The Fauna of Papago Springs Cave, Arizona,
and
A Study of *Stockoceros;*
with
Three New Antilocaprines from Nebraska and Arizona

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Article VI.—THE FAUNA OF PAPAGO SPRINGS CAVE, ARIZONA,

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THREE NEW ANTILOCAPRINES FROM NEBRASKA AND ARIZONA

By Morris F. Skinner[1]

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List of Abbreviations of Institutions Cited

A.M. = American Museum of Natural History
A.M:M. = American Museum, Department of Mammalogy
F:A.M. = Frick Collection, American Museum of Natural History
F:A.M:I.P. = Frick Collection, American Museum, Invertebrate Paleontology
F:A.M:R. = Frick Collection, American Museum, Fossil Reptiles and Birds
L.A.M. = Los Angeles Museum
M.C.Z. = Museum of Comparative Zoölogy, Harvard University
N.S.M. = Nebraska State Museum
S.M.U. = Southern Methodist University
U.S.N.M. = U. S. National Museum
U.S.B.S. = U. S. Biological Survey

INTRODUCTION

This report deals with the exploration of Papago Springs Cave, southeast of Sonoita, Arizona, and describes the contained late Pleistocene fauna, including a remarkable series of skulls, jaws and skeletal remains of the extinct Quentin Pronghorn. Descriptions of new Antilocaprine horn-cores from several Pleistocene localities in Nebraska and Arizona are appended.

In 1934, Messrs. Quentin Roosevelt and J. W. Burden[1] discovered fossils in Papago Springs Cave and presented their collection to The American Museum of Natural History. In a brief notice they described a new member of the Antilocapridae, "*Tetrameryx*" *onusrosagris*. The collection was augmented by additional finds by the same investigators in 1936. No articulated material was reported and examples of associated fauna were rare. In the winter of 1937–38 a party from the Frick Laboratory, American Museum of Natural History, comprised of Howard Scott Gentry, Albert Potter and Morris F. Skinner, sought further evidence at the cave and found unsuspected rich concentrations of the new antilocaprid, together with a representative associated fauna. In 1940, supplementary comparative material was obtained by Gentry and Skinner.

The main entrance to the cave is a narrow, crooked, rubble-filled passage that opens into a high-domed room. Two principal fissures continue back into an inner system of passages. One fissure leads upward to entrance "A," beyond which is a filled passage probably connecting with North Papago Cave. Sixty feet below and 100 feet beyond the main entrance, the second fissure narrows to a passage so small that it was difficult for the workers to wriggle through. Most of the fossils were concentrated in the ceiling of this passage. Collecting was carried on by gas light under very trying conditions, the space permitting chiseling of the overhead matrix only from a sitting or lying position.

The two Frick Laboratory expeditions yielded a large series of additional antilocaprid specimens, among which there are 55 skulls or partial skulls, 59 horn-cores, 115 complete and partial mandibular rami, 7 articulated partial skeletons, 627 isolated major limb elements, numerous other unassociated skeletal parts and a large unworked block, suitable for exhibit. In addition to the antilocaprid collection, an associated fauna represented by more than 350 specimens was obtained. The late Pleistocene faunal assemblage from the

[1] Roosevelt, Quentin, and Burden, J. W., 1934, Amer. Mus. Novitates, No. 754.

cave is now represented by 34 genera and 39 species. Human artifacts (Figure 3) were found mingled with remains of the Recent fauna, but not in the late Pleistocene matrix.

The writer is particularly indebted to: Mr. Childs Frick for the privilege of carrying out a study of the Papago Springs Cave fauna and for suggestions; Mr. Fred C. Winn, U. S. National Forest Supervisor, and his staff at Tucson, Arizona, for helpful cooperation at the cave; Dr. Erwin H. Barbour and Dr. C. Bertrand Schultz for the privilege of describing new antilocaprid horn-cores from the University of Nebraska State Museum collection; Dr. Gerrit S. Miller, the late Mr. W. H. Howell, Mr. Charles W. Gilmore, Dr. C. Lewis Gazin, Dr. Erwin H. Barbour, Dr. C. Bertrand Schultz, Dr. T. E. White, Dr. O. J. Murie, Dr. Harold E. Anthony and the late Dr. Walter Granger for the loan of various specimens and casts; Dr. Henry Pilsbry for the identification of the invertebrates and Dr. J. Eric Hill for cooperation in the identification of rodents and bats; Dr. William K. Gregory and others of The American Museum of Natural History for suggestions; Mr. Ralph Mefferd for his illustrations; other members of the Frick Laboratory, especially Messrs. Charles H. Falkenbach, Floyd Blair, Beryl Taylor and Gordon K. Fletcher for aid; Mrs. Morris F. Skinner for the typing and Mr. Sydney E. Helprin for the editing of the manuscript; and to my able co-workers, Howard Scott Gentry and Albert Potter, for their aid in the arduous task of removing the fossils from the cave.

DESCRIPTION OF THE CAVE AND ITS DEPOSITS

Papago Springs Cave is located in the Canelo Hills of Santa Cruz County, Arizona, in the Coronado National Forest, about $5^1/_2$ miles southeast of Sonoita, Arizona, in the S.E. $^1/_4$ of Sect. 16, T. 21 S., R. 17 E., at an elevation of approximately 5,200 feet.

North Papago Cave, discovered by the 1938 expedition, is a continuation of the main cave. It has a separate entrance ("N") which opens into a narrow, dangerous, rubble-filled fissure.

The cave is in a tilted massive limestone of Pennsylvanian or early Permian age. An intrusive igneous mass, which lies southwest of the cave and is well exposed in Papago Springs Wash, may have contributed to the original fracturing of the limestone. The cave is a series of typical solution fissures formed by ground water seeping through the fractured limestone.

The presumed consecutive sedimentary history of the cave may be tentatively outlined as follows (see map and profiles, Figure 1): During the early Pleistocene the main room, which is formed by the junction of two principal fissures having definite directional trends, is believed to have been an open cave with a narrow sunlit entrance which faced the south (stage 1). The floor of this entrance ("B") was only slightly above the level of Papago Springs Wash, so that water from freshets could flow into the main room, carry in sediments, and

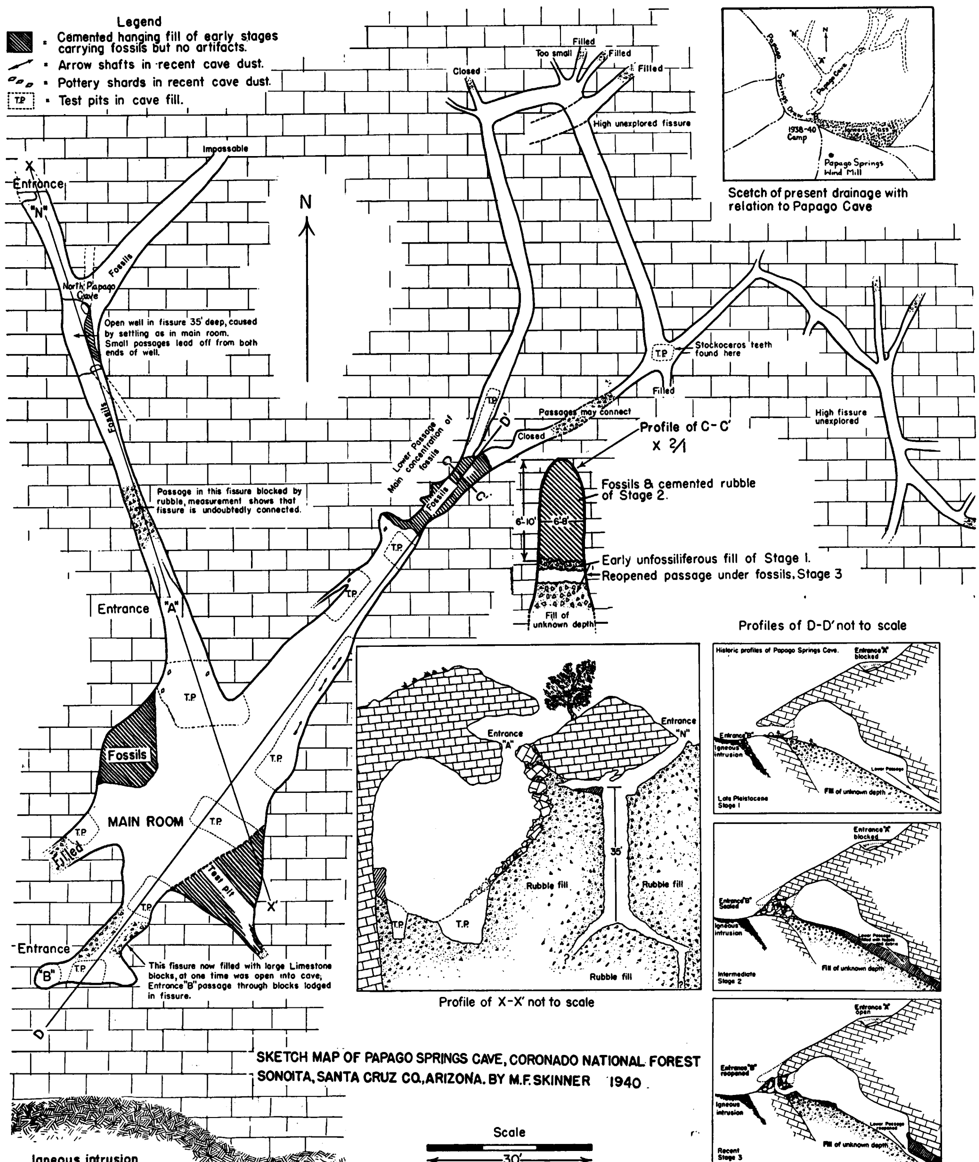


Fig. 1. Map of Papago Springs Cave, showing main room and passages. Historic profile of main room D-D′ (not to scale) shows stages of sedimentary accumulation: Stage 1, late Pleistocene sediments accumulating, entrance "B" open, "A" sealed; Stage 2, entrance "B" sealed, no sediments or fossils accumulating, settling taking place; Stage 3, entrance "B" partially reopened and "A" opened, recent fauna accumulating. Scale 1 inch = 35 feet.

form stratified water-carried fill, closing off the inner passages. Suspended remnants of these early unsettled deposits contain rounded pebbles of rhyolite, etc., derived from the wash. The last deposits of the open cave (stage 2) show that it had been used for many seasons by animals. Fossils were deposited to a depth of several feet in the back and lower portions of the main room, where it narrows into a fissure that received all of the rubble and fossils from the upper slope (profile C-C′). These Pleistocene deposits were locally cemented by mineralized seepage water that crystallized in and around the rubble and fossils, and was instrumental in preserving them for the future. Still later the fill of the main room settled, and the cemented spots were left as suspended remnants in which the fossils were exposed for discovery.

The Pleistocene filling period was closed by blocking of the original entrance "B" by large limestone boulders, making the cave uninhabitable (stage 2).

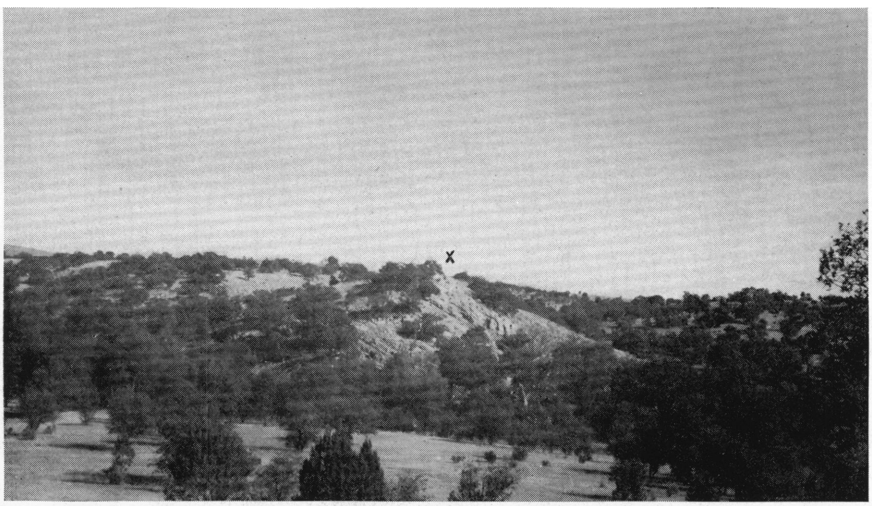


Fig. 2. Cave hill (X) in center background, showing tilted limestone beds forming the cave.

The present reopened entrance "B" leads through the loose, interlocked limestone blocks and is of recent origin. After this period, the uncemented deposits settled—caused, perhaps, by an earth shock, or by a gradual process of compaction, or by the collapse of a lower undiscovered room—and the lower fissures leading to the other passages of the cave were reopened (stage 3).

In Recent times, another entrance has reopened in the top of the north fissure (entrance "A") which was not open during late Pleistocene habitation of the cave. A Recent deposit of numberless rodent bones derived from owl pellets, as well as pottery shards, was found below this entrance. A test cut 7–10 feet deep disclosed that the underlying late Pleistocene matrix at this point was unfossiliferous, indicating that entrance "A" was closed during the earlier habitation period.

Many interesting conjectures may be brought forward to explain the use of the cave by the extinct pronghorns. They might have been attracted by its accumulated water, mineral salts, by its warmth in winter or in summer as a retreat from heat and flies. Nearly all of the remains are of fully mature animals, suggesting a seasonal use of the cave in winter, preceding fawning time (see page 201).

The great preponderance of remains of Quentin's Pronghorn over the other rarer forms may best be explained by the former's frequent use of the cave. The collection indicates the presence of at least 125 individuals of *Stockoceros*. The occurrence of articulated skeletons and the absence of carnivore-gnawed bones lead to the belief that the accumulation was not the work of predatory animals.

The type of *Stockoceros conklingi* came from a cave in the Organ Mountains of New Mexico, and a referred form of *Stockoceros onusrosagris* is reported from Burnet Cave, New Mexico. The three known occurrences of *Stockoceros* in caves may be indicative of its habitat, although this may be mere coincidence.

HUMAN ARTIFACTS ASSOCIATED ONLY WITH RECENT FAUNA

The occurrence of artifacts has been observed only in the superficial dust accumulated long after all of the aforementioned filling, settling, blocking of entrance "B" and partial reopening of entrance "A" had taken place.

Dr. Emil Haurey and Dr. Ned Spicer, of the Archaeological Department of the University of Arizona, who visited our 1940 expedition, were interested in the pieces of arrow shafts and the pottery shard we had recovered from the Recent dust lying on the older fossiliferous matrix. While showing them the places where the artifacts were found, we again uncovered pottery shards and several other arrow shafts, so recent that some still retained feathers and sinew wrappings (Figure 3). According to Mr. Nels C. Nelson of The American Museum of Natural History, the style of the shards places them in a period not over 900 years old, long after the Basket Makers. The pottery was plain, undecorated cooking ware, of the same style as the piece found in 1934 by Quentin Roosevelt and J. W. Burden,[1] who reported, "In the main room we found a piece of pottery and a bone crackled by fire." In a later paper on the cave fauna, Colbert and Chaffee[2] presumably interpreted this statement to imply an association of the artifacts with the fauna of the fossiliferous matrix. Insofar, however, as our extensive workings of the fossil matrix show no sign of artifacts, we can only suppose that the Roosevelt and Burden artifacts were also derived from the Recent fill.

[1] Roosevelt, Q., and Burden, J. W., 1934, Amer. Mus. Novitates, No. 754, p. 3.
[2] Colbert, E. H., and Chaffee, R. G., 1939, ibid., No. 1034, p. 1.

Detailed List of Artifacts
(Figure 3)

	F:A.M.[1]
Wooden arrow shaft with bow-string notch, distal sinew feather lashing in place, fragment of wooden fore-shaft still in socket; shaft length, overall, 730 mm.; shaft diameters, anterior of feather lashing, 8.7, center, 9.3, distal, 10.5 mm...	42760A
Partial wooden shaft, sinew for distal feather lashing preserved, shaft complete from distal lashing to fore-shaft socket; length ahead of feather lashing to socket, 510 mm.; diameters, at feather wrapping, 8.3, center, 9.3, socket, 10.0 mm....	42760B
Partial wooden shaft with central portion between feathers and socket; diameters, notch end, 7.7, center, 8.4, socket-end, 9.0 mm....	42760C
Partial reed shaft with portion of fore-shaft, base of fore-shaft tapered; diameter of reed, 9.0, fore-shaft, 6.5 mm....	42760D
Fragment of wooden shaft at notch end, some wrapping indicated....	42760E
Fragment of wooden shaft at notch end with sinew wrappings, feathers partially preserved, arranged with one in line with bow-string notch and others equally spaced from it, the feathers having about $\frac{1}{8}$-turn twist from distal to proximal lashing; diameter between lashings, 6.0, distance between lashings, 80.0 mm.	42760F
Fragments of 6 shafts (1 wooden and 5 reed)....	42760G–L
Worked, crooked stick, bark removed....	42760M
Pottery shards, undecorated, with moderately fine filler; one shard has carbon of camp fire on surface....	42760N–R
?Gourd shell....	42760S

The fauna collected from the Recent dust below entrance "A" (in association with some of the pottery shards) consist of species known from the region today. Generic identification can be made with assurance, but specific identification is doubtful in about half the examples, because of the incompleteness of the specimens and the great similarity in the teeth and mandibular rami in closely related species, for example, in *Reithrodontomys*.

Dr. J. Eric Hill of the Department of Mammalogy, American Museum of Natural History, has given generously of his time and knowledge in the painstaking identification of the Recent and fossil rodents and bats.

The Recent remains are represented by 11 genera or subgenera and 18 species. Rodents predominate, as evidenced by 8 genera, 1 subgenus and 18 species. They possibly represent a collection of prey brought in by owls from the surrounding region (not necessarily from the exact vicinity of the cave). Recent bat remains are not so plentiful as those of the late Pleistocene.

Rodentia	Occurrence[2]
Sciuridae (Squirrels)	
Citellus (*Otospermophilus*) *grammurus* (Say) (Rock Squirrel)....	N–
Geomyidae (Pocket Gophers)	
Thomomys sp. (may be either a form of the *bottae* or *umbrinus* groups; the teeth and fragmentary material do not make distinction practical)....	N

[1] F:A.M. = Frick Collection, American Museum of Natural History.
[2] Occurrence: N+ very numerous, N numerous, N– not numerous, R rare.

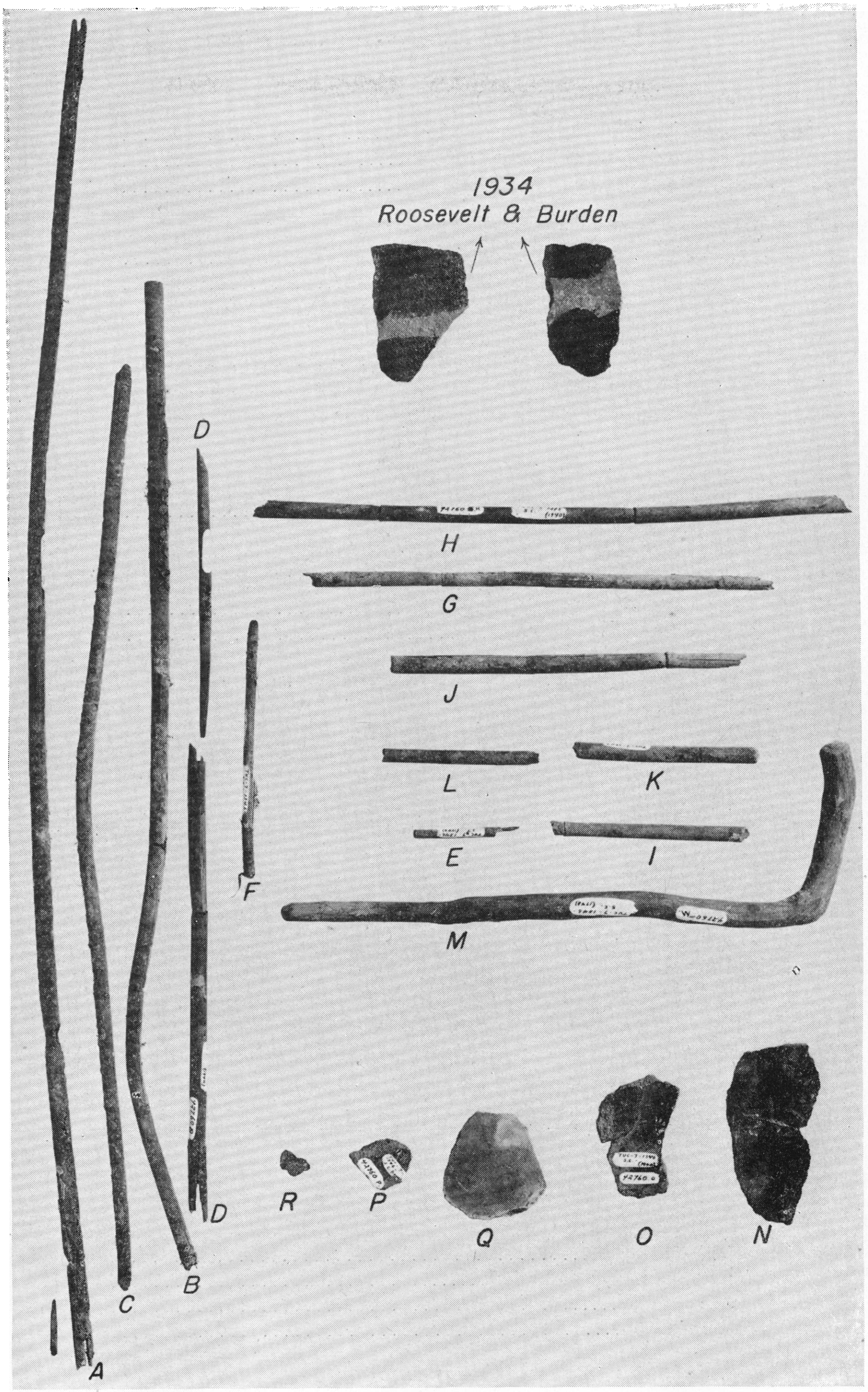


Fig. 3. Artifacts from Recent dust of the cave (F:A.M.42760A–R) and pottery shards found by Roosevelt and Burden in 1934 (these specimens discolored by shellac). Approx. × ¼.

HETEROMYIDAE (Pocket Rats and Mice)	
Dipodomys merriami Mearns (Kangaroo Rat)...........................	N
Perognathus baileyi Merriam (Pocket Mouse)...........................	N+
Perognathus apache Merriam (Pocket Mouse)...........................	N
CRICETIDAE (Native Rats and Mice)	
Neotoma (?)*mexicana* Baird or *N.*(?)*albigula* Hartley (Pack Rat)..........	N–
Onychomys leucogaster (Weid) (Grasshopper Mouse).....................	N–
Reithrodontomys (?)*megalotis* (Baird) or *R.* (?)*albescens* Cary (Harvest Mouse)	N–
[Note: *R.* (?)*albescens* unrecorded from this area.]	
Sigmodon hispidus Say and Ord (Cotton Rat)..........................	N–
Peromyscus maniculatus (Wagner) (White-footed Mouse).................	N–
Peromyscus (?) *boylii* (Baird) or *P.* (?)*truei* (Shufeldt) (White-footed Mouse)	N–
INSECTIVORA	
SORICIDAE (Shrews)	
Genus indet. (part of one ramus).......................................	R
CHIROPTERA (Bats)	
VESPERTILIONIDAE (small to medium-sized bats)	
Myotis (?)*evotis* (H. Allen) (Little Long-eared Bat).......................	R
Myotis (?)*velifer* (Allen) (Cave Bat)..................................	R

LATE PLEISTOCENE FAUNA

INVERTEBRATA

Five species of land snails were found in the fossiliferous matrix of the cave. Dr. Henry A. Pilsbry of the Academy of Natural Sciences of Philadelphia, who kindly identified the material, remarks[1] of the assemblage:

"It seems that they afford little information as to dating the deposit, except that they indicate very late Pleistocene or later, since all are Recent species known from the region around Patagonia and in the Canelo Hills. It is thus a foothills fauna, such as lives in hills below the well-wooded mountain zone of the Huachucas, but with oak, etc., and not the well known desert flora."

Dr. Pilsbry's conclusions are further supporting evidence that *Stockoceros* was probably a mountain- rather than a plains-dwelling antelope.

The following is a list of Dr. Pilsbry's determinations:

REFERRED.—

	F:A.M:I.P.
HELICIDAE	
Helicodiscus singleyanus Pils..	25379
Retinella indentata paucilrata (Morelet).................................	25380
Sonorella huachucana Pils..	25378
Thysanophora horni Gabb..	25381
UROCOPTIDAE	
Holospira ferrissi Pils...	25377

[1] Personal communication.

VERTEBRATA

Statement

The late Pleistocene fauna of Papago Springs Cave is represented by 29 genera, 4 of which (or 14%) are extinct, and 34 species or subspecies, 10 of which (or 30%) are extinct and 3 species of which (or 9%) are not living in the region today. The degree of extinction is most pronounced in the larger mammals; the bats and rodents have not changed appreciably.

The following is a tabular list[1] of the cave's vertebrates:

Aves

1 **_Ibis_-like bird

Mammalia

Rodentia

2 **_Marmota flaviventris_
3 _Citellus (Otospermophilus) variegatus_
4 _Eutamias_ (?)_dorsalis_
5 _Thomomys_ (?)_bottae_ or (?)_umbrinus_
6 _Perognathus_ (?)_apache_
7 _Neotoma_ (?)_mexicana_ or (?)_albigula_
8 _Onychomys_ (?)_leucogaster_
9 _Microtus_ (?)_mexicanus_
10 _Peromyscus maniculatus_
11 " (?)_boylii_ or (?)_truei_

Lagomorpha

12 _Lepus californicus_
13 _Sylvilagus auduboni_

Chiroptera

14 _Myotis_ (?)_velifer_
15 " (?)_thysanodes_
16 " (?)_evotis_
17 _Corynorhinus_ (?)_rafinesquii_
18 _Antrozous pallidus_
19 _Tadarida_ (?)_mexicana_

Carnivora

20 *†_Ursus americana gentryi_, n.subsp.
21 *_Canis caneloensis_, n.sp.
22 " _nubilus_
23 _Urocyon cineroargenteus_
24 *† _Taxidea taxus papagoensis_, n.subsp.
25 _Mephitis occidentalis_
26 _Spilogale arizonae_
27 *_Bassariscus sonoitensis_, n.sp.

