

**ON THE PRESENCE OF *GRACILECHINUS* (ECHINOIDEA, ECHINIDAE) IN THE  
LATE MIOCENE OF THE ANTWERP AREA (BELGIUM)**

by

Joris Geys,  
University of Antwerp (RUCA), Antwerp, Belgium

and

Robert Marquet,  
Antwerp, Belgium.

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Some well-preserved specimens of the regular echinoid *Gracilechinus gracilis nysti* (Cotteau, 1880) were collected in a temporary outcrop at Borgerhout-Antwerp, in sandstones reworked from the Deurne Sands (Late Miocene). The systematic status of this subspecies is discussed. The present state of knowledge of the Echinidae from the Neogene of the North Sea Basin is reviewed.

Prof. Dr J. Geys, Dept. of Geology, University of Antwerp (RUCA), Groenenborgerlaan 171, B-2020 Antwerp, Belgium. Dr R. Marquet, Constitutiestraat 50, B-2008 Antwerp, Belgium.

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## INTRODUCTION

Because of extensive excavations along the western verge of motorway E17-E18 (also indicated as E3 'Kleine Ring') at Borgerhout-Antwerp (Belgium), a remarkable outcrop of Neogene and Quaternary beds was accessible from March to November 1987. The outcrop was situated between this motorway and the 'Singel'-road, and extended from the 'Stenenbrug' to the 'Zurenborgbrug', on both sides

of the Borgerhout motorway exit. Extensive collections of fish-teeth and shells from the Antwerp Sands and the overlying beds were made, mainly by a large number of private collectors.

Locally in this section, in between the Miocene (Hemmoorian) Antwerp Sands and chaotic Quaternary deposits, a greyish-brown sand bed is present, containing abundant fossil material, of which the greater part seems to be reworked. Most striking are a large number of whale bone fragments and more or less rounded, greyish-yellow sandstones, containing many bryozoans, badly preserved molluscs and incidentally echinoids. Among the non-reworked faunal elements the bivalve *Neopycnodonte navicularis* (Brocchi, 1814) is common and well-preserved, frequently in double-valved specimens.

This rather enigmatic deposit is probably what is meant in literature with the obsolete indication 'Sables à Hétérocètes', a name based on sediment adhering to whale bones in collections and therefore stratigraphically undefined. The same level was indicated as 'Laag 1 Borgerhout' in van den Bosch (1967).

Van den Bosch made his observations along the same motorway-cut, only a few hundred meters North of the present temporary outcrop. In the northern outcrop this 'Laag 1' was found overlying the Deurne Sands, whereas still somewhat further to the North, near Deurne cemetery, Kattendijk Sands were seen overlying the Deurne Sands. From these observations and from the faunal characteristics it may be concluded that the sand with abundant whale bone fragments stratigraphically has to be placed in between the Deurne Sands and the Kattendijk Sands. Its age therefore might as well be Late Miocene as Early Pliocene. An intended further investigation of sediment and fauna, leading also to a formal lithostratigraphical indication of this deposit, will certainly reveal more information on its correct stratigraphical position. For the time being we use van den Bosch's provisional indication 'Laag 1 Borgerhout'. A schematic section of the Borgerhout outcrop is given in Fig. 1.

The yellowish sandstones, found at the base of 'Laag 1', are supposed to originate from the Deurne Sands. Presumably they were transported over a very short distance only: the type-locality of the Deurne Sands is hardly a few hundred metres North of the outcrop under discussion. In addition to typical Deurne Sands molluscs, e.g. *Pseudamussium clavatum* (Poli, 1795), *Astarte fusca incrassata* (Brocchi, 1814), *Dentalium* aff. *badense* Partsch, 1856, and, relatively abundant, *Ficus simplex* (Beyrich, 1856), the sandstones also yielded a number of echinoids, some of which are fairly well preserved. This paper discusses the systematic status of some of these echinoids.

