

## ELASMOBRANCHII FROM THE ATUATUCA FORMATION (OLIGOCENE) IN BELGIUM

by

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Some recent finds of elasmobranch teeth are described from the Atuatuca Formation (Oligocene) in the neighbourhood of Tongeren in Belgium. Three sharks species, *Odontaspis cuspidata*, *Rhizoprionodon secundus* and '*Galeorhinus*' *latus*, and four types of *Dasyatis* are described for the first time from this formation.

The formation was deposited in an euryhaline environment, comparable with a lagoon or coastal lake. The occurrence of elasmobranch teeth in these non-marine deposits is discussed and related to the sedimentary history of this formation. According to the elasmobranch faunas a Lattorfian age for the Atuatuca Formation seems acceptable at this moment.

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## INTRODUCTION

Teeth of sharks and rays (Pisces, Elasmobranchii) are found only very rarely in the Atuatuca Formation (Oligocene, Belgium), which is not surprising considering the euryhaline environment in which these sediments were deposited. In general these fishes prefer open sea, although some Recent species are known to penetrate into lagoons, estuaries, rivers and lakes.

Very little is known in literature about the occurrence of elasmobranch teeth in the Atuatuca Formation. Within the framework of the investigation of the lateral variations in the sedimentary developments of Oligocene deposits in Belgium by the Werkgroep voor Tertiaire en Kwartaire Geologie (The Netherlands) and the Rijksmuseum van Geologie en Mineralogie (Leiden, The Netherlands) the deposits of the Atuatuca Formation were extensively studied and sampled during the last decade, by which also some elasmobranch teeth were collected. Although these investigations are not yet finished, publication of the elasmobranch results seems justified, because they may contribute to the discussion on the time-stratigraphical position of the Atuatuca Formation.

## GEOLOGY OF THE ATUATUCA FORMATION

The Atuatuca Formation (the so-called 'Tongrien supérieur' of the older authors, also indicated as 'Couches Supérieures de Tongeren' or 'Upper Tongeren Formation') comprises about 12 m of clayey and sandy sediments. The mollusc fauna's indicate deposition in an environment with strongly fluctuating chloride content (euryhalinicum). It is known to occur with certainty in the area North of Tongeren to Bilzen, to the West as far as St.-Truiden and eastwards to Herderen. Comparable deposits are known from the region Leuven-Tienen in Belgium and from the Dutch province of Limburg.

In the region North of Tongeren the formation comprises the following deposits (Janssen et al., 1976):

- alternation of sands and clays. Molluscan content variable, with especially in the sandy parts sometimes extremely many shells. In the clays well-preserved pollen is present. Thickness up to 5 m.
- heavy clay, only locally with molluscs. Pollen is found only in the upper part of this clay. Thickness ca. 3 m.
- sand or clayey sand, locally with many gullies. In these gullies shell-concentrations and lumps or bits of reworked clay are sometimes found. Thickness up to 2 m.
- heavy clay without pollen. Locally with pyrite and gypsum and only rarely molluscs. Thickness ca. 4 m.

The interpretation of this sequence, as given by Janssen et al. (1976), is as follows. The lower clay was deposited in a basin, to a high degree isolated from open sea by some kind of coastal barrier system. This basin might have been a lagoon or a coastal lake. Because of the high degree of evaporation the environment was not favourable for molluscs, as considerable changes in chloride content and pH occurred. Pollen was completely disturbed by oxidation because sedimentation took place (almost) at the water level. Increasing influence of the sea caused tidal streams and erosion of the coastal barrier system. A sandy deposit with many gullies was deposited on top of the lower clay. Because of the increased marine influence environmental conditions had become less extreme, and the development of an euryhaline fauna became possible. After the deposition of this sand marine influence decreased and again a clayey sediment was formed. The sudden appearance of

pollen in the upper part of this clay indicates deposition in deeper water. Alternating sands and clays on top of the upper clay level point to quickly changing environmental conditions.

Mollusc fauna's from these sediments are usually rich in individuals, but relatively poor in species. The bivalve *Polymesoda convexa* (Brongniart, 1822), and the gastropods *Melanoides fasciatus* (Sowerby, 1819), *Pirenella plicata monilifera* (Deshayes, 1825) and *Tympanotonus labyrinthus* (Nyst, 1836) are the most frequently occurring species.

