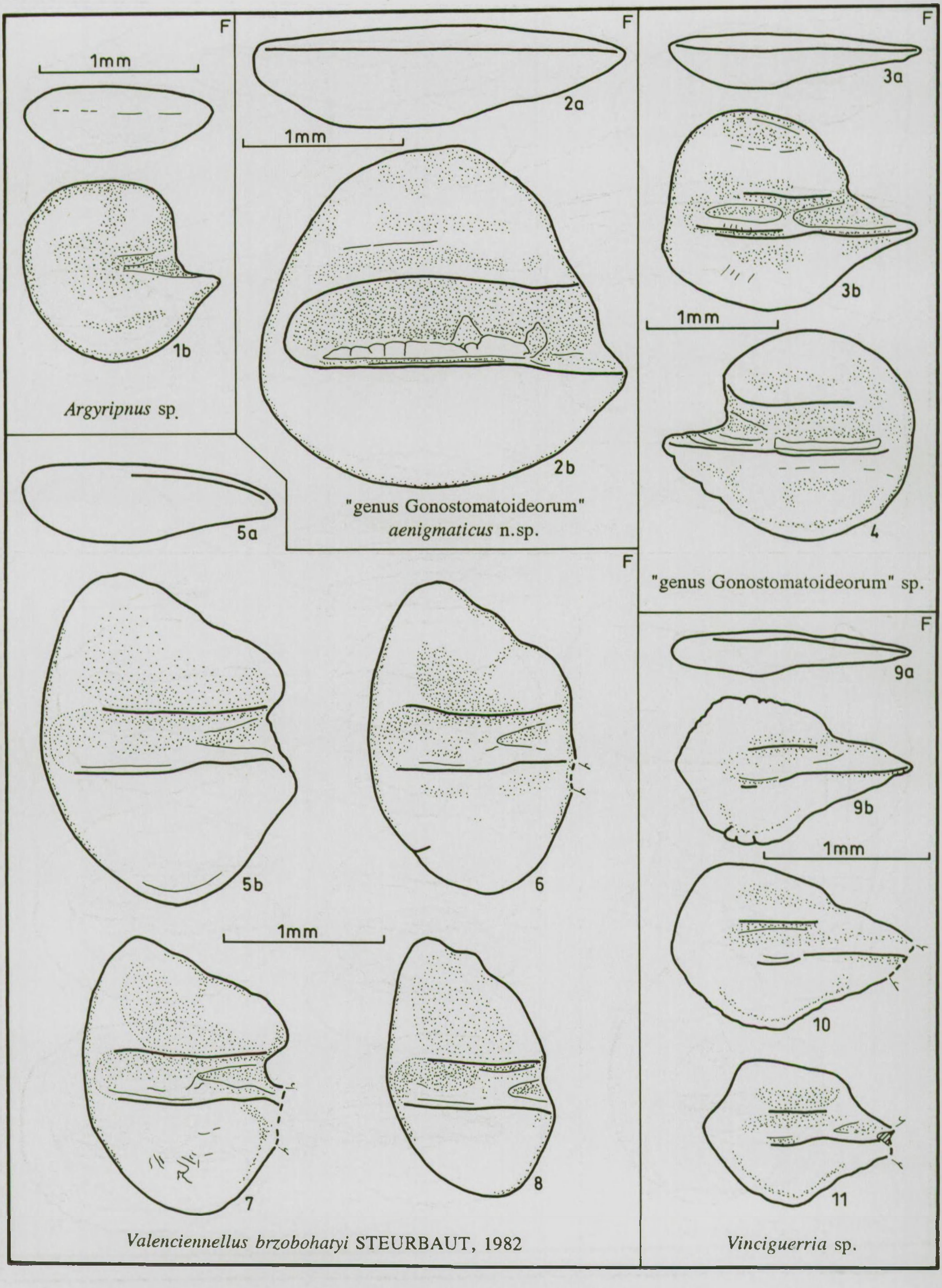
Plate 2



Xenodermichthys copei (GILL, 1884)

Xenodermichthys senesi n.sp.

Plate 3



Argyripnus sp.

