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Cadulus [gadila] dingdenensis SP. NOV. AND *Cadulus [gadila] benoisti houthalenensis* SUBSP. NOV. FROM THE NEOGENE OF THE NORTH SEA BASIN

by B. GODDEERIS (*)

SUMMARY. - The description and distribution of *Cadulus dingdenensis* sp. nov. and *Cadulus benoisti houthalenensis* subsp. nov. are given and discussed. Both were known from the Neogene of the North Sea Basin as *Cadulus gadus* (MONTAGU, 1803). Biometrical data on the inflation of the shell are used as taxobasis. *Cadulus benoisti houthalenensis* seems to have some stratigraphical value by its widespread geographical distribution in the North Sea Basin and its limited chronological occurrence.

Cadulus (Gadila) benoisti houthalenensis subsp. nov.

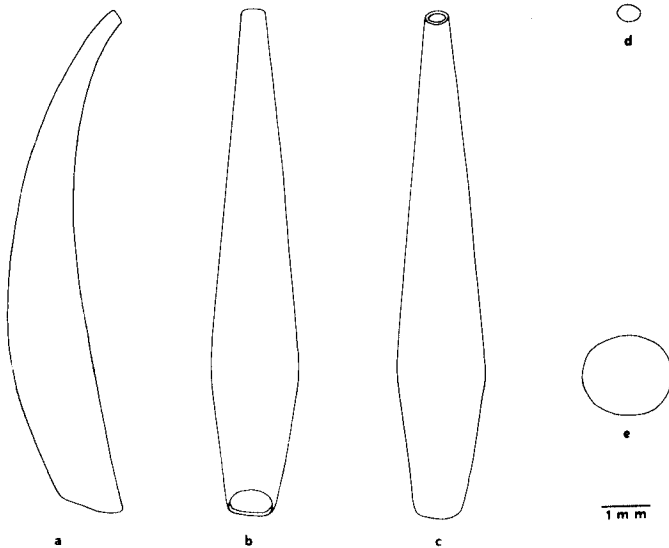


Fig. 1. - *Cadulus benoisti houthalenensis*.
a. lateral view; b. ventral view; c. dorsal view; d. section of the apex;
e. section of the swelling.

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- ? *Cadulus subfusiformis* SARS. - von KOENIG, A., 1882, p. 327-328 (partim non SARS, 1865).
Cadulus (Gadila) gadus Montg.-KAUTSKY, F., 1925, p. 54 (partim non MONTAGU, 1803).
Cadulus gadus (Montagu) - SORGENFREI, T., 1958, p. 143-144 (partim non MONTAGU, 1803).
Cadulus (Gadila) gadus (MONTAGU, 1803) - SEIFERT, F., 1959, p. 31, pl. 2 fig. 1 (non MONTAGU, 1803).
Cadulus (Gadila) gadus (MONTAGU, 1803) - JANSSEN, A.W., 1965, p. 81 (non MONTAGU, 1803) (partim).
Cadulus (Gadila) gadus (MONTAGU, 1803) - NORDSIECK, F., 1972, p. 47, pl. 11 fig. 1 (non MONTAGU, 1803).

DERIVATIO NOMINIS.

According to the stratum typicum : Houthalen Sands.

DIAGNOSIS.

A species of the subgenus *Gadila* : The shell is compressed dorso-ventrally. The dorso-ventral diameter of the inflation is about 1,6 mm.

HOLOTYPE.

5596 I.S.T. (K.B.I.N.) *

LOCUS TYPICUS.

Wijshagen (Belgium).

STRATUM TYPICUM.

Houthalen Sands.

DESCRIPTION.

