

OTOLITHS FROM THE TYPE LOCALITY OF THE SANDS OF BERG (MIDDLE OLIGOCENE) AT BERG,  
BELGIUM

by

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11 species are listed from the type locality of the Sands of Berg (Rupelian) at Berg, Belgium. Three new species were found, viz. *Onobergensis*, *Sebastes weileri* and *Encitharus belgicus*. It is the first time that the genus *Sebastes* has been found in the fossil record. The fauna is poor in species and lived without a doubt in shallow marine waters very close to the coast. The otoliths of the Sands of Berg do not contradict an age of Middle Oligocene for this formation, which had already been deduced from other fossil groups, such as mollusca.

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In commemoration of the late Prof. Dr. Wilhelm Weiler

## INTRODUCTION

The otoliths of bony fishes from the Sands of Berg (Rupelian, Middle Oligocene) have not yet been described. During the Whitsun excursion of the Werkgroep voor Tertiaire en Kwartaire Geologie in 1971, the type locality of these sediments was exposed in the bank of the road "Keistraat" at Berg, Kleine Spouwen, municipality Spouwen, province of Limburg, Belgium. The top of the Sands of Berg is outcropping here at + 103 metre O.P. (Ostende watermark). In these sands is a bed of molluscs which were washed together. This bed belongs to the Zone of *Astarte trigonella* and was sampled for fossils. The greatest part of the collection of otoliths was collected in early July, 1971. At that time Mr. M. van den Bosch and Mr. A. W. Janssen initiated a big drive for the benefit of the collections of the Rijksmuseum van Geologie en Mineralogie (Netherlands National Museum of Geology and Mineralogy) in Leiden, The Netherlands.

In the older Zone of *Callista kickxi*, also belonging to the Sands of Berg, otoliths have not yet been found. The latter zone contains several lenses with concentrations of molluscs that for the most part were washed out of the Sands of Oude Biezen. In the Sands of Oude Biezen (Tongrian) otoliths are found only sporadically.

Specimens stored at the Rijksmuseum van Geologie en Mineralogie in Leiden will be marked "RGM" followed by the collection number of this museum.

The following abbreviations have been used: L = length, H = height, T = thickness of the otolith, L/H = length-height ratio, L/T = length-thickness ratio.

#### ACKNOWLEDGEMENTS

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Finally I am grateful to Mrs. G. P. Bieger-Smith for correcting the English text.

#### SURVEY OF THE FAUNA OF BONY FISHES

Name of species	number of specimens
1. <i>Trisopterus elegans</i> (Koken, 1884)	3442
2. <i>Raniceps latisulcatus</i> (Koken, 1884)	2
3. <i>Onos bergensis</i> n. sp.	9
4. <i>Boops</i> sp.	3
5. <i>Dentex</i> sp.	1
6. (Sparidarum) sp.	1
7. <i>Spondyllosoma</i> sp.	1
8. <i>Trachinus mutabilis</i> Koken, 1891	227
9. <i>Trachinus verus</i> Koken, 1891	17
<i>Trachinus</i> sp. (juvenile specimens)	53
<i>Trachinus</i> sp. (damaged specimens)	80
10. <i>Sebastes weileri</i> n. sp.	1
11. <i>Eucitharus belgicus</i> n. sp.	5
total	3842

List of species of otoliths from the type locality of the Sands of Berg (Berg, Kleine Spouwen, Belgium).

From the list of species it is obvious that *Trisopterus elegans* completely dominates in this formation. It is followed by *Trachinus mutabilis*, with about 10% of the most common species. *Trachinus verus* and *Onos bergensis* are next, again after a large gap. With the exception of *T. elegans*, we can be sure that these species represent an environment of shallow water in the immediate vicinity of the coast. The living habits of the first species, *T. elegans*, are difficult to determine. This species is encountered in sediments that are deposited in shallow

as well as in deeper waters. Thus it is very likely that *T. elegans* was a fish with a pelagic way of life in the uppermost waterlayers. The remaining species, except *Eucitharus belgicus*, are so scarce that their importance for the determination of the environment is questionable. Therefore our conclusion is that the Sands of Berg were formed in a shallow marine environment close to the coast. This is in close agreement with the conclusions for mollusca of the same formation.