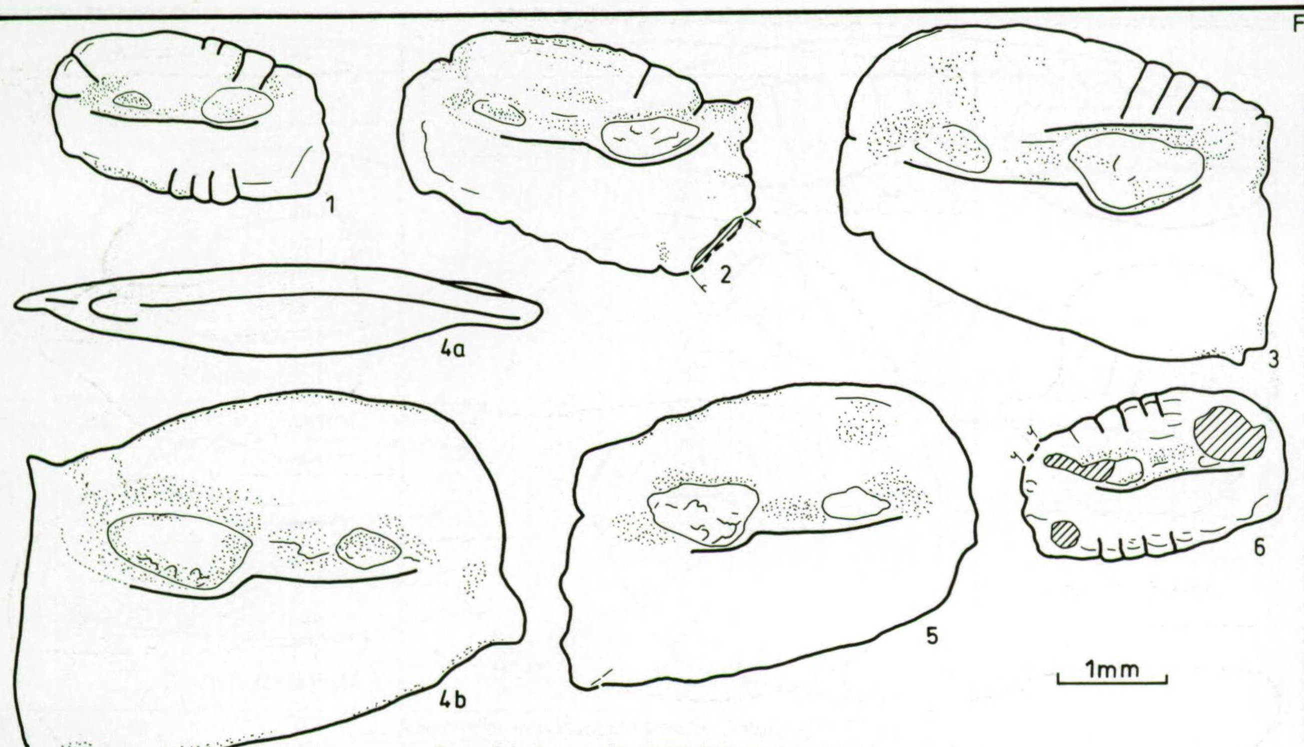
"genus Gonostomatoideorum" *aenigmaticus* n.sp.

"genus Gonostomatoideorum" sp.

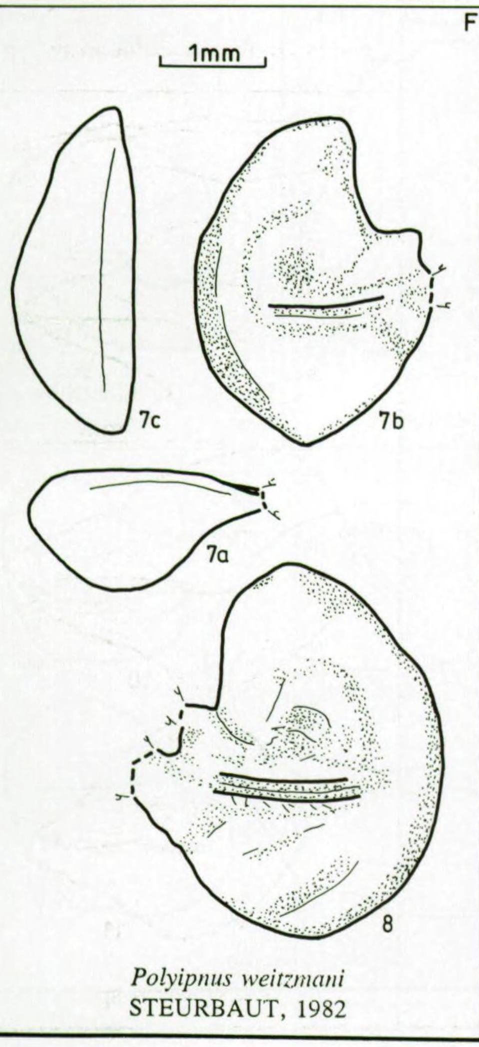
Valenciennellus brzobohatyi STEURBAUT, 1982

Vinciguerria sp.

