

Systematical notes on *Cardium edule* L. and *Cardium glaucum* Brug. in the Netherlands I

R.M. VAN URK

c/o Rijksmuseum van Natuurlijke Historie, Leiden

Cardium edule L. is one of our most variable bivalve species and many varieties have been described. One of these, the brackish water form, was recognized by Petersen (1958) as a separate species, and is widely accepted now as such.

The differences between *C. edule* and *C. glaucum* are mainly found in sculpture and hinge. Shape and colour, though of help in certain cases, show much variation and generally present no reliable taxonomical characters. Since in older works the shape was considered to be of major importance for identification, it is easily understood, that *C. edule* and *C. glaucum* were almost generally misinterpreted.

In this paper descriptions of the two species are given, together with a discussion of their systematic position and a general outline of their variability. Though names of varieties are mentioned now and then, this has merely been done for practical reasons, as will be seen in the text. The variability in species as *C. edule* and *C. glaucum* is continuous and gradual, the forms being linked with each other by intermediates. This was already stated by Mars (1951): "Malgré le grand nombre de formes..... il est fréquent de rencontrer des échantillons ne correspondant à aucune d'entr'elles." Once this kind of variation is recognized and accepted, the "complex" may turn into a most interesting and fascinating group.

As to nomenclature I have followed the recent publications of Russell (1969, 1971a-b) for the name of the brackish water species, thus *C. glaucum* is used instead of *C. lamarcki*. Only a few synonyms have been added, either those recently used or regularly found in Dutch

literature. Since a more or less full synonymy of both species with references would include some 100 different names and at least some 300 works and scattered publications, I felt that the result would reach far beyond the scope of this paper.

Cardium edule Linnaeus, 1758 (Dutch: kokkel)
figs. 1-2

Cerastoderma edule (L); non *Cardium edule* var. *paludosa*, var. *lamarcki* and var. *rusticum*.

Shell solid, broadly oval in outline, slightly inequilateral; complete specimens on dorsal view obtuse both posteriorly and anteriorly (fig. 2).

Ligament long, up to about $\frac{2}{3}$ of the posterior hinge-part.

Hinge. — Left valve: central tooth rather broad, often rectangular, posterior cardinal tooth longer and narrower, directed towards the basal margin of the hinge; central pit as a result of this not especially broad, posterior cardinal pit elongate, often hardly narrower than the central pit, anterior cardinal pit — as far as it can be considered as such — in open connection with the anterior lateral groove; posterior lateral groove in open connection with the ligament groove (in large specimens, however, often separated from it by the nymph, which in that case may have reached the dorsal shell margin). Lateral teeth less acute than in *C. glaucum*, somewhat truncate or rounded; posterior lateral tooth behind the ligament much shorter than the anterior lateral tooth; in juvenile specimens with a shorter ligament the length is about equal. Right valve: central tooth elongate basally, but decidedly shorter than $\frac{1}{2}$ of the ligament, anterior cardinal tooth short, often inconspicuous or fused with the dorsal shell margin; central pit triangular, posterior cardinal pit elongate, anterior cardinal pit inconspicuous, obsolete or wanting; ligament groove in open connection with the upper posterior lateral groove, the latter, however, often inconspicuous or wanting. Lower lateral teeth less acute than in *C. glaucum*, somewhat truncate or rounded; upper anterior lateral shorter than the lower and of about the same length as the lower posterior lateral; upper posterior lateral very short, often fused with the dorsal shell margin.

Muscle scars. — Posterior adductor scar situated partly opposite the posterior end of the lateral tooth.

Sculpture. — Ribs on the middle part of the shell broad and flattened, alternating with narrow furrows, and provided with numerous more or less widely spaced scales, the furrows smooth or with inconspicuous concentric lines; ribs well-developed behind the ligament, so that the valves here close in an undulating line, the crenulations at the postero-ventral margin are deep and convex; inside the furrows, which

correspond to the ribs on the outside, run for a short distance only.

The sculpture on posterior and anterior parts of the shell is somewhat different and should not be used for identification: posteriorly the furrows may reach about half the breadth of the ribs, anteriorly (the narrowest part of the shell) the scales on the ribs are closer together; besides in large specimens the basal part of the shell often shows a continuous sculpture of ridges on ribs and furrows.

Periostracum poorly developed, covering a small part of the shell surface only.

Young specimens of about 1-2 cm differ from adult material by (a) a thin shell, (b) their often quite regular outline, (c) the still short ligament (less than $\frac{1}{2}$ of the lateral hinge part to about $\frac{1}{2}$ of it), (d) the relatively wider furrows (about $\frac{1}{2}$ of the ribs on the middle part of the shell and as broad as the ribs on the posterior region), (e) the ribs on the inside of the shell which are visible to below the umbones (this character is apparently correlated to the thickness of the shell).

Short note on the distribution in the Netherlands. — Common all along the coast, in the Wadden Sea and the estuarine area of the rivers Rhine, Meuse, and Scheldt. Material from the former Zuiderzee (now IJsselmeer) all belongs to *C. glaucum*, though in the northernmost part the two species may have lived together.

Variability. — *C. edule* is an extremely variable species, also in the Netherlands, the following characters being especially involved:

1. The shape, or rather the outline, of the shell, varying from
 - a. equilateral to (rather) strongly inequilateral, and from
 - b. broad to high.
2. The scales on the ribs, varying from
 - a. widely spaced to close together;
 - b. the breadth of the scales also being variable.
3. The length of the ligament, and
4. The position of the posterior cardinal tooth in the left valve.

