

CAMELS OF THE FOSSIL GENUS CAMELOPS.

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One of the most interesting revelations furnished us by the study of vertebrate paleontology is that our country was inhabited, still after the beginning of the Pleistocene, by camels belonging to more than one genus and to several species. Our knowledge of these species has been meager enough, although the number named has not been so restricted. Most of these species have been founded on such scanty materials that comparisons among them could hardly be made with any accuracy or certainty. In 1898¹ Doctor J. L. Wortman considered the materials then available, and he ended by including under the name *Camelops kansanus*, given by Leidy in 1854, not only the type of this species, but likewise Leidy's species *Megalomeryx niobrarensis* and his Californian *Auchenia hesterna*, Cope's *Holomeniscus sulcatus*, and the specimens from Oregon and Texas which the author just mentioned had described under the name of *Holomeniscus hesternus*, and Cragin's *Auchenia huerfanensis*, found in Colorado. *Camelops kansanus* had itself been based on a fragment of the snout, consisting of portions of the left premaxilla and maxilla, with the root of an incisor and a part of the socket of a canine. This specimen had been found in 1854, or previously, in what was described as "gravel drift," somewhere within the present State of Kansas.

Happily, these camels are beginning to emerge from the obscurity which has enveloped them. That wonderful deposit of remains of Pleistocene vertebrates, the asphalt beds of Rancho La Brea, near Los Angeles, California, has furnished to Doctor John C. Merriam a few complete skulls and the greater part of the skeleton of one, possibly of two, species of camels. The skulls are described by him in a paper recently issued.² Two complete skulls are figured, of which one is identified as representing the species which Leidy called *Auchenia hesterna*, the other as being near this species and probably belonging to it. Merriam accepts Wortman's conclusion that these camels are

¹ Bull. Amer. Mus. Nat. Hist., vol. 10, p. 93.

² Univ. California Publ., Geol., vol. 7, pp. 305-323, figs. 1-11.

generically distinct from *Auchenia* and with him accepts Leidy's name *Camelops*.

The present writer has recently had occasion to study some of the materials belonging to Pleistocene camels. In the United States National Museum is Leidy's type of his *Megalomeryx niobrarensis*, a fragment of the left side of the lower jaw containing a much worn second premolar; likewise the little worn right lower second molar identified as belonging to the same species.¹ In looking for other materials the writer found Cragin's type of his *Auchenia huerfanensis*. This was discovered in 1884 in beds of volcanic ashes, along a small tributary of the Huerfano River, in Huerfano County, Colorado, by the geologist Mr. R. C. Hills, of Denver. It had afterwards been for some time deposited in the Colorado Scientific Society, and while there had been described by Professor F. W. Cragin. Later it was presented, together with a considerable quantity of other fossil materials, by Hills to the United States National Museum. Here it now has the catalogue number 7819. It presents a part of the right maxilla with the last premolar and the molars, all in good condition; a part of the left maxilla with the roots of two premolars and of two molars; the right ramus of the lower jaw, lacking most of the symphysis and containing the fourth premolar and the first molar; the left ramus, lacking most of the ascending portion, and of the symphysis, and furnishing all the molars in fair condition, and the root of the fourth molar; portions of both premaxillæ; a part of the occiput; many small fragments of the brain-case and of the face; the distal ends of the metapodials of one foot; and one proximal phalanx.

The writer has at hand likewise some remains of two or three individuals of a camel which evidently belonged to the same genus as those already mentioned. These remains consist of two symphyses of lower jaws, with the incisors and canines; a part of a right horizontal portion of a lower jaw, containing the cheek-teeth; a few other lower teeth and parts of still others; and one as yet uncut upper last molar. These materials were found in 1905, by Mr. F. C. Horn, at Minidoka, Idaho, not far from Shoshone, in a bed of gravel which was overlain by a lava flow. In the same gravels were found bones of a large elephant, a part of a lower jaw of a horse, and two horn-cores of a bison, which the writer identifies as *Bison alleni*. A part of the camel remains bears the United States National Museum catalogue number 2579; another part, the number 5315.