The lower clay is indicated as Henis Clay, the higher part of the sequence as Sands and Marls of Oude Biesen. Below the Atuatuca Formation lie the Neerrepen Sands, whereas the Berg Sands are found on top of it (compare Tab. 1). The Atuatuca Formation was eroded to a higher or lower degree during deposition of the Berg Sands.

O L I G O C E N E	Rupelian	Boom Clay	Rupel Formation
		Kerniel Sands	
		Nucula Clay	
		Berg Sands	
	Lattorfian	Sands and Marls of Oude Biesen	Atuatuca Formation
		Henis Clay	
		Neerrepen Sands	"Grimmertingen Formation"
		Grimmertingen Sands	

Table 1. Stratigraphy of Oligocene deposits in the Belgian province of Limburg.

#### LIST OF LOCALITIES AND DEPOSITS WHICH PROVIDED ELASMOBRANCH TEETH

Kleine Spouwen, Nachtegaalstraat.

Location: exposure in road-cut of Nachtegaalstraat at Kleine Spouwen, municipality of Bilzen (formerly municipality of Spouwen), province of Limburg, Belgium.

Map-sheet: 34/1-2, Bilzen-Veldwezelt.

Lambert co-ordinates: x = 233,175 y = 170,275.

File number Geological Survey of Belgium: 93W 301 (1).

Bibliography: van Hinsbergh et al., 1973, p. 15, fig. 1-2.

Stratigraphical level: level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation.

Rijkhoven, Oude Biesen castle.

Location: exposure between the Oude Biesen castle and the Apostelenhuis at Rijkhoven, municipality of Bilzen (formerly municipality of Spouwen), province of Limburg, Belgium.

Map-sheet: 34/1-2, Bilzen-Veldwezelt.

Lambert co-ordinates: x = 231,57 y = 170,74.

File number Geological Survey of Belgium: 93W 567IXa.

Bibliography: van Hinsbergh et al., 1973, p. 14, fig. 1-2.

Stratigraphical level: shell bed in sandy part of level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation.

Tongeren, Francart clay-pit.

Location: clay-pit of the Francart Brickworks at Tongeren, about 1225 m North and 475 m East of Tongeren Basilica, province of Limburg, Belgium.

Map-sheet: 34/5-6, Tongeren-Herderen.

Lambert co-ordinates: x = 227,75 y = 165,17.

File number Geological Survey of Belgium: 107W 195 (1) and (2).

Bibliography: Janssen et al., 1976, p. 99, fig. 1-2, 5, 14; Janssen et al., 1978, p. 23, fig. 2, 6-7.

Stratigraphical level: gully level in the Sands and Marls of Oude Biesen, Atuatuca Formation.

Tongeren, Galgeberg.

Location: exposure on the Galgeberg at Berg, Tongeren, province of Limburg, Belgium.

Map-sheet: 34/5-6, Tongeren-Herderen.

Lambert co-ordinates: x = 230,10 y = 164,90.

File number Geological Survey of Belgium: 107W 92 (1).

Bibliography: Cadée et al., 1976, p. 54, fig. 1-2; Janssen et al., 1976, p. 86, fig. 1-2; Janssen et al., 1978, p. 26, fig. 2, 7-8.

Stratigraphical level: level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation; 1,20 - 1,30 m below surface (compare section in Cadée et al., 1976).

## SYSTEMATICAL PART

Specimens stored at the Rijksmuseum van Geologie en Mineralogie, Leiden, the Netherlands, will be marked 'RGM' followed by the registration number of this museum.

Lists of synonyms only contain few references to publications with adequate illustrations.

### *Odontaspis cuspidata* (Agassiz, 1844)

Pl. 1, fig. 1

1910 *Odontaspis cuspidata*, L. Agassiz, 1844 - Leriche, p. 268-271, pl. 15, fig. 1-21.

1971 *Odontaspis cuspidata* (L. Agassiz 1844) - van den Bosch, p. 49, fig. 8-22.

Material - 1 commissural lower right tooth, Tongeren, Francart clay-pit (RGM 176 230, leg. V.W.M. van Hinsbergh).

