

# Miocene Decapoda and Mollusca from Ramsel (province of Antwerpen, Belgium), with a new crab genus and a new cephalopod species

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Reworked phosphoritic concretions from the base of the Diest Sands (Miocene) at Ramsel (Belgium) yield many magnificent crabs and molluscs in mould preservation. Two species of crabs are present, viz. *Mursia lienharti* (Bachmayer, 1961) and *Tasadia carniolica* (Bittner, 1884), *Tasadia* being a new genus. The palaeoecology of the decapod fauna is discussed and compared with Paratethyan occurrences.

The age of the fauna in the concretions as indicated by the mollusc fauna is Middle Miocene, Hemmoorian, youngest Oxlundian. A similar fauna, also in reworked concretions, is known from the base of the Deurne Sands at Borgerhout (Antwerpen city area). A new coleoid cephalopod species, *Spirulirostra baetensi* sp. nov., is described. The European *Spirulirostra* and *Spirulirostrina* species are discussed.

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Introduction	2
Description of the locality	2
Characteristics of the basal gravel	5
The mollusc fauna	5
Age interpretation	8
Description of <i>Spirulirostra baetensi</i> sp. nov.	9
Description of the decapod fauna	19
General remarks on the Ramsel decapod fauna	23
Age of the Ramsel material compared to the Paratethyan occurrences	24
References	24

## Introduction

In the former Hermans clay-pit, situated 400 m north of the church of Ramsel in the municipality of Herselt (province of Antwerpen, Belgium), a thin Miocene deposit is present on top of the exploited Boom Clay (Oligocene, Rupelian). In the basal part of these Miocene sediments a level with phosphoritic concretions is found, containing i.a. magnificent moulds of crabs, in a state of preservation as never found before in the North Sea Basin. These concretions also contain numerous molluscs in mould preservation. The same horizon yields furthermore many shark teeth and some skeleton parts of marine mammals. In the present paper attention is paid to the decapod and mollusc faunas.

Especially the abundant crabs attracted a lot of non-professional collectors and many specimens were incorporated in private collections or sold at mineral fairs etc.

Through the agency of Mr P. Baetens, an amateur palaeontologist at Antwerpen (Belgium) the first author had an opportunity to collect some material at this locality in the summer of 1980. This material is kept in the collections of the Rijksmuseum van Geologie en Mineralogie at Leiden (RGM). The molluscs in this collection and additional material in the extensive collection of Mr Baetens, as well as that of Mr W. Groeneveld (Santpoort-Noord, The Netherlands) were analyzed in order to achieve an estimation of the relative age of the fauna concerned. During this study the existence of an undescribed cephalopod species could be established.

The second author studied the crab material. This led to a morphological description of two species and the introduction of a new genus. Furthermore the palaeoecology of the crab fauna is discussed.

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Thanks are due to Dr M. Warth, Staatliches Museum für Naturkunde (Stuttgart, F.R.G.) for his permission to study the specimen of *Spirulirostrina lovisatoi*. We are indebted to Dr L. B. Holthuis (Rijksmuseum van Natuurlijke Historie, Leiden), who loaned crab material for this study.

Mr W. A. M. Devilé (RGM) made quite a lot of photographs. Mr J. van der Linden prepared plaster casts of the new cephalopod species. Mrs J. Vitz (M. Á. Földtani Intézet, Budapest) drew Fig. 4. Mrs J. Petermann-Huigsloot (RGM) took care of the administration of studied material. We are grateful to them all for their dedication.

Finally Dr Ph. J. Hoedemaeker (RGM) contributed by critical reading of the part on the cephalopod systematics. His help is gratefully acknowledged.



Fig. 1. Location of the Hermans clay-pit at Ramsel, municipality of Herselt (Belgium, province of Antwerpen). Topographical map of Belgium, map-sheet 24/3-4 Booischot-Westerlo, 1:25 000.

#### DESCRIPTION OF THE LOCALITY (A.W.J.)

##### *Location*

The geographic position of the locality is given in Fig. 1. Coordinates of the topographical map 1:25 000 (map sheet 24/3-4 Booischot-Westerlo) are  $x = 182.800$ ,  $y = 192.100$ .

The locality is usually indicated as 'Ramsel', according to its position close to that village. It is situated, however, within the boundaries of the municipality of Herselt.

### *Stratigraphy*

Unfortunately only restricted information on the lithology of the section is available, because the owner of the clay-pit complex refused to allow further investigation and sampling after the first visit in 1980. The proprietor probably took offence at the frequent unauthorized digging activities of private collectors. Still, such digging could do no harm, as exploitation of the clay-pits had stopped already several years ago. Also the owner was given permission to use the pit for waste dumping, which was prevented however by neighbouring inhabitants. So, the locality is still accessible in fact nowadays.

Anyhow, we have only data at our disposal on the lithology of the sediments at one place in the complex and only very little information on the lateral variations, which apparently are present.

This section, comprising the most important fossil-bearing site, was described as follows (date of measurement 7 August 1980):

(about 1.50 m of sediment was cleared away)

- 0.00 - 0.60 m light yellowish brown sand, rather fine, with a low clay content (Quaternary deposits)
- 0.60 - 1.10 m clayey sand, bright yellowish brown, mottled with grey, rather fine to rather coarse (Miocene, Diest Sands)
- 1.10 - 1.50 m dark greenish black 'glaucinite' sand, with a low content of clay; from 1.40 to 1.50 m with many fossiliferous phosphoritic concretions, claystones, rounded silex and bone fragments (Miocene, base of Diest Sands)
- 1.50 - 8.00 m heavy, grey clay (Oligocene, Rupelian, Boom Clay Formation, Putte Clay Member).

Lateral variation of this section mainly concerns the thickness of the basal blackish part of the Diest Sands. Locally this part of the section is absent, in which case the fossil-bearing concretions are found in the basal part of the yellowish Diest Sands, but still directly on top of the Boom Clay. Usually preservation of the material is less favourable then; as a result of chemical processes the concretions are soft or covered by an irremovable crust of sediment grains.

The yellowish Diest Sands locally contain a thin level of soft sandstone in which moulds of large terebratulids are found. This fossil is regularly found in the Diest Sands and their equivalent in the Antwerpen area, the Deurne Sands. This sandstone also contains moulds of molluscs, but these have not been studied here.

The presence of Diest Sands at this locality is mentioned by Vandenberghe & Vandenberghe (1979). These sands represent an erosive deposit, reaching considerable thicknesses in more southern and eastern directions and cutting deeply into underlying sediments, locally even far into the solid Boom Clay.

At Ramsel the blackish colour of the basal part of the Diest Sands has to be explained by the presence of a large quantity of dark minerals, reworked from older Miocene deposits. Also the components of the basal gravel must be considered as reworked material, as is indicated by their presence at the very base of the Diest Sands. This was acknowledged by the analysis of the mollusc fauna (see below).

Initially the blackish glauconitic sediments were considered to represent the so-called Zonderschot Sands. These sands were mentioned from this locality by Huyghebaert & Nolf (1979, p. 64, boring 24) and judging from their information an occurrence of Zonderschot Sands at Ramsel fits the distribution pattern of this deposit in the area around Heist-op-den-Berg, where the type section is situated.

Still, the faunal composition, as studied below, suggests an age slightly younger than that of the Zonderschot Sands. This, and the position of the concretions in the basal gravel, seem to indicate that this part of the section belongs to the Diest Sands already.

### CHARACTERISTICS OF THE BASAL GRAVEL (A.W.J.)

Sieving residues of the basal gravel yield, apart from the many dark-green to blackish phosphorites, also quite a number of bones and bone fragments, shark teeth, small wood chips, rounded grey-coated flints, soft grey claystones with a low carbonate content, and brown oxidized very hard claystones free of carbonate. Pyrite is only rarely found. The fractions below 1 mm mainly consist of 'glauconite' and quartz grains.

The phosphoritic concretions are very irregular in shape. They show hardly any traces of transport. Externally they are completely decalcified, but internally sometimes remnants of aragonitic fossils may be present. Some of the concretions can clearly be recognized as burrow-fillings, sometimes containing concentrations of bony fish skeleton parts, together with external moulds of otoliths. Several concretions show structures that are difficult to interpret as bone or wood, though some pieces of driftwood could be recognized as they are attacked by shipworms.

Most of the concretions contain internal and external moulds of molluscs, but also other fossil groups are represented, e.g. crustaceans, echinoderms, bryozoans. The number of double-valved bivalve shells and the very complete crabs suggest that the phosphorites originated in a deposit with a fauna *in situ*.

Though the basal gravel contains elements (flints, shark teeth) with distinct traces of transport, this cannot be said about the concretions, which seem to originate all from the same stratigraphic level. Maybe they were concentrated by a process of sediment erosion not powerful enough to remove also the concretions, resulting in a heterogeneous composition of the basal gravel. At any rate the concretions are reworked, as is convincingly demonstrated by the age of the mollusc fauna.

### The mollusc fauna (A.W.J.)

As stated in the introduction, the study of the mollusc fauna was based on material kept in the collections of Mr P. Baetens (Antwerpen), Mr W. Groeneveld (Santpoort-Noord) and in the RGM collection. The procedure followed consisted of careful washing of the concretions to remove all sediment particles from cavities. The surfaces of all concretions were inspected for the presence of internal or external moulds, sometimes the concretions were broken to find specimens preserved internally. Notwithstanding the rather coarse composition of the concretions the surface ornamentation of the molluscs is generally well-preserved, facilitating an easy recognition of the species by means of artificial casts. The constitution of the concretions, however, prevents the finding and identification of very small-sized specimens.

Table 1 gives a complete survey of the mollusc fauna found in the phosphoritic concretions at Ramsel, together with some non-molluscs. The number of specimens should be regarded as maxima, it is very well possible that internal and external moulds of one and the same specimen were both counted in some cases. For the more important species also the percentages are calculated.