#### AGE OF THE SANDS OF BERG

All species described here (except those newly described) are known from the Middle Oligocene and Upper Oligocene. Koken (1891) mentions variety "delta" of *Raniceps latisulcatus* only from the Middle and Upper Oligocene. An age of Middle Oligocene (Rupelian) for the Sands of Berg, already established by means of the molluscs, is not contradicted by the otolith material.

#### SYSTEMATIC DESCRIPTIONS

Phylum PISCES  
Superclassis TELEOSTOMI (OSTEICHTHYES)  
Classis ACTINOPTERYGII  
Subclassis TELEOSTEI  
Ordo GADIFORMES  
Familia GADIDAE Rafinesque, 1810  
Genus *Trisopterus* Rafinesque, 1814

*Trisopterus elegans* (Koken, 1884)

Plate 2, fig. 1a-b, 2

Otolithus (Gadidarum) *elegans* Koken, 1884, p. 542, pl. 11, fig. 2, 4.

*Gadus elegans* - Weiler, 1942, p. 74, pl. 5, fig. 5, 7, 9.

Description - Otolith small and strong. Outline oval and elongated; variations in length-height ratios give more slender (pl. 2, fig. 2) and higher (pl. 2, fig. 1 a-b) forms; when knobs are present, ventral rim has larger knobs than dorsal rim; rims blunt and also frequently smooth.

Inner surface convex; sulcus acusticus supramedian (= closer to dorsal than ventral rim) and filled by colliculi, cauda nearly two times as long as ostium; knobs on ventral part up to clearly visible ventral furrow.

Outer surface convex; thickest part always opposite the ostium; usually largest knobs in the middle; knobiness ranging from nearly smooth to completely and densely knobbed.

L 3.88 mm, H 1.94 mm, T 1.38 mm, L/H 2.0, L/T 2.81 (plate 2, fig. 1a-b)

L 3.97 mm, H 1.78 mm, T 1.25 mm, L/H 2.23, L/T 3.18 (plate 2, fig. 2)

Material - A total of 3443 sagittas, 3030 sagittas RGM 175 459, 175 460, 175 461; 276 sagittas, coll. Cadée; 112 sagittas, coll. Gaemers, 24 sagittas, coll. Gaemers, leg. Janse.

Distribution - Middle Oligocene - Upper Oligocene; Middle Miocene.

Remarks - For discussion of the change from genus *Gadus* to genus *Trisopterus*, see Gaemers (1971, p. 242, 244).

Genus *Raniceps* Cuvier, 1817

*Raniceps latisulcatus* (Koken, 1884)  
Plate 2, fig. 3 a-b

Description - Otoliths small and strong. Outline oval; both dorsal and ventral rims knobbed and sharp; dorsal rim with larger knobs; photographed specimen shows a postcaudal indentation.

Inner surface flat; sulcus acusticus median and bent slightly toward ventral side; cauda somewhat larger than ostium; cauda and ostium distinctly separated; crista superior obvious; furrows in the dorsal part up to crista superior; furrows in the ventral part shorter and shallower.

Outer surface convex; heavily knobbed in the middle; peripheral knobs nearly perpendicular to the rim.

L 3.0 mm, H 2.26 mm, T 1.05 mm, L/H 1.33, L/T 2.86 (plate 2, fig. 3 a-b)

Material - 1 sagitta, coll. Gaemers, 1 sagitta (eroded), coll. RGM 175 462.

Distribution - Upper Eocene - Upper Oligocene.

Discussion - Sagitta shown agrees completely with the description of variety "delta" in Koken (1891, p. 87). The knobs on the outer surface are also irregular and with different relief. The thickest part is somewhat closer to the dorsal side. Koken (1891) mentions this variety from the Middle and Upper Oligocene in Western Germany.