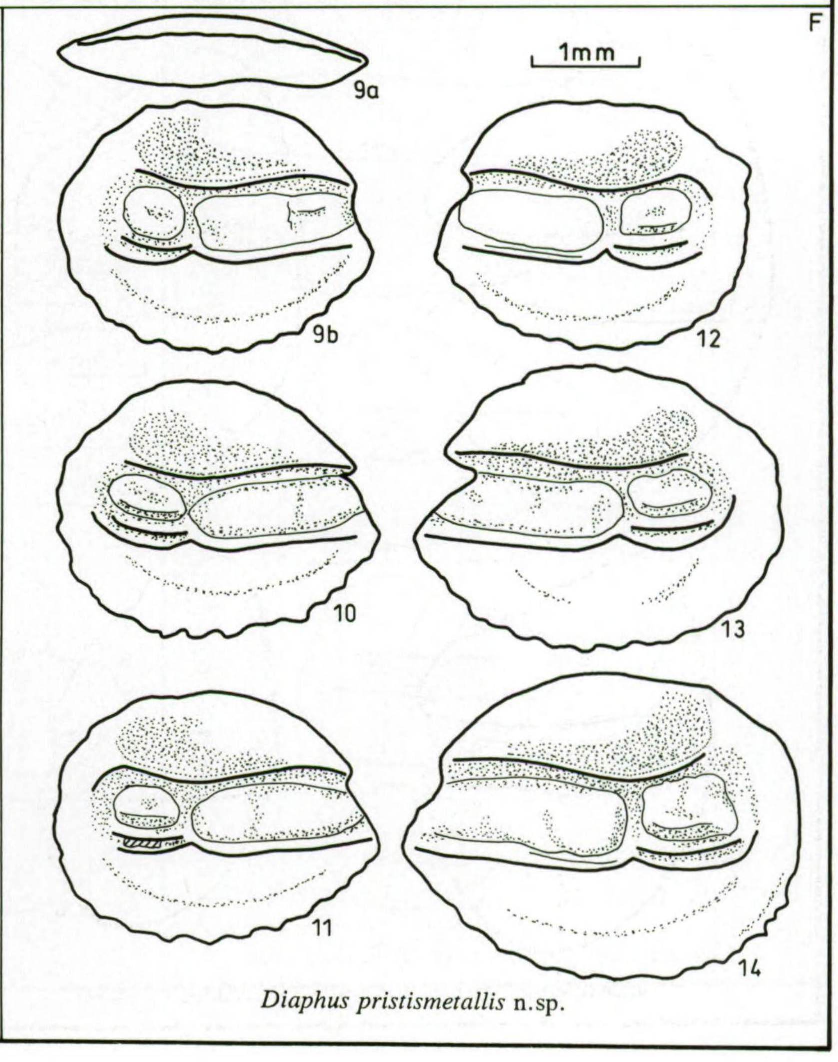
Plate 4



Scopelarchus nolfi STEURBAUT, 1982



Polyipnus weitzmani
STEURBAUT, 1982



Diaphus pristismetallis n.sp.