The total number of identified molluscan individuals is nearly 2000. Some specimens, only identified to genus or family level, could possibly belong to other, specifically identified species present in this fauna. These are: *Aequipecten* sp., *Astarte* (s.lat.) sp., Tellinidae sp., *Abra* (*Abra*) sp., Bivalvia sp., *Xenophora* sp., Naticidae sp., Muricidae sp., ? Muricidae sp., Turridae sp., and *Conus* (s. lat.) sp.

It follows that the mollusc fauna under concern comprises at least 98 species. Looking through the list it strikes the eye once more that so few small-sized species were encountered. Considering the state of preservation of the material this is however not very astonishing.

Table 1. List of species found in phosphoritic concretions from Ramsel, reworked at the base of the Diest Sands.

R – RGM collection

G – Groeneveld collection

B – Baetens collection

T – total

Valves of bivalve species were counted for 1/2. Percentages less than 0.5 are indicated with +.

	R	G	B	T	%
Mollusca - Bivalvia					
<i>Leionucula haesendoncki</i> (Nyst & Westendorp, 1839) s. lat.	1	–	1/2	1 1/2	+
<i>Nuculana (Saccella) westendorpi</i> (Nyst, 1839)	1 1/2	1/2	3	5	+
<i>Portlandia (Yoldiella) pygmaea</i> (von Münster, 1837)	1/2	–	–	1/2	+
<i>Yoldia (Yoldia) glaberrima</i> (von Münster, 1837)	1	–	1/2	1 1/2	+
<i>Scapharca (Scapharca) diluvii</i> (Lamarck, 1805)	6	1/2	24 1/2	31	1.4
<i>Limopsis (Limopsis) aurita</i> (Brocchi, 1814)	4 1/2	–	6 1/2	11	0.5
<i>Limopsis (Pectunculina) anomala</i> auct., non von Eichwald, 1830	1/2	–	1 1/2	2	+
<i>Glycymeris (Glycymeris) obovata baldii</i> Glibert & v. d. Poel, 1965	1/2	–	–	1/2	+
<i>Arcoperna sericea</i> (Bronn, 1831)	2	–	2	4	+
<i>Modiolula phaseolina</i> (Philippi, 1844)	1/2	–	–	1/2	+
<i>Atrina pectinata</i> (Linné, 1767)	8	1	40 1/2	49 1/2	2.3
<i>Pinctada phalaenacea</i> (Lamarck, 1819)	–	–	1	1	+
<i>Aequipecten angelonii</i> (de Stefani & Pantanelli, 1880)	9 1/2	6 1/2	42	58	2.7
<i>Aequipecten seniensis</i> (Lamarck, 1819)	2 1/2	–	7 1/2	10	+
<i>Aequipecten</i> sp. indet.	–	–	1 1/2	1 1/2	+
<i>Hilberia duwelzi</i> (Nyst, 1861)	1 1/2	–	2	3 1/2	+
<i>Korobkovia woodi</i> (Nyst, 1861)	2	1/2	11 1/2	14	0.6
<i>Pseudamussium lilli</i> (Pusch, 1837)	2 1/2	1/2	2 1/2	5 1/2	+
<i>Limea (Limea) aff. strigilata</i> (Brocchi, 1814)	1/2	–	–	1/2	+
<i>Limatula sulcata</i> (Brown, 1827)	1/2	–	–	1/2	+
<i>Neopycnodonte navicularis</i> (Brocchi, 1814)	–	–	1/2	1/2	+
<i>Anisodonta duvergieri</i> Cossman & Peyrot, 1909	–	–	1/2	1/2	+
<i>Diplodonta (Diplodonta) rotundata</i> (Montagu, 1803)	–	–	1	1	+
<i>Cyclocardia (Cyclocardia) sp.</i>	1/2	–	5	5 1/2	+
<i>Astarte (Astarte) goldfussi</i> Hinsch, 1952	–	–	1/2	1/2	+
<i>Astarte (Astarte) gracilis convexior</i> Anderson, 1959	1/2	–	1/2	1	+
<i>Astarte (Astarte) radiata</i> Nyst & Westendorp, 1839	2 1/2	1 1/2	4	8	+
<i>Astarte</i> (s. lat.) sp. indet.	–	–	1 1/2	1 1/2	+
<i>Parvicardium scabrum</i> (Philippi, 1844)	1/2	–	–	1/2	+
<i>Parvicardium straeleni</i> (Glibert, 1945)	–	–	1/2	1/2	+
<i>Laevicardium (Habecardium) dingdense</i> (Lehmann, 1885)	1/2	–	1 1/2	2	+
<i>Laevicardium (Habecardium) subturgidum subturgidum</i> (d'Orbigny, 1852)	5	5	44	54	2.5
<i>Spisula (Spisula) sp.</i>	1/2	–	–	1/2	+
<i>Lutraria frangula</i> van Urk, 1980	–	–	1 1/2	1 1/2	+
<i>Angulus (Moerella) aff. donacillus</i> (Wood, 1857)	–	–	1/2	1/2	+
<i>Angulus (Peronidia) posterus</i> (Beyrich, in von Koenen, 1868)	–	–	1 1/2	1 1/2	+
Tellinidae sp. indet.	–	–	3 1/2	3 1/2	+
<i>Macoma (Psammacoma) elliptica</i> (Brocchi, 1814)	1 1/2	1/2	11 1/2	13 1/2	0.6

<i>Abra (Abra) antwerpiensis</i> Glibert, 1945	1/2	1/2	5 1/2	6 1/2	+
<i>Abra (Abra)</i> sp.	–	–	1 1/2	1 1/2	+
<i>Arctica islandica islandica</i> (Linné, 1758)	–	–	1	1	+
<i>Glossus (Glossus) lunulatus</i> (Nyst, 1835)	5 1/2	1 1/2	86 1/2	93 1/2	4.3
<i>Venus (Ventricoloidea) multilamella multilamella</i> (Lamarck, 1818)	13	4 1/2	83	100 1/2	4.7
<i>Cyrtodaria angusta</i> (Nyst & Westendorp, 1839)	–	–	1/2	1/2	+
<i>Hiatella (Hiatella) arctica arctica</i> (Linné, 1758)	2	1/2	1	3 1/2	+
<i>Panopea (Panopea) meynardi</i> Deshayes, 1828	1	–	25 1/2	26 1/2	1.2
<i>Corbula (Varicorbula) gibba gibba</i> (Olivi, 1792)	4	1 1/2	13	18 1/2	0.9
Teredinidae sp. indet.	2	–	3	5	+
<i>Thracia (Thracia) inflata</i> Sowerby, 1845	9 1/2	4	174	181 1/2	8.4
<i>Pholadomya (Pholadomya) cf. alpina</i> Matheron, 1843	–	1/2	1 1/2	2	+
<i>Cuspidaria (Cuspidaria)</i> sp.	1/2	–	–	1/2	+
<i>Cuspidaria</i> (s. lat.) sp.	–	–	1/2	1/2	+
<i>Bivalvia</i> indet.	–	–	2 1/2	2 1/2	+
Mollusca - Scaphopoda					
<i>Dentalium (Antalis) aff. dumasi</i> (Cossmann & Peyrot, 1916)	1	–	–	1	+
<i>Dentalium (Dentalium) dollfusi</i> von Koenen, 1882	1	–	–	1	+
<i>Dentalium (Dentalium)</i> sp.	1	1	2	4	+
<i>Laevidentalium</i> sp.	–	–	1	1	+
Mollusca - Gastropoda					
<i>Calliostoma (Ampullotrochus) ? laureatum</i> (Mayer, 1874)	2	–	3	5	+
<i>Solariella (Solariella) marthae</i> Kautsky, 1925	1	–	–	1	+
<i>Haustator (Haustator) eryna</i> (d'Orbigny, 1852)	1	–	1	2	+
<i>Turritella (Archimediella) subangulata</i> (Brocchi, 1814)	4	1	10	15	0.7
<i>Amaea (Scalina) subreticulata</i> (d'Orbigny, 1852)	–	–	1	1	+
<i>Niso (Niso) terebellum acarinatoconicum</i> Sacco, 1892	1	–	–	1	+
<i>Xenophora burdigalensis</i> (Gratoloup, 1847)	–	–	1	1	+
<i>Xenophora deshayesi</i> (Michelotti, 1847)	–	–	1	1	+
<i>Xenophora</i> sp. indet.	1	1	14	16	0.7
<i>Euspira helicina protracta</i> (von Eichwald, 1830)	2	1	4	7	+
<i>Natica hoernesii</i> Fischer & Tournouer, 1873	–	–	2	2	+
Naticidae indet.	–	2	8	10	+
Cypraeaacea indet.	–	–	1	1	+
<i>Aporrhais (Aporrhais) alata</i> (von Eichwald, 1830)	80	10	928	1018	47.2
<i>Eudolium dingdense</i> Anderson, 1964	–	–	1	1	+
<i>Ficus (Ficus) conditus</i> (Brongniart, 1823)	4	–	14	18	0.8
<i>Ficus (Ficus) simplex</i> (Beyrich, 1854)	1	–	–	1	+
<i>Semicassis (Echinophoria) bicoronata bicoronata</i> (Beyrich, 1854)	1	–	14	15	0.7
<i>Semicassis (Semicassis) miolaevigata</i> (Sacco, 1890)	1	–	2	3	+
<i>Murex (Haustellum) inornatus inornatus</i> Beyrich, 1854	1	–	1	2	+
<i>Murex (Tubicauda) spinicosta</i> Bronn, 1831	1	–	2	3	+
Muricidae sp. indet.	–	–	7	7	+
? Muricidae sp. indet.	–	–	1	1	+
<i>Anachis (Costoanachis) hosiusi</i> (von Koenen, 1872)	1	–	–	1	+
<i>Mitrella (Macrurella) nassoides</i> (Gratoloup, 1827)	3	–	–	3	+
<i>Kelletia (Boreokelletia) hosiusi</i> (Beyrich, 1856)	–	–	1	1	+
<i>Amyclina facki</i> (von Koenen, 1872)	–	–	1	1	+
<i>Hinia (Hinia) bocholtensis</i> (Beyrich, 1854)	1	1	3	5	+
<i>Hinia (Hinia) holsatica</i> (Beyrich, 1854)	1	–	–	1	+
<i>Hinia (Hinia) turbinella</i> (Brocchi, 1814)	2	–	1	3	+
<i>Hinia (Tritonella) tenuistriata</i> (Beyrich, 1854)	–	–	1	1	+
<i>Streptochetus (Streptodictyon) sexcostatus</i> (Beyrich, 1856)	1	–	4	5	+
<i>Ancilla (Baryspira) obsoleta</i> (Brocchi, 1814)	1	–	–	1	+
<i>Scaphella (Scaphella) bolli</i> (Koch, 1862)	1	–	3	4	+
<i>Acamptogenotia escheri</i> (Mayer, 1861)	–	–	1	1	+
<i>Orthosurcula steinvorthi</i> (von Koenen, 1872)	1	–	–	1	+