Genus *Onos* Linnaeus, 1758

*Onos bergensis* n. sp.  
Plate 1, fig. 4; plate 2, fig. 4, 5 a-b

Holotype: plate 2, fig. 5 a-b, coll. RGM 175 463

Paratypes: plate 2, fig. 4, coll. RGM 175 464; plate 1, fig. 4, coll. RGM 175 465; coll. RGM 175 466.

Locus typicus: Keistraat, Berg, Kleine Spouwen, municipality Spouwen, Belgium.

Stratum typicum: Sands of Berg, Zone with *Astarte trigonella* (Middle Oligocene)

Derivatio nominis: named after the type locality Berg

Diagnosis - A weak, thin species with elongated, triangular outline. Outer surface with distinct furrows, especially in the middle.

Description - Otoliths slender to thin. Outline elongated triangle; highest part near the collum together with predorsal angle which is usually inconspicuous; dorsal and ventral rims both sharp; rims smooth in juvenile specimens and knobbed in adult specimens.

Inner surface convex; sulcus acusticus deep and therefore clearly visible, with cauda nearly 1.5 times as long as ostium; collum and cauda near the collum narrow; cauda with a pronounced convex bend toward ventral side; sulcus is situated in the median part.

Outer surface concave; distinct knobs and furrows generally perpendicular to the outline; most pronounced knobs on the middle.

L 2.83 mm, H 1.17 mm, T 0.64 mm, L/H 2.42, L/T 4.42 (holotype).

L 2.35 mm, H 0.99 mm, T 0.44 mm, L/H 2.37, L/T 5.34 (paratype)

Material - 9 sagittas, coll. RGM 175 463, 175 464, 175 465, 175 466 (5 specimens are fragments)

Distribution - Middle Oligocene (Rupelian)

Discussion - The entire sulcus corresponds in great detail with the sulcus of the recent species *Onos cimbrius* Linnaeus, 1758, as well as the recent species *Molva molva* Linnaeus, 1758. The outline of *Onos cimbrius* closely resembles *Onos bergensis* whereas the outline of *Molva molva* is not as similar.

Ordo PERCIFORMES

Familia SPARIDAE Bonaparte, 1831

Genus *Boops* Cuvier, 1815

*Boops* sp.

Plate 2, fig. 6 a-b

Description - Otoliths strong. Outline oval; predorsal angle just above the collum; dorsal rim with irregular knobs; ventral rim with more regular but smaller knobs; rostrum eroded but must have been sharp and pronounced.

Inner surface convex; sulcus acusticus situated in the median part; ostium with a wide outward opening; cauda shallower, longer and narrower than ostium; posterior part of cauda distinctly bent toward ventral side; distinct knobs and furrows along dorsal rim.

Outer surface concave lengthwise and convex across; knobs and furrows in dorsal part highly developed, in ventral part very weakly developed.

L 2.39 mm, H 1.38 mm, T 0.52 mm, L/H ca. 1.8, L/T ca. 4.6 (RGM 175 467)

Material - 3 sagittas, coll. RGM 175 467, 175 468 (all specimens eroded)

Discussion - There is considerable resemblance between this *Boops* sp. and *Boops insignis* (Prochazka, 1893). Because of the medium-to-strong erosion of the otoliths a specific identification cannot be given.

Genus *Dentex* Cuvier, 1815

*Dentex* sp.

Plate 1, fig. 3

Description - Only one big fragment is known from the Sands of Berg. Thick, large otolith. Outline probably hexagonal (broken); big knobs along the middle of the dorsal rim.

Inner surface convex; posterior part of the cauda poorly preserved, but distinct bend to the ventral side at the back of the cauda can still be seen.

Outer surface convex; indistinct furrows between the knobs on the dorsal rim.

Material - 1 fragment of sagitta, coll. RGM 175 469.

Discussion - The fragment shows many similarities with *Dentex gregarius* (Koken, 1891). Because of the very poor condition of the fragment, nothing can be said about the name of the species.

Otolithus (Sparidarum) sp.  
Plate 2, fig. 7 a-b

Description - Thin and weak otolith. Outline probably pentagonal (broken); dorsal as well as ventral rim heavily knobbed and sharp; especially the dorsal rim deeply indented; postdorsal angle more distinct than predorsal angle.

