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## TROGONThERIUM CUVIERI FISCHER FROM THE NEEDE CLAY (MINDEL-RISS INTERGLACIAL) OF THE NETHERLANDS

by

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(with pls. XIII-XIV)

Some time ago Mr. G. M. Roding, director of the natural history museum at Enschede, sent me for identification two mandibular fragments with teeth of a large rodent collected in the clay pit at Needse Berg, province of Gelderland, by Mr. Ten Bokkel Huinink, the owner of the pit. The Neede Clay, Needian of Dutch terminology (Van der Vlerk and Florschütz, 1950, p. 149), is characterized by the abundance of the freshwater molluscs *Viviparus diluvianus* (Kunth) and *Valvata naticina* Menke; the scanty remains of large mammals found in this deposit, representing *Elephas antiquus* Falconer, *Cervus elaphus* L., and *Dicerorhinus merckii* (Jäger), were described already half a century ago by Rutten (1909).

The Neede Clay corresponds to the great Mindel-Riss Interglacial; it is to be correlated with the English interglacial deposits of Clacton-on-Sea, Hoxne, and Swanscombe (Van der Vlerk, 1955, p. 37), and with those of Mauer and the main fauna of Mosbach in Germany (Azzaroli, 1951, p. 169). Both of these two last-mentioned localities yield *Trogontherium cuvieri* Fischer, an extinct beaver-like rodent, to which the mandibles from Neede should be referred.

Abundant remains of another species of *Trogontherium*, *T. boisvilletti* (Laugel), have been described from the Tegelen Clay, province of Limburg, Netherlands, by Schreuder (1929); this deposit dates either from a Günz Interstadial (Schreuder, 1945) or from the Günz-Mindel Interglacial (Azzaroli, 1951, p. 169). In her last paper on *Trogontherium*, Schreuder (1951) refers the Pleistocene remains from the English and continental European localities west of the Rhine to *T. boisvilletti*, and those from the localities east of the Rhine to *T. cuvieri*.

My thanks are due to Mr. G. M. Roding for entrusting the Neede material

to me for description, as well as to Professor I. M. van der Vlerk and Dr. C. O. van Regteren Altena for permission to study comparative material of *Trogotherium* in the collections of the Geological Museum at Leiden and in the Teyler Museum at Haarlem, respectively.

The largest mandibular fragment from Neede (Pl. XIII) is from the right side; it comprises part of the incisor as well as two grinding teeth, P<sub>4</sub> and M<sub>1</sub>. The front end is incomplete, the lower border of the mandible is damaged, and the ramus is broken off behind the alveolus of M<sub>2</sub>.

In cross section the incisor shows a strongly convex face coated with granular enamel, while the outer and inner surfaces are slightly concave from side to side. The greatest diameter of the incisor, over the outer and inner curves, is 12.6 mm; the width is 11.5 mm, which gives a width-height index of 91. In shape as well as in size the Neede lower incisor closely resembles that of *T. cuvieri* from Mosbach figured by Schreuder (1929, p. 151, fig. 5c); in *T. boisvilletti* the cross section is relatively higher and the outer and inner surfaces are convex or flat; exceptionally they exhibit a groove shown as a notch in section (Schreuder, l.c., fig. 5a-b).

The anterior grinding tooth (P<sub>4</sub>) in the Neede mandible is moderately worn; the four main folds (one outer and three inner) are still open to the marginal enamel. The height of the outer fold from the base to the grinding surface is 8 mm, that of the middle of the three inner folds, 6½ mm. The grinding surface has just reached the bases of the anterior and posterior inner folds; with a little more wear these folds would have become separated from the margin as enamel islands. There is an accessory fold, which is placed antero-internally; it is shown on the grinding surface as a distinct notch, and extends downward from the grinding surface for a length of 9½ mm. It does not penetrate into the crown as the other folds do, however, and it would never become isolated as an island. There is no trace of cement either on the crown surface or in any of the folds.

As the tooth is still in its alveolus and increases in diameters rootward the greatest length and width of the crown cannot be given; the length and width at the level of the base of the outer fold are 13 and 10.4 mm, respectively.

The second tooth (M<sub>1</sub>) in the same ramus fragment has three inner folds just isolated from the margin; the height of the outer fold is barely 2 mm. This tooth is much smaller than the P<sub>4</sub>, its length and width at 8 mm below the grinding surface being 7.4 and 9.0 mm. The roots of P<sub>4</sub> and M<sub>1</sub> are not exposed, but those of M<sub>2</sub>, as judged by the preserved portion of its alveolus, consist of one large posterior and two small anterior roots.