This tooth, found by Mr van Hinsbergh in May 1972, was already mentioned by Janssen et al. (1976, p. 84). Height of the tooth is 4.5 mm. Its shape is typical for the commissural teeth in the lower jaw of *Odontaspis*. The relatively robust shape and the broad, obtuse and irregular trenchant edges of the lateral denticles are characteristic for *Odontaspis cuspidata*. The preservation of the tooth is excellent, only very slight traces of abrasion are visible. The apex of the crown is damaged, which was caused probably by functional use.

In N.W. Europe teeth of *Odontaspis cuspidata* are regularly found in marine deposits of Rupelian and Chattian age.

*Rhizoprionodon secundus* (Winkler, 1874)

Pl. 1, fig. 2

1905 *Physodon secundus*, Winkler, 1874 - Leriche, p. 132-133, pl. 8, fig. 1-18.

1964 *Carcharias (Physodon) secundus* (Winkler, 1874) - van den Bosch, p. 134, fig. 4.

Material - 1 lateral lower right tooth, Tongeren, Francart clay-pit (RGM 176 231, leg. T. J. Bor).

This tooth was found by the author in a sample taken in August 1977. Height of the tooth is 1.7 mm. Its preservation is almost identical with the above described tooth of *Odontaspis cuspidata*, only some more traces of abrasion are visible and the tooth is very fragile. Like the tooth of *Odontaspis cuspidata* the crown is coloured dark bluish grey, the root is greyish white. The damage of the tooth is caused during the sieving procedure.

The crown of this tooth is too erect and the commissural cutting edge is too well rounded for a commissural tooth of '*Galeorhinus*' *latus* (Storms, 1894), which species is also known from the Atuatuca Formation.

Usually this species is placed in the genus *Physodon* Müller & Henle, 1839, but in my opinion it fits better in the genus *Rhizoprionodon* Whitley, 1929 [type-species: *Carcharias (Scoliodon) crenidens* Klunzinger, 1880].

*Rhizoprionodon secundus* is a common species in marine deposits of Eocene age. But for the Eocene the species is also known from the Early Oligocene of Belgium (Grimmerten Sands; van den Bosch, 1964) and England (Bembridge Oyster Bed; Ward, in prep.). This species is unknown until now from other Oligocene deposits in N.W. Europe.

'*Galeorhinus*' *latus* (Storms, 1894)

Pl. 1, fig. 3

1910 *Galeus latus* Storms, 1894 - Leriche, p. 297-298, pl. 19, fig. 31-45.

1971 *Galeorhinus latus* (Storms 1894) - van den Bosch, p. 54-55, fig. 72-83.

Material - 1 lateral upper left tooth, Rijkhoven, Oude Biesen castle (coll. F. von der Hocht, Mainz, Western-Germany).

This tooth was collected by Mr von der Hocht in April 1972. Its height is 8.5 mm. The root is abraded (not full-grown tooth?), but the email of the crown is rather well-preserved. The crown is coloured light bluish-grey, the root light brownish-yellow. The specimen is a typical lateral tooth from the upper jaw of this species: crown relatively large and wide and inclined towards the commissure, lower half of the symphyseal cutting edge clearly and irregularly serrated.

Many authors reckon this species to the genus *Galeorhinus* Blainville, 1816, but the habitus of the teeth of this species is so different from that of the type-species of *Galeorhinus* (= *Squalus galeus* Linnaeus, 1758), that it is not justified to reckon the present species to this genus. Further investigation will be necessary to decide in which genus this species belongs.

Teeth of '*Galeorhinus*' *latus* occur frequently in marine deposits of Rupelian and Chattian age in N.W. Europe. This species is also known from the sands underlying the Boom Clay, 'Sands of Ruis-

broek and St. Nikolaas<sup>1</sup>) (Lattorfian), at Ruisbroek, Antwerp area (coll. RGM).

*Dasyatis* sp. div.

Five very well preserved dasyatiform teeth (crowns coloured orange-like brown, roots brownish) are present which will be described below as four different types of *Dasyatis*. It was not possible to split up these teeth into distinct species because the number of specimens is too small and a sufficient number of comparable teeth from other deposits is lacking, so it is difficult to get an idea of symphyseal-commissural and sexual dimorphism. Therefore it is not excluded that some types belong to one and the same species.