## SYSTEMATIC PALAEOONTOLOGY

### *Gracilechinus gracilis nysti* (Cotteau, 1880)

#### Plate 1

- 1880 *Echinus Nysti*, Cotteau, pp. 17-18, figs 27-29.
- 1868 *Echinus Lamarcki* Forbes — Nyst in Dewalque, p. 433 (non Forbes).
- 1878 *Echinus Lamarcki*, Forbes — van den Broeck, p. 135 (non Forbes).
- 1880 *Echinus Nysti*, Cotteau, 2880 — Cotteau, p. 17-18, figs 27-29.
- 1881 *Echinus Nysti*, Cott. — Mourlon, p. 234.
- 1914 *Pseudechinus Nysti* Cotteau — Lambert & Thiery, p. 244.
- 1941 *Echinus nysti* Cotteau — Engel, p. 12-13.
- 1943 *Echinus Nysti*, described by Cotteau — Mortensen, p. 22.

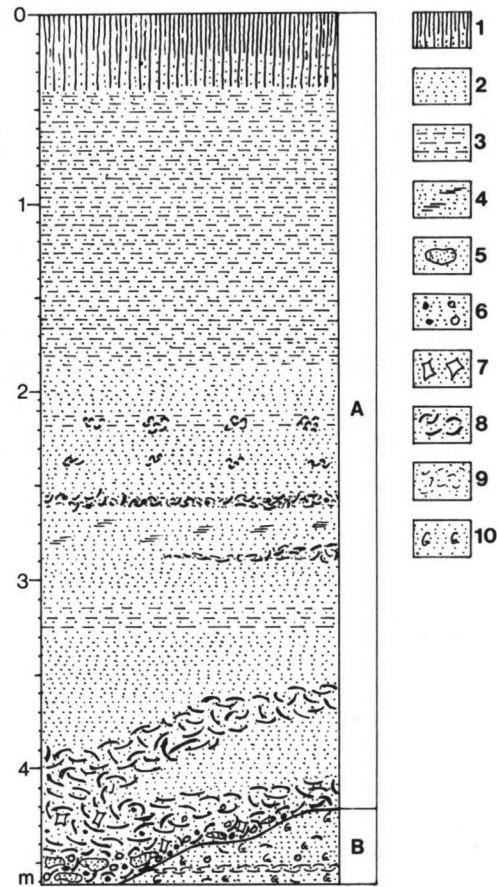


Fig. 1. Schematic section of temporary exposure in Neogene and Quaternary beds at Borgerhout.

A: Pleistocene river beds, with at their base (upper boundary uncertain) the so-called 'Laag 1 Borgerhout', with shell concentrations, whale bone fragments and reworked greyish-yellow sandstones;

B: Antwerp Sands, Miocene.

1: topsoil; 2: sand; 3: clayey sand; 4: clay lenses in sand; 5: sandstone fragments; 6: pebbles; 7: bone fragments; 8: shells; 9: shell fragments; 10: glauconite.

Material studied—2 specimens, R. Marquet coll.; 2 specimens, D. Lauwers coll.; 1 specimen, W. Vandekorput coll.; 8 specimens J. de Ceuster coll. All specimens from reworked greyish-yellow sandstones found at the base of 'Laag 1 Borgerhout', from the temporary outcrop on the E3 'Kleine Ring' motorway, Borgerhout, Antwerp city area.

Dimensions—Diameter: 62 mm; height: 51 mm; diameter of peristome: 14 mm; h/D-ratio: 0.82; dp/D-ratio: 0.23 (specimen illustrated in Plate 1)

Description—Large, conical *Gracilechinus*, with a small, circular and slightly sunken peristome, showing shallow gill slits.

