ON LOWER TERTIARY MOLLUSCA FROM S.W. AND CENTRAL CELEBES

BY

C. BEETS.

(with one plate).

1) In the "Rijksmuseum van Geologie en Mineralogie", Leyden, there is a small collection of Lower Tertiary mollusca from S.W. Celebes which allows of comparison with ABENDANON's Celebes fossils described by DOLLFUS and kept in the "Instituut voor Mijnbouwkunde", Delft.

The present note deals especially with *Turritella krooni* DOLLFUS (S.W. Central Celebes; said to be of Cretaceous age), a new subspecies *T. krooni batukuënsis* (S.W. Celebes; Eocene), and the new *T. krooni kalosiensis*, formerly described as *T.* cf. *angulata* SOWERBY and *T.* cf. *assimilis* SOWERBY (S.W. Central Celebes; probably of Upper Eocene age, formerly considered to be of Oligocene age).

The material from S.W. Celebes discussed below was collected some years ago by Dr H. G. J. SAX on behalf of the "BATAAFSCHE PETROLEUM MAATSCHAPPIJ", The Hague. It was forwarded to Prof. K. MARTIN and briefly discussed in an unpublished report to the B. P. M. dated August 1931. Dr SAX's geologic report was dated July, 1931.

The present note appears thanks to the courtesy of the directorate of the "BATAAFSCHE PETROLEUM MAATSCHAPPIJ", which also gave permission to consult unpublished reports.

2) The fossil shells described below were collected west of the well-known Batoekoe-anticline[1]), lying approximately in the middle part of S.W. Celebes[2]). The locality is No. 41 of Dr SAX's survey; it is indicated northwest of Batoekoe on the sketch-map figured herewith (fig. 1). The Turritellas now discussed were mentioned as *Turritella* spec. in MARTIN's report, showing sufficient features to conclude that they represent a species hitherto not described, their general character being in accordance with the supposed Lower Tertiary age of the sediments exposed (the species does not show any affinities to Neogene Turritellas). The same applies to an *Ostrea* spec., occurring associated with the Turritellas. These species, moreover, are not known from the javanese Upper Eocene Nanggoelan beds.

MARTIN made no comparisons with ABENDANON's collection, nor mentioned it, this apparently being a consequence of his critical discussion of DOLLFUS's study (MARTIN, 1917).

Dr SAX collected the fossils in an area the geology of which may be directly compared with the S.W. part of Central Celebes, where ABENDANON made the fossil collections studied by DOLLFUS.

[1]) Dutch orthography *oe* corresponds with English *oo*.
[2]) Cf. RUTTEN, 1927, pp. 541—49.

Loc. No. 41, west of the well-known Batoekoe coal-field, lies in a series of "Nummulitic" limestones (thickness at least 250 m, according to the literature) containing intercalations of fossiliferous marly and calcareous sandstones. The latter contain large bivalves and gastropods (*Turritella*). From bottom to top of the series the intercalations increase and the upper portion

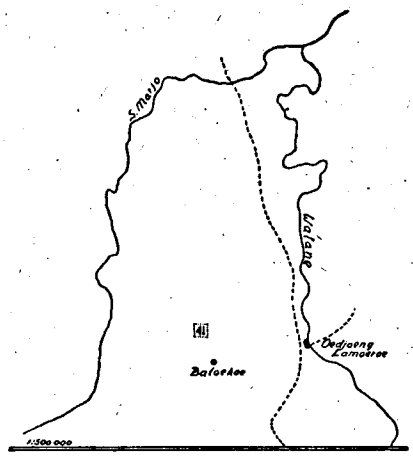


Fig. 1. The Batoekoe area west of Oedjoeng Lamoeroe, S. W. Celebes (after SAX, 1931).

of the series consists of lenses of calcareous matter lying in a marly-sandy, coal-bearing series. The "Nummulitic" series covers the supposed aequivalent of the Maroro-formation of Central Celebes (vide infra), which is believed to be of Tertiary A-age, according to VAN DER VLERK & UMBGROVE's subdivision of the East Indian Tertiary.

For a general survey of the geology of S.W. and S.W. Central Celebes we may refer to the compilations given by RUTTEN [1]), LEUPOLD & VAN DER VLERK (1931) and BADINGS (1936).

