Eruption and Variation of the Teeth of Peromyscus maniculatus bairdi. (Hoy and Kennicott)

by

Mildred Pearl Parker
A. B. University of Kansas May 1926

Submitted to the Department
of ZOOLOGY and the Faculty
of the University of Kansas
in partial fulfillment of the
requirements for the degree of
Master of Arts.

Approved by:

H. H. Lane
Instructor in Charge

H. H. Lane
Head or Chairman of Department

Aug. 14, 1926.

CONTENTS

LIST of PLATES

Plate XII. Block graphs of lower molars of male and female

Plate XIII. Block graphs. Composite of upper molars of male, and of female, and also of the lower molars, (male and female) Figure 1-4.

Eruption and Variation of the Teeth of Peromyscus maniculatus bairdi (Hoy and Kennicott)

INTRODUCTION

The purpose of this paper is two fold; first to discover at what age the eruption of the teeth occur; and secondly, to find the variations occuring in the molar teeth according to dental indices.

The writer was unable to find literature bearing directly upon this study. Of a considerable amount of material examined, only a few references were helpful. Tomes' Manual of Dental Anatomy provided a useful, general description of teeth. The paper by Lane on Protypotherium martini, was the source for the dental index. The method of Taking the Incisive Index in Rodents by Thomas was examined. It did not seem to be applicable since it required a certain type of apparatus, which as figured, seemed to lack a concise method of reading and defining the indices.

The writer wishes to express her appreciation to Dr. H. H. Lane for his suggestion of the problem and his advice and instruction concerning it; and to all others who in any way have assisted with this paper.

MATERIAL and METHODS

The Peromyscus maniculatus bairdi used in this experiment were from the Zoology laboratory stock, University of Kansas, originally from Harvey County Kansas.

At the beginning of the experiment the mice were permanently placed in separate cages, a pair in each cage. During the winter indoor cages made of heavy quarter inch wire cloth were used. These were placed in the University animal house which is heated to a fairly even summer temperature. During the latter part of April several pairs were placed in outdoor cages. There was little or no difference in the habits or in the productivity of the mice under these two conditions. Peromyscus maniculatus has a varied appetite. The bulk of the food consisted of grain oats; this was supplemented by freshly cut alfalfa, lettuce or carrot tops, carrots, small portions of apple and uncooked potato, unroasted peanuts, and frequently a piece of bacon or other pork containing fat. The animals seem to need some meat and if given in small quantities, it is readily eaten. Water was given in shallow dishes, and, because of contamination by debris it was necessary to change it every second day. The animals were killed by placing them in a tightly corked bottle containing a small wad of cotton saturated with chloroform. Death

occured quickly. The head was then removed from the body, the body cavity opened and the entire mouse placed in a solution of four per cent formalin. Material for the study of the eruption of the teeth consisted in consecutive stages of development from one to thirty five days. Stages at which eruption occur were then checked and rechecked at intervals of three or four weeks by other animals as they became of the required age.

It was difficult to determine an exact method of measurement. After some experimentation the most satisfactory method found was that of a micrometer and needle point dividers. A block of wood was used as a rest for the dividers in order to keep them at a given level for measurement. The relation of the different parts may be seen in Figure 1. Plate I. The apparatus was so arranged that when the dividers were in normal position (i.e. on the block with the tip of the handle in the notch), the thickness of the closed tips measured four tenths of a millimeter. This amount was subtracted from every measurement made, thus giving the actual size of the object measured. Definite points were used in the measurement of the teeth as may be seen in Figure 2. Plate I. These were determined arbitrarily, seeking to find points that were constant in position. Only the molars on the right side, both upper and lower jaws were measured.

By comparing the measurements of the right and left sides very little variation in individual cases was found and practically none at all in the series of measurements. Drawings of the molars show a magnification of ten. In measurements where the whole skull or jaw was outlined, the teeth were exposed by dissecting away the flesh and bone, then the entire head was cut lengthwise into right and left halves. The right half, exposing the teeth, was placed on a glass slide so that the tips of the parts extending down were brought into correspondence with a line which had been scratched on the slide. Measurements were made to, and from this line. These drawings show a magnification of five. Plates II and III.

Lane, in an unpublished paper, Protypotheriummartini, sp. nov., read before the American Society of Mammalogists at Washington, D. C. April 1925, used a dental index in his description of that species. The dental index as a criterion showing the range of variability of a given molar, is used in this paper. Measurements were taken as indicated in Figure 2 Plate I, the point from which all measurements were begun, being the bulge where the tooth leaves the gum. The dental index was found by dividing the greatest transverse measurement by the greatest longitudinal measurement. Dental indices for fifty skulls of Peromyscus maniculatus bairdi are shown in Plates V, VI, VII, VIII.

These skulls were obtained from the University of Kansas Museum, the group being chosen at random.

DISCUSSION

The dental formula of Peromyscus maniculatus bairdi is, $i\frac{1}{1}, m\frac{3}{3}$. $\times 2 = 16$. The incisors are chisel like and extend far back into the jaw and are much curved, the upper incisors, in the words of Owen, forming a larger segment of a smaller circle than the lower, which are less curved. The length and curvature of these incisors relieve their growing pulps from direct pressure, the posterior ends of which come to be situated far back in the jaw. The open end of the lower incisor for example, being in many cases actually behind the last of the molar teeth. This may be observed in Figures 15, 16 Plate III. The incisors terminate in cutting edges, the sharpness of which is constantly maintained by wear. The dentine of the tooth being much softer wears away quicker than the enamel, and this enamel forms the cutting edge. The jaws for some distance behind the incisors are devoid of teeth forming an interval (diastema), beyond which are the molars. The lips dip deeply into this interval and so separate the mouth into an anterior and posterior chamber. Probably this is advantageous in preventing the husks of grains etc. . . from passing back into the mouth. The molars have distinct roots, that is, they are not of persistent growth as are the incisors.

The three molars are of different sizes, the most anterior (I) is usually the largest, and the posterior (III) the smallest. In comparison with the other two, the middle molar (II) is relatively constant. Molars I and Molar II are the teeth which receive the most wear. Molar III appears to be somewhat useless and it may be compared functionally, to our so called "wisdom" tooth.

At birth the young Peromyscus has no teeth, its skin is a bright pink in color, and its eyes are tightly closed. The skin grows darker each day showing the growth of hair, so that there is a fine silky coat of hair by the time the eyes are open, about the twelfth day. If a dissection of the teeth of a new born mouse be made, it will be found that the teeth are very soft, and of a cloudy white color. The third molar (III) is very small and difficult to find. The incisors in the upper jaw are short and show little curvature, while these of the lower jaw are much longer and extend the length of the jaw. Changes are very rapid in the second, third, and fourth days. The teeth become harder, differing from the soft milky mass around them. The upper incisor grows rapidly in width and length making a more definite curve. The lower incisors also grow in length and width, and usually extend the length of the jaw. The cusps of the molars change from round to a more pointed shape. A dissection of a ten day

head shows the cusps fully formed and becoming quite hard. The incisors also, have become hardened and pushed through the gums. Rapid development has taken place. Comparison of these stages may be made from Plates II and III.

Eruption of Teeth

The first teeth to appear are the incisors. The tips of the upper incisors are through the gum on the third day, [but the lower incisors usually appear on the third day], but the lower incisors usually appear on the fourth day. However, both upper and lower incisors have been observed to appear on the third day. The molars are much slower in making their appearance. The most anterior molar (I) usually breaks through the gum on the sixteenth day although in some cases it has not appeared until the seventeenth day. Molar II appears on the seventeenth day and invariably follows the next day after the eruption of Molar I, but in many cases both appear on the same (sixteenth) day. The posterior Molar III does not become visible until the thirtieth day when the gum is broken and a portion of it may be seen. The entire tooth appears on the thirty first day.

