FOSSIL GEESE

OF THE McKITTRICK ASPHALT DEPOSITS.

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THE PROBLEM.

The geese although widespread in Recent times and well known have always been difficult of classification. Richard Lydekker (1910) says: "Although it has been attempted to divide the members of the order (Anseres) into several distinct families, the whole of them are so nearly allied that it seems impossible to do more than group the genera of the one family Anatidae under several subfamilies, and even some of these are very difficult of definition." The Anserinae or geese are one of these intergrading subfamilies.

The difficulties encountered in the determination and classification of modern geese from osteological criteria alone have severely handicapped the recognition of fossil members of the Anserinae. The present problem involved -- (1) an attempt to obtain a series of structural characters in the major skeletal elements by which specific types of geese can be distinguished, and -- (2) an application of these distinguishing characteristics in the study of the fossil goose material from the McKittrick Pleistocene with a view to determining the types of geese present in the fauna from these asphalt deposits.

As a result of the critical examination of modern types, sufficient data are assembled to show the intergradation of twelve native races. The same studies are being applied to foreign geese, bringing the races under observation to a total of twenty-four, which is 72% of the known Anserine species. The interspecific gradation is found to arise in a remarkable range of individual variation, coupled with sex, age and possibly health variations. Because of this variability within a species the criteria of current usage, length and stoutness, are seen to be mostly incorrect, and seldom usable. However, these data are quite useful in showing the extent of variation <u>within</u> particular species of geese, as follows:

CRITICAL STUDIES IN PROGRESS.

The size of tarsometatarsus described for Branta hypsibata (Cope) (1878 p.387) is found to fall well within the range of Branta canadensis canadensis (Linnaeus) from which the former species was distinguished by length, general robustness and certain structural details. Such characters are subject to great individual variation. The supposed superiority of length is invalid, for out of eleven available tarsal specimens of Branta canadensis, only one is as short as that in Branta hypsibata.

Branta propinqua Shufeldt (1892 p.407), from the Fossil Lake Pleistocene, as observed in a photograph and as measured therefrom, may well be Anser albifrons albifrons. Shufeldt's description has not been available for study as yet.

Branta minuscula Wetmore (1924 p.6), although described from the Upper Pliocene (San Pedro Valley beds, Cochise County, Arizona) suggests possible identity with the new species here described from the McKittrick Pleistocene.

Branta bernicla (Linnaeus) recorded from Fossil

Lake, Oregon by Schufeldt is of doubtful occurrence in fresh water associations, or in inland waters of any kind at Oregon latitudes. The description of the structural features of the fossil type fits the new McKittrick species better than it does the modern species to which the Fossil Lake material is assigned. A doubt as to the occurrence of the sea goose so far inland prompted a close scrutiny of the McKittrick specimens. These, like Schufeldt's specimens, are slightly smaller than <u>Branta bernicla</u>. An examination of Schufeldt's material is highly desirable.

It should be noted that Loye H. Miller (1925a, pp.314,315) commented on the pigmy geese of the McKittrick asphalt, assigning them to <u>Chen hyperboreus</u>. A study of the two specimens, which have been determined as belonging to this species, indicates that they agree in essential characters with the McKittrick material in the collections of the California Institute. Unquestionably Miller's material represents the type now recognized on the basis of additional specimens from the same locality. Moreover, the two unassigned tarsi from the Rancho La Brae Pleistocene (Miller, L.H., 1925, p.73) are likewise referable to this type.

COMPARATIVE MATERIAL

Of the Recent true geese (Anserinae), there are now assembled for a comparative study one hundred fifty-eight skull and skeletal specimens from the following sources:

University of California - Museum of Vertebrate Zoology	47
University of California at Los Angeles - L. H. Miller Collection	46
Harvard University - Museum of Comparative Zoology	22
American Museum of Natural History	16
United States National Museum	9
Fish and Game Commission - James Moffitt Collection	8
Dickey Laboratory, California Institute of Technology	3
Los Angeles County Museum	2
Ross Collection	5
	158

The total collection represents seven genera, eighteen species and twenty-four forms or geographic races from the Old and New World. This number includes approximately seventy per cent of the described genera, species and races, respectively.

It is an unfortunate fact that few avian osteological specimens available for comparative studies are complete. Various parts and single elements are frequently lacking due to the common practice of making comparative skeletal material out of portions left over after making up study skins and other preservations.

For example; out of twenty-eight specimens of native small geese representing three species, only one-half of these, i.e. fourteen, had tarsi. Singularly enough the tarsi of the small fossil Anserine from McKittrick equal in number those of all three comparable living races available in this Recent collection.

McKITTRICK MATERIAL

Among the Pleistocene avian remains from the McKittrick asphalt examined by the writer, elements have been found that are indistinguishable from comparable skeletal parts of the large _Branta canadensis canadensis_ (Linnaeus).