The name *Dasyatis* is used here as a form-genus without phylogenetic meaning. There are a lot of recent genera of rays which have more or less the same morphology of teeth as in the genus *Dasyatis* Rafinesque, 1810. Because the differences between these genera are not yet well-defined for the teeth, most palaeochondrichthyologists use the genusname *Dasyatis* for dasyatid teeth.

The terminology used in the descriptions is adopted from Cappetta (1970, p. 86-87) and Ward (1979, p. 76-78).

*Dasyatis* sp., type A

Pl. 2, fig. 1

Material - 1 tooth, probably of a female specimen, Tongeren, Galgeberg (RGM 175 886, leg. A. W. Janssen); 1 tooth, probably of a female specimen, Kleine Spouwen, Nachtegaalstraat (RGM 176 503, leg. A. W. Janssen).

Dasyatiform teeth with small dimensions:

RGM 175 886: L = 1.08 mm, H = 1.03 mm, W = 1.35 mm.

RGM 176 503: L = 0.92 mm, H = ? (root defect), W = 1.18 mm.

On the oral surface of the crown a well-developed central depression is present. The anterior surface is slightly convex with some indistinct scalloped ornamentation. Other ornamentation is absent. The postero-lateral surfaces are concave, forming a concave posterior crest. The antero-basilar surface of the crown ('rebord inférieur de la visière antérieure' of Cappetta, 1970, p. 87) is rather wide and somewhat convex. The root/crown junction lies in a shallow depression in the basilar surface. The root of the former tooth (RGM 175 886) is bilobate with one large central foramen between the lobes. These lobes are not very extended. The root of the latter (RGM 176 503) is broken.

This tooth-type of *Dasyatis* is hitherto unknown from Tertiary deposits.

*Dasyatis* sp., type B

Pl. 2, fig. 2

Material - 1 tooth, probably of a male specimen, Tongeren, Galgeberg (RGM 176 502, leg. A. W. Janssen).

1) Provisional name used by van den Bosch et al. (1975, p. 107-108, encl. 2) to indicate the sands underlying the Boom Clay in North-western Belgium, in literature also called 'Rlb Sands', 'Assise inférieure de l'Oligocène Rupélien' or 'Sables à *Pycnodonte callifera*'.

Small dasyatiform tooth: L = 1.29 mm, H = 1.47 mm, W = 1.57 mm. The crown is tetrahedral. The oral surface presents a roughly 'scalloped' ornamentation and a depression. The postero-lateral surfaces are very concave, forming a very concave posterior crest. The base is surrounded by a rim which is expanded into a posteriorly directed lip. The antero-basilar surface of the crown is rather wide and slightly convex. The root/crown junction lies in a shallow depression in the basilar surface. Between the lobes of the bilobate root four foramina are present. The lobes of the root, sloping posteriorly, are divergent and not very extended.

This tooth resembles the male teeth of the *Dasyatis* species occurring commonly in the Berg Sands and the Nucula Clay in the Tongeren region and the base of the Boom Clay in the Antwerp area, although the present specimen is certainly not typical for this species. Some *Dasyatis* teeth from the type-locality of the Grimmeringen Sands (coll. T. J. Bor) also show some similarities with this tooth. It is also not excluded that this tooth belongs to the same species as the above described teeth of type A.

*Dasyatis* sp., type C  
Pl. 2, fig. 3

Material - 1 tooth, Tongeren, Galgeberg (RGM 175 885, leg. A. W. Janssen).

Dasyatiform tooth with rather small dimensions: L = 1.35 mm, H = 1.35 mm, W = 1.79 mm. The oral surface is convex and has no central depression. The anterior surface is convex with some indistinct ornamentation. The postero-lateral surfaces are concave, the posterior crest is slightly convex. The antero-basilar surface of the crown is rather narrow and convex. One large central foramen is present between the lobes of the root.

Another tooth of this type is known from the 'Sands of Ruisbroek and St. Niklaas' at Ruisbroek, Antwerp area (coll. RGM).

*Dasyatis* sp., type D  
Pl. 2, fig. 4

Material - 1 tooth, Tongeren, Galgeberg (RGM 176 501, leg. A. W. Janssen).

