PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES

Further Note on the Remains of Elephas cypriotes from a Cave-Deposit in Cyprus

Dorothea M. A. Bate

Phil. Trans. R. Soc. Lond. B 1905 **197**, 347-360
doi: 10.1098/rstb.1905.0012

XII. *Further Note on the Remains of* Elephas Cypriotes *from a Cave-Deposit in Cyprus.*

By Dorothea M. A. Bate.

Communicated by Dr. Henry Woodward, F.R.S.

Received April 18,—Read June 9, 1904.

[Plates 21 and 22.]

Previous to 1901, no systematic search of the cave deposits of Cyprus appears to have been attempted. The geology was studied by M. Albert Gaudry, who published in 1862 an elaborate work with a geological map,* and Drs. Unger and Kotschy, in 1865,† also gave a geological map of the island, differing somewhat from that of their predecessor.

As long ago as 1700 the Dutch traveller Corneille le Brun‡ (Van Bruyn), published an account of his wanderings in Cyprus and the Levant, and mentions having visited a bed of bones, believed to be those of saints, not far from the Monastery of Haghios Chrysostomos. A drawing of one of these bones is given which Dr. Forsyth Major has since shown to be that of *Hippopotamus minutus*.§

The author started in 1901, in expectation of discovering an extinct fauna in this ossiferous breccia, and this expectation was amply fulfilled, and altogether no fewer than twelve ossiferous cave-deposits were found, five at Cape Pyla in the south-east, and seven on the southern slopes of the Kerynia Hills in the north of the island.

Two caves at Cape Pyla (mentioned by General di Cesnola in 1877, as containing *human* fossilised bones), were first visited. The rock in which these caves were found is a Miocene (probably Helvetian) limestone, weathered to a very great extent, and full of marine shells and corals as well as numerous Echinoids (*Clypeaster portentosus*), also met with in the Miocene limestones of Malta.

Here a number of caves were discovered in the cliffs, five of which yielded remains of *H. minutus*. These were: (1) The Red Cliff Cave; (2) the Great Anonymous Cave; (3) the Small Anonymous Cave; (4) Haghios Jannos; and (5) Haghios Saronda.

* 'Géologie de l'Ile de Chypre,' Paris, 1862.

† 'Die Insel Cypern,' Wien, 1865.

‡ 'Voyage au Levant,' etc., Delft, 1700, p. 375.

§ 'Zool. Soc. Proc.,' vol. 2, 1902, p. 107.

This last is the cave to which formerly pilgrimages were made, and candles burned in honour of the supposed sacred remains of saints.

The rocks of the Kerynia Hills are of uncertain geological age, no fossils having been obtained from the limestone of which they are chiefly composed. Professor GAUDRY concludes that the rock is of Cretaceous age and, therefore, the oldest sedimentary deposit in the island.

The seven caves discovered in this range are all on the southern side between the Aghirdhir Pass and the village of Kythræa, in a low broken line of cliffs, which runs parallel with the main ridge. They are named: (1) Coutzaventis; (2) Haghios Chrysostomos; (3) Anoyero Spelios; (4) Dikomo Mandra; (5) Haghios Elias; (6) the Elephant Deposit; and (7) the Western Cave.

Most of these caves have, by reason of long atmospheric erosion, partially or wholly disappeared, leaving the stalagmatic flooring containing mammalian remains unprotected and exposed, often at a considerable distance from the face of the cliffs. But although many of them are now almost obliterated by the falling in of the roof and walls, it was found that wherever this has happened the limits of the floor are sharply defined by the hard ossiferous deposit and the stalagmitic floor. In close proximity there are caves still preserved containing precisely similar deposits.

The fauna of the caves is comparatively scanty, the only other important extinct form besides the dwarf elephant and hippopotamus being a new species of Genet (*Genetta plesictoides*).*

The remains of the pigmy elephant, *Elephas cypriotes*, from Cyprus, with regard to which a short note has already been published,† were all procured from a single cave deposit situated on the southern side of the Kerynia Range. This restriction is somewhat remarkable in view of the fact that there are several otherwise similar deposits in the immediate vicinity, one small cave being only about 150 yards distant. The teeth and mandibular rami of this species were present only in small numbers but were associated with a large quantity of remains of *H. minutus*. This deposit, like others found in the same locality, was evidently the floor of a former cave of which but one original wall is still standing.

During the excavations made here many bones and teeth were found fractured; and that this had taken place subsequent to their accumulation on the floor of the cave was proved by the parts of a bone or tooth being found in natural juxtaposition, only falling apart when removed from the surrounding earth or rock. The opposing surfaces thus revealed were brown and discoloured by the infiltration of water and earth, showing that the fractures had not taken place at any very recent date. This occurred similarly in all the deposits where the cave walls and roof have disappeared, but amongst the remains of *H. minutus* obtained from a large cave in the same hills, none were found to have been broken prior to their separation from the matrix.

* 'Zool. Soc. Proc.,' 1903, vol. 2, p. 121.

† 'Roy. Soc. Proc.,' vol. 71, 1903, pp. 498–500.

The collection of elephant remains includes forty-six molars, or parts of molars, also a few isolated "tooth plates"; amongst the former are a number of perfect teeth, some still retaining their position in the jaws. In several instances pairs of molars similar in every respect, except in belonging to opposite sides of the mouth, are thought to have undoubtedly belonged to a single animal. Besides these one perfect and six slightly damaged specimens of permanent incisors and fragments of others were obtained. The only portion of the skeleton found was the imperfect distal extremity of a femur.

Incisors.

Milk Incisors.—Unfortunately none of the small milk incisors were found: it would have been of much interest to discover whether these were, or not, capped with enamel like those of the African and Maltese species.*

Permanent Incisors.—Several good pieces of tusks procured probably include those of both the male and female elephants and all differ from examples from Malta in being considerably compressed laterally (Plate 22, fig. 9), more especially those of the female and young. They appear to be curved to a greater extent than is the case in those of *E. melitensis*, and are slightly more so than the tusk in the collection of the British Museum ascribed by Busk to *E. falconeri* and figured in the 'Transactions of the Zoological Society.'† The Cypriote specimens resemble the Maltese in the ivory being longitudinally grooved; this feature is quite noticeable in the young teeth, but generally becomes almost lost exteriorly in aged examples, though it is still very apparent on the inner layers of the ivory when the outermost has been removed. The one exception to this is found in the incisor (B.M., M. 8610), believed to be that of an adult female, in which I have been able to find no trace of this longitudinal channelling.

The central portion of a tusk of *E. melitensis* in the collection of the British Museum (No 44,322) measures 157 millims. ($6\frac{1}{4}$ inches) in circumference, which size is not equalled in any of the specimens from Cyprus ('Trans. Zool. Soc.,' vol. 9, Plate 11, fig. 13). The largest (B.M., M. 8614, Plate 22, fig. 8), includes almost the entire tooth except the proximal end and the extreme tip; it measures 297 millims. (12 inches) along the outer curve, its greatest circumference being 134 millims. Another piece (B.M., M. 8610) containing part of the pulp cavity, is 279 millims. (11 inches) long, and has a girth similar to the last-mentioned tooth. Both are yellowish-brown in colour and exceedingly brittle. Almost the whole of a further specimen (B.M., M. 8609) was secured, although in several pieces, and is considered to be that of a young male. The tip is somewhat worn on its upper surface, while the under surface for a short distance is excessively so, the centre of the tooth

* See Falconer, 'Pal. Mem.,' vol. 2, Plate 11, fig. 3.

† Vol. 6, Plate 52, fig. 48.

being exposed at this point. Another (B.M., M. 8609A), the distal extremity of which is missing, is evidently the tooth of a slightly older animal than the owner of the last mentioned. Of the two remaining tusks, one (B.M., M. 8610) I believe to be that of an adult, and the other (B.M., M. 8608, Plate 22, fig. 7), that of a young female; as may be seen from the following table of measurements they are both much shorter in comparison with their bulk than are the other specimens, and are also considerably more compressed laterally. The distal end of the latter is curiously worn round the whole of its circumference, the layers of ivory becoming lost as they approach the tip, the outer one disappearing at a distance of about 39 millims. from the point of the tooth.

The following table shows some measurements, given in millimetres, of the best preserved specimens of tusks obtained.

	(M. 8610.*)	(M. 8608.)	(M. 8614.)	(M. 8610.)	(M. 8609.)	(M. 8609A.)
Length along outer curve .	227	133	297	279	186	215
,, ,, inner ,, .	158	116	234	208	170	202
Greatest circumference . .	123	85	134	134	85	94
Greatest transverse diameter	28	23	37	34·5	21·5	25

Upper Molars.

