

DESCRIPTION OF REMAINS OF BISON OCCIDENTALIS FROM CENTRAL MINNESOTA.

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In the autumn of 1921 a letter was received at the United States National Museum from F. W. Uhler, chief engineer, in behalf of John A. Savage & Co., owners of the Sagamore Iron Mine, at Riverton, Minnesota. In this letter it was written that many buffalo bones had been uncovered in working their mine. The inquiry was made whether or not the United States National Museum would be interested in the discovery. Photographs enclosed in the letter showed that the bison material was valuable and also that antlers of a reindeer had been unearthed at the same place. At the request of the officers of the Museum the owners of the mine shipped and presented to the United States National Museum a large amount of bones, in fact, enough to fill trays occupying about 35 cubic feet of space. Among these bones are two practically complete skulls, several others in various stages of incompleteness, besides vertebrae, ribs, and limb bones in great numbers. However, no carpal or tarsal bones, and no bones of the feet are included. These smaller bones had been swept away by the streams of water used in removing the peat. Out of this lot of bones have been selected enough to make up a skeleton for exhibition.

The officers of the company have shown a commendable appreciation of the value of these remains and much intelligence in bringing them to the notice of the United States National Museum.

It is found that most of the skulls belong to *Bison occidentalis*, but one nearly complete skull and a good maxilla and premaxilla belong to *B. bison*.

The mine is close to the eastern bank of Mississippi River, about 10 miles northeast of Brainerd and near the town of Crosby. The surveyor's description runs thus: "Section 19, township 46, range

29." The bones were met with in a peat swamp which forms a part of the overburden of the iron ore. This peat, about 6 or 8 feet deep, was being removed by hydraulic operations and thus the bones were exposed. They were at or near the bottom of the peat.

This discovery brings to us new information regarding the time of disappearance of *Bison occidentalis*. From the remains of this species hitherto discovered, the writer had concluded that it had died out before the oncoming of the Wisconsin ice sheet. Mr. Uhler reports that underneath the peat of the bog where the bones were found there is about 30 feet of drift. On my consulting Prof. Frank Leverett about the age of this drift, he wrote as follows:

The drift at the iron mine in section 19, township 46, range 29, near Crosby, Minnesota, is a moraine of red Wisconsin drift, of about the age of the Kalamazoo morainic system in Michigan, and the outer moraine of the Green Bay lobe in Wisconsin. It is older than the gray drift of Minnesota and younger than the Shelbyville, Bloomington, and Marseilles moraines of Illinois. It is, therefore, about mid-Wisconsin in age.

We can be certain therefore that *Bison occidentalis* lived in Minnesota until the middle of the last glacial stage. How much longer we can not now determine. Nor can we be certain just when the bones of *Bison bison* were left in that peat swamp. The two species may have lived in that region together, or the existing buffalo may have arrived there after the other species had become extinct.

It will perhaps occur to those reading this account that these animals became mired in that bog and perished. Possibly some of them did thus meet their fate; but others may have died there from other causes. It may be doubted further that more individuals died in that bog than died on an equal area of upland. In the bog, where water was always present, the bones were preserved; on the hills, they gradually dissolved into soil.

In studying the skulls the writer has taken a series of measurements in order to show the dimensions of the parts. See Table 1, page 3. In the first and second columns are measurements taken from the two complete skulls of *B. occidentalis*; in the third, fourth, and fifth columns are measurements from the injured skulls. In the sixth column are corresponding measurements of a good specimen of the existing bison (Cat. No. 22, 374, U. S. N. M.). In the seventh are similar measurements of a specimen of the European bison, *Bison bonasus* (Cat. No. 11, 514 U. S. N. M.). In an eighth column are measurements derived from a very complete skull of *Bison alleni* found in Alaska (Cat. No. 7706 U. S. N. M.). This specimen was described by the writer in 1913.¹

¹ Proc. U. S. Nat. Mus., vol. 46, pp. 182-192, pls. 16, 17, text figs. 7-9.

TABLE I.
[Measurements in millimeters.]