Perissodactyla

28 ***_Equus conversidens_
29 ***_Equus tau_

Artiodactyla

30 ***_Platygonus alemanii_
31 * _Bison taylori_
32 **_Cervus_ sp.
33 ***Camel sp.
34 ***_Stockoceros onusrosagris_

The apparent absence of such typical Pleistocene forms as Felidae, *Arctotherium, Megalonyx, Mylodon, Nothrotherium,* tapir, mammoth, mastodon and musk ox, is presumably a matter of chance and may not necessarily be considered as evidence of their extinction before the time when fossils were accumulating in the cave.

A generalized table summarizing the number of living and extinct genera and species in some of the better known Pleistocene cave faunas of North America is particularly interesting in one respect. The extinction of genera would appear to be more characteristic of faunal antiquity than the extinction of species. The arrangement of the table does not attempt to indicate the relative ages of the faunas.

[1] Single asterisk and dagger (*†) signifies the subspecies is extinct; one asterisk (*), the species is extinct; two asterisks (**), not living in region today; three asterisks (***), the genus is extinct.

TABLE I

	Total genera	Extinct genera included	Percent extinct	Total species or sub-species	Extinct species or sub-species included	Percent extinct
Williams Cave (Tex.)............	19	3	16	22	3	13
Burnet Cave (N. Mex.)	32	8	25	43	10	23
Papago Springs Cave (Ariz.).....	29	4	14	34	10	29
Samwel Cave (Calif.)............	28	6	21	34	12	35
Conard Fissure (Ark.)...........	37	4	11	51	24	47
Potter Creek Cave (Calif.).......	37	9	24	44	21	48
Hawver Cave (Calif.)............	22	7	32	24	12	50
Cumberland Cave (Md.).........	41	8	20	46	28	61
Port Kennedy Fissure (Pa.)......	36	10	30	47	29	62

AVES

CICONIIFORMES

(Herons, Storks, Flamingos and Ibises)

Threskiornithoidae

Genus indet.

REFERRED.—

F:A.M:R.

One furcula.. 7017

This specimen closely resembles some of the ibises and, to a lesser degree, some of the shore birds. It does not resemble the owls and hawks.

One fragmental tibia or radius.. 7017A

MAMMALIA

RODENTIA

Nine genera and from 10 to 13 species of fossil rodents are known from Papago Cave. With the exception of *Marmota* (which has changed its habitat), all are known to be living in the general region today and are quite comparable to Recent forms. The most southern occurrence of Recent *Marmota* is 350 to 400 miles north of the cave in the high mountains of New Mexico. The retreat of the marmot population suggests that since late Pleistocene the climate of southern Arizona has become too warm or dry for *Marmota*.[1]

[1] Wilson, R. W., 1942, Carn. Inst. Wash. Pub., VI, p. 173. The flora of Rampart Cave appears to be essentially the same as today. The presence here of *Marmota*, however, is explained by favorable topographic conditions unlike those in southern Arizona.

Sciuridae

Marmota flaviventris (Audubon and Bachman)

Discussion

Marmots were found throughout the Pleistocene deposition of the cave, but not in the Recent dust. The great size range in the fossil collection is duplicated in a modern marmot collection (made by G. G. Goodwin in 1936) from the Rio Blanco district, Colorado, 400 miles northeast of Papago Springs Cave and at an elevation of 6,500 feet. The variation in the size of skulls and jaws having mature dentition is pronounced (Figure 4). The size of the skull and mandible of *Marmota* continues to increase for some time after the permanent dentition appears. The size and diameter of the incisor increase gradually with age, but those of the molars and premolars are constant characters, not affected by age.

Table II.—Comparative Measurements of Smallest and Largest Skulls and Mandibular Rami, Showing Age Variation (Figure 4)

(Millimeters)

	Minimum (Mature?) F:A.M. 42826	Maximum (Old?) F:A.M. 42833	Minimum/Maximum %
Skulls:			
Length, overall	77.5	96.8	80
" basilar	64.5	83.5	77
Interorbital width	15.5	24.4	62
Postorbital constriction	19.0	15.0	126
Mastoid width	34.2	45.1	76
Rostral width	15.5	22.3	70
Ant. of I/ to post. of M^3	42.2	53.1	80
I/–P^3, diastema	17.7	24.2	73
P^3–M^3	19.9	20.5	97
Alv. diam. of Is/:			
anteroposterior	4.5	7.2	63
transverse	3.2	5.0	64
		F:A.M. 42840	
Mandibular Rami:			
Post. of condyle to post. of /I alv.	48.2	61.5	79
Depth of mandible at post-symphysis	7.1	11.0	65
Diastema, /I–P_4	11.0	16.0	69
P_4–M_3	18.2	18.7	98

One hundred and fourteen specimens:

Referred.—

	F:A.M.
Skeleton with skull, mandible, two humeri, two radii and ulnae, two femora and tibiae, scapula, pelvis, misc. vertebrae, ribs and foot bones. (Represents smallest mature individual, probably female.) *Fig. 4*	42826

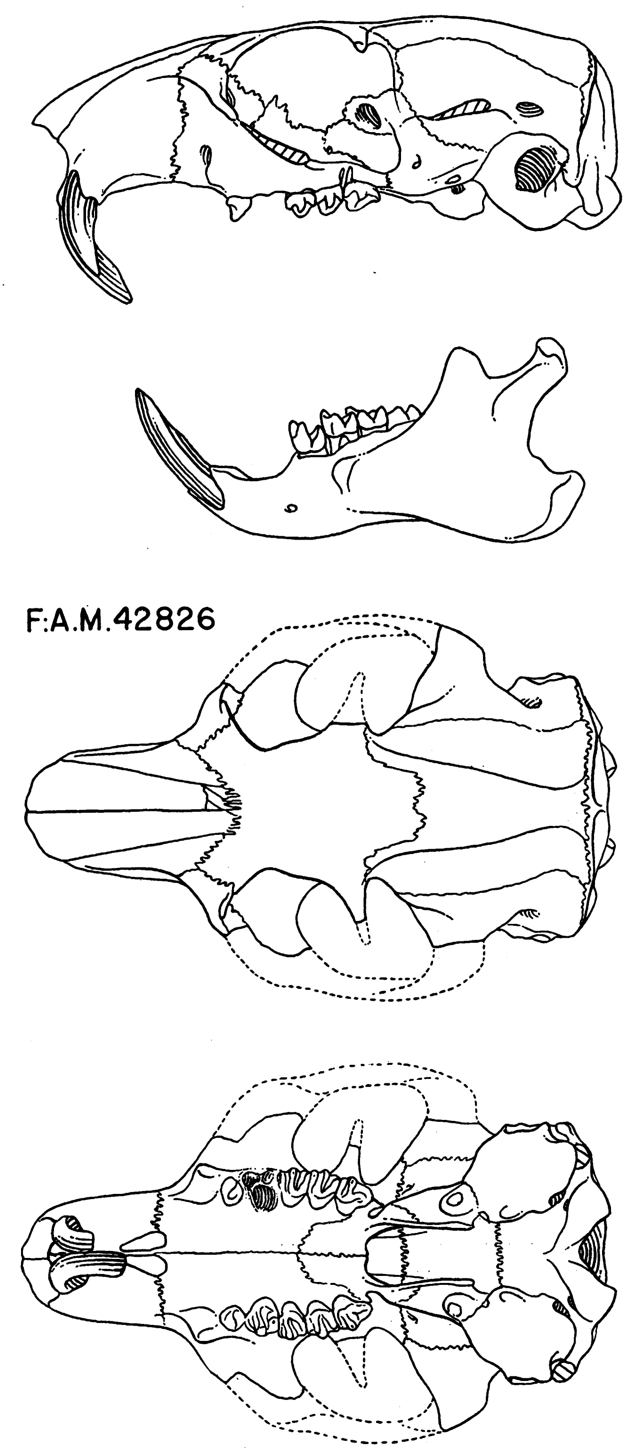


Fig. 4. *Marmota flaviventris* (Audubon and Bachman), ref., showing size variation from young to old. Small associated skull and mandible, F:A.M.42826. × 1. (See opposite page.)

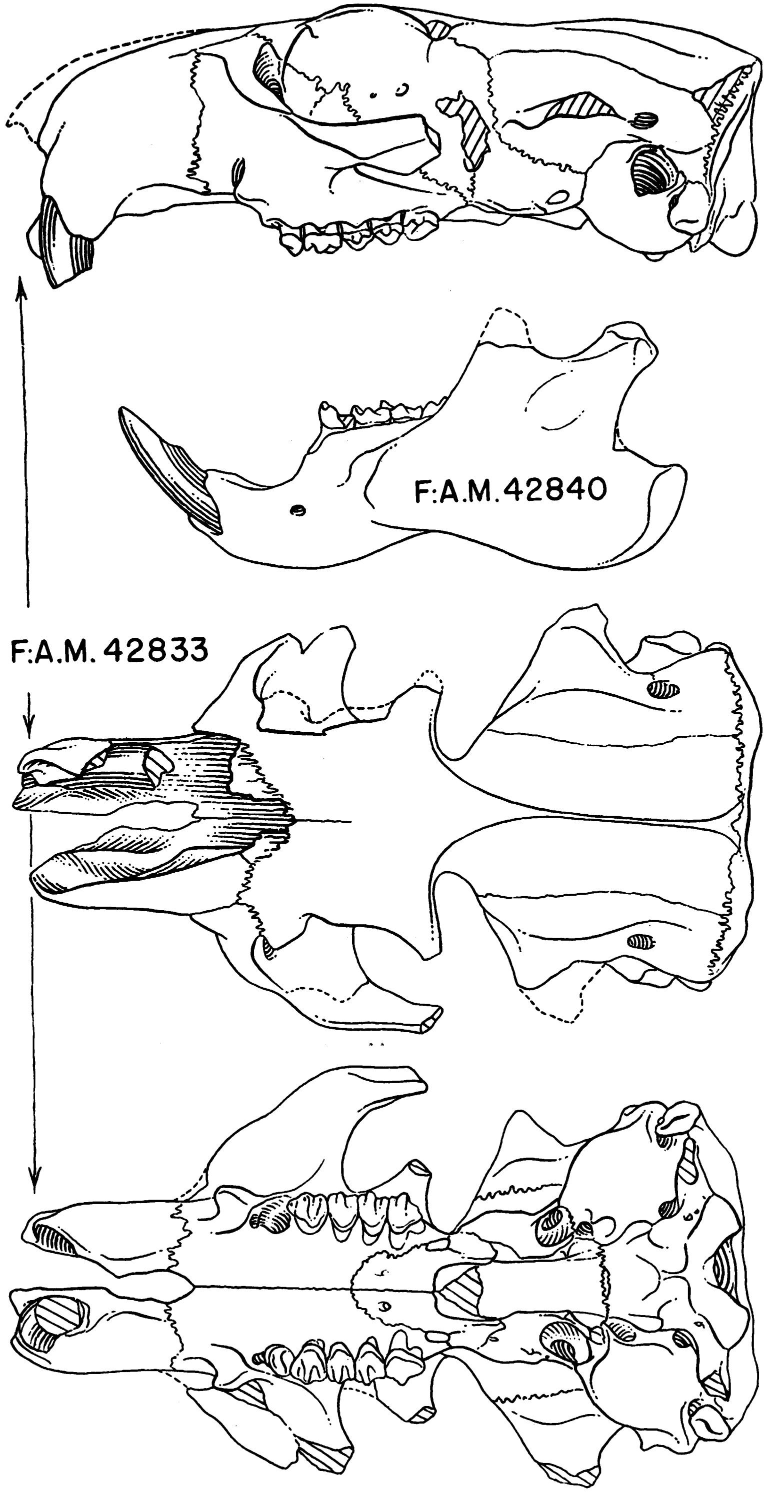


Fig. 4 (cont.; see legend opposite). Large skull, F:A.M.42833, and mandibular ramus, F:A.M.42840. × 1.

Associated skull, mandible, two humeri, two radii, two scapulae and misc. foot bones	42828
Associated immature partial skeleton with partial skull and mandible	42829
Nine complete or partial skulls with Is/ and P^3–M^3 or alveoli (42833, largest, *Fig. 4*)	42830–8
Six fragmental skulls and partial crania	42839–A–E
Twenty partial right and left maxillae, misc. detached Is/	42839F
Thirty-eight complete or partial left rami, /Is and P_4–M_3 or alveoli. (42840, *Fig. 4*)	42840–A–Z 42841–A–J
Thirty-eight complete or partial right rami, /Is and P_4–M_3 or alveoli	42842–A–Z 42843–A–J
Numerous detached limbs, ribs, vertebrae, etc.	42827

	Rami	Maxillae	F:A.M.
Rodentia			
Sciuridae (Squirrels)			
Citellus (*Otospermophilus*) *variegatus* (Say), ref. (Rock Squirrel)	3		42871
Eutamias (?)*dorsalis* (Baird), ref. (Chipmunk)	2		42872
Geomyidae (Pocket Gophers)			
Thomomys (?)*bottae* (Eydoux and Gervais) or *T.* (?)*umbrinus* Richardson, ref. (Pocket Gophers)	4		42870
Heteromyidae (Pocket Rats and Mice)			
Perognathus (?)*apache* Merriam, ref. (Pocket Mouse)	1 (pt.)		42873
Cricetidae (Native Rats and Mice)			
Neotoma (?)*mexicana* Baird or *N.* (?)*albigula* Hartley, ref. (Pack Rat)	12	1 (pt.)	42875
(Note: The material does not permit a satisfactory separation of these closely related groups.)			
Onychomys (?)*leucogaster* (Weid), ref. (Grasshopper Mouse)	1 (pt.)		42877
Microtus (?)*mexicanus* Bailey, ref. (Meadow Mouse)	6	1 (pt.)	42876
Peromyscus maniculatus (Wagner), ref. (White-footed Mouse)	29	1 (pt.)	42874
Peromyscus (?)*boylii* (Baird) or *P.* (?)*truei* (Shufeldt), ref. (White-footed Mouse)	19		42882
(Note: The material does not permit a satisfactory separation of these closely related groups.)			

LAGOMORPHA

The Lagomorphs are represented by rare remains of mandibular rami. The jack rabbit of the cave fauna compares well with either *L. californicus deserticola* or *L. californicus eremicus* and seems to have wider and larger teeth than *L. californicus texianus* found in Texas and farther to the north. The cottontail compares with *S. auduboni minor* but not with *S. auduboni warreni* found in northern Arizona.

Leporidae

Lepus californicus Gray

(Jack Rabbit)

Referred.—

	F:A.M.
Right ramus with /I alv., P_3–M_3	42852
Right ramus with /I, P_3–P_4	42853

The rami compare more readily with the California than with the Texas races.

Misc. detached partial limbs	42856

Sylvilagus auduboni (Baird)

(Cottontail)

Referred.—

	F:A.M.
Right ramus with /I, P_3–M_3	42854
Right ramus with /I alv., P_3 alv., P_4–M_2, M_3 alv	42855

CHIROPTERA

Fossil bats, represented by 4 genera and 6 species, are all comparable to living forms known from the general region today. Their remains are chiefly represented by mandibular rami. Our more extensive working of the fossil matrix than of the Recent dust may account for the larger fossil fauna.

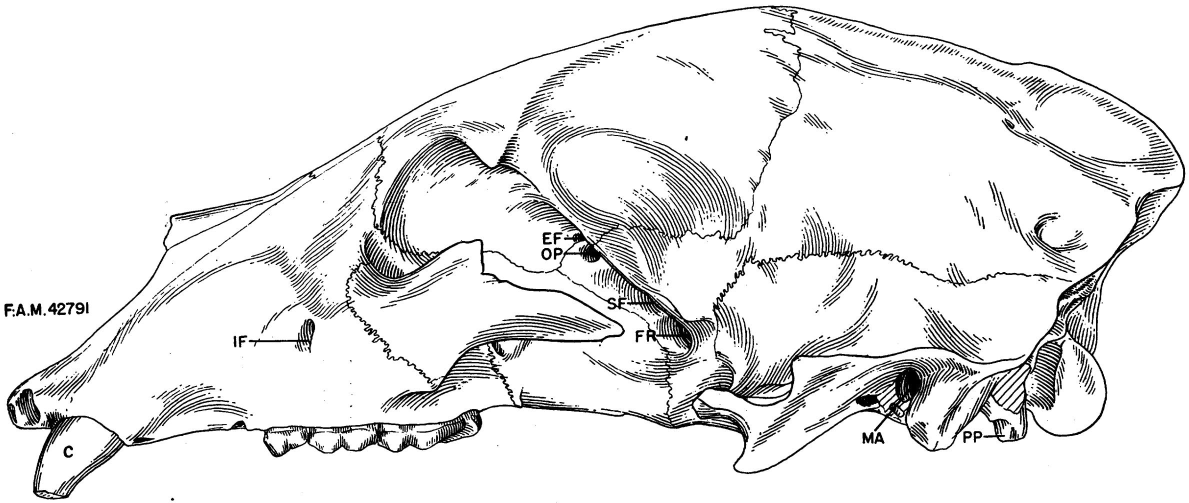
	Rami	F:A.M.
Chiroptera		
vespertilionidae (small to medium-sized bats)		
Myotis (?)*velifer* (Allen), ref. (Cave Bat)	23	42866
Myotis (?)*thysanodes* Miller, ref. (Fringed Bat)	12	42865
Myotis (?)*evotis* (H. Allen), ref. (Little Long-eared Bat)	4	42864
Corynorhinus (?)*rafinesquii* (Lesson), ref. (Lump-nosed Bat)	1	42867
Antrozous pallidus (Le Conte), ref. (Big-eared Bat)	2	42869
molossidae (Free-tailed Bat)		
Tadarida (?)*mexicana* (Saussure), ref. (Mexican Free-tailed Bat)	3	42868

CARNIVORA

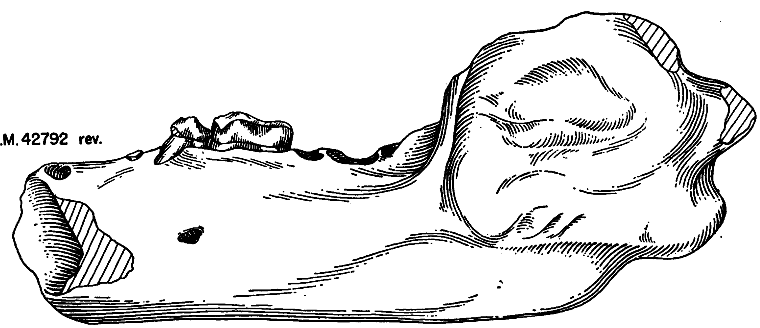
Carnivora are represented in the fauna by 7 genera and 8 species or subspecies, 50% of which are of extinct forms. *Bassariscus sonoitensis,* n.sp., and *Canis caneloensis,* n.sp., are exampled by well-preserved skulls exhibiting characters distinct from living species. *Urus americanus gentryi,* n.subsp., and *Taxidea taxus papagoensis,* n.subsp., are variations of living species.

The complete absence of representatives of the Felidae and the relative scarcity of other predatory carnivores is noteworthy.

F:A.M. 42791



F:A.M. 42792 rev.



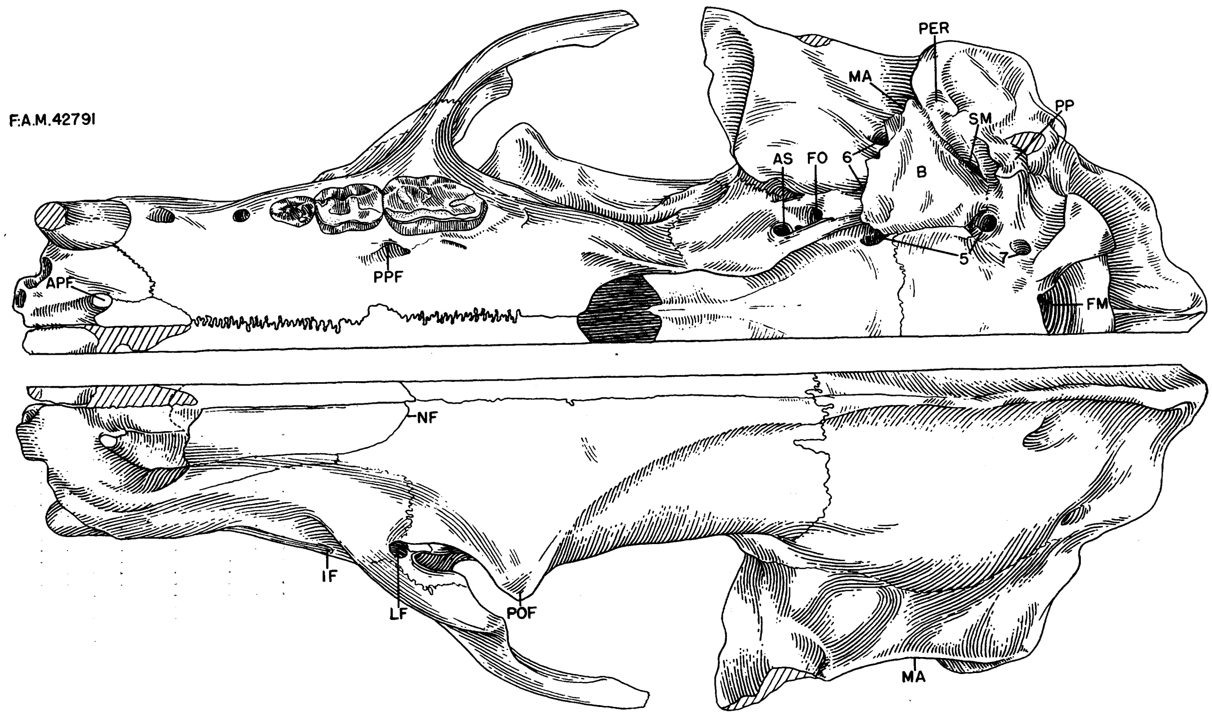


Fig. 5. *Ursus americanus gentryi*, n.subsp., holotype skull, F:A.M.42791, and ref. mandibular ramus, F:A.M.42792. × ½.
APF = anterior palatine foramen; AS = posterior opening for alisphenoid canal; B = auditory bullae; EF = ethmoidal foramen; FM = foramen magnum; FO = foramen ovale; FR = foramen rotundum; IF = infraorbital foramen; LF = lacrimal foramen; MA = external auditory meatus; NF = nasal-frontal suture; OP = optic foramen; PER = mastoid portion of the periotic; POF = postorbital process of the frontal bone; PP = paroccipital process; PPF = postpalatine foramen; SF = sphenoidal fissure; SM = stylomastoid foramen; 5 = lacerate foramina; 6 = glenoid foramina; 7 = condylar foramen.

Ursidae

Ursus americanus gentryi,[1] new subspecies

SUBSPECIFIC CHARACTERS

SKULL.—Equal to that of *U. a. americanus* in size, but palate and rostrum exceptionally wide; C/–P^4 diastema relatively long; the palate posterior to M^2 heavy and posteriorly extended; pterygoid region extremely heavy and interpterygoid fossa relatively narrow.

DENTITION.—The teeth of the holotype, F:A.M.42791, are moderately worn but are relatively narrow and small for the size of the skull; the enamel is smooth with a bare indication of a cingulum; the deuterocone is situated posteriorly on the P^4.

DISCUSSION

The skull, F:A.M.42791 (Figure 5), is chosen as the holotype. The variability of the modern Black Bear makes the determination of exact subspecific characters difficult. Hall[2] and Allen[3] have presented useful tables of measurements of some of the living subspecies of *U. americanus* which were compared with *U. americanus gentryi*. Examples of *U. a. americanus* in the Department of Mammalogy, American Museum, were also studied, and those which were similar to the holotype have been included in the subjoined table.

TABLE III.—COMPARATIVE MEASUREMENTS OF SKULLS OF *U. americanus gentryi* AND *U. americanus*

(Millimeters)

	U. americanus gentryi	*U. americanus*		
	Arizona	Texas	Oregon	Minnesota
	F:A.M. 42791	A.M:M. 8803	A.M:M. 1997	A.M:M. 34966
Length, overall	310.0	303.0	297.5	289.0
" basilar	268.3	275.7	262.5	255.7
Width, mastoid	142.1	134.9	140.0	130.2
Width of rostrum outside of alveolar border of C/	67.0	66.2	65.5	62.5
Median palatal length	145.0	146.5	138.5	138.5
Transverse width of pterygoid at narrowest point	46.5	44.1	40.1	44.5
Tooth row, ant. C/–M^2 incl.	112.0	104.6	96.6	102.4
C/–P^4 diastema	36.5	26.5	21.5	24.4
P^4–M^2	56.2	57.9	55.1	57.3
P^4 length	11.2	11.5	11.8	12.6
width	8.0	8.7	9.7	9.0

[1] Named in honor of Howard Scott Gentry, who has collected in the Southwest for the Frick Laboratory.
[2] Hall, R. E., 1928, Univ. Calif. Pub. in Zool., XXX, No. 10, p. 231.
[3] Allen, J. A., 1909, Bull. Amer. Mus. Nat. Hist., XXVI, p. 233.

Seven specimens were found:

	F:A.M.
HOLOTYPE.—Skull, lacking zygomatic arches and Is/, with C/, P^4–M^2. *Fig. 5*....	42791

REFERRED.—

Left ramus with /C alv., P_1 alv., P_3 rt., P_4–M_1, M_2–M_3 alv. *Fig. 5*.............	42792

This ramus is exceptionally deep below the diastema and is too large to be associated with the type skull. The teeth are moderately worn and relatively narrow.

MEASUREMENTS, F:A.M.42792

Post. edge of condyle to /C	186.0 mm.
Depth at postsymphysis	45.0
/C–P_4 diastema	34.0
P_4–M_3 alveolar border	69.0
P_4 length	10.9
width	6.3
M_1 length	20.5
width	10.0

Misc. detached teeth	42793
Left humerus, articular length = 313 mm	42794
Proximal fragment of left humerus	42794A
Right femur, articular length = 351 mm	42795
Misc. metacarpi and phalanges	42796

Canidae

Canis caneloensis,[1] new species

SPECIFIC CHARACTERS

SKULL.—Equal in size to that of Recent *Canis estor* and other small species of coyote; posterior palate and face relatively wider proportioned in relation to the muzzle; bullae more inflated and larger than in *C. estor*.