As stated above the geology of S.W. Central Celebes in general agrees well with that of the Batoekoe area. In both areas the Tertiary series start with characteristic reddish violet sand and clay deposits regarded as aequivalents, and called Maroro formation in the Kalosi area of Central Celebes. In this area the type of DOLLFUS's *Turritella krooni* was collected. The fossil has the same colour as its matrix. The other fossils derived from the typical Maroro formation in the Kalosi area, are: *Thracia abendanoni* DOLLFUS, *Cytherea verbeeki* DOLLFUS and *Cardium* cf. *productum* SOWERBY (DOLLFUS, 1915, pp. 965 etc.), all being poorly preserved.

These fossils could not serve as age indicators, but unfortunately ABENDANON has gone farther than DOLLFUS while considering the Maroro formation as being of Cretaceous age on account of the fossils mentioned above. DOLLFUS, on the contrary, stated (*in* ABENDANON): "Il n'y a rien de particulièrement caractéristique, et ces fossiles pourraient être aussi bien Tertiaire inférieure que Crétacé supérieur; c'est la position stratigraphique [that is to say, below Eocene deposits] qui a été ici déterminante, ...". (1915, p. 965).

[1]) RUTTEN, l. c., and pp. 607 etc.

Afterwards, the Maroro formation appeared to yield undoubtedly Eocene fossils [1]), but partly it certainly belongs to the Cretaceous as is proved by identifications by REYZER and VAN DER VLERK & DOZY.

As *Turritella krooni* has been collected by Dr SAX in undoubtedly Eocene beds it might also indicate an Eocene age of the Maroro locality of the type. SAX's material, however, contains no typical *T. krooni* but a different form now adopted as a subspecies. The real *T. krooni* may still be of Upper Cretaceous age. On the other hand *Turritella* is a rapidly evolutionizing genus, many of its species giving rise to subspecies. These subspecies may be more or less typical for strata which do not differ considerably as regards age. The Batoekoe locality therefore may be only slightly younger than the Maroro locality of *T. krooni* s.str.

It is noteworthy that neither *T. krooni krooni*, nor its supposed subspecies *batukuënsis* subspec. nov. and *T. krooni kalosiensis* subspec. nov. (which has been called *T.* cf. *assimilis* and *T.* cf. *angulata* by DOLLFUS) have been met with in Neogene deposits nearby (S.E. and E. Borneo [2]). This also may plead for their non-Neogene age. This supposition is corroborated by an *Ostrea* species associated with the Batoekoe *Turritella*. This species, like *T. krooni*, shows (strong) affinities to Palaeogene oysters and no similarity to any Neogene one.

The material of *T. kalosiensis* which is supposed to be a subspecies of *T. krooni*, has been collected in alluvial deposits of the Enrekang-Kalosi area in S.W. Central Celebes. As the shells seem to belong to one form, we may assume their source beds to be of approximately the same age. It is perhaps not a too speculative supposition to expect further recording of this form from the limestone deposits (Tertiary B?) of the region indicated, in which no Tertiary C, D, or Lower E has been found up to now [3]). The fairly constant differences between *T. krooni batukuënsis* and *T. krooni kalosiensis* suggest different stratigraphic ranges. The Kalosi form may be preliminarily considered a younger subspecies which most probably will not occur in any Neogene deposit (vide infra).

In 1917 MARTIN criticized DOLLFUS's identifications (according to figures only) and confidently stated that DOLLFUS's "Oligocene" fossils from the Enrekang area Alluvium were derived, at least partly, from Neogene deposits. Comparison of the ABENDANON collection in the Mining Institute, Delft, has proved MARTIN's conclusion to be correct as concerns the mollusca [4]), and a short time ago UMBGROVE (1943) stated that of three "Oligocene" (alluvial) corals identified by DOLLFUS, two cannot be identified, the third is a recent species.

MARTIN did not renounce his usual taste for settling questions clearly, going only as far as he felt the proves given, and so he has not considered all alluvial fossils of the Enrekang area (1917, 1, p. 303) as derived Neogene fossils, leaving the possibility of a mixture of fossils of different ages.

[1]) Cf. RUTTEN, l. c., pp. 618, 621: VAN DER VLERK & DOZY, 1934, p. 216; BADINGS, 1936, p. 267.

[2]) A large series of molluscan faunas from E. and W. Borneo are studied by the author. These faunas range from Lower Miocene to Quarternary.

[3]) Cf. VAN DER VLERK & DOZY, 1934, p. 217.

[4]) Cf. especially *Clementia papyracea* (GRAY).