The second mandible from Neede (Pl. XIV) is likewise from the right

side but less complete than the first in that it lacks the incisor; it has, however, P<sub>4</sub>-M<sub>2</sub> in situ and even shows the base of M<sub>3</sub>. This dental series is more worn than the first; the base of the outer fold of P<sub>4</sub> is 5½ mm below the grinding surface, and that of the middle inner fold, 4 mm. The anterior inner fold is well separated from the margin, the posterior inner fold is just losing its contact with the inner enamel border. Again, there is a marked but shallow accessory antero-internal fold, the height of which is 9 mm. It does, therefore, extend further downward beyond the middle inner fold than it does in the P<sub>4</sub> first described, and it shows up on the grinding surface as a notch in the margin. The dimensions of the present P<sub>4</sub>, at the base of the outer fold, are 13 mm anteroposteriorly and 10.0 mm transversely. There is no crown cement.

M<sub>1</sub> has even the outer fold turned into an island; its dimensions at the alveolar border (about 6 mm below the grinding surface) are 7.8 by 9.5 mm. M<sub>2</sub> is very similar, 8.1 by 9.3 mm; only the outer fold is still open to the margin. Some enamel is lost posteriorly. The length P<sub>4</sub>-M<sub>2</sub> is 29.5 mm along the grinding surfaces, and 31 mm along the alveolar borders.

Thus, the two mandibular fragments of the Neede *Trogotherium* agree very well in tooth size as well as in possessing a marked but shallow accessory antero-internal fold in P<sub>4</sub>. Although we know nothing as yet about the cranial characters (Mr. Roding wrote to me that there were rumours about a skull having been found at Neede, but these have never been confirmed), the two fragments now available bear out the relationships of the Neede *Trogotherium* satisfactorily.

As we have already seen above, the Neede incisor agrees well with that from Mosbach (*T. cuvieri*) figured by Schreuder (1929, p. 151, fig. 5c); in *boisvilletti* the outer and inner surfaces are not concave transversely as they are in the Neede specimen. The lower incisors of *T. boisvilletti* from Tegelen (table 1) are at most 14.2 mm high and 11.8 mm wide in cross section; the width-height index varies from 74 to 86. The Forest Bed *boisvilletti* may be larger, as shown by the lower incisor recorded by Newton (1882, p. 68, pl. XI fig. 1), but its index is within the limits of the Tegelen *boisvilletti* (79). In the lower incisor of *T. cuvieri* from Jockgrim (Schreuder, 1929, p. 152) the average width-height index is 96. This index is 91 in the Neede incisor, as it is also in the Mosbach specimen of *T. cuvieri* figured by Schreuder (l.c., p. 151), and in that from Püspöckfördö (Schreuder, 1935, p. 24).

Consequently, the incisor of the Neede mandible agrees with that of *T. cuvieri* rather than with that of *T. boisvilletti* (table 1).

TABLE I  
Diameters of lower incisors of *Trogotherium*

|                        |       | <i>T. boisvilletti</i> (Tegelen)       |      |                               |                                 |  |  |      |       |
|------------------------|-------|--|------|-------------------------------|---------------------------------|--|--|------|-------|
| Teyler<br>Museum       | 15530 | 15531                                  |      | 15532                         | 15535                           | 15536  |  |      | 15539 |
|                        |       | b                                      | e    | b                             | a                               | a  | b  | c    |       |
| Height                 | 12.5  | 11.0                                   | 13.1 | 12.3                          | 12.6                            | 14.2   | 13.1                                     | 12.7 | 13.7  |
| Width                  | 9.7   | 9.2                                    | 10.1 | 10.5                          | 10.2                            | 10.5   | 10.5                                     | 10.0 | 11.8  |
| Width-<br>height index | 78    | 84                                     | 77   | 85                            | 81                              | 74   | 80                                       | 79   | 86    |
|                        |       | <i>T. boisvilletti</i><br>(Forest Bed) |      | <i>T. cwivieri</i><br>(Neede) | <i>T. cwivieri</i><br>(Mosbach) | <i>T. cwivieri</i><br>(Jockgrim,<br>average) | <i>T. cwivieri</i><br>(Püspök-<br>fürdő) |      |       |
| Height                 |       | 16                                     |      | 12.6                          | 12.7                            | 11.7   | 13.0                                     |      |       |
| Width                  |       | 12.7                                   |      | 11.5                          | 11.6                            | 11.2   | 11.8                                     |      |       |
| Width-height index     |       | 79                                     |      | 91                            | 91                              | 96   | 91                                       |      |       |