In the National Museum there are three incisors and a part of a large molar of a camel which were found in 1867, by Mr. E. L. Berthoud, in "loess deposits of the big ravine on north bank of Big Thompson River," near Greeley, Colorado. The locality is close

¹ Journ. Acad. Nat. Sci. Phila., n. s., vol. 7, p. 161, pl. 14, figs. 12-14.

to the line between townships 4 and 5 north, range 66 west. The teeth were discovered at a depth of 35 feet from the surface. The catalogue number is 870.

The most important of the specimens above mentioned are, of course, those constituting the type of Cragin's *Auchenia huerfanensis*.

It may be as well, first of all, to establish, if possible, the relationships of Leidy's *Camelops kansanus*, Leidy's *Auchenia hesternus* (as represented by Merriam's specimens), and Cragin's *Auchenia huerfanensis*. That all belong to the same genus there seems to be little reason to doubt. Comparisons between *Camelops kansanus* and Merriam's specimens are limited to the anterior half of the premaxilla, the anterior extremity of the maxilla, the last incisor, and a part of the socket for the canine. Merriam¹ writes that compared with Leidy's type the anterior end of the rostral region of the Rancho La Brea skulls shows little to distinguish it, the general proportions of the elements present and the location of the teeth being nearly the same. However, it seems to the writer that Merriam's drawing, figure 5, shows that the premaxilla has almost exactly the form and proportions of that of the lama. At the point of the alveolar border where the maxillo-premaxillary suture is encountered, the premaxilla begins to narrow as it passes backward. In the type of *Camelops kansanus* the bone continues to widen backward as far as it is preserved. Leidy's figure appears to show also that the whole alveolar border in front of the canine was more strongly sigmoid than in the specimens from Rancho La Brea. Leidy himself stated that the premaxilla is of very much more robust proportions than in the lama or the camel. It seems to me that Merriam has done right in not identifying his specimens as *Camelops kansanus*.

It is still more certain that the type of *Camelops huerfanensis* is different from both *C. kansanus* and *C. hesternus*. Plate 25, figure 2, represents an exterior view of the left premaxilla of the Huerfano specimen and Plate 25, figure 3, the inner surface of the same bone; while figure 4 of the same plate presents a view of the maxillary border. That part which was in front of the exit of the incisor is wanting. It is evident that the maxilla extended forward on the alveolar border nearly to the incisor tooth. Just below, behind, and outside of the bottom of the socket for the incisor there is a great thickening of the premaxilla. On this thickening, mesiad of the line of suture, there is a concave surface which is taken to be a part of the wall of the socket for the canine. The presence of the canine here furnishes the reason for the thickening of the premaxilla at this place. If this conclusion is correct, the canine must have emerged immediately behind the incisor just as it does in the Bactrian camel.

¹Univ. California Publ., Geol., vol. 7, p. 318.

In the type of *Camelops kansanus* there is a space of 45 mm. between the two teeth. It is to be noted further that the maxillo-premaxillary suture in *C. kansanus* crosses the alveolar border 20 mm. behind the incisor. What may have been the form of the nasal border of the premaxilla of *C. kansanus* behind the part present in the type, we do not know. As will be seen, that of *C. huerfanensis* is strongly concave, differing thus from *C. hesternus*, the species of *Camelus*, and the lama, in all of which this border is sinuous. Unfortunately, the anterior end and the upper border of the left maxillary which came into contact with the premaxilla is broken away.

The type of *C. huerfanensis* differs from Merriam's specimens of *C. hesternus* in having the posterior palatine foramina placed farther backward; that is, opposite the first molar, instead of opposite the third or fourth premolar. In the specimens described by Merriam the mental foramina are said to be situated immediately below or slightly behind the canine, as in the lama. In *C. huerfanensis* they are placed but little in front of the hinder end of the symphysis and probably well behind the canines. In the camel last mentioned the coronoid process of the lower jaw is relatively wider than in the *C. hesternus*, as shown by Merriam's figure 5.

It is possible to describe some of the very fragmentary parts of the skull of Cragin's type. A part of the occipital region (Plate 25, fig. 1) is present, but it does not extend down to the foramen magnum. There was a strong sagittal crest, but its summit has crumbled away. The width of the occiput, measured along a line passing through the lateral foramina, was close to 110 mm., the same as in the case of the dromedary present. The lambdoidal crest is thin and sharp. On the supraoccipital surface there is a median descending ridge, rough and rounded, and separating two deep excavations. Exterior to these there is on each side another deep excavation, at the bottom of which is placed the lateral foramen. This region resembles that in Merriam's specimens. The paroccipital process is longer, thicker, and wider than in the Bactrian camel, and at its extremity presents a hook. Its form is quite like that of the lama. A fragment of the right maxilla has near its upper edge a depression which corresponds, doubtless, to the fossa mentioned by Merriam.