Small dasyatid tooth: L = 1.17 mm, H = 0.87 mm, W = 1.08 mm. The oral surface is slightly concave, a central depression is lacking. Ornamentation is absent. The postero-lateral surfaces are concave, forming an indistinct concave posterior crest. The antero-basilar surface of the crown is rather narrow and extremely convex. The bilobate root is rather massive and extended, the lobes are divergent and rather short.

This tooth-type of *Dasyatis* is hitherto not recorded from Tertiary deposits.

## DISCUSSION AND CONCLUSIONS

Although some elasmobranch teeth found in the Atuatuca Formation show more or less traces of transport, we may assume that they are not reworked from older deposits and that the abrasion is due to some horizontal post-mortem transport in the relatively high energetical environment of

deposition. Reworking of the *Rhizoprionodon secundus* tooth from e.g. the Grimmertingen Sands is out of the question because of its fragility.

Leriche (1910, p. 244-245) mentioned *Odontaspis acutissima* (Agassiz, 1844) and *Myliobatis* sp. from the 'Tongrien supérieur' of Kleine Spouwen and Grote Spouwen (municipality of Bilzen, province of Limburg, Belgium). It is not clear where exactly and from which stratigraphical level the material was collected. Leriche studied existing collections, and it must be feared that mistakes in labelling could occur. So these data are not very reliable and both species may only be mentioned from the Atuatuca Formation with a question-mark.

Summarizing the following elasmobranch species are known from the Atuatuca Formation:

*Odontaspis cuspidata* (Agassiz, 1844)

? *Odontaspis acutissima* (Agassiz, 1844)

*Rhizoprionodon secundus* (Winkler, 1874)

'*Galeorhinus*' *latus* (Storms, 1894)

*Dasyatis* sp., type A

*Dasyatis* sp., type B

*Dasyatis* sp., type C

*Dasyatis* sp., type D

? *Myliobatis* sp.

All elasmobranch teeth found in the Atuatuca Formation belong to species or genera which were common in the marine environment. It is known of some Recent elasmobranch species that they penetrate into lagoons, estuaries, rivers and lakes. For example in southern Africa it is known from a Recent representative of *Dasyatis*, *D. uarnak* (Forsskal, 1775), that it penetrates into rivers and lakes (Bass et al., 1973 and Wallace, 1967), from a Recent representative of *Rhizoprionodon*, *R. acutus* (Rüppell, 1835), that it may enter brackish water on occasion (Bass et al., 1973 and 1975a) and from a Recent representative of *Odontaspis*, *O. taurus* (Rafinesque, 1810), that it may swim short distances up estuaries when seawater pushes in with an incoming tide (Bass et al., 1973 and 1975b). So most probably the individuals which were present in the euryhaline Atuatuca Formation environment, were just visitors from the adjacent marine environment. This means that during deposition of the gully level and the level with alternating sands and clays an open connection was present between the area of deposition and the open sea, which was also implicitly assumed by Janssen et al. (1976).

It is difficult to draw conclusions on the stratigraphical position of the Atuatuca Formation based on elasmobranch teeth, because only few teeth are available and the elasmobranch faunas of some other Oligocene deposits in Belgium are insufficiently known, e.g. the 'Sands of Ruisbroek and St. Niklaas' (Boom area) and the Grimmertingen Sands in the Tongeren region. The elasmobranch fauna from the Atuatuca Formation contains species that are more or less typical for Rupelian and Chattian faunas, e.g. *Odontaspis cuspidata*, as well as typical Lattorfian faunal elements like *Rhizoprionodon secundus*. In spite of extensive sampling in the Boom Clay in the Antwerp area (Steurbaut & Herman, 1978) and the Berg Sands and the Nucula Clay in the Tongeren region (RGM) *Rhizoprionodon secundus* and *Dasyatis* sp., type A, ?B, C and D are still unknown from these deposits, which is not only a facies problem. The composition of the elasmobranch fauna from the bed of phosphoritic concretions at the base of the Boom Clay at St. Niklaas (Antwerp area) is almost identical with that from the Berg Sands in the Tongeren region (unpublished data). Possibly the Atuatuca Formation in the Tongeren region is time-equivalent to the sands underlying the Boom Clay in the Antwerp area, the 'Sands of Ruisbroek and St. Niklaas' (Lattorfian), which contain a mollusc fauna with both Lattorfian and Rupelian elements (van den Bosch et al., 1975, p.