<i>Fusiturris duchasteli flexiplicata</i> (Kautsky, 1925)	1	-	2	3	+
<i>Gemmula (Gemmula) denticula borealis</i> (Glibert, 1954)	1	-	-	1	+
<i>Gemmula (Gemmula) zimmermanni</i> (Philippi, 1846)	3	-	3	6	+
? <i>Unedogemmula boreoturricula</i> (Kautsky, 1925)	-	-	1	1	+
Turridae sp. indet.	-	-	1	1	+
<i>Asthenotoma pannoides</i> (von Koenen, 1872)	1	-	-	1	+
<i>Crassispira</i> (s. lat.) <i>borealis</i> (Kautsky, 1925)	2	-	1	3	+
<i>Conus (Conolithus) antediluvianus</i> Bruguière, 1792 s. lat.	-	-	6	-	+
<i>Conus</i> (s. lat.) sp. indet.	-	-	3	3	+
<i>Strioterebrum (Strioterebrum)</i> sp.	1	-	-	1	+
<i>Terebra (Myurellina) acuminata neglecta</i> (Michelotti, 1847)	2	-	3	5	+
<i>Ringicula (Ringiculina) buccinea</i> (Brocchi, 1814)	6	1	2	9	+
<i>Ringicula (Ringiculina) ventricosa</i> (Sowerby, 1824)	-	-	1	1	+
<i>Roxania (Roxania) utriculus</i> (Brocchi, 1814)	-	-	1	1	+
<i>Scaphander (Scaphander) grateloupi</i> (Michelotti, 1847)	2	-	-	2	+
Mollusca - Cephalopoda					
<i>Spirulirostra baetensi</i> sp. nov.	1	-	-	1	+
Annelida					
<i>Serpula</i> sp.	-	-	1	1	
<i>Spirorbis</i> sp.	-	-	35	35	
indet.	2	-	16	18	
Bryozoa					
lunulitiforme	12	3	37	52	
incrustating	2	2	14	18	
Anthozoa					
indet.	1	-	1	2	
Echinodermata					
Irregularia, indet.	1	-	7	8	
Irregularia, <i>Echinocyamus</i> sp.	-	1	2	3	
Regularia, indet.	1	-	-	1	
Regularia, indet., spines	5	-	5	10	
Crustacea					
Decapoda	14	2	v	v	
Cirripedia, <i>Balanus</i> sp.	2	-	3	5	
Vertebrata					
Pisces, Selachii, teeth	+	+	v	v	
Pisces, Teleostei, skeleton parts	+	+	+	+	
Pisces, Teleostei, otoliths	+	-	+	+	
Mammalia, skeleton parts	+	+	+	+	

## AGE INTERPRETATION

The species composition of the mollusc fauna indicates beyond any doubt a Middle Miocene age. The ten most common species and their percentages are:

<i>Aporrhais (Aporrhais) alata</i>	47.2%
<i>Thracia (Thracia) inflata</i>	8.4%
<i>Venus (Ventricoloidea) multilamella</i>	4.7%
<i>Glossus (Glossus) lunulatus</i>	4.3%
<i>Aequipecten angelonii</i>	2.7%
<i>Laevicardium (Habecardium) subturgidum</i>	2.5%
<i>Atrina pectinata</i>	2.3%

<i>Scapharca (Scapharca) diluvii</i>	1.4%
<i>Panopea (Panopea) meynardi</i>	1.2%
<i>Corbula (Varicorbula) gibba</i>	0.9%

This list comprises such fragile species as *Thracia inflata* and *Atrina pectinata*. The relatively high percentages of these species should mainly be explained by the preservation as internal moulds. In faunas with shell preservation these species usually are much less important constituents. Each of the ten species mentioned occurred during the entire Middle Miocene of the North Sea Basin. Especially striking of course is the very high percentage of the gastropod *Aporrhais alata*, which cannot be explained by the way of preservation.

Occurrence of this species in such high percentages is only known from one other, almost identical fauna, also preserved in reworked phosphoritic concretions. These were collected from the base of the Deurne Sands at Borgerhout near Antwerpen (Janssen, 1983a). The Deurne Sands are considered to be a lateral equivalent of the Diest Sands (Glibert, 1957; de Meuter & Laga, 1976), so both reworked faunas occur at a similar stratigraphic level. At Borgerhout, however, the layer with concretions overlies the Antwerpen Sands, so the fauna in the concretions is younger than the Antwerpen Sands s.s. Considering the almost complete identity of both faunas a similar age can be expected for the Ramsel fauna.

At Ramsel a number of species were found that are only known from the older Middle Miocene (Hemmoorian), viz.: *Cyrtodaria angusta*, *Dentalium dumasi*, *Haustator eryna*.

On the other hand one species (in one specimen, Baetens collection) was encountered, which is exclusively known from the younger Middle Miocene (Reinbekian), viz. *Eudolium dingdense*.

Huyghebaert & Nolf (1979) consider the Zonderschot Sands to be a lateral equivalent of the Antwerpen Sands. The mollusc fauna of the Zonderschot Sands has not yet been published; therefore two samples from the type area (Heist-op-den-Berg, Belgium) were analyzed to obtain an idea of the faunal composition. The results were laid down in an internal report (Janssen, 1983b). The typical Zonderschot Sands may, according to the mollusc fauna, be correlated with the upper part of the Antwerpen Sands in Belgium and with the *Astarte radiata* Acme Zone in the eastern part of the Netherlands (Winterswijk area, see van den Bosch et al., 1975). In the time stratigraphic nomenclature valid all over the North Sea Basin the age of the Zonderschot Sands may be indicated as Hemmoorian (Oxlundian, in euhaline facies).

From the position of the fauna at Borgerhout and from the faunal composition we may conclude that the Ramsel fauna is slightly younger than the fauna of the Zonderschot Sands. It may be indicated as Hemmoorian, Oxlundian, of which it is one of the youngest known facies. Up to now the fauna is only known from the reworked concretions and not yet found in situ. Deposits of Reinbekian age remain unknown from Belgium, but the Ramsel material approaches it closely.

#### DESCRIPTION OF *SPIRULIROSTRA BAETENSIS* SP. NOV. (A.W.J.)

Phylum Mollusca  
 Classis Cephalopoda  
 Subclassis Coleoidea  
 Ordo Sepiida  
 Familia Spirulirostridae

Genus *Spirulirostra* d'Orbigny, 1842

*Type species* — *Spirulirostra bellardii* d'Orbigny, 1842 by monotypy.

*Spirulirostra baetensi* sp. nov.

Fig. 3; Pl. 1, figs. 1-4; Pl. 2, figs. 1-3.

*Diagnosis* — A *Spirulirostra* species with a relatively small rostral shell part and a very large phragmocone. Capitulum produced, but not very voluminous. Processus ventralis absent. The lateral wings of the rostrum are only slightly expanded. The posterior ventral part of the phragmocone between the lateral wings is not covered by a calcareous plate.

*Locus typicus* — Ramsel, municipality of Herselt, Belgium, as described in the introduction.

*Stratum typicum* — Reworked in basal gravel of Diest Sands, directly on top of the Boom Clay.

*Age* — Middle Miocene, Hemmoorian, youngest Oxlundian (compare the chapter on the mollusc fauna above).

*Holotype* — The only available specimen, RGM 226 786 (internal mould) and RGM 226 787 (external mould), collected by Mr P. Baetens (Antwerpen), who generously donated the specimen. Sets of plaster casts of the holotype were placed in the collections of Mr P. Baetens (Antwerpen), the Institut royal des Sciences naturelles de Belgique (Bruxelles), the Senckenberg Museum (Frankfurt/Main), and the British Museum (Natural History) (London). These casts were very skillfully prepared by Mr J. van der Linden (RGM).

*Derivatio nominis* — This new species is named after the collector.

*Description* — The specimen is, as all other molluscs from this locality, preserved in a phosphoritic concretion. Both the external mould and the internal mould (which was separated from the concretion) are present. The same concretion also contains several other fossils, for instance some external moulds of bony fish otoliths.