Anterior Milk Molar (m.m. 2).—No specimens of the anterior milk molar (m.m. 2) were obtained, although the alveolus of this tooth is still to be seen in a portion of a left maxilla (B.M., M. 8617, Plate 22, fig. 3), which also contains a second milk molar (m.m. 3). In all probability this tooth resembled that of the Maltese species in being composed of three plates. The absence of a specimen for comparison with that of the other dwarf forms is all the more unfortunate on account of the examples from Malta being peculiar in having but a single conical root. Judging from the alveolus the same was the case in the present instance.

Penultimate Milk Molar (m.m. 3).—This milk molar is represented by two worn examples, one of these being still attached to a small portion of the left maxilla, and in a perfect state of preservation. This last (B.M., M. 8617) consists of five ridges, all worn, and a small posterior talon. Possibly there was also a further small anterior ridge, though this cannot be accurately ascertained on account of the advanced state of wear of both specimens. In the figured specimen (B.M., M. 8617, Plate 22, fig. 3), the four posterior plates of dentine are very little thicker than the intervening areas of cement; its greatest length is 39 millims. and its breadth 22 millims.

There are often both broad and narrow-crowned specimens of the different molars; the second milk molars obtained are of the former variety, and curiously enough the

* The measurements of this tusk are only approximate, it being still partially embedded in the matrix.

breadth of their crowns is not equalled by that of the single specimen obtained of the following upper m.m. 4 (B.M., M. 8603). It is also noteworthy that the above-mentioned specimens are considerably larger than the representatives of this milk molar from Malta, whereas, amongst the other teeth in the series, those from Cyprus are almost invariably smaller than, or barely attain, the size of the corresponding molars of *E. melitensis*.

Last Milk Molar (m.m. 4).—Only one tooth in the collection (B.M., M. 8603, Plate 22, figs. 4 and 4A) undoubtedly belongs to this position in the series. It is perfectly preserved and consists of seven plates, a small anterior ridge and a talon; the stout anterior fang is still present, and the fourth plate just coming into wear. The antero-posterior length of the tooth is 47 millims., and its height 34 millims., whilst the crown is of medium width, being 18·5 millims. at its widest.

First True Molar (m. 1).—It is often a matter of some difficulty to decide whether a tooth should rather be considered as a last milk molar or a first true molar. The two generally consisting of a similar number of plates, they must necessarily be chiefly distinguished by the difference in size, which is usually considerable, though, as this varies, large specimens of the milk tooth may approach very closely to the smallest examples of the succeeding molar. One seemingly constant characteristic in the first upper true molars is the very much greater height of their crowns compared with that of the last of the upper milk series. This difference is well shown by the specimens of these two molars figured in Plate 21, fig. 4A, and Plate 22, fig. 4A. The first true molar (B.M., M. 8602, Plate 21, figs. 4 and 4A) is a partially worn tooth somewhat damaged posteriorly. Its greatest height is 53·5 millims.; its antero-posterior length 49 millims., and the width of the crown 25 millims.; the number of plates of which it is composed is not accurately determinable, but was probably either seven or eight.

Second True Molar (m. 2).—This molar is represented by three specimens, the crowns of two of these being extensively worn, whilst that of the third (B.M., M. 8601) is but slightly invaded. Two views of one of the former (B.M., M. 8599) are given in Plate 22 (figs. 1 and 1A). The number of plates in this molar appears to vary from eight to ten.

Third True Molar (m. 3).—Three isolated molars in the collection are considered to be the last of the upper series. Two of these (B.M., M. 8591 and B.M., M. 8601) from their similar appearance are probably those of the same animal; both are tall and extremely narrow, in this respect resembling the lower molar, B.M., M. 8591 (Plate 22, figs. 6 and 6A), which might almost have been taken for one of the opposing teeth were it not that they differ somewhat in the state of wear of the crowns. The anterior ridge in each is almost entirely worn away, probably from pressure against the preceding teeth, for the fourth plate only just coming into use shows that these could not have progressed far along the alveolar cavity. The greatest width of the abraded surfaces of the crowns is only 25 millims., whilst the

height, taken behind the anterior fang, which is broken off in both cases, is 67 millims., and the total length 95 millims. in M. 8591 and 94 millims. in M. 8601, though these last measurements would have been slightly greater were the teeth quite perfect.

The third, a half-worn tooth (B.M. M. 8600, Plate 22, figs. 2 and 2A), is more robust than the two former specimens, its broader crown being 30·5 millims. across, and its greatest height 71 millims. The first plate has been worn away, and there is one, or possibly more, missing posteriorly. When compared with the last upper molars of *E. melitensis*, this, the largest of the three examples from Cyprus, is found to be appreciably smaller, though the pattern of its crown is somewhat similar to that of a tooth figured by Dr. FALCONER ('Pal. Mem.,' vol. 2, Plate 11, figs. 1 and 1A). However, this last is larger, its greatest height being 84 millims., and the breadth of the crown 37 millims.; these measurements in the Cypriote specimen being, as already mentioned, respectively 71 millims. and 30·5 millims. Larger still, both in height and width, are a pair of last molars of this Maltese species situated in a portion of the upper jaw, and differing further in showing a slight central expansion of the plates of dentine.*

Lower Molars.

In the lower molars the plates before, and at the time of, coalescing, lie in a slanting position, sloping downwards and backwards from their upper aspect. The anterior plates very soon assume a vertical position, and later incline forwards, so that the lower edges are well in advance of their worn surfaces, thus reversing their original direction. As the tooth advances and the crown becomes more worn, a similar alteration is carried out in all the successive ridges. This also takes place in much the same manner in the molars of the upper jaw.

Anterior Milk Molar (m.m. 2).—As already mentioned, not a single specimen of this tooth was obtained.

Penultimate Milk Molar (m.m. 3).—A perfectly preserved worn example of this molar was obtained (B.M., M. 8597, Plate 21, fig. 5), besides which an unworn tooth (B.M., M. 8623), consisting of four plates, ought, most probably, to be referred to this position in the series. Like the corresponding teeth of the upper jaw already described, the crown of the former is wide, being 18 millims. across, while its antero-posterior length is 35 millims. An undamaged specimen of this milk molar of *E. melitensis* (B.M., 44,226) in the British Museum collection† is 35 millims. in length, and only 15 millims. wide.

Last Milk Molar (m.m. 4).—This tooth is represented in the collection by six well-preserved specimens, as well as by several others more doubtfully referred to this position in the series. The almost entire left mandibular ramus of a young individual

* 'Zool. Soc. Trans.,' vol. 9, Plate 4, fig. 1.

† Figured 'Zool. Soc. Trans.,' vol. 9, Plate 1, figs. 8 and 8A.

(B.M., M. 8595, Plate 22, fig. 5A) was obtained; anteriorly this is somewhat elongated, being 45 millims. from the front of the symphysis to the edge of the half-worn tooth it contains. There is a single foramen situated below and in front of the molar, but this number, or position, is not constant, for in more than one jaw-bone in the collection there are two of these openings present.

A drawing is given (Plate 22, fig. 5) showing the crown view of the tooth contained in the ramus just noticed (B.M., M. 8595). It consists of eight plates, the sixth of which, very slightly abraded, is only just coming into wear, and at its hinder end is a well-defined talon. Its total antero-posterior length is 56 millims., its height, measuring from the edge of the fourth plate, 37 millims., while the greatest width of the crown is 17·5 millims.

Like the other worn examples of the last milk molar, this tooth is strongly convex inwards, the plates consequently running in an oblique direction; this seems more strongly marked than in the corresponding teeth from Malta. The three anterior ridges are much worn, but there is no simultaneous mesial expansion of the plates of dentine and their surrounding bands of enamel such as occurs in many of the similarly worn molars of *E. melitensis*. The intervening spaces filled with cement are narrow, which is often the case in teeth in an advanced state of wear. Dr. LEITH ADAMS has shown* that this diminution of the areas of cement may be due to their rapidly decreasing in thickness from the top of the tooth downwards. However, that the cement does not always so decrease in the teeth of the Cypriote species is shown in the drawing of a section (B.M., M. 8605, text-fig. 1) in which it maintains an almost uniform thickness until an extremely low level is reached. This figure is interesting when compared with that given by Dr. LEITH ADAMS,† from which it differs markedly. The second section of a specimen from Cyprus (B.M., M. 8618, Plate 21, fig. 6) more closely resembles the one from Malta, and it seems probable that the width and extent of the cement areas is not constant in the molars of either the Maltese or Cypriote species, though it is more usual to find those of the latter nearly equalling in width the plates of dentine.