Inner surface slightly convex; only cauda preserved: long and straight, bent toward ventral side at the back; furrows sharp and deep, longer in dorsal part than in ventral part; furrows in ventral part up to ventral furrow, which is only weakly marked.

Outer surface slightly concave; highly knobbed over the whole surface except in the middle.

L 2.02 mm (defect), H 1.7 mm, T 0.44 mm (coll. Gaemers)

Material - 1 sagitta (defect), coll. Gaemers.

Familia KYPHOSIDAE  
Genus *Spondyliosoma* Cantor, 1849

*Spondyliosoma* sp.  
Plate 1, fig. 1

Description - Only one fragment is known and therefor an identification of the species is not possible. Rear section of cauda is markedly bent toward ventral side; form and place (supramedian) of cauda is very characteristic for *Spondyliosoma*; between posterior end of cauda and end of the otolith is a relatively large region. Undoubtedly the outer surface was concave and the inner side convex. All properties mentioned are good points for identification of this genus.

Material - 1 sagitta (fragment), coll. RGM 175 470

Familia TRACHINIDAE Günther, 1860  
Genus *Trachinus* Linnaeus, 1758

*Trachinus mutabilis* Koken, 1891  
Plate 2, fig. 8, 9

Description - Thick, compact and strong otoliths. Outline (oblong) pear-shaped; both rims smooth, sometimes knobbed; posterior part extremely variable: clearly pointed to blunt.

Inner surface convex; sulcus acusticus median or supramedian, generally slightly supramedian; sulcus deep, ostium longer and wider than cauda; area distinct, deepest part just above transition ostium-cauda; in some cases therefor distinct crista superior.

Outer surface convex; posterior part in many cases with characteristic triangular depression, which opens outward; irregular knobs and furrows which

are usually not very pronounced and sometimes practically absent; above the place where the ostium opens, there is frequently a deep and relatively long furrow.

L 3.08 mm, H 1.7 mm, T 0.93 mm, L/H 1.81, L/T 3.31 (RGM 175 472)

L 3.0 mm, H 1.62 mm, T 0.85 mm, L/H 1.85, L/T 3.55 (RGM 175 473)

Material - a total of 227 sagittas. 195 sagittas, coll. RGM 175 471, 175 472, 175 473; 17 sagittas, coll. Cadée; 11 sagittas, coll. Gaemers; 5 sagittas, coll. Gaemers, leg. Janse.

Distribution - Lower Oligocene - Lowermost Upper Miocene

Discussion - This species is extraordinarily variable. It seems that there is a transition between *Trachinus mutabilis* and *T. verus*. For further discussion see *T. verus*.

*Trachinus verus* Koken, 1891

Plate 3, fig. 1 a-b, 2 (*T. aff. verus*: plate 3, fig. 3)

Description - Strong and elegant otoliths. Outline oblong pear-shaped; non-eroded specimens with knobs on the rim; knobs most pronounced along dorsal and posterior rims.

Inner surface convex; sulcus acusticus always suprmedian; ostium nearly two times as long as cauda; crista superior more obvious than crista inferior.

Outer surface flat lengthwise and slightly concave or convex; convex across; well-preserved specimens with many knobs; above the place where the ostium opens, there is sometimes a deep furrow; posterior part occasionally with rectangular depression; slightly behind the middle a round thickening can often be found.

L 3.68 mm, H 1.74 mm, T 0.85 mm, L/H 2.11, L/T 4.33 (RGM 175 474)

L 4.7 mm, H 2.03 mm, T 1.21 mm, L/H 2.32, L/T 3.88 (RGM 175 476)

L 3.81 mm, H 1.94 mm, T 0.97 mm, L/H 1.96, L/T 3.93 (RGM 175 477 *T. aff. verus*)

Material - Total of 17 sagittas. 14 sagittas, coll. RGM 175 474, 175 475, 175 476, 175 477; 2 sagittas, coll. Gaemers; 1 sagitta, coll. Cadée.

