TRANSACTIONS OF THE WAGNER FREE INSTITUTE OF SCIENCE OF PHILADELPHIA

VOLUME V.

JANUARY, 1898

WAGNER FREE INSTITUTE OF SCIENCE
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A STUDY

OF

HAWAIIAN SKULLS

BY

HARRISON ALLEN, M.D.

WAGNER FREE INSTITUTE OF SCIENCE OF PHILADELPHIA

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PREFATORY NOTE

IN presenting this remarkable craniological study to the scientific public, a few words in reference to its lamented author and to the chief results which it reaches will not be unwelcome to readers.

This memoir was the last of Dr. Allen's many contributions to our knowledge of organic forms and their modifications. Only a week before his sudden death he handed it to the Publication Committee, prepared so carefully that it was in all respects ready for the printer. As on several occasions he showed me his manuscript and explained to me what features in it he considered of special importance, it may be well in these introductory lines, which the Committee on Publication has kindly suggested I should write, to single out these points for comment.

In a general sense this memoir is a continuation of Dr. Allen's previous earlier article on "Crania from the Mounds of the St. John's River, Florida," etc., published in the Journal of the Academy of Natural Sciences, Philadelphia (vol. x., November 24, 1896). The same terminology is adopted and the lines of investigation are analogous. That paper attracted most favorable attention from the leading craniologists of Europe, and Professor Emil Schmidt, of Leipsic, did not exaggerate its merits when he closed his review of it in the *Centralblatt für Anthropologie* (Bd. ii., Heft 3, p. 258) with the words, "Allen's work is the most important craniological investigation which American scientific literature has had to show for a long series of years."

It was one of Dr. Allen's chief aims to establish some other, and if possible more stable criteria of cranial comparison than those in common use; and, on the other hand, to subject the latter to a much closer criticism than they have heretofore received.

In the former direction he emphasized the significance of the presence of the prenasal fossa as determining grade; pointed out the value of the infraorbital suture, which is generally neglected; and offered as entirely new the comparisons of the pyramidal process of the palatal bone and the prominence or recession of the zygoma when the skull is viewed from above. He estimated with precision the signification of pædomorphism as a sign not so much of arrested as of incompleted development.

Undoubtedly the most striking of the results demonstrated in the present memoir, and that on which in conversation he laid the greatest stress, was in his own words that "the differences between the crania are not due to race, but to methods of living, and in some degree to differences of mental strength in individuals." This modest statement by no means conveys the full import of his demonstration. What his laborious, skilful, and accurate measurements, taken in conjunction with the proved unity of race but diversity of nutrition and culture-conditions of his specimens, show, is that the ordinary contrasts in skull-forms, upon which many stately theories of races and schemes of prehistoric interminglings have been erected, are of such minor and doubtful significance that they are inadequate for that purpose.

Pursuing this line of research further, Dr. Allen asked himself, What is the proximate and remote etiology, what are the immediate and more distant factors, in the modification of skull-forms? In the present memoir he brings out some of these with force, while others, which, had he lived, he would have developed fully, are merely suggested. Thus, the correlation of the loss of the upper front teeth with important variations in cranial conformation is admirably set forth; and the influence of diseased action causing disuse, and thus, in turn, lessening nutrition and modifying shape and contour, is clearly explained.

The tentative inquiries which he placed in the paragraph previous to his "concluding remarks" were of far more weight in his own mind than his expressions indicate. In the last conversation I had with him, a few days before his decease, he asked my attention particularly to the consideration whether the whole range of exanthemata, and especially measles, to which the white race has been time out of mind exposed and is now largely immune, are not chargeable with many of its peculiar characteristics in facial and cranial anatomy. It was clearly his intention to present this from a much wider comparative scheme than the present memoir permitted.

He also almost incidentally refers in the present paper to a subject which interested him deeply and on which he would have made more extended examinations; that is, as above mentioned, the mental capacity of the individual as a distinct cause of modified skull-form. While this in itself is not new, he aimed to approach it by novel tests.

The last lines of the memoir are indicative of his loftier estimate of craniology than as a mere criterion of race. As such, he did not esteem it highly; but he saw in the investigation of the nutritive, psychical, cultural, and morbid processes which alter the cranial contours admirable illustrations of those profound forces which shape and mould life-forms everywhere, and are the underlying momenta of all morphology, whether of plants or of animals. In this loftier sense craniology takes just rank among the great and leading subjects of scientific investigation.

In conclusion, some reference should be made to the novel graphic method which Dr. Allen devised, and which is published for the first time in this memoir. He called it the "terrace" method, and points out its superior advantages over the graphic system of comparison by curves. Its excellence for this and allied purposes will be obvious to the student at a glance.

D. G. BRINTON, M.D.

INTRODUCTION

THE study of the skulls of the Hawaiian Islanders is of exceptional interest. The specimens represent the most remote, yet isolated, locality of a vast range of distribution which began in Southeastern Asia at a period varying in estimation from the fifth to the eleventh centuries.[10] The accounts preserved of the methods of burial are sufficiently exact to define two kinds of crania,—one of a noble class from the caves, and one of the people from the superficial graves. The crania of the time before and that after the European conquest can be distinguished, and the sad record of deterioration due to infectious diseases traced in indubitable characters.

In no other series of crania of a primitive people is the student similarly assisted, not only by chronology, but by the operation of factors which have modified the form in recent and relatively short periods of time.

That the distinction between three social classes—the nobles, the priests, and the people—into which the ancient Hawaiians were divided extended into their methods of burial, we are informed by W. D. Alexander.[1] According to this authority, the deified bones of the chiefs were generally carefully concealed in secret and inaccessible caves. This statement is confirmed by J. M. Whitney,[17] who says, "The most ancient and favorite of these places of interment were in the old lava caves, with which the island of Hawaii particularly abounds. A lava stream flowing from some opening on the mountain-side would cool first on the surface, leaving the still flowing lava within to empty itself on the country below, and thus long irregular caves of varying dimensions would be formed, many of these open from mountain-sides, and often from apparently inaccessible precipices." Alexander, indeed, qualifies these accounts with reference to bones that have been found in ancient coral beds that evidently are of great antiquity. Also, in steep cliffs running down to the water's edge at Kealakeakua Bay, are a great number of ancient Hawaiian burial-places, which appear to be readily inspected by the casual observer. The remains of Captain Cook himself lie buried in one of these caves. Yet, as a whole, the caves are said by Dr. Whitney to be the ancient sepulchres, while the coast burials are more recent. The specimens herewith studied appear to have come from one or the other of these localities. It must be acknowledged that the account of W. Ellis[9] of a depository of the dead is of separate value. A house is described by him built of fragments of lava, laid up evenly on the outside, generally about eighty feet long, from four to six broad, and about four feet high. Some were apparently ancient, others evidently had been standing but a few years. The bodies of the priests were buried within the precincts of the temple, while those of the common people—though in some instances placed in caves and subterranean caverns—were, as a rule, buried in small pits near houses or in the sand. The number of the priests is necessarily small and can be here excluded. I am of the opinion that the statements here made do not invalidate the conclusion that the material forming the basis of this paper represents two classes of crania, which are separated into a high and a low class group.

The difference noted in mortuary customs harmonizes with certain contrasts in physical proportions between the upper and lower caste. The nobility were of large stature. They had more abundant food than the lower caste; indeed, were great gluttons. Dr. Chapin[4] describes them, as late as 1837, as eating three or four heavy meals of flesh and poi daily and becoming excessively corpulent. Diseases local to the alimentary canal and lungs were common. The people were subject to apoplexy and asthma, and a mild form of rheumatism attacked both classes. Nothing was known of the systemic diseases with which Europeans are afflicted, such as measles, typhus fever, typhoid fever, scarlet fever, whooping-cough, mumps, and syphilis. Malarial diseases and leprosy were also unheard of.

But both classes had much in common. The supply of food in pre-European times was monotonous. With the exception of a few fruits and an occasional fish, hog, or fowl, the islanders subsisted on poi, a farinaceous dish prepared from the taro (*Colocasia antiquorum*).

In 1893 a collection of skulls was made by Dr. Whitney, under circumstances which make it certain that they are all of the noble class. In the same year Professor Benjamin Sharp, of the Academy of Natural Sciences, and Professor William Libbey, of Princeton University, made a collection at Kipakai, on the island of Kauwai, which are as certainly of the lower class. The Academy of Natural Sciences of Philadelphia possesses a miscellaneous series of Hawaiian skulls which have been collected from superficial graves, and most of them of recent origin. All the specimens above named, sixty-five in number, fortunately came under my observation. The specimens of the cave crania are of two series collected at one time by Dr. Whitney from a lava cave on the island of Hawaii. One of these, eighteen in number, he presented to the Academy of Natural Sciences of Philadelphia; the other, fourteen in number, he presented to the Museum of the Harvard Dental School. The coast crania studied, thirty-three in number, are in the main in the series represented in the Academy of Natural Sciences of Philadelphia and in Princeton University. Sixteen of these were collected by Messrs. Sharp and Libbey.

In general appearance the specimens form two groups, those having a uniform Isabella brown tint and those which were bleached in whole or in part. The statements of residents explain these contrasts. The brown specimens are from the caves and the bleached specimens are from the superficial graves. The cave skulls are undoubtedly more than a hundred years old, since the natives ceased to use the caves for burial purposes after European intrusion, yet they are intact, the smallest processes in the interior of the nose, and even the tartar and food detritus on the teeth, being undisturbed. The coast skulls, on the other hand, are rarely perfect. The teeth are often lost by dropping out, or even sometimes knocked out. The laborers introduced from other islands of late years, according to Dr. Whitney, seek everywhere for the skulls, and remove the teeth for the purpose of making necklaces.

The cave skulls are, for the most part, free from disease affecting the periphery, but are commonly the subject of defective nutrition, the bones being often thin and occupied with numerous foramina of absorption; together with this, and in a measure concomitant, were numerous small exostoses and arthritic deformations. The specimens, with few exceptions, are well developed, but, as will be seen, show evidences of low grade in many details.

The coast skulls, on the whole, are of a lower structural type as compared with those of the cave, and show a greater variety of diseased action. The miscellaneous series of the Morton cabinet exhibit in marked degree evidences of diseases of inflammatory origin; they are often stunted, almost uniformly of an inferior grade, and are bleached and deteriorated in other ways by exposure to the air.

It is impossible to say to what extent the above differences were due to caste, through the operation of which the bodies of the ruling class were buried in the caves and the lower classes in the sand, or to what degree Whitney's statement can be accepted, that the coast crania are all more recent than those of the caves, and by inference that they show detrimental effects of contact with Europeans, not only in the abrupt departure from a diet to which the people had been accustomed, but in the character of the attacks of infectious disease to which they were in no degree immune.

In recording the peculiarities of these crania two methods were entertained. The first included measurements, the second a systematic record of selected characters. The conclusions drawn from these methods is that the first, all things being considered, is most fruitful, the ranges of anatomical variation between the cave and coast groups being naturally much the same, since the ethnic type had been long isolated. But while the contrasts between the two series in measurement was striking and expressed in terms of precision, the differences in percentages of anatomical variation was also found to be of considerable interest.

The specimens will be often mentioned by the names of the institutions where they are owned or by the initials of the same.

The crania of the Hawaiian Islands have received attention from Retzius,[16] Uhde,[17] Dumoutier,[7] J. B. Davis,[5] Flower,[11] Turner,[15] and Virchow.

The most elaborate studies are those of Davis and Turner. The former measuring thirty-two examples (four of which were from caves) and the latter thirty-seven, with nine from the caves. It will be seen that the number of the cave series in this paper is much the largest of any that has been observed.

HAWAIIAN SKULLS

Sex

The sex of all the skulls examined is male with the exception of five,—namely, one P. U., one H. U., and three A. N. S. The female skulls have been excluded from all the studies of averages and indices, and being so few in number, I have contented myself with recording their measurements.

In the Hawaiian crania studied by Turner, nineteen were found to be males and fourteen to be females. The discrepancy between this result and mine is so great that a word of comment is demanded. Turner had but four cave skulls under observation, all of them being males; this corresponds nearly to the skulls in the largest series of this paper, since but one female was found in all the cave crania. In the tabulated twenty-seven crania from Oahu, expressly stated by Turner not to be from caves (and, therefore, comparable to my coast series), there were twelve females. It is probable that the smaller number of females noted by myself is due to the fact that the coast crania were for the most part collected from an ancient battle-field at Kipakai.

Measurements

Cubical Capacity.—The cubical capacity of the cave series shows fifteen (fifty-two per cent.) to be megacephalic, ten (thirty-four per cent.) to be mesocephalic, and four (fourteen per cent.) microcephalic. In Turner's series of four cave crania, only one was mesocephalic, one megacephalic, and two microcephalic; yet, according to the law of averages, this series is regarded by Turner to be mesocephalic. Of the coast series, seven (twenty-three per cent.) only are megacephalic, fourteen (forty-five per cent.) microcephalic, and ten (thirty-two per cent.) mesocephalic; a conclusion in full harmony with other deductions drawn in contrasting the two series of skulls. In Turner's group of Oahu crania (eighteen tabulated) the three kinds of crania were about evenly distributed,—viz., seven megacephalic, six mesocephalic, and five microcephalic.

Breadth Index.—The analyses of the breadth index in the cave series show that twenty-one (sixty-five per cent.) are brachycephalic, ten (thirty-one

HAWAIIAN SKULLS

MEASUREMENTS OF

Catalogue Number.	Age.	Sex.	Capacity of Brain-Case.	Length, Ophryo-occipital	Greatest Breadth.	Height, Basibregmatic.	Auriculobregmatic.	Minimum Frontal.	Biauricular.	Index of Breadth.	Index of Height.	Horizontal Circumferen'e	Basinasal Length.	Basialveolar Length.	Alveolar Index.	Greatest Diam. of Face.	Least Diameter of Face.	Interorbital Width.	Orbital Height.	Orbital Width.	Orbital Index.	Nasal Height.
1104	30	♂	1470	193	133^p	149	135	89	123	69	77	522	110	112	102	115	97	26	35	37	95	49
1105	30	♂	1465	188	142^p	143	133	93	127	75	76	528	115	109	94	123	100	30	37	37	100	57
1106	25	♂	1355	170	145^p	146	137	96	122	85	86	505	96	92	96	115	99	0	33	35	100	52
1107	25	♂	0	170	140^s	145	130	0	115	82	85	0	100	100	100	0	0	20	31	36	86	48
1108	40	♂	1650	175	146^p	140	137	95	123	83	80	508	99	97	98	116	97	25	34	35	97	50
1109	40	♂	1435	182	139^p	144	132	92	120	76	79	510	105	105	100	114	96	25	31	33	94	47
1110	40	♂	1365	168	142^s	133	125	90	120	84	79	488	102	102	100	106	95	22	34	34	100	54
1111	40	♂	1400	179	139^p	139	129	90	0	78	78	510	105	100	95	115	100	26	35	36	97	55
1112	40	♂	1545	173	150^p	140	135	87	118	87	59	505	104	105	101	101	95	19	35	35	100	56
1114	19	♂	1265	165	139^p	130	125	81	112	84	79	472	96	97	101	101	92	20	33	31	106	45
1120	45	♂	1520	180	143^p	140	135	95	120	79	78	510	97	98	101	113	95	23	35	36	97	50
1121	30	♂	1340	173	142^s	133	125	89	125	82	77	485	94	96	102	112	97	20	34	35	97	50
1122	50	♂	1465	184	140^p	138	132	92	113	76	75	491	100	105	105	0	98	26	31	35	89	49
1749	40	♂	1526	177	145^p	137	133	93	126	82	77	505	105	100	95	117	100	26	34	41	84	57
1750	50	♂	1410	177	146^p	136	129	90	121	82	77	503	101	101	100	110	94	23	34	35	97	59
1751	30	♂	1554	179	146^s	146	136	90	125	82	82	510	102	109	104	117	106	25	38	36	106	57
1752	25	♂	1750	174	143^p	131	126	90	117	82	75	506	99	99	100	106	95	24	34	34	100	49
1753	40	♂	1475	176	144^p	140	132	94	121	82	79	496	104	99	95	116	101	23	47	45	104	49
1754	35	♂	1501	181	136^p	144	130	95	119	75	80	495	103	113	110	113	95	20	35	36	97	50
1755	35	♂	1745	180	152^p	150	143	96	121	84	83	528	108	103	95	119	108	25	31	37	84	55
1756	40	♂	1580	172	145^s	144	129	93	121	84	84	505	102	101	99	104	91	22	34	35	97	50
1757	25	♂	1335	170	137^s	132	124	92	112	81	78	495	90	98	109	110	99	20	34	37	92	46
1758	60	♂	1570	187	147^p	145	134	96	129	79	77	529	106	0	0	115	99	25	33	35	94	52
1759	40	♂	1440	169	140^p	145	132	89	120	83	86	490	100	109	109	115	105	25	32	35	91	52
1760	30	♂	1440	165	144^p	138	129	94	121	87	84	491	101	103	102	108	92	20	33	36	92	49
1761	40	♂	1605	189	146^p	153	139	96	130	77	81	528	114	113	99	120	107	29	34	36	94	51
1762	35	♂	1540	179	148^p	137	132	91	119	83	76	518	100	99	99	112	97	26	33	33	100	48
1763	19	♂	1390	175	144^s	139	130	97	126	82	79	508	109	105	96	109	99	24	32	35	91	49
1764	40	♂	1660	174	146^p	149	141	95	126	84	86	502	100	99	99	114	99	27	36	36	100	52
1765	50	♂	0	180	150^s	0	140	94	133	83	0	515	0	0	0	119	101	25	39	37	105	57
1766	40	♂	1340	180	140^s	136	127	89	124	78	76	500	105	97	92	119	99	25	31	35	89	51
Aver'ge			1487	177	143	141	132	99	122	81	79	506	103	102	96	113	98	24	34	36	96	51
1113	30	♀	1305	165	133^p	134	128	83	109	81	81	475	95	90	95	101	83	18	34	33	103	47

No. 1104 to No. 1122—Harvard University.