DENTITION.—P^1 uncrowded but P^2–P^4 incl. placed closely together. P^4 tending heavier and wider transversely across the protocone which is more prominent than in *C. estor*. M^1 distinguished by the smaller, less crescent-shaped hypocone, which is more posteriorly and transversely placed than in *C. estor;* protoconule weakly indicated; M^2 slightly wider transversely; hypocone smaller and protoconule not so well developed as in *C. estor*.

DISCUSSION

The holotype of *Canis caneloensis*, F:A.M.42800 (Figure 6), is a coyote-like canid, slightly more robust and heavy-proportioned than the small *Canis estor* found in the region today. Some of the tooth and facial characters suggest a

[1] Named after the Canelo Hills in the Coronado National Forest, Arizona.

wolf-like affinity, although the specimen is too small to be considered as such. *C. caneloensis* is smaller than *C. ochropus*, *C. lestes* and *C. nebracensis*, with the same difference in tooth characters as observed in *C. estor*, particularly in the size and shape of the hypocone.

When compared to canids from the Pleistocene of Rancho La Brea, *C. caneloensis* is smaller than *C. furlongi*, *C. orcutti* and *C. milleri*, but is somewhat larger, with a larger P^4, than *C. andersoni*, which appears to be the species most closely related to the Papago Springs Cave specimen.

TABLE IV.—COMPARATIVE MEASUREMENTS OF SKULLS OF *C. caneloensis* AND *C. estor*

(Millimeters)

	C. caneloensis F:A.M. 42800	*C. estor* (New Mexico) A.M:M. 1310	A.M:M. 1312	A.M:M. 1313
Length, overall	184.5	200.0	185.7	184.8
" basilar	162.2	166.5	167.3	161.5
Width, zygomatic (max.)	97.2	95.4	97.0	93.8
Facial width at infraorbital foramina	32.2	33.8	34.7	32.2
Outside facial width between P^4 and M^1	57.6	53.8	52.0	49.7
P^4 length (max.)	19.4	20.0	19.2	18.8
width across protocone	10.5	8.0	8.4	9.0
M^1 length (max.)	13.0	12.3	12.0	11.6
width (max.)	15.5	15.5	14.6	14.0
M^2 length (max.)	7.4	7.9	8.0	7.0
width (max.)	11.2	10.5	10.4	10.3

	F:A.M.
HOLOTYPE.—Skull complete with I^1–P^3 alv., P^4–M^2. *Fig. 6*	42800

REFERRED.—

Partial left maxilla with M^1–M^2	42803
Partial left ramus with P_2–P_4	42801
Fragment of left ramus	42802
Partial humerus and misc. isolated foot bones	42807

Canis nubilus Say

(Gray Wolf)

The specimens compare favorably with a moderate sized Gray Wolf and are distinct from the smaller *C. caneloensis*.

REFERRED.—

	F:A.M.
Atlas	42798
Isolated left P_4 and M_2	42798A
Left 4th metacarpus, overall length = 86.2 mm.	42798B
Left 3d metatarsus, overall length = 79.5 mm.	42798C
Misc. fragments	42798D

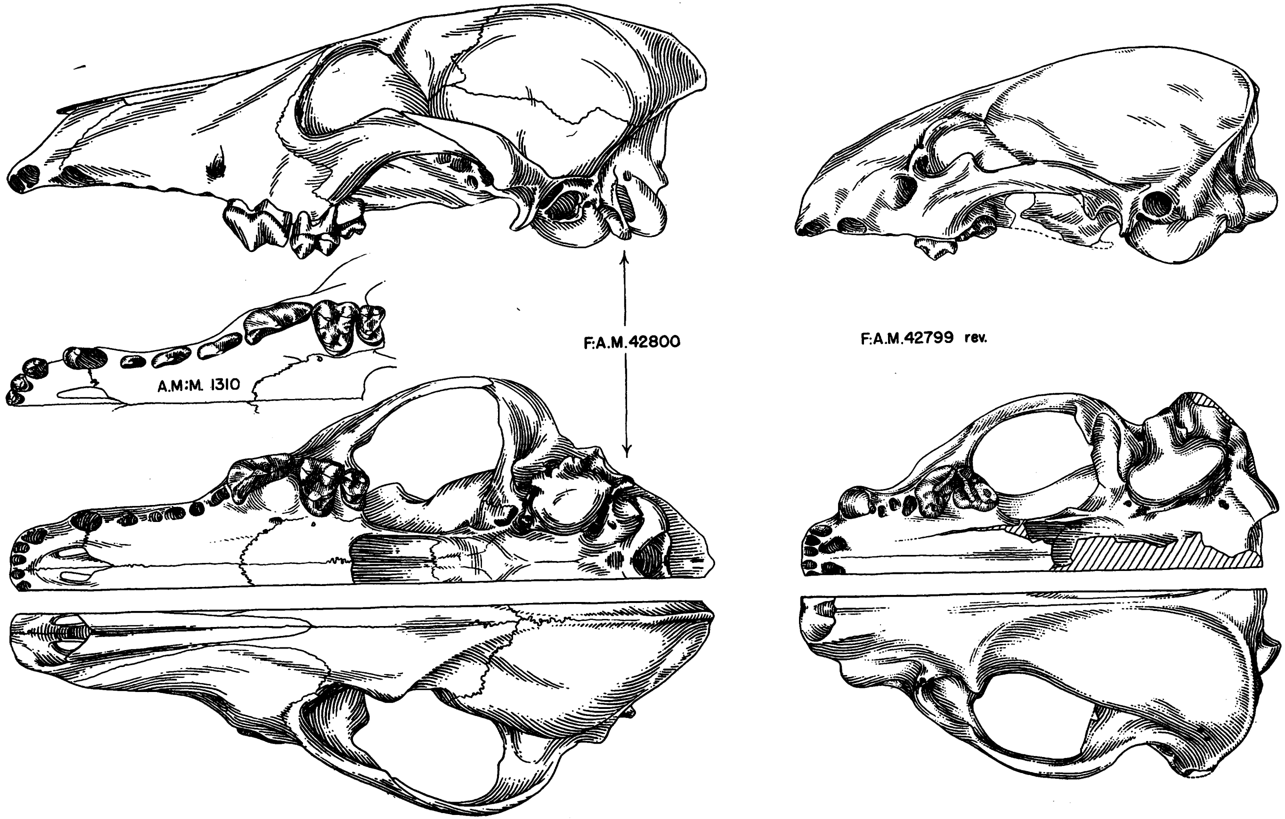


Fig. 6. *Canis caneloensis*, n.sp., holotype skull, F:A.M.42800; comparative dentition of *C. estor* Merriam, A.M:M.1310; ***Taxidea taxus papagoensis***, n.subsp., holotype skull, F:A.M.42799. × ½.

Urocyon cineroargenteus (Schreber)

(Gray Fox)

REFERRED.—

	F:A.M.
Partial skull with P^2–P^3 alv., P^4, M^1 alv., M^2, rostrum lacking	42805
Three partial rami with teeth missing	42804–A,B
Misc. isolated limbs	42806

Mustelidae

Taxidea taxus papagoensis,[1] new subspecies

SUBSPECIFIC CHARACTERS

SKULL.—Equal in size to *Taxidea taxus taxus*, but more brachycephalic.

DENTITION.—P^2–P^3 crowded, P^4–M^1 much like those of *T. taxus taxus*, but slightly larger in relation to the size of the skull.

DISCUSSION

The holotypic skull, F:A.M.42799 (Figure 6), displays brachycephalic tendencies that are not duplicated in the modern collections of the American Museum (see Table V). The difference, although small, appears to be of subspecific importance.

TABLE V.—COMPARATIVE MEASUREMENTS OF SKULLS OF *T. taxus papagoensis* AND *T. taxus taxus*

(Millimeters)

	T. taxus papagoensis Arizona F:A.M. 42799	*T. taxus taxus* Canada A.M:M. 15636	*T. taxus taxus* Wyoming A.M:M. 15577
Length, overall	125.3	129.5	129.5
" basilar	112.2	116.3	116.0
Width, zygomatic	85.0	83.0	85.0
" interorbital (min.)	35.0	30.6	31.5
" postorbital process (max.)	45.0	36.0	38.7
" " constriction	33.0	29.0	30.0
Tooth row, ant. C/–M^1 incl.	41.5	42.9	43.0

Two specimens: F:A.M.

HOLOTYPE.—Skull (lacking left arch and basal cranium), I^1–P^3 alv., P^4–M^1. *Fig. 6* 42799

REFERRED.—

Left tibia, articular length = 76.6 mm. 42863

[1] Named after the Papago Springs Cave.

Mephitis occidentalis Baird

(Large Striped Skunk)

REFERRED.—

	F:A.M.
Posterior portion of skull	42844
FIVE MANDIBULAR RAMI	
Left ramus with /C alv., P_2–M_1, M_2 alv.	42845
Left ramus with /C, P_2, P_3 alv., P_4–M_1, M_2 alv.	42846
Left ramus with /C–P_2 alv., P_3–M_1, M_2 alv.	42847
Right ramus with /C, P_2 alv., P_4–M_2	42848
Right ramus with /C–P_3 alv., P_4–M_1, M_2 alv.	42849

Spilogale arizonae Mearns

(Arizona Spotted Skunk)

REFERRED.—

	F:A.M.
TWO MANDIBULAR RAMI	
Left ramus with /C, P_2–M_2	42850
Partial left ramus with /C–P_2 alv., P_3–P_4, M_1–M_2 alv.	42851

Bassariscidae

Bassariscus sonoitensis,[1] new species

SPECIFIC CHARACTERS

SKULL.—Equal to that of *Bassariscus astutus* in size; muzzle tending more robust but having more characters in common with *B. astutus* than with *B. sumichrasti*, which averages larger than the holotypic skull, F:A.M.42857 (Figure 7).

DENTITION.—As compared to *B. astutus*, the P^2 and P^3 tend to be heavier; the P^4 tending slightly heavier and different in proportion, the metaconule more posteriorly placed; the M^1 protocone somewhat larger and more anteriorly placed, the hypocone not so strongly crescent-shaped, the metaconule well developed. The M^1 of *B. sonoitensis* has a rectangular rather than a triangular outline when viewed from the palatal side. In *B. astutus*, the more triangular-shaped M^1 constitutes the character which most readily distinguishes the two species.

As compared to *B. sumichrasti*, the P^2 and P^3 are nearly equal in size. The protocone of P^4 in *B. sumichrasti* is much larger and lingually extended and the metaconule reduced or lacking, causing a different shaped carnassial which easily distinguishes *B. sumichrasti* from *B. sonoitensis* or *B. astutus*. M^1 of *B. sumichrasti* is also distinctive, has a more expanded central valley and is

[1] Named after the town of Sonoita, Arizona, near Papago Springs Cave.

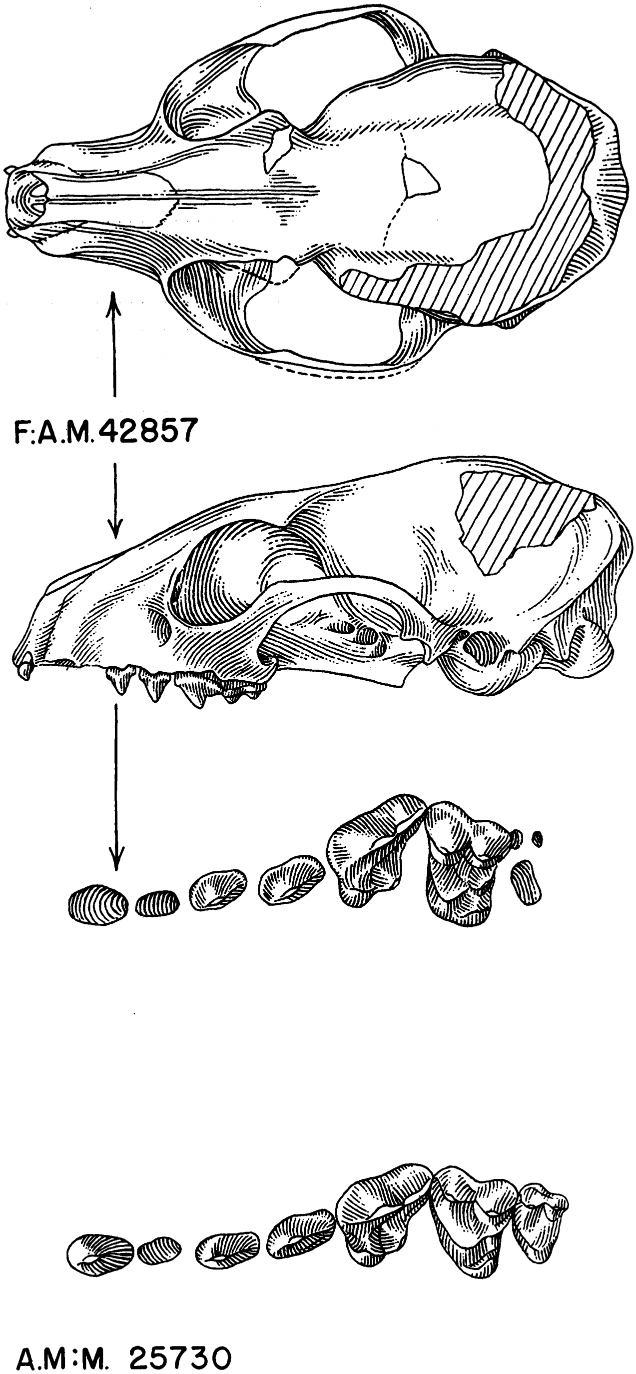


Fig. 7. *Bassariscus sonoitensis*, n.sp., holotype skull, F:A.M.42857, and comparative dentition of *Bassariscus astutus* (Lichtenstein), A.M:M.25730. Skull × 1, dentitions × 2.

larger than M^1 of either *B. sonoitensis* or *B. astutus.* M^2 of the holotype of *B. sonoitensis* is not preserved but that of *B. sumichrasti* is larger than *B. astutus.* The cones of the molars of *B. sumichrasti* tend to be lower and more rounded than those of either *B. sonoitensis* or *B. astutus.*

Discussion

B. sonoitensis was compared with a large series of Recent skulls of *B. astutus* and *B. sumichrasti* in the Department of Mammalogy, American Museum. Recent specimens of *B. astutus* from Arizona, Texas and California were found to differ noticeably from *B. sonoitensis* in tooth characters and general size, but specimens from Jalisco, Mexico, approached it (Figure 7). *B. sonoitensis* has tooth characters that appear to place it between *B. astutus* and the Central American species, *B. sumichrasti,* which has been considered subgenerically or even generically separate from *B. astutus.*

Table VI.—Comparative Measurements of Skulls of *B. sonoitensis* and *B. astutus*

(Millimeters)

	B. sonoitensis Arizona *Fig. 7* F:A.M. 42857	Mexico *Fig. 7* A.M:M. 25730	*B. astutus* Arizona A.M:M. 587	Texas A.M:M. 10649
Length, overall	80.1	81.8	77.2	78.4
" basilar	73.8	77.1	69.6	74.2
Length, ant. C/ alv. to post. M^3 alv.	31.2	31.8	30.6	31.1
P^2 width (max.)	2.2	1.9	1.8	2.0
length "	4.0	4.1	3.5	3.7
P^3 width "	2.4	2.2	2.1	2.2
length "	4.5	4.4	3.6	4.0
P^4 width "	5.2	5.4	5.3	4.8
length "	7.1	7.6	7.0	6.9
M^1 width "	7.7	7.5	7.2	6.8
length "	5.9	5.5	5.4	5.1

	F:A.M.
Holotype.—	
Skull complete with I^1–I^2 alv., I^3, C/ alv., P^1 alv., P^2–M^1, M^2 alv. (*Fig. 7*)	42857
Referred.—	
Skull (lacking arches and tip of premaxilla) with I^3, C/–P^1 alv., P^2–M^1, M^2 alv.	42858
TWO MANDIBULAR RAMI	
Left ramus lacking teeth with /C–M_2 alv.	42859
Left ramus with /C erupt., dP_{3-4}, M_1 germ	42860

LIMBS

Right humerus, articular length = 64.0 mm.	42861
Left humerus, articular length = 65.7 mm.	42861A
Left humerus, articular length = 65.0 mm.	42861B
Left femur, articular length = 73.2 mm.	42861C
Left tibia, articular length = 69.5 mm.	42861D

PERISSODACTYLA

Equidae

Equid remains are rare but indicate the presence of two forms—a medium-sized, heavy-limbed horse and a very small form that closely approach Owen's types of *Equus conversidens* and *Equus tau* from the Valley of Mexico. *E. conversidens* is represented by parts of an associated skeleton and other isolated remains, *E. tau* by a single phalanx.

Equus conversidens Owen

Equus conversidens Owen, 1869, Phil. Trans., CLIX, p. 563, Pl. lxi, Fig. 1. Gidley, 1901, Bull. Amer. Mus. Nat. Hist., XVI, p. 18, Pl. xxi. Hay, 1915, Proc. U. S. Nat. Mus., LXVIII, No. 2086, p. 535.

Referred (Presumably Associated).—

	F:A.M.
Skull (♂), complete and uncrushed. *Fig. 8*	42810
Right and left mandibular dentitions, P_2–M_3	42812
	42813
Left humerus (253.4 mm.); left radius (292.0); right radius (291.5) and ulna; left metacarpus (212.7); 1st phalanx (79.0); 2d phalanx (37.0); 3d phalanx (40.0); partial pelvis; partial femur; right tibia (340.0); misc. vertebrae, carpal and tarsal elements (lengths cited are articular)	42817–A–N

Referred (Not Part of Presumably Associated Skeleton).—

Partial skull, very old individual, P^2–M^3, rostrum and top of skull missing	42811
Fragment of right ramus, P_4–M_2, very old individual	42814
Fragment of immature left ramus, dP_2–dP_4, M_1–M_2	42815
Misc. detached teeth	42816
Distal end of right radius	42818

Equus tau Owen, 1869

Referred.—

	F:A.M.
One 1st phalanx	42819

The single specimen of *Equus tau* is very different from the larger *Equus conversidens* of the cave fauna. The phalanx is slender proportioned and resembles some of the large Pliocene Equidae.

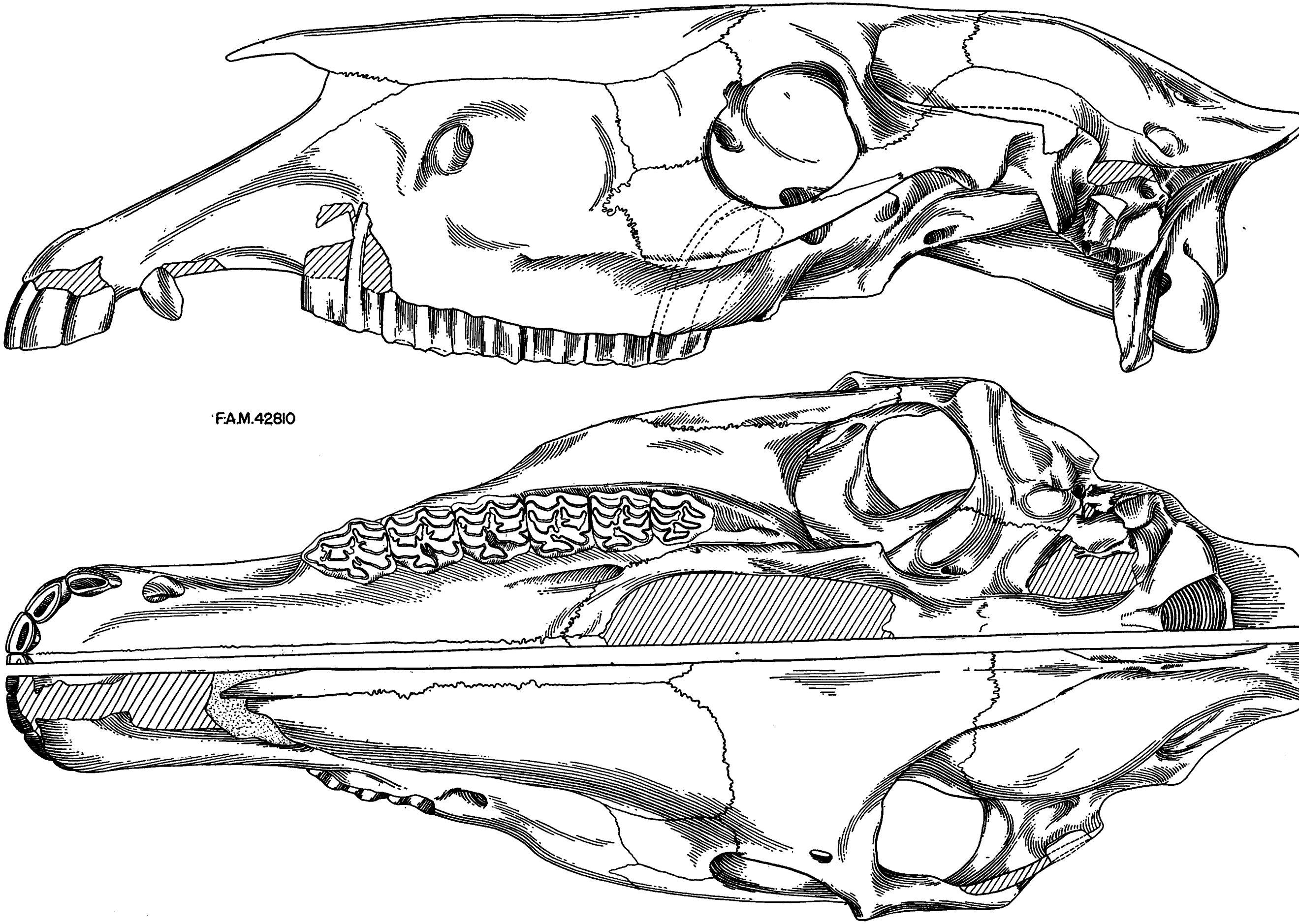


Fig. 8. *Equus conversidens* Owen, ref. skull, F:A.M.42810. × $\frac{1}{3}$.

Maximum length	78.5 mm.
Proximal end	
Anteroposterior diameter	26.0
Transverse diameter	25.0
Center of shaft	
Anteroposterior diameter	20.0
Transverse diameter	19.0
Distal end	
Anteroposterior diameter	18.2
Transverse diameter	29.0

ARTIODACTYLA

The Artiodactyla in the cave fauna are represented by 5 genera and species, of which at least 80% are extinct in North America. Three of the species are but poorly represented, while the extinct Quentin's Pronghorn makes up the great majority of the collection. *Platygonus*, of which there are 4 individuals represented, is second in frequency of occurrence among the larger mammals, and, like the extinct pronghorn, was probably a cave-frequenting animal.

Unfortunately, cervid remains are so rare in the fauna that it is impossible to note more than their occurrence. If a better representation of this family had been found, the local cervids might prove to have belonged to extinct species, which would then imply a complete extinction of the Artiodactyla.

Tayassuidae

Platygonus alemanii Dugès

Platygonus alemanii Dugès, 1887–1890, La Naturaleza, Ser. 2, I, pp. 16–18, Pls. I and II. (Note: Dugès' correspondence is dated "Diciembre, 1883" in this publication.) Gidley, 1920, Proc. U. S. Nat. Mus., LVII, No. 2324, p. 658.

The four skulls of *P. alemanii* represent the stages of tooth wear from young to well matured individuals. The dentitions agree more closely with figures of Dugès' species, *P. alemanii* (from the State of Guanajuato, about 150 miles north of Mexico City), than with *P. compressus*. The skulls are smaller than *P. cumberlandensis* or *P. leptorhinus*. Specific allocation of the specimens requires a first-hand examination of the types of *P. alemanii* and *P. compressus*. The variation noted in the vertical expansion of the zygoma in other forms of *Platygonus* is not evident and suggests the same sex in all four specimens.

Tentatively Referred.—

	F:A.M.
Skull with P^2–M^3, lacking canines and incisors, dPs/ partially shed, M^3 erupt.; mandible with I_1, I_2, /C alv., P_2–M_3	42784

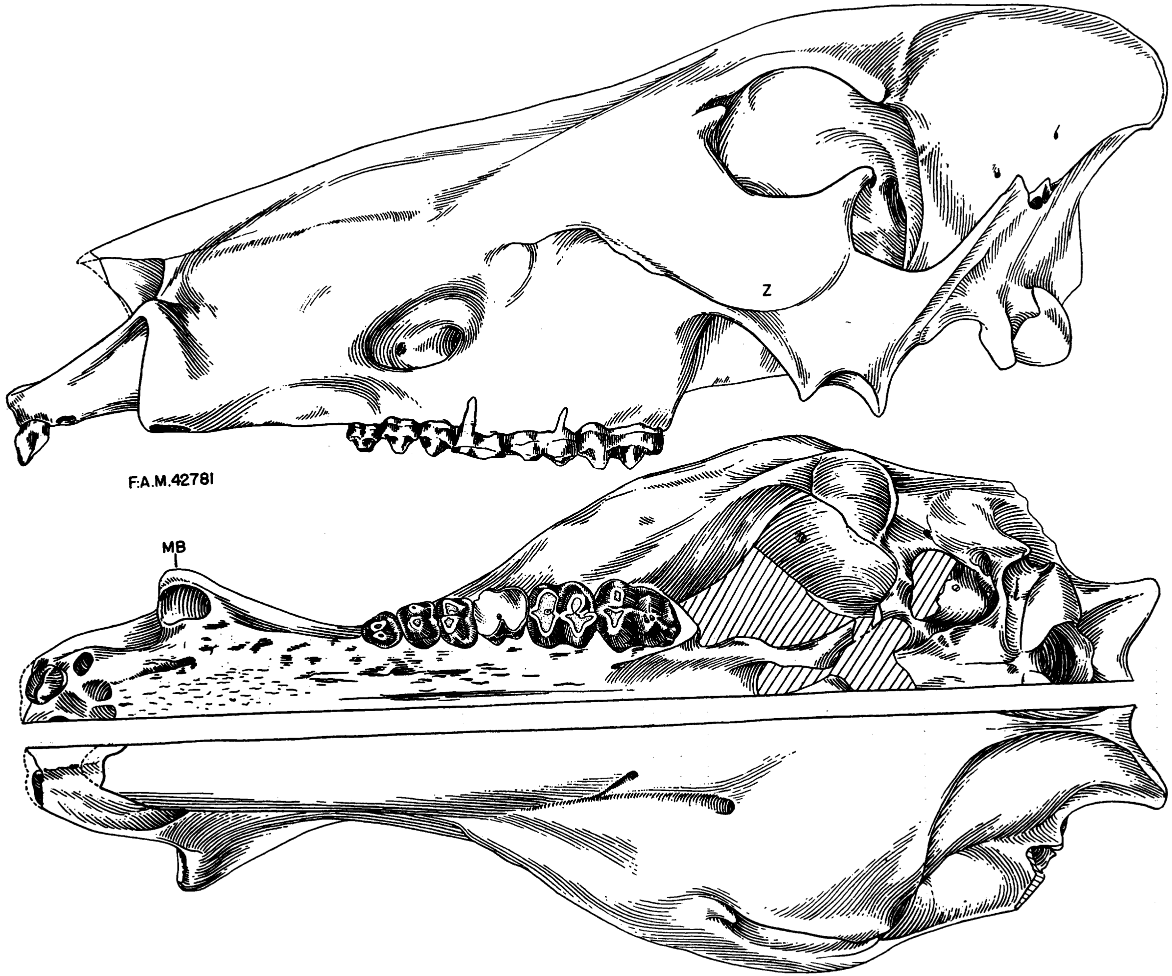


Fig. 9. *Platygonus alemanii* Dugès, ref. skull, F:A.M.42781. × ½.
MB = maxillary buttress of the canine, Z = zygoma.