As yet no additional material has been recognized in the collections representing the gigantic goose, _Branta dickeyi_, described from these deposits by L. H. Miller (1924, p.178).

A third type of Anserine bird is now known from the McKittrick Pleistocene by several tarsi. In addition several small humeri, exhibiting clearly goose-like structural characters occur in the collection and may represent the same type known by the tarsus. However, definite association of the wing and foot elements still remains to be established.

NEW GENUS AND NEW SPECIES

(Subfamily as yet not determined)

Type: Left tarsometatarsus #1168 California Institute of Technology, Collection of Vertebrate Paleontology. Complete and unworn; characters typically goose-like, but element delicate and small.

Measurements: (in millimeters)

Total length over all	61.8
Minimum shaft width (transverse)	4.4
Minimum shaft depth (anteroposterior)	3.4
Minimum shaft area (cross section)	14.96 sq.mm.
Transverse width proximal end	11.6
Anteroposterior depth proximal end (inner cotyla)	5.5
Anteroposterior depth proximal end (including hypotarsus)	11.0
Anteroposterior depth first calcaneal ridge	5.5
Transverse (total) extent of distal end, condyles II,III,IV.	10.4
Transverse extent of condyles III and IV	8.4
Minimum transverse width of condyle II	2.9
Maximum transverse width of condyle III	5.0
Mean transverse width of condyle IV	3.6
Anteroposterior depth of condyle II	5.6
Anteroposterior depth of condyle III	7.2
Anterpposterior depth of condyle IV	7.0
Minimum transverse width of shaft to condyle IV from distal foramen to outer border	3.2

<u>Paratypes</u>: One nearly complete and six incomplete tarsal elements.

#1169 right; lacking only the extended portions of the hypotarsus.

#1170 left; proximal two-thirds, perfect.

#1171 right; proximal one-half, lacking only second calcaneal ridge.

#1172 right; complete; proximal end shows some superficial decay or corrosion, but with characters distinct.

#1173 left; proximal two-thirds; outer border of proximal end abraded slightly.

#1174 left; proximal five-sixths to point where shaft flares for condyle II; outer wall and half of external cotyla preserved, also lower portion of hypotarsus; remainder of proximal end gone.

#1175 left; distal one-half; posterior third of condyle II lacking.

DISCUSSION

The small goose-like tarsi from the McKittrick Pleistocene now number eight in all. Of these three are complete or nearly complete in their preservation. These specimens were at first regarded as belonging to the smallest native goose of North America, the black sea brant (Branta bernicla nigricans Lawrence), due to close similarity in tarsal lengths and to the fact that extremes of range of this character are alike for the sea goose and the Pleistocene species. It was soon discovered, however, that like all other native geese, the four pigmy races intergrade in the character of tarsal lengths, a fact that precludes specific identification by tarsal lengths alone.

Proximal end: Several points of difference (#1-5) from native small geese are suggested by inspection of the proximal end.

#1. The hypotarsus ends abruptly distally without grading down into the shaft as in all true geese. This is a very marked character in the tree-ducks, Dendrocygninae, a subfamily closely related to true geese, Anserinae. The hypotarsus agrees further with that in the tree-ducks in relative and actual shortness of its vertical extent.

#2. Following down the main (inner) calcaneal ridge to its junction with the shaft, one finds an interrupted junction of this ridge with the intermuscular line. In the Anserinae on the other hand, the latter line extends without interruption into the calcaneal ridge. This disjunction is a structural character of the Dendrocygninae.

#3. Concerned with this disjunction is the deflected intermuscular line which in the Dendrocygninae swings aside prominently and obliquely on the inner surface. The fossil specimens show a deflection of a less degree. Moreover, the line has a more limited extent and stands in much weaker relief. In the true geese, as examined by the author, no deflection or disjunction exists.

These three deviations relate the fossil species to tree-ducks; the balance of the evidence is predominantly goose-like with two exceptions indicated below (#4 and #5).

#4. The bearing surfaces (cotylae) of the proximal end of the tarsometatarsus are noticeably of less anteroposterior dimension in the Pleistocene species, and measurement proves them to be so. (graph 4a). The width transversely does not differ much from that in bernicla (chart 4a), but is separable from that in minima and rossi. However, the relatively slight anteroposterior depth is noticeable and is a sure diagnostic character. This anteroposterior diameter of the proximal end (hereafter referred to as "depth") when put into a ratio by dividing by the length of the element, yields a value which suggests that the fossil species is not nearly related to bernicla although evidently resembling it in actual size (graph 4b). The ratio indicates definite relation to minima; but minima is specifically separable on the basis of greater size.

These suggested relationships by proportion are significant, and place the proposed new species with the Branta canadensis group rather than with Branta bernicla which so nearly resembles it in general size.