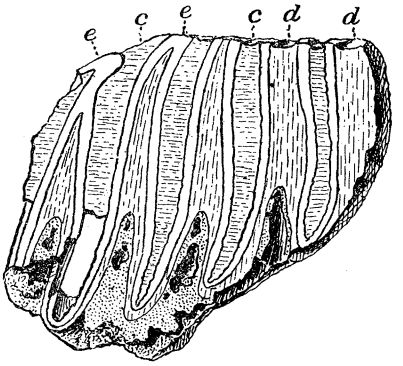


Fig 1.—Section of upper molar. B.M., M. 8605 (nat. size), *c*, cement; *d*, dentine; *e*, enamel.

Two isolated last molars of the lower milk series (B.M., M. 8604) probably belonged to one individual, for they agree very closely in general appearance, size, and stage of wear; in both the last plate is just coming into use. They still retain their roots, which are long, the teeth being about 45 millims. in height; the crowns are broad, measuring 20 millims. from edge to edge at their widest. They

* 'Zool. Soc. Trans.,' vol. 9, p. 6.

† *Op. cit.*, Plate 2, fig. 6.

show a slight indentation on the talons, which, considering their worn condition, may have been caused by pressure from the succeeding teeth pushing up from behind. Apparently two further examples, B.M., M. 8604 and B.M., M. 8621, likewise belonged to a single animal; in these the fangs have almost completely disappeared, thus materially altering the height of the teeth, which in this instance is only about 30 millims., showing a difference of 15 millims. from Nos. M. 8604 and M. 8621 just described. Compared with the above a corresponding molar of *E. melitensis* (B.M., 49,239) is slightly narrower in the crown, though its antero-posterior length is greater than that of the first described m.m. 4 from Cyprus (B.M., M. 8595), being 57·5 millims., although part of the front ridge is missing.

A worn tooth attached to an imperfect left mandibular ramus (B.M., M. 8597), and several unworn specimens showing an anterior flattening of the crown caused by pressure against their predecessors, are all referred to the third lower milk molar (m.m. 4).

First True Molar.—Several good specimens of this tooth are included in the collection. Two mandibular rami, each containing a first molar, are evidently those of the same animal; that of the right side (B.M., M. 8590, Plate 21, fig. 1A) is almost perfect, while that of the left (B.M., M. 8592) is considerably more damaged.

The tooth (B.M., M. 8590, Plate 21, figs. 1 and 1A) contained in the ramus just described, apparently consists of eight plates and is somewhat worn away anteriorly, although the enamel of the sixth plate is only slightly abraded and that of the seventh still concealed by its covering of cement. The crown is of medium width, measuring 22·5 millims. at its broadest. Considering the position and state of wear of this tooth, it might have been expected that the following one would be in a fairly advanced stage of growth; however, when the specimen was found, the cavity behind, which is separated by a septum of bone from the first molar, contained only a partially developed tooth plate 19 millims. wide and 14 millims. in height.

The specimen (B.M., M. 8596) shown in Plate 21, figs. 2 and 2A, is of special interest, being the only one in which the entire symphysis is preserved. The two anterior portions of the jaw are not known to have been found in connection, but it can hardly be doubted that they originally belonged to a single mandible. As indicated in the drawing they were discovered already broken off just behind the much-worn molar contained in each. It is a matter of some doubt whether these are first or second true molars, for, being considerably worn away anteriorly and only the five last ridges remaining, it is impossible to discover what was the original number of plates of which the teeth were composed. The greatest width of the crowns is 25 millims., almost equalling that of an example of the second lower molar (B.M., M. 8588, Plate 21, fig. 3), but from the size of this portion of the mandible I am inclined to believe that they are unusually broad-crowned examples of the first true molar. The areas of cement are wide and the ridges run very obliquely owing to the curvature of the teeth; these are much raised above the level of the alveolar border

and, viewed from the side, the plates are seen to be greatly reflexed. The beak is short and deflected, and the symphysis broad and of considerable antero-posterior length, measuring 32 millims. from its inner margin to the point of the beak. However these last particulars are not of much value, Dr. Leith Adams having shown* to how great an extent individual differences occur in the anterior extremity of the mandible in the larger elephants.

A lower m. 1 of *E. melitensis* (B.M., 44,265) figured by Dr. Leith Adams† agrees in its general proportions with the corresponding molars of *E. cypriotes* though differing somewhat in its crown pattern. This shows the persistence of the separation into islands of the dentine and surrounding enamel, this being more strongly marked than in specimens from Cyprus.

Second True Molar (m. 2).—A fine specimen was obtained of a right mandibular ramus (B.M., m. 8588, Plate 21, figs. 3 and 3a) which, though considerably larger, in shape resembles the example containing a first true molar already described (B.M., m. 8590). It contains a second true molar with all but the last two ridges in wear, while behind, and still separated from this by the bony septum, may be seen some of the germ plates of the succeeding tooth (Plate 21, figs. 3 and 3a). The front of this worn molar is missing; its present antero-posterior length is 86 millims., the height at its hinder end 57 millims., and the greatest width of the crown 23·5 millims. The inner half of the cement area connecting what are probably the third and fourth plates is hollowed, thus exposing the enamel of the latter to a depth of about 4·5 millims. and showing it to have a smooth and unplicated surface; the same is apparent in the enamel of the two teeth (B.M., m. 8596) figured in Plate 21, fig. 2.

Two other second lower molars, both of the left side, are among the collection, one (B.M., m. 8593) only partially worn, has a somewhat broad crown and apparently consisted of nine plates, though possibly there may have been an additional one posteriorly; the height of this tooth is 45 millims. The other specimen (B.M., m. 8593a), of which the anterior end is broken off, is a much older tooth, having all except the three last ridges in wear.

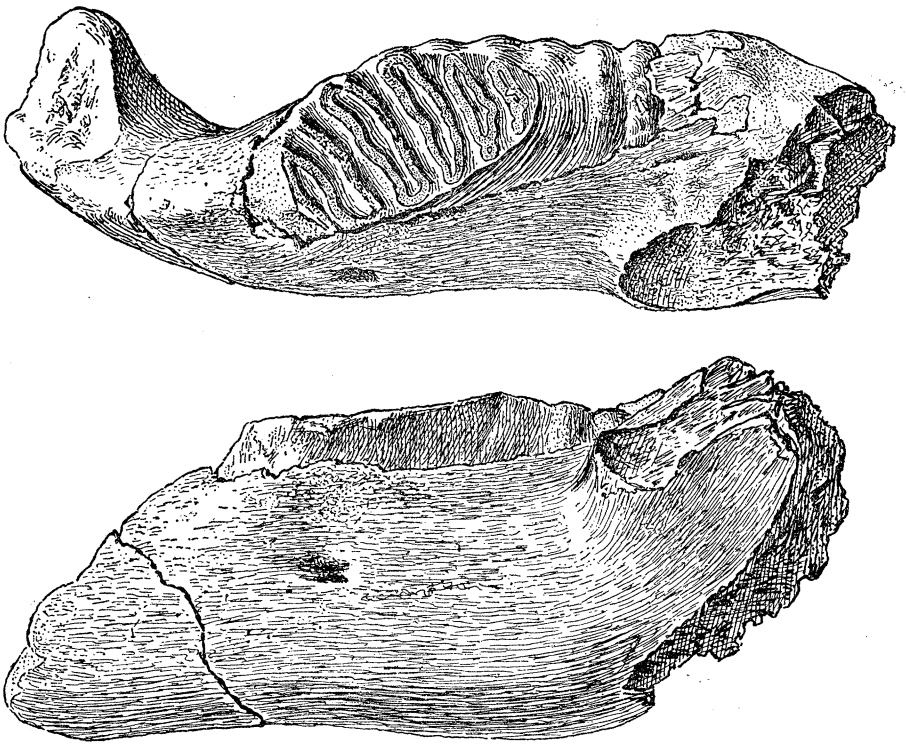
Last True Molar (m. 3).—Only two specimens were obtained of molars believed to be the ultimate ones of the lower series, on account of their superior size and greater number of ridges compared with the second true molars mentioned above. These are in a perfect state of preservation, both being of the left side and in much the same condition of wear. One (B.M., m.8591, Plate 22, figs. 6 and 6a), an isolated tooth, is very narrow, the greatest width of the crown being 26 millims., while that of the other specimen (B.M., m. 8589) is 29 millims. Allowing for one ridge having been partially worn away anteriorly in both cases, the former consists of thirteen plates and the latter of twelve.

The ramus in which this last is situated (text-figs. 2 and 3) is broken off just behind

* 'Monograph on the British Fossil Elephants,' London, 1877–81, Part 2, pp. 134–139, figs. 4–32.