The greatest diameters of the grinding teeth of the Neede *Trogotherium* cannot be given; P<sub>4</sub> measures 13 by 10.0-10.4 mm at the level of the base of the outer fold. The smallest P<sub>4</sub> of *T. boisvilletti* from Tegelen (Teyler Museum, no. 16234a) measures 11.0 by 9.7 mm at this level; the largest P<sub>4</sub> from Tegelen that I have seen (Geol. Mus. Leiden, no. 47425) measures 13.8 by 10.8 mm. In the last-mentioned tooth the length increases to 15.4 mm at the crown base; this tooth is larger than the P<sub>4</sub> from Neede. In *T. cwivieri* from Choukoutien (China) the basal length of P<sub>4</sub> is again greater, 15½ to 16½ mm in three specimens, as judged by the figures (Young, 1934, fig. 18A, pl. V figs. 5-6). The Mosbach lower premolars of *T. cwivieri* (Von Reichenau, 1912, p. 223) vary in alveolar length from 10.0 to 16.2 mm, and in width from 8.8 to 11.2 mm, ranges that include the observations of the Neede P<sub>4</sub>. As far as size is concerned, the Neede premolars are within the limits of *T. boisvilletti* as well as of *T. cwivieri*.

The presence of an accessory antero-internal fold in P<sub>4</sub> has been noticed by various authors both in *T. boisvilletti* and in *T. cwivieri*. Newton (1882, pp. 68, 74, pl. XI figs. 9-10) found it to occur in two or three instances in *T. boisvilletti* from the Forest Bed; it is shown as a tiny enamel island in two figured specimens. In the Tegelen *T. boisvilletti* this fold is occasionally present; it has been described as a very shallow longitudinal groove that never becomes isolated from the margin (Schreuder, 1929, pp. 159-160). In the Teyler Museum collection from Tegelen there are two specimens, one right and one left (no. 15535a-b), in which the extra antero-internal fold of P<sub>4</sub> is as distinctly developed as that in the two Neede specimens, extending 6 mm downward beyond the base of the middle inner fold (which

is only 2 mm below the grinding surface), and forming a notch in the margin of the grinding surface. The length of  $P_4$  at the base of the outer fold is 13 mm in both Tegelen specimens, the width at the same level is 9.8 mm in no. 15535a, and 10.4 mm in no. 15535b. The  $M_1$  and  $M_2$  in these Tegelen mandibles also agree in size (8 by 9.3 mm, and 8 by 9.4 mm) with those in the Neede mandibles. The only difference between the Tegelen mandibles and those from Neede is found in the incisors, which in those from Tegelen are convex instead of concave transversely along the outer and inner surfaces, and which have a lower width-height index (81 as opposed to 91, see table 1) than has the Neede lower incisor. Ruger (1928, p. 226, pl. III figs. 5-6) noticed the extra antero-internal fold in the  $P_4$  of *T. cuvieri* (vide Schreuder, 1928) from Mauer; it is longer than the middle inner fold and shows up as a notch in the contour of the grinding surface. Schreuder (1929, p. 160) describes the extra fold in *T. cuvieri* both from Mosbach (l.c., pl. VII fig. 3) and from Jockgrim (l.c., pl. VII fig. 19); in the Mosbach  $P_4$  it is at least as high as the middle inner fold, and it becomes isolated from the margin with prolonged wear, whereas in the Jockgrim  $P_4$  it extends about  $2\frac{1}{2}$  mm into the crown. Finally, the accessory antero-internal fold is noticed by Young (1934, p. 55, pl. V fig. 6) in one out of three isolated  $P_4$  from Choukoutien.