The shell is small (length about 9 mm), smooth and glossy. The wall is thin. The shell is rather slender, slightly swollen and moderately curved. The inflation is at the anterior fourth and the proportion "Length of the shell/diameter of the inflation" is about six. In lateral view the ventral outline describes a regular curve. The dorsal outline is evenly curved in the posterior half; the anterior half is a little straightened with a very slight bulge at the inflation. In dorsal view the straight lateral outlines diverge slowly from a narrow apex to the inflation; thence they converge more rapidly to the relatively broad aperture. In dorsal view the inflation is slightly angular. In lateral view the aperture is oblique and slightly sigmoid; the inside of its peristome is somewhat thickened. The apex is simple. The shell is dorso-ventrally compressed over the whole length (see fig. 2). The growth lines are very fine and oblique. Some shells display dark and light bands parallel to the growth lines.

NUMBER OF SPECIMENS.

More than a thousand fragments and several complete specimens.

RESULTS ON MEASUREMENTS ON THE SWELLING OF THE SHELL.

x = dorso-ventral diameter, y = lateral diameter (see also fig. 2 and 3).
 (the dimensions are given in mm).

Cadulus benoisti houthalenensis

Houthalen Sands : Wijshagen	Miste Bed : Miste (Winterswijk)	Antwerpen Sands : Borgerhout
$\bar{n} = 30$	$\bar{n} = 30$	$\bar{n} = 15$
$\bar{x} = 1,587$	$\bar{x} = 1,529$	$\bar{x} = 1,672$
$\bar{y} = 1,683$	$\bar{y} = 1,612$	$\bar{y} = 1,774$
$s_x = 0,141$	$s_x = 0,1361$	$s_x = 0,1388$
$s_y = 0,1393$	$s_y = 0,1444$	$s_y = 0,1345$
$r = 0,9752$	$r_y = 0,988$	$r = 0,9712$
$a = 0,9881$	$a = 1,061$	$a = 0,9687$
$\sigma_a = 0,04085$	$\sigma_a = 0,02981$	$\sigma_a = 0,05955$
$b = 0,1152$	$b = -0,01089$	$b = 0,1549$

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Cadulus benoisti benoisti

Burdigalian :
St.-Paul (France)

n = 21
 \bar{x} = 1,206
 \bar{y} = 1,262
 s_x = 0,07395
 s_y = 0,07661
r = 0,9715
a = 1,036
 σ_a = 0,05352
b = 0,01256

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION.

Miocene :

Belgium :

Houthalen Sands : Deep boring Wijshagen (K.B.I.N.)
Deep boring Helchteren (K.B.I.N.)

Antwerpen Sands : Borgerhout XI Br (I.A.L.)*: sample 3, 4 and 6 (see DE MEUTER, WOUTERS and RINGELE, 1976, pp. 14-14).

Germany (B.R.) :

Hemmoor-Stufe : Hoerstgen (SEIFERT, 1959).

Vaginellen kalksandstein : Basbeck-Osten (KAUTSKY, 1925).

The Netherlands :

Miste Bed : Miste-Winterswijk (K.B.I.N.)

REMARKS.

In studies on the North Sea Basin one does not often distinguish *Cadulus gadus* (MONTAGU, 1803), the type species of the subgenus *Gadula* GRAY, 1847. *C.gadus* was found by MONTAGU (1803, p. 496) "in many parts of the British channel", but this locality is at least very doubtful (see PILSBRY and SHARP, 1897-98, p. 186-188). The dimensions given by MONTAGU (1803, p. 496) conform to those of *C.benoisti houthalenensis*. Based on the figures, given by MONTAGU (1803, pl. 14, fig. 7) and PILSBRY and SHARP (1897-1898, pl. 31, fig. 27-32), we see that the shell of *C.gadus* is much more swollen dorsally than the shell of *C.benoisti houthalenensis*. Furthermore the shell of *C.gadus* is not so slender as the shell of *C.benoisti houthalenensis*.