## The internal mould

The preserved part of the internal mould of the phragmocone has a length of 36 mm. Nineteen chambers are preserved of which the last 14 are visible from all around. The first five chambers are slightly damaged on their ventral side. The initial chamber and presumably two subsequent ones are missing. Here we indicate the preserved chambers as the 4th to 22nd ones. The posterior part of the phragmocone is curved endogastrically. The curved part comprises the chambers 4 to about 11. The following chambers form together a straight cone with an apical angle of 15°. The diameter of chamber 4 is approximately 1.7 mm, that of the last preserved one (no 22) is 10 mm. From the 9th

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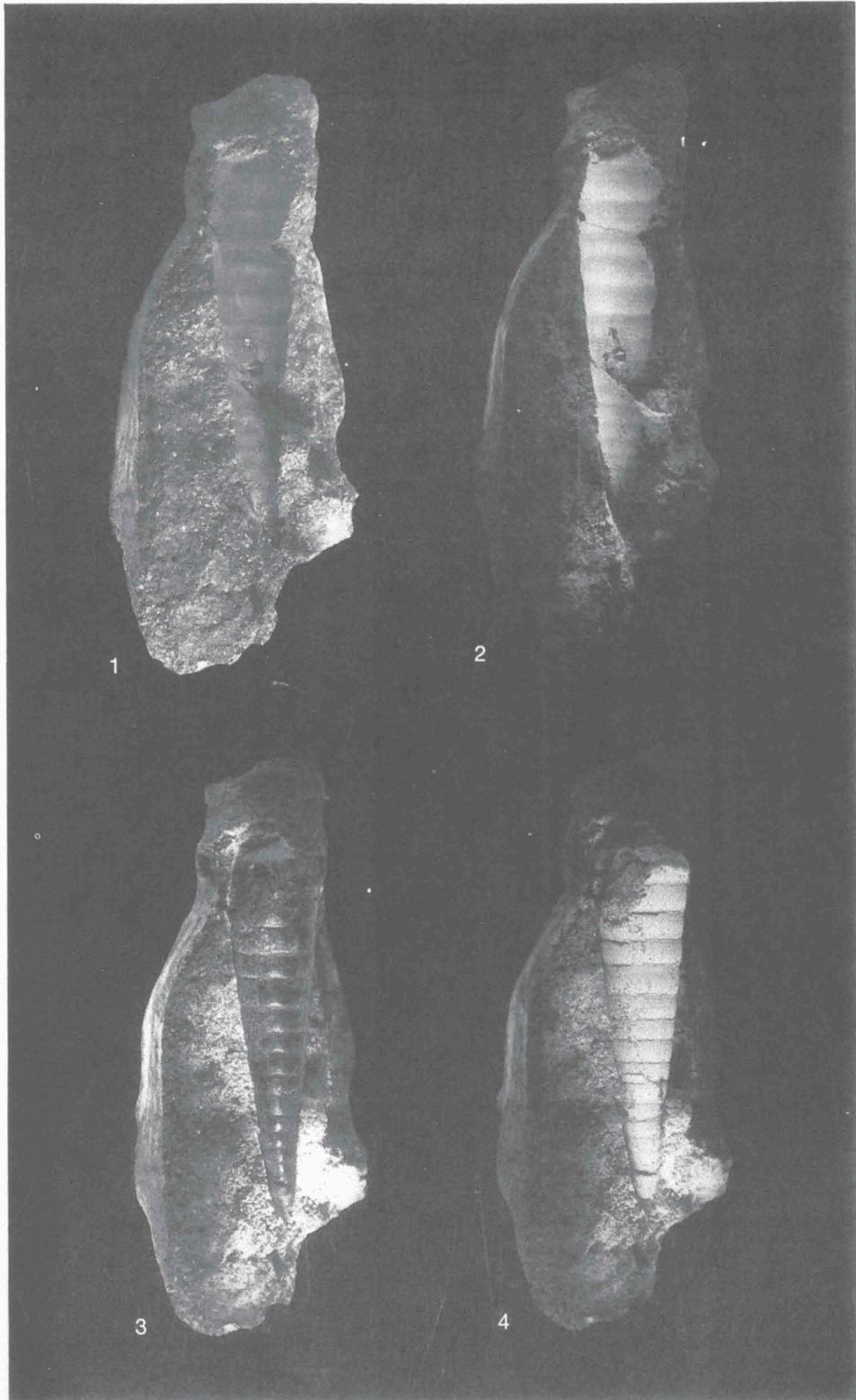
 Plate 1

Ramsel, Hermans clay-pit, Belgium; Miocene (Hemmoorian).

Figs. 1-4. *Spirulirostra baetensi* sp. nov. Holotype, RGM 226 786-787;  $\times 1\frac{1}{2}$ .

1. External mould in phosphoritic concretion. 2. Ditto, sprayed with ammonium chloride. 3. Ditto, with internal mould of phragmocone in situ. 4. Ditto, sprayed with ammonium chloride.

Plate 1



chamber onwards the transverse section of the phragmocone is circular, which because of the damaged ventral side is not certain for the first five chambers. Anteriorly the ventral side of the phragmocone becomes very slightly flattened.

The suture lines are clearly visible on the internal mould. In a lateral view they are slightly oblique with respect to the cone's axis, their dorsal side being the most anterior part. On the ventral side of the phragmocone the suture lines describe a small v-shaped incurvation pointing adapically. The row of successive v's is not lying exactly on the midline of the ventral side, but is slightly shifted towards the right side. They are, however, in the middle of the ventral flattening of the phragmocone, so this characteristic could also be described by saying that the curvature of the phragmocone does not exactly coincide with the plane of symmetry of the specimen.

The septa seem to be extremely thin, because decalcification of the fossil did not result in a separation of the chambers in isolated casts. The length of the chambers does not increase regularly. The successive lengths are (measured on the dorsal side): 0.8; 1.3; 1.3; 1.5; ?; 1.6; 1.5; 1.8; 1.8; 2.0; 1.8; 2.2; 2.0; 2.3; 3.0; 2.4; 2.7; 2.8; 3.1 + ? mm. On the internal mould the suture lines appear as slight constrictions; the chamber walls in between are somewhat convex. Growth-lines are vaguely visible between the sutures. The siphon is not preserved in the specimen at hand, but the presence of the v-shaped incurvations indicates that it must have been situated very close to the ventral wall.

#### The external mould

The concretion from which the internal mould was separated exhibits the external mould of the entire ventral side of the specimen and the adapical part of its left side. The ultimate part of the rostral spine is not visible. Unfortunately the dorsal side of the specimen is absent, as the counterpart of the concretion containing the imprint of that side of the specimen has not been found. So nothing can be seen of the prolongation of the lateral wings into a possible proostracum. The imprint left by the specimen can most easily be studied by casting it (Pl. 2, fig. 1a-b). This gives a nice picture of the external appearance of the shell. The preserved length of the specimen is 40 mm. The shell of the phragmocone seems to have been extremely thin-walled, because the internal mould exactly fits the imprint. On the external mould the chambers are visible by very weak, unsharply delimited constrictions. One more chamber (the 23rd) is visible on the anterior end, which is not preserved on the internal mould.

The left lateral wing of the posterior shell part is visible from the 11th chamber downwards. Only a small part of the right side wing is preserved. In a lateral view (Pl. 2, fig. 1a) the rims of the lateral wings are very oblique. Adapically they develop into a protruding capitulum, containing the initial chamber of the phragmocone. The precise outline of the capitulum is uncertain, as just below this part of the shell another fossil

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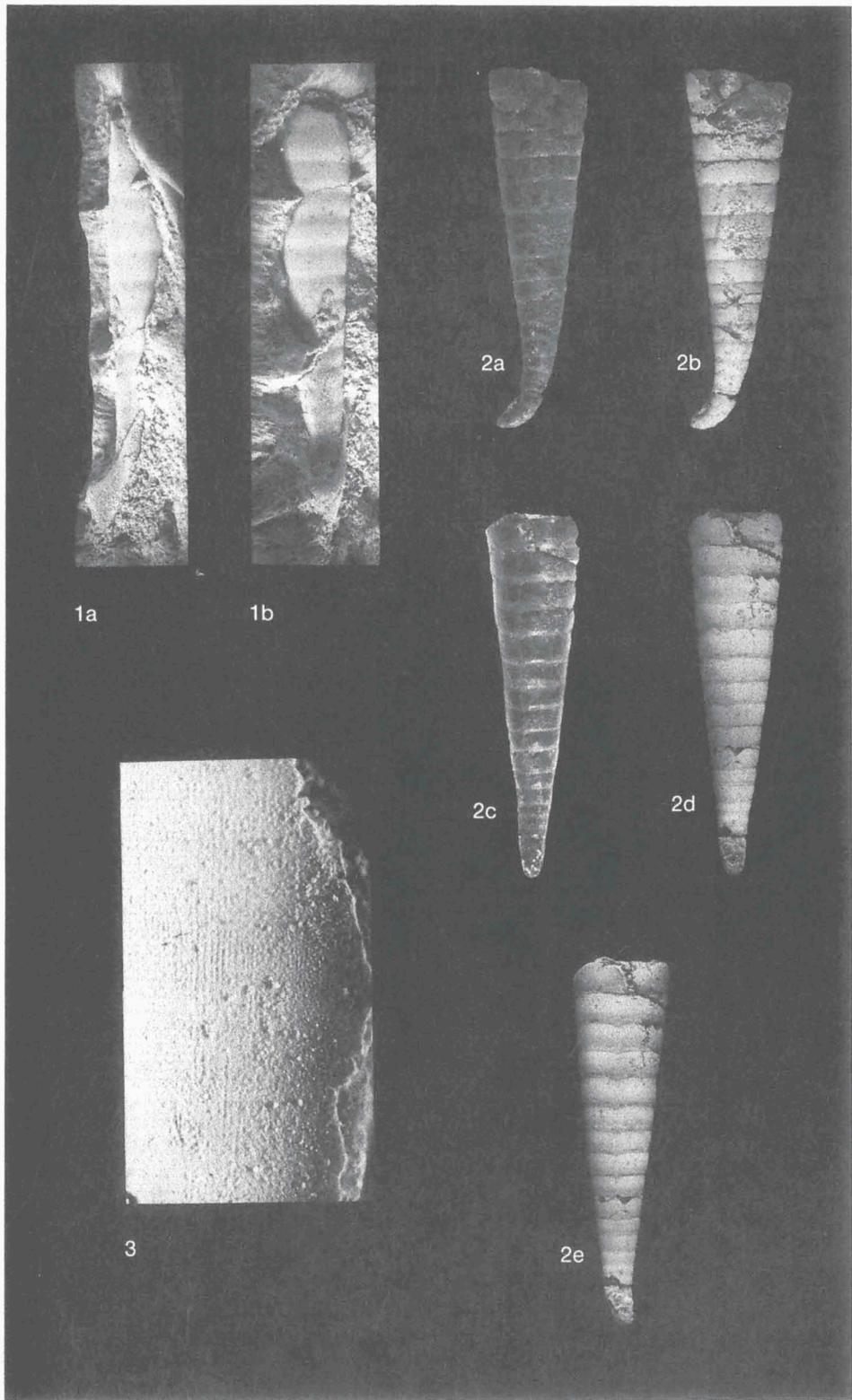
## Plate 2

Ramsel, Hermans clay-pit, Belgium; Miocene (Hemmoorian).