Since these characters are also of importance in distinguishing the species from *C. glaucum*, it can be understood, that the latter has often been misinterpreted.

Several other variable characters have been mentioned, e.g.:

5. The number of the ribs, and
6. The dimensions of the shell.

In order to get a better idea of this variation I have tried to show this in a diagram (fig. 1), which is based on characters 1-4. It shows in the right column the equilateral forms, in the left one the inequilateral forms, from top to bottom the broadly oval forms (I-II), the forms with

about equal breadth and height (III-IV), and the forms with the height exceeding the breadth (V-VI).

A short description of these forms will first be given:

1. (a) Shell slightly inequilateral, hinge-line curved, (b) breadth exceeding the height, (c) posterior margin slightly angular, (d) scales more or less widely spaced, narrow, (e) ligament long, up to $\frac{2}{3}$ of the lateral hinge-part, or even more, (f) posterior cardinal tooth in the left

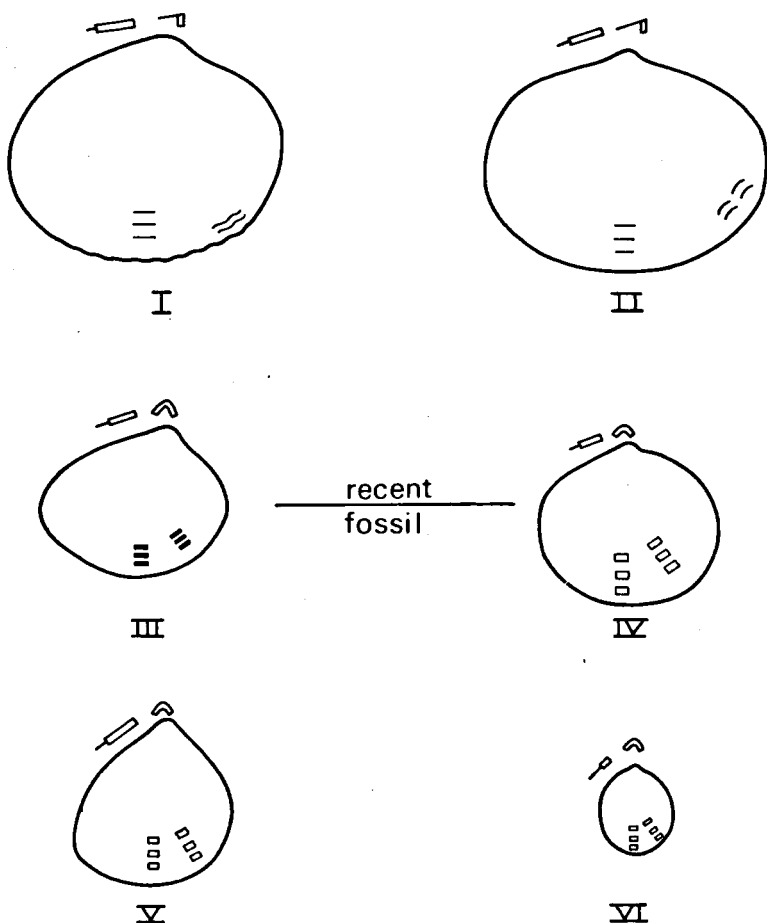


Fig. 1. Diagram showing the variation of *Cardium edule* in connection with its recent and fossil occurrence in the Netherlands. For explanation see text.

valve decidedly longer and narrower than the central tooth, (g) large form. Short definition: the typical, recent form.

II. (a) Shell equilateral, hinge-line straight, (b) as I, (c) margins rounded, (d) scales rather widely spaced, narrow, (e) ligament long, but generally somewhat shorter than in I, (f) as I, (g) as I. Short definition: '*belgica*' form auct., non De Malzine.

III. (a) Shell decidedly to strongly inequilateral, the posterior end being elongate and wedge-shaped, (b) as I, (c) as I, (d) scales close together, narrow; furrows on the posterior part of about the same breadth as the ribs, (e) ligament long, as in I, or even longer, (f) posterior cardinal tooth in the left valve of about the same length and shape as the central tooth, the two teeth forming an inverted V under the top of the shell, (g) rather small, or medium-sized form. Short definition: '*glaucum*-form', (cf.) var. *loppensi* Mars.

IV. (a) Shell equilateral, oval, very regular in outline, (b) of about the same breadth and height, (c) as II, (d) scales rather close together, in the postero-ventral part close together, broad and rectangular, (e) ligament moderately long, hardly exceeding $\frac{1}{2}$ of the lateral hinge-part, (f) as III, (g) medium-sized form. Short definition: oval form.

V. (a) Shell slightly to moderately inequilateral, oblique, beaks more or less pointed and curved inwards, (b) the height equalling the breadth or exceeding it, (c) posterior end more or less wedge-shaped, (d) as IV, (e) as I, (f) as III and IV, the two teeth sometimes close together, (g) medium-sized form. Short definition: '*altior*-form of *edule*'.

VI. (a) Shell equilateral, elongate oval, very regular in outline, (b) the height exceeding the breadth, (c) as II and IV, (d) as IV and V, (e) ligament short, less than $\frac{1}{2}$ of the lateral hinge-part, (f) as IV, hinge strongly built, (g) small form. Short definition: small, high-oval form.

This variability is rather confusing as long as we cannot find any system in it. When indicating the variable characters on the diagram, however, their development in several directions becomes more clear:

Ligament from short to long: (VI, IV) — II — (V, III, I); correlated with increasing shell-breadth.