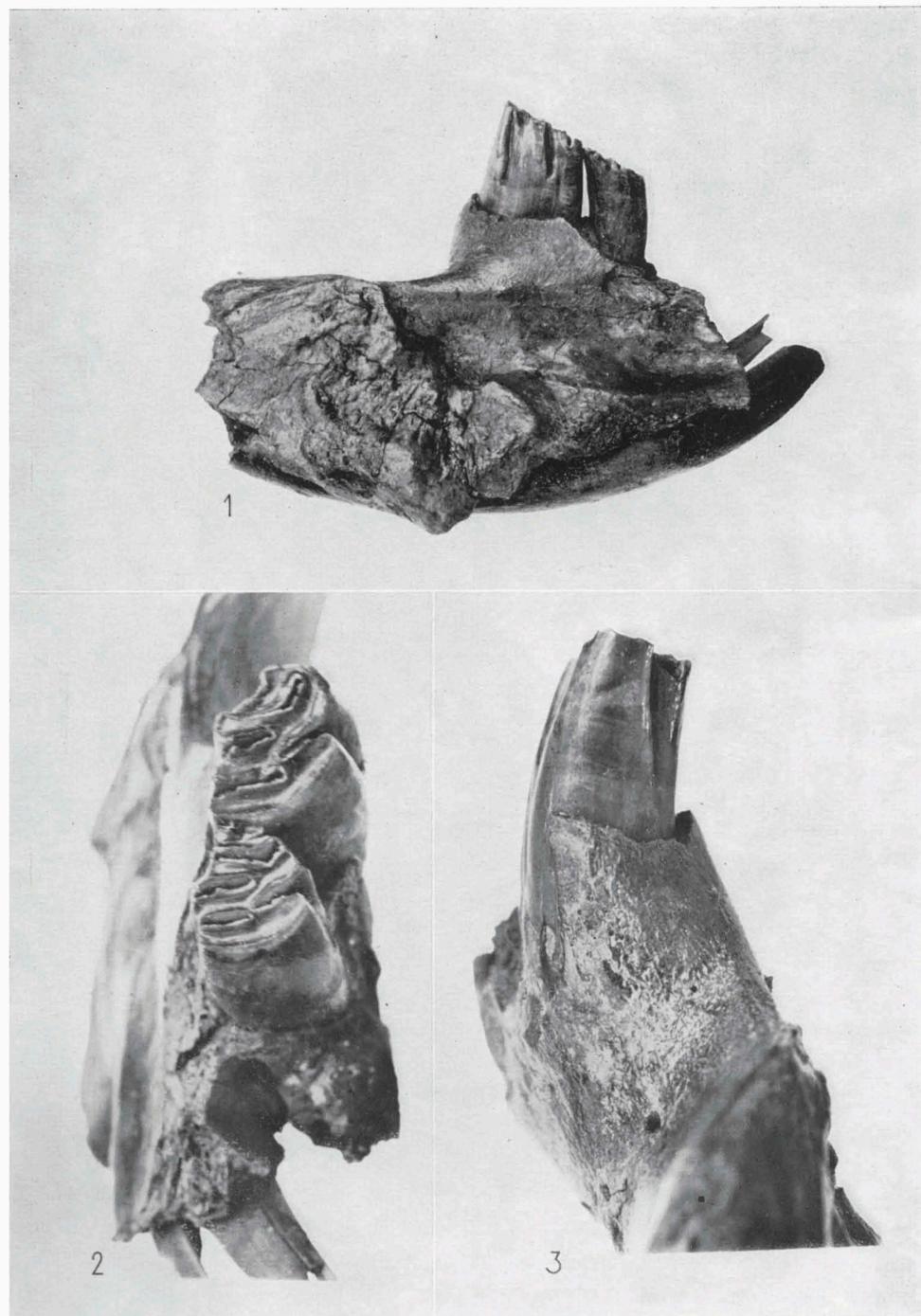
Thus, the accessory antero-internal fold occurring in both of the Neede  $P_4$  is a character occasionally found in *T. boisvilletti* as well as in *T. cuvieri*. In addition to this extra fold there may be an accessory antero-external fold in  $P_4$  of *T. boisvilletti*; in the Tegelen form it may be very distinct and even unite with the extra antero-internal fold so as to cut off a small pillar at the anterior end of the tooth (Schreuder, 1929, p. 160, pl. VII figs. 13 and 17). Such a marked antero-external extra fold does not appear to develop in *T. cuvieri*; it was observed only in one of the Mosbach  $P_4$  as a very faintly developed groove (Schreuder, l.c.), and has not been mentioned in the descriptions of *cuvieri* from other sites. In the two Neede  $P_4$  there is no trace of an antero-external accessory fold.