Figs. 1-3. *Spirulirostra baetensi* sp. nov. Holotype, RGM 226 786-787.

1. Artificial cast of external mould,  $\times 1\frac{1}{2}$ ; a: left lateral view; b: ventral view.
2. Internal mould of phragmocone,  $\times 1\frac{1}{2}$ ; a: left lateral view; b: ditto, sprayed with ammonium chloride; c: ventral view; d: ditto, sprayed with ammonium chloride; e: ditto, row of v-shaped inclinations of suture lines orientated in centre of ventral side.
3. Micro-sculpture on external mould of phragmocone, sprayed with ammonium chloride, appr.  $\times 10$ .

Plate 2



seems to be present in the concretion, the cavity of which is connected with the imprint of the capitulum, thus obscuring the shape of its extreme anterior end.

The width of the rostrum, measured at the most anterior part of the capitulum, is about 5 mm. The lateral wings are only very slightly expanded (ventral view). Posteriorly the rostrum is gradually narrowed into a rostral spine, the exact shape of which can only be inferred.

Because of a rather coarse-grained matrix nothing can be observed of a possible surface ornamentation of the rostral shell part. The external surface of the phragmocone is covered with a fine granular ornamentation, in which the granules are arranged in very fine longitudinal lines (Pl. 2, fig. 3). This sculpture becomes less distinct near the anterior end of the cone.

*Discussion* — The present specimen was compared with the detailed information on this cephalopod group given by Naef (1922). This paper still is the most comprehensive study of fossil Sepiida and not rendered out of date by more recent publications.

As to the genus assignment, the slightly oblique position of the chambers and the size of the phragmocone in relation to the rostral shell part are reminiscent of *Spirulirostrina* Canavari, 1892, as reconstructed by Naef (1922, p. 76, figs. 29a-d). This genus is based on a single species, *S. lovisatoi* Canavari, 1892, from Miocene clays (Langhian) at Fangario near Cagliari, Sardinia (and not from the 'Argille fanghiane di Fangano presso Cagliari', as stated by Naef). In his original paper Canavari gives an extensive description of his species, of which three specimens were available, and also a reconstruction of the shell. The differences between Canavari's and Naef's reconstructions are so considerable that one can hardly imagine that they concern the same taxon. Naef didn't know Canavari's paper (which he supposed to be insufficiently complete!) and based his observations on a fourth specimen from the same locality, kept in the collections of the Staatliches Museum für Naturkunde at Stuttgart (F.R.G.). Fortunately this specimen is still available. Dr M. Warth of that museum was so kind to lend it to me for a renewed inspection. It is unknown if the type material of *S. lovisatoi* is still extant. A request to the Museo geologico e paleontologico at Pisa (Italy) remained unanswered.

The Stuttgart specimen of *S. lovisatoi* is illustrated on Pl. 3, fig. 4a-b. An unbiased study of this fossil undoubtedly demonstrates the correctness of Canavari's views, whereas Naef has to be credited with quite a number of incorrect observations and conclusions, which at least partially seem to have been induced by wishful thinking. This latter reproach may be elucidated by Naef's willful and repeatedly stated concept that *Spirulirostrina* has to be considered an evolutionary link between *Spirulirostra* and the

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### Plate 3

Figs. 1-3 from Twistringen, O. Sunder clay-pit (F.R.G., Lower Saxony); Miocene, Reinbekian, Twistringer Schichten. Fig. 4 from Fangario near Cagliari, Sardinia (Italy); Miocene (Langhian) clays.

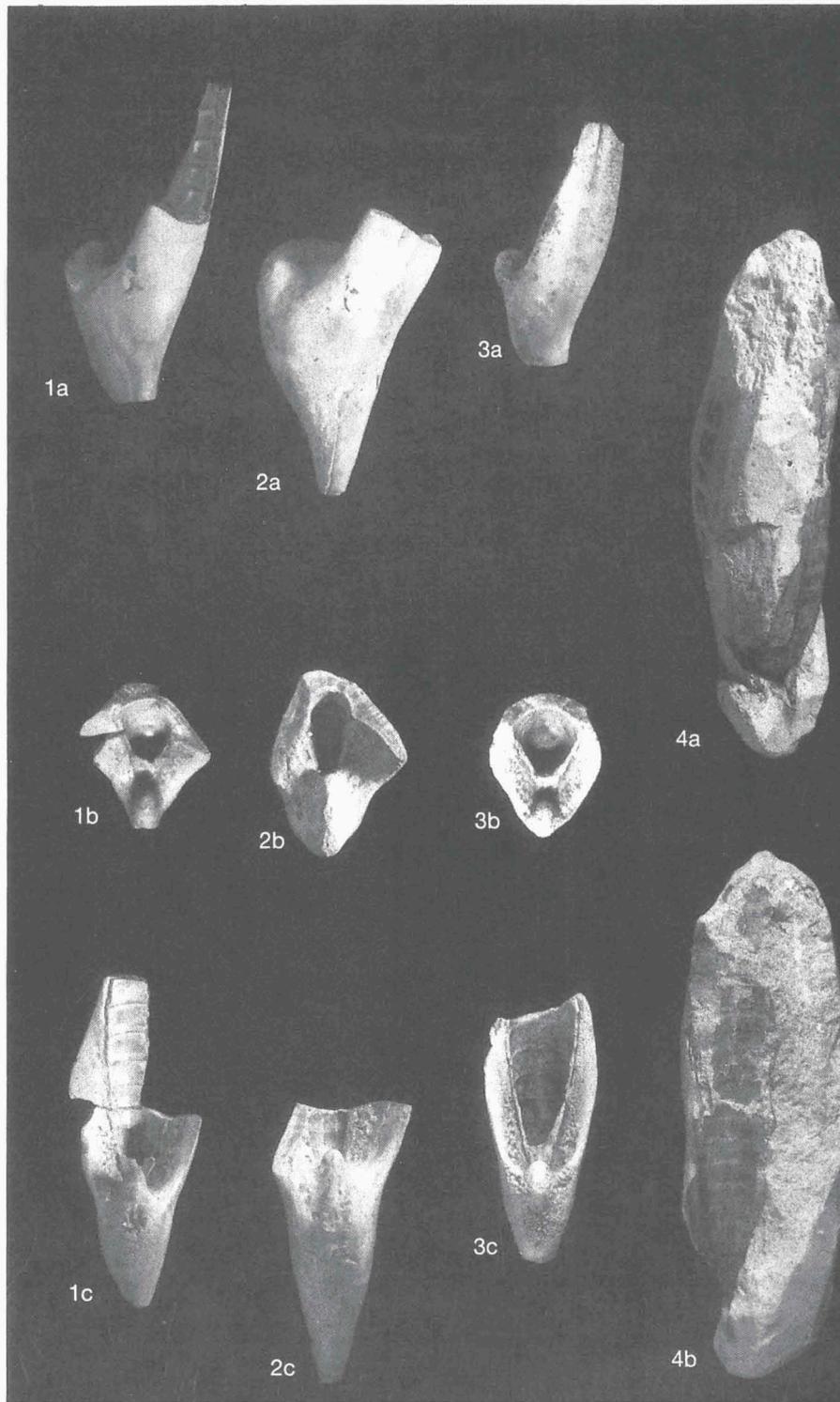
Fig. 1. *Spirulirostra bellardii* d'Orbigny, 1842 f. *sepioidea* Naef, 1922; ×2; a: left lateral view; b: adapical view; c: ventral view; RGM 116 878a.

Fig. 2. *Spirulirostra bellardii* d'Orbigny, 1842; typical form; ×2; a: left lateral view; b: adapical view; c: ventral view; RGM 115 874.

Fig. 3. *Spirulirostra bellardii* d'Orbigny, 1842 f. *hoernesii* von Koenen, 1867; ×2; a: left lateral view; b: adapical view; c: ventral view; RGM 116 878b.

Fig. 4. *Spirulirostrina lovisatoi* Canavari, 1892; ×1½; original of Naef (1922, fig. 29a-d); a: left lateral view; b: dorsal view; coll. Staatliches Museum für Naturkunde, Stuttgart (registration no. 9185).