108). At this moment only a restricted number of teeth is available from these sands (coll. RGM), but among them is one tooth of *Dasyatis* sp. type C and '*Galeorhinus*' *latus*.

According to the elasmobranch faunas a Lattorfian age for the Atuatuca Formation seems acceptable at this moment.

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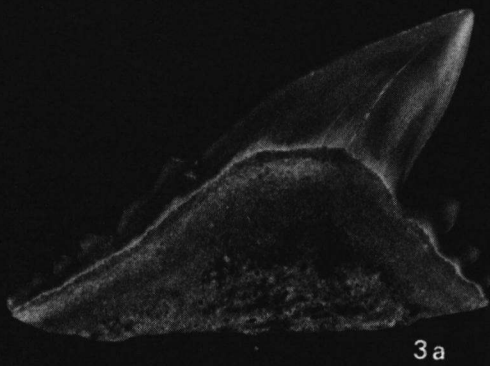
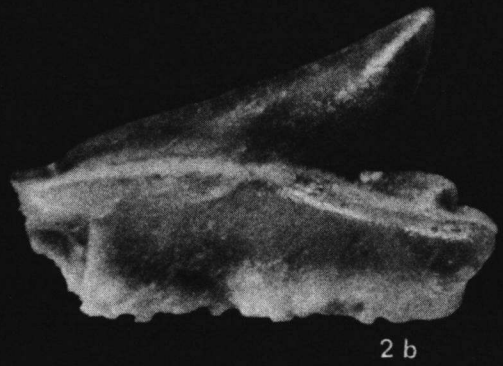
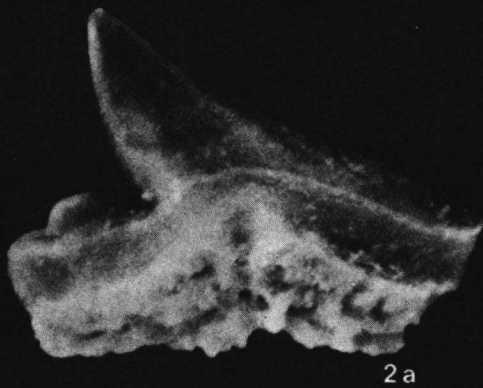
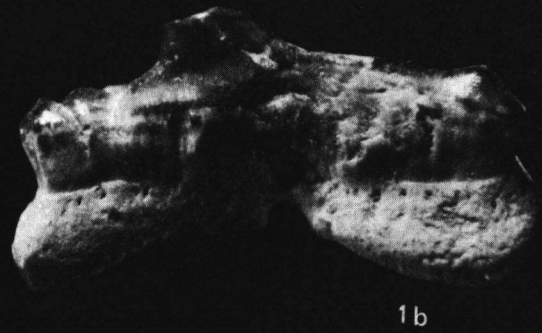
#### REFERENCES