CAVE SKULLS

Nasal Width.	Nasal Index.	Nasomalar Line.	Bimalar Line.	Iniobasion.	Basiopticon.	Opticonasion.	Vomerobregmatic Heig't.	Least Alisphenoid Diam.	Squamosal Height.	Ant. Pal. Width.	Post. Pal. Width.	Palatal Length.	Choanal Height.	Choanal Width.	Choanal Index.	Alveolus at Incisors.	Alveolus at Second Molar	Pyramidal Process.	Lachrymal Bone Index.	Sconce.	Frontal Arc, long.	Parietal Arc, long.	Occipital Arc, long.
25	51	108	102	54	59	55	130	70	53	30	39	59	25	12	48	20	14	15	69	98	125	130	125
29	51	113	105	36	65	60	129	74	45	30	45	61	26	15	58	15	0	15	69	122	135	125	105
24	46	108	100	43	55	49	127	76	50	30	38	50	27	14	52	12	11	13	56	168	133	135	108
24	50	0	0	51	55	50	125	70	44	30	40	47	24	15	62	11	8	9	0	100	130	126	103
25	50	110	100	39	55	48	126	75	50	31	36	53	27	16	59	17	13	12	43	180	130	130	112
26	55	108	99	50	57	53	125	78	47	39	41	58	21	14	67	16	15	7	55	122	133	130	115
22	41	100	95	45	55	48	120	65	49	26	35	57	21	14	66	18	15	10	63	130	122	108	108
26	47	110	100	48	60	55	125	73	47	30	42	55	22	15	68	20	11	15	55	130	130	120	115
25	45	103	95	45	55	53	127	68	43	29	39	60	27	13	48	11	12	10	71	124	135	110	109
23	51	93	85	0	55	47	115	65	41	25	36	50	22	13	59	0	12	13	50	136	110	110	115
25	50	106	100	37	60	48	128	75	45	31	38	53	23	14	60	17	15	14	66	148	140	120	118
25	50	105	95	47	56	48	120	75	46	0	0	48	20	16	80	20	14	12	44	100	130	112	100
25	51	105	96	38	52	50	123	72	47	0	0	55	30	15	50	10	0	10	33	120	125	130	118
25	44	100	100	43	57	52	124	72	50	26	38	58	26	15	58	14	19	15	50	170	133	123	102
23	39	104	95	50	57	52	122	67	47	27	32	53	24	15	62	17	0	11	67	132	130	120	108
26	46	110	100	53	60	53	130	75	50	30	45	61	25	15	60	15	23	15	40	126	130	120	120
24	49	100	91	44	53	49	120	71	43	26	40	50	20	14	70	19	15	10	40	180	132	112	110
29	59	108	99	37	60	50	126	80	48	27	34	54	25	17	68	13	19	10	33	148	126	120	104
24	48	105	95	44	58	50	127	75	48	27	37	54	25	15	60	20	25	15	40	126	125	130	109
27	49	108	99	45	58	54	134	79	51	32	41	52	26	16	62	15	15	18	93	150	135	130	119
22	44	102	95	41	53	50	129	70	45	30	36	55	21	11	52	15	14	13	55	150	130	125	107
23	50	104	96	53	52	50	118	69	54	24	38	46	24	15	62	0	10	13	56	86	119	120	112
22	42	104	99	41	59	48	132	70	48	0	0	0	25	16	64	12	0	10	80	144	140	130	125
26	50	101	95	43	56	52	132	67	45	25	38	58	0	0	0	17	13	10	46	130	131	127	107
25	51	102	96	45	45	59	121	72	55	28	36	55	25	17	68	18	13	10	46	0	123	125	107
29	57	110	104	51	65	53	136	77	50	31	40	61	22	12	54	13	15	13	0	120	133	133	114
32	67	102	0	53	55	50	125	70	55	27	35	52	24	15	62	20	11	12	58	156	132	120	115
26	53	109	98	48	61	54	124	73	50	30	40	55	23	14	60	15	14	12	53	120	122	115	108
27	52	106	99	49	54	55	135	74	46	25	0	55	22	16	73	15	12	15	55	150	138	129	118
24	42	107	100	0	0	53	136	70	53	0	0	0	25	16	64	20	0	0	40	144	138	125	0
25	49	105	97	47	58	55	119	79	47	29	35	53	25	14	56	16	11	16	57	102	127	120	110
25	49	105	98	46	57	52	126	72	48	29	38	54	24	14	61	16	14	12	56	134	130	123	112
26	55	95	86	45	50	49	119	65	48	26	38	50	0	0	0	12	12	12	47	124	122	120	112

No. 1749 to No. 1766—Academy of Natural Sciences of Philadelphia.

MEASUREMENTS OF

Catalogue Number.	Age.	Sex.	Capacity of Brain-Case.	Length, Ophryo-occipital	Greatest Breadth.	Height, Basibregmatic.	Auricolobregmatic.	Minimum Frontal.	Biauricular.	Index of Breadth.	Index of Height.	Horizontal Circumferen'e	Basinasal Length.	Basialveolar Length.	Alveolar Index.	Greatest Diam. of Face.	Least Diameter of Face.	Interorbital Width.	Orbital Height.	Orbital Width.	Orbital Index.	Nasal Height.
1023	35	♂	1280	170	137^p	139	124	80	110	81	82	485	104	107	103	115	85	20	35	36	97	49
1863	35	♂	1540	191	133^p	143	136	91	120	70	75	525	106	0	0	115	94	25	35	37	95	45
1999	40	♂	1480	183	135^s	139	130	95	123	74	76	510	109	105	96	120	100	25	40	38	105	58
2003	30	♂	1270	169	136^p	133	127	87	118	80	79	495	98	105	107	109	92	21	33	36	92	44
2000	40	♂	1400	180	130^p	138	126	84	100	72	77	500	97	90	93	100	95	18	36	35	103	50
572	25	♂	1210	175	134^p	132	0	80	120	77	75	493	100	95	95	100	93	25	34	33	103	52
1957	50	♂	1240	182	134^s	0	125	93	118	74	0	510	0	0	0	120	103	25	33	36	92	50
1300	0	♂	1335	174	145^p	138	130	88	122	83	79	495	105	106	101	109	97	20	35	36	97	48
565	0	♂	1390	174	144^p	130	125	90	117	83	75	505	94	98	104	109	95	25	36	37	97	48
1872	40	♂	1310	175	133^p	135	130	85	100	76	77	490	99	100	100	102	90	20	30	33	91	46
1861	25	♂	1325	170	134^s	136	126	90	119	79	80	500	97	97	100	110	90	25	34	34	100	45
2087	35	♂	1405	170	139^p	137	134	91	120	82	81	500	100	96	96	109	96	24	35	35	100	49
2088	35	♂	1285	162	135^p	130	123	85	114	83	80	480	93	86	92	103	95	22	35	33	106	46
2089	30	♂	1555	174	143^p	143	135	92	121	82	82	0	95	94	99	105	94	22	32	35	91	45
2090	30	♂	1295	171	138^p	140	127	90	108	81	82	500	103	105	102	103	93	24	33	36	93	45
2092	35	♂	1230	166	135^p	135	132	89	111	81	81	493	98	96	98	105	95	26	32	34	94	46
2093	35	♂	1270	179	132^s	135	128	87	114	74	75	505	105	97	92	109	96	23	35	37	95	46
2094	26	♂	1360	165	140^p	140	123	89	117	85	85	482	100	97	97	115	108	29	38	36	106	55
1	30	♂	1470	185	135^p	140	127	90	119	73	76	514	105	0	0	109	95	24	34	35	97	50
2	0	♂	1475	177	144^p	134	127	91	0	81	76	507	99	91	92	100	103	28	34	36	94	51
4	60	♂	1445	165	125^p	126	135	87	127	76	77	470	105	101	96	109	100	23	37	35	105	54
5	30	♂	1204	162	133^p	139	123	86	104	82	86	458	97	102	105	109	90	23	31	33	94	50
6	40	♂	1505	194	142^p	135	129	90	121	73	70	523	109	105	96	103	98	25	35	36	97	55
7	0	♂	1285	165	135^p	140	128	87	115	81	85	475	100	104	104	109	96	23	35	35	100	52
8	25	♂	1245	170	130^p	130	120	87	101	76	76	485	99	95	96	100	87	25	35	35	100	49
9	24	♂	1435	170	140^p	135	125	90	112	82	79	498	98	99	101	105	95	20	36	37	97	44
1116	30	♂	1340	168	136^p	134	124	85	0	81	80	485	104	95	91	109	92	21	33	35	94	49
1117	35	♂	1375	184	135	130	122	87	115	73	71	558	104	100	96	102	89	20	35	36	97	49
1768	35	♂	1375	182	134^p	139	127	90	119	74	76	507	105	105	100	109	97	26	34	35	97	49
Aver'ge			1356	174	136	136	127	88	115	78	79	498	101	99	98	108	95	23	34	35	97	49
2161	0	♀	1475	173	139^p	138	131	85	120	80	80	490	100	102	100	100	95	20	32	35	91	50
2091	25	♀	1235	163	130^p	131	122	85	112	80	80	496	96	92	96	105	94	24	32	32	100	49
3	25	♀	1190	166	110^s	125	117	86	103	66	75	467	98	99	101	100	88	21	30	32	94	46
1767	30	♀	1225	175	127^p	129	114	83	117	72	74	485	99	94	95	97	87	20	32	34	94	44
Aver'ge			1281	169	126	131	121	85	113	74	77	484	98	97	98	101	91	21	31	33	95	47

No. 1 to No. 9—Princeton University. No. 1116 and No. 1117—Harvard University.

COAST SKULLS

Nasal Width.	Nasal Index.	Nasomalar Line.	Bimalar Line.	Iniobasion.	Basiopticon.	Opticonasion.	Vomerobregmatic Heig't.	Least Alisphenoid Diam.	Squamosal Height.	Ant. Pal. Width.	Post. Pal. Width.	Palatal Length.	Choanal Height.	Choanal Width.	Choanal Index.	Alveolus at Incisors.	Alveolus at Second Molar	Pyramidal Process.	Lachrymal Bone Index.	Sconce.	Frontal Arc, long.	Parietal Arc, long.	Occipital Arc, long.
26	53	98	64	56	57	54	119	66	40	29	32	56	25	12	48	20	15	7	0	130	120	130	105
27	60	110	100	84	60	53	129	70	45	27	35	55	26	15	57	0	15	0	0	125	135	150	110
25	43	107	100	89	58	57	125	75	0	27	31	56	24	15	62	19	15	0	0	105	125	130	110
26	59	103	87	62	52	52	119	66	50	28	48	53	21	12	57	18	14	10	0	117	123	111	113
25	50	100	91	65	57	44	123	70	50	26	33	50	25	15	60	13	10	0	0	0	135	130	123
25	48	100	91	65	54	40	120	78	50	26	36	47	21	15	71	15	11	11	59	123	120	125	110
27	54	110	99	0	0	53	0	71	46	28	32	51	25	12	48	0	10	0	0	0	123	125	0
25	52	100	92	65	58	54	128	70	40	28	35	55	25	14	56	18	10	9	0	120	120	110	110
23	48	106	100	58	54	57	118	71	40	28	34	55	20	13	65	15	10	0	0	0	125	110	115
24	52	95	89	56	54	54	125	66	47	26	32	55	22	13	59	17	10	10	0	0	130	115	113
22	49	98	90	35	55	47	120	62	41	27	35	49	20	11	55	15	10	0	58	116	123	120	110
25	51	103	96	63	55	40	125	65	47	30	36	52	21	14	67	15	12	0	67	140	135	120	95
22	48	96	90	59	49	47	117	65	46	25	31	47	22	12	55	11	0	8	89	120	120	125	113
22	49	100	91	66	61	45	127	72	50	29	37	52	22	12	55	20	19	10	53	136	135	122	122
25	55	103	85	59	60	49	126	66	45	24	34	55	22	12	55	13	20	11	0	146	130	110	130
26	56	103	96	55	55	54	119	69	46	25	36	55	22	12	55	16	11	13	59	130	127	120	111
25	54	105	95	50	56	52	127	70	45	25	35	50	0	0	0	15	7	8	83	150	130	130	105
25	45	105	100	48	59	47	0	69	47	31	44	51	26	16	61	20	17	16	59	102	128	115	114
25	50	103	94	51	56	52	122	70	46	0	0	0	22	13	59	13	0	14	85	98	135	120	110
24	47	111	100	50	55	52	0	66	46	30	36	46	22	13	59	11	12	12	53	120	120	120	115
25	44	100	98	60	65	47	109	75	46	21	33	51	27	13	48	8	0	0	53	104	110	120	105
25	50	98	90	45	55	47	123	67	50	28	37	55	25	14	56	17	0	11	60	130	124	130	104
28	51	98	97	40	60	55	120	75	52	29	40	54	26	15	57	15	19	12	40	126	135	135	113
25	48	105	96	48	55	46	125	70	49	26	35	57	21	12	57	10	8	8	0	120	118	118	110
28	57	95	95	42	55	50	115	72	40	27	35	55	19	13	68	15	0	14	47	0	120	120	115
24	54	103	97	42	50	49	121	65	45	29	37	55	20	14	70	18	16	15	0	144	120	120	110
25	51	101	92	77	66	50	115	64	46	27	29	46	0	0	0	15	15	0	0	124	119	120	115
22	45	100	90	68	50	53	126	65	46	26	32	52	22	12	55	15	0	10	0	118	120	120	122
25	51	107	101	48	57	50	123	69	50	0	0	51	24	15	62	18	10	10	100	140	120	123	125
25	51	102	93	57	57	50	122	69	46	27	35	52	23	13	58	15	13	11	64	124	125	122	112
28	56	97	120	42	54	50	123	70	45	30	34	53	22	12	55	10	10	0	0	132	130	120	115
25	51	95	90	60	53	55	117	68	46	21	31	50	22	12	55	15	10	11	46	140	120	115	105
28	61	100	0	44	53	47	109	61	47	25	33	50	27	12	44	10	13	0	86	122	110	120	105
20	45	101	89	42	53	59	104	59	42	24	32	49	24	12	58	19	13	0	0	140	106	125	108
25	53	98	75	47	53	53	113	64	45	25	32	50	24	12	53	14	11	11	66	134	116	120	108

The remaining numbers—Academy of Natural Sciences.

per cent.) mesaticephalic, and only one (No. 1104 H. U.) is dolichocephalic. This skull is described under the head of *Diseased Action* as an example of change in skull-form, due to disease. Turner's cave series were all brachycephalic. The coast series, on the contrary, exhibit fifteen (fifty per cent.) brachycephalic, ten (thirty-three per cent.) dolichocephalic, and five (seventeen per cent.) mesaticephalic. The Oahu series of Turner exhibited seven brachycephalic, eleven mesaticephalic, and fifteen dolichocephalic.