Dimensions.	<i>Bison occidentalis.</i>					<i>Bison bison.</i>		<i>Bison bonasus.</i>	<i>Bison atteni.</i>
	10541	10542	10545	10546	10544	22374	11514	7706	
	1	2	3	4	5	6	7		
1. Length from rear of condyle to front of premaxillae.....	500	545				495	525	600	
2. Length from front of foramen magnum to front of premaxillae (basal length).....	472	505				465	483	500	
3. Length from occipital crest to front of premaxillae.....	518	572				500	538	680	
4. Length from occipital crest to rear of nasals.....	232	270	250	262	237	225	268	287	
5. Length from occipital crest to front of nasals.....	470±	472				412	440	512	
6. Length from occipital crest to line joining rear of orbits.....	195	233	202	215	202	190	208	232	
7. Length from front of premaxillae to line joining rear of orbits.....	350	363				335	355	404	
8. Length from front of foramen magnum to rear of hard palate.....	185	195				187	190	200	
9. Length from lower border of foramen magnum to rear of hard palate.....	262	272	288		190	250	275	295	
10. Height of occipital crest from lower border foramen magnum.....	145	142	146		138	150	136	111	
11. Greatest width at process just above ear opening.....	265	275	280		252	260	243	282	
12. Width on maxillary ridges midway between maxillomalar suture and rough eminence.....	172	182			182	190	176	200	
13. Width at hinder ends of horn-cores.....	327	355	338	180	146	162	187	190	
14. Width at constrictions between bases of horn-cores and orbits.....	280	302	296	285	258	248	265	286	
15. Width at articulations of lower jaws.....	246	258	260			225	248	286	
16. Width at rear of orbits.....	328	355	330	343	310	305	325	333	
17. Width at front of orbits.....	272	294	272			247	248	268	
18. Width on maxillary ridge at maxillomalar suture.....	193	205	190			196	195	212	
19. Width from outside to outside of nasals, straight, greatest.....	100	110	105	105	105	97	103	113	
20. Diameter of orbit, fore-and-aft.....	70	70	68			72	75	78	
21. Diameter of orbit, vertical.....	70	70	68			72	75	78	
22. Height of skull from palate to rear of nasals.....	172	180	99			166	165	185	
23. Diameter of base of horn-cores, fore-and-aft.....	91	105	99	90	77	80	76	97	
24. Diameter of base of horn-cores, vertical.....	94	102	96	80	75	74	73	83	
25. Circumference of base of horn cores.....	294	316	305	290	233	245	250	340	
26. Length of horn-core on upper curve.....	263	280	332	322	190	190	230	430	
27. Length of horn-core on lower curve.....	318	340	285	245	253	240	303	505	
28. Distance from upper border of base of horn-core to tip, straight.....	240	253	285	245	170	165	190	425	
29. Distance between tips of horn-cores.....	732	800	795	800	680	600	570	900	
30. Length of the premaxillae.....	185	186				145	145	192	
31. Projection of the muzzle beyond the line joining the front premolars.....	137	142				116	137	153	
32. Distance between bases of horn-cores added to length of upper curves of horn-cores.....	853	915	1,002	859	672	680	770	1,170	

The writer makes use furthermore of various indices based on the measurements just mentioned. These are intended to show the ratio between measurements of important parts in each skull and to bring out the variations found in the different individuals. They are to be employed also in determining the resemblances and the differences between the various species. The record of these indices forms Table 2. The numerals found in the second column on the left side of the page refer to measurements correspondingly numbered in Table 1. The basal length (measurement 2 of the latter table) is valued at 100.

TABLE 2.—Indices.

	<i>Bison occidentalis.</i>		<i>Bison bison.</i>	<i>Bison alleni.</i>	<i>Bison bonasus.</i>
	10541	10542	22374	7706	11514
1. Basal length in 4.....	67	70	66	59	67
2. Basal length in 6.....	41	46	41	41	43
3. Basal length in 7.....	74	72	72	72	71
4. Basal length in 11.....	56	54	56	50	50
5. Basal length in 12.....	36	36	41	36	36
6. Basal length in 13.....	36	36	35	34	38
7. Basal length in 14.....	70	70	67	55	64
8. Basal length in 15.....	59	60	53	51	55
9. Basal length in 17.....	67	70	66	59	67
10. Basal length in 19.....	41	41	42	38	40
11. Basal length in 27.....	56	55	41	77	48
12. Basal length in 31.....	39	37	31	34	31
13. Basal length in 32.....	29	28	25	27	28
14. Basal length in 33.....	181	181	146	210	159

In this table the first three indices pertain to measurements which lie in the median sagittal plane. These seem to show that no important differences in longitudinal proportions exist among the species *B. occidentalis*, *B. bison*, *B. bonasus*, and *B. alleni*. *Bison alleni*, however, seems to have a somewhat shorter brain-case; but additional specimens are needed to prove this.