In conclusion, there does not appear to be much or any difference in structure or in size of the lower grinders between *T. boisvilletti* and *T. cuvieri*. The lower incisor, however, affords the means of distinguishing between the two, and the Neede mandible agrees in the characters of its incisor with that of *T. cuvieri*. Hence, it would seem evident that the Neede mandibles described and figured in the present paper represent the species *Trogontherium cuvieri* Fischer, which, as shown by Schreuder (1951, p. 420), is at present known to occur in Eurasia east of the Rhine, from Mosbach in the Rhine valley to Choukoutien in northern China. Neede,

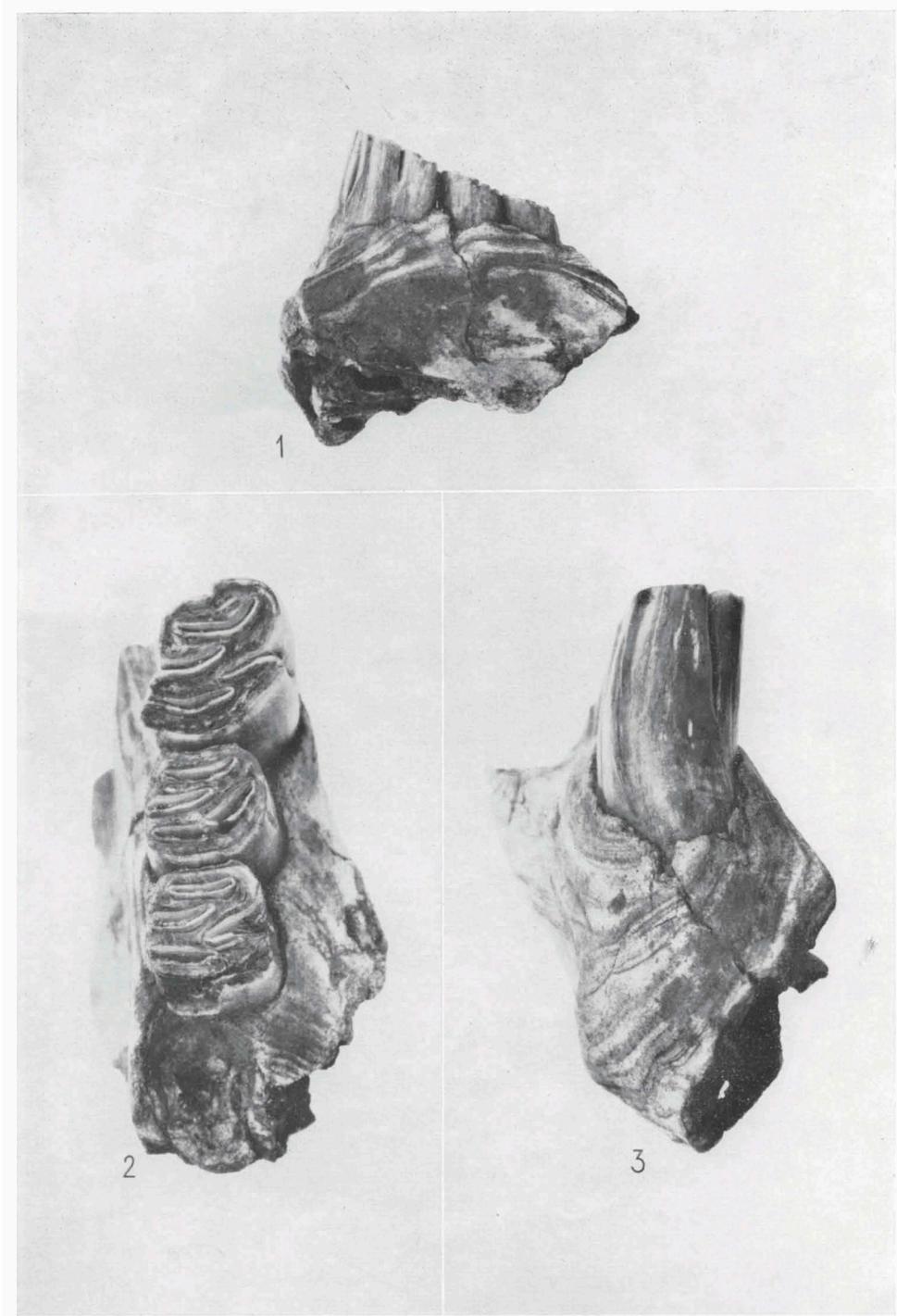
which is 100 km N.N.E. of Tegelen and 260 km N.N.W. of Mosbach, is the first Dutch and most westerly locality at which *T. cuvieri* has ever been found.

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*Trogontherium cuvieri* Fischer, Neede, Netherlands. Right mandibular ramus with I and P4-M1. Fig. 1, inner view; fig. 2, crown view; fig. 3, anterior view.  
 Fig. 1, natural size; figs. 2-3, twice natural size.



*Trogontherium cuvieri* Fischer, Neede, Netherlands. Right mandibular ramus with P4-M2.

Fig. 1, inner view; fig. 2, crown view; fig. 3, anterior view.

Fig. 1, natural size; figs. 2-3, twice natural size.