The form of *C.benoisti houthalenensis* resembles that of *Cadulus benoisti benoisti* COSSMANN and PEYROT, 1919 of the Burdigalian of the Aquitaine Basin. We have never found a significant difference between the dorso-ventral compression of the shell of different populations of the North Sea Basin and Aquitaine Basin (see fig. 2). The populations of the North Sea Basin however have to be considered subspecifically distinctly different from *C.benoisti benoisti*. *C.b.benoisti* and *C.b.houthalenensis* are geographically well isolated, whilst they are very different in size. Comparing specimens of the Burdigalian at St. Paul (France, Aquitaine Basin) and specimens of the Miste Bed at Miste-Winterswijk (The Netherlands, North Sea Basin), we found a significant difference ($t = 9,88$) in mean of the dorso-ventral diameter of the inflation (see fig. 3). The overlap is very small : more than 83% of the specimens of Miste are different from all the specimens of St. Paul. The differences in mean of the populations of the North Sea Basin are much smaller : only the difference between the samples of the Miste Bed and the Antwerpen Sands is significant ($t = 3,30$). The overlap however, is great (coefficient of difference C.D. = 0,52).

Comparing *C.benoisti houthalenensis* with *Cadulus dingdenensis* sp. nov., we see that *C.b.houthalenensis* (and *C.b.benoisti* also) is compressed dorso-ventrally, while *C.dingdenensis* is compressed laterally. Furthermore *C.dingdenensis* is smaller than *C.b.houthalenensis*, the apex of *C.dingdenensis* is relatively broader and the inflation is not angular.

C.benoisti houthalenensis seems to have a widespread geographical distribution in the North Sea Basin but is chronologically limited. This occurrence however, should be

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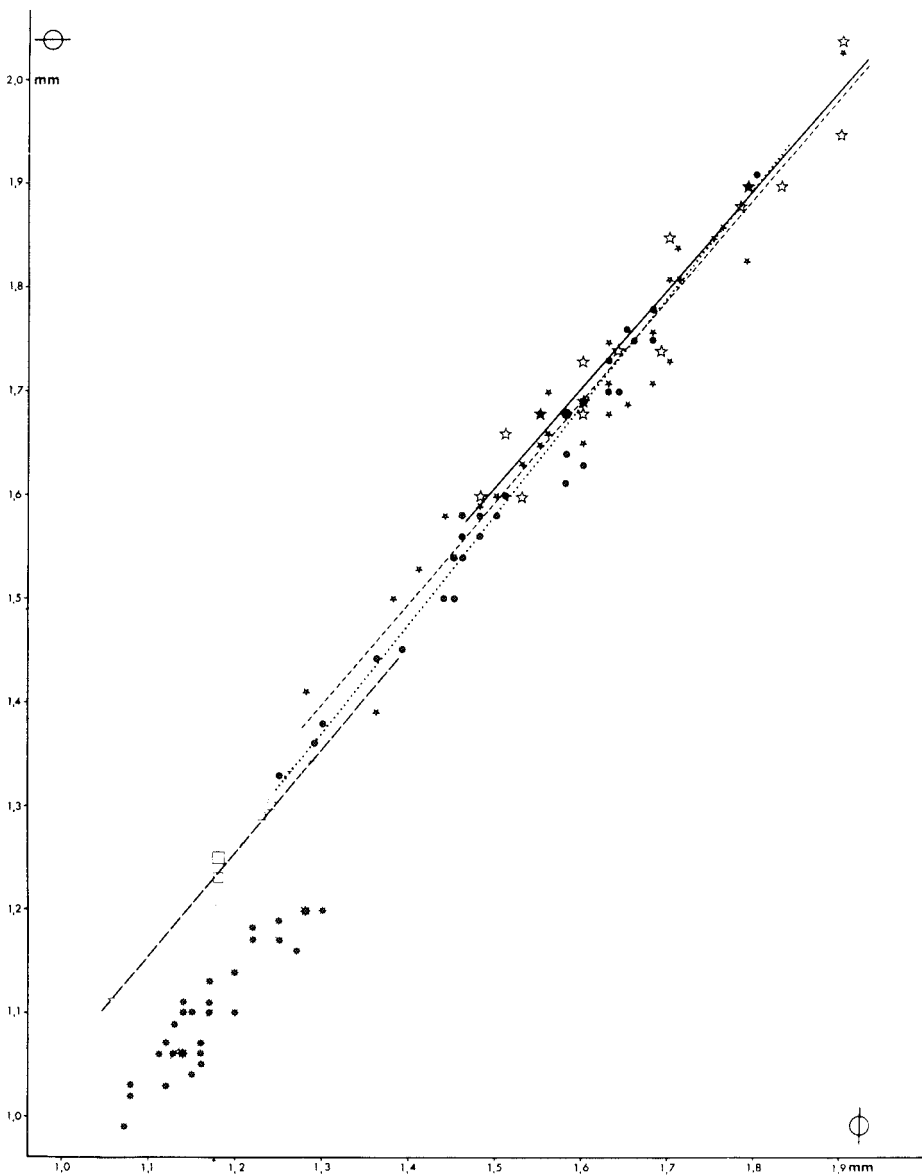