Scales from close together to rather widely spaced: (III) — (VI, V, IV) — (I, II); closest together in III, the wedge-shaped form reminding one of *C. glaucum*, otherwise correlated with increasing shell-breadth.

Scales from broad to rather narrow: (VI, V, IV) — (III, II, I); correlated with increasing shell-breadth.

Posterior cardinal tooth in left valve from short and broad to long and narrow: (VI, V, IV, III) — (II, I); correlated with increasing shell-breadth, but not with increasing obliqueness (compare III) of the shell.

Outline of the shell from high to broad (VI, IV) – (V) – (III) – (I, II); correlated with a sequence from fossil to recent.

Size of the shell from small to large: correlated with a sequence from fossil to recent.

It is interesting that the variable characters in hinge and sculpture are apparently correlated to the shape of the shell, this latter being again correlated to the stratigraphy.

An essential feature in *C. edule* is, that the forms or varieties are not sharply delimited, systematic units. They merge one into another, thus forming a continuous and gradual variation. This does not mean, that all varieties mentioned in the European literature can be dismissed as being of no importance at all or as impossible to correctly recognize. Actually, I was surprised to see, how readily several of those listed by Mars (1951) could be recognized among Dutch material. But it is equally true, that in a mixed sample of e.g., 100 shells, there will always be a remainder of intermediates of all kind. As regards this one is also referred to the paragraph of Mars (1951: 7) cited in the introduction. It is still doubtful, how many varieties may be distinguished. The present number of at least about 100 in the European literature may seem excessive, it is also true, that no purpose would be served by mixing up everything without distinction.

Though *C. edule* approaches *C. glaucum* by way of its form no. III, there is no real connection between the two species. This form, which in outline and general appearance can hardly be distinguished from *C. glaucum*, to which also its sculpture shows a superficial resemblance, nevertheless differs from it by its particularly long ligament (*glaucum*: short), and also by the short posterior cardinal tooth (*glaucum*: long) in the left valve, which is situated close to the central tooth (*glaucum*: close to the shell-margin). These variable characters develop in an opposite direction: *C. edule* forms with a short ligament differ markedly from *C. glaucum* in outline (oval versus wedge-shaped), whereas *C. edule* forms approaching *C. glaucum* in outline differ from it by their hinge with the long ligament and the short cardinal tooth. It is thus possible to separate the two species, even where single characters are variable. Of course, other available characters should always be checked.

Although form no. III is separated from *C. glaucum* by a number of characters, it is linked with the more typical forms of *C. edule* by a series of intermediates. It is identical or almost identical with the var. *loppensi* Mars, 1951: "..... à laquelle il ne convient certes pas d'accorder une valeur systématique importante mais qu'il est tout à fait nécessaire de distinguer, pour éviter des erreurs d'interprétation son contour devient très inéquilatéral par étirement postérieur, tandis que les côtes

demeurent apaties et squameuses." Though the variety has never been mentioned in the Dutch literature, it occupies a central position in the variation of *C. edule* and *C. glaucum*.

Fossil and recent *C. edule* may now be distinguished with more or less certainty. According to my experience and judging from Dutch material forms nos. I and II are always recent, nos. V and VI exclusively fossil, while nos. III and IV, though usually fossil, may be recent as well. This means, that the line separating fossil from recent lies about in the middle of the diagram, the variable characters and their different combinations giving further indications as regards the origin of the material.

The only Dutch form, which does not quite fit into the scheme is the so-called 'var *major*', a fossil of uncertain origin, and as broad as recent, typical *C. edule*¹. Kaas & Ten Broek (1937) in a paper on fossil shells from Terheyde beach north of Hook of Holland write, that the cockle-shells found there, are often fragile and of a very worn appearance. Though these features are characteristic for fossil material, it is very difficult to decide, they say, whether such specimens are really of fossil origin. The original paragraph (p. 36) runs as follows: "... dat exx. van *Cardium edule* L. en *C. edule* L. var. *Lamarcki* Reeve daar ter plaatse er vaak sterk verweerd uitzien en ook zeer bros zijn, eigenschappen die kenmerkend voor fossielen genoemd kunnen worden. Echter is het natuurlijk zeer moeilijk om van deze exx. vast te stellen of we hier met recente of fossiele schelpen te maken hebben." The conclusion here can be that, at least to a certain degree, it is quite possible to distinguish between fossil and recent *C. edule*. Statistical researches may well make it possible to fix the limit more precisely or may even tell us something about the age of the material washed up along the coast.

Cardium glaucum Bruguière, 1789 (Dutch: brakwaterkokkel).

figs. 2-14

C. glaucum Poir., *C. lamarcki* Reeve; *C. edule* var. *paludosa* B.D.D., var. *lamarcki* Reeve & var. *rusticum* Chemn. in Dutch literature; *Cerastoderma lamarcki* (Reeve), *C. glaucum* (Brug. or Poir.)

Shell thin and, with a few exceptions, fragile, obliquely triangular in outline, moderately to strongly inequilateral, the posterior end being elongate and wedge-shaped; complete specimens on dorsal view obtuse anteriorly but more or less tapering posteriorly (fig. 2).

¹ Revising the material in the Rijksmuseum van Natuurlijke Historie I found recent specimens of comparable size while Mrs. N.F. McMillan (Liverpool) kindly sent me large specimens from Orkney and Shetland. It is probably a temperate/cold water form of typical *C. edule* and should be placed in the diagram close under I.