† 'Zool. Soc. Trans.,' vol. 9, Plate 5, fig. 2.

the molar, exposing a septum of bone overlying the posterior end of the tooth. This shows on its hinder surface a smooth, circular indentation which it was thought, at first sight, might have been caused by an advancing tooth, in which case the specimen in question would necessarily be the penultimate instead of ultimate molar. However, in view of its early stage of wear—there being six plates still untouched—it is improbable that this depression was so caused. The late development of the tooth destined to take the place of the one in use is well shown by several examples in the collection and it seems that frequently, if not invariably, almost the entire crown of a molar is in wear whilst its successor is as yet only partially formed. One of these



Figs. 2 and 3.—Crown and side views of left mandibular ramus containing a last true molar, B.M., M. 8589 (two-thirds nat. size).

specimens is that of an imperfect left mandibular ramus containing a somewhat damaged last milk molar, which very possibly had the total number of its ridges in wear (B.M., M. 8597). Behind this is a single germ plate of the succeeding tooth, its evident isolation and small size indicating that it had been in existence but a very short time. The right mandibular ramus (B.M., M. 8590, Plate 21, fig. 1) with a first true molar in position, to the rear of which is a large cavity enclosing a small germ tooth plate, has already been referred to (p. 354). A second true molar situated in another right mandibular ramus (B.M., M. 8588, Plate 21, figs. 3 and 3A) has the surfaces of all but the two last ridges abraded from use, nevertheless the following

tooth is represented in the cavity behind by only two germ plates not yet cemented together.

Compared with those of *E. melitensis* the two above-mentioned last lower molars of *E. cypriotes* are somewhat smaller, both in antero-posterior length and in the width of their crowns. Dr. LEITH ADAMS calculated the entire length of one of the former* to have been 5·4 inches and also describes and figures another 6 inches in length (= 151 millims.).† The same measurement in the Cypriote specimens cannot be taken absolutely correctly but they had approximately a total length of 125 millims. (in B.M., M. 8589) and 114 millims. (in B.M., M. 8591) respectively.

Limb Bones.—The only limb bone obtained that has been determined as that of *E. cypriotes* is the distal extremity of a femur, which is unfortunately too imperfect to admit of a description being given.

Conclusions.

Although from an examination of the teeth alone conclusive evidence cannot perhaps be deduced as to the relationship of the Cypriote elephant to other forms, still several interesting and suggestive points may be noticed. The characters of the dentition of *E. cypriotes* do not point to any connection with the recent Asiatic species, from which this pigmy form differs markedly in the lowness of its ridge formula and in the simple construction of the enamel of the molars.

Undoubtedly there is a strong resemblance between the teeth of *E. cypriotes* and those of the Maltese and Sicilian forms, more especially *E. melitensis*, but this likeness is very apt to be over-estimated owing to the respective dwarf proportions of these island races. The Maltese pigmy species have been considered to be most closely allied to *E. antiquus* and *E. africanus*.‡ On the other hand it seems more probable that *E. cypriotes*, which so far as available material is concerned shows no close affinity to the African species, is rather connected with *E. antiquus* and *E. meridionalis*, agreeing with this last in the lowness of its ridge formula,§ though differing in wanting the persistence of the strongly marked digitation of the plates which is usually found in the molars of that elephant.

In this connection it is interesting to note that from the characters of the carpal and tarsal bones (the only remains known) of *E. lamarmoræ*, the dwarf elephant of Sardinia, Dr. C. I. FORSYTH MAJOR considers it to have been most closely allied to *E. meridionalis*.‖ It is perhaps also noteworthy that the remains of *E. cypriotes*, as well as those of *Hippopotamus minutus*, appear to vary but little in size, whereas in

* Figured in FALCONER, 'Pal. Mem.,' vol. 2, Plate 12, figs. 4 and 4A.

† 'Zool. Soc. Trans.,' vol. 9, pp. 30 and 31, Plate 6, figs. 1 and 1A.

‡ See 'Cat. Foss. Mamm., Brit. Mus.' R. LYDEKKER, 1886, Part 4, p. 138.

§ The agreement in this respect with *E. meridionalis* has already been pointed out by Dr. LEITH ADAMS in the case of the Maltese dwarf species, 'Zool. Soc. Trans.,' vol. 9, p. 112.

‖ "Die Tyrrhenis," 'Kosmos,' vol. 7, 1883, p. 7.

the case of the dwarf species of elephants and hippopotami from Malta and Sicily this occurs to a considerable extent, so much so in the case of the latter that molars may be found of intermediate sizes connecting *H. melitensis*,* *H. pentlandi* and *H. amphibius*.†

Since writing the first notice of *E. cypriotes* I have come to the conclusion that the average number of plates in the true molars is somewhat less than was at first supposed, therefore the corrected ridge-formula, exclusive of talons, would stand as follows: $\div, \frac{5}{5}, \frac{7-8}{7-8}, \frac{7-8}{7-8}, \frac{8-9}{8-9}, \frac{11-12}{11-12}$.

This is slightly lower than that of *E. melitensis* which Dr. Leith Adams, later than Dr. Falconer and after examining a further large amount of material, gives as $\frac{3}{3}, \frac{5}{5}, \frac{8-9}{8-9}, \frac{8-9}{8-9}, \frac{10}{10}, \frac{12}{12}$.

The marked lateral compression of the tusks of *E. cypriotes* (Plate 22, fig. 9), which is a constant character in all the specimens so far obtained, would in itself be almost sufficient to distinguish this from the other pigmy elephants of the Mediterranean region. Specimens of the penultimate and last milk molars (m.m., 3 and 4) are somewhat larger than those of *E. melitensis*, but from the size of the true molars of these species it is believed that the latter must have been slightly the larger animal of the two. Compared with examples from Malta in the collection of the British Museum, the isolated tooth plates of *E. cypriotes* appear to be smoother and more faintly sculptured both anteriorly and posteriorly and also less strongly digitated, thus causing the generally simpler pattern of the crowns of the worn molars.

Presupposing that the dwarf elephants of the Mediterranean region were all derived from a common ancestor, the simpler construction of the molars of *E. cypriotes* might be explained on the assumption that this species was isolated and subsequently differentiated from the parent stock, prior to a similar fate overtaking the Maltese and Sicilian races. This is borne out by the fact that *E. cypriotes* lived contemporaneously with *H. minutus*, a more generalised and primitive form‡ than either *H. pentlandi* or *H. melitensis*, the associates of the pigmy elephants of Malta and Sicily.

The geological evidence, as distinguished from the palæo-zoological, also supports this theory, for it appears probable that Cyprus became an island at an early period. On consulting the Admiralty Chart it will be found that there is no submerged bank indicating a recent connection with the neighbouring mainland, but that, on the contrary, the 200-fathom line is reached within a very short distance from the land round the whole of the coast line. This hypothesis is likewise strengthened by the

* Dr. Forsyth Major, 'Geol. Mag.,' (IV.), vol. 9, 1902, p. 198.

† 'Cat. Foss. Mamm., Brit. Mus.,' Part II., 1885, p. 292.

‡ See Dr. Forsyth Major, 'Zool. Soc. Proc.,' vol. 2, 1902, p. 107.

characteristics of the recent terrestrial fauna and the avifauna, both of which groups include a number of distinct races peculiar to the island. Further, as Dr. Forsyth Major* has already pointed out, Kobelt† was led to the same conclusion from his investigations of the recent mollusca of Cyprus. Of the bearing of the flora on this question I cannot s] ak, but I believe that here also are included a number of forms confined to this loca ty.

On the other hai ' Malta appears to have been, comparatively speaking, quite recently connected w h Sicily, and consequently with Italy to the north, and southwards with the nort of Africa. The actual submerged lands which formed the highways between these different points were discovered by Admirals Smyth and Spratt and a chart showing their position and present depth below the sea was included by the latter in a paper on the Maltese bone-caves.‡ This proof of the former continuity of land between Malta and Sicily may well account for the occurrence of the same species of elephant—*E. mnaidriensis*—and also of hippopotamus—*H. pentlandi*—in the cavern deposits of both islands.

I should like to take this opportunity of expressing my sincere thanks to all those who have done so much to help me, both whilst in Cyprus and when working out some of the results of my excavations in the island. These are more especially due to Mrs. Clarence Wodehouse, with whom I went to Cyprus, to Dr. Henry Woodward, F.R.S., to the members of the Government Grant Committee for enabling me to continue my explorations, and to Dr. Arthur Smith Woodward, F.R.S., for so kindly giving me access to specimens in the collection of the British Museum; also to Dr. C. I. Forsyth Major and Dr. C. W. Andrews for valuable assistance and advice whilst working out my collections.