Multiplying width by "depth" of proximal end (measurements II and IX) gives a rough approximation of the area. In this character the new species stands out again by itself. (graph 5a).

#5. An excessive "depth" of hypotarsus (anteroposteriorly) is an apparent characteristic of the fossil tarsus. This character becomes even more distinctive when thrown into proportion either with the area of the proximal end (graph 5b), or with the "depth" of the cotyla (graph 6a). A study of the larger members of the genera Branta, Chen and Anser is being made to check with these data on the pygmy representatives.

The characters of the proximal end as discussed above are so pronounced it is necessary to give generic distinction to the Pleistocene bird.

Distal end: The spread of the three condyles is a character in which the tarsi from McKittrick are goose-like. Graph 11 shows that the Dendrocygninae also have goose-like proportions in the transverse width of the distal end. However, notable difference between the McKittrick type and the Recent forms mentioned above is shown in the actual size of the individual condyles II, III and IV. For ranges in depth of condyles see graph 8a, b, c.

The width of condyle IV is also distinctive (graph 9ab). Ratios here resolve all differences into general family proportions, except that the ratio of depth in condyle II to length of tarsus separates adequately the fossil bird from _Branta bernicla_, the one living goose like it in size. (graph 10a).

Thus while size of proximal and distal ends of the tarsus does not distinguish the fossil from _Branta bernicla_, the proportions of this element readily furnish a basis for separating the former type. On size alone it is separable from all other Recent geese that have been examined.

The Shaft: The delicacy of the fossil goose is strikingly exhibited in the long, slender and gracefully tapered shaft. This portion of the tarsus is throughout quite goose-like and differs noticeably from the tree-duck's stout, untapered, graceless shaft.

It bears the fine inner extensor groove of Anserinae, contrasting thus the ribbon-like groove of Dendrocygninae.

Relative stoutness seems to be an individual development, as in the Anserinae (graph 2 and 7ab), although the minimal cross section area is smaller in the fossil bird than in all Recent forms except _Branta bernicla_ (graph 2).

TENTATIVE ASSIGNMENT OF THE SMALL GEESE FROM THE McKITTRICK PLEISTOCENE

1. A true goose, probably Anserinae.

2. Separable from ducks (Anatinae) and from tree-ducks (Dendrocygninae) which are near relatives of the Anserinae.

3. Intergrades in size and in many proportions with the four native races of small geese.

4. Distinguished from all Anserinae by several characters, two of which relate it to the tree-ducks, and one makes it seemingly unique. This unique character, the slight "depth" of cotyla, separates it from the above subfamilies and from the swans. There remain to be studied three other subfamilies in this regard.

5. Definite generic determination is withheld for this reason, and until possible correlations with other skeletal elements is established. The form is clearly a new specific type.

FAUNAL RANGE

A study of the small fossil geese from the McKittrick asphalt has led to the recognition of similar or identical forms in the Pleistocene deposits at Rancho La Brea and at Fossil Lake. The distribution of the determinable specimens may be indicated as follows:

California Institute:	
McKittrick Specimens	8
L. H. Miller:	
McKittrick Specimens	3
Rancho La Brea Specimens	2
Fossil Lake Specimens	1
TOTAL TARSI: New species --	14

Thus the geographic range of this type is now known to have extended in Pleistocene time from at least southern California to south-central Oregon.

ACKNOWLEDGEMENTS

The present study was suggested by Dr. Loye H. Miller of the University of California at Los Angeles. Dr. Miller has not only generously provided use of his collections of fossil and Recent avian osteological materials, but has given of his time and knowledge in guiding the investigation.

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Thanks are also due to several institutions and individuals furnishing collections of Recent comparative materials.

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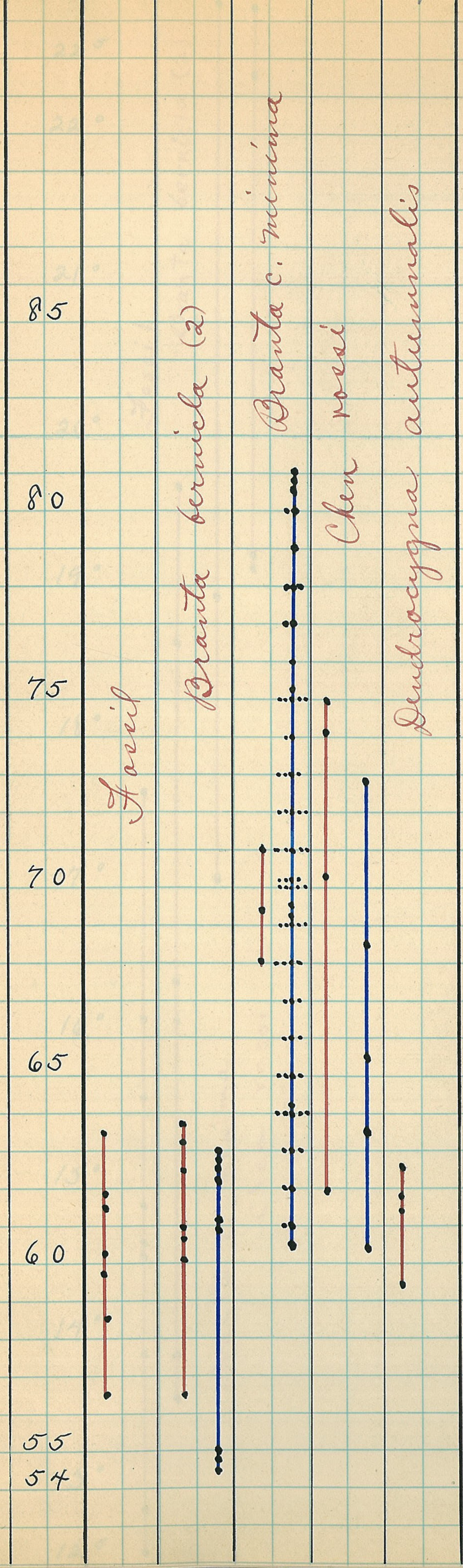
GRAPHS AND MEASUREMENTS