Tooth Pattern

The tooth pattern of Peromyscus maniculatus bairdi varies little. Changes, due to wear upon the teeth occur but these are in line with the general pattern. Comparison of Figures 1-6 Plate IV of young, mature,

and old individuals show differences which are due to wear. It will be seen by this comparison that the pattern is essentially the same for all three. Variation does occur, but rarely in Molars I and II. It is found more frequently in Molar III, both upper and lower jaws. Such variations may be seen in Figures 9, 10, 192 Plate IV. There was only one variation found in Molar I. This is shown in Figure 11 Plate IV. It was observed that when Molar I of the upper jaw was quite large, Molar I of the lower jaw was smaller than the average, but Molar III of the lower jaw seemed to compensate for this by being larger than the corresponding molar on the upper jaw. The entire length of the molars on the upper jaw closely correspond with that of the lower jaw, whatever differences were found in individual teeth. This is shown by Figures 7 and 8 Plate IV.

Dental Indices

Dental indices were taken for the molar teeth (right side only) of fifty skulls. Plates V, VI, VII, VIII. These indices are placed in order according to sex, and also according to the serial arrangement of Molar I. The indices were grouped in intervals of four and line graphs used to indicate their variability Plates IX and X.

In the upper jaw of the male Molar I shows a low range of variability covering only three intervals, Molar II a range of variability covering six intervals,

and Molar III a range of eleven intervals. From this it may be seen that the variability of Molar III is relatively three times as great as that of Molar I and nearly twice that of Molar III. In the upper jaw of the female Molar I has a variability range of three intervals. The variability of the female is similar to that of the male except that it is greater. Molar III is more than three times as variable as Molar I and lacking one interval of being twice that of Molar II. This can readily be observed in Figures 1, 2, 3, 7, 8, 9 Plate IX.

In the lower jaw of the male, Molar I has a variability range of four intervals, Molar II five intervals, and Molar III eight intervals. From this it is evident that Molar III has a wider range than Molar I being relatively twice as great. The difference of range of Molar II and Molar III is not so great as was found in the upper jaw. The interval range of Molar III being about one and a half times that of Molar II. In the lower jaw of the female a different range of variability is found. Molar I has a range of six intervals, Molar II five intervals, and Molar III nine intervals. It will be seen that there is less difference in the interval range of Molars I and III than in the upper jaw, and a greater difference of II and III. Molar I is therefore more variable in the female than in the male, Molar II is relatively the same, while Molar III has a slightly greater range in the female than in the male. Figures

4, 5, 6, 10 11, 12 Plate IX.

From the differences of the individual teeth already shown it will be seen that in the upper jaw the interval range of Molar I in the male and female are very similar, in fact the same. Molar II also has the same interval range in the male and female, but Molar III has a greater range in the female than in the male. In the lower jaw Molar I is more conservative in the male, having only four intervals while the female has six intervals, thus showing a wider range of variability. Molar II has the same interval range in both sexes, and in Molar III we find a greater interval range in the female than in the male.

If we compare the corresponding molars of the upper and lower jaws we find that Molar I in the upper jaw has the narrow interval range of three as compared with that of six in the lower jaw. This shows us that there is more variability in Molar I lower than in Molar I upper. Molar II is more variable in the upper jaw having six intervals, than in the lower jaw where there are only five. This shows a greater range in the upper Molar II than that of the lower Molar II. Molar III is also more variable in the upper jaw than in the lower jaw, the upper Molar III having twelve intervals, the lower nine intervals. See Figures 1-6 Plate X. The relation of the variability of Molars I, II, III, to each other may be seen in Figures 7 and 8 Plate X. We may say therefore, that in general the molars of the upper jaw are more

variable than those of the lower jaw.

A graphic representation showing the range of variability of the teeth of the upper jaw is given in Plate XI. The relative height of the different squares show the variability of the indices, and the number of squares on a given line indicate the number of individuals having that measurement. Thus, Molar I male, index fifty eight hundredths, has six individuals having that index. From this graph it will again be observed that the male is conservative while the female is more variable. In Plate XII a similar comparison is given for the lower jaw. This shows very plainly the conservative range of Molars II and III as compared to those of the upper jaw. Plate XIII indicates the relation among the teeth of one jaw, the variability of the teeth of male and female, and the relation of the teeth of the upper and lower jaws to each other. From this, and the foregoing diagrams it may then be concluded that:

(1) Molars I, II and III of the upper jaw of the female are more variable than those of the male.

(2) Molars I, II, and III of the lower jaw of the female are more variable than those of the male.

(3) Molar I upper jaw appears conservative compared with Molar I lower jaw.

(4) Molar II upper jaw is more variable than Molar II lower.

(5) Molar III upper jaw is more variable than Molar III lower.

(6) Of the three molars, Molar III is most variable.

(7) With the exception of Molar I, the lower jaw is more conservative than the upper jaw.

SUMMARY

1. Peromyscus maniculatus bairdi has no teeth at birth.

2. The upper incisors appear on the third day and the lower incisors on the fourth day.

3. The first Molar (I) appears on the sixteenth day, the second Molar (II) on the seventeenth day, and the third Molar (III) on the thirty-first day.

4. The tooth pattern of Peromyscus maniculatus bairdi is constant for the species, showing very little variation.

5. Dental indices show that there is a wider range of variability among the females than the males.

6. The lower molars have a narrower range of variability than the upper molars.

7. The greatest range of variability is in Molar III, and the smallest range in Molar I, with the one exception of Molar I female lower jaw.

BIBLIOGRAPHY

Allen, J. A. and Coues, Elliot

Monograph of North American Rodentia Report of United States Geol. Survey of the Territories. Vol. XI. Washington Government Printing Office 1877.

Broom, R.

Dental Variations in Mammalian Skulls. London Proc. Zool. Soc. 1914 pages 1071-2

Cope, E. D.

Mechanical Causes of Development of the Hard Parts of the Mammalia. Journal Morph. Vol. iii No. 2 1889 pages 137-290.

Eaton, Walter Richard

Little Folks that Gnaw. Harper's Magazine Feb. 1919 pages 345-357.

Flower, W. H.

An Introduction to Osteology of the Mammalia. Macmillan & Co. London 1870

Gidley, J. W.

Tooth Characters and Revision of the North American Species of the Genus Equus. Bull. Am. Museum. Natural History. Vol XIV. pages 91-142 1901.

Hammet and Justice

The Geommetrical Symmetry of Growth of the Upper Incisors of the Albino Rat. Anat. Rec. Phila. Vol. 26. Sept 20, 1923 pages 141-44.

Hinton, Martin A. C.

The Dental Formula of the Muridae with Especial Reference to the Mp. 4 Theory. Ann. Magazine Natural History London Series 9 Vol. 11 1923 pages 162-170

Osborne, H. F.

Evolution of Mammalian Molar Teeth
Macmillan Co. N. Y. 1907

Osborne, H. F.

Succession of Teeth in Mammals American Naturalist Vol. 27 1893 p. 493

Osgood, Wilfred H.

Revision of the Mice of the North American Genus Peromyscus.
U. S. Dept. Agr. Biol. Survey. North American Fauna, No. 28. Government Printing Office Washington D. C. 1909.

Ryder, J. A.

Mechanical Genesis of Tooth Forms.
Proc. Acad. Nat. Sci. Philadelphia 1878

Scott, W. B.

The Evolution of the Premolar Teeth in the Mammals.
Proc. Phila. Acad. Nat. Sci. 1892 p. 405.

Stoner, David.

The Rodents of Iowa. Iowa Geol. Survey Bull. No. 5 Published by Iowa Geol. Survey 1918

Summer, F. B.

Peromyscus Maniculatus Geographic Variations and Mendelian inheritance. Journal Exp. Zool. Phil. Vol. 30 No. 3 April 5, 1920 p. 369.

Taylor, Walter P.

The Vertebrate Zoologist and National Efficiency Science August 10, 1917 pages 123-27

Thomas, O.

The Method of Taking the Incisive Index in Rodents. Ann. Mag. Nat. Hist. Series 9 Vol. 4 London 1919 pages 289-290.