Ambulacra are straight and moderately wide. Their width corresponds to  $14^\circ$ , the ambital circumference being  $360^\circ$ . Poriferous zones are not depressed. Ambulacral plates are trigeminate; the slightly oblique pore-pairs are arranged in short, very steeply oriented arcs. Poriferous zones hardly

widen near the peristome. Each ambulacral plate shows one primary and a varying number of secondary tubercles. The height/width-ratio of these plates is 0.37 at the ambitus. Primary tubercles are non-crenulate and imperforate. They are arranged in very regular series of 35 each. Scrobicules and areoles are indistinct except on the adoral side. On each plate, a moderately large secondary tubercle is present between the primary tubercles and the perradial suture. Smaller secondary tubercles can be seen adradially, between successive arcs of pore-pairs. The secondary tubercles are also arranged in vertical series. The remainder of the ambulacral plates is covered by a very fine granulation.

Interambulacra are more than twice as wide as ambulacra, corresponding each to 58°. An interambulacral series consists of 22 plates. At the ambitus, the height/width-ratio of these plates is 0.35: although they are larger than ambulacral plates, their shape is similar. A primary tubercle, which is non-crenulate and imperforate, is present on each plate. These tubercles are closer to the adradial than to the interr radial suture. They are arranged in straight and regular series. Scrobicules are indistinct, except on the adoral side. A variable number of secondary tubercles is present on each plate. We counted up to 11 of them on ambital plates. Their number decreases adorally and adapically. Adorally, the relative size of the secondary tubercles increases, until they have, in the vicinity of the peristome, almost the same size as the primary tubercles. Secondary interambulacral tubercles are not arranged in vertical series. Remaining surfaces between them are covered with a fine granulation.

## DISCUSSION

When Cotteau (1880) described the Tertiary echinoids of Belgium, the genus *Echinus* was only known from small fragments and internal moulds, most of which were described as *Echinus nysti* Cotteau, 1880.

In the type species of the genus *Echinus* (*E. esculentus* Linné, 1758), primary tubercles are only present on every alternate (or every third) ambulacral plate. A new genus, *Gracilechinus* Fell & Pawson, in Moore, 1966, was created for species with primary tubercles on each ambulacral plate and *Echinus gracilis* A. Agassiz, 1869 was chosen as its type species.

Thorough examination of the ambulacra was hardly possible on the fragments known hitherto from the Belgian Miocene. The specimens discovered by one of us and discussed herein, clearly show that Cotteau's *nysti* in fact belongs to *Gracilechinus*. The excellent description of *Gracilechinus gracilis* by Mortensen (1943) fits the Antwerp specimens almost perfectly. A minor point of difference is the peristome, which is slightly sunken in '*E.*' *nysti*, while Mortensen stresses its being not sunken in *G. gracilis*. Secondary tubercles are less clearly arranged in horizontal rows in '*E.*' *nysti* than in *G. gracilis*. These subtle differences can probably not be interpreted as specific characteristics. Hence, we treat '*E.*' *nysti* as a subspecies of *G. gracilis*, to be labelled *Gracilechinus gracilis nysti* (Cotteau, 1880). If future discoveries of more Neogene specimens are to show the above mentioned subtle differences to be constant, or if other more or less substantial differences should come to light, even then Cotteau's taxon cannot be more than a subspecies.

According to Mortensen (1943), *Gracilechinus gracilis* actually lives off the American East coast, from Cape Cod to Cuba, in depths between 120 and 445 m. The discovery of specimens in the Late Miocene of Belgium indicates that its area was, at that time, considerably larger.