The indices found in lines 4 to 10 are concerned with transverse measurements and show, therefore, the relative widths of the skulls. It will be observed that there is no wide variation in the two skulls of *B. occidentalis*; nor is *B. bison* far away. In line 8 the index is 53, but another individual at hand brings it up to 59. *Bison bison* seems again to differ from both *B. occidentalis* and *B. bonasus* in the greater width of the constriction on the maxillary ridge in front of the orbit. This view is strengthened by another individual at hand.

It is to be noted that the indices of the widths in *B. alleni* are always lower than the corresponding ones in *B. occidentalis* and *B. bison*. An examination of the author's figure of this species²

² Proc. U. S. Nat. Mus., vol. 46, pl. 16, fig. 1.

will show that this is a long-faced, narrow-headed species. *B. occidentalis* is a broad-headed form, surpassing *B. bison* in this respect.

Indices for the horn-cores (pls. 1, 2) are obtained by dividing the length along the lower curve by the distance from the base of the horn-core on the upper side to the tip in a straight line. The following table presents the indices as obtained:

<i>B. occidentalis.</i>				<i>B. bison.</i>		<i>B. alleni.</i>	<i>B. bonasus.</i>
10541	10542	10545	10546	10544	22374	7706	11514
133	134	145	133	140	145	119	161

It will be seen that there is a wide range of curvature in *B. occidentalis*. There is no less in *B. bison*. Five individuals of the latter had this index varying from 128 to 145. From the curvature alone *B. bison* can not be distinguished from *B. occidentalis*. Nevertheless, their horn-cores are very different, those of the existing bison being short and stubby, those of *B. occidentalis* much longer and relatively slenderer. It will be observed, too, that the index of the curvature of *B. alleni* is low; that of *B. bonasus*, very high, at least as shown by the specimen at hand.

Formerly the writer proposed,³ in view of the imperfection of most skulls of bisons, to make the distance from the lower lip of the foramen magnum to the rear of the nasals a unit for measurements. This unit has been applied in the case of the skulls studied for this paper, but the results have not been satisfactory.

A full face view of the skulls of *B. occidentalis* (pl. 1, fig. 1) shows that the face is more narrowed in front of the orbits than it is in *B. bison*. This may be tested by dividing the width at the rear of the orbits into the width on the maxillary ridge at the maxillomalar suture and multiplying the result by 100. The following results are obtained:

1	2	3	4	5	6	7	8
10541	10542	10545	10544	22374	22665	7706	11514
59	58	58	65	64	64	64	60

Of these skulls here measured the first three belong to *B. occidentalis*. That of the fourth column accompanies the materials from Minnesota and is in good condition, except that the muzzle is injured. The fifth, sixth, seventh, and eighth columns belong, respec-

³ Proc. U. S. Nat. Mus., vol. 46, p. 163.

tively, to *B. bison*, *B. bison*, *B. alleni*, and *B. bonasus*. It will be noted that there is close agreement among the first three skulls, and again between the fifth and sixth; and at the same time a good deal of difference between the two groups. The skull of the fourth column agrees with the skulls of *B. bison* and not with those of *B. occidentalis*. On other grounds it had been concluded that this skull belongs to *B. bison*. The horn-cores are those of *B. bison*, as may be seen in the measurements of Table 1.

If measurements across the face be taken halfway between the maxillomalar sutures and the rough eminence on the ridge, and these be compared with the width at the rear of the orbits, the following indices will be obtained:

<i>B. occidentalis.</i>		<i>B. bison.</i>			<i>B. alleni.</i>	<i>B. bonasus.</i>
10541	10542	10544	22374	22665	7706	11514
52	52	58	60	58	60	53

Here again it is found that the faces of the two specimens of *B. occidentalis* are relatively narrower than those of the two recent bisons; also that number 10544 from Minnesota ranges itself with the recent bisons. The European bison No. 11514 is shown in this table, as in the preceding one, to have a face nearly as narrow, relatively to the width at the rear of the orbit, as has *B. occidentalis*.