Plate 5

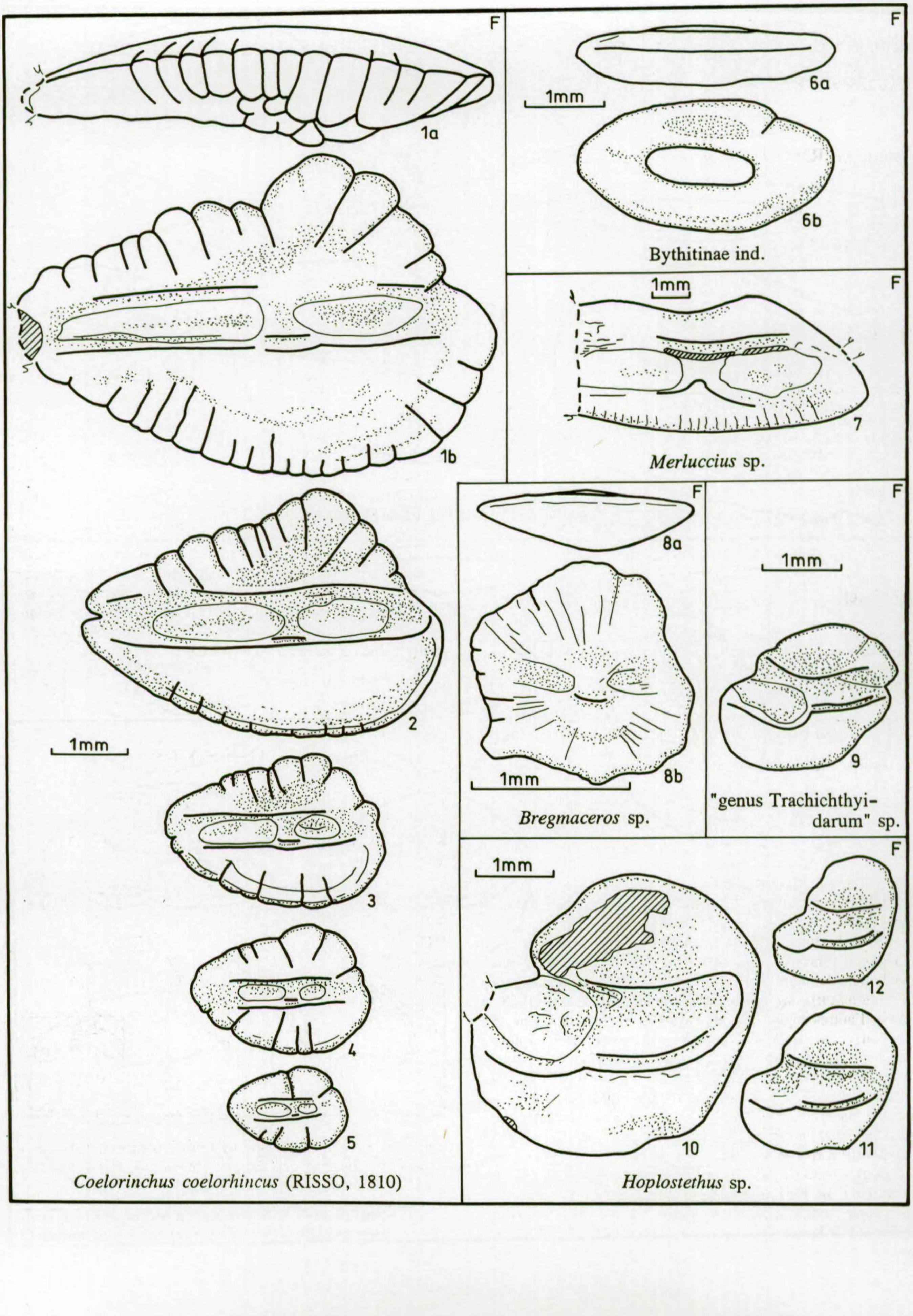

F
1a
1b
2
1mm
3
4
5
Coelorinchus coelorhincus (RISSO, 1810)
6a
1mm
6b
Bythitinae ind.
1mm
7
Merluccius sp.
8a
8b
1mm
Bregmaceros sp.
1mm
9
"genus Trachichthyi-
darum" sp.
1mm
10
11
12
Hoplostethus sp.