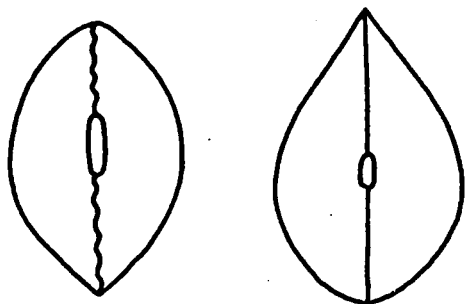


Fig. 2. Dorsal view of *Cardium edule* (left) and *C. glaucum* (right) shown in outline (posterior end on top of the figures). Note the difference in the length of the ligament, the (almost) straight line where the closed valves meet in *C. glaucum*, and the rounded posterior end in *C. edule*. There is a certain amount of variation in *C. edule*: the anterior end may be slightly more acute than the posterior end (as shown in the figure), both ends may be rounded or slightly acute, while the var. *loppensi* is close to *C. edule* in dorsal aspect.

Ligament short, not exceeding $\frac{1}{2}$ of the posterior hinge-part and often considerably less.

Hinge. — Left valve: central tooth rather broad, often triangular, posterior cardinal tooth longer and narrower, often parallel to the dorsal shell-margin; central pit as a result of this conspicuously broad, but the posterior cardinal pit, if present, no more than a short linear groove, anterior cardinal pit — which is about half as broad as the central pit — separated from the anterior lateral groove by a small transverse ridge; in a similar way the posterior lateral groove is separated from the ligament-groove. Lateral teeth acute (fig. 1); posterior lateral tooth behind the ligament as long as the anterior lateral tooth or longer. Right valve: central tooth elongate basally, up to about $\frac{1}{2}$ of the length of the ligament, anterior cardinal tooth usually present, short, but sometimes elongate, central pit triangular, not particularly broad, posterior cardinal pit elongate, anterior cardinal pit linear and narrow if present; ligament-groove separated from the upper posterior lateral groove by a small transverse ridge. Lower lateral teeth acute (fig. 1); upper anterior lateral shorter than the lower, about half as long as the lower posterior lateral; upper posterior lateral well-developed and rather long, about $\frac{1}{2}$ of the lower posterior lateral and about as long as the upper anterior lateral.

Muscle scars. — Posterior adductor scar situated just beyond the end of the lateral tooth.

Sculpture. — Ribs rather narrow, alternating with furrows, which may be about half as wide as the ribs in the middle part of the shell and

become as wide as these posteriorly, especially on the posterior part of the shell the ribs becoming rather sharp-edged and more or less triangular in cross-section; they are covered with numerous scales, placed close together and running into each other between the ribs, the effect being that of a rather irregular, somewhat undulating, continuous sculpture on ribs and furrows; ribs poorly developed behind the ligament, so that the valves close here in an almost straight line, the crenulations at the postero-ventral margin less marked than in *C. edule*; on the inside the furrows, which correspond to the ribs on the outside, are clearly marked from top to margin.

Periostracum well-developed, covering the major part of the shell.

Young specimens do not differ much from adult ones. They are always more or less inequilateral (with the exception perhaps of the '*beltica*' form, which may be almost symmetrical) and the ligament is relatively still shorter. When comparing young *C. glaucum* with *C. edule* of the same size it is obvious, that also in these stages *C. glaucum* has a shorter ligament. The more or less flattened ribs are another character of young material; in fact the keels on the ribs only become more prominent in large shells.

Short note on the distribution in the Netherlands. — On the landside of the dikes in creeks, pools, ditches, etc. in brackish water, mainly in the north and the south of the country; it also occurred in the former Zuiderzee (now IJsselmeer). In a few localities the species has been found together with *C. edule*. See Dutch summary localities nr. 2 & 3, recent, living, and 1 & 4, perhaps referring to (sub)fossil material.

Variability. — *C. glaucum* is also a very variable species and this variation covers several characters:

1. The more or less marked elongation of the posterior end.
2. The breadth — height ratio.
3. The relative breadth of the furrows.

Variation is also found in:

4. The thickness of the shell, and
5. The dimensions.

An idea of this variation is given in fig. 1, showing some characteristic forms. A short description of these is given below.

I. (a) Shell strongly elongate posteriorly, wedge-shaped, (b) breadth exceeding the height, (c) posterior dorsal margin (nearly) straight, (d) furrows more than $\frac{1}{2}$ of the breadth of the ribs, (e) ligament about $\frac{1}{2}$ of the lateral hinge-part, (f) rather large form, (g) fragile. Short definition: typical, recent form agreeing with the type of *C. lamarcki* Reeve

(figured in Tebble, pl. 12, figs. f & g); also the *C. edule* var. *lamarcki* of Brakman (1936).

II. (a) as I, (b) as I, (c) postero-dorsal margin curved, (d) as I, (e) ligament less than $\frac{1}{2}$ of the lateral hinge-part, (f) small or rather small form, (g) fragile. Short definition: extremely wedge-shaped form.

III. (a) Shell moderately to rather strongly elongate posteriorly, (b) as I, (c) as II, (d) furrows about $\frac{1}{2}$ of the breadth of the ribs, (e) as II, (f) medium-sized form, (g) solid. Short definition: common (sub)fossil form of the Netherlands beach.

IV. (a) Shell slightly inequilateral, oblique, (b) of about equal breadth and height, (c) posterior dorsal margin curved, (d) as I, (e) as II, (f) small form, (g) fragile. Short definition: small, slightly oblique form nearing *C. edule* 'bellica'-form in appearance.

V. (a) Shell (slightly) inequilateral, oblique, (b) height exceeding the breadth, (c) as I, (d) furrows less than $\frac{1}{2}$ of the ribs, (e) as II, (f) medium-sized form, (g) solid. Short definition: 'altior-form', fossil.