Figures 2-4 of Plate 25, as already stated, give views of the left premaxilla. The total length of the fragment is 126 mm.; the width of the upper end is 26 mm.; at the narrowest part, 20 mm.; near the anterior end, 31.5 mm. The thickness, a short distance below the upper, or hinder end, is 7 mm.; just at the bottom of the socket for the incisor, 17 mm. The incisor socket indicates that the tooth was large, its height, close to the place of emergence of the tooth, being 22 mm. The socket was at least 40 mm. deep. The surface believed

to have supported the upper side of the canine indicates that this tooth also was one of considerable size. The left maxilla shows that the infraorbital foramen was above the front of the first molar. The region in front of this is not so constricted as in the dromedary. Between the fourth premolars the palate was 50 mm. wide; at the front of the last molars, 87 mm. The palate was therefore narrower than in Merriam's specimens. The left posterior palatine foramen is situated somewhat behind that of the opposite side (Plate 26, fig. 1).

The right ramus of the lower jaw permits various measurements to be taken. The symphysis presents only about 22 mm. of its hinder end. From the hinder end of this to the rear of the bone, above the angle, is 385 mm.; to the rear of the condyle, 415 mm.; to the extremity of the coronoid process, about 450 mm. The depth of the jaw at the rear of the symphysis is 48 mm.; at the front of pm.₄, 59 mm.; at the front of m.₃, 83 mm.; at the rear of m.₃, 110 mm. The measurements indicate a jaw longer than that of Merriam's specimen 20028, but with the depth about the same.

It is not possible to determine accurately what was the length of the symphysis in the type of *C. huerfanensis*. After making such estimates as are possible with the materials at hand the length is taken to have been at least 125 mm. On this assumption the length of the jaw, to a point on the hinder border and on a level with the premolars, will be about 505 mm.; to the rear of the condyle, about 530 mm.; to the rear of the coronoid process, about 540 mm.

The width of the coronoid process at the middle of its height is 46 mm.; that from the front of this process to the rear of the condyle, is 92 mm.; the former being therefore just one-half of the latter dimension. In the specimens of *Camelus* and *Auchenia* at hand the width of the process is considerably less than half that of the jaw across the condyle; and the same appears to be true in the case of Merriam's specimens.

Returning to the symphyses it may be well here to describe those from Minidoka, Idaho. The largest one, No. 2579, is 120 mm. long and was about 50 mm. wide at the narrowest place; 58 mm. wide at the bases of the outer incisors. The mental foramen is placed four-fifths of the distance from the front to the rear of the symphysis and well behind the canine. In Merriam's specimens the foramen is below or slightly behind the canine, and somewhat further forward than in *C. huerfanensis*. In the other specimen from Minidoka (Plate 26, fig. 2), the symphysis has a length of 103 mm. and the foramen is nearer the rear of the union. In these jaws, which probably belonged to the same species as Cragin's specimen, the canines are situated nearer the incisors than they are in those found in California. It may be noted here that in the type of *C. huerfanensis* the fourth

premolar is placed 65 mm. behind the symphysis, while in Merriam's specimen, No. 20028, furnishing a shorter jaw, the same tooth seems to be at a distance of 75 mm. from the symphysis. Merriam has stated that the symphysis in *Camelus* is much longer than in *Auchenia*. This depends, however, on the species. From the specimens at hand it is found that in the Bactrian camel the length of the symphysis equals about 26 per cent of the length from the incisive border to the rear of the condyle; in *Auchenia*, 28 per cent; in the dromedary, 35 per cent. On the assumption that the symphysis of Cragin's species was 125 mm. long, its length would be 23.5 per cent of the length of the jaw. It is not improbable that the symphysis was really longer than 125 mm. Judging from the drawings presented, Cope's Texas specimen¹ referred to *hesternus*, had a symphysis equal to 24 per cent of the length of the jaw, estimated as in the other cases. In that jaw the position of the canine and that of the mental foramen are as in Cragin's type. That jaw was, however, shorter than the latter by about 100 mm. Furthermore, the fourth premolar appears to be much nearer to the symphysis than in the case of Cragin's type, apparently only about 40 mm. distant.