Three skulls with	
I^1, I^2, C/ alv., P^2–M^3. *Fig. 9*	42781
I^1, I^2, C/ alv., P^2–M^3, lacking basicranium	42783
I^1, I^2, C/, P^2–M^3	42782
Three left humeri, articular lengths, 42785 = 163.5 mm., A = 156, B = 160.0	42785–A,B
Left radius and ulna, articular length = 151 mm	42786
Two right radii and ulnae, articular lengths, A = 161 mm., B = 145.5	42786–A,B
Left femur, articular length = 185.5 mm	42787
Two left tibiae, articular lengths, 42788 = 175.5 mm., A = 190.0	42788–A
Right tibia, articular length = 190.0 mm	42788B
Four metatarsi, articular lengths, 42789 = 88.5 mm., A = 93.3, B = 90.0, C = 87.0	42789–A–C
Misc. carpi, tarsi and phalanges	42790

Table VII.—Measurements of *P. alemanii* Skull, F:A.M.42781 (*Fig. 9*)

Length, basilar	266.5 mm.
" overall	313.0
Depth, occipital	95.0
Width, interorbital (min.)	99.5
Width across zygomatic arches (max.)	125.0
Zygomatic expansion below orbit (max.)	31.7
Transverse width of maxillary buttresses of canines (max.)	69.0
Diastema, I^2–ant. C/ alv	21.0
" post. C/ alv.–P^2	41.5
P^2–M^3, crown length	82.8
M^1–M^3, " "	53.7

Bovidae

Bison taylori Hay and Cook

Bison taylori Hay and Cook, 1928, Proc. Col. Mus. Nat. Hist., VIII, No. 2, Pt. 1, p. 33; 1930, ibid., IX, No. 2, p. 26, Pl. viii, Figs. 1, 2; Pl. x, Figs. 2, 3.

Tentatively Referred.—

	F:A.M.
Right tibia, articular length = 420 mm	42820
Right metacarpus, articular length = 226 mm	42821

The tibia and metacarpus are large, heavy proportioned, and compare favorably with *B. taylori* from Folsom, New Mexico.

Right calcaneum	42822
Two 1st phalanges	42823
Two 2d phalanges	42824
One 3d phalanx	42825

Cervidae

Cervus sp. indet.

REFERRED.—

	F:A.M.
Left dP³ and fragment of maxilla	42862

The specimen compares with examples of large immature *Cervus canadensis* in the Department of Mammalogy, American Museum.

Camelidae

Camel(?) small species

QUESTIONABLY IDENTIFIED.—

	F:A.M.
Distal fragment of an immature cannon bone	42797

Antilocapridae

STOCKOCEROS FRICK

DISCUSSION

Stockoceros and *Antilocapra* are two closely related members of the Antilocaprini. The restoration of *Stockoceros* (Figure 10, modeled from skull and mandible, F:A.M.42533) shows that the striking difference between it and *Antilocapra* is the presence of a pair of horns arising over each orbit from a short core-base. Each horn-core possessed a separate sheath in contrast to the single-cored forked sheath of male *Antilocapra*.

The skeleton of *Stockoceros* is slightly smaller than that of *Antilocapra*, differing only in minor details of proportions. The outstanding elongation of the tibia (page 213) and, to a lesser degree, the femur (page 210) suggests a greater bounding ability. The limb ratios, with the exception of the metatarsus-femur (page 210), indicate equal fleetness in both forms.

Antilocapra is the only surviving genus of the hosts of Antilocaprines that once roamed North America. From it must be drawn many of the homologies for horns, sex characters and life habits. Its trend involved a partial loss of growth in the anterior horn-core. Male *Antilocapra*, with known secondary sex-linked characters (page 201), experimented with excessive growth in the posterior horn-core and broadening of the base anteroposteriorly to include the recessive anterior horn-core, resulting in the persistently forked sheath and the variable anterior expansion of the blade-like core. This is well demonstrated in a series of skulls showing successive stages of growth. Several geographic variants of *Antilocapra* have been observed in which the cross section of the cores ranges from nearly rounded to the extreme of broadly expanded blades (Figure 15), but all adhering to the generic pattern of reduced growth of the anterior horn-core. The conservative female *Antilocapra* retains only a vestigial posterior horn-core with an unforked sheath and a frontal protuberance as a token of the ancestral anterior horn-core. There is, however, no indication of anterior horn-core development in the bone of the protuberance.

Some northern forms of *Antilocapra* tend to have slender, rounded horn-cores with sheaths tending to separate into small anterior and large posterior forks. This is evidenced by several U. S. National Museum specimens from Alberta, Canada. Some plains variants have high, smooth, forked sheaths on moderately heavy, bladed horn-cores. Some southern forms have still heavier sheaths and cores and, in addition, the sheaths tend to be roughened and to develop accessory growths that are not reflected in the horn-cores. The position of the horn-cores of all the variants is normally erect over the orbits. The degree of anterior or posterior divergence, as well as the outward flare, seems to be an individual rather than a geographic variation.

The horn-cores of *Stockoceros* originate from two separate sources on the frontal and involve an equal growth in both the anterior and posterior cores, as shown by the immature cranium, F:A.M.42699 (Figure 10), and the large collection of mature skulls.

Antilocaprini Horn-cores

The Antilocaprini[1] division of the Antilocapridae is typified by hypsodont teeth, a tendency of the premolars to become molariform and more hypsodont in the later forms, supraorbital horn-cores of diversified form and widely separated parietal ridges. As noted by Frick,[2] a separation of this homogeneous group is nearly impossible on the evidence of dentition, without the added evidence of horn-cores.

The Antilocaprini of the Pliocene and Pleistocene may be separated into two main groups on the basis of known ancestral horn-core characters: the "low core-based" and the "high core-based" forms. In some forms, the diversification has been accomplished by continued growth and development of the ancestral pattern; in others, by excessive, retarded or partial loss of growth in either the main anterior or posterior horn-cores, or the core-base when considered as a separate element. The two central points of horn-core eruption are the strongest and most active, and are mainly affected by the above mentioned manners of growth. In addition, one other accessory incipient anterior or posterior horn-core may appear in any of the lines.

The Antilocaprini placed in the "low core-based" group seem to have originated from an ancestral form with two main anteroposterior points of horn-eruption on the supraorbital and connected by a very low bony ridge. Later, the ridge became a moderately large pseudo-core-base or was modified by specialization. The ancestral two horn-cored pattern is strongly reflected in the core-bases of this group. The "low core-based" group is represented by

[1] Frick, Childs, 1937, Bull. Amer. Mus. Nat. Hist., LXIX, pp. 11–27, 267.
[2] Idem., p. 267.

the following genera: *Plioceros* (in part), *Ceratomeryx*, *Stockoceros*, *Tetrameryx*, *Hexameryx*, *Capromeryx*, *Hayoceros* and *Antilocapra*.[1]

The Antilocaprini placed in the "high core-based" group originated from an ancestral form with a relatively higher bony beam or core-base situated anteroposteriorly over the orbits. *The true bony ridge or beam appears to be an element lacking in the low core-based group*, although the advanced low core-based forms have a pseudo-beam resembling this element. The same main points of horn-origin are superimposed on the distal or upper end of the "high core-base." The accessory incipient points of horn origin are located well up on the anterior and posterior edges of the core-base and are often indicated, but seldom become active enough to produce distinct horn-cores. The "high core-based" forms are for the most part from the Pliocene and are represented by *Plioceros* (in part), *Texoceros*, *Sphenophalos*, *Proantilocapra* and *Osbornoceros*.

The horn-cores of the Pleistocene Antilocaprines of the low core-based group may be separated into three divisions, exampled by *Stockoceros*, *Capromeryx* and *Antilocapra*, in which parallelisms in the process of horn-core growths are observed.

Antilocapra, the only living representative, has apparently lost the prominent anterior horn-core which is present in *Stockoceros* and *Capromeryx*. *Hayoceros* has paralleled *Antilocapra* in the loss of anterior horn-core growth, combining its original anterior core with the posterior but adding a new character, the growth of a posterior incipient horn-core, thus losing growth in one horn and gaining a new one.

A second, distinctive horn-core division is evidenced by *Stockocèros*, *Tetrameryx* and *Hexameryx*. The horn-cores of *Stockoceros* have maintained equal growth in the anterior and posterior cores, but *Tetrameryx* has added a new character, the excessive growth in the posterior horn-core. *Hexameryx*, it appears, continued the growth of the main anterior and posterior horn-cores as in *Stockoceros*, but added a new character also evidenced in *Hayoceros*—the growth of a posterior incipient horn-core.

The distinctive horn-cores of *Capromeryx* are at present represented by two lines of growth. Thus, while *C. furcifer* parallels the growth process of *Antilocapra*, in which the loss of the anterior horn-core is taking place, *C. arizonensis*, n.sp. (page 218), parallels *Stockoceros*, maintaining equal growth in the anterior and posterior cores. The distinctive shape and erectness combined with the known skull characters do not seem to warrant a generic separation as strongly as do the cores of the other groups.

The Antilocaprines of the late Pliocene may also be separated into distinctive divisions of the high and low core-based groups. *Plioceros* seems to the author to be the logical genus to have given rise to *Stockoceros* and *Antilocapra*. Frick[2] considered *Texoceros* as the most likely genus to have given rise to *Stockoceros*.

[1] Certain morphological characters of *Antilocapra* and *Hayoceros* suggest their possible derivation from a high core-based form. Other characters, however, link them more closely with a low core-based group. *Ilingoceros* is likewise an extremely specialized form with affinities for this group.

[2] Frick, Childs, 1937, Bull. Amer. Mus. Nat. Hist., LXIX, p. 521.

Texoceros, however, has a "high core-base" or true beam which is lacking in *Stockoceros* (pages 177, 198). *Plioceros,* on the other hand, has horn-core characters in common with both genera. *Capromeryx* has no recognized ancestral horn-core type in the Pliocene. It is tentatively placed in the "low core-based" group.

Two species and a new subspecies (described in the appendix) of *Stockoceros* are here recognized:

Stockoceros conklingi (Stock), genotype
Stockoceros onusrosagris (Roosevelt and Burden)
Stockoceros onusrosagris nebrascensis, n.subsp.

Historical

Stock,[1] in his description of *Tetrameryx(?) conklingi,* suspected that it was a distinct genus. He concluded:

> "While the skull is as yet but imperfectly known, the characters displayed by the horn cores and more particularly by the associated lower jaw and skeletal material, point strongly to the presence of a family bond with the Antilocapridae... In the light of the variation in structure of horn core of the modern pronghorn, some of the more striking characters which distinguish *T.*(?) *conklingi* from *T. shuleri* and which may be regarded as of generic value are attributed to a difference in age and sex. The material from Shelter Cave is therefore assigned, at least tentatively, to the genus *Tetrameryx.*"

In a second paper on *Tetrameryx conklingi,* on the evidence of more material, Stock[2] stated:

> "Among the specimens collected are horn-cores somewhat larger than those of the type, but smaller than the comparable structures in *Tetrameryx shuleri.* Although incomplete these horn-cores doubtless represent the larger antelope whose presence in the Shelter Cave fauna has been recognized on the basis of lower jaw and limb material. A further comparison of the large and small forms, in the light of the material now available, emphasizes the essential similarity of the two types. The resemblance of the larger horn-cores to those of *T. shuleri* gives added reason for regarding the species from Shelter Cave as belonging to the genus *Tetrameryx.*"

At that time, the Roosevelt and Burden species, *Stockoceros onusrosagris,* was unknown, and Stock assigned the larger form to *Tetrameryx.* The present study of the extensive collection from Papago Springs Cave, in which no variants that resemble *Tetrameryx* either in size or in horn-core characters have been found, substantiates Stock's first conclusion that a new genus was represented.

Frick,[3] in his comprehensive study of the "Horned Ruminants," established *Stockoceros* as a new subgenus of *Texoceros* and considered *Stockoceros conklingi* as the subgenotype. He included one other species, *Stockoceros onusrosagris.* Colbert and Chaffee[4] considered that the difference between *Tetrameryx* and

[1] Stock, Chester, 1930, Los Ang. Mus. Pub. No. 2, p. 18.
[2] Stock, Chester, 1932, ibid., No. 3, p. 1.
[3] Frick, Childs, 1937, Bull. Amer. Mus. Nat. Hist., LXIX, pp. 521, 526.
[4] Colbert, E. H., and Chaffee, R. G., 1939, Amer. Mus. Novitates, No. 1034, pp. 17–18.

Stockoceros did not seem sufficient to be of subgeneric importance, basing their opinion on an analogy of the varied sizes and forms in a living African antelope, *Gazella*.

In previous studies, the range of individual, age and sex variations was limited by the small collections (*Antilocapra* excepted). The present enlarged series of *Stockoceros* has made possible a more complete knowledge of these variations. Several of the specific characters of *S. onusrosagris* may well apply to the genus, but they are limited by the known attributes of the genoholotype of *Stockoceros conklingi*. On the other hand, the range of characters in *S. onusrosagris* clearly demonstrates distinct specific differences from *S. conklingi*, and no variants of horn-core characters or size approach *Tetrameryx shuleri*. Without intending to add confusion to the host of named genera, *Stockoceros* is here considered to be generically distinct from *Texoceros* and *Tetrameryx*.

GENOTYPE.—*Stockoceros conklingi* (STOCK).

Tetrameryx(?) *conklingi* STOCK, 1930, Los Ang. Mus. Pub. No. 2, p. 6, Figs. 1–3.

Tetrameryx conklingi STOCK, 1932, ibid., No. 3, p. 1, Figs. 1–10, Pls. I–III. COLBERT AND CHAFFEE, 1939, Amer. Mus. Novitates, No. 1034, pp. 17–18.

Stockoceros conklingi (STOCK), FRICK, 1937, Bull. Amer. Mus. Nat. Hist., LXIX, pp. xv, 30, 474, 521–522, 526, 535, Fig. 53.

GENERIC CHARACTERS

SKULL.—Small to moderate size; paired, subequal horn-cores over posterior portion of orbit, diverging anteroposteriorly, with a tendency to flare outwardly; anterior horn-cores flared more than posterior; horn-cores rounded to elliptical in cross section and joined at proximal end by a low core-base[1] that is nearly parallel to the median line of the skull; diameters of both horn-cores strongly shown in core-base. A distinct pit is present on the proximal end of the core-base, at the junction of the supraorbital process (lacking or barely discernible in *Tetrameryx*). Parietal ridges separated as in *Antilocapra;* bullae more inflated than in *Antilocapra*.

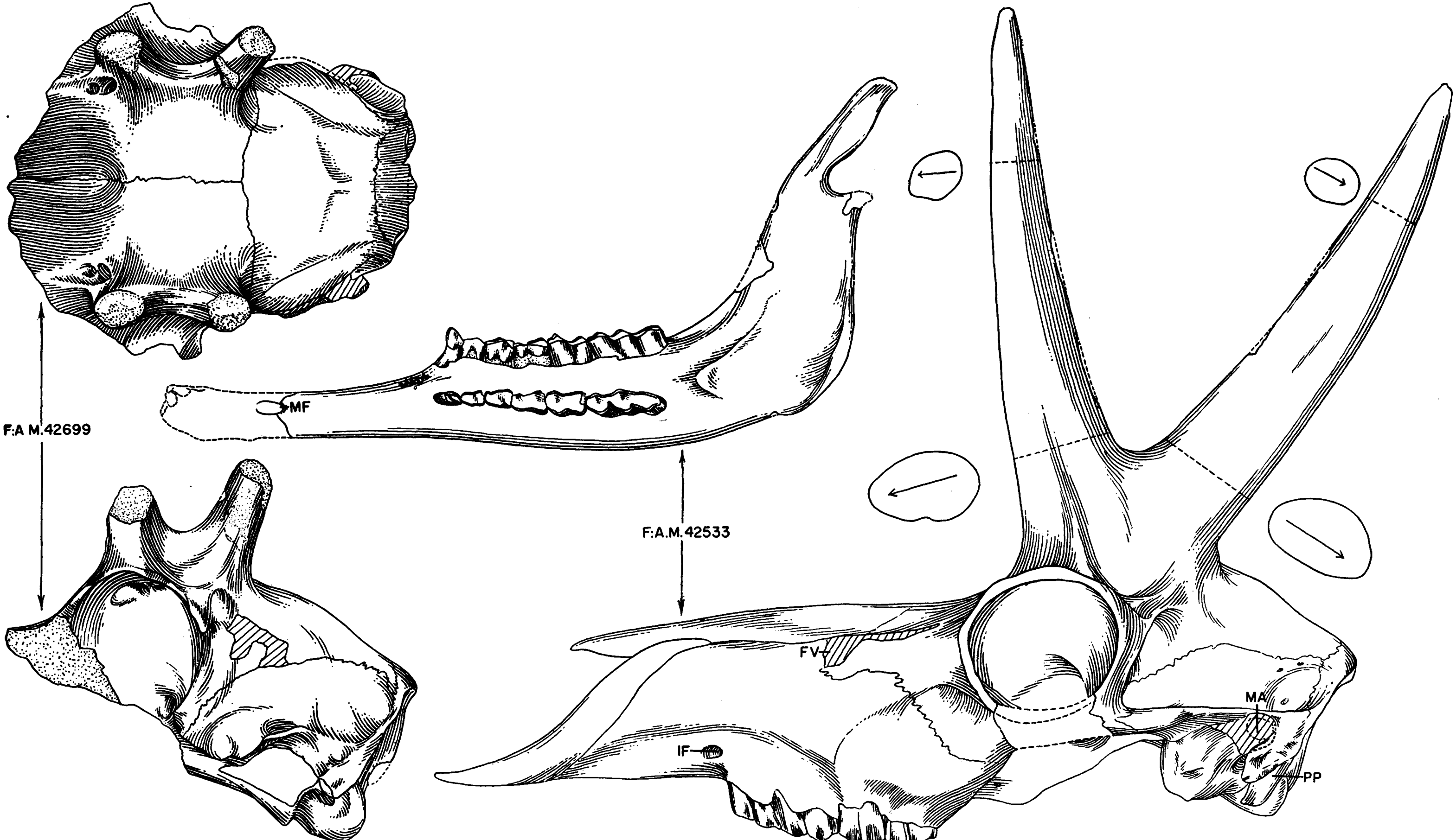
In comparison, the posterior horn-cores of *Tetrameryx* are 284% longer than the anterior, while the anterior horn-cores of *Ceratomeryx* are 300% longer than the posterior.

MANDIBLE.—Larger than *Capromeryx* and approaching *Antilocapra* in size; diastema of relatively the same proportions as in *Antilocapra;* angle formed by vertical and horizontal ramus more abrupt, and angular process of ramus more pronounced than in *Antilocapra*.

DENTITION.—Is^0_3, C^0_1, P^3_3, M^3_3; the teeth smaller and less hypsodont than in *Antilocapra* and decidedly smaller than in *Tetrameryx*.

LIMBS.—Small to moderate size, approaching those of *Antilocapra;* as slender as, or heavier than, *Antilocapra*.

[1] The term "core-base" is used rather than "pedicle," to avoid confusion with the Cervidae. It is treated as a distinct part of the horn-core of Antilocaprini and is applied to both the true and pseudo-core-bases, pp. 177, 198. See key to cranial measurements, Figure 12, p. 191.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F:A.M.42533
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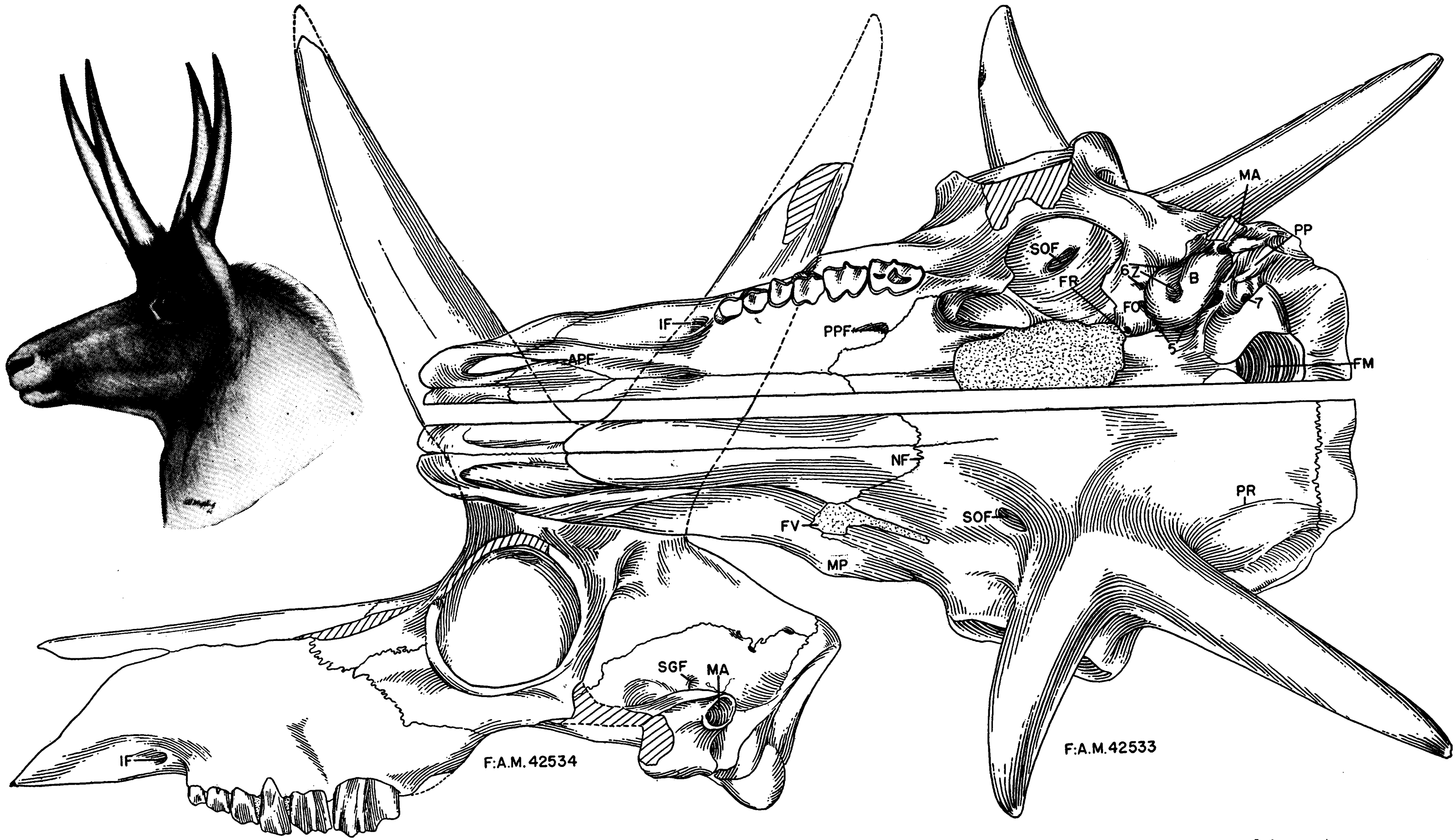

Fig. 10. *Stockoceros onusrosagris* (Roosevelt and Burden), ref. skull and mandible, F:A.M.42533, skull, F:A.M.42534, and immature cranium, F:A.M.42699. × ½. Restoration from skull F:A.M.42533, approx. × ⅛.

APF = anterior palatine foramen; B = auditory bullae; FM = foramen magnum; FO = foramen ovale; FR = foramen rotundum; FV = facial vacuity; IF = infraorbital foramen; NF = nasal-frontal suture; MA = external auditory meatus; MF = mental foramen; MP = masseteric process; PP = paroccipital process; PPF = postpalatine foramen; PR = parietal ridge; SOF = supraorbital foramen; SGF = supraglenoid foramen; Z = tympanohyal pit; 5 = lacerate foramina; 6 = glenoid foramina; 7 = condylar foramen.