VI. (a) Shell slightly elongated posteriorly, (b) as IV, (c) as II, (d) as I, (e) as II, (f) large form, (g) solid. Short definition: 'major-form', fossil; probably also recent. This form is not of any taxonomical importance, but is mentioned here as a parallel to *C. edule* var. *major*. Besides it shows, that *C. glaucum* should not be regarded as a more or less underdeveloped ecological form of *C. edule* in brackish water.

Specific distinction. — A number of characters distinguish *C. glaucum* from *C. edule*, the more important of them being summarized below (see also fig. 2):

	<i>C. edule</i>	<i>C. glaucum</i>
Shell	solid (juv. thin) equilateral to slightly inequilateral (juv. equilateral and of very regular appearance)	rather thin and often fragile moderately to strongly inequilateral (juv. always more or less inequilateral)
Ligament	long, up to $\frac{2}{3}$ of the lateral hinge-part (juv. short, less than $\frac{1}{2}$)	short, $\frac{1}{2}$ of the lateral hinge-part at most (juv. less than $\frac{1}{2}$)
Hinge	posterior cardinal tooth in left valve directed to basal margin of hinge central pit not particularly broad ligament-groove in open connection with lateral groove	posterior cardinal tooth in left valve nearly parallel to upper shell-margin central pit (often) conspicuously broad ligament-groove separated from lateral groove by a small, transverse ridge

Sculpture	ribs on the middle of the shell broad and flattened (juv.: ribs less broad)	ribs rather narrow and more or less keeled, especially towards the posterior shell-margin
	widely spaced scales on the ribs	scales close together, connected with each other between the ribs, thus producing a continuous and more or less irregular sculpture
	furrows narrow, less than $\frac{1}{2}$ of the ribs (juv.: up to about $\frac{1}{2}$ of the ribs)	furrows broad, from about $\frac{1}{2}$ of the ribs in the middle part of the shell to about as broad as the ribs towards the posterior shell region
	posterior margin crenulate; ribs well-developed on posterior shell region	posterior margin almost straight; ribs flattened on posterior shell region
	ribs on the inside visible for a short distance only (juv. as <i>glaucum</i>)	ribs on the inside visible to below the umbones

Since most of these characters are more or less variable, the species has usually been misinterpreted in the past. Authors such as Brakman (1936), Altena (1937), Jutting (1943), and Eisma (1965) considered it an ecological variety of *C. edule*: var. *lamarcki* Reeve or var. *paludosa* B.D.D., or, in older literature, var. *rusticum* Chemn. Yonge (1949) writes: "They are often found in regions of mixed mud and sand and sometimes extend well within estuaries on a muddy substratum and where the salinity is low. Under these conditions the shell is more lightly built, possesses fewer ribs and is more asymmetrical, although why lowered salinity should have these effects remains an unsolved problem."

Mars (1951: 7, 13) distinguishes two 'groups' ('ensembles' or 'groupes') which he describes in the following way:

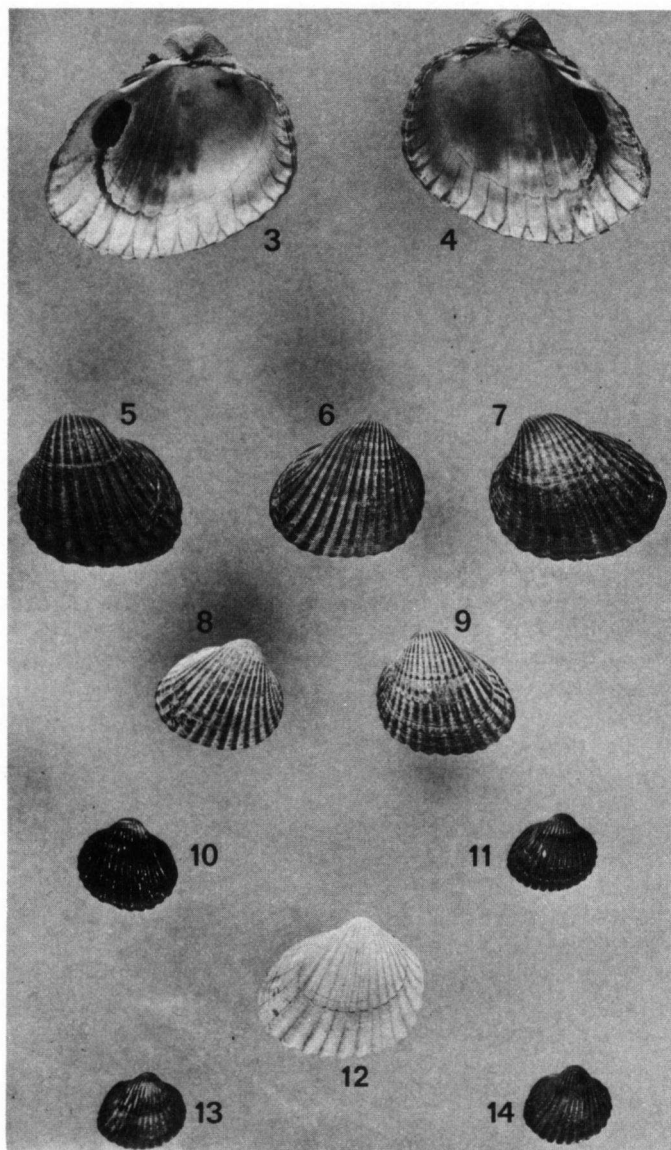
"I. — Groupe du *Cardium edule* Linné." "Formes à côtes subarrondies-aplaties, contigues ou plus larges que leurs intervalles, et ornées de lamelles transverses."