Timms, H. W. Marrett

The Succession and Homologies of the Molar and Premolar Teeth in Mammalia. Journal Anatomy and Physiology. Vol. 36 pages 321-343.

Tomes, Charles S.

Tomes Dental Anatomy Edited by H. W. Marret Tims and A. Hopewell Smith. J. C. A. Churchill London 1914.

Woodward, M. F.

On the Milk Dentition of the Rodentia With A Description of a Vestigial Milk Incisor in the Mouse (Mus Musculus) Anal. Anzeiger 1894 bd. ix. pages 619-631.

PLATE I.

Figure 1. Apparatus

A. drawing board upon which entire apparatus is mounted.

B. Micrometer (Carl Zeis, Jena) held in position by large headed tacks.

C. Block of wood used as a rest for the needle point dividers (D) and held in place by strips of wood (E).

F. A small board tacked to the block to provide a stop for the handle of the dividers.

G. A small notch cut in F. to provide a secure and definite point for the rounded tip of the handle of the dividers to rest.

Figure 2. Points of transverse measurement
The longitudinal measurement is the greatest length of each tooth.

Plate I

Figure 1

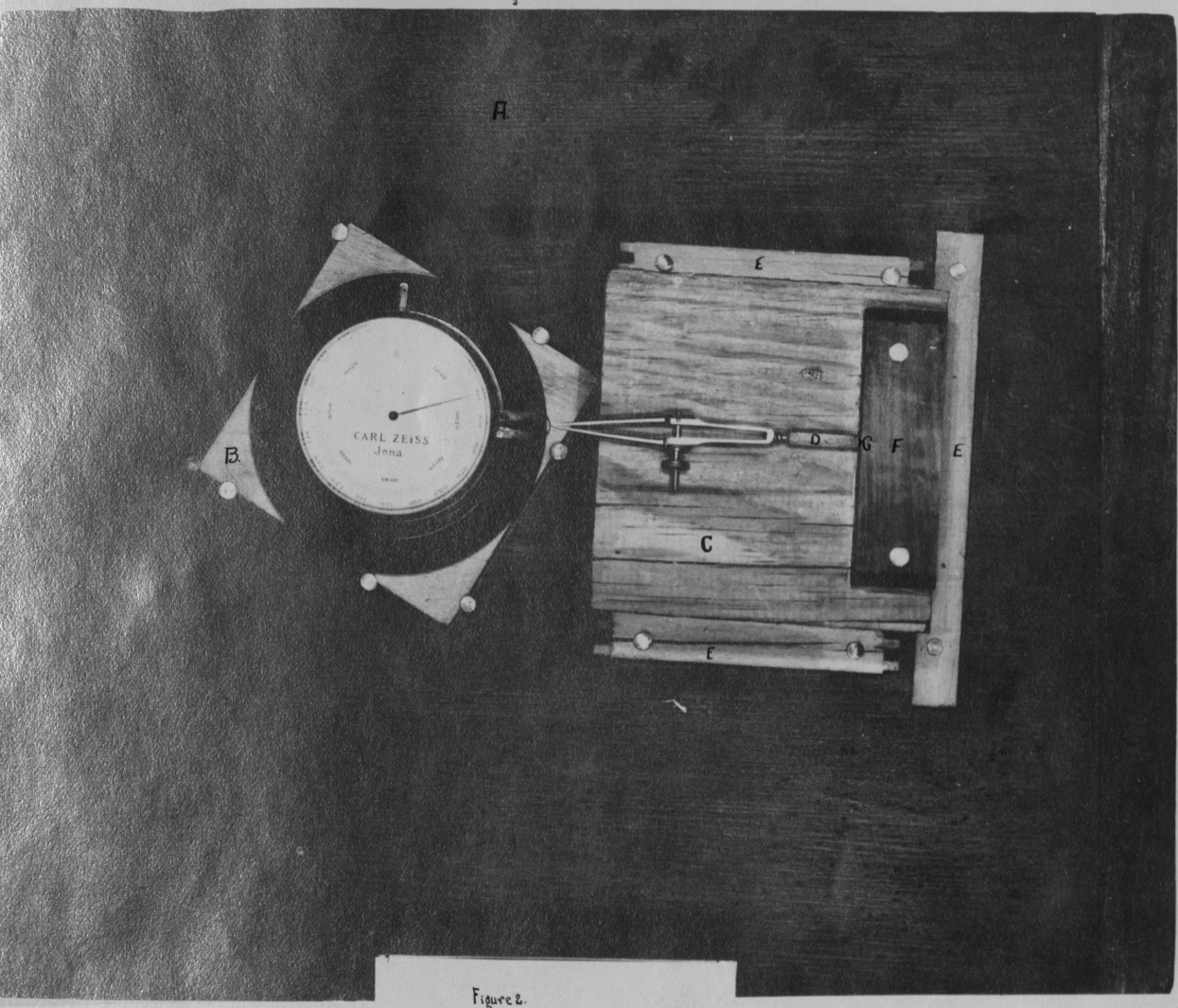


Figure 2.

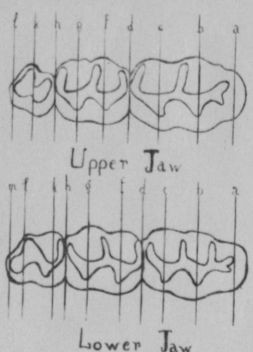


PLATE II.

Dissection of upper jaw side view.

Figure 1. New born

Figure 2. One day

Figure 3. Two days

Figure 4. Three days

Figure 5. Four days

Figure 6. Ten days

Plate II

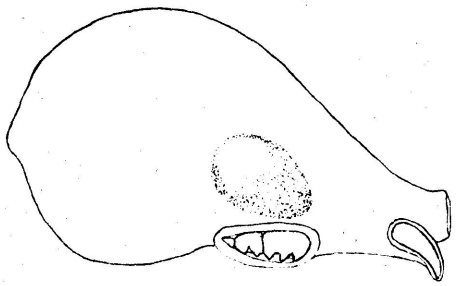


Fig. 1.

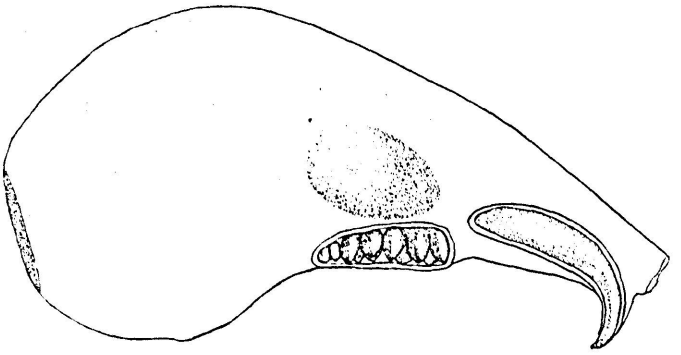


Fig. 6.

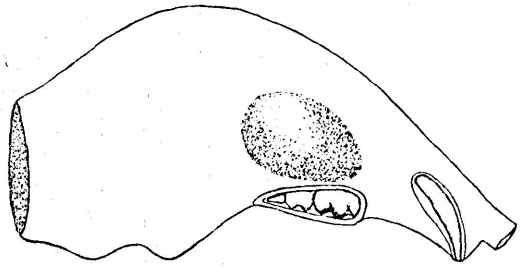


Fig. 2.

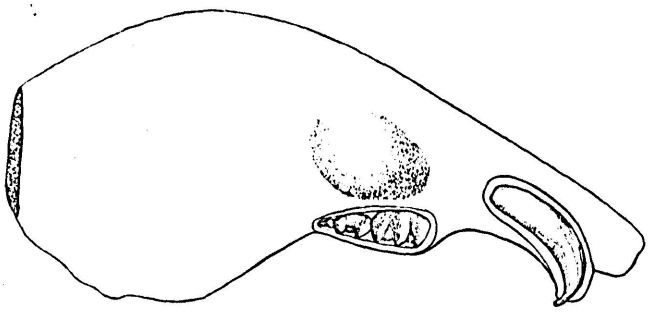


Fig. 5.