Plate 3



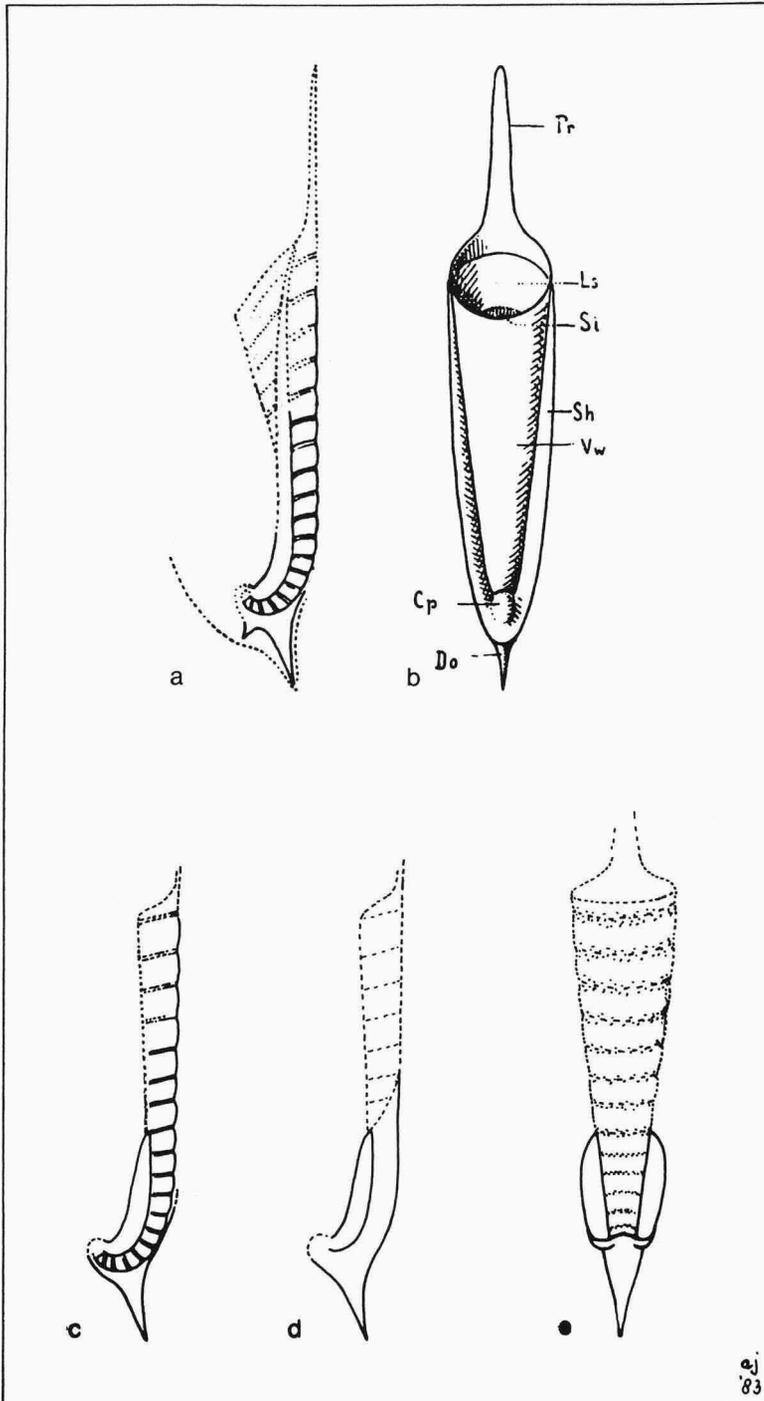


Fig. 2. *Spirulirostrina lovisatoi* Canavari, 1892,  $\times 1\frac{1}{2}$ ; a-b: reconstruction after Naef (1922, fig. 29 b, d); c: revised reconstruction, based on Naef's fig. 29b, with basal part of phragmocone visible; d-e: ditto, with reconstructed rostral shell part; d: left lateral view, e: ventral view.

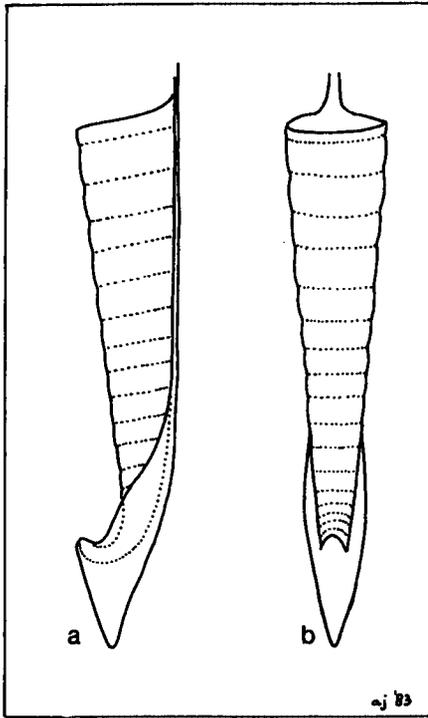


Fig. 3. *Spirulirostra baetensi* n. sp.,  $\times 1\frac{1}{2}$ ; reconstruction; a: left lateral view; b: ventral view.

Sepiidae. Naef's reconstruction of *S. lovisatoi* is revised here on the basis of the Stuttgart specimen and on data supplied by Canavari. It seems to be the only specimen in which the rostral shell part is preserved (in the form of an external mould with some shell remnants). The most important differences with regard to Naef's concept are:

- 1) The absence of a processus ventralis. It is quite incomprehensible how Naef arrived at the conclusion on the presence of such a shell part, because not the slightest indication of this organ can be found in the specimen itself. Naef's figs. 24b and d are, by the way, contradictory in this respect. In fig. 24b the adapical part of the lateral wings is correctly drawn, whereas they are erroneously reconstructed in fig. 24d.
- 2) The anterior extension of the lateral wings. Neither the Stuttgart specimen nor Canavari's fossils justify the supposition that the lateral wings are elongated all along the phragmocone up to its anterior end, as suggested by Naef. Canavari's observations agree perfectly with the Stuttgart specimen.
- 3) The dorso-ventral compression of the phragmocone, which is much greater than supposed by Naef. The anterior part of the cone is distorted in the Stuttgart specimen, but the posterior part agrees very well with the specimens investigated by Canavari. In its posterior part the phragmocone is flat or even concave at its ventral side, whereas more anteriorly the transverse section becomes regularly elliptical, with the short axis directed dorso-ventrally.
- 4) The oblique position of the chambers, which is far less important than thought by Naef.

This revised reconstruction of *S. lovisatoi* clearly demonstrates that the differences between *Spirulirostra* and *Spirulirostrina* are less considerable than indicated by Naef. Still, the dorso-ventral compression of the phragmocone, the peculiar shape of the lateral wings and also the somewhat dorsal direction of the rostral spine may justify the maintainance of a separate genus for *lovisatoi*. Naef's opinion that *Spirulirostrina* is more closely related to the Sepiidae than *Spirulirostra* still stands.

If we compare the new reconstruction of *Spirulirostrina* (Fig. 2) with that of the Ramsel specimen (Fig. 3) it is obvious that in spite of a superficial resemblance there are important differences with respect to the shape of the lateral wings and the rostral spine, whereas a dorso-ventral compression of the phragmocone is practically absent in *baetensi*, which inevitably leads us to the genus *Spirulirostra*.

In *Spirulirostra* two European species were described, viz. *S. bellardii* d'Orbigny, 1842 (type species) from the Miocene of Turin, North Italy, and *S. hoernesii* von Koenen, 1867 from the Miocene of northwestern Germany. Naef (1922, p. 66, figs. 24B1-4) introduced a third species, *S. sepioidea*, also from the Miocene of Turin, in which he included one of the syntypes of *S. hoernesii* on the basis of von Koenen's illustrations (pl. 14, fig. 6a). Anderson (1964, p. 338 and explanation of pl. 52, figs. 307a-c) complicated the situation by designating this very specimen as the lectotype of *S. hoernesii*.

Of these three species of *Spirulirostra* in each case only the rostral shell parts are known. Nothing can be said about the size of the phragmocone in relation to that of the rostrum. Naef's reconstruction of *S. hoernesii* (p. 64, figs. 23a-c) supposed this shell part to protrude hardly beyond the lateral wings (side view), but this is no more than an assumption. The presence of such a long phragmocone in *baetensi* is entirely due to the way of preservation of the fossil, so different from that of the other *Spirulirostra* species and allowing the conservation of extremely fragile shell parts. It cannot be regarded as a distinguishing characteristic.

According to Naef the main differences between the three species are to be found in the size of the capitulum, which is small in *hoernesii* and *sepioidea*, but voluminous in *bellardii*, and in a weak so-called processus ventralis, absent in *hoernesii* and *bellardii*, but present in *sepioidea* (note that apparently the presence of this processus ventralis influenced Naef in his denomination *sepioidea*!). Naef accepted the joint occurrence of *S. bellardii* and *S. sepioidea* in the Miocene of Turin on the one hand, and that of *S. hoernesii* and *S. sepioidea* in the Miocene of northwestern Germany on the other.

In the North Sea Basin *Spirulirostra* is known from the Reinbekian localities Dingden, Twistringen and Berssenbrück (Woltrup), all F.R.G. From Dingden only a very restricted material is known, among which the lectotype of *S. hoernesii*. At Twistringen, however, *Spirulirostra* is not very rare. In the RGM collection are one badly preserved specimen and a fragment from Dingden (Bislich Beds) and seven specimens from Twistringen. This latter material, all more or less damaged rostral shell parts, shows a considerable variability. It was possible to isolate specimens demonstrating the distinguishing characteristics of each of the three species *bellardii*, *hoernesii* and *sepioidea*. These specimens are illustrated here on Pl. 3, figs. 1-3. The conclusion must be, as could already be expected by the earlier mentioned joint occurrences, that *bellardii*, *hoernesii* and *sepioidea* all belong to one and the same variable taxon, that has to be indicated as *Spirulirostra bellardii* d'Orbigny, 1842. The names *hoernesii* and *sepioidea* can be applied to indicate formae.

The stratigraphical provenance of the occurrences outside the North Sea Basin is only vaguely known. Their age is usually indicated as 'Langhian'. Inside the basin the vertical distribution of the species is restricted to the Reinbekian, so all the material seems to be more or less of the same age. Possibly this fossil represents a useful tool for interregional correlations!

The specimen from Ramsel differs from *S. bellardii* in the first place by the restricted lateral expansion of the wings. More important, however, is the absence of a Calcareous plate, present in *bellardii* (see Pl. 3, figs. 1c, 3c; also indicated by Naef, 1922, p. 61, fig. 24B4 as 'Ventralwand mit Rippe', symbol Vr) on the extreme ventral-posterior part of the phragmocone, between the lateral wings. Unlike Naef's drawing this part of

the phragmocone becomes almost completely flat on the outside by the presence of this plate, the centre of which is procured with a narrow longitudinal rib. The available material of *S. bellardii* does not allow to observe how far this plate extends in anterior direction, but in the specimen illustrated on Pl. 1, fig. 3 its length has been 5 mm at least. The imprint of the Ramsel specimen distinctly indicates that such a plate is absent in *S. baetensi*.