The distal end of the muzzle of *B. occidentalis* (pl. 1, fig. 1) is not cut off as squarely as it is in *B. bison*. Another character which appears to distinguish *B. occidentalis* from *B. bison* is found in the premaxilla. This is much longer in the former (pl. 2, fig. 2) than in the latter. In the former its length is equal to the distance from the hinder end of the bone to the rear of the orbit or slightly in front. In *B. bison* the length of the premaxilla reaches only to the front of the orbit or a little beyond. As a result of this greater length of the premaxilla in *B. occidentalis* the free border of the maxilla in the nasal opening is only about one-half as long as it is in *B. bison*. The specimen from Minnesota having the catalogue number 10544 resembles in this respect the recent skulls of *B. bison*.

The upper teeth of the two best skulls in the Minnesota collection are nearly all badly injured (pl. 2, fig. 1). So far as preserved, they appear to present no differences when compared with those of *B. bison*.

It is very difficult or impossible to find means for distinguishing the teeth of any of our species of bison from those of the others. It is somewhat surprising, therefore, to find that the teeth of *B. bonasus*

offer distinct differences. The following table of measurements is presented:

A. Measurements of upper teeth of bisons.

Teeth.	<i>B. bison.</i>		<i>B. bonasus.</i>	
	Length.	Width.	Length.	Width.
Pm ²	19	19	19	18
Pm ³	19	19	19	20.5
Pm ⁴	19	23	19	23
M ¹	25	27	27	24
M ²	32	29	30.5	25
M ³	32	26	30	24

A fairer measurement for M³ is on the outer face near the bone. In each species this is 33 mm.

It will be noted that the measurements of the premolars differ little in the two species. In the case of the molars those of *B. bonasus* are distinctly narrower than those of *B. bison*. Important differences are found on the outer face of the upper molars. In Pm⁴ of *B. bison* the three outer styles are narrower than the corresponding ones of *B. bonasus*, and the middle one does not extend out to a ruler laid against the face of the tooth. In M¹ of *B. bison* the median style lies mesiad of a line laid against the outer face of the tooth, and it disappears much before the base of the tooth is reached. In *B. bonasus* this style projects out beyond a line extending from the front to the rear style, and it continues quite to the base of the tooth. In M² of *B. bison* all of the styles come out close to a line laid against the tooth at the middle of the height; in *B. bonasus* the median style stands out much beyond a line from the front to the rear style. In M³ of *B. bison* the styles all extend out approximately to the same line; in *B. bonasus* the median style extends out far beyond a line joining the front and rear styles. It was formerly supposed that *Bison bonasus* and *B. bison* were closely related or were even of the same species, but it appears that the American members of the genus were more closely connected with one another than any of them are with *B. bonasus*.

In his description of the skeleton of *Bison occidentalis*, now in the University of Kansas,⁴ the writer gave the dimensions of various bones of the limbs, and compared them with those of the existing bison. The same bones from the Minnesota collection, taken from those chosen for a mount, have been measured in the same way. In most cases these are slightly smaller than the corresponding ones of the Kansas specimens; but yet somewhat larger than those of the existing bison. However, a radius is 360 mm. long and 65 mm. wide

⁴ Proc. U. S. Nat. Mus., vol. 46, p. 173.

at the middle. In the Kansas specimen these dimensions are respectively 345 mm. and 48 mm. It must be remembered that any one of these bones may belong to the existing bison. It is, however, probable that all belong to *B. occidentalis*.

EXPLANATION OF PLATES.

Skull of *Bison occidentalis* Lucas.

PLATE 1.