I have compared DOLLFUS's *Volutilithes celebensis* [1]), based on rather poor material, with the javanese Upper Eocene (Nanggoelan) species described by MARTIN. After careful examination I consider *V. celebensis* to be identical with *V. ickei* MARTIN [2]). Young shells of the latter (coll. Geol. Inst. Amsterdam) could not be separated from *V. celebensis*. *V. ickei* presumably indicates Upper Eocene (Tertiary B) age, although VAN DER VLERK's statement that "most of the species, described by MARTIN from the Nanggoelan-beds will doubtless prove to be guide fossils for the Upper-Eocene" (1931, p. 291) is not fully supported by the faunal succession in Burma, where, according to DE P. COTTER's investigations, elements of the poor fauna below the Upper Eocene (Yaw) series may occur in beds of Upper Eocene age. One Yaw species occurs in Lower Oligocene strata.

Strata of Tertiary A—B age have been recorded with certainty from the Kalosi area, so the source-beds of *V. celebensis* will also be found in the Kalosi area. Accordingly, the representatives of *Turritella krooni kalosiensis* which partly show exactly the same preservation as the type of *V. celebensis*, might also be derived from the Eocene deposits of this area being probably of Tertiary-B age.

Unfortunately, I had no time to revise the whole ABENDANON collection, but it may be mentioned that DOLLFUS's *Cardita* cf. *veretrapezoides* DE GREGORIO [3]) differs much from Neogene Carditas, showing close affinities to or being identical with *C. hillegondae* MARTIN from Nanggoelan [4]).

Summarising the stratigraphic and palaeontologic observations we may assume *T. krooni* and its offsprings to range from beds of Upper Cretaceous or lowermost Eocene age to Upper Eocene approximately. The following not too speculative scheme might be of some value for further investigation of the Batoekoe and Kalosi areas.

T. krooni kalosiensis: Tert. B? (presumably living contemporaneously with *Volutilithes ickei* = *celebensis*).
↑
T. krooni batukuënsis: Tert. A (together with *Ostrea* spec. and *Arca*? (*Noetia*?) spec.).
↑
T. krooni krooni: Maroro formation (together with *Thracia abendanoni*, *Cytherea verbeeki* and *Cardium* cf. *productum*).

3) Descriptions.

TURRITELLA KROONI KROONI DOLLFUS.

Plate, fig. 4.

1915. DOLLFUS, p. 965, pl. 2, fig. 851.

I have refigured the type specimen. The photograph reveals that the strength of the spirals and their direction as well as that of the sutures are different from DOLLFUS's drawing, in which the strong spiral and sutures are running clearly more obliquely than in reality. The sculpture was described as consisting of one big spiral lamella and anteriorly of it "une série de cordons moins importants au tiers inférieurs" of the whorls. It

[1]) DOLLFUS, 1915, p. 986, pl. 3, figs. 856, 856a. Locality N.E. of Kalosi, in alluvial deposits.
[2]) MARTIN, 1914—15, p. 134, pl. 3, figs. 70—71.
[3]) DOLLFUS, l.c., p. 995, pl. 2, figs. 819, 819a, 826, 826a.
[4]) MARTIN, l.c., p. 186, pl. 7, fig. 198; pl. 8, figs. 199—200.

proves to be the same sculpture as that of the other subspecies (generally speaking), viz., three main spirals of which the two foremost are obsolete, and a few spirals at the transition between the posterior part of the body-whorl and its base. The type is poorly preserved. For more particulars we may refer to the next descriptions.

TURRITELLA KROONI BATUKUËNSIS subspec. nov.

Plate, figs. 1—3.

Some specimens available which are embedded in a marly sandstone. I did not succeed in preparing free shells, but the shell-parts exposed are better preserved than the type of *T. krooni* s.str. I figure three shells of Dr SAX's collection. This material shows that the older whorls (fig. 3) bear three spirals and a fourth along the anterior suture. The middle spiral disappears on younger whorls (figs. 1—2 [1])) and the lowermost of the three main spirals also becomes obsolete (fig. 2), the uppermost growing strong and lamellate, being low and weaker on the body-whorl only.

T. krooni s.str. (fig. 4) may be distinguished from the new subspecies on account of its more obsolete, not clearly lamellate upper spiral, much less swollen whorls and a broader spiral zone behind the shoulder. Thus the conditions which are reached by *T. krooni batukuënsis* only in its body-whorl are developed much earlier in the typical subspecies, which is, moreover, smaller.