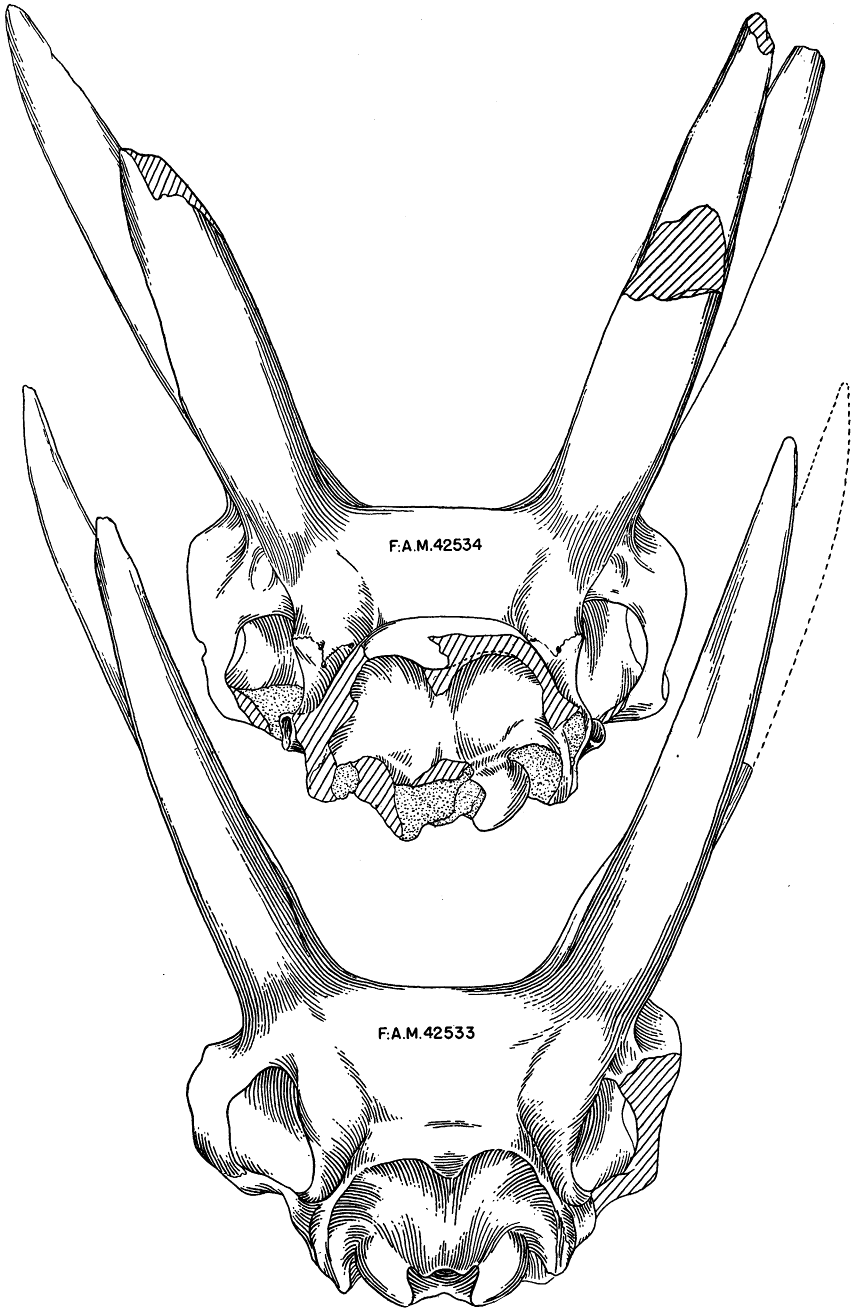

Fig. 11. *Stockoceros,* ref. skulls, F:A.M.42533 and 42534, posterior views. (See Fig. 10.) × ½.

Stockoceros onusrosagris (Roosevelt and Burden)

Tetrameryx onusrosagris ROOSEVELT AND BURDEN, 1934, Amer. Mus. Novitates, No. 754, pp. 1–4. COLBERT AND CHAFFEE, 1939, ibid., No. 1034, p. 6, Figs. 4–12.
Stockoceros onusrosagris (ROOSEVELT AND BURDEN), FRICK, 1937, Bull. Amer. Mus. Nat. Hist., LXIX, pp. xv, 512, 522, 526–527, 535–536, Figs. 49 and 53.

SPECIFIC CHARACTERS

SKULL.—Smaller than average examples of *Antilocapra americana* and larger than that of *S. conklingi;* supraorbital horn-cores paired, subequal, antero-posteriorly divergent and two to three times as large, more divergent and more outwardly flared than those of *S. conklingi.* In comparison, the anterior horn-cores of *Tetrameryx shuleri* are as large, but the posterior are longer; those of *Ceratomeryx prenticei* are smaller, with the anterior relatively longer than the posterior. The anterior horn-cores of *S. onusrosagris* are always more outwardly flared than the posterior. The nasal bones are relatively longer and more posteriorly expanded, the rostrum equal in length but less transversely distended, the facial vacuity narrower, and the bullae more inflated than those of *Antilocapra*[1]; the orbits are of the same relative size, position and shape as in *Antilocapra;* the parietal ridges are widely separated as in all Antilocaprini.

MANDIBLE.—Smaller than that of *Antilocapra* and larger than that of *S. conklingi;* angle between horizontal and vertical ramus greater than in *Antilocapra* but less than in *S. conklingi;* angular process of ramus more prominent than in *Antilocapra,* less than in *S. conklingi;* premolar-canine diastema of same relative proportions as those of *Antilocapra* and *S. conklingi* but metrically shorter than that of *Antilocapra* and larger than in *S. conklingi.*

DENTITION.—Is^0_3, C^0_1, P^3_3, M^3_3. Teeth approaching *Antilocapra* and larger than *S. conklingi* in size; lower premolars less hypsodont, having stronger double roots than those of *Antilocapra;* M_3 more variable in size than that of *Antilocapra;* P^2 has open lingual groove which forms a shallower fossette than in *Antilocapra* and *Tetrameryx shuleri;* metastyle of M^3 less developed than in *Antilocapra.*

LIMBS.—In size approach those of *Antilocapra.* As a group, the posterior limbs are nearly 5% longer than the anterior limbs; tibia prominently, femur to lesser degree, longer proportioned than in *Antilocapra;* humerus-manus relation 5% greater and femur-pes 4% less than in *Antilocapra.*

Stockoceros onusrosagris was as slender limbed and light an animal as *Antilocapra,* but of slightly different proportions, while *S. conklingi* was apparently smaller and heavier limbed in proportion.

DISCUSSION

The original Roosevelt and Burden collection of the extinct pronghorn consisted of about 150 specimens, including 3 partial skulls, 17 complete or partial

[1] In this paper, *Antilocapra* is used to signify the species *Antilocapra americana*; and *Stockoceros*, the species *Stockoceros onusrosagris*, unless obviously referring to the genus.

horn-cores, 3 maxillae, 5 complete or partial mandibular rami and 13 isolated, complete major limb elements. The Frick collection is composed of over 3,000 specimens, including 55 skulls or partial skulls, 59 complete or partial horn-cores, 35 complete or partial maxillae, 115 complete or partial mandibular rami, 7 articulated, partial skeletons and 627 isolated, complete major limb elements.

This substantial enlargement of the collection has brought together, for the first time, complete skulls and articulated skeletons of *Stockoceros onusrosagris*. The information obtained from the present study is presented in comparison with *Antilocapra americana*, the only surviving member of the family.

HOLOTYPE.—Partial skull, P^2–P^3 alv., P^4–M^3, horn-cores, orbits and nasals incomplete, rostrum lacking, maxillae partial, no contact to skull.	A.M.22488	Figured by Roosevelt and Burden, 1934, Fig. 1; by Colbert and Chaffee, 1939, Fig. 4. *Fig. 15*, this paper.

REFERRED FROM TYPE LOCALITY BY ROOSEVELT AND BURDEN, 1934, AND COLBERT AND CHAFFEE, 1939 (American Museum of Natural History collection, 1934 and 1936).—

	TWO SKULLS	
Skull (w3)	A.M.22489	Figured by Frick, 1937, Fig. 53; by Colbert and Chaffee, 1939, Fig. 7.
Skull (w3)	A.M.22657	1939, Fig. 7
	THREE MAXILLAE	
Two left maxillae (w1)	A.M.22659	1939, Fig. 7.
	22649F	" " "
Right maxilla (w1)	22659G	
	SEVENTEEN COMPLETE AND PARTIAL HORN-CORES	
Ten horn-cores with core-base attached	A.M.22484A–E	
	22659A–D	
Seven fragments of horns	22659	
	THREE COMPLETE AND PARTIAL MANDIBULAR RAMI, ETC.	
Right ramus (w5)	A.M.22658	1939, Figs. 6 and 7.
Left ramus (w3)	22490	1934, Fig. 1.
		1939, Figs. 4 and 7.
Left ramus (w3)	22659H	1939, Fig. 7.
Fragments of two left and one right rami, etc.	22659I	
	22484	

SKELETAL ELEMENTS

One hundred and five elements of the appendicular skeleton (92 partial) and seventeen elements of the axial skeleton, as follows:

Scapulae, 8 (partial); humeri, 10 (5 partial); radii and ulnae, 9 (7 partial); carpal bones, 7; metacarpi III and IV, 16 (13 partial); fore phalanges, three 1st, two 2d and three 3d; one pelvic girdle; femora, 18 (17 partial); tibiae, 9 (8 partial); tarsal bones, 4; metatarsi III and IV, 4 (3 partial); hind phalanges, 10 (7 partial); vertebrae, 17 (complete and partial).	A.M.22459 and 22483	Figured by Colbert and Chaffee, 1939, Figs. 8, 9, 10 and 11 (in part).

REFERRED FROM TYPE LOCALITY (F:A.M. collection, 1937 and 1940, by Howard Scott Gentry, Albert Potter and Morris F. Skinner).—

Twenty-seven complete or partial skulls with P^2–M^3 or alveoli, nearly complete or partial horn-cores:

					F:A.M.
42528[1] (W)	42535 (W1) (*Fig. 15*)	42539 (W1)	42544 (W2)	42548 (W1)	42701 (W1)
42531[1] (M)	42536 (W3)	42540 (W1)	42545 (W3) (*Fig. 15*)	42549 (W1)	42702 (W3)
42533[2] (W4) (*Figs. 10, 11, 12, 14*)	42537 (W3) (*Fig. 15*)	42541 (M)	42546 (W2)	42550 (W) (*Fig. 16*)	42703 (W4)
42534 (W3) *Figs. 10, 11, 15*)	42538 (W1)	42542 (W1)	42547 (W2)	42551 (W3)	42709 (W4)
		42543 (M)		42700 (W1)	42710 (W)

Eighteen posterior crania with complete or partial horn-cores, orbits and basicrania:

42552	42555	42558	42561	42704	42707
42553	42556	42559	42562	42705	42708
42554	42557	42560	42699 (immature) (*Fig. 10*)	42706	42711 .

		F:A.M.
Twenty-two cranial fragments with partial right or left horn-core attached...		42570–A–V
Thirty-seven right and left horn-core fragments...........................		42570W
Two palates with P^2–M^3..	(W1)	42571
	(W3)	42573

[1] See questionable association with partial skeletons, page 187.
[2] See articulated mandible, page 186.

THIRTY-FIVE MAXILLAE

Eighteen complete and partial right maxillae:

P^2–M^3 or alveoli				P^4–M^3		misc.		misc.		misc.	
42581	(M)	42584	(W1)	42589	(W1)	42585	(M)	42585C	(W1)	42588	(W3)
42582	(W6)	42587	(W2)	42590	(W1)	42585A	(W1)	42585D	(W3)	42581	(W)
42583	(W3)	42716	(W1)	42715	(W)	42585B		42586	(W3)	42592	(W1)

Seventeen complete and partial left maxillae:

P^2–M^3 or alveoli				misc.		misc.		immature	
42573	(M)	42580		42576	(M)	42580A		42575	(I)
42574	(M)	42713	(W1)	42578	(W2)	42585B		42577	(I)
42577A	(W)	42718	(W2)	42579	(W2)	42712	(W1)		
42577B	(W1)			42714	(W)	42717	(W3)		

Misc. detached teeth.

ONE HUNDRED AND TWENTY-SIX MANDIBULAR SPECIMENS

Nine mandibles with		F:A.M.
P_2–M_3, lacking symphysis (associated with skull, page 185) (*Fig. 10*)...	(W5)	42533
/Is, /Cs and P_2–M_3; no ascending rami (*Fig. 16*).....................	(M)	42592
/Is alv., /Cs alv., P_2–M_3; partial ascending rami.....................	(W3)	42593
/Is alv., /Cs alv., P_2–M_3..	(W6)	42594
/Is alv., /Cs alv., P_3–M_3; partial ascending left ramus................	(W1)	42595
P_2 alv., P_3–M_3..	(W2)	42596
/Is alv., /Cs alv., P_2 alv., P_3–M_3..................................	(W3)	42597
/Is alv., /Cs alv., P_2–M_3; no ascending rami...........................	(W)	42719
/Is alv., /Cs alv., P_2 alv., P_3, P_4–M_1 alv., M_2–M_3; no ascending rami...	(W6)	42720

Twenty-four right rami with symphyses:

P_2–M_3 or alveoli											
42598	(W1)	42602 (*Fig. 15*)	(W2)	42606	(W3)	42610	(W6)	42634 (*Fig. 15*)	(W3)	42631	(W5)
42599 (*Fig. 16*)	(W1)	42603	(W2)	42607	(W4)	42611	(W5)	42627	(W1)	42633	(W6)
42600	(W4)	42604 (*Fig. 15*)	(W4)	42608	(W1)	42619	(W2)	42629	(W1)	42733	(W1)
42601 (*Fig. 15*)	(W4)	42605	(W4)	42609	(W3)	42632	(W2)	42630	(M)	42644	(I)

Twenty partial right rami:

		P_2–M_3 or alveoli				misc.		misc.		misc.	
42625	(W2)	42612	(W3)	42618	(W6)	42614	(W2)	42622	(W)	42628	(W2)
42626	(W2)	42620	(W3)	42734	(W6)	42616	(W2)	42623	(W1)	42635	(W)
42617	(W3)	42613	(W2)	42735	(W1)	42621	(W1)	42624	(M)	42636	(W2)
42615	(W3)			42736	(W1)						

Nine fragmentary right rami:

42637		42639	(W6)	42641	42643	42738
42638	(W2)	42640		42642	42737	

Eighteen left rami with symphyses:

				P_2–M_3 or alveoli						misc.	
42645	(W4)	42648	(W3)	42655	(W2)	42669	(W6)	42683	(W5)	42692	
42646	(W3)	42649	(W4)	42657	(W2)	42675	(W2)	42686	(W4)	42694	(I)
42647	(W2)	42654	(W3)	42666	(W4)	42676	(W6)	42721	(W2)		
								42722	(W1)		

Thirty-five partial left rami:

P_2–M_3 or alveoli								misc.		misc.	
42650	(w2)	42659	(w6)	42685	(w2)	42727	(w1)	42661	(w1)	42668	(M)
42651	(w2)	42660	(w2)	42687	(w4)	42728	(w2)	42665	(w1)	42689	(w1)
42652	(M)	42662	(w4)	42723	(w2)	42739	(w1)	42695	(I)	42690	(w)
42653	(w3)	42663	(w2)	42724	(w4)			42667	(w2)	42693	(w2)
42656	(w6)	42664	(w3)	42725	(w3)			42668	(w3)	42696	(w)
42658	(w2)	42684	(w6)	42726	(w2)			42670	(w2)	42729	(w4)
								42671	(w1)	42730	(w6)
								42672	(w4)		

Eleven fragmentary left rami:

42673	(w4)	42677	(w3)	42679	(w3)	42681		42691	(w2)	42732	(w2)
42674	(w2)	42678		42680		42682		42731	(w2)		

SKELETAL ELEMENTS

Skeletal elements are exampled by four referred partial skeletons (two of which are questionably associated with dentition), associated limbs of three individuals and misc. unassociated bones. Measurements of all major limbs have been included in the tables, pp. 209–213.

F:A.M.

Articulated appendicular skeleton, nearly typical of group average (pp. 211–212) (*Fig. 18*) 42526

Articular lengths of right limbs of above skeleton:

Humerus	= 162 mm.	Femur	= 217 mm.
Radius	= 186	Tibia	= 262
Carpals	= 20	Tarsi	= 41
Metacarpus	= 197	Metatarsus	= 205
1st Phal.	= 46	1st Phal.	= 47
2d "	= 28	2d "	= 27
3d "	= 23	3d "	= 25

Articulated appendicular skeleton, also includes two cervical, two dorsal, one lumbar vertebrae and sacrum 42527

Partial skeleton, includes axis, two cervical, nine dorsal and six lumbar vertebrae, sacrum, ten partial ribs; right scapula, radius and ulna and metacarpus; left humerus, metacarpus, femur, tibia and pelvis. (See ?associated skull, page 185) 42528

Associated right femur, tibia, tarsi, metatarsus and left tibia.................... 42529

Associated right humerus, left humerus, radius and ulna and metacarpus........ 42530

Partial skeleton, includes right scapula, radius and ulna and metacarpus; left humerus, radius and ulna and metacarpus. (See ?associated skull, page 185).. 42531

Associated right scapula, humerus, radius and ulna.......................... 42532

Six hundred and twenty-seven unassociated limb elements:

	F:A.M.
Seventy-one right humeri	42884–A–Z
	42501–A–Z
	42502–A–P
Fifty-six left humeri	42503–A–Z
	42504–A–Z
	42742–A,B

Maximum, F:A.M.42502C = 171.5 mm.
Minimum, F:A.M.42884 = 146.7

Fifty-three right radii and ulnae	42505–A–Z 42506–A–Y
Thirty-six left radii and ulnae	42507–A–Z 42508–A–H

Maximum, F:A.M.42506S = 195.2 mm.
Minimum, F:A.M.42505 = 165.3

Fifty right metacarpi	42509–A–Z 42510–A–W
Sixty-one left metacarpi	42511–A–Z 42512–A–Z 42743–A–G

Maximum, F:A.M.42512T = 203.5 mm.
Minimum, F:A.M.42511 = 179.3

Fifty-one right femora	42513–A–Z 42514–A–W
Forty-three left femora	42515–A–Z 42516–A–P

Maximum, F:A.M.42514I = 232.7 mm.
Minimum, F:A.M.42513 = 202.3

Forty-six right tibiae	42517–A–Z 42518–A–R
Thirty-seven left tibiae	42520–A–Z 42521–A–I

Maximum, F:A.M.42527 = 278.2 mm. (see skeleton, page 187).
Minimum, F:A.M.42520 = 241.0

Sixty-five right metatarsi	42522–A–Z 42523–A–Z 42740–A–K
Fifty-eight left metatarsi	42524–A–Z 42525–A–Z 42741–A–C

Maximum, F:A.M.42525W = 220.0 mm.
Minimum, F:A.M.42524 = 185.3

Seventeen hundred carpal and tarsal elements, phalanges, etc., not included in the tables:

	F:A.M.
One hundred and thirty-three right and fifty-one left carpal elements	42744
Forty-two right and thirty-four left patellae; fifty right and forty-eight left calcanea; ninety-six right and one hundred and seven left astragali; fifty-nine right and fifty-three left cuboid-naviculars; sixty-two right and fifty-three left other small tarsal elements	42751
Three hundred and seventy-six 1st phalanges	42745
Three hundred and thirty-three 2d phalanges	42746
One hundred and seventy-eight 3d phalanges	42747
Ten right and seven left scapulae	42748
Seven pelvic girdles	42750
Five complete sterna and misc. parts	42749

Misc. detached limb elements, F:A.M. Coll.

Three hundred and seventy-five unassociated elements of the axial skeleton:

	F:A.M.
One hundred and four 1st (atlas) to 7th cervical vertebrae	42752–8, inc.
Eighty-four 1st to 13th dorsal vertebrae	42759–71
Fifty-six 1st to 6th lumbar vertebrae	42772–7
Eight fused sacral vertebrae (sacrum)	42778
Misc. caudal vertebrae	42779
Sixty-four right and sixty left misc. detached ribs	42780
Misc. unlisted partial vertebrae and ribs.	

MORPHOLOGY OF *STOCKOCEROS ONUSROSAGRIS*

Discussion

The following pages are devoted to comparisons of *Stockoceros* and wild *Antilocapra*, demonstrating by indices and measurements the relative similarities and differences as groups, rather than as individuals.

The large collection of fossil pronghorns equals the available Recent material. The wild *Antilocapra* measured and studied consist of 76 skulls and mandibles including 12 associated skeletons. The skeletons of 4 game preserve and 5 zoo *Antilocapra* were also studied. Measurements are given to demonstrate how confinement may affect the bone growth and limb relationships of animals reared in captivity, rendering them useless for detailed comparison.

Other related and ancestral forms of Antilocaprini supplement the comparisons. Indices have been used to project the measurements of *Stockoceros* and *Antilocapra* to a uniform scale and thus eliminate deceptive differences in size. The range of size and the average within a set of measurements are shown in the summarized minimum, average, maximum tables. Individual differences are cited in tables of representative specimens. A uniform system of cranial measurements is illustrated in Figure 12. The tooth wear classification, as described on this page, has been followed throughout.

Age Classification and Effect of Wear on Tooth Ratios

A system of expressing tooth wear and relative age of individual specimens developed by Mr. Frick in his study of the Camelidae has been adopted in this paper. The stages of wear are:

(I)	Milk premolars present.
(M)	Milk premolars just shed, permanent premolars well erupted, M_3 unworn.
(W)	Premolars starting to wear. First molar retains anterior fossette. (Figure 16, F:A.M.42592.)
(W1)	Anterior fossette of first molar worn away and posterior fossette wearing smaller. (Figure 16, A.M:M.130197.) [The articulated skulls and mandibles of *Antilocapra* show that in the superior dentitions the count is different (one less than in the inferior).]
(W2)	Posterior fossette of first molar gone and anterior fossette of second molar wearing smaller.
(W3)–(W6)	Successive loss of fossettes in molars with wear.

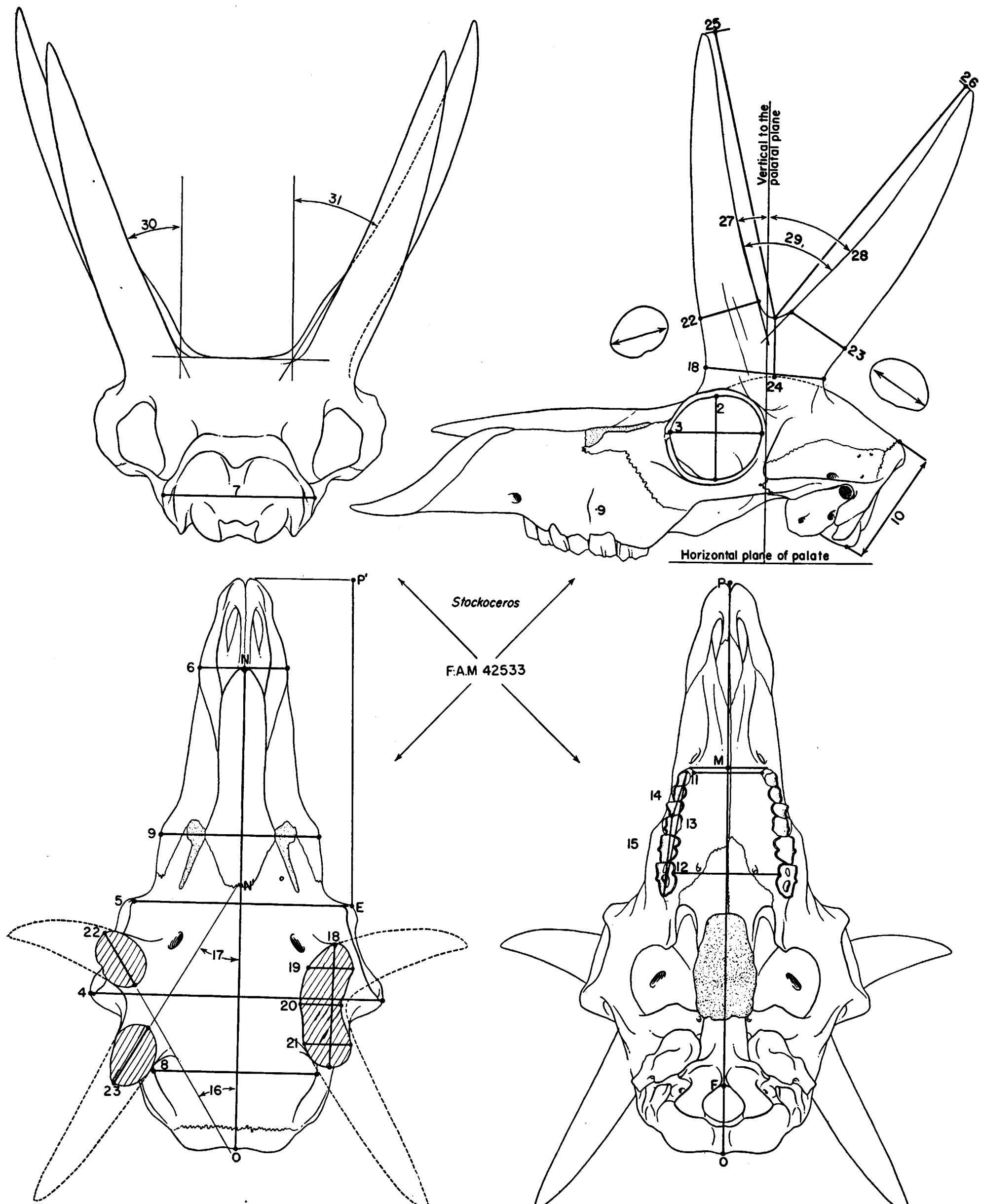

Fig. 12. Key to cranial measurements of *Stockoceros*, ref. skull, F:A.M.42533. (See opposite page.) × $\frac{1}{4}$.

Fig. 12 (see opposite page). Key to cranial measurements of *Stockoceros*.[1]

O-P = Length, overall, tip of premaxilla to occipital crest.
F-P = Length, basilar.
M-F = Length, anterior of P^2 on median line to foramen magnum.
M-P = Length, anterior of P^2 on median line to tip of premaxilla.
E-P′ = Length, anterior of orbit to tip of premaxilla. (Facial length.)
O-N = Length, occipital crest to tip of nasals.
N-N′ = Length, median length of nasal bones.
2 = Vertical diameter of orbit.
3 = Horizontal diameter of orbit.
4 = Postorbital width (max.).
5 = Interorbital width (min. in notch).
6 = Rostral width below tip of nasals.
7 = Mastoid width.
8 = Width of cranium (max.).
9 = Facial width at masseteric process above M^2.
10 = Depth, occipital crest to bottom of condyles.
11 = Width of palate, inside at P^2.
12 = Width of palate, inside at M^3.
13 = P^2–M^3, crown length incl.
14 = P^2–P^4, crown length incl.
15 = M^1–M^3, crown length incl.
16 = Angle formed by median line of skull and long diameter of anterior horn-core. (Angular set of anterior horn-core.)
17 = Angle formed by median line of skull and long diameter of posterior horn-core. (Angular set of posterior horn-core.)
18 = Long diameter of core-base.
19 = Transverse diameter of anterior end of core-base.
20 = Transverse diameter of middle of core-base.
21 = Transverse diameter of posterior end of core-base.
22 = Long diameter of anterior horn-cores.
23 = Long diameter of posterior horn-cores.
24 = Inside length of core-base from crown of cranium to crotch.
25 = Length of anterior horn-core.
26 = Length of posterior horn-core.
27 = "Anterior divergence" of anterior horn-core from a vertical plane with palate in a horizontal plane.
28 = "Posterior divergence" of posterior horn-core from a vertical plane with palate in a horizontal plane.
29 = Angle of divergence of anterior and posterior horn-cores.
30 = "Outward flare" of posterior horn-core with top of cranium in horizontal plane parallel to the palate.
31 = "Outward flare" of anterior horn-core with top of cranium in horizontal plane parallel to the palate.