Alveolar Index.—Of the cave series, eight (twenty-seven per cent.) are orthognathous, sixteen (fifty-five per cent.) mesognathous, and five (seventeen per cent.) prognathous. In the Turner crania two were mesognathous and two were orthognathous. In the coast series thirteen (fifty per cent.) are orthognathous, nine (thirty-four per cent.) mesognathous, and four (fifteen per cent.) prognathous. In Turner's Oahu series seven were orthognathous, sixteen mesognathous, and three prognathous.

Orbital Index.—The orbital index exhibits in the cave series twenty-four (ninety-two per cent.) megaseme, two (eight per cent.) mesoseme, and none microseme. Turner's conclusions are practically the same. In the coast series there are no examples which are not megaseme. This statement is of interest, since Turner regards the Oahu crania to be mesoseme.

Nasal Index.—Of the cave crania, ten (thirty per cent.) are leptorhine, seventeen (fifty-one per cent.) mesorhine, and six (eighteen per cent.) platyrhine. This series embraces skull 1753 H. U., which has a very well pronounced prenasal fossa. It is doubtful in what manner skulls having this peculiarity should be measured for this index, since the limitation for height is a difficult matter to determine. It may be well to say, in taking the measurement, I selected the nasion for one point, and the top of the incisor crest as the second. Of the coast series, five (sixteen per cent.) are leptorhine, fifteen (fifty per cent.) mesorhine, and ten (thirty-three per cent.) platyrhine. According to Turner, in the cave series two were mesorhine and two leptorhine, and of the Oahu crania, three were platyrhine, six mesorhine, and two leptorhine.

By the *vomerobregmatic height* (see Florida Skulls,[2] p. 412) I denote the distance between the bregma and the alæ of the vomer as they join the body of the sphenoid bone, to indicate (when this measurement is compared to the basibregmatic) the degree of inclination of the basilar process. It must be conceded, however, that this height may measure the degree of depression of the bregma itself. I do not consider it, therefore, a measurement of great value.

Observations on the Collation of Measurements

It must be acknowledged that the results obtained by the measurement of skulls have not met the expectation of those who have made them. The average measurement is often inadequate as a means of expression of general conclusions. I venture to propose a method of treatment of the figures which appears to me to have advantages over mere summation or the securance of averages,—an arrangement which will include all the numbers of a given series in order from the minimum to the maximum, and which will indicate precisely those measurements most frequently recurring as well as those which are absent. I will illustrate my meaning by reference to the measurements of the *Interorbital Width*, because this is subject to the least amount of variation. The figures as copied from the table are as follows:

Cave.	Coast.	Cave.	Coast.	Cave.	Coast.
26	20	20	25	20	23
30	25	26	24	25	23
20	25	26	22	25	25
25	21	23	22	20	23
25	18	25	24	29	25
22	25	24	26	26	20
26	25	23	23	24	21
19	20	20	29	27	20
20	25	25	24	25	26
23	20	22	28	25	

These figures when arranged with the maximum number at the top and the minimum at the bottom, and grouped as indicated by braces, are herewith given:

Cave.	Coast.	Cave.	Coast.	Cave.	Coast.	Cave.	Coast.
30	29	25	25	24	24	20	21
29	28	25	25	24 $_2$	24	20	21 $_2$
27		25	25		24 $_3$	20	
26	26	25	25	23		20	20
26	26 $_2$	25	25	23	23	20	20
26		25	25	23 $_3$	23	20 $_6$	20
26		25	25	22	23		20
26 $_5$		25 $_8$	25 $_8$	22 $_2$	23 $_4$		20 $_5$
					22		
					22 $_2$	19	18

In each of the columns ten kinds of numbers are recorded, and in each there has been two breaks in sequence,—namely, between 20 and 22, 27 and 29, in the cave, and between 18 and 20, and 26 and 28, in the coast: in both these occur towards the ends.

In attempting to record these peculiarities in a graphic manner I have placed the numbers on quadrille paper as follows:

CHART I.

INTERORBITAL WIDTH

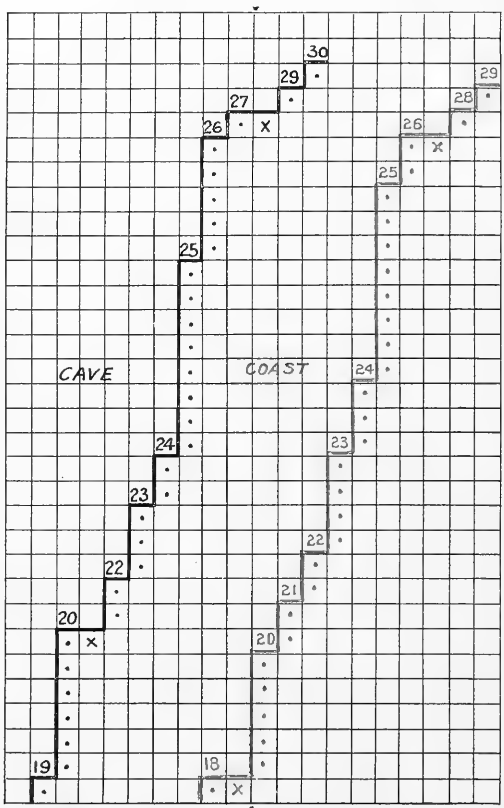
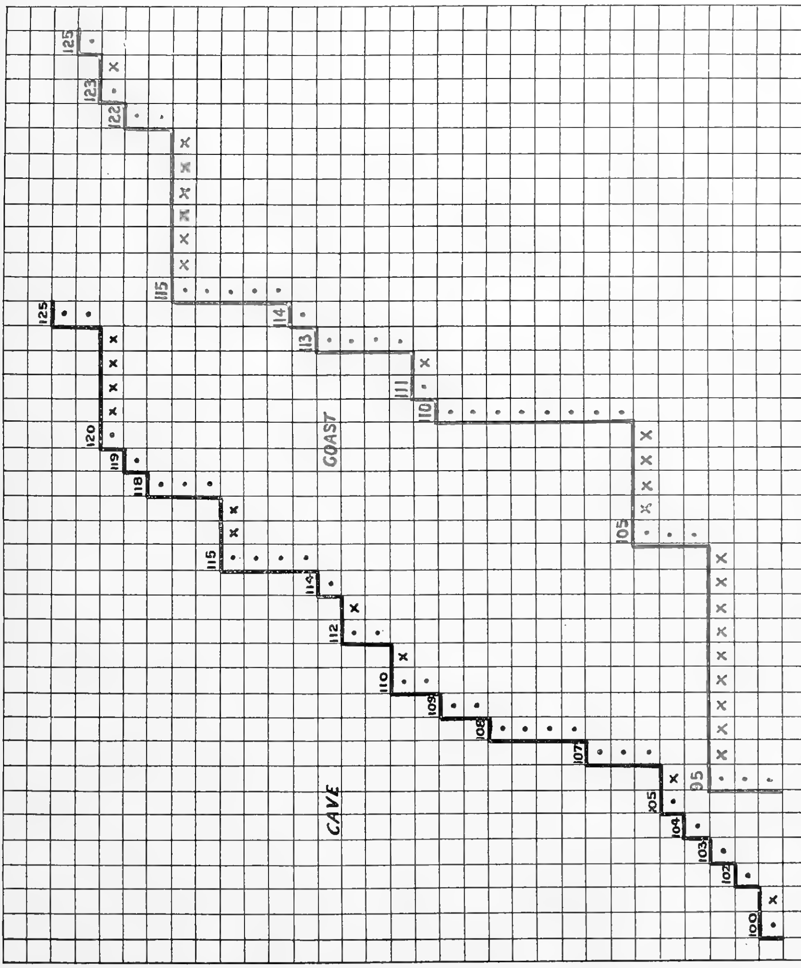


CHART II.

LONGITUDINAL OCCIPITAL ARC



The line is to be read from below upward. The number 19 in the cave series indicates that the minimum measurement is 19 mm., and that is represented by a single square of the paper, marked by a central dot, which indicates that there is one specimen in the series which has an interorbital diameter of 19 mm. The number above that of 19 is 20, there being six skulls in the series of this measurement of 20 mm.; but between 20 and 22 there is a break in the sequence, and since there is no skull in the series having a measurement of 21 mm., an asterisk is employed in place of the missing number. Reviewing the entire series, it is seen at a glance that the number which is most frequently represented is 25. Comparing the line for the cave series with that of the coast, it will be noted that the most constant number in this series, also, is 25, and the general appearance of the two records is much the same.

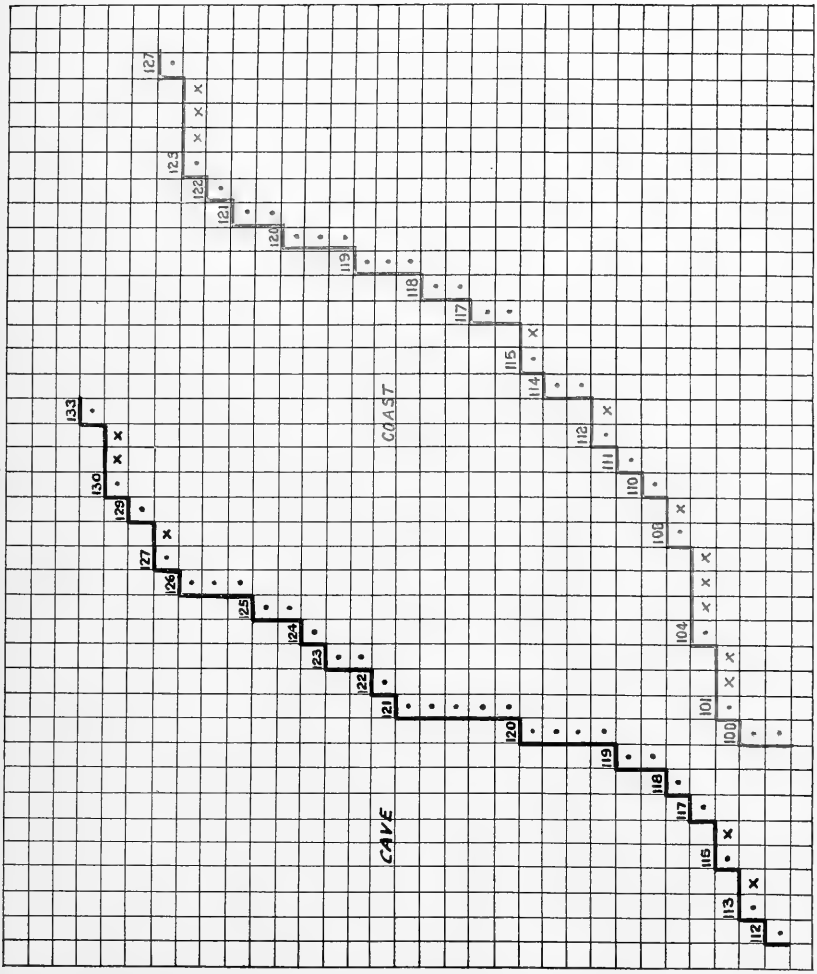
I contrast the *interorbital width* with the *longitudinal occipital arc*, since this measurement is of the most variable. It is evident that the dissimilarity between the coast and the cave series is marked, not only in those numbers which repeat themselves most frequently, but in the breaks in sequence,—the coast series exhibiting constancy in many instances, but also greater breaks in sequence in others. The differences in these measurements is more easily detected by mapping out the lines in the manner above indicated than in any other way known to me.

The *biauricular* measurement and the *opticonasion* measurement are, also, herewith presented, in evidence of contrasts which can be accepted as corresponding to the distinctions between the high and low caste. All things being the same, I believe a measurement of the *opticonasion* (which is approximately for the base of the anterior frontal lobe) correlates, in this group, with mentality, for we learn that the cave series show not only a higher grade of numbers (the series running from 47 to 60, while the coast series is but 30 to 57), but that the cave series, save in two instances only, exhibit no breaks in sequence, while that of the coast shows five such interruptions at the same time that the cave series is disposed to be relatively more constant. There are five crania measuring 48 mm. in the *opticonasion* length, seven measuring 50 mm., five measuring 53 mm., and four measuring 55 mm. In the coast series there is a less marked disposition for the skulls to have the same number,—five skulls only being in the same series, namely, 47 mm. The *biauricular* measurement can be accepted as having the same significance as the *opticonasion*.

The *greatest breadth*, as a rule, is interparietal for both cave and coast

CHART III.

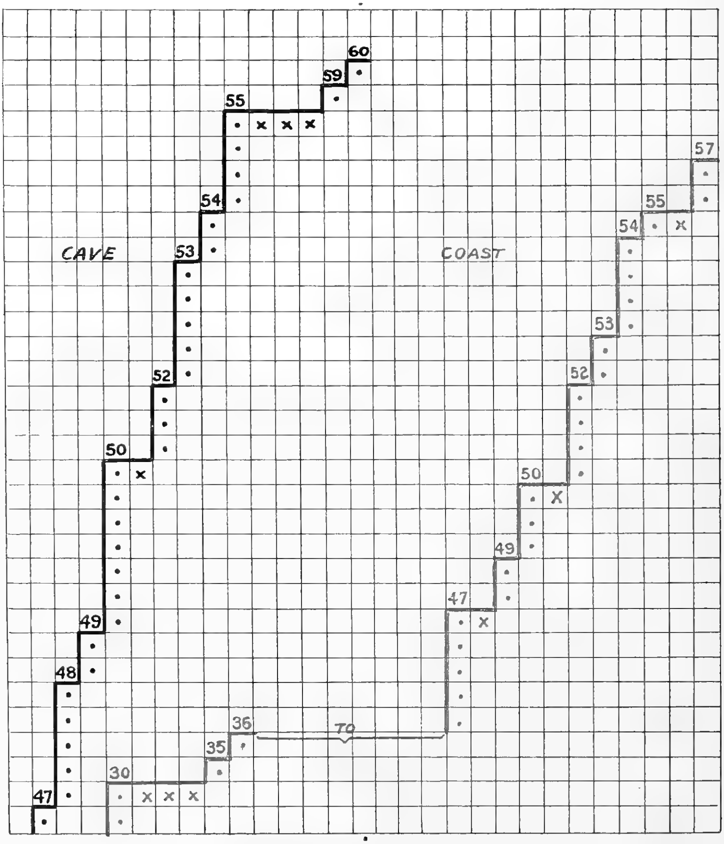
BIAURICULAR



series. The instances of the greatest breadth being intersquamosal are more frequent in the cave than in the coast, as shown in the figures 9 for the former and 4 for the latter.

CHART IV.

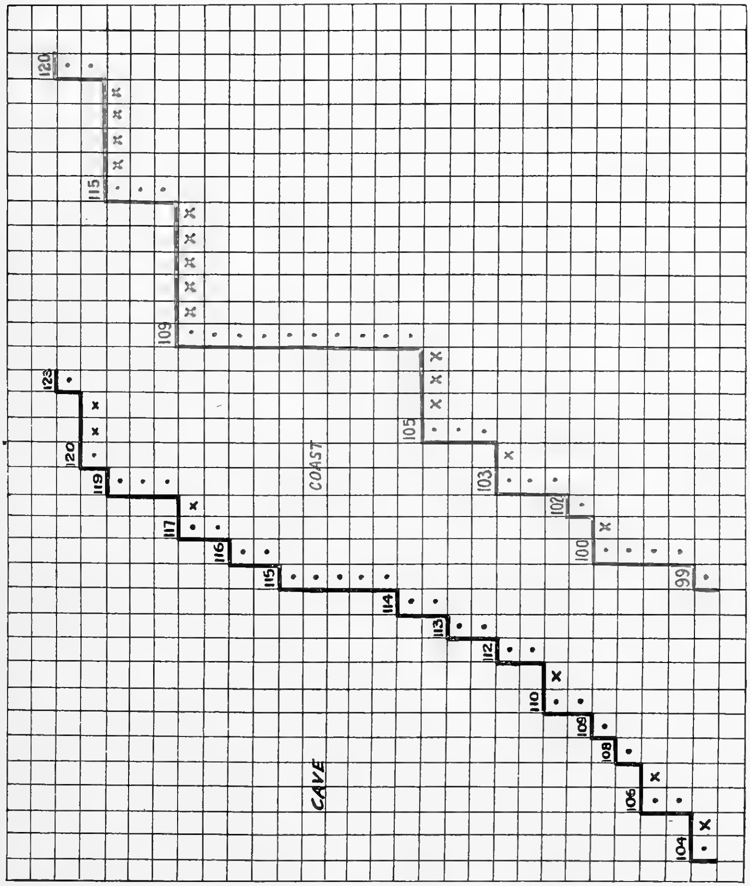
OPTICONASION



In the *greatest diameter of the face* a notable contrast is detected between the series. The numbers that are absent in the coast series are those best represented in the cave series. On the whole, the disposition for constancy is best marked in the former, while at the same time the interruptions of the sequence is greater, fourteen numbers being represented in the cave and eight only in the coast.