The growth-lines of all three subspecies (fig. 4: youngest part of body-whorl; fig. 2, fig. 8) are identically developed. Above the shoulder of the whorls the growth-lines run obliquely from the left (behind) to the right, being straight or slightly protruded, forming a sinus shortly before the strong upper spiral, then running to the left and forming a protrusion between the third and fourth (sutural) spiral. The sinus lies between the first and middle spiral. Anteriorly of the sutural spiral again a shallow but distinct sinus is formed (fig. 2). The most anterior part of the growth-lines was not observed.

Both the typical form and the Batoekoe form bear a few further spirals on the body-whorl: at the transition to the base.

TURRITELLA KROONI KALOSIENSIS subspec. nov.

Plate, figs. 5—11.

1915. DOLLFUS, p. 991 (*T.* cf. *angulata* SOW.), pl. 1, figs. 804, 806.
1915. DOLLFUS, p. 991 (*T.* cf. *assimilis* SOW.), pl. 1, fig. 805; pl. 3, figs. 852, 854, 855, 857.

After careful re-examination of ABENDANON's material I am convinced that both "*T.* cf. *angulata*" and "*T.* cf. *assimilis*" belong to one and the same form which must be considered a subspecies of *T. krooni*. This material was collected in alluvial deposits in the Enrekang area, S.W. Central Celebes. MARTIN (1917, 1, 2) correctly pointed out that it does not show affinities to the Neogene species *T. assimilis* and *T. angulata* (and varieties), but in his report on the Batoekoe material he did not refer to *T. krooni* nor to DOLLFUS's identifications.

The small specimen of *T. krooni batukuënsis* (fig. 3) clearly connects DOLLFUS's "Cretaceous" *T. krooni* with his "Oligocene" material, especially

[1]) The middle spiral is still indicated on the top of the holotype (fig. 1).

"*T.* cf. *assimilis*" (our figs. 9 and 10): here (fig. 10) the obsolete middle spiral lies close to the anterior (third) spiral, whereas in both specimens this third spiral is close to the fourth (sutural) spiral. In both shells secondary spirals are developed between the primary.

The Kalosi form is supposed to be a smaller subspecies of *T. krooni*. It is rather variable, being slenderer than *T. krooni batukuënsis* and showing more the tendency to maintain the features of the older shell portions. Further it clearly developes more spiral sculpture. The third and middle spiral do not become obsolete as rapidly as in the Batoekoe form, and the first, strong spiral only occasionally grows lamellate and is closer to the upper suture than that of *T. krooni batukuënsis*. The narrow spiral zone above the shoulder of the whorls is, moreover, clearly concave. In extreme cases the posterior strong spiral may be lamellate as in the Batoekoe form, but it is horizontal, broader lamellate and thinner (sharper), clearly distinguished from the whorls, whereas in *T. krooni batukuënsis* (and in the typical subspecies) the lamella is the regular prolongation of the posterior slope of the whorls.

This spiral is accompanied on the older whorls of the Kalosi form by a spiral close to the suture; it disappears on younger whorls but may be indicated as a spiral swelling along the suture (cf. figs. 6, 8).

On another shell (fig. 7) the third spiral in the beginning is even stronger than the first, on younger whorls it is more obsolete. Fig. 5 shows the two main spirals (1 and 3) lying closely together. Fig. 8 shows a fairly well preserved specimen bearing a distinct spiral along the upper suture and a well-defined sculpture of fine spiral threads between the primary and secondary ones. The same applies to another shell (fig. 10). Fig. 11 represents a poorly preserved shell. Growth-lines are visible on the specimen figured in fig. 8 only. Their development is the same as in the other subspecies.

The whorls of the Kalosi form alter slowly (cf. the Batoekoe form) and their shapes differ much from those of the other subspecies.

T. krooni and its subspecies show exactly the same variability as the Neogene, Indian and East Indian *T. angulata*-group.

The older portions of the spire of *T. krooni* s. l. may show affinities to the Eocene (Upper Ranikot) *Turritella hollandi* COSSMANN et PISSARRO [1]), but this smaller species is certainly slenderer and has higher whorls which do not show the rapid alteration of the whorls as is typical for the Batoekoe subspecies.

T. ranikoti VREDENBURG also shows affinities [2]), but in this species the lowest spiral is stronger than the other spirals.

The small, Lower Eocene *T. lahirii* COX [3]) seems to be related, but it bears granulate spirals of equal strength.

Another allied species occurs in the Egyptian Eocene, *T. transitoria* MAYER-EYMAR [4]).