* 'Zool. Soc. Proc.,' vol. 2, 1902, p. 110.

† "Studien sur Zoogeographie," II, 'Die Fauna der Meriodionalen Subregion,' pp. 337–339, 1898.

‡ 'Geol. Soc. Quart. Journ.,' vol. 23, 1867, p. 293.

EXPLANATION OF PLATES 21 AND 22.

Plate 21.

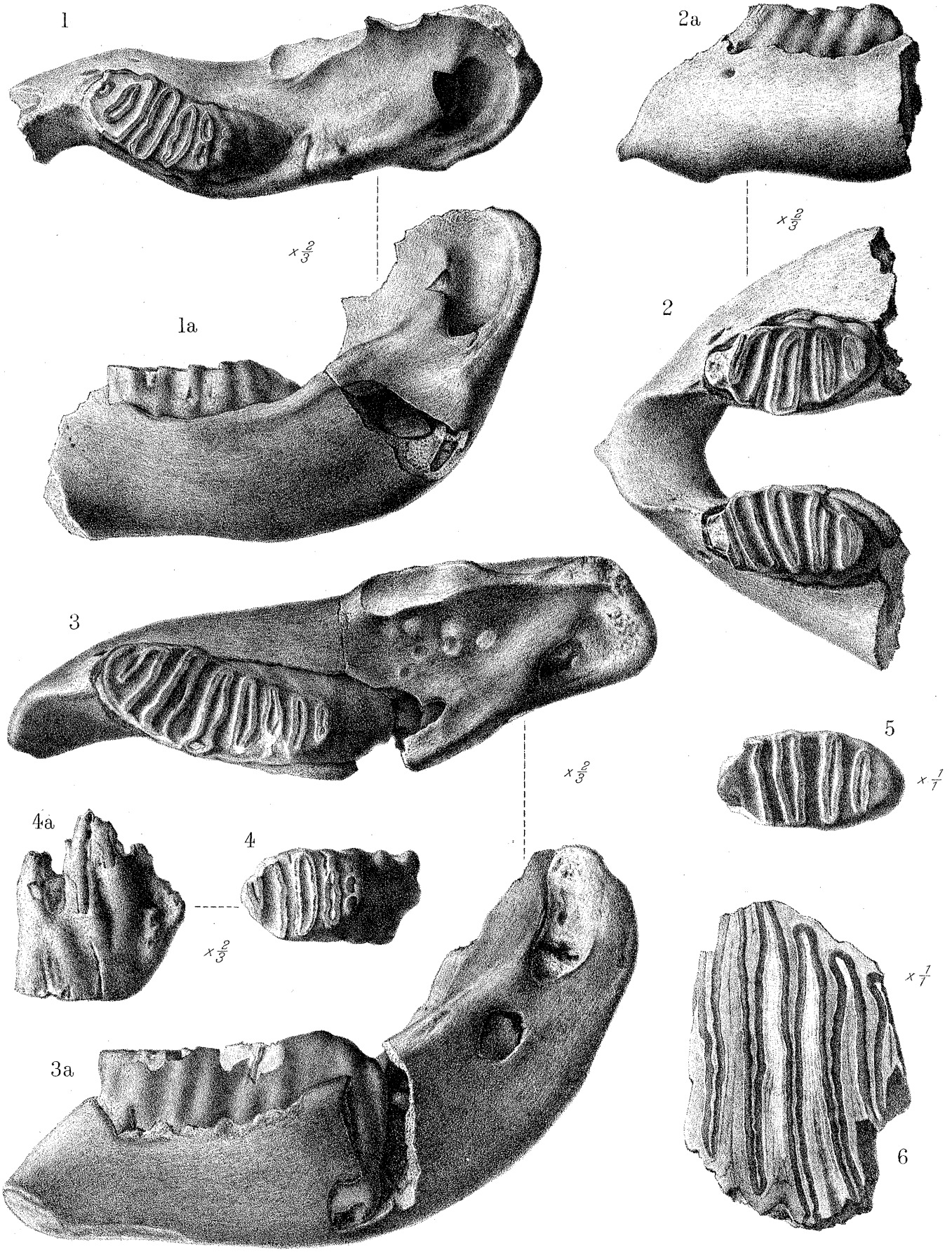
Fig. 1. Crown view of first lower true molar in right mandibular ramus. B.M., M. 8590, p. 354.
Fig. 1a. Side view of ditto.
Fig. 2. Crown view of portion of mandible with two first (?) true molars. B.M., M. 8596, p. 354.
Fig. 2a. Side view of ditto.
Fig. 3. Crown view of second true molar in right mandibular ramus. B.M., M. 8588, p. 355.
Fig. 3a. Side view of ditto.
Fig. 4. Crown view of upper first true molar. B.M., M. 8602, p. 351.
Fig. 4a. Side view of ditto.
Fig. 5. Crown view of penultimate lower milk molar. B.M., M. 8597, p. 352. Natural size.
Fig. 6. Section of portion of upper true molar. B.M., M. 8618, p. 353. Natural size.

All figures are two-thirds natural size except Figs. 5 and 6 which are natural size.

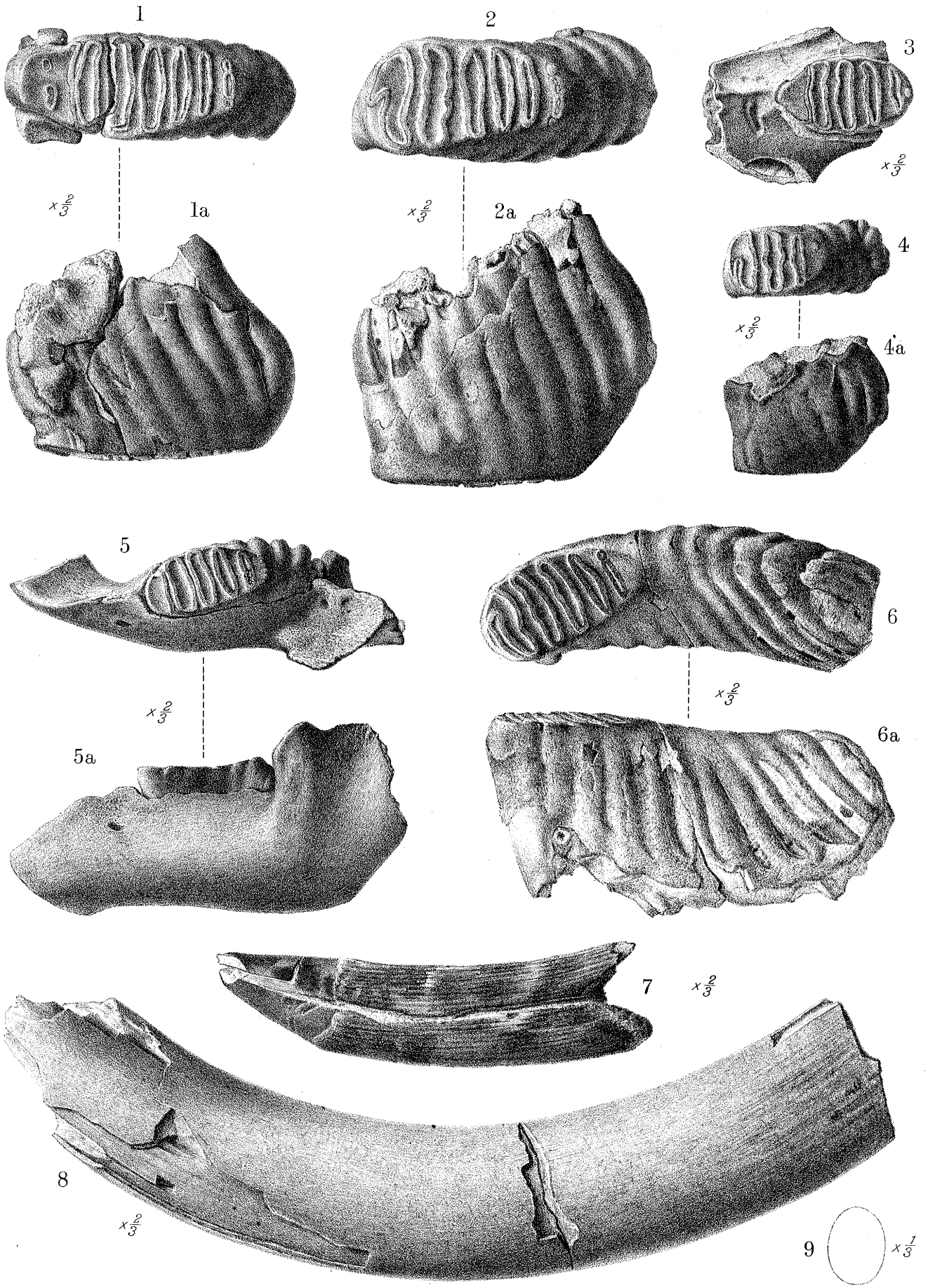
Plate 22.