Fig. 2. - Compression of the swelling of the shell : reduced major axis for the dorso-ventral diameter (x) and lateral diameter (y).

- * *Cadulus dingdenensis* : Dingdener Feinsand : Dingden-Königsmühle.
- □ *Cadulus benoisti benoisti* : Burdigalian : St. Paul.
- ★ *Cadulus benoisti houthalenensis* : Houthalen Sands : Wijshagen.
- ● *Cadulus benoisti houthalenensis* : Miste Bed : Miste (Winterswijk).
- ☆ *Cadulus benoisti houthalenensis* : Antwerpen Sands : Borgerhout.

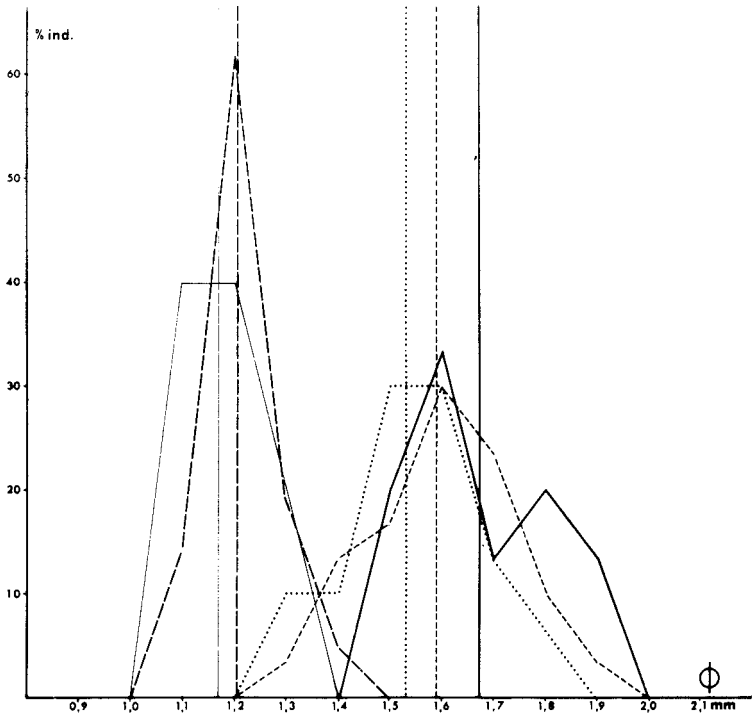


Fig. 3. - Frequency distribution of the dorso-ventral diameter (x) of the swelling of the shell.

- *Cadulus dingdenensis* : Dingdener Feinsand : Dingden-Königsmühle.
- - - *Cadulus benoisti benoisti* : Burdigalian : St. Paul.
- - - *Cadulus benoisti houthalenensis* : Houthalen Sands : Wijshagen.
- *Cadulus benoisti houthalenensis* : Miste Bed : Miste (Winterswijk).
- *Cadulus benoisti houthalenensis* : Antwerpen Sands : Borgerhout.

affirmed by further research. It is noticeable that *C. benoisti houthalenensis* in the Antwerpen Sands only occurs in the lower part.