Distribution - Middle Oligocene - Middle Miocene

Discussion - It is not always easy to distinguish between the specimens of *T. mutabilis* and *T. verus*. When we find eroded or juvenile specimens, it is usually impossible to identify the species. In that case we list only the genus *Trachinus*: 53 sagittas, coll. RGM 175 478 (juvenile specimens), 75 sagittas, coll. RGM 175 479 (eroded specimens); 5 sagittas, coll. Gaemers (eroded specimens). Adult specimens of *T. mutabilis* are very variable. Specimens RGM 175 472 and RGM 175 473 are very characteristic of this species, and RGM 175 474 is a good example of *T. verus*. *T. aff. verus* (RGM 175 477) is representative of a specimen in between the two species. The thickness and the height suggest that the otolith belongs to *T. mutabilis*, but the outline and the location of the sulcus acusticus are more in accordance with *T. verus*. Therefore it is not impossible that the point - in time as well as in place - where the two species met is not very far away. Moreover it is quite likely that *T. verus* is a group of closely related species which originate from each other, when we consider all specimens known from Oligocene up to Miocene. The identification of a *T. verus* from Upper Eocene (Shepherd, 1916) is not correct.

Familia SCORPAENIDAE Risso, 1826  
Genus *Sebastes* Cuvier, 1829

*Sebastes weileri* n.sp.

Plate 1, fig. 5; plate 3, fig. 4 a-b

Holotype: plate 3, fig. 4 a-b, coll. RGM 175 480

Locus typicus: Keistraat, Berg, Kleine Spouwen, municipality Spouwen, Belgium.

Stratum typicum: Sands of Berg, Zone with *Astarte trigonella* (Middle Oligocene).

Derivatio nominis: named for the late Prof. Dr. Wilhelm Weiler, who contributed greatly to our knowledge of fishes and otoliths.

Diagnosis - A *Sebastes* species with small predorsal part. Excisura ostii insignificant. Predorsal angle distinct. Ventral rim regularly undulating. Outer surface slightly concave with a round posterodorsal thickening.

Description - Medium-sized otolith. Outline oval with very pronounced rostrum and insignificant excisura ostii; antirostrum small; predorsal angle distinct; ventral rim regularly undulating; dorsal rim rather smooth but somewhat irregular.

Inner surface convex; sulcus acusticus median; ostium longer, wider and deeper than cauda; ostium with large opening along dorsal rim of rostrum up to antirostrum; area distinct.

Outer surface slightly concave; small furrows along anterior part of ventral rim; posterodorsal thickening big and round.

Inner surface somewhat eroded in the middle.

L 4.13 mm, H 2.51 mm, T 0.72 mm, L/H 1.65, L/T 5.74 (holotype)

Material - 1 sagitta, coll. RGM 175 480

Discussion - There are many similarities to the recent species *Sebastes viviparus* Krøyer (see Schmidt, 1968). The length-height ratio (L/H) is 1.51 for this species (according to Schmidt, 1968) and 1.65 for *Sebastes weileri*. Therefore the latter is somewhat more elongated. Another difference is in the predorsal angle which is much more pronounced in *Sebastes viviparus*. In this respect there is a greater likeness with the recent species *Helicolenus dactylopterus* Delaroche (see Schmidt, 1968). The sulcus acusticus and the rostrum resemble the genus *Sebastes* the most.

Ordo PLEURONECTIFORMES

Familia BOTHIDAE

Genus *Eucitharus* Gill, 1888

*Eucitharus belgicus* n. sp.

Plate 1, fig. 2, plate 3, fig. 5 a-b, 6

Holotype: plate 3, fig. 5 a-b, coll. RGM 175 481

Paratypes: plate 3, fig. 6, coll. RGM 175 482 and RGM 175 483

Locus typicus: Keistraat, Berg, Kleine Spouwen, municipality Spouwen, Belgium

Stratum typicum: Sands of Berg, Zone with *Astarte trigonella* (Middle Oligocene)

Derivatio nominis: named after Belgium



Diagnosis - Outline oval with small indentations; sulcus acusticus narrow; outer surface with big central knob.

Description - Small, rather compact otoliths. Outline oval with small indentations; all rims blunt; one or two posterior angles which are distinct; rostrum blunt.