Fig. 1. Crown view of second upper true molar. B.M., M. 8599, p. 351.
Fig. 1a. Side view of ditto.
Fig. 2. Crown view of third upper true molar. B.M., M. 8600, p. 352.
Fig. 2a. Side view of ditto.
Fig. 3. Crown view of penultimate milk molar with portion of left maxilla, showing alveolus of anterior milk molar. B.M., M. 8617, p. 350.
Fig. 4. Crown view of last upper milk molar. B.M., M. 8603, p. 351.
Fig. 4a. Side view of ditto.
Fig. 5. Crown view of last milk molar in left mandibular ramus. B.M., M. 8595, p. 353.
Fig. 5a. Side view of ditto.
Fig. 6. Crown view of last lower true molar. B.M., M. 8591, p. 355.
Fig. 6a. Side view of ditto.
Fig. 7. Immature incisor ♀. B.M., M. 8608, p. 350.
Fig. 8. Incisor ♂. B.M., M. 8614, p. 349.
Fig. 9. Section of incisor. One-third natural size.

All figures two-thirds natural size except Fig. 9 which is one-third natural size.



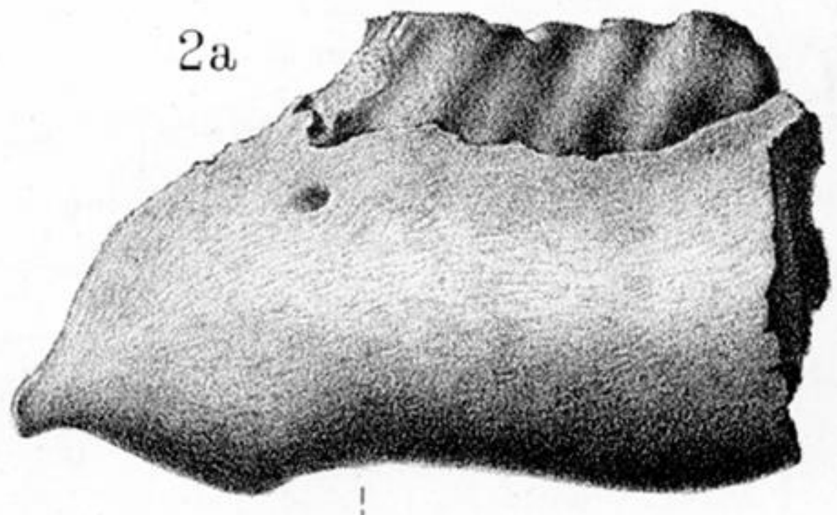
A. H. Searle del. et lith. West, Newman imp. London.

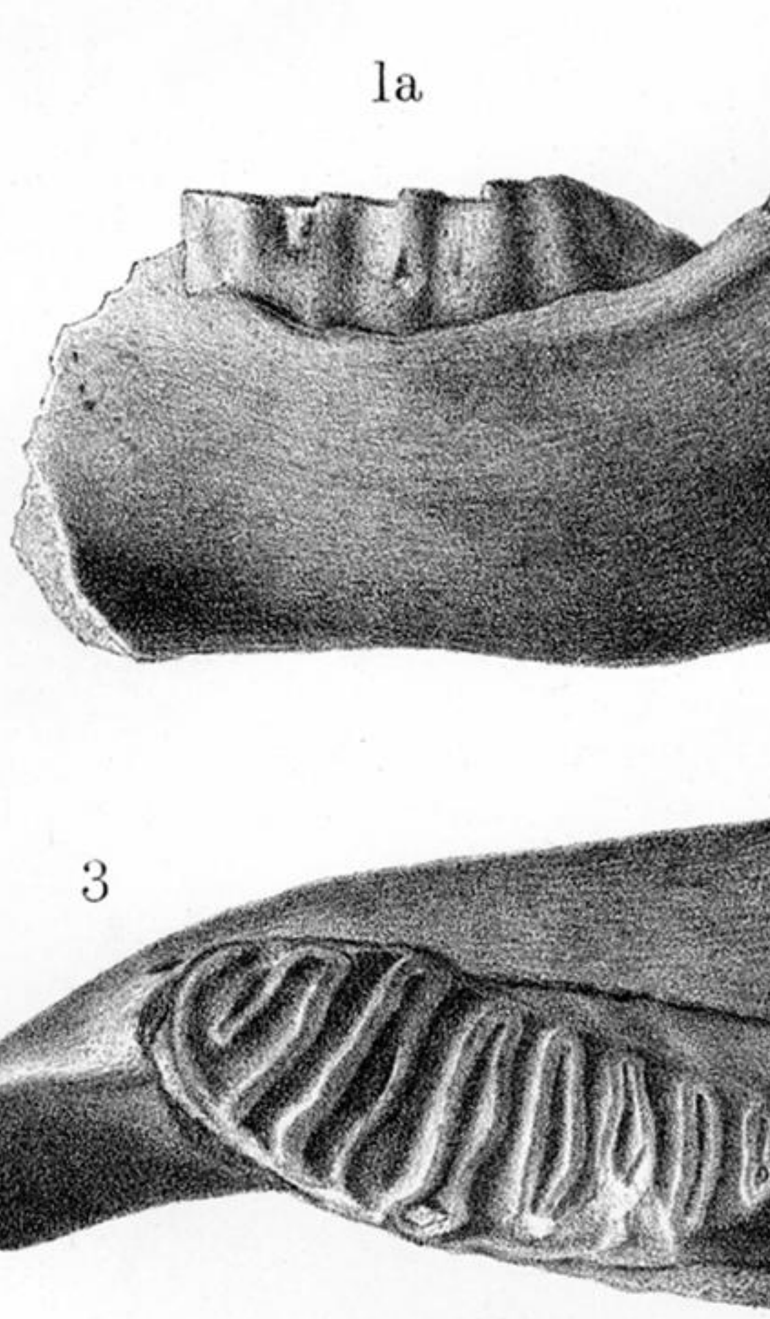


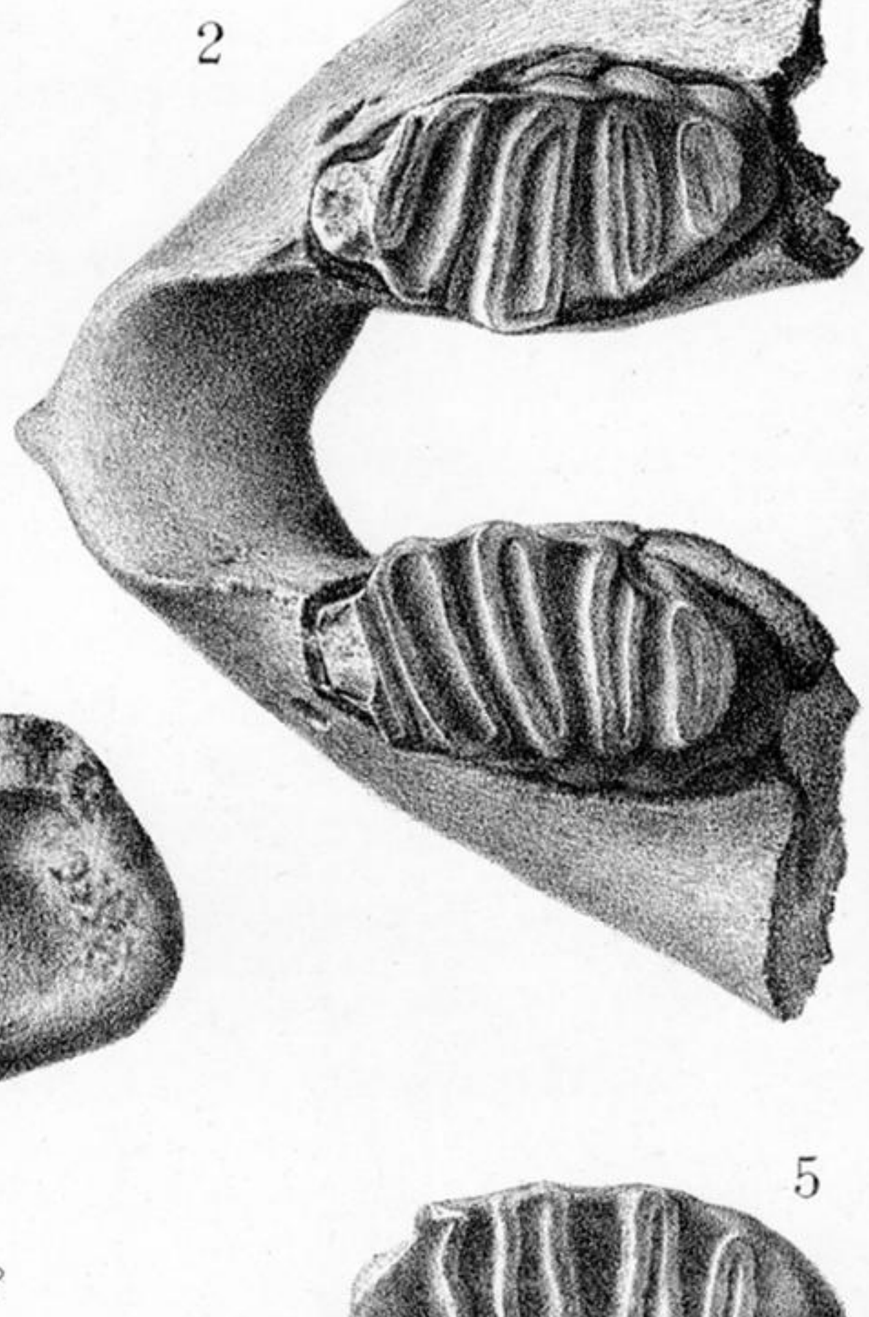
A. H. Searle del. et lith.