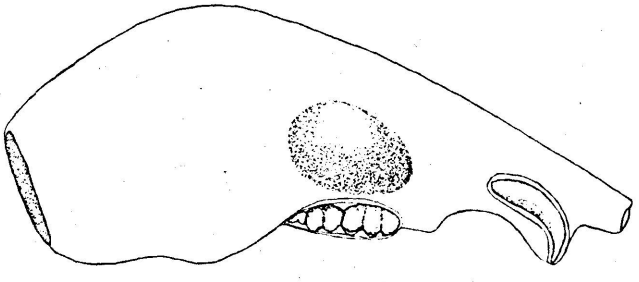


Fig. 3.

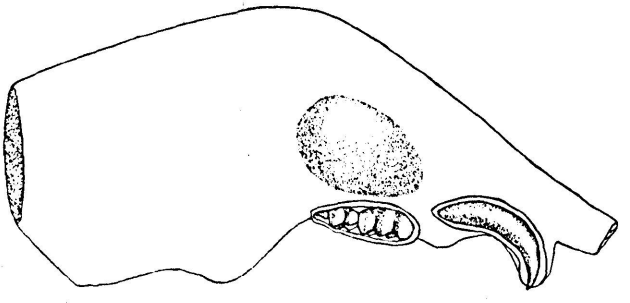


Fig. 4.

PLATE III.

Dissections showing the cutting surface of the upper and lower Molars. Also dissection of the lower jaw, side view.

Figures 1-6 Surface of molars upper jaw

Figures 7-12 Surface of molars lower jaw

Figures 13-18 Side view of lower molars

Figures 1, 7, 13 New born

Figures 2, 8, 14 One day

Figures 3, 9, 15 Two days

Figures 4, 10, 16 Three days

Figures 5, 11, 17 Four days

Figures 6, 12, 18 Ten days

Plate III

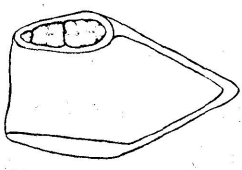


Fig. 1.

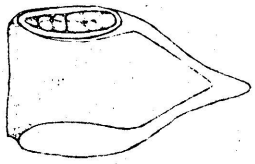


Fig. 2.

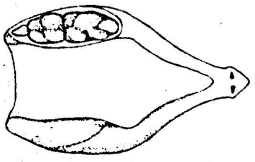


Fig. 3.

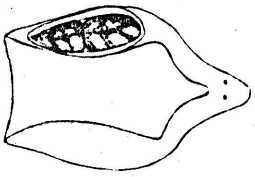


Fig. 4.

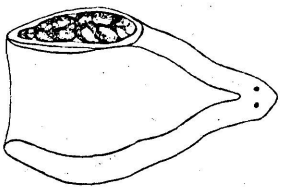


Fig. 5.

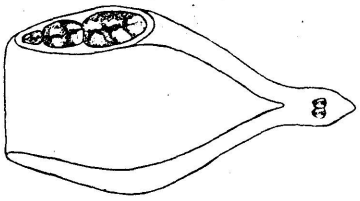


Fig. 6.

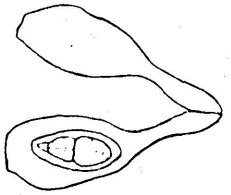


Fig. 7.

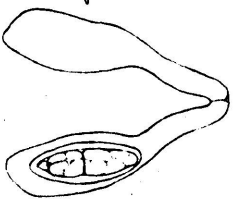


Fig. 8.

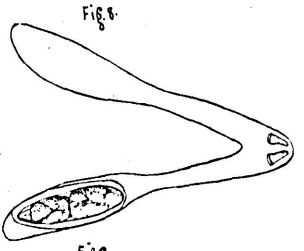


Fig. 9.

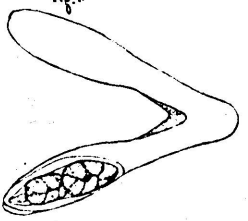


Fig. 10.

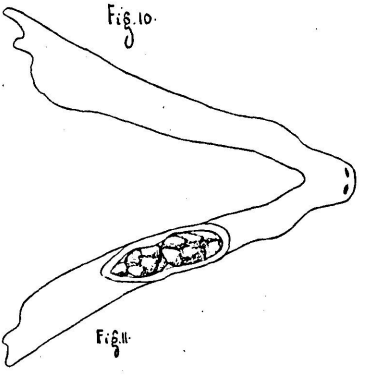


Fig. 11.

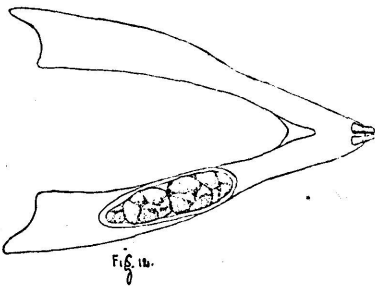


Fig. 12.

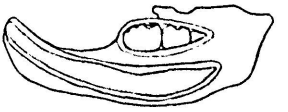


Fig. 13.

Fig. 14.

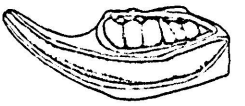


Fig. 15.

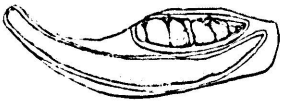


Fig. 16.

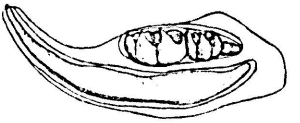


Fig. 17.

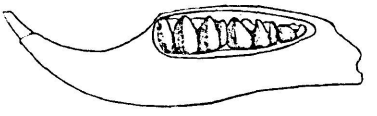


Fig. 18.

PLATE IV.

Tooth Pattern

Figure 1. Upper molars, and Figure 2 lower molars representing young individual.

Figure 3, 4 similar views representing mature individual.

Figures 5, 6 similar views representing old individual.

Figure 7. upper molars and Figure 8 lower molars showing the compensation of Molar III lower jaw.

Figure 9. Variation of Molar III lower jaw

Figure 10. Variation of Molar III lower jaw

Figure 11. Variation of Molar I lower jaw

Figure 12. Slight variation of Molar III lower jaw.

Plate IV

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Fig. 9

Fig. 10.

Fig. 11.

Fig. 12.

PLATE V.

Indices of Upper Molars, Male

Upper Jaw

Plate V.

Sex	No.	Molar I.	Molar II.	Molar III.
♂	599	.5112	.8523	.98000
	568	.5131	.7708	.8620
	911	.5200	.7097	.9000
	550	.5266	.7609	.8623
	552	.5347	.7944	.9000
	913	.5429	.8427	.9124
	567	.5448	.8969	.9358
	796	.5466	.7343	.9220
	554	.5522	.7759	.9800
	559	.5538	.8943	.9323
	565	.5600	.7745	.9485
	582	.5694	.8758	.8814
	555	.5714	.8800	1.0000
	4661	.5722	.8385	1.0929
	575	.5724	.8019	.8088
	781	.5728	.7818	.9650
	595	.5800	.8863	1.0406
	586	.5800	.8736	1.0737
	558	.5827	.8007	1.0000
	570	.5890	.8383	1.1851
	628	.5899	.8427	.8227
	581	.5899	.9047	.9800
	4660	.5926	.8779	.9657
	556	.5948	.8990	.9365
	4663	.6068	.8204	1.2107

PLATE VI.

Indices of Upper Molars, female

Upper Jaw.

Plate VI.