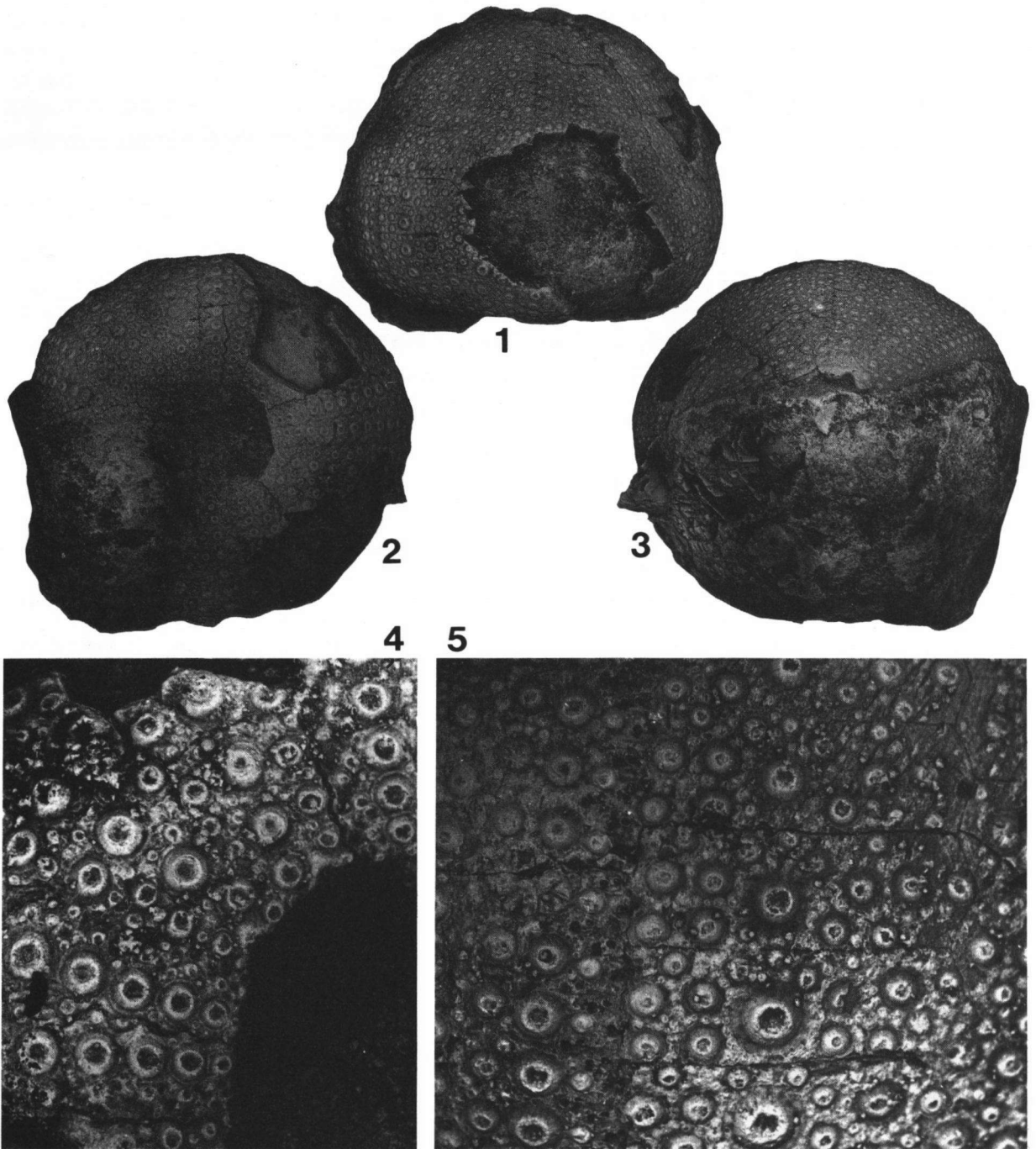


Plate 1. *Gracilechinus gracilis nysti* (Cotteau, 1880)

Borgerhout near Antwerp, Belgium, from reworked greyish-yellow sandstones, supposed to originate from the Deurne Sands, Diest Formation, Late Miocene. R. Marquet collection, Antwerp.

1. Lateral view,  $\times 0.85$ .
2. Adoral view,  $\times 1.15$ .
3. Adapical view,  $\times 1.15$ .
4. Detail of rim of peristome,  $\times 5.3$ .
5. Detail of test at the ambitus,  $\times 5.3$ .