The teeth of the various specimens at hand which are supposed to belong to *C. huerfanensis* must be described. None furnishes the last upper incisor; but the left premaxilla (Plate 25, figs. 2-4) described above contains the socket of this tooth. This has already been described. Likewise, the only trace of the upper canine is shown on that premaxilla, as already noted.

In Cragin's type the fourth premolar of the right side and all the molars are present and in excellent condition. On the left side little is left of the teeth except the roots of the third and fourth premolars and of the first and second molars. (Plate 26, fig. 1.) So far as may be determined from the two roots of the third premolar, this tooth had the size of the corresponding one in Merriam's specimen, referred to *C. hesternus*. In the table below are given the measurements of the upper cheek-teeth. The height of the crowns is given as an indication of the stage of wear; for as the teeth are worn down, the antero-posterior diameter, here called the length, diminishes (except in the case of the third premolar and the last molar), while the transverse diameter increases. In these measurements the length of the crown is taken along the middle of the width of the grinding surface, while the width of the tooth is taken at the base and where greatest. The length of the whole series and of the molar series is taken in a straight line, not along the curve.

¹ Geol. Surv. Texas, 4th Ann. Rep., 1892, pp. 71, 93, pl. 21, figs. 3, 4.

Measurements of the premolars and molars of the upper jaw.

	mm.
Length of the premolar-molar series, pm. ³ —m. ³ , inclusive.....	171
Length of the teeth, from front of pm. ⁴ to rear of m. ³	152
Length of the molar series.....	129
Pm. ³ , height.....	
length.....	18.8
width.....	11
Pm. ⁴ , height.....	38
length.....	25
width.....	25
M. ¹ , height.....	35
length.....	38.5
width.....	30
M. ² , height.....	57
length.....	48
width.....	30
M. ³ , height.....	62
length on grinding surface.....	45
length at middle of height.....	56
width.....	28.5

These measurements may be compared with those given by Merriam on page 316 of his paper; but some of his measurements appear to have been taken somewhat differently. If in the Huerfano specimen we measure the distance from the front of pm.⁴ to the rear of m.³ along the outer curve we shall have 167 mm.; and along the outer curve of the molars alone, 138 mm. Merriam mentions the fact that in his specimen 20028 the metastyle of the last upper molar is drawn out posteriorly as a wing; but that this wing is not present in the specimen 20040. In the Huerfano specimen this metastyle is large and is bent strongly inward, as may be seen from figure 1, plate 26. The width of this metastyle, from side to side, is 14 mm. Accompanying the materials from Minidoka is a third upper molar which had not yet been cut, and whose base had not yet been completed. The metastyle forms a broad sharp border, but shows no tendency to be bent mesiad.

The lower incisors of the Huerfano specimen are missing. They are present in the two symphyses from Minidoka. Those of No. 5315 are shown in figure 2 of Plate 26. The outer incisors had only just begun to wear. They have a length of 60 mm., a width of 13 mm. at the middle of the length, and a thickness of 9 mm. The second incisors are naturally more worn. They have a width of 18 mm. and a thickness of 10 mm. at the middle of the length. The first incisors are about 17 mm. wide and 12 mm. thick. All are flat on the upper surface and convex from side to side on the lower, or front, surface. They are relatively more powerful teeth than in the lama or the dromedary.

The incisors of No. 2579, from Minidoka, are still more worn than those just described, and they belonged to a larger animal. Those of the first pair, in their worn condition, are at least 73 mm. long. All these incisors were directed forward more strongly than in the lama and the Bactrian camel, as the latter is represented in the specimen at hand. It must be stated further, that the lateral incisors of figure 2, Plate 26, are, relatively to the others, much larger than in Cope's specimen from Texas.¹ None of these incisors are as strongly curved as they are in the lama.