"II. — Groupe du *Cardium glaucum* Bruguière." "Formes à côtes convexes devenant subcarénées dans la région postérieure; à ornementation plus ou moins confuse."

It is interesting that he refers to Turnouer (1878), who apparently did the same. I have not seen Turnouer's paper, but there can be no doubt that the two 'groups' of Mars represent our two species.

Petersen (1958), who does not mention Mars, pays full credit to *C. glaucum* as a separate species, giving the differences with *C. edule* in a paragraph which may be quoted here in full:

"*C. edule* and *C. lamarcki* (= *C. glaucum*) were easily distinguished by the following characters: The ribs on the middle part of the shell of



C. edule are flat with widely spaced scales; in *C. lamarcki* these ribs are sharp with small three edged scales close together made of the periostracum. The ribs on the posterior part are fairly well developed in *C. edule*, but almost undeveloped in *C. lamarcki*. On account of this difference the part of the shells around the siphons close in a wavy line in *C. edule* and in an almost straight line in *C. lamarcki*. The periostracum is poorly developed in *C. edule*. The periostracum in *C. lamarcki* is rather thick and covers about 75% of the surface of the shell. The two types differ also in colour and shape, *C. edule* being the whiter and rounder, but as colour and shape vary much, these are no taxonomical characters."

In recent times *C. glaucum* has been the subject of many studies of which may be mentioned here: Tulkki (1961), Pohlo (1963), Eisma (1965), Boyden (1969), Russell (1969, 1971a, 1971b), Wolff (1972, 1973).

A fine illustration of the type specimen of *C. lamarcki* (= *C. glaucum*) is to be found in Tebble (1966: pl. 12, figs. f & g); his figs. 55 and 56, however, are not quite clear in showing the differences with *C. edule*. Figures of Dutch material are supplied here (figs. 3-14).

REFERENCES

- ALTENA, C.O. VAN REGTEREN, 1937. Bijdrage tot de kennis der fossiele, subfossiele en recente mollusken, die op de Nederlandse stranden aanspoelen, en hunner verspreiding.-Nieuwe Verh. bataaf. Genoot. proefonderv. Wijsbeg. (2) 10 (3) : 1-XII, 1-184.
- BOYDEN, C.R., 1969. Ecology of the cockle *Cardium glaucum* Bruguière.-Essex Nat. 32: 223-236.
- BRAKMAN, C., 1936. *Cardium edule* L. var. *Lamarcki* Reeve.-Basteria 1: 39-44.

Figs. 3-14. *Cardium glaucum* Brug. 3-4. Breskens, Zeeland, swimming pool connected with the sea, 1962, leg. E. Gittenberger, Leiden museum; measurements 4.7 x 3.6 cm, shell nearly as solid as *C. edule*. 5-9. Scheveningen, beach, typical (sub)fossil material collected on 30.XII.1958, 4.XII.1959, 26.XI.1961, 20.VI.1959, and 4.XI.1959, leg./colln. R.M. van Urk; all valves brown or blue, nos. 5 and 7 illustrating the variation in breadth of the ribs. 10-11, 13-14. Scheveningen, beach, (sub)fossil, 7.V.1966, leg./colln. R.M. van Urk; slightly inequilateral to nearly equilateral valves, cf. *beltica*-form in literature. 12. Diemen, flood-mark of IJsselmeer, possibly 'Zuiderzee fossil', 16.IV.1950, leg. G. Spaink, Leiden museum; this shows the 'spreading' ribs with wide furrows on the posterior part of the shell. All figures roughly three quarters natural size. Photographs B. Kieft.

- EISMA, D., 1965. Shell-characteristics of *Cardium edule* L. as indicators of salinity.-Neth. J. Sea Res. 2: 493-540.
- ENTROP, B., 1966. Schelpen vinden en herkennen: 1-320. Zutphen (2nd. ed).
- JUTTING, W.S.S. VAN BENTHEM, 1943. Mollusca (I). C. Lamellibranchia.-Fauna Ned. 12: 1-477. Leiden.
- KAAS, P. & A.N.Ch. TEN BROEK, 1937. Over het voorkomen van Eemfossielen langs de Zuidhollandse kust.-Basteria 2: 36-39.
- PETERSEN, G. HØPNER, 1958. Notes on the growth and biology of the different *Cardium* species in the Danish brackish water areas. Meddr Danm. Fisk.- og Havunders. (N.S.) 2 (22): 1-31.
- MARS, P., 1951. Essai d'interprétation des formes généralement groupées sous le nom de *Cardium edule* Linné.-Bull. Mus. Hist. Nat. Marseille 11: 1-31.
- POHLO, R.H., 1963. Notes on the discrimination between *Cardium edule* L. and *Cardium lamarcki* Reeve (Lamellibranchia).-Cah. Biol. mar. 4: 177-182.
- RUSSELL, P.J.C., 1969. Studies on the ecology, distribution and morphology of the cockles *Cardium edule* L. and *C. glaucum* Brug. Thesis, London University.
- , 1971a. A reappraisal of the geographical distribution of the cockles, *Cardium edule* L. and *C. glaucum* Bruguière.-J. Conch., Lond. 27: 225-234.
- , 1971b. A significance in the number of ribs on the shells of two closely related *Cardium* species.-J. Conch., Lond. 27: 401-409.
- TEBBLE, N., 1966. British bivalve seashells: 1-212. London.
- TURNOUER, M., 1878. Sur quelques coquilles marines recueillies par divers explorateurs dans la région des chotts sahariens.-C.r. Ass. fr. Avanc. Sci. 1878: 608-622.
- TULKKI, P., 1961. *Cardium lamarcki* Reeve in Norwegian waters. Sarsia 4: 55-56.
- VISSER, G.J.M., 1966. Texel-weekeind op 23 en 24 april 1966.-Zee-
paard 26(6): 129-131.
- , 1968a. De binnendijkse mollusken van Texel I.-Basteria 32: 49-75.
- , 1968b. Om het behoud van de brakwaterfauna op het eiland Texel.-Levende Nat. 71: 221-230.
- , J.P. REYDON & M.J. VAN DE WAL, 1967. Bijdrage tot de kennis van de mariene mollusken van het eiland Texel.-Zee-
paard 27(4): 57-97.
- WOLFF, W.J., 1972. *Cardium edule* en *Cardium glaucum* in het Delta-
gebied.-Gloria Maris Antw. 6: 107-111.
- , 1973. The estuary as a habitat, an analysis of data on the