CHART V.

Greatest Diameter of Face

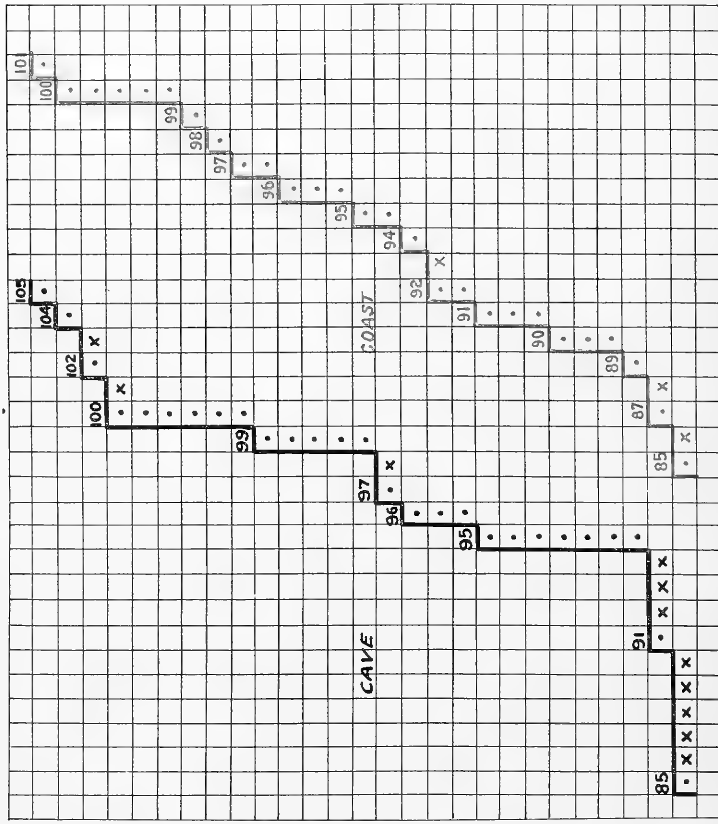


In the biauricular measurement, important because it approximately represents the transverse measurement of the base of the brain, the contrast between the two series is noteworthy, the cave series showing fewer breaks in sequence and more constancy.

The prominence of the root of the nose, or "radix," is well seen in the measurements of the nasomalar line. There is more constancy in the coast

CHART VI.

Bimalar Line

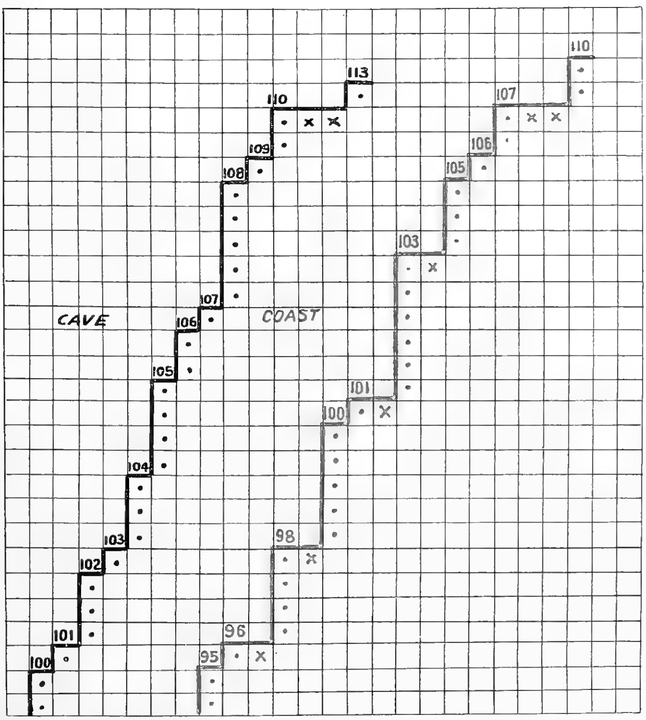


than in the cave series, while those of the cave series are all of higher grade. The bimalar diameter, when compared with the greatest facial diameters, shows curious contrasts, the degrees of constancy being greater in the cave group.

The *opticonasion* measurement is also important, since it is an approximation to the length of the frontal lobes.

CHART VII.

NASOMALAR LINE



The dotted squares represent numbers of skulls of the measurement in millimeters, represented over the dotted vertical row. The horizontal lines are breaks in the numeration. Thus, in the coast series the line between 30 and 34 represents that the numbers 31, 32, or 33 are absent in the series.

It will be seen that there are more breaks in the coast than in the cave series, and less disposition for the skulls of the same measurement to form clumps. In a word, as a rule, there is less uniformity. These facts, taken with the lower figures themselves (viz., 47 mm., 60 mm., as opposed to 30 mm., 57 mm.), indicate inferiority, a conclusion which is harmonious with the results obtained from other observations on the same group.

The widths of the face, as shown in the *greatest face diameter*, the *bimalar line* and the *nasomalar lines*, also exhibit striking contrasts.

Studies in Variation

I concede that, in the almost numberless ways in which the subject of variation can be approached, something must be left to the personal inclination or interest of the observer. The following features are held by me to be worthy of comparison, for I had in the paper on Floridan skulls [2] made observations on the same peculiarities. My method consisted in tabulating all the characters which form the basis of this section, and afterwards using them as data for the brief conclusions here preserved. It is not thought to be necessary to print the tables themselves.

The word "terrace" is an appropriate term to use in arranging the numbers and lines on the quadrille paper, and appears to me more instructive than would a curve, which is usually employed in making graphic records.

The reader is referred to the Florida Skull Memoir for explanation of all terms. Some of these, as in the curves of the profile, the description of the nasal bones, and the anterior nasal aperture, are innovations.

Chamæprosopy

In races which are leptoprosopic the few chamæprosopic skulls become of special interest. I have noted such in the paper on Floridan skulls, and I again invite attention to three examples found among the Hawaiians. The frowning expression, the projecting jaw, the receding chin, are striking characters. All the chamæprosopic crania closely resemble one another.

In both Nos. 1107 (plate i.) and 1105 (plate ii.), H. U., the skull-rest is on condyle and opisthion. The glabella is large, the nose-root (radix) depressed, the anterior nasal spine and incisor crest rudimentary, and the temporal impression not interrupted at the stephanion. The chief contrasts are noted in the degree of projection of the upper jaw. In No. 1105 this is highly projecting, while in No. 1107 it is straight. In the specimen, 1105, the skull is massive and heavy.

In specimen No. 1104, H. U., which is described in the section on diseased action, the type is also chamæprosopic. It is dolichocephalic and massive. The skull-rest is condyle-opisthotic.

Pædomorphism

The retention of the child type of skull in the adult, or of individual traits of the child's skull, is much more conspicuous in the coast than in the cave series. Indeed, it may be said to be almost absent in the latter. Among the former three, Nos. 565 and 1300, A. N. S., and 1116, H. U., striking examples of the retention are seen, especially in the proportions of the parietal bone, in the retention of an open sagittal suture, and in the flat hard palate. In No. 1300, the admission of the malar bone into the sphenomaxillary fissure is exceptionally large. The nasal bones, the mastoid processes, and the shape of the temporal impression are almost exactly as in the skull of a child.

Inflated Maxillæ

Two rhombocephalic skulls, No. 1755, A. N. S., cave, and No. 2094, A. N. S., coast, show peculiar inflation of the superior maxillæ. The anterior surfaces of the bones are convex, and give a swollen appearance to the face. The infraorbital canal is 10 mm. below the orbital margin. In sharp contrast to the maxillæ, the premaxilla exhibits well-defined depressions. The skulls resemble one another in having wide pterygoid plates and markedly hyperbolic hard palates. In the cave skull the malar bone is remarkable for joining the lachrymal bone. Well-developed tympanic exostoses and small prenasal fossæ are seen in both specimens. The cave skull is much higher in grade than the coast. The malar bone in the cave skull enters the sphenoidal fissure, while in the coast skulls it does not; in the former the bone is without suture trace, while on the right side of the coast skull the bone is deeply furrowed on the inner side.

It appears that both specimens are of persons who belonged to the same variable type, as seen in the resemblances above noted, yet were separated by circumstances in conditions of life which embraced differences in nutrition, and yielded some equally striking individual contrasts.

The Lachrymal Bone

While classified with the bones of the orbit, one cannot separate the lachrymal bone from the outline of the nasal chamber, or, indeed, as comparative anatomy teaches, from the face. It is of interest to note that the hamular process will not infrequently articulate with the maxilla, where the base of the ascending process enters into the composition of the inferior orbital margin. Specimen No. 1751, H. U., which, in many respects, showed evidences of interstitial absorption in the wall of the nasal chamber, exhibits the hamular process marked by numerous minute foramina and of different textures; a peculiarity, in all probability, the result arising from a centre of ossification.

The Prenasal Fossa

In the specimen No. 3, P. U., æt. 25, ♀, the nasal eminence (*a*) is raised well above the floor of the nose. The fossa proper (*b*) is defined between this eminence and the openings (*c*, *c*, *c*, *c*) which are placed over the roots of the incisor teeth. The vomer (*e*) retains the sulcus for the accommodation of the triangular cartilage. The well-defined contours of the bone overlie the incisor crest just over the basal eminence. The maxillæ exhibit marked asymmetry at the incisor region. On the right side the parts are of normal proportion. But on the left they are stunted, a peculiarity embracing the alveoli of the incisor, which are scarcely half the size of those on the opposite side. The left fossa, while as wide as the right, is not so deep, and extends over the region of the roots of the teeth. The alveolar line (*d*) is unusually bold and trenchant on the right side, but is not well defined on the left below the level of the basil eminence. Indeed, the fossa is insensibly blended with the alveolar region over the almost rudimentary incisors. Other peculiarities of the maxillæ should not escape notice. The infraorbital margin of the left maxillæ is with open suture. The part here called the *ectal* (see *Infraorbital Suture*) passes over the *ental*, thus excluding it from the margin and entering into composition of the *ductus ad nasum*. On the right side the union between the ectal and ental portions is obliterated. Again, on the right side the lachrymal crest at the base is advanced so as to form part of the outer wall of the *ductus ad nasum*: on the left side it is excluded. The other parts of the face present nothing unusual.

In varying degrees of development the prenasal fossa is present in thirty-nine per cent. of the cave series as opposed to twenty-four per cent. of the coast, thus showing that is of significance in determining grade. The actual number was seven in the former and fourteen in the latter.

The Pyramidal Process

The pyramidal process of the palatal bone is a character which has been overlooked, so far as I know, in the comparative study of the skull. I noted the subject in the study of the Florida skulls, where reference is made to the large size of the process in the Hawaiian form. In the study, as now completed, the process is found to be 12 mm. wide at the free margin in the cave and 11 mm. in the coast.

The Lower Jaw

In specimen No. 1752, A. N. S., the lower jaw presents an extraordinary variation in both the body and the ramus. The body presents a convex lower border in the region answering to the teeth, as accurately shown in plate iv. I have seen but one example similar to this in my examinations of crania, which now embrace many individuals. The variation is probably due to premature symphysal union. The ramal peculiarity was confined to a foramen on the inner side of the base of the coronoid process, and just above the beginning of the inferior dental canal. The position is shown by the arrow engraved on the figure.

Comparisons of the degree of angulation on the condyles of the lower jaw—the degree of concealment of the last molar by the base of the coronoid process, the position of the mental foramen with respect to the teeth, the peculiarities of the genial spine and crest—were made in all examples. The entire number of bones examined was twenty-two, but the number of lower jaws in the coast are so few as to make results inadequate.

The disposition for the condyloid process to be angulated is more marked in the cave series than in the coast, six examples being found in the former and two only in the latter.

The partial concealment of the third molar by the base of the coronoid process, thus indicating a disposition for the body of the bone to be shortened, is present in three of the cave series, and in one only is the molar distinctly in advance of the process. It would be desirable to select a measure by which the relative degree of growth of the body of the bone could be fixed.

The short goniosymphyseal length is well seen in an Hawaiian skull figured by Dumoutier.

The following tables of measurements of the lower jaw will prove useful. Some of the specimens are unaccompanied with the skulls.

CAVE.

	Width, Lower Jaw.		Height, Lower Jaw.				Of Ramus.	
	Bicondylar.	Bigoniac.	Symphyseal.	Molar.	Coronoid Process.	Goniosymphyseal Length.	Height.	Ant. Post Breadth.
1722	70	97	29	25	70	100	67	34
1752	85	100	24	30	62	90	56	33
1773	83	92	29	29	70	105	72	45
1771	79	100	30	28	65	98	60	37
1775	79	80	35	29	56	90	55	32
1107	80	93	32	25	70	100	54	40
1105	82	93	31	33	73	102	69	41
1104	80	91	31	29	70	93	73	35
1114	79	82	31	30	65	86	55	35
1120	88	89	25	26	59	85	53	35
1106	76	85	29	30	58	85	52	30
1751	82	89	34	35	74	100	72	40
1749	87	99	35	31	67	87	67	37
Averages	81	91	30	29	66	94	62	36

COAST.

	Width, Lower Jaw.		Height, Lower Jaw.				Of Ramus.	
	Bicondylar.	Bigoniac.	Symphyseal.	Molar.	Coronoid Process.	Goniosymphyseal Length.	Height.	Ant. Post. Breadth.
1863	86	99	32	0	62	89	60	35
1999	87	89	32	32	70	98	61	37
2000	75	86	29	25	65	88	61	35
1957	0	0	0	0	68	0	0	0
1872	75	78	31	26	0	80	60	36
2093	74	87	31	29	67	89	63	35
2092	83	83	25	24	56	77	54	31
1116	0	90	23	26	57	89	55	30
Averages	80	87	29	27	63	87	59	34
2091 ♀	83	83	23	22	57	86	55	32

The Infraorbital Suture

Halbertsma, in 1859, described a suture which extended upward from the infraorbital foramen into the floor of the orbit. In 1885, Turner re-described this suture. In examining the Hawaiian crania with reference to its presence, I find that in the cave series it was found in twenty-two examples. In the coast crania it was present in eleven instances only.

The malar bone holds varying relations to the maxilla in the region of this suture. In nine of the cave series it joins that portion of the maxillary margin lying to the outer side of the suture. In the coast series the malar bone was so situated in but five examples. That the malar bone should ever cross the suture is not mentioned either by Halbertsma or Turner, but I find it so placed symmetrically in ten of the cave series and in six of the coast. In this group of variations the infraorbital suture, of course, does not extend into the orbit, but juts directly against the zygomatic process of the malar bone. The following observations were made upon three crania in which the entrance of the zygomatic process into the composition of the lower orbital margin took place to the mesal side of the infraorbital suture asymmetrically.

Table correlating the Position of the Infraorbital Suture to Orbital Measurements

		Orbital Height.	Orbital Width.
Left side, with malar bone crossing infraorbital suture.	No. 1764, right	34 mm.	37 mm.
	" " left	35 "	37 "
	No. 1104, right	35 "	36 "
	" " left	34 "	37 "
Right side, with malar bone crossing infraorbital suture.	No. 1105, right	37 "	37 "
	" " left	35 "	36 "

The most striking difference was noted in the shape of the superior orbital margin. In Nos. 1764 and 1104 the margin on the left side in both specimens was inclined downward to a greater degree than on the right side. In a word, the malar bone appeared to be pushed downward and inward (mesad) by the initial inclination of the external frontal process, to extend to a corresponding degree mesad, and the end of the zygomatic process to reach beyond the infraorbital suture. In the third specimen (No. 1115) no essential difference obtained between the two frontal processes, though the right orbit was the larger. That the side having the mesad disposition of the zygomatic process is the stronger side is shown by numerous minute signs. In No. 1115 the impressions of the internal pterygoid and masseter muscles are the stronger, and the measurements of the lower jaw larger, on the right side.

In No. 1755 the zygomatic process extends on each side mesad as far as the lachrymal bone which it joins.