Inner surface slightly convex; sulcus acusticus narrow; ostium with outward opening; cauda about two times as long as ostium; crista inferior very broad and flat; crista superior sharper; area distinct.

Outer surface flat to slightly convex; big central knob that does not rise above the rest of the outer surface; circular furrow around knob; some radial furrows which are short and shallow.

L 2.67 mm, H 1.9 mm, T 0.6 mm, L/H 1.4, L/T 4.4 (holotype)

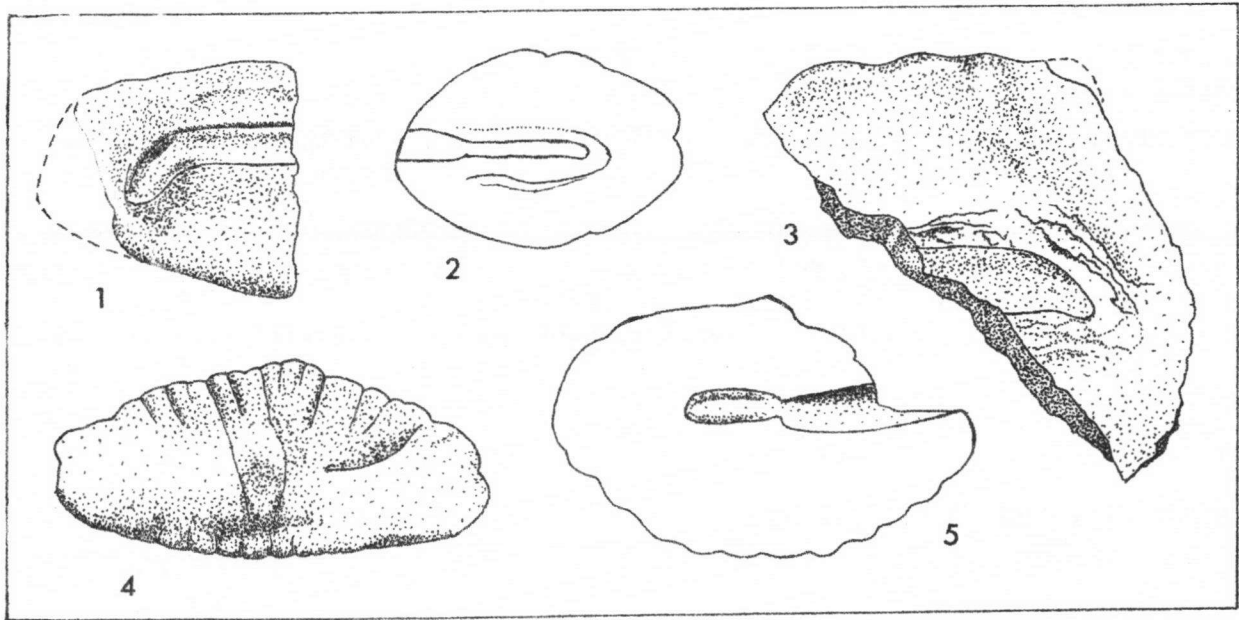
L 3.15 mm, H 2.35 mm, T 0.72 mm, L/H 1.34, L/T 4.37 (RGM 175 482)

Material - 5 sagittas, coll. RGM 175 481, 175 482, 175 483 (mostly eroded).

Remark - Sulcus acusticus more or less damaged. Holotype best preserved specimen.

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## PLATE 1

Fig. 1 *Spondylisoma* sp., coll. RGM 175 470. 15 x.

Fig. 2 *Euclitharus belgicus* n. sp., holotype, sagitta with reconstructed sulcus acusticus, coll. RGM 175 481. 15 x.

Fig. 3 *Dentex* sp., coll. RGM 175 469, 7½ x.

Fig. 4 *Onos bergensis* n. sp., paratype, coll. RGM 175 465, 15 x.

Fig. 5 *Sebastes weileri* n.sp., holotype, sagitta with reconstructed sulcus acusticus, coll. RGM 175 480. 15 x.