The number of large Echinidae in the Neogene of the North Sea Basin, with which confusion is possible, is very limited. *Echinus lamarcki* Forbes, 1852 and *Echinus woodi* Desor, 1855 (= *Echinus melo* Forbes, 1852, non Lamarck, 1816) are true *Echinus*, with primary tubercles on every second ambulacral plate. As to *Echinus colbeaui* Cotteau, 1880, the holotype and only known specimen is an internal mould. This specimen cannot be reliably identified. The affinities of *E. colbeaui* with other Echinidae are unknown and we treat this name as *nomen dubium*.

## ECHINIDAE IN THE NEOGENE OF THE NORTH SEA BASIN—SOME CONSIDERATIONS ON SYSTEMATICS

Three monographs have been published on the echinoids from the Neogene of the North Sea Basin, one by Forbes (1852), a second by Cotteau (1880) and a third by Gregory (1891).

Forbes (1852) mentioned five species of Echinidae from the Plio-Pleistocene Crags of East Anglia, England, all of them referred to the genus *Echinus*, viz.:

<i>Echinus lamarcki</i> Forbes, 1852	(Coralline Crag)
<i>Echinus melo?</i> Lamarck, 1816 = <i>E. woodi</i> Desor, 1855)	(Coralline Crag)
<i>Echinus lyelli</i> Forbes, 1852	(base of Coralline Crag)
<i>Echinus henslowi</i> Forbes, 1852	(Red Crag)
<i>Echinus charlesworthi</i> Forbes, 1852	(Coralline Crag).

Cotteau (1880) described five additional species from the Neogene of the Antwerp area (Belgium), classified in two genera, *Echinus* and *Psammechinus*. The main differences between both genera are the overall size and the density of buccal platelets. Large species, with an almost naked buccal membrane are grouped into *Echinus*; small to medium-sized species with a scaly buccal membrane are referred to *Psammechinus*. Obviously, information about the buccal membrane is lacking in fossil specimens, leaving merely size to distinguish between both genera. Cotteau listed:

<i>Echinus nysti</i> Cotteau, 1880	(‘Diestien’)
<i>Echinus colbeaui</i> Cotteau, 1880	(‘Diestien’)
<i>Psammechinus sphaeroideus</i> Nyst, 1868	(‘Diestien’, ‘Scaldisien’)
<i>Psammechinus dewalquei</i> Cotteau, 1880	(‘Diestien’)
<i>Psammechinus cogelsi</i> Cotteau, 1880	(‘Diestien’)

Gregory (1891) reviewed the echinoids from the British Tertiary, adding five species of Echinidae to Forbes’s list:

<i>Echinus woodwardi</i> Desor, 1846
<i>Echinus esculentus</i> Linné, 1758
<i>Echinus miliaris</i> Müller, 1767
<i>Echinus sphaeroideus</i> (Nyst, 1868)
<i>Echinus paucimiliaris</i> Gregory, 1890

The need to distinguish between species with primary tubercles on every ambulacral plate, and those with primary tubercles on alternate ambulacral plates, was recognised by Lambert & Thiery (1914). The first category includes *Echinus esculentus*, from the present-day North Sea, the type species of the genus *Echinus*. The second category was transferred by Lambert & Thiery (1914) to the genus

*Pseudechinus*, which at that time included *P. woodi*, *P. lyelli*, *P. charlesworthi* and *P. nysti*. *Echinus henslowi* Forbes, 1852 was transferred to the genus *Psammechinus*. The three species of *Psammechinus* listed by Cotteau (1880) were not mentioned by Lambert & Thiery (1914).

Although this emended classification was an important step forward, Lambert & Thiery (1914) made a serious mistake: the type-species of *Pseudechinus*, as designated by Mortensen (1903), is *P. albocinctus* (Hutton, 1872), a Recent temnopleuroid from New Zealand, unrelated to the Echinidae.