[1] These measurements and *Figure 12* have been patterned after Osborn, 1912, "Craniometry of the Equidae," Mem. Amer. Mus., New Ser., I, Part III.

Table VIII illustrates the different tooth ratios obtainable in a large series of inferior dentitions and the resulting average ratios, if grouped by wear, from (w) to (w6). The lengthening of M_3 and the shortening of /Ps with wear occasions the changing tooth ratios (Figure 16).

TABLE VIII.—*Stockoceros*

PROGRESSIVE CHANGES IN TOOTH RATIOS WHEN GROUPED ACCORDING TO STAGES OF WEAR

	Stage of Wear	(w)	(w1)	(w2)	(w3)	(w4)	(w5)	(w6)
	No. of Spec..	3	5	11	11	9	2	6
$\frac{P_2–P_4}{M_1–M_3}$	**Group Av....**	**55%**	**52%**	**50%**	**48%**	**48%**	**44%**	**45%**
	Range.......	52–60%	48–54%	45–54%	45–54%	42–53%	–44%	43–50%
	No. of Spec..	3	2	6	4	3	0	5
$\frac{M_3}{P_2–P_4}$	**Group Av....**	**81%**	**82%**	**93%**	**98%**	**94%**	...	**108%**
	Range.......	73–85%	80–83%	86–101%	96–104%	89–100%	...	106–117%
	No. of Spec..	5	10	13	10	12	2	7
$\frac{M_3}{M_1–M_3}$	**Group Av....**	**44%**	**45%**	**46%**	**47%**	**48%**	**49%**	**49%**
	Range.......	43–45%	44–46%	44–48%	44–49%	45–52%	48–51%	46–51%

SKULL

Orbits

The orbits of *Stockoceros* and *Antilocapra* are of nearly the same size, placement and protuberance. The following indices show only a negligible difference in position. In the first indices, the parallelism of the orbit is expressed in a percentage, which decreases as the degree of forward tilt becomes greater. The degree of orbital protuberance is expressed in the second indices. (Table X, p. 196.)

Rostrum

The anterior face or rostrum of *Stockoceros* is less specialized than that of *Antilocapra*. The nasals are extended and the rostrum unexpanded, producing a slenderer, more graceful muzzle in contrast to the semi-retracted nasals and inflated rostrum of *Antilocapra* (Figure 13). Rostral expansion in *Antilocapra* has affected the premaxillae and the upper part of the maxillae but not the palatal width. (Table IX, pp. 194 and 195.)

The rostral width compared with various parts of the skull shows the relative proportions in the two species and the sexual differences in *Antilocapra*.

Nasal Bones

The nasal bones of the two species are quite different. In *Stockoceros*, the nasals are expanded posteriorly, extend beyond the anterior junction with the premaxillae and terminate in a definite point. As a group, they are consistently of one shape. In *Antilocapra*, the nasals are less expanded posteriorly and con-

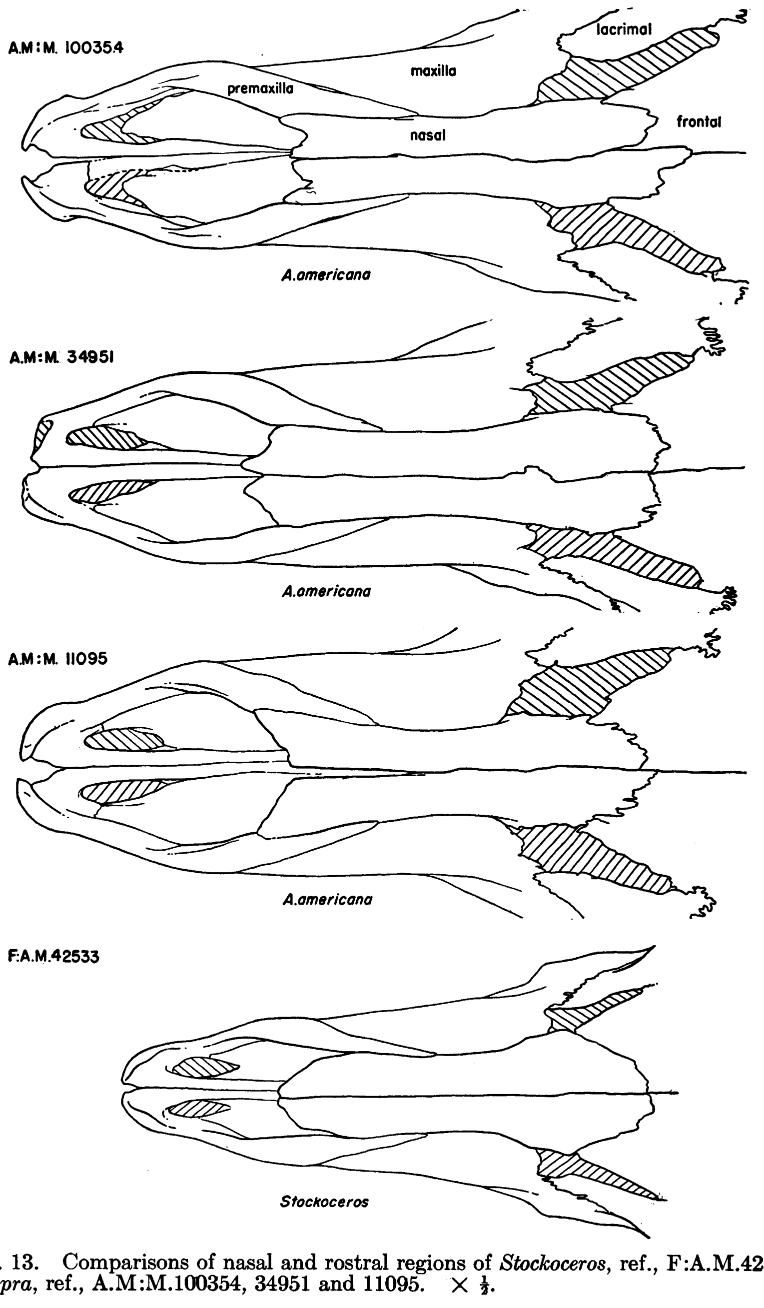

Fig. 13. Comparisons of nasal and rostral regions of *Stockoceros*, ref., F:A.M.42533, and *Antilocapra*, ref., A.M:M.100354, 34951 and 11095. × ½.

TABLE IXA.—MEASUREMENTS OF REPRESENTATIVE SKULLS OF *Stockoceros* AND *Antilocapra*

(Millimeters)
(See Figure 12 for points of measurement)

	Stockoceros						*Antilocapra*				
	Holotype	Referred					Referred (wild)				(Zoo)
	A.M. 22488	A.M. 22657	F:A.M. 42533	F:A.M. 42535	F:A.M. 42543	F:A.M. 42546	A.M:M. 75243	A.M:M. 11094	A.M:M. 11096	A.M:M. 6349	A.M:M. 21529[1]
Age or tooth wear	(w1)	(w3)	(w6)	(w1)	(w1)	(w3)	(w)	(w1)	(w2)	(w3)	(w2)
Length, overall	..	255.0	260.7	258.0	...	...	295.4	282.7	298.1	265.5	273.7
Length, basilar	..	225.7	228.1	228.6	...	...	261.1	249.5	255.5	232.5	242.5
Length, ant. of P^2 on median line to foramen magnum	..	148.4	143.9	148.6	141.5	137.7	162.0	155.7	162.2	147.6	154.2
Facial length, orbit to premax.	..	147.0	153.7	151.4	...	...	180.8	172.8	172.2	158.3	169.5
Horizontal diameter of orbit	..	42.0	43.7	40.0	40.0	41.0	45.4	44.6	46.5	45.0	43.7
Postorbital width (max.)	..	124.0	129.6	(124.6)[2]	127.0	129.3	136.8	139.7	135.4	121.9	140.7
Interorbital width (min. notch)	..	100.4	93.5	(95.4)	89.8	95.5	111.4	108.5	98.2	91.3	107.0
Rostral width below tip of nasals	..	38.5	37.8	38.2	...	...	48.9	46.6	47.0	41.4	39.7
Mastoid width	80.7	75.4	79.3	(79.0)	78.0	80.0	85.8	84.8	78.8	74.5	73.4
Facial width at masseteric process	..	69.3	68.0	65.0	67.5	...	74.9	77.0	75.5	69.5	73.5
Width of palate between M^3 s	..	43.3	43.0	42.0	41.1	...	52.0	52.7	42.0	45.2	46.7
P^2–M^3 crown length incl.	(64.2)	65.5	57.5	61.4	62.4	...	69.0	69.2	61.8	64.5	69.1
M^1–M^3 crown length incl.	38.6	43.3	36.5	36.7	38.3	...	42.5	46.4	42.7	40.1	43.4
M^3 length on crown	14.1	17.0	15.7	13.1	14.3	...	14.1	19.0	17.0	16.2	15.8

[1] A.M:M.21529, zoo specimen exhibiting evidence of rickets and not typical of *Antilocapra* in relative skull proportions.
[2] ( ) = approximate measurements.

TABLE IXB.—SUMMARY OF SKULL MEASUREMENTS OF *Stockoceros* AND *Antilocapra*

(Millimeters)

	Stockoceros				*Antilocapra* (wild female)				*Antilocapra* (wild male)			
	No. of spec.	Min.	**Group av.**	Max.	No. of spec.	Min.	**Group av.**	Max.	No. of spec.	Min.	**Group av.**	Max.
Length, overall	3	255.7	**258.1**	260.7	16	264.5	**275.1**	293.5	33	268.6	**285.2**	299.4
Length, basilar	3	225.7	**227.5**	228.6	16	228.5	**241.9**	258.0	28	235.1	**250.8**	261.1
Length, ant. of P^2 on median line to foramen magnum	21	134.5	**145.2**	155.2	18	142.6	**151.1**	162.2	32	147.1	**163.6**	165.0
Facial length, orbit to premax.	3	147.0	**150.7**	153.7	16	158.2	**167.0**	175.9	36	156.0	**172.7**	184.0
Horizontal diameter of orbit	19	38.5	**41.4**	43.7	14	41.5	**42.2**	47.0	37	43.0	**45.9**	48.9
Postorbital width (max.)	21	114.0	**127.0**	136.0	16	121.0	**128.9**	135.7	33	134.7	**141.6**	148.9
Interorbital width (min. notch)	19	87.4	**95.2**	104.0	16	87.5	**94.6**	100.9	36	100.0	**108.2**	120.4
Rostral width below tip of nasals	11	32.0	**37.3**	38.5	16	41.4	**44.9**	48.7	36	42.5	**48.5**	56.9
Mastoid width	19	73.3	**78.1**	81.5	16	71.0	**76.0**	81.0	35	76.2	**84.0**	90.1
Facial width at masseteric process	17	63.8	**68.6**	77.0	16	65.0	**72.2**	76.0	38	68.0	**74.0**	85.2
Width of palate between M^3 s	19	39.3	**42.5**	45.7	16	43.3	**48.5**	52.0	37	47.5	**50.8**	55.3
P^2–M^3 crown length incl.	23	57.0	**62.8**	67.0	16	62.8	**68.0**	73.5	32	62.5	**69.2**	76.2
M^1–M^3 crown length incl.	23	36.5	**39.5**	43.3	15	39.6	**42.9**	45.2	36	39.2	**43.7**	46.4
M^3 length on crown	25	13.1	**15.3**	17.9	15	13.5	**16.8**	21.5	15	14.1	**16.7**	19.1

TABLE X.—ORBITAL INDICES

(Percentages)
(See Figure 12 for key to measurements)

	Stockoceros Male and female				*Antilocapra* Female				*Antilocapra* Male			
	No. in group	Min.	**Group av.**	Max.	No. in group	Min.	**Group av.**	Max.	No. in group	Min.	**Group av.**	Max.
Interorbital width (min.) / Postorbital width (max.)	14	70.6	**74.3**	78.8	16	70.8	**73.8**	80.5	15	74.4	**76.9**	82.2
Facial width at mass. proc. / Postorbital width (max.)	11	52.2	**53.8**	57.1	16	54.2	**56.3**	59.0	15	50.7	**53.7**	58.0

TABLE XI.—ROSTRAL INDICES

(Percentages)
(See Figure 12 for key to measurements)

	Stockoceros				*Antilocapra* Female				*Antilocapra* Male			
	No. in group	Min.	**Group av.**	Max.	No. in group	Min.	**Group av.**	Max.	No. in group	Min.	**Group av.**	Max.
Rostral width / P[2] median to foramen magnum	8	25.0	**25.7**	26.8	11	27.1	**29.8**	34.6	10	29.0	**31.2**	34.2
Rostral width / Facial width	8	52.5	**55.9**	59.5	11	57.4	**62.9**	70.4	10	60.5	**65.7**	70.0
Rostral width / Mastoid width	8	45.0	**48.6**	54.0	11	54.7	**59.6**	64.3	10	53.8	**57.3**	62.5

tribute to a larger facial vacuity. The anterior ends are irregularly shaped and retracted, may or may not extend beyond the anterior junction with the premaxillae, and at times form a convex border in the nasal opening. Figure 13 shows the variation in *Antilocapra* nasals and the consistency in those of *Stockoceros.*

Facial Vacuity

The size and shape of the facial vacuity are affected by the four bones forming its border. The vacuity is open and expanded in *Antilocapra* and proportionately longer and narrower in *Stockoceros.* In *Antilocapra,* the frontal and lacrimal are further separated, the maxilla forms a larger portion of the border and the nasal is less important than in *Stockoceros* (Figure 15).

Representative extremes of both species demonstrate the relative importance of the four component bones forming the vacuity border.

TABLE XII.—REPRESENTATIVE VACUITY COMPONENTS

(Percentages)

	Stockoceros		*Antilocapra*	
	F:A.M. 42534	F:A.M. 42537	A.M:M. 11094	A.M:M. 130201
Component Part:				
Nasal	29.1%	25.7%	16.8%	19.9%
Lacrimal	39.7	38.4	36.9	32.5
Frontal	21.0	23.7	29.6	26.7
Maxilla	10.2	12.2	16.7	20.8

Cranium

The cranium of *Stockoceros* has the median frontal suture well fused posteriorly. Its junction with the parietal is seen only in immaturity; in maturity it is evident from the shallow dorsal depression between the supraorbital foramina to the frontal nasal sutures. The supraorbital foramina are located on the anterior, internal part of the core-base, are more forward, smaller and more inclosed than in *Antilocapra* and are extended dorsoventrally along the core-base. A shallow facial groove, leading from the foramina towards the posterior border of the facial vacuity as in *Antilocapra,* is relatively smaller than in either *S. conklingi* or *Tetrameryx shuleri.* A transverse bulge between the core-bases is located more anteriorly than in *Tetrameryx shuleri* or *Antilocapra.* The bulge is not so pronounced in *S. conklingi.* The suture between the parietal and the squamosal is strongly braced and presents a distinct ridge on the sides of the cranium as in *Antilocapra.* At times, foramina occur posteriorly along the suture line in both species. The suture between the supraoccipital and the parietal is somewhat less crenulated than in *Antilocapra,* and is evident in well matured skulls. A comparatively larger expanse of the occipital is present on the dorsal surface than in *Antilocapra.* The dorsal surface of the cranium is slightly more curved and transversely expanded in *Stockoceras;* the shape of the paramastoid processes and cranial foramina of *Stockoceros* and *Antilocapra* is similar when viewed from the side of the cranium.

The parietal crests[1] are widely separated and, as in *Antilocapra,* form distinct ridges from the dorsal side of the supraoccipital to the lower posterior sides of the core-bases. The greatest constriction of the ridges occurs anterior to the supraoccipital, and is strongest in *S. conklingi.*

The auditory bulla of *Stockoceros* is more swollen and smoothly rounded and relatively larger than in *Antilocapra.* The external auditory meatus of *Stockoceros* is somewhat differently shaped than that of *Antilocapra.* It is slightly larger and from an externally rounded tube, becomes flattened, merging into the general contour of the bulla where it forms part of an inclosed tympanohyal pit on the external ventral side. The meatus of *Antilocapra* joins with the bulla to produce an open, deeply cleft tympanohyal pit; it is more tubular and at times has a pronounced ridge running from the ventral anterior side of the pit toward the external opening.

Core-base

The core-base of *Stockoceros* is formed by the convergence of the anterior and posterior horn-cores which, in immaturity, originate from two separate sources on the frontal bones. The diameters of the horn-cores increase, converge toward each other, and produce the core-base.[2] The fork of the core-base is above the posterior rim of the orbit. The angular set and flare of the horn-cores are strongly reflected in the core-base, producing a shallow pit on the exterior side below the fork. The proximal portion is nearly parallel with the median line of the skull. The texture of the bone suggests that it was covered with skin rather than with horn-sheath.

A distinct, rounded pit is present on the frontal bone below the core-base at its junction with the supraorbital process. The pit is indicated in all Antilocaprini. It is strongly developed in *Hayoceros,* moderately in *Antilocopra* and *Stockoceros* and hardly discernible in casts of *T. shuleri* and *Sphenophalos nevadanus.*

Horn-cores

The single horn-core of male *Antilocapra* has nearly the same position over the orbit as the anterior horn-core of *Stockoceros.* It is synonymous, however, with the posterior horn-core of *Stockoceros.* The anteriorly expanded core and

[1] The separation of the parietal ridges at their junction with the supraoccipital crest may prove to be one of the important distinguishing characters found in the ancestral Antilocaprini. In *Plioceros dehlini,* the ridges are well separated and the supraoccipital is relatively more exposed in the dorsal view, whereas in the antelope-like Merycodontini genera, *Meryceros* and *Cosoryx,* of the Pliocene, the ridges are not strongly separated on the posterior part of the cranium.

[2] In certain Antilocaprini, this manner of core-base production cannot be considered a true element of structure. This type of core-base has a pseudo-relationship to the true beam or bony ridge of the "high core-based" group, pages 177, 178.

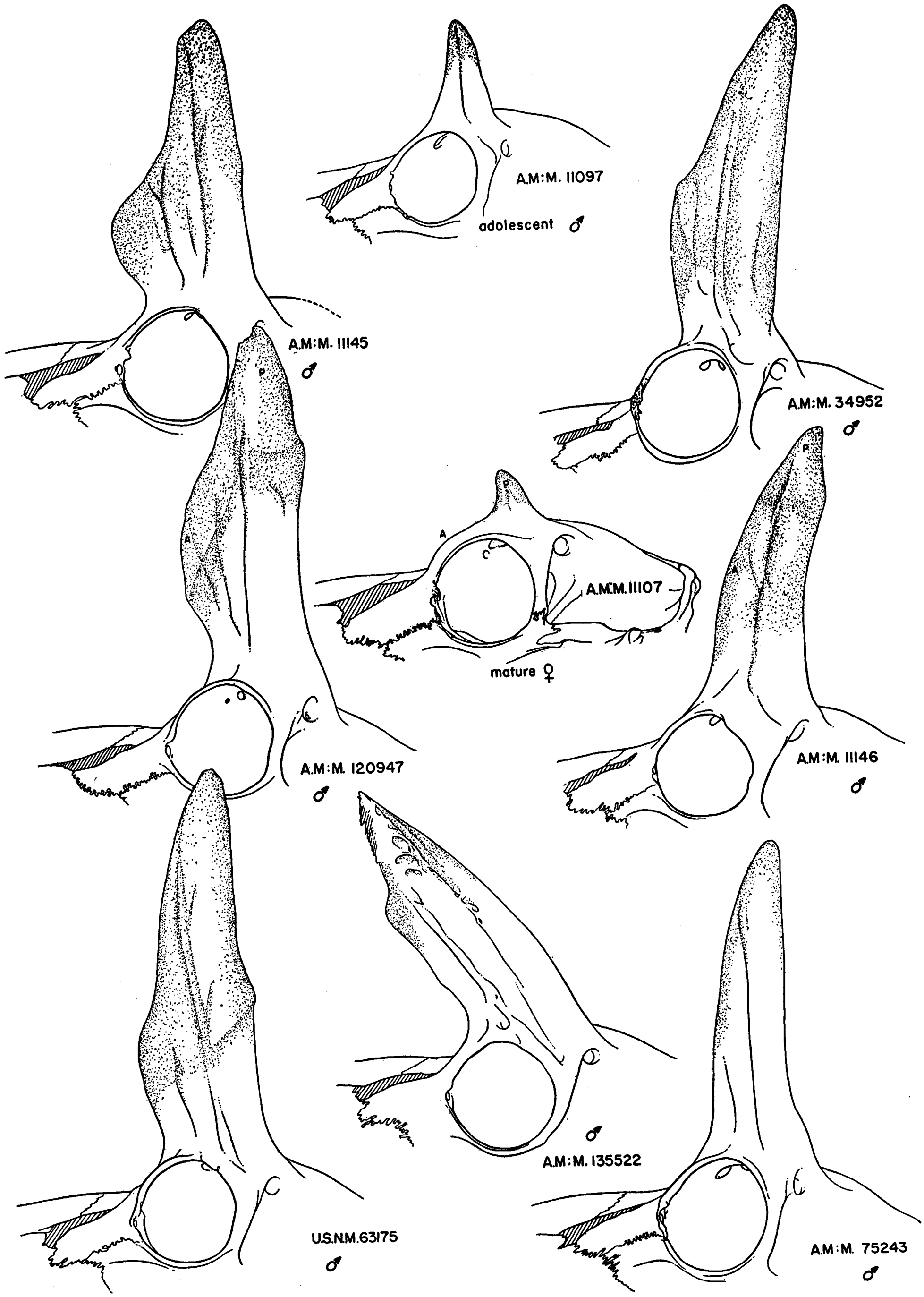

Fig. 14. Variations in horn-cores of wild *Antilocapra*, ref., A.M:M.75243, 135522, 120947, 11146, 11145, 34952, and U.S.N.M.63175, mature males; A.M:M.11097, immature male; A.M:M.11107, mature female. × ⅓.

In the central figures, A = remnants of ancestral anterior horn-core (anterior prong of male sheath and orbital protuberance of female); P = relationship of male horn-core and vestigial female horn-core to ancestral posterior horn-core.

forked sheath are the only remaining indications of the anterior horn-core in male *Antilocapra* (Figure 14).

In female *Antilocapra*, no examples of an anteriorly forked sheath are found in the vestigial female horn. There are, however, a distinct ridge and protuberance anterior to the vestigial horn-core; they appear to be synonymous with the anterior horn-core of *Stockoceros* and the vestigial core with the posterior horn-core.

The first indication of horn-cores appears on the frontal above the posterior portion of the orbit in both sexes of *Antilocapra*. As age progresses, a swelling forms anterior to the original button between the orbital rim and supraorbital foramen. In the immature cranium of *Stockoceros* (Figure 10) the horn-cores are small enough to indicate the points of origin on the frontal. They are slightly more posterior than the horn-core and protuberance of female *Antilocapra*.

Both the anterior and posterior horn-cores of *Stockoceros* may vary in length and shape, but still remain subequal. Whenever the cores assume an elliptical outline, the outside of the posterior and inside of the anterior core tend to be flattened. The anteroposterior divergence of the horn-cores varies from 41 to 74° and averages 54°. Related forms, *S. onusrosagris* from Burnet Cave and *S. conklingi*, suggest less divergence. The divergence, angular set and flare of the horn-cores are best illustrated in F:A.M.42533 (Figure 12). The anterior cores flare outwardly from 18 to 35°, averaging 23°. The outward flare of the posterior cores is always individually less, ranging from 7 to 27° and averaging 15°. With the exception of the outward flare, which is 5° above average, and the core-base length, which is 5 mm. longer than average, the illustrated specimen (F:A.M.42533) is representative of the mean of 15 or more specimens from which measurements were available.

The tendency for the posterior horn-cores to remain more erect is not confined to *Stockoceros* but is evidenced in many of the related Antilocaprini and contributes to the observed twist or twine of certain horn-cores.

Horn-core Sulcus

A single sulcus is seen at a median point on the external surface of the anterior and posterior horn-cores in *Stockoceros*. They originate at the proximal end of the core-base, ascend half way up the cores and swing toward the anterior surface at the tip of the anterior horn-core, and toward the posterior surface at the tip of the posterior horn-core.

Male *Antilocapra* horn-cores normally possess two main sulci, which originate on the median external surface at the base of the core, ascend parallel to each other, and then branch. The anterior sulcus leads to the forward edge where the fork of the sheath occurs. The posterior leads to the tip of the horn-core. The vestigial horn-cores of female *Antilocapra* normally have one sulcus on the external side of the posterior half. This again suggests the male retention and female loss of the ancestral anterior horn-core.

Horn-sheaths

The horn-sheaths of *Stockoceros* were presumably long and sharp, probably extending beyond the cores from 2–5 inches and giving the animal a formidable weapon—unless, like *Antilocapra,* the sheath-tips were curved sharply on the ends.

Sexual Separation

Of over 60 individuals represented by complete skulls and crania, no hornless specimens are present. This strongly indicates that both sexes were well horned in antithesis to *Antilocapra,* in which the horn development is related to the sex.[1]

The entire cave collection may represent a seasonal phenomenon, in which only the males frequented the locality. This is not improbable, for the fauna shows a pronounced lack of immature individuals who would have been with the females after fawning time. Male and female *Antilocapra* are known to separate into sexual herds in winter and early spring previous to the fawning period. The herds again mingle in late summer and early fall.