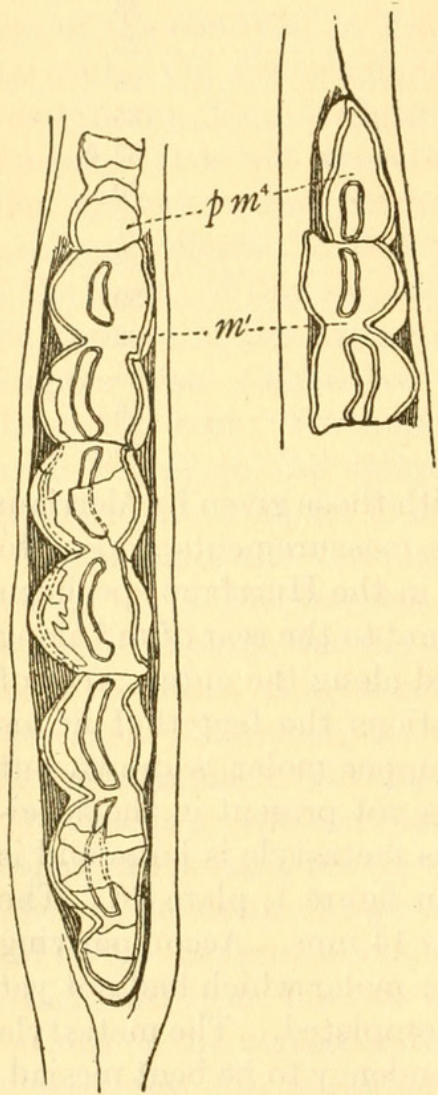


FIG. 1.—MOLARS (m^1) AND PREMOLARS (pm^1) OF LOWER JAWS OF THE TYPE OF *CAMELOPS HUERFANENSIS*. X $\frac{1}{2}$.

Figures 3 and 4, Plate 26, represent of the natural size the two incisors, i_2 and i_3 right side, which were found in 1867 by E. L. Berthoud. It is, of course, not certain that they belonged to *Camelops*, but it is probable that they did. These teeth are spatulate in form, not greatly curved, and are somewhat twisted. What is taken to be the second right incisor (Plate 26, fig. 4) is worn very slightly; the other incisor (fig. 3) not all. I_2 has a length, in a straight line, of 92 mm.; a width of 23 mm. near the anterior end; while at the middle of the length, the width is 18 mm.; the thickness 10.5 mm. A section of the tooth at this place would greatly resemble that of the corresponding tooth from Minidoka. I_3 had not quite completed its growth at the base. It is 80 mm. long, 26 mm. wide near the front; 21 mm. wide and 10 mm. thick at the middle of the length.

As in other specimens supposed to belong to *Camelops*, the lower jaw of the Huerfano skull has present no traces of any premolars in front of the fourth. In a part of a jaw (Plate 26, fig. 5) from Minidoka, which belongs possibly with the symphysis numbered 5315, there is left the base of the crown and the root of a small third premolar. This has a diameter of 7 mm., fore and aft, and a transverse diameter of 6 mm. In the anterior border of the fourth premolar there is a groove which appears to have been occupied by the crown of this third premolar.

¹ Geol. Surv. Texas, 4th Ann. Rept., 1892, pl. 21, fig. 4.

The following are the measurements of the fourth premolar and the molars of the type of *Camelops huerfanensis* (fig. 1) and of teeth of No. 5315, from Minidoka. Merriam's measurements of the lower teeth of his specimen No. 20040, referred to *C. hesternus*, are added in the third column; and in the fourth the measurements given by Cope for his Texas specimen. In *C. huerfanensis* the fourth premolar and first molar are present in the right ramus, while in the left ramus the premolar is represented by the socket only.

Measurements of lower premolars and molars.

Teeth measured.	Huerfano specimen.	Minidoka specimen.	No. 20040 Univ., Cal.	Cope's Texas specimen.
	mm.	mm.	mm.	mm.
Length of lower teeth, pm. ₄ to m. ₃ , inclusive.....	171	143	162.2	.....
Length of molar series.....	144	118	134.7	.....
Pm. ₄ , height.....	30	25	.....	.....
length.....	27	23	27.5	27
width.....	15	14	13.4	16
M. ₁ , height.....	30	30±	.....	.....
length.....	35	27	39	38
width.....	20	17	21.5	19
M. ₂ , height.....	55±	45	.....	.....
length.....	45	40	46	44
width.....	24	20	21.2	20
M. ₃ , height.....	65±	63	.....	.....
length.....	62	56	58	56
width.....	21	20	18.5	16

It will be observed that the teeth of the Minidoka specimen are distinctly smaller than those of the type of *C. huerfanensis*. As regards the premolar and the first two molars, the shortness along the grinding surface may be partly explained by their being more worn; but this explanation does not apply to the last molar. Moreover, the teeth are all narrower. It may be that the individuals which bore these teeth differed considerably in size; and this difference in size may have been due to difference of sex.