- Bass, A. J., J. D. D'Aubrey & N. Kistnasamy, 1973. Sharks of the east coast of southern Africa. I. The genus *Carcharhinus* (Carcharhinidae). - Invest. Rep. Oceanogr. Res. Inst. Durban, 33.
- Bass, A. J., J. D. D'Aubrey & N. Kistnasamy, 1975a. Sharks of the east coast of southern Africa. III. The families Carcharhinidae (excluding *Mustelus* and *Carcharhinus*) and Sphyrnidae. - Invest. Rep. Oceanogr. Res. Inst. Durban, 38.
- Bass, A. J., J. D. D'Aubrey & N. Kistnasamy, 1975b. Sharks of the east coast of southern Africa. IV. The families Odontaspidae, Scapanorhynchidae, Isuridae, Cetorhinidae, Alopiidae, Orectilobidae and Rhinodontidae. - Invest. Rep. Oceanogr. Res. Inst. Durban, 39.
- Bosch, M. van den, 1964. Enige haaietanden uit de Zanden van Grimmertingen. - Natuurhist. Maandblad, 53 (9): 131-138.
- Bosch, M. van den, 1971. Elasmobranchii uit het Rupelien van Lintdorf bij Düsseldorf (Westduitsland). - Meded. Werkgr. Tert. Kwart. Geol., 8 (2): 46-61.
- Bosch, M. van den, M. C. Cadée & A. W. Janssen, 1975. Lithostratigraphical and biostratigraphical subdivision of Tertiary deposits (Oligocene-Pliocene) in the Winterswijk-Almelo region (eastern part of the Netherlands). - Scripta Geol., 29.
- Cadée, M. C., V. W. M. van Hinsbergh & A. W. Janssen, 1976. Een profiel door tertiaire en kwartaire afzettingen tussen Tongeren en Waltwilder (België, provincie Limburg). - Meded. Werkgr. Tert. Kwart. Geol., 13 (2): 35-58.
- Cappetta, H., 1970. Les sélaciens du Miocène de la région de Montpellier. - Palaeovertebrata, mém. ext.: 1-139.
- Hinsbergh, V. W. M. van, A. W. Janssen & L. M. B. Vaessen, 1973. Een profiel door oligocene en kwartaire afzettingen ten westen van het dorp Kleine Spouwen (België, provincie Limburg). - Meded. Werkgr. Tert. Kwart. Geol., 10 (1): 9-28.

(continued on p. 16)

EXPLANATION OF PLATE 1

- Fig. 1 *Odontaspis cuspidata* (Agassiz, 1844), commissural lower right tooth.  
Gully level Sands and Marls of Oude Biesen, Atuatuca Formation. Francart clay-pit near Tongeren, Belgium. RGM 176 230, leg. V. W. M. van Hinsbergh. Magnification 8.9 x.
- Fig. 2 *Rhizoprionodon secundus* (Winkler, 1874), lateral lower right tooth.  
Gully level Sands and Marls of Oude Biesen, Atuatuca Formation. Francart clay-pit near Tongeren, Belgium. RGM 176 231, leg. T. J. Bor. Magnification 27.4 x.
- Fig. 3 '*Galeorhinus*' *latus* (Storms, 1894), lateral upper left tooth.  
Shell bed in sandy part of level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation. Exposure between the Oude Biesen castle and the Apostelenhuis at Rijkhoven, Belgium. Coll. F. von der Hocht, Mainz. Magnification 5.1 x.



EXPLANATION OF PLATE 2

Fig. 1 *Dasyatis* sp., type A, tooth, probably of a female specimen.

Level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation. Exposure on the Galgeberg at Berg, Tongeren, Belgium. RGM 175 886, leg. A. W. Janssen. Magnification 25 x.

Fig. 2 *Dasyatis* sp., type B, tooth, probably of a male specimen.

Level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation. Exposure on the Galgeberg at Berg, Tongeren, Belgium. RGM 176 502, leg. A. W. Janssen. Magnification 25 x.