Measurements standardized to the number of fourteen (I - XII, XVI, XVII) are in the author's "Tarsus work book". Each measurement has been applied to each specimen of each type studied.

Charts which summarize these data for all species have been developed.

Computations in which the above data are utilized in ratios and products are arranged so as to contrast the several species.

Graphs to illustrate features of significance found in any of the above data have been prepared. Only the more significant ones are presented in the remaining pages.



Graph 1.

Total Length (I)

Left columns = osteological specimens

Data from Chart 5c

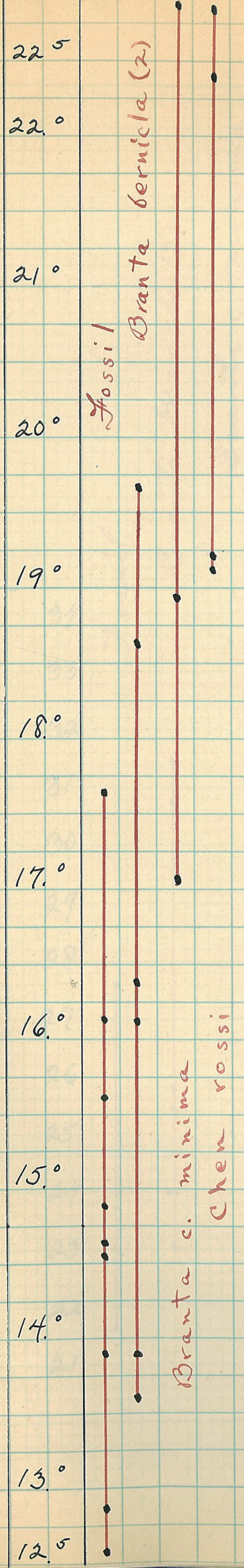
Right columns = skin specimens

Data from:

1. Skins measured locally
2. Records from literature

See Charts 3 and 3a

[Note skin measurements have been shown to have about 1% variance from osteological.]



Graph 2

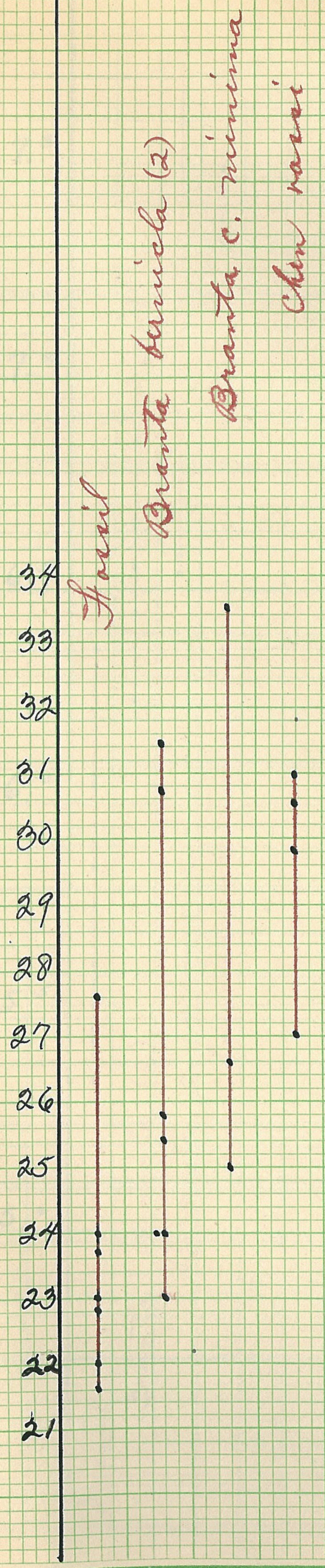
Area of cross-section of shaft taken at minimal points

[VII x VIII]

gives a square (area) for minimal stoutness of shaft.