I propose calling that portion of the inferior orbital margin of the maxilla lying to the outer (lateral) side of the infraorbital suture the *ectal* portion, and that lying to the inner (mesad) side the *ental* portion.

Miscellaneous Notes

The proportion of the *phænozygous crania* to the *cryptozygous* is confirmatory of the relative grades of the two castes. The percentage in which the zygoma is concealed, when the skull is viewed from above, is nearly twice as large in the cave series as in the coast.

Respecting the shape of the skull, it can be said that it is in harmony with other facts. Thus, there are but eight oval skulls in the cave series and twenty-three rhombecephalic, whereas there are nineteen oval skulls in the coast series and thirteen rhombecephalic.

The basal aspect of the *petrosal portion* of the temporal bone, as it lies near the basilar process, is disposed to be swollen (*i.e.*, inflated) in the lower caste group.

The disposition for the *alisphenoid to unite with the parietal bone*, or, in its absence, permitting the *squamosal element to join with the frontal bone*, is made the subject of special scrutiny. The frontosquamosal junction is found in two examples of cave crania and in one, only, of the coast. In one cave and in one coast cranium the junction is found on the right side,—the left being alisphenoidoparietal.

The *nasal septum* is straight, as a rule, in both groups. It is deflected to the left in thirty-two per cent. of the cave skulls and in fifteen per cent. of the coast,—facts which bear out the conclusion that high-grade people exhibit a tendency for the nasal septum to be deflected to the left.

In my memoir on Florida skulls I noted the *curves seen in the profile* of the brain-case. At first sight it would seem that a well-developed skull is an expanded one, and would tend to present a single curve (opisthioglabellar) from opisthion to the glabella. Yet in the cave series such a curve is present in twenty-three per cent., while in the coast it is found in twenty-six per cent. The next grade is found in an interruption of the curve (opisthioinion; inioglabellar) by a prominent inion; this process, being created by muscle traction, appears to have no connection with grade, for in the cave series it is present in forty-two per cent., and only in three per cent. of the coast; so the curve must be read not by the standard of intellection, but of muscular power, which, nevertheless, is best expressed in the first grade. When the inion is over-prominent and yet the rest of the cranial curve (opisthioinion; inio-interparietal; interparietoglabellar) interrupted at the intertuberal portion of the sagitta, or a little farther in advance of this place near the bregma, we have a great preponderance of the coast grade over the cave, as shown in the following statement: for the cave series nineteen per cent. and for the coast series fifty-two per cent.

The remaining curves are so few in number as not to be thought worthy of expressing by percentages. It is of interest to note, however, that but one cave skull shows a depression at the lambda sufficiently marked to cause an interruption of the profile curve, while three of this kind are found in the coast series. In the coast series in one skull (No. 3, ♀, Princeton University) a marked depression is found at the obelion, marking an opisthioinion; inio-obelial: obelial intertuberal curve, which is of the lowest grade possible, since it indicates a retarded expansion of both the occipital squama and the parietal bones.

The *glabella* is slightly larger in the cave people, being 5 mm. as against 3 mm. in diameter. The junctions of the nasal bones with the frontal bone, the maxilla, and premaxilla are as follows: with frontal bone, 3 mm. for both series; with maxilla, 20 mm. for the cave and 19 mm. for the coast; with premaxilla, 4 mm. for the cave and 3 mm. for the coast.

The *nose-root* (radix) is 9 mm. long in cave and 8 mm. for the coast; the *angulation* 83° of the former as against 82° of the latter. The *salient* is 14 mm. long in the cave and 12 mm. in the coast, with a salient of 35° in the former as against 41° of the latter. In all the crania, therefore, a singular uniformity is noted in the characters selected for comparison excepting the nose salient, where the projection is more marked in the coast.

The position of the *mental foramen* is subject to slight variation. In the cave series the foramen is opposite the second premolar in four examples, between the premolars in three, and between the second premolar and first molar in one.

The *genial spine* is double as a rule. It is present in nine cave bones and in seven coast, and single in one cave and two coast.

The *genial crest* is developed in the same way in both series and appears to have little significance.

The Hard Palate

Since the hyperbolic form is found in advanced stages of civilization, it is natural to infer that the cave series would show a higher percentage than the coast,—*i.e.*, eighty-nine per cent. as against eighty-five per cent. The parabolic form, on the other hand, is found in lower types, and the four per cent. of the cave as against fifteen per cent. of the coast was to be expected.

The *foramen lacerum medium*, whether present or absent, is a study which has interested me. It is closed in lower types both of quadrupeds and of men. The comparison here is rather against than in favor of the proposition as stated, for the percentage of the closed foramina while small is confined to the cave series.

The *spinous process* of the sphenoid bone when overlapping the petroso-sphenoidal suture is assumed by me to indicate an advance from the juvenile expression, and all things remaining the same, from the primitive adult type. But the examination does not bear out this conclusion, for the cave series exhibits the overlapping in twenty-one per cent. as against twenty-seven per cent. of the coast.

The *anterior nasal opening* yields some interesting contrasts in the two groups. The high incisor crest is found only in the cave series, where it exists in the proportion of six per cent. It is absent in the coast series. On the contrary, the absence of the crest, a sign of low grade, is more frequent in the cave than in the coast, as seen in the figure, sixty-eight per cent. of the former as compared to the fifty per cent. of the latter.

The *temporal line* as it crosses the coronal suture in the coast series is more uniform than in the cave series, and is, therefore, an indication of the harmony of development existing between the frontal bone as compared with that of the parietal. Such uniformity is indicated in the percentage, seventy-five per cent. of the coast as contrasted with the sixty-three per cent. of the cave.

The *lambdoidal suture* near the asterion is determined by causes which largely relate to the volume of the return blood from the brain, as shown in the position of the venous sinuses. In a morphological sense the region of the asterion is a weak part of the skull, and, all things remaining the same, the sutures will close less firmly in the higher types, so it is reasonable to find forty-three per cent. of harmonic suturation in the cave series as against thirty-three per cent. in the coast, and but fifty per cent. of serrate suturation in the cave as against sixty-seven per cent. in the coast. We have found the weaker of the two temporal muscles to be associated with the harmonic variety of suturation in specimen No. 1104 (page 47) showing that the weaker temporal muscle naturally correlates with luxury and the more sedentary life of the higher caste.

The *skull-rest* as it effects the occiput is of importance in studying the relation between the brain and the skull. The skull rests on the occipital bone well up from the foramen magnum in the coast series only, and here but twenty per cent.; it rests in thirty-three per cent. of the series as against twenty-eight per cent. of the coast on the posterior border of the foramen magnum, while it rests on the occipital condyles in thirty-nine per cent. of the cave as against twenty-seven per cent. of the coast, thus showing a marked difference in the two groups, though it is difficult to assign reasons for it. It can be stated in definite terms that the lower the type of the Hawaiian skull the more convex and more depressed becomes the occipital bone in the position answering to the position of the cerebellar hemispheres.

The *marginal process* of the malar bone has been accepted to be a character of sex. I took observation on the presence or absence of the process to ascertain if it might not also be a character of grade. The contrast of the presence of the process of fifty-six per cent. in the cave series as opposed to sixty-two per cent. in the coast would indicate that it is disposed to be such a character.

The *sphenomaxillary* fissure when admitting the malar bone into its composition expresses the fact that the bone is disposed to be large and the temporal fossa at the region of the frontal bone deep. If we accept this method of reasoning, we are not surprised to find that the malar bone enters into the fissure in seventy-two per cent. of the cave series, while it is present but in sixty-five per cent. of the coast. The contrast is striking even if the above attempt at explanation be not accepted. Froment (*see* Henle's Anatomie) notes three hundred and seventy-five skulls in which in one hundred and five times the malar bone entered the fissure on both sides and eighty-five times on one side.

The *suture trace* on the inner side of the malar bone is present in twenty-eight per cent., only, of the cave series, while in forty-seven per cent. of the coast.

It will be convenient to present some of the foregoing variations in columns, as follows:

	Cave.	Coast.
Hard Palate.		
Hyperbolic	24, 89 per cent.	22, 85 per cent.
Parabolic	1, 4 per cent.	4, 15 per cent.
U-shaped	2, 7 per cent.	0
Foramen Lacerum Medium.		
Open	25, 83 per cent.	27, 87 per cent.
Closed	1, 3 per cent.	0
Nearly closed	4, 13 per cent.	4, 13 per cent.

The opening was small in two examples.

	Cave.	Coast.
Spinous Process.		
Overlapping	6, 21 per cent.	9, 27 per cent.
Not overlapping	22, 78 per cent.	24, 73 per cent.
Nasal Vestibule.		
Macrolophic	2, 6 per cent.	o
Microlophic	8, 26 per cent.	16, 50 per cent.
Analophic	21, 68 per cent.	16, 50 per cent.
Temporal Ridge.		
Interrupted	10, 34 per cent.	8, 26 per cent.
Not interrupted	19, 65 per cent.	23, 75 per cent.
Lambdoidal Suture.		
Harmonic	13, 46 per cent.	11, 33 per cent.
Serrate	15, 54 per cent.	22, 67 per cent.
"Skull-rest."		
Conceptum Cerebellum	o	6, 20 per cent.
Opisthion	8, 28 per cent.	10, 33 per cent.
Condyloid Process	11, 39 per cent.	8, 27 per cent.
Mastoid Process	9, 32 per cent.	6, 20 per cent.
Malar Bone.		
In Sphenomaxillary Fissure	21, 72 per cent.	21, 65 per cent.
Not in Sphenomaxillary Fissure	8, 28 per cent.	11, 34 per cent.
Suture trace on Malar Bone	9, 28 per cent.	15, 47 per cent.
No Suture trace on Malar Bone	23, 72 per cent.	17, 53 per cent.
Marginal Process on Malar Bone.		
Present	15, 56 per cent.	20, 62 per cent.
Absent	12, 44 per cent.	12, 37 per cent.

The Teeth

The teeth exhibited much variation in size and anomaly. No. 2092, A. N. S., aged twenty-one years, the second right lower molar showed a supplemental denticle 10 mm. long on the buccal border posteriorly; in the upper jaw the second right deciduous molar remained in position. On the left side the tooth had been lost, but its space in the alveolar arch was reserved, though the second permanent premolar had not taken its place. The third molar was absent. No. 2091, A. N. S., the right second premolar had not been erupted, though the space for it had been reserved. No. 2087, A. N. S., the third upper molar had not been erupted. No. 2094, A. N. S., the third upper molar showed a supplemental cusp interposed on posterior border between metacone and hypocone. In a Princeton skull the third upper molar on both sides was absent. No. 2089, A. N. S., the hypocone of the first molar extended forward back of the protocone; in the second molar the metacone and hypocone were rudimental and reduced to a mere posterior hem, while they were absent in the small nodular third molar.

No. 1105, H. U., exhibited lower molars $\frac{2}{2}°$-$\frac{2}{2}°$, upper molars 4 3 3. The lateral upper incisor almost conical. The first left upper premolar inclined forward the canine, with which tooth it is functionally associated. The second and third upper molars were with protocone occupying the entire palatal aspect of the tooth; the metacone was rudimentary, while the hypocone was absent. The left third molar resembled in form that of the premolar; the left third molar was absent. In No. 1999, A. N. S., the third upper molar was very large, measuring 13 mm. within outward and 10 mm. from side to side. It was composed of six large cusps. In No. 2092, A. N. S., age twenty-five years, the deciduous second premolar had been retained on the right side and but recently lost on the left. The third upper molar was not erupted. The right exoccipital bone was smaller than the left and deformed. The lower central incisors have been prematurely lost, or possibly may never have appeared. The second lower molar, right side, possessed a supplemental cusp. The third lower molar was present. The body of the lower jaw was markedly convex on the lower border, as in No. 1752, A. N. S., and like this tooth retained an accessory opening to the outer side of the inferior dental canal. The genial spine was enormous and double. The skull can be regarded as an example of retarded development. It appears to have been arrested in growth at about the thirteenth year, when the second permanent premolar should have made its appearance. The disposition for the right squama and parietal to be very convex is marked, while the corresponding parts of the opposite side are flat.

The Effects of Disuse

That disuse creates alteration in the bones is a statement accepted by all anatomists. The establishment of the initial loss or tendency is of importance to study in every instance, and I assume, both in the interest of the etiology of the variation in skull form, as well as in the more restricted problems of the influence of environment over the primary factors in the pathology of a race, that the following observation may be accepted as germane in a comparative study of crania.

The Loss of Upper Front Teeth determining Important Changes in the Shape of the Skull

Some or all of the upper incisor teeth were found wanting in nine specimens,—namely, Nos. 1117, 1120, H. U., 1749, 1755, 1757, 1763, A. N. S., of the cave, and Nos. 1957, 2088, 2089, A. N. S., of the coast series. It is evident that these losses had occurred at a time sufficiently early to permit the alveoli to be completely absorbed, while the remaining teeth were scarcely at all worn, and the sagittal suture remained open. In three specimens all the incisors were lost; in one the centrals; in two the laterals; three specimens showed loss of one tooth only; in one all the teeth on the left side were wanting. The crown being removed, though the root remained in the socket, it was interesting to note the attempt on the part of the alveolus to cover in the root. In two specimens only (Nos. 1117, H. U., and 2088, A. N. S.) were the lost teeth to be accredited to age. I believe it is tenable to associate this peculiar condition of the teeth with the following statement. The natives of the Sandwich Islands were in the habit of knocking out some of the upper front teeth as a sign of mourning for the death of a chief. W. Ellis states that a front tooth was broken off. The loss of a single front tooth sufficed for an occasion of mourning, but the mutilations being repeated, few men were seen with an entire set of teeth (p. 165). According to S. Dibbles, " The people not only wailed, but shaved their heads, burnt their bodies with sharp, pointed sticks, and knocked out their front teeth" (p. 84). A similar account is given by W. D. Alexander. If the men deferred the operation, an opportunity was taken by the women to do it for them while they slept. It is evident, from the fact that more specimens of the premature loss of teeth are found in the cave specimens than in the coast, that the chiefs were subjected to the same mutilation as the lower class.

In a lower jaw without skull (No. 1773, A. N. S.) the right canine and the left incisor had been early lost. The changes subsequent to their loss had increased the interval between the right premolars by moving the first premolar forward while having no influence upon the second. This corresponds to the statement made in my memoir on Florida Crania,[1] that the second premolar relates in the main to the molar series. The loss of the left incisors leaves an interval of but 7 mm., and is associated with the left canine moving forward.

Specimen No. 1221, H. U., without lower jaw, male, estimated age thirty years, the individual had lost all the left upper teeth excepting the central incisor, which had been broken off close to the socket and was partly encysted in bone; the third molar had probably been lost posthumously. The alveolus from the central incisor to the molar series was hard, sharp, and thin, but that of the molar series was porose. The study of the cranium led me to believe that the loss of such an extensive series of teeth might have led to changes in the skull, which would correspond to loss of masticatory power on the left side of the head as compared with the right, the teeth being scarcely worn. The following comparisons were accordingly instituted. The face seen from in front exhibited osteophytes along the lines of the malomaxillary suture, and the suture itself was open. The infraorbital foramen retained an osteophyte on the inner margin. The suture between two parts of the maxilla in the infraorbital margin was rugose and elevated. On the right side of the face all these conditions were reversed. A hyperostosis directly back of the last molar on the left side, while there was none on the right. This hyperostosis as usually seen in edentulous skulls gave the impression that the retention in position of the last upper molar had not been sufficient to prevent the left side of the jaw undergoing the same change as though all the teeth had been lost. The left external pterygoid plate was much narrower than the right. The squama on the left side was provided with numerous coarse denticles at the posterior half of the upper margin. On the right side these were confined to the middle third, and were much larger than on the left side. Numerous details in the texture of the surfaces of the temporal fossæ indicated that the left temporal muscle had been less powerful than the right.

The part of the asterion into which the parietal bone enters was provided with harmonic sutures on the left side, while on the right they were coarsely lobate. When the skull was examined by transmitted light the left half was seen to be more opaque, at the same time several small areas on the frontal bone were translucent. On the right side the entire region of the squama was normally translucent, and no isolated translucent areas were seen. The surface for contact of the semiarticular cartilage of the left glenoid cavity was much smaller than on the right side.

Making allowance for the difference the observer expects to find between the two sides of any skull, the contrasts noted above were of a kind and degree different from what is usually found, and in my opinion should be associated with the gross changes in the upper jaw in the region of the teeth. That absorption should go on in the maxilla of the left side is in full consonance with what is known of the laws controlling use and disuse. The parts above the alveolus no longer receiving the stimulus arising from impact and not yet entering into the senile state showed the effect of prolonged disuse.