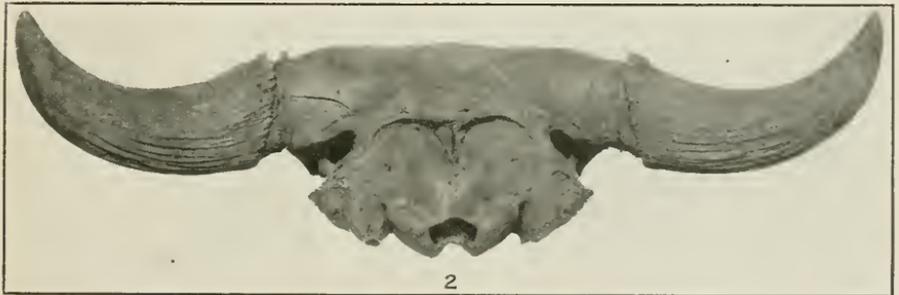
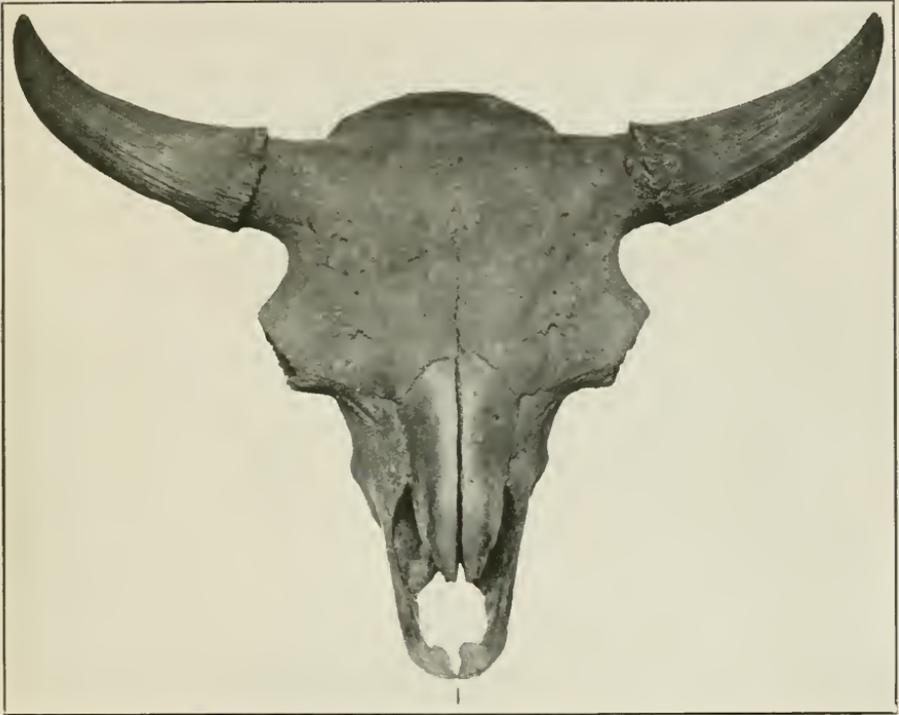
FIGS. 1, 2.

1. View from in front. $\times .14$.
2. View from behind. $\times .14$.

PLATE 2.

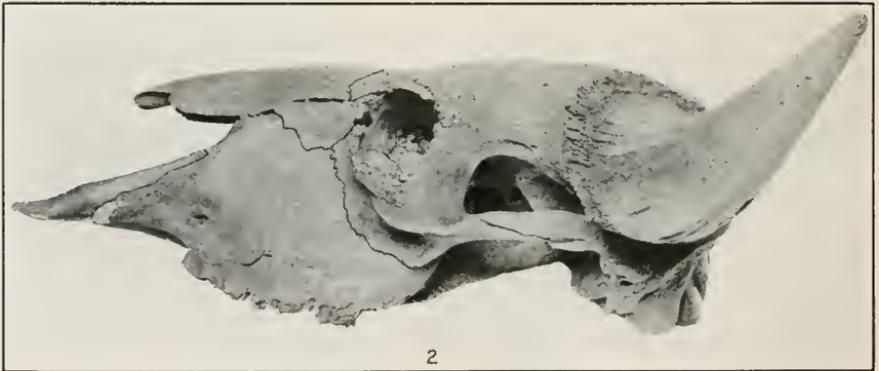
FIGS. 1, 2.

1. View of under surface. $\times .135$.
2. View from left side. $\times .17$.



SKULL OF *BISON OCCIDENTALIS*.

FOR EXPLANATION OF PLATE SEE PAGE 8



SKULL OF *BISON OCCIDENTALIS*.

FOR EXPLANATION OF PLATE SEE PAGE 8.