Plate 6

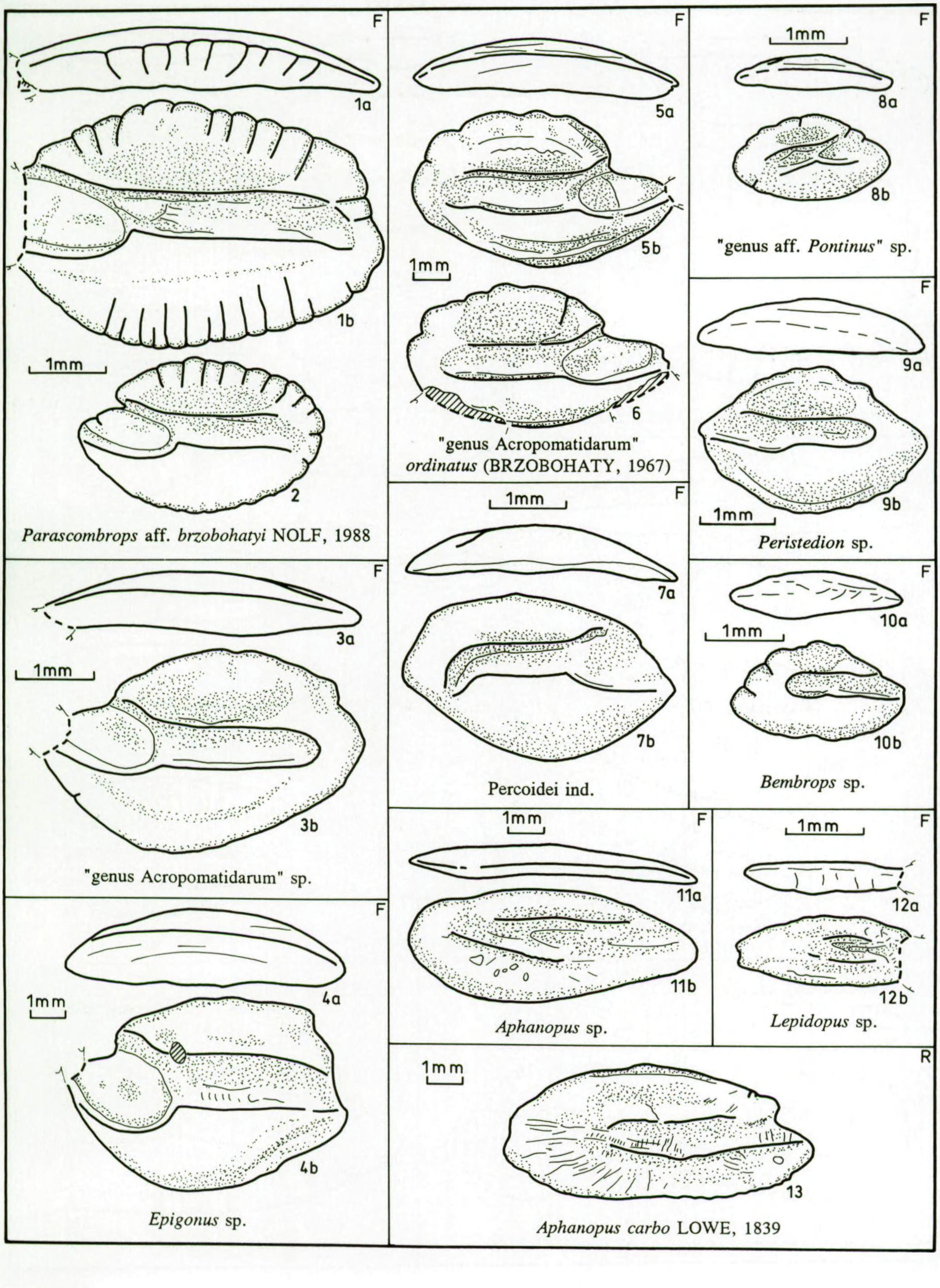

F
1a
1b
1mm
2
Parascombrops aff. *brzobohatyi* NOLF, 1988
5a
5b
1mm
6
"genus Acropomatidarum"
ordinatus (BRZOBOHATY, 1967)
1mm
8a
8b
"genus aff. *Pontinus*" sp.
9a
9b
1mm
Peristedion sp.
3a
1mm
3b
"genus Acropomatidarum" sp.
1mm
7a
7b
Percoidei ind.
10a
1mm
10b
Bembrops sp.
4a
1mm
4b
Epigonus sp.
1mm
11a
11b
Aphanopus sp.
1mm
12a
12b
Lepidopus sp.
R
1mm
13
Aphanopus carbo LOWE, 1839