Data from Computation 14a

Graph 3.



Stoutness

Relative

to Length.

[area of Minimal Cross-section divided by Total Length]

XIII ÷ I

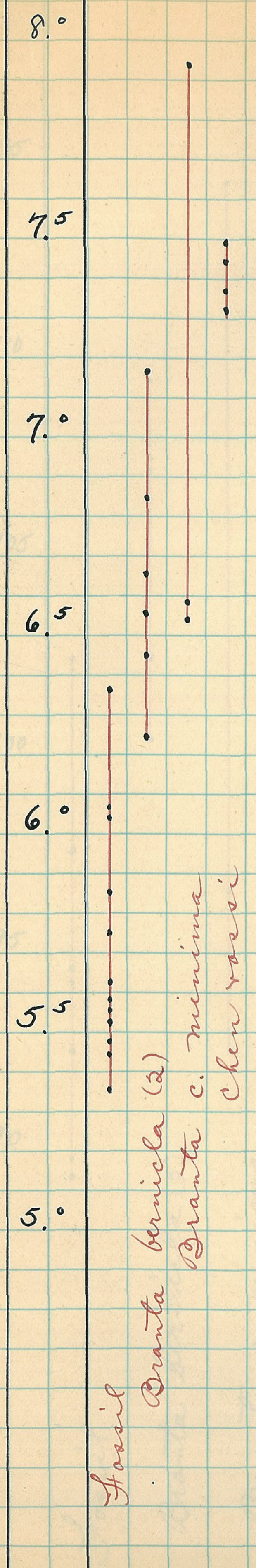
Computation 146.

Graph 4a

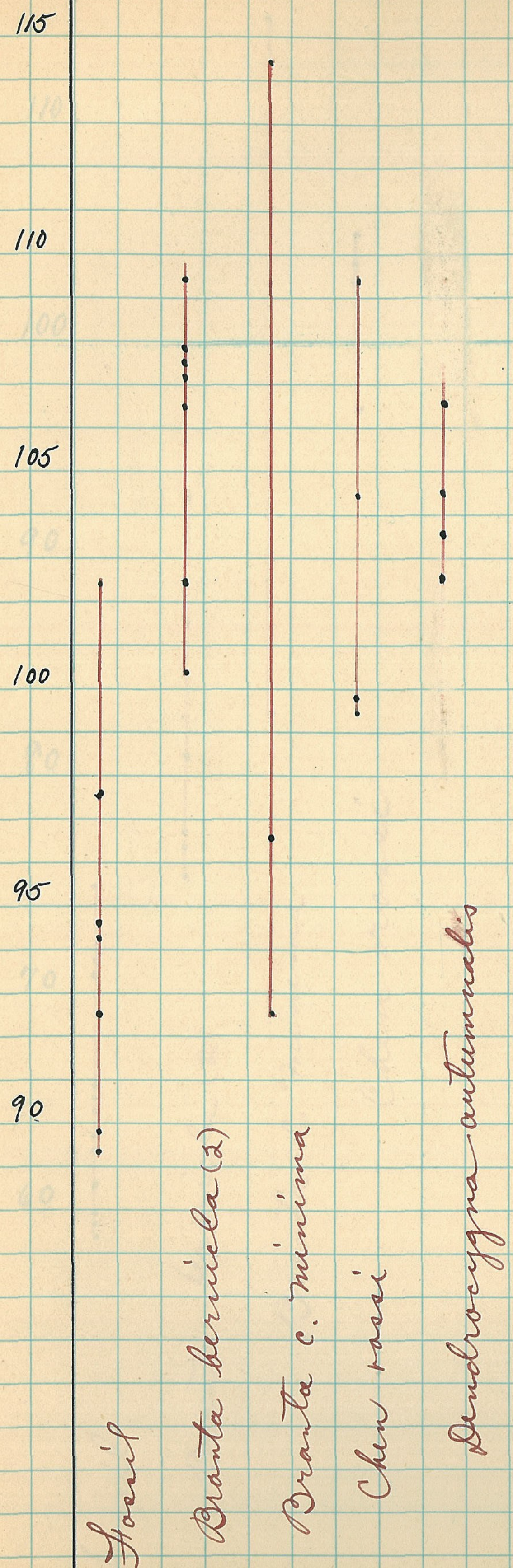
Depth (ant-posterior) of Internal Cotyla

Proximal end.

Data from chart 66.



Graph 46



Depth (anter-posterior) of Internal Cotyla ÷ Length (total) of Element.