## PLATE 2 (page 83)

Fig. 1 a-b *Trisopterus elegans* (Koken), coll. RGM 175 459. 15 x.

Fig. 2 *Trisopterus elegans* (Koken), coll. RGM 175 460. 13 x.

Fig. 3 a-b *Raniceps latisulcatus* (Koken), coll. Gaemers. 15 x.

Fig. 4 *Onos bergensis* n. sp., paratype, coll. RGM 175 464. 20 x.

Fig. 5 a-b *Onos bergensis* n. sp., holotype, coll. RGM 175 463. 20 x.

Fig. 6 a-b *Boops* sp., coll. RGM 175 467. 15 x.

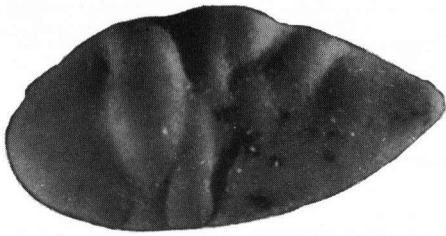
Fig. 7 a-b *Otolithus* (Sparidarum) sp., coll. Gaemers. 15 x.

Fig. 8 *Trachinus mutabilis* Koken, coll. RGM 175 472. 15 x.

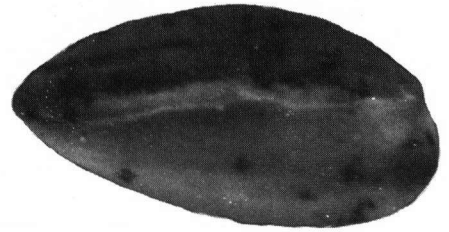
Fig. 9 *Trachinus mutabilis* Koken, coll. RGM 175 473. 15 x.

All specimens figured: Sands of Berg, Zone with *Astarte trigonella* (Middle Oligocene), Keistraat, Berg, Kleine Spouwen, municipality of Spouwen, Belgium.

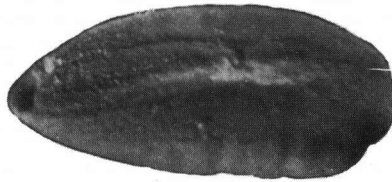
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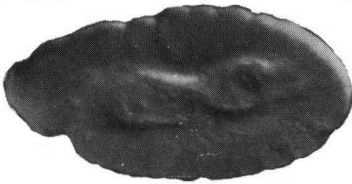
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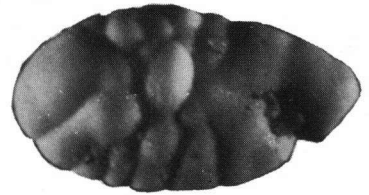
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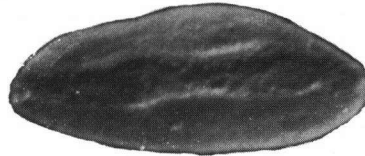
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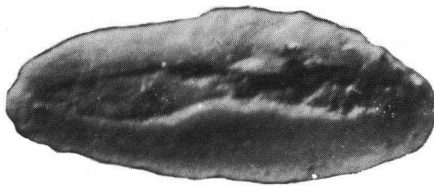
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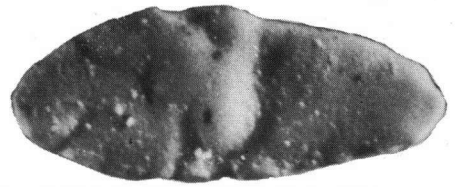
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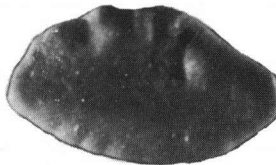
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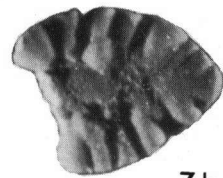
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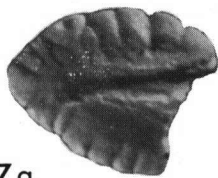
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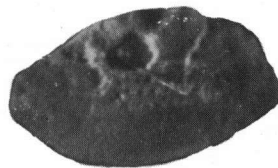
6a