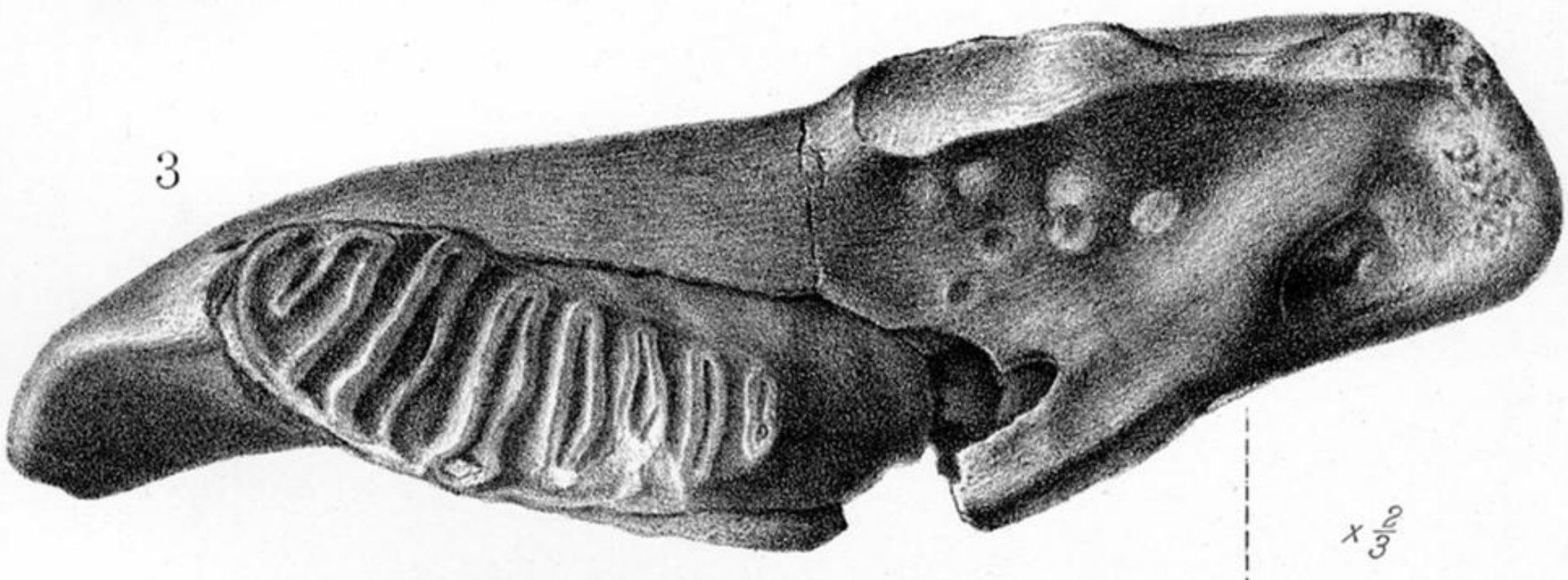
West, Newman imp. London.

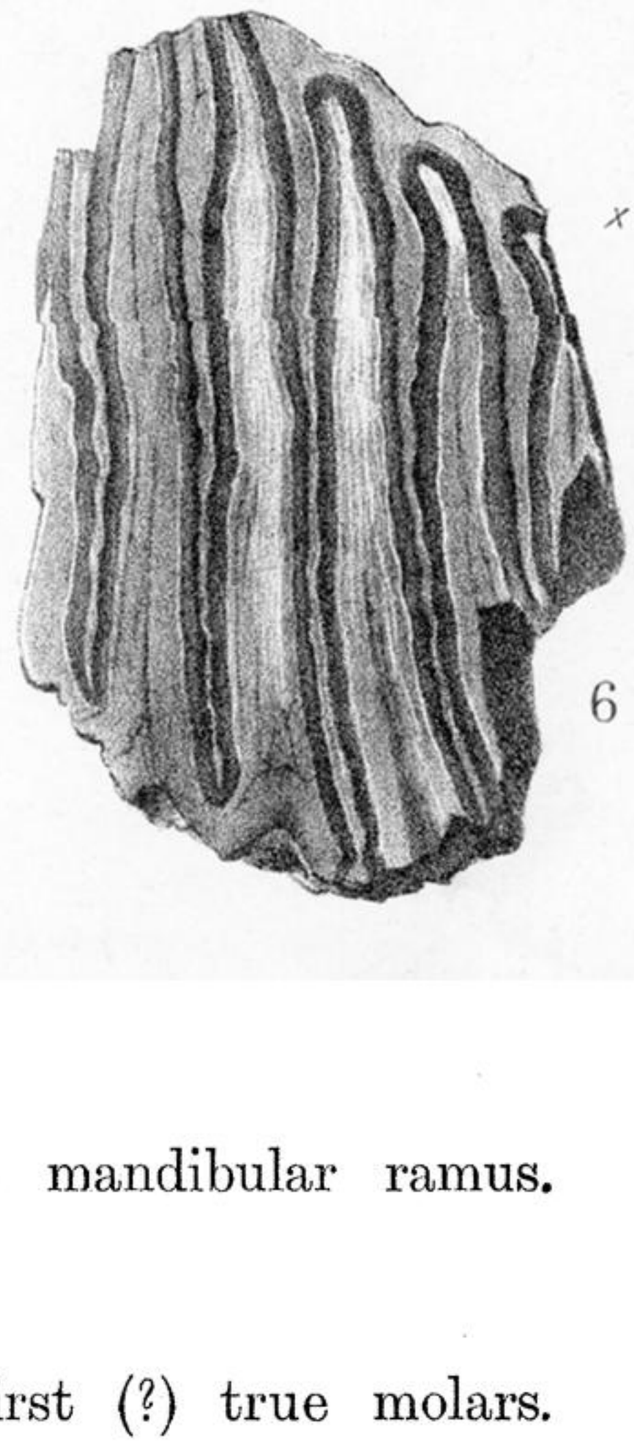
PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B BIOLOGICAL SCIENCES