Sex	No.	Molar I.	Molar II.	Molar III.
♀	564	.5046	.8909	1.0415
	907	.5047	.7419	1.0000
	563	.5184	.7823	.8589
	584	.5300	.8872	.9184
	560	.5400	.9231	.9960
	573	.5405	.8437	.8983
	901	.5433	.8211	.9546
	891	.5501	.6955	.8858
	566	.5555	.7549	.9206
	896	.5627	.8453	.9800
	588	.5630	.7550	.9557
	903	.5714	.8075	.9329
	551	.5715	.8100	.9476
	564	.5728	.8724	1.0000
	583	.5737	.7800	.9550
	593	.5744	.7829	.9800
	572	.5757	.7966	.9375
	909	.5761	.7447	1.0737
	569	.5763	.9222	1.1454
	780	.5785	.8356	.9501
	892	.5854	.8116	1.1554
	905	.5876	.8221	.9420
	778	.6022	.8402	.7767
	585	.6075	.8747	1.0324
	589	.6112	.8295	1.1875

PLATE VII.

Indices of Lower Molars, male

Lower Jaw

Plate VII.

Sex	No.	Molar I.	Molar II.	Molar III.
♂	913	.4985	.7762	.6730
	911	.5281	.8009	.7564
	568	.5357	.7389	.7761
	554	.5363	.7567	.7649
	599	.5442	.8010	.6660
	555	.5504	.7651	.8425
	4660	.5524	.7761	.7382
	796	.5621	.7700	.7300
	595	.5657	.8013	.6878
	582	.5657	.7269	.7300
	552	.5691	.7545	.6288
	4663	.5725	.8064	.7211
	4661	.5725	.7876	.7492
	556	.5744	.7684	.9086
	567	.5797	.7843	.7500
	628	.5811	.8163	.6779
	570	.5820	.7800	.7848
	550	.5836	.8445	.6388
	581	.5871	.7896	.7901
	565	.5970	.7843	.7356
	575	.6172	.7894	.6000
	556	.6200	.7700	.7211
	595	.6282	.7733	.6696
	586	.6382	.8356	.7353
	781	.6438	.7324	.7300

PLATE VIII.

Indices of Lower Molars, female

Lower Jaw

Plate VIII.

Sex	No.	Molar I.	Molar II.	Molar III.
♀	584	.4682	.8100	.6845
	907	.5031	.7670	.6790
	780	.5283	.8387	.7539
	583	.5303	.7663	.8010
	903	.5369	.8147	.7973
	891	.5408	.8163	.7253
	572	.5488	.7863	.7863
	909	.5495	.7800	.7191
	589	.5532	.8355	.8097
	566	.5540	.8229	.7875
	551	.5639	.7300	.8133
	892	.5644	.7761	.8183
	560	.5651	.8237	.7117
	905	.5690	.8926	.9228
	593	.5723	.8356	.7550
	585	.5728	.8654	.7390
	561	.5800	.8445	.7248
	778	.5815	.8097	.6976
	588	.5860	.8345	.7441
	573	.5877	.8586	.7023
	569	.6076	.8315	.6585
	896	.6143	.8562	.7626
	563	.6217	.9010	.5800
	901	.6415	.8525	.8385
	564	.6634	.8617	.8442

PLATE IX.

Line graphs for individual molar teeth of male and female.

Figures 1, 3 Upper molars of male

Figures 4, 6 Lower molars of male

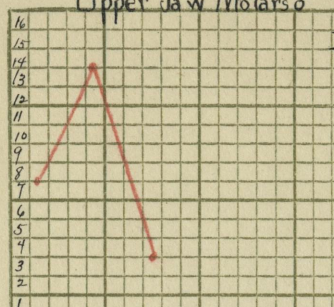
Figures 7, 9 Upper molars of female

Figures 10, 12 Lower molars of female

Plate IX

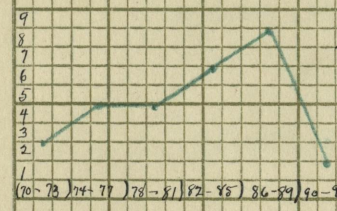
Upper Jaw Molars ♂

I. Fig 1



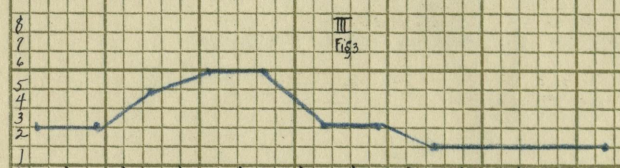
(51-54) (55-58) (59-62)

II. Fig 2



(70-73) (74-77) (78-81) (82-85) (86-89) (90-93)

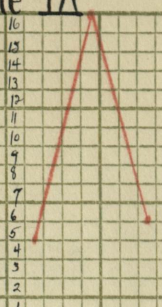
III. Fig 3



(80-83) (84-87) (88-91) (92-95) (96-99) (100-103) (104-107) (108-111) (112-115) (116-119) (120-123)

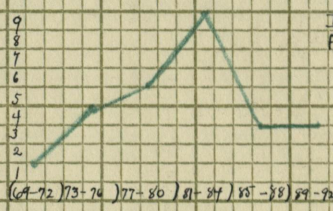
Upper Jaw Molars ♀

I. Fig 7



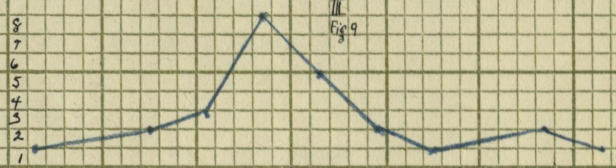
(50-53) (54-57) (58-61)

II. Fig 8



(69-72) (73-76) (77-80) (81-84) (85-88) (89-92)

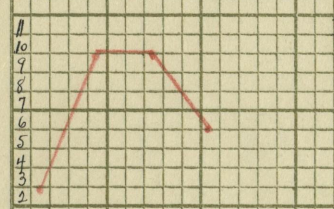
III. Fig 9



(77-80) (81-84) (85-88) (89-92) (93-96) (97-100) (101-104) (105-108) (109-112) (113-116) (117-120)

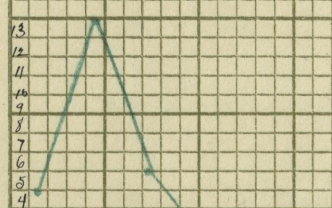
Lower Jaw Molars ♂

I. Fig 4



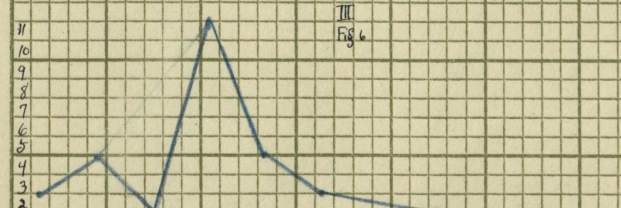
(49-52) (53-56) (57-60) (61-64)

II. Fig 5



(72-75) (76-79) (80-83) (84-87) (88-91)

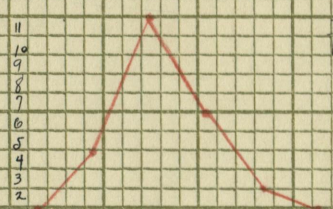
III. Fig 6



(60-63) (64-67) (68-71) (72-75) (76-79) (80-83) (84-87) (88-91)

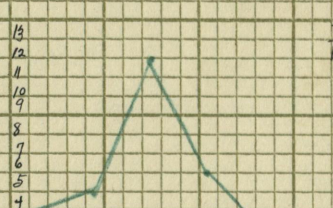
Lower Jaw Molars ♀

I. Fig 10



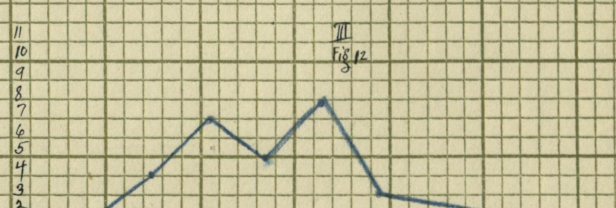
(46-49) (50-53) (54-57) (58-61) (62-65) (66-69)

II. Fig 11



(73-76) (77-80) (81-84) (85-88) (89-92)

III. Fig 12



(58-61) (62-65) (66-69) (70-73) (74-77) (78-81) (82-85) (86-89) (90-93)

PLATE X.