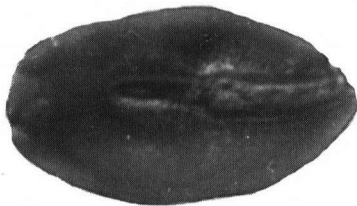
7b



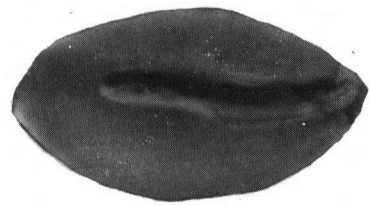
7a



6b



8



9

Plate 3

Fig. 1 a-b *Trachinus verus* Koken, coll. RGM 175 474. 15 x.

Fig. 2 *Trachinus verus* Koken, coll. RGM 175 476. 15 x.

Fig. 3 *Trachinus* aff. *verus* Koken, coll. RGM 175 477. 15 x.

Fig. 4 a-b *Sebastes weileri* n. sp., holotype, coll. RGM 175 480. 15 x.

Fig. 5 a-b *Eucitharus belgicus* n.sp., holotype, coll. RGM 175 481. 20 x.

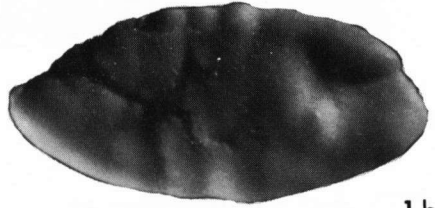
Fig. 6 *Eucitharus belgicus* n. sp., paratype, coll. RGM 175 482. 15 x.

All specimens figured: Sands of Berg, Zone with *Astarte trigonella* (Middle Oligocene), Keistraat, Berg, Kleine Spouwen, municipality of Spouwen, Belgium.

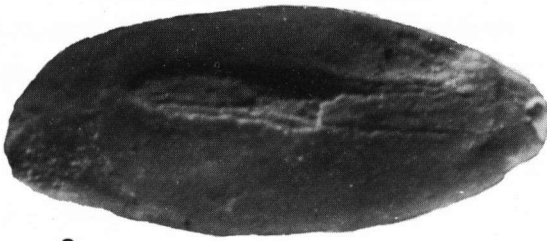
plate 3



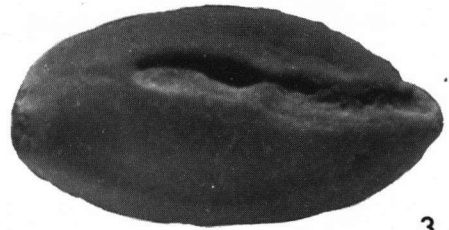
1a



1b



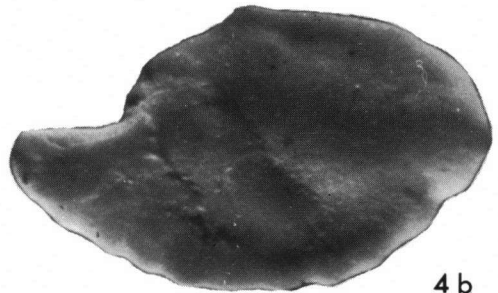
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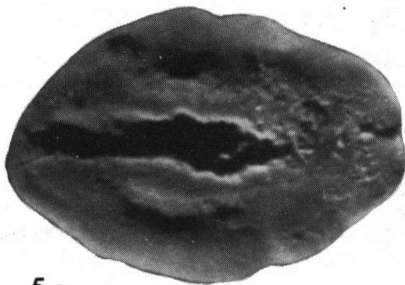
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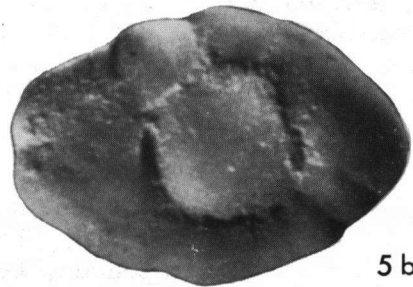
4a



4b



5a



5b



6