[1]) COSSMANN and PISSARRO, 1909, p. 60, pl. 5, figs. 17—19; COX, 1930, p. 155, pl. 17, figs. 10—11.

[2]) COSSMANN and PISSARRO, l. c., p. 59, pl. 6, figs. 3—5 (*T. angulata* [nec] SOW.); VREDENBURG, 1928, pp. 58—59, pl. 5, fig. 8 (var. *leilanensis*).

[3]) COX, 1930, p. 153, pl. 17, fig. 17.

[4]) NEWTON, 1912, p. 80, pl. 31, figs. 3—4.

OSTREA spec. indet.

Plate, fig. 12.

This specimen is from Dr SAX's locality No. 41. It is a right valve resembling that of the Eocene Tethyan *Ostrea turkestanensis* ROMANOWSKI[1]), but the differences in outline and sculpture do not allow of identification with this species.

Another allied form is *Ostrea pharaonum* OPPENHEIM var. *aviculina* MAYER-EYMAR, recorded from the Egyptian Eocene and the Upper Ranikot stage of India [2]).

ARCA? (NOETIA?) spec. indet.

A small valve from Dr SAX's locality No. 41 which could not be identified. Even its generic position must remain doubtful.

4) Explanations of figures.

Fig. 1: *Turritella krooni batukuënsis* subspec. nov. (holotype of the subspecies); length of the damaged shell 72 mm; Loc. No. 41 SAX, N.W. of Batoekoe, S.W. Celebes.

Fig. 2: *Turritella krooni batukuënsis* subspec. nov.; length 54 mm; Loc. No. 41 SAX.

Fig. 3: *Turritella krooni batukuënsis* subspec. nov.; length 26.3 mm; Loc. No. 41 SAX.

Fig. 4: *Turritella krooni krooni* DOLLFUS; Type specimen; DOLLFUS, 1915, p. 965, pl. 2, fig. 851 (No. 11614 coll. Mining Inst. Delft); length 41 mm. Loc. No. 851 ABENDANON, S.W. Central Celebes.

Fig. 5: *Turritella krooni kalosiensis* subspec. nov.; DOLLFUS, 1915, p. 991, pl. 1, fig. 806 ("*T.* cf. *angulata* SOW.") (No. 11599 coll. Mining Inst. Delft); length 35 mm. Loc. No. 806 ABENDANON, S.W. Central Celebes.

Fig. 6: *Turritella krooni kalosiensis* subspec. nov. (holotype of the subspecies); DOLLFUS, 1915, p. 991, pl. 3, fig. 855 ("*T.* cf. *assimilis* SOW.") (No. 11617 coll. Mining Inst. Delft); length 53 mm. Loc. No. 855 ABENDANON, S.W. Central Celebes. The shell is overgrown with oysters.

Fig. 7: *Turritella krooni kalosiensis* subspec. nov.; DOLLFUS, 1915, p. 991, pl. 3, fig. 852 ("*T.* cf. *assimilis* SOW.") (No. 11618 coll. Mining Inst. Delft); length 45.5 mm. Loc. No. 852 ABENDANON, S.W. Central Celebes. The specimen is overgrown with oysters.

Fig. 8: *Turritella krooni kalosiensis* subspec. nov.; DOLLFUS, 1915, p. 991, pl. 1, fig. 804 ("*T.* cf. *angulata* SOW.") (No. 11598 coll. Mining Inst. Delft); length 34 mm. Loc. No. 804 ABENDANON, S.W. Central Celebes.

Fig. 9: *Turritella krooni karosiensis* subspec. nov.; DOLLFUS, 1915, p. 991, pl. 3, fig. 854 ("*T.* cf. *assimilis* SOW.") (No. 11619 coll. Mining Inst. Delft); length 39 mm. Loc. No. 854 ABENDANON, S.W. Central Celebes.

Fig. 10: *Turritella krooni kalosiensis* subspec. nov.; DOLLFUS, 1915, p. 991, pl. 3, fig. 857 ("*T.* cf. *assimilis* SOW.") (No. 11621 coll. Mining Inst. Delft); length 35 mm. Loc. No. 857 ABENDANON, S.W. Central Celebes.