A new genus, *Gracilechinus*, embracing all large *Echinus*-like species with primary tubercles on all the ambulacral plates, was proposed by Fell & Pawson (1966).

epitheton specificum	author, year	original genus	time	remarks
<i>acutus</i>	Lamarck, 1816	<i>Echinus</i>	Recent	
<i>alexandri</i>	Danielssen & Koren, 1883	<i>Echinus</i>	Recent	
<i>charlesworthi</i>	Forbes, 1852	<i>Echinus</i>	Pliocene	transferred to <i>Psammechinus</i>
<i>cogelsi</i>	Cotteau, 1880	<i>Psammechinus</i>	Miocene	
<i>colbeaui</i>	Cotteau, 1880	<i>Echinus</i>	Miocene	known only from steinkern; nomen dubium
<i>dewalquei</i>	Cotteau, 1880	<i>Psammechinus</i>	Miocene	
<i>elegans</i>	Düben & Koren, 1844	<i>Echinus</i>	Recent	transferred to <i>Gracilechinus</i>
<i>esculentus</i>	Linné, 1758	<i>Echinus</i>	Plio-Pleistocene-Recent	type species of <i>Echinus</i>
<i>etheridgei</i>	A. Bell, 1898	<i>Echinus</i>	Pliocene	insufficiently known
<i>gracilis</i>	A. Agassiz, 1869	<i>Echinus</i>	Recent	type species of <i>Gracilechinus</i>
<i>henslowi</i>	Forbes, 1852	<i>Echinus</i>	Plio-Pleistocene	transferred to <i>Psammechinus</i>
<i>lamarcki</i>	Forbes, 1852	<i>Echinus</i>	Pliocene	
<i>lyelli</i>	Forbes, 1852	<i>Echinus</i>	Pliocene	transferred to <i>Psammechinus</i>
<i>melo</i>	Lamarck, 1816	<i>Echinus</i>	Recent	Pliocene specimens belong to <i>E. woodi</i>
<i>miliaris</i>	Müller, 1771	<i>Echinus</i>	Plio-Pleistocene-Recent	type species of <i>Psammechinus</i>
<i>multicostatus</i>	Engel, 1941	<i>Echinus</i>	Pliocene	known only from radioles; nomen dubium
<i>nortoni</i>	A. Bell & R. Bell, 1872	<i>Echinus</i>	Plio-Pleistocene	nomen nudum
<i>nysti</i>	Cotteau, 1880	<i>Echinus</i>	Miocene	subspecies of <i>Gracilechinus gracilis</i>
<i>paucimiliaris</i>	Gregory, 1890	<i>Echinus</i>	Plio-Pleistocene	insufficiently known
<i>sphaeroideus</i>	Nyst, 1868	<i>Psammechinus</i>	Mio-Pliocene	
<i>woodi</i>	Desor, 1855	<i>Echinus</i>	Pliocene	
<i>woodwardi</i>	Agassiz & Desor, 1846	<i>Echinus</i>	Plio-Pleistocene	nomen nudum

Table 1. Neogene to Recent Echinidae of the North Sea Basin

Other Echinidae from the Neogene of the North Sea Basin were described by A. Bell & R. Bell (1872) (*Echinus nortoni*; Red Crag, East Anglia), by A. Bell (1898) (*Echinus etheridgei*; St. Erth Beds, Cornwall) and by Engel (1941) (*Echinus multicosatus*; Middle Pliocene, The Netherlands). *E. multicosatus* Engel, 1941 is based merely on isolated spines, which are in fact unidentifiable. *Echinus woodwardi* Agassiz & Desor, 1846 has never been figured; its original description is very vague and of little use. The present whereabouts of the type specimen are unknown. This species was tentatively assigned to the genus *Psammehinus* by Mortensen (1943). Gregory (1891) considered *E. woodwardi* a senior synonym of *E. lamarcki* Forbes, 1852 and a very close ally of *E. nysti*. *E. nortoni* has never been figured nor described and the type specimen cannot be located. In our opinion, *E. multicosatus* is a nomen dubium, while *E. woodwardi* and *E. nortoni* are nomina nuda.

A summary of the present state of knowledge of Echinidae from the Neogene of the North Sea Basin, is given in Tab. 1.

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