The presence of the osteophytes on the disused side is of interest, since it shows that they may appear under conditions of disuse.

The small size of the left external pterygoid plate, the small impression general of the left temporal fossa, the harmonic suture at the posterior part of the temporal fossa, all show weakened left temporal muscle.

Diseased Action causing Disuse, with resultant Changes in Skull-form

The result of disuse are beautifully illustrated in No. 1104; in this instance not from loss of teeth but from disease of the jaw. The specimen is that of a male, aged about forty years; the right lower jaw exhibits a large mass of hyperostosis on the free surface of the right condyloid process,* which doubtless interfered with mastication, and notably on the corresponding side, as shown in the great amount of wear of the molars and premolars. Notwithstanding that the disease had presumably appeared after the skull had become mature, the affected side shows a number of characters due to disuse which are not noted upon the other. The infraorbital margin has a minute exostosis on ectomaxillary element at the suture; the outer pterygoid plate is perforate in the centre; the parietotemporal line is more remote from the lambda than on the opposite side; the lower border of the malar bone is thin.

The great contrast between the external pterygoid plates in the above specimen is also a feature in a skull of the Princeton series (No. 6), forty years of age. The teeth on the right side are lost or worn down to stumps; in other respects the series is intact. The left zygomatic arch showed the effects of fracture with displacement of the fragments. Correlated with these

* Several examples of hyperostosis of the condyles are described by J. B. Davis [5]

conditions, the left external pterygoid plate is much smaller than the right, and the teeth on the corresponding side of the skull are not worn. The left maxillary sinus is open posteriorly and expanded anteriorly. The left orbito-sphenoidal septum is absorbed in part and the sphenomaxillary fissure enormously widened. The ascending process of the malar bone measures 15 mm. on the left side and 17 mm. on the right. The alisphenoidosquamosal suture remains open on the base of the skull, but is closed on the right. It is evident that a blow on the left zygoma had thrown an excess of labor in mastication on the teeth of the right side. They were, indeed, worn away before the fortieth year. The act of chewing, however, had strengthened the muscular impression on this side of the skull. From disuse the parts on the left side remained uniformly less developed than on the right.

The asymmetry of the external pterygoid plates is marked in a skull from a dissecting room, in the collection of Professor M. H. Cryer, of the University of Pennsylvania. The right plate measured 15 mm. and the left 20 mm. in diameter. In addition the left extended to the spinous process, and was perforated at its base near the oval foramen. Coincident with the larger plate was obliteration of the articular eminence, a greatly reduced condyloid process of the lower jaw, and a relatively strong impression for the left temporal muscle. The skull was that of a nearly edentulous female whose sutures were closed, this statement even including the squamosa-parietal suture.

The wear of the condyloid process is sometimes so great as to cause the expanded part normally articulating with the glenoid cavity to disappear. Such lower jaws really articulate with the neck of the bone, which is thus adventitiously converted into a condyle. In one specimen of the lower jaw, from a dissecting room, in my possession, of a nearly edentulous individual, the left condyle measured but 10 mm. in length and 7 mm. in width. In a second specimen the condyloid process had been worn away to the level of the beginning of the posterior dental canal; the coronoid process being apparently elongated on the condyloid recedent so that it represents a height from the alveolus of 33 mm.

In No. 1104, H. U., a markedly dolicocephalic skull, massive, had with prominent glabella a large outgrowth of bone, the result of arthritis at the right condyloid process, was accompanied with numerous minute changes in the corresponding half of the skull. The changes were apparently the results of disuse following the inefficiency of the right mandibulosquamosal articulation, and are as follows: the right teeth less worn than the left, the mid-temporal crest 53 mm. from the sagitta on the right, while, as it is 48 mm. from the same on the left, and the posterior part of the temporal right 41 mm. distant from the lambda, where it was but 22 mm. distant on the left side, a difference of 19 mm., thus indicating in low degree of development of the right temporal muscle, the right ramus of the lower jaw was 3 mm. narrower than the left; a greater distance from the orbit to the alveolus at the second molar on the right side as compared with the left, 40 mm. on right 35 mm. on left; the right upper orbital margin was straight or nearly so, while the left was greatly inclined downward; the orbital measurement on the two sides were as follows: right, $35^h \times 38^w$; left, $34^h \times 38^w$. A distinct though small exostosis was seen at the junction of the ectal and endal tributaries to the infraorbital margin, while no exostosis was seen on the left side.

While the greater measurement in the above enumeration was on the left side, the greater coracoid height was on the right side, the distance being 71 mm., while on the left side it is but 66 mm., a difference which answers pretty nearly to the amount of new bone deposited on the right condyloid process by reason of the old arthritis. In addition to these the left orbito-sphenoid was perforated at its pedicle.

I am of the opinion that the exostosis noted in the above specimen on the weaker side harmonized with the appearance in the specimen No. 1121, H. U., in which similar outgrowths were noted in the infraorbital region of the weaker side, and the suggestion is received that in the skulls generally the weaker or less well-nourished specimens are apt to exhibit the greater number of nodosities or osteophytic outgrowths; this tendency is shown even in the crests at borders of some muscular impressions, as in No. 1761, A. N. S., a skull of light texture and thin walls, yet which showed large shelf-like projections of the superior semicircular line of the occipital bone. No. 1109, H. U., exhibited two small nodosities on the left side of the frontal bone in the temporal fossa, one being on the line of the closed coronal suture.

Diseased Action

Among the difficulties associated with craniology the changes of form, due to disease, holds a prominent place. No people, however primitive they may be, appear to have been free from these pathological conditions, though it must be said that the tendency is increased among the civilized. The effects of malnutrition in determining the time of the closure of sutures; the inability of the base of the skull to resist flattening from the weight of the superimposed head; the hyperostosis, probably rheumatic, as shown in the increased thickness of the cranial vault, are familiarly seen in every osteological collection, no matter of what people or of what grade. Gross variations, probably pathological in character, are of greater frequency in some groups than in others; among these may be named the auditory exostoses so common among Peruvians and the islands of the South Seas, and the exostoses on the inner side of the lower jaw in the northern examples of man in America.

Among the appearances to be noted in the Hawaiian skulls are the following: osteoporosis; ostitis and hyperostosis; defects in maxillæ; premature closure of sutures; effects of measles on the conformation of the facial bones.

It has been already noted (page xiii) that the cave skulls were disposed to osteoporosis, minute exostoses, and arthritis, while the coast skulls were prone to effects of ostitis. Statements are here made in more detail respecting these conditions.

Osteoporosis

Two specimens, Nos. 1112, H. U., and 1756, A. N. S., were very light and exhibited the effects of interstitial absorption, with concomitant disposition to superficial hyperostosis. In No. 1112 the process was less developed than in No. 1756, and confined to the region of the face. The turbinated bones were perforated by numerous foramina. The maxillary sinus on each side was inflated back of the malar process, both towards the nasal chambers where the outer wall was convex posteriorly, and towards the sphenomaxillary fissure, where the tuberosity was conspicuously distended and porose. While the age of the individual was not over forty years, the teeth were much protruded from their sockets, and the second and third molars were lost. A disposition to hyperostosis was co-ordinate. Ossicles in the facial suture lines were numerous. The process for the superior oblique muscle was prolonged, the exostoses on the tympanic bones were conspicuous, and the frontal and sphenoid bones in the temporal fossæ were rugose. The alisphenoid at the level of the orbit was occupied by a large vacuity. The floor of the right orbit exhibited a large vacuity near the infraorbital canal.

In No. 1756 the process of absorption was more diffuse, and had caused the outer plate of the parietal bone to give way and expose the diploe to a great extent on the left bone at the vertex, in front of the tuber, and to a slight extent on the right bone near the coronal suture. The lambda was also the seat of a similar exposure. The alisphenoid, basiocciptal, and orbital plates of the frontal bones were the locations for numerous venous openings. Hyperostoses were present in the tympanic bone as it entered into the composition of the external auditory meatus, at the lower orbital margin. The specimen, while not over thirty years of age, exhibited the teeth distinctly protruded. The frontal and sphenoid bones were distinctly rugose as they entered into the composition of the temporal fossæ.

The process of absorption shaded off, and, while detectable in Nos. 1760 and 1751, A. N. S., was not present in sufficient degree to demand detailed description. No. 1751, the inner wall of the right orbit had in great part given way, as well as the floor along the line of the infraorbital canal. No. 1760, a similar absorptive area was seen on the floor of the left orbit. The only specimen possessing a lower jaw was No. 1751. The bone was massive and exhibited a convex lower margin to the body.

In No. 1749, A. N. S., about fifty years of age, the disposition to porosis was moderate in degree, yet the tendency to exostosis marked. This is noted in many places, chiefly in the suture lines of the face, the outgrowths on the tympanic bone in the external auditory meatus, the marginal hyperostosis for the origin of muscle at the occiput. A remarkable nodule 11 mm. in width at base was attached to the frontotemporal crest, near the stephanion. While these outgrowths were so conspicuous, the postglenoid process was rudimentary. The teeth were scarcely prolonged. Maxillary tuberosities were greatly pitted and rugose. The condyloid process had undergone inflation and subsequent wear.

No. 2094, A. N. S., the skull was light, teeth unworn, yet the sagittal suture had disappeared. The sinuses of face were inflated. The pyramidal processes were of great size (see page 31). The uncinate processes were placed transversely to the axis of the nasal chamber, and conspicuous exostoses were seen in the external auditory meatus. The sconce was marked with numerous depressions in the same locations as in the specimen in which this region had given way. The left side of the hard palate was remarkably deflected and had the best developed teeth, the second molar having the hypocone well developed, while on the right side of the corresponding tooth this cusp was rudimental.

Ostitis

Besides osteoporosis, the coast series showed many evidences of diseased action. Knowing of the terrible devastation to which the natives were subjected after European contact, it is not strange that the bones should in some sense record it. In No. 1023, the skull of a young woman, the turbinated bones and vomer were in part destroyed. The superficies of the face were covered with a new growth from the periosteum, the result of ostitis. The abrupt changes in contour of the sconce in many of the coast crania belonging to the Academy of Natural Sciences, the presence of node-like swellings, which are doubtless of inflammatory origin, give the impression that many of these skulls had been collected after the natives had become infected with syphilis.* The specimens obtained by Messrs. Sharp and Libbey at Kipakai appear to be free from syphilis. The only effect of inflammation being apparent in the bones of the nasal chamber.

Hyperostosis of the Condyloid Process of the Lower Jaw retaining the Normal Division of the Articular Surface

In 1867[3] I described the variations in the form of the condyloid process, especially considering the degree of angulation, due to the wearing away of the outer half of the process, and the tendency for the inner half (being rela-

* The following notes on crania which were collected after diseases of European origin had left their impression on the natives may prove of interest.

No. 1860. Much diseased; ostitis of frontal bone; caries of the turbinals.

No. 1863. Age, thirty-five, a good example of a dolichocephalic skull, with large prenasal fossa. Alveolar process diseased and prematurely absorbed. Central incisors lost, probably from caries. Excessive ostitis in right nasal chamber, involving the nasal bones; the sutures in the orbits closed, excepting that between the ethmoid and lachrymal bones. The molars and second premolars lost and alveolus absorbed.

No. 2003. Nasal bones almost *nil*. Ostitis of the bones of the vertex, evidently syphilitic inflammation of childhood. Coronal suture wide, low at stephanion. Lambdoidal suture very large, wide, coarse, and open. Wormian bones present. A rudiment of transverse occipital suture present on both sides. Marked symmetrical convexity seen below the frontotemporal crest.

No. 2000. Nasal bones compressed, narrow, large, depression on left frontal bone apparently the seat of a syphilitic gumma.

No. 1957. Much diseased, apparently from syphilitic ostitis; ethmoidal suture broad and coarsely lobate. Front teeth knocked out, probably post mortem. After loss of molar teeth, instead of the customary absorption of alveolus a hyperostosis set in.

tively free from friction effects) to extend upward and inward. In specimen No. 1749, A. N. S., the left condyloid process exhibits great wear on both inner and outer facets, at the same time indicating effects of diseased action. Notwithstanding the confusion naturally incident to these combinations, the inner and outer regions are clearly separated by an irregular fissure, thus demonstrating that a pathological process is limited to the areas which have already been determined by physiological action.

See also page 46 for description of hyperostosis of the condyloid process changing the form of the skull.

Tympanic Exostosis in the External Auditory Meatus

Tympanic exostosis was noted in twelve specimens. Good examples are seen in Nos. 1112, 1120, H. U., and Nos. 1752, 1749, 1756, 1999, A. N. S. The specimens were equally distributed between the cave and coast series. In seven specimens the exostosis was confined to the upper margin of the tympanic bone as it entered into the composition of the meatus. In two examples only was the outgrowth in the form of elliptical swellings in adjacent parts of the canal. It would appear, from this examination, that the exostoses result, in the main, as outgrowths of the tympanic bone. Instances of similar tendencies are seen in the styloid process and the perpendicular plate of the ethmoid bone. The conclusion that some bones continue to grow, unless checked by pressure from an opposed bone, is a tentative conclusion.

Defects in the Maxilla

In two cave specimens, Nos. 1124 and 1114, H. U., the superior maxillæ exhibited a peculiar stunting in the regions of the sinuses. The anterior surfaces were deeply concave beneath the orbits. No. 1124, H. U., aged thirteen years, showed the effect on the incisors and canines of an inflammation of the gums at a time before the teeth were erupted. In No. 1114, aged eighteen years, the effects were less marked, though of the same kind as in the foregoing, though the teeth were well formed. (See description of this skull under the head of Premature Closure of Sutures.) No. 1860, A. N. S., coast, aged about thirty years, possessed a peculiarity similar to the above. The bones of the vertex and the interior of the nasal chamber showed the effects of chronic inflammation, probably of syphilitic origin.

Premature Closure of the Sutures

The cave series exhibited twelve instances (nearly one-half) of absolute or almost absolute closure of the sagittal suture, while the coast showed thirteen instances of the same. When the average age of the two series is borne in mind, it is seen that the closure of the suture tends to take place earlier than in other races, at least earlier than in the European. I was unable to give the condition of the suture much weight in ascertaining the age of the individual. No connection between the state of the suture and the degree of tooth wear could be ascertained. I am of the opinion that this tendency to early obliteration of the suture is pathological.

On page 53 several instances are noted of the premature closure of the sutures of the orbit.

Premature union of the sutures of the Hawaiian skull has been noted by J. B. Davis, who gives brief descriptions of some of them.

Obliteration of Right Half of the Lambdoidal Suture.—The specimen No. 1114, H. U., that of a youth about nineteen years of age, is remarkable for the disappearance of the right parieto-occipital suture from the lambda to near the asterion. In the inner two-thirds of the line all traces of the suture are lost, the skull being as smooth as over the parietal eminence. In the outer third the suture position is evident, and at the asterion is open, a small Wormian appearing at the asterial point, which is not seen on the left. The left parieto-occipital suture is open throughout.

The loss of the right suture is accompanied by a depression on the right side of the skull from the sagitta to the parietal eminence, but in all other respects the skull seems normal. The parietal bones retain the subacuminate eminence seen in childhood. The obelional foramina are absent on both sides.

Measurements of the parietal bones in No. 1114:

	Right.	Left.
Skull Height and Bregmatic	126	122
Bregmasquamosal Length	92	90
Pterioasterial Length	97	97
Coronal Length	98	96
Lambdoidal Length	90	80
Sagittosquamosal Circumference over Tuber	130	138
Bregmasquamosal " " "	115	105
Bregma-auditory " " "	150	145

The measurements of the two parietal bones are in essentials the same, excepting on the lambdoidal border, where the affected side is 10 mm. longer. The circumference, however, often contrasts; the measurement on the sagitto-squamosal suture being 8 mm. less on the right than on the left side, while the bregmasquamosal is 10 mm. more. The skull height is greater on the right side by 4 mm., and the bregma-auditory circumference greater by 5 mm.

An Account of a Child's Skull whose Teeth exhibit the Effects of Measles on the Enamel: these Appearances being correlated with Changes in the Facial Bones

Six skulls of children are not accounted for in the above enumeration. In two of these the six-year molar had not been erupted, and the interfrontal suture was open. The remaining skulls (Nos. 695, A. N. S., 1680, A. N. S., 2096, A. N. S., and 1124, H. U.) will receive some notice. The six-year molar was erupted in all, and the interfrontal suture was closed. With the exception of 1124, H. U., which was about thirteen years of age, the skulls were from individuals barely twelve years of age. Still, the skulls as numbered can be compared, for the general appearances of age were in all much the same.