IX ÷ I

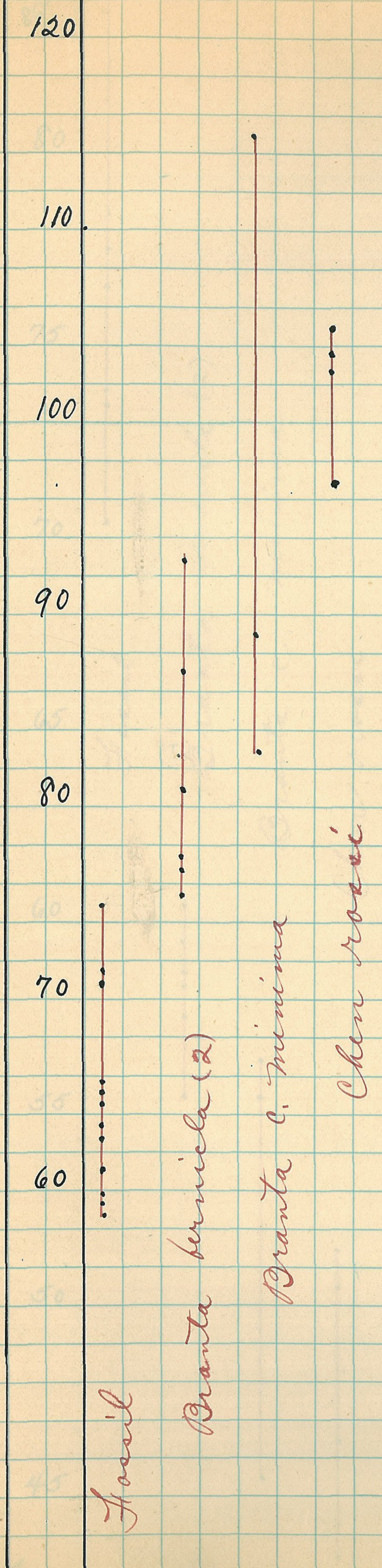
Data from Computation 1 d.

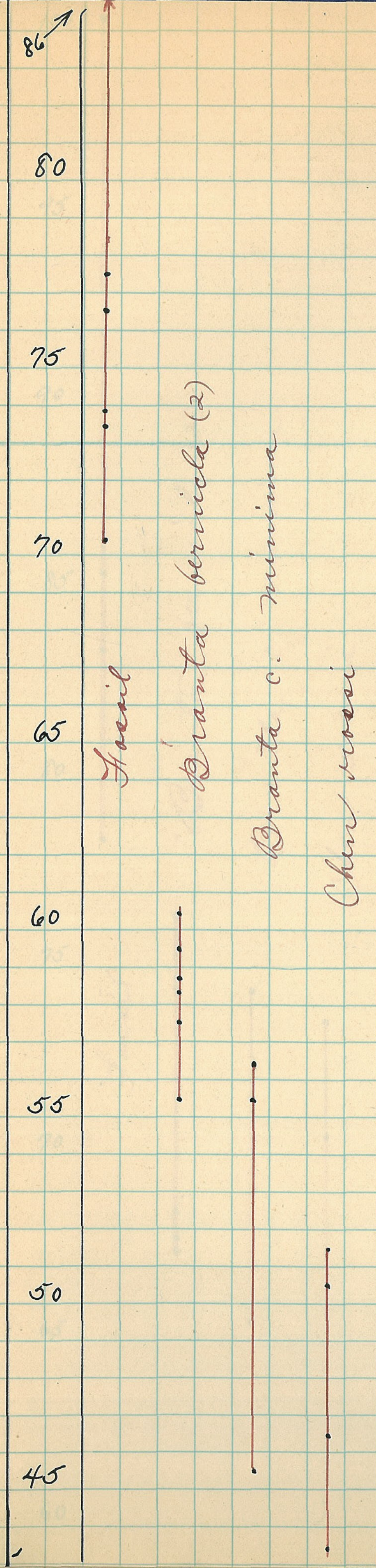
Graph 5 a

Area of Proximal End

(II x IX)

Data from XV





Graph 56.