Skulls which might represent female *Stockoceros* have horns tending to be transversely compressed, smaller in diameter, shorter in length and more widely divergent than the male. In *Antilocapra,* where sex is easily determined, the supraglenoid foramen is relatively larger in the female. A correlative enlargement is indicated in the referred female skulls of *Stockoceros.*

Superior Dentition

The cheek teeth of *Stockoceros onusrosagris* are smaller and less hypsodont than those of *Antilocapra* (Figure 16), and are decidedly smaller than those of *Tetrameryx shuleri.*[2] The premolars curve backward and the external styles are not so strongly folded as in *Antilocapra.* The most distinguishing difference between the P^2 of *Stockoceros* and *Antilocapra* is the development of a lingual fold, slightly anterior to the median point of the tooth. In *Stockoceros* it is seldom closed enough to form a fossette, and its indentation continues well down the tooth toward the root; in *Antilocapra* the fold is usually closed and forms a fossette. *Tetrameryx shuleri* also has the fossette and closed fold as observed from Yale Peabody Museum cast (S.M.U.1.50) and Dr. Lull's[3] illustrations. The open fold is presumably a primitive character, present in the dP^3 of immature *Antilocapra* and *Ceratomeryx prenticei,* and in both the P^2 and P^3 of *Plioceros dehlini,* an ancestral Antilocaprini of the basal Ash Hollow formation.

The P^3 and P^4 of *Stockoceros* are similar to *Antilocapra* in pattern and relative size.

The para- and mesostyles of M^1–M^3 in *Stockoceros* are not so prominent but

[1] Pocock, R. I., 1905, Proc. Zool. Soc. London, I, p. 191.
[2] Lull, R. S., 1921, Amer. Journ. Sci., (5), II, p. 163, Figs. 2, 3.
[3] Idem., p. 163, Fig. 2.

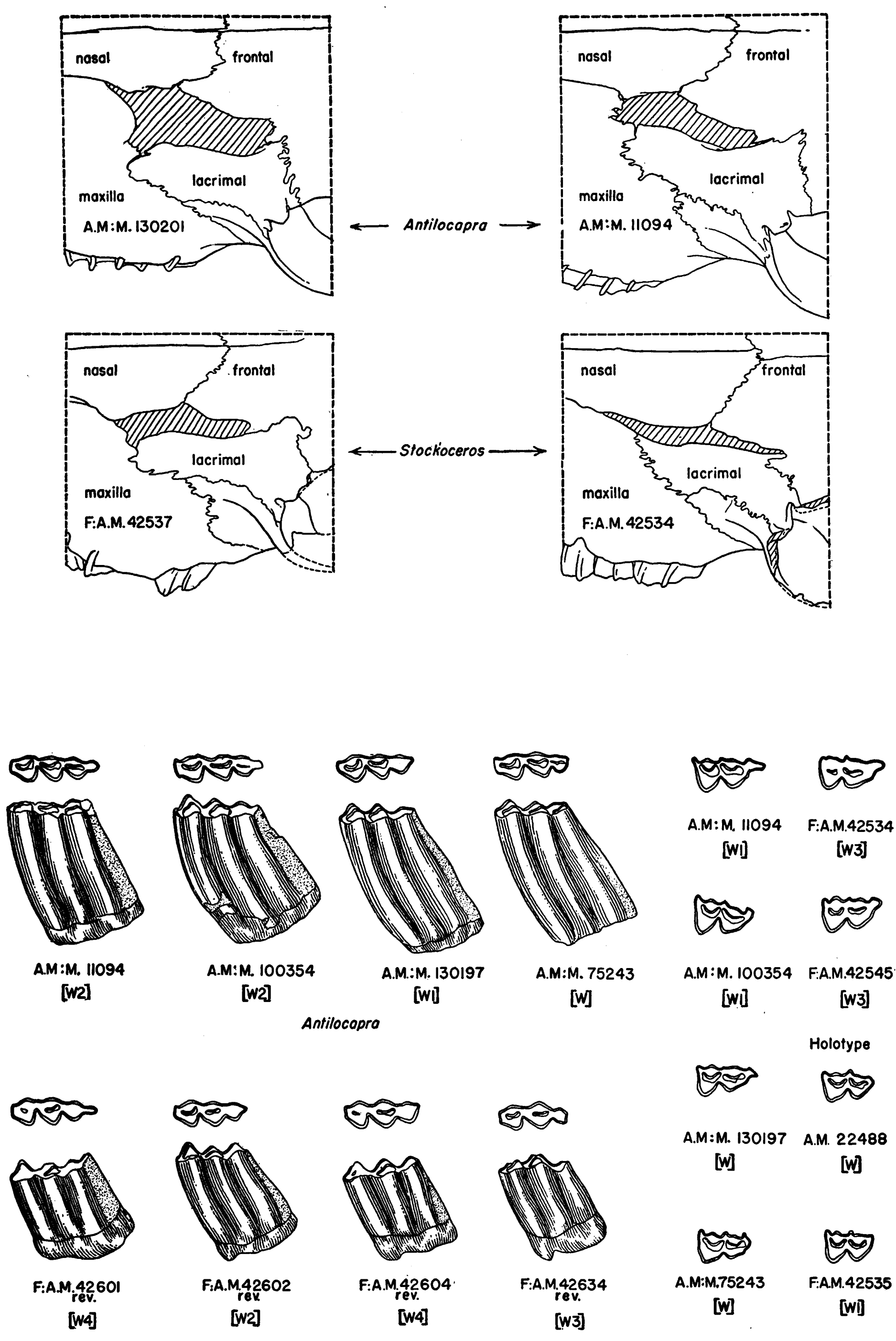

Fig. 15. Variations in superior and inferior 3d molars and facial vacuities of *Stockoceros* and *Antilocapra*, ref. F:A.M. and A.M. numbers, *Stockoceros;* A.M:M. numbers, *Antilocapra.* (The variable 4th lobe of M_3 is stippled in the lateral views.) $\times \frac{1}{2}$.

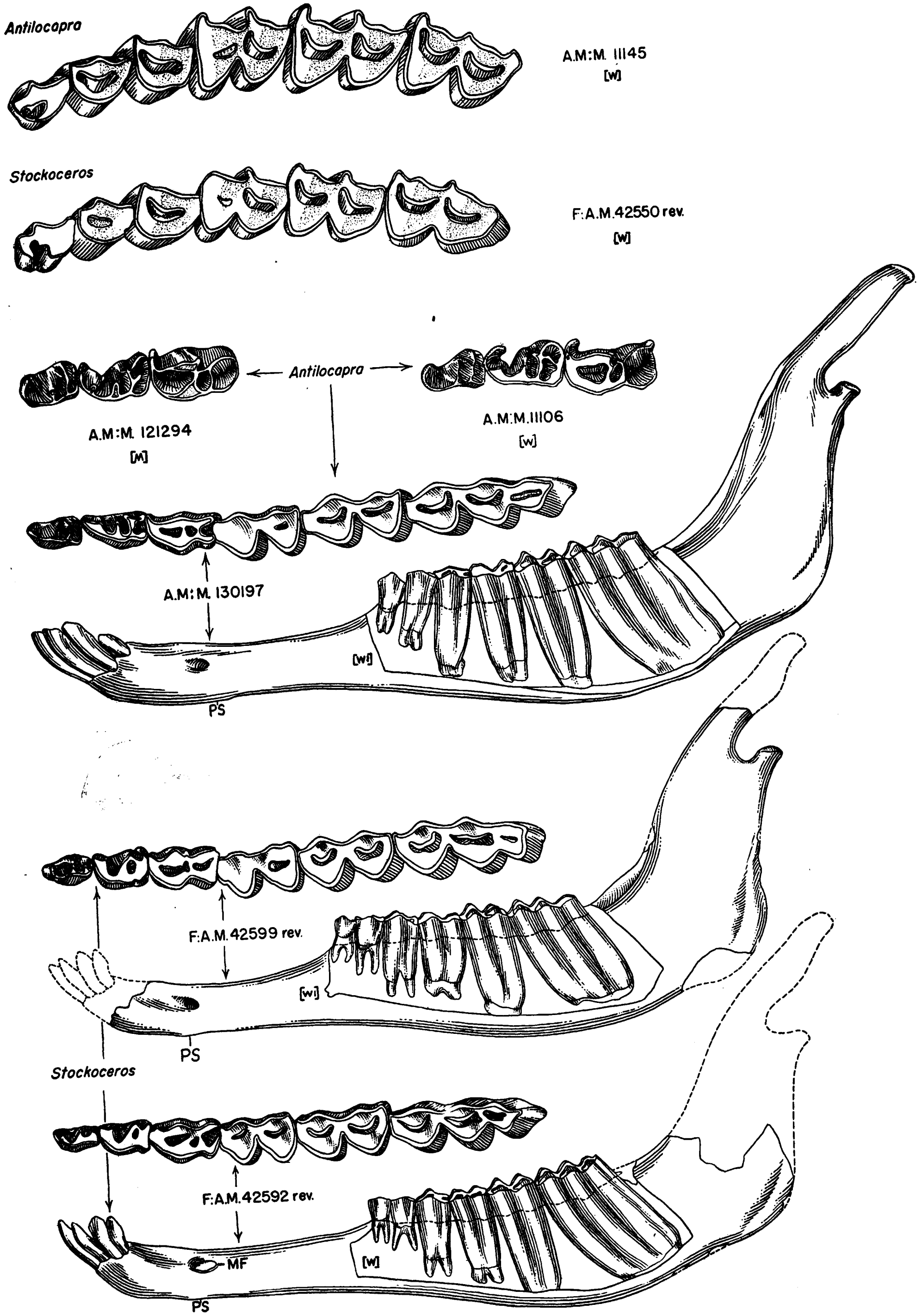

Fig. 16. Comparative maxillary and mandibular dentitions of *Stockoceros* and *Antilocapra*, ref., illustrating wear and tooth pattern. Lateral views × ½, occlusal × 1.

the metastyles of M^1–M^2 resemble those of *Antilocapra,* while that of M^3 is definitely smaller (Figure 15). The M^3 of both species has a tendency to add an extra column or heel to the posterior external side. *Antilocapra* shows the greatest variation in this respect, whereas in the mandible of *Stockoceros* the M_3 is most variable (Figure 15). At times, another posterior, internal column is found on the M^3 of both forms.

Mandible

The mandibular ramus of *Stockoceros* is smaller than that of *Antilocapra* but proportionately very similar. The ventral side of the horizontal ramus is less curved, the angular border of the vertical ramus more pronounced, and the angle formed by the vertical and horizontal rami more abrupt than *Antilocapra.* The /C–P_2 diastema is so variable that a single specimen of either species is not typical. As a group, the diastema length of *Stockoceros* is 8–10 mm. shorter but its proportions to other parts of the ramus are nearly the same as in *Antilocapra.* The ratio of $\frac{\text{Post /C–P}_2}{\text{M}_3}$ ranges from 241 to 365% (average 309%) in *Stockoceros.* It differs sexually in *Antilocapra,* ranging in the males from 272 to 377% (average 315%) and in the females from 292 to 374% (average 302%). The combined average, however, of male and female *Antilocapra* equals 308%, the same as the sexually indeterminate *Stockoceros.*

Inferior Dentition

The premolars of *Stockoceros* are decidedly less hypsodont than *Antilocapra* (Figure 16). The double roots of the premolars are strongly separated, while those of *Antilocapra* are nearly eliminated. The crown of P_2 in *Stockoceros* is not so deeply folded as that of *Antilocapra.* In both species, the P_3s are much alike and well advanced toward molariformity in pattern. The posterior lingual fold between the metaconid-entoconid (open in *Plioceros dehlini*) has become closed and forms a shallow median fossette. The P_4 is more molariform. The anterior lingual fold is closed by the union of the paraconid and metaconid. The posterior lingual fold is closed by the union of the metaconid and entoconid, forming anterior and median fossettes.

The molars of *Stockoceros* are less hypsodont than those of *Antilocapra.* In pattern, the first two molars of both species are similar, but in *Stockoceros* the variability of M_3 is of special interest.

In nearly all Pliocene antilocaprids, the M_3 is a three-lobed tooth, occasionally with a posterior accessory ridge or heel which seldom develops enough to be called a 4th lobe. In *Stockoceros,* the M_3 varies from a three- to a four-lobed tooth (Figure 15), but obviously the 4th lobe is not a dependable character. In *Antilocapra,* the M_3 does not exhibit an equal amount of variation. The 3d lobe is consistently larger and is not appreciably affected in size by the presence of a 4th lobe. In *Stockoceros,* the 4th lobe is longer at the base of M_3 and

TABLE XIIIA.—MEASUREMENTS OF REPRESENTATIVE MANDIBULAR RAMI OF *Stockoceros* AND *Antilocapra*

(Millimeters)

	Stockoceros Referred						*Antilocapra* Referred (wild)				
	A.M. 22658	F:A.M. 42645	F:A.M. 42648	F:A.M. 42655	F:A.M. 42598	F:A.M. 42644	A.M:M. 75243 ♂	A.M:M. 11094 ♂	A.M:M. 11096 ♀	A.M:M. 6349 ♀	A.M:M. 120947[1] ♂
Age or tooth wear	(w5)	(w4)	(w3)	(w2)	(w1)	(I)	(w)	(w2)	(w4)	(w4)	(w5)
Length, post. edge of /C alv. to post. of M_3 alv.	134.5	125.5	135.2	128.6	(129.0)	125.0	155.1	149.5	148.8	134.8	150.3
Length, diastema, /C alv. to P_2	67.1	61.5	65.6	62.3	60.0	60.5	75.0	68.7	73.2	62.5	79.7
Depth of symphysis, post. of mental foramen	13.5	13.9	15.5	14.3	14.2	12.8	14.0	14.2	14.6	17.0	13.5
P_2–M_3, alv. border	66.5	64.0	70.5	66.8	70.0	dP-50.0	79.5	80.5	76.2	72.8	72.3
M_1–M_3, crown length incl.	43.3	41.2	46.7	42.4	43.7	43.5	47.0	50.7	48.6	46.5	48.4
M_3, length on crown	21.3	20.0	21.6	19.2	18.8	19.0	19.9	25.1	23.4	22.3	23.8

[1] Specimen A.M:M.120947, although wild, is one of the largest and has the longest, most slender symphysis in the collection.

TABLE XIIIB.—SUMMARY OF RAMAL MEASUREMENTS OF *Stockoceros* AND *Antilocapra*

(Millimeters)

	Stockoceros				*Antilocapra* (wild female)				*Antilocapra* (wild male)			
	No. of spec.	Min.	Group av.	Max.	No. of spec.	Min.	Group av.	Max.	No. of spec.	Min.	Group av.	Max.
Length, post. edge of /C alv. to post. of M_3 alv.	28	122.0	**129.4**	138.7	13	134.8	**144.1**	151.7	12	141.4	**148.5**	155.1
Length, diastema, /C alv. to P_2	31	53.5	**62.8**	70.5	13	61.6	**70.6**	78.5	12	60.0	**70.6**	79.7
Depth of symphysis, post. of mental foramen	36	12.1	**14.0**	16.0	13	14.1	**15.4**	17.0	12	13.5	**15.0**	16.5
P_2–M_3, alv. border	63	56.8	**64.4**	70.0	13	66.9	**72.1**	81.9	12	69.6	**75.0**	82.4
M_1–M_3, crown length incl.	60	39.5	**43.5**	49.0	13	44.5	**48.1**	51.0	12	43.5	**47.8**	50.7
M_3, length on crown	74	17.2	**20.3**	25.2	13	20.5	**23.4**	26.8	12	19.4	**22.4**	25.1

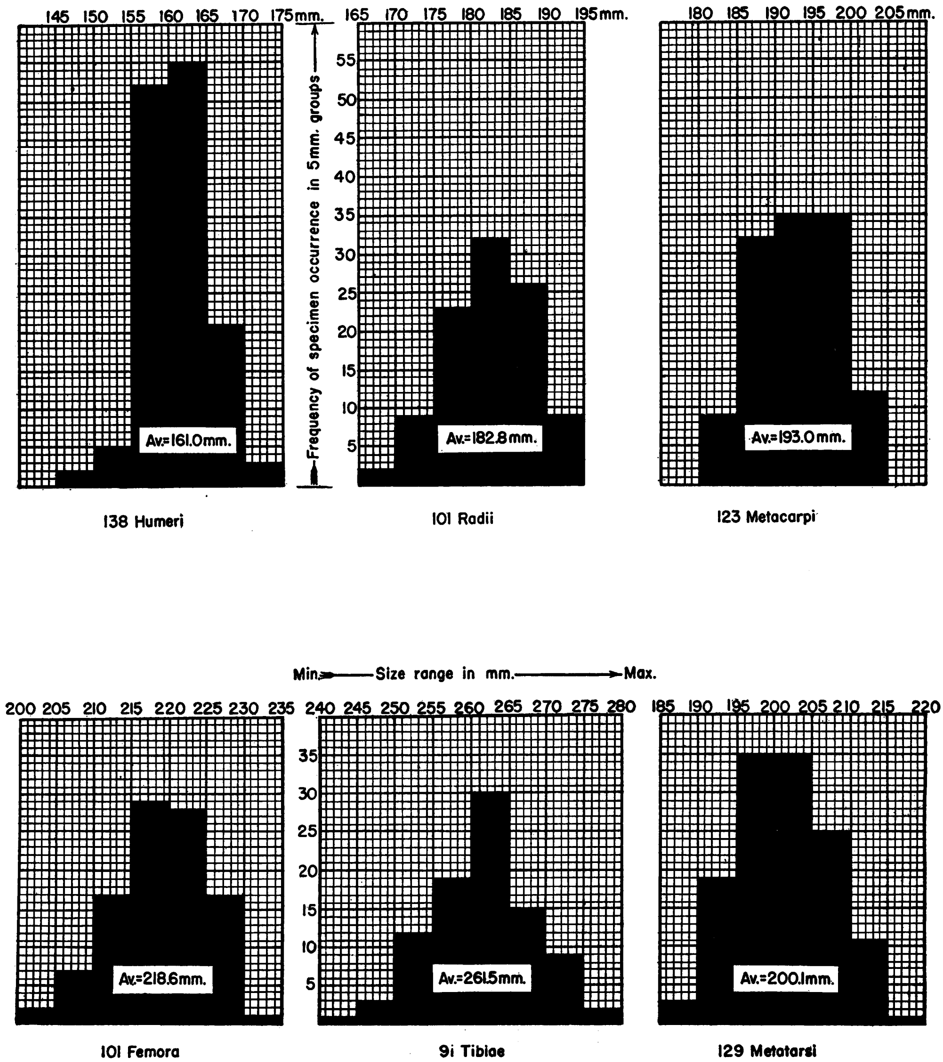

Fig. 17. Chart of limb sizes and distributions in *Stockoceros*, showing symmetrical distribution of size groups.

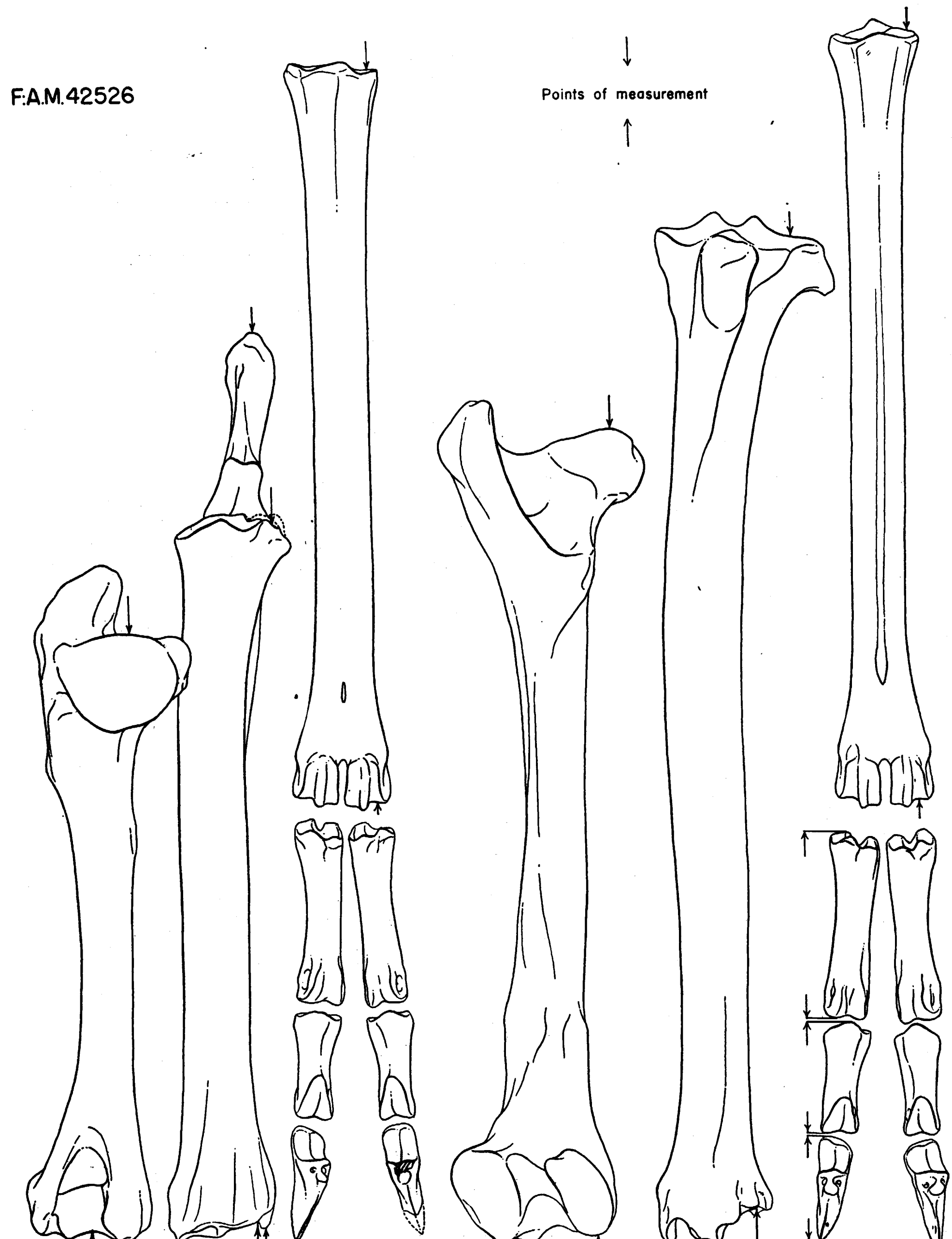

Fig. 18. *Stockoceros*, ref., F:A.M.42526, indicating points of measurements used in obtaining articular lengths of limbs. (See page 187.) × ½.

progressively elongates on the crown with wear (Figure 15). Whenever the 4th lobe is absent, the 3d tends to be smaller.

One hundred and thirty M_3s of *Stockoceros* were examined and classified as follows:

	Specimens
Min. Group.—3 lobes to slight indication of 4th lobe	24
Av. Group.—Small to moderately large 4th lobe	94
Max. Group.—4th lobe one-half to as large as 3d lobe	12

Appendicular Skeleton

The 683 measurable major limb elements of *Stockoceros* in the Papago Springs Cave collection, some of which are articulated, permit a comparison of the size range and average limb lengths and proportions. Only 12 skeletons of fully mature wild *Antilocapra* have been available, and, therefore, the results are not so conclusive as in the extinct pronghorn collection.

The skeletons from zoos and game preserves are not typical of wild antelope (page 211). Captivity or artificial conditions apparently have a deteriorating effect upon the limb relationships of *Antilocapra.* The humerus and femur are shortened in captivity and, when compared to the manus and pes, create a false impression of foot elongation, not observed in wild antelope. The individual limb ratios are erratic when compared to the wild forms, no doubt due to lack of exercise or to rickets caused by unnatural food selection which produces a vitamin-deficient diet. The semi-wild game preserve specimens are not so noticeably affected as the zoo animals (pages 211,212). The life histories of the captive animals disclosed that many had been bottle-raised from young fawns.

The quantitative occurrence of the major limbs of *Stockoceros* is graphically presented in Figure 17, and the minimum, average and maximum measurements are presented in the comparative summary of articular limb lengths (Table XV). The articulated skeleton, F:A.M.42526 (Figure 18 and page 187), illustrates the points of measurements used for articular lengths.

Scapula

The scapula of *Stockoceros* is smaller than that of *Antilocapra* (the glenoid cavity slightly shallower, the tuber scapulae slighter) and lacks a process on the exterior upper portion of the posterior border that is present in *Antilocapra.* The general shape is alike in both forms.

	Greatest length	Greatest width
Stockoceros, F:A.M.42748	180 mm.	110 mm.
Antilocapra, A.M:M.130201	198	115

Humerus

As a group, the humeri of *Stockoceros* average 13 mm. smaller than those of *Antilocapra;* the largest equals that of small *Antilocapra;* the smallest is slightly larger than the known humerus of *S. conklingi.* The lateral and medial tuberosities on the proximal end, and the lateral and medial epicondyles on the distal end are slightly smaller; the olecranon fossa is shallower and less inclosed; the shaft is slenderer than that of *Antilocapra.* The deltoid ridges are well developed in both forms. The relative articular length of the average radius to the average humerus is 1% greater than in *Antilocapra* and 9% greater than in the known relationship of *S. conklingi.*

The ratios of the average articular length of the rest of the limbs to that of the humerus are as follows:

	Radius / Humerus	Metacarp. / Humerus	Femur / Humerus	Tibia / Humerus	Metatars. / Humerus
Stockoceros	113%	120%	136%	162%	124%
Antilocapra (wild)	112	119	128	146	123

Radius and Ulna

As a group, the radii of *Stockoceros* average 12 mm. shorter than those of *Antilocapra;* the largest radius is as large as that of average *Antilocapra;* the smallest is larger than the known radius of *S. conklingi.* The radius of *S. onusrosagris* is less transversely expanded on the proximal and distal articular surfaces; the shaft is relatively lighter, less expanded transversely and more flattened anteroposteriorly than *Antilocapra.* Viewed from the side, the radii of both forms are equally bowed.

The ulna of *Stockoceros* is more centrally reduced and strongly fused to the radius from the proximal interosseous space to the distal end. Occasionally a small distal, interosseous space is present; the external articular surface for the lateral condyle of the humerus is nearly absent and the olecranon is smaller. The ulna of *Antilocapra* is centrally heavier and weakly fused to the radius.