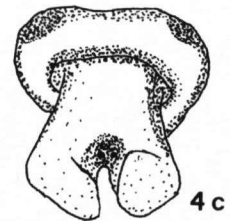
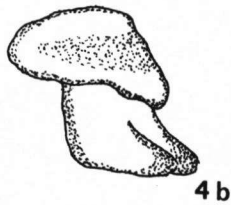
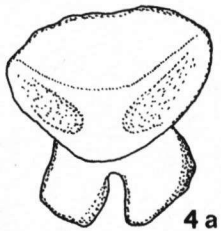
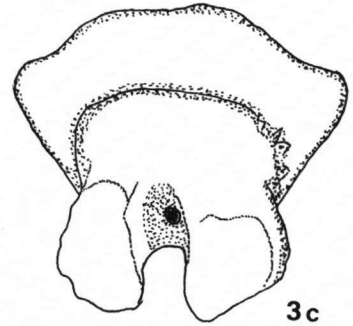
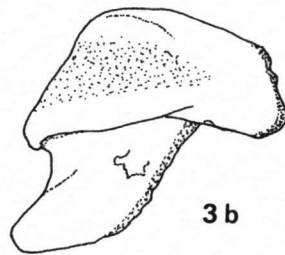
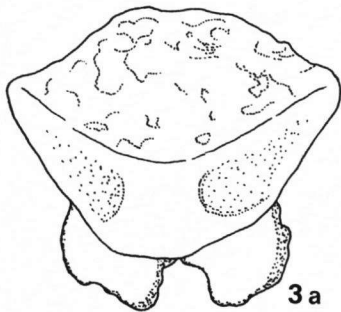
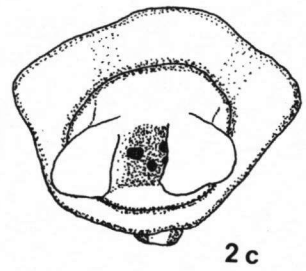
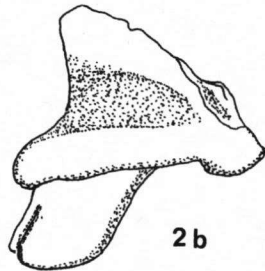
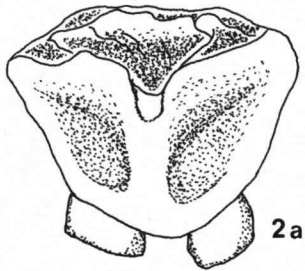
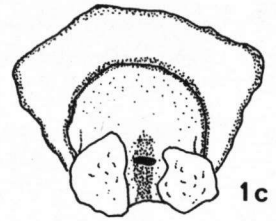
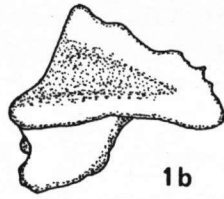
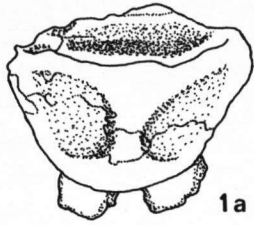
Fig. 3 *Dasyatis* sp., type C, tooth.

Level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation. Exposure on the Galgeberg at Berg, Tongeren, Belgium. RGM 175 885, leg. A. W. Janssen. Magnification 25 x.

Fig. 4 *Dasyatis* sp., type D, tooth.

Level with alternating sands and clays in the Sands and Marls of Oude Biesen, Atuatuca Formation. Exposure on the Galgeberg at Berg, Tongeren, Belgium. RGM 176 501, leg. A. W. Janssen. Magnification 25 x.

All drawings were made by the author with a *camera lucida* of a Wild M5 binocular.



- Janssen, A. W., V. W. M. van Hinsbergh & M. C. Cadée, 1976. Oligocene deposits in the region North of Tongeren (Belgium), with the description of a new lithostratigraphical unit: the Atuatua Formation. - Meded. Werkgr. Tert. Kwart. Geol., 13 (3): 75-115.
- Janssen, A. W., M. C. Cadée, V. W. M. van Hinsbergh & P. A. M. Gaemers, 1978. Lithology and stratigraphy of Oligocene of the Belgium provinces Limburg and Brabant. Excursion-guide for the field Trips D (26 September 1978) and H (1 October 1978). - Paläontologische Gesellschaft and Palaeontological Association, Joint annual meeting, Maastricht 25.9.-1.10.1978.
- Leriche, M., 1905. Les Poissons éocènes de la Belgique. - Mém. Mus. roy. Hist. Nat. de Belgique, 11.
- Leriche, M., 1910. Les Poissons oligocènes de la Belgique. - Mém. Mus. roy. Hist. Nat. de Belgique, 20.
- Sturbaut, E. & J. Herman, 1978. Biostratigraphie et poissons fossiles de la Formation de l'Argile de Boom (Oligocène Moyen du Bassin Belge). - Géobios, 11 (3): 297-325.
- Wallace, J. H., 1967. The Batoid Fishes of the East Coast of Southern Africa. Part II: Manta, Eagle, Duckbill, Cownose, Butterfly and Sting Rays. - Invest. Rep. Oceanogr. Res. Inst. Durban, 16.
- Ward, D. J., 1979. Additions to the fish fauna of the English Palaeogene. 2. A new species of *Dasyatis* (Sting Ray) from the London Clay (Eocene) of Essex, England. - Tertiary Res., 2 (2): 75-81.
- Ward, D. J., in prep. A checklist of the sharks, rays and chimaeroids from the English Palaeogene. - Tertiary Res.