Line graphs of upper and lower molars, and a composite of the molars of each jaw.

Figures 1, 3 Composite of male and female Upper molars.

Figures 4, 6 Composite of male and female Lower molars

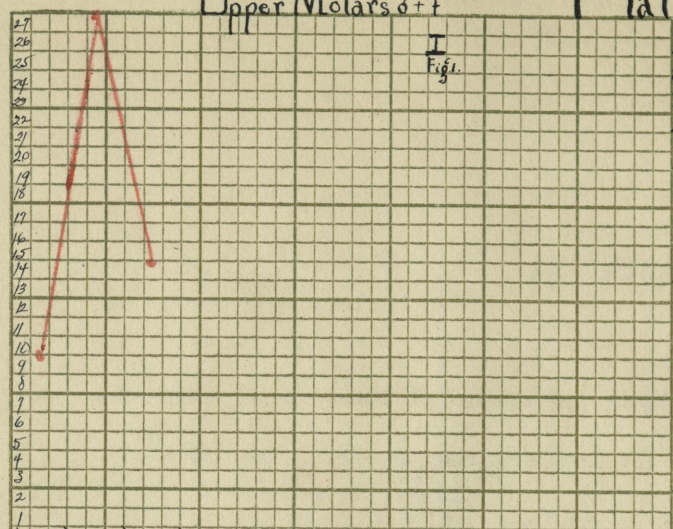
Figure 7 Composite graph of figures 1, 2, 3.

Figure 8 Composite graph of figures 4, 5, 6.

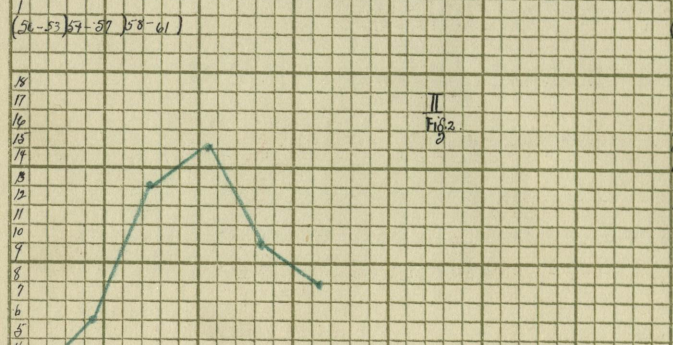
Plate X

Upper Molars ♂+♀

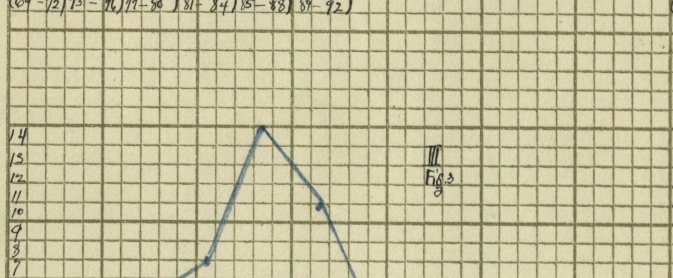
I
Fig. 1.



II
Fig. 2.

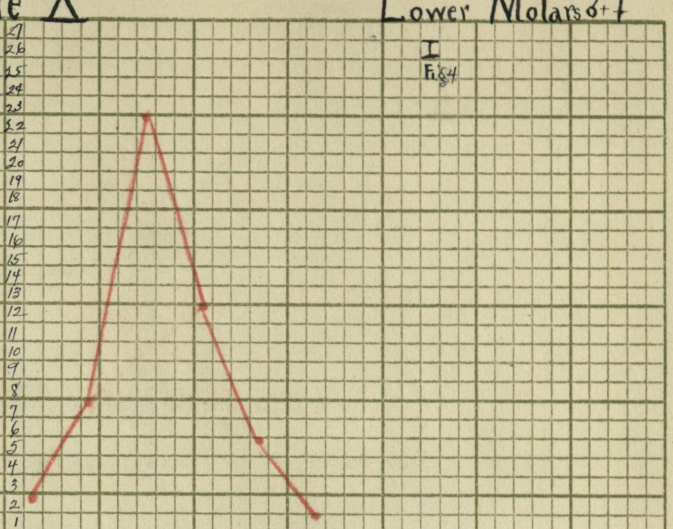


III
Fig. 3.

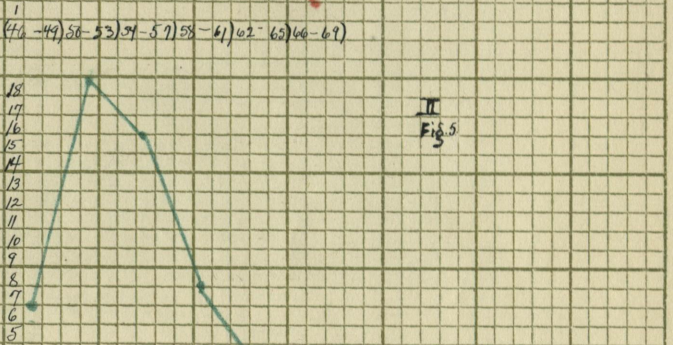


Lower Molars ♂+♀

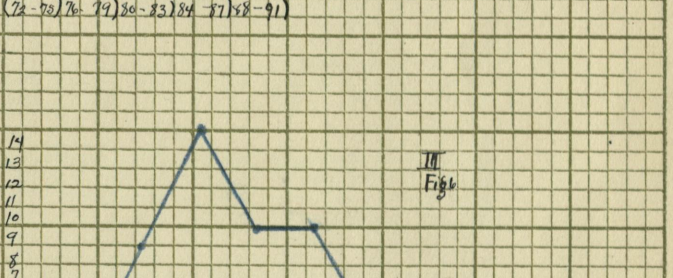
I
Fig. 4.



II
Fig. 5.

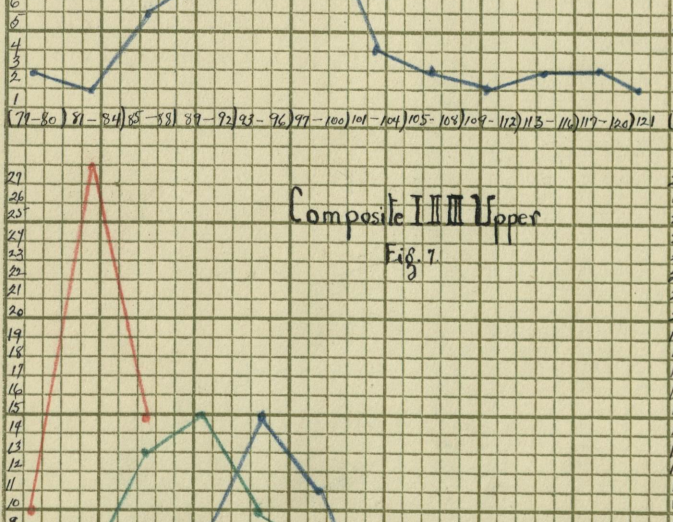


III
Fig. 6.



Composite I II III Upper

Fig. 7.



Composite I II III Lower

Fig. 8.

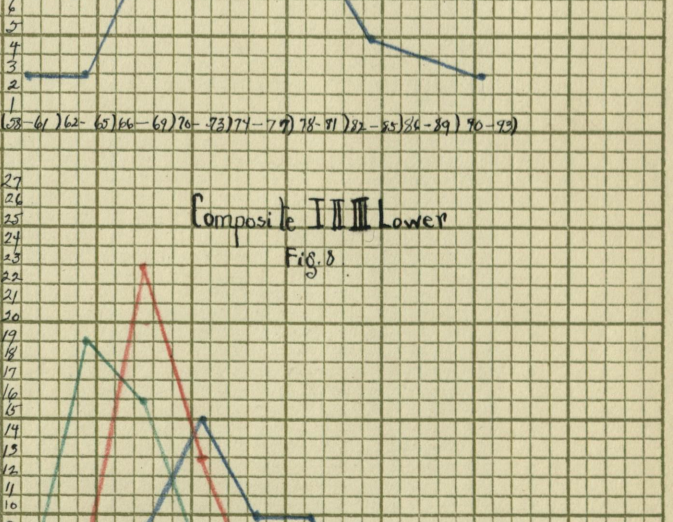


PLATE XI.

Block graphs of upper molars of male and female.

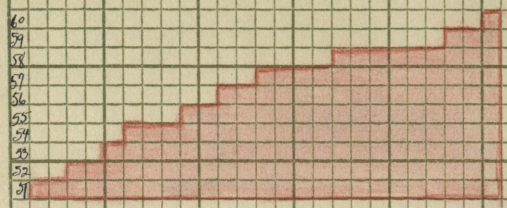
Figures 1, 3 Molars of upper jaw of male.

Figures 4, 6 Molars of upper jaw of female.

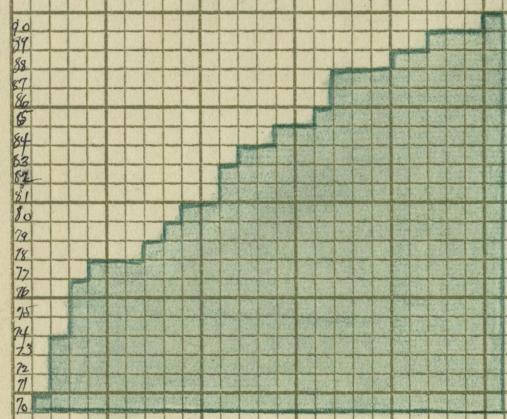
Note: each vertical column represents an individual.

Plate XI

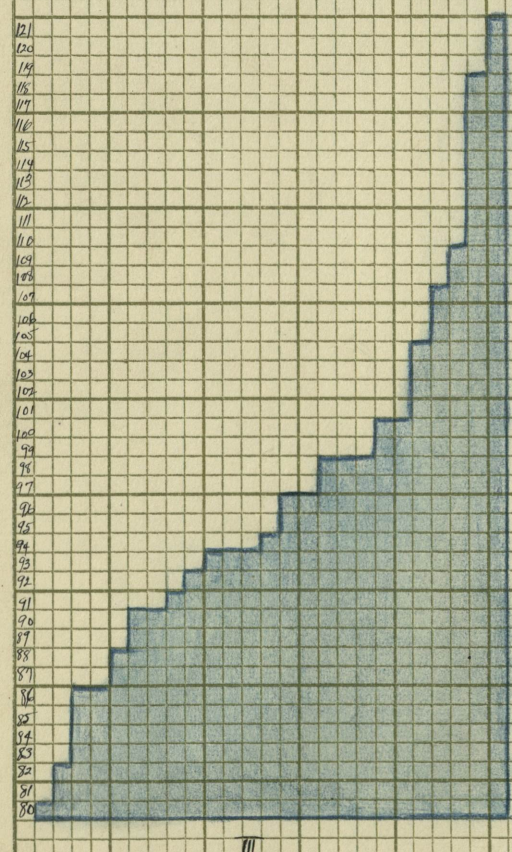
Upper Molars ♂



I
Fig. 1

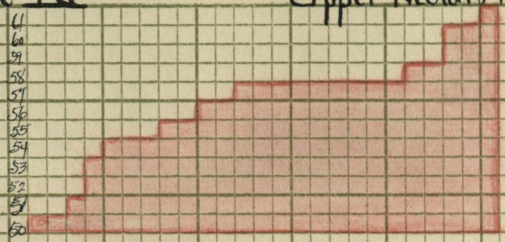


II
Fig. 2

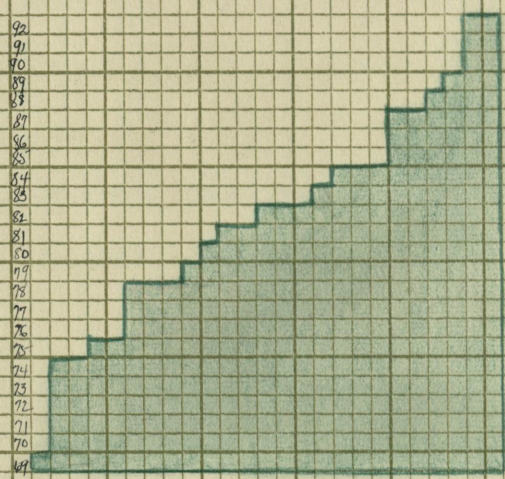


III
Fig. 3

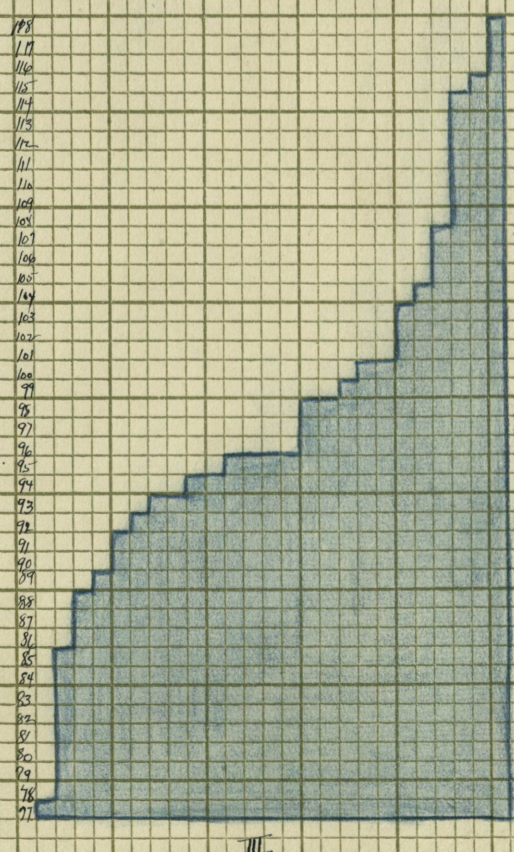
Upper Molars ♀



I
Fig. 4



II
Fig. 5



III
Fig. 6

Plate 12

Block graphs of lower molars of male and female.

Figs. 1-3 Molars of lower jaw of male.

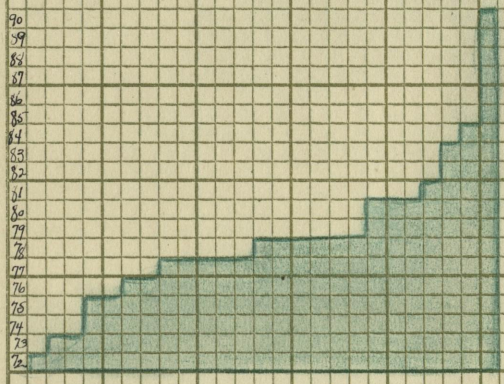
Figs. 4-6 Molars of lower jaw of female.

Note: Each vertical column represents an individual.

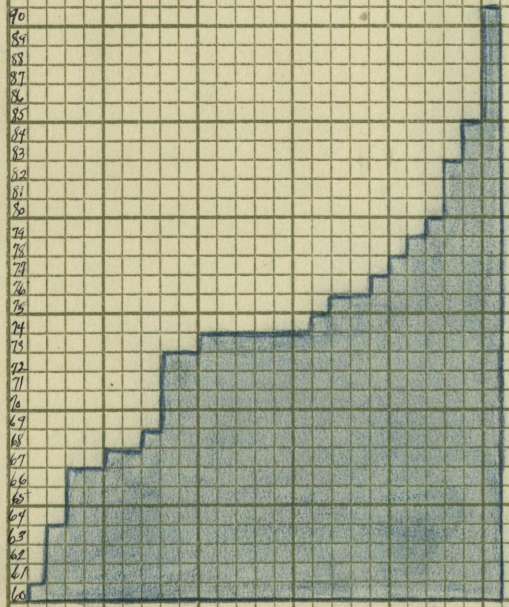
Plate XII

Lower Molars ♂

I
Fig 1

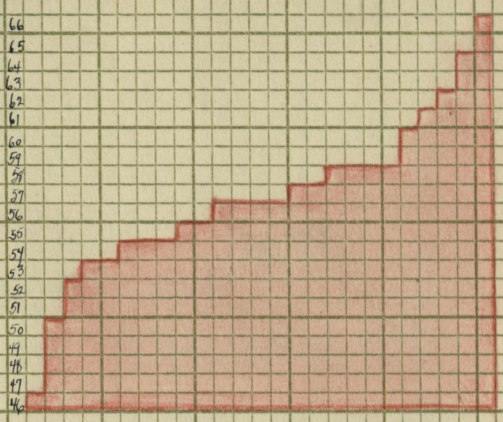


II
Fig 2.

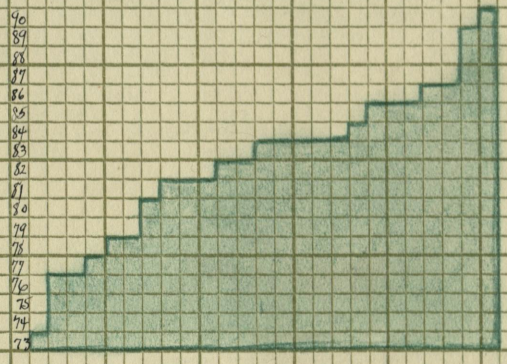


III
Fig 3

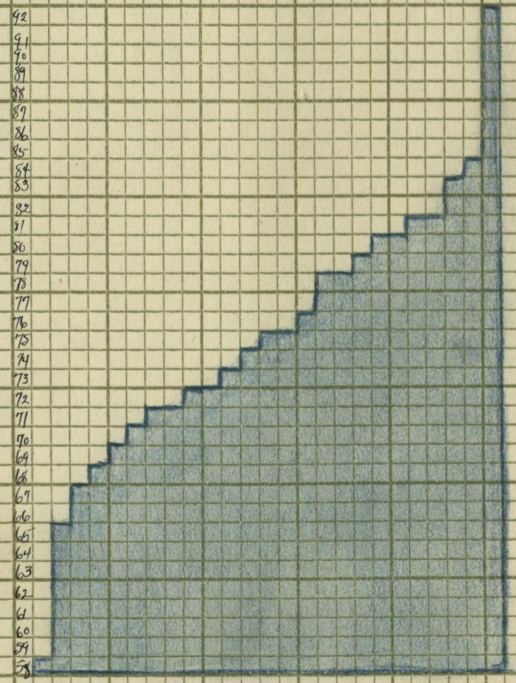
Lower Molars ♀



I
Fig 4



II
Fig 5



III
Fig 6.

PLATE XIII.

Block graphs. Composite of upper molars of male, and of female; also of the lower molars of male, and female.

Figure 1. Composite of upper molars I, II, III male.

Figure 2. Composite of upper molars I, II, III female.

Figure 3. Composite of lower molars I, II, III male.

Figure 4. Composite of lower molars I, II, III female.

Plate XIII

Upper Molars ♂

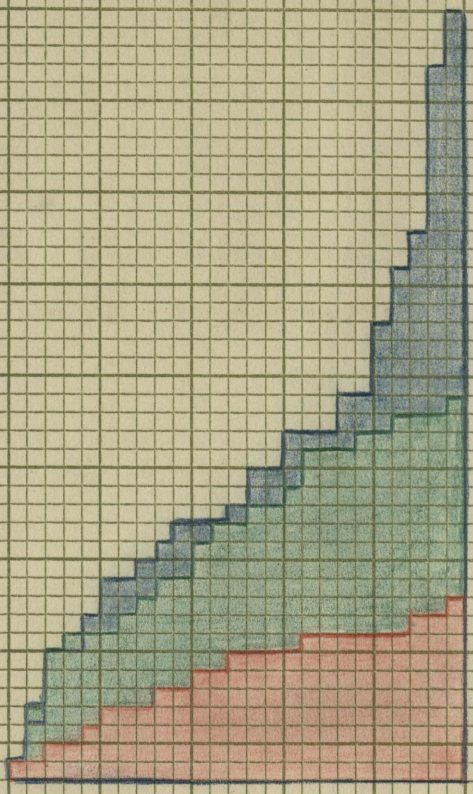


Fig 1.

Upper Molars ♀

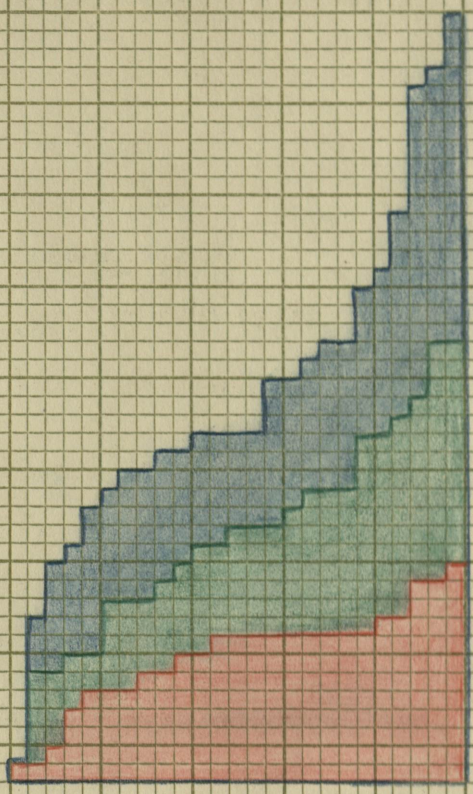


Fig 2.

Lower Molars ♂

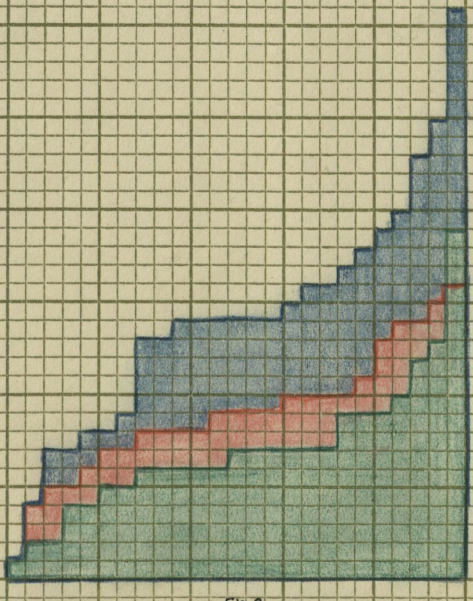


Fig 3.

Lower Molars ♀

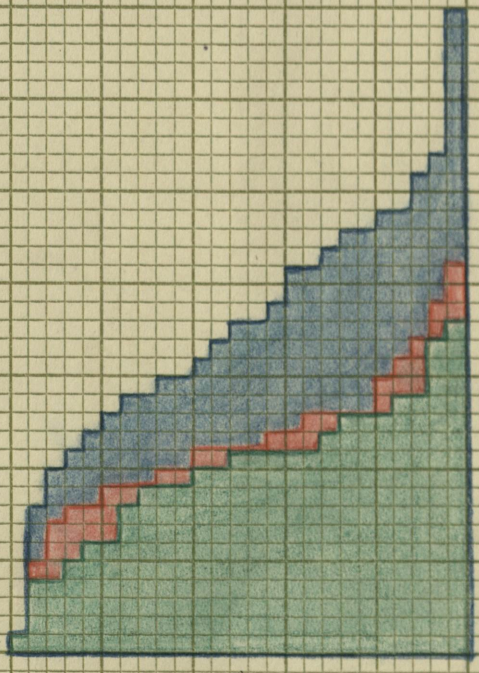


Fig 4.