soft-bottom macrofauna of the estuarine area of the rivers Rhine, Meuse, and Scheldt. — Zool. Verh. Leiden 126: 1-242.

YONGE, C.M., 1949. The sea shore: i-xvi, 1-311. London.

SAMENVATTING

Cardium edule en *C. glaucum* in Nederland

Cardium edule is een van onze meest algemene en variabele soorten, waarvan in de loop der tijden vele variëteiten en vormen beschreven zijn. Een hiervan, de zgn. brakwatervorm, werd door Petersen (1958) als een zelfstandige soort onderscheiden en wordt nu vrijwel algemeen als zodanig erkend.

De kenmerken ter onderscheiding zijn vooral te vinden in sculptuur en slot. Vorm en kleur daarentegen zijn variabel en kunnen in dit opzicht alleen in bepaalde gevallen dienst doen. Aangezien in vroegere werken juist veel nadruk op vorm en kleur werd gelegd, is het geen wonder, dat de brakwaterkokkel als een standplaatsvorm van *C. edule* werd beschouwd.

De verschillen tussen beide soorten kunnen als volgt worden samengevat (zie ook fig. 2):

	<i>C. edule</i> (kokkel)	<i>C. glaucum</i> (brakwaterkokkel)
Schelp	stevig (juv. dunschalig)	dun en breekbaar; alleen de grootste schelpen iets steviger.
	gelijkzijdig tot zwak ongelijkzijdig (juv. gelijkzijdig, ovaal, zeer regelmatig van omtrek)	matig tot sterk ongelijkzijdig (juv. altijd min of meer ongelijkzijdig)
Ligament	lang, tot $\frac{2}{3}$ van het laterale slotgedeelte (juv. kort, minder dan $\frac{1}{2}$)	kort, hoogstens $\frac{1}{2}$ van het laterale slotgedeelte (juv. kort, minder dan $\frac{1}{2}$)
Slot	achterste cardinale tand in de linker klep naar de onderrand van de slotplaat gericht	achterste cardinale tand in de linker klep tegen de bovenrand van de schelp gelegen
	centrale holte onder de top niet opvallend breed.	centrale holte onder de top naar verhouding zeer breed, veel breder dan de aangrenzende holten
	ligament-groeven in open verbinding met de laterale groeven	ligament-groeven gescheiden van de laterale groeven door een min of meer opvallende dwarsrichel

Sculptuur	ribben op het middengedeelte van de schelp breed en afgeplat (juv. ribben minder breed) schubben wijd tot tamelijk wijd uiteengeplaatst	ribben tamelijk smal, vooral naar achteren min of meer gekield schubben dicht opeen tot vrijwel tegen elkaar aan liggend, in elkaar overgaand op de groeven, op deze wijze een doorlopende, min of meer onregelmatige sculptuur vormend
	groeven smal, minder dan $\frac{1}{2}$ van de ribben (juv. tot $\pm \frac{1}{2}$ van de ribben)	groeven breed, van ca. $\frac{1}{2}$ van de ribben in het middengedeelte van de schelp tot ongeveer even breed als de ribben op het achtergedeelte van de schelp
	achtterrand gegolfd; ribben in het achtergedeelte van de schelp goed ontwikkeld	achtterrand vrijwel recht; ribben in het achtergedeelte van de schelp zwak ontwikkeld tot vrijwel vlak
	ribben aan de binnenkant van van de schelp alleen zichtbaar langs de onderrand van de schelp (juv. als <i>glaucum</i>)	ribben aan de binnenkant duidelijk zichtbaar van de top tot de onderrand van de schelp

Voor overige kenmerken als die van het voorste spierindrúksel, periostracum e.d. mag verwezen worden naar de beschrijvingen.

De variabiliteit van beide soorten is uitvoerig besproken in de tekst en leidt, zeer kort samengevat, tot de volgende conclusies:

a) Ondanks de grote variabiliteit blijven de twee soorten duidelijk gescheiden.

b) Hoe meer *C. edule* in vorm naar *C. glaucum* neigt, des te meer wijkt hij daarvan af in slotkenmerken.

c) De variabiliteit van *C. edule* maakt het mogelijk iets omtrent de al of niet rossië herkomst van ons strandmateriaal vast te stellen.

d) Grote exemplaren van *C. glaucum* ('major-vorm', die overigens geen systematische waarde heeft) tonen aan, dat de brakwaterkokkel niet als een onderontwikkelde standplaatsvorm van *C. edule* kan gelden.

e) De vormen bij beide soorten gaan geleidelijk in elkaar over; vele van de beschreven variëteiten zijn weliswaar goed herkenbaar, maar het is praktisch onmogelijk 100% van het materiaal onder te verdelen.