### Description of the decapod fauna (P.M.)

Crab remnants from the Miocene of northwest Europe are not very common. Still, several publications deal with them, indicating the presence of a rather rich fauna, e.g. Noetling (1881), Gripp (1964a, b, 1967, 1968, 1969), R. Janssen (1972), Holthuis (1949), and Höpfner (1974). Unfortunately, most of the remnants are either isolated fingers or fragments of carapaces. The Ramsel material is the first fauna consisting of abundant well-preserved specimens in this area.

The specimens are preserved as internal moulds or as partly decorticated carapaces in phosphoritic concretions. Only a few external moulds are present unfortunately. The state of preservation suggests that the crabs were embedded as carrions, the decomposing soft parts could have favored the formation of the concretions (Hückel & Mundlos, in Seilacher, 1976, pp. 372-374).

Two species were recognized in the studied material. Both are also known from the Badenian of the Central Paratethys, though some differences, judged as infrasubspecific ones, are evidently present between the older Ramsel and the younger Paratethys specimens (see below).

The studied material is kept in several public and private collections, among which that of Mr P. Baetens (Antwerpen) may be mentioned in particular. The investigation was executed on the basis of some specimens that were sent to Budapest, whereas all other specimens, totalling 99 individuals, were studied by means of photographs. These were made very skillfully by Mr W. A. M. Devilé (RGM, Leiden), and I would like to thank him for his dedication. Of this material 90 specimens belong to *Tasadia carniolica* (Bittner, 1884), seven belong to *Mursia lienharti* (Bachmayer, 1961), whereas two defective specimens remained unidentified. Additional material collected by Mr Baetens remained unstudied, but doesn't seem to contain other species.

Ordo Decapoda  
Subordo Brachyura  
Familia Calappidae

Genus *Mursia* Desmarest, 1823

*Type species* — *M. cristata* H. Milne-Edwards, 1837.

*Mursia lienharti* (Bachmayer, 1961)

Pl. 4, figs. 1, 2.

1961 (?) *Calappa lienharti* n.sp., Bachmayer, p. 41, pl. 2, fig. 2.

- ? 1964 *Calappa* sp. — Gripp, p. 55, text-fig. 1.  
 1972 (?) *Calappa lienharti* Bachmayer — R. Janssen, p. 93, fig. 39.  
 1974 *Parthenope loczyi* n. sp., Müller, pp. 277, 281, 283, pl. 1, fig. 7.  
 non 1979 *Mursia* sp. — Förster, p. 257, pl. 4, fig. 1.  
 in pr. *Mursia lienharti* (Bachmayer) — Müller (with further synonymy).

*Material* — Ramsel, 1 carapace (coll. Meurisse, Antwerpen), 3 carapaces (coll. Indeherberghe, Antwerpen), 3 carapaces (coll. Baetens, Antwerpen); all preserved as internal moulds. Achim, 12 right dactyli of cheliped (coll. Niedersächsisches Landesamt für Bodenforschung; see R. Janssen, 1979). For a specification of *Paratethys* material see Müller (in press).

*Description* — The anterior part of the carapace is semicircular, while the posterior side is delimited by converging, almost straight postero-lateral margins. The front is prominent, trilobed. The antero-lateral margin is decorated with ten lobes. The row of these lobes is closed posteriorly by a lateral spine which is of a considerable length, straight and directed perpendicularly to the longitudinal axis of the carapace. The posterior margin is laterally delimited by lobes or rudimentary spines. The whole surface of the carapace is covered by an array of tubercles.

Parts other than the carapace are unknown from Ramsel. Fingers are known from the Paratethyan as well as from NW Germany (Achim well, see R. Janssen, 1972, p. 93). There is no stridulating ridge on their inner side. Other parts of this species are described by Müller (in press).

*Remarks* — The form of the carapace and its decoration are identical in Paratethyan and Ramsel specimens. The lateral spine is longer and more straightened in the North Sea Basin form, however. It is directed more sideways when compared with that of the Paratethyan specimens. Also the spiniform lobes at the limits of the posterior margin are bigger. These features probably reflect an evolutionary process and are regarded as being of infrasubspecific value.

The fingers are peculiar, for those of other *Mursia* species invariably have a stridulating ridge, which is absent in the European Miocene species. Obviously this is a specific pattern.

Familia Cancridae Latreille, 1803

#### Genus *Tasadia* gen. nov.

*Type species* — *Cancer carniolicus* Bittner, 1884 by monotypy.

*Derivatio nominis* — The genus is named after the type locality of *C. szontaghii*, Tasádfő (Transsylvania, formerly Hungary, now Rumania). *C. szontaghii* is a junior synonym of *C. carniolicus* (see below).

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### Plate 4

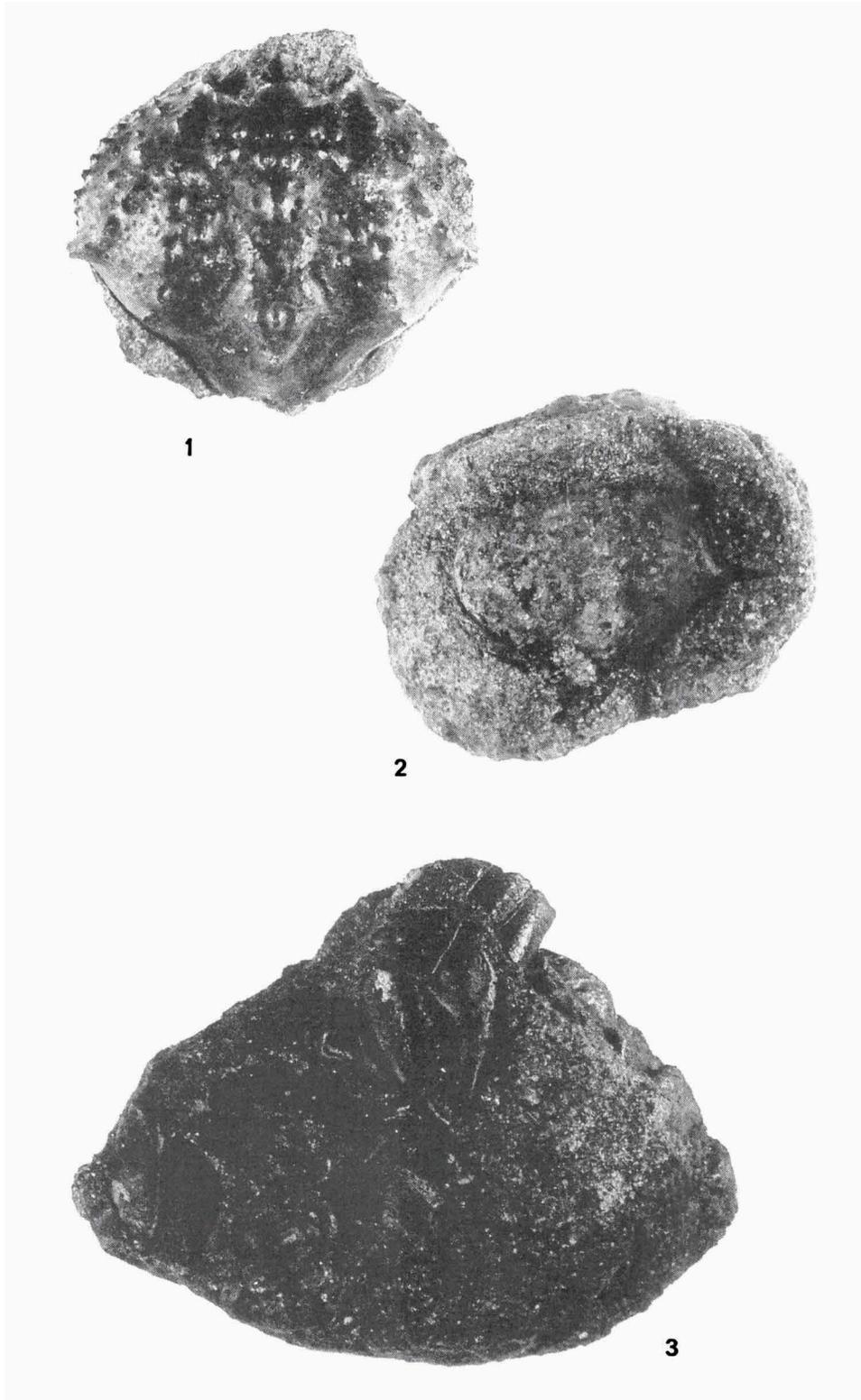
All specimens from Ramsel, Hermans clay-pit, Belgium; Miocene (Hemmoorian).

Fig. 1. *Mursia lienharti* (Bachmayer, 1961);  $\times 2$ ; internal mould of carapace; coll. P. Baetens, Antwerpen.

Fig. 2. *Mursia lienharti* (Bachmayer, 1961);  $\times 2$ ; internal mould of carapace, note the external mould of right lateral spine; coll. R. Meurisse, Antwerpen.

Fig. 3. *Tasadia carniolica* (Bittner, 1884);  $\times 2$ ; ventral view of male specimen, showing internal mould of left chela; RGM 225 308.

Plate 4



*Diagnosis* — A densely decorated elliptical carapace. The basis-ischium of the third maxilliped is *Cancer*-like (see Fig. 4).

*Remarks* — *Tasadia* differs from any *Cancer* species by its densely decorated carapace. The coarse, compound granulae and tuberculae are absent in the genus *Atelecyclus* as well. Beurlen (1958, p. 15) tentatively ranged this species in his new genus *Cyclocancer*, which in turn was based on a newly described Brazilian Miocene species, *C. tuberculatus* Beurlen. According to Beurlen the feature unifying *C. tuberculatus* with *szontaghii* was their presumed transitional position between *Cancer* and *Atelecyclus*. Contrary to his opinion, *C. tuberculatus* seems to me to be more closely related to *Hepatus*, rather than to any Cancroidea. On the other hand *Tasadia* seems to be closely related to *Cancer*, as far as this can be judged from the form of the third maxilliped. Thus its transitional position is dubious.