Plate 7

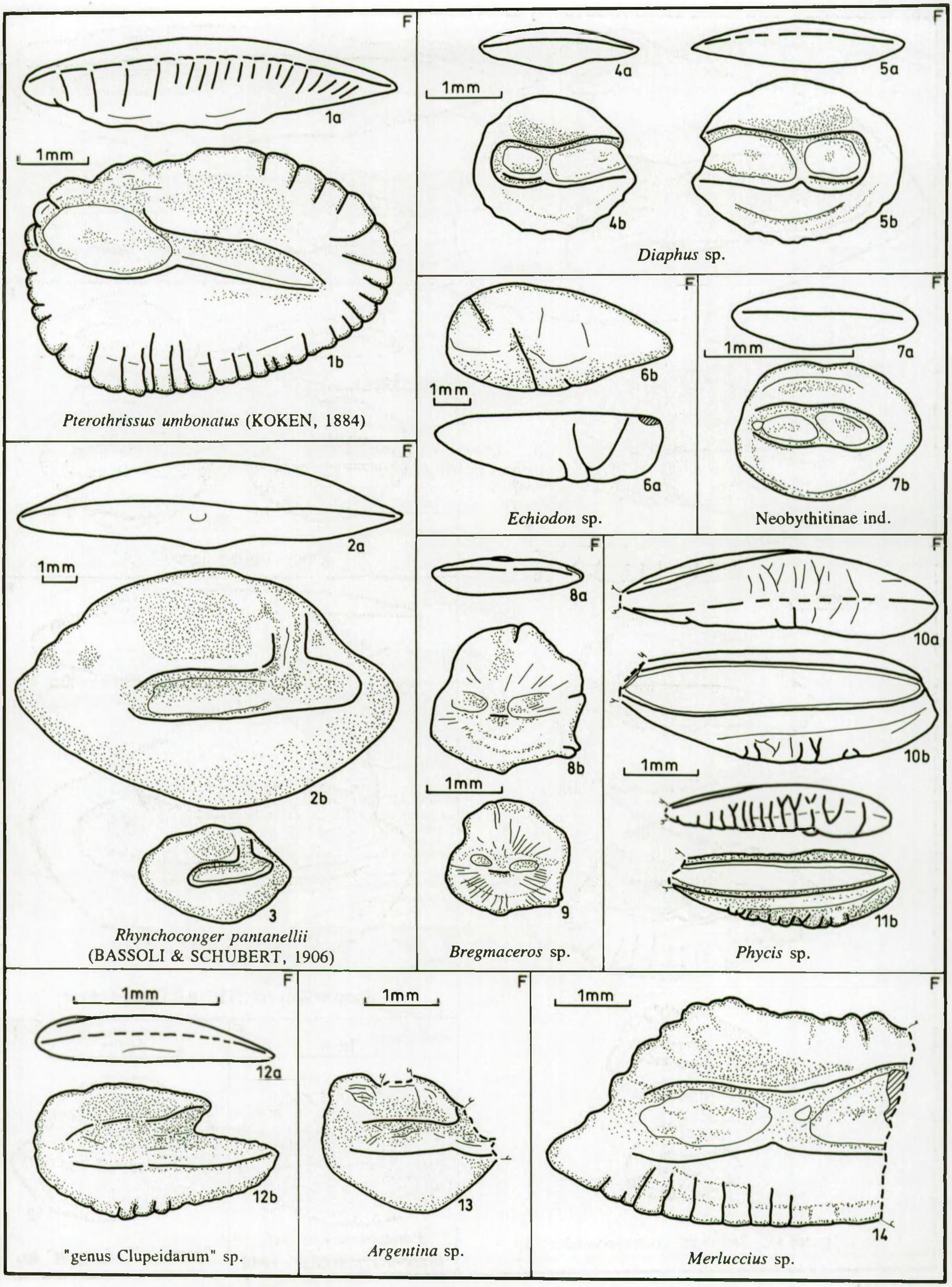