The conclusions reached by the writer may be put into the following form:

1. *Camelops kansanus* is known from the type only and is a species distinct both from *C. hesternus*, as represented by Merriam's specimens, and from *C. huerfanensis*.
2. *C. hesternus* is a species distinct from *C. huerfanensis* Cragin.
3. Cope's Texan specimen, referred to *C. hesternus*, can not be determined as yet with certainty. It probably belongs to *C. huerfanensis*, as does probably *C. sulcatus* Cope. Merriam is inclined to refer the Texan specimen to *C. hesternus*, as represented by the California specimens; but it is to be noted that in the latter the line of the lower cheek teeth is considerably shorter than the distance from the front of the fourth premolar to the incisive border, while in Cope's specimen the tooth line is considerably longer than the jaw, in front of the premolar. This would appear to furnish some indication that

the Texan specimen belongs with neither *C. hesternus* nor *C. huerfanensis*.

4. It is impossible at present to decide the status of *Megalomeryx niobrarensis* Leidy. The decision must await new discoveries.

5. The writer accepts, therefore, as species of *Camelops* to be carried on the rolls, until further knowledge is obtained, *C. kansanus*, *C. californicus*, *C. hesternus*, *C. vitakerianus*, *C. niobrarensis*, *C. macrocephalus*, and *C. huerfanensis*, the latter to include provisionally *C. sulcatus* (Cope) and the Texan mandible referred by Cope to *C. hesternus*.

Leidy and Cragin referred to the genus *Auchenia* the species mentioned in this paper. Wortman distinguished the two genera on the presence of a prominent lamina, or style, at the anterior outer angle of the two hinder lower molars of *Auchenia*, a structure absent from the same teeth of the species of *Camelops*. Merriam accepts this separation. It seems to the present writer that there are various other characters which are of perhaps genera importance. It is evident that the species of *Camelops*, so far at least as represented by *C. hesternus*, had skulls relatively longer and narrower than those of *Auchenia*. In the latter the width at the rear of the orbits is equal to about 54 per cent of the length from the front of the foramen magnum; while, according to Merriam's illustrations and measurements, the corresponding width in *Camelops* equals only about 45 per cent of the corresponding length. There is an important difference in the upper molars. In *Auchenia* the length of the grinding surface is nearly equal to the width of the tooth measured at the base; that is, when these molars are well worn down the grinding face is nearly square. In *Camelops* the teeth are relatively long antero-posteriorly. In *Camelops* the lower incisors are less curved than in *Auchenia* and directed more strongly forward; that is, they are more procumbent. In *Auchenia* the nasals are strongly expanded at the hinder end; in *Camelops* they are narrow posteriorly. In *Auchenia* the lachrymal vacuity is crowded outward against the inner border of the lachrymal, while in *Camelops* the vacuity hardly or not at all comes into contact with the lachrymal. In *Camelops* there is fossa in the upper border of the maxilla; in *Auchenia* there is none.

EXPLANATION OF PLATES.

PLATE 25.

Figs. 1-4. *Camelops huerfanensis* Cragin.

1. Rear of the skull, to show its form, the two excavations on each side of the midline, and the intervening ridges. Part of the right side is missing.
- 2-4. Left premaxilla.
 2. View from the outside.
 3. View from the inner side. *i*, Socket for the third incisor.
 4. View of the border which articulated with the maxilla. *c*, Surface which formed a part of the socket for the canine.

PLATE 26.

- Fig. 1. *Camelops huerfanensis*. Palate showing premolars and molars. Type. $\times\frac{1}{2}$.
2. *Camelops huerfanensis*? Symphysis showing incisors and canines. No. 5315 U. S. Nat. Mus. $\times\frac{1}{2}$.
- 3, 4. Third and second incisors. No. 870 U. S. Nat. Mus. $\times 1$.
5. Part of right ramus of lower jaw. Shows minute pm.₃. pm.₄ m.₁ and m.₂. No. 5315 U. S. Nat. Mus. $\times\frac{1}{2}$.



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