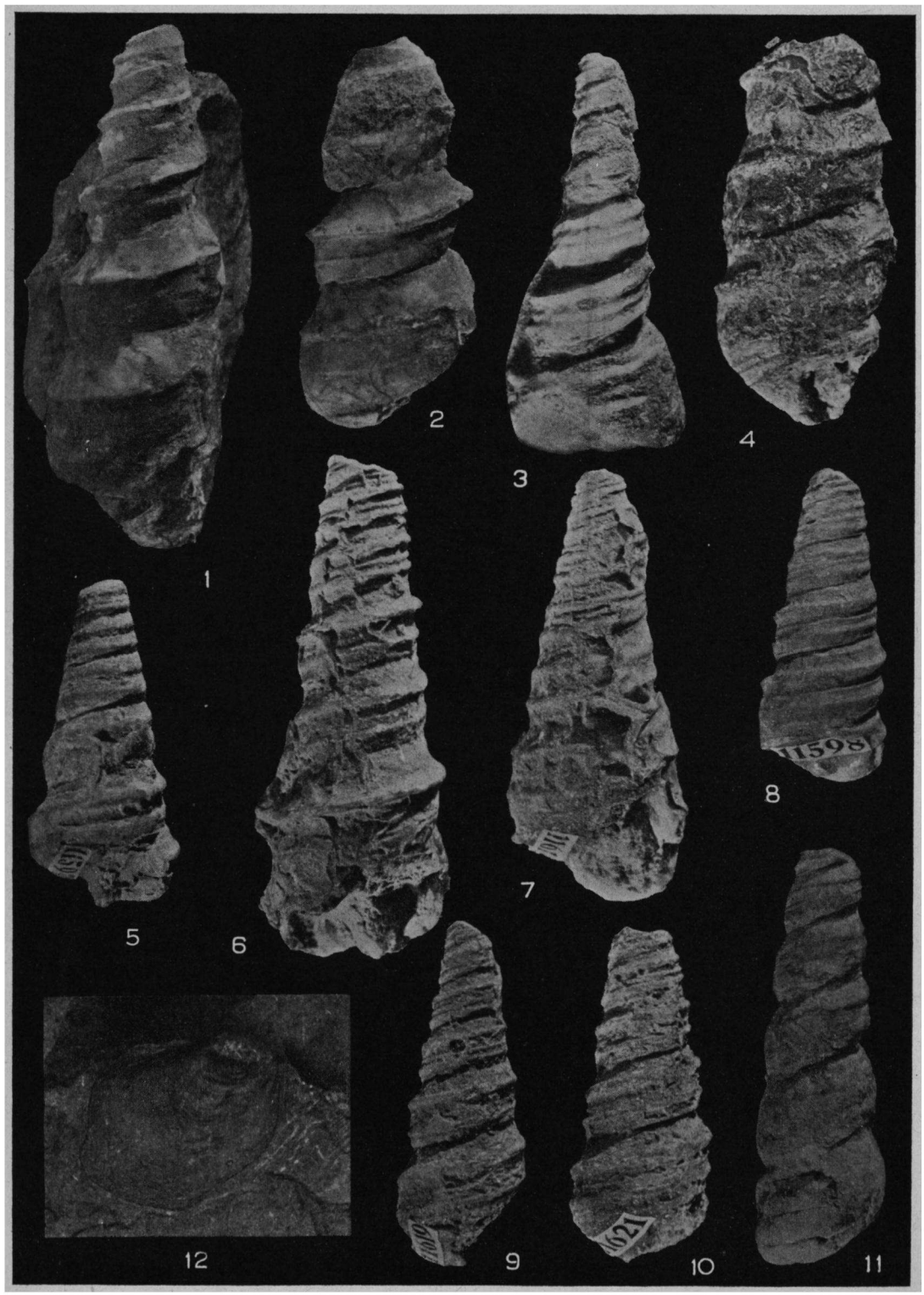
Fig. 11: *Turritella krooni kalosiensis* subspec. nov.; DOLLFUS, 1915, p. 991, pl. 1, fig. 805 ("*T.* cf. *assimilis* SOW.") (No. 11600 coll. Mining Inst. Delft); length 43 mm. Loc. No. 805 ABENDANON, S.W. Central Celebes.

Fig. 12: *Ostrea* spec. indet.; diameter at the most 31 mm. Loc. 41 SAX, N.W. of Batoekoe, S.W. Celebes.

[1]) COX, 1936, p. 30, pl. 4, figs. [6—]8.

[2]) VREDENBURG, 1927, p. 8, pl. 2, figs. 1—9; OPPENHEIM, 1903, p. 13, pl. 3 [pl. 4, figs. 13—16: var.].

C. Beets — Lower Tertiary mollusca from S.W. and Central Celebes.



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