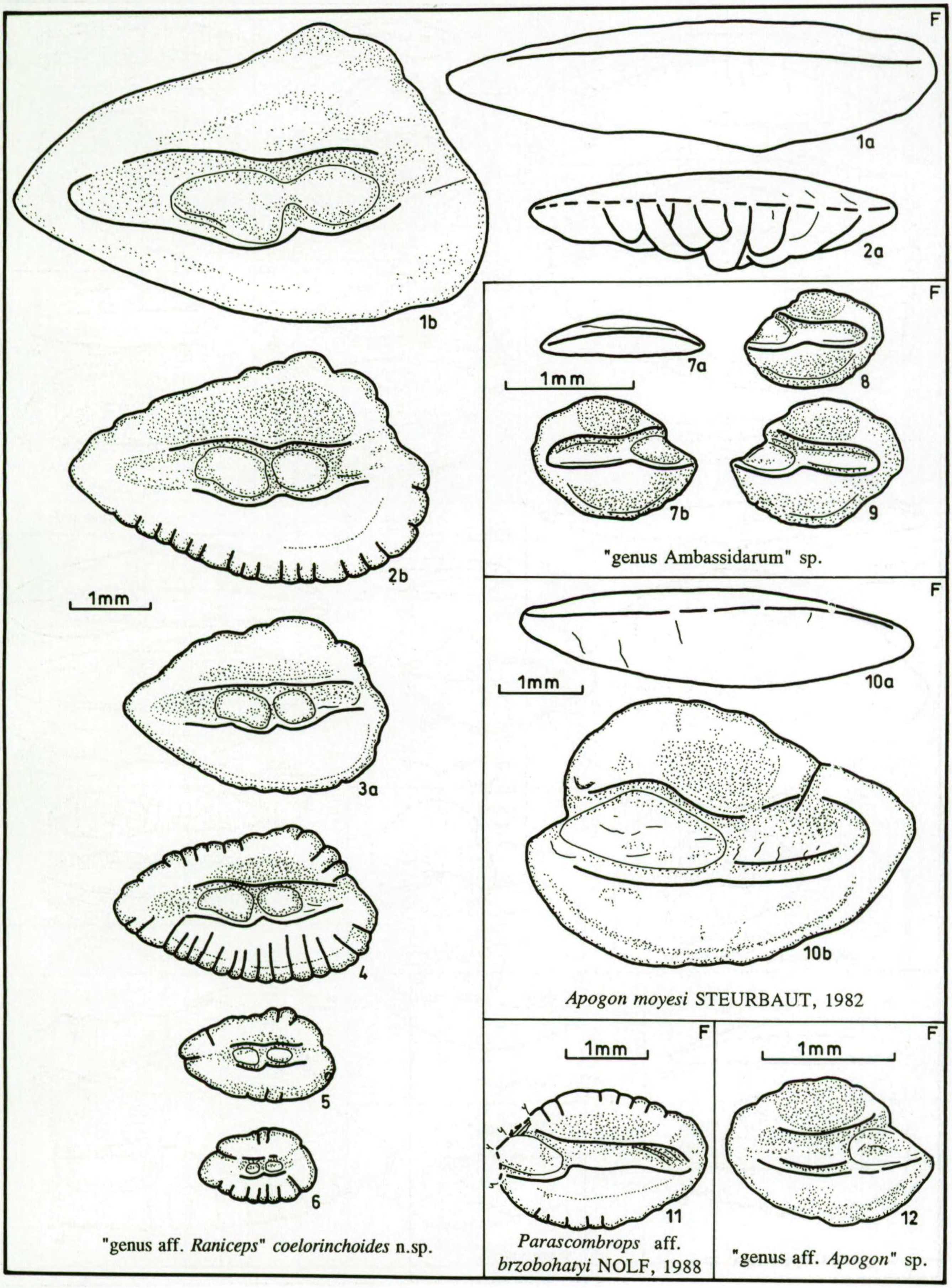