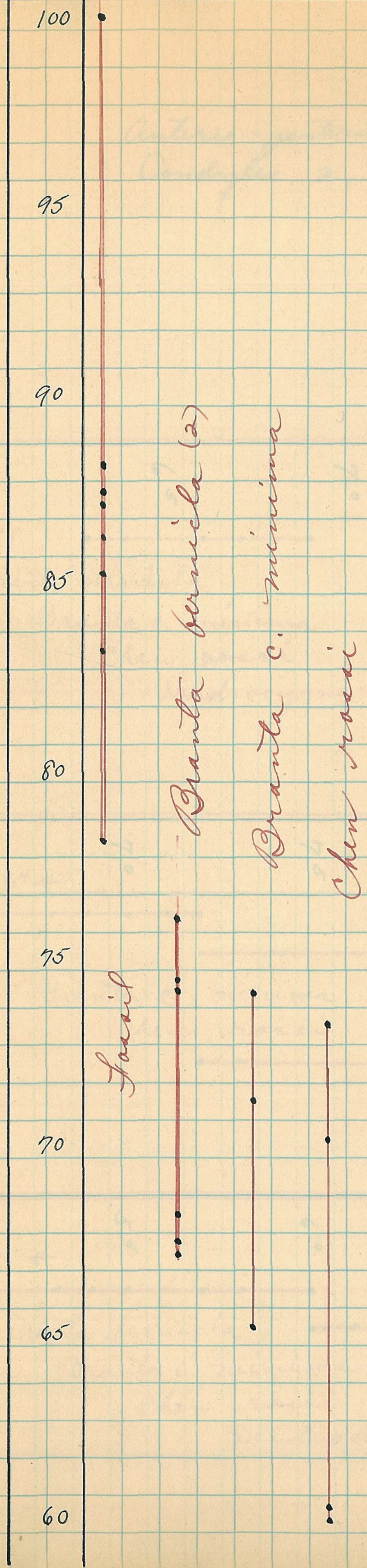
Anterio-posterior Extent of Inner Calcaneal Ridge of the Hypotarsus

divided by

Area of the Proximal End

(XIV ÷ II × IX)

Data from Computation 96



Graph 6a

Anterio-posterior Depth of Inner Calcaneal Ridge of the Hypotarsus

divided by the

Depth (anterio posterior) of the Inner Cotyla

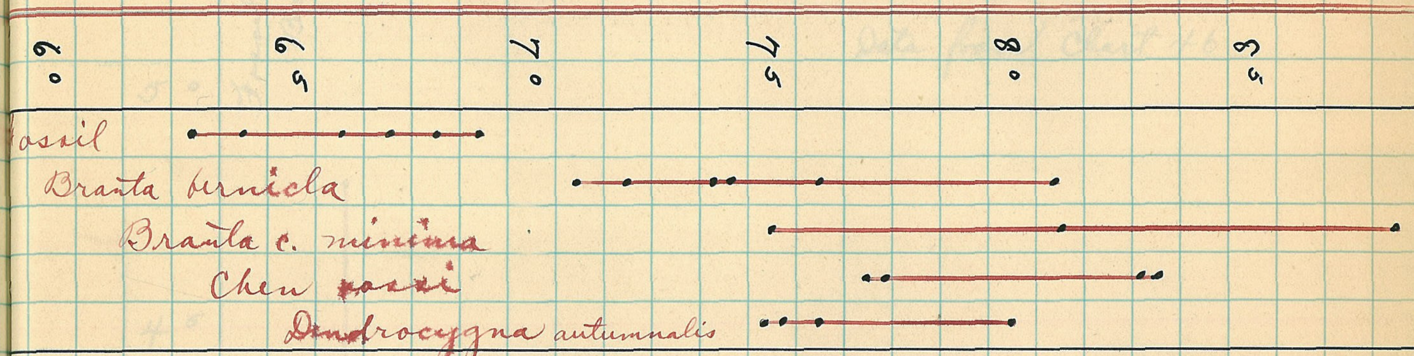
(XIV ÷ IX)

Data from Computation 9c

This ratio is between two obvious (i.e apparant) characters

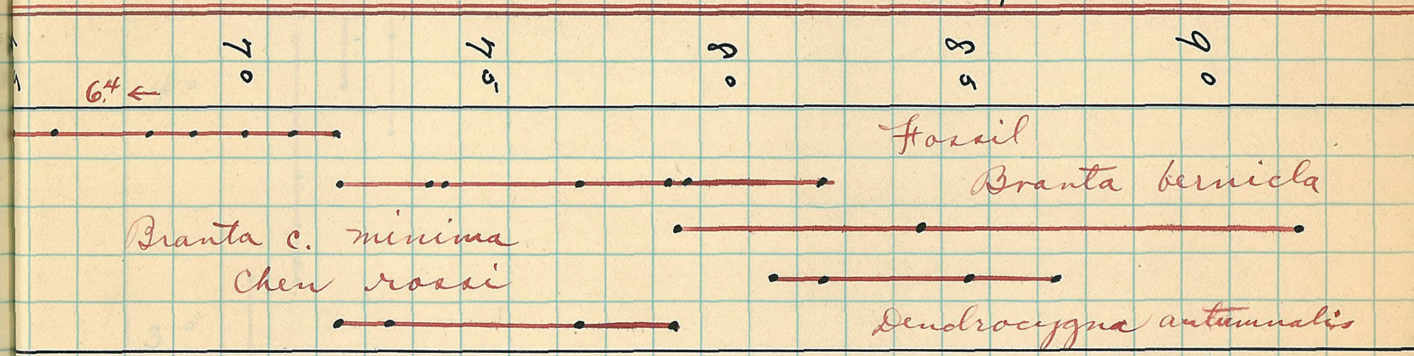
Graph 8 a b c

Anterio-posterior Depth of Condyles 2, 3, 4.