The ratios of the average articular length of the rest of the limbs to that of the radius are as follows:

	Humerus / Radius	Metacarp. / Radius	Femur / Radius	Tibia / Radius	Metatars. / Radius
Stockoceros	88%	106%	120%	143%	109%
Antilocapra (wild)	90	106	114	131	110

Carpal Bones

The carpal bones of both forms are similar except that the distal end of the radius and the proximal end of the metacarpus are more transversely expanded in *Antilocapra,* causing a corresponding amount of carpal expansion. The articular length of the carpals is 1–2 mm. less in *Stockoceros.*

Metacarpus

As a group, the metacarpi of *Stockoceros* average 14 mm. shorter than those of *Antilocapra;* the largest approximates the size of average *Antilocapra;* the smallest is 25 mm. larger than the known cannon bone of *S. conklingi.* The difference in the relative diameters of the metacarpal shafts is hardly discernible; the articular surfaces of the proximal and distal ends are less transversely expanded; the anterior longitudinal groove is not distinct but the posterior groove is well defined and somewhat stronger in *Stockoceros* than in *Antilocapra.*

The ratios of the average articular length of the rest of the limbs to that of the metacarpus are as follows:

	Humerus / Metacarp.	Radius / Metacarp.	Femur / Metacarp.	Tibia / Metacarp.	Metatars / Metacarp.
Stockoceros..................	83%	95%	113%	135%	104%
Antilocapra (wild)............	84	94	107	123	103

Phalanges

Phalanges 1, 2 and 3 have relatively the same proportions in both species. The ratio of their total length to the metapodials in the articulated skeletal material of *Stockoceros* approaches 48% in the forelimbs and 50% in the hind limbs, as in *Antilocapra.* The phalanges of *Stockoceros* are slightly smaller, but possess no outstanding morphological differences.

Pelvis

The pelvis of *Stockoceros* is smaller than that of *Antilocapra* but otherwise shows no marked difference in its relative proportions. An exception, which may have been caused by rickets, was observed in the zoo specimen, A.M:M. 21529. It was lighter and less sturdy, with weaker processes for muscular attachment than either *Stockoceros* or wild *Antilocapra.*

Femur

As a group, the femora of *Stockoceros* average 4 mm. shorter than those of *Antilocapra;* the largest equals that of large *Antilocapra;* the smallest is 10 mm. longer than the known specimen of *S. conklingi.* In *S. onusrosagris,* the relative length of the femur to the rest of the limbs is greater than in *Antilocapra.* The shaft is comparatively as slender and, when viewed from the side, the femora of both forms are equally bowed. On the proximal end of the *Stockoceros* femur, the trochanter minor is larger; on the shaft, the lateral supracondyloid crest is narrower and more ridged; on the distal end, the trochlea groove for the patella is narrower and extends farther around the anterior side; the intercondyloid fossa is broader and the rugosities for the gastrocnemii muscular attachments are larger than in *Antilocapra.*

The ratios of the average articular length of the rest of the limbs to that of the femur are as follows:

	Humerus / Femur	Radius / Femur	Metacarp. / Femur	Tibia / Femur	Metatars. / Femur
Stockoceros..................	74%	84%	88%	119%	92%
Antilocapra (wild)............	78	87	93	115	96

TABLE XIV.—COMPARATIVE INDIVIDUAL LIMB RATIOS AND GROUP AVERAGES

(Percentages)

Stockoceros Specimen number	Radius / Humerus	Manus / Humerus	Tibia / Femur	Pes / Femur
F:A.M.				
42526.....	114	194	122	158
42527.....	113	192	123	153
42528.....	115	...	122	...
42529.....	...	...	118	...
42530.....	115	...	...	...
42531.....	113	...	...	...
Group averages	**114**	**193**	**121**	**155**

Antilocapra (wild) Specimen number	Radius / Humerus	Manus / Humerus	Tibia / Femur	Pes / Femur
A.M:M.				
75243.....	114	190	115	163
130197....	114	185	117	159
130198....	114	190	115	159
U.S.N.M.				
13980.....	114	(186)	115	(162)
22659.....	113	190	114	157
3137......	112	118	113	158
A.M:M.				
100354....	112	186	114	156
10419.....	111	184	116	168
100353....	110	193	113	160
U.S.B.S.				
245622....	109	188	113	155
U.S.N.M.				
22387.....	108	189	115	162
A.M:M.				
130201....	108	186	115	159
Group averages	**112**	**188**	**115**	**159**

Antilocapra (preserve) Specimen number	Radius / Humerus	Manus / Humerus	Tibia / Femur	Pes / Femur
U.S.B.S.				
251131....	116	191	122	168
251133....	115	193	121	167
256666....	111	190	115	163
251104....	117	193	114	162
Group averages	**115**	**192**	**118**	**165**

Antilocapra (zoo) Specimen number	Radius / Humerus	Manus / Humerus	Tibia / Femur	Pes / Femur
A.M:M.				
21529[1].....	124	199	123	170
5036......	118	199	118	169
U.S.N.M.				
256454....	116	197	116	168
A.M:M.				
19350.....	114	194	120	168
22991.....	110	194	115	167
Group averages	**116**	**197**	**118**	**168**

[1] *Antilocapra* zoo skeleton, A.M:M.21529, is an extreme example of the effects of rickets probably produced by confinement.

TABLE XV.—SUMMARIZED COMPARATIVE ARTICULAR LENGTHS OF MAJOR LIMB ELEMENTS

(Millimeters)

	Stockoceros				*Antilocapra* (wild)				*Antilocapra* (game preserve, semi-wild)				*Antilocapra* (zoo)			
	No. of spec.	Min.	**Group av.**	Max.	No. of spec.	Min.	**Group av.**	Max.	No. of spec.	Min.	**Group av.**	Max.	No. of spec.	Min.	**Group av.**	Max.
Humerus.....	138	146.7	**161.0**	171.5	12	168.5	**174.1**	181.1	4	165.9	**174.1**	181.2	5	151.0	**165.1**	177.0
Radius......	101	165.3	**182.8**	195.2	12	183.8	**194.5**	205.5	4	188.7	**199.5**	209.3	5	179.2	**192.5**	202.9
Metacarpus..	123	179.3	**193.0**	202.5	12	195.5	**206.8**	220.0	4	201.8	**211.7**	222.1	5	191.9	**205.2**	217.3
TOTAL.....	362	479.1	**536.8**	570.2	36	574.8	**575.4**	606.6	12	556.4	**585.3**	612.6	15	522.1	**562.8**	597.2
Femur.......	101	202.3	**218.6**	232.7	12	214.8	**222.5**	233.5	4	206.0	**219.8**	230.0	5	191.0	**207.5**	219.3
Tibia........	91	241.0	**261.5**	278.2	12	245.0	**254.5**	265.3	4	247.6	**258.9**	277.2	5	228.0	**246.8**	262.2
Metatarsus	129	185.3	**200.1**	220.0	12	203.7	**213.8**	227.0	4	208.7	**219.9**	232.9	5	194.0	**210.0**	221.7
TOTAL.....	321	628.6	**680.2**	730.9	36	636.5	**691.7**	725.8	12	662.3	**698.6**	740.1	15	613.0	**664.3**	703.2
Fore limb / Rear limb %.	...	78%	**79%**	78%	..	83%	**83%**	84%	..	84%	**84%**	83%	..	85%	**85%**	85%

Tibia and Fibula

As a group, the tibiae of *Stockoceros* average 6 mm. longer than those of *Antilocapra.* This is an outstanding difference in the skeletons of the two species, since *Antilocapra* is the larger animal. The relative length of the tibia to the other limbs is prominently greater. On the proximal end of the *Stockoceros* tibia, the median and lateral condyles are smaller and more curved, the anterior crest more externally folded and heavy; the shaft is relatively slenderer; the distal end is not so transversely expanded as in *Antilocapra.* When viewed from the distal end, the intermediate ridge between the articular grooves is smoothly rounded for articulation with the astragalus and lacks the synovial fossa which is present in *Antilocapra.*

The proximal portion of the fibula is fused to the tibia and equal in both forms.

The ratios of the average articular length of the rest of the limbs to that of the tibia are as follows:

	Humerus / Tibia	Radius / Tibia	Metacarp. / Tibia	Femur / Tibia	Metatars. / Tibia
Stockoceros..................	62%	70%	74%	84%	77%
Antilocapra (wild)...........	68	76	81	87	84

Tarsal Bones

The tarsal bones, like the carpals, show a few slight differences, mainly in proportion and size. In the articulated skeletons of *Stockoceros,* their articular length is 1 to 2 mm. less than in *Antilocapra.*

Metatarsus

As a group, the metatarsi of *Stockoceros* average 14 mm. less than those of *Antilocapra;* the longest approaches moderately large *Antilocapra;* the shortest is 20 mm. longer than the known metatarsus of *S. conklingi.* The shaft is relatively as slender and is transversely compressed, with the anteroposterior diameter exceeding the transverse as in *Antilocapra,* but unlike that of *S. conklingi.* The anterior and posterior longitudinal grooves are clearly marked and relatively deeper; the foramina at the distal end of both grooves are well developed; the articular surfaces of both the proximal and distal ends are not so expanded as in *Antilocapra.*

The ratios of the average articular length of the rest of the limbs to that of the metatarsus are as follows:

	Humerus / Metatars.	Radius / Metatars.	Metacarp. / Metatars.	Femur / Metatars.	Tibia / Metatars
Stockoceros..................	80%	91%	96%	109%	130%
Antilocapra (wild)...........	81	91	97	104	119

Axial Skeleton Appendix

The vertebrae and ribs of *Stockoceros* are smaller and lighter than those of *Antilocapra*, with some pronounced differences in the various vertebrae. The skeletons of both forms have the same number of cervical, dorsal, lumbar and sacral vertebrae. As a rule, the centrum is lighter in *Stockoceros*.

Sternum

The sterna of both *Stockoceros* and *Antilocapra* have seven sternebrae with the same indicated rib or cartilage attachments. The sternum of *Stockoceros* is slightly narrower relative to its length and smaller than *Antilocapra*.

APPENDIX

NEW ANTILOCAPRINE HORN-CORES FROM NEBRASKA AND ARIZONA

(1) *Stockoceros onusrosagris nebrascensis*, (?) n.subsp.
(2) *Hayoceros barbouri*, (?)n.sp.
(3) *Capromeryx arizonensis*, n.sp.
(3a) *Capromeryx arizonensis schultzi*, n. subsp.
(3b) *Capromeryx furcifer* Matthew, ref.

(1) **Stockoceros onusrosagris nebrascensis,** (?)new subspecies

From Middle Pleistocene of the Middle Loup River, Cherry County, Nebraska

Subspecific Description

The new subspecies differs from the species *S. onusrosagris* in the more widely divergent horn-cores (approximately 84° versus an observed maximum of 74° in the Papago Springs Cave collection) and in the noticeably stubbier posterior core. As in the species, the posterior core is flattened on the anterior external surface, with a shallow sulcus extending from the root of the horn up the posterior external surface towards the tip; a shallow external pit is present below the fork of the horn-cores on the posterior part of the orbit.

Discussion

The Nebraska subspecies exhibits characters in the posterior horn-core that may well be extremes of individual variation. Unfortunately, the holotype gives no evidence of the condition of anterior horn-core growth or of other parts of the skull. The earlier geological occurrence and the geographic separation may eventually show that this subspecies is a distinct species.

The Nebraska record extends the geographic range of this antilocaprid from the mountains of the southwest to the western plains of North America, indicating both a mountain and plains habitat.

HOLOTYPE.—Right posterior horn-core and portions of the core-base.	N.S.M.1-6-1-41	From Univ. Nebr. State Mus. Mullen Locality A, Q. 2, Cherry Co., Nebr.; collected by E. L. Blue and associates, 1941. *Figure 19.*

MEASUREMENTS OF HORN-CORE, N.S.M.1-6-1-41

Length of core-base from top of orbit to fork	=	(24.0) mm.
Length of posterior core from fork to tip	=	(97.0)
Anteroposterior diameter of posterior core	=	29.6
Transverse diameter of posterior core	=	21.6

HAYOCEROS FRICK

(2) **Hayoceros barbouri,**[1] (?)new species

From Middle Pleistocene Deposits, Niobrara River, Sheridan County, Nebraska

DESCRIPTION

The holotype of *H. barbouri* (?)n.sp. (N.S.M.6-5-1-41, Figure 19), differs from the genotypic species, *H. falkenbachi,* in the posterior incipient horn-core which is transversely compressed rather than cylindrical in cross section; the pit present at the median root of the posterior horn-core is much shallower and not foramen-like as in *H. falkenbachi.*

ANTERIOR HORN-CORE.—The *Antilocapra*-like bladed anterior horn-core is larger than the posterior incipient core. It is in a nearly erect position over the posterior portion of the orbit. In cross section, it is rounded posteriorly and narrows anteriorly. Two shallow sulci, which originate at the base of the core, are evident on the external surface. The anterior sulcus extends upward along the anterior edge of the core, ending near the tip, and the less prominent posterior sulcus extends upward along the posterior external surface. The bone texture of the core is suggestive of *Antilocapra* and possibly indicates a similarly pronged sheath.

POSTERIOR INCIPIENT HORN-CORE.—The root of the posterior horn-core is on the cranium posterior to the orbit. The transversely compressed core is here considered as an accessory third horn which developed in *Hayoceros,* since the original anterior and posterior horn-cores have combined to produce the bladed anterior core as in *Antilocapra* (page 175).

ORBITS.—The remaining portions of the orbit indicate that it protruded strongly, like *Antilocapra* and unlike *Sphenophalos.* A broad shallow depression lies below the fork of the cores on the posterior dorsal side of the orbital rim.

[1] **Named in honor of Dr. E. H. Barbour, Director Emeritus of the University of Nebraska State Museum.**

CRANIUM.—A supraorbital foramen, dorsoventrally elongated, is present on the forward internal base of the anterior horn-core. A shallow pit is formed at the external median base of the posterior horn-core, possibly functioning as a muscular attachment. Some indication of a transverse cranial bulge is evident between the anterior horn-cores.

DISCUSSION

Complete sets of horn-cores or skulls of this rare antilocaprid as yet remain unknown, but on the basis of the available evidence there may have been at least two species of *Hayoceros*, both from closely related geographic localities.

HOLOTYPE.—Portion of the cranium and orbit with complete left anterior horn-core and root of posterior incipient horn-core.	N.S.M.6-5-1-41	From Univ. Nebr. State Mus. Gordon Q. 1, Pit 3, Niobrara River, Sheridan Co., Nebr.; collected by E. L. Blue and associates, 1941. *Figure 19.*

COMPARATIVE MEASUREMENTS OF *Hayoceros*

		H. falkenbachi F:A.M. 25526	*H. barbouri* N.S.M.6-5-1-41
Length of ant. horn-core above orbital rim	=	(122.0) mm.	(127.0) mm.
Length of post. incipient horn-core	=	......	......
Anteroposterior diam. of ant. core at fork	=	(38.0)	38.2
Trans. diam. of ant. core at fork	=	21.7	20.7
Anteroposterior diam. of post. incipient horn-core	=	23.0	(28.5)
Trans. diam. of post. incipient horn-core	=	19.1	(16.0)

CAPROMERYX MATTHEW

(3) **Capromeryx arizonensis,** new species

From Dry Mountain, 15 Miles Southeast of Safford, Graham County, Arizona

DISCUSSION

Capromeryx arizonensis is known from two widely separated localities. The holotype, F:A.M.42878 (Figure 19), consisting of portions of the cranium and the left horn-cores, was found in 1938 by Ted Galusha about 100 miles northeast of Papago Springs Cave. Its presumably earlier Pleistocene occurrence may account for its absence from the cave fauna.

A second, slightly smaller specimen, N.S.M.26-2-9-40 (Figure 19), consisting of a crushed cranial saddle with both horn-cores, is considered as a geographic variety of the species from the early Pleistocene of southwestern Nebraska. It is impossible to determine the exact shape of the horn-cores, but their approximate length may be observed.

Unfortunately, no associated dentition was found with either specimen. *C.*

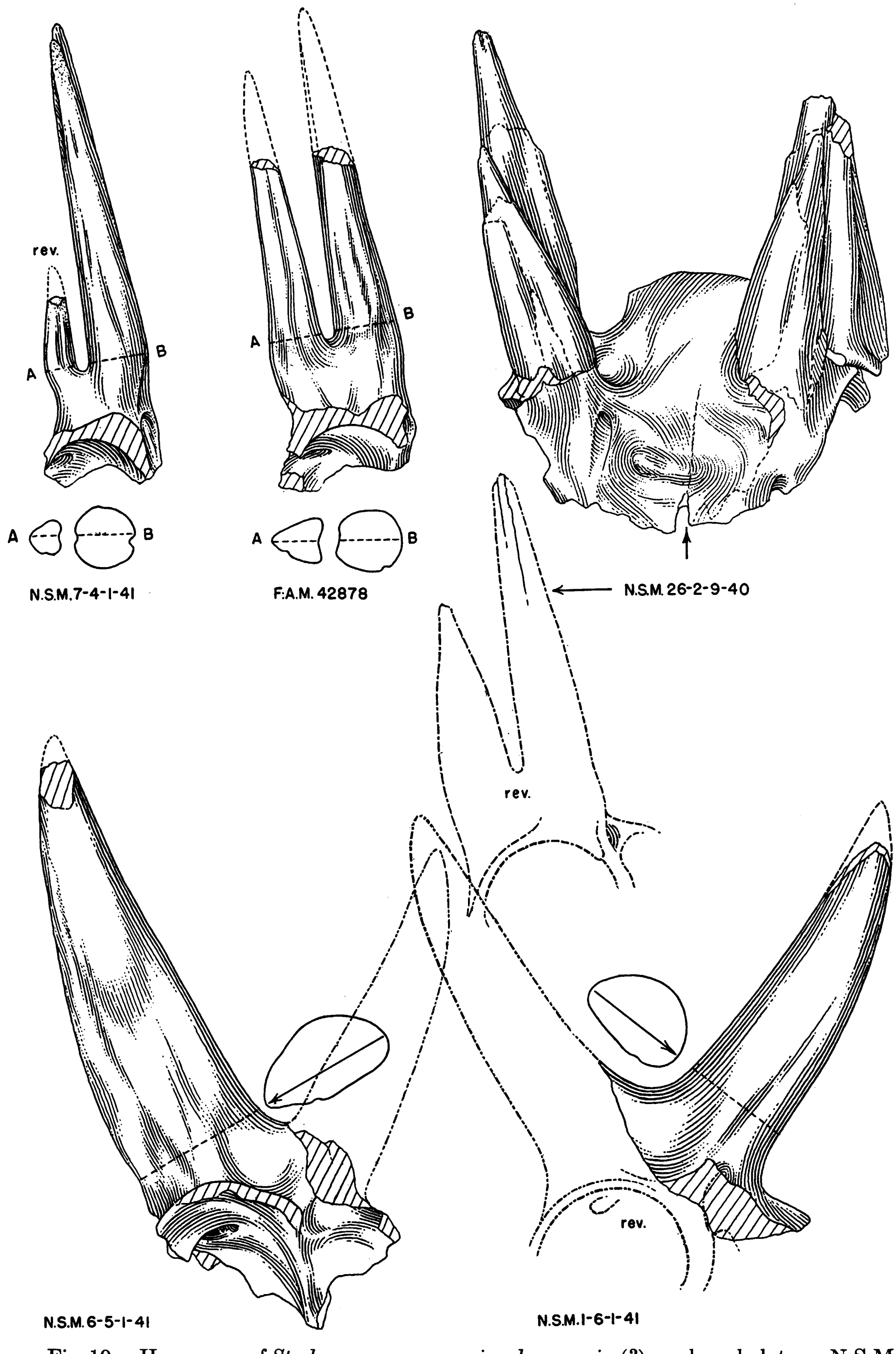

Fig. 19. Horn-cores of *Stockoceros onusrosagris nebrascensis*, (?)n. subsp., holotype, N.S.M.-1-6-1-41; *Capromeryx furcifer* Matthew, ref., N.S.M.7-4-1-41; and *Hayoceros barbouri*, (?)n.sp., holotype, N.S.M.6-5-1-41, from the Pleistocene of Nebraska; *Capromeryx arizonensis*, n.sp., holotype, F:A.M.42878, from the Pleistocene, near Safford, Arizona; and *Capromeryx arizonensis schultzi*, n.subsp., holotype, N.S.M.26-2-9-40, from the Pleistocene, near Broadwater, Nebraska. × ½.

mexicana is the only recorded occurrence of a dentition in association with the horn-cores. *C. furcifer*, the genotype, and *C. minor* have been established on mandibular dentitions; subsequently horn-cores have been referred to each of these species (see Table XVI). Other species of *Capromeryx* have been described from dentitions, but no distinctive horn-cores have been found in association.

Horn-cores

The horn-cores of *Capromeryx arizonensis* are larger than the type of *C. mexicana* and referred horn-cores of *C. furcifer* and *C. minor*. Unlike these species of *Capromeryx*, in which the anterior horn-cores are relatively small, *C. arizonensis* has an anterior horn-core nearly as large as the posterior (Figure 19 and page 177).

The anterior and posterior horn-cores are situated over the posterior portion of the orbit on a relatively large core-base, which has a slight anteroposterior constriction below the junction of the cores. The core-base appears to have been produced by the confluence of the horn-cores, which apparently erupted from two separate spots on the frontal. Those *Capromeryx* species with small anterior horn-cores have smaller, lower core-bases.

The anterior horn-core of *C. arizonensis* extends approximately 70 mm. above the fork and is longer than the posterior core of *C. mexicana* or of referred *C. minor*. It is distinctly triangular in cross section, with the apex facing anteriorly. The posterior horn-core extends approximately 85 mm. above the fork. Anteriorly, the core presents an almost flat, slightly concave surface on the portion facing the forward core; the lateral sides continue the triangular outline of the anterior core to the convexly rounded posterior edge.

The inner faces of the horn-cores diverge 10°, which is slightly more than has been observed in other species of *Capromeryx*.

From the preserved portion of the cranium, the horn-cores appear to have been in a nearly erect position over the orbits. The texture of the bone in the horn-cores suggests that each possessed a separate sheath. In life, the sheaths appear to have been closely joined proximally between the opposing faces of the anterior and posterior cores. The taper of the cores would permit shedding of the sheaths from the skin-covered core-base.

Two main sulci are present on the external portion of the core-base. They are not so deep and prominent as those of other *Capromeryx* species. The anterior sulcus, which is followed with difficulty, extends upward along the external surface of the anterior core. On the posterior core, the sulcus extends upward along the posterior external surface.

The supraorbital foramen is located at the anterior internal base of the horn-cores and appears to be dorsoventrally elongated.

Cranial Characters

A broad, shallow, internal depression is present on the frontal directly below the fork of the horn-cores at the junction of the core-base. It is produced by two small anterior and posterior transverse ridges or braces extending from the frontal to the core-base. This pit, which appears to be more strongly developed in *Capromeryx* than in any of the other Antilocaprini, may be a useful identifying character of the genus.

The remnant of a small deep pit is present at the posterior base of the horn-cores at the confluence of the frontal and the supraorbital process. It is apparent in several other Antilocaprini in varying stages of development, and may represent a site for muscular attachment.

A small, distinct, but poorly preserved ridge extends from the proximal portion of the posterior core-base and joins the frontal as in other species of *Capromeryx*.

	F:A.M.
Holotype.—Partial left horn-cores, lacking tips, with portions of cranium attached. *Figure 19*	42878,

(3a) **Capromeryx arizonensis schultzi,**[1] new subspecies

From Early Pleistocene Deposits of Southwestern Nebraska

Subspecific Description

Horn-cores.—Slightly shorter than *C. arizonensis;* supraorbital foramen on the frontal near proximal internal side of the core-base; moderately deep sulcus leads anteriorly from the supraorbital foramen; core-base joined to the cranium by two small anterior and posterior transverse ridges, creating the typical cranial depression on the internal sides of the core-bases of *Capromeryx;* horn-cores crushed and shape of anterior core (triangular in *C. arizonensis*) indeterminate.

Discussion

The holotype (N.S.M.26-2-9-40) of *C. arizonensis schultzi* extends the geographic range of this species from Arizona to Nebraska.

Holotype.—Partial cranium, crushed, with horn-cores attached.	N.S.M.26-2-9-40	From Univ. Nebr. State Mus. Broadwater Locality A, Q. 4, Morrill Co., Nebr.; collected by Joe Johnson and Work Projects Administration field party, 1940. *Figure 19.*

[1] Named in honor of Dr. C. Bertrand Schultz, Director of the University of Nebraska State Museum.

(3b) **Capromeryx furcifer** Matthew, referred

From Middle Pleistocene Deposits of Northwestern Nebraska

Capromeryx furcifer Matthew, 1902, Bull. Amer. Mus. Nat. Hist., XVI, p. 318. Frick, 1937, ibid., LXIX, p. 528.

The posterior horn-core of N.S.M.7-4-1-41, referred to *C. furcifer*, is the longest so far recorded and gives additional evidence of individual variation for the genotypic species (Table XVI, Figure 19).

Referred.—Right horn-cores. N.S.M.7-4-1-41 From Univ. Nebr. State Mus. Gordon Locality A, Q. 1, Niobrara River, Sheridan Co., Nebr.; collected by E. L. Blue and associates, 1941. *Figure 19.*

Table XVI.—Comparative Measurements of Horn-Cores of *Capromeryx*

	C. arizonensis Holotype	*C. arizonensis schultzi* Holotype	*C. furcifer* Ref.		*C minor*[2] Ref.	*C. mexicana*[3] Ref.
	F:A.M. 42878 *Fig. 19*	N.S.M. 26-2-9-40	F:A.M.[1] 25687	N.S.M. 7-4-1-41 *Fig. 19*	L.A.M. 49	U.C. 26648
Length of ant. core above orbital rim	(95.0)	(67.0)	(33.0)	(39.0)	33.7	38.0
Length of post. core above orbital rim	(113.0)	(97.0)	(94.0)	(109.0)	64.5	82.1
Trans. diam. of ant. core at crotch...	12.5	...	7.7	9.5	6.0	..
Trans. diam. of post. core at crotch	15.6	...	14.2	16.7	14.0	11.5
Length of core-base, crotch to orbital rim.............	20.7	19.2	15.0	(15.0)	16.0	16.0
Anteroposterior diam. of core-base at greatest constriction.........	33.0	...	22.5	25.4	20.1	22.5

[1] Frick, Childs, 1937, Bull. Amer. Mus. Nat. Hist., LXIX, p. 520, Fig. 53.
[2] Chandler, A. C., 1916, Univ. Cal. Pub. Bull. Dept. Geol., IX, p. 113, Fig. 1.
[3] Furlong, E. L., 1925, Univ. Cal. Pub. Bull. Dept. Geol. Sci., XV, p. 146, Figs. 7, 8.