F
1a
1mm
1b
Pterothrissus umbonatus (KOKEN, 1884)
4a
5a
1mm
4b
5b
Diaphus sp.
6b
1mm
6a
Echiodon sp.
7a
1mm
7b
Neobythitinae ind.
2a
1mm
2b
3
Rhynchoconger pantanellii
(BASSOLI & SCHUBERT, 1906)
8a
8b
1mm
9
Bregmaceros sp.
10a
10b
1mm
11b
Phycis sp.
1mm
12a
12b
"genus Clupeidarum" sp.
1mm
13
Argentina sp.
1mm
14
Merluccius sp.

Plate 8



"genus aff. *Raniceps*" *coelorinchoides* n.sp.

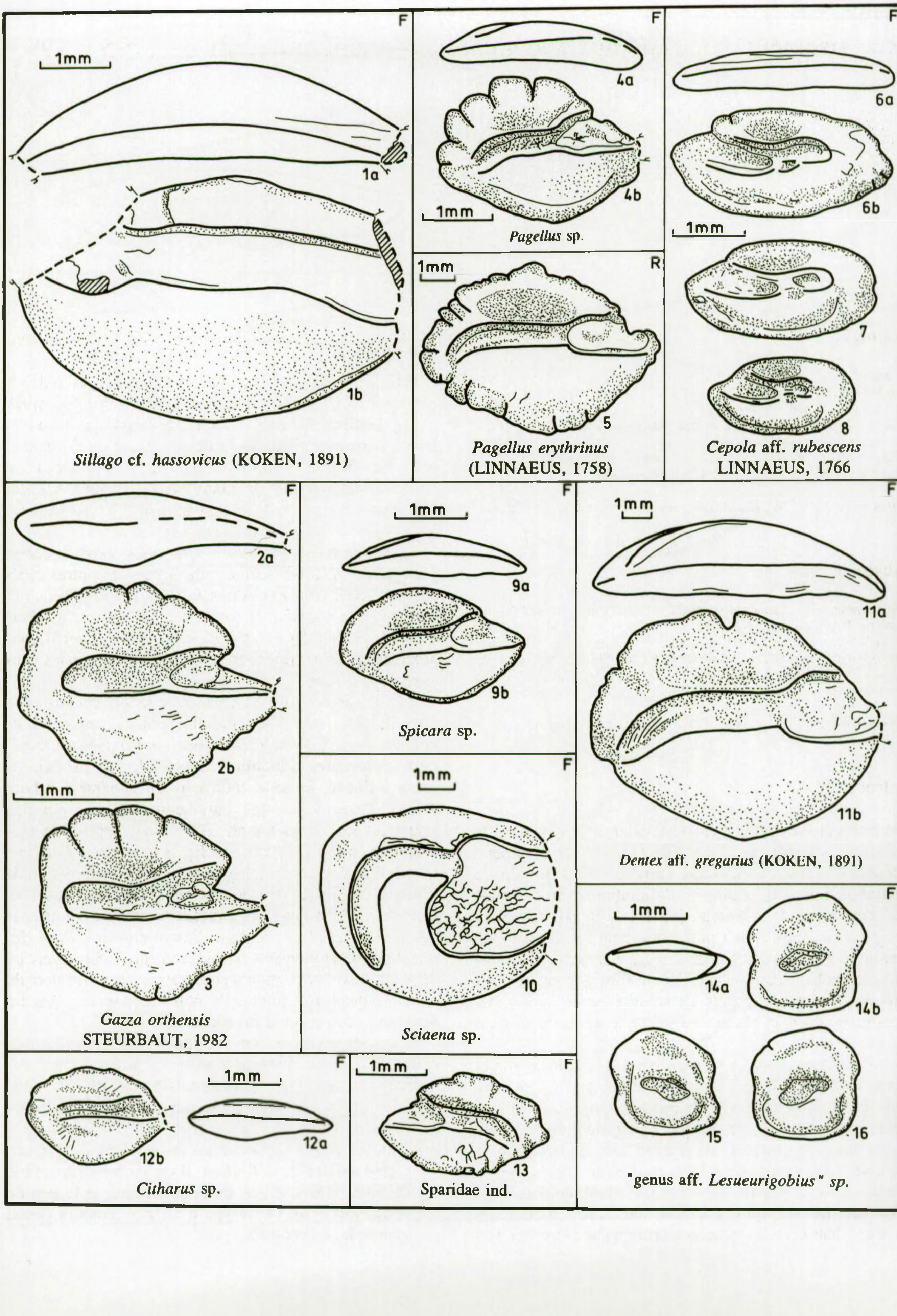
"genus Ambassidarum" sp.

Apogon moyesi STEURBAUT, 1982

Parascombrops aff. *brzobohatyi* NOLF, 1988

"genus aff. *Apogon*" sp.

Plate 9



Sillago cf. *hassovicus* (KOKEN, 1891)

Pagellus sp.

Pagellus erythrinus (LINNAEUS, 1758)

Cepola aff. *rubescens* LINNAEUS, 1766

Gazza orthensis STEURBAUT, 1982

Spicara sp.

Sciaena sp.

Dentex aff. *gregarius* (KOKEN, 1891)

Citharus sp.

Sparidae ind.

"genus aff. *Lesueurigobius*" sp.