The measurements of the facial region were as follows:

	Nasal Index.	Orbital Index.	Interorbital Diameter.	Least Facial Diameter.	Great Facial Diameter.	Face Height.	Palate Length.	Palate Width.
695	53	90	22	88	109	59	48	37
1680	45	97	20	84	92	61	43	36
2096	53	100	22	100	0	55	47	34
1124	48	100	14	69	91	51	42	31

It will be observed in these figures that the proportion of the nasal index to the orbital index in specimen No. 1124 is of higher grade than in any other crania. This can scarcely be due to age, since there is not more than a year's difference between the skulls. The interorbital diameter in this skull is also much the smallest of the series, a striking fact when the tendency to constancy of this measurement is remembered. The least and greatest facial diameters, face height, and palatal length and width are all smaller than in the other specimens.

The acutely arched nasal bones, the ascending process of the maxilla lying nearly parallel to the inner wall of the orbit, the deep recession of the anterior aspect of the body of the maxilla, the wide megaseme orbit, all indicate a pinched, narrow, under-developed facial region. Yet precocity of a certain kind is seen in the closure of the sutures in the infraorbital margin and the disappearance of the intermaxillomaxillary suture on the hard palate. Asymmetry is seen in a prenasal fossa, being confined to the right side, and a small pteriotic bone being found on the left, while there is none on the right side. What cause can be given for these features occurring in so young an individual? And why should the oldest skull in a series of four show the smallest face proportions? I venture to believe that it is to be found in an attack of measles, which has left characteristic impressions. The central incisors are pitted on the crowns near the cutting edges, the remaining single-rooted teeth are gibbous (*i.e.*, abruptly convex at the base of the crowns posteriorly): all the teeth are stunted. A wide interval lies between the centrals, and all the single-rooted teeth are intervalled on the left side. The interior of the nose shows signs of inflammation.

The other appearances above noted are probably the outcome of the attack. It must be recalled that measles was unknown to the Hawaiians until it was brought to them by the Europeans. It was terribly devastating, the survivors exhibiting many evidences of the ordeal through which they had passed. It is fair to assume that the skull, so different from other Hawaiian crania of about the same age, yields the sequelæ of a virulent type of the disease.

Reflecting upon these features I was lead to ask myself the question, To what extent does the action of the exanthemata modify the skull in our own people? The deformities in the Hawaiian child were impossible before the measles came to the community of which he was a part. How many of the deformations of our own children's heads are due to the exanthemata whose ravages are familiar in the communities of which they are a part? To what extent do these diseases, caused by the operation of the law of transmission of acquired characters, produce a gradual alteration in the ethnic type which is unknown to the peoples to whom the exanthemata are also unknown?

Concluding Remarks

In the study just completed I have described a new graphic method of collating measurements. I have endeavored to establish the proposition, that the differences between the crania called here the "cave and the coast crania," are not due to race but to methods of living, and in some degree to differences of mental strength in individuals. The cave series represents the dominating and superior type and the coast series the weak and conquered type. I have suggested that some of the contrasts that obtain in the proportions of the face of the crania after European contact may be traced to the impress made upon the individual by the action of the exanthematous diseases. I remain of the opinion that the interest attached to the study of the human skull is not confined to attempting to limit race, but to the study of the effects of nutritive and even morbid processes upon the skull form.

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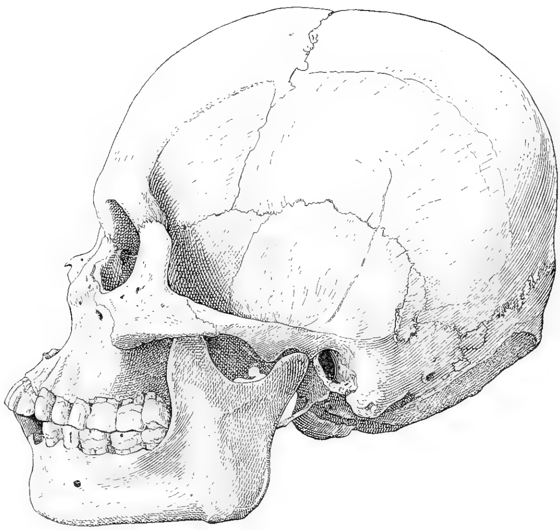
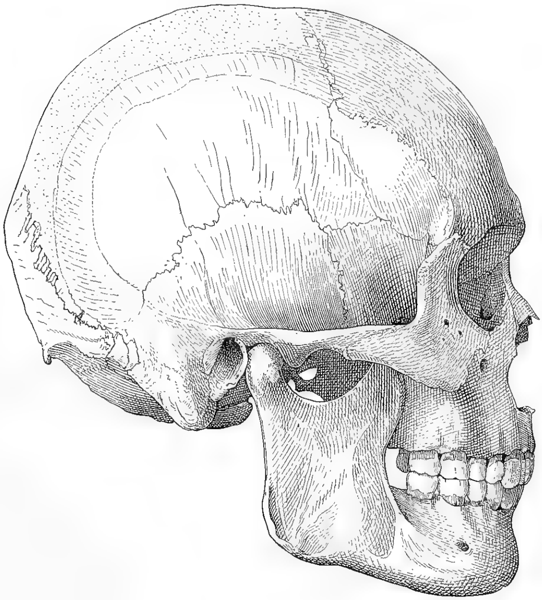
PLATE I.



No. 1107, H. U.

PLATE II.



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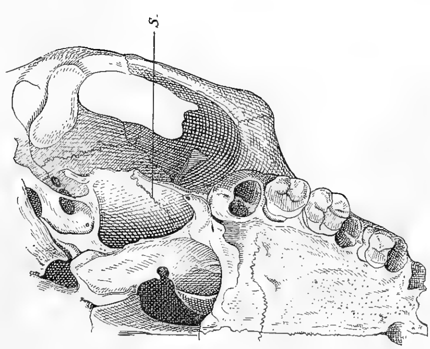
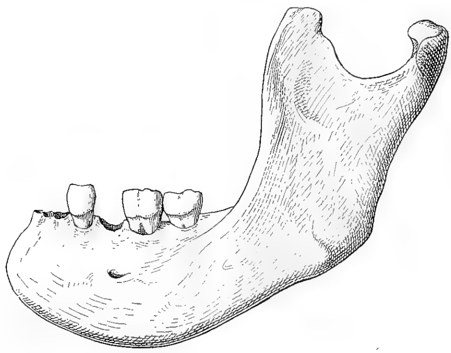


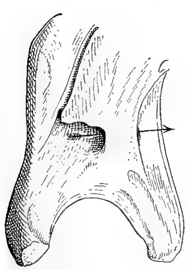
No. 2094, A. N. S.

PLATE III.



No. 1752, A. N. S.

PLATE IV.



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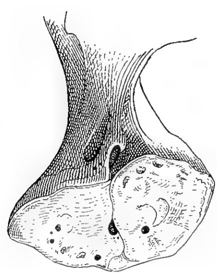

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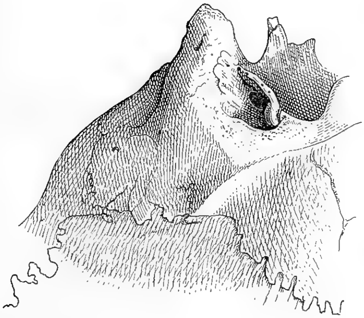
PLATE V.



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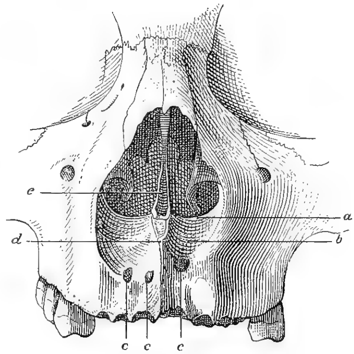
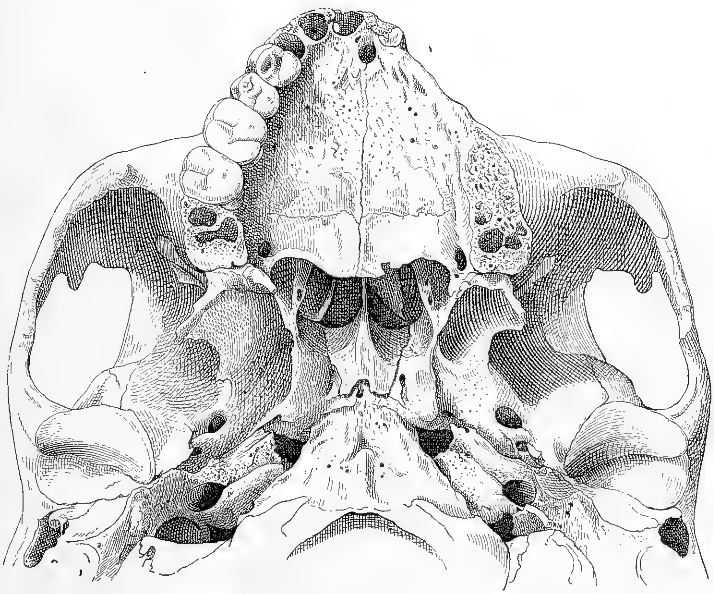


No. 3, P. U.

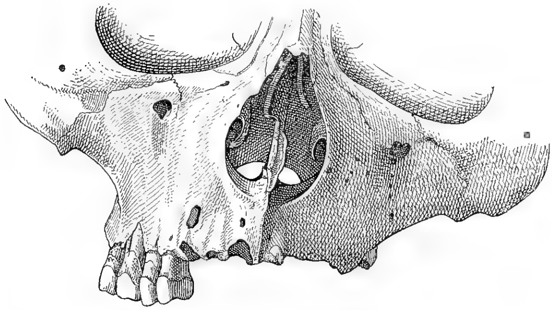
No. 1121, H. U.

PLATE VI.



No. 1121, H. U.

PLATE VII.



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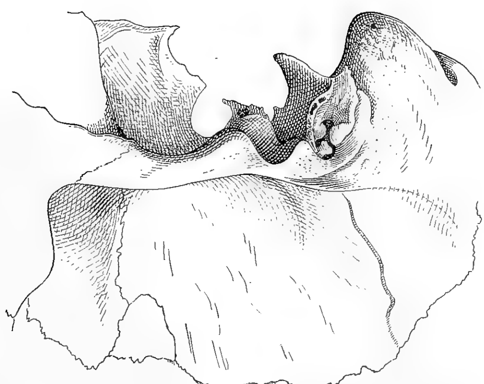
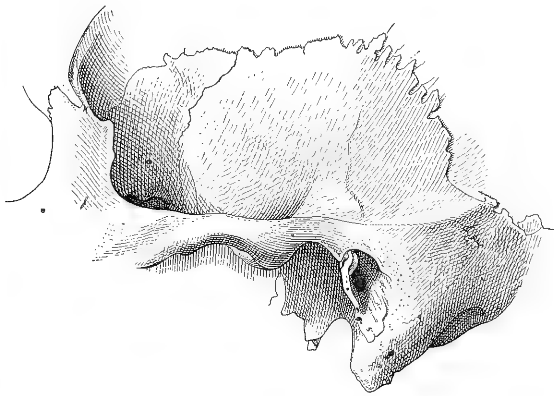


No. 1755, A. N. S.

PLATE VIII.



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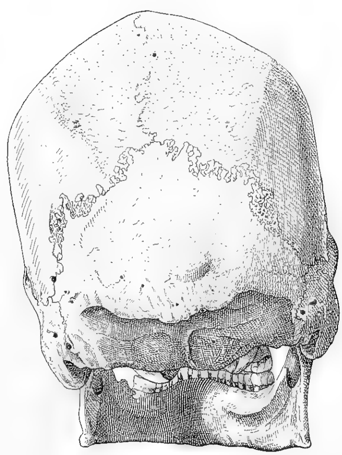
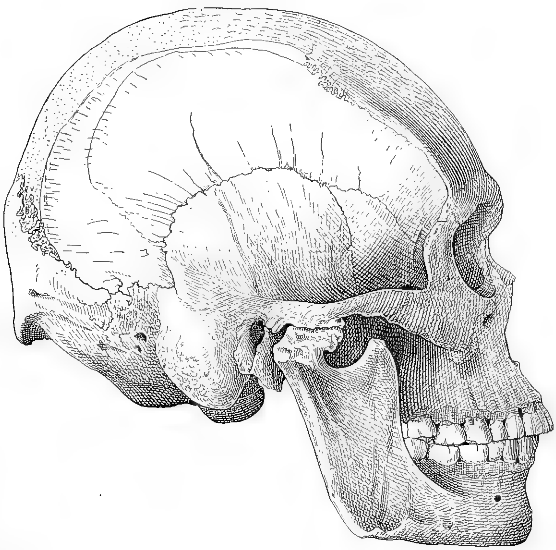


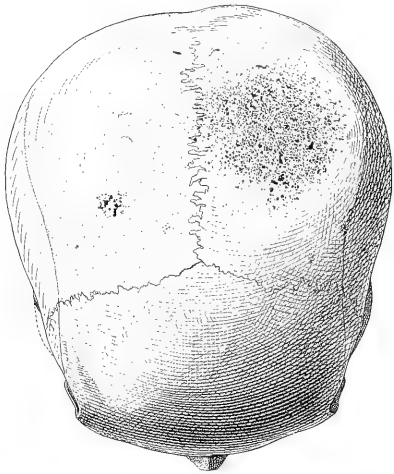
No. 1104, H. U.

PLATE IX.



No. 1104, H. U.

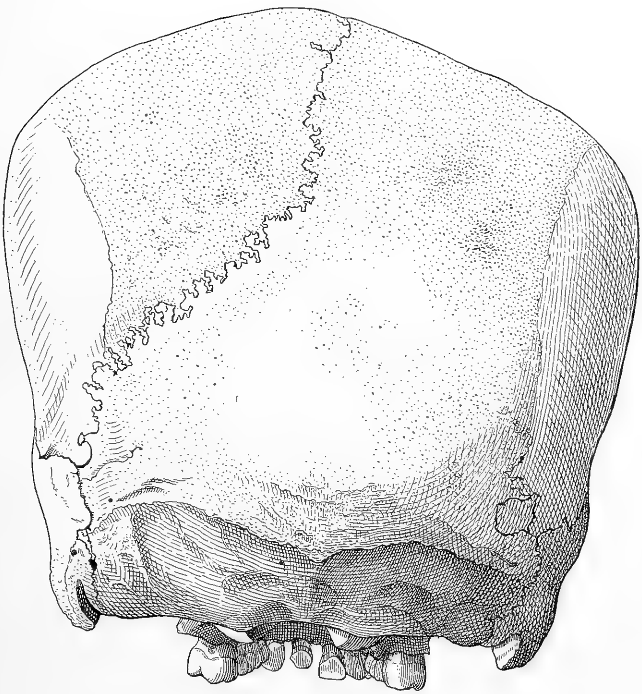
PLATE X.



No. 1756, A. N. S.

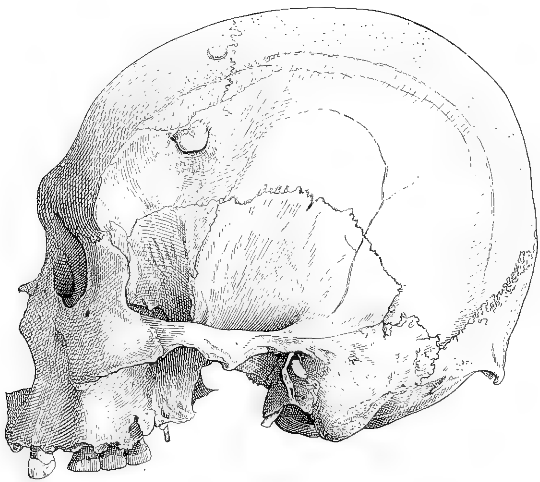
No. 1124, H. U.

PLATE XI.



No. 1114, H. U.

PLATE XII.



No. 1749, A. N. S.

NOTES ON THE PALEONTOLOGICAL PUBLICATIONS OF PROFESSOR WILLIAM WAGNER

BY

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Professor of Invertebrate Paleontology, Wagner Free Institute of Science.