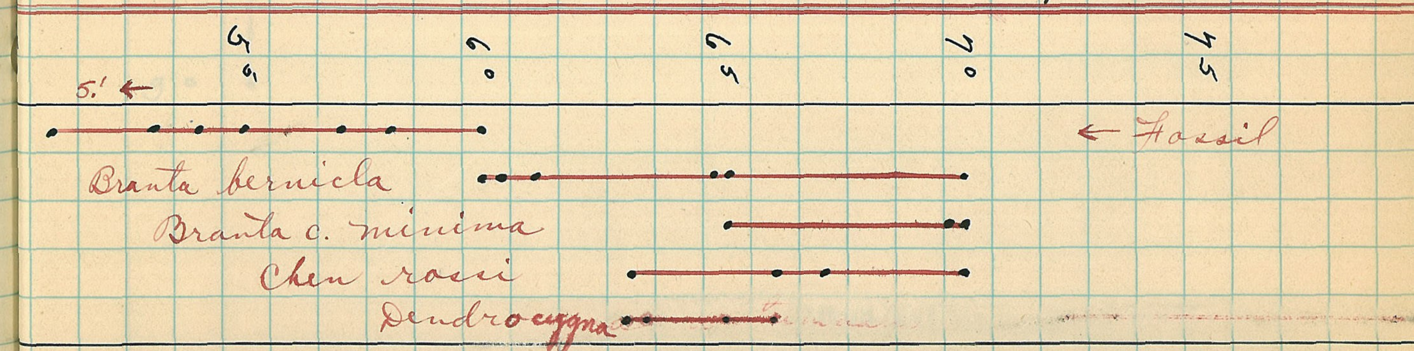
Graph 8a

III of Condyle 4
Data from Chart 7a



Graph 8b

XVI of Condyle 3
Data from Chart 8b



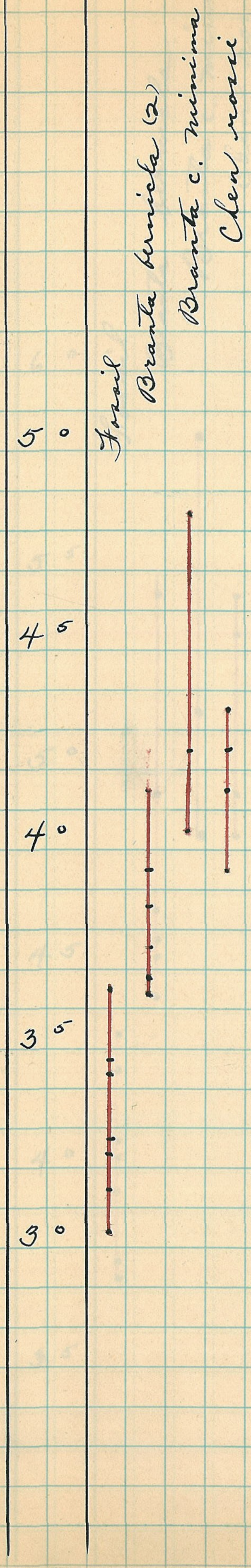
Graph 8c

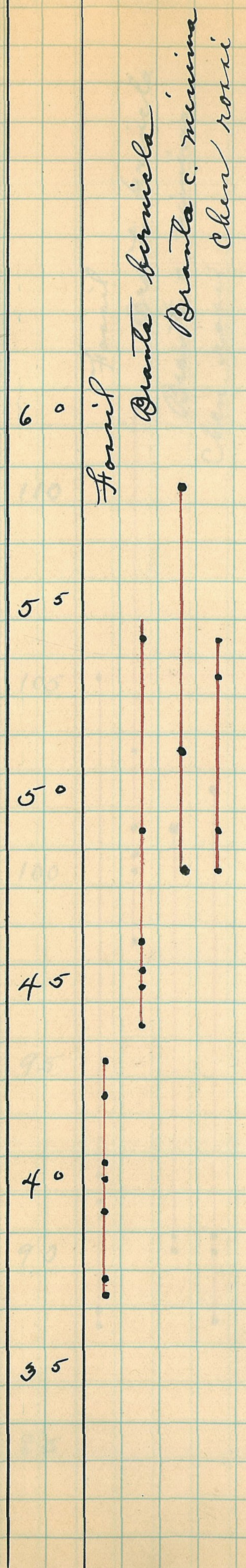
XI of Condyle 2
Data from Chart 7b

Graph 9a

Mean transverse width of condyle IV

Data from Chart 46





Graph 96.

Extreme maximum width of condyle IV including prominences on external side.

Graph 10 a.

Ratio of condyle depth to total length.

(C II depth ÷ length)

Data from Computation 116.