Cadulus (Gadila) dingdenensis sp. nov.

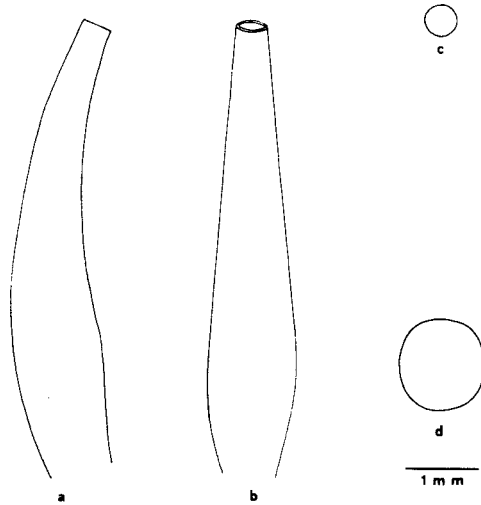


Fig. 4. - *Cadulus dingdenensis*.

a. lateral view; b. dorsal view; c. section of the apex; d. section of the swelling.

Cadulus (Gadila) gadus (MONTAGU, 1803) - ANDERSON, H.J., 1964, p. 194-195 (non MONTAGU, 1803).

Cadulus (Gadila) gadus (MONTAGU, 1803) - JANSSEN, A.W., 1965, p. 81, pl. 2 fig. 5 (non MONTAGU, 1803) (partim).

DERIVATO NOMINIS.

According to the locus typicus : Dingden (Germany B.R.).

DIAGNOSIS.

A species of subgenus *Gadila* : The shell is compressed laterally. The dorso-ventral diameter of the inflation is about 1,17 mm.

HOLOTYPE.

5863 I.S.T. (K.B.I.N.)

LOCUS TYPICUS.

Dingden-Königsmühle (Germany B.R.).

STRATUM TYPICUM.

"Dingdener Feinsand".

DESCRIPTION

The shell is very small (length about 6 mm), smooth and glossy. The wall is thin. The shell is rather slender and only slightly curved, with its inflation at about the anterior third. The proportion "Length of the shell/diameter of the inflation" is about five. In lateral view the ventral outline describes a regular arch, very lightly broken

at the inflation. The dorsal outline is regularly curved in the posterior half; in the anterior half it is straighter with a light convexity at the inflation. In dorsal view the lateral outlines diverge slowly from the rather broad apical orifice to the inflation, which region is flattened; thereafter they converge more rapidly to the aperture. The aperture is not known. The apex is simple. The shell is laterally compressed (see fig. 2), except at the apex, which section is round. The growth lines are very fine and oblique. Sometimes, on the swelling there are very weak longitudinal grooves.

NUMBER OF SPECIMENS.

About fifty fragments.

RESULTS ON MEASUREMENTS ON THE SWELLING OF THE SHELL.

x = dorso-ventral diameter, y = lateral diameter (see also fig. 2 and 3).
(the dimensions are given in mm).

Cadulus dingdenensis

"Dingdener Feinsand": Dingden Königsmühle

\bar{n} = 30
 \bar{x} = 1,172
 \bar{y} = 1,102
 s_x = 0,06236
 s_y = 0,06000
 r = 0,9288
 a = 0,9615
 σ_a = 0,06499
 b = 0,02531

STRATIGRAPHICAL AND GEOGRAPHICAL DISTRIBUTION.

Miocene

Germany (B.R.) :

"Dingdener Feinsand" : Dingden-Königsmühle (K.B.I.N.).

REMARKS.

The shell of *C. dingdenensis* is very different from the shell of *C. gadus*. The first is compressed laterally, while *C. gadus* is compressed dorso-ventrally. Furthermore *C. dingdenensis* is much more smaller than *C. gadus*.

For a comparison with *C. benoisti houthalenensis* see the remarks of this species.

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