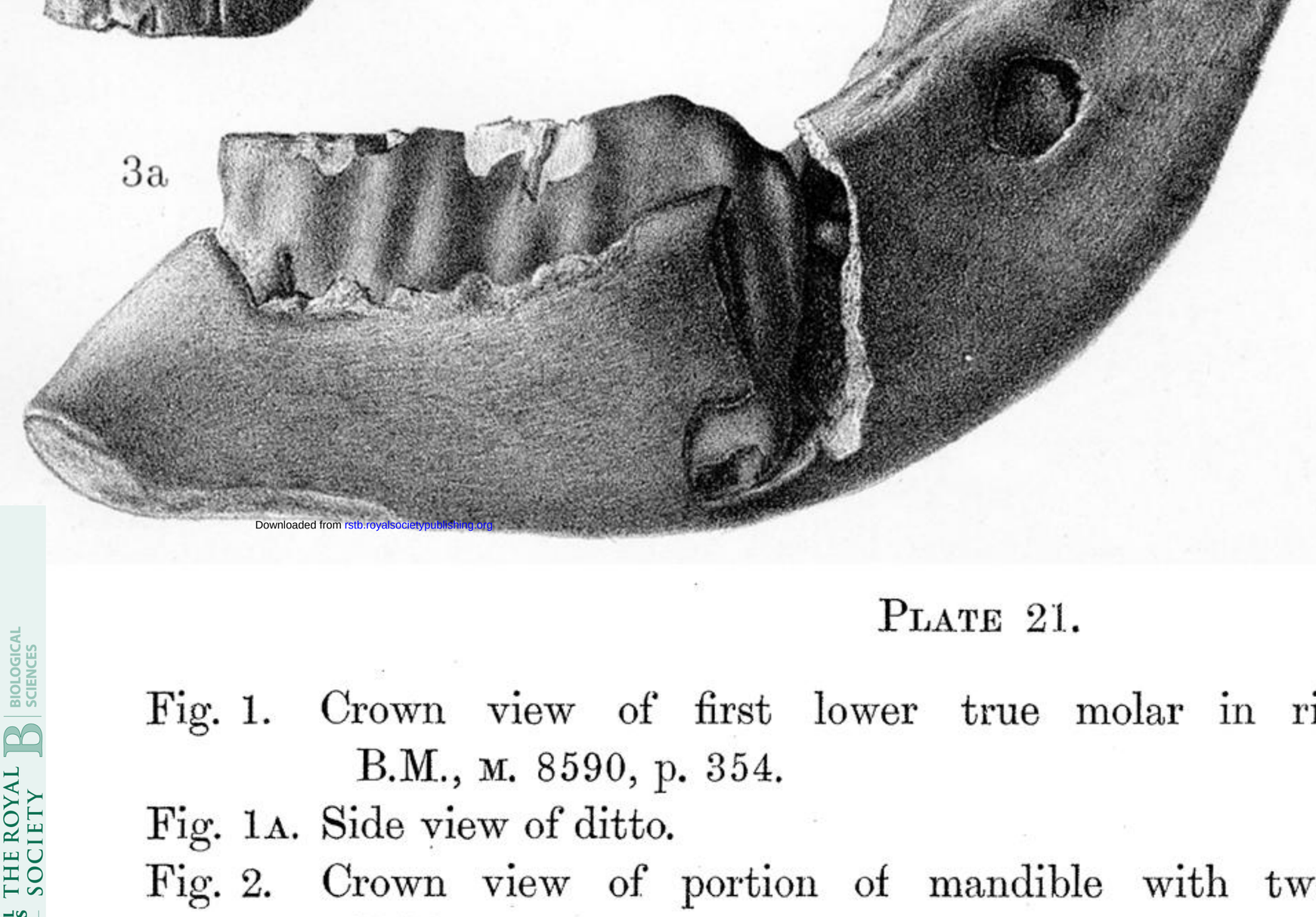


Plate 21.

Fig. 1. Crown view of first lower true molar in right mandibular ramus. B.M., M. 8590, p. 354.

Fig. 1A. Side view of ditto.

Fig. 2. Crown view of portion of mandible with two first (?) true molars. B.M., M. 8596, p. 354.

Fig. 2A. Side view of ditto.

Fig. 3. Crown view of second true molar in right mandibular ramus. B.M., M. 8588, p. 355.

Fig. 3A. Side view of ditto.

Fig. 4. Crown view of upper first true molar. B.M., M. 8602, p. 351.

Fig. 4A. Side view of ditto.

Fig. 5. Crown view of penultimate lower milk molar. B.M., M. 8597, p. 352. Natural size.

Fig. 6. Section of portion of upper true molar. B.M., M. 8618, p. 353. Natural size.

All figures are two-thirds natural size except Figs. 5 and 6 which are natural size.

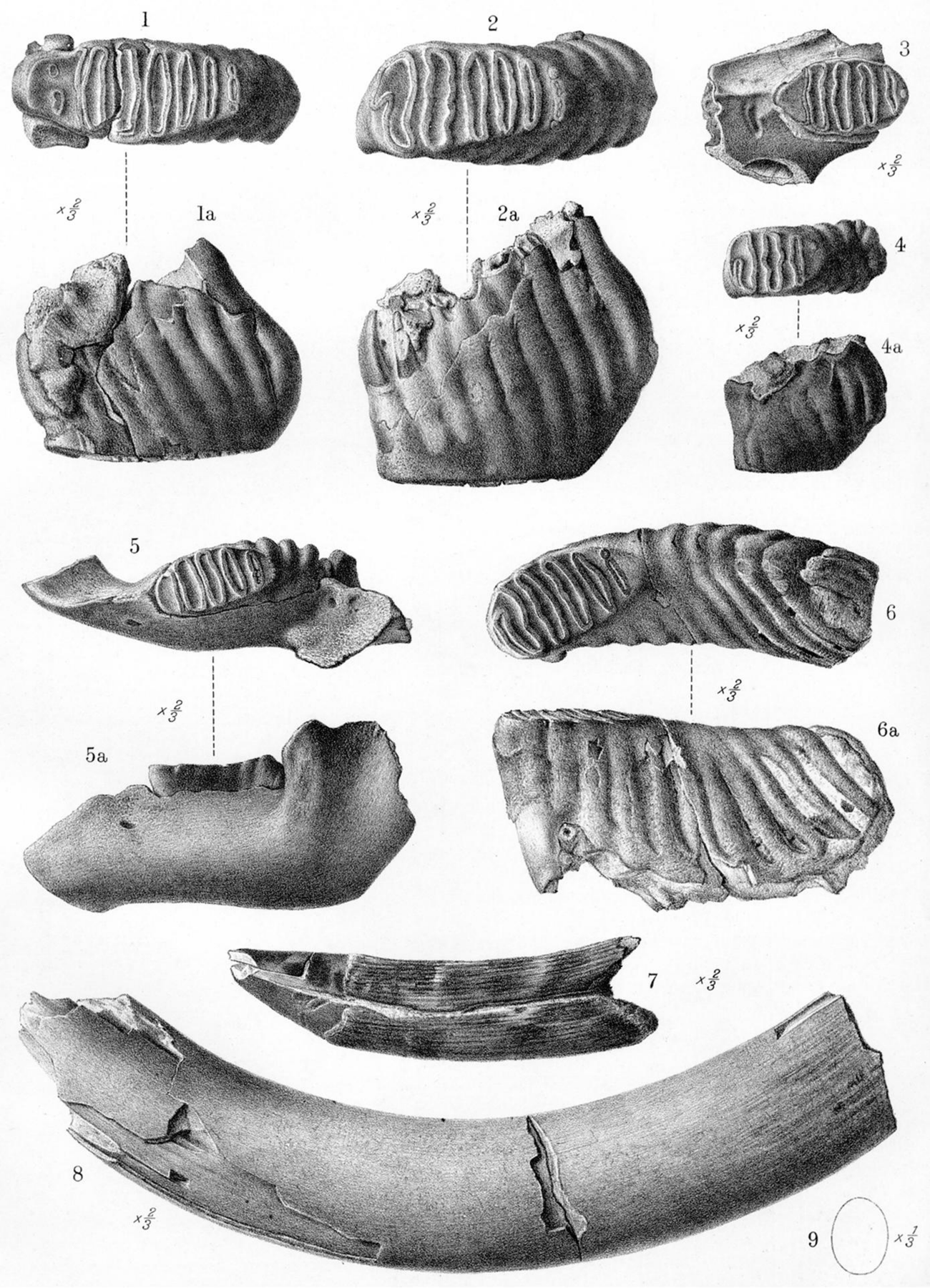


Plate 22.

Fig. 1. Crown view of second upper true molar. B.M., M. 8599, p. 351.
Fig. 1A. Side view of ditto.
Fig. 2. Crown view of third upper true molar. B.M., M. 8600, p. 352.
Fig. 2A. Side view of ditto.
Fig. 3. Crown view of penultimate milk molar with portion of left maxilla, showing alveolus of anterior milk molar. B.M., M. 8617, p. 350.
Fig. 4. Crown view of last upper milk molar. B.M., M. 8603, p. 351.
Fig. 4A. Side view of ditto.
Fig. 5. Crown view of last milk molar in left mandibular ramus. B.M., M. 8595, p. 353.
Fig. 5A. Side view of ditto.
Fig. 6. Crown view of last lower true molar. B.M., M. 8591, p. 355.
Fig. 6A. Side view of ditto.
Fig. 7. Immature incisor ♀. B.M., M. 8608, p. 350.
Fig. 8. Incisor ♂. B.M., M. 8614, p. 349.
Fig. 9. Section of incisor. One-third natural size.

All figures two-thirds natural size except Fig. 9 which is one-third natural size.