*Tasadia carniolica* (Bittner, 1884)

Fig. 4a; Pl. 4, fig. 3; Pl. 5, figs. 1,2.

1884 *Cancer carniolicus* nov. spec., Bittner, p. 27, pl. 1, figs. 8-9.

1897 *Cancer szontaghii* n. sp., Lörenthey, pp. 159, 160, 167, 168.

1929 *Atelecyclus szontaghii* Lörenthey — Lörenthey (in Lörenthey & Beurlen), pp. 156-158, pl. 9, fig. 9.

1958 *Cyclocancer szontaghi* (Lörenthey) — Beurlen, p. 15.

1969 *Atelecyclus szontaghi* Lörenthey — Gripp, pp. 86-87, pl. 3, fig. 1.

in pr. '*Cancer*' *szontaghii* Lörenthey — Müller (with further synonymy).

*Material* — Ramsel: 3 carapaces with ventral parts, 3 isolated carapaces, 1 propodus (coll. Indeherberghe, Antwerpen); 9 carapaces with ventral side, 1 carapace (coll. Marquet, Antwerpen); 1 carapace with ventral side (coll. Meurisse, Antwerpen); 45 carapaces with ventral side, 10 carapaces, 1 chela (coll. Baetens, Antwerpen); 13 carapaces with ventral side and several fragments (coll. RGM 225 301-225 315); 2 carapaces with ventral side (coll. Groeneveld, Santpoort-Noord); Winterswijk-Miste (the Netherlands): 1 carapace with ventral side and chelae, shell partly preserved (coll. R. van Uum, Lelystad); Segrahn (NW Germany): 1 carapace with chelipeds (coll. ? Kümmel, Hamburg, see Gripp, 1969). For a specification of Paratethyan material see Müller (in press).

*Description* — The carapace is elliptical, all regions are delimited by deep furrows. The front is adorned with four or five spiniform teeth. The antero-lateral margin bears 9 to 10 flattened denticulated lobes, which are rather irregular in outline. The postero-lateral margin consists of 5 to 6 short ridges. This row of ridges ends at a level superior to that of the posterior margin. The regions of the carapace are densely decorated with tubercles scattered all over the surface or grouped in clusters. Some tubercles are spiniform. The chelae are rather robust, especially those of the larger specimens. The palm is decorated with rows of tubercles.

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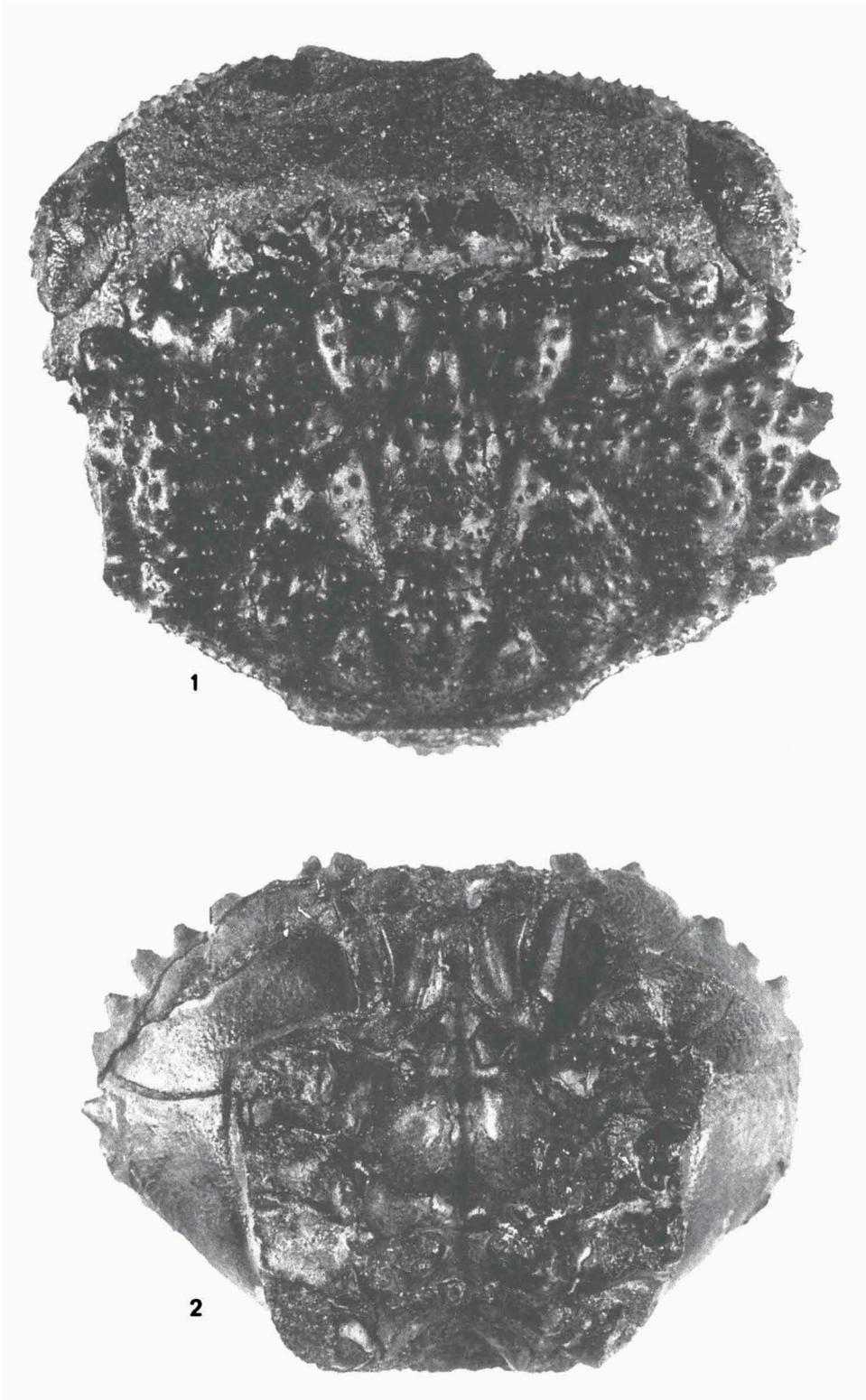
Plate 5

Both specimens from Ramsel, Hermans clay-pit, Belgium; Miocene (Hemmoorian).

Fig. 1. *Tasadia carniolica* (Bittner, 1884);  $\times 1\frac{1}{2}$ ; internal mould of carapace, dorsal view; coll. P. Baetens, Antwerpen.

Fig. 2. *Tasadia carniolica* (Bittner, 1884);  $\times 2$ ; ventral view of male specimen; coll. RGM 225 304.

Plate 5



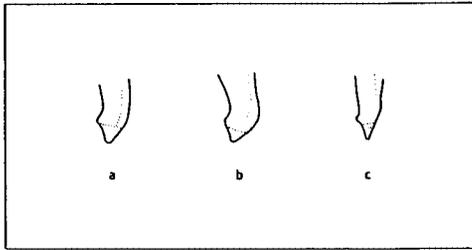


Fig. 4. Proximal end of basis-ischium of third maxillipeds of: a: *Tasadia carniolica* (Bittner, 1884); b: *Cancer pagurus* Linnaeus, 1758; c: *Atelecyclus undecimdentatus* (Herbst, 1783).

**Remarks** — Löbrenthey's specimen (collected by T. Szontag) is very well preserved. It is kept in the collection of the Magyar Állami Földtani Intézet at Budapest (registration number M 35). Compared with the similarly well-preserved but decorticated specimens from Ramsel some minute differences were observed. The chelae of most Ramsel specimens are more robust than those of the type specimen, owing to differences in size. The decoration of the carapace is rather variable from specimen to specimen. In this respect the type seems to fit well among the Ramsel specimens. The general outline, the marginal teeth, the decoration of the chelae, and the form of the third maxilliped are exactly the same in the specimens from the various countries, so Gripp's identification (1969, p. 86) is confirmed by the new material.

The type-series of *Cancer carniolicus* was recently rediscovered in the Naturhistorisches Museum at Vienna. Comparison with the holotype and newly collected specimens from Tasádfő (type locality of *Cancer szontaghii*) demonstrated convincingly the identity of Bittner's and Löbrenthey's forms. Thus the name *Tasadia carniolica* (Bittner), being a senior synonym of *T. szontaghii* (Löbrenthey), should be used for the Ramsel specimens, too.

A third form, regarded as related to *T. carniolica*, is *Atelecyclus szontaghii vindobonensis* Bachmayer & Küpper, 1952. This form is much less strongly decorated than *T. carniolica*.

#### GENERAL REMARKS ON THE RAMSEL DECAPOD FAUNA

The extremely well-preserved fauna is surprisingly poor in species. This may partly be due to a selective process of fossilisation, favouring the preservation of larger specimens. The various Badenian faunas consist of few larger species, whereas the bulk of the crabs are of moderate to small dimensions. *Tasadia carniolica* was found at Tasádfő in three specimens without even a fragment of any other species, but *Mursia lienharti* lived in rich associations.

The Ramsel occurrence may be compared to some extent with the Eocene *Harpac-tocarcinus* beds in which one or a few large crab species occur abundantly. Whether or not this similarity is superficial cannot yet be decided.

*Mursia lienharti* was found in localities showing characteristic features for shallow sublittoral sandy or silty bottoms, with a sea depth of c. 10 to 20 m and a salinity approaching that of the ocean. Extant *Mursia* species rarely occur in shallow environments, however. Unfortunately, *Tasadia* gives no information on the palaeoecology as the type locality was not studied in this respect.

## AGE OF THE RAMSEL MATERIAL COMPARED TO THE PARATETHYAN OCCURRENCES

The Paratethyan occurrences of the mentioned crab species may be slightly younger than the Ramsel fauna. This latter one is considered to be of Hemmoorian (Oxlundian) age (see the chapter on the mollusc fauna). *Mursia* was found in Late Badenian (Early Serravallian) beds. The age of the Tasádfő locality is unknown, but it is probably not older than Early Badenian (Langhian).

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