Verspreiding in Nederland

C. edule is een van de meest algemene soorten langs onze gehele kust. In het Waddengebied en aan de Noord-Hollandse kust ten noorden

van Bergen is het de overheersende soort in het aanspoelsel, ten zuiden daarvan overheerst *Spisula subtruncata* (da C.). Te oordelen naar het geregeld aanspoelen van vers materiaal te Scheveningen, moet de soort daar dicht onder het strand leven en hetzelfde geldt ongetwijfeld voor een groot deel van onze kust.

De kokkels van de Waddenzee behoren alle tot *C. edule*; in de voormalige Zuiderzee werd de soort vervangen door *C. glaucum*. Het is moeilijk om aan de hand van het aanwezige materiaal de juiste scheidingslijn tussen beide soorten vast te stellen, maar deze moet gelegen hebben tussen de tegenwoordige Afsluitdijk en de lijn Enkhuizen-Stavoren. In het Rijksmuseum van Natuurlijke Historie te Leiden bevinden zich *C. edule*-monsters van Medemblik (10/2), Zeeburg (5/2), Huizen (1) en Harderwijk (1). Al dit materiaal is waarschijnlijk van (sub)fossiele oorsprong; van het Huizense exemplaar, dat zich tussen *C. glaucum* van dezelfde vindplaats bevond, is het bovendien niet zeker of het hier wel in thuis hoorde.

Ook in de Zuid-Hollandse—Zeeuwse stromen leeft uitsluitend of vrijwel uitsluitend *C. edule*; *C. glaucum* heeft een ander oecologisch verspreidingspatroon en is beperkt tot binnendijkse kreken, enz.

Fossiel en subfossiel materiaal spoelt aan langs de gehele kust, naast verkleurd en verweerd recent materiaal. Aan de hand van de variabiliteit (zie fig. 1) is in vele gevallen iets omtrent de herkomst van zulk materiaal vast te stellen.

C. glaucum is als brakwatersoort vrijwel uitsluitend tot het noorden en zuiden van ons land beperkt. Alle waarnemingen, een enkele mogelijke uitzondering daargelaten, zijn afkomstig van binnendijkse kreken, plassen, kanalen e.d.

Dit eigen verspreidingspatroon wordt o.a. bevestigd door Wolff (1972, 1973) voor het Delta-gebied. Visser c.s. (1967) vermelden voor Texel: "leeft in diverse brakwaterplassen binnendijs." Zelf zocht ik tevergeefs naar de soort in de eerste slenk van Terschelling.

In de vroegere Zuiderzee, met uitzondering wellicht van het meest noordelijke gedeelte, leefde uitsluitend *C. glaucum*. De enkele monsters van *C. edule* hebben waarschijnlijk alle betrekking op (sub)fossiel materiaal. De afsluiting van de Zuiderzee deed het grootste aaneengesloten verspreidingsgebied van *C. glaucum* in ons land verloren gaan.

Een monster van de Moerdijk (Moerdijkbrug, 1-6-1949, coll. C.J. Verhey, reg. no. 2003, 3/2 ex., museum Leiden) heeft wellicht op (sub)fossiel materiaal betrekking, maar dit is niet met zekerheid uit te maken. In hoeverre *C. glaucum* landinwaarts in de grote rivieren voorkomt of voorkwam, is mij niet bekend.

Langs de Noord- en Zuid-Hollandse vastelandskust is, afgezien van aangespoeld materiaal, de enige mij bekende vindplaats gelegen in de

brakwaterplassen achter de Hondsbosse Zeewering, waar de soort tezamen met *C. edule* voorkomt. Of het hier recent dan wel (sub)fossiel voorkomen betreft, is uit het materiaal niet op te maken.

Slechts op enkele plaatsen is een gezamenlijk voorkomen van de twee soorten bekend:

1. De zo juist genoemde plassen achter de Hondsbosse Zeewering.
2. Het Kanaal door Zuid-Beveland bij Wemeldinge, 2-3 vaam, coll. J.A.W. Lucas, 27-8-1951, coll. Comité ter Bestudering van de Nederlandse Molluskenfauna no. 3684, in museum Leiden; enige tientallen *C. glaucum* en 12 ex. *C. edule*, alle juv. en levend verzameld, althans met vleesresten, *C. edule* in een afwijkende vorm. Hierop sluit aan:
3. Havenkanaal van Goes, zie Wolff (1972: 109-110).
4. Medemblik. Vrij zeker betreft het hier (sub)fossiel, al of niet aangespoeld, materiaal van *C. edule*, zie aldaar, en mogelijk ook van *C. glaucum*.

Fossiel en subfossiel materiaal spoelt vermoedelijk aan langs de gehele kust. Te Scheveningen is *C. glaucum* een van de tien meest algemene soorten op het strand, maar het materiaal is steeds min of meer verkleurd of verweerd, dikschalig en van hoogstens middelmatige grootte. Ook bij schelpen van minder dan 0,5 cm vond ik tot nu toe geen enkele zelfs maar min of meer verse klep. Mogelijk stamt al dit materiaal uit de Holocene hafperiode, maar dan uit de tijd, dat de verzoeting al vrij ver was voortgeschreden en er condities heersten, die te vergelijken zijn met die in de voormalige Zuiderzee.