PROFESSOR WAGNER'S best-known publication on American Paleontology is his paper in the eighth volume of the first series of the Journal of the Academy of Natural Sciences in Philadelphia. This article occupies pages 51–53, is illustrated by Plate 1 of this volume, and was published in 1839, having been read before the Academy January 2, 1838. It is probable that extra copies of this paper were printed some time in 1838, as such a copy, though not dated, is now before me, which differs in typography, pagination, and plate numbers from the text of the Academy's Journal. The following collation will show the discrepancies:

	Extra copy.		Academy's Journal.
	No date of reading.		"Read January 2, 1838."
Pecten marylandicus,	p. 1, pl. 2, fig. 1.	[Same]	p. 51, pl. 1, fig. 2.
Venus inoceriformis,	p. 2, pl. 2, fig. 2.	"	p. 51, pl. 1, fig. 1.
Panopea goldfussii,	p. 2, pl. 2, fig. 3.	"	p. 52, pl. 1, fig. 3.
Mysia nucleiformis,	p. 3, pl. 2, fig. 5.	"	p. 52, pl. 1, fig. 4.
Trochus eboreus,	p. 3, pl. 2, fig. 4.	"	p. 52, pl. 1, fig. 5.

In the Academy's text the references to the figures of *Pecten marylandicus* and *Venus inoceriformis* are printed "figure 1" and "figure 2" respectively, but on the plate the numbers are reversed.

I conclude from these discrepancies that the extra copy appeared at a time when it was supposed another plate would precede Professor Wagner's in the Journal, and hence before the printing of the latter and not subsequently.

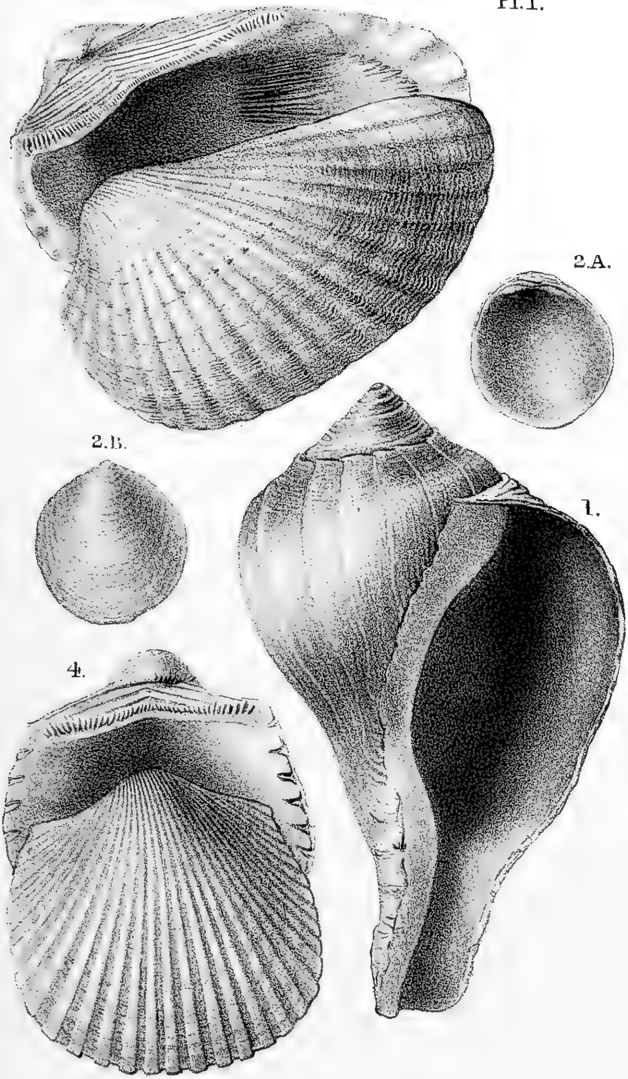
From the figures and descriptions it appears that *Pecten marylandicus* is probably identical with a form subsequently named *Pecten tenuis* by H. C. Lea [Trans. Am. Phil. Soc., 2d ser., ix., p. 246, pl. 35, fig. 33, 1846], but which is not *Pecten virginianus* Conrad, as supposed by Heilprin [Proc. Acad. Nat. Sci. Phila. for 1881, p. 420]. Professor Wagner's name for this *Pecten* will, therefore, be retained. Specimens are in the Academy's collection.

The species is most nearly related to *P. islandicus* of Müller. Like the other species of this paper it is of Miocene age. *Panopea goldfussii* is a good and well-recognized species. *Venus inoceriformis* is now referred to the genus *Clementia* Gray. *Mysia nucleiformis* is undoubtedly a *Diplodonta*, but, in the absence of the type specimens, it will be difficult to discriminate the species. *Trochus* (now *Calliostoma*) *eboreus* is a well-recognized species. Its synonymy has been discussed in the Transactions of the Wagner Free Institute of Science, volume iii., page 398.

About the year 1839, Professor Wagner had prepared three plates illustrating other fossils supposed to be new and contained in his collection. These were lithographs of a very good quality for the time, and the printed sheets have for the most part remained in the Institute ever since. No text appears to have been printed, yet certain copies with manuscript names attached to them were evidently circulated, as the names have entered into the literature. For this reason it was deemed best to issue the edition with explanatory references, especially since several of the species are perfectly good and have not been described or figured elsewhere, notwithstanding the lapse of half a century.

In the Handbuch einer Geschichte der Natur von H. G. Bronn (Dritter Band, 1ste und 2te Abtheilung) is included an Index Palæontologicus compiled with the assistance of Professors Göppert and von Meyer. This is a classical work, known to and used by every paleontologist, indispensable to every library of reference. The first part, or Nomenclator, alphabetically arranged, was printed at Stuttgart in 1848. In 1849 the Enumerator, or systematic arrangement of the material, with discussions on the development of organic life, was also issued. That the editor or compilers of this work were acquainted with the plates of Professor Wagner is certain, as under their list of abbreviations (p. lxxx.) appears "Wagn. Wm. Wagner in Philadelphia (Konch.)," and throughout the volumes are scattered references to the various species figured on the plates in question, though with no reference to any text. In the following references the titles of Bronn's volumes will be abbreviated as "Bronn, 1848," and "Bronn, 1849," respectively.

Pl.1.



3.

2.A.

2.B.

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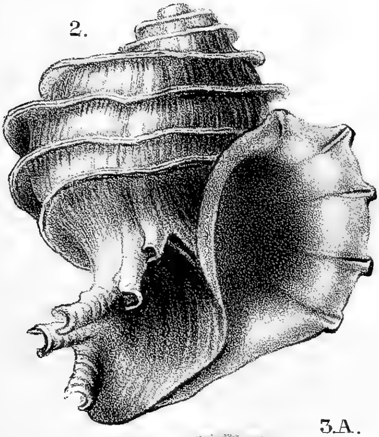
Pl. 2.

2.



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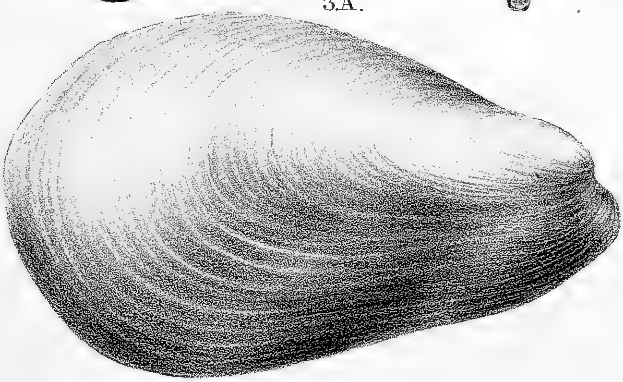

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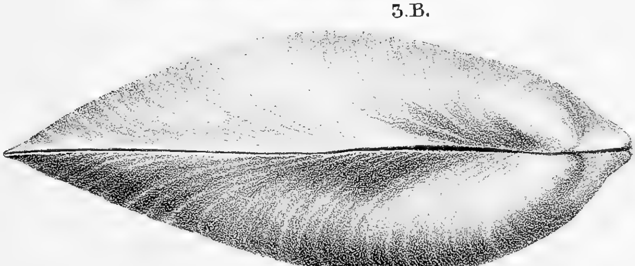

PLATE 1.

Figure 1. *Pyrula nansemondi* Wagner. [Bronn, 1848, pp. 1070–71; 1849, p. 457.] This is now referred to the genus *Fulgur* and is probably identical with *F. maximum* Conrad, Fos. Tert. Form , No. 2, cover, pl. 48, fig. 1, 1840. The name seems to imply that Professor Wagner's specimen came from the Miocene beds on the Nansemond River, near the town of Suffolk, Nansemond County, Virginia.

Figure 2, A, B. This is the only species figured to which I have not been able to discover a reference in Bronn. Either it is omitted or is inserted under some generic name which has not occurred to me. I have been disposed to regard it as representing the upper valve of *Discinisca lugubris* Conrad, which is not uncommon in the formation from which several of the species here figured are known to be derived.

Figure 3. *Arca virginiæ* Wagner. [Bronn, 1848, p. 99; 1849, p. 283.] This is an excellent species of which the figured types are still in the Wagner collection.

Figure 4. *Arca carolinensis* Wagner. [Bronn, 1848, p. 93; 1849, p. 283.] This also is a well-characterized species to which no name has been applied during the half-century which has elapsed since it was figured from the types still existing in the Wagner collection. A valve in the collection of the U. S. National Museum was obtained from the Upper Miocene of Duplin County, North Carolina.

PLATE 2.

Figure 1. *Fusus fragilis* Wagner. [Bronn, 1848, p. 513; 1849, p. 453.] This resembles *Fusus equalis* Emmons (Geol. Rep. N. Car., p. 250, fig. 111, 1858) so much that it is probably identical with it. It will be observed that the species was undescribed when figured by Professor Wagner. Specimens in the National Museum were obtained from the Upper Miocene of the Natural Well, Duplin County, North Carolina. A broken fragment, without label, in the Wagner collection may perhaps be the remains of the type, though this is doubtful. This fragment is hardly identifiable, but may represent *Fusus exilis* Conr. rather than *F. equalis.*

Figure 2. *Fusus umbilicatus* Wagner. [Bronn, 1848, p. 517, cites this in the synonymy of *F. quadricostatus* Say (Journ. Acad. Nat. Sciences, iv., p.

127, pl. 7, fig. 5, 1824); Bronn, 1849, p. 455, cites it as a variety of Say's species.] There is no doubt of its identity with one of the varieties of *Ecphora quadricostata* of our Atlantic Miocene.

Figure 3, A, B. *Modiola gigas* Wagner. [Bronn, 1848, p. 736; 1849, p. 274.] This differs a good deal from *Modiola ducatelii* Conrad (Fos. Medial Tert., p. 53, pl. 28, fig. 2, 1840) in outline, though Professor Wagner's specimen has been somewhat distorted by pressure. If the differences are normal there is no doubt of the validity of both species. Specimens somewhat approaching the figure of *M. gigas* have been obtained from the Miocene of Maryland by the collectors of the Maryland Academy of Sciences.

PLATE 3.

Figure 1, A, B. *Chama agassizii* Wagner. [Bronn, 1848, p. 282; 1849, p. 292.] The type in the Wagner collection appears to be a senile specimen of *Chama corticosa* Conrad (Am. Journ. Sci., xxiii., p. 341, July 1833).

Figure 2. *Cardium ingens* Wagner. [Bronn, 1848, p. 282; 1849, p. 465.] This is a fine species, seldom found in good condition, but abundant in the Maryland Miocene. It appears to be identical with the shell described as *C. laqueatum* Conrad (Journ. Acad. Nat. Sciences, Phila., vi., p. 258, 1831; Fos. Medial Tert., p. 31, pl. 17, fig. 1, 1838), though I have never seen a specimen with so many as the forty-three ribs ascribed to *laqueatum* in Conrad's diagnosis. The number appears to be usually thirty-six or thirty-seven. Under *Cardium virginianum* in Conrad's Medial Tertiary Fossils (part 2, 1840, p. 33) occurs the following note: "The specimen figured belongs to the fine cabinet of William Wagner, Esq., who procured it with other fine fossils in Virginia. He gave it the name of *C. ingens* and read the description at a meeting of the Academy of Natural Sciences in the winter of 1838–39. As I do not recognize a species until the description appears in print, it is necessary to adopt the name under which it was published in April, 1839." This appears to be one of those cases in which Conrad exercised his unrivalled capacity for mixing things up. It is probable that his note should have been placed under the description of *C. laqueatum*. It is useful in showing that Professor Wagner read his account of these fossils as early as the winter of 1838–39, and that the date of the plates may be as early as 1839. A cessation of

Pl.3.

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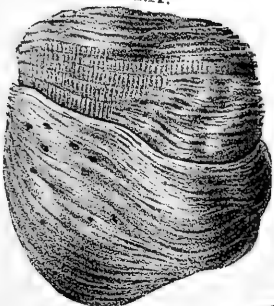
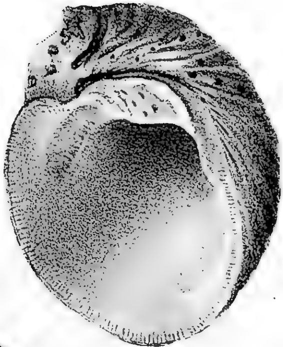


1.B



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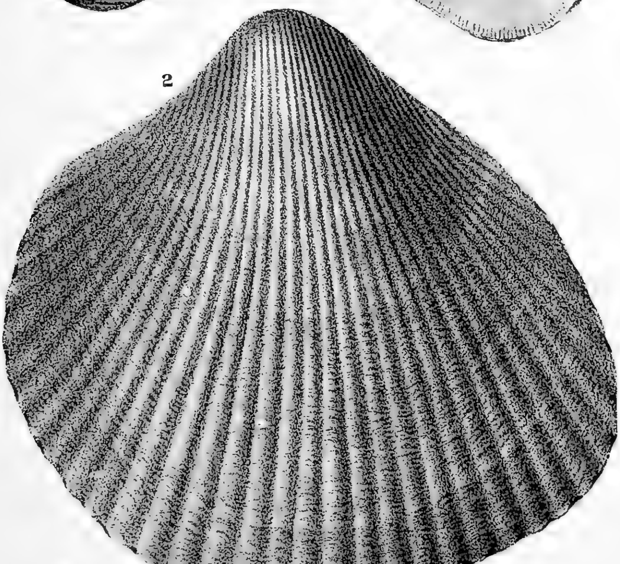

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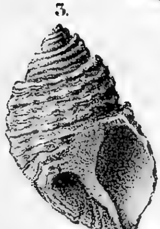

4.

5.

publication by the Academy occurred between the early months of 1839 and the year 1842, for reasons unknown, and this long delay may have had something to do with the failure of the Academy to publish Professor Wagner's paper, for the illustration of which these plates were evidently intended.

Figure 3. *Cancellaria antiqua* Wagner. [Bronn, 1848, p. 208; 1849, p. 465.] This species has not been recognized. From the figure it should be nearly related to the *C. tenera* Philippi, of the Pliocene and recent faunas, and in the Miocene to *C. perspectiva* Conrad, from Duplin County, North Carolina.

Figure 4. *Trochus cinctus* Wagner. [Bronn, 1848, p. 1298; 1849, p. 418.] This species in the absence of its typical specimens can hardly be recognized with certainty. It is probably a *Calliostoma.*

Figure 5. *Pectunculus virginiæ* Wagner. [Bronn, 1848, p. 940; 1849, p. 283.] This well-marked species has been described at a much later date by Tuomey and Holmes (Pleiocene Fossils of S. Carolina, p. 50, pl. 17, fig. 5, 1855), from the Pliocene of the Waccamaw beds, South Carolina, under the name of *Pectunculus lævis.*

From the above notes it will be observed that the species figured come from the Upper Miocene and Pliocene of the Atlantic slope, from Maryland, Virginia, and the Carolinas. When Professor Wagner read his descriptions at the Academy of Natural Sciences in the winter of 1838–39, with few exceptions the species were conspicuous, characteristic, and undescribed. It is an obvious commentary on the want of interest which, up to ten years ago, was felt in the Tertiary faunas of the United States, that in all the years which have passed since these fossils were brought to the attention of the Academy, a fair proportion have not been named or, indeed, noticed in any way whatever. It seems highly appropriate under the circumstances that we should very largely owe to the Wagner Institute the stimulus which has brought about a renewed and deeper